Options and Feasibility of a European Refund System for Metal Beverage Cans

Final Report
Appendix 6: Cost Benefit Analysis

Authors:

Dominic Hogg

Tim Elliott

Simon Croasdell

16th November 2011

16th November 2011

Contents

1.0 Introduction

The Project Specifications describe the tasks to be carried out in order to complete a *'Cost-benefit analysis of the identified solutions in relation to the size of the problem'*. These are as follows:

> *The contractor shall perform a cost benefit analysis of each option identified in Task 3 in relation to the size of the problem and the status quo scenario. Costs and benefits should be expressed in quantified and monetary terms to the highest degree possible.*
>
> *For different options of implementation tools special attention needs to be given to assessing:*
>
> > *a) proportionality with regard to the magnitude of the problem and the improvement expected;*
> >
> > *b) administrative effort to be expected for implementation and enforcement by public administrations and economic actors;*
> >
> > *c) new opportunities and benefits generated by the measures;*
> >
> > *d) degree to which impacts identified in Task 2 would be reduced;*
> >
> > *e) risks of possible unintended environmental, social and economic side-effects.*
>
> *In addition, the contractor shall assess any elements that might influence the feasibility of the identified options, such as legal, technical and operational constraints, risks of possible unintended environmental, social and economic side-effects etc.*
>
> *On the basis of the cost benefit analysis, the contractor shall make policy recommendation(s) and develop implementation scenarios for the best identified option(s).*

As a reminder, the interoperability options that were identified in the early stages of the project were:

- 1: National requirement for the German deposit to be applied to all metal cans sold in Germany;
- 2: Bi-lateral agreement between Germany and Denmark to compensate for cost of managing cross-border cans;
- 3: Bi-lateral agreement between Germany and Denmark to ensure the national systems are interoperable;
- 4: Requirement for all existing and future Deposit Refund Systems (DRSs) for metal cans to be interoperable;
- 5: Requirement for all existing and future Deposit Refund Systems (DRSs) for metal cans to form a single system;
- 6: A single European Union Deposit Refund System (DRS) for metal cans to cover all member states.

The Specifications note that cost benefit analysis (CBA) should be carried out in relation to the *magnitude of the problem and the improvement expected*. As the final interoperability option was not deemed to be a proportionate response to the scale of the problem, it was not considered appropriate to use resources to subject it to a detailed CBA. The more detailed cost benefit analysis has focused on options which more directly address issues of interoperability.

This Appendix to the final report is structured in the following way:

- *Approach to Cost Benefit Analysis* – first, a brief description of the approach taken to conducting the CBA is given;
- *Cost Benefit Analysis*
  - *Determination of Impacts* (Section 2.0) –this section includes a discussion around how the impacts were determined;
  - *Development of Systems Models* (Section 3.0) – models for the deposit refund systems and other processes where developed to enable the calculation of any impacts resulting from the interoperability options. These are described in this Section;
  - *Calculation of Interoperability Impacts* (Section 4.0) – the methodologies for calculating the relevant impacts are described here;

1.1 Approach to Cost Benefit Analysis

The Project Specifications states that:

> *Costs and benefits should be expressed in quantified and monetary terms to the highest degree possible.*

Market-based impacts will already be expressed in monetary terms. However, non-market (environmental and social) impacts are generally not, due to their nature, reflected in market prices (unless specific policy mechanisms 'internalise' environmental and social costs) and do not, therefore, have a monetary value. However, there are a number of methods for monetising impacts within a CBA.

Market based, financial impacts are tangible and can be assessed by the costs associated with the development and operation of any market based process – these may include labour costs, energy costs, capital expenditure, consumer product costs or deposit payments in the deposit refund systems. In conventional cost benefit analyses, the approach which is generally taken is to consider the costs and benefits from a societal perspective, with all taxes and transfers stripped from the analysis, and with the costs of capital valued at a social discount rate. This has the merit of enabling the analysis to appraise the resource costs – from a societal perspective – of competing options. In the current case, however, one of the critical aspects regarding the merits, or drawbacks, of different approaches to addressing interoperability is the question of the distribution of relevant costs. Because the aforementioned approach would lead to a presentation of costs which did not reflect market prices, it might be misleading to those who are likely to be affected by the policies (if the costs were estimated using a social discount rate, rather than a market oriented 'cost of capital', and if taxes and transfers were stripped away, these costs

would be very different to those with which the affected actors would be more familiar).

For this reason, the approach in this study has been to calculate the cost under what might be considered 'market conditions', or a 'private cost' metric. In this approach, taxes and subsidies (transfers) are included in the costs, and the costs of capital are estimated at a market rate. Hence all costs will appear as those seen by economic actors in the market. One of the consequences of this is that the financial costs and the estimated non-market costs are not strictly 'additive' because there may be environmental taxes and other economic instruments which internalise, wholly or partially, the environmental benefits being measured. There is, therefore, a risk of double-counting the benefits being considered.

Non-market or intangible costs arise from environmental or social impacts and are less related to tangible assets – which are included in market-based economics. They rely on scientific, or social, assessments which value the impacts in monetary terms. These costs are, perhaps for obvious reasons, less certain than for tangible assets.

The general approach to the CBA was as follows:

1) Describe the interoperability options in more detail;
2) Consider the consequences of the options;
3) Identify the resulting financial and environmental impacts, and upon which actor they fell (these being relative to a baseline of the current situation);
4) Develop systems models to assess the material and financial flows;
5) Calculate the impacts which fall on each actor;
6) Aggregate and compare the overall impacts.

The next section 'Determination of Impacts' firstly describes the interoperability options in more detail, then goes on to consider the relevant impacts and how they are distributed.

2.0 Determination of Impacts

This section describes the process of determining the impacts that would alter the balance of costs and benefits. To recap, the interoperability options to be assessed are:

- 1: National requirement for the German deposit to be applied to all metal cans sold in Germany;
- 2: Bi-lateral agreement between Germany and Denmark to compensate for cost of managing cross-border cans;
- 3: Bi-lateral agreement between Germany and Denmark to ensure the national systems are interoperable;
- 4: Requirement for all existing and future Deposit Refund Systems (DRSs) for metal cans to be interoperable;
- 5: Requirement for all existing and future Deposit Refund Systems (DRSs) for metal cans to form a single system.

During the development of these options a number of distinct variants were considered for:

- 3: Bi-lateral agreement between Germany and Denmark to ensure the national systems are interoperable.

Consequently, multiple options were developed. The four main variants are as follows:

- 3a: Bi-lateral agreement between Germany and Denmark: German Deposit is applied in Border Shops –Danish Deposit is paid back to Danish Consumers in Denmark;
- 3b: Bi-lateral agreement between Germany and Denmark: German Deposit is applied in Border Shops –German Deposit is paid back to Danish Consumers in Denmark;
- 3c: Bi-lateral agreement between Germany and Denmark: Cans from Dansk Retursystem are sold in Border Shops – Danish Deposit is paid back to Danish Consumers in Denmark;
- 3d: Bi-lateral agreement between Germany and Denmark: Border Deposit is applied in Border Shops – Border Deposit is paid back to Danish Consumers in Denmark;

In the following sections the consequences of each option, the actors impacted, and the distribution of the impacts are considered.

2.1 Effects of Options

The consequences that follow from the implementation of the interoperability options are now considered. The consequences of the Bilateral options (i.e. those considering Germany and Denmark only) are considered first. This is followed by the options considering all EU DRSs. The most significant effects for all options are first tabulated, and for each option it is indicated whether the effect applies or not. Each effect is described in more detail thereafter.

2.1.1 Bilateral options

Effect	1	2	3a	3b	3c	3d
Border cans included in DPG	x		x	x		
Border cans included in Dansk Retursystem					x	
Border cans included in system linked to Dansk Retursystem						x
Some consumers reduce / stop border shopping	x		x	x	x	x
Reduced consumption of beer and CSDs	x		x	x	x	x
Some consumers return the border cans to Germany (Increase in number of border cans handled through DPG)	x					
Some consumers return the border cans to Danish retailers/RVMs (Increase in number of border cans handled through DPG)			x	x	x	x
Fewer border cans through bring sites	x		x	x	x	x
DRS Collection infrastructure implemented/updated	x		x	x	x	x
Border cans segregation required			x	x	x	x
DPG pay Dansk Retursystem for returned empties			x	x		
Border cans included in compensation scheme		x				
Danish Municipalities use fee to increase bring system density		x				
Fewer border cans disposed of via residual waste disposal or littering in Denmark	x	x	x	x	x	x

Border cans included in DPG (1, 3a, 3b)

Under these options, cans sold in the border shops to Danes will be included in the DPG deposit system. Producers will, therefore, pay fees and deposits on these cans and label them accordingly, consumers will pay the deposits and the border shops will accept and administer the payment of the deposits.

Border cans included in Dansk RS (3c)

As a result of the border cans being added to Dansk RS, they would now be subject to any relevant producer fees for administration, collection and logistics. Any products not in the container database already would have to be added. This may be the case if there are some specific brands / products manufactured in Denmark, which are currently only destined for the export market, but not sold in Denmark.

Border cans included in system linked to Dansk RS (3d)

If a parallel, but linked, system was setup to manage the border cans, then a number of actions would be required. Firstly, all products sold in the border shops would require a separate label system indicating that they had a 'border deposit', a separate or additional container database would be required to store the information and be used to update whatever collection infrastructure was put in place to manage the take-back of the empty containers. New or additional administrative structures will also be required to manage the additional deposits payments, producer fees, collection and logistics, for example.

Some consumers reduce / stop border shopping (1, 3a, 3b, 3c, 3d)

It is possible that as a result of the deposit being charged on border cans, some consumers may reduce, or stop altogether, their border shopping. This would be the case if they perceive the deposits to represent a cost of the beverages they consume. This would be more likely if a) they purchased cans with no intention of returning the cans they had purchased, or b) if, as under 3a, the refund they receive is lower than the deposit they pay, or c) if they are unwilling to make additional efforts that may be required to make returns (for example, under 1, where in order to take cans back, some additional effort and storage space would be required). Any resulting change in the demand will affect the border shops, ferries (in terms of reduced traffic) and producers/distributors, whose sales would decline. Associated with this, consumers would travel less. Consumers are expected to partially compensate by increasing domestic purchases, albeit of (we assume) lower quantities.

Reduced consumption of beer and CSDs (1, 3a, 3b, 3c, 3d)

Overall there would be reduction in consumption of beer and carbonated soft drinks as a result of some consumers stopping border shopping (and only partially compensating by shopping in their home country). This would reduce the government's revenue from alcohol excise duty. The decrease in consumption would deliver health benefits to consumers, and these health benefits would be reflected in lower government spending on health services and on policing, as well as other social benefits.

Some consumers return the border cans to Germany (1)

The deposit would be redeemed at the border shops through additional automated take-back infrastructure such as RVMs or small scale counting centres. The DPG system would benefit by retaining the unredeemed deposits initially paid by the border shoppers, and the border shops from the sale of the material collected for recycling.

Some consumers return the border cans to Danish retailers/RVMs (3a, 3b, 3c, 3d)

Consumers would return cans and redeem part of the deposit that they had paid at the border shops. The deposit would be paid out by the RVMs or manually at Danish retailers. The Danish system would benefit from the sale of the material collected for recycling, but the additional volume of returns may require additional investment in RVMs and / or other infrastructure.

Fewer German cans through bring sites (1, 3a, 3b, 3c, 3d)

Border cans are currently disposed of either by putting them in a Danish RVM (without deposit redemption), recycled by consumers taking them to bring sites, disposed of in the residual waste, or discarded as litter. Under these options, these waste material streams would all decrease. Local government bring sites would see reduced collections and reduced material revenue.

DRS Collection infrastructure implemented/updated (1, 3a, 3b, 3c, 3d)

As more border cans are recycled through the German or Danish deposit refund system's collection infrastructure, such as reverse vending machines, space for can storage (in retail outlets without RVMs), and haulage of recyclates will need to be expanded. The cost of this would ultimately be borne by the German producers.

Border cans segregation required (3a, 3b, 3c, 3d)

As border cans for the Danish market would be subject to a deposit, but those destined for other markets would not, then they would need to be segregated in the border shops – this would increase the cost of sales in the border shops. Evidently, in principle, one could extend the logic of the options proposed to cover other countries, but the focus here is on bilateral solutions,

DPG pay Dansk Retursystem for returned empties (3a, 3b)

Deposits would be redeemed on empty cans returned through Dansk Retursystem. DPG will pay back the deposit on each returned can to Dansk Retursystem.

Border cans included in compensation scheme (2)

In this option, border cans would be included in a compensation scheme. Producers would pay a fee to Dansk Retursystem for each can placed on the market in the border shops. No new labelling would be required. New legislation may be required to institute the scheme.

Dansk RS use fee to increase bring system density (2)

Dansk Retursystem could use the fees they receive from this scheme in a number of ways. In this study we assume that the money would be granted to local government organisations to enhance the existing bring system for can recycling. New bring sites and/or containers could be added (and appropriate communication carried out) to increase the capture of border cans and reduce the extent of littering. The additional material captured would result in some additional revenue once sold on to reprocessors.

Fewer border cans disposed of via residual waste disposal or littering (1, 2, 3a, 3b, 3c and 3d)

As more border cans are captured via the bring system, then the number that are disposed of via residual waste or through littering will reduce the cost of collection and disposal for which the local government are responsible. Residual waste weights would fall, and, where energy from waste is used, recovered metal from beverage cans would also be reduced.

2.1.2 Multilateral options

Consequence	4	5
Existing national systems become interoperable	x	
Central organisation is set up, manages the data and sets the deposit value		x
Domestic cans included in the single system		x
Deposits charged on border cans	x	x
Border cans included in the single system		x
Some consumers stop / reduce border shopping	x	x
Reduced consumption of beer and CSDs (as a result of reduced border trade)	x	x
Consumers return cans to their national system (including some border cans)	x	x
Fewer border cans through bring sites /disposal	x	x
Collection infrastructure implemented/updated	x	x
Border can unredeemed deposits shared between disposal countries	x	

Systems become interoperable (4)

Under this option, the countries' deposit refund systems will update their collection infrastructure to accept cans from all other systems in the EU. Retailers that currently accept domestic cans would be required to accept cans from the border trade also.

There a number of issues with the payment of VAT on the unreturned packaging. The taxable event is at the point of sale (which would be in the country of purchase), thus VAT may be required on all sales at this point. However, the VAT Directive requires that VAT should, in essence, be payable on the unreturned containers. Thus adjustments can be made once the packaging has been returned as an alternative. This, however, would also require some mechanism to ensure all the containers returned in other countries had been taken into consideration. The VAT on the deposit would have to be paid to the country in which the sales took place, but the non-VAT element could then be distributed between the other countries to help fund the collection of the border cans. Alternatively, the possibility of implementing a zero rate

of VAT on deposits for border cans could be evaluated (these issues are discussed below, in more depth, in Section 4.2.1.3).

Central organisation owns the data and sets the deposit for national systems (5)

The central organisation will set the deposit level and act as a clearing house for trans-national payments of deposits. It would take ownership of the EAN code data relating to the beverage cans, and provide a central database used by the collection infrastructure across the countries in which a deposit refund system is in operation. It is assumed that the current national system will continue to run the logistics, collections and reprocessing, as there is no reason to change the current arrangements.

This option would entail harmonising the deposit across all the national systems involved and producing new labelling and branding. The branding of the system would be set centrally, with the national systems responsible for communicating the change with their consumers, in the appropriate languages.

As there would be a single deposit applicable to all the deposit-using countries, ferries between those destinations could also now charge deposits on their beverage cans. However, the detail of this arrangement has not been modelled in this study.

Domestic cans included in the single system (5)

The operation of the system for domestic cans is very similar to the current situation. The producers and distributors would need to pay the deposit per can, plus any nationally-determined fees, to the central organisation. The experience for the consumers and domestic retailers would also be the same as today except for the different rate of deposit.

Deposits charged on border cans (4)

Cans sold in the border shops would be introduced into the deposit system, thus necessitating a change to the labelling of them, and payment of deposit and appropriate fees by the producers and distributors to the national system in the country of purchase. When the products are sold the retailer pays the producer the full price including the deposit. The border shops will stock the beverage cans with the deposit valid for the country of purchase, and will therefore need no segregation of stock for different countries' consumers.

Border cans included in the single system (5)

Cans sold in the border shops would be introduced into the deposit system, thus necessitating a change to the labelling of them, and payment of deposit and appropriate fees by the producers and distributors to the national system. When the products are sold the retailer pays the producer the full price including the deposit. The border shops will stock the beverage cans with the harmonised deposit which can be sold to all customers regardless of their destination country.

Some consumers stop border shopping because of the introduction of deposits on border cans (4, 5)

As a result of the deposit charged on border trade cans, some consumers may stop border shopping, as the upfront price of cans rises (albeit with the deposits easily redeemable in their destination countries). This change in the demand will affect the

border shops, ferries (in terms of reduced traffic) and producers/distributors whose sails would decline. Associated with this, consumers would travel less. Consumers would partially compensate by increasing domestic purchases.

Reduced consumption of beer and CSDs (as a result of reduced border trade) (4, 5)

Overall there would be reduction in consumption of beer and carbonated soft drinks as a result of some consumers stopping border shopping (and only partially compensating by shopping in their home country). This would reduce the government's revenue from alcohol excise duty. The decrease in consumption would deliver health benefits to consumers, and these health benefits would be reflected in lower government spending on health services and policing, as well as other social benefits.

Consumers return cans to their national system (including some border cans) (4, 5)

As consumers return cans to the system including border cans, local government would expect to spend less on litter picking. For the border cans, the deposit would be redeemed by retailers in the country of disposal. Retailers would be paid back for the deposits they have redeemed by the deposit refund system in operation in the country of disposal. In turn, that system would be compensated by the national deposit system in the country of purchase. The country of purchase would be identified by the EAN code on the can. The system in the country of disposal would benefit by the amount of the border can material recycled.

Fewer border cans through bring sites /disposal (4, 5)

Two of the ways that border cans are currently disposed of are either recycled by consumers taking them to bring sites, or disposed of in the residual waste. Under this option, more border cans would be recycled via the deposit refund system, thus reducing the number through bring or residual channels. Bring sites would see reduced collections and reduced material revenue. Residual waste weights would fall, and, where energy from waste is used, recovered metal from beverage cans would also be reduced.

Collection infrastructure implemented/updated (4, 5)

As more border cans are recycled through the deposit refund system, collection infrastructure, such as reverse vending machines, space for can storage (in retail outlets without RVMs), and haulage of recyclates will need to be expanded. The cost of this would be split between the national deposit refund system in the country of disposal, the retailers and the ferries. The deposit refund system would pay for haulage, communications with RVMs and (in Denmark) compacters. Retailers would pay for new RVMs, retail space consumed by can recycling operations and any retail staff time required to redeem deposits to consumers.

