Title:
Changes to the Glass Packaging Recycling Business Target to 2017
IA No: DEFRA1534

Lead department or agency:
Defra

Other departments or agencies:
Scottish Government, Welsh Assembly Government, Dept of the Environment Northern Ireland, HM Treasury

Impact Assessment (IA)

Date: 01/12/2013

Stage: Consultation

Source of intervention: EU

Type of measure: Secondary legislation

Contact for enquiries:
Sarah Steeds, 020 7238 4346

Summary: Intervention and Options

RPC Opinion: Not Applicable

Cost of Preferred (or more likely) Option				
Total Net Present Value	**Business Net Present Value**	**Net cost to business per year** (EANCB on 2009 prices)	**In scope of One-In, Measure qualifies as Two-Out?**	
£ m	£ m	£ m	No	NA

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

The management and disposal of packaging waste produces environmental externalities such as greenhouse gas emissions and disamenity impacts from landfill, the full social cost of which is not taken into account in production or consumption decisions. Without intervention, there would be overproduction of packaging and insufficient levels of recycling. The EU sets mandatory packaging recycling targets. The UK complies through mandatory statutory recycling business targets, achieved through a producer responsibility system. By making packaging handlers and producers pay some of the costs of recycling packaging, these costs are internalised and lead to reduced environmental impacts and a more efficient outcome.

What are the policy objectives and the intended effects?

The policy objectives are to make adjustments to the market based system that the UK uses to meet the EU targets and internalise the costs of packaging for packaging producers. The adjustments are required because of new information on the flow of glass packaging and the discovery of fraud in previous years which has revealed that the business targets set for packaging producers had been set too high causing high costs and significant overachievement against the EU targets. The intended effect is to reduce costs for packaging producers and reduce the social costs associated with the current targets.

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

Option 1 - Keep glass packaging business recycling target at 81% (do nothing).
Option 2a - Reduce glass packaging business recycling target to 75% which would deliver 62% recycling, above EU minimum.
Option 2b - reduce glass packaging business recycling target to 75% and additionally amend the end use split to 35%/65% aggregate to remelt to reflect the reduction in aggregate in the market
Option 3a - Reduce glass packaging business recycling target to 77% which would deliver 65% recycling, above EU minimum
Option 3b - Reduce glass packaging business recycling target to 77% and amend split to 34%/66% to reflect the reduction in the aggregate market. All options are classed as tax-and-spend and are therefore out of scope of One In, Two Out process required for regulation

Will the policy be reviewed? It will be reviewed. If applicable, set review date: 2017

Does implementation go beyond minimum EU requirements?			Yes / No / N/A		
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.	**Micro** No	**< 20** No	**Small** Yes/No	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions? (Million tonnes CO_2 equivalent)			**Traded:**	**Non-traded:**	

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

Signed by the responsible SELECT SIGNATORY: ---------- Date: ----------

Summary: Analysis & Evidence

Policy Option 1

Description: OPTION 2a - Lower the glass packaging recycling business target to 75% and maintain the split between remelt and other applications at the same percentages

FULL ECONOMIC ASSESSMENT

Price Base Year	PV Base Year	Time Period Years	Net Benefit (Present Value (PV)) (£m)		
2013	2013	5	**Low:** Optional	**High:** Optional	**Best Estimate:** 4.23

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	**Optional**		**Optional**	Optional
High	**Optional**		**Optional**	Optional
Best Estimate			**39.4**	144.9

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

Costs to reprocessor and export businesses of no longer receiving PRN revenue £136.5m. Costs to MRFs and businesses in the supply chain of no longer receiving material revenue from recovered glass £7.5m. Costs to society of reduced avoided greenhouse gas emissions from reduction in recycling activity £0.8m

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

Maximum of 5 lines

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	**Optional**		**Optional**	Optional
High	**Optional**		**Optional**	Optional
Best Estimate			**40.6**	149.1

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

Benefits to obligated businesses of having to buy fewer PRNs and a reduction in the PRN price £136.5m. Benefits to businesses of having to collect and pay for less glass for recycling and divert it to landfill £4.4m Benefits to local authorities of having to collect less glass for recycling £8.2m

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

Maximum of 5 lines

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

The analysis assumes average collection and sorting costs and material prices over the next 5 years. A reduction in obligated recycling is expected to lead to a reduction in PRN prices back to the level assumed in the analysis in 2012. This analysis is sensitive to changes in collection and sorting costs, the split between household and C&I collections, traded carbon prices and the level of material revenue.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			In scope of OITO?	Measure qualifies as
Costs: 31.2	**Benefits:** 30.5	**Net:** -0.7	No	NA

Summary: Analysis & Evidence

Policy Option 2

Description: OPTION 2b – Lower the glass packaging recycling business target to 75% and amend the split between remelt and other applications

FULL ECONOMIC ASSESSMENT

Price Base Year	PV Base Year	Time Period Yrs	Net Benefit (Present Value (PV)) (£m)		
	2013	5	**Low:** Optional	**High:** Optional	**Best Estimate:** 3.41

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	**Optional**		**Optional**	Optional
High	**Optional**		**Optional**	Optional
Best Estimate			**39.0**	143.1

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

Costs to reprocessor and export businesses of no longer receiving PRN revenue £136.5m. Costs to MRFs and businesses in the supply chain of no longer receiving material revenue from recovered glass £5.8m. Costs to society of reduced avoided greenhouse gas emissions from reduction in recycling activity £0.7m

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

Maximum of 5 lines

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	**Optional**		**Optional**	Optional
High	**Optional**		**Optional**	Optional
Best Estimate			**39.9**	146.5

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

Benefits to obligated businesses of having to buy fewer PRNs and a reduction in the PRN price £136.5m. Benefits to businesses of having to collect and pay for less glass for recycling and divert it to landfill £3.5m Benefits to local authorities of having to collect less glass for recycling £6.5m

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

Maximum of 5 lines

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

The analysis assumes average collection and sorting costs and material prices over the next 5 years. A reduction in obligated recycling is expected to lead to a reduction in PRN prices back to the level assumed in the analysis in 2012. This analysis is sensitive to changes in collection and sorting costs, the split between household and C&I collections, traded carbon prices and the level of material revenue.

BUSINESS ASSESSMENT (Option 2)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: 30.8	**Benefits:** 30.3	**Net:** -0.5	No	NA

Summary: Analysis & Evidence

Policy Option 3

Description: OPTION 3a - Lower the glass packaging recycling business target to 77% and maintain the split between remelt and other applications at the same percentages

FULL ECONOMIC ASSESSMENT

Price Base Year	PV Base Year	Time Period Years	Net Benefit (Present Value (PV)) (£m)		
	2013	5	**Low:** Optional	**High:** Optional	**Best Estimate:** 2.82

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	**Optional**		**Optional**	Optional
High	**Optional**		**Optional**	Optional
Best Estimate			**26.3**	96.6

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

Costs to reprocessor and export businesses of no longer receiving PRN revenue £91.1m. Costs to MRFs and businesses in the supply chain of no longer receiving material revenue from recovered glass £5.4m. Costs to society of reduced avoided greenhouse gas emissions from reduction in recycling activity £0.8m

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

Maximum of 5 lines

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	**Optional**		**Optional**	Optional
High	**Optional**		**Optional**	Optional
Best Estimate			**27.1**	99.4

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

Benefits to obligated businesses of having to buy fewer PRNs and a reduction in the PRN price £91.1m. Benefits to businesses of having to collect and pay for less glass for recycling and divert it to landfill £2.9m Benefits to local authorities of having to collect less glass for recycling £5.4m

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

Maximum of 5 lines

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

The analysis assumes average collection and sorting costs and material prices over the next 5 years. A reduction in obligated recycling is expected to lead to a reduction in PRN prices. This analysis is sensitive to changes in collection and sorting costs, the split between household and C&I collections, traded carbon prices and the level of material revenue.

BUSINESS ASSESSMENT (Option 3)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: 20.8	**Benefits:** 20.4	**Net:** -0.4	No	NA

Summary: Analysis & Evidence

Policy Option 4

Description: OPTION 3b – Lower the glass packaging recycling business target to 77% and amend the split between remelt and other applications.

FULL ECONOMIC ASSESSMENT

Price Base Year	PV Base Year	Time Period Years	Net Benefit (Present Value (PV)) (£m)		
	2013	5	**Low:** Optional	**High:** Optional	**Best Estimate:** 1.51

COSTS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	**Optional**		**Optional**	Optional
High	**Optional**		**Optional**	Optional
Best Estimate			**18.8**	69.1

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

Costs to reprocessor and export businesses of no longer receiving PRN revenue £72.3m. Costs to MRFs and businesses in the supply chain of no longer receiving material revenue from recovered glass £2.5m. Costs to society of reduced avoided greenhouse gas emissions from reduction in recycling activity £0.4m

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

Maximum of 5 lines

BENEFITS (£m)	Total Transition (Constant Price)	Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	**Optional**		**Optional**	Optional
High	**Optional**		**Optional**	Optional
Best Estimate			**19.2**	70.6

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

Benefits to obligated businesses of having to buy fewer PRNs and a reduction in the PRN price £72.3m. Benefits to businesses of having to collect and pay for less glass for recycling and divert it to landfill £1.5m Benefits to local authorities of having to collect less glass for recycling £2.7m

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

Maximum of 5 lines

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

The analysis assumes average collection and sorting costs and material prices over the next 5 years. A reduction in obligated recycling is expected to lead to a reduction in PRN prices. This analysis is sensitive to changes in collection and sorting costs, the split between household and C&I collections, traded carbon prices and the level of material revenue.

BUSINESS ASSESSMENT (Option 4)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: 14.9	**Benefits:** 14.7	**Net:** -0.2	No	NA

Executive Summary

The management and production of waste incurs environmental externalities such as greenhouse gas emissions and disamenity impacts from litter. The full social costs and benefits are not taken into account in production or disposal decisions, resulting in the over production of waste and sub optimal decisions on waste management options. A waste management system that internalises the environmental impacts in pricing of treatment options should result in a more efficient level of waste and allocation to different treatment options.

Decisions about the design and production of packaging are made without taking into account the costs of dealing with the discarded packaging at the point of consumption. This can lead to the over-production of packaging as the suppliers of packaging do not face the full costs of dealing with packaging waste. Further, there are environmental benefits of moving packaging waste up the waste hierarchy[1] at end of life that are not reflected in waste management costs and result in a sub-optimal mix of waste management. The waste hierarchy ranks different waste management options broadly according to their environmental impact. For example, shifting waste from landfill to recycling results in environmental benefits from avoided use of virgin materials and associated greenhouse gas impacts. Shifting waste further up the hierarchy to reuse would provide even greater environmental benefits from, for example, reduced reprocessing impacts.

The UK has had since 1997 a statutory producer responsibility scheme for packaging recycling, which implements the EU Packaging Directive. This scheme internalises some of the externalities of dealing with packaging at the end of its life. This reduces the amount of packaging waste going to landfill and reduces the associated environmental impacts. It does so by setting minimum recycling and recovery targets on UK businesses in the packaging supply chain. The current targets run from 1 January 2013 for five years.

In order to comply with the Packaging Directive, obligated packaging producers and handlers must demonstrate a minimum level of recovery and recycling has occurred by purchasing Packaging Waste Recovery Notes (PRNs). PRNs are issued by exporters or recyclers when a tonne of relevant packaging material has been recovered and is sold for reprocessing. This demand for PRNs from obligated producers creates a market for PRNs that can be issued by accredited domestic reprocessors and exporters of recovered material. The price for PRNs, although volatile, should reflect the marginal cost of meeting the obligation. Specifically, for each PRN it should reflects the additional cost of diverting material from landfill to recycling that is not covered by existing economic drivers. In this way obligated packaging producers and handlers internalise some of the cost of dealing with packaging at the end of its life. A very low PRN level would indicate that little additional incentive is required to deliver the level of recycling set by business targets.

Due to significant volatility in the glass recycling market in 2012, Defra tasked the Advisory Committee on Packaging (ACP) with investigating the causes of the perceived glass recyclate shortage in 2012 and subsequent price spike for PRNs. We also tasked them with identifying ways in which stability in the PRN system can be improved and ways of better identifying and mitigating price spikes in future. To assist with this work, WRAP commissioned Valpak Consulting to carry out a detailed study into glass packaging flows. The WRAP/Valpak GlassFlow report has gone back to first principles and produced a new estimate of glass packaging waste arisings based on a thorough and detailed analysis of the glass market. Their work indicates that the glass waste arisings figures (the so called 'flow' figure) that Government used to calculate our achievement of the EU Packaging Directive target, and set the statutory

[1] https://www.gov.uk/government/publications/guidance-on-applying-the-waste-hierarchy

business targets for 2013-2017, is some 350k tonnes too high. The report also indicates that there is likely to be no incremental growth in the industry over the same period: at best it is flat.

The business target for obligated businesses is set at a level which is calculated to ensure the UK meets its recovery and recycling targets. It is set at a higher rate to take into account the de minimis producers who will not have glass obligations. Historically, the tonnage of glass packaging produced or handled by businesses that are out of scope due to de minimis has been relatively steady as a proportion of the total amount of packaging. Glassflow has indicated that this is no longer the case, and the tonnage of non obligated glass has fallen as a percentage of the total amount of glass packaging. This has resulted in a higher proportion of glass packaging recycling for the UK than previously estimated.

This IA reviews the glass packaging recycling targets that came into effect on 1 January 2013, with a view to reducing the target for obligated glass producers. There are different options, including amending the split target for end use. The target for glass was split on 1 January 2012 to ensure that we continue to recycle via remelt a high proportion of glass because remelt has a higher environmental benefit than using recycled glass in other applications, for example, aggregate. Recycling glass through a remelt application (e.g. back into bottles or jars) achieves a carbon equivalent saving of between 0.253 – 0.315 tonnes per tonne. However, using recycled glass into other applications delivers a much lower carbon saving.

The current split target freezes the amount of glass recycling through the system which goes to aggregate at 37% of the whole, up to 2015. This is the same as the amount of glass recycled through the system which Government thought went into aggregate when the targets were set.

The options under consideration are:

Option 1 – Do nothing – keep the glass packaging recycling business target at 81% until 2017.

Option 2a – Lower the glass packaging recycling business target to 75% and maintain the split between remelt and other applications at the same percentages:

Option 2b – Lower the glass packaging recycling business target to 75% and amend the split between remelt and other applications.

Option 3a – Lower the glass packaging recycling business target to 77% and maintain the split between remelt and other applications at the same percentages.

Option 3b – Lower the glass packaging recycling business target to 77% and amend the split between remelt and other applications.

These options are based on ensuring we achieve a minimum level of recovery and recycling of glass in order to continue to meet the EU Packaging Directive minimum targets. Sub options 2a and 3a maintain the current split between remelt and other applications. Sub options 2b and 3b amend the split based on recalculations of the amount of recycling aggregate given the discovery of fraudulent activity.

Keeping the targets at current levels incurs higher costs on obligated producers to deliver the required level of recycling set by the business targets. This is indicated by the current PRN prices and the current evidence on costs and benefits. Options 2 and 3 deliver a net benefit, but also a net cost to business. This is due to the reduction in material revenue that reprocessing businesses receive which more than offsets lower collection and sorting costs for businesses. Obligated producers benefit significantly from a lower PRN price but this is offset directly by the lower PRN revenue received by reprocessors and exporters.

On the basis of this impact assessment options 2(a) and 2(b) and 3(a) and 3(b) will deliver a net benefit in comparison with option 1, with all 4 alternate options lowering the cost to society of

recycling glass. The net benefit of option 2(a) is £4.23m compared to £3.41m in option 2(b). The net benefit of options 3(a) and 3(b) are lower at £2.82m and £1.51m respectively as the overall reduction in recycling tonnage is lower than in option 2. However, on an assessment of the net cost to business, option 2(a) has the highest negative Net Present Value (NPV) compared to the other options.

