Anthesis

British Glass

Comparison between the British Glass Scottish DRS model and the Zero Waste Scotland DRS model

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1 Introduction

1.1 Background to project

In September 2018 British Glass (BG) commissioned Anthesis Group (Anthesis) to undertake financial modelling on the four Deposit Return Scheme scenarios that were presented in the Scottish Government's DRS consultation. BG used the outputs of the modelling exercise to inform their response to the Scottish DRS consultation.

In January 2019 the Scottish Government announced that it intended to implement a DRS in Scotland that included glass beverage containers (as well as plastic and metal beverage containers). The DRS Final Business Case (FBC) was published in May 2019. The modelling done to support this FBC, was undertaken by Zero Waste Scotland (ZWS). One of its main conclusions was that the inclusion of glass in the DRS would result in a net positive financial contribution to Scotland and that the additional financial costs of including glass in the scheme was not prohibitive.

The results of the ZWS financial assessment have a number of variances from the results of the modelling undertaken by Anthesis. ZWS also do not support BG's position that glass should not be included in the Scottish DRS for a number of reasons, including the disproportionately higher costs of a DRS system with glass included.

BG therefore commissioned Anthesis to compare the modelling approach and assumptions used in the original BG DRS model with those used by ZWS. This report is the output from this piece of work.

1.2 Further modelling

A number of key assumptions that Anthesis developed for the BG DRS model were based on the information contained within the Scottish DRS consultation document. To enable a fair comparison between the ZWS modelling, as presented in the FBC documents and the BG modelling, it was agreed that Anthesis would update the BG model based on the FBC document. The main assumption changes are shown in Table 1.

Table 1: Assumption changes

Assumption type	BG original assumption	Proposed new assumption
Deposit value	10p	20p
DRS performance	80%	90%
Number of Reverse Vending Machine (RVM) locations	951	3021
Number of manual redemption points	16456	2871

Assumption type	BG original assumption	Proposed new assumption
% of tonnage flowing through RVMs and manual redemption points	34% of tonnage to RVMs 66% of tonnage to manual points	90% of tonnage to RVMs 10% of tonnage to manual points
Impact of RVM on retail staff time	6 hours per RVM location	2 hours per RVM
Impact of manual redemption points on retail staff time	2 hours regardless of number of units being handled	Change model set up to calculate time based on number of units handled per site. Use assumption that it takes 10 seconds to handle one unit

1.3 Impacts of changes in assumptions

The impacts of the changes in assumptions on the overall net DRS costs, as modelled in the BG model, are provided in Table 2.

This shows that, in the amended BG model, the total net costs are significantly reduced from the original model for a DRS with or without glass included. However, the proportion of total DRS operating costs that are due to including glass increases from 42% to 51%. In particular, by including glass, DRS handling fees are doubled, and collection costs are more than doubled.

Table 2: Comparison of costs and benefits (units Millions)

	Original BG model: DRS Example 3*			**Amended BG model**		
	Without glass	With glass	The DRS without glass value as a % of the DRS with glass value	Without glass	With glass	The DRS without glass value as a % of the DRS with glass value
Handling fee	-£88m	-£180m	49%	-£56.7m	-£112.1m	51%
Scheme Administration costs	-£4.8m	-£6.3m	76%	-£4.7m	-£5.3m	89%
Collection costs	-£8.8m	-£57.3m	15%	-£8.8m	-£19.9m	44%
Total cost	-£101.6m	-£243.6m	42%	-£70.2m	-£137.3m	51%

	Original BG model: DRS Example 3*			Amended BG model		
	Without glass	With glass	The DRS without glass value as a % of the DRS with glass value	Without glass	With glass	The DRS without glass value as a % of the DRS with glass value
Unredeemed deposits	£25	£35.7m	70%	£25.2m	£35.7m	71%
Material sales	£1.7m	£2.6m	65%	£2m	£3m	67%
Total benefits	-£74.9m	-£205.3m	36%	-£43m	-£98.6m	44%
Net cost	-£48.2m	-£167m	29%	-£15.8m	-£59.9m	26%

* in the original modelling undertaken for the consultation response, Anthesis modelled four DRS examples as outlined in the consultation document. The example 3 DRS from the consultation has the closest similarities to the DRS in the FBC document. The costs from example 3 are provided here to demonstrate the impact of changing these assumptions on the original model outputs.

