Technical Annex

Delivering Scotland's circular economy

A Route Map to 2025 and beyond

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Scottish Government
Riaghaltas na h-Alba
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Introduction

Purpose of Route Map

The Scottish Government's Programme for Government 2020-21[1] and Scotland's Climate Change Plan update in 2020[2] set out our intention to accelerate progress and made a commitment to develop a Route Map to reduce waste and meet our waste and recycling targets for 2025 in a way that maximises carbon saving potential. The Route Map is a strategic plan which, working with partners, allows us to identify how the waste and resources sector will contribute to Scotland journey towards net zero in the period to 2030 and beyond.

Purpose of this annex

This Annex sets out the rationale underpinning the Route Map: Delivering Scotland's circular economy, identifying our progress to date and the case for further change to meet our waste and recycling targets. It provides a transparent rationale and evidence base that underpins the proposed actions and measures identified in the Route Map, and signposts to wider information, evidence, and research.

Scotland's existing waste and recycling targets

The waste and recycling targets are:

- 15% reduction of all waste, against a 2011 baseline, by 2025
- 33% reduction of food waste, against a 2013 baseline, by 2025
- Minimum of 60% recycling of all household waste by 2020
- Minimum of 70% recycling of all waste by 2025
- Maximum 5% of all waste to landfill.

Origin of targets

The majority of the targets, based on waste tonnages, were set in the early 2010s along with the publication of the Zero Waste Plan[3] and Safeguarding Scotland's Resources[4]. Over the last decade the acceleration of the climate emergency has intensified the focus on impacts of carbon and we have committed to reducing emissions by 75% by 2030 and to be net zero by 2045. The Route Map will focus on the achievement of the 2025 targets but also consider the longer-term pathway to transform Scotland into a circular economy that will support the vision set out in our Climate Change Plan Update, and EU targets that extend beyond this period. For example in line with our commitment to seek to maintain or exceed EU

[1] A Fairer, Greener Scotland: Programme for Government 2021-22
[2] Securing a green recovery on a path to net zero: climate change plan 2018-2032 - update
[3] Scotland's Zero Waste Plan (2010)
[4] Safeguarding Scotland's Resources - A Programme for the Efficient Use of Our Materials: Analysis of Consultation Responses (2013)

environmental standards, we have met EU targets for the amount of biodegradable waste going to landfill, and for recycling of construction & demolition waste.

Progress to date and the case for further action

Introduction & Context

This section summarises progress against the five waste targets. Four of the targets are reported by SEPA and the most recent reporting year has been used as of March 2022[5]. The food waste target requires a bespoke methodology which is carried out by Zero Waste Scotland using several distinct data sources and is only updated periodically based on data availability.

At the time of writing, we have relatively limited information on any changes to waste arising and management since the COVID-19 pandemic. The SEPA cyber-attack means that *all waste* reporting (i.e. the basis of four of the five targets) for 2019 and 2020 is on hold, with only limited data available[6]. Household waste and landfilled waste data is available for 2020 and is used in the relevant sections below.

Target	Likelihood of success	Trend
15% **reduction of all waste**, against 2011 baseline	The latest figures (2018) showed a 4% reduction in waste, but the target may have been met in 2020 due to Covid-19. High year to year variation, with no clear overall trend. Target strongly linked to scale of construction activity.	
33% **reduction of food waste**, against 2013 baseline	Little change in food waste generated between 2013-2018. No reliable data available after 2018 due to Covid-19. Available evidence suggests that pace of change is currently insufficient to achieve the 2025 target.	
Minimum of 70% **recycling of all waste**	In 2018 we recycled 61% of all waste managed in Scotland, but progress has slowed. Year-on-year variability from 2011-2016, largely driven by construction and demolition waste.	
Minimum of 60% **recycling of household waste** (by 2020)	Scotland's recycling rate more than doubled between 2004 - 2011, but progress has slowed to around 45% for several years, missing our target. Fell to 42% in 2020 (Covid impact), local authority recycling rates range from 18% - 58%.	
Maximum 5% of all **waste to landfill**	In 2018 32% of waste was sent to landfill. Waste sent to landfill fell from around 7 million tonnes in 2005 to around 2.6 million tonnes in 2020. Rapid decline waste going to landfill recently, driven by shift from landfill to incineration.	

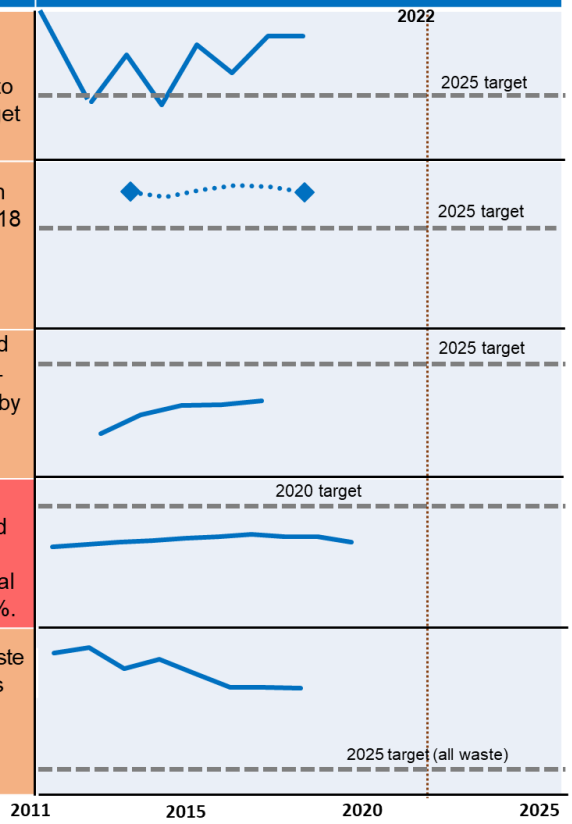

Figure 1: Progress towards Scotland's 2025 waste and recycling targets. Key: Red indicates a **missed target [Minimum 60% recycling of household waste by 2020];** Orange indicates **target at risk [All other targets].**

[5] For the household recycling target the most recent data available is 2020. For the three 'all waste' targets, the most recent data available is 2018. SEPA has published 2020 landfill tonnages, but to calculate a landfill rate requires an 'all waste' generation figure, and the latest data is 2018.
[6] For further details please see SEPA waste data

In addition to these waste and recycling targets, the 2020 Climate Change Plan update[7] set out emission 'envelopes' for each sector, which reflect the pathway to meeting our statutory targets to reduce emissions by 75% by 2030 (compared with 1990) and to net zero by 2045. In 2019, greenhouse gas emissions from the waste management sector[8] were 1.5 MtCO2e. To achieve our emissions envelopes we must reduce this to 0.9 $MtCO_2e$ by 2025 and 0.7 $MtCO_2e$ by 2032. These envelopes are built upon achieving our waste and recycling targets, as the foundation for our pathway to 2025 and baseline for future action.

15% Waste Reduction Target

All waste generated since 2011 (blue line) is summarised in Figure 2, expressed as a proportion of the 2011 baseline of 11.96 million tonnes. The amber dashed line represents the 15% waste reduction target (10.2 million tonnes) by 2025.

The 10.2 million tonnes of waste required to meet the 2025 15% reduction target was met in 2012 (10.1 million tonnes) and 2014 (10.0 million tonnes) but has not been met in the four most recent reporting years (2015-18). Since 2015, the amount of waste generated compared to the 2011 baseline has reduced by between 4 and 9% depending on the year. In 2018 there was 11.45 million tonnes of waste generated, which was a 4% reduction on the 2011 baseline.

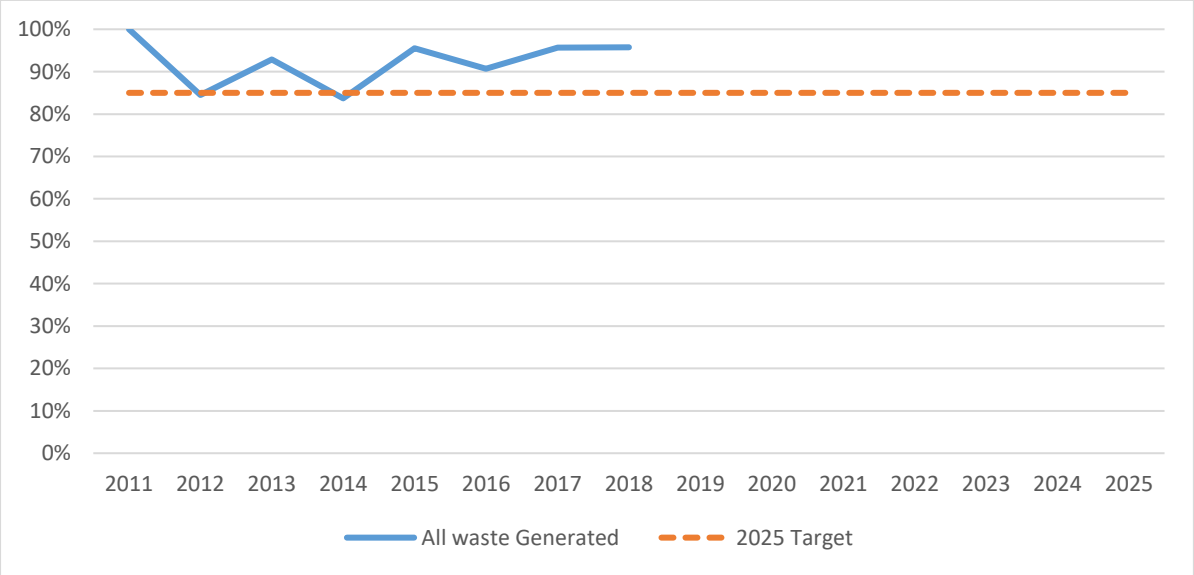

Figure 2: All waste generated since 2011 expressed as a proportion of the 2011 baseline of 11.96 million tonnes

The trend in waste arisings by waste source type between 2011 and 2018 is summarised in Figure 3. Although there is variation from year to year, both Household waste and Commercial & industrial waste have shown downward trends from 2011 to 2018 with a combined reduction in waste generated for these two

[7] Securing a green recovery on a path to net zero: climate change plan 2018–2032 - update - gov.scot
[8] Covering waste disposed of to landfill sites, waste incineration, and the treatment of waste water

waste sources of 1.1 million tonnes (17%), Construction and demolition wastes comprised 5.8 million tonnes, or approximately 50% of Scotland's waste in 2018, and shows considerable variability in the quantities generated during the period 2011 to 2018[9], with an overall increase of 12%. Recent trends suggest Construction & demolition waste (which will be affected by the relative strength of activity in the construction sector) will largely determine whether or not the target is achieved in 2025.

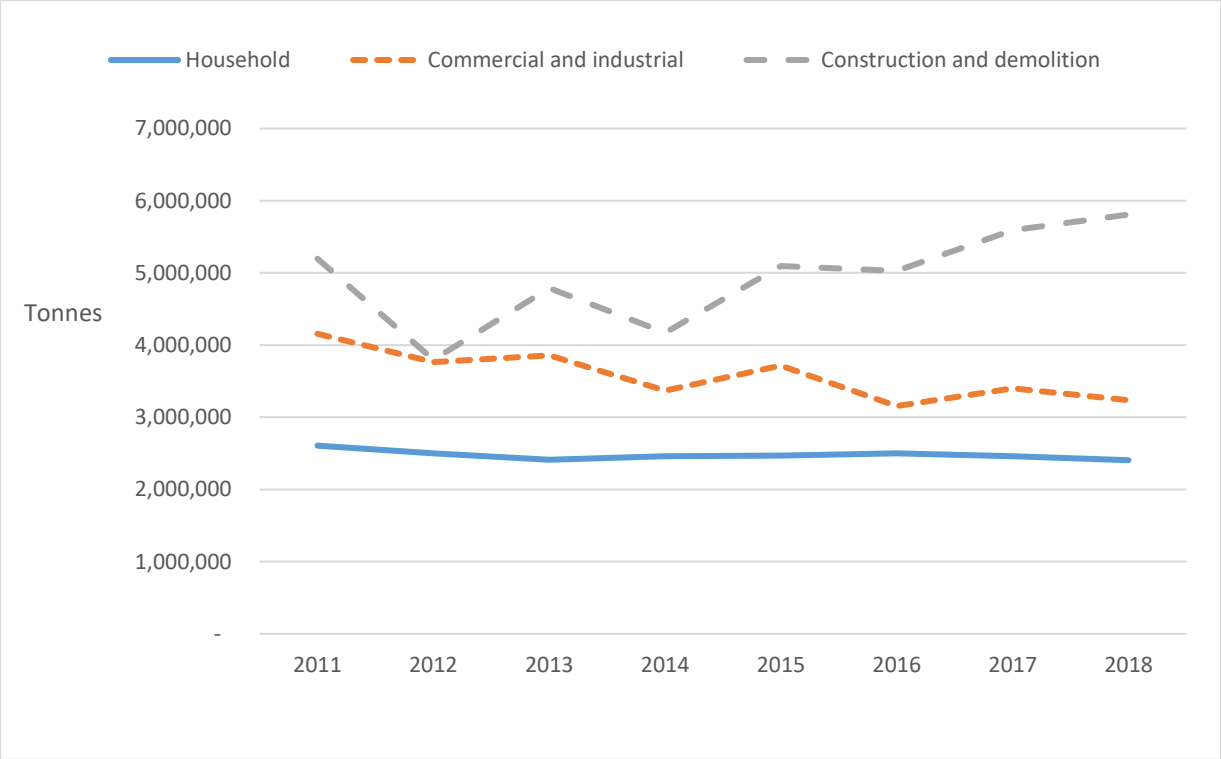

Figure 3: Waste arisings between 2011 and 2018, from households, commercial and industrial sectors, and the construction and demolition sector.

The carbon footprint of Scotland's waste

The carbon footprint of Scotland's waste shows the impacts of the materials through their life (growing/extracting, processing, transporting etc) as well as their end-of-life impacts – effort that is thrown away when the materials become waste. In contrast to the relatively modest changes in the amount of waste generated in tonnage terms, the carbon footprint of Scotland's waste has fallen around 30% since 2011[10].

Of the 4.6 million tonnes CO_2 equivalent reduction in carbon emissions between 2011 and 2018, 3.8 Mt CO_2 equivalent (84%) was accounted for by the reduction in the carbon impact of materials production. Improvements in this metric do not therefore all show up in waste sector emissions. These savings contribute right

[9] According to SEPA, between 2011-18 the amount of construction and demolition waste generated varied by -26.9% to +26.1%.

[10] The Carbon Footprint of Scotland's Waste: Carbon Metric Summary Report 2017 & 2018

across Scotland's economy, and on Scotland's overseas footprint as well. As we pursue a circular economy, and think increasingly about policy targeting material inputs, rather than starting with 'end-of-pipe' waste outputs, this need to think about the carbon impact of waste and resource policies across all sectors will be critical to delivering Scotland's net zero ambitions.