Options 2 and 3 do contribute less to overall recycling rates than option 1, but on the basis of the evidence, the do nothing option would not deliver the optimal outcome in terms of net benefit. As such, the Government is not minded to pursue a do nothing option however it does invite views onoption 1 as well as views on the other options.

As a result of the distributional issues between the different options, Government do not have a preference between option 2 and 3 at this stage. The responses to the consultation will be used to help determine the final preferred option.

Background – the Packaging Directive and producer responsibility in the UK

The environmental externalities associated with packaging waste are greenhouse gas emissions from sending packaging to landfill, disamenity impacts from littering and impacts on land use from landfill sites. Not all environmental externalities are internalised in decision-making by households and businesses. Intervention is required by government to reduce the environmental impact of packaging waste.

The EC Directive on Packaging and Packaging Waste (94/62/EC, as amended by Directive 2004/12/EC, and hereafter referred to as 'the Packaging Directive') aims to harmonise the management of packaging waste by reducing the impact of packaging and packaging waste on the environment and by avoiding obstacles to trade and distortion and restriction of competition within the Community.

The Packaging Directive sets a minimum overall recovery target of 60% (of which a minimum of 55% must be recycling), as well as material-specific recycling targets. For glass this is 60%.

These targets are to be met by Member States by 31 December 2008. After that date, Member States must continue to meet these minimum targets, but they have the freedom to set higher national targets.

It is implemented in the UK by (i) the Packaging (Essential Requirements) Regulations 2003 (as amended); and (ii) the **Producer Responsibility Obligations (Packaging Waste) Regulations 2007** (as amended). This IA assesses options relating to amendment of the glass packaging recycling targets contained in the latter set of Regulations, which are thereafter referred to as 'the Packaging Regulations'.

Using a producer responsibility system to internalise some of the costs of dealing with packaging provides incentives for packaging producers to reduce the environmental impacts of waste and ensure a proportion is recycled. Packaging producers have to pay towards the cost of recycling and are therefore incentivised to reduce the total amount of packaging resulting in a reduction in the environmental impacts of packaging at the end of its life. If set at the correct level, the recycling target should reduce the environmental impact of packaging waste through reduced impacts of virgin material extraction and associated environmental impacts.

In the UK, a "packaging producer" includes any business involved in the packaging supply chain, i.e. that manufactures raw materials for packaging, converts raw materials into packaging, uses packaging to wrap goods, or sells or imports packaged products. The 'responsibility' for the packaging is split between these actors in the supply chain.

Under the Packaging Regulations, to show they have discharged this legal obligation, businesses must obtain evidence in the form of Packaging Waste Recovery Notes (PRNs) or Packaging Waste Export Recovery Notes (PERNs). These evidence notes are issued by accredited packaging waste reprocessors and exporters, respectively, and are bought by packaging producers. An accredited reprocessor/exporter can issue PRNs/PERNs to the amount of packaging waste reprocessed (e.g. 100 tonnes of packaging steel waste reprocessed allows the reprocessor to 'sell' 100 PRNs in steel).

The evidence notes have two functions. Firstly, they are a 'counting tool' for the amount of recovery/recycling undertaken on the behalf of producers. Secondly, they are a way to channel producer funding to recycling/recovery operations, since business pay for these PRNs / PERNs. This internalises the cost of recovery and recycling to the packaging producers.

The Packaging Regulations include a de minimis threshold, exempting businesses which have a turnover below £2m and who handle under 50 tonnes of packaging a year; they are 'not obligated'. However the packaging that is handled by those exempt businesses still counts when calculating the UK's recycling performance. This is because the Packaging Directive Targets are set as a percentage of the total packaging waste arising in each Member State. Business targets are therefore set for obligated businesses that are higher than the actual EU minimum target in order to take this exempt packaging into account. The actual amount of exempt packaging changes from year to year. Business targets are therefore set at a level to take into account these fluctuations. Table 1 shows that it was estimated that an 81% business target would achieve a UK recycling rate of 62%.

Businesses obligated under the Regulations have a choice as to how they comply. They can undertake the recycling/recovery themselves in order to obtain the required PRNs; they can contract directly with reprocessors/exporters and acquire evidence of compliance in the form of PRNs and PERNs (known as individual registration) or they can pay to join one of several registered compliance schemes, who takes on the regulatory reporting and contractual duties, with greater market clout than individual producers. The majority of packaging producers have chosen to join a compliance scheme.

The price of PRNs and PERNs varies depending on availability. The Regulations do not mandate the use to which the proceeds from the sale of PRNs/PERNs to producers can be put, though accredited reprocessor and exporters are required to report on the use of these funds as they are intended to finance improvements in the collection and reprocessing infrastructure across the UK.

Annex 1 fully explains the PRN mechanism and cash flows.

Rationale for intervention and Policy Objectives

The management and disposal of waste results in environmental impacts such as greenhouse gas emissions and disamenity impacts. The full social cost of producing and dealing with waste is not taken into account in decisions by households and businesses. This results in the over-production of waste and sub-optimal allocation of waste treatment. Intervention by government can help reduce the amount of packaging waste to a more efficient level and shift the allocation of treatment to a more optimal level. Without government intervention, waste treatment options

with better environmental performance may be penalised relative to treatments with poorer performance due to higher costs.

Packaging waste constitutes about 10% of the commercial and industrial (C&I) waste stream and about 20% of the household waste stream in the UK. Packaging provides benefits such as the protection of goods in transit and it helps ensure that products are undamaged. The benefits of packaging should be considered against the extra cost of producing and dealing with that packaging at the end of its life.

Recovery and recycling targets are set at a level to increase the amount of packaging that is recovered and recycled from a sub-optimally low level. There are environmental benefits from a shift from landfill to recycling and recovery. The shift will reduce the adverse environmental impacts of: climate change, primarily through the release of methane gas from biodegradable material; possible damage to soil and water quality through leaching from landfill sites; disamenities such as noise and odour. It would be more efficient to reduce the amount of packaging waste that is sent to landfill.

Recycling packaging results in reductions in emissions of greenhouse gases because less energy is used to produce recycled raw materials than in the production of virgin raw materials. It also avoids the extraction of raw materials, which can have a negative impact on the environment and biodiversity. Increased recovery and recycling of packaging waste could have amenity benefits by contributing to a decrease in packaging litter.

Externalities and reaching an efficient level of recycling

All environmental costs and benefits of waste disposal decisions are not reflected in the relative costs of each disposal option. The policy objective is to move towards a more efficient level of recycling.

In the absence of intervention in recycling, there are monetary incentives to move waste away from landfill, due to pre-existing regulation (the Landfill Tax). However, there are no incentives which reflect the *additional* benefits of recycling compared to other non-landfill options. Under landfill tax, all materials are equally incentivised away from landfill, despite the benefits of different waste types moving up the waste hierarchy[2] to recycling being very different.

[2] https://www.gov.uk/government/publications/guidance-on-applying-the-waste-hierarchy

Box 1: Why do we need additional recycling intervention, when we have the landfill tax and the EU ETS?

1. Environmental externalities:
The existing key intervention, the landfill tax is £72/tonne in 2013/14 and rises to £80/tonne in 2014/15. At this level it takes into account the greenhouse gas externalities from landfill for all the materials in the packaging targets at current carbon prices.

Although the externality associated with landfill is covered, the landfill tax alone is insufficient to drive the right amount of recycling. The landfill tax does not aid the allocation of glass across all the treatment options in the waste hierarchy; prevention, re-use, recycling and recovery. Additional incentives are required to allocate across different treatment to a more efficient level.

There are different impacts for glass depending on the treatment option, which are not taken into account (in fact the aggregates levy incentivises glass to be used for aggregates rather than mining new materials and therefore doesn't reflect the carbon benefit of this glass being sent to and end use of remelt). For glass, there is a carbon benefit of moving glass from an end-use of aggregates to re-melt. The split target moves the proportions of end-use from other applications, including aggregates to re-melt, to reflect this carbon benefit.

EU ETS: The carbon emissions associated with recycling and with raw material production in Europe are included in the EU Emissions Trading Scheme. However, carbon emissions not covered by existing intervention include international transport emissions, emissions involved in extraction and production outside the EU (or outside similar electricity schemes).

2. Market Imperfections:
Interventions such as the landfill tax are insufficient to deliver an efficient level of recycling for each material due to market imperfections that occur through the complex chain of waste disposal. The price signal does not impact on activity through the chain of agents in waste disposal due to rigidities and pricing in waste disposal contracts, issues where the individual contract negotiator may not benefit in full from any changes to increase recycling activity (principal agent issues) and general misaligned incentives. Householders are not directly incentivised through pricing signals to increase recycling, although piloted reward and recognition schemes aim to incentivise recycling. Local authorities are subject to the landfill tax and are incentivised to provide alternatives to landfill but are not incentivised to provide an efficient level of recycling.

Both these points mean that, in the absence of Government intervention in recycling, levels of recycling will not reach the efficient level for each material.

Intervention is required to move towards a more efficient level of recycling. This intervention may be statutory targets, voluntary producer responsibility deals or other alternatives. Where the intervention is statutory (mandating a higher recycling rate and resulting in a higher tonnage of PRNs required), the cost of the PRN to the producer (and resulting revenue to the recycling sector as a spend) addresses the environmental externalities to a certain extent.

<u>Achieving targets set by EU packaging legislation</u>
The second policy objective is to ensure that the minimum packaging recycling and recovery targets included in the Packaging Directive continue to be met. This will avoid potentially costly infraction proceedings.

In the absence of intervention, the market prices for recyclates **do not** ensure UK recycling levels meet EU packaging targets. The costs of collecting and reprocessing a material may be

greater than the value which can be earned from selling the material, resulting in no incentives to recycle. To ensure the EU packaging targets are met, Government intervention is required.

2012 – A volatile year in glass recycling

During 2012 the UK experienced significant volatility in the glass PRN prices. Low recycling figures published in the first half of the year meant there would have to be a considerable increase in the recycling rate in the latter half of the year to ensure the UK would meet its glass packaging recycling target for the year.

In 2012, based on what we had assumed the total amount of glass placed on the market was, the UK needed to recycle 1,660k tonnes of glass packaging to meet the EU Directive target of 60%. This was based on the PackFlow[3] mid-point estimate of glass packaging consumption in the UK. However, with low quantities of glass being accepted for reprocessing in the first three quarters of the year, this put significant pressure on the market to increase glass recycling in the last quarter. This saw PRN spot prices rise from around £10 per tonne early in the year to approximately £75 per tonne towards the end of the year[4], meaning that the compliance costs for obligated glass packaging producers increased significantly.

The reasons for this volatility were not fully understood, so, as a result, Defra asked the ACP to investigate the causes of the perceived shortage of glass recyclate in 2012 and subsequent PRN price spike. They were also tasked with identifying ways in which stability in the PRN system could be improved and ways of better identifying and managing price spikes in future. Part of that exercise has involved the production of the 'GlassFlow'[5] report. The WRAP/Valpak GlassFlow report has gone back to first principles and produced a new estimate of glass packaging waste arisings based on a thorough and detailed analysis of the glass market. The report also indicates that there is likely to be no incremental growth in the industry over the period, at best, it is flat.

The analysis in the GlassFlow report concluded that the revised flow/consumption of glass packaging onto the UK market is significantly lower than that estimated in the earlier PackFlow study. It has significantly changed our understanding of non-obligated glass production, and led us to the conclusion that the obligation placed on obligated businesses was higher than necessary. So, the main implication of the lower revised flow of glass packaging is that it significantly affects the UKs packaging glass recycling rate – it would suggest that the UK over achieved against the EU Directive target of 60% by some 8% or 185k tonnes of glass packaging.

Further, during 2011, it was discovered that there was evidence of the issuance of fraudulent PRNs, where PRNs were being sold for material that did not exist. The amount of fraud was significant, with GlassFlow estimating the amount at between 100,000 and 200,000 tonnes of PRNs issued for material that had not been collected or reprocessed. Previous analysis had therefore been based on a lower level of actual recycling and lower associated costs than estimated at the time. The actual cost of achieving the business targets was higher than expected. Once this fraudulent tonnage had been removed from the reprocessed figures, it provided a more accurate view to the market of the likely availability of PRNs in future years and

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3 http://www.valpak.co.uk/docs/default-source/environmental-consulting/packflow_2012_summary_report_and_recommendations.pdf?sfvrsn=0

4 Lets Recycle

5 http://www.wrap.org.uk/content/glassflow-2012-report-0

signalled that more glass packaging waste had to be obtained and processed in order to comply with the targets.

These factors combined have caused a shortage of glass packaging waste available to be recycled, an underestimating of the cost of achieving recycling targets and a subsequent increase in glass PRN prices. We are also overachieving at high cost against the Packaging Directive target. Glass producers have effectively been over-obligated as a result of these issues, and the consultation seeks views onaddressing this over obligation by reducing the glass packaging targets.

The directly affected businesses are obligated packaging producers who have to pay for PRNs to meet the business recycling targets. There were 1,296 obligated packaging producers in 2012. There were 68[6] accredited reprocessors and exporters that issue PRNs and receive money from obligated producers. Both these numbers change from year to year but give an indication of the number of businesses are directly affected by this policy through the PRN system. Due to this chain of activity, there are significant distributional issue of the proposed changes.

The options

Option 1 – Do nothing – keep the glass packaging business recycling target at 81% until 2017.

Option 2a – Lower the glass packaging recycling business target to 75% and maintain the split between remelt and other applications at the same percentages:

Option 2b – Lower the glass packaging recycling business target to 75% and amend the split between remelt and other applications.

Option 3a – Lower the glass packaging recycling business target to 77% and maintain the split between remelt and other applications at the same percentages.

Option 3b – Lower the glass packaging recycling business target to 77% and amend the split between remelt and other applications.

Analysis of Options

Option 1 – Do nothing – keep the glass packaging recycling target at 81% until 2017

This option establishes the counterfactual for the period 2013-17 in the absence of any changes to the policy. Options 2 and 3 are measured relative to this option.

This section analyses the difference between the glass packaging flow and recycled tonnages that were used in the impact assessment[7] for packaging targets in 2012 and the updated information in the Glassflow report. Updated evidence on the costs and benefit of recycling is compared to the figures used in 2012 and updated figures are used to estimate the counterfactual for 2013-17. Further information on these costs and benefits are sought at question 4 of the consultation.

Background

The business targets for glass for 2013-17 were consulted on in 2011 and the final targets were announced at Budget in March 2012. The targets were set using the best available evidence at

[6] Source: NPWD

[7] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/82441/packaging-ia.pdf

the time. The tonnage achievement was as recorded on the National Packaging Waste Database which records the obligated tonnage and recycling achievement.

Table 1: Previous Glass packaging estimates made in 2011/12 for consultation on 2013-17 targets

Glass Packaging estimates made in 2011/12	**2013**	**2014**	**2015**	**2016**	**2017**
Total tonnes of packaging in waste stream	2,795,062	2,823,013	2,851,243	2,879,756	2,908,553
Growth rate of packaging	1.0%	1.0%	1.0%	1.0%	1.0%
Total tonnes of obligated packaging	2,130,471	2,151,775	2,173,293	2,195,026	2,216,976
Growth rate of obligated packaging	1.0%	1.0%	1.0%	1.0%	1.0%
Obligated tonnage	81%	81%	81%	81%	81%
Recycling tonnage achieved through business targets	1,725,681	1,742,938	1,760,367	1,777,971	1,795,751
Recycling rate	62%	62%	62%	62%	62%
EU minimum recycling rate	60%	60%	60%	60%	60%

Source: Final Impact Assessment Packaging Targets 2013-17

Changes to glass packaging estimates are required as evidence has arisen since the announcement of targets in 2012 that indicates:

1. The baseline for costs and benefits had included fraudulent activity and therefore costs to achieve current targets are higher than previously estimated.
2. The total amount of glass packaging placed on the market is significantly lower than the projections used in 2012. This would reduce the amount of recycling required to achieve the EU packaging targets.

