

Plastics

Partial financial impact assessment of a Quality Protocol for the manufacture of secondary raw materials from waste non-packaging plastics

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1. Objective

- 1.1 The Quality Protocol for the manufacture of secondary raw materials from non-packaging plastic waste.
- 1.2 This is a partial impact assessment that focuses on the financial costs and benefits of the Quality Protocol to those involved in the supply of non-packaging plastics. It excludes social and environmental impacts with the exception of carbon dioxide (CO₂) emissions. Furthermore, the analysis focuses only on the financial costs and benefits to the waste producers, processors and users. Impact to those involved in the supply of virgin or other secondary materials are not included.

2. Purpose and Intended Effect

2.1 Objective and rationale for Government intervention

- 2.1.1 Currently, most recycled non-packaging plastic sold by recyclers is in the form of pellets not chips. Converting chips into pellets involves an expensive and energy-intensive melt process. In some cases recyclers are selling pellets when chips would be fit for purpose in order to avoid their output being classified as 'waste'. The waste classification is resulting in an unnecessary additional melt process producing unnecessary CO₂ emissions and energy costs.¹
- 2.1.2 The proposal is to introduce a Quality Protocol that moves the point at which recycled non-packaging plastics stops being classified as a waste (fully recovered) to earlier in the recycling supply chain. Recycled non-packaging plastic chips (produced in line with the specification defined by the Quality Protocol) will no longer be classified as waste when they leave the recycler.
- 2.1.3 This financial impact assessment (FIA) examines how the Quality Protocol may affect the non-packaging plastics recycling industry and the impact on CO₂ emissions. It does not investigate the costs and benefits for the regulatory bodies. It is likely to lead to both a cost saving and a fall in revenue for the Environment Agency. Charges for waste management licences² are set to cover costs.
- 2.1.4 A Technical Advisory Group (TAG) made up of different industry representatives supported the development of the Quality Protocol and this FIA. See Appendix A for a list of members.

1 Chips are not always fit for purpose. Pellets have a regular shape, which enables converters to blend them with other pellets with the same physical form and avoid separation. The melt process to convert chips to pellets also enables a further filtration step to reduce contamination and also enables the introduction of additives such as colours or anti oxidants etc.

2 On 6 April 2008 the Environmental Permitting (England and Wales) Regulations 2007 came into force. On this date waste management licences issued under the Environmental Protection Act 1990 (as amended) automatically became environmental permits and exemptions from the need for a waste management licence registered under Regulation 18 and Schedule 3 of the Waste Management Licensing Regulations 1994 (as amended) came under schedule 3 of the Environmental Permitting (England and Wales) Regulations 2007.

This FIA was completed prior to 6 April 2008 therefore regulatory compliance cost estimates are based on compliance with the waste management licensing regime. These remain the best available cost estimates and continue to be the basis for this FIA. As such the terminology used in this FIA continues to refer to the waste management licensing regime.

3. The Market for Recycled Non-Packaging Plastics

3.1 Used plastics arisings

3.1.1 There are no detailed figures available for the annual arisings of waste non-packaging plastics. We can get a rough idea, though, by looking at the quantity of plastics consumed by industry. Table 1 shows the different quantities of non-packaging plastics used by industry sectors in 2000.

Table 1: Consumption of polymer (virgin & recycle) by sectors

	1000s tonnes consumption of polymers	%
Packaging	1640	37
Building / Construction	1050	23
Electric and Electronic Equipment (EEE)	355	8
Transport	335	8
Furniture / Houseware	335	8
Agriculture / Horticulture	310	7
Toys / Leisure and Sport	145	3
Medical	95	2
Mechanical Engineering	95	2
Footwear	50	1
Other	40	1
Total	4450	

Source: Reference 4

It is estimated that plastic consumption will grow by four per cent year-on-year.

Figures for 2000. Note that these figures apply to the UK as a whole, whereas the Protocol would apply to England and Wales only.

- 3.1.2 The total annual consumption of non-packaging plastics will be an overestimate of annual arisings of waste non-packaging plastics. For example most buildings that are currently reaching their end of life used a lot less plastic than modern buildings in their construction and a lot of the plastic is underground so it is not economically viable to retrieve it.
- 3.1.3 In 2000 it was estimated that 3 to 3.5 million tonnes of post-use plastic entered the UK waste stream (reference 4).
- 3.1.4 Table 2 provides estimates for post-use non-packaging plastic. The figures come from consultation with the TAG.

Table 2: Estimates of waste non-packaging plastics arisings³

Sector	1000's tonnes per year in 2000
Waste Electrical and Electronic Equipment (WEEE)	220
End of Life Vehicle (ELV)	200
Construction	400
Other (furniture/houseware; toys/leisure/sport; medical; mechanical engineering; footwear etc)	200
Total	1,020

3.2 Levels of non-packaging plastics recycling

3.2.1 Table 3 gives projected figures for the amount of post-use non-packaging plastics that come from end of life vehicles (ELV) and waste electrical and electronic equipment (WEEE). It also projects the possible levels of recycling of ELV and WEEE to 2015. There are likely to be significant increases in recycling rates, driven partly by the ELV and WEEE Directives.