2 Overall modelling approach

ZWS and Anthesis undertook different modelling activities to look at the impact of a Scottish DRS. ZWS undertook two modelling exercises:

- Cost benefit analysis (CBA) of implementing a DRS in Scotland over a 25 year period. This takes into account the costs and benefits to the main stakeholders directly and indirectly effected by a DRS.
- A financial model, which looks at the financials of the DRS over a 10 year period

The Anthesis / BG model is a one year snap shot financial model from the perspective of the Scheme Administrator when the system is in steady state and provides insight into the DRS Fees for the producers.

The main differences in these two approaches are seen the in the scope of the stakeholders covered in the assessment, the type of modelling outputs and the timeline considered. These difference are shown in Table 3 to Table 5 below.

Table 3: Stakeholders included in the modelling

Actor in scope	ZWS	Anthesis
Scheme administrator	✓	✓
Return Points	✓	✓
Producers	✓	✓
LA	✓	X
Commercial Premises	✓	X
Other Sectors	✓	X
Public	✓	X

Table 4: Modelling outputs

Outputs	ZWS	Anthesis
Financial	✓	✓
NPV	✓	X

Table 5: Modelling timeline

Time period	ZWS	Anthesis
25 years	✓	X
10 years	✓	X
1 year	✓	✓

The assumptions that are most material to the overall cost of the system are:

- The tonnage and number of units in the DRS;
- Reverse vending machine (RVM) configurations, costs and associated handling fee;
- Manual handling points configurations, costs and associated handling fee; and
- The collection costs.

3 Tonnage and number of units in the DRS

3.1 Summary of key points

The number of units in the DRS and the weight of the obligated materials are key parameters used to model directly or indirectly the cost and benefits of a DRS. In particular, these parameters affect the cost of running the redemption points (handling fees and collection costs) and the benefits from the unredeemed deposits and the sales value of materials collected by the DRS.

- In both models the sales unit numbers were sourced from third party data sources and then converted to tonnage using average unit weights. Anthesis and ZWS used different data sources for the sales units numbers and different approaches for converting these to tonnage.
- The scope of each model is different as the BG model considered only off-premise retail sales whereas the ZWS model included both off-premise and on-premise sales. This was expected to result in higher tonnages and number of units in the ZWS model. However, this is not the case as there are approximately 40% more tonnage and number of units in the BG model.
- The ZWS model assumes 253 million off trade glass units (data source Kantar) while the Anthesis model has 523 million glass units (data source Global Data).
- The ZWS model assumes 116,620 tonnes of glass ((data source Kantar) while the Anthesis model has 135,687 tonnes of glass (data source Global Data)
- In summary the BG model has:

  - Over 50% more glass tonnage compared to the ZWS model and over double the number of glass units
  - 9% less metal tonnage and 28% more metal units
  - 6% less plastic tonnage and 14% more plastic units

- Looking at average unit weights of the materials in the DRS system, it appears that in the ZWS model the:
  - Glass unit weight is 35% higher in the ZWS model compared to the BG model, it therefore seems the ZWS model is weighted towards larger beer and wine bottles;
  - Metal can unit weight is 41 % higher in the ZWS model compared to the BG model, this is much higher than average can weights expected; and
  - Plastic bottle unit weights is 20% higher in the ZWS model compared to the BG model, it therefore seems the ZWS model is seems weighted towards larger PET bottles.

3.2 Data sources of unit numbers and method for converting to tonnage

The data sources and approach in the two models are outlined below:

Anthesis' approach:

- Anthesis purchased from GlobalData (https://www.globaldata.com/) 'off premise sales' sales data for the UK;
- This was apportioned to Scotland based on population, which is standard methodology and one which the BG members support,
- Anthesis used an internal database of pack-sizes and average unit weights to estimate the total tonnage within the DRS.

