



# DRS – The Case for Glass

Report to the DRS Programme Board

Zero Waste Scotland

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**EUROPE & SCOTLAND**  
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Investing in a Smart, Sustainable and Inclusive Future

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## Executive Summary

Following the Deposit Return Scheme (DRS) Programme Board meeting on 4<sup>th</sup> December 2018, Zero Waste Scotland has been asked to prepare a paper outlining the case for including or excluding glass in a Scottish DRS. The reason for providing a separate paper on the inclusion of glass in the DRS is that it poses unique challenges with regards to the scheme design compared to the other materials such as aluminium cans and PET. These include technical challenges (increased manual handling risks, more complex and costly logistics and material reprocessing) as well as economic risks (increased costs to retailers to include costs, the economic impact of switching from an existing kerbside scheme to a DRS model).

## Recommendations

Programme Board members are requested to:

- Note and agree the underpinning assumptions which inform this paper;
- Agree the recommendation that glass should be included in a DRS for Scotland. As a working assumption. This recommendation is based on the benefits to the environment, the NPV savings of including glass to the scheme and individual actors in the supply chain benefits.

## Assumptions

The following supporting assumptions have been made:

- Glass will be collected whole from return locations using a soft drop method<sup>1</sup>;
- The sorting centre will be able to easily separate whole bottles by colour;
- A model will be developed to understand the impact of DRS on each Local Authorities existing collection infrastructure and service contracts;
- A model will be developed to understand the impact of DRS on retailers;
- Soft drop requires additional floor space put aside for storage (25% larger space and 10% increased capital costs);
- Flexible and achievable delivery methods
- Glass bottles would be counted and sorted at a counting centre(s).

## Approach

To assess the merit for including glass in the DRS, a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis on the inclusion of glass was undertaken by Zero Waste Scotland which will be presented to the Programme Board. This paper provides a more detailed discussion on each point raised in the SWOT analysis.

The SWOT analysis was conducted in line with the four overarching DRS scheme principles:

1. Increase the quantity of target materials collected for recycling;
2. Improve the quality of material collected, to allow for higher value recycling;
3. Encourage wider behaviour change around materials;
4. Deliver maximum economic and societal benefits for Scotland.

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<sup>1</sup> A 'soft drop' system ensures that the glass containers remain whole after being deposited by the consumer. Avoiding crushing the container at the return locations prevents the formation of crushed mixed glass and therefore makes it easier to colour separate glass containers via a barcode scan at the sorting centres. This in turn, increases the overall quality of the recycled glass.

The feedback from the public consultation exercise is also factored in. Where possible independent research has been used to evidence each position, with international best practice also considered where appropriate.

## Results

The results of the SWOT analysis highlighted that including glass in the DRS will significantly contribute to achieving the four principles. Based on the success of other schemes, it is estimated that glass bottle capture rates will increase from 64% to between 84-91% over the forecast 2-3 year period thereby contributing to **Principle 1**.

Regarding **Principle 2**, a soft drop system will promote colour separated glass streams which will ensure that high quality recycled glass is available on the market. This increases the viability of closed loop recycling in Scotland and hence leads to significant energy savings and CO<sub>2</sub> emissions reduction.

In terms of **Principle 3**, glass is estimated to make up 17% of drinks containers in the DRS (or 77.5% by weight). As such, it is believed that it will play an important role in normalising behaviour and increasing capture rates. It should also minimise the risk of market distortion by material switching. Including glass will also help reduce litter rates of glass – which is the most problematic litter material compared to aluminium cans and PET.

Finally, including glass offers several economic benefits thereby contributing to **Principle 4**. Firstly, it offers an overall scheme NPV of £832,176,408 compared to £522,839,378 without. Secondly, it will offer an additional high volume, high quality feedstock (1.1Mt by 2043) of recycled glass to the Scottish glass industry. It will also benefit society through increasing the CO<sub>2</sub>e emission reductions by 1.2Mt over 25 years.

Although there are several strengths associated with including glass in the DRS, it is important to acknowledge the associated weaknesses and threats which will need to be addressed to ensure efficient functioning of the system. Although they are discussed in detail in this paper, the **key threats and weaknesses** are as follows:

- Most best practice examples that include glass elsewhere differ from the Scottish context – as such it is difficult to accurately predict the extent of public participation in the scheme – at least in the short term<sup>2</sup>. This risk has been mitigated to some extent by other components of scheme design being selected to incentivise participation.
- Approximately 10% of glass containers (by weight), such as jam jars, will not be included in system. This may cause the unintended consequence of increasing glass in the residual waste streams and still requires Local Authorities to collect it. Yet, there is the potential to include a fraction of this 10% in the DRS in future. Furthermore, the negative effect is assumed to be negligible relative to the positive effects associated with the predicted increase in recycled glass volume and quality from including it.
- There is a risk, in the short term at least, that additional sorting and recycling infrastructure is required to ensure collected glass is colour separated and recycled to a high enough quality to be used in closed loop processes.

There are also a handful of outstanding knowledge gaps which require further assessment prior to the final recommendation being made. These include: (i) quantifying the impact of including glass bottles on Scottish local authorities; (ii) modelling the impact on retailers; and (iii) clarifying the collection and processing infrastructure required.

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<sup>2</sup> It is assumed there will be a ramp up of participation in the scheme over 4 years to achieve the desired capture rates

Based on the results of the SWOT analysis, Zero Waste Scotland recommends that glass bottles are included within the DRS using a soft drop system (See Footnote 1) as a working assumption. Although it offers many strengths, this decision has predominantly been driven by the ~£310 million additional NPV offered combined with the likely high capture rates of high quality feedstock. In addition, although Zero Waste Scotland recognises the existence of weaknesses and threats associated with including glass – it is believed they are not insurmountable and that the benefits of including, in this case, outweigh the risks.

## 1.1 Background

The Outline Business Case (OBC) followed HM Treasury “five cases” model of business case development and presented a strategic, socio-economic, financial and commercial case for the introduction of DRS in Scotland. The OBC, published alongside the Consultation in June 2018, presented four principles for a DRS for Scotland:

- 1 Improve recycling quantity.
- 2 Improve recycling quality.
- 3 Encourage wider behaviour change around materials.
- 4 Deliver maximum economic and societal benefit for Scotland during the transition to a low carbon world.

Assessment for each material has, in part, already been evaluated within the Strategic Outline Case (SOC) and OBC and therefore has already been subjected to a certain level of interrogation and validation. However, the Full Business Case, which is presented to the Programme Board alongside this supplementary paper on the Case for Glass, provides a summary of the preferred scheme and highlights any outstanding issues that need to be addressed. Regarding “Materials in Scope” the scheme design paper outlines the sources of key statements, data or assumptions before making a recommendation on the materials that should be in scope for a DRS for Scotland.

Due to the increased complexity of glass as a material, relative to the other scheme materials, it was requested by the December 2018 Program Board meeting that ZWS provide a separate document outlining the case for including glass within the scheme.