Table 3: Sectors with figures for the amount of non-packaging plastic waste they generate

Sector	Projections	2005	2008	2010	2015
ELV ⁴	Plastics waste generated (000's tonnes per annum (Kt/a))	196	204	234	252
	Collected for recycling (Kt/a)	Low	23-68	47-117	101-177
	% recycled	Low	11-33%	20-50%	40-70%
WEEE available for recycling ⁵	Plastics waste generated (Kt/a) ⁶	219	242	258	281
	Collected for recycling (Kt/a)	Low	68	89	104 ⁷
	% recycled	Low	28%	34%	37%

Source: Reference 3

The ranges represent different growth scenarios or technical developments. Additional separation technology may be necessary to achieve the high separation rates for 2010 to 2015.

- 3.2.2 Most plastic recycling in the UK is of 'process scrap' from industry, that is, polymers left over from the production of plastics. There is a high recycling rate in the UK (95 per cent of 250,000 tonnes per year (reference 4)), because process scrap is relatively uncontaminated. The recycling of process scrap is often called 'reprocessing'.
- 3.2.3 An approximate estimate for the amount of recycling of post-consumer non-packaging plastics (excluding agricultural waste plastics) is currently at least 160,000 tonnes per year. This includes 60,000 tonnes polyvinyl chloride (PVC) recycling from construction waste.⁸

3 Source: communication with the TAG and reference 5.

4 Plastics consumption is expected to increase in the ELV sector. Plastics waste from ELV will grow by over 50,000 tonnes per annum by 2015. Plastics use in cars is increasing in absolute terms. Changes in the amount of polymers in vehicles will increase the amount of plastics available for recovery during the period 2008-2015.

5 WEEE plastic waste is predicted to grow at the rate of three to five per cent a year (reference 3).

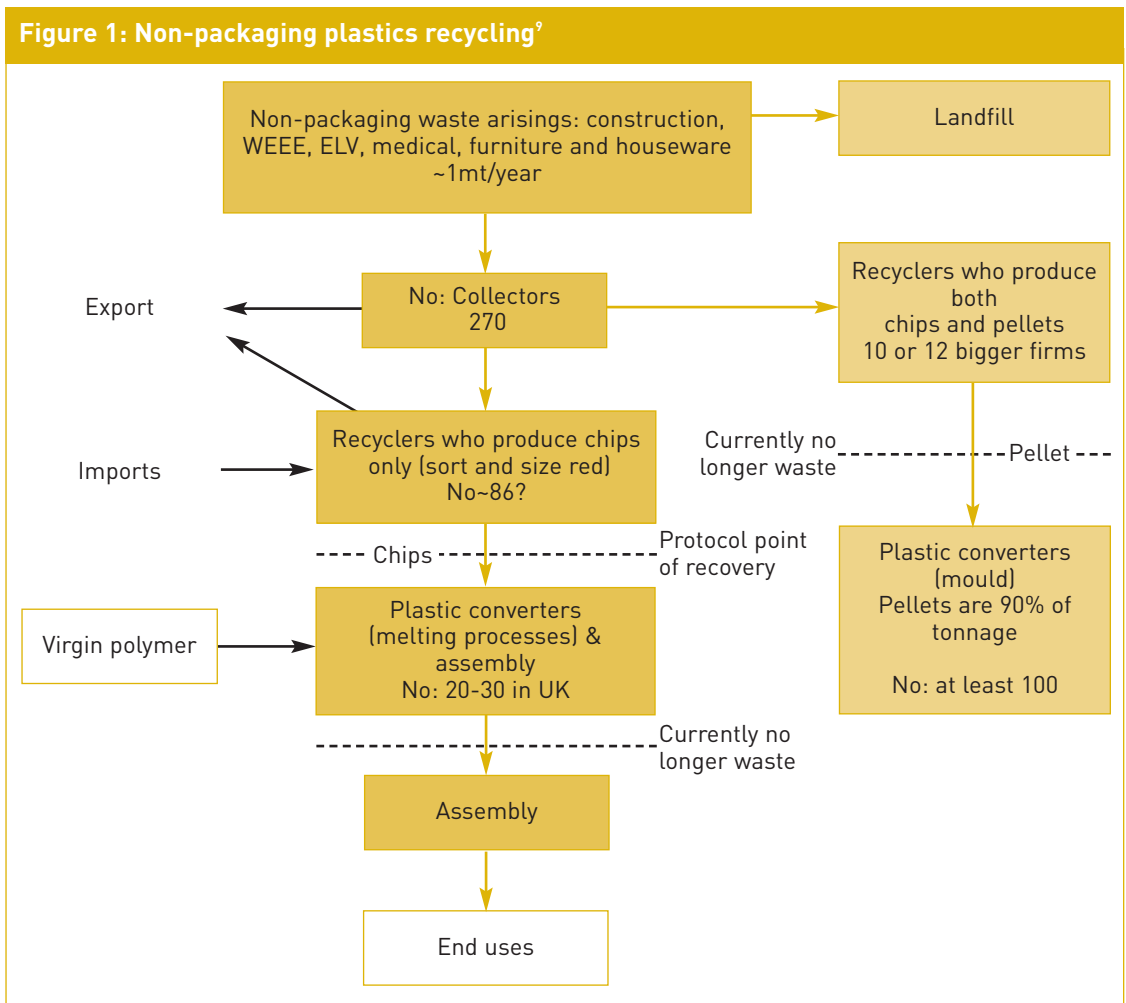
6 Assumes 22 per cent of WEEE is plastics (ICER 2000).