Fraudulent PRN issuance

The Glassflow report estimates that the reduction in PRN issuance as a result of the discovery of the fraudulent activity in the relevant years is between 100,000-200,000 PRNs. The Glassflow report states 'this figure is likely to be a low estimation'[8] as it does not include the deterrence impact on other possible issuers of fraudulent PRNs who may now perceive a greater chance of being caught and therefore have ceased illegal activity. As the Agencies operate on a risk-based system when planning and delivering their routine monitoring activity, this has brought this particular issue into focus.

This 100,000-200,000 figure is used as the best estimate of the impact of fraudulent activity on the system. The report further states that this reported recycling tonnage would have dropped out of the system in 2011 and 2012.

Looking at the base years for calculation of the impact of packaging targets announced in 2012, the reported recycling associated with PRN issuance in the relevant years was 1,658,467 tonnes in 2009, and 1,647,917 in 2010[9]. Taking into account the estimates of the fraudulent PRN issuance, the actual recycling tonnage is 100,000-200,000 tonnes lower (details in Annex 2). Taking the midpoint as the best estimate, the real tonnage of glass being recycled was 1,508,467 tonnes in 2009 and 1,497,917 in 2010, which is 150,000 lower than previously reported.

[8] Glassflow report p.v

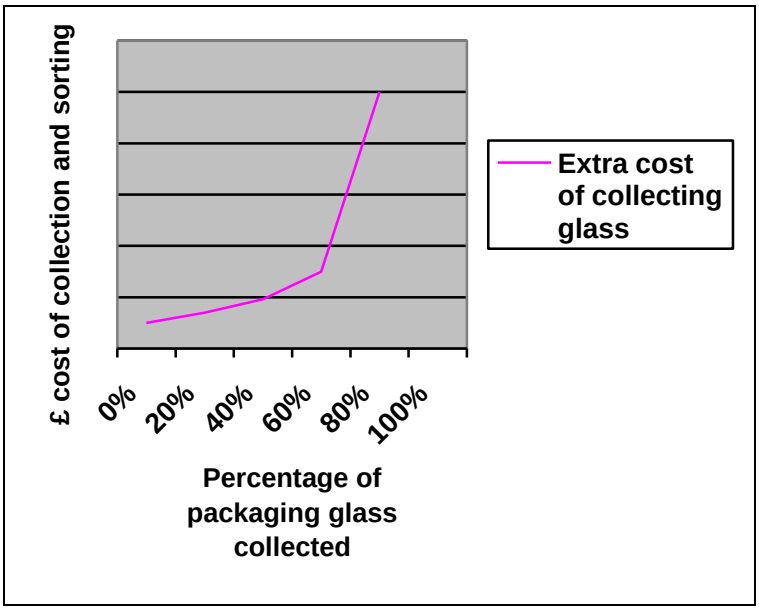
[9] This is the actual recycling that was undertaken in the relevant years. Each year recycling can be carried over from the previous year so the total recycling recorded in a particular year can he higher than the actual recycling. Further detail of actual recycling and amounts carried over is in Annex 2

Following the discovery of the fraud, but no change to the business target, the actual tonnage of recycling of glass needed to significantly increase in order to meet the targets in the subsequent years. Comparing the tonnage of glass required to be recycled in 2011-2013 to 2010, based on the existing business targets and the actual recorded obligated tonnage, the increase was +17% in 2011, +11% in 2012 and estimated +9% in 2013[10]. This is much higher than the expected 1% increase resulting from flat business targets and a 1% estimate growth in obligated tonnage. For simplification, Table A3 shows the effect of the fraudulent activity ceasing at the end of 2010. The Glassflow report states that it expects the activity to have dropped out of the system in 2011 and 2012 so it is likely that the full impact may not have taken effect until 2012.

The discovery of fraudulent activity has shown that the real baseline for the analysis for Packaging Targets 2013-17, which was based on actual 2010 data, was an estimated recycled glass amount of between 1,447,917 to 1,547,917 tonnes rather than the reported recycling tonnage of 1,647,917. The analysis for packaging targets 2013-17 indicated that increasing the glass business targets above 81% was not beneficial as the extra costs of collecting and sorting additional tonnage would rise to a level that was higher than the benefits of increased recycling[11]. Given this evidence it would be net beneficial to lower the amount of glass recycling if possible.

The impact of the discovery of the fraudulent activity resulted in a significant increase in effort to collect and sort the extra glass required to meet obligated targets in subsequent years compared to the situation in 2010. As more and more glass needs to be collected and sorted, it is likely that costs start to rise. The extra, or marginal, cost of collecting a material can rise quite rapidly as it becomes more scarce. A typical marginal cost curve for glass is depicted in Figure 1. We do not have sufficient evidence to accurately plot a marginal cost curve for collecting different percentages of glass at any point in time. Changes in many factors, including household behaviour and infrastructure scale can significantly affect this cost profile over time. Costs also differ according to geographical location and concentration of households. Higher rates of recycling are achieved in other Member States. The current evidence base for the UK indicates that a higher rate is not net beneficial for the UK.

Figure 1: Example of the possible shape of the cost curve for collection and sorting cost for glass



[10] Table A3, Annex 2

[11] Final impact assessment Packaging targets, Annex 4, costs of collection and sorting https://www.gov.uk/government/consultations/recovery-and-recycling-targets-for-packaging-waste-for-2013-2017

Costs and benefits of recycling

Costs and benefits are calculated for each additional tonne of recycling as per Porter ("The Economics of Waste", 2002) and it assumed the material is diverted from landfill.

1. The **additional tonnes of each material are calculated**, depending on the targets and projected tonnages.
2. The benefits per tonne are: the **material revenue** and the **value of the carbon benefit**;
3. The costs per tonne of each material are the additional costs of recycling (**collection and sorting costs** minus **savings in residual waste costs**)

There are additional environmental impacts such as disamenity impact of landfill sites. However the alternative treatment, recycling also incurs local environmental impacts. In the absence of accurate information on those impacts, the local disamenity impacts are described qualitatively but are not monetised. It is assumed that the local environmental impact of both a landfill site and a sorting facility for glass is likely to be negative.

Costs and benefits are per tonne.

The Social NPV is calculated as:

Additional tonnes x benefits of material (material prices & carbon)

– additional tonnes x costs of material (additional recycling collection costs, compared to residual route)

for each material.

(1) Updating collection and sorting costs

The final impact assessment for packaging targets 2013-17 estimated the overall collecting and sorting costs of glass for recycling to be £96 per tonne on average over the 5 year period, with an increase to £103 per tonne for separate glass collection and £62 per tonne for mixed glass collection (see Annex 4 of the IA). These costs estimated in 2012 were based on an assumption that 1,649,571 tonnes of glass was collected and recycled in 2010, the last year of fully available data. We now know that the cost figures actually corresponded to a smaller amount of glass being collected and sorted (estimated 1,499,571 tonnes). Estimates from correspondence with WRAP indicate that the current cost of separately collecting from households may not have changed much. The costs of collecting C&I mixed glass have increase from £36 per tonne to £44 and separate collection is £80 per tonne. These figures are used for our estimates but the perceived shortage of glass for recycling at the end of 2012 indicates that the marginal costs of collection may be higher than these estimates.

In the original packaging impact assessment in 2012, the assumption for collection from household to C&I was 45:55[12]. Given the relatively small amount of glass packaging from non consumers (601kt compared to 1,798kt from consumers[13]), and assuming equal effort to collect from both sources, it is assumed extra collected glass is more likely to be from households than C&I. The estimated tonnage of glass not recycled in 2012 was 282kt for non-consumer and 490kt for consumer[14]. On this basis, assuming equal increase in collections from both sources,

[12] Packaging Impact Assessment 2012, Annex 4

[13] Source: Glassglow report p.104

[14] Glassflow p.38

at the margin, the cost of collection is estimated to be around 65% household and 35% C&I[15]. This split is applied to the separate figures for household and C&I and gives an updated £70 gross cost of collection for mixed glass and £101 for C&I. The growth in co-mingled collections also indicates that there are extra sorting costs required for glass to be sent to remelt. These are estimates only and further information is being sought at consultation.

Table 2: Updated collection cost estimates (2013 prices)

Updated glass collection costs	HH	C&I	Average based on a 65:35 HH to C&I ratio	Previous estimate for flat targets
Mixed	£107	£44	£70	£62
Separated	£113	£80	£101	£103

Source: WRAP

Although PRN prices are affected by many factors, it is possible that the recent increase in PRN prices is an indication of the increase in costs of delivering glass recycling. Reported glass PRN prices were fairly low in 2011, with the price steady between £6 and £13 over the year. In 2012, however, the glass PRN spot price rose steadily from £9-12 in January to £75 in December[16]. As shown in Table 3, the total tonnage required in 2012 was 11% higher than that in 2010. If we assume that all reprocessors and exporters face the same cost profiles, the price of PRNs should reflect the marginal costs and reprocessors and exports do not make excess profits. However if reprocessors and exporters do not face the same cost curves, then low cost businesses, or those than can access low priced recovered material will make higher profits.

The trend has continued in 2013. The target for glass was split into remelt and aggregate end use in 2013. The related PRNs are currently £40-45 for aggregate and £67-71 for remelt (September prices)[17]. In 2012, PRN revenue for glass was £44.5m. This compares to £14m in 2011 and £21m in 2010. Of the £44.5m PRN revenue in 2012, £7.5m was spent on infrastructure and capacity and £15.6m was spent on funding collection[18]. This investment may be expected to result in more efficient infrastructure and may possibly lower costs in the future.

Given the current higher marginal costs of collecting glass, and assuming some PRN revenue may be used to alleviate collection and sorting constraints, the costs of collection and sorting could be expected to fall over time. It is estimated that investment in infrastructure could feed through in the following year. This is based on information that it takes 12 to 18 months for a new sorting line to be installed. This assumption is being tested at consultation. Assuming the costs fall back to the levels in the previous IA and costs are assumed to be flat in real terms, the updated assumptions are shown fully in Annex 2.

It is assumed that glass that is not collected for recycling is sent to landfill. Therefore the net cost or benefit of collecting and recycling an extra tonne of glass is the extra cost of collection net of the resource cost savings of reduced waste to landfill. The latest WRAP gate fees report has a median non hazardous gate fee of £21[19]. This is within the 5 year range assumed for gate fees and therefore is unchanged. The mixed waste collection costs were based on modelling[20] are also assumed to remain unchanged. All figures are uprated to 2013.

[15] The actual percentages are 37% non consumer and 63% consumer share of remaining glass to landfill in Glassflow which are assumed to approximately indicate the split between C&I and household, acknowledging the definitional differences.

[16] Let's Recycle PRN price archive

[17] Let's Recycle PRN prices

[18] Source: NPWD, EA

[19] http://www.wrap.org.uk/content/wrap-gate-fees-report-2013

[20] Eunomia Landfill Bans model 2010

Updated costs and benefits: material revenue and carbon impact

The benefits of recycling an extra tonne of glass are the value of the recovered material and the avoided carbon emissions from not sending a tonne of glass to landfill and avoiding virgin material production. Recovered colour separated glass prices are currently £20-£45 per tonne (estimate of £24 over 5 year period in Packaging Targets IA) and mixed glass is £5-£25 per tonne (estimate of £5 over same period)[21]. Over the past 5 years, the highest mid-price for clear remelt has been £37.50 and for £17.50 for aggregate. This has been in the last year when PRN prices have been very high. Therse prices reflect recovered glass from a MRF, which is the higher proportion of household collected glass. There is a difference in price for recovered glass depending on the source from a MRF or kerbside sort[22]. Further information will be sought at consultation, but there seems to be insufficient evidence at this stage to change these assumptions.

The carbon impacts remain as indicated in the Scottish Carbon Metric in Annex 4 of the Packaging Final Impact Assessment. Carbon impacts are valued in accordance with HMT Green Book guidance[23]. Updated traded carbon prices (detailed in Annex 2) have fallen significantly over the period (from £23 per tonne in the 2012 IA to £3.49 in 2013[24] in this analysis) so the monetised carbon benefit of diverting a tonne of glass from landfill to remelt has reduced by over 80% from £9.32 to £1.91in 2013. The impact of changes to carbon prices is covered in the summary section below.

There are additional energy benefits to producing glass from cullet (recovered glass) rather than raw materials. As glass producers pay their energy bills directly, it is assumed that the differential in costs arising from energy use will be taken into account when deciding on prices to pay for material inputs. This assumes that firms make efficient decisions on production choices. As glass producers are covered by EU ETS[25], it is also assumed that the greenhouse gas impact associated with the energy use is also taken into account in decision-making.

Summary of costs and benefits of counterfactual

The consultation impact assessment for Packaging Targets in 2011 noted that the carbon benefit and the higher material revenue (net £19 per tonne) were not sufficient to offset the increase in collection costs. Further evidence was sought at consultation. The split target was supported by industry and adopted with option 3a. The information at this stage does not seem to have changed this situation. Further information will be sought at this consultation.

The summary of the estimated costs and benefits of additional material recovery are in Table 3 below. An updated median gate fee for landfill is £21[26], taken from the WRAP gate fees survey. There is a wide range around this figure, but the median is used as the best estimate. It shows that there has been an increase in the cost of additional recycling over the period, but that the material revenue is unchanged.

[21] Source: Let's Recycle, September prices

[22] WRAP also publishes prices as part of its Materials Pricing Report. In the third week of October: the prices for mixed glass ranged from £20 to £37 per tonne and the prices for colour separated glass ranged from £22 to £38 per tonne. http://www.mrw.co.uk/Journals/2013/10/29/g/l/o/MPR-October-week-4.pdf There is a difference in mixed glass prices between the MPR and Let's Recycle. The mixed glass price in the MPR presents a range reflecting more kerbside sort while Letsrecycle more from a MRF. It is clarified in the MPR material specs on the MPR page what we are showing while recognising that lower quality mixed material is £10-£20 per tonne cheaper

[23] Supplementary guidance provided by DECC https://www.gov.uk/government/collections/carbon-valuation--2

[24] DECC https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/240095/short-term_traded_carbon_values_used_for_UK_policy_appraisal_2013_FINAL_URN.pdf

[25] Correspondence with British Glass

[26] WRAP Gate Fees Report http://www.wrap.org.uk/content/wrap-gate-fees-report-2013

Table 3: Key assumptions for glass recycling, 2013 prices

Key assumptions 2013 prices	Mixed	Separated
Marginal glass collection costs	£70.00	£101.00
Carbon factor (traded)	0.19	0.38
Carbon factor (non traded)	0.01	0.01
material revenue	£5.00	£24.00
Black bag collection costs (2012 prices inflated to 2013)	£38.80	£38.80
landfill gate fee (updated)	£21.0	£21.0

Source: WRAP, Packaging IA 2012

Under the current assumptions for the counterfactual, diverting a tonne of glass to either recycling or remelt is a net cost. The cost of diverting a tonne of waste from landfill to recycling is greater than the combined monetised benefits of increased material revenue and carbon savings. A rise in the average material price for remelt from £24 to over £41.50 would shift the balance to a net benefit. For aggregate, we would need to see an increase from in aggregate prices from £5 to over £8.90. An increase in the traded carbon prices used in the analysis could also reduce the net cost. The short term trade carbon price would need to rise to above £13 for it to be net beneficial to recycle aggregate and over £92 for it to beneficial to recycle glass to remelt. Short term traded carbon prices could increase in a scenario with a more ambitious cap on the EU ETS. A combination of a smaller rise in both carbon traded prices and material price could result in it being net beneficial to recycle glass at this level. For example, an increase in the material price of 65% and an increase in the short term traded carbon of 50% would deliver a net benefit of recycling glass to both remelt and aggregate.