Assumptions made prior to SWOT analysis:

- Glass will be collected whole from return locations using a soft drop method<sup>3</sup>;
- The sorting centre will be able to easily separate whole bottles by colour;
- A model will be developed to understand the impact of DRS on each Local Authorities existing collection infrastructure and service contracts; and
- A model will be developed to understand the impact of DRS on retailers.
- Soft drop requires additional floor space put aside for storage (25% larger space and 10% increased capital costs);
- Glass bottles would be counted and sorted at a counting centre(s).
- Flexible and achievable delivery methods<sup>4</sup>.

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<sup>3</sup> A ‘soft drop’ system ensures that the glass containers remain whole after being deposited by the consumer. Avoiding crushing the container at the return locations prevents the formation of crushed mixed glass and therefore makes it easier to colour separate glass containers via a barcode scan at the sorting centres. This in turn, increases the overall quality of the recycled glass.

<sup>4</sup> A target for all materials rather than individual materials (metal, glass, plastic) is recommended as it provides flexibility to the Scheme Administrator and increases the likelihood of achieving the target – in other words the goal is ambitious but deliverable. A 90% capture rate by container number rather than weight will also ensure that the disparity in weight between the different materials collected will not inadvertently skew the results. Assuming glass is included in the final DRS design, a high collection rate under this target will therefore not screen low collection rates for aluminium or plastic containers.

## 1.2 The Case for Glass

This section presents the strengths, weaknesses, opportunities and threats associated with including glass in the Scottish DRS.

### 1.2.1 Strengths

#### 1.2.1.1 Principle 1: Increase the quantity of target materials collected for recycling

The question of whether glass should be included within the DRS should be addressed under the context of near and midterm recycling targets. The Scottish Government have set out ambitious targets for waste and recycling, with 70% of waste to be recycled by 2025<sup>5</sup>, while the European Commission Circular Economy revised waste proposal has a target for recycling 75% of packaging waste by 2030<sup>6</sup>.

Although such ambitious targets have been agreed to, the ZWS Economic Model identifies that the current recycling rate for glass bottles in Scotland from Local Authority household collections is 64% (119,843 tonnes from an annual total of 188,588 tonnes of glass arisings from households and businesses).

The Strategic Environment Assessment indicates that, under business as usual, the recycling rate for glass is unlikely to increase above 64% by 2043, however, depending on the final DRS design, recycling rates are expected to increase to between 84-91% (range for the examples laid out during the Consultation). As such, it is estimated that by including glass in the DRS, a total of 1.1Mt of glass will be diverted, in addition to business as usual<sup>7</sup>, from disposal and recycled by 2043<sup>8</sup>. This will allow a significant additional tonnage of clean, segregated material to be available to reprocessors thereby reducing the demand for virgin materials.

Apart from Norway and Sweden, all best practice schemes collect glass along with metal cans and plastic bottles, however some collect glass for refilling not recycling (Table 1). Best practice from such countries shows that the inclusion of glass in DRS contributes towards achieving and maintaining recycling targets and is therefore an effective way to collect and recycling glass drinks containers.

**Table 1: European DRS examples inc. glass.** Source: [https://reloopplatform.eu/wp-content/uploads/2019/01/2019\\_ACR\\_Deposit-refund\\_systems\\_in\\_Europe\\_Report.pdf](https://reloopplatform.eu/wp-content/uploads/2019/01/2019_ACR_Deposit-refund_systems_in_Europe_Report.pdf)

Country	Materials inc.	Glass return rate
Croatia	Glass, PET, metal	82%
Denmark	Glass, plastic, metal	89%
Estonia	Glass, metal, plastic	88.7%
Finland	Glass, plastic, metal	87%
Germany	Glass, plastic, metal	Not available
Iceland	Glass, PET, aluminum	87%
Lithuania	Glass, plastic, metal	83%
Netherlands	Glass, plastic, metal	Not available
Norway	Plastic, metal (not glass)	-
Sweden	PET, aluminum (not glass)	-

#### 1.2.1.2 Principle 2: Improve the quality of material collected, to allow for higher value recycling

The production of new drinks containers from virgin materials can contribute to pressures on renewable and non-renewable resources, through demand for paper/cardboard, glass, metal and plastics (derived

<sup>5</sup> <https://www.gov.scot/policies/managing-waste/>

<sup>6</sup> [http://ec.europa.eu/environment/waste/target\\_review.htm](http://ec.europa.eu/environment/waste/target_review.htm)

<sup>7</sup> The diverted tonnages of glass bottles are benchmarked against the current recycling rate and assumes the recycling rate of glass containers will not increase over the next 25 years and no additional policy measures would be introduced which would influence the recycling rate.

<sup>8</sup> Derived from the ZWS Economic Model

from processing of crude oil and natural gas). Where spent containers are recycled and remanufactured, the material demand is significantly reduced. The DRS principles seeks to increase both the *quantity* and the *quality* of recyclate collected; to provide a strong reduction in the tonnage of materials required to generate any shortfall in quantity of containers needed by the market<sup>9</sup>.

Currently between 20-50% of glass is not suitable for closed loop recycling due to way it is currently collected and processed in Scotland (mixed and crushed)<sup>10</sup>. Moreover, a previous ZWS report on Glass Collection and Reprocessing options in Scotland stated that optical sorting would still result in a loss of this percentage i.e. if all material is sorted then there would still be a minimum loss<sup>11</sup>.

The existence of demand for higher quality recycled glass feedstock in Scotland and opportunity to add more value was determined through industry consultations and the Scotch Whisky Association's Environmental Report<sup>12</sup>. The consultations suggested that this demand is predominantly for cullet for recycled content in glass bottles – since most of glass in Scotland is collected mixed.

The Final Business Case (FBC) outlines that soft drop collection should be adopted (See Footnote 1 for a description). This is based on the premise that soft drop collection enables more effective and efficient colour separation compared to the current mixed crushed glass collection. Collecting glass that has been broken at the collection point presents issues with the handling of broken glass in store as well as introducing glass dust into the RVMs. Best practice from overseas visits suggests that glass should be collected whole, with one DRS operator raising the issue of hygiene and dust if glass is crushed in store along with the issue of reducing its quality as it is not separated by colour at this stage<sup>13</sup>, and another stating that their glass that is broken in the machine only goes onto become “mixed colour”.

As such, soft drop would lead to a higher quality feedstock enabling increased closed loop glass recycling. Closed loop glass recycling, in this sense, refers to using the recycled glass to produce new glass bottles, as opposed to downcycling the collected glass into a lower quality product which is difficult to recapture such as glass fibre, filtration media or aggregate.

There are several important advantages of using cullet (glass ready to be remelted) to make new glass containers (as opposed to using virgin materials or downcycling glass into lower value applications such as aggregate). Near closed loop recycling creates significant energy savings and CO<sup>2</sup> emissions reductions. Substituting 1 tonne of cullet for raw materials saves 322 kWh. It takes less energy to melt cullet than virgin raw materials – even though both must reach the same temperature; this is because the chemical reactions to convert the raw materials to a glass have already occurred and subsequent remelting of cullet only requires the energy to reheat to a molten state<sup>14</sup>.