7 More than 100,000 tonnes of WEEE plastics could be available for recycling by 2015. This figure could, though, be significantly higher, depending on how the WEEE Directive is implemented and on how plastics separation technologies develop and are implemented.

8 Communication with the TAG.

3.2.4 The construction sector is likely to generate more and more plastics for recycling. It is the strongest growth area of plastics consumption in the UK.

3.2.5 Figure 1 illustrates the flows of waste non-packaging plastics in the UK recycling supply chain. The number of companies involved in the market and their characteristics are indicated, together with the points in the recycling supply chain where secondary raw materials currently cease to be a waste. The point of recovery where secondary raw materials that comply with the requirements of the Quality Protocol cease to be classified as waste is also shown at an earlier point in the supply chain.



3.3 Constraints and opportunities for increased non-packaging plastics recycling and increases in supply into end markets

3.3.1 There will be an increase in waste and potentially a rapid growth in the amount collected and recycled. The drivers for this will be:

- i. The WEEE Directive. Its aim is to reduce the amount of electronic and electrical waste, increase recovery and boost recycling. It requires 70-80 per cent recovery and 50-75 per cent recycling for all collected WEEE. It is not material-specific. To meet the WEEE Directive more than 50 per cent of the plastics content of waste etc may need to be recycled.

⁹ Source: communication with the TAG and reference 5.

- ii. The End of Life Vehicles (ELV) Directive (2000/53/EC). This requires a 95 per cent recovery and 85 per cent recycling rate of total ELV weight by 2015. These targets are not material-specific, but will require increasing efforts in terms of non-metal fraction recovery. The quantity of plastics that must be recycled to meet 2015 targets is estimated to be between four and seven per cent of the total vehicle weight (reference 3).
- iii. The continuing increase in the landfill tax up to a maximum of £48 per tonne in 2010/11 will make recycling more attractive. The landfill tax is £24 per tonne in 2007 and is set to rise by £8 per tonne per year from 1st April 2008.
- iv. The progress of segregation technology should increase the amount of plastics that can be recycled economically.
- v. Sustained high oil prices would make virgin polymers expensive, which in turn makes recyclate more competitive.

3.3.2 There are barriers to non-packaging plastics recycling, chiefly:

- i. Further advances in recycling technologies are required to further boost supply. To increase recycling rates in the ELV sector, for example, we need to be able to recover single stream polymer fractions from automotive shredders. At the moment, in the UK, trained members of staff sort most plastics for mechanical recycling into polymer type by hand. Technology is being introduced to do this automatically. Investing in sorting technologies will increase the volumes of materials separated at source. But shredder operators don't yet see a financial benefit to investing in new separation technologies (reference 3).
- ii. Demand from plastic converters is lower than it could be due to the stigma of chips being classified as waste. Recycled material is used in place of virgin plastics, concrete, wood or natural fibres in a wide range of products. Economic considerations usually affect the use of plastic recyclate in manufacturing. Using recycled plastic can, in fact, be a better material and it is generally cheaper than virgin polymers. Suppliers of recycled plastics also need to offer the same level of service, quality assurance and market capacity as the virgin polymer industry. Converters are primarily concerned with level and security of supply, together with the specification of the product and its reliability. Some of the user industry (ELVs) may still believe that recovered plastic is unsuitable for new products where quality and performance is important. In reality, many high-quality products can be manufactured from recycled materials.
- iii. Contamination can prevent recovered plastics from being used in high-grade, high-value applications. Common contaminants include other polymer types, other materials such as oil, metal, glass, dust and/or moisture. Reducing the number of polymer streams in products would cut the cost of recycling.
- iv. There may be inadequate collection infrastructure for the recycling of plastics from certain sources/ sectors.
- v. If more collected waste non-packaging plastic material is exported, this will further restrict the supply to UK recyclers, although currently little non-packaging plastic waste is exported with the exception of WEEE. The non-metal fraction of ELVs is also starting to be exported.¹⁰
- vi. Recycled plastic is rarely used in food packaging (this is the biggest single market for plastics) because of concerns about food safety. The recycled material can be enclosed in layers of virgin material. The recycling process can't eliminate colours, and so recyclate can't be used for light or transparent packaging.

3.3.3 Recovered plastics can be used in many sectors including: construction/building; car manufacturing; electronic equipment; agriculture; packaging; furniture and houseware etc.

3.4 Automotive manufacturing

The non-metal fraction of ELVs is known as automotive shredder residue (ASR). It should be possible to recycle ASR on a large scale in the period up to 2015. There are several drivers for this including the continued improvements in separation technologies, increases in landfill disposal costs and potential financing from producers (subject to ELV Directive 2015 targets). There is a non-recoverable fraction but this should reduce as technology develops.

The extent to which the automotive sector can use recycled plastics will depend on the quality of material. It is possible to use recycled polypropylene (PP) from ELVs in the automotive industry and other sectors. The markets for recovered plastics from ASR are, though, currently limited. One of the main trends in polymer consumption within the automotive industry is the growing use of PP. This is likely to increase rapidly over the next 10 to 15 years. Recycled PP could meet some of this demand. The recycled content of automotive components currently manufactured in the UK usually ranges from 5 to 60 per cent. In some cases, though, it can be as high as 75 per cent.