Landfill Tax impacts are calculated and detailed in the Annex, but as the tax is a transfer and does not have an impact on net costs and benefits it is not included in the analysis tables.

Non monetised impacts may also alter the net impacts. Other environmental impacts such as local amenity impacts from diverting a tonne of glass from a landfill facility to a sorting facility are not monetised. It is possible that some of the disamenity impacts may offset one another.

Table 4: Net impact of glass recycling under updated assumptions, 2013 prices

£ 2013 prices	Remelt	Aggregate
Collection and sorting for recycling	-101.5	-70.0
Change in landfill cost (collection and gate fee)	59.8	59.8
Material revenue	24.0	5.0
Carbon impact (2013 prices)	1.9	1.2
Total net impact per tonne	-15.7	-3.9

Source: WRAP, DECC, estimates

Updated PRN price estimates

The previous impact assessment estimated an average PRN price of £22 over the 5 years of analysis. The average price achieved in 2012 was £25.50[27]. Spot prices in 2013 have

[27] Source: NPWD

remained at high levels, between £45 and £71[28]. Assuming the increased PRN revenue in 2013 will reduce the costs of collecting and sorting, it is possible that the PRN price could fall back to £22 in later years. However, taking into account the current high level, unless the price falls to a very low level for 18 months to 2 years, the average PRN price 2013-17 is unlikely to be £22. PRN prices are driven by many factors and it is very difficult to estimate an average price. Table 7 below shows a best estimate of a price range over the period, taking into account a potential reduction in collection and sorting costs in 2014 may alleviate some supply pressure on PRNs. Further views on this will be sought at consultation.

Table 5: PRN estimates for 2013-17

PRN prices	Previous IA assumption	Current price	Average price 5 years 2013-17
PRN price aggregate	22	42.5	40
PRN price remelt	22	69	45

Source: Packaging IA 2012

Change in estimates to glass packaging placed on market

Recent evidence from the Glassflow project indicates that the actual amount of packaging glass being placed in the market is significantly lower than the projections used in setting the 2013-17 targets. The GlassFlow report has gone back to first principles and produced a new estimate of glass packaging waste arisings based on a thorough and detailed analysis of the glass market. The data used in the report to estimate glass packaging consumption has been cross-checked with alternative sources where available, and is deemed reliable, robust and the best available. The flow figures used in the previous impact assessment were verified during consultation and the final figures were unchanged as there were no comments were received regarding the possible inaccuracy of any data in response to that consultation. Although this new research is also subject to uncertainty, the involvement of industry experts and the comprehensive nature of the analysis results in this being the most detailed research currently available. The Glassfow report includes an estimate of illegal glass packaging. Illegal glass packaging is not included in the analysis here as it is not taken into account when setting business targets for obligated producers which are clearly operating as legitimate businesses. Additional evidence on the flow of glass packaging will be sought at consultation.

At the time of the Packaging Targets analysis in 2012, the trend in change in packaging placed on the market (the 'flow' figure) and the amount of obligated packaging had been similar. It was assumed that these trends would continue and both would rise by 1% a year, as estimated by Packflow. These figures are indicated in Table 1.

Data from 2011-13 shows that the obligated tonnage, and so the total obligation, has not actually risen steadily by 1% over the period, but has in fact fallen over the period. Table A6 in Annex 2 shows there has been a drop of 2% in reported obligated tonnage in 2013 (2,007,210t compared to 2,049,180t in 2012). The reasons for the drop in tonnage has been partly been attributed to the light-weighting and substitution of glass packaging. The recent high glass PRN prices may have also incentivised businesses to reduce the amount of glass packaging that is handled.

If this trend continues, the counterfactual for obligated tonnage is unlikely to be 1% growth over the period 2013-17. The analysis in the Glassflow report estimates flat growth on the basis of the trends in packaging away from glass. It would be prudent to lower this growth to at least a

[28] Source: Let's Recycle, October 2013

flat growth rate. This assumption is being tested at consultation and will be revised in the light of any new evidence.

The counterfactual for the tonnage of glass packaging that needs to be recycled is therefore the updated estimate of the obligated tonnage remaining at a flat level over the 2013-17 period, multiplied by the business target (81%) as shown in Table 6. Small businesses may choose the allocation method to determine their recycling obligations. This is a method that avoids the cost of identifying and calculating the amount of packaging handled and uses the turnover of the business to calculate a tonnage of glass recycling that is required or 'allocated' to the small business. This is a very small percentage of the total recycling tonnage but is taken into account here for completeness. In 2013, 5,396 tonnes of glass recycling will occur through the allocated method. This is 0.3% of the 1,631,236 tonnes which will be recycled through the obligated tonnage (81% x obligated tonnage). The allocated tonnage has ranged between 3,000 and 6,000 over the past 5 years so using an average of the past 3 years, the allocated tonnage is assumed to be 5,576[29] for 2014-17. Taking into account the reported glass recycling that will occur through businesses choosing the allocation method, the total obligated tonnage of recycling is calculated in Table 8 below. The targets from 2013 are split into remelt and aggregate. The splits and resulting tonnages are also shown below.

Table 6: Updated counterfactual for glass recycling tonnage

	2013	2014	2015	2016	2017
Tonnage of glass obligated (actual in 2013, estimated 2014-17)	2,007,210	2,007,210	2,007,210	2,007,210	2,007,210
Current business targets	81.0%	81.0%	81.0%	81.0%	81.0%
Remelt	63.0%	63.0%	63.0%	64.0%	64.0%
Aggregate	37.0%	37.0%	37.0%	36.0%	36.0%
Total tonnes of obligated glass recycling though existing targets on obligated tonnage	1,625,840	1,625,840	1,625,840	1,625,840	1,625,840
Tonnes of obligated glass recycling through allocation method	5,396	5,576	5,576	5,576	5,576
total tonnes of obligated glass recycled through existing targets	1,631,236	1,631,416	1,631,416	1,631,416	1,631,416
Of which remelt	1,024,279	1,024,279	1,024,279	1,040,538	1,040,538
Of which aggregate (allocated tonnage assumed to go to aggregate)	606,957	607,137	607,137	590,878	590,878

Source: NPWD

Taking into account the new estimated 'flow' figures[30], Table A7 in Annex 2 shows we have actually achieved a much higher recycling rate for glass than current statutory requirements. The counterfactual for 2013-17 shows that the recycling rate will also remain high at an estimated 68% which is significantly above the 60% minimum EU requirement.

Given the comfortable margin of exceeding the UK's EU targets, it is possible to lower the business targets, recycling a lower total tonnage of glass and still meet our statutory and EU

[29] Average of 5,808t in 2011, 5,524t in 2012 and 5,396 in 2013.

[30] Glassflow Report

targets. The costs and benefits of lowering the business targets and changes to the split between remelt and other applications are considered below.

Option 2a: Lower the glass packaging business recycling targets to 75% and maintain the split between remelt and other applications at the same percentages.

The sensitivity of overall recycling achievement compared to business targets based on the new Glassflow figures is set out in Table A7 in Annex 3. It shows that setting the business target at 75% would achieve an estimated 63.0% UK recycling rate. This is a 62.6% rate when the allocated tonnage is deducted and is a similar recycling rate[31] to the analysis used to determine the 81% business target in the Packaging Targets 2013-17 impact assessment. Setting the business target at a lower rate than 75% would result in a greater risk of missing EU targets should the obligated tonnage trend differ significantly from the overall glass flow trend. Obligated tonnage needs to fall by 4% relative to the overall flow for a business target set at 75% to miss EU target (assuming businesses fulfil their obligations).

The expected new tonnages of recycling required are shown in Table 7, using the new business targets of 75% and the latest obligated tonnage figure reported by businesses for the 2013 year. This shows there is a significant reduction in recycling tonnage required from the previous target and flow assumptions from 1,631,416 estimated on business targets of 81% to a fall of 120,433 to 1,510,984 on the assumption of 75% business targets.

Table 7: Obligated glass recycling tonnage based on new business targets

	2013	2014	2015	2016	2017
Obligated Glass tonnage (based on 2013 actual data and revised 0% growth rate)	2,007,210	2,007,210	2,007,210	2,007,210	2,007,210
Allocated tonnage	5,396	5,576	5,576	5,576	5,576
New business targets		75%	75%	75%	75%
Remelt		63%	63%	64%	64%
Aggregate		37%	37%	36%	36%
Total tonnes of glass recycled through new business targets and flow figures		1,505,408	1,505,408	1,505,408	1,505,408
Total tonnes of glass recycled through new business targets and flow figures including allocated tonnage		1,510,984	1,510,984	1,510,984	1,510,984

The reduction in separated and mixed tonnages for remelt and aggregate end use are also shown. For option 2(a), the split is assumed to remain as set out in the regulations, that is 37% aggregate and 63% remelt for 2014 and 2015 and then 36% aggregate and 64% remelt for the subsequent 2 years. Table 8 shows applying these percentages to the new obligated recycling tonnage results in a significant reduction in the required recycling of glass for both aggregate and remelt. The analysis and underlying remelt and aggregate glass figures are in Annex 3.

[31] It was calculated that a business target of 81% would achieve a 62.1% recycling rate, not taking allocated tonnage into account.

Table 8: Resulting glass tonnages from new business targets and impact on total recycling activity by end-use

Change in glass to be recycled from new 75% business target and updated flow figures (Option 2a)				
	2014	2015	2016	2017
Total change in glass recycled (t)	- 120,433	- 120,433	- 120,433	- 120,433
Change in glass to remelt (t)	- 75,873	- 75,873	- 77,077	- 77,077
Change in glass to aggregate (t)	- 44,560	- 44,560	- 43,356	- 43,356

Taking into account the costs and benefits described in the counterfactual, the reduction in tonnage is expected to lead to a net benefit (it is assumed that at the margin, the packaging targets incentivise a shift from landfill to recycling). As the analysis in the counterfactual has shown, the current level of recycling results in a net cost to society.

The benefit of diverting a tonne of glass from landfill to recycling is described in the counterfactual and shown again below:

Additional tonnes x benefits of increased recycling (material prices & carbon) – additional tonnes x costs of diverting material to recycling (additional recycling collection costs, compared to residual route)

With a reduction in the tonnage of glass recycling, the reverse will be calculated, i.e .the benefit of reduced collection and sorting costs will be offset by reduced revenue from the recovered material and increased greenhouse gas emissions (from reduced recycling and an assumed increase in virgin material production)[32]. Other impacts such as local disamenity impacts are not monetised in this analysis due to insufficient information on local environmental impacts.

For each tonne of glass not recycled, the impacts are calculated as follows:

Net reduction in collection costs	Reduction in collection for recycling (Table 2), net of black bag collection costs and landfill gate fees (Table 3 and Annex 2)
Reduction in greenhouse gas impacts	Carbon factors (Table 3) multiplied by carbon prices (Annex 2)
Reduction in material revenue	Material revenue per tonne (Table 3)

The breakdown for remelt and aggregate tonnages are detailed and summarised in Annex 3. Overall the reduction in recycling tonnage to remelt is expected to reduce costs by £3,613,268 PV and the reduction in recycling tonnage to aggregate by £616,238 PV. This is a total impact of £4,229,506 PV.

Impacts by affected party

Table 9 shows the impact by affected parties. It is assumed the split between household and business collections is 65:35 as described in the counterfactual. Taking this split, local

[32] Further details in Annex 2

authorities save £8.2m PV from no longer having to collect and sort household glass packaging but can send it to landfill instead. Local authorities will however have an additional cost of landfill tax for the 120,433 tonnes of extra glass that is assumed to go to landfill. This cost is not included in this summary of the net impact as the landfill tax is a transfer and does not affect the cost benefit analysis. Further details are in in Annex 3.

There are significant distributional impacts on businesses. Overall businesses benefit from no longer having to pay the collection costs of diverting waste from landfill (£4.4m PV) but will also no longer benefit from material revenue from recovered material (£7.5m PV). Businesses in general will benefit from no longer having to divert waste from landfill to recycling by the £5.5m PV. Reprocessing businesses will no longer receive material revenue of £7.5m PV. The net impact to business of £7.5m - £4.4m,which results in a net cost of £3.1m.

There will no longer be environmental benefits of avoided carbon emissions from recycling of £-0.8m. Other environmental impacts such as local disamenity costs are not monetised. In total the net benefit of the policy is £4.2m. As noted, the impact of the Landfill Tax is not taken into account in this analysis as it is a transfer payment.

This policy is expected to incur minimal transition costs as obligated tonnage needs to be calculated on an annual basis and in many cases is handled by compliance schemes. This change should require simply applying a different business target to the calculated tonnage obligation in each year. Compliance schemes and large businesses that calculate their own obligation are assumed to be frequent users of the National Packaging Waste Database system which has all the up to date information on it.

Table 9: Summary of impacts by affected party, Present Value

Annual impact of policy(PV) 2013 prices	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
Benefit of reduction on collection and sorting costs		3,453,675	3,124,401	3,049,159	2,946,048	12,573,283
of which savings to LAs £		2,245,485	2,031,400	1,982,480	1,915,440	8,174,804
of which savings to business £		1,208,190	1,093,001	1,066,679	1,030,608	4,398,479
Cost of CO2 increase £		-198,278	-195,506	-199,223	- 203,368	- 796,375
Cost of material revenue that business does not receive £		-1,974,629	- 1,907,854	-1,863,976	- 1,800,943	- 7,547,402
Total £		**1,280,768**	**1,021,041**	**985,960**	**941,737**	**4,229,506**

PRN impacts

With lower targets and a correspondingly lower tonnage of glass recycling, it is expected that the average PRN price over the period would return to £22 as estimated in the Packaging Impact assessment published in 2012. The PRN cost is a transfer between obligated producer of glass packaging and reprocessors or exporters and results in no net impact on business NPV. The impacts are shown here for distributional purposes and are shown as both a gross cost and a gross benefit to businesses.

The impact of the changes to PRN costs for remelt and aggregate for each year is calculated as:

PRN price in counterfactual x tonnage reduction
Plus Change in PRN price x new obligated tonnage

This is calculated as a total of £148.7m (£136.5m PV) over 4 years of which £101.7m relates to the impact of a reduction in remelt tonnage and £47.0m relates to the reduction in aggregate tonnage. Further details of the underlying calculations are in Annex 3.

Table 10: Summary of PRN impacts

£	2014	2015	2016	2017	Total
Total change in PRN costs for remelt and aggregate	- 37,136,403	- 37,136,403	- 37,217,695	- 37,217,695	- 148,708,197
Total change in PRN costs for remelt and aggregate PV	- 35,880,583	- 34,667,230	- 33,568,229	- 32,433,071	- 136,549,113

Taking this as a reduction in costs to obligated businesses and a reduction in revenue to reprocessors and exporters, the net impact will be zero and therefore it does not affect the net figures in the analysis. The gross impact is a net benefit to business of £153.5m over the period, but a cost of £156.9m resulting in a net cost to business of £3.4m (£3.2m PV). The impact on business is sensitive to the assumption on the split between household and C&I collection and an assumption of 40:60 household to C&I collection would result in a switch to a net benefit to business (with resulting reduction in benefit to LAs).
The EANCB on 2009 prices is calculated as £0.68m.