ZWS's approach:

- ZWS obtained retail sales (off premise sales) from Kantar (Scottish panel); and
- An average weight per container type (i.e. glass, plastics, metal) was applied to container numbers;
- Although not relevant to this model comparison project, for information, ZWS obtained the hospitality sector sales data from a variety of sources as there is no single source for this.

It should be noted that although the use of population to apportion UK wide sales data is common practice (and supported by BG members), ZWS has highlighted that ONS data on Scottish consumer behaviour indicates that for some products, purchasing levels may be different to other parts of the UK.

3.3 Comparison of tonnage and number of units in the DRS models

Table 6 below provides a summary of the unit sales and tonnage assumptions used in the ZWS and BG model.

Table 6: ZWS model - tonnage and number of units assumptions

	Total in the System		Total off-premise (consumed at home)		Total on-premise (consumed on the go or in premises)	
Obligated material	**Tonnage**	**units**	**Tonnage**	**units**	**Tonnage**	**units**
Glass	116,620	333,011,097	88,654	253,153,385	27,966	79,857,712
Metal	10,984	639,361,200	9,073	528,116,992	1,911	111,244,208
Plastic	22,906	694,115,099	17,106	518,378,657	5,799	175,736,442
total	150,511	1,666,487,396	114,834	1,299,649,035	35,677	366,838,361

Table 7: BG model - tonnage and number of units assumptions

	Total in the System		Total off-premise (consumed at home)		Total on-premise (consumed on the go or in premises)	
Obligated material	**Tonnage**	**units**	**Tonnage**	**units**	**Tonnage**	**units**
Glass			135,687	523,130,000	n/a	n/a
Metal			8,214	673,620,000	n/a	n/a
Plastic			16,136	588,400,000	n/a	n/a
total			160,037	1,785,150,000	n/a	n/a

Note- the BG model only consider the off sale tonnage and unit information, which is why there are blank cells in the table above

Table 8: comparison of average unit weights in the two models

Obligated material	ZWS model - Average unit weight (g)	BG model - Average unit weight (g)	Variance (g)	Variance (%)
Glass	350.2	259.4	90.8	35%
Metal	17.2	12.2	5.0	41%
Plastic	33.0	27.4	5.6	20%

4 RVM comparison

4.1 Summary of key points

- The two models used different RVM specifications to model the requirements of the DRS;
- The BG model increases the number of RVMs per location when glass is included in the DRS, compared to a DRS without glass. This is because introducing glass to an RVM considerably reduces its throughput capacity compared to plastic and cans

only, because the glass cannot be compacted and the RVM has to be emptied more frequently.

- This effect substantially increases costs in the BG model associated with the RVMs from including glass, in particular the handling fees paid to the retailers;
- ZWS does not change the number of RVMs for a DRS with and without glass. Instead it changes the specification of the RVMs;
- It is unclear that the cost of the RVMs in the ZWS model are representative of the more complex RVMs that collect whole glass bottles via a soft-drop mechanism;
- The handling fees in the two models are significantly different. The main factors for these differences are:
    - The cost of retail space in the model is significantly different, with the ZWS cost being over ten times greater than the assumption used in the BG model. Using the ZWS assumptions in the BG model for this would increase the handling fees as follows:
        - DRS with glass; £57,000
        - DRS without glass; £28,500
    - The BG model assumes a much greater impact on retail staff time compared to the ZWS model; approximately 2.5 hours per day in the BG model compared to 20 minutes in the ZWS model. Greater clarity on the requirements placed on retail staff to maintain the RVM locations needs to be provided so that this can be estimated more accurately. ZWS should make sure the current trials being undertaken by retailers within the IAG Retailer group include research into staff time. This is critical in working out the retail handling fee.
- As shown in section 6, in the ZWS model the collection costs for serving the RVMs does not increase significantly when glass is included in the DRS. It is surprising to Anthesis that more of a difference is not seen. Efficient collection system costs are usually driven by tonnage and/or volume of materials and by frequency of collections. This is especially the case when the throughput capacity of RVMs can be limited by the weight of the glass. One possibility to explore is whether ZWS has over-specified the RVM machine for a non-glass DRS, effectively having more RVM capacity than is needed to collect the plastic and metal materials obligated. Another reason could be the differences in the number of units and weights modelled (see section 3).
- Anthesis undertook initial steps with ZWS to further understand the RVM specification used in the modelling for a DRS with and without glass. ZWS provided more details on the RVM specifications that the modelling was based on, however more detailed information is needed before a complete analysis of the RVM capacities in the two models can be compared.