Border can unredeemed deposits shared between disposal countries (4)

The deposits paid on beverage cans sold in the border shops that remain unredeemed are held by the deposit refund system in the country of purchase. Periodically, this fund will be shared between the disposal countries, with an amount held back to cover the administrative costs of the system in the country of purchase. Potential arrangements to facilitate this process are described in Section 4.2.2.2.

2.2 Actors Affected

2.2.1 Bi-lateral Options

Danish Government

The Danish central government is assumed to be the affected by changes to the amount of taxation levied in Denmark and the cost of changing / updating legislation. The relevant taxes include excise duty on domestic consumption, VAT, packaging tax, energy taxes and other waste taxes. Clearly some tax revenues will change more significantly than others, and some will be fairly negligible.

German Government

The German Government is affected due to the changes in tax take from VAT and alcohol excise duty (among other indirect taxes). The may also be required to facilitate the management of VAT on the deposits between countries and also update any legislation to set the framework for economic actors in the country.

Danish Local Government

The Danish municipalities are considered to be the organisations responsible for household waste management in Denmark, and they are not financially supported by a producer responsibility organisation. It will therefore be affected by changes to the waste flows caused by the increased return of deposit bearing border cans either to Germany and the DPG, or through Dansk Retursystem.

Producers/Distributors

Producers and distributors of beverage cans pay fees for cans put on the market and may be required to change the labelling they use. They would be affected by any change in demand for their products caused by the system changes proposed. They would finance collection costs for the returned border cans, though these costs should be funded by revenue from material sales and (depending upon the system) the unclaimed deposits.

DPG

The German deposit system is managed by DPG. It will manage the labelling requirements and data relating to deposit clearing, insofar as the border cans are required to be included in the DPG system.

Dansk Retursystem

The Danish deposit system is managed by Dansk Retursystem. The operation of the system will be affected depending upon the number of cans taken-back through the RVMs and the demands placed upon logistics. The financing of the system will also be affected depending on the fees, deposits and revenue received, and any payments made. These impacts will vary between options.

Consumers

Consumers of beverage cans may buy canned beverages on the domestic market or abroad. They may be affected by changes to the level of deposit, and the ease with which they can be returned.

Border Shops

Border shops are those that benefit from the private cross-border trade in beverage cans. They are specifically established, in Schleswig-Holstein in Northern Germany (and other areas), to take advantage of the cross-border trade. These shops would be affected to the extent that the options affect demand for their product, and impose additional costs upon them.

Danish Retailers

These are the retailers in Denmark that cater for the domestic, rather than border trade, in beverage cans. If there is any change in the relative pricing of products between countries, more consumers may find it advantageous to buy more beverages on the Danish domestic market through these shops.

Ferries

Some of the journeys undertaken by consumers for private import of beverage cans will be via ferry. Therefore, the demand for travel may be affected by a change in the volume of border trade. However, there is little evidence to show the extent consumers use the ferries for multi-purpose trips (leisure, tourism, business) as opposed to using them exclusively for purchasing beverages in the border shops. The higher the proportion of multi-purpose trips, the lower the change in demand for ferry services is likely to be (assuming that the interoperability option does indeed result in a reduction in demand for border cans, a matter discussed in more detail below).

2.2.2 Multilateral Options

Member State Governments

Member State governments may be required to alter / enact legislation to facilitate a change from the current set up. Taxes such as alcohol excise duty, sugar tax and value added tax will change with the implementation of a new system.

Local Government

Local government is considered to be the organisation responsible for domestic waste management activities, not including the deposit refund system. This may be funded by the municipality, or paid for through fees channelled via a packaging recovery organisation (PRO) scheme, or a combination of both.

Producers/Distributors

Producers and distributors of beverage cans pay fees for cans put on the market and may be required to change the labelling. They would be affected by any change in demand for their products caused by the system change.

Existing country system – Country of purchase

The existing country systems are:

- Deutsche Pfandsystem GmbH;
- Dansk Retursystem;
- Svenska Returpack AB;
- Suomen Palautuspakkaus Oy; and

- Eesti Pandipakend.

These systems would need to update their collection systems to include cans from all deposit systems in the EU. They must require retailers to accept all these cans. When acting as the system in the country of purchase, the system must return the deposit on cans returned in another deposit bearing country to the system applicable to that country.

Existing country system – Country of disposal

When acting as the system in the country of disposal, these organisations are responsible for paying retailers the deposits for border cans returned by consumers. They will then receive these deposits from the deposit refund system in the country of purchase, on delivery of the proof of return and redemption.

Central Organisation

This would be a new organisation, taking on the cross-border business processes that are associated with the single system approach.

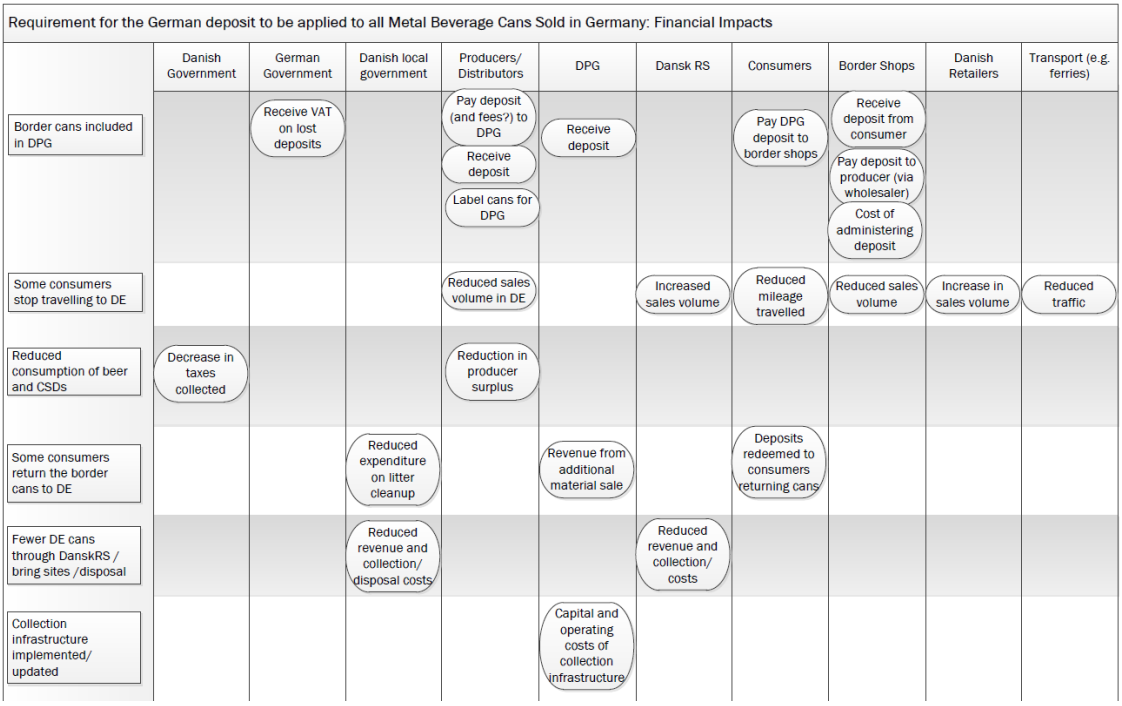
Ferries

Some of the journeys undertaken by consumers for private import of beverage cans will be via ferry. Therefore the demand for travel will be affected by a change in the volume of border trade.

2.3 Distribution of Impacts

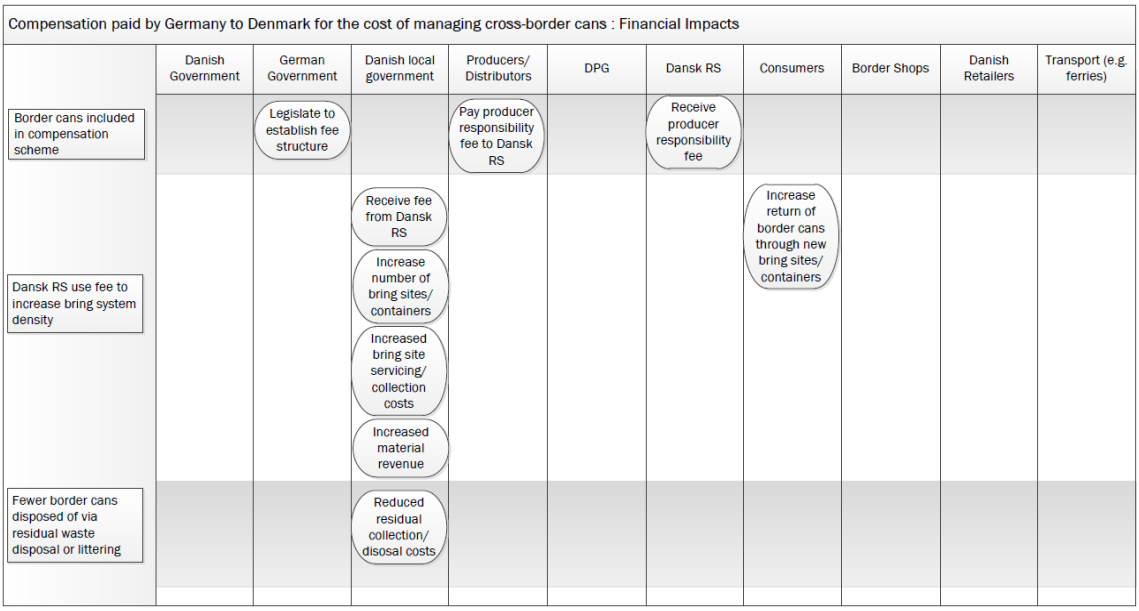
To clearly identify how the consequences of each interoperability option would impact upon each of the actors described above, business process diagrams were used to visually indicate the impacts and upon whom they fell. For each of the interoperability options a diagram was created – these are shown in the Figures below. These 'consequence / actor' diagrams were used to ensure that all relevant impacts were captured in the analysis, but also to highlight where they were expected to arise. The set of figures below relate to the financial consequences of the options.

Figure 2-1: (1) Consequence / Actor Diagram of the German Deposit Applied to all Metal Beverage Cans Sold in Germany



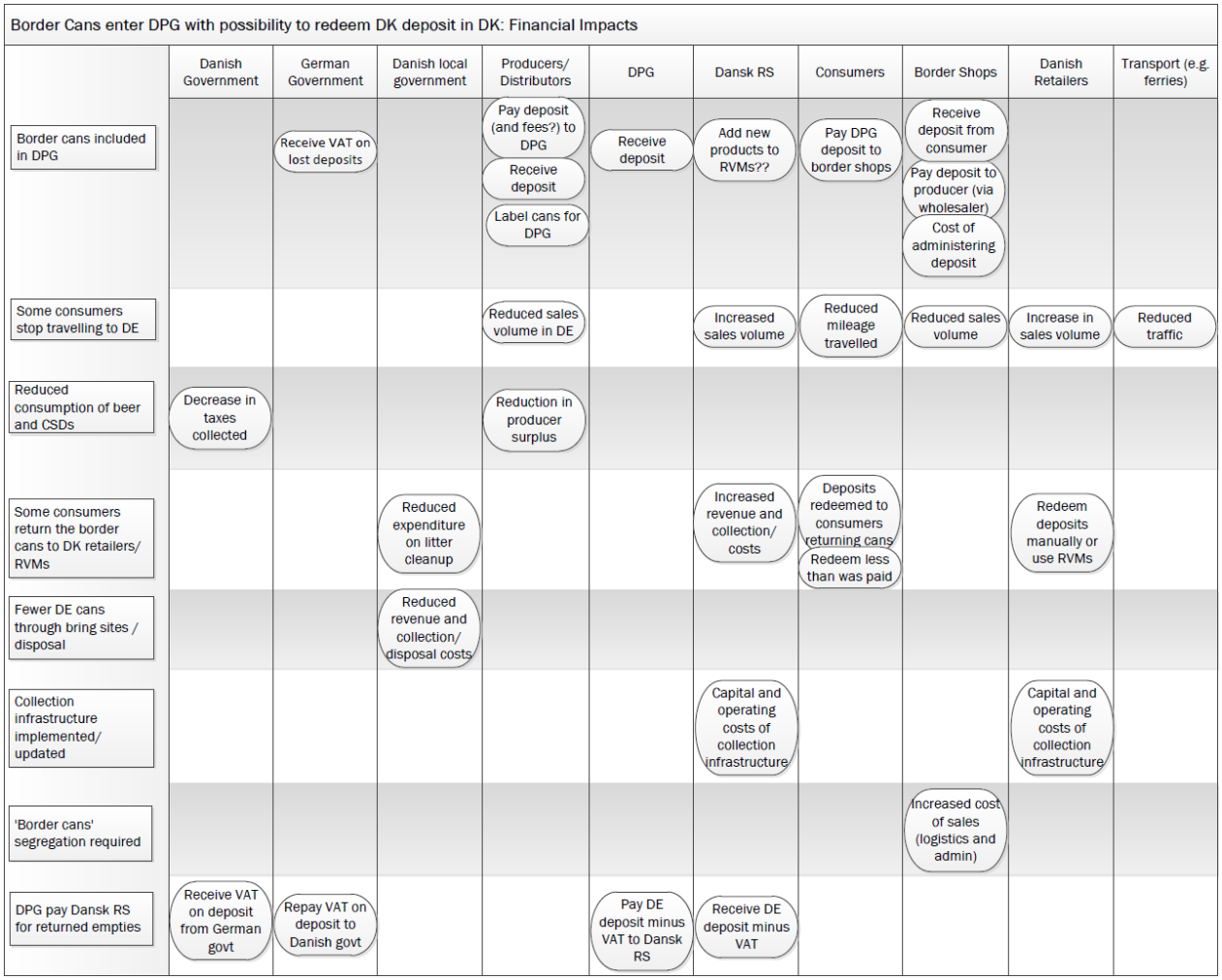
Source: Eunomia

Figure 2-2: (2) Consequence/ Actor Diagram for Compensation paid by Germany for Cost of Managing Border Cans



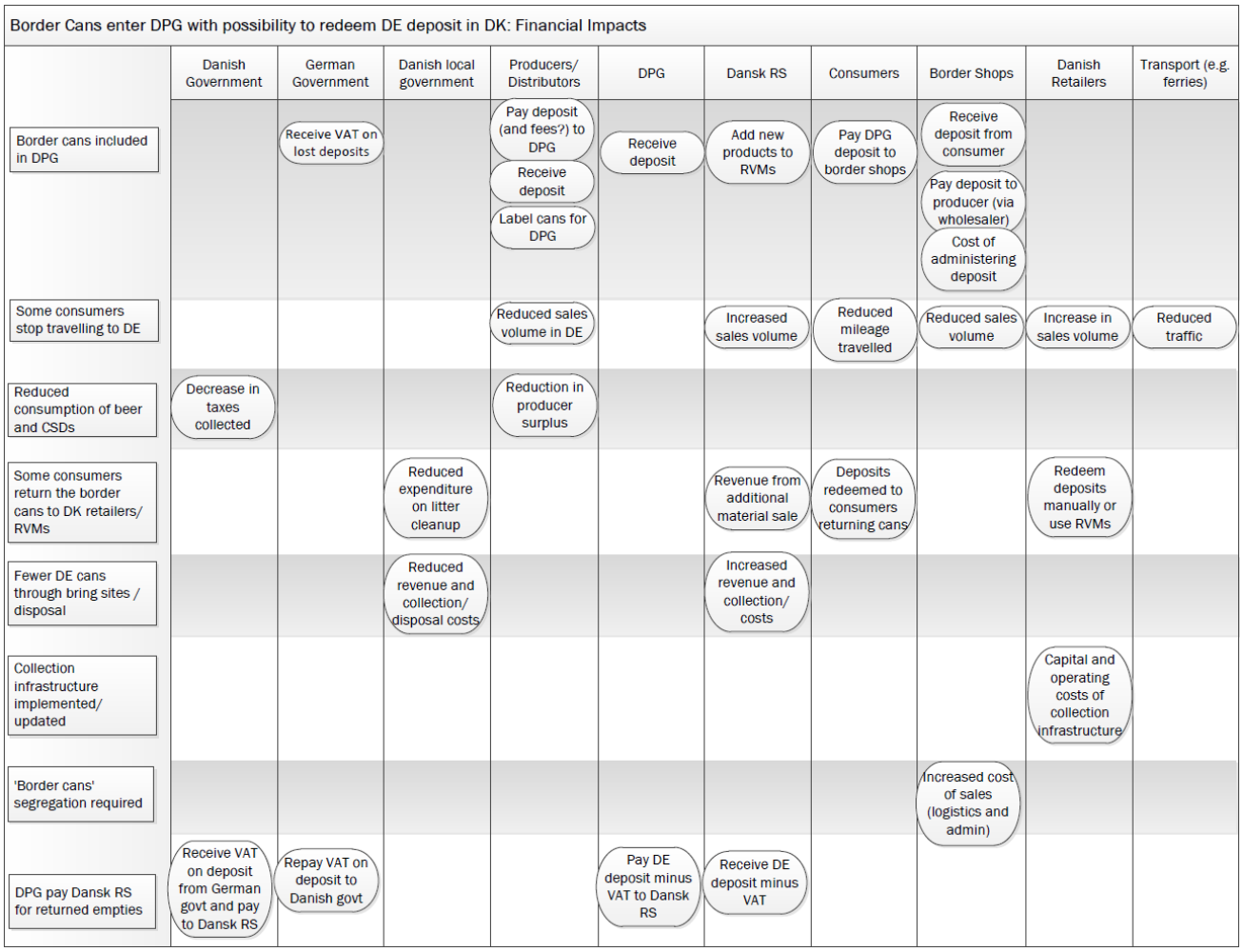
Source: Eunomia

Figure 2-3: (3a) Consequence / Actor Diagram of the German deposit levied, with Danish Deposit Redeemable in Denmark