3.5 Waste electrical and electronic equipment (WEEE)

There is currently very low recycling in this sector. The main barrier to recycling polymers in WEEE is the wide range of equipment and polymer types used. The polymers need to be segregated before they can be recycled. The dismantling process can therefore be costly. The risk of contamination is also relatively high. On-going improvements in the efficiency of traditional mechanical recycling processes should, though, lead to more WEEE recycling. Components designed with fewer polymers should also boost recycling rates.

The figures in Table 3 for the amount of WEEE potentially recycled by 2015 will depend on how the WEEE Directive is implemented and on the separation technologies developed.

The UK has a relatively small electrical and electronics manufacturing industry. This will not provide a strong base for demand for plastics recycle.

There is evidence that large quantities of electrical and electronic equipment (up to 50 per cent) are exported for re-use or recycling instead of being recycled in the UK. Projections of exports of WEEE are: 2008 (50,000 tonnes), 2010 (72,000 tonnes) and 2015 (209,000 tonnes).

3.6 Medical sector

The medical sector uses 95,000 tonnes of plastics a year. There are no specific recycling targets for this sector. Most medical applications are exempt from WEEE and the potential for the use of recycled plastics in the medical sector is limited. Standards are restrictive in many applications, and health and safety concerns are a priority.

3.7 Houseware and furniture sector

Currently there are no specific legislative drivers relating to the recycling of plastic furniture and houseware waste. This sector used 20,000 tonnes of recycled plastics in 2000. It is recognised that the volumes available and the complexity of requirements make a recycling solution unlikely.

The amount recycled could be increased greatly by developing separation technology.

3.8 Construction/building sector

This sector is likely to be a big growth area for the use of plastics and therefore potentially the use of recycled plastic. The sector can use recycled material from a wide range of sources, including WEEE, ELV, agricultural plastics, packaging, construction etc. The Government's Sustainable Buildings Task Force recommends that at least 10 per cent of a construction project's material should consist of reused/recycled material.

It may be difficult to significantly increase the amount of recycled material going to this sector. There are cultural barriers, and the sector is very risk-averse. Products must meet high specifications and be tested to high standards. It is expected that the sector will increase the use of recycled materials for applications such as pipes, cladding and interior decoration, road construction, for roof and flooring and as a wood-polymer composite.

3.9 Current waste regulation of the market for recycled non-packaging plastic chips

Currently the plastic converters who buy chips need a waste management licence exemption, which is free, or a waste management licence, depending on the quantity handled. Those who buy pellets only are not handling waste. If they transport the chips, then they need to be registered as waste-carriers.

4. Consultation

- 4.1 Initial consultation during the development of this document was confined to the TAG. Details of the TAG members are highlighted in Annex B. These members cover a cross section of stakeholders affected by the introduction of the Quality Protocol including:
- Industry representatives
 - Environment Agency
 - WRAP
- 4.2 TAG meetings occurred at regular intervals throughout the development of this FIA.
- 4.3 This document was subject to public consultation between 10 December 2007 and 3 March 2008.

5. Methodology and Options

5.1 The options to be assessed within the financial impact assessment are:

- Option A – Business as Usual (BAU);
- Option B – introduce the Quality Protocol.

5.2 Annex A explains in more detail the assumptions made in this assessment.

5.3 Option A – Business as Usual

5.3.1 This is the baseline. Under this option the Quality Protocol would not be introduced.

5.3.2 It is likely that recyclers would continue to convert an inefficiently high amount of chips into pellets to avoid the waste classification. Plastic converters will continue to have concerns over the quality of chips and therefore demand pellets.

5.3.3 The analysis assumes in the baseline that the amount of ELV and WEEE plastic waste recycled each year over the next 10 years is in line with the increase in recycling set out in Table 3. It assumes that the quantity of other plastics (construction, houseware etc) recycled starts at 145,000 tonnes a year (in 2006) and increases by one per cent a year until 2017. This rate is low because there are no specific regulations covering these sectors. Table 4 sets out the assumed levels of recycling to 2017 used in the analysis. It assumes the WEEE and ELV directives are successful. The total levels of recycling are assumed to be the same under option A (baseline) and option B.

5.3.4 The current proportions of total non-packaging plastic waste that end up as chips and pellets are 1/10 and 9/10 respectively.¹¹ This is the current proportion. The baseline assumes that these proportions will remain the same over the assessment period (see Table 5).

Table 4: The projected tonnes of non-packaging plastics recycling

Year	2008 000's tonnes	2011 000's tonnes	2017 000's tonnes
Total recycled	237-282	301-372	393-471
Sources: WEEE	68	92	110
ELV	23-68	58-129	123-201
other (construction etc)	146	151	160

Note 1: assumes in 2006 the levels of recycling tonnes are: 145,000 (construction, houseware etc), 5,000 WEEE, 5,000 ELV. Total 155,000 tonnes per year.