Wastes soils alone made up 4.29 million tonnes or 37% of all waste generated in 2018. Soil is a low-carbon waste stream, and overfocusing on this element of the target may not offer the best returns from waste prevention in terms of Scotland's net zero ambitions, with smaller tonnage materials having far greater carbon impacts.

In recent years we have also invested in several waste prevention actions to tackle problems other than weight or carbon impacts of waste. Specifically, this includes measures that target very high frequency items (such as single-use plastics) that frequently reach our shared environment as litter pollution on land or in the sea. The tonnage and carbon benefits from these changes are relatively small, but these measures help us avoid other social and ecological impacts.

33% Food Waste Reduction Target

Food waste generated in Scotland in 2013 and 2018 is summarised in Figure 4 , expressed as a proportion of the 2013 baseline of 987,890 million tonnes. The amber dashed line represents the 33% waste reduction on the 2013 baseline by 2025. Food waste tonnage is very difficult to measure, as discussed below, and robust, annual data is not currently available. The 2018 data point in Figure 4 is not directly comparable with the 2013 baseline hence there is an element of uncertainty regarding progress against this target.

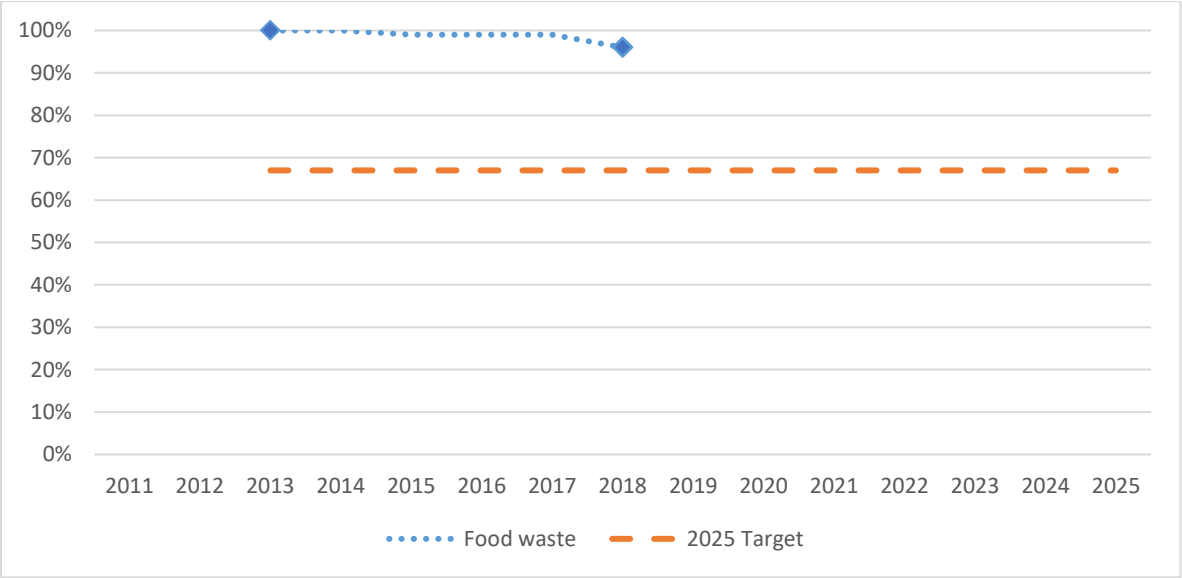

Figure 4: Food waste generated in Scotland in 2013 and 2018 (red markers), expressed as a proportion of the 2013 baseline of 988,000 tonnes. Amber dash line represents the 33% reduction on 2013 baseline by 2025.

The 2019 Food Waste Reduction Action Plan (FWRAP) laid out the actions required to help Scotland deliver the ambitious target of a 33% reduction in per capita food waste below 2013 levels by 2025. To support monitoring progress, an estimate was calculated for the baseline line year of 2013.

Food & Drink manufacturing generated 25% (248,230 tonnes) of the 2013 baseline (987,890 tonnes), other sectors (hospitality, public sector, retail) generated 14% (140,714 tonnes), with the remaining 61% (598,946 tonnes) generated by Scotland's 2.4 million households.

An update to the baseline was published in 2016[11], this built on the original baseline calculation[12], and the scope of the original estimate[13]. Unlike the other targets, not all elements of this target are separately measured and reported each year. In particular household food waste estimates are dependent on bespoke waste compositional studies, plus an estimate of sewer disposal and home composting (which is out of scope for waste data recording systems altogether). For commercial waste streams, an estimate must be made of which material is food, and which is other waste, for many waste streams.

The household food waste to sewer and composting studies have not been updated since the original baseline estimate so are now out-of-date. The household waste composition analysis studies used to produce the baseline estimate were carried out during 2013 to 2015. New estimates of household waste composition analysis, including food waste should be available in early 2023. This makes any current assessment of progress highly uncertain until the various contributing studies are updated.

Ahead of a full analytical assessment of progress towards the FWRAP target as part of the updated FWRAP, our best estimate of progress against the 2013 baseline comes from voluntary reporting submitted to the EU food waste platform as part of the EU Delegated Act to the Waste Directive and common methodology for reporting food waste[14]. The data reported to the EU was from 2018.

The EU reporting differs from the Scottish baseline methodology in several ways. The EU allows for direct and indirect measurement of food waste, includes primary production, but excludes food waste to sewer and home composting from the household estimate. EU estimates are broken down into 5 sectors: primary production (excluded from Scottish baseline); processing and manufacturing (direct mapping to Scottish baseline); retail and other distribution of food (a subsection of other sectors in the Scottish baseline); restaurants and food services (a subsection of other sectors in the Scottish baseline); households (Scottish baseline includes food waste to sewer and home composting).

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[11] Safeguarding Scotland's Resources - A Programme for the Efficient Use of Our Materials: Analysis of Consultation Responses

[12] Report: How much food and drink waste is there in Scotland?

[13] Report: Detailing the scope of Scotland's food and drink waste prevention targets

[14] See Commission Implementing Decision (EU) on a format for reporting of data on food waste

Processing and manufacturing maps directly on to the Scottish baseline and can be estimated from direct measurement using data reported to SEPA[15]. Retail and other distribution of food and restaurants and food services were estimated from UK level data from WRAP[16] and scaled to the number of businesses in each sector located in Scotland using ONS data[17]. Household waste was estimated by scaling the stratified per capita food waste for the UK[18] to the population of Scotland in 2018[19] and adding an estimate of food waste to sewer and home composting by scaling the UK estimates to the Scottish population in 2018. This is not sufficiently accurate to use this estimate as anything other than an approximate indicator of progress. Updated household data, and updated composition estimates, are required to produce a comparable estimate to the 2013 baseline that factors in changes in behaviour within households.

This data is summarised in Figure 5. Although the two estimates are not directly comparable due to the methodological differences described above, the percentage of waste generated by each sector is broadly similar between both time points. The overall estimate for 2018 was 96% of the 2013 baseline, which is not sufficient progress to achieve the 2025 target.

2018 data was used as the most recent source of data due to the cyber-attack on SEPA, and because COVID-19 significantly disrupted all food waste producing sectors, meaning we lack much of the data we need to assess progress beyond 2018. The most up-to-date data on UK food waste showed a reduction of 4.8% in UK food waste between 2015 and 2018[20]. There is also evidence that the COVID-19 lockdown in March 2020 led to a 43% reduction in household food waste across the UK[21], but this appears to have rebounded as restrictions have eased[22].

The carbon footprint of food waste

The method of generating food waste estimates also makes it difficult to estimate the carbon footprint of the food waste that is comparable to other targets and Scotland's overall carbon footprint.

Scotland's carbon metric[23] reported that in 2018, food waste was 5% of the total waste by tonnage, but 25% of the total carbon footprint of Scotland's waste. Food waste from Scottish households produced 1.887 million tonnes CO2eq, while non-

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[15] See SEPA's waste sites and capacity data tool
[16] Courtauld Commitment 2025 food waste baseline for 2015
[17] ONS UK Business Activity Workbook available for download here.
[18] WRAP synthesis of household food waste compositional data
[19] National Records of Scotland Population Estimates Time Series Data
[20] UK progress against Courtauld 2025 targets and UN Sustainable Development Goal 12.3
[21] WRAP: Life under Covid-19: Food waste attitudes and behaviours in 2020
[22] WRAP: Food waste trends survey 2021
[23] Zero Waste Scotland : The Carbon Footprint of Scotland's Waste, Carbon Metric Technical Report 2017 & 2018, https://www.zerowastescotland.org.uk/sites/default/files/2017-18%20ZWS%20Carbon%20Metric%20Technical%20Report%20V02.00.pdf

household food waste was responsible for a further 0.762 million tonnes CO2eq[24]. This represents 2.7% and 1.1%, respectively, of Scotland's total carbon footprint[25]. The carbon metric does not measure food waste as a distinct material stream (for similar reasons to the ones outlined above) so the tonnage used to generate the food waste estimate is likely to be an underestimate. Regardless, this demonstrates that food waste has a much higher carbon impact that other waste materials.

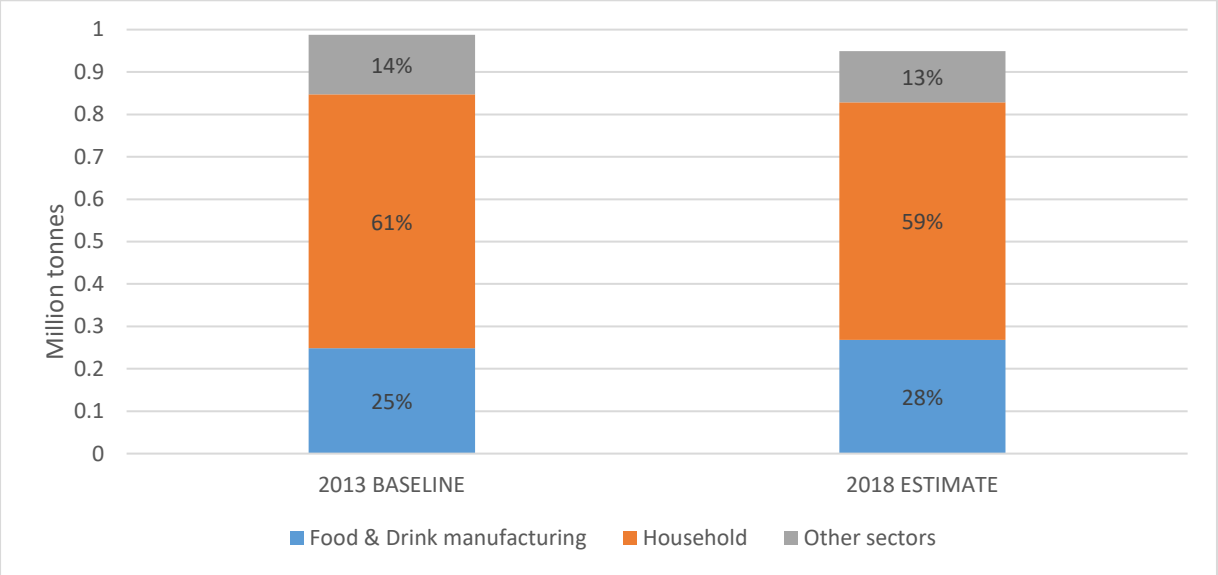

Figure 5: Food Waste by Sector – 2013 Baseline & 2018 Estimate

There is very strong alignment between food waste prevention and Scotland's net zero ambitions. Upstream prevention eliminates not just waste management emissions, but also the emissions involved in growing, harvesting, processing, and transporting items that ultimately go to waste. There are also significant financial savings opportunities (primarily from avoided purchase) for organisations and individuals. Downstream prevention activity – such as diversion to bioeconomy applications – have smaller carbon benefits, but still avoids disposal emissions and offers additional economic opportunities. This downstream activity will never be fully eliminated as some food waste is an unavoidable by-product (e.g., inedible parts) and cannot typically be prevented upstream.

60% Household Recycling Target

Progress against the target to recycle, compost and reuse 60% of household waste in Scotland by 2020 is summarised in Figure 6. Following significant progress from 2004 to 2014, between 2015 and 2019 the household recycling rate plateaued around 45% and fell back to 42% in 2020 (impacted by COVID-19 restrictions); we have missed our target to recycle 60% of household waste by 2020.

[24] See table 3.3 in The carbon footprint of Scotland's waste technical report.
[25] Scotland generated 70.4 Million tonnes of CO2eq in 2018, according to Scotland's Carbon Footprint. This assumes the carbon impacts of Scotland's food waste are included in Scotland's carbon footprint.

In terms of absolute tonnages recycled since 2011, 2013 was lowest at 1 million tonnes, and 2016 the highest at 1.12 million tonnes. In 2019 1.09 million tonnes of household waste was recycled. More recently, 2020 was an exceptional year due to the COVID-19 pandemic and it is important to view the reduction in recycling rate in 2020 in that context. People spent most of their time at home, transferring significant waste producing activities, such as food consumption, back to the household. There were also significant disruptions to kerbside and household recycling centre services in some areas. The extent to which changes in how we live, and how we work will persist beyond the pandemic period is unknown. It is possible that the household waste stream will increase in importance if some economic activity has permanently shifted from the workplace to the home.

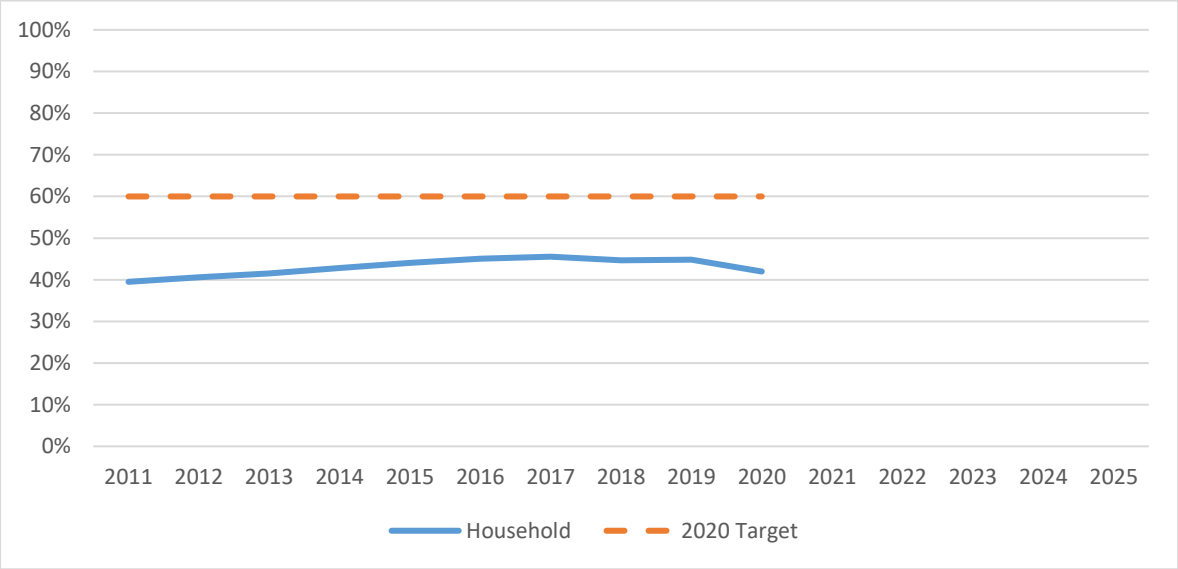

Figure 6: Household recycling rate (blue line) since 2011 and the 60% recycling rate target by 2020 (amber dash line)

The most significant driver of household recycling performance is how much recyclable waste is thrown away in the non-recyclable kerbside bin. The last time Zero Waste Scotland delivered a comprehensive programme of kerbside waste composition analysis was between 2013 to 2015[26]. The work showed that approximately 670,000 tonnes, or just under 60% of kerbside residual waste, is made up of waste types that could have been recycled with existing kerbside recycling services.