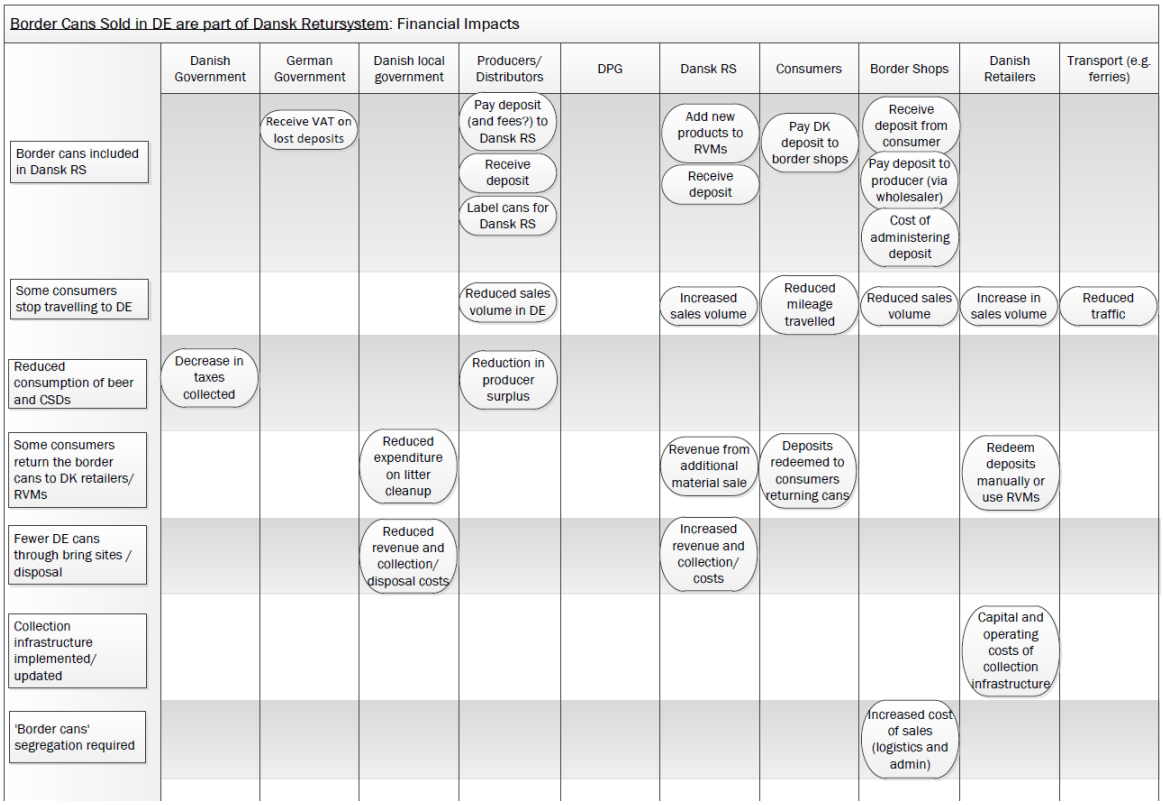
Source: Eunomia

Figure 2-4: (3b) Consequence / Actor Diagram of the German Deposit levied in Border Shops and Redeemable in Denmark



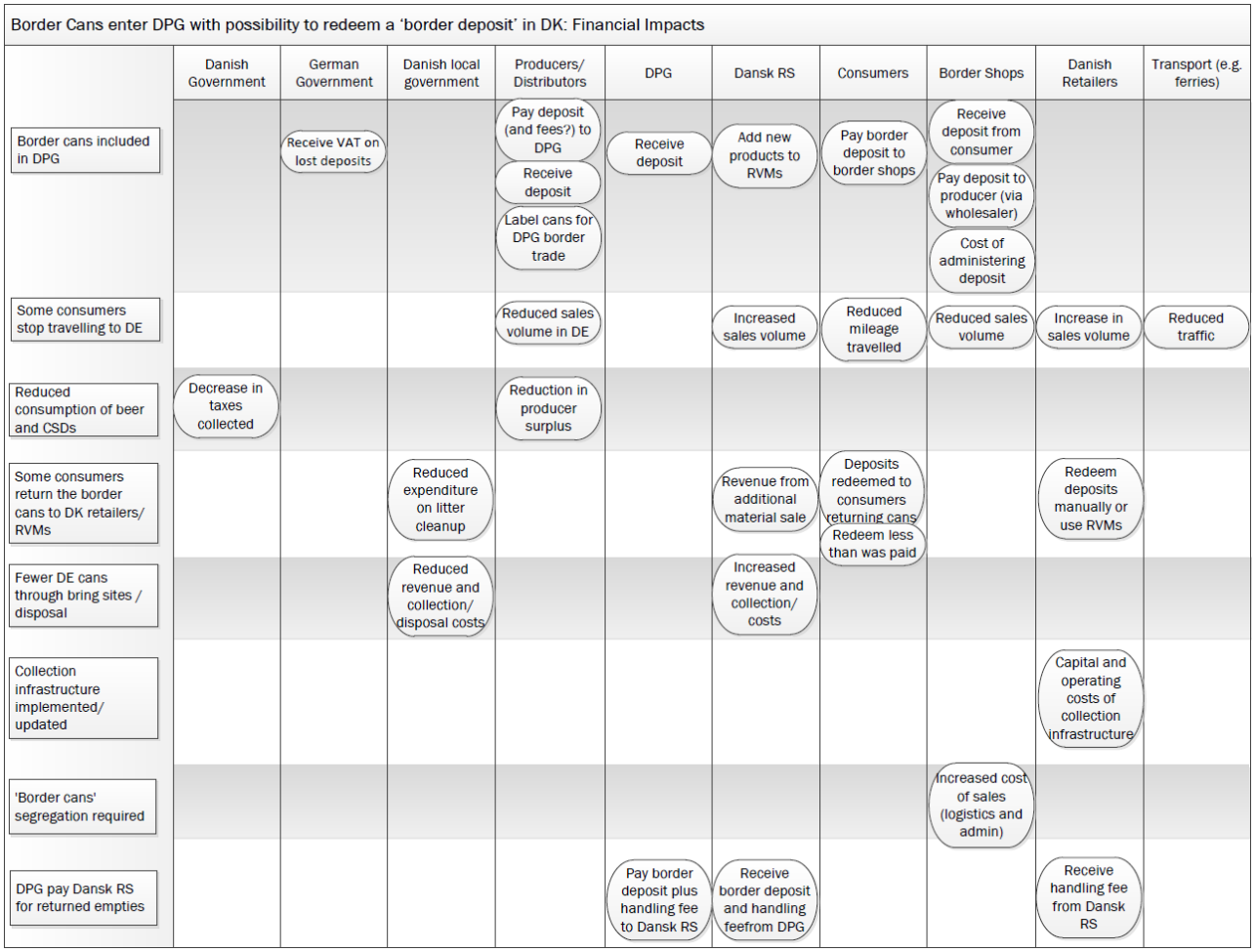
Source: Eunomia

Figure 2-5: (3c) Consequence / Actor Diagram of the Cans Entered into Dansk Retursystem, with Danish Deposit Redeemable in Denmark



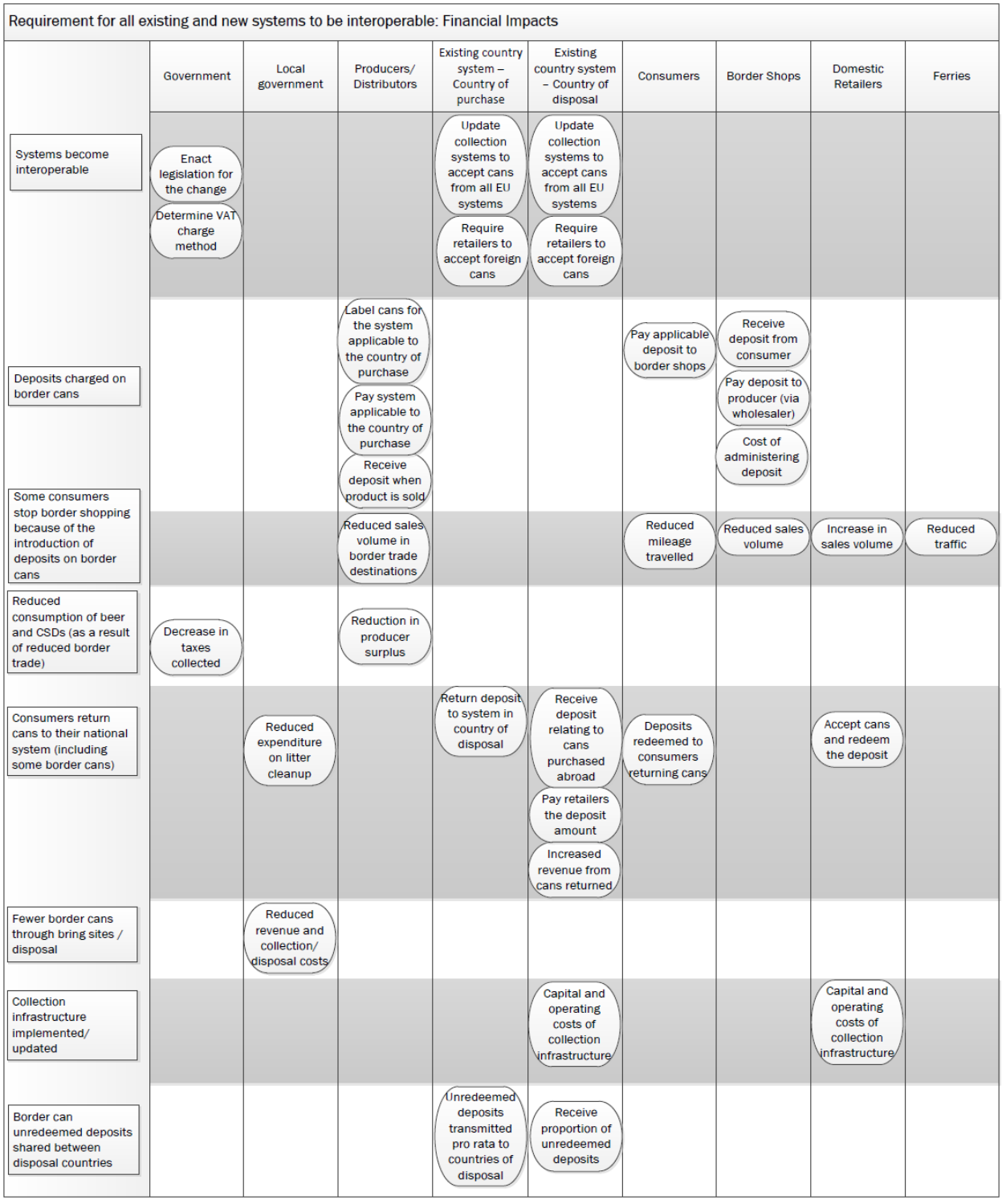
Source: Eunomia

Figure 2-6: (3d) Consequence / Actor Diagram of a Border Deposit levied in Border Shops and Redeemable in Denmark



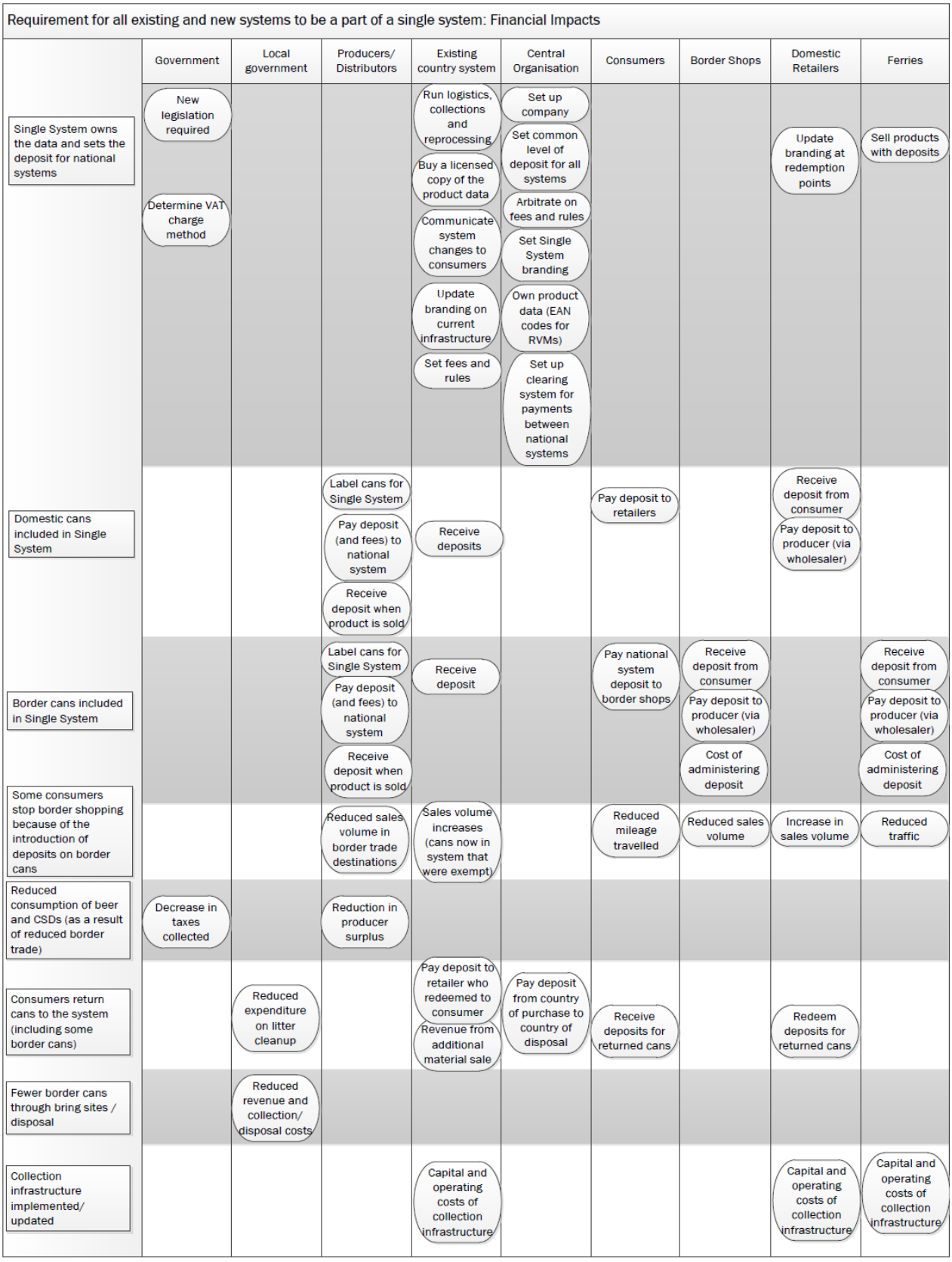
Source: Eunomia

Figure 2-7: (4) Consequence / Actor Diagram of the Interoperable Systems Approach



Source: Eunomia

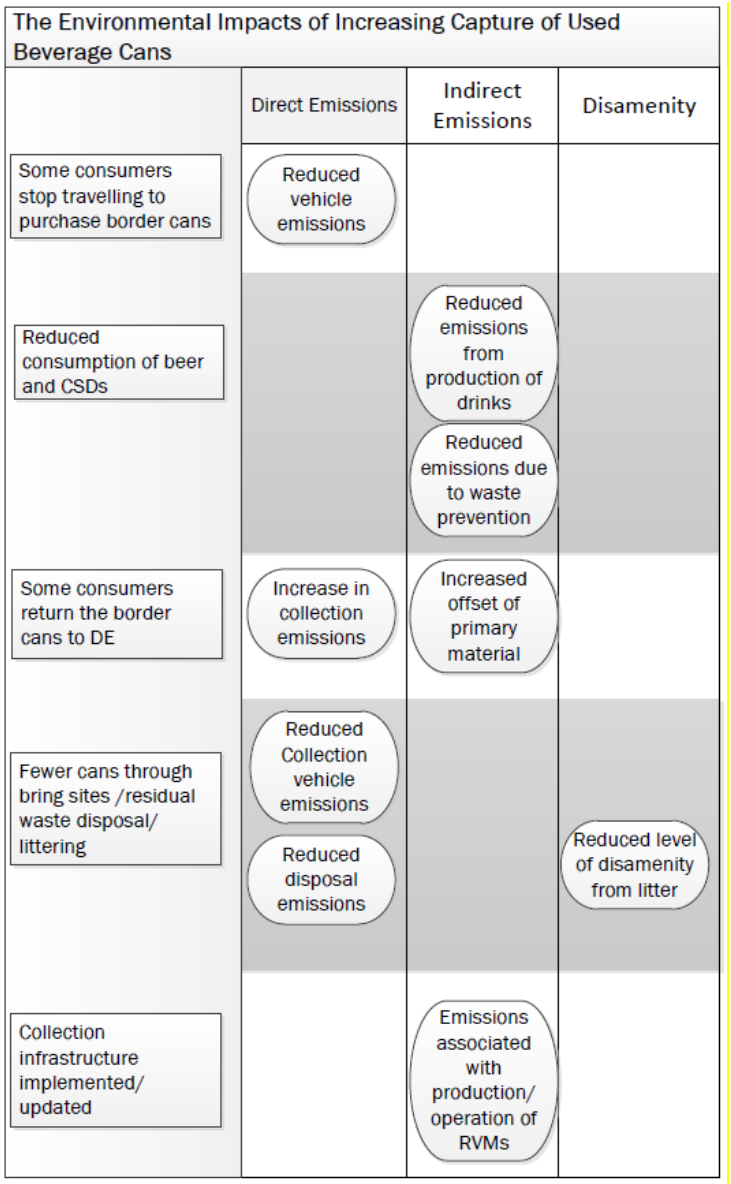
Figure 2-8: (5) Consequence / Actor Diagram of the Single System Approach



Source: Eunomia

The following Figure shows the non-market, environmental impacts resulting from the interoperability options, in general. It was not considered necessary to show diagrams for each option, as they would be very similar. In addition, the social impact of willingness to pay for recycling services relates to all options.

Figure 2-9: Consequence / Actor Diagram Showing Environmental Impacts



Source: Eunomia

3.0 Development of Systems Models

To be able to model the impacts associated the interoperability options, all relevant systems had to be considered, and the changes to them assessed. This task was undertaken by constructing Excel based models for the sale of beverage containers, deposit refund systems and other waste management systems. Parameters could then be flexed, in direct relation to the consequence of the interoperability options, and the resulting changes in materials flows and costs determined. Firstly 'baseline' systems models for the bilateral and multilateral options were developed (i.e. one baseline for options 1 to 3 and one for options 4 and 5). These baseline models are described in this section.

The key aspects of the systems model are:

1) The total number of metal beverage cans placed on the market;
2) The flows of metal beverage cans between Member States with DRSs;
3) The return of metal beverage cans to the DRSs;
4) The management of deposit cans not returned through the DRS;
5) The management of non-deposit cans;
6) The financial payments within each DRS;
7) The financial payments between DRSs, or Member States in relation to DRSs;
8) The cost of non-DRS management of cans;
9) Existing fee structures and payments by beverage producers

Firstly an overview of DRSs and the relevant processes which were modelled is given. Following this, the required data relating to the material flow of cans is considered. Then, for each country, the key data that was used to construct the baseline models are given, along with the source or approach to rationalising the figure if no publicly available figure was found.

3.1 Overview of Deposit Refund Systems

Currently there are 5 DRSs operating in the EU (other, smaller systems in Europe exist where some types of glass bottle, for example, are covered by a deposit, but these are not covered under the scope of this study). These are identified in the table and figure below.