As such, every tonne of glass that goes back to re-melt saves around 314kg of carbon dioxide (compared to ~275kg CO<sup>2</sup> savings if glass is down-cycled to glass fibre or -2kg CO<sup>2</sup> savings as aggregate)<sup>15</sup>. In the case of the DRS, if 87%<sup>1617</sup> of captured glass in system is used in a closed loop

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<sup>9</sup> [Strategic Environment Assessment](#) (Scottish Government, 2018)

<sup>10</sup> The figure of 20-50% is based on the ZWS Glass Report which outlines the expected process loss from mechanical colour separating technology i.e. if you managed to collect 90% of glass for recycling in this way then would still lose this %. Report: <https://www.zerowastescotland.org.uk/content/glass-collection-re-processing-options-report-0>

<sup>11</sup> [Glass Collection & Re-processing Options Appraisal in Scotland](#) (ZWS)

<sup>12</sup> <http://www.scotch-whisky.org.uk/news-publications/publications/documents/environmental-strategy-refresh/#.WfAuJ7Q2w>

<sup>13</sup> ZWS visit to overseas operators in Autumn 2017

<sup>14</sup> <https://www.britglass.org.uk/knowledge-base/resources-and-publications/balance-between-furnace-operating-parameters-and-recycled>

<sup>15</sup> [http://www.wrap.org.uk/sites/files/wrap/ZWS%20Glass%20Options%20Appraisal%20IMR001-002\\_1.pdf](http://www.wrap.org.uk/sites/files/wrap/ZWS%20Glass%20Options%20Appraisal%20IMR001-002_1.pdf)

<sup>16</sup> The preparation of glass in terms of logistics, removing labels, closures and creating the cullet will result in waste and other recycling. Any process loss would be negligible in comparison to current systems where material is tipped, processed and moved multiple times. Losses would equate to 2.1% according to the ZWS Glass Report report for a colour separated process. ZWS estimate the the losses in the DRS should be less given controls on entry to the system as such losses would have a negligible impact on NPV.

<sup>17</sup> According to the ZWS Carbon metric – 87% of captured glass is used for closed loop recycling. As such, the ZWS Economic Model for the DRS assumes the same rate of closed loop recycling. As such the main benefit is based on a higher overall quantity of glass being recycled.



system then the cumulative additional carbon emission savings would equate to 1.29Mt of CO<sup>2e</sup> and in year 9, approximately 52kt of CO<sup>2e</sup> would be saved<sup>18</sup>. However, this is believed to be a conservative estimate as it is expected that the percentage of closed loop glass would increase under the DRS model.

Additional benefits to closing the loop on glass include increasing the lifetime of glass furnaces as there are less chemical reactions with a mix of raw materials and cullet, so there is less chemical attack on the furnace structure. Also, it makes glass forming easier to manage – due to the reduced energy usage there is greater furnace flexibility and higher temperatures are easier to reach with a greater cullet percentage.

### 1.2.1.3 Principle 3: Encourage wider behaviour change around materials

The consultation response indicated 93% (57% organisations and 97% of individuals)<sup>19</sup> of responses want glass included therefore increasing positive reaction to DRS introduction. As such, there is a majority consensus surrounding the inclusion of glass.

Perhaps the most important strength for including glass to address Principle 3 is that glass will make up 17% of drinks containers. Therefore, by including glass, it will contribute to normalising behaviour and increase capture rates. It will also help minimise potential for market distortion by material switching. The FBC also outlines several positive impacts on large number of non-quantified additional benefits.

A recent report by the British Retail Consortium (BRC)<sup>20</sup> made the statement that glass returns at ‘corner shops’ are seen by the public as the quintessential DRS and there may be increased confusion by consumers if glass is not included. It also suggested that including glass offers the most potential for increasing footfall as the quintessential container return model.

Including glass is also expected to contribute to overall litter reduction. According to the Marine Conservation Society (MCS) Great Beach Clean survey, glass was identified as one of the main components of the litter stream. Although it is a smaller number of litter items prevented relative to aluminium and PET containers, glass litter is more problematic relative to other materials and more expensive to clean up. Previous research has shown that glass is a frequent cause of wounds in patients who present to an emergency department. Armstrong and Molyneux (1992) observed that 5% of all injuries at their hospital in Liverpool, England, were caused by glass and that most glass related injuries occurred on the street – and over half over those incidents were bottles<sup>21</sup>. Both in England and the US, broken bottle glass has been reported to be the leading cause of lacerations, accounting for 15–27% of all lacerations seen in an urban emergency department. Glass is also a particular health problem for children. Of 241 children, 83 (34%) had been cut at least once while walking outdoors. In one study, on the reasons for lacerations to children on the street, the majority of lacerations (86%) were caused by broken glass<sup>22</sup>. Lacerations due to glass can result in several health problems. Fragments of glass in a wound may lead to persistent pain, delayed healing, increased scarring, neuropraxis, and infection. In a prospective study of 415 children with cleaned and sutured lacerations in the lower extremities, 8.5% developed an infection. In addition, foreign body retention is more common when the wound is caused by stepping on glass as opposed to falling on glass, putting one's hand through glass, or being struck by glass. Glass injuries are special because the clinical assessment of the presence of a foreign body is difficult, and often insufficient to exclude the presence of retained glass<sup>23</sup>.

Finally, some best practice DRS which include glass reusable/refillable business models which offer even greater resource efficiency and energy savings. There is therefore potential for such models to be promoted in the future in Scotland as outlined in the BRC Report<sup>24</sup>.

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<sup>18</sup> The carbon savings are benchmarked against the current recycling rate and assumes the recycling rate of glass containers will not increase over the next 25 years and no additional policy measures would be introduced which would influence the recycling rate.

<sup>19</sup> Based on the Final Consultation Responses report

<sup>20</sup> British Retail Consortium (2019) ‘Deposit Return Schemes (DRS) in the UK: Implications for Retailers’

<sup>21</sup> <https://europepmc.org/backend/ptpmcrender.fcgi?accid=PMC1881214&blobtype=pdf>

<sup>22</sup> <https://injuryprevention.bmj.com/content/4/2/148#ref-6>

<sup>23</sup> <https://injuryprevention.bmj.com/content/4/2/148#ref-6>

<sup>24</sup> British Retail Consortium (2019) ‘Deposit Return Schemes (DRS) in the UK: Implications for Retailers’

#### 1.2.1.4 Principle 4: Deliver maximum economic and societal benefits for Scotland

The commercial case presented in the OBC was based on evidence of best practice from overseas schemes which include glass (See page 104 of OBS and the report Deposit systems for one-way beverage containers global overview<sup>25</sup>).

Regarding the need to deliver maximum economic benefits, the ZWS Economic Model suggests an NPV of £832,176,408 including glass and £522,839,378 excluding glass. This is a difference of ~£310 million over a 25-year period thereby producing a considerable income stream for the scheme. The effects of glass being included or excluded on the NPV of difference actors in the scheme can be seen in Appendix A. Appendix A also provides a full description of how the NPV was calculated and relevant assumptions.