Table 11: Total business impact, 2013 prices

Business Impact		2014	2015	2016	2017	Total
Savings in collection costs	-	1,250,477	1,170,850	1,182,647	1,182,647	4,786,620
Reduced PRN costs	-	37,136,403	37,136,403	37,217,695	37,217,695	148,708,197
Total benefits to business		38,386,880	38,307,253	38,400,342	38,400,342	153,494,817
Material revenue that business does not receive £	-	- 2,043,741	- 2,043,741	-2,066,623	- 2,066,623	- 8,220,729
PRN revenue no longer received	-	- 37,136,403	- 37,136,403	- 37,217,695	- 37,217,695	-148,708,197
Total costs to business		- 39,180,145	- 39,180,145	- 39,284,319	- 39,284,319	-156,928,927
Net impact		- 793,264	- 872,891	- 883,977	- 883,977	- 3,434,109
Net impact (PV)		- 766,439	- 814,853	- 797,296	- 770,335	- 3,148,923

As the impacts are distributed through the supply chain for recycling, the costs and benefits will fall on different business groups. The net impact of the reduction in recycling leads to a net benefit overall as there are reduced costs to local authorities of £8.9m resulting in a total gross benefit of £161.7m which is greater than the overall costs of £157.8m (costs to business of £156.9m and the reduced greenhouse gas emissions of £0.9m).

Option 2 (b) Lower the glass packaging recycling targets to 75% and amend the split between remelt and other applications.

The Regulations introduced in 2012 split the glass target by end use. The end-use of recycled glass determines the benefits per tonne. Glass with an end-use of re-melt (i.e. recycled into containers) has a much higher carbon benefit than a tonne of glass recycled into aggregates (see table below). This was around £8/tonne carbon benefit for glass recycled back into glass in 2011. Updated carbon prices have reduced the benefit to a lower amount of £1-2. There is a lower carbon benefit for glass recycled into aggregates.

Table 12: Relative carbon benefits of a sample of recycling method

1 tonne of...	**Saves...**
glass recycled into containers	0.263-0.315t of CO_2eq
glass recycled into aggregates	on average 0

The analysis in 2012 was based on maintaining the current split between glass going to remelt and aggregate and then steadily increasing the proportion to remelt. Although analysis showed that shifting the percentage to remelt was not net beneficial, the split targets were supported by responses to the consultation and were adopted in 2013. There may be additional benefits from a higher level of recycling that are not reflected in the monetised figures such as security of supply. The additional costs of collection and sorting were not fully offset by the higher material revenue and environmental benefit of a reduction in greenhouse gas emissions. The current marginal impact of shifting a tonne of material from aggregate to remelt is estimated to be around -£11 based on the marginal cost of collecting and sorting a tonne of glass for remelt (extra £31) compared to the additional material revenue £19 and additional 0.2 tonnes of avoided CO_2e (extra £0.70)[33]. This is higher than in 2011 due to the change in collection costs and carbon prices. If we assume that the total tonnage falls back to the levels of around 1.5mt as described in option 2 and similar to the actual level of recycling in 2011, then the impact of a shift on collection costs could be assumed to be lower (from £96 average cost to £103 marginal cost in 2011 prices)[34]

As the detected fraudulent activity was in aggregate glass, and the original split in targets was based on the reported recycling split, a new split target could be set by adjusting the aggregate amount by the estimated fraudulent activity. In the consultation for packaging targets in 2012, the tonnage of aggregate recycling delivered by the EU minimum would be 690,000 in 2013[35]. Assuming the estimate of fraudulent activity (100,000-200,000t) relates to aggregate recycling, and assuming the undetected fraud that was stopped as a result of greater risk of detection, the actual tonnage of aggregate glass recycling was around 490,000 to 590,000 with a best estimate at 540,000. Using this as the basis for determining a suitable split between aggregate and remelt gives the following splits[36] over the period as in Table 13:

Table 13: splits for option 2 (b)

New split for business targets	**2014**	**2015**	**2016**	**2017**
Remelt	65%	65%	66%	66%
Aggregate	35%	35%	34%	34%

[33] Using £3.49 as price of traded carbon in 2013 prices; see Annex 2

[34] Packaging Targets final impact assessment, Annex 4, p.24

[35] Table A14, p.71 (link to consultation IA)

[36] 540k/1.551k=35%

This split would not change the total amount of recycling, but would change the reductions in type of recycling compared to option 2(a). The resulting change in tonnages are illustrated below in Table 14. The reduction in aggregate tonnage is higher than in option 2(a) due to the lower percentage split for aggregate

Table 14: Glass tonnages resulting from option 2(b)

Change in obligated glass to be recycled from new targets and flow figures (Option 2b)					
	2013	**2014**	**2015**	**2016**	**2017**
Total change in obligated glass recycled (t)		- 120,433	- 120,433	- 120,433	- 120,433
Change in obligated glass to remelt (t)		- 51,324	- 51,324	- 52,528	- 52,528
Change in glass to aggregate (t)		- 69,109	- 69,109	- 67,905	- 67,905

The benefits of a reduction in recycling are calculated in the same way as option 2(a) and the results are shown in Table 15 below. Further details of the underlying calculations are in Annex 3. There is a lower impact from the reduction in obligated remelt recycling tonnage (£2,452,459) and a correspondingly higher impact from the reduction in aggregate recycling tonnage (£960,160) compared to option 2(a). This results in a lower overall net benefit of £3,707,596 (£3.4m PV).

Impacts by affected party

Tables 15 show the impact by affected party. It is assumed the split between household and business collections is 65:35 as described in the counterfactual. Assuming this split, local authorities save £6.5m PV from no longer having to collect and sort household glass packaging but can send it to landfill instead. Businesses benefit from no longer having to pay the collection costs of diverting waste from landfill (£3.5m PV) but will also no longer benefit from material revenue from recovered material (£5.8m PV). The net impact is a net cost to business of £5.8m - £3.5m PV which is a net cost of £2.3m PV. There will no longer be environmental benefits of avoided carbon emissions from recycling of £0.7m PV. In total the net benefit of the policy is £3.4m PV. The impact of the landfill tax is not taken into account in this analysis as it is a transfer payment.

Table 15: Summary of impacts by affected party, PV table, 2013 prices

Annual impact of policy(PV)	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
Benefit of reduction in collection and sorting costs		2,718,392	2,482,733	2,429,190	2,347,044	9,977,359
of which savings to LAs £		1,767,424	1,614,205	1,579,393	1,525,983	6,487,005
of which savings to business £		950,968	868,528	849,797	821,060	3,490,353
CO2 increase £		- 182,099	- 179,526	- 182,732	- 186,215	- 730,572
Material revenue that business does not receive £		- 1,523,972	- 1,472,437	- 1,443,282	- 1,394,476	- 5,834,167
Total		**1,012,321**	**830,770**	**803,176**	**766,352**	**3,412,619**

PRN Impacts

The PRN impacts are analysed in the same way as in option 2(a) with a resulting reduction in PRN costs to obligated producers of £136.5m PV shown in Table 16 which is exactly the same as under 2(a). The split between remelt and aggregate is different, but as the PRN price is assumed to fall back to £22 average over the period for both remelt and aggregate, the overall impact of the same reduction in tonnage will be similar. The underlying calculations are in Annex 3.

Table 16: Summary of impact of PRN costs

£	2014	2015	2016	2017	Total
Total change in PRN costs for remelt and aggregate	- 37,136,403	- 37,136,403	- 37,217,695	- 37,217,695	- 148,708,197
Total change in PRN costs for remelt and aggregate PV	- 35,880,583	- 34,667,230	- 33,568,229	- 32,433,071	- 136,549,113

The total business impact is a gross benefit to business of £152.2m which consists of the reduced PRN costs to obligated businesses and savings in collection costs for general businesses. The costs to reprocessing and exporting businesses of PRN revenue no longer received by reprocessors and exporters and material revenue no longer received is £155.1m. The net impact is a net cost to business of £2.6m (£-2.3m PV). The details are described below in Table 18.
The EANCB on 2009 prices is calculated as £0.51m

Table 17: Total business impact, 2013 prices

Business Impact	2013	2014	2015	2016	2017	Total
Savings in collection costs	-	984,252	930,389	942,185	942,185	3,799,011
Reduced PRN costs	-	37,136,403	37,136,403	37,217,695	37,217,695	148,708,197
Total benefits to business		38,120,655	38,066,792	38,159,881	38,159,881	152,507,209
Material revenue that business does not receive £	-	- 1,577,311	- 1,577,311	- 1,600,193	- 1,600,193	- 6,355,008
PRN revenue no longer received	-	- 37,136,403	- 37,136,403	- 37,217,695	- 37,217,695	- 148,708,197
Total costs to business		- 38,713,714	- 38,713,714	- 38,817,888	- 38,817,888	- 155,063,205
Net impact		- 593,059	- 646,922	- 658,008	- 658,008	- 2,555,996
Net impact (PV)		- 573,004	- 603,909	- 593,485	- 573,416	- 2,343,813

Option 3a: Lower the glass packaging recycling targets to 77% and maintain the split between remelt and other applications at the same percentages.

There are environmental benefits and benefits to reprocessing businesses from additional recovered material. Although the current business targets of 81% are incurring high costs to some businesses, other businesses are beneficiaries of the current situation. In comparison to 2a and 2b, options 3a and 3b would contribute more towards national recycling rates, including the household recycling rate. Using glass recycling to achieve a higher recycling rate is unlikely to be the most cost effective measure given the current estimate of a net cost per tonne of material.

As shown in Table A7 in Annex 3, a 77% business target is expected to result in a recycling rate of 64.7%.

Analysis is carried out in the same way as for option 2. The resulting tonnages are shown in Table 18 with the underlying calculation in Annex 3. The total reduction in tonnage of obligated glass is 80,288 with 50,582 reduction in glass to remelt and a 29,707 reduction in tonnage of glass to aggregate.

Table 18: Resulting glass tonnages from new business targets and impact on total recycling activity by end-use

Change in glass to be recycled from new targets and flow figures (3a)					
	2013	**2014**	**2015**	**2016**	**2017**
Total change in glass recycled (t)		- 80,288	- 80,288	- 80,288	- 80,288
Change in glass to remelt (t)		- 50,582	- 50,582	- 51,385	- 51,385
Change in glass to aggregate (t)		- 29,707	- 29,707	- 28,904	- 28,904

The impact of a reduction in recycling are calculated in the same way as in option 2. As the total reduction in tonnage is lower, there is a smaller reduction in recycling and a lower net benefit from option 3(a) of £2.4m PV from a reduction in remelt recycling tonnage and £0.4m PV from a reduction aggregate recycling tonnage. The total benefit is £2.8m PV as shown in Table 30.

Impacts by affected party

Table 19 shows the impact by affected party. Assuming the same split between household and business collection, local authorities save £5.4m PV from no longer having to collect and sort household glass packaging but can send it to landfill instead. Businesses benefit from no longer having to pay the collection costs of diverting waste from landfill (£2.9m PV) but will also no longer benefit from material revenue from recovered material (£5.0m PV). The net impact is a net cost to business of £5.0m - £2.9m PV which is a net cost of £2.1m PV. There will no longer be environmental benefits of avoided carbon emissions from recycling of £0.7m PV. In total the net benefit of the policy is £2.8m PV. The impact of the landfill tax is not taken into account in this analysis as it is a transfer payment. The Landfill Tax impact is shown in Annex 3.

Table 19: Summary of impacts by affected party, Present Value, 2013 prices

Annual impact of policy(PV)	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
Benefit of reduction in collection and sorting costs		2,302,450	2,082,934	2,032,773	1,964,032	8,382,189

of which savings to LAs £		1,496,593	1,353,907	1,321,302	1,276,621	5,448,423
of which savings to business £		805,858	729,027	711,471	687,411	2,933,766
CO2 increase £		- 132,185	- 130,337	- 132,815	- 135,579	- 530,917
Material revenue that business does not receive £		- 1,316,419	- 1,271,903	- 1,242,651	- 1,200,629	- 5,031,602
Total		**853,846**	**680,694**	**657,307**	**627,824**	**2,819,671**

PRN Impacts

In option 2, the PRN price is assumed to fall back with a reduction in obligated recycling demand. For option 3, as the fall in tonnage of recycling, and therefore PRNs demanded is less than in option 2, it is reasonable to assume the PRN price may be less affected by this option. The PRN price is assumed to fall by proportionately less than in option 2.For example, the fall in option 3a is 33% less than in 2a, and therefore the PRN price is assumed to fall only 66% from the counterfactual. For option 3b, the remelt tonnage does not fall by very much at all and so the PRN price is therefore assumed not to fall by as much.

Table 20: PRN price assumption for option 3

PRN prices	Previous IA assumption	Current price	Average price 5 years	Option 2 average PRN price assumption	Option 3a average PRN price assumption	Option 3b average PRN price assumption
PRN price aggregate	22	42.5	40	22	28	22
PRN price remelt	22	69	45	22	30	40

The PRN impacts are analysed in the same way as in option 2(a) with a resulting change in PRN impacts of £91.0m PV shown in Table 21. The underlying calculations are in Annex 3.

Table 21: Summary of PRN impacts

	2013	**2014**	**2015**	**2016**	**2017**	**Total**
Total change in PRN costs for remelt and aggregate		- 24,754,441	- 24,754,441	- 24,808,585	- 24,808,585	- 99,126,052
Total change in PRN costs for remelt and aggregate PV		- 23,917,334	- 23,108,535	- 22,375,923	- 21,619,249	- 91,021,041

The total business impact is a gross benefit to business of £102.3m which consists of the reduced PRN costs to obligated businesses and savings in collection costs for general businesses. The costs to reprocessing and exporting businesses of PRN revenue no longer received and material revenue no longer received is £104.6m. The net impact is a net cost to business of £2.3m (£-2.1m PV). The details are described below in Table 22.
The EANCB on 2009 prices is calculated as £0.45m

Table 22: Total business impact, 2013 prices

Business Impact	2013	2014	2015	2016	2017	Total
Savings in collection costs	-	834,063	780,952	788,820	788,820	3,192,655
Reduced PRN costs	-	24,754,441	24,754,441	24,808,585	24,808,585	99,126,052
Total benefits to business		25,588,503	25,535,393	25,597,405	25,597,405	102,318,707
Material revenue that business does not receive £	-	- 1,362,494	- 1,362,494	- 1,377,749	- 1,377,749	- 5,480,486
PRN revenue no longer received	-	- 24,754,441	- 24,754,441	- 24,808,585	- 24,808,585	- 99,126,052
Total costs to business		- 26,116,935	- 26,116,935	- 26,186,334	- 26,186,334	- 104,606,539
Net impact		- 528,432	- 581,542	- 588,929	- 588,929	- 2,287,832
Net impact (PV)		- 510,562	- 542,876	- 531,180	- 513,217	- 2,097,835

Option 3 (b) Lower the glass packaging recycling targets to 77% and amend the split between remelt and other applications.

The split between remelt and other applications is calculated using the best estimate of 540,000 tonnes of aggregate glass recycling in 2010. Using this as a basis for determining the split, the Percentage to aggregate in remelt is 34%. The new splits are shown in Table 23 below.

Table 23: Splits for option 3(b)

New split for business targets	2014	2015	2016	2017
Remelt	66%	66%	67%	67%
Aggregate	34%	34%	33%	33%

Using the same methodology for the other options, the resulting glass tonnages are shown below. The fall in the aggregate tonnage is similar to option 2 (b) as the fall from the counterfactual level to the percentage closest to 540,000 tonnes has the same impact. As the total tonnage reduction in this option is less, only 80,288t per year, most of the reduction in tonnage is from aggregate recycling.

Table 24: Resulting glass tonnages from new business targets and impact on total recycling activity by end-use

	2013	2014	2015	2016	2017
Total change in glass recycled (t)		- 80,288	- 80,288	- 80,288	- 80,288
Change in glass to remelt (t)		-11,230	-11,230	- 12,033	- 12,033
Change in glass to aggregate (t)		- 69,058	- 69,058	- 68,255	- 68,255

The impact of a reduction in recycling are calculated in the same way as in option 2. As the total reduction in tonnage is lower, there is a smaller reduction in recycling and a lower net benefit from option 3(b) of £0.6m from a reduction in remelt recycling tonnage and £1.0m from a reduction aggregate recycling tonnage. The total benefit is £1.5m PV. The underlying calculations are in Annex 3.