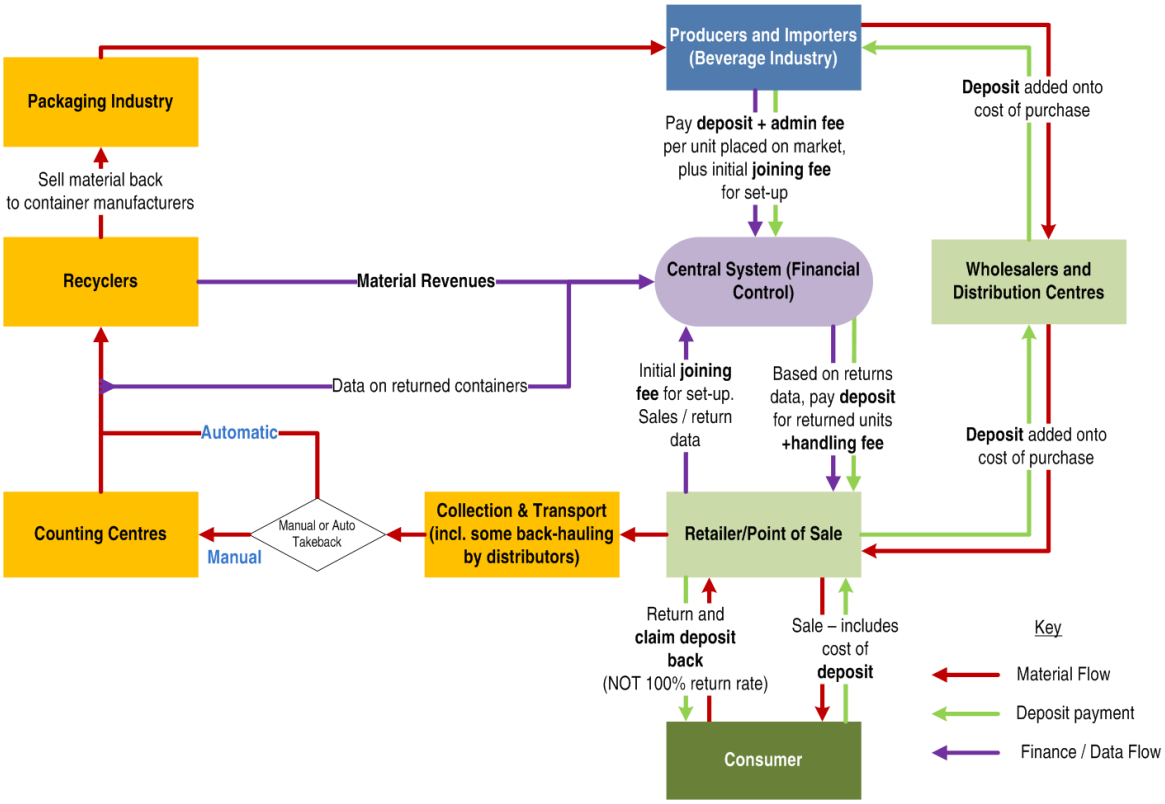
Currently there are no major interconnections between the deposit systems. They all operate independently, either under national legislation, or run by the private sector at a national level, and are effectively closed systems. There have been some negotiations between some systems with regards to accepting national cans from the border trade, but there are no other formal connections.

Table 3-1: Existing Deposit Refund Systems in the EU-27 for Metal Beverage Cans

Member State	Deposit System	Abbreviation
Germany	Deutsche Pfandsystem GmbH	DPG
Denmark	Dansk Retursystem	Dansk RS
Sweden	Svenska Returpack AB	Returpack
Finland	Suomen Palautuspakkaus Oy	Palpa
Estonia	Eesti Pandipakend	EPP

The overall design of a general deposit refund scheme (DRS) is summarised in Figure 3-1. The basic system revolves around the initial addition of the deposit to the cost of each beverage purchased by the distributor and subsequently by the retailer, which is consequently passed onto the consumer at the point of purchase. At the same time, the equivalent deposit per unit sold is paid by the producer/ importer into the central system, ready for the central system to reimburse the retailers at a later point for any deposits paid back to the consumer for returned containers. The deposit thus circulates around the system, with any unclaimed deposits remaining in the central system (and these can be used to support the costs of the system, so reducing the revenue which is required to be raised from administration fees – see below).

Figure 3-1: General Material and Financial Flows in Deposit Refund Systems



Source: Eunomia

In addition to the deposit, the central system pays a handling fee to the retailer for each returned container that they handle, to compensate the retailer for loss of space (storage requirements) and time (in processing the deposit and taking back the containers). This fee will vary according to whether the retailer employs an automated or manual system of take-back.

Where the containers are collected via an automated machine, the sorted (and predominantly compacted) material can be transported directly to a recycler, with material revenues being paid back into the central system, or the retailer. Material revenues will also be paid on those containers that are collected manually, though this material will first have to be transported to a processing centre for sorting, counting and compacting, before it can be hauled on to a recycling facility. These costs are met by the central system.

The central system is the focal point for the flow of information regarding container sales and finance for the whole deposit refund system. A significant one-off cost will be required to initially set up the deposit refund system, including all the necessary administrative support, which can be met by 'one-off' producer and retailer joining fees. There will also be on-going costs associated with administering the system which are covered as part of the producer administration fee paid on each unit that is placed on the market. The overall administration fee payable by the producers/ importers is calculated as the balance of income from material revenues and unclaimed deposits against the costs of collection, transport, processing, admin and

handling fees. In other words, the administration fee guarantees the system operates in a cost neutral manner.

This general system is based upon systems which exist in Denmark (Dansk Retursystem) the Scandinavian countries (Norsk Resirk, Returpack and Palpa), and in a number of provinces within Canada (ENCORP Atlantic Ltd, ENCORP Pacific Inc). In these countries, a central system or organisation exists which is responsible for monitoring the flow of sales data and container returns in order to ensure that the correct deposits and fees are distributed around the system. This system, however, is not primarily a government agency.

It is worth noting that the system modelled here differs to that which exists in Germany, where the organisation that manages the deposit refund scheme, the DPG, only has an 'over-seeing' role; the system in Germany is much less centralised, with retailers able to set up their own systems of collection and processing, and payments moving directly between the producer and retailer, rather than going through a central system.[1]

Within each national DRS there are a number of key processes which are all under its control. These are represented in Table 3-2 below.

Some of these costs are incurred by the producers of beverage companies (in the labelling of the containers). Other costs are incurred by the retail businesses in purchasing RVMs for take-back. The remaining costs are incurred during the operation of the DRSs. Most costs will constitute an expense to the relevant agent, but the cost of reprocessing will be offset by the income generated by the downstream sale of the material back to the producers, thus the cost will be negative (i.e. an income). It is important to understand which are related to the DRSs directly, to be able to show how the financial flows within the systems work.

[1] Ernst & Young (2009) *Assessment of Results on the Reuse and Recycling of Packaging in Europe*, report produced for the French Agency for Environment and Energy Management (ADEME), March 2009.

Table 3-2: Processes Relevant to the Operation of DRSs

Process	Description
Container Labelling	The process of producing the container will also include designing and printing the label that goes on the container.
Retailers (Point of Collection)	Automatic collection machines, such as RVMs, are used to collect the empty beverage containers and pay the deposits back to consumers. Retail staff can also facilitate the manual take-back of empties and payments of deposits back to consumers.
Collection of Empties	Collection vehicles collect the compacted empties and transport them to reprocessors for recycling, or non-compacted empties and transport them to processing facilities for counting. The collection vehicles include drivers and perhaps additional crew for handling.
Processing Facility	Processing facilities (counting centres) count how many empties have been collected manually by retail outlets. These include counting machines and baling operations, and are operated by a number of staff.
Logistics and Data Management	A logistics and data management centre includes administration staff and managers to a) co-ordinate the logistics b) manage the container data in the system c) make and receive financial transactions d) manage marketing etc. e) other tasks. These staff are housed in a building which requires some IT infrastructure and the like. This process is either part of contractors operations or the DRS itself.
Recycling	The empty containers, that are transported to reprocessors, are handled and processed back into raw materials for use in beverage container production and the like.

The structure of each individual system and the payments within it are described in more detail in 'Appendix 1 – Member State Reports'. Table 3-3 describes the main financial payments that occur within each DRS (or its outsourced / contracted elements).

Table 3-3: Relevant Financial Payments in DRSs

Payment		Description
Expense	Retailer Handling Fees	In Denmark, Sweden, Finland and Estonia, retailers are compensated per container they handle
	Collection / Logistics Costs	Cost of operating the collection service and preparing the recyclate for sale
	Counting Centre Costs	Cost of operating the counting centre, including buildings, plant, operating costs and labour
	Deposits Paid to Consumers	Deposits redeemed by consumers from the collection points (retailers) – paid by the DRS to the retailers, per returned container
Income	Deposits Paid by Producers	Container deposit paid per container put on the market
	Sale of Recyclate	Income from the sale of the processed recyclate
	Producer Fees*	This may include an initial set up fee, an annual fee per producer, and a fee per container

** The producer fees are the difference between all of the other payments for expenses and income, in order for the system finances to balance.*

It is perhaps easier to assess the potential change in costs that occur, through changes in the quantity of containers managed, by assessing the change in payments, rather than the costs of the processes themselves. This would require primary data (most of which would be commercially sensitive) or through a modelling exercise. As most of the DRSs publish information on the fees paid per container (or similar) then these can be used to generate a financial model based upon a number of input parameters. These parameters (such as number of containers managed) can then be altered to assess the resulting change in total costs of the DRS operation. The exception is the deposit system in Germany, which operates in a decentralised way. This is further discussed in the section below.

3.2 Consumption and Waste Flows

To understand the implications of waste management policy one must understand the quantities of waste that are currently being managed. Without this, the quantitative effects of the policy cannot be estimated. The key quantitative inputs that are required are:

- The quantity of metal cans placed on the national market in each Member State (after imports and exports from production);
- The quantity of metal cans taken in and out of each Member State through private trade (border-shopping);
- For each Member State with a DRS:
    - The quantity of metal cans collected through the national DRS for recycling;
    - The quantity of metal cans collected through other collection systems for recycling;
    - The quantity of metal cans collected through refuse collection for disposal or recovery as part of residual waste (and in some cases, metal in cans will be recycled from ash where the material is incinerated or subject to mechanical biological treatment);
    - The quantity of metal cans littered in the environment and subsequently collected for recycling; and
    - The quantity of metal cans littered in the environment and not collected.

In addition, data relating to the size, weight and material contents (aluminium vs. tinplate) was required. Much of this was taken from beverage data analysts and industry experts, including the Beverage Can Makers Europe (BCME).

3.2.1 Privately Imported Cans

One of the key parameters in assessing the costs and benefits of any interoperability options is the volume of private cross-border trade in beverage cans. The greater the volume of trade, the greater the effect on operational costs and revenues is likely to be. However, costs may be distributed over a larger number of units, so the impacts expressed in 'per can' terms may be lower if the volume was greater.

As discussed in 'Appendix 3 – Impacts Associated with Incompatibility' there are no data sources, to which high confidence levels can be attached, to draw upon for understanding cross-border flows. Some estimates have been made through surveying border shoppers and by industry experts. However the level of confidence that can be attached to this information is relatively low. Moreover, there are some cross-border flows which are not well understood at all, including how many beverages are sold in tax-free areas and on ferries in the Baltic Sea. Given that the level of confidence in any set of estimates for cross-border flows is low, a central estimate was made from the data gathered. This approach was taken to a) simplify the modelling and b) because there was not enough information available to estimate high and low figures (in order to give a range) in any case.

As noted above, very little information was available on the sale of beverages on ferries. In addition, beverages sold on ferries are not considered to be covered by the requirements of any national collection system. Some change to existing EU legislation may be needed to require waste, effectively sold outside of the EU-27, to be covered by the jurisdiction of EU packaging policy. Thus, any additional deposit

system which may cover the sale of beverages on ferries is not considered in the scope of the interoperability options modelled here. A separate detailed analysis of the potential for the inclusion of beverages in any packaging waste collection system would be required. Consequently, the number of containers considered relevant to the change in costs and benefits does not include any estimates of sales on ferries. Finally, only the key container flows between countries with DRSs were considered.

The following table summarises the beverage flows from and into the countries in the EU-27 with DRSs.

Table 3-4: Sale of Canned Beverages: National Market and Private Imports, million units per annum

Parameter	Denmark	Germany	Sweden	Finland	Estonia
Total Placed on Market (in DRSs)	380	950	1,114	1,100	134
Additional placed on Market (not in DRS)		740			
Private trade (Export to)					
Denmark		540	0	0	0
Germany	0		0	0	0
Sweden	25	200		0	0
Finland	0	0	10		40
Estonia	0	0	0	0	
Total	**25**	**740**	**10**	**0**	**40**
Private trade (Import from)					
Denmark		0	25	0	0
Germany	540		200	0	0
Sweden	0	0		10	0
Finland	0	0	0		0
Estonia	0	0	0	40	
Total	**540**	**0**	**225**	**50**	**0**

Source: 'Appendix 3 – Impacts Associated with Interoperability'

3.2.2 Beverage Can Parameters

To calculate a number of the impacts described above, parameters relating to beverage cans were required. The sizes of different cans (i.e. 330ml or 500ml) were taken from the data obtained from Canadean.[2] The weight of the cans was required to estimate the total weight of material captured for recycling – these figures were taken from a number of sources. The average weights used for 330ml cans, for example, were 14.5 grams (aluminium) and 22 grams (steel). Finally, the proportions of aluminium and steel cans produced in each country were provided by industry experts, but are not published due to the commercially sensitive nature of the data.[3]

The following sections present the data gathered for each country with a deposit refund system in the EU-27.

3.3 Denmark – Dansk Retursystem

Table 3-5: Consumption and Management Data – Domestic Cans (Denmark)

Parameter	Value	Source
Domestic cans returned to Dansk Retursystem	86%	Dansk Retursystem
Domestic cans not returned to Dansk Retursystem	14%	100% – return rate (86%)
Other recycling of non-returned domestic cans	0%	Eunomia – majority of deposit bearing cans expected to be recycled through DRS
Landfill of non-returned domestic cans	0%	Danish EPA – very low levels of landfilling for mixed municipal wastes
Incineration of non-returned domestic cans	98%	Danish EPA / Eunomia – high levels on incineration in Denmark
Littering of non-returned domestic cans	2%	Danish EPA / Eunomia – it is noted that this figure is very difficult to estimate, however, it is clear that there is some littering of empty beverages containers
Percentage recovery of metal cans from incinerators	*50%*	*Danish EPA / Danish Aluminium Association*

[2] Canadean is a beverage industry data company which provided information on the sales on beverages in most EU-27 Member States.

[3] Data provided by the Beverage Can Makers Europe (BCME).

Table 3-6: Consumption and Management Data – Privately Imported Cans (Denmark)

Parameter	Value	Source
Privately imported cans returned to Dansk Retursystem	4%	Dansk Retursystem
Privately imported cans not returned to Dansk Retursystem	96%	100% – return rate (4%)
Other recycling of non-returned privately imported cans	40%	Eunomia Estimate based upon experience of collection system performance.
Landfill of non-returned privately imported cans	0%	Danish EPA – very low levels of landfilling for mixed municipal wastes
Incineration of non-returned privately imported cans	58%	Danish EPA / Eunomia – Remaining waste after recycling, landfill and littering – this was benchmarked against the national figure for incineration of 50 to 60%.
Littering of non-returned privately imported cans	2%[4]	Danish EPA / Eunomia – it is noted that this figure is very difficult to estimate, however, it is clear that there is some littering of empty beverages containers
Percentage recovery of metal cans from incinerators	*50%*	*Danish EPA / Danish Aluminium Association*

Table 3-7: Deposit System Financial Data (Denmark)

Parameter	Value	Source
Producer Fees - per year if new packaging types are introduced (fee covers all new packaging registered in a calendar year)	2000 DKK (268€) per year	Dansk Retursystem
Danish deposit value for average can size of 330 ml	1 DKK / 13.4	Dansk Retursystem

[4] Note that this % figure used is the same for the littering of domestic cans. However, it is a proportion of the cans *not* collected by the DRS, thus as a % of total cans placed on the market it would be greater than the proportion of domestic cans (covered by the DRS) that are littered.

Parameter	Value	Source
	eurocents per can[5]	
Material Revenue (aluminium)	1,050 € per tonne / 1.5 eurocents per can	Dansk Retursystem
Collection fee per can (aluminium)	9.8 ore / 1.32 eurocents per can	Dansk Retursystem
Logistics fee per can (aluminium) – Part of Collection Fee	0 ore / 0 eurocents per can	Dansk Retursystem

Table 3-8: Costs from Dansk Retursystem Annual Report (2010) (Denmark)[6]

Parameter	Cost, DKK	Cost, €	Cost, eurocents per Can
Managing Repayment (Handling fees paid to stores)	6 M	0.8 M	0.2 eurocents (per can returned)
Collection Costs for Disposable Packaging	116 M	15.6 M	4.1 eurocents
Staff Costs			
Amortized Capital			
Gross System Costs per Can			**4.3 eurocents**

The collection and logistics fee (Collection fee per can (aluminium)) shown in Table 3-7, does not represent the actual costs of operating the system i.e. it is not equivalent to the 'Gross System Costs per Can'. Rather, it reflects the shortfall in income after taking the revenue received from material sales and unredeemed deposits into account. Therefore, the Collection fee alone cannot be used to assess the true 'costs' of the DRS.

[5] 0.134287 Euro per 1 Danish Krone, exchange rate from Universal Currency Converter on 16/09/2011, http://www.xe.com/

[6] These figure were checked as far as is possible by Dansk Retursystem.

We have sought to estimate the ongoing costs of running the system by assuming a cost neutral operation for cans alone (i.e. there is no cross-funding of material revenues and unredeemed deposits between packaging types). In the model the retailer handling fee was set at 0.2 eurocents per can returned (taken from the average figure calculated from the annual report) and the other system costs - as shown in Table 3-9 - were calculated by ensuring the balance of income and expenditure was zero for the baseline system model. Adjusting the calculations to express them per can placed on the domestic market, the results are shown in Table 3-9.

The following summarises the main finances that relate just to cans. Again we note that it is difficult to assess whether these costs relate only to the cans, as the total systems costs, and associated fees per item, are likely to be balanced depending on a number of factors, such as bulk density, collection costs, material value etc. In reality the system is likely to include some level of cross-material / product subsidy, which is not possible to assess simply by considering cans, or without more detailed financial data. However, this does provide a start to assessing the potential change in costs which may be seen as a result of the interoperability options.

The total costs are calculated based upon the number of cans and the return rates for Dansk Retursystem given in Table 3-5.

Table 3-9: DRS Estimated Income and Expenditure Related to Metal Cans, per annum (Denmark)

	Total, € million	Per Can (Placed on the Market)[1]
Income		
Collection Fees	4.9 € M	1.3 eurocents
Unredeemed Deposits[2]	5.7 € M	1.5 eurocents
Material Revenue	5.7 € M	1.5 eurocents
Expenditure		
Handling Fees	0.8 € M	0.2 eurocents
Other System Costs	15.6 € M	4.1 eurocents
Net Income / Expenditure	**0 € M**	**0** eurocents

Notes:

1. The total number of cans placed on the market is around 380 million.

2. The revenue from unredeemed deposits is calculated as the deposit value reduced by the proportion not returned and less the VAT (25%) which is payable to the Danish Ministry of Taxation.