4.2 RVM configuration

The RVMs specification and numbers per location in the BG model:

- Standard T-90 Tomra RVM;
- Since the T-90 has 2 chambers, it was decided to site 1 RVM per location for a DRS including plastic and metal can and 2 RVMs per sites when the glass was also included;
- The number of sites modelled reflects the number in the Scottish Government's FBC; and
- The RVMs do not have soft drops.

The RVMs specifications and numbers per location in the ZWS model:

- Two Tomra models - T63 Trisort (or newer T70) and the T9 Easy pac.
- No difference in the number of RVMs per sites were made between a DRS for plastic and metal and for one that also includes glass;
- The RVM specifications are instead different. For a DRS with glass ZWS modelled RVMs with soft-drops, which increased the RVM costs (by £2,500 per RVM for the larger RVMs and £1,900 for the Standard RVM) and footprint (by 25%)
- The retail space assumption is the same for both types of RVM, although the larger model would be expected to much greater space

4.3 Tables comparing the RVM assumptions

Below is a series of tables that show the RVM related assumptions from the two models. Table 9 and Table 10 provide assumptions around the configuration of the RVMs, and Table 11 and Table 12 show the cost assumptions. All values presented below are for a DRS with glass, unless otherwise stated.

Table 9: BG model - RVM assumptions

Description	Footprint (M^2)	Glass soft drop	Number of chambers	Annual retail staff time allocated	Number of redemption points	Number of containers per point	Total number of RVMs
Standard RVM	2.5	No	2	0.2 FTE Assumed 12 hour shifts = approximately 2.5 hours per RVM	3021	With glass = 2 RVMs Without glass = 1 RVM	With glass = 6,042 RVMs Without glass = 3,021 RVM

Table 10: ZWS model - RVM assumptions

Description	Footprint (M^2)	Glass soft drop	Number of chambers	Annual retail staff time allocated	Number of redemption points	Number of containers per point	Total number of RVMs
Large RVM with backroom	With glass – 4.8 Without glass – 3.6	With glass – yes Without glass – no	ZWS did not consider the number	0.04 FTE per RVM 7.5 hour shift = 20 mins per RVM per day	283	41 sites - 3 RVMs 242 sites - 2 RVMs	607

Description	Footprint (M^2)	Glass soft drop	Number of chambers	Annual retail staff time allocated	Number of redemption points	Number of containers per point	Total number of RVMs
Standard RVM	With glass – 1.6 Without glass – 1.2		of chambers in the modelling		2737	9 sites – 2 RVMS 2,728 sites – 1 RVMs	2,747
Totals					3021		3,354

Table 11: BG model - RVM cost assumptions

RVM type	Capital cost (per unit)	Installation costs (per unit)	Maintenance (per unit)	Insurance (per unit)	Leasing cost (per unit)	Electricity consumption (per unit)	Retail staff time costs (per RVM)	Retail space value £/m2/year
Standard RVM	£25,000	£2,000	£1,250	Not considered	£7,190*	£352	£9,700	£336

**assumed 5 years life of RVM*

Table 12: ZWS model - RVM cost assumptions

RVM type	Capital cost (per unit)	Installation costs (per unit)	Maintenance (per unit)	Insurance (per unit)	Leasing cost (per unit)	Running costs	Retail staff time costs per RVM	Retail space value £/m2/year
Large RVM with backroom	With glass – £25,000	£1,200	£2,500	£200	Not considered	£153	£683	£4,541

RVM type	Capital cost (per unit)	Installation costs (per unit)	Maintenance (per unit)	Insurance (per unit)	Leasing cost (per unit)	Running costs	Retail staff time costs per RVM	Retail space value £/m2/year
	Without glass – £22,500							
Standard RVM	With glass – £19,000 Without glass – £17,100	£700	£1,900	£200		£123	£683	£4,541

**assumed 7 years life of RVM*

ZWS also considered RVM bags at 11p per bag – currently not consider in the British Glass model but could be incorporated, see Table 13.