Impacts by affected party

Table 25 show the impact by affected party. Assuming the same split between household and business collection, local authorities save £2.7m PV from no longer having to collect and sort household glass packaging but can send it to landfill instead. Businesses benefit from no longer having to pay the collection costs of diverting waste from landfill (£1.5m PV) but will also no longer benefit from material revenue from recovered material (£2.3m PV). The net impact is a net cost to business of £2.3m - £1.5m PV which is a net cost of £0.8m PV. There will no longer be environmental benefits of avoided carbon emissions from recycling of £0.4m PV. In total the net benefit of the policy is £1.5m PV. The impact of the landfill tax is not taken into account in this analysis as it is a transfer payment.

Table 25: Summary of impacts by affected party, Present Value, 2013 prices

Annual impact of policy(PV)	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
Net change in collection and sorting costs		1,123,813	1,054,358	1,038,980	1,003,846	4,220,997
of which savings to LAs £		730,478	685,333	675,337	652,500	2,743,648
of which savings to business £		393,335	369,025	363,643	351,346	1,477,349
CO2 increase £		- 106,251	- 104,722	- 106,380	- 108,083	- 425,437
Material revenue that business does not receive £		- 594,029	- 573,941	- 568,291	- 549,074	- 2,285,335
Total		**423,533**	**375,695**	**364,308**	**346,689**	**1,510,225**

PRN Impacts

PRN impacts are calculated as before and the underlying tables are in Annex 3. The summary of impacts is in Table 26 below. The total change in PRN impacts is £66.3m PV which is the lowest of all the options. This differs from the PRN imacts in option 3(a) as the price assumptions for aggregate and remelt PRN differs and therefore the composition of the fall in PRN price (as well as the actual PRN price) result in a different total impact on the PRN price.

Table 26: Summary of PRN impacts

	2014	2015	2016	2017	Total
Total change in PRN costs for remelt and aggregate £	- 18,164,556	- 18,164,556	- 17,973,319	- 17,973,319	- 72,275,750
Total change in PRN costs for remelt and aggregate £ PV	- 17,550,296	- 16,956,807	- 16,210,904	- 15,662,709	- 66,380,716

The total business impact is a gross benefit to business of £73.9m which consists of the reduced PRN costs to obligated businesses and savings in collection costs for general businesses. The costs to reprocessing and exporting businesses of PRN revenue no longer received and material revenue no longer received is £74.8m. The net impact is a net cost to business of £0.9m (£-0.8m PV). The details are described below in Table 27.
The EANCB on 2009 prices is calculated as £0.18m.

Table 27: Total business impact, 2013 prices

Business Impact £	2013	2014	2015	2016	2017	Total
Savings in collection costs	-	407,101	395,309	403,178	403,178	1,608,766
Reduced PRN costs	-	18,164,556	18,164,556	17,973,319	17,973,319	72,275,750
Total benefits to business		18,571,657	18,559,865	18,376,496	18,376,496	73,884,515
Material revenue that business does not receive £	-	- 614,820	- 614,820	- 630,075	- 630,075	- 2,489,789
PRN revenue no longer received	-	-18,164,556	-18,164,556	-17,973,319	-17,973,319	- 72,275,750
Total costs to business		- 18,779,376	- 18,779,376	- 18,603,394	-18,603,394	- 74,765,539
Net impact		- 207,719	- 219,511	- 226,897	- 226,897	- 881,023
Net impact (PV)		- 200,694	- 204,915	- 204,648	- 197,728	- 807,986

Summary:

There is a difference between the options based on net present value and the net present value to business. There are also significant distributional impacts on business.

The net benefit of option 2(a) is £4.23m PV which is higher than the net benefit of all the other options and on that basis could be considered the preferred option. However, on an assessment of the net cost to business, option 2(a) could be the least preferred option due to the net cost to business of £-3.15m which is the highest negative NPV to business. Table 28 shows an assessment of the NPV, impacts on business and PRN impacts.

Table 28: Summary of options, 2013 prices

Summary of options	Option 2(a)	Option 2(b)	Option 3(a)	Option 3(b)
Change in obligated tonnage recycling	-120,433	-120,433	- 80,288	- 80,288
Reduction in obligated remelt tonnage	- 75,873	- 51,324	- 50,582	-11,230
Reduction on obligated aggregate tonnage	- 44,560	- 69,109	- 29,707	- 69,058
NPV £m	4.23	3.41	2.82	1.51
NPV to business £m	- 3.15	- 2.34	- 2.10	- 0.81
Change in PRN impacts £m	148.71	148.71	99.13	72.28

The business NPV is negative in all options which reflects the impact of reduced recycling on recovered material revenue. The chain of activity in recycling is complex and the impact of these proposals has distributional impacts. For obligated businesses, this will significantly reduce their costs of complying with the obligations. Reprocessors and exporters will see a correspondingly significant fall in their revenues. These businesses will, however still receive the PRN revenue for all the existing recycling.

As stated in the executive summary, the UK Government does not have a preferred option. We therefore welcome views from respondents on which option is most

desirable and the reasons why. We would also welcome any further evidence and comments on the analysis provided especially regarding the data which underpins the targets and impacts on the costs/benefits.

The UK Government's overarching aim is to have appropriate targets which ensure that the UK complies with the EU Packaging Directive targets whilst maximising the benefits for consumers, businesses and the environment.

OITO

One In Two Out

Given that PRN revenue has been classified by ONS as a tax rather than a regulatory cost, this proposal should not come within the scope of One-In, Two-Out.

SPECIFIC IMPACT TESTS

Equity and Fairness

The proposed changes have no undue effect on rural areas, racial groups, income groups, gender groups, age groups, people with disabilities, or people with particular religious views.

Small firms impact test

Businesses that do not simultaneously satisfy the two threshold tests in the Regulations (i.e. an annual turnover in excess of £2m and handle more than 50t of packaging) are excluded from the producer responsibility obligations in the Regulations. The proposed changes do not directly affect small businesses below these thresholds, though they may incur indirect costs through changes to costs in the supply chain.

Competition

The proposed target scenarios will affect the recovery and recycling obligations of approximately 1,360 businesses in the UK (glass producers and reprocessors, exporters). The costs incurred under any new targets (in the same way as for existing targets) will vary between businesses, since the costs are related to the amount and type of packaging the business handles.

The Government does not expect the proposals to affect the current market structure or change the number or size of firms. New businesses will not face higher charges than existing companies and the proposals should not restrict businesses choice of products. The Government is not aware of the industry being characterised by technological change that would radically alter the state of the market.

The Government have examined competition in the recycling market, material specific market (e.g. glass and plastic) and the end user market (e.g. the market for bottles). In general, the Government has been unable to identify markets where there are serious competition concerns. Competition in the recycling market is unlikely to be adversely affected as a result of adopting any of the proposed options and related targets.

Annex 1 PRN/PERNs Mechanism and Cash Flows

Over the period of operation of the producer responsibility system and the requirement to show evidence of compliance in the form of Packaging Recovery Notes/ Packaging Recovery Export Notes (PRN/PERNs), the overall cost of PRN/PERNs to producers has generally remained relatively stable on average; rising slightly as targets have increased. There have been significant variability and price spikes for short periods for particular materials, as would be expected in a market. The relative stability has been regarded as evidence that the system can compensate for incrementally rising targets with costs returning to an 'equilibrium level' that reflects the additional cost to the existing waste management system of extracting the required material from the waste stream.

In theory, in a functioning market with few imperfections, the additional PRN/PERN cash flows should reflect the costs of collecting, sorting, and transporting the additional waste to the reprocessor, minus the revenues from the sale of the material collected at the reprocessor gate[37] and the 'costs avoided' of collecting the materials as refuse and disposing these to landfill (see Box 4).

It is then left to the market to find the most cost effective ways of working collaboratively across the supply chain to carry out investments in the recycling infrastructure, to be innovative and to exploit new markets. Inevitably, markets are not perfect and the relative costs of compliance with the packaging requirements will depend on the relative knowledge and bargaining powers of producers, waste managers and local authorities and vary across the country depending on relative levels of demand/supply for waste materials.

Box 4: Costs for collection of household packaging waste	
A) Cost of collecting and sorting, and delivery of segregated packaging to reprocessor	Say £110 per tonne
Revenues	
B) Avoided landfilling cost of packaging material	Say £50 per tonne
C) Market value (price paid) of packaging material for sale to reprocessor	Say £20 per tonne
Revenue Total	£70 per tonne
D) Net loss	£40 per tonne

To cover (D) revenue needs to come from the PRN system. A number of actions (or combination of actions) can be taken, for example:

pay capital cost of the system (A) - thus reducing the operational costs;

invest in technology, develop new markets for recycled material to increase demand, hence the value of packaging waste and price (C);

The decision is in the hands of industry, primarily the reprocessors in collaboration with obligated businesses, on what mixture of support measures is needed for any given material.

Other factors can affect (A), (B) and (C) and hence the deficit (D) the PRN revenues need to cover. For example:

- costs of (A) may change as economies of scale and improvements in sorting technology develop;
- costs of (B) may change due to increases in the tax levy on landfill or mandatory targets;

[37] Alternatively, the value of the reprocessed material could be considered alongside the additional, average re-processing cost.

- the price of (C) is affected by global supply and demand factors in markets for specific recycled materials.

As the PRN/PERN system is a market based mechanism, industry opinion suggests that without a degree of' stretch' in the targets there will be no 'demand-pull' for PRNs and, linked to the belief that similar levels of recycling will occur annually, the PRN/PERN price will be likely to start to drop towards a floor price.

This has been seen in the market for PRNs for paper and wood where, due to the existing infrastructure and material price, there has historically been an over-supply of evidence for these materials and so depressed PRN/PERN prices (that have been around £2-4 for long periods in recent times).

A long term depression in PRN prices would mean low costs for producers, but would remove an important source of funds for investment and support to collectors/reprocessors/exporters of materials and indirectly to Local Authorities.

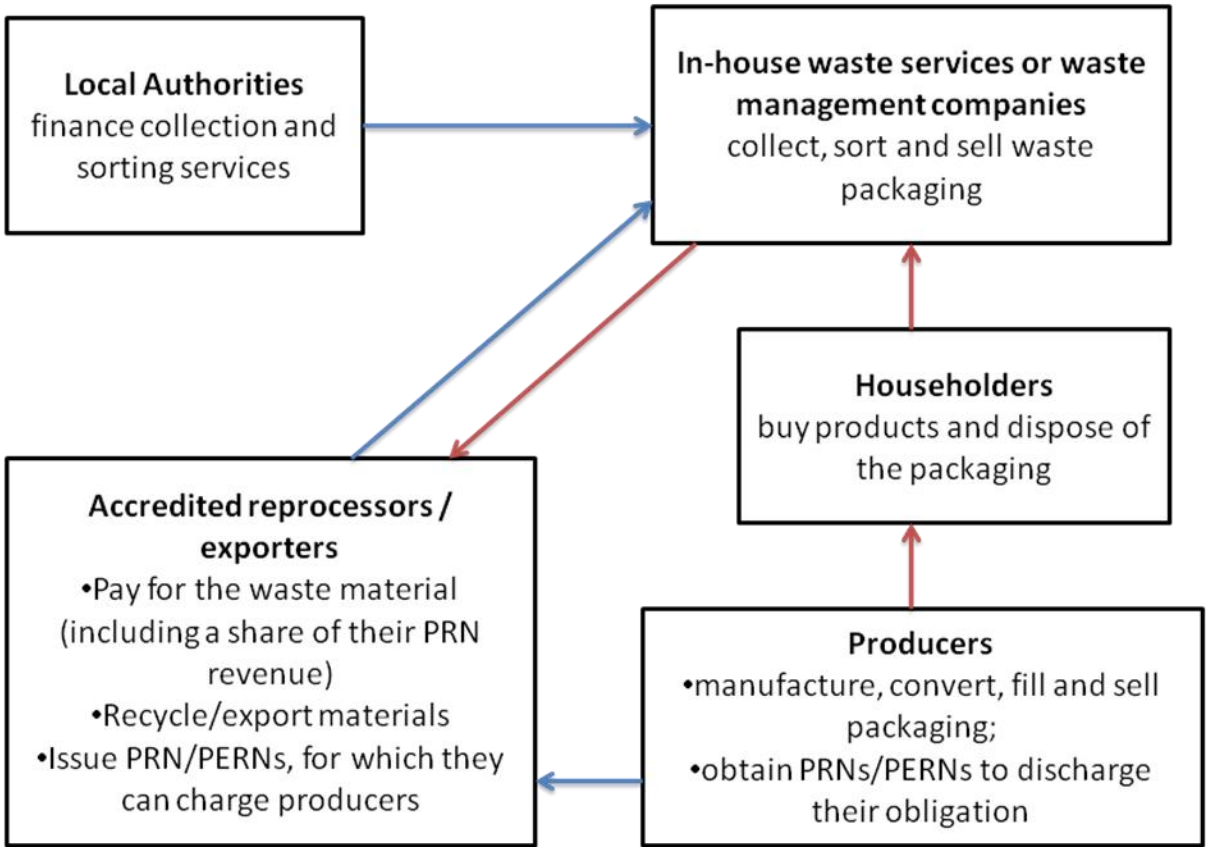
To a limited extent, given market imperfections, the estimated costs for PRNs can be used to cross check the anticipated costs of acquiring additional packaging waste. PRN costs should (in an effective market) broadly equate to the difference between material revenues (at the reprocessor gate) plus avoided costs of disposal, less costs of acquiring the material (collection and sorting).

Figure 1 gives a depiction of the flow of funds within the PRN system on the household side[38].

Figure 1: Funds flow of PRNs (household)

The diagram below shows the flow of materials (in red) and the funding flows (in blue) between the key actors in the household packaging chain. For commercial and industrial waste, the situation is similar in many respects, though businesses pay waste management companies (or local authorities) to collect their recyclable waste, or they may have direct contracts with reprocessors or exporters.

[38] There is a funding issue here with regard hidden subsidy to producers from local authorities, in that some packaging waste gets picked up by local authorities and treated as municipal waste and therefore funded by local authorities rather than business.


Local Authorities
finance collection and sorting services
In-house waste services or waste management companies
collect, sort and sell waste packaging
Householders
buy products and dispose of the packaging
Accredited reprocessors / exporters
•Pay for the waste material (including a share of their PRN revenue)
•Recycle/export materials
•Issue PRN/PERNs, for which they can charge producers
Producers
•manufacture, convert, fill and sell packaging;
•obtain PRNs/PERNs to discharge their obligation

Annex 2

Table A1: Detailed of PRN issuance, carry over and total recycling recorded 2009-13

Year	Waste Accepted for UK Reprocessing	Waste Exported for Overseas Reprocessing	Total Waste Accepted or Exported	Carry over from previous year into the current compliance period	PRN availability for the current compliance period	UK producer obligation (non Allocation method)	UK Producer obligation (Allocation method)	Overall UK producer glass obligation	End of the year compliance by schemes /producers
2009	1,294,207	364,260	1,658,467	66,836	1,725,303	1,648,990	4,172	1,653,162	1,652,750
2010	1,385,896	262,022	1,647,917	63,657	1,711,574	1,692,779	4,545	1,697,324	1,697,095
2011	1,455,387	296,439	1,751,826	12,215	1,764,041	1,697,020	5,808	1,702,828	1,702,962
2012	1,314,998	311,590	1,626,588	58,592	1,685,180	1,659,863	5,524	1,665,387	1,665,378

Source: NPWD, EA

Table A2: Calculations of impact of fraudulent activity and resulting best estimate of actual recycling activity in 2009-10

Estimated impact of fraud activity	Reported recycling	Fraudulent activity		Actual recycling		
		High estimate	Low estimate	Low estimate	High Estimate	Best estimate (mid point)
2009	1,658,467	200,000	100,000	1,458,467	1,558,467	1,508,467
2010	1,647,917	200,000	100,000	1,447,917	1,547,917	1,497,917

Source: NPWD, Glassflow

Table A3: Change in annual recycling tonnages taking fraudulent activity in 2009-10 into account

Impact of fraudulent activity on tonnage increases	**2009**	**2010**	**2011**	**2012**	**2013**
Total tonnes of glass recycled through existing targets (based on reported tonnage)	1,658,467	1,647,917			
Actual amount of glass recycled (best estimate, taking off the estimate of fraud activity)	1,508,467	1,497,917			
Actual glass recycled based on existing business targets and obligated tonnage, 2011-13 actual figures[39]			1,702,828	1,665,387	1,631,236
Amount carried over from previous year's compliance			12,215	58,592	17,302
Net amount of glass to be recycled (actual 2011 and 2012). Calculated for 2013[40]			1,751,82	1,626,58	1,613,93

[39] 2013 figure is subject to change as the year has not been finalised.