Table 3-10: Non-deposit System Financial Data (Denmark)

Parameter	Value, per tonne	Source
Cost of recycling services	180 €	Producer fee for aluminium from Fost Plus was used as a basis for implying an actual cost of operation. This figure was used because it most closely reflects the real costs of the system, as the coverage and recycling rate are very high. The figure takes into account the sale of material.
Incineration (including tax)	65 €	Danish EPA
Landfill (including tax)	110 €	Danish EPA

3.4 Sweden – Returpack

Table 3-11: Consumption and Management Data – Domestic Cans (Sweden)

Parameter	Value	Source
Domestic cans returned to Returpack	75%	Returpack – 824 M domestic cans returned out of a total of 1,114 (2010)
Domestic cans not returned to Returpack	25%	100% – return rate (75%)
Other recycling of non-returned domestic cans	0%	Eunomia – majority of deposit bearing cans expected to be recycled through DRS
Landfill of non-returned domestic cans	0%	Eunomia – very low levels of landfilling for mixed municipal wastes in Sweden
Incineration of non-returned domestic cans	98%	Eunomia – high levels of incineration in Sweden
Littering of non-returned domestic cans	2%	Eunomia – small volumes littered – it is noted that this figure is very difficult to estimate, however, it is clear that there is some littering of empty beverages containers
Percentage recovery of metal cans from incinerators	*50%*	*Danish EPA / Danish Aluminium Association – same figure used for Sweden as no other data was obtained*

Table 3-12: Consumption and Management Data – Privately Imported Cans (Sweden)

Parameter	Value	Source
Privately imported cans returned to Returpack	20%	Returpack / import assumptions – 55 M non-domestic cans returned to Returpack out of around 225 M imported
Privately imported cans not returned to Returpack	80%	100% – return rate (20%)
Other recycling of non-returned privately imported cans	50%	Returpack / import assumptions – ~ 110 M privately imported cans recycled through bring systems (FTI) out of around 225 M imported
Landfill of non-returned privately imported cans	0%	Danish EPA – very low levels of landfilling for mixed municipal wastes
Incineration of non-returned privately imported cans	48%	Eunomia – remaining waste after recycling, landfill and littering – high levels of incineration in Sweden
Littering of non-returned privately imported cans	2%	Danish EPA / Eunomia – it is noted that this figure is very difficult to estimate, however, it is clear that there is some littering of empty beverages containers
Percentage recovery of metal cans from incinerators	*50%*	*Danish EPA / Danish Aluminium Association – same figure used for Sweden as no other data was obtained*

Table 3-13: Deposit System Financial Data (Sweden)

Parameter	Value	Source
Producer Fees – Annual Membership Fee	10,000 SEK (1,100 €) per year	Returpack / Currency conversion[7]
Swedish deposit value for metal can	1 SEK / 11 eurocents per can	Returpack / Currency conversion
Material Revenue (aluminium)	900 € per tonne / 1.3 eurocents per can	London Metals Exchange (systems not able to share due to contractual obligations)
Sorting fee per can (aluminium)	0 SEK per can	Returpack
Admin fee per can (aluminium)	0 SEK per can	Returpack
Note: Figures for aluminium are given as this is the main material type in the Nordic deposit countries.		

Table 3-14: DRS Estimated Income and Expenditure Related to Metal Cans, per annum (Sweden)

	Total, € million	Per Can (Placed on the Market)[1]
Income		
Collection Fees	0 € M	0 eurocents
Unredeemed Deposits[2]	23 € M	2.1 eurocents
Material Revenue	11 € M	1.0 eurocents
Expenditure		
Handling Fees	13 € M	1.2 eurocents
Other System Costs	21 € M	1.9 eurocents
Net Income / Expenditure	**0 € M**	**0** eurocents

Notes:

1. The total number of cans placed on the market is around 1,114 million.

2. The revenue from unredeemed deposits is calculated as the deposit value reduced by the proportion not returned and less the VAT (25%) which is payable to the Swedish Tax Agency.

[7] 0.109839 Euro per 1 Swedish Krona, exchange rate from Universal Currency, http://www.xe.com/

Table 3-15: Non-deposit System Financial Data (Sweden)

Parameter	Value, per tonne	Source
Cost of recycling services	180 €	Producer fee for aluminium from Fost Plus was used as a basis for implying an actual cost of operation. This figure was used because it most closely reflects the real costs of the system, as the coverage and recycling rate are very high. The figure takes into account the sale of material. FTI packaging fees were not considered to represent the full costs of collecting cans in Sweden.
Incineration	70 € (640 SEK)[8]	Avfall Sverige Annual Report 2011
Landfill (including tax)	88 € (800 SEK)	Avfall Sverige Annual Report 2011

3.5 Finland – Palpa

Table 3-16: Consumption and Management Data – Domestic Cans (Finland)

Parameter	Value	Source
Domestic cans returned to Palpa	94%	Palpa
Domestic cans not returned to Palpa	6%	100% – return rate (94%)
Other recycling of non-returned domestic cans	0%	Eunomia – majority of deposit bearing cans expected to be recycled through DRS
Landfill of non-returned domestic cans	75%	Finnish Ministry of Environment – landfilling rate for residual waste
Incineration of non-returned domestic cans	23%	Remaining residual waste assumed incinerated
Littering of non-returned domestic cans	2%	Eunomia – small volumes littered – it is noted that this figure is very difficult to estimate, however, it is clear that there is some littering of empty beverages containers
Percentage recovery of metal cans from incinerators	*50%*	*Danish EPA / Danish Aluminium Association – same figure used for Finland as no other data was obtained*

[8] 0.109839 Euro per 1 Swedish Krona, exchange rate from Universal Currency Converter, http://www.xe.com/

Table 3-17: Consumption and Management Data – Privately Imported Cans (Finland)

Parameter	Value	Source
Privately imported cans returned to Palpa	20%	Additional return from non-domestic cans was reported by Palpa as around 3.5%. The resulting number of returned cans was 'benchmarked' against the product of 20% and the number of privately imported cans.
Privately imported cans not returned to Palpa	80%	100% – return rate (20%)
Other recycling of non-returned privately imported cans	50%	No relevant data available from Finland. A similar figure as for Sweden has been used.
Landfill of non-returned privately imported cans	35%	Finnish Ministry of Environment – landfilling rate for mixed municipal wastes
Incineration of non-returned privately imported cans	13%	Eunomia – remaining waste after recycling, landfill and littering
Littering of non-returned privately imported cans	2%	Danish EPA / Eunomia – it is noted that this figure is very difficult to estimate, however, it is clear that there is some littering of empty beverages containers
Percentage recovery of metal cans from incinerators	*50%*	*Danish EPA / Danish Aluminium Association – same figure used for Finland as no other data was obtained*

Table 3-18: Deposit System Financial Data (Finland)

Parameter	Value	Source
Producer Fees – Initial Joining Fee	7,600 €	Palpa
Producer Fees – Product Registration Fee	350 € per item	Palpa
Swedish deposit value for metal can	15 eurocents per can	Palpa
Material Revenue (aluminium)	900 € per tonne 1.3 eurocents per can	London Metals Exchange (systems not able to share due to contractual obligations)
Recycling fee per can (aluminium)	1 eurocents per can	Palpa
Figures for aluminium are given as this is the predominant material type in the Nordic deposit countries.		

Table 3-19: DRS Estimated Income and Expenditure Related to Metal Cans, per annum (Finland)

	Total, € million	Per Can (Placed on the Market)[1]
Income		
Collection Fees	11 € M	1 eurocents
Unredeemed Deposits[2]	8 € M	0.7 eurocents
Material Revenue	14 € M	1.2 eurocents
Expenditure		
Handling Fees	16 € M	1.4 eurocents
Other System Costs	17 € M	1.5 eurocents
Net Income / Expenditure	**0 € M**	**0 eurocents**

Notes:

1. The total number of cans placed on the market is around 1,100 million.

2. The revenue from unredeemed deposits is calculated as the deposit value reduced by the proportion not returned and less the VAT (22%) which is payable to the Finnish Tax Administration.

Table 3-20: Non-deposit System Financial Data (Finland)

Parameter	Value, per tonne	Source
Cost of recycling services	180 €	Producer fee for aluminium from Fost Plus was used as a basis for implying an actual cost of operation. This figure was used because it most closely reflects the real costs of the system, as the coverage and recycling rate are very high. The figure takes into account the sale of material.
Incineration	70 €	Danish EPA – same figure for Sweden used as no relevant data was obtained for Finland
Landfill (including tax)	130 €	Finnish Ministry of Environment – a mid-range landfill tax gate fee of around 100 € per tonne has been and added to the landfill tax of 30 € per tonne

3.6 Estonia – EPP

Table 3-21: Consumption and Management Data – Domestic Cans (Estonia)

Parameter	Value	Source
Domestic cans returned to EPP	59%	EPP
Domestic cans not returned to EPP	41%	100% – return rate (59%)
Other recycling of non-returned domestic cans	0%	Eunomia – majority of deposit bearing cans expected to be recycled through DRS
Landfill of non-returned domestic cans	75%	Estonian Ministry of Environment – landfilling rate for residual waste
Incineration of non-returned domestic cans	23%	Remaining residual waste assumed incinerated
Littering of non-returned domestic cans	2%	Eunomia – small volumes littered – it is noted that this figure is very difficult to estimate, however, it is clear that there is some littering of empty beverages containers
Percentage recovery of metal cans from incinerators	*50%*	*Danish EPA / Danish Aluminium Association – same figure used for Estonia as no other data was obtained*

Table 3-22: Deposit System Financial Data (Estonia)

Parameter	Value	Source
Producer Fees – Initial Joining Fee	31.96 €	EPP
Producer Fees – Administration Fee	0 € per item	EPP
Estonian deposit value for metal can	8 eurocents per can	EPP
Material Revenue (aluminium)	900 € per tonne / 1.3 eurocents per can	London Metals Exchange (systems not able to share due to contractual obligations)
Figures for aluminium are given as this is the predominant material type in the Nordic deposit countries.		

Table 3-23: Estimated Income and Expenditure Related to Metal Cans, per annum (Estonia)

	Total, € million	Per Can (Placed on the Market)[1]
Income		
Collection Fees	0 € M	0 eurocents
Unredeemed Deposits[2]	4 € M	3.3 eurocents
Material Revenue	1 € M	0.8 eurocents
Expenditure		
Handling Fees	2 € M	1.6 eurocents
Other System Costs	3 € M	2.5 eurocents
Net Income / Expenditure	**0 € M**	**0** eurocents

Notes:

1. The total number of cans placed on the market is around 134 million.

2. It has been reported by the Estonian Authorities that the deposit is exempt from VAT, so there is no reduction in the value received by EPP.

3.7 Germany – DPG

The setup of the deposit system in Germany is very different to those in other Member States. Producers are obliged to include their products in DPG, but the role of DPG itself is limited to dealing with labelling and security issues, and managing some fees and data. A number of clearing companies have been setup to manage the collection and logistics of empty containers, and the clearing of deposits. These companies operate within their own boundaries and are not required to publish any of the data relating to performance or costs. Thus it would be very difficult to attempt to construct a detailed model of the German deposit system for analysis. This was not a significant problem in this study due to the direction of flow of metal beverage containers: i.e. the majority were away from Germany, thus there would be limited change to the operation of DPG, if any at all. However, detailed discussions were held with the main suppliers of RVMs in Germany, and a number of the clearing companies which provide collection services and the like to understand the system well.

4.0 Calculation of Interoperability Impacts

In this section the calculation of the financial, environmental and social impacts is described. The system models described above were developed to include the key processes required by each DRS. The introduction of new, or changes to existing, processes may affect the number of containers managed by these systems, and consequently the costs.

Where the issue of interoperability is concerned, changes in the number cans in the system, and their management, are influenced by both consumer demand and consumer behaviour. These changes in behaviour are a consequence of the effects that arise due to the implementation of the interoperability options. Importantly, the change in demand for beverages, and resultant management of the waste packaging, strongly relates to the costs and environmental consequences of the interoperability options. These factors are considered first, followed by a description of how the financial, environmental and social costs were calculated.

In assessing interoperability impacts it is clear that a number of factors are uncertain, and indeed contested. In addition, for the bi-lateral interoperability option, the aim was not to replicate the existing detailed work carried out by the German and Danish authorities, but to investigate, and highlight, some key principles at the macro level. In this light, central, worst and best case figures for many of the parameters were used, to give a range to the outputs. These are clearly set out where appropriate.

In addition, a multivariate analysis tool (Oracle Crystal Ball) was used to perform Monte Carlo simulations. This is a method used to vary multiple inputs in line with pre-determined probability distributions which enables investigation of the value, and probability distribution of a number of key outputs. This tool is used for the multi-lateral options (4 and 5) as the number of inputs, and complexity of the model, mean that straight-forward best / worst case scenarios are difficult to implement. The tool was used to provide 90% confidence intervals around a mean value.

4.1 Consumer Behaviour

Firstly, the potential change in beverage consumption, which may result from any interoperability option, is considered, followed by the effect of the options on beverage can return.

4.1.1 Change in Beverage Consumption

As a result of the interoperability options consumers may change their behaviour and alter consumption patterns, based upon changing prices of goods or other factors (such as changes in the level of convenience).

It is important to make a distinction here between changes in the pre-deposit sales price (pre-deposit) as a result of the option, and the change in the amount paid by the consumer at the point of sale, including the deposit (which is wholly, or partly, redeemable). In relation to the former, the sales price may increase if implementing the interoperability options imposes additional costs, and if the slope of the demand

curve allows these to be passed through to the consumer. In relation to the latter, the question arises as to whether the deposit, which is redeemable, should be considered to have the same impact on demand as those changes in price which represent unrequited payments. It seems reasonable to argue that they should not, especially where the mechanism for returns is convenient and implies minimal effort on the behalf of the consumer. In such situations, deposits are likely to be paid on the understanding that they will be refunded at some later date. The impact on demand arguably becomes one of the effect of the deposit on cashflow. For all but the poorest consumers, this is unlikely to have a major impact, especially not beyond the first round of purchases. It may have implications for some major, organised border shopping operations, where the volume of the purchases may imply that a delay in the refund associated with the return of cans impacts upon cashflows of what would be a business-like transaction. Here again, the effect is likely to be one of adjusting to the change in cashflow over the first round of purchases and returns.

Some of the scenarios clearly lead to price effects. Some of these are related to the options we have proposed for the deposit and refund mechanism. For example, we have included options where consumers are refunded only part of the deposit they pay. Consumers might (assuming they know where they plan to consume the beverages) be expected to perceive the differential between the deposit paid and the refund received as an effect on price.

Where consumers see a real change in price, which materially affects their disposable income, then the demand for the good is likely to change. This can be measured using own- and cross-price elasticities of demand. Where the change in the amount paid on purchase relates to the presence of a redeemable deposit, the same calculation is no longer valid. If the consumer's disposal income is not affected in the longer term then there is likely to be only a small in demand – all other things being equal. There may be a short term dip as the presence of a deposit implies a step change in cost (though even this might not occur to a major extent), but once the deposits are redeemed, behaviour is expected to equalise. [9]

In addition to price effects, a number of stakeholders suggest that changing from a situation where a deposit is not paid at all, to one where it is, and consumers are travelling long distances only once or twice a year to make purchases, then the inconvenience factor of having to store the empty containers for a long period would see demand drop. This factor was also highlighted in the stakeholder consultation. Conversely, others suggest that if consumers have space to store 6 to 12 months of full beverage containers waiting for consumption, then by the same token, there should be enough space to store the empty containers for their return. But again this point is disputed by others. In terms of market segmentation, the consumers who travel across borders to make use of varying price levels of beverages, are expected to be those seeking 'hard discounts' and are very much motivated by price. In economic terms, these consumers may value their leisure time lower than others on higher incomes, and are thus more likely to travel for border shopping. These

[9] This assertion was confirmed by a number of industry experts.

consumers might perceive any increase in deposit more negatively than others, with the cash flow implications possibly being more important to such consumers also. Even if one accepts this argument, these shoppers might not necessarily stop shopping altogether, but they may, instead, shop less often, or buy marginally less each time they shop. Such changes may lead to a drop in demand for beverages in border shops.

There are clearly opposing views on this subject. The retail trade is concerned about what it believes may be the possibility of a reduction in demand, whereas deposit system operators have found little or no evidence to suggest the presence of a deposit radically affects demand for beverages above and beyond any other additional driver on consumer demand. For example, no discernible change, over and above other effects, could be seen in beverage consumption in Sweden when the deposit value was recently doubled.[10] This would tend to support the view that deposits act on demand very differently from pre-deposit price increases.

A number of key stakeholders from industry and Government, in Denmark and Germany, were asked whether consumers had actually been consulted about any change in deposit level, and what their response might be. It was indicated by all stakeholders that they did not believe this had ever happened. One study by the University of Aland asked around 250 consumers what they thought about the introduction of a deposit on the tax free beverages.[11] The results suggested that 68% of those interviewed said that they would not change their consumption patterns at all following the introduction of a deposit. The remaining 32% did not suggest that their consumption would immediately fall to zero. One study by GfK Prisma in 2005 of Danish shoppers purchasing beverages in German border shops indicated that 33% would not purchase cans from the border shops if a German deposit was applied and was not refundable in Denmark.[12] However, consumers were not asked what the change to their consumption patterns would be if the deposit could be refunded.

We note that, if there was further concern with regards the impact the introduction of a deposit would have where it currently did not exist (as with cans sold in German border shops) then it may be useful to consult with consumers if there is any uncertainty. An additional survey could be carried out by the Danish Treasury when they conduct the annual survey of border shoppers travelling to Germany. A well-structured survey could help reduce uncertainty in this debate.

Economists and econometric studies use the term elasticity to measure how much alcohol consumption or alcohol-related harm changes when the price of alcohol changes. A demand elasticity less than 1 means that the consumption of the good is 'inelastic', or in other words consumers strongly desire the product and a given change in price does not produce the same percentage change in demand. This is

---

[10] Returpack Svenska.

[11] A. Sjobolm and S. Taskinen (2010) *Rapport om enkatundserokning: Taxfree-burkar, en del av ett pantsystem?* University of Aland, (January 2010)

[12] German border shopping association Interessengemeinschaft der Grenzhändler.

true for alcohol, and other products such as petrol and diesel. One key study on alcohol in Europe indicated the following data in relation to the demand elasticity of alcohol:[13]

- *The mean elasticity of alcohol demand across selected European countries, averaged for the years 1980-1995, was indicated as -0.55;*
- *An analysis of annual data from Australia, Canada, Finland, New Zealand, Norway, Sweden, and the United Kingdom from the mid 1950's to the mid 1980's found price elasticities of -0.35 for beer;*
- *More recent estimates found price elasticities of -0.48 for beer consumed on premises and -1.03 for beer purchased and consumed off premises;*

A 2010 study on alcohol and tobacco demand in the UK used regression models to calculate demand elasticities for different alcohol types, including beer.[14] A figure of -0.57 was calculated for beer consumed on-site and -0.78 for beer purchased and consumed off-site.