Table 5: Projected levels of chips and pellets sold by recyclers

Year	2008 000's tonnes	2011 000's tonnes	2017 000's tonnes
Chips (1/10 of total recycled) tonnes/year	24-28	32-39	39-47
Pellets (9/10 of total recycled) tonnes per year	213-254	284-350	353-424

5.4 Option B – Introduce the Quality Protocol

- 5.4.1 The proposal is to produce a voluntary Quality Protocol for the manufacture of secondary raw materials from non-packaging plastic waste that is recognised by and produced with the support of industry. The Quality Protocol is a formalised quality control procedure for manufacturing and using recycled non-packaging plastics and has three main purposes (reference 1):
- i. to clarify the point at which secondary raw material from waste non-packaging plastics ceases to be waste (fully recovered) and waste regulatory controls are no longer needed;
 - ii. to provide users with confidence that the recycled non-packaging plastic that they buy conforms to their agreed specification; and
 - iii. to protect the environment and human health by setting standards for the production and use of non-packaging plastics.
- 5.4.2 Protocol compliant chips will no longer be classified as waste when they leave the recycler.
- 5.4.3 To comply with the Quality Protocol, materials must (reference 1):
- i. have been processed into secondary raw materials in line with one of the European Standards listed in Appendix B of the Quality Protocol;
 - ii. meet a technical specification agreed between producer and buyer that is appropriate for the intended use; and
 - iii. be supplied to the customer for an identified intended use; supplied with a safety data sheet that meets the requirements REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) (Regulation (EC) No 1907/2006).
- 5.4.4 The Quality Protocol is voluntary. Producers can choose not to comply and to continue to sell chips as waste or to convert the chips into pellets.
- 5.4.5 This analysis assumes that, if the Quality Protocol is introduced, the total level of recycling (chips and pellets) over the next 10 years will be the same as the baseline.¹² That is, the Quality Protocol does not lead to an increase in the amount of recycled plastics (chips and pellets) being sold in end markets. The assumed levels of recycling are those in Table 4.
- 5.4.6 Where the Quality Protocol does make a difference is in the proportions that end up as of chips and pellets. The option B analysis includes 2 scenarios of the possible proportions of chips and pellets.

12 This was the view of the TAG.

- 5.4.7 In option B scenario 1, of the extra amount of recycled plastic produced each year (beyond the figure for 2007) a third is sold as chips and two-thirds converted into pellets.¹³ It is assumed that throughout the assessment period the annual quantity of pellets produced does not fall below the 2007 level. Those companies that are currently producing pellets continue to do so and do not stop producing pellets and start producing chips. For example under option B scenario 1, the quantity of chips sold to converters in 2008 is assumed to equal 1/10 of the 2007 total level of non-packaging plastic recycling plus 1/3 of the increase in total recycling since 2007. This contrasts with the baseline, which assumes that the 2008 quantity of chips sold is equal to 1/10 of all non-packaging plastic recyclate produced in 2008. The TAG suggested this scenario as a feasible outcome of the Quality Protocol although it was considered to be the upper end of what is possible. Of the extra amount recycled each year (beyond the 2007 level) a greater proportion will be chips than if the Quality Protocol hadn't been introduced. See Table 6 for details of option B scenario 1.
- 5.4.8 Pellets will continue to be produced under this scenario to meet market demand. Pellets have a regular shape, which enables converters to blend them with other pellets with the same physical form and avoid separation. The melt process to convert chips to pellets also enables a further filtration step to reduce contamination and also enables the introduction of additives such as colours or antioxidants etc.
- 5.4.9 A less optimistic scenario was investigated. In option B scenario 2, of the extra amount of recycled plastic produced each year (beyond the quantity for 2007) 1/5 is sold as chips and 5/6 is converted into pellets. Table 7 gives the tonnes of chips and pellets produced over the period, under this scenario.

Table 6: Option B scenario 1

Year	2008 000's tonnes	2012 000's tonnes	2017 000's tonnes
Chips (1/10 2007 level of recycling, 1/3 above 2007 level)	45-60	71-96	97-123
Pellets (9/10 up to 2007 level and 2/3 above 2007 level) tonnes per year	192-222	244-292	295-347

Table 7: Option B scenario 2

Year	2008 000's tonnes	2012 000's tonnes	2017 000's tonnes
Chips (1/10 2007 level of recycling, 1/6 above 2007 level)	30-37	43-55	56-69
Pellets (9/10 up to 2007 level and 5/6 above 2007 level) tonnes per year	208-245	273-333	337-402

¹³ This scenario was provided by the TAG as a realistic outcome of the Quality Protocol. It was thought to be the more optimistic scenario. The Quality Protocol could result in a lower level of chips sold by recyclers.

5.5 Methodology

- 5.5.1 The method used to assess the impact of the Quality Protocol involves comparing option A (baseline) with option B.
- 5.5.2 The quantifiable benefits and costs of the Quality Protocol were calculated for each year over a 10 year period. They were then discounted at 3.5 per cent (following Green Book guidance (reference 6)) and summed to provide the total present value benefit or cost. A 10 year time horizon was chosen in line with recent Defra Regulatory Impact Assessments (RIAs), with the financial year 2008/09 used in year 1 (assessment period 2008 to 2017). All benefit and cost flows were assumed to stay constant in real terms. In other words it is assumed that they rise in line with inflation. The analysis uses 2007 prices.
- 5.5.3 The model used involves several simple assumptions. It is an attempt to give an indication of the possible benefits of the Quality Protocol.

6. Costs and Benefits to Industry of the Quality Protocol

6.1 This section sets out the costs and benefits of the Quality Protocol to industry, including the sectors and groups affected.