[40] The actual amount of recycling does not equate to the obligation minus the carryover from previous year due to carry over into the next year. See Table Ax in Annex 2. 2013 figures assume zero carry over for simplicity.

			6	8	4
Increase in amount of glass to be recycled compared to actual estimated recycling in 2010 (best estimate)			253,909	167,470	133,319
Percentage difference in amount of glass to be recycled compared to 2010 (best estimate)			17%	11%	9%

Table A4: Carbon prices

	2013	2014	2015	2016	2017
CO2 traded price 2013	3.49	3.59	3.67	3.92	4.22
CO2 non traded price 2013	58.2	59.2	60.2	61.3	62.3

Source: DECC, non traded carbon prices are uprated from 2011 to 2013 using the GDP deflator.

Table A5: Updated assumptions for collecting and sorting glass for recycling 2013-17 (2013 prices)

Collecting and sorting costs	**2013**	**2014**	**2015**	**2016**	**2017**
Mixed	£70	£70	£70	£70	£70
Separated	£101	£101	£98	£98	£98

Source: WRAP

Table A6: Actual obligated tonnage 2010-2013

Obligated tonnage for glass	**2010**	**2011**	**2012**	**2013**
Reported obligated tonnage	**2,089,286**	**2,090,803**	**2,049,180**	**2,007,210**
% change year on year		**0.1%**	**-2.0%**	**-2.0%**
UK producer obligation (non Allocation method)	**1,692,779**	**1,697,020**	**1,659,863**	**1,625,840**
UK Producer obligation (Allocation method)	**4,545**	**5,808**	**5,524**	**5,396**
Overall UK producer glass obligation	**1,697,324**	**1,702,828**	**1,665,387**	**1,631,236**
% Change year on year		**0.3%**	**-2.2%**	**-2.1%**

Source: NPWD

Table A7: Estimated recycling rate using updated flow figures from Glassflow

	2011	2012	2013	2014	2015	2016	2017
Glassflow estimate of packaging placed on market (tonnes)	2,427,657	2,399,235	2,399,235	2,399,235	2,399,235	2,399,235	2,399,235
% change YoY	-2%	-1%	0%	0%	0%	0%	0%
Tonnage of glass obligated (actual to 2013, estimated 2014-17)	2,090,803	2,049,180	2,007,210	2,007,210	2,007,210	2,007,210	2,007,210
Tonnes of glass recycling through allocation method	5,808	5,524	5,396	5,576	5,576	5,576	5,576
Total tonnes of glass reported as recycling compliance through existing targets (2011-12 actual; 2013-2017 forecast producer obligation)	1,702,962	1,665,378	1,631,236	1,631,416	1,631,416	1,631,416	1,631,416
Recycling rate achieved on Glassfow figures	70%	69%	68%	68%	68%	68%	68%

Source: Glassflow

Annex 3: Option 2(a) detailed calculations

Table A8: Relationship between business targets and actual recycling rate based on Glassflow estimates

	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014
Glassflow estimate	2,399,235	2,399,235	2,399,235	2,399,235	2,399,235	2,399,235	2,399,235	2,399,235	2,399,235	2,399,235
Obligated tonnage	2,007,210	2,007,210	2,007,210	2,007,210	2,007,210	2,007,210	2,007,210	2,007,210	2,007,210	2,007,210
Business target	81%	80%	79%	78%	77%	76%	75%	74%	73%	72%
Recycling compliance from business target	1,625,840	1,605,768	1,585,696	1,565,624	1,545,552	1,525,480	1,505,408	1,485,335	1,465,263	1,445,191
Recycling compliance from allocated tonnage	5,576	5,576	5,576	5,576	5,576	5,576	5,576	5,576	5,576	5,576
Total recycling compliance required	1,631,416	1,611,344	1,591,272	1,571,200	1,551,128	1,531,056	1,510,984	1,490,911	1,470,839	1,450,767
Recycling rate	68.0%	67.2%	66.3%	65.5%	64.7%	63.8%	63.0%	62.1%	61.3%	60.5%

NB rounding issues result in some tables not totalling up

Table A9: Option 2(a) resulting glass tonnages from new business targets and impact on total recycling activity by end-use

	2013	**2014**	**2015**	**2016**	**2017**
Counterfactual					
Total tonnes of glass reported as recycling compliance through existing targets (2011-12 actual; 2013-2017 forecast producer obligation)	1,631,236	1,631,416	1,631,416	1,631,416	1,631,416
Remelt	1,024,279	1,024,279	1,024,279	1,040,538	1,040,538
Aggregate (allocated assumed to go to aggregate)	606,957	607,137	607,137	590,878	590,878
Total tonnes of glass recycled through new business targets and flow figures		1,510,984	1,510,984	1,510,984	1,510,984
Remelt		948,407	948,407	963,461	963,461
Aggregate (allocated assumed to go to aggregate)		562,577	562,577	547,523	547,523
Change in glass to be recycled from new 75% business target and updated flow figures (2a)					
Total change in glass recycled (t)		-120,433	-120,433	-120,433	-120,433
Change in glass to remelt (t)		-75,873	-75,873	-77,077	-77,077
Change in glass to aggregate (t)		-44,560	-44,560	-43,356	-43,356

Table A10: Summary of impacts of reduction in remelt recycling tonnage 2013-17

Impact of reducing remelt recycling no longer required	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**

tonnage change		- 75,873	- 75,873	- 77,077	- 77,077	
Net change in collection and sorting		3,122,227	2,894,609	2,940,556	2,940,556	
CO2 impacts		- 148,436	- 151,517	- 162,031	- 171,605	
material revenue		- 1,820,941	- 1,820,941	- 1,849,845	- 1,849,845	
Total	**-**	**1,152,851**	**922,152**	**928,680**	**919,106**	**3,922,788**
Total PV		**1,113,865**	**860,839**	**837,616**	**800,948**	**3,613,268**

Table A11: Summary of impacts of reduction in aggregate tonnage

Impact of reducing aggregate recycling no longer required	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
tonnage change		- 44,560	- 44,560	- 43,356	- 43,356	
Net change in collection and sorting		452,327	452,327	440,102	440,102	
CO2 impacts		- 56,782	- 57,914	- 58,851	- 61,765	
material revenue		- 222,800	- 222,800	- 216,779	- 216,779	
Total		**172,745**	**171,612**	**164,472**	**161,558**	**670,387**
Total PV		**166,903**	**160,202**	**148,344**	**140,789**	**616,238**

Table A12: Annual impact of option 2(a)

Annual impact of policy	2013	2014	2015	2016	2017	Total
Net change in collection and sorting costs		3,574,554	3,346,936	3,380,657	3,380,657	**13,682,805**
of which savings to LAs £		2,323,460	2,175,509	2,197,427	2,197,427	**8,893,823**
of which savings to business £		1,251,094	1,171,428	1,183,230	1,183,230	**4,788,982**
CO2 increase £		- 205,218	- 209,431	- 220,882	- 233,370	**- 868,900**
Material revenue that business does not receive £		- 2,043,741	- 2,043,741	- 2,066,623	- 2,066,623	**- 8,220,729**
Total		**1,325,595**	**1,093,764**	**1,093,152**	**1,080,664**	**4,593,176**

Table A13: Summary of impacts by affected party 2013-17, 2013 prices PV

Annual impact of policy	2013	2014	2015	2016	2017	Total
Net change in collection and sorting costs		3,574,554	3,346,936	3,380,657	3,380,657	**13,682,805**
of which savings to LAs £		2,324,077	2,176,086	2,198,011	2,198,011	**8,896,185**
of which savings to business £		1,250,477	1,170,850	1,182,647	1,182,647	**4,786,620**
CO2 increase £		- 205,218	- 209,431	- 220,882	- 233,370	**- 868,900**

Material revenue that business does not receive £		- 2,043,741	- 2,043,741	- 2,066,623	- 2,066,623	**- 8,220,729**
Total		**1,325,595**	**1,093,764**	**1,093,152**	**1,080,664**	**4,593,176**

Table A14: Option 2 Landfill tax impacts

Option 2 Landfill tax impact	**2013**	**2014**	**2015**	**2016**	**2017**
Tonnage assumed to go to landfill	0	120,433	120,433	120,433	120,433
Landfill tax rate From March £	64	72	80	80	80
Total impact £		8,430,282	9,393,743	9,634,608	9,634,608

Table A15: Detailed PRN calculations of option 2(a) Maintaining the split targets

Remelt PRN impacts	**2014**	**2015**	**2016**	**2017**	**Total**
Remelt PRN price in counterfactual	45	45	45	45	
Remelt PRN price in option 2a	22	22	22	22	
Difference in price	-23	-23	-23	-23	
Change in obligated remelt tonnage	- 75,873	- 75,873	- 77,077	- 77,077	
Remaining obligated remelt tonnage	948,407	948,407	963,461	963,461	
Change in PRN cost due to reduced remelt tonnage	- 3,414,264	- 3,414,264	- 3,468,459	- 3,468,459	- 13,765,446
Change in PRN costs due to lower PRN price on remaining obligated remelt tonnage	- 21,813,355	- 21,813,355	- 22,159,598	- 22,159,598	- 87,945,906
Total change in PRN costs	- 25,227,619	- 25,227,619	- 25,628,057	- 25,628,057	- 101,711,352

Aggegrate PRN impacts	**2014**	**2015**	**2016**	**2017**	**Total**
Aggregate PRN price in counterfactual	40	40	40	40	
Aggregate PRN price in option 2a	22	22	22	22	
Difference in price	-18	-18	-18	-18	
Change in obligated aggregate tonnage	- 44,560	- 44,560	- 43,356	- 43,356	
Remaining obligated aggregate tonnage	562,577	562,577	547,523	547,523	
Change in PRN cost due to reduced tonnage	- 1,782,402	- 1,782,402	- 1,734,229	- 1,734,229	- 7,033,264
Change in PRN costs due to lower PRN price on remaining obligated tonnage	- 10,126,382	- 10,126,382	- 9,855,409	- 9,855,409	- 39,963,581
Total change in PRN costs	- 11,908,784	- 11,908,784	- 11,589,638	- 11,589,638	- 46,996,845

	2014	2015	2016	2017	Total
Total change in PRN costs for remelt and aggregate	- 37,136,403	- 37,136,403	- 37,217,695	- 37,217,695	- 148,708,197

Table A16: Option 2(a) PRN impacts breakdown

£	2014	2015	2016	2017	Total
Change in remelt PRN costs from lower obligated recycling tonnage	- 3,414,264	- 3,414,264	- 3,468,459	- 3,468,459	- 13,765,446
Change in remelt PRN costs from lower PRN prices for the remaining obligated recycling tonnage	- 21,813,355	- 21,813,355	- 22,159,598	- 22,159,598	- 87,945,906
Change in aggregate PRN costs from lower obligated recycling tonnage	- 1,782,402	- 1,782,402	- 1,734,229	- 1,734,229	- 7,033,264
Change in aggregate PRN costs from lower PRN prices for the remaining obligated recycling tonnage	- 10,126,382	- 10,126,382	- 9,855,409	- 9,855,409	- 39,963,581
Total change in PRN costs for remelt and aggregate	- 37,136,403	- 37,136,403	- 37,217,695	- 37,217,695	- 148,708,197
Total change in PRN costs for remelt and aggregate PV	- 35,880,583	- 34,667,230	- 33,568,229	- 32,433,071	- 136,549,113

Option 2(b) detailed calculations

Table A17: Option 2(b) Resulting glass tonnages from new business targets and impact on total recycling activity by end-use

Total tonnes of glass recycled through existing targets	1,631,236	1,631,416	1,631,416	1,631,416	1,631,416
Remelt	1,024,279	1,024,279	1,024,279	1,040,538	1,040,538
Aggregate	606,957	607,137	607,137	590,878	590,878
Total tonnes of obligated glass recycled through new business targets and flow figures (option 2(b)		1,510,984	1,510,984	1,510,984	1,510,984
Remelt		972,956	972,956	988,010	988,010
Aggregate		538,028	538,028	522,974	522,974
Change in obligated glass to be recycled from new targets and flow figures (2b)					
Total change in obligated glass recycled (t)		- 120,433	- 120,433	- 120,433	- 120,433
Change in obligated glass to remelt (t)		- 51,324	- 51,324	- 52,528	- 52,528
Change in glass to aggregate (t)		- 69,109	- 69,109	- 67,905	- 67,905

Table A18: Option 2(b) Summary of impacts of reduction in obligated remelt recycling tonnage 2013-17, 2013 prices

Impact of increasing remelt recycling	2013	2014	2015	2016	2017	Total
Tonnage change		-51,324	-51,324	-52,528	-52,528	
Net change in collection and sorting costs		2,112,014	1,958,043	2,003,989	2,003,989	
CO2 impacts		-100,408	-102,493	-110,424	-116,949	
Material revenue		-1,231,766	-1,231,766	-1,260,670	-1,260,670	
Total	**-**	**779,840**	**623,785**	**632,896**	**626,371**	**2,662,891**
Total PV		**753,468**	**582,310**	**570,835**	**545,846**	**2,452,459**

Table A19: Option 2(b) Summary of impacts of reduction in obligated aggregate recycling tonnage , 2013 prices

Impact of reducing aggregate recycling no longer required	2013	2014	2015	2016	2017	Total
tonnage change		-69,109	-69,109	-67,905	-67,905	
Net change in collection and sorting		701,522	701,522	689,297	689,297	
CO2 impacts		-88,064	-89,820	-92,174	-96,738	
material revenue		-345,545	-345,545	-339,524	-339,524	
Total		**267,913**	**266,157**	**257,600**	**253,036**	**1,044,706**
Total PV		**258,853**	**248,460**	**232,340**	**220,506**	**960,160**

Table A20: Summary of impacts of reduction in obligated recycling tonnage 2013-17 (2013 prices), PV

Annual impact of policy	2013	2014	2015	2016	2017	Total
Net change in collection and sorting costs		2,813,536	2,659,565	2,693,286	2,693,286	**10,859,674**
of which savings to LAs £		1,828,798	1,728,717	1,750,636	1,750,636	**7,058,788**
of which savings to business £		984,738	930,848	942,650	942,650	**3,800,886**
CO2 increase £		-188,473	-192,313	-202,598	-213,686	**-797,070**
Material revenue that business does not receive £		-1,577,311	-1,577,311	-1,600,193	-1,600,193	**-6,355,008**
Total		**1,047,753**	**889,941**	**890,495**	**879,407**	**3,707,596**