In terms of soft-drinks, the literature suggests that demand is also inelastic. In one study considered, the average own price elasticity for soft-drinks was given as -0.55, slightly higher than that for alcohol (-0.50).[15] In another study from the US, the demand for soft-drinks was calculated as -0.52.[16]

The literature suggests that the demand for beverages varies depending on its type and where it is purchased and consumed. No specific data was found which related specifically to canned alcoholic or non-alcoholic drinks. It appears as though alcohol demand is similar to the demand for soft-drinks and that the demand is more sensitive to the price when purchased and consumed off-site. The latter more closely reflects the situation considered in this study where beverages are purchased in border shops and consumed back at the consumer's residence. An own-price elasticity of demand of -0.6 was estimated to reflect the consumption of alcoholic and non-alcoholic beverages, whilst taking the off-site nature of the consumption into account. The literature suggests that cross-price elasticities of demand may also be expected to be of high relevance in determining demand for alcoholic beverages (for example, an increase in beer prices may lead to an increase in demand for wine), but these are not considered here as a whole product type (i.e. canned beverages) is considered rather than a specific brand.

The approach to estimating the change in consumer demand for beverages under each interoperability option is summarised in the table below. As there is uncertainty

---

[13] Anderson, P. & Baumberg, B. (2006) *Alcohol in Europe,* Institute of Alcohol Studies

[14] Collis, J., Czubek, M. and Johal, S. (2010) Estimating Price Elasticities of Demand for Alcohol and Tobacco in the UK, HMRC

[15] Selvanathan, A. and Selvanathan, S. (2005) *The Demand for Alcohol, Tobacco and Marijuana: International Evidence*, Ashgate Publishing Company Ltd, Aldershot, England

[16] Kaiser, H., M. and Zheng, Y. (2008) Advertising and U.S. Nonalcoholic Beverage Demand, *Agricultural and Resource Economics Review 37/2 (October 2008) 147–159*

about the exact change in beverage consumption, high and low, scenarios are considered around a central case.

The high scenario is calculated based upon an own-price elasticity of demand of alcohol or soft-drinks sales and the full level of the deposit (i.e. the consumer 'feels' the change in price in real terms), or for option 1 (where the deposit could not be redeemed close to the consumers residence) a behavioural approach is used, which has a greater impact. The low scenario is where there is no change in demand, and the central change in demand only occurs where there is a real difference in price caused by a difference in deposits paid and deposits redeemed.

Table 4-1: Impact of Change in Deposit Levels

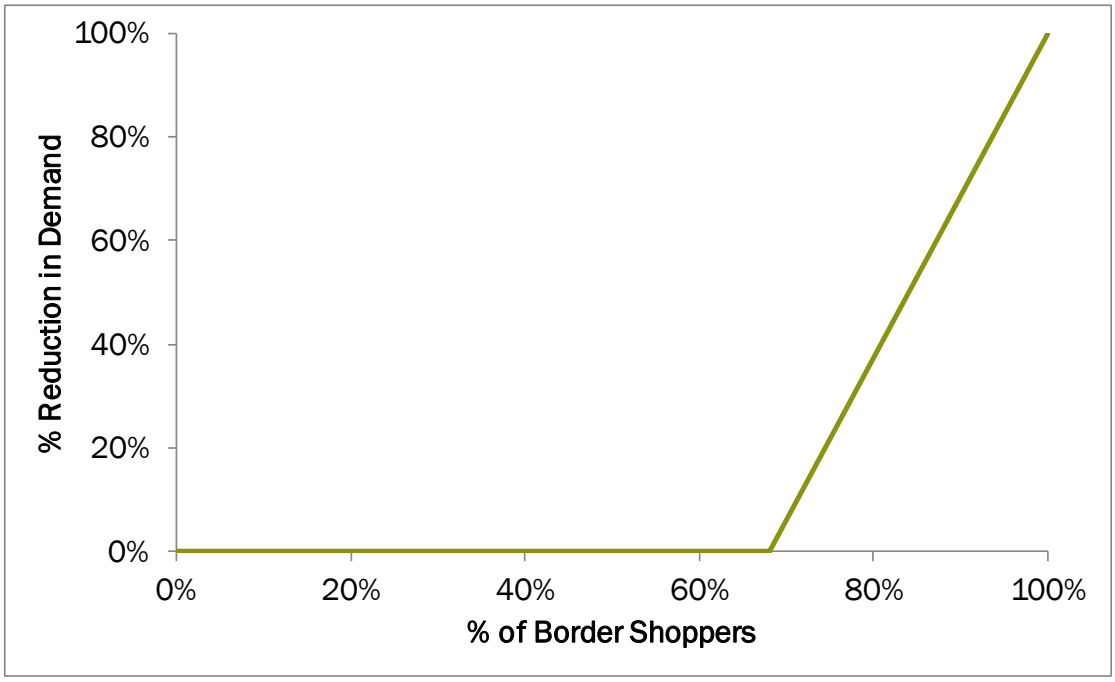
Interoperability Option	High	Central	Low
1: National requirement for the German deposit to be applied to all metal cans sold in Germany;	Behavioural – some consumers change demand	0.25 € increase in price	No change in demand
2: Bi-lateral agreement between Germany and Denmark to compensate for cost of managing cross-border cans;	Price increases by cost of additional producer fee per can	No change in demand	No change in demand
3a: Bi-lateral agreement between Germany and Denmark: German Deposit is applied in Border Shops – Danish Deposit is paid back to Danish Consumers in Denmark;	0.25 € increase in price	0.12 € increase in price (difference in deposits)	No change in demand
3b: Bi-lateral agreement between Germany and Denmark: German Deposit is applied in Border Shops – German Deposit is paid back to Danish Consumers in Denmark;	0.25 € increase in price	No change in demand	No change in demand
3c: Bi-lateral agreement between Germany and Denmark: Cans from Dansk Retursystem are sold in Border Shops – Danish Deposit is paid back to Danish Consumers in Denmark;	0.13 € increase in price	No change in demand	No change in demand
3d: Bi-lateral agreement between Germany and Denmark: Border Deposit is applied in Border Shops – Border Deposit is paid back to Danish Consumers in Denmark;	Increase in price relating to border deposit	No change in demand	No change in demand

For the multi-lateral options (4 and 5), the central case only was considered (i.e. no significant change in demand). This was to simplify the modelling, but also is likely to be reflective of the net change. Some consumers may reduce demand if a deposit is

introduced on the German border cans, but others may increase demand if they know they can redeem their deposit in other areas across the EU.

For the behavioural constraint under the worst case for option 1, the data from the University of Aland study was used.

Figure 4-1: Response of Border Shoppers to Introduction of Deposit



68% of consumers were assumed to continue purchasing at the same rate as now, with the remaining 32% changing behaviour in a linear fashion from zero change to a 100% reduction in demand for border cans. As exemplified by Figure 4-1.

Of course, although the consumer has changed their purchasing patterns (i.e. they have reduced consumption) there is some disposable income remaining to purchase additional beverages if desired. It is likely, therefore, that additional consumption will take place in the country of residence (though equally, this income could be used in consumption of other products and services). So an increase in domestic consumption will occur, but as the domestic price is higher the number of units sold will be less than would otherwise have been purchased in the existing situation.

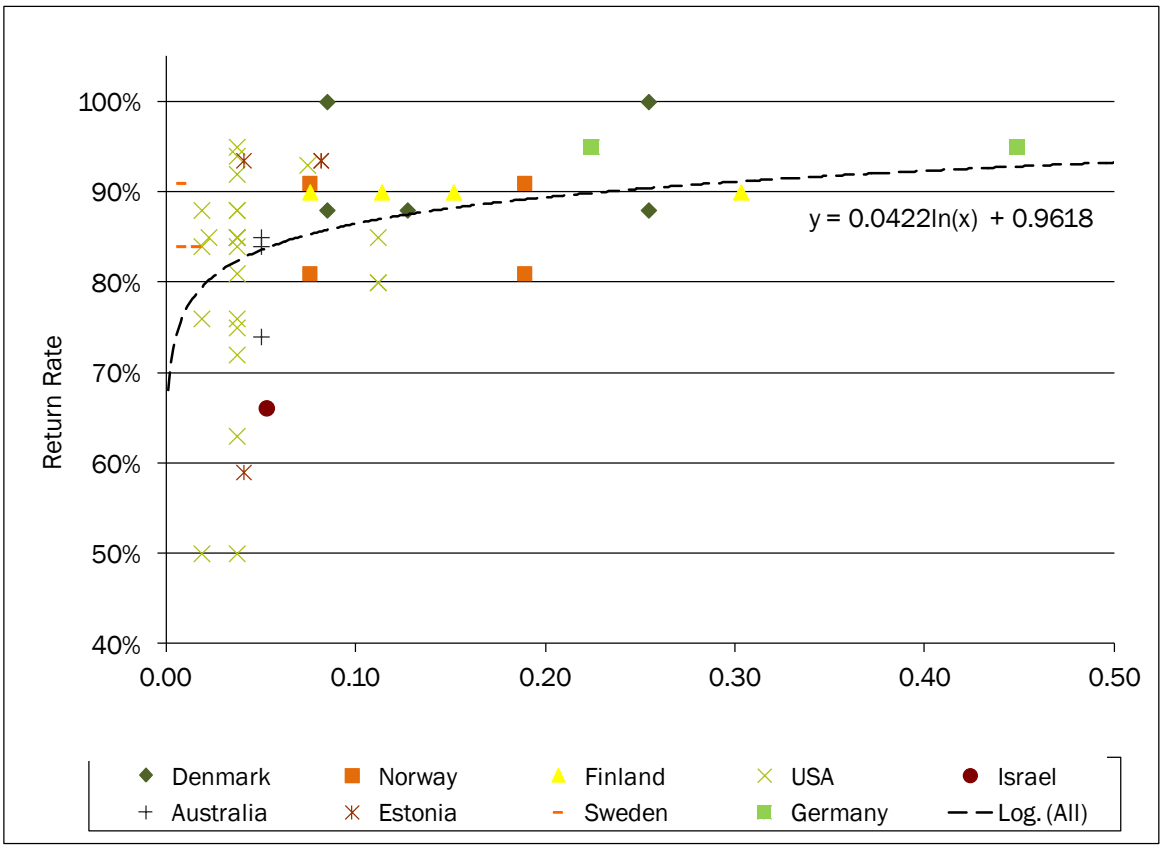
4.1.2 Return Rates for Empty Containers

It has been assumed that the return rate for empty beverage containers relates, to some extent, to the level of deposit charged on the border cans. When considering deposit values and return rates from numerous deposit refund systems around the world, there appears to be a relationship, exemplified in Figure 4-2 below, in which the return rate approaches, asymptotically, 100%. In other words, at lower deposit rates, the response is relatively strong, but at higher deposit levels, the relationship is not strong, and other factors such as convenience of return points and cultural values are likely to become significant. However, for many consumers purchasing beverages from other Member States with DRSs, there is already a national DRS in place. Thus if the density of collection is similar, and the only difference is an increased value of the

deposit, all other things being equal it is likely that there will be a marginal increase in the return rate. Again, we chose to use high and low scenarios. The low scenario reflects a lower level of *unreturned* containers, and the high scenario where there is a higher level of *unreturned* containers.

We have sought to use the actual return rate of domestic cans in this calculation. Private imports and exports influence the reporting return rate / recycling rate, but these often do not reflect the actual situation. We have also assumed a border deposit value (for Scenario 3d – border deposit paid in Germany and redeemed in Denmark) of 0.05 €. For this scenario we estimate a lower return rate would be seen in Denmark than the national average, perhaps around 80%.

Figure 4-2: Return Rates as a Function of Deposits in PPP-Adjusted GB Pounds.



Source: Eunomia

For option 5 (all existing and future systems form a common system) a range of deposit values is used. Thus a range of return rates is used to reflect high and low scenarios. As discussed in the main report, the range of deposit values to be assessed in the modelling was as follows:

High: 0.20 € to Low: 0.10 €

4.2 Financial Impacts

The market-based financial impacts relate to:

1) The operational costs of the deposit refund systems;

2) The costs required to manage the interoperability of the systems;
3) Producer surplus – the welfare generated by the sale of goods and products;
4) The operational costs of the additional (non-deposit) waste infrastructure;
5) The change in deposits paid out and redeemed by consumers; and
6) Other impacts.

The calculation of these impacts is described in the following Sections.

4.2.1 Impacts Relating to the Operation of Deposit Refund Systems

The financial impacts of the deposit systems are, in the main, calculated as the change in net income and expenditure, from the baseline, whose main characteristics are described in Section 3.0 for all existing deposit systems. The calculation of various elements relating to the operation of the deposit refund systems is described in this Section.

4.2.1.1 Material Revenue

A number of existing deposit refund systems were asked for information relating to the revenue they obtain from the sale of the collected cans. In all cases it was indicated to us that these prices are considered commercially confidential. We have therefore used a range in prices to reflect expected revenues generated.

Table 4-2: Material Value

Material Value, € per tonne	Low	Central	High
Value of Aluminium	800	900	1,200
Value of Steel	125	150	175

4.2.1.2 Producer Fees

In the case of interoperability arrangements between Germany and Denmark, it has been assumed that the same collection fees paid on beverages placed on the market in Denmark are also paid by producers placing on the market in German border shops. Given that a large volume of containers are labelled for the Danish market, it is unlikely to be problematic to understand the number of containers for which the fee should be paid. If this is more difficult than imagined, collection fees could be paid by the producers for the cans that were returned through Dansk Retursystem. The fees would be paid in Danish Krone and would be updated on a yearly basis.

For other cross-border flows, it may not be explicitly known to which country the beverages are to end up. Thus it would not be possible to levy producer fees on these items at the points of sale. The obvious solution, therefore, it to charge collection and logistics fees when the beverages are returned, by the system that they are returned to. The EAN code will indicate to which producer the fees would be recharged.

In practice the fee paid by producers may differ to the existing structure of charges due to the nature of additional collection systems put in place, or any additional costs incurred by the interoperability arrangements. The latter are captured in the estimations of interoperability costs below in Section 4.2.2.

One of the principles of the Nordic deposit systems is that they should retain revenues, including from unredeemed deposits, within the system and operate with costs and revenues balanced. However, the German system is not structured in quite the same way. The principle of revenue neutral DRSs has been used to show where the financing of any additional cost would most likely fall. In other words, if there are additional costs to the deposit systems, and the material revenue and unredeemed deposits do not cover these, it is assumed that the producer fees have to be increased to cover these costs.

4.2.1.3 Deposit Payments and Unredeemed Deposits

The transfer of deposit payments between countries is made more complex due to the fact that in most countries with deposits, VAT is charged on the deposit value itself. Article 92 of the VAT Directive states the following:[17]

> *As regards the costs of returnable packing material, Member States may take one of the following measures:*
>
> *(a) exclude them from the taxable amount and take the measures necessary to ensure that this amount is adjusted if the packing material is not returned;*
>
> *(b) include them in the taxable amount and take the measures necessary to ensure that this amount is adjusted if the packing material is in fact returned.*

It is not entirely clear whether this was intended to apply only to the value of the packaging itself, or to include the value of deposits themselves, which are not, strictly speaking, part of the value of the packaging, In most countries, however, the deposit is deemed part of the 'cost' of the packaging material, and therefore the implication is that it should be taxed.

Currently, all countries, except Estonia, charge VAT on all deposit payments throughout the supply chain – in other words, they adopt measure (b) above.

Thus if the German deposit is paid by a consumer in Germany this includes 19% VAT (the 25 cents paid is made up of around 4 euro cents VAT and 21 cents deposit). They also return the full amount (including the VAT element) if the packaging is returned. So if the same deposit was to be paid back to consumers in Denmark, the deposit + VAT would have to be paid to Dansk Retursystem to be passed on to the consumer: the consumer would, in effect, be paid 20 euro cents + 25% VAT to make the equivalent of 25 euro cents, though paid in Danish Krone. The unequal VAT rates may make this transaction somewhat more complex. In addition, VAT can only be collected by the relevant Ministries of Taxation, so these institutions would have to manage the collection, transfer and distribution of VAT relating to the deposits.

---

[17] Council Directive 2006/112/EC of 28 November 2006 on the common system of value added tax

If the cans were included in Dansk Retursystem the presence of the deposit logo would imply a 1 DKK deposit, which includes 25% VAT. However, if VAT is paid on a good or product it must normally relate to the country in which the product is sold, in this case Germany, which has a different VAT rate to that of Denmark. Hence, it might not be possible to sell a good in one country which bears the deposit (including VAT) of another country if the VAT rates are different. Further clarity on this matter from VAT experts would be prudent.

Measure (a) in the above extract appears to provide the possibility for adjusting for VAT on any deposits that are not redeemed at the end of the year, rather than paying the VAT throughout the packaging supply chain, which may or may not be returned later. The deposits that are paid by consumers could exclude the VAT, so the payment between countries for redeemed deposits would be simpler, and could be managed by the deposit systems, as opposed to the Ministries of Taxation. The VAT on the unredeemed deposits would presumably be paid by the beneficiary organisation to the Ministry of Taxation in the country in which they were paid.

If the German deposit was paid by consumers, through retailers, to the fillers, then the German VAT rate on unredeemed deposits would have to be paid to the German Ministry of Taxation.

Although this is not the current situation, it could be recommended that the unredeemed deposits be transferred from the fillers to the organisation which managed the subsequent collection of the empty beverage cans in the country of consumption. There appears no strong reason to suggest the non-VAT element of these unredeemed deposits could not be paid from the fillers placing the containers on the market in Germany to Dansk Retursystem. In fact, if the arrangements for the border cans, which were to be included in DPG, were adjusted so that the total value of the deposits (not including VAT) were paid to Dansk Retursystem when they were first placed on the market in Germany, then the unredeemed deposits would be maintained in Denmark, and thus would already be with the organisation which would be managing the collection. However, it is not known whether this type of arrangement would be possible. In addition, it has been noted by stakeholders that cans currently sold in the German border shops have Danish labelling and can be purchased in Danish Krone. (The details of this pricing arrangement are not fully known). Thus including a German deposit value in eurocents may be problematic.

Alternatively, if Danish cans included the Danish deposit and did not include VAT, the deposits could be paid directly to Dansk Retursystem and thus the unredeemed deposits would occur in Denmark. Subsequently, the VAT adjustment could be made at the end of the year, and Danish VAT paid to the Danish Ministry of Taxation on the unredeemed deposits.

Further support for paying VAT in the country of destination could be suggested due to the fact that the cans placed on the market are destined for export. In the summary of the VAT Directive from Europa, the following is noted:

> *There are also exemptions with a right to deduct whose main aim is to take into account the place where the goods or services are deemed to have been consumed and so taxed: these transactions are relieved of all VAT in their EU country of origin because they will be taxed in the country of destination.*

Given that the good is consumed in the country of destination, and notwithstanding that for most private transactions the VAT in the country of origin is paid (unless the sale includes delivery by post etc. across borders), then the Directive could be taken to imply that the deposit should be taxed in the country of destination also. This could be possible if the full amount of deposits paid in the country of origin were transferred to the destination country (this is described above).