6.2 Benefits of the Quality Protocol

6.2.1 If the point of recovery is moved from its current position (when post consumer plastics have been through a heat process; see Figure 1) back to where they have been sorted and size reduced (in the form of chips) then the possible benefits could include:

- i. An increase in demand for chips from converters because the waste classification no longer applies. Some recyclers may be able to increase the price of chips (assumed £30 to £60 per tonne¹⁴) if they comply. If more chips are sold relative to the baseline, and there is an increase in price relative to the baseline, then producers would gain.
- ii. A cut in costs for recyclers who would under the baseline have produced pellets, but who now produce chips instead. It costs an extra £80 to £120 (reference 5) per tonne to produce pellets. Some of the energy cost savings may be passed onto plastic converters if the price of Quality Protocol compliant chips is lower than that for pellets. The extent of the sharing of the cost saving between recyclers and converters was not investigated.
- iii. Plastic converters who buy Quality Protocol compliant chips will no longer need to comply with waste regulations. This benefit is small. Waste management exemptions that converters need are free (although there will be a reduced administrative burden as they will no longer need to apply for exemptions). If converters collect waste from producers, they will need to register as waste carriers, which costs approximately £100 (subsistence charge) over three years. Due to the difficulty in determining the number of exemptions used it has not been possible to calculate this cost.
- iv. The increase in the amount of chips and decrease in the amount of pellets relative to the baseline will result in carbon savings. Producing a tonne of chips emits 60kg of CO₂. Producing a tonne of pellets emits 230kg of CO₂.¹⁵
- v. If the Quality Protocol results in an increase in the amount of plastics recycled and the waste plastic would have gone to landfill in the baseline, then there will be a reduction in disposal costs. In addition, firms along the recycled plastic supply-chain may benefit from increased profits. If the increase in recycled plastic displaces virgin plastic then the Quality Protocol will also result in carbon savings. Production of a tonne of virgin polymer emits 2600kg of CO₂.¹⁶
- vi. When chips are converted to pellets just to avoid the waste classification there is an unnecessary heat process. Recycled plastics can only go through a certain number of heat processes and still be useable. A benefit of the Quality Protocol is that it potentially increases the amount of times plastics can be recycled.

¹⁴ Personal communication with the TAG.

¹⁵ Personal communication with the TAG.

¹⁶ Personal communication with the TAG.

Table 8: Benefits of introducing the Quality Protocol

	Total quantified benefits (10 years 3.5% discount rate) 2008 to 2017 (2007 prices)	Benefits of the Quality Protocol that are not quantified but are important	Assumptions used
Scenario 1: of the extra amount recycled beyond the 2007 amount, 1/3 is chips and 2/3 is pellets	<p>£24.8m to £52.2m cost saving over 10 years for recyclers who produce Quality Protocol compliant chips who would switch from pellet manufacture. Part of this cost saving is likely to be passed onto plastic converters if the price of Quality Protocol compliant chips is lower than that received for pellets in the baseline.</p> <p>Carbon savings from producing chips, not pellets (tonnes): 69,857 to 97,468, or using Shadow price of carbon: £1.6m to £2.3m over 10 years.</p> <p>£7.37m to £17.94m over 10 years. Revenue gain for recyclers who would have produced chips in the baseline but sell Quality Protocol chips at a higher price.</p>	<p>When producing chips instead of pellets, an unnecessary heat process is avoided. Recycled plastics can only go through a certain number of heat processes and still be useable. A benefit of the Quality Protocol will be that it potentially increases the amount of times plastic can be recycled.</p> <p>Avoided waste regulation compliance costs if relevant.</p>	<ul style="list-style-type: none"> ■ Of the extra amount recycled beyond the 2007 amount, 1/3 are chips and 2/3 are pellets. ■ The conversion of chips into pellets costs £80 to £120 per tonne. ■ The price of QP chips is £30 to £60 per tonne greater than what the price of chips in the baseline case. ■ 100% of recyclers, who were previously producing chips and would have produced chips even if the QP is not introduced, comply with the QP. ■ The projected levels of recycling in Table 3 are achieved. ■ Avoiding the conversion of a tonne of chips into pellets reduces CO₂ emissions by 0.17 tonnes. ■ There is an increase in recycling of non-WEEE and non-ELV plastics (construction etc) by 1% a year in the baseline.

Table 8: Benefits of introducing the Quality Protocol			
	Total quantified benefits (10 years 3.5% discount rate) 2008 to 2017 (2007 prices)	Benefits of the Quality Protocol that are not quantified but are important	Assumptions used
Scenario 2: of the extra amount recycled beyond the 2007 amount, 1/6 is chips and 5/6 is pellets	<p>£7.1m to £14.9m cost saving for recyclers who produce Quality Protocol compliant chips who switch from pellet manufacture. Part of this cost saving is likely to be passed onto plastic converters if the price of Quality Protocol compliant chips is lower than that received for pellets in the baseline.</p> <p>Carbon savings from producing chips, not pellets (tonnes): 19,959 to 27,848, or using the shadow price of carbon: £0.46m to £0.65m over 10 years.</p> <p>£7.63m to £18.57m: revenue gain for recyclers who would have produced chips in the baseline but sell Quality Protocol chips at a higher price.</p>	<p>When producing chips instead of pellets, an unnecessary heat process is avoided. Recycled plastics can only go through a certain number of heat processes and still be useable. A benefit of the Quality Protocol will be that it potentially increases the amount of times plastic can be recycled.</p> <p>Avoided waste regulation compliance costs if relevant.</p>	<p>As scenario 1, except:</p> <ul style="list-style-type: none"> ■ Of the extra amount recycled beyond the 2007 amount, 1/3 are chips and 2/3 are pellets.