Table A21: Summary of impacts by affected party, 2013 prices

Annual impact of policy	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
Net change in collection and sorting costs		2,813,536	2,659,565	2,693,286	2,693,286	**10,859,674**
of which savings to LAs £		1,829,284	1,729,177	1,751,101	1,751,101	**7,060,663**
of which savings to business £		984,252	930,389	942,185	942,185	**3,799,011**
CO2 increase £		-188,473	-192,313	-202,598	-213,686	**-797,070**
Material revenue that business does not receive £		-1,577,311	-1,577,311	-1,600,193	-1,600,193	**-6,355,008**
Total		**1,047,753**	**889,941**	**890,495**	**879,407**	**3,707,596**

Table A22: Summary of impacts by affected party, 2013 prices

Annual impact of policy	2013	2014	2015	2016	2017	Total
Net change in collection and sorting costs		2,383,036	2,231,291	2,253,772	2,253,772	**9,121,870**
of which savings to LAs £		1,548,973	1,450,339	1,464,952	1,464,952	**5,929,216**
of which savings to business £		834,063	780,952	788,820	788,820	**3,192,655**
CO2 increase £		-136,812	-139,621	-147,255	-155,580	**-579,267**
Material revenue that business does not receive £		-1,362,494	-1,362,494	-1,377,749	-1,377,749	**-5,480,486**
Total		**883,730**	**729,176**	**728,768**	**720,443**	**3,062,117**

Table A23: Detailed PRN calculations for option 2(b), changing the split targets

Remelt PRN impacts	**2014**	**2015**	**2016**	**2017**	**Total**
Remelt PRN price in counterfactual	45	45	45	45	
Remelt PRN price in in option 2	22	22	22	22	
Difference in price	-23	-23	-23	-23	
Change in obligated remelt tonnage	-51,324	-51,324	-52,528	-52,528	
Remaining obligated remelt tonnage	972,956	972,956	988,010	988,010	
Change in PRN cost due to reduced remelt tonnage	-2,309,561	-2,309,561	-2,363,755	-2,363,755	-9,346,632
Change in PRN costs due to lower PRN price on remaining obligated remelt tonnage	-22,377,981	-22,377,981	-22,724,225	-22,724,225	-90,204,411
Total change in PRN	-	-	-	-	-

costs	24,687,542	24,687,542	25,087,980	25,087,980	99,551,043

Aggegrate PRN impacts	**2014**	**2015**	**2016**	**2017**	**Total**
Aggregate PRN price in counterfactual	40	40	40	40	
Aggregate PRN price in option 2	22	22	22	22	
Difference in price	-18	-18	-18	-18	
Change in obligated aggregate tonnage	-69,109	-69,109	-67,905	-67,905	
Remaining obligated aggregate tonnage	538,028	538,028	522,974	522,974	
Change in PRN cost due to reduced tonnage	-2,764,361	-2,764,361	-2,716,188	-2,716,188	-10,961,098
Change in PRN costs due to lower PRN price on remaining obligated tonnage	-9,684,501	-9,684,501	-9,413,527	-9,413,527	-38,196,056
Total change in PRN costs	-12,448,862	-12,448,862	-12,129,715	-12,129,715	-49,157,154

Table A24: Option 2(b) PRN impacts breakdown

£	**2014**	**2015**	**2016**	**2017**	**Total**
Change in remelt PRN costs from lower obligated recycling tonnage	- 2,309,561	- 2,309,561	- 2,363,755	- 2,363,755	- 9,346,632
Change in remelt PRN costs from lower PRN prices for the remaining oblgiated recycling tonnage	- 22,377,981	- 22,377,981	- 22,724,225	- 22,724,225	- 90,204,411
Change in aggregate PRN costs from lower obligated recycling tonnage	- 2,764,361	- 2,764,361	- 2,716,188	- 2,716,188	- 10,961,098
Change in aggregate PRN costs from lower PRN prices for the remaining obligated recycling tonnage	- 9,684,501	- 9,684,501	- 9,413,527	- 9,413,527	- 38,196,056
Total change in PRN costs for remelt and aggregate	- 37,136,403	- 37,136,403	- 37,217,695	- 37,217,695	- 148,708,197
Total change in PRN costs for remelt and aggregate PV	- 35,880,583	- 34,667,230	- 33,568,229	- 32,433,071	- 136,549,113

Option 3(a) Detailed Calculations

Table A25: Option 3(a) resulting glass tonnages from new business targets and impact on total recycling activity by end-use

	2013	2014	2015	2016	2017
total tonnes of glass recycled through existing targets	1,631,236	1,631,416	1,631,416	1,631,416	1,631,416

Remelt	1,024,279	1,024,279	1,024,279	1,040,538	1,040,538
Aggregate	606,957	607,137	607,137	590,878	590,878
Total tonnes of glass recycled through new business targets and flow figures		1,551,128	1,551,128	1,551,128	1,551,128
Remelt		973,698	973,698	989,153	989,153
Aggregate		577,430	577,430	561,975	561,975
Change in glass to be recycled from new targets and flow figures : Option 3(a)					
Total change in glass recycled (t)		- 80,288	- 80,288	- 80,288	- 80,288
Change in glass to remelt (t)		- 50,582	- 50,582	- 51,385	- 51,385
Change in glass to aggregate (t)		- 29,707	- 29,707	- 28,904	- 28,904

Table A26: Option 3(a) Summary of impacts of reduction in obligated remelt recycling tonnage 2013-17

Impact of reducing remelt recycling no longer required	2013	2014	2015	2016	2017	Total
tonnage change		- 50,582	- 50,582	- 51,385	- 51,385	
Net change in collection and sorting		2,081,485	1,929,740	1,960,370	1,960,370	
CO2 impacts		- 98,957	- 101,011	- 108,021	- 114,403	
material revenue		- 1,213,961	- 1,213,961	- 1,233,230	- 1,233,230	
Total	**-**	**768,567**	**614,768**	**619,120**	**612,737**	**2,615,192**
Total PV		**742,577**	**573,892**	**558,411**	**533,965**	**2,408,845**

Table A27: Option 3(a) Summary of impacts of reduction in obligated aggregate recycling tonnage 2013-17

Impact of reducing aggregate recycling no longer required	2013	2014	2015	2016	2017	Total
tonnage change		- 29,707	- 29,707	- 28,904	- 28,904	
Net change in collection and sorting		301,551	301,551	293,401	293,401	
CO2 impacts		- 37,855	- 38,610	- 39,234	- 41,177	
material revenue		- 148,534	- 148,534	- 144,519	- 144,519	
Total		**115,163**	**114,408**	**109,648**	**107,705**	**446,925**
Total PV		**111,269**	**106,801**	**98,896**	**93,859**	**410,825**

Table A28: Option 3(a) Summary of impacts of reduction in obligated remelt recycling tonnage 2013-17, PV

Option 3(a)	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
Tonnage change	-	- 80,288	- 80,288	- 80,288	- 80,288	
Benefit from reduction in collection and sorting costs	-	2,383,036	2,231,291	2,253,772	2,253,772	
CO2 impacts	-	- 136,812	- 139,621	- 147,255	- 155,580	
Reduced material revenue	-	- 1,362,494	- 1,362,494	- 1,377,749	- 1,377,749	-
Total	**-**	**883,730**	**729,176**	**728,768**	**720,443**	**3,062,117**
Total PV	**-**	**853,846**	**680,694**	**657,307**	**627,824**	**2,819,671**

Table A29: Detailed PRN calculations for option 3(a)

Remelt PRN impacts	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
Remelt PRN price in counterfactual		45	45	45	45	
Remelt PRN price in option 3a		30	30	30	30	
Difference in price		-15	-15	-15	-15	
Change in obligated remelt tonnage		- 50,582	- 50,582	- 51,385	- 51,385	
Remaining obligated remelt tonnage		948,407	948,407	963,461	963,461	
Change in PRN cost due to reduced remelt tonnage		- 2,276,176	- 2,276,176	- 2,312,306	- 2,312,306	- 9,176,964
Change in PRN costs due to lower PRN price on remaining obligated remelt tonnage		- 14,539,075	- 14,539,075	- 14,769,854	- 14,769,854	- 58,617,858
Total change in PRN costs		- 16,815,251	- 16,815,251	- 17,082,160	- 17,082,160	- 67,794,822

Aggegrate PRN impacts	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
Aggregate PRN price in counterfactual		40	40	40	40	
Aggregate PRN price in option 2a		28	28	28	28	
Difference in price		-12	-12	-12	-12	
Change in obligated aggregate tonnage		- 29,707	- 29,707	- 28,904	- 28,904	
Remaining obligated aggregate tonnage		562,577	562,577	547,523	547,523	
Change in PRN cost due to reduced tonnage		- 1,188,268	- 1,188,268	- 1,156,153	- 1,156,153	- 4,688,843
Change in PRN costs due to lower PRN price on remaining obligated tonnage		- 6,750,921	- 6,750,921	- 6,570,272	- 6,570,272	- 26,642,387
Total change in PRN		-	-	-	-	-

costs		7,939,190	7,939,190	7,726,425	7,726,425	31,331,230

Table A30: Detailed breakdown of PRN impacts for option 3(a)

£	2013	2014	2015	2016	2017	Total
Change in remelt PRN costs from lower obligated recycling tonnage		-2,276,176	-2,276,176	-2,312,306	-2,312,306	-9,176,964
Change in remelt PRN costs from lower PRN prices for the remaining oblgiated recycling tonnage		-14,539,075	-14,539,075	-14,769,854	-14,769,854	-58,617,858
Change in aggregate PRN costs from lower obligated recycling tonnage		-1,188,268	-1,188,268	-1,156,153	-1,156,153	-4,688,843
Change in aggregate PRN costs from lower PRN prices for the remaining oblgiated recycling tonnage		-6,750,921	-6,750,921	-6,570,272	-6,570,272	-26,642,387
Total change in PRN costs for remelt and aggregate		-24,754,441	-24,754,441	-24,808,585	-24,808,585	-99,126,052
Total change in PRN costs for remelt and aggregate PV		-23,917,334	-23,108,535	-22,375,923	-21,619,249	-91,021,041

Table A31: Landfill tax impacts of option 3

Option 3 Landfill tax impact	2013	2014	2015	2016	2017
Tonnage assumed to go to landfill	0	80,288	80,288	80,288	80,288
Landfill tax rate From March £	64	72	80	80	80
Total impact £		5,620,188	6,262,495	6,423,072	6,423,072

Option 3(b): Detailed Calculations

Table A32: Option 3(b) resulting glass tonnages from new business targets and impact on total recycling activity by end-use

	2014	2015	2016	2017
total tonnes of glass recycled through existing targets	1,631,416	1,631,416	1,631,416	1,631,416
Remelt	1,024,279	1,024,279	1,040,538	1,040,538
Aggregate	607,137	607,137	590,878	590,878
Total tonnes of glass recycled through new business targets and flow figures	1,551,128	1,551,128	1,551,128	1,551,128
Remelt	1,013,049	1,013,049	1,028,504	1,028,504
Aggregate	538,079	538,079	522,623	522,623

Change in glass to be recycled from new targets and flow figures : Option 3(b)				
Total change in glass recycled (t)	- 80,288	- 80,288	- 80,288	- 80,288
Change in glass to remelt (t)	- 11,230	- 11,230	- 12,033	- 12,033
Change in glass to aggregate (t)	- 69,058	- 69,058	- 68,255	- 68,255

Table A33: Option 3(b) Summary of impacts of reduction in obligated remelt recycling tonnage 2013-17

Impact of reducing remelt recycling no longer required	2013	2014	2015	2016	2017	Total
tonnage change		- 11,230	- 11,230	- 12,033	- 12,033	
Net change in collection and sorting		462,142	428,451	459,082	459,082	
CO2 impacts		- 21,971	- 22,427	- 25,296	- 26,791	
material revenue		- 269,530	- 269,530	- 288,799	- 288,799	
Total	**-**	**170,641**	**136,494**	**144,986**	**143,492**	**595,613**
Total PV		**164,871**	**127,419**	**130,769**	**125,045**	**548,103**

Table A34: Option 3(b) Summary of impacts of reduction in obligated remelt recycling tonnage 2013-17

Impact of reducing aggregate recycling no longer required	2013	2014	2015	2016	2017	Total
tonnage change		- 69,058	- 69,058	- 68,255	- 68,255	
Net change in collection and sorting		701,004	701,004	692,854	692,854	
CO2 impacts		- 87,999	- 89,754	- 92,649	- 97,237	
material revenue		- 345,290	- 345,290	- 341,276	- 341,276	
Total		**267,715**	**265,960**	**258,929**	**254,342**	**1,046,946**
Total PV		**258,662**	**248,277**	**233,539**	**221,644**	**962,122**

Table A35: Option 3(b) Summary of impacts by affected party, 20213 prices, PV

Option 3(b)	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
Tonnage change	-	- 80,288	- 80,288	- 80,288	- 80,288	
Benefit from reduction in collection and sorting costs	-	1,163,146	1,129,455	1,151,936	1,151,936	
CO_2 impacts	-	- 109,970	- 112,181	- 117,946	- 124,028	
Reduction in material revenue	-	- 614,820	- 614,820	- 630,075	- 630,075	
Total				**403,915**		**1,642,559**

	-	438,356	402,454		397,833	
Total PV	-	423,533	375,695	364,308	346,689	1,510,225

Table A36: PRN Impacts of option 3(b)

Remelt PRN impacts	2013	2014	2015	2016	2017	Total
Remelt PRN price in counterfactual		45	45	45	45	
Remelt PRN price in option 3a		40	40	40	40	
Difference in price		-5	-5	-5	-5	
Change in obligated remelt tonnage		-11,230	-11,230	-12,033	-12,033	
Remaining obligated remelt tonnage		948,407	948,407	963,461	963,461	
Change in PRN cost due to reduced remelt tonnage		-505,369	-505,369	-541,498	-541,498	-2,093,734
Change in PRN costs due to lower PRN price on remaining obligated remelt tonnage		-4,770,486	-4,770,486	-4,846,208	-4,846,208	-19,233,387
Total change in PRN costs		-5,275,854	-5,275,854	-5,387,706	-5,387,706	-21,327,121

Aggregate PRN impacts	2013	2014	2015	2016	2017	Total
Aggregate PRN price in counterfactual		40	40	40	40	
Aggregate PRN price in option 2a		22	22	22	22	
Difference in price		-18	-18	-18	-18	
Change in obligated aggregate tonnage		-69,058	-69,058	-68,255	-68,255	
Remaining obligated aggregate tonnage		562,577	562,577	547,523	547,523	
Change in PRN cost due to reduced tonnage		-2,762,319	-2,762,319	-2,730,204	-2,730,204	-10,985,047
Change in PRN costs due to lower PRN price on remaining obligated tonnage		-10,126,382	-10,126,382	-9,855,409	-9,855,409	-39,963,581
Total change in PRN costs		-12,888,701	-12,888,701	-12,585,613	-12,585,613	-50,948,628

Table A37: Option 3(b) Summary of change in PRN costs

£	2013	2014	2015	2016	2017	Total
Change in remelt PRN costs from lower obligated recycling tonnage		-505,369	-505,369	-541,498	-541,498	-2,093,734
Change in remelt PRN costs from lower PRN prices for the remaining obligated recycling tonnage		-4,770,486	-4,770,486	-4,846,208	-4,846,208	-19,233,387

Change in aggregate PRN costs from lower obligated recycling tonnage		-2,762,319	-2,762,319	-2,730,204	-2,730,204	-10,985,047
Change in aggregate PRN costs from lower PRN prices for the remaining obligated recycling tonnage		-10,126,382	-10,126,382	-9,855,409	-9,855,409	-39,963,581
Total change in PRN costs for remelt and aggregate		-18,164,556	-18,164,556	-17,973,319	-17,973,319	-72,275,750
Total change in PRN costs for remelt and aggregate PV		-17,550,296	-16,956,807	-16,210,904	-15,662,709	-66,380,716