There is also some argument to suggest that the VAT on deposits should be exempted or given a zero rate value. Notwithstanding the implications of Article 92 on returnable packaging, it could be argued that because the deposit is redeemable it does not constitute part of the 'cost' of the packaging, nor is there any 'value added' from the 'sale' of the deposit to the consumer. The additional payment (which is always kept separate from the sales price) is to provide a financial incentive for the return of the packaging. It is noted that the relevant Governments are currently benefiting from the tax revenue generated from VAT on the unredeemed deposits. Thus, if the status quo was considered appropriate for domestic consumption, then perhaps the conditions relating to cans destined for export could be changed. However, this would only benefit a discreet segment of the market, not the market as a whole. Thus transfer of deposits for casual consumers, tourists or business persons would still be problematic if the VAT was charged on deposits and payment issues remained.

The approach taken in this study is to assume differing conditions for the central, best and worst case scenarios. For the worst case scenario, unredeemed deposits remain in the country of origin and, therefore, are not used to support the collection of the empty packaging in the country of purchase. Under the central case, the non-VAT element of the deposit is transferred to the deposit system in the country of consumption (with the VAT remaining with the country of origin), and under the best case scenario, there is no VAT payment, or the rate is zero, so the full value is transferred to the DRS in the destination country.

4.2.1.4 Dansk Retursystem

This section considers the change in costs for Dansk Retursystem. This is considered separately due to the high volumes of border cans that may be required to pass through the system. A number of deposit system operators in the EU-27 suggested that to manage an additional 540 million cans would incur an additional cost on the system, despite the high value of the material and the lost deposits. The premise that collection systems cannot be fully funded by the sale of recyclate is confirmed in 'Appendix 2 – Comparative Analysis of Collection Systems for Metal Beverage Cans'. In nearly all cases some fee is still charged to producers placing packaging on the market, even if it is a high value material such as aluminium. It may be the case that adding aluminium to an existing recycling system does not alter the costs (and may even reduce overall costs), and the issue may have much to do with how one decides to apportion costs across materials.

The change in costs to the deposit systems relates to a number of factors, and is ideally captured by understanding the true marginal costs of additional collection and logistics. This will be affected by whether existing infrastructure can be optimised, or whether new capital investment is required. It has been noted by a number of stakeholders that there are some capacity concerns at peak times in Denmark with

the existing quantity of border cans flowing through the system (around 4% of border cans). There is some concern that additional border cans from Germany (from the remaining 96%) would lead to capacity constraints within the existing infrastructure. Thus it is likely that new infrastructure, of some kind, would be required. The plans for the development of this infrastructure are currently being worked up, in detail, by Dansk Retursystem. These plans are not currently in the public domain.

It is not appropriate to seek to identify a detailed solution for this cost benefit analysis, but simply to include realistic costs for collection, logistics and management of the privately imported cans. Thus a range of figures for 'other operating costs' (per can) for all deposit systems were used.

For Denmark, the high scenario is slightly higher than the current estimated average cost per container, and the low is around 50% of the central figure.[18]

Table 4-3: Costs of Dealing with Additional Cans in the Deposit System in Denmark

Marginal Cost, eurocents per can	High	Central	Low
Dansk Retursystem			
Retailer handling fee	0.2	0.2	0.2
Other system costs	5.4	4.1	2.1

4.2.1.5 Fillers Placing Products on the Market in German Border Shops

The costs to fillers placing products on the market in German border shops relate to any additional labelling requirements, the number of beverages sold and the cost of take-back and clearing infrastructure. These costs vary for the different scenarios depending upon the requirements. The structure of DPG is more complex than other deposit systems. The aim was not to model a significant level of detail with regards to the operation of this system, but to use a range of realistic average costs per can to present a range.

The central case in Germany is cheaper than in Denmark because less infrastructure would be required, and thus, the marginal cost of collecting the border cans at the border shops would be lower. Estimated costs for clearing were provided by CCR, a clearing company in Germany.[19]

[18] These figures were also validated by Dansk Retursystem, as a realistic potential range in additional costs per can.

[19] Personal communication with CCR logistics.

Table 4-4: Costs of Dealing with Additional Cans in the Deposit System in Germany

Marginal Cost, eurocents per can	High	Central	Low
DPG			
Other system costs	4	2.5	0.5

The worst case reflects the requirement for a significant number of RVMs to manage peak flow rate of take-back at weekends. The best case could be imagined as bulked logistics costs and counting at a centre in Northern Germany. Consumers would register on-line or at the shops, bag and tag the returned cans, drop them off quickly at take-back points and have the tags registered, and then the cans would be taken to the counting centre and payments credited directly to consumers' bank accounts using BACS transfer.

4.2.1.6 Other Deposit Systems

For other deposit systems the marginal cost of collection is varied under the different scenarios. Under the central and best cases, the marginal cost of collection is zero due to the lower volumes passing through the systems. However, in some cases, the volume of border cans could incur additional costs, and require more collection points, greater frequency of collection from retailers, and so forth, so the worst case scenario is where the current average cost of operation is used as the marginal cost.

In addition, retailer handling fees are paid to retailers in all but the high scenario.

4.2.1.7 German Border Shops

Under the scenario where the German deposit is redeemable in Germany, the empty cans are returned by Danish consumers to the border shops. Thus the border shops would be part of the return system under DPG. The retailers would pay for whatever was required to take-back the empty cans, but they would also keep the revenue that is generated from the sale of material collected at their stores.

To estimate the additional cost for take-back, a likely number of RVMs required was estimated based upon average figures per can handled in Germany and Denmark, and the cost annualised over a period of 7 years.

4.2.2 Interoperability Costs

4.2.2.1 RVM Upgrade Costs

The existing German system (DPG) has implemented a security mark, using a special printing ink, to ensure that barcodes cannot simply be photocopied and applied to non-deposit-bearing cans to defraud the system.

To meet the security needs of the German system, existing anti-fraud measures may need to be included in any interoperability solutions. This would entail fitting all the

RVMs affected (either Danish for the bi-lateral options (1 to 3) or Nordic and Estonian RVMs for the multi-lateral options (4 and 5)) with extra equipment. This has been costed at between 1,500 € to 3,000 € per RVM.

In addition to the security element, all RVMs would need to have a software upgrade to enable them to hold the larger barcode set and additional deposit values (200 € per machine), and some older RVMs in the Nordic countries may require memory upgrades also (however the number of machines is now small). The latter of these measures is only included in the 'high' scenario. The costs were obtained by speaking with all the main RVM manufacturers, including TOMRA.

The cost of upgrading RVMs, to enable them to handle the barcode set from all 5 deposit countries and to recognise the German security mark has been estimated at just over 31 € million.

However, software and hardware upgrades are usually expected to be amortised over the useful life of the asset.[20] As RVMs are usually amortised over 7 years, the same period has been chosen. A discount rate of 10% was also used. Therefore the annual value of the high scenario figure (31 € million) is just 6 € million.

4.2.2.2 Clearing Costs

The national deposit refund systems must make a number of business process changes to support international interoperability, either in bilateral or multilateral scenarios. The business processes affected are:

- Data handling (options 3a, 3b, 3c, 3d, 4, 5)
- Deposit setting (options 3b, 3c, 3d, 4, 5)
- Repatriating redeemed deposits (options 3a, 3b, 3c, 3d, 4, 5)
- Transmitting international payments (options 2, 3a, 3b, 3c, 3d, 4, 5)
- Handling unredeemed deposit amounts (options 3a, 3b, 3c, 3d, 4, 5)
- Hold the full database of beverage cans subject to deposits (options 3a, 3b, 3c, 3d, 4, 5)
- Serve on the 'Interoperability Board' (options 4, 5)

Further details of these business processes and the financial impacts on each option are shown below. These were developed through speaking with deposit and clearing system operators, and through in-house experience of waste management activities, business process development and IT.

Collate the data from RVMs and report it by country and deposit amount

The RVMs will hold a database covering the EAN codes for all beverage cans sold in the 5 EU countries operating deposit refund systems. They will redeem deposits for national and international cans. For example, currently in Denmark there are three

[20] Deloitte (2011) Summaries of International Financial Reporting Standards: IAS 38 Intangible Assets, Accessed 12th November 2011, http://www.iasplus.com/standard/ias38.htm

deposit levels (A – DKK1.00, B – 1.50, C – DKK 3.00). Current reporting distinguishes between different types of packaging as well as different deposit levels. Interoperability would add further deposit levels to this. A coding structure needs to be designed to distinguish the deposit levels (e.g. distinguish Estonian deposit level A from Danish deposit level A). If the reporting mechanism is set up to be able to handle changes and additions to the current system (e.g. either deposit levels change, or perhaps, level D is added), then adding the international deposit values does not materially change reporting of the RVM data. We therefore assume no cost for this process.

Calculate the deposit for each country's beverage packaging in local currency, using an agreed method

Each country's national system will need to have the deposit levels of non-national cans added to the database. These deposit levels will be converted into domestic currency. It is suggested that this exercise be undertaken annually, or when deposit levels change, or when there is a significant currency fluctuation (how much is deemed significant will be agreed by the Interoperability Board). The calculation can be done outside IT systems, with the resulting deposit levels then added to the systems. As the IT systems must currently be set up to allow for changes and additions to deposit levels, there will be no cost for this process

Calculate the amount of deposit to be returned to the country of purchase

This reporting will be a part of the normal portfolio of reports, although these reports may not currently be publicly available. The amount of deposit returned by deposit letter/level will be reported from the systems and will show the different international deposit amounts to be returned to the country of purchase. The data supporting the claim for redemption of the deposit will have to comply with the data standards that apply to domestic deposit redemption. Some software, and accompanying procedures for each country, will need to be built to fulfil the requirement, as shown below. As the German system has 6 service providers receiving data relating to deposits redeemed, and each one will require this update, the total cost for Germany will be six times the total shown below.

Table 4-5: Set up Costs for Returning Deposits:

Role	Man-days	Daily Rate (€)	Total Cost (€)
Data input (including testing)	20	400	8,000
Data analyst/programmer	15	1,200	18,000
Project Manager	10	1,000	10,000
Sign-off authority	3	1,200	3,600
Total	48	-	39,600

Table 4-6: Operating Costs for Returning Deposits (per annum):

Role	Man-days	Daily Rate (€)	Total Cost (€)
Data input (including testing)	20	400	8,000
Data analyst/programmer	8	1200	9,600
Total	28	-	17,600

Transmit the foreign deposits to the appropriate national system

This process will use established methods of international bank transfer. If these are not already in use, then there may be a small setup cost.

Periodically distribute the unredeemed deposits according to an agreed method

The deposits paid on beverage cans sold in the border shops that remain unredeemed are held by the deposit refund system in the country of purchase, or in the case of Germany, by the fillers. Periodically, part of this revenue could be shared between the countries where beverages are consumed to support the costs of the system, with an amount held back to cover the administrative costs of the system in the country of purchase. For some flows of privately imported beverages the origin and destination is better known than for smaller, more marginal purchasing patterns which take place across the EU-27. Thus this process may only be required if the relevant Member States agree that a payment needs to be made, and agree the mechanism which should be used. In our modelling we assume well characterised input data relating the origin and destination of private imports of beverages. Thus it is assumed that all unredeemed deposits have been transferred in the modelling, but we recognise that this approach may not be easy in practice. It is envisaged that this exercise would be a bespoke process carried out at an agreed frequency. Some countries could be both payers and recipients. If this is quarterly, then the annual costs may be as follows, per national system:

Table 4-7: Invoicing Costs

Role	Man-days	Daily Rate (€)	Total Cost (€)
Data analyst	15	600	9,000
Finance Manager (for invoicing)	8	900	7,200
Sign-off authority	6	900	5,400
Total	29	-	21,600

Table 4-8: Costs Incurred in Receiving Payments

Role	Man-days	Daily Rate (€)	Total Cost (€)
Data analyst	5	600	3,000
Finance Manager (for invoicing)	3	900	2,700
Sign-off authority	1	900	900
Total	9	-	6,600

Alternatively, for Germany at least it may be that the unredeemed deposits amount is used as a form of compensation (potentially split between retailers and fillers) for the inclusion of beverage cans into the deposit system. This is because the German system separates the unredeemed deposits from the fees paid by the stakeholders to DPG, and so if the unredeemed deposits were distributed to the destination countries it would make the net fees per beverage can much higher than for other (domestic German) retail channels.

Hold the full database of beverage packaging

The full database of barcodes and deposit levels from all the 5 EU deposit system countries would be required in the central database of each national system. This would necessitate either ensuring each national database was shared with all the national systems, or holding a single master database centrally, with each national system having access to its records for changing/adding/deletion. It is suggested that a central system be developed to keep the cost to a minimum. The cost (shared between the 5 countries) of setting up a central system is shown below.

Table 4-9: Development of Central Database of Barcodes and Deposit Levels

Role	Man-days	Daily Rate (€)	Total Cost (€)
Data input (including testing)	25	400	10,000
Data analyst/programmer	20	1,200	24,000
Project Manager	15	1,000	15,000
Sign-off authority	3	1,200	3,600
Development Days Total	34	-	52,600
Database licence	-	-	2,800
Hardware, software, setup	-	-	15,000
Project total	-	-	70,400

The cost of maintenance of this database would be the same as the current cost of database maintenance.

Serve on the Interoperability Board to participate in an agreed process of interoperability issue resolution with other country systems (meeting twice a year)

The Interoperability Board would meet quarterly. It is assumed that 2 representatives from each of the 5 countries would attend. Including travel this would take a day. Therefore the annual cost per national system would be four man days charged at €900 per day plus four man days charged at €600 per day, plus €300 expenses per representative per visit. This totals €8,400 per annum.

Summary of clearing costs

The costs of setting up and operating clearing systems were estimated as in Table 4-10 and Table 4-11.

Table 4-10: Costs for Setting Up Clearing System

Task	Cost per country (€)	Total Cost (€)
Database setup	14,080	70,400
Calculate deposits to be returned, and transmit them (Germany split into 6 service providers)	39,600	396,000
Total	53,680	466,400

Table 4-11: Operating Costs for Clearing System

Task	Cost per country (€)	Total Cost (€)
Unredeemed deposit invoicing	21,600	108,000
Unredeemed deposit receiving (Germany split into 6 service providers)	6,600	66,000
Interoperability Board	8,400	42,000
Deposit transmission (Germany split into 6 service providers)	17,600	176,000
Total	54,200	392,000

4.2.2.3 Labelling Costs

Basic labelling

On beverage cans, the artwork includes the deposit labelling required. It is applied to the can during manufacture, prior to filling with the beverage. The cost of deposit system-specific labelling is contained within the cost of all labelling. Any marking for the deposit system does however impact the area on each can available to the filler for marketing purposes. It is estimated that the application of the filler's artwork onto the can costs around €1,500 per product type.[21] This cost will be spread across the number of cans that are printed with this artwork, which depends on the market being served. The Nordic markets are most expensive in this regard, as each has its own deposit system with different labelling required.

Security labelling for Germany

The German deposit system requires a special security mark on the cans, using a particular ink. This necessitates a separate printing station, and specific procedures to manage the use and storage of the ink. It is estimated that this adds around 0.5 cents per can, if the cost of the setup and procedures is included.[22] Once these have been put in place, the marginal cost of printing the German labels is around 0.05 to 0.1 cents per can. The cost of storage may be affected by the security required, as these empty cans are worth 25 cents each (for the deposit), rather than the 1.5 to 2 cents of their material value. No cost has been attributed to this.

Other impacts of labelling

The need for separate labelling for a particular national market impacts the logistics cost for the filler and distributor. Also, more storage is required to keep a 'float' of stock with each label, sufficient to ensure no production stops. However, it has not been possible to estimate these costs.

4.2.2.4 Summary of Total Interoperability Costs by Option

The following Tables summarise the costs that would be borne by each country. Option 1 will not incur any interoperability costs. Option 2 requires the international transmission of payments, which would incur a small charge if not already setup (for example may be setup to pay international suppliers). No estimate has been made for this cost.

Option 1

There are no interoperability costs associated with this option.

Option 2

The only interoperability cost associated with this option may be the transfer of payments between countries. This is not expected to be significant. We have

[21] Personal communications with the metal can industry

[22] Personal communications with the metal can industry

estimated the cost based upon a number of days of resource cost and bank transaction fees. A nominal figure of around 10,000 € per annum was used.

Option 3

In Option 3a it is assumed that no RVMs require any upgrade, but that labelling may be required (so costs for labelling are counted in the high response scenario).

Table 4-12: Option 3a Interoperability Costs (Low Scenario), € millions

Option 3a Interoperability Costs – Low			
	Denmark	Germany	Total
RVM Upgrade Costs	0	0	0
Clearing Costs	0.11	0.43	0.54
Labelling Costs	0	0	0
Total	**0.11**	**0.43**	0.54

Table 4-13: Option 3a Interoperability Costs (Central Case), € millions

Option 3a Interoperability Costs – Central			
	Denmark	Germany	Total
RVM Upgrade Costs	0	0	0
Clearing Costs	0.11	0.43	0.54
Labelling Costs	0	0	0
Total	**0.11**	**0.43**	0.54

Table 4-14: Option 3a Interoperability Costs (High Scenario), € millions

Option 3a Interoperability Costs – High			
	Denmark	Germany	Total
RVM Upgrade Costs	0	0	0
Clearing Costs	0.11	0.43	0.54
Labelling Costs	1.90	0	1.9
Total	**2.01**	**0.43**	2.44

Option 3b requires RVM upgrades and security labelling, as the cans will be entered into the German (DPG) deposit system.

Table 4-15: Option 3b Interoperability Costs (Low Scenario), € millions

Option 3b Interoperability Costs – Low			
	Denmark	Germany	Total
RVM Upgrade Costs	0.71	0	0.71
Clearing Costs	0.11	0.43	0.54
Labelling Costs	0.19	0	0.19
Total	**1.01**	**0.43**	1.44

Table 4-16: Option 3b Interoperability Costs (Central Case), € millions

Option 3b Interoperability Costs – Central			
	Denmark	Germany	Total
RVM Upgrade Costs	1.71	0	1.71
Clearing Costs	0.11	0.43	0.54
Labelling Costs	0.38	0.00	0.38
Total	**2.2**	**0.43**	2.63

Table 4-17: Option 3b Interoperability Costs (High Scenario), € millions

Option 3b Interoperability Costs – High			
	Denmark	Germany	Total
RVM Upgrade Costs	6.51	0	6.51
Clearing Costs	0.11	0.43	0.54
Labelling Costs	1.90	0.00	1.9
Total	**8.52**	**0.43**	8.95

Option 3c is assumed to require no RVM upgrades (as the addition of any new products is already carried out and no new labelling is required).

Table 4-18: Option 3c Interoperability Costs (Central Case), € millions

Option 3c Interoperability Costs			
	Denmark	Germany	Total
RVM Upgrade Costs	0	0	0
Clearing Costs	0.11	0.43	0.54
Labelling Costs	0	0.00	0.0
Total	**0.11**	**0.43**	0.54

Option 3d is assumed only to require memory upgrades to the Danish RVMs – no labelling costs or label security costs will be added.