Increased capture rates will provide a feedstock for export and the existing reprocessing sector in Scotland i.e. 400k p/a glass manufacturing exists in Scotland. Including glass will also provide more feedstock for increased recycled content in the manufacturing of bottles. For example, Whisky distilleries cannot currently get a collection of colour separated glass, especially in rural areas, and are therefore unable to close the loop on this material and put it back into bottles. As such, the Scottish Whisky sector see DRS logistics operations as an opportunity to assist in this. Increasing capture rates also helps the Scotch Whisky Association to more easily meet their target of increasing the recycled content of the industry's packaging to 40% by 2020. Furthermore, by providing higher quality recycled glass on to the market, the whisky industry would be more able to close glass recycling loops thereby significantly reducing the embodied emissions of their glass bottle manufacturing compared to using virgin materials. This would contribute to the SWA realising their target for greenhouse gas emissions to be 170,000 tonnes lower by 2020<sup>26</sup>. It should be noted that SWA hold a neutral position on the benefits of the DRS relative to alternative solutions.

Regarding the need to deliver maximum societal benefits for Scotland, the consultation process demonstrated that individuals are almost unanimously in favour of including glass whereby 97% of individual responses wanted glass included. As discussed above, including glass also contributes to glass litter avoidance and matches stated ambition for the DRS to be an ambitious scheme.

### 1.2.2 Weaknesses

#### 1.2.2.1 Principle 1: Increase the quantity of target materials collected for recycling

Although including glass increases the total volume of glass being recycled at a higher overall quality, it omits approximately 10% of other non-DRS glass containers (such as jam jars) which will still require some form of collection by Local Authorities<sup>27</sup>. This is in line with previous estimates from industry.

Glass containers not covered by the DRS will need to continue to be managed and collected by Local Authority household recycling services, be that at the kerbside, in bring banks or at Household Waste Recycling Centres. In terms of the impacts on current glass collections, there are several potentially different implications for current recycling services, as listed below:

- Kerbside glass collections - most of services are Local Authority operated, however, there is only partial coverage nationally. If kerbside services are reduced or suspended (due to an opportunity for Local Authorities to reduce costs), waste compositional evidence suggests that could mean more non-DRS glass in the residual bin. However, any negative impact is likely more than balanced out if glass bottles are included in DRS due to the increase in recycling rates seen for drink container glass.

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<sup>25</sup> <https://reloopplatform.eu/w-p-content/uploads/2017/05/BOOK-Deposit-Global-24May2017-for-Website.pdf>

<sup>26</sup> [https://www.scotch-whisky.org.uk/media/86084/enviromental\\_strategy\\_refresh\\_2016.pdf?Action=download](https://www.scotch-whisky.org.uk/media/86084/enviromental_strategy_refresh_2016.pdf?Action=download)

<sup>27</sup> The 10% glass containers figure was derived from Valpak's Glass Flow 2012 report: [http://www.zerowastescotland.org.uk/sites/default/files/SPRN\\_0.pdf](http://www.zerowastescotland.org.uk/sites/default/files/SPRN_0.pdf)

- Household Waste Recycling Centres - these are typically Local Authority operated. If they see a very large drop in tonnage there are questions over whether they would just reduce the number of containers and the frequency in which these are emptied, or whether they would remove these glass containers. This would create reduced Local Authority costs but likely have little effect on recycling capture rate.
- Bring sites (including Household Recycling Charter glass recycling points) - these tend to be a mix of Local Authority and private sector collection. If the number of these was reduced there would be a reduction in Local Authority costs but likely little effect on recycling capture rate.
- Comingled acceptance of glass - concern would be the economic case of sorting contracts. To address this, there will be a review of council collections to factor in DRS materials not just for glass and such a review will also provide cost savings to be identified for not collecting material

Estimated savings in disposal costs presented in the OBC for Local Authorities and the Hospitality sector from the introduction of DRS were derived from the ZWS economic model (outlined in Estimation of Costs pg. 57 OBC). This was based on an extrapolation from industry tonnage provided. The Board has already signed off avoidance compliance costs, however, for further information see OBC Page 57-66. The extent of glass litter avoidance was drawn from the Equality Impact Assessment and OBC (Pg.62).

In terms of impact on overall household recycling rate, consideration should be given to the balance of impacts on each waste stream. For example, DRS will likely reduce the number of glass bottles placed in the residual bin, however, if Local Authorities amend and/or reduce glass collection services this could result in some non-drinks bottle glass (e.g. jars) ending up in the residual bin. However, the overall glass recycling rate in Scotland under DRS is expected to increase (drinks containers and other glass containers combined).

Another consideration to be made is the impact of the PRN reform due to take place. For example, if the reform dictates that producers must foot the bill for full cost recovery, this cost would entirely rest with the producers who produce glass containers which are categorized as non-DRS containers (such as jam jars). Further work is necessary to ensure that, even if they are required to recover full cost, that the cost will not be excessively prohibitive (due to the loss of economies of scale of collection through the removal of DRS containers from Local Authority collections systems).

Most best practice examples that include glass elsewhere differ from the Scottish context – as such it is difficult to accurately predict the extent of public participation in the scheme – at least in the short term. This risk has been mitigated to some extent by other components of scheme design (e.g. a 20p deposit level) being selected to incentivise participation. Experience from best practice overseas suggests that by adding a value to items often considered as a waste by the consumer it will incentivise the return of these items to redeem the deposit. As such the quantity of glass collected in recycling in Scotland is expected to increase under a DRS.

#### **1.2.2.2 Principle 2: Improve the quality of material collected, to allow for higher value recycling**

Due to the increased weight and complexity of a soft drop glass system within the DRS, there will inevitably be an increase in the requirement for manual handling during collection. As outlined in the FBC, there will be the need for an additional staff at the counting centres. This may also be a strength of including glass as it will provide more long-term jobs overall. There will be an additional cost as well in terms of providing storage bags to manual drop off locations.

There is a perception that the inclusion of soft drop glass in DRS will cause manual handling issues for both the consumer and return locations. However, while glass is heavier than the other DRS materials, within a return to retail model, customers should not be taking the material somewhere they do not already go to buy (heavier) full containers.

In terms of return location staff and those involved in the collection of this material they may have to handle the material while it has a product in it. There may therefore be the need for additional training and/or communication around how to handle glass should it be included – however this will only apply to manual drop off locations (approximately 10% of containers). ZWS believe the challenge of ensuring

safe manual handling systems is not insurmountable and should not be a roadblock for including glass in the scheme.