Table 13: Bags per RVM site in the ZWS model

RVM site type	Number of sites	Number of bags per site per year
3 RVM and backroom	41	5418
RVM with backroom	242	2278
2 standalone RVMs	9	1587
1 standalone RVM	2729	352

4.4 Handling fee comparison

The tables (Table 14 and Table 15) below provide a summary of the handling fees in the two models. Anthesis estimated the handling fees in the ZWS model, based on the information provided. As part of this process, Anthesis provided Table 15 to ZWS for comments. The following information was provided in response; *"The financial model calculated the costs incurred for acting as return points as a global total and not by return point type. As the level at which handling fees will be set has not been determined, we would not wish to commit to any proposed breakdown of handling fees".*

Table 14: BG model - RVM handling fee

Description	Annual handling fee per site
Standard RVM -with glass (2 RVMs)	£36,000
Standard RVM – without glass (1RVM)	£18,000

Table 15: ZWS model - RVM handling fee

Description	Annual handling fee per site type*
3 RVM and backroom	£83,500
RVM with backroom	£28,000
2 standalone RVMs	£23,500
1 standalone RVM	£11,500

*These handling fees have been estimated by Anthesis based on the data provide by ZWS.

5 Manual redemption point assumptions

5.1 Summary of key points

- Both models assumed a bag collection from the manual redemption points and compensation paid to the redemption point operators in the form of a handling fee
- The handling fees paid to each redemption point differ significantly between the two models. Anthesis has deduced an average handling fee of £280 per site in the ZWS model compared to a handling fee between £730 and £1000 depending if glass is included or not.
- The reason for this difference is that the BG model assumes a higher impact on retail staff time compared to the ZWS model.

5.2 Tables comparing the manual redemption point assumptions

Below are a series tables that show the manual redemption point assumptions from the two models. Table 16 and Table 17 provide assumptions around the setup of the manual redemption points, Table 18 and Table 19 show the cost assumptions and

As part of this process, Anthesis provided *Table 20* to ZWS for comments. The same response as above was provided i.e. *"The financial model calculated the costs incurred for acting as return points as a global total and not by return point type. As the level at which handling fees will be set has not been determined, we would not wish to commit to any proposed breakdown of handling fees".*

Table 20 provide a comparison of the associated handling fees.

Table 16: BG model – manual redemption point assumptions

Description	Annual retail staff time allocated	Type of containers used (manual only e.g. bags / crate)	Number of containers per point*	Number of redemption points	Retail space lost (m2)
Manual redemption point	10 seconds per unit	Single use plastic sacks	With glass – 33 sacks per week Without glass – 5 sacks	2871	Not considered

** Determined by the model based on collection assumptions see section 6*

Table 17: ZWS model - manual redemption point assumptions

Description	Annual retail staff time allocated	Type of containers used (manual only e.g. bags / crate)	Number of containers per point	Number of redemption points	Retail space lost (m2)
Manual	0.01% = 5 mins	Bags	This information was not provided by ZWS	2871	0.5
Manual - hospitality	0.01% = 5 mins	Bags		2303	0.5

Table 18: BG model – manual redemption point cost assumptions

RVM type	Container costs	Tags	Retail staff time costs	Retail space value £/m2/year
Manual redemption point	*5p*	*Not considered*	With glass – £1000 Without glass – £730	*Not considered*

Table 19: ZWS model - manual redemption point cost assumptions

RVM type	Container costs	Retail staff time costs	Retail space value £/m2/year
Manual	3p	£109	£125
Manual - hospitality	3p	£109	£125

As part of this process, Anthesis provided *Table 20* to ZWS for comments. The same response as above was provided i.e. *"The financial model calculated the costs incurred for acting as return points as a global total and not by return point type. As the level at which handling fees will be set has not been determined, we would not wish to commit to any proposed breakdown of handling fees".*

Table 20: Manual redemption point handling fees

Description	Annual handling fee per site
BG model – with glass	£1,000
BG model – without glass	£730
ZWS model*	£460

*These handling fees have been estimated by Anthesis based on the data provide by ZWS.