Table 4-19: Option 3d Interoperability Costs (Central Case), € millions

Option 3d Interoperability Costs			
	Denmark	Germany	Total
RVM Upgrade Costs	0.63	0	0.63
Clearing Costs	0.11	0.43	0.54
Labelling Costs	0	0.00	0.0
Total	**0.74**	**0.43**	1.17

Options 4 and 5

The RVM, clearing and labelling costs were considered to be similar for both options 4 and 5 (where all DRSs become interoperable or form a single system). Many of the same changes and ongoing processes are needed, regardless of the final organisation and control of the DRSs.

Table 4-20: Option 4 and 5 Interoperability Costs (Low Scenario), € millions

Options 4 & 5 Interoperability Costs – Low						
	Denmark	Germany	Sweden	Finland	Estonia	Total
RVM Upgrade Costs	0.71	5.80	0.71	0.71	0.18	8.11
Clearing Costs	0.11	0.43	0.11	0.11	0.11	0.87
Labelling Costs	0.19	0.00	0.56	0.55	0.07	1.37
Total	**1.01**	**6.23**	**1.37**	**1.37**	**0.36**	10.34

Table 4-21: Option 4 and 5 Interoperability Costs (Central Case), € millions

Options 4 & 5 Interoperability Costs - Central						
	Denmark	Germany	Sweden	Finland	Estonia	Total
RVM Upgrade Costs	1.71	5.80	1.71	1.71	0.18	11.11
Clearing Costs	0.11	0.43	0.11	0.11	0.11	0.87
Labelling Costs	0.38	0.00	1.11	1.10	0.13	2.72
Total	**2.20**	**6.23**	**2.93**	**2.92**	**0.42**	14.7

Table 4-22: Option 4 and 5 Interoperability Costs (High Scenario), € millions

Options 4 & 5 Interoperability Costs - High						
	Denmark	Germany	Sweden	Finland	Estonia	Total
RVM Upgrade Costs	6.51	5.80	10.03	8.11	1.03	31.48
Clearing Costs	0.11	0.43	0.11	0.11	0.11	0.87
Labelling Costs	1.90	0.00	5.57	5.50	0.67	13.64
Total	**8.52**	**6.23**	**15.71**	**13.72**	**1.81**	45.99

4.2.3 Non-deposit System Waste Management Costs

The proportions of non-deposit cans being managed in different ways remain as in the baseline other than for Option 2 (where the Danish recycling scheme is improved). In all other cases, there is no rationale for assuming any change. The change in the number of cans and tonnages of waste managed through the following routes are calculated as a consequence of the proportion not returned to the national deposit systems:

- Collected for recycling;
- Collected as refuse and incinerated;
- Collected as refuse and landfilled; and
- Littered.

Treatment / disposal costs are calculated using unit costs for each country (see Section 3.0 above). The costs of collecting refuse were taken from a UK study which sought to calculate them by assessing vehicle and labour costs.[23] The figure used in the study was 70 € per tonne.

Under the central case the cost for operating the back-up bring system is estimated very conservatively (in terms of not setting the cost too low) at 180 € per tonne. The exact nature and cost of this system is not known so a range was used for the best and worst case scenarios. Under the best case scenario the scrap value of the aluminium compensates for any collection and sorting costs, so the system is effectively revenue neutral. If the system was just collecting cans, and it was simple in nature, the revenues may even outstrip collection costs and provide a revenue stream (see Table 4-23).

Table 4-23: Bring Collection Costs in Denmark for Cans, € per tonne

	High	Central	Low
Bring Collection Costs, € per tonne	250 €	180 €	0 €

4.2.4 Consumer Surplus

Consumer surplus is a measure of the welfare that people gain from the consumption of goods and services, or a measure of the benefits they derive from the exchange of goods. If there is a change in the price of a good or service and consumption changes there will be a change in consumer surplus. This is relevant to the scenarios where consumers experience the changes as a change in price. The overall change in consumer surplus in any given country will be related not only to the consumption of

[23] Eunomia (2010) *Feasibility of Landfill Bans*, Final Report for WRAP

the good in question (beverages) but also to those goods where consumption increases as a result of the changes. This would be complex to calculate and has been omitted from calculation in this study.

4.2.5 Producer Surplus

Producer surplus relates to the welfare that businesses can achieve by supplying products to the market. It is measured as the difference between what producers are willing and able to supply a good for, and the price they actually receive. Again, the real producer surplus would be very difficult to calculate in this study. As a proxy the loss in value of net beverages sold is used. In other words, the difference in total beverages sold (reduction in country of origin + increase in country of consumption) is multiplied by the average value of the beverages to give a net reduction in producer surplus, which is counted as a loss in profit. We note that by using this methodology, we may slightly over estimate producer surplus; however it is not possible to go into further detail in this study.

4.2.6 Unredeemed Deposits

The deposits that are unredeemed are included as a revenue stream for the deposit refund systems for managing the collection of the empty cans, but the consumer is losing this value from their disposable income. Thus the unredeemed deposits are included as a cost to the consumer.

Unredeemed deposits are the product of the number of cans not returned and the deposit value.

In the multilateral scenarios (4 and 5) there may be a decrease in unredeemed deposits as consumers can now redeem the deposit in the country of consumption if they have first purchased the beverage in another country with a deposit system. In these options it has been assumed that the balance of unredeemed deposits is transferred to the country of consumption to help fund the collection of the empty cans. This is described above in Section 4.2.2.2.

4.2.7 Central Government – Legislative Changes

The costs of the legislative change are very difficult to estimate prior to the development of a detailed implementation plan. However, they are not expected to be significant in relation to the other costs and benefits which are generated. Moreover, there is a question as to whether administrative costs of government should indeed be included in a cost benefit analysis. Civil servants are paid annual salaries to make such changes. However, clearly there will be some constraints to the relevant Governments if there is little capacity in the system. Moreover, an assessment of the costs requires a detailed solution to be considered in an Impact Assessment on a country by country basis.

4.3 Non-market Impacts

Non-market impacts are those which are not valued by normal financial payments of goods, services, wages, taxes and the like. In this cost benefit analysis there are environmental and social impacts, which mostly relate to air pollutant emissions and

their impact on health, willingness to pay for recycling services, and visual disamenity impacts associated with littering. We also discuss, briefly, the matter of the impact of beverage consumption on health.

4.3.1 Environmental Impacts

4.3.1.1 Recycling

Benefits from recycling arise from, amongst other sources, a reduction in greenhouse gas emissions and other air pollutants emitted to the atmosphere during the production of virgin material. The main material which beverage cans are made of in deposit countries is aluminium (partly due to the higher value of the material off-setting a greater proportion of costs), but steel cans are also included in the mix to some extent. It is possible that some of the aluminium collected does go into production processes which are using recycled material already. Thus the benefits would be reduced. However, at the margin, it can be assumed that 100% of the material offsets primary production.

The determination of GHG impacts was considered in 'Appendix 3 – Impacts Associated with Incompatibility'. The headline figures are given below. In addition, the approach to calculating the monetised savings from the avoided greenhouse gas and other air pollutant emissions follows thereafter.

GHGs - Steel

We have used the UK WRAP figure of 1.34 tonnes CO_2 per tonne of steel recycled for the current analysis. This value is marginally higher than the mean of the other studies cited.

GHGs - Aluminium

We have used the EEA value (9.677 tonnes CO_2 eq per tonne of aluminium) in the current analysis, which is slightly lower than an average obtained from the average ERM and WRAP values.

Carbon Valuation

To include these impacts in a cost benefit analysis, they have to be expressed in monetary terms. To do this we have sought to use a figure value relating to carbon dioxide (CO_2) equivalent. This factor converts all carbon emissions into a comparable format. There are no stated preferences for carbon valuation at the EU level. Thus, for this study, the same approach was taken in measuring the value of carbon dioxide equivalent in an Impact Assessment for a proposed Biowaste Directive in 2009.[24] The approach was to use the social cost of carbon (SCC) valuation from the UK's Department of Energy and Climate Change. In 2002 this was £19.00 (with a low of £10.00 and a high of £38.00). The guidance included provision for a real terms

[24] Eunomia Research & Consulting and Arcadis (2009) *Assessment of the Options to Improve the Management of Bio-waste in the European Union*, Report for European Commission, 1 November 2009

increase in the value of SCC by £0.27 per annum. Following this the figure was converted to Euros. It should be noted that some of these benefits may already be internalised through the operation of the EU-Emissions Trading Scheme, but the manner of internalisation is not complete.

Table 4-24: Carbon Valuation, € per tonne

	Low	Central	High
Value of CO_2 equivalent	14 €	24 €	46 €

Air Quality

Table 4-25 shows the air quality benefits associated with recycling of the metals concerned (i.e. the emissions avoided where a product is manufactured from recycled material as opposed to primary material). These are sourced from the life-cycle assessment tool, WRATE.

Table 4-25: Avoided Emissions - Recycling

Pollutant	Avoided emissions through recycling (kg pollutant / t recyclate)	
	Ferrous metal	Nonferrous metal
NH_3	0.07	0.15
VOCs	0.25	2.20
$PM_{2.5}$	0.78	4.62
SOx	0.01	0.01
NOx	2.70	18.00
Pb	0.00	-0.04

Source: WRATE

These avoided emissions were converted into avoided environmental damages using estimates of the unit damage costs from the different pollutants. These estimates were taken from the work undertaken in the context of the Clean Air for Europe programme. It should be noted that the benefits from the avoided emissions will not necessarily arise in the countries where the recycling takes place.[25] We have used the average damages for the EU-25 reported in the relevant study (see Table 4-26). It

[25] AEA Technology Environment (2005) *Damages per tonne emission of PM2.5, NH3, SO2, NOx and VOCs from each EU25 Member State (excluding Cyprus) and surrounding seas*, Service Contract for Carrying out Cost-Benefit Analysis of Air Quality Related Issues, in particular in the Clean Air for Europe (CAFE) Programme, March 2005, http://www.cafe-cba.org/assets/marginal_damage_03-05.pdf

should be noted that other studies have included estimates of damage costs for other pollutants. The figures from WRATE, however, suggest that of these pollutants, only emissions of lead would contribute to the valuation of damages. The valuation of lead-related externalities is relatively scarce, though a recent study suggested values of 18,000 €/tonne to 203,000 €/tonne for neurotoxicity effects between 2000 and 2002, with central values of the order 41,000 €/tonne to 83,000 €/tonne.[26] At these levels, the effect on the analysis would be relatively slight, and would only influence externalities from aluminium recycling.

Table 4-26: CAFÉ Unit Damage Costs for non-GHGs (€/tonne) in 2010 prices

Emission	Low	Central	High
NH_3	€11,000	€16,000	€31,000
VOCs	€950	€1,400	€2,800
SOx	€5,600	€8,700	€16,000
NOx	€4,400	€6,600	€12,000
$PM_{2.5}$	€26,000	€40,000	€75,000

Source: AEA Technology Environment (2005) Damages per tonne emission of PM2.5, NH3, SO2, NOx and VOCs from each EU25 Member State (excluding Cyprus) and surrounding seas, Service Contract for Carrying out Cost-Benefit Analysis of Air Quality Related Issues, in particular in the Clean Air for Europe (CAFE) Programme, March 2005, http://www.cafe-cba.org/assets/marginal_damage_03-05.pdf

Combining the avoided emissions and the unit damage cost estimates gives the figures shown in Table 4-27 for the benefits from recycling a tonne of aluminium or steel. When modelling scenarios, we have used low values under the Low response scenario and High values under the High Response scenarios. The Central Response scenario draws on the central values.

[26] M. Pizzol et al (2010) External costs of atmospheric Pb emissions: valuation of neurotoxic impacts due to inhalation, *Environmental Health* 2010, 9:9, http://www.ehjournal.net/content/9/1/9

Table 4-27: Unit Impacts (Benefits) from Recycling, € per tonne

		Low	Central	High
Aluminium	GHGs	136 €	234 €	442 €
	Air Quality	179 €	285 €	550 €
	Total	**315 €**	**519 €**	**992 €**
Steel	GHGs	19 €	32 €	61 €
	Air Quality	33 €	51 €	94 €
	Total	**52 €**	**83 €**	**155 €**

4.3.1.2 Transport

Annual distances travelled by consumers in cars and by collection vehicles transporting empty containers were estimated for each border flow and system. Figures were cross-checked with published data where available. The air pollutant and GHG emission from Euro 6 class vehicles (the most stringent category) were used to estimate the emissions per mile. These pollutants were then valued according to the methodology described in the section above.

4.3.1.3 Consumer WTP for recycling

During the assessment of impacts which may result from the incompatibility of national collection systems for metal beverage cans, a brief literature review of consumer's willingness to pay for recycling services was carried out. The key conclusions are now given.

Table 4-28 summarises the figures for willingness to pay for 1% increase in metal beverage can recycling, relative to the total tonnage of beverage cans placed on the market in the EU-27.

Table 4-28: Willingness to pay for Metal Beverage Can Recycling Services

Study	Country	Willingness to pay per 1% recycling of metal beverage cans, €
Blaine et al	United States	9.7 million
Blomquist et al	United States	13.7 million
Tiller et al	United States	31 million
Lake et al	United Kingdom	39 million
Jakus et al	United Kingdom	70 million
Covec	New Zealand	18 million

Sources:

Blaine, T. W., Lichtkoppler, F. R., Jones, K. R. And Zondag, R. H. (2005) An Assessment of Household Willingness to Pay for Curbside Recycling: A Comparison of Payment Card and Referendum Approaches, Journal of Environmental Management 76 (2005) 15-22

Blomquist, G., Hardesty, D., Hughes, M., Koford, B. And Troske, K. (2008) Estimating Willingness of Citizens to Pay for Recycling, http://www.industrystudies.pitt.edu/chicago09/docs/Troske%202.7.pdf

Tiller K. H., et al. (1997) Household Willingness to Pay for Dropoff Recycling, Journal of Agricultural and Resource Economics, Vol 22 (2), pp 310-320)

Lake, I. R., Bateman, I. J. And Parfitt, J. P. (1995) Assessing a Kerbside Recycling Scheme: A Quantitative and Willingness to Pay Case Study, Journal of Environmental Management (1996) 46, 239-254

Jakus P. M., et al. (1996) Generation of Recyclables by Rural Households, Journal of Agricultural and Resource Economics, Vol 21 (1), pp 96-108

Covec (2007) Recycling Cost Benefit Analysis, Prepared for the Ministry for the Environment. Wellington

Bruvoll, A., B. Halvorsen and K. Nyborg (2002), Households' Recycling Efforts, Resources, Conservation and Recycling, 36: 337-354.

A range of results was used, but not extending to the maximum values estimated in the United Kingdom. Table 4-29 shows the range used in this study.

Table 4-29: Willingness to pay for Recycling Services, € million per 1% increase in EU-27 Metal Beverage Can Recycling Rate

	Low	Central	High
Willingness to pay	5 €	15 €	30 €

4.3.1.4 Litter Disamenity

There is a negative environmental impact, or disamenity, associated with uncollected litter. However, very few credible studies have been identified which seek to value the disamenity of litter. None explicitly assess the value of metal beverage cans alone. The fact that many people across the EU are prepared to use their leisure time to go out and collect litter from the environment, does imply that the social benefits associated with a reduction in litter are non-zero.

One UK based study by Cambridge Economic Associates indicates that the average household would be willing to pay £25 (~28 €) per annum to live in a neighbourhood where the streets are kept clean.[27] Unfortunately, however, this value does not cover the potential willingness to pay to remove litter from rural areas, and, as far as we are aware, there are no studies attempting to place a value on the disamenity experienced in such circumstances in the EU.

The only significant study of this nature of which we are aware was carried out in Australia by Pricewaterhouse Coopers. This indicated that households are willing to pay, on average, AUS $4.15 per 1% reduction in litter. The quantification of 'reduction' is not clear, but if, in line with the work of Stein and Syrek, we take the view that size (volume) is a proxy for visual impact, and that visual impact is what residents most notice, then we might assume that households interpreted this in terms of volume reduction.[28]

Assuming this to be the case, then if one also assumes:

- Beverage cans occupying 25% by volume of litter (which may be conservative); and
- 80% reduction in beverage-related litter as a result of a cans being included in a DRS.[29]

---

[27] Cambridge Economic Associates et al (2010) Developmental Work to Value the Impact of Regeneration, Technical Report: Environmental Quality and Amenity, May 2010

[28] Steven Stein and Daniel Syrek (2005) New Jersey Litter Survey: 2004, A Baseline Survey of Litter at 94 Street and Highway Locations, Report for the New Jersey Clean Communities Council, January 28, 2005. http://www.njclean.org/2004-New-Jersey-Litter-Report.pdf

[29] These figures are typical of the levels of reduction reported under DRSs for beverage containers (see, for example, Perchards (2005) *Deposit Return Systems for Packaging Applying International*

then the effective reduction in litter volume would be equivalent to 20% of the total. Using the Pricewaterhouse Coopers figures, converted to Euro, the value of this would be 54 € per household per annum.

The approach is exemplified by taking Denmark as an example. There are around 1.4 million households in Denmark.[30] Taking the UK study this gives a net figure of 40 € million per annum and the PWC study 75 € million per annum. Neither of these approaches seeks to estimate the value of a clean rural environment, where much of the uncollected litter can be found, and where the disamenity value is likely to be higher (due to the wealth of the citizens which reside in these areas).

As discussed above citizens are willing to spend their leisure time collecting litter from the environment. This implies that the litter has some value also. This value could be estimated in relation to the value of the citizen's leisure time – this is often represented as the value of over-time in economic analysis. The following analysis was thus carried out:

- People litter picking each year = 100,000
- Leisure time / overtime = 6 € per hour
- Time spent per person picking litter each year = 5 hours
- % of litter which is beverage cans in Denmark (by volume) = 25%
- The value of litter for the remainder of the population was assumed to fall to zero from the maximum per person value derived from these calculations. The aggregated figure was again averaged over the number of households.

Taking Denmark as an example, the value each household would place on the removal of the uncollected litter would be 30 € per annum. This equates to a total of 40 € million per annum.

The different approaches are summarised in Table 4-30.

Table 4-30: Value of Litter Disamenity per Household per Annum

Method / Source	Country	Value
Cambridge Economic Associates	UK	28 €
Price Waterhouse Coopers	Australia	54 €
Implied value from litter picking	Denmark	30 €

Experience to the UK, Peer Review of a Study by Oakdene Hollins Ltd., Report to Defra 14 March 2005).

[30] Statistics Denmark (2011) *Households and Families*, Accessed 15th September 2011, http://www.dst.dk/HomeUK/Statistics/focus_on/focus_on_show.aspx?sci=567

As there is uncertainty in the 'per household' values for disamenity associated with littering, and the distribution of value within the population, a large range has been used in this study. The figures in Table 4-31 were related to the number of cans estimated to remain in the environment, and, importantly, the change in cans littered as a result of the interoperability options. The product of the number of cans not littered and the 'per can' disamenity was calculated to give the overall benefit.

Table 4-31: Disamenity Associated with Littering, €/hhld/yr

	Low	Central	High
Willingness to pay for littered cans to be collected per hhld per year	5 €	30 €	60 €