6.3 Sensitivity Analysis

- 6.3.1 Varying the assumptions will result in different benefit results. Table 8 gives the results for the base case.
- 6.3.2 The base case analysis assumes that the WEEE and ELV Directives are successful in achieving the planned levels of recycling shown in Table 3. If, pessimistically, it is assumed they only achieve half the targets then the benefits are almost halved. This is illustrated in Table 9, which shows that the levels of recycling achieved influence the results significantly.

Table 9: Effect of pessimistic WEEE and ELV non-packaging plastic recycling levels on benefits

	CO ₂ saving (tonnes) Over 10 years	CO ₂ saving (£) Over 10 years	Cost saving for recyclers producing chips Over 10 years	Costs of the Quality Protocol for recyclers Over 10 years
Scenario 1	36,558 – 50,364	£0.85m – £1.2m	£12.98m – £26.95m	£0.28m – £0.35m
Scenario 2	7,044 – 9,864	£0.16m – £0.23m	£2.5m – £5.2m	£0.18m – £0.22m

- 6.3.3 The base case analysis also assumes that the level of recycling of non-packaging waste plastic from other sources than WEEE and ELV (construction etc) increases by 1% a year. This may be conservative. However increasing this variable does not have a significant impact on the results, as shown in Table 10.

Table 10: Effect of varying % recycling of non-packaging plastics from other sources on benefits

	CO ₂ saving (tonnes) Over 10 years	CO ₂ saving (£) Over 10 years	Cost saving for recyclers producing chips Over 10 years	Costs of the Quality Protocol for recyclers Over 10 years
Scenario 1	73,318 – 100,930	£1.7m – £2.3m	£26m – £54m	£0.46m – £0.61m
Scenario 2	20,948-28,937	£0.48m – £0.67m	£7.4m – £15.43m	£0.28m – £0.35m

6.4 Costs of the Quality Protocol

- 6.3.4 The analysis assumes that those firms that would have converted chips into pellets in the baseline, but which chose to comply with the Quality Protocol and sell chips gain a cost saving of £80 to £120 per tonne.
- 6.3.5 Estimates are available of the costs of developing REACH compliant data sheets.¹⁷ Total cost is around £11,000 per year,¹⁸ spread over around 7,000 tonnes throughput (£1.5 per tonne testing costs). A lot of this may have to be done anyway irrespective of whether the Quality Protocol is introduced or not. The analysis assumes that half of this can be allocated to the Quality Protocol (£0.75 per tonne).

¹⁷ Provided by Roger Morton (Axion Recycling).

¹⁸ One off costs for understanding the requirements and producing the data sheets were about 10 man days of a senior consultant (£400 per day). £4,000 to produce the documents which should last for 2 years. A possible 3 days per year of time (£1200 per year) to keep up with the regulations. Also had to purchase test equipment with total value £50,000 which will be used 50% of the time for REACH compliance testing. The equipment should last 5 years, so about £5,000 per year capital costs. If allocate 25% of one member of staff to undertake testing (£5,000 per year) for routine testing.

Table 11: Effect of varying assumption of proportion of chips and pellets produced on costs

Scenario	Total NPV cost to recyclers over 10 years
Scenario 1: of the extra amount recycled beyond the 2007 amount, 1/3 is chips and 2/3 is pellets.	£0.45m – £0.6m
Scenario 2: of the extra amount recycled beyond the 2007 amount, 1/6 is chips and 5/6 is pellets.	£0.27m – £0.34m

Note 1: assumes all recyclers producing chips comply with the Quality Protocol

Note 2: uses a Quality Protocol compliance cost of £0.75 per tonne.

6.4.2 The Quality Protocol is voluntary. If recyclers perceive the costs of compliance to be high relative to expected benefits then they can choose to avoid the costs by not complying and still selling material classified as waste.

6.5 Summary Results

6.5.1 Summary results are presented in Table 12. Low and high estimates across both scenarios are combined into a single average value. Annual average estimates of each component are also presented.

Table 12: Summary net financial benefit results

	NPV (10 years, 3.5%)	Annual Average
Benefits		
Cost saving from producing chips not pellets	£24.8	£2.7m
Increased revenue from selling QP compliant chips at a higher price	£12.9	£1.4m
Total	£37.7	£4.2m
Costs		
Compliance cost high over 10 years	£0.4	£0.05m
Net financial benefit (exc. Carbon values)	£37.2	£4.1m
Carbon Dioxide Reductions	£1,245,976 54k tonnes	£154,387 5k tonnes

7. Small Firms Impact Test

- 7.1 The Quality Protocol is a form of deregulation for end users of recycled non-packaging plastic. Regulations tend to impact disproportionately on small businesses so the deregulation of the Quality Protocol is likely to disproportionately benefit smaller end users.
- 7.2 Compliance costs can be disproportionately higher for smaller recyclers but they are likely to benefit overall from the introduction of the Quality Protocol. The fall in production costs should more than compensate. It will benefit recyclers enabling them to sell a product not a waste. The costs and benefits of compliance can be avoided by choosing not to comply.