Since completing that study, using 2019 as a comparator year, the overall quantity of kerbside residual waste collected has reduced by approximately 10%[27], reflecting further recycling service roll outs. While the 670,000 tonnes and 60% estimate above will have reduced to some degree, a very large quantity of recyclable wastes continues to be thrown away in the non-recyclable bin. Zero Waste Scotland is currently undertaking a new two-year programme of kerbside waste composition

[26] The composition of household waste at the kerbside in 2014-2015, Zero Waste Scotland, 2017
[27] In 2019 local authorities collected 1.01 million tonnes of kerbside residual waste, compared to approximately 1.13 million tonnes used in the original waste composition analysis project.

analysis with local authorities and new national estimates should be available in early 2023.

The carbon footprint of household waste

In 2018 household waste comprised approximately 21% of Scotland's total waste by weight, but 55% of the total whole life carbon emissions associated with Scotland's waste[28].

The carbon emissions associated with Scotland's household waste have been steadily falling since 2011[29], reflecting changes in the amount of waste generated and how waste is managed. In 2019 the amount of household waste generated was 7% below that reported in 2011; approximately 185,000 tonnes. The reduction in waste arisings between 2011 and 2019 has led to carbon savings of approximately 1.1 million tonnes (-16%).

In 2019 the embodied carbon impacts from material production (i.e., impacts of producing the material in the first place before they become waste) were the largest contributor (5.78 million tonnes CO_2 equivalents) to household waste carbon impacts. Landfilling household wastes remained the second largest carbon contributor (307,600 tonnes CO_2 equivalents), followed by incineration (129,700 tonnes CO_2 equivalents), which was an increase of nearly 78,800 tonnes when compared to 2018. Recycling reduced Scotland's household waste carbon impacts by 545,100 tonnes CO_2 equivalents in 2019.

The scale of emissions associated with producing the material in the first place before they become waste highlights the importance of preventing waste, particularly for carbon-intensive materials such as food waste, textiles, metal, plastic, paper, and card. Those top five most carbon intensive materials accounted for under half (45%) of all household waste in 2019 by weight, but 82% of household waste carbon impacts.

70% Recycling of all wastes

The all-waste recycling target comprises all wastes managed, including waste from households, construction and demolition activities, and commerce and industry. Figure 7 summarises recent trends for the target.

Between 2011 (5.8 million tonnes) and 2018 (7.0 million tonnes) the amount of waste recycled has significantly increased, but also shown marked year-on-year variability, reflecting the large variations in the arisings and subsequent management of soils, sludges and mineral wastes from the construction and demolition sector.

The trend since 2016 has been a plateauing, or reduced rate of increase, in recycling performance, with the recycling rate for 2018 being around 61%. The current trajectory suggests it will be challenging to meet the 70% 2025 target without further interventions. For example, for the 2025 all waste recycling target to be met, there

[28] The Carbon Footprint of Scotland's Waste: Carbon Metric Summary Report 2017 & 2018 The Carbon Footprint of Scotland's Waste: Carbon Metric Summary Report 2017 & 2018

[29] The Carbon Footprint of Scotland's Household Waste: 2019 Household Carbon Metric Brief The Carbon Footprint of Scotland's Household Waste: 2019 Household Carbon Metric Brief

would need to be an annual increase in the recycling rate of 1.3 percentage points, for each year between 2018 and 2025. The historical annual increase between 2011 and 2017 has been approximately 1 percentage point.

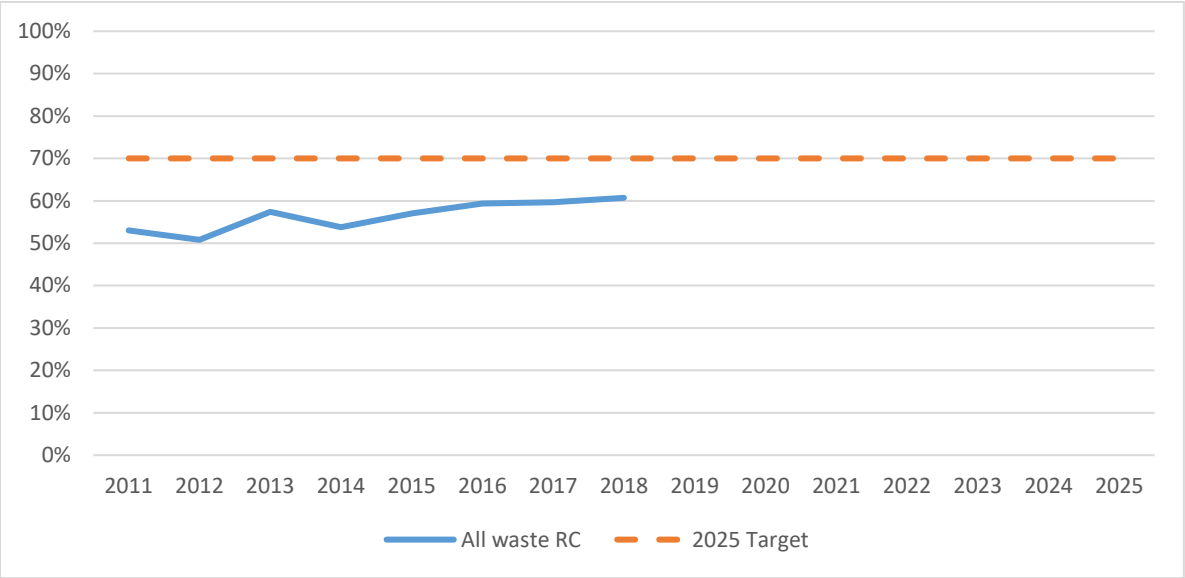

Figure 7: All-waste recycling rate (blue line) since 2011 and the 70% recycling rate target by 2025 (amber dash line)

Like the waste generation target, the variation in construction and demolition waste generated (principally soils and mineral wastes), and the ability to recycle those wastes, drives much of the variation in the reported recycling rate. This variation seems likely to continue. As with the waste generation target, the largest tonnage wastes do not represent the highest value area to focus on in carbon terms. The long-term impacts of Covid-19 on this target are not yet known.

In addition to household recycling, the mixed waste portion of commercial and industrial arisings represents a significant opportunity to improve both recycling rate and reduce carbon emissions, though there is significant uncertainty regarding the exact composition. There may also be opportunities for construction waste – including options for higher value recycling or reuse for material that is already counted as recycled.

5% Landfill Target

The all-waste landfill rate is the proportion (%) of all waste managed that is landfilled and the target set a maximum of 5% by 2025. Figure 8 summarises the trend in landfill rate since 2011, against the 2025 target.

In 2011 4.7 million tonnes of waste was landfilled, or 42.8% of all waste managed. By 2018 this had reduced to 3.7 million tonnes, or 32.1% of all waste managed. Following a clear decline between 2011 and 2016, the landfill rate has plateaued at around 32% between 2016 and 2018 (the most recent landfill rate published by SEPA).

According to more recent data, the absolute quantity of waste landfilled has significantly reduced from 3.7 million tonnes in 2018 to 2.6 million tonnes in 2020.[30] This reflects the expansion of incineration as an alternative to landfill for some wastes[31] and COVID-19 restrictions may also have impacted the 2020 figure. The ban on landfilling Biodegradable Municipal Waste (BMW) will be implemented in 2025. The ban is driving investment in the incineration of combustible wastes. In 2020 691,000 tonnes of biodegradable municipal waste was landfilled, half that reported in 2011.

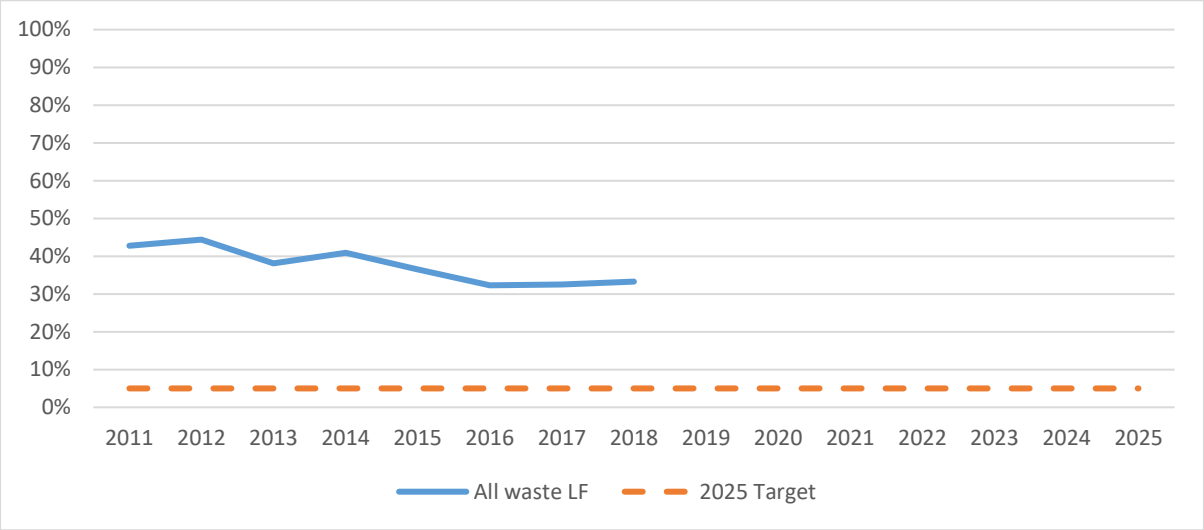

Figure 8: All waste landfill rate since 2015 against the 2025 Target of 5%

In 2020 four waste types comprised 94% of all landfill tonnage: soils (834,000 tonnes, 32% of total landfilled); household and similar wastes (736,000 tonnes, 28% of total); sorting residues (689,000 tonnes, 26% of total); and mineral wastes (208,000 tonnes, 8% of total).

Despite the rapid growth in the incineration of waste, the 5% landfill target will be very challenging to meet by 2025. It is not technically or economically feasible to divert all currently landfilled wastes to incineration (e.g., soils and stones, mineral wastes, some sorting residues, and incinerator outputs). Assuming the 2025 waste generation target (15% reduction on 2011) is met, approximately 10.2 million tonnes of waste will require management[32]. Assuming a 5% maximum landfill rate on that amount, this equates to 508,000 tonnes, when soils and mineral wastes landfilled alone comprised over 1 million tonnes in 2020.

[30] Waste landfilled in Scotland, SEPA waste data, 2020

[31] In 2011 incineration accounted for approximately 400,000 tonnes of waste, by 2020 this had increased to over 1.25 million tonnes.

[32] For clarity no assumption is made regarding the food waste prevention target, which in practice will also be subject to the ban on landfilling BMW.

Rationale for the Proposed Interventions

Need for system-wide approach

Systems thinking is a holistic approach to analysis that focuses on the way that a system's constituent parts interrelate and how systems work over time and within the context of larger systems. This allows the development of a package of measures where “the sum is greater than the parts” i.e., the collective impact of proposed policies and measures is greater than individual implementation. This drives system-wide change which is not possible through a ‘cherry picking’ of individual measures.

This approach was used to develop appropriate interventions and measures which could address ‘broken incentives’; these are the things which make it easier to do the wrong thing with materials and as a result it is more challenging to make progress towards the waste and recycling targets. Figure 9 is an example of the incentives associated with waste prevention. The intention for the Route Map is to identify packages of interventions which will ‘fix’ these incentives through a systems approach and align behaviours of all actors required with the desired outcome of achieving the waste and recycling targets and delivering a circular economy.

For individual actors, at each stage of the supply chain, incentives were mapped on a per target basis for those waste streams or product categories that were identified as having a substantial contribution to achievement of each of the targets. These were then qualitatively assessed to determine the direction (positive or negative) and strength of their influence on the actor’s decision making. By looking at all the positive and negative incentives influencing an actor it is possible to then form a view of how aligned the behaviour of that actor is towards the delivery of the target.

Interventions were identified to introduce new positive incentives to one or many actors to better align those actors to the target. The interventions had one of three aims:

a. to directly reduce the influence of an existing negative incentive,
b. to strengthen the influence of an existing positive incentive, and/or
c. to introduce a new area of influence to the actor.

Policy interventions have been selected within the policy categories to fulfil the function required to influence the identified behaviour, as per the Behaviour Change Wheel model (see figure 9).

Finally, the systems thinking approach was applied to the proposed package of interventions, again per target, to ensure that the incentives carry through the entire supply chain to deliver the desired outcome i.e. doesn’t move or create a disincentive either up or down the supply chain. In addition, actors frequently have many incentives that are not concerned with waste prevention or recycling, as waste is one of many considerations. Therefore, a lessening in negative alignment is just as important as a strengthening of positive behaviour. This ensures that the package of interventions proposed in this consultation document “fixes the incentives” and aligns behaviours of all actors required with desired outcome of delivering a circular economy.