By operating a soft drop system, the bottles remain whole until they have been colour sorted in the collection centres. Whole bottles take up more space in the transport vehicles than crushed glass leading to an overall increase in journeys between return locations and collection centre(s). This increases the carbon emissions of the scheme and costs of maintaining a larger fleet of vehicles. However, it is important to compare the potential increase in emissions and costs of collecting and transporting bottles whole to the wider scheme emissions and cost savings. Regarding emissions, WRAP have outlined that the overall the transport related CO<sub>2</sub> emissions are a very minor component for both production routes accounting for less than 4% of total emissions<sup>28</sup>. This is due to the relative carbon intensity associated with running the melting furnace, the energy required to manufacture soda ash and the emissions from the soda ash as it breaks down in the furnace. Furthermore, with the Scottish Government pledging to phase out new petrol and diesel cars and vans by 2032, it is reasonable to suggest that a proportion of collection vehicles could be electric powered thereby significantly reducing the additional emissions<sup>29</sup>.

Regarding potential increased logistics costs, as outlined in Section 1.2.1.4, the overall NPV of the system increases by £310 million if glass is included. The increased costs of additional transport are included within the overall NPV.

#### 1.2.2.3 Principle 4: Deliver maximum economic and societal benefits for Scotland

A recent report by BRC suggested that including glass will increase the retailers' costs by up by a factor of two. A large proportion of this is due to opportunity loss. This may be due, in part, to soft drop requiring additional floor space in stores for whole glass bottles<sup>30</sup>. As a consequence, there is the risk that large retailers may remove glass containers from their product ranges to reduce the volume of glass in the system and the volume to be recovered front of house. It is difficult to estimate at this time as to whether such a change would have positive or negative impacts on the overall operation of the system.

Including glass requires additional manual handling with associated costs and Health & Safety implications for retail staff at manual drop off points as well as collection and processing staff.

One weakness of the scheme was that Local Authorities may take a financial hit with regards to there being stranded glass collection assets. However, as outlined in Appendix A, Local Authorities stand to make a combined 25 year NPV of £193 million.

A question was also raised around the need for existing glass collection staff to be transferred to new delivery organisation. This is being explored with Scottish Government lawyers.

### 1.2.3 Opportunities

#### 1.2.3.1 Principle 1: Increase the quantity of target materials collected for recycling

One of the weaknesses of the system is that ~10% of glass containers would not be included in the DRS. The reason that these glass containers are currently not included is that there was commitment from the Programme for Government 2017/18 was for a DRS for drinks containers. However, due to the versatility of the return vending machines (RVMS) there is a future opportunity to include other glass containers with barcodes such as jars to the scheme if necessary thereby further increasing recycling rates. Nonetheless, the remaining 10% glass containers will still be covered by packaging rules and so a system is needed for this and should be considered in future PRN reform and any revision to the Scottish Household Recycling Charter. Scottish Government and ZWS are continuing to work with COSLA to explore maximising the capture of materials which are not included in the DRS (including the 10% of glass containers mentioned above).

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<sup>28</sup> [http://www.packagingfedn.co.uk/images/reports/Enviros\\_Report.pdf](http://www.packagingfedn.co.uk/images/reports/Enviros_Report.pdf)

<sup>29</sup> This does not extend to HGV's. Rather smaller vehicles (i.e. vans used to collect glass from return sites).

<sup>30</sup> Approximately 10% additional costs and 25% larger space.

An additional opportunity afforded to the system due to including glass is that it more easily allows the scheme to be designed to maintain “future flexibility”. Incorporating flexibility for cups, HDPE and cartons can be done at minimal cost to scheme administrator. As such, if those materials are excluded from the “core” materials it is recommended that there is a specification that the scheme needs to plan for future flexibility. If glass is excluded from the system, this specification cannot be made as reserving future flexibility for glass adds significant additional cost. This is because the retailers would effectively need to keep the space free in the retail environment for a soft drop. This would result in PET and can producers paying a significant amount extra in handling fee but getting no benefit for this. Likewise, specifying the counting centre buildings for potentially including glass would add additional costs.

#### **1.2.3.2 Principle 4: Deliver maximum economic and societal benefits for Scotland**

Due to the reduced burden on Local Authorities to collect and dispose of glass collection, including glass in the DRS offers Local Authorities the opportunity to free up labour and cash to better increase other collection services. An additional model will be provided to Local Authorities to better understand and plan for the expected impact on them due to the introduction of a DRS in Scotland.

At the time of publication of this paper, DEFRA are currently undertaking research into what materials may or may not be included in the English DRS system. Therefore it is assumed logical to include glass in the system in Scotland to align with the English system if glass is included in it. If glass is not included in the English system, it is assumed there will be limited impact as the Scottish Scheme can be designed to only take Scottish barcodes thereby preventing fraud. However, this may increase the complexity for producers having to operate in two different systems in England and Scotland.

#### *1.2.4 Threats*

##### **1.2.4.1 Principle 1: Increase the quantity of target materials collected for recycling**

One key threat which is not easily mitigated is that most best practice examples differ from Scottish context whereby they use systems like the green dot rather than kerbside collection. As such it is difficult to accurately predict the extent of public participation in the scheme – at least in the short term.

Currently in Scotland, households in 16 out of the 32 Local Authorities receive some form glass kerbside collection. However, out of the 16 Local Authorities, not all householders are fully served by a kerbside system<sup>31</sup>. For example, Glasgow excludes high densely populated areas. As such, this equates to a total of 33% total tonnage (36.6kT out of 109kT)<sup>32</sup>. There is a risk that the households which are participating in a kerbside system may be slow/resistant to change behaviour from kerbside depositing. In acknowledgement of such a risk, the preferred scheme outlined in the FBC has attempted to mitigate it by adjusting the scheme components such a 20p deposit level being selected to incentivise participation.

There is recognition that Local Authority collections will need reviewed and optimised once DRS has been introduced, however each of the 32 Local Authorities will be different. ZWS will need to support Local Authorities to make appropriate choices for local situations including looking at the balance between redeploying assets and efficiencies of collections and review alignment with the Household Recycling Charter. However, the revision of the Household Recycling Charter is not a specific outcome of including glass – but of the introduction of the DRS in general.

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<sup>31</sup> There is currently no data available to determine the absolute number of households being served by a kerbside system in Scotland.

<sup>32</sup> Figures are for 2017 from waste data flow extract (SEPA) – See Appendix B

#### 1.2.4.2 Principle 4: Deliver maximum economic and societal benefits for Scotland

There is no guarantee that glass reprocessors switch from buying imported recycled glass to the recycled glass produced in the DRS. This is dependent on whether domestic prices can compete which is difficult to predict. However, based on examples of best practice elsewhere, the costs of domestic recycled glass from the DRS outcompetes imported recycled glass. Finland, Estonia and Lithuania all stated that they export glass collected via DRS for cullet recycling, as they don't have the same domestic bottle manufacturing facilities that we do. The increased quality justifies the additional haulage. So, if the scheme can produce the same quality but without the haulage costs then there should be no financial barrier to use as a feedstock for this domestic industry. Currently, the main reprocessing sites in Scotland are designed to handle mixed crushed glass collection. Collecting uncrushed colour sorted glass may present operational challenges.

Finally, including glass will increase the complexity of the scheme which increases delivery risks – particularly under the short timeframes of rolling out the scheme. This will need to be taken into consideration and a full risk assessment should be undertaken to identify any risk in increased complexity as well as mitigation activities.