8. Competition Assessment

- 8.1 The key market affected by the introduction of the Quality Protocol is the non-packaging plastic recycling industry.
- 8.2 The Quality Protocol would not create any barriers to entry into this market and is unlikely to reduce the number of recyclers. Any costs of compliance would not affect some firms substantially more than others and the costs are likely to be more than compensated by the benefits. Existing firms will face the same compliance costs as a new entrants. The regulation would not restrict the ability of firms to choose the price, quality, range or location of their products. It would widen their options.
- 8.3 Recyclers can avoid the cost by choosing not to follow the Protocol and still operate in the market, although if most end users start to demand Protocol compliant material it will become more difficult to avoid compliance. It was not considered necessary to undertake a more detailed competition assessment.

9. Enforcement, Sanctions and Monitoring

- 9.1 If secondary raw materials are produced that fail to comply with the Quality Protocol they will remain waste. In such circumstances, the appropriate waste management controls will apply to their transportation, storage and use.
- 9.2 Evidence of compliance with the requirements of the Quality Protocol may be provided by supply documentation issued to the customer. It is expected that this will include documents showing (in addition to the Safety Data Sheet) (reference 1):
- date of supply
 - quantity by weight/volume and batch
 - name and address of receiving business/establishment
 - nature of receiving business/establishment
 - statement of conformance to the European standard to which the material has been produced
 - statement of conformance to specification agreed between producer and customer
 - statement of conformance to this Quality Protocol
- 9.3 It is suggested that copies of supply documentation should be retained for a minimum of 4 years.

10. Conclusions

- 10.1 There are likely to be significant benefits derived from the introduction and use of the Quality Protocol
- 10.2 In many, but not all, cases the waste classification results in an unnecessary additional melt process for recyclers, who manufacture and sell pellets when chips would be fit for purpose. This results in unnecessary high CO₂ emissions and energy costs for recyclers. Some of the energy cost savings may be passed onto plastic converters if the price of Quality Protocol compliant chips is lower than the price that recyclers would have been able to charge for pellets. The extent that the cost saving is shared between recyclers and converters was not investigated. The initial analysis suggests that the benefit to the recyclers is likely to outweigh the costs of complying with the Quality Protocol.
- 10.3 The analysis estimates that the Quality Protocol could lead to production cost savings of up to £52.2m over 10 years. Part of this may be shared with plastic converters. Recyclers that would have produced chips anyway and that comply with the Quality Protocol may be able to raise their prices relative to the baseline. The analysis estimates possible increased revenue of up to £17.94m over 10 years. CO₂ emission benefits could be up to 97,000 tonnes over 10 years at a present value of up to £2.3m.
- 10.4 The removal of the unnecessary CO₂ emissions and the associated energy costs represents an overall efficiency gain from society's perspective.

11. References

1. Environment Agency and WRAP, 2007 The Quality Protocol for the manufacture of secondary raw materials from waste non-packaging plastics.
2. Environment Agency and WRAP, 2007 Technical Report on the Manufacture of Secondary Raw Materials from Waste Non-packaging Plastics.
3. WRAP, 2006 UK Plastics Waste: A Review of Supplies for Recycling, Global Market Demand, Future Trends & Associated Risks.
4. Waste Watch www.wasteonline.org.uk. Plastics in the UK Economy.
5. Questionnaire responses from Paul Davidson (Waste & Resources Action Programme); Mark Burstall (British Plastics Federation Recycling Council) and James Woodcock (National Industrial Symbiosis Programme).
6. HM Treasury, 2003 The Green Book. Appraisal and Evaluation in Central Government. 3rd edn. Available from <http://greenbook.treasury.gov.uk/>
7. Defra, 13/08/07 How to Use the Shadow Price of Carbon in Policy Appraisal. Interim Guidance.

12. Specific Impact Tests: Checklist

Use the table below to demonstrate how broadly you have considered the potential impacts of your policy options.

Ensure that the results of any tests that impact on the cost-benefit analysis are contained within the main evidence base; other results may be annexed.

Specific Impact Tests: Checklist		
Type of testing undertaken	Results in Evidence Base?	Results annexed?
Competition Assessment	Yes	No
Small Firm's Impact Test	Yes	No
Legal Aid	No	No
Sustainable Development	No	No
Carbon Assessment	Yes	No
Other Environment	No	No
Health Impact Assessment	No	No
Race Equality	No	No
Disability Equality	No	No
Gender Equality	No	No
Human Rights	No	No
Rural Proofing	No	No

Appendix A: Technical Advisory Group Membership

Organisation	Representative	Type of Member
Axion Recycling	Roger Morton	Attending
British Plastics Federation	Peter Davis	Attending
British Plastics Federation recycling council	Mark Burstall	Attending
Environment Agency	Suzanne Laidlaw	Attending
	Michelle Steer	Attending
	Dominic O'Neill	Attending
	Clare McCallan	Correspondence
	John Comber	Correspondence
Environment Agency Wales	Rebecca Favager	Correspondence
SEPA	John Harris	Correspondence
Scott Wilson Plc	David Smith	Attending
Veolia	Sabrina Rubio	Attending
WRAP (Waste & Resources Action Programme)	Paul Davidson	Attending
	Sarah Clayton	Attending
	Olwen Cox	Attending

Appendix B: Assumptions used in the Analysis

The analysis assumed that:

- levels of predicted waste and recycling for WEEE and ELV are as in reference 3 and Table 3. The analysis assumes that the ELV and WEEE directives are successful;
- the Quality Protocol does not increase the amount of recycling of non-packaging plastics;¹⁹
- the Quality Protocol results in more