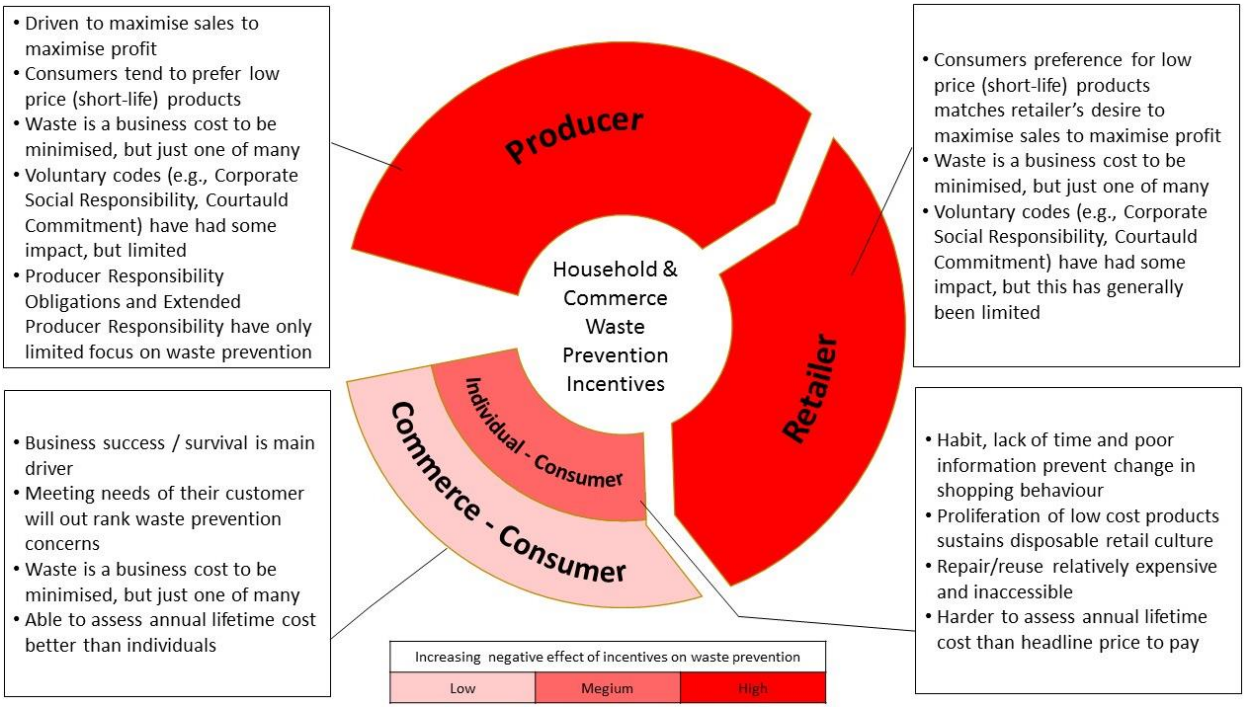

Figure 9: Incentives associated with waste prevention

Behaviour Change

Almost all Route Map activity requires someone to do something differently. Our focus when we talk about 'individual behaviour change' is on people (householders, service users, or consumers), and not organisations[33]. We are considering situations where individuals can be encouraged, compelled, or enabled to choose, consciously or unconsciously, to do something in a more environmentally friendly way.

Behaviour change is often equated with communications and engagement activity. This definition is too narrow. Table 1 gives examples of other behaviour change interventions include.

Behaviour change interventions can occur at different scales from the hyper-local to the national and international, and hopefully these scales would be mutually reinforcing. Whilst it is tempting to focus heavily on scalability, this may lead to an over-expectation that a 'one-size fits all' approach exists, or that 'top down' approach is better. Diversity of interventions may be a key feature in reaching a diverse population. This is something we should seek to understand better. There is no doubt multi-method approaches have the strongest track record overall.

[33] Behaviour change in organisations can be individual level (e.g., "turn off the lights"), but can be reinforced or undermined by policies, procedures, and organisational hierarchies. It is likely to be complex, involving organisational decision-making structures, formal upskilling, and / or explicit cost-benefit calculations. While some learning is transferable, we focus here on non-work situations.

Table 1: Example of Behaviour Change Interventions[34]:

Intervention	Example
Eliminate individual choice	• Ban single use items
Restrict or restructure individual choice	• Ban items made with specific materials • Make items harder to obtain • Change the default option
Fiscal disincentives	• Charging, Charging deposits[35] • Fines • Taxes • Price rises
Fiscal incentives	• Rewards • Returning deposits • Rebates • Payments • Price cuts
Non-fiscal incentives and disincentives	• Convenience and inconvenience, such as providing extra services, restricting residual services • Improved product quality to compete • Fewer materials used in packaging making systems easier to understand, • Nudge interventions, peer pressure, social norms, enforcement
Persuasion/discouragement	• Communications • Community engagement • Peer pressure
Provide information	• Communications around service use, • Direct “ask for a new bin” calls to action • Dispelling myths
Changes to the physical/temporal environment	• Infrastructure • Collection timing • Electric charging for cars, better public transport
Changes to the default policy	• Opt in vs opt out
Social norms and salience	• applying behavioural insight to the policy process, • public statements • Community conversations • Local examples

[34] This list is adapted from House of Lords, Science and Technology Committee -Second Report Behaviour Change, Chapter 2. The items and examples in the list are not wholly distinct but give a good sense of the range of options.

[35] Lower value deposits, expected to be quickly redeemed, should make little or no difference to demand, but in other contexts may shape purchasing choices and encourage end of life behaviours.

Our own conceptual framework for considering behaviour change explicitly highlights the individual, social, and material factors that constrain or encourage individual behaviours and provides a framework to consider them in the context of a specific policy or intervention objective[36].

Finally, it is also useful to distinguish broad types of behaviour changes we might target as some may be more rewarding to deliver than others:

- Very regular behaviour that is part of day-to-day life (e.g. packaging recycling, food shopping, switching off lights, commuting choices).
- Infrequent behaviour, which locks in an ongoing benefit. We see this with energy infrastructure investments (e.g., choosing a new boiler, fitting insulation) where it has been successful. Circular economy service models might also qualify in some contexts (e.g., car sharing models, leasing).
- Infrequent behaviour, with a one-off benefit (e.g., furniture purchase/disposal). For bigger decisions, people may think choices through more consciously (if not, in practice, more "rationally"), but getting the environmental impacts to be part of this decision framework may still be very difficult. An added challenge is that any effort to intervene may need to be done afresh every time, as infrequent behaviour is unlikely to become automatic.

Package Focus

Package 1: Promote responsible production, consumption and reuse

This section sets out in more detail the rationale for the proposed interventions to support progress towards the waste targets as a result of better resource management through waste prevention, reduction, and reuse.

The scale of the challenge

Beyond climate change, material consumption and waste are also the primary driver of nearly every other environmental problem currently faced, from water scarcity to habitat and species loss[37]. In the last 30 years, global material extraction has increased 60%, and today, humanity's material footprint covers a third of earth's landmass. In Scotland it is estimated that we use on average 18.4 tonnes of resources per person[38]; UN research has indicated that a sustainable level of consumption is around 6-8 tonnes per person[39]. Current levels are clearly unsustainable and to help manage resource use globally and ensure equitability we would need to more than half our resource use overall, with even more significant

[36] See Scottish Government's User Guide for the ISM Tool
[37] Making Peace with Nature, United Nations Environment Programme (2021)
[38] Scotland's Materials Flow Accounting, Zero Waste Scotland (2021)
[39] Managing and conserving the natural resource base for sustained economic and social development, UNEP International Resource Panel (2014)

reductions required for some materials. In addition, it is estimated that around four fifths of Scotland's carbon footprint is caused by the production, consumption, and all too often waste, of goods, services, and materials[40]. This means that despite the considerable carbon saving benefits, recycling can never eliminate the majority of waste carbon impacts. Preventing the need for new products and maximising the life of existing products would bring significant environmental and carbon benefits to Scotland and beyond.

Scotland has recognised the importance of waste prevention, in both Safeguarding Scotland's Resources[41] and Making Things Last[42], and a number of waste prevention policies and interventions are in place or planned, including targeting single use plastics, Extended Producer Responsibility and providing direct technical and financial support to organisations operating in this space. However, we know current policy does not go far enough given our net zero ambitions, and the critical role reducing both waste and material consumption can play. Waste and material consumption reduction initiatives should be central to climate policy progress, as recognised in Scotland's Climate Change Plan and in alignment with EU and UN priorities. However, designing interventions and measures to target a reduction in the significant volumes of 'household type wastes' which account for some of the biggest carbon potential, requires an understanding and assessment of the existing incentives and their ability to impact on and influence producer, seller, and buyer behaviour in relation to the consumption and disposal of products. The buyer in this context could be households, businesses, or the public sector.

Factors impacting on consumption behaviour

According to the Reuse Network 10 million household items are sent to landfill every year across the UK[43]. Of these, around 3 million could be reused by people in need, rising to more than 5 million if small repairs were carried out. However, it is all too often cheaper and/or easier to replace than repair. The quantity and complexity of short-life products around the home and work environment grows each year. In many cases these products are designed and priced in a way that precludes them from being repaired or reused at end of life. Where repair is possible, often the cost and/or availability of a repair service (or parts) or a second-hand replacement means that it is simply easier, more convenient and/or cheaper to purchase a new replacement product instead. However, notably, where products are expensive, as for example with vehicles and more recently, smart phones, repair services arise. Overall, this presents challenges in tackling waste arisings in relation to many common household goods such as furniture, electrical goods, and clothing.

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[40] Scotland's Carbon Footprint report 1998-2017

[41] Safeguarding Scotland's Resources - A Programme for the Efficient Use of Our Materials: Analysis of Consultation Responses (2013)

[42] Making Things Last: A Circular Economy Strategy for Scotland

[43] For example, see Why #Every2ndcounts this May

There has been much research into why consumers behave a certain way, and what impacts on their consumption choices; knowing the cause (which can be multiple reasons of varying significance) ensures that measures proposed to drive more sustainable behaviour are appropriate[44]. Consumers can lack sufficient knowledge of what sustainable choices are available and while they may desire to make the 'right' choice, they are often limited by time and knowledge to assess the 'best' option for them. Convenience can be a significant factor, particularly with time stressed consumers; the pace of adoption for alternative systems such as reuse will depend very much on how easy it is to make the change[45].

The consumer faces a marketplace with a propensity of choice within many common household product groups and often purchasing choices are primarily price driven. Whilst choice architecture, which describes the presentation of choices to consumers and the impact that presentation has on consumer decision-making, can help end-users adopt, low carbon options, including sustainable consumption[46], the cost of purchasing a more sustainable product, such as one designed for repair/upgrade (and hence durability and longevity), or accessing a product as a service, can often be considerably higher at point of sale even if the lifetime cost is lower; this can be prohibitive for some consumers.

Producers are not always compelled to design sustainable products. While producers and retailers are, to an extent, incentivised to minimise their own waste arisings and hence costs, a focus on maximising sales can encourage them to drive consumption at an individual level. Tackling waste prevention is therefore a challenge where there is a lack of sufficient incentives in place to ensure that the design and production of products placed on the market facilitates economical viable repair and long-term reuse.

Labour costs and skills shortage present barriers in market development[47]. Shifting to a greater emphasis on repair and remanufacture is challenging as labour costs are higher in the UK than many of the countries from which we import; reuse and repair services are often operating at small scale and hence are unable to compete on a cost basis with primary production. This is coupled with a recognised skills shortage in terms of repair and remanufacture.

Large scale procurement activities are not placing sustainability at the forefront of purchasing decisions. The weak demand for sustainable products and services in the business-to-business marketplace also has an influence on, and impacts, producers and service providers offer. Developing sustainable products and services requires considerable time and investment, and carries considerable risk, particularly

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[44] White, K., Habib, R., Hardisty, D., (2019), How to SHIFT Consumer Behaviours to be More Sustainable: A Literature Review and Guiding Framework, Journal of Marketing

[45] World Economic Forum (2021), Future of Reusable Consumption Models: Platform for Shaping the Future of Consumption, Insight Report

[46] Intergovernmental Panel on Climate Change (2022), Climate Change 2022 – Mitigation of Climate Change, Working Group III, Sixth Assessment Report of the IPCC

[47] Consultation on the Waste Prevention Programme for England: Towards a Resource-Efficient Economy

when it involves a step change from an established product or service to something as yet unseen. By identifying target products and services and procuring sustainable solutions, large private sector organisations and public bodies can provide the base-level demand required to give businesses the confidence needed to invest in sustainable innovation. Once proven, these solutions can then generate demand more widely in the private sector, and scale to meet it.

Changing consumption behaviour

When considering where to target interventions and measures there are a number of further considerations. This includes whether there is a degree of 'unavoidable' wastes, such as certain fractions of food waste, and excavation materials from building projects, which are more challenging to prevent, versus those wastes which are 'potentially' avoidable such as surplus food, single use packaging and textiles. In considering our journey to net zero, focussing on the reduction of specific carbon intensive materials such as textiles and plastics should also be considered a priority for targeted interventions. For example, textiles made up just 4% of waste arisings by weight in 2020 but accounted for 32% of the carbon impact of waste[48].
The 2019 ClimateXChange[49] evidence review also highlights the need for "a range of prescriptive/regulatory instruments and infrastructure actions". We have already acted in this way to address material pollution from single-use plastic items and may need to consider interventions more widely to achieve change in consumption patterns elsewhere at the speed and scale necessary.

The proliferation of cheap disposable products is a key challenge if we are to reduce consumption. Applying a charge to products which are unnecessary, or which have an environmentally preferable alternative, has long been shown to incentivise more responsible consumption choices, as long as the financial stimulus is set at a level to engage the consumer[50]. In Scotland we have already successfully introduced the single use carrier bag charge which reduced usage by 80% in the first year[51] by applying a small charge at the point of purchase. There is scope to extend this approach to other materials to consolidate consumer awareness of consumption, particularly where wider policy measures, such as DRS and EPR, are driving change in product design and use. Research has shown that all ages, genders, and income groups have responded positively to the carrier bag charge by changing their behaviour and there is a suggested "spill over" effect[52]. We have also conducted research on charging measures through the Expert Panel on Environmental Charges and Other Measures (EPECOM) which recommended introduction of a charge on disposable cups as part of a range of measures to reduce consumption. The Panel noted evidence has shown that a disposable cup charge is more effective in generating a positive behaviour change than an equivalent reusable cup discount. Taking account of EPECOM's recommendations, we have committed to introduce a

[48] The Carbon Footprint of Scotland's Household Waste - 2020 Household Carbon Metric Brief
[49] Black, I, and Eiseman, D, 2019, Climate Change Behaviours -Segmentation Study
[50] OECD (2008), Promoting Sustainable Consumption: Good Practices in OECD Countries
[51] Scotland's Carrier Bag Charge One Year On report, Zero Waste Scotland (2015)
[52] The English Carrier Bag Charge Changed Behaviour and Increased Support for Other Charges to Reduce Plastic Waste, Thomas et al, Frontiers in Psychology (2019)

charge on single-use disposable beverage cups and to establish an Advisory Group to inform implementation plans.

The primary aim of any charges will be to reduce consumption, moving away from single-use consumerism whilst avoiding unnecessary purchases of reusable items which have a longer environmental payback period. It is noted that any measures will need to consider the likelihood of material switching and the whole-life impact of alternatives against the baseline.

It is widely reported that individual consumption patterns are affected by a number of factors, including affordability and accessibility of more or less sustainable choices on markets. Alternative options must provide equal convenience, quality and availability to the linear buy-new options that currently dominate the marketplace. Reducing individual ownership and increasing leasing or subscription business models, will help reduce resource demand, and help shift behaviours and attitudes towards ownership of products. These models have additional benefits in that retained ownership by businesses incentivises upgradeability and repair, as well as clearer routes to improved recycling when products reach their end-of-life. However, at present leasing and subscription business models tend to target specific sectors or markets such as high value, niche products, higher socio-demographic customers, or have restricted reach. There may be higher start-up costs which makes it more difficult to enter the marketplace competitively, and whilst EPR schemes will increasingly incentivise reuse models for select products, more support to encourage greater diversity and innovation in products may be required.

We have already committed to support the growth of sharing libraries over the next three years[53], however we are interested in considering what other measures are required to further develop and maximise the impact of alternative business models and support their growth.

Significant progress has been made in improving accessibility and raising the profile of reuse opportunities in recent years, specifically as a result of community based operations and collaborations and partnerships between various public sector organisations and associated networks. In addition, specific support tools, such as Revolve certification[54], have raised standards and ensured enhanced in-store measure are place. To date 120 stores in Scotland have been awarded the Revolve certification, representing around 10% of all third sector and high street charity shops. However, we do not have the evidence to demonstrate the impact of certification on normalising or mainstreaming reuse by providing the consumer with confidence; more work is required in this area to ensure the most appropriate support tools are in place.

In addition, we recognise that international examples of alternative ways of presenting reuse operations could give us a clearer sense of what could be achieved

[53] See Network of sharing libraries and repair cafes

[54] For further information see Zero Waste Scotland information on the Revolve Certification

with sufficient planning, collaboration, and clarity of objectives[55]. Again, the application of similar approaches in Scotland is not fully understood in terms of the potential benefits and contribution to mainstreaming reuse but we recognise the need to work together to continue to explore opportunities.

We recognise that there is a need for further evidence and research to support progress towards more sustainable consumption. The latest IPPC report[56] details a wide range of research and evidence in relation to consumption behaviour and the changes which can be made as a result of action and interventions, however there is also clear acknowledgement of the limitation of research in some areas and quality of data in terms of its credibility and application. Further specific research into waste prevention activities is required, considering where success has been achieved in eliminating waste and changing behaviour of the local community, and its application in Scotland.

Package 2: Reduce Food Waste

This section sets out in more detail the rationale for the proposed interventions to support progress towards the food waste reduction target.

Factors impacting on progress

Zero Waste Scotland undertook an exercise to review the current actions detailed in the FWRAP and identify updates required to achieve the target. The exercise combined aspects of benefit and logic mapping.

Considering how enablers[57] can deliver benefits that in turn lead to an objective allows the exploration of why actions are undertaken and how benefits are realised and measured. Combining the two approaches and applying them to the FWRAP target led to a map that details the sequence of benefits that arise from types of enablers that will ultimately result in the FWRAP target but also realise intermediate benefits and objects that are important to other stakeholders.

This analysis of progress towards the existing actions in the Food Waste Reduction Action Plan (FWRAP) revealed the following insights that have helped to inform the interventions and measures proposed in this consultation document, and include:

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[55] ReTuna in Sweden is a globally recognised example of a reuse superstore which covers 5,000 square feet, 3,600 of which can be leased by individual organisations, and which is funded and operated by the local municipality who own the building. There is a collection and sorting facility integrated into the building, and around 15 stores sell a diverse range of products including sportswear, furniture, fashion items and toys. In 2020, Ikea opened a 'pop up' second-hand furniture store within ReTuna, selling products returned by customers and providing an outlet for damaged furniture. The stores all pay rent which includes access to the donated goods and the administrative costs of the supply of goods. There was an initial subsidy in years 1 to 3 but all are expected to operate a financially viable business model. ReTuna also hosts events, exhibitions and workshops, a one-year education programme and a café on site. The aim of these additional services is to both attract visitors and raise awareness of the concept of reuse. ReTuna employs over 50 people on the site and welcomes between 250,000 and 300,000 visitors per year.

[56] Intergovernmental Panel on Climate Change (2022), Climate Change 2022 – Mitigation of Climate Change, Working Group III, Sixth Assessment Report of the IPCC

[57] Enablers are projects, outputs, outcomes, capabilities, or activities that lead to benefits.

- The structure and demographics of a sector significantly influence how to achieve the greatest reach and impact within that sector, requiring a differentiated approach; there is no one size fits all solution.
- Although the majority of food waste is generated in the household, individuals are strongly influenced by the wider environment (e.g., how food is marketed, sold, packaged). This influencing role means that other food system stakeholders must be involved in the solution even though they themselves generate smaller volumes of food waste.
- Interventions are inter-dependent, and need to be designed to address systemic change; individual interventions will not achieve sufficient impact to meet the 33% target.
- Embedding sustained change across the system can be considered a 5-stage process: we need to engage with businesses and individuals to raise the issue of food waste; this will then provide the opportunity to raise awareness of the impact of food waste and create intentions to act; the first step in taking action is to measure how much food waste there is and set a target; then we can implement actions that attempt to reduce food waste; and finally, successful actions will result in a reduction in food waste.
- The above process will only be effective if it occurs in an environment that enables action to be taken, otherwise the process stalls at awareness.
- Existing data and systems for capturing data are not sufficient to monitor or assess progress towards the FWRAP.

Mainstreaming food waste prevention behaviours

The review also highlighted that there are very few policy incentives that directly target reducing food waste for businesses or for individuals. This is true for most countries. In the UK messaging has typically focused on food waste as an environmental or food poverty issue. While individuals are aware of food waste as an environmental issue and recognise the need for change at a societal level, this does not appear to resonate in the same way as other environmental issues or always translate into behaviour change at an individual level[58]. Scottish Government have sought to highlight the importance of food waste by running two phases of a national food waste awareness campaign since 2019[59]. The campaigns focused on food waste's link to climate change and the best ways households can prevent and reduce food waste, while recycling the food waste they cannot prevent.

Understanding the reason why individuals don't consider food waste an environmental issue, and why awareness does not always translate to action[60] is fundamental to designing and delivering effective interventions that move beyond traditional awareness campaigns through communications.

[58] WRAP survey data suggests that 81% of people are concerned about climate change, but only 32% see a link between food waste and climate change.
[59] Eating Greener | Net Zero Nation
[60] Christiano, A., & Neimand, A. (2017). Stop Raising Awareness Already. SSIR, 15(2), 34–41.

While progress has been made to incorporate behaviour change into intervention pilot studies, more work is needed to better understand the existing behaviours and attitudes and other barriers in the food environment that prevent people adopting new behaviours that are aligned with reducing food waste.

Behaviours and attitudes will vary across different groups, as will the knowledge, skills and opportunities required to implement change. We need to understand the composition of the audience, and the common features (e.g., behaviours, attitudes, knowledge, skills, and opportunities) within each segment of the audience[61]. We then need to design interventions that are most likely to engage each audience segment and provide them with tools that align with the common features of the group[62].

Applying behaviour change theories to existing behaviours and attitudes can help determine the best ways of initiating the desired behaviour changes, but it is also necessary to provide the environment in which an intention to act can be transformed into action and become a sustained behaviour.

This step-change in approach will require a significant programme of research to understand all the aspects described and develop a body of evidence that can then inform and underpin all other aspects of the FWRAP.

This has to take in to account the current societal and legislative landscape and also work within the situations in which individuals interact with food. This requires an understanding of the motivations and incentives of all the actors in each situation. For example, what are the motivations of a food retailer and how well do these align with the motivations of the individual when purchasing food to be prepared and consumed in the home? What are the motivations of a hospitality business when an individual purchases and consumes food on the premises and do these change when the food is ordered to go? How can producers, manufacturers, retailers, and hospitality influence individuals and vice versa? We need to take a holistic approach to designing interventions that account for all these factors, and we need to invest in research that informs our approach to all aspects of the food waste reduction journey.

Alternative uses of food surplus

Beyond behaviour change, we also need to understand where food surplus and waste is generated across the whole supply chain. We can then optimise the outcomes for the surplus or waste according to the food waste hierarchy and attempt to rebalance a system that produces too much food to accommodate down-stream waste while simultaneously having to support people experiencing food insecurity[63].

Preventing food waste is always the priority: food businesses should be following the food waste and surplus hierarchy to prevent or reduce food waste. However, food

[61] See The Principles of Behaviour Change Communications

[62] See Influencing behaviours: ISM technical guide

[63] Intergovernmental Panel on Climate Change (2022), Climate Change 2022 – Mitigation of Climate Change, Working Group III, Sixth Assessment Report of the IPCC

surplus can arise due to many reasons. These include over supply, incorrect labelling, supply chain management issues, inadequate forecasting, and seasonal fluctuations (both weather and demand related)[64].

Current data on food surplus is sparse, potentially inaccurate, or inconsistent, and may be sensitive and therefore not publicly available. Better food surplus data would help to address this issue and potentially allow for greater volumes of food surplus to be redistributed either for human consumption or, if not suitable, to animal feed before it enters the waste stream. Without monitoring of both food waste and surplus we may not be able to identify potential feedback loops or unintended consequences of food waste prevention actions or assess any improvement in supply chain efficiencies and resilience to extreme events.

If food surplus cannot be eliminated and is still fit for human consumption, then it should be redistributed to humans. Redistribution of food surplus has grown rapidly in recent years with a 65% increase in the tonnage of food fit for human consumption redistributed between 2018 and 2020 across the UK[65]. This has huge benefits in terms of preventing food from becoming waste. However, this rapid increase puts pressure on infrastructure and human capacity, particularly for the charitable sector.

Covid-19 increased the number of individuals and households who were reliant on food banks[66] and similar community support mechanisms[67], and highlighted issues around the logistics of getting high quality surplus food fit for human consumption from producers and retailers to organisations and charities that could distribute the food within communities. The initial increase in food bank usage is clearly linked to the Covid-19 pandemic, and that increase appears to have been sustained during 2021. The cost of living crisis is now also contributing to sustained levels of food insecurity[68].

We need to undertake research to understand the demand, legal implications, barriers, nature, and geographical distribution of existing services. This would allow us to establish best practice and the most appropriate support to facilitate interactions between producers and distributers of food surplus. It would also ensure our redistribution evolves beyond addressing food insecurity to providing high quality surplus food as an attractive choice for everyone, while also improving efficiency and effectiveness of the redistribution ecosystem in Scotland.

Redistribution to humans, and for animal feed will result in a reduction of food waste, as the food will never be classed as waste, and has the potential to displace food and feed from the supply chain. It is important to recognise that there will always be a component of inedible food waste that is not suitable for human consumption. This could be diverted to animal feed if suitable, but there are biorefining processes that

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[64] Jeswani, Harish K., Gonzalo Figueroa-Torres, and Adisa Azapagic. "The extent of food waste generation in the UK and its environmental impacts." SPC 26 (2021): 532-547.
[65] Surplus food redistribution in the UK 2015-2020
[66] House of Commons Library: Food Banks in the UK
[67] See IFAN's latest figures collated from Scotland's independent food banks
[68] See The Food Foundation: New data shows food insecurity major challenge to levelling up agenda

extract components of food surplus and waste that can then be used to create high value materials that would otherwise be made from virgin materials or fossil fuels. This may not directly result in reduced food waste, but it could result in a reduction in overall material consumption and overall waste and displace materials with high carbon costs.

The need for a circular bioeconomy

This highlights the connections between activities to improve redistribution to humans, and circular bioeconomy activities that seek to extract additional value from food surplus before it is used as animal feed, and to convert food surplus and waste to feedstocks for high value bioeconomy processes.
Developing better redistribution infrastructure and legislation, and understanding what technologies are available and how they can be integrated in technology cascades will be crucial to ensuring the system does not create unintended consequences that do not follow the waste hierarchy, as is happening with anaerobic digestion (AD).

Historically, AD has been treated as a renewable energy technology, and benefited from subsidies such as the Feed-in Tariff and Renewable Heat Incentive. These subsidies have seen a large increase in facilities across the UK. Farms and businesses that generate by-products that could provide a feedstock for AD, such as distilling and brewing, have invested heavily in the technology in Scotland. However, recent evidence suggests[69] that the economic benefits of diverting food surplus to AD are displacing traditional routes to disposal of food waste and surplus. Distillery waste is being diverted from animal feed to AD in Scotland. This has resulted in the importation of animal feed from England, and projections suggest that if the trend continues then feed will have to be imported from abroad. AD is a better outcome for waste than incineration or landfill[70], but the carbon impacts of importing virgin animal feed from abroad[71] could outweigh this benefit[72] and should not be further facilitated without careful consideration of the impacts.

Continuing with the subsidies based on energy production may lock-in AD as the dominant technology, at the expense of new technologies and processes that can extract components from food surplus and waste for high value biorefining processes while still preserving the components that are required for AD. This means designing an environment that has AD as the final stage of processing food waste, with redistribution and bioeconomy/biorefining as the primary and secondary destinations for food waste, respectively, before AD.

There is also a need for technology and logistical infrastructure so that those with a feedstock can supply it to those with the technology to process it and extract

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[69] Scottish Government: Distillery by-products, livestock feed and bio-energy use: report
[70] Zero Waste Scotland Carbon Metric
[71] Schestak, I., Styles, D., Black, K. and Williams, A.P., 2022. Circular use of feed by-products from alcohol production mitigates water scarcity.*SPC, 30*, pp.158-170.
[72] Report for ClimateXChange: Whisky by-products in renewable energy

maximum value. This is only possible if we fully understand and can track the amount of material that can be diverted to these outcomes, which offer significant environmental benefits over current disposal methods like AD, incineration, or landfill[73].

Creating an environment that encourages research into new technologies[74] that can process food surplus and waste and supports the creation of businesses that employ these technologies and process is essential to support the effective and efficient use of the food surplus and waste that cannot be fed to humans or animals and extract the significant value that is contained in it.

The outputs of research need to be supported as quickly as possible to ensure that commercially viable technologies are operationalised by businesses. Businesses also need investment and incentives to take up new technologies through fiscal mechanisms. How quickly the research and technology development can occur will dictate the impact on the 2025 target, but this is likely to have a bigger impact beyond 2025.

Considering all organic materials for the circular bioeconomy, and not just food surplus and waste, would impact on the overall waste reduction target as well as reducing food waste and improving recycling rates for food waste that cannot be prevented or redistributed to humans or to animal feed.

If food surplus and waste is available and technologies are able to process it, then there needs to be infrastructure in place to ensure that materials can be efficiently transported and processed. This will require an understanding of where particular feedstock are being produced and considering localised infrastructure that has the ability to process the feedstock. If the output of that processing is a feedstock for subsequent processes, then the subsequent processes should be either co-located or within the same geographical location to minimise transport.

At present, large amounts of food surplus and waste are transported from across Scotland to large AD facilities in the central belt[75]. Smaller, localised facilities that can process food surplus and waste with a final AD stage and distribution of the digestate to land improvement could potentially maximise value and minimise transport emissions of the original feedstock and the outputs.

This requires research into the amount and location of: existing feedstocks; availability of processing technologies; matching of feedstocks to processes; optimal design and location of physical infrastructure to transport, store and process the feedstock; and efficient integration with subsequent uses for the processed materials. The benefits of creating a strong circular bioeconomy extend beyond

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[73] Stegmann, P., Londo, M. and Junginger, M., 2020. The circular bioeconomy: Its elements and role in European bioeconomy clusters. Resources, Conservation & Recycling: X, 6, p.100029.

[74] Scotland CAN DO: an innovation action plan for Scotland

[75] This map shows the location of AD facilities in Scotland with a clear cluster across the central belt:. SEPA waste site return data shows that organic waste is transferred from across Scotland to the central belt.

waste reduction. A correctly functioning circular bioeconomy will create green jobs, economic opportunities, and high value materials that can displace fossil fuel-based products. The climate change mitigation opportunities provided by a circular bioeconomy are also considerable, and well aligned with the latest IPCC report[76].

Supporting Scottish Businesses

There is considerable ongoing work to support food businesses to voluntarily report their food surplus and waste in Scotland through Zero Waste Scotland's activities and, at the UK level, the Food Waste Reduction Roadmap (launched in 2018). Based on the 'Target, Measure, Act' principles, the Roadmap is facilitating voluntary food waste and surplus reporting towards the Courtauld 2025 target of 20% reduction in food waste by 2025 and the UN Sustainable Development Goal (SDG) 12.3 goal of a 50% reduction by 2030. The latest Roadmap progress report shows that 171 UK businesses have implemented 'Target, Measure, Act', 138 businesses have reported their food surplus and waste in confidence to Wrap, and 60 businesses have made the data publicly available[77]. The combined turnover of the 171 businesses now implementing 'Target, Measure, Act' is around £234bn, representing 56% of the overall turnover for UK food manufacture, retail and hospitality and food service, and includes the UK's large grocery retailers and 155 other businesses. This shows a clear trend among food businesses towards greater measurement and openness, particularly among the large retailers. However, very few Roadmap signatories submit Scotland specific data and some sectors, such as hospitality, are underrepresented.

By 2020, Over 80%[77] of businesses who committed to the FWRR have provided evidence of implementing Target, Measure, Act, and those that have publicly reported food surplus and waste have delivered a 17% reduction in food waste. This demonstrates that the process of monitoring food waste is effective at reducing food waste, but the current Courtauld 2030 signatories do not cover enough of the food supply change to deliver the reductions needed to meet the 2025 FWRAP target.

In Scotland, Zero Waste Scotland has delivered a Food Waste Reduction Business Support Service to work directly with SMEs to audit and recommend interventions to reduce food waste. Between 2016 and 2020, the Business Support Service identified over £4m cost savings, 15,000 tonnes of food waste savings, 31000 tonnes of CO2eq savings, and almost £2m of potential revenue across ~250 audits. This represents between 5% and 10%[78] of Scottish SMEs involved in food-related activities. The audits identified potential savings of 15,000 tonnes of food waste, which is 12% of the reduction required from manufacturing and other sectors.

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[76] Intergovernmental Panel on Climate Change (2022), Climate Change 2022 – Mitigation of Climate Change, Working Group III, Sixth Assessment Report of the IPCC

[77] The Food Waste Reduction Roadmap Progress Report 2020

[78] The total number of food-related businesses is known, but existing data cannot provide a specific number of SME food businesses. The range quoted represents the minimum and maximum based on several methods of estimating the number of businesses classes as micro, small, medium and large.

However, the actual implementation rate of audit recommendations is a maximum of 50%. This means that the Support Service has helped SME businesses reduce food waste at a maximum of 1.5%[79] per year between 2016 and 2020. If a similar level is maintained between 2020 and 2025, then this would result in an additional 7.5% reduction against the required reduction, resulting in SMEs contributing 13% of the required reduction from manufacturing and other sectors by 2025 through direct interventions recommended by Zero Waste Scotland.

SMEs account for between 12% and 22% of all food-related businesses in Scotland, with large businesses between 0.4% and 1.7%. Micro businesses make up the remaining 77% to 88%. We don't know what percentage of the total waste is generated by micro, small, medium and large enterprises, but it is likely that despite a significant majority of food businesses being classed as micro, the bulk of food waste will be generated by medium and large enterprises. In this context, 13% from SMEs is not enough.

Given these issues and Scotland's ambitious food waste reduction target (33% by 2025), the voluntary approach to food waste and surplus reporting is not expected to meet our demands for food waste and surplus data or to drive business behaviour change, and its subsequent benefits, sufficiently.

Considering legislation that requires mandatory reporting of food waste, along with the planned implementation of electronic waste tracking, is a potential solution to the problems associated with lack of Scottish specific data to drive targeted food waste prevention, redistribution, and the circular bioeconomy. The legislation would require careful implementation to encourage positive engagement with food waste recording and reporting and should also be linked to the interventions designed to engage households and members of the public with food waste reduction.

Package 3: Improve Recycling from Households

This section sets out in more detail the rationale for the proposed interventions for improving recycling from households.

Factors driving the current national recycling performance

There are several different factors which impact on recycling performance[80]. To achieve recycling performance levels of 60% and above most households will have to recycle most wastes most of the time. Evidence from previous waste composition analysis and waste and recycling tonnages reported by SEPA suggests this is not the case currently. The complexity[81] of short-life household products (e.g food,

[79] Assuming a simple linear relationship.

[80] Previous research by WRAP described barriers to recycling broadly as situation, behaviour, knowledge and attitudes. See Jesson, J.K., Pocock, R.L. Stone, I. (2014) Barriers to Recycling: A review of evidence since 2008, M-E-L Research, for WRAP

[81] Complexity refers to both the range of materials used in products (e.g composite packaging, electricals) and how they are designed, constructed and marketed, and the subsequent ability to recycle and repair products.

packaging, paper and card, clothing, electricals) grows each year. A significant portion of household products placed on the market do not have technical or economic options for reuse or recycling[82].

Household participation in recycling grew significantly from the early 2000's until the middle part of the last decade, as evidenced from improving recycling rates. Participation is reliant on goodwill and a social norm to 'do the right thing', and whilst goodwill has produced good progress in the early years, progress has since plateaued. Other options are required for those not motivated by goodwill alone.

It is usually cheaper and easier for individuals to dispose of waste than to reuse or recycle. Cheaper refers to the time and cost to recycle when compared to disposing in the non-recyclable bin. Recycling requires for example the additional washing of packaging, segregation of food waste in kitchen caddies and temporary storage before collection.

Greater cognitive and physical effort is also required to recycle. We are required to make judgements on each item before they are separated, whereas placing everything in the non-recyclable bin promotes cognitive ease. Ideas and actions that induce a sense of cognitive ease are judged more favourably. Those that induce cognitive strain make us more vigilant and suspicious[83]. Individuals are expected to be knowledgeable and make relatively complex daily decisions on the fate of wastes they produce; our expectations may be unrealistic for many. Where people do the wrong thing there is currently little or no feedback provided by the waste collector. The findings from a wide range of citizen surveys and data on the contamination of dry recycling collections[84] would suggest approaches to date have not been particularly effective.

Shared or communal waste and recycling services represent a significant challenge to further improving recycling performance in urban areas[85]. Service users tend to be more transient, subject to higher levels of multiple deprivation, and subject to physical restrictions for storing recycling prior to collection. Providing high performing services in more complex urban environments is likely to require different approaches (e.g changes to physical infrastructure, more transient populations will require more regular communication)[86].

Food waste incurs high overall 'costs' of participation due to well-established attitudes and behaviours around hygiene[87], which is reflected in the relatively poor

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[82] For example, only 64% of plastic packaging was classed as "recyclable", see The UK Plastics Pact Annual Report 2019-20, WRAP

[83] Daniel Kahneman, Thinking, Fast and Slow, 2011,

[84] During previous waste composition analysis non-target materials (which are items that could be recycled in current services, but which have been placed in the wrong container – e.g. glass in a paper collection) and non-recyclable wastes (which are items that cannot be recycled in current kerbside services) typically make up 19% of the overall recycling bin.

[85] Increasing recycling in urban areas, WRAP

[86] Making recycling work for people in flats

[87] WRAP report: Barriers to recycling: A review of evidence since 2008

recycling performance for household food waste. In a high performing system, it needs to be easier and cheaper to reuse or recycle than to dispose of waste, particularly for those waste types where we know current performance is lacking.

There is currently significant variation in recycling performance between local authorities in Scotland. This is reflected in the national household recycling rate calculated and reported by SEPA[88] which shows widely varying performance between local authorities in Scotland. In 2019, local authority household recycling rates ranged from 17% to 68%, in 2020 between 18% and 58%. Between 2011 and 2019, variation in performance has remained consistently high (27% and above). Significant variation in recycling performance between local authorities is therefore the norm, despite significant increases in the performance of individual local authorities. The diverse nature of Scotland's geography presents very different challenges (e.g islands, remote rural, dense urban) when further improving recycling performance.

Figure 10 plots local authority recycling performance (vertical axis) and proportional circles representing how much household waste is generated by each local authority on a national share basis. Local authorities with lower household recycling performance also tend to manage the largest national shares of household waste. Further improving national recycling performance is therefore disproportionately weighted towards improving the performance of those local authorities.

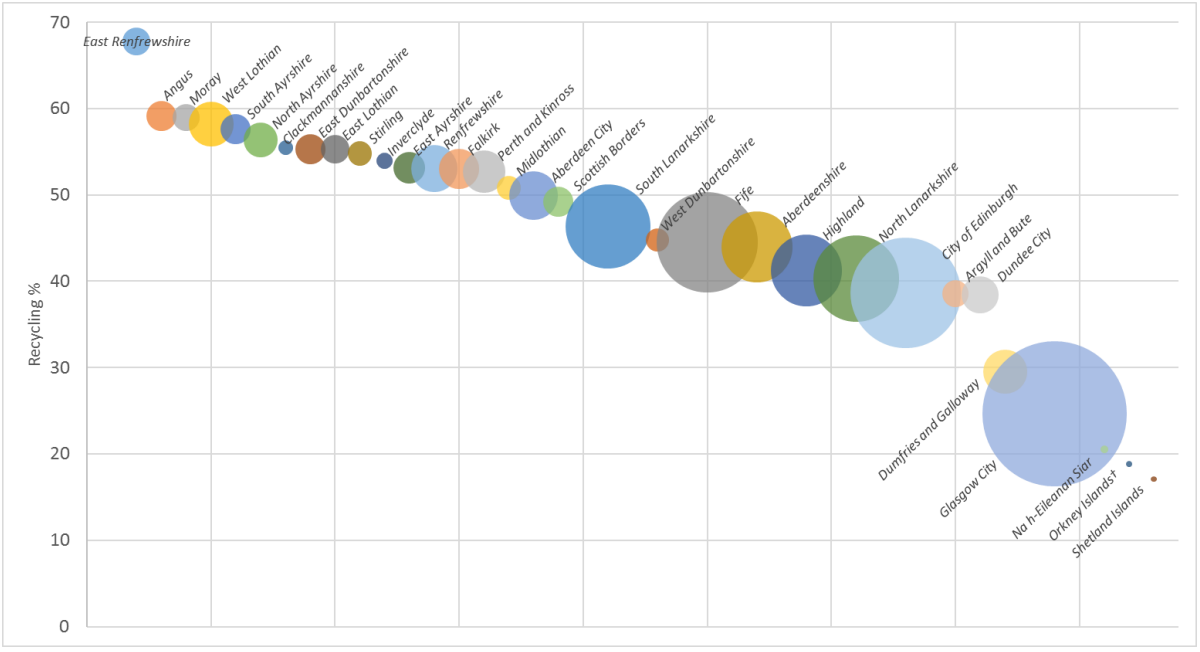

Figure 10: Local authority household recycling performance in 2019 (%, vertical axis) and corresponding proportional circles representing the national share of household waste generated for each local authority

Household waste services are currently delivered by thirty-two unique organisations, with very different operating contexts. Each organisation must balance a much wider

[88] SEPA Household Waste Data

range of local priorities (e.g., social care, education). In previous analysis[89] a higher level of deprivation (percentage of social grade D&E), the presence of a subscription (paid for) garden waste collection, higher residual waste bin capacity and a lack of food waste collection have all been found to be associated with lower recycling rates.

Most households in Scotland have access to common recycling services, with Scotland's 2012 Waste (Scotland) Regulations placing requirements on Local Authorities to provide a comprehensive recycling service to their householders, and establishing the minimum recycling service.

To build on this, in partnership with the Convention of Scottish Local Authorities (COSLA), the Scottish Government created the voluntary Scottish Charter for Household Recycling[90], which seeks to deliver more consistent recycling collections across Scotland. It has an associated Code of Practice which provides guidance and best practice to support the design of recycling services and promote reuse. 31 of 32 local authorities have currently signed up to the Charter, and around a third of councils have aligned their services with the guidance provided in its supporting Code of Practice. Through our Programme for Government, we have committed to evaluate the Charter and review its supporting Code of Practice to ensure that it aligns with Scotland's forthcoming deposit return scheme, and reforms to extended producer responsibility (for example, packaging).

To help support alignment with the Charter, and modernise Scotland's recycling infrastructure, in 2021 we launched the Recycling Improvement Fund[91], a five-year £70 million fund designed to support local authorities to improve recycling and reuse infrastructure. The first investments are funding a range of improvements, including more frequent recycling collections, the extension of food and garden waste collections, new capacity to recycle problematic materials like plastic films, and local service redesigns to align with Scotland's Household Recycling Charter.

Tackling the Current Challenges

In developing the rationale for the proposed interventions for household recycling, we have looked globally to better understand the types of policies and practices that support high-performance.

The implementation plan developed by the European Commission to support the revised waste directives[92] describes a wide range of policies and practices to support waste prevention and recycling, including the examples below:

- "Promote the use of economic instruments at national level to provide adequate financial incentives to ensure better implementation of the waste hierarchy (in particular, landfill/incineration charges, EPR schemes, direct variable charging schemes)".
- "Expand systems for door-to-door separate collection schemes as soon as possible and undertake pilot projects on separate collection to develop solutions for local circumstances".

[89] WRAP (2015), Analysis of recycling performance and waste arisings in the UK 2012/13
[90] Zero Waste Scotland: Charter for Household Recycling
[91] Scottish Government: £70 million fund to improve recycling
[92] EU Implementation Plan for the Revised Waste Framework Directives

- “Introduce and gradually increase charges on landfill/MBT/incineration. Revenues from these charges should be used to support separate collection, awareness raising and the creation of modern infrastructure, focusing on prevention, re-use and recycling”.
- “Reform administrative structures and procedures to simplify administration of waste management, e.g. bundle capacities via inter-municipal associations”.

In 2019 Zero Waste Scotland and Eunomia carried out detailed qualitative comparative analysis of the policies and practices associated with high household recycling rates[93]. No single policy or practice was sufficient on its own to fproduce household recycling rates of 65% and above. For those with a 65% household recycling threshold, a stretching local target, comprehensive collections, direct charging for residual waste collections and other incentives to recycle were present in all four cases. Extended producer responsibility schemes and comprehensive communication were in place for three of the four cases over the 65% threshold. The findings suggest that high household recycling performance occurs when a range of complementary measures are in place.

In 2021 we commissioned Eunomia[94] to look in-depth at the types of policies and practices associated with high recycling performance, focusing on case studies from urban and rural areas. It found that providing as many households as possible with access to a full range of recycling services is a common feature of successful systems; Communal collections should be minimised as far as possible and restricting access to shared containers may be required (e.g swipe cards); Services should be complemented by recycling centres or other provision (e.g mobile recycling centres, especially in dense urban and highly rural areas); Steps should be taken to disincentivise the production of residual waste, for example restricting residual waste capacity by reducing collection frequency or container size, or restricted access to communal bins (e.g swipe cards); Binding targets may be applied to the waste collector and in the case of packaging wastes a performance uplift is often driven by a financial incentive built into extended producer responsibility schemes.

Supporting the desired behaviours

There is no single ‘type’ of recycling service that will meet the needs of all households in Scotland. A more useful way to approach this topic is to ask how the regular, desirable recycling behaviour can be supported in different contexts. For example, the challenges of supporting effective recycling behaviour in remote rural areas are very different from those in dense urban areas. Examples of sharing good

[93] Williams, P., (2019), Comparative Analysis of the Policies and Practices Associated with High Household Recycling Rates, Zero Waste Scotland

[94] Eunomia, (2021), Review of High Performing Recycling Systems, research for the Scottish Government

practice in designing and delivering recycling and reuse services in different contexts are readily available[95].

More recently Zero Waste Scotland has carried out a structured COM-B analysis[96] of three key recycling behaviours:

- Putting food waste into food bins
- Separating out, rinsing, and putting only the correct items in recycling bins
- Putting recyclable items into recycling bins.

This analysis, which highlighted the importance of the design and operation of recycling services and associated communication activities, will be vital to inform work to boost future recycling rates, along with other key research highlighted in this consultation, and collected through consultation responses. For example, it highlighted that a good recycling service should be reliable and easy to use; with clear, consistent, and joined up communications to make the connection between material and bin.

Use of economic instruments to promote recycling behaviour

Economic instruments such as landfill/incineration charges, EPR schemes, and direct variable charging are established policies in other countries to further incentivise waste prevention and improved recycling[97].

Scotland is already implementing two such economic instruments, a deposit return scheme for drinks containers and extended producer responsibility schemes for key waste types. Both policies are explicitly based on the idea that the waste producer contributes to the costs of managing those wastes for environmental benefit. Further research is required to better understand the potential application of economic instruments in Scotland.

Regarding charging in Scotland, fourteen local authorities apply a direct charge (typically less than £50 per year) for the collection of garden waste. Many councils also charge for uplift collection of bulky items in Scotland. Charging households to do the 'right thing' could be argued to send a confusing signal on the relative value of recycling.

The Eunomia Review of High Performing Recycling Systems[98], outlined above, set out the importance of taking steps to disincentivise or reduce residual waste production and collection as part of boosting recycling rates. In other countries this has been achieved in multiple ways, for example through restricting effective weekly residual waste capacity (via smaller bins and/or less frequent collections), enforced

[95] Waste Management Intelligent Systems and Policies, Interreg Europe: Good Practice Projects
[96] Refer to: The Behaviour Change Wheel: A guide to designing interventions
[97] EU Implementation Plan for the Revised Waste Framework Directives
[98] Eunomia, (2021), Review of High Performing Recycling Systems, research for the Scottish Government

volume limits (as in Wales), or other fiscal measures such as direct variable charging[99].

Package 4: Improve Recycling from Commercial Businesses

This section sets out in more detail the rationale for the proposed interventions for improving recycling from businesses and commercial operations.

Understanding the challenges

All business activity generates a volume of materials that are considered waste by the producer; the choice businesses are making is whether to dispose of the material (to landfill or incineration) or recycle or reuse it. However, we recognise that commercial waste is the least understood part of the waste stream with a very large stakeholder base of over 350,000 businesses operating in Scotland and engaged in a wide variety of activities, including agriculture, forestry and fishing, manufacture of chemicals, plastics and pharmaceuticals, manufacture of food and beverage products, manufacture of wood products, mining and quarrying, power industry, waste management and the water industry.

SEPA estimates that the commercial and industrial recycling rates in Scotland are currently 53% (2018 data)[100], and waste has steadily reduced year on year with a 22.1% decrease between 2011 and 2018. The changes in commercial waste management are significant and highlight the success of the waste industry in supporting their customers to recycle more and dispose of less. The most significant changes between these periods include:

- Separately collected food waste more than doubling from 123,904 to 329,787 tonnes.[101]
- An increase in separately collected glass (79%) and plastics (36%).
- Mixed municipal waste nearly halving from 1.35 million to 721,797 tonnes.

Changes in how we use some materials has had a significant impact on the waste requiring management[102].

Recycling performance in the business and commercial sector is not well understood internationally. There are few comparators for recycling rates and where they exist different methodologies have been used. This is due to several factors including the

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[99] Direct Variable Charging (DVC) is measure to incentivise source-segregation and waste prevention for producers of household and municipal waste. DVC is also used to provide a stable revenue to support overall service delivery, and is employed as a policy to incentivise waste reduction and increased recycling in other countries. For example, in a study from 2012, seventeen EU member states employed schemes for municipal waste. For more see Skumatz, L.A., Freeman, D.J., 2006. Pay as you Throw (PAYT) in the US: 2006 Update and Analyses and Watkins et al, 2012, Use of economic instruments and waste management performances

[100] SEPA estimate

[101] SEPA waste data

[102] For example, there have been significant decreases in paper use in recent years.

co-collection of household and commercial materials and the need to make assumptions on the split of the material collected and end-destination.

The clearest opportunity for C&I waste to further contribute to the 'all waste' recycling target is in the segregation of municipal-type commercial wastes, rather than industrial waste; approximately 700,000 tonnes of residual municipal waste is produced, however we do not have any robust compositional data. Assuming a similar composition to residual household waste, 60% of this material could be readily recycled using existing services; as much as 420,000 tonnes. The significant tonnage combined with the source of the material merits further investigation to establish the potential opportunity contained within this material stream.

Better understanding of the composition of commercial waste streams will provide essential insights to as to how we can maximise prevention, reuse and recycling.

It is worth noting that the COVID-19 pandemic had a significant impact on waste generation with some estimates showing reductions in collected C&I waste tonnage of around 50%.[103] According to SEPA recovery has been a mixed picture with some trade waste collectors continuing to report tonnages less than pre-pandemic levels while others report a return to normal.

Factors impacting on recycling behaviours

In terms of incentives to move up the waste hierarchy, currently, the Waste (Scotland) Regulations, introduced in 2014, place a requirement on producers of waste to separate out their recyclable materials (paper, card, metals, plastic, glass and food). A summary of inspections by SEPA and local authorities following the implementation of the Waste (Scotland) Regulations concluded that 60% of businesses had the correct recycling infrastructure and were using it, 20% were at least attempting to recycle and 20% did not have the necessary infrastructure. There is an opportunity therefore, to optimise recycling collections from this 80% of businesses who have the correct infrastructure or are attempting to recycling, ensuring recycling performance is maximised.

SEPA's inspections of compliance with the regulations highlights those least likely to have a compliant waste service being businesses that tend to have high staff turnovers and can be time and resource poor, such as small independent food businesses. Total waste management costs can be relatively small and as a result do not always incentivise good recycling practices.

Other incentives to recycle more, such as consumer demand creating competition on sustainability grounds and reducing costs of their waste management to increase profitability, are significantly weaker than the drive to maximise profit/sales for businesses. In addition, for the majority of businesses in Scotland their waste management costs will be minimal in comparison to the costs of operating their business, and the variability in the recycling market does not create certainty for

[103] See Tolvik Briefing: COVID-19 and UK Waste Sector

waste collectors to significantly incentivise recycling behaviour through differential charging.

As a result, businesses can comply with the regulations but not be making active changes to systems which could drive a change in the composition of their waste and increase recyclability. The waste collectors are ultimately reliant on the goodwill and correct use of the recycling facilities provided to businesses to maximise recycling.

Mismanagement of waste as a consequence of criminal activities has seen a reported increase during COVID-19 pandemic, according to SEPA, with an increase in waste services being advertised via Facebook and other informal channels. Criminals continue to operate in the waste sector in Scotland, undercutting legitimate operators for collections and impacting on performance and progress towards waste targets.

Commercial waste service provision is highly competitive and there may be a tension between downward pressure on operating costs and efforts to maximise recycling performance. High performing services require significant ongoing investment and the certainty to make that investment.

Collection options for difficult to manage but low frequency commercial wastes – lightbulbs, batteries etc. – are limited. Drop off points for business wastes are rare.

There are opportunities to invest in technology (e.g., smart card access containers, the siting of containers underground, fill sensors) that are not being realised in Scotland.

Improving performance

To bring more businesses into compliance and maximise capture of quality materials from all premises requires greater insights to the barriers to participation and optimisation. The potential to co-design commercial waste services is evident, bringing together enabling and support mechanisms to address knowledge gaps and identifying and responding to emerging issues as other policy measures come online, such as EPR schemes.

Businesses can be challenged with the array of commercial waste services available, which can also vary in terms of engagement, awareness raising of optimal practice and enforcement measures taken. The variety of providers, operating different collection infrastructure and uplift times also impacts on the local environment in terms of air quality and emissions from multiple vehicles entering the same area to service different clients with similar waste arisings. Zoning could reduce vehicle movements and optimise efficiency of collections as well as providing a measure of consistency. A single provider in an area also assists enforcement since that provider will be able to monitor participation by all businesses who should be receiving a service.

Zoning has been utilised in a number of locations including Los Angeles, New York, Waregem (Belgium), Barcelona and London to encourage collaboration and reduce local environmental impacts, such as a reduction in local air quality. Analysis by

WRAP has suggested that businesses could save up to 40% by collaborating on service procurement[104]. Collaboration could also improve service consistency and improve recycling performance through optimised efficiency of collections. Commercial waste zoning has not been tested in Scotland, and we do not yet have evidence on the administrative burden to define zones and manage contracts, the impact on waste service providers, implications of reduced competition, and overlap with local authority services, therefore further research is required.

Package 5: Embed Circular Construction Practices

This section sets out in more detail the rationale for the proposed interventions to reduce resource needs, reduce waste, and encourage refurbishment and reuse in construction.

Factors impacting on arisings

Construction and demolition (C&D) accounts for around half of all waste produced in Scotland, with 5.8 million tonnes of construction and demolition waste generated in 2018[105]. Every year, a relatively small number of sites can be responsible for a significant share of the overall C&D waste arisings, with arisings varying greatly year to year due to differences in construction and wider economic activity. The origin of the waste is often uncertain, with different construction activities (excavation, construction, refurbishment, demolition) and project types (infrastructure, residential or commercial new builds etc.) posing specific waste-related requirements and challenges which can require bespoke interventions and measures to prevent the generation of waste and divert waste from landfill.

Of the 5.8 million tonnes of waste, approximately 70% is recycled although this figure rises to 97%[106] if soil and stones are excluded as per the reporting under the Waste Framework Directive. With soil as the majority material in this sector it is worth noting that this term covers a wide spectrum of quality, from high value top soil to low value contaminated material requiring disposal.

Soil and stones accounted for 38% of all waste send to landfill in 2018[107], although some material is used to infill quarry and landfill sites to bring them back into economic use or meet licensing requirements; there is a need for sufficient volumes of the soil and stones waste stream to fulfil closure conditions and ensure infilling of landfill sites and quarries can be completed, otherwise alternative, likely virgin materials will be required for these purposes. However, as infilling of major quarry sites is completed in the coming years, there will be a need to find alternative uses or locations for some of this material.

Use of secondary and recycled aggregate in construction whilst desirable can be much more challenging than using primary aggregate. Primary aggregates can be

[104] Extended Producer Responsibility for Packaging consultation (2021)
[105] SEPA informatics – waste from all sources
[106] SEPA informatics; key figures: recycled C&D waste, excluding soil and stones
[107] SEPA waste from all sources: waste data tables 2018

generated to a consistent output at a location that is convenient to the end user of the material. Sites generating secondary and recycled aggregates for use in the construction sector have an inconsistent input material which leads to a less uniform output material. They are also generally less convenient for the end user and transport costs combined with the potential for a reduced consistency do not incentivise the end user to use secondary material, as their priority is to complete their project to a defined standard. In addition, the cost differential for secondary and recycled aggregates compared to primary aggregates is too small to incentivise their use where less convenient.

The majority of C&D waste arisings could be prevented through better design and handling practices. Despite progress by the sector, poor planning, design and handling practices still exist, leading to unnecessary waste arisings.

There are other factors which impact directly or indirectly on arisings such as a lack of financial incentives to improve performance when operating within very tight margins. There is a lack of demand from clients to do things differently, especially if more sustainable concepts and practices impact on cost and timescales for delivery, although this is starting to be addressed in the National Planning Framework 4, Standard 7, and the Route Map outlines that we will be considering the possibility of mandating 'design for deconstruction' through building standards.

Supporting changes in behaviour[108]

With the sector exposed to tight margins and a high reliance on public sector clients, the economic viability and cost implications on public spending are important considerations. Regulatory requirements, such as building standards, planning permission and procurement clauses, strongly influence the practices and culture that ultimately determine the amount of waste generated and how it is managed.

It is recognised that soil is an important natural resource, and there are high value uses for some of this material, if well managed[109]. However, construction activity will continue producing high volumes of low impact low value soils. Finding nearby uses for this material is essential to keeping transport costs low and maximising any carbon savings available. A soil symbiosis service which anticipates large volumes of soil and identifies nearby uses for it (e.g., on another construction site) have been successful in the north of England, France and Canada.

A fundamental principle of the circular economy is to keep materials and products in productive use for as long as possible. This extends to larger products and goods, such as buildings, where structural integrity and compliance with regulations have been maintained. Research shows that extending building life reduces the generation of low-value, high-tonnage construction and demolition waste, and significantly reduces embodied carbon emissions[110]. However, there is a prevalence

[108] See Zero Waste Scotland information on circular construction for additional information
[109] For example, see New Community of Practice for construction soil management (ciria.org)
[110] For example Hybrid Input-Output Analysis of Embodied Carbon and Construction Cost Differences between New-Build and Refurbished Projects, Langston et al (2018) Sustainability 10(9), AECOM

of practice where buildings are demolished and downcycled into aggregate when they could be refurbished. It is not clear what incentives and measures would drive prioritisation of refurbishment and further evidence is required. The draft NPF4 requires refurb and reuse (where appropriate), but this will depend on how this is interpreted.

The construction industry has a number of voluntary and mandatory standards in place to ensure efficient, effective and safe working practices[111]. These include project-based waste reduction and reuse targets or benchmarks, site waste management plans and waste generation reporting at project level. There are numerous examples of best practice which has demonstrated significant impact on waste reduction, reuse and higher value recycling. Detailed sector guidance also exists but is not always followed. Small and medium sized enterprises also face significant barriers to adoption of voluntary practices such as cost, time, and awareness; however small and medium sized enterprises make up the largest share of the sector by some margin[112]. Site Waste Management Plans would provide a means to evaluate total waste arisings by category, identify opportunities to prevent arisings, evaluate the merits of retrofits and refurbishments and create an audit trail to provide compliance with waste regulation[113.]. Considering existing practices and mechanisms and exploring the most impactful approach may support progress in this area.