## 2 FAQs

**What are the views expressed by those who oppose the inclusion of Glass in the DRS?**

*[Redacted]*

**Does the BRIA modelling highlight a more cost-effective way to collect glass?**

The Full Business Regulatory Impact Assessment currently being completed by ZWS does not specifically identify specific alternative options for collecting glass, rather it looks at overseas best practice with regards to the most cost-effective approaches to increasing overall recycling rates. As such it is not possible to extrapolate whether there is a more cost-effective method for dealing specifically with glass.

**What are the impacts on the consumer in terms of the way they will return glass in a DRS and does this cause a problem re transport/accessibility?**

DRS will mean that the consumer must change the way in which they currently return glass for recycling, however, this is true for all in scope materials not just glass. DRS creates an incentive for the consumer to travel further than their kerbside recycling bin due to the monetary value that is placed on in scope containers.

A Return to Retail model will mean that the consumer can return their containers for redemption locally at point of purchase or within a suitable distance, rather than having to travel to a larger dedicated drop off point as can be seen under a Return to Depot model. The impact on the consumer, and the level of change from their current method for recycling, will therefore depend on the convenience of return locations and whether all retailers are obligated to take part in the scheme and whether the Scheme Administrator is mandated to install a return point if there is not a take back point within a certain distance.

There is a perception from some that products that come in glass tend to be consumed in the home (or at hospitality premises) and are therefore consumed near existing recycling infrastructure and that DRS is potentially introducing a more complicated model for recycling this material stream. However, not all Local Authorities collect glass at the kerbside, with only 16 of the 32 of Local Authorities collecting mixed glass at the kerbside in a dedicated collection<sup>33</sup>, with some of the most densely populated areas not having a glass collection. Kerbside glass collection therefore only collects 33% of total household glass tonnage (See Appendix B). DRS is therefore no more inconvenient than current glass collections, depending on where return locations are placed. DRS is looking to improve both the quantity and quality of recycling in Scotland whilst also reducing litter. By adding a monetary value to items that are often considered as a waste, consumers will be incentivised to return their containers for recycling, thus increasing the recycling quantity of glass and reducing litter. This is however linked to the value of the deposit and the convenience of return locations.

#### **Is there any qualitative or quantitative information on glass injuries from littering?**

While some perceive glass to make up a small component of the litter stream, data suggests that for every 1 tonne of litter collected, it is estimated that DRS affected materials make up approximately one fifth of the Scottish litter composition with packaging glass making up 9% of litter composition found on the ground by weight<sup>34</sup>. MCS found that that glass is the second most commonly found material on beach clean ups<sup>35</sup>. Qualitative research has suggested that litter creates a negative impact on perceptions of a local area through visual disamenity, with littering being one of the most frequently reported neighbourhood problems in Scotland since 2006<sup>36</sup>.

In terms of injuries caused by glass that has been littered in public spaces, qualitative research<sup>37</sup> shows that items that can cause injury (e.g. broken glass) cause public concern, and perhaps thus disamenity). Quantitative research<sup>38</sup> does not identify costs by type of litter, but glass may be disproportionately associated with certain types of economic damage (punctures, injuries etc).

[Redacted]

[Redacted]

#### **What about accessibility issues regarding consumers returning glass bottles to deposit sites?**

Local Authorities tend to provide an assisted kerbside waste collection service (including recycling) to households with limited mobility. The Equalities Impact Assessment<sup>39</sup> outlined that DRS will require consideration of existing support for waste and recycling services (however this will be true of all materials, not just glass). National figures on the number of assisted recycling collections are not publicly available. In the time available, Zero Waste Scotland contacted three local authorities, who provide assisted waste collections to between 5% and 11% of households in their area<sup>40</sup>.

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<sup>33</sup> 2017 waste data flow extract (SEPA)

<sup>34</sup> [Scotland's Litter Problem](#) (ZWS)

<sup>35</sup> <https://www.mcsuk.org/media/gbbc-2018-report.pdf>

<sup>36</sup> [Scottish Household Survey](#) (2016) – [Equalities Impact Assessment](#) (2018)

<sup>37</sup> [Public Perceptions and Concerns around Litter](#) (ZWS)

<sup>38</sup> [Scotland's Litter Problem](#) (ZWS)

<sup>39</sup> [Equalities Impact Assessment](#) (2018)

<sup>40</sup> [Equalities Impact Assessment](#) (2018)



### **What will be the impact on those who currently sort glass ([Redacted])?**

Scotland currently has a mature glass re-processing industry which DRS has the potential to support. Some perceive that glass in DRS will have a negative effect on infrastructure already in place, depending on the way in which glass is collected under DRS, however there is no quantitative data available on this.

Redacted

Regarding perceived impacts, if glass is collected whole it may undermine existing infrastructure as it may require processing/sorting in the way in which glass is currently collected and sorted at such facilities across Scotland (as such facilities may be over-specified for DRS needs). Such facilities have a requirement for colour separated material, if the inclusion of glass in DRS results in high degree of displacement from existing colour separated collection, this will require a number of contracts to be consolidated and assumes a contract can be secured with the System Administrator.

### **What will be the impact on the four main users of recycled glass in Scotland ([Redacted])?**

Including glass in a DRS for Scotland will increase the availability of high quality Scottish glass to those processors who have made alternative arrangements to meet their needs in the current landscape. Engagement with stakeholders has suggested that only 50-60% of the requirement for one manufacturer comes from Scotland with the other ~40% being imported (a breakdown by colour was not provided), with the manufacture stating that they have the infrastructure to process more cullet but not the throughput.

Clear bottles produced by the manufacturer currently contain 15% of flint cullet while green bottles contain approximately 70-80% cullet. Under DRS the total amount of available high-quality cullet to this sector would likely increase, and subject to processing there may also be a reduction in process loss. Differences in quantity are hard to quantify, however, the glass industry have stated that they do not believe DRS will increase the quality of glass (this is their experience of other DRS countries), while also stating that the quality of glass is crucial to them and that a new system for the collection of used glass is needed.

This sector has also raised concerns that if glass is included in DRS producers and retailers will move away from using it as a packing material due to the increased inconvenience. Their experience from one European country with DRS is that because of the scheme they had to close 6 furnaces due to a decrease in glass demand. This issue is not unique to glass as other material types may not be included in the scheme. The likelihood of this is also dependent upon wider PRN reform from Westminster as it is unclear at this stage whether packaging glass will be most cost effective in or out of DRS. Specifically to glass, supply chain logistics and the cost of transporting glass will likely prevent producers from switching to this material to avoid DRS costs.

## APPENDIX A: Scenario Comparison: “Preferred” and “Preferred – No Glass”

The actor specific outputs in the model for these two scenarios are:

- (A) Preferred – Plastic, Cans, Glass, no dairy – 20p deposit – 90% capture  
All annual figures are year 9. NPV is 25 years.

Actor no.	Actor name	Economic cost per annum (£)			NPV from economic profile (£)		
		Costs (Econ)	Benefits (Econ)	Net benefit (Econ)	Costs NPV	Benefits NPV	Net benefit NPV
1	Local Authority	-£2,813,375	£14,618,090	£11,804,715	-£46,371,933	£239,810,012	£193,438,079
2	Hospitality - open loop (out of home sales, and out	-£1,052,531	£656,254	-£396,277	-£17,447,287	£10,750,833	-£6,696,454
3	Hospitality - closed loop (out of home sales, on-site	-£1,693,456	£1,483,396	-£210,060	-£28,310,640	£24,301,180	-£4,009,460
4	Other commerce (non-retailer/caterer) (NOT USED)	£0	£0	£0	£0	£0	£0
5	Other organisations (NOT USED)	£0	£0	£0	£0	£0	£0
6	Private Waste Management (excluding LAs)	-£2,139,649	£2,075,460	-£64,189	-£35,052,012	£34,000,452	-£1,051,560
7	Logistics	£0	£0	£0	£0	£0	£0
8	RVM Service Industry	-£5,947,846	£6,131,800	£183,954	-£98,029,511	£101,061,351	£3,031,841
9	Retailers - supermarkets	-£36,944,943	£0	-£36,944,943	-£768,352,372	£0	-£768,352,372
10	Retailers - other	-£3,687,696	£0	-£3,687,696	-£72,617,566	£0	-£72,617,566
11	Depot operator (NOT USED)	£0	£0	£0	£0	£0	£0
12	Industry - producers	-£3,403,712	£60,174,611	£56,770,899	-£131,755,104	£989,982,347	£858,227,243
13	Industry - packagers (COSTED AS PRODUCERS)	£0	£0	£0	£0	£0	£0
14	Third Sector	£0	£0	£0	£0	£0	£0
15	Consumer	-£44,037,123	£0	-£44,037,123	-£758,295,937	£0	-£758,295,937
16	Society (Wider public benefit/disbenefit not quantif	£0	£69,593,713	£69,593,713	£0	£1,114,467,909	£1,114,467,909
17	Investor (NOT USED)	£0	£0	£0	£0	£0	£0
18	Regulator/Government/SEPA/Trading Standards	-£22,500	£0	-£22,500	-£393,334	£0	-£393,334
19	Fire Scotland/Police Scotland/Planning/HSE	-£22,500	£0	-£22,500	-£393,334	£0	-£393,334
20	System owner	-£38,463,884	£43,473,538	£5,009,654	-£503,059,260	£777,880,615	£274,821,355
	TOTAL	-£130,229,216	£98,206,860	£67,977,644	-£2,460,078,290	£3,292,254,699	£832,176,408

- Carbon saving in year 9 is 165,000 t CO<sub>2</sub>e
- Additional recycling tonnage in year 9 is 88,000t.

- (B) Preferred (no glass) – Plastic, Cans, no dairy – 20p deposit – 90% capture  
All annual figures are year 9. NPV is 25 years.

Actor no.	Actor name	Economic cost per annum (£)			NPV from economic profile (£)		
		Costs (Econ)	Benefits (Econ)	Net benefit (Econ)	Costs NPV	Benefits NPV	Net benefit NPV
1	Local Authority	-£2,683,821	£6,918,729	£4,234,908	-£44,249,553	£113,678,080	£69,428,526
2	Hospitality - open loop (out of home sales, and out	-£1,027,787	£644,749	-£382,987	-£17,038,638	£10,562,365	-£6,476,272
3	Hospitality - closed loop (out of home sales, on-site	-£1,177,176	£407,128	-£770,050	-£19,801,603	£6,669,626	-£13,131,977
4	Other commerce (non-retailer/caterer) (NOT USED)	£0	£0	£0	£0	£0	£0
5	Other organisations (NOT USED)	£0	£0	£0	£0	£0	£0
6	Private Waste Management (excluding LAs)	-£1,051,877	£1,020,321	-£31,556	-£17,231,992	£16,715,032	-£516,960
7	Logistics	£0	£0	£0	£0	£0	£0
8	RVM Service Industry	-£5,359,061	£5,518,620	£165,559	-£88,226,560	£90,955,216	£2,728,656
9	Retailers - supermarkets	-£29,659,255	£0	-£29,659,255	-£632,561,984	£0	-£632,561,984
10	Retailers - other	-£3,207,035	£0	-£3,207,035	-£63,540,552	£0	-£63,540,552
11	Depot operator (NOT USED)	£0	£0	£0	£0	£0	£0
12	Industry - producers	-£2,725,555	£46,070,173	£43,346,618	-£116,661,417	£755,783,417	£639,122,000
13	Industry - packagers (COSTED AS PRODUCERS)	£0	£0	£0	£0	£0	£0
14	Third Sector	£0	£0	£0	£0	£0	£0
15	Consumer	-£37,235,548	£0	-£37,235,548	-£639,701,767	£0	-£639,701,767
16	Society (Wider public benefit/disbenefit not quantif	£0	£57,019,957	£57,019,957	£0	£916,461,630	£916,461,630
17	Investor (NOT USED)	£0	£0	£0	£0	£0	£0
18	Regulator/Government/SEPA/Trading Standards	-£22,500	£0	-£22,500	-£393,334	£0	-£393,334
19	Fire Scotland/Police Scotland/Planning/HSE	-£22,500	£0	-£22,500	-£393,334	£0	-£393,334
20	System owner	-£21,507,596	£35,365,916	£13,858,320	-£382,196,307	£634,011,054	£251,814,746
	TOTAL	-£105,671,661	£152,965,592	£47,293,931	-£2,021,997,041	£2,344,836,419	£522,839,378

- Carbon saving in year 9 is 113,000 t CO<sub>2</sub>e
- Additional recycling tonnage in year 9 is 25,000t

Note that in the absence of a handling fee being switched on, costs are not always fully (re)allocated between return point operators/the central system/producers in the output tables, but this is consistent between the two versions.

### Actor by actor differences:

#### Local authorities:

- Where local authorities currently collect glass separately and receive an income for it, they lose this revenue in (A) and keep it in (B). This is a very small change.
- In scenario (B) LAs lose all savings associated with management and disposal costs for the glass tonnages in both residual and recycle streams, relative to (A).
- In scenario (B) local authorities lose a small litter management and cleansing benefit relative to (A).
- We note that LAs gain equally from route optimisation in modelling both scenarios. Arguably this may overstate the case for (B) as glass collections could be scaled back in (A) and not (B).

#### Hospitality:

- Costs and benefits are both somewhat smaller in (B) relative to (A) as fewer containers are in scope.

*Private waste management:*

- Costs and benefits are both somewhat smaller in (B) relative to (A) as fewer containers are in scope – thus revenue and operational cost changes are both reduced.

*RVM service industry:*

- Costs and benefits relate to revenue and operational costs of maintenance, which is a percentage of initial capital costs. These capital costs are slightly higher for “with glass” equipment in (A), and this is then applied to the maintenance calculation by the model.