6 Collection operations and costs assumptions

6.1 Summary of key points

- The two models used different methods to model the collection costs; and
- In the BG model the total collection cost for a DRS including glass is twice the cost of a DRS that does not include glass. Whereas in the ZWS model there is only a 1.2 times increase in cost if glass is included. This is part related to the modelling

method and in part related to the differences in the unit numbers and tonnage between the two models, as covered in section 3.

6.2 Method for calculating the collection costs

The two models, modelled the collection from the RVMs and the manual redemption points was modelled using difference methods, these are outlined below.

The ZWS collection modelling process:

Logistics costs are modelled on a £/t input basis for manual/automated return. However, the £/t figure was derived from a separate calculation of total costs derived top-down and linked to overall system parameters. As non-weight constraints proved critical (number of return points, minimum frequency of collection etc), the overall costs are relatively inflexible to changes in material weight. The figures for logistics costs come from third party modelling (Eunomia and Ecocentric) as well as estimates provided by stakeholders/overseas systems.

The BG collection modelling process:

The BG model determines the number of weekly collections each RVM requires, based on the volume of returned obligated materials and the RVM specification. The RVM specifications state an average number of units of each material type that the RVM can hold. The model then applies an assumption on the cost of a single collection from an RVM. For the manual redemption points, as outlined above, the model assumes a bag collection. It estimates the number of bags that each redemption point would need to hold all the units that are redeemed at that point. The model assumes that each point receives the same number of units and fixes the maximum weight of the bag at 3kg.

6.3 Tables comparing collect cost assumptions

Table 21 below provide a summary of the collection costs in the two models.

Table 21: BG model - overall collection costs

	With glass	Without glass	Comments
RVM collections	£11,300,000	£7,500,000	The RVM collections are 1.5x more expensive when glass is included in the DRS compared when it is not.
Manual redemption points	£8,500,000	£1,300,000	The manual redemption point collections are over 6x more expensive to run when glass is included.
Total collection costs	£19,800,000	£8,800,000	A DRS with glass is, in total, is 2x the cost of collection from compared to a DRS without glass

Table 22: ZWS model - overall collection costs

	With glass	Without glass	Without glass system is
RVM collections	£8,923,211	£6,809,556	The RVM collections are 1.3 times more expense when glass is included in the DRS compared when it is not.
Manual redemption points	£4,007,356	£3,323,615	The manual redemption point collections are over 1.2 times more expenses to run when glass is included.
Total collection costs	£12,930,567	£10,133,171	A DRS with glass is, in total, is 1.2 the cost to collection from compared to a DRS without glass

7 Conclusions

As expected, there are a number of differences between the model approaches and assumptions used in the two models being compared. The main differences are:

- There are significant difference in the number of obligated beverage containers in the model. The ZWS model assumes 253 million off trade glass units while the Anthesis model has 523 million glass units. The ZWS model assumes 116,620 tonnes of glass while the Anthesis model has 135,687 tonnes of glass.
- In both models the unit numbers were then used to estimate the tonnage of obligated materials in the system. Both the numbers and weight of materials play a fundamental part in the calculations that model the system costs and benefits. In particular they impact on:
    - The RVM redemption fees
    - The manual redemption handling fees
    - The collection costs
    - The value of the unredeemed deposits
    - The material sales value of the obligated containers collected

  The number of units and tonnage within the DRS therefore plays a significant role in determining the feasibility of a DRS in any given jurisdiction. It is therefore imperative that the unit sale data and associated tonnage accurately reflects the situation in Scotland.
- The models have been based on different RVMs specifications and further work is needed to determine if the models have adequate provision of RVMs to handle the volumes of material collection. The RVM associated costs are a significant contributor to the overall DRS costs. Over provision of RVM capacity within the system could result in unnecessary financial burden to stakeholders with minimal benefit. It is therefore worth looking at this further.
- There is discrepancy between the two models related to the handling time and cost implications on retail staff. These cost estimates feed into the overall handling fees paid to the redemption point operators and therefore more clarity is needed to understand the assumptions and to test them against retailer experience in other countries where there are Deposit Return Systems.