Providing a platform for construction companies to store, reprocess, certify, source and utilise used materials and products could prevent significant waste arisings and divert material to reuse. There are many examples of salvage and reuse of construction materials in the UK and overseas[114], however activity is often ad hoc and relies on stakeholders to drive the market. The practice remains relatively niche and faces challenges of supply, geography, specifications, and certification. Under current conditions, it is thought unlikely that reuse of construction materials will become commonplace, therefore without intervention the environmental benefits will remain largely unrealised.

Potential for economic instruments

The Scotland Act 2012 devolved, to the Scottish Parliament, the power to tax disposals made to landfill. This power is exercised through the Landfill Tax (Scotland) Act 2014 which provides for the setting of tax rates and bands, qualifying materials, administration and reporting requirements[115]. The Aggregates Levy is an environmental tax designed to discourage the extraction of virgin aggregate and encourage the recycling of construction and demolition waste. The Scotland Act

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The carbon and business case for choosing refurbishment over new build and Refurbishment & Demolition of Housing. Embodied Carbon: Factsheet, University College London

[111] For example, see SICEF white paper

[112] Statista, Number of construction firms in Scotland in 3rd quarter 2019, by size

[113] See Zero Waste Scotland guidance on creating a site waste management plan

[114] For examples see Materialrest24, Retrovius, FCRBE, Buildings As Material Banks, New Horizon

[115] Scottish Landfill Tax - Taxes - gov.scot (www.gov.scot)

2016 gave the Scottish Parliament the power to introduce a devolved aggregates levy. The Scottish Government continues to progress work to introduce the necessary enabling legislation[116]. Both taxes provide an opportunity to drive better environmental outcomes for Scotland.

The Scottish Landfill Tax has meant residual waste has long been subject to one of the most direct interventions to change incentives to divert waste away from landfill. It comprises two rates - a standard rate and a lower rate for qualifying materials, including inert waste such as soil and stones.[117] There is a significant difference between the rates (currently £3.15 per tonne at the lower rate, and £98.60 per tonne at the standard rate). Currently, as stated the use of secondary and recycled aggregates faces challenges of quality and location. Construction companies must be confident in the quality of material grades to ensure construction projects meet stringent regulatory requirements. Similarly, the cost of materials and transportation must make economic sense therefore aggregate markets must be close to the construction locations to minimise transport fees for heavy material. At present, primary aggregates have a high confidence of quality and are often closer to the sites required, making them often a cheaper option with less perceived risk.

As with amendment of any economic measures, it is important that the impacts of any change are fully understood to avoid unintended consequences such as worse environmental outcome, disproportionate economic impacts on the construction sector and opportunities for waste crime.

Bonds are another fiscal tool, that are commonly used in the construction industry to protect against poor contractor performance or non-competition, guard against default of the company, secure use of plant or materials stored off-site, or provide for dispute resolution. There is the potential to further develop the use of bonds, imposing a recycling bond which would require construction projects over a threshold, to post a proportionate monetary value, returnable when specific reuse or recycling performance targets are met. The bond would be returned on completion of the project accompanied by evidence of performance. Further research is required to ensure recycling bonds achieve the objective of greater recycling of materials without having a disproportionate financial impact, administrative burden or monitoring requirements.

Package 6: Minimise the Impact of Disposal

Other packages set out measures that will help to reduce the amount of residual waste produced, recognising that this is ultimately the best way to minimise the impact of residual waste. As Scotland moves to an increasingly circular economy model, we will see reducing amounts of materials going to disposal, with a focus instead on supporting optimised use, reuse and then recycling of materials. Where

[116] Scottish Government: Aggregates Levy

[117] Scottish Landfill Tax - Taxes - gov.scot (www.gov.scot)

materials must be disposed of, we want to focus on the best environmental outcome for different material streams.

This section sets out in more detail the rationale for the proposed interventions to minimise the impact of disposal of unavoidable residual waste.

Understanding the challenge

We sent around 2.6 million tonnes of material to landfill in 2020, less than half of what we sent in 2005. The proportion of waste sent to landfill has decreased from 43% in 2011 to 32% in 2018[118]. This trend has been driven by a number of factors, including increased landfill taxes, a marked shift from landfill to incineration[119], improved recycling rates and upstream management of waste, and the upcoming ban on sending biodegradable municipal waste (BMW) to landfill.

Nevertheless, achieving the 5% to landfill target set in 2010 represents a significant challenge, since much of the waste we landfill cannot easily be recycled or disposed of by other means. In addition, actions taken to drive tonnage away from landfill to achieve the 5% to landfill target may not align with ambitions to reduce carbon and other environmental impacts in the long term. In particular, the current policy framework for the sector is focused on weight and, therefore, does not account for the carbon impact of materials sent for disposal, either through full life cycle assessment or at end of waste treatment. We recognise there is support for driving the best environmental outcomes by balancing further progress towards the current landfill target with steps to align to our net zero targets.

In reducing the amount of waste sent to landfill, the number of landfill sites across Scotland has decreased. There are now around 41 operational landfill sites compared to 129 in 2005. While there will ultimately be a reduction in the required capacity for residual waste treatment as Scotland moves towards a circular economy, this needs to be a planned reduction to ensure that there is sufficient capacity to treat Scotland's residual waste in a way which minimises environmental impacts while avoiding unintended consequences.

Factors impacting on disposal

The Scottish landfill tax escalator has played a significant and positive role in reducing the volume of waste being sent for disposal since introduction in 1996 and is one of the most direct interventions to divert residual waste away from landfill. An escalator was applied, so the standard tax rate increased from £15 per tonne in 2005 to £98.60 per tonne in 2022. This was effective in making alternatives to landfill more attractive for investment.

However, whilst the Scottish landfill tax has been successful in driving change, further increases in landfill tax alone are likely to be insufficient to influence reductions in carbon emissions of waste management, given the weight based approach to measuring and monitoring residual waste, nor changes in behaviour

[118] See page 14

[119] Incineration accounted for approximately 400,000 tonnes of waste in 2011 and 1.25 million tonnes in 2020. See Waste Incinerated in Scotland Data Tables

since individuals and businesses producing the waste rarely experience any direct impacts of increases in disposal cost.

The Waste (Scotland) Regulations 2012 prevent separately collected materials, such as firm plastics, from being incinerated or landfilled. However, as the report on the review of the role of incineration into the waste hierarchy in Scotland[120] notes, there is still a large proportion of recyclable materials in the residual waste stream[121].

Driving change

The size of investment required in any residual waste solution requires a stable commercial environment to give investors confidence of a viable and profitable operation, and waste producers/collectors a reliable solution to their residual waste needs. There is a critical need to allow for research, development and innovation in the waste and resources sector, while accounting for the need for medium to long-term disposal contracts to ensure financial viability of necessary treatment infrastructure at the required scale, and the significant changes that will occur across the economy which will influence how waste materials need to be managed, as we drive to net-zero by 2045.

Stakeholders have also raised the need for a more strategic approach to waste infrastructure. The recent independent report into the role of incineration in Scotland's waste hierarchy[120] highlights this and recommends that a more strategic approach to planning and deploying waste collection, reprocessing and management facilities.

The review of the role of incineration into the waste hierarchy in Scotland[127] concludes that that incineration in a properly regulated and operated facility remains the most appropriate treatment route for residual biogenic and biodegradable municipal waste, especially once everything that can be extracted for recycling has been taken out and where waste prevention and reuse have been maximised.

Evidence suggests that the best residual management for some other materials might well be landfill[122]. Examples include some contaminated soils, sorting residues[123] and asbestos. Sorting residues have steadily increased in landfills as more municipal and construction waste is processed to recover useful material rather than being landfilled directly. Very little mixed construction and demolition waste is directly landfilled anymore - a significant change from 10 years ago.

The review into the role of incineration in Scotland's waste hierarchy has commissioned further research into the decarbonisation options for existing residual waste infrastructure, with a focus on incineration. Pending the outcome of this

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[120] Stop, Sort, Burn, Bury - incineration in the waste hierarchy: independent review

[121] The composition of household waste at the kerbside in 2014-15,. Zero Waste Scotland. (2017).

[122] See The climate change impact of burning municipal waste in Scotland Technical Report and The 2017-18 ZWS Carbon Metric Technical Report (Annex 2a)

[123] Sorting residues aka 'trommel fines' are difficult to deal with and a major focus of non-compliant activity in the waste industry. There is very limited use of this fraction as it stands and, depending on the source and composition it may be only suitable for further sorting, incineration, or landfill.

research, the recent report from the independent review suggested that one decarbonisation option is to recover more of the recyclable material from the residual waste stream[124].

We are aware that the cost of removing material from mixed waste streams could be prohibitive, the secondary markets for such material may be very limited and that there is a balance to be found between material removal and ensuring optimal efficiency of plants. A sector-led plan to reduce fossil carbon sent for incineration could ensure economic and environmental viability, and identification of the measures required to implement the optimum solutions. This work would be strongly aligned with the development of the Residual Waste Plan, building particularly from the long-term policy objectives identified and utilising the research outputs that help assess future arisings and composition.

The importance of making further progress to decarbonise the sector suggests there is a need to consider what additional fiscal measures could be introduced to reduce the carbon emissions associated with disposal of waste. This is particularly true for incineration facilities[125] and we are working with UK Government to consider the potential expansion of the UK Emissions Trading Scheme to include incineration[126]. The proposed expansion of the UK ETS could provide an incentive for the development and uptake of decarbonisation technologies or practices to reduce emissions from waste incineration and Energy from Waste, principally by strengthening long-term investment incentives. For example, by enhancing the pre-treatment of waste before it is incinerated to reduce fossil plastic in the waste stream (a costly and intensive process). However, it is important that other fiscal incentives are also considered and that these are considered alongside other measures that are in place, or proposed in this Route Map. There are international examples of such practices that can inform further discussions with industry, such as the co-regulation approach taken by Denmark[127].

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[124] The report makes a provisional recommendation that "The Scottish Government should immediately strengthen existing requirements for pre-treatment and work with local authorities and industry to apply them to all existing and future incineration facilities to remove as much recyclable material as feasible, with a particular focus on plastics."

[125] The Climate Change Committee recommended in a report to UK Government that government needs to "address with urgency the rising emissions from, and use of, Energy from Waste"

[126] Developing the UK Emissions Trading Scheme

[127] Denmark's Integrated National Energy and Climate Plan: The Danish model takes a dual approach of taxing the energy generated and the quantity of fossil carbon utilised in the production of that energy

Process for Developing the Route Map

Scoping

The Scottish Government's Programme for Government 2020-21[128] and Scotland's Climate Change Plan update in 2020[129] set out our intention to develop the Route Map. The process to develop the Route Map was initiated in 2020, with the development of a scoping document in partnership with Scottish Government, Zero Waste Scotland and SEPA, setting out key challenges in meeting the waste targets. We utilised SEPA waste data, previous research by the Scottish Government, Zero Waste Scotland, and other parties, and were supported by experienced policy and research analysts, to develop the scoping content.

Diagnosis

Throughout 2021 we analysed our current performance and considered our trajectory towards achieving the targets and undertook an initial diagnosis of the incentives/disincentives (e.g., economic, regulatory, behavioural) that affect all actors in the design, production, consumption, and waste lifecycle stages. We identified those interventions that we consider are working and their likely effect on performance and focused on the identification of other potential interventions which would support progress towards the 2025 targets and beyond. In addition, we identified areas where we considered there was a good range of evidence available, and areas where there were gaps in our collective knowledge.

Pre-consultation Stakeholder Engagement

A long list of possible measures was developed for consideration and this was used as the basis for discussions in a pre-consultation stakeholder engagement process, which was undertaken from October 2021 to January 2022. This provided the opportunity to sense check and validate the diagnosis to date and support the development of proposed interventions for consultation. This process was initiated with an introductory webinar and was followed by a series of group presentations and workshops focusing on the following themes: Product Design and Stewardship; Consumption; Food Waste; Household Recycling; Business and Commerce; Construction and Demolition; and Disposal.

In total 87 stakeholders attended the series of themed sessions, representing 45 unique organisations. As delivery was remote, numbers for the themed sessions were limited to 15-20 participants and priority was given to representative bodies, networks, research groups and membership organisations across the value chain and waste and resource management sector, in order for multiple views to be captured and considered.

Stakeholders were provided with pre-reading for each of the themed sessions and were asked to undertake an offline task. The discussions were focused around

[128] A Fairer, Greener Scotland: Programme for Government 2021-22

[129] Securing a green recovery on a path to net zero: climate change plan 2018-2032 - update

considering the challenges to target delivery and opportunities to address these challenges and stimulate progress. The group presentations and workshops were independently facilitated and outputs from the discussions were collated and used to support development and refinement of the interventions for consultation.

An internal review process by Scottish Government, Zero Waste Scotland and SEPA then took place to refine the proposals, taking into consideration the requirements for specific actions to support delivery and seeking clarity in terms of appropriate timescales. Specific expertise in relation to each theme was sought to test the thought processes and justifications for each of the interventions. This included further pre-consultation engagement with key stakeholders, including local government and COSLA.

Intervention Impact Estimation Process

The inter-dependency and early stage of development of some of the proposed interventions and measures made it difficult to estimate their potential impact in relation to the targets. Therefore, an approach was taken to set up a Panel[130] of experts to seek their views and provide an estimation of impact either in terms of the reduction of arisings or the increase in recycling rate, at three points in time (2025, 2030 and 2035) to give an idea of how quickly impact would be achieved. Interventions were grouped into packages reflecting where dependency between them was highest, and the method for estimating was based on the Sheffield Elicitation Framework[131]. This information was used to support content development and review the interventions and measures proposed. Qualitative information was also secured from the Panel and again, this was used to help inform content development.

Next stage

Following this consultation process, further refining, consideration and assessments of the proposed interventions and measures will take place, based on the feedback from the consultation, before publication of the final Route Map document.

Island Community Impact Assessment, Fairer Scotland Duty Assessment, Equality Impact Assessment, and Business and Regulatory Impact Assessment have all been undertaken and will be reviewed post consultation. In consultation with statutory consultees, it is our view at this stage that the cumulative environmental effects from the Route Map are likely to be significant and a Strategic Environmental Assessment would therefore be required. Through this consultation we ask for further evidence regarding the environmental impact of proposals, which will help inform the strategic environmental assessment process for the Route Map, in line with legislative requirements.

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[130] The Panel consisted of twelve experts with experience of working with waste data or currently working in the waste management industry, and included consultants, representatives from the waste management industry, academics, and researchers.

[131] Oakley J. E. and O'Hagan, A. (2019). SHELF: the Sheffield Elicitation Framework (version 4). School of Mathematics and Statistics, University of Sheffield, UK.

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