*Retailers – supermarkets and other:*

- We assume lower equipment costs (less complex specification reducing equipment costs) and a lower amount of retail space (less containers, less complex equipment, with ongoing savings) for automated take back in (B) relative to (A).
- We see some savings for manual take back in (B) relative to (A) as there are fewer containers (and the cost burden modelled is in part marginal to the container flow).
- Note that we assume the same number and configuration of machines in both. It could be argued that fewer containers in scenario (B) might allow some stores to switch to fewer machines with additional savings. Some retailers would argue the back-end logistics of glass are qualitatively different, and thus (B) would have greater savings relative to (A) than shown. Neither of these arguments is reflected in the model.

*Industry:*

- Avoided compliance costs are ~£14m a year lower in (B), relative to (A). A very large tonnage is removed in (A), but we have somewhat offset this by calculating an avoided compliance per tonne figure that is higher for (B) – reflecting the fact that the cost per tonne for glass PRNs (and therefore achieving additional recycling for this material) is lower.
- Industry costs here are modelled on a per container basis, so fewer containers in (B) means lower costs. In practice the lower return point costs in (B) would also be transferred as industry savings in an actual system. While there remains uncertainty about industry costs overall, we would be confident this should scale broadly as modelled.
- Note the model does not factor in potential material switching by industry (i.e. additional use of non-deposit bearing glass in (B)), as there is no evidence for this to draw on.

*Consumer:*

- Fewer containers means fewer unredeemed deposits, leading to reduced costs in (B) relative to (A)
- Note the cost of consumer participation is not dynamic in the model and is currently the same for (A) and (B). It might be expected to fall with fewer containers. However qualitative factors might complicate this. For example, in convenience terms removing “heavy” glass in (B) might benefit those with existing kerbside collections and disadvantage those without and could also affect overall satisfaction with the scheme.

*Society:*

- Carbon savings fall in (B) relative to (A) as less material is covered (~£1m per annum).
- Litter disamenity benefits fall in (B) relative to (A) as less material is covered (~£10m per annum).

*Regulation/Government/Policing etc (actors 18 & 19):*

- These do not change dynamically in the model and are the same for (A) and (B). This seems appropriate as the number of return sites and manufacturers will be broadly the same.

*System (NB: detailed breakdown below)*

- Logistics costs are lower in (B) relative to (A). There is a very reduced tonnage in (B) – as glass is heavy - however we have increased the “per tonne” fee in the modelling, reflecting that wider logistics costs (route length, truck space) are more likely to be the constraining factors than weight alone once glass is removed.
- System central infrastructure reduces in (B) relative to (A) with less equipment needed at counting centres. This affects both running costs and initial investment.
- System administration and communications requirements do not change.

- Fraud is slightly lower in (B) relative to (A). Fraud levels are calculated as a percentage of containers, so this simple reflects reduced containers in scope.
- Income from unredeemed deposits is lower in (B) relative to (A) for the same reason as above.
- Material revenue is lower in (B) relative to (A) due to fewer containers. However, as glass commands low material prices relative to other target materials, this effect is less than might be expected from the tonnage.
- Producer fees are not “turned on” fully in these model versions. However, any system shortfall (experienced in the set-up year) does still see a fee calculated. This is slightly lower for (B) relative to (A) as the capital investment required is less. This effect would be greater if this functionality was calculated in full (as producers would have to additionally offset any handling fee payments).

**Appendix: System costs summary (all per annum figures for year 9)**

A - "Preferred"						
	Per annum			NPV		
	Cost	Benefit	Net	Cost	Benefit	Net
System costs breakdown	- 28,463,884	43,473,538	15,009,654	- 503,059,260	777,880,615	274,821,355
Logistics	- 19,818,752	-	- 19,818,752	- 324,673,375	-	- 324,673,375
Bulking Point 1	- 184,826	-	- 184,826	- 7,002,799	-	- 7,002,799
Counting Centre	- 2,522,366	-	- 2,522,366	- 71,732,166	-	- 71,732,166
System administration	- 942,928	-	- 942,928	- 16,782,235	-	- 16,782,235
Communications	- 400,000	-	- 400,000	- 7,592,606	-	- 7,592,606
Fraudulently redeemed containers	- 4,595,012	-	- 4,595,012	- 75,276,079	-	- 75,276,079
Material revenue income	-	9,436,415	9,436,415	-	154,588,580	154,588,580
Unredeemed deposits	-	34,037,123	34,037,123	-	593,480,791	593,480,791
Producer Fee - counterparty effect	-	-	-	-	29,811,244	29,811,244

B - "Preferred - No Glass"						
	Per annum			NPV		
	Cost	Benefit	Net	Cost	Benefit	Net
System costs breakdown	- 21,507,596	35,365,916	13,858,320	- 382,196,307	634,011,054	251,814,746
Logistics	- 15,101,625	-	- 15,101,625	- 247,396,788	-	- 247,396,788
Bulking Point 1	- 184,826	-	- 184,826	- 7,002,799	-	- 7,002,799
Counting Centre	- 1,201,417	-	- 1,201,417	- 43,188,080	-	- 43,188,080
System administration	- 942,928	-	- 942,928	- 16,782,235	-	- 16,782,235
Communications	- 400,000	-	- 400,000	- 7,592,606	-	- 7,592,606
Fraudulently redeemed containers	- 3,676,799	-	- 3,676,799	- 60,233,799	-	- 60,233,799
Material revenue income	-	8,130,368	8,130,368	-	133,192,748	133,192,748
Unredeemed deposits	-	27,235,548	27,235,548	-	474,886,621	474,886,621
Producer Fee - counterparty effect	-	-	-	-	25,931,684	25,931,684

## APPENDIX B: Waste data flow extract (SEPA)

Row Labels	All household glass reported as separately collected at the kerbside (tonnes)	All household glass reported as separately collected in total – kerbside plus HWRC/bring sites (tonnes)	All household glass reported as extracted from comingled recycling – (tonnes)
Aberdeen City		-	3,735
Aberdeenshire		5,637	
Angus		193	2,277
Argyll and Bute	961	2,890	
City of Edinburgh	8,718	10,300	
Clackmannanshire	1,225	1,396	
Dumfries and Galloway	498	1,467	
Dundee City	2,124	2,248	816
East Ayrshire	2,310	2,494	
East Dunbartonshire		-	2,787
East Lothian		639	1,355
East Renfrewshire		216	1,266
Falkirk	3,084	4,136	
Fife		5,769	
Glasgow City	5,510	7,418	
Highland		5,871	17
Inverclyde	690	953	

Midlothian	1,936	1,957	
Moray	2,267	2,795	
Na h-Eileanan Siar	409	618	
North Ayrshire		-	2,964
North Lanarkshire	4,101	5,299	6,262
Orkney Islands	360	490	
Perth and Kinross		1,144	1,583
Renfrewshire		-	3,561
Scottish Borders		2,446	14
Shetland Islands		200	
South Ayrshire		-	2,809
South Lanarkshire	85	215	7,522
Stirling	2,191	2,405	
West Dunbartonshire	158	876	
West Lothian		2,006	
<b>Grand Total</b>	<b>36,631</b>	<b>72,079</b>	<b>36,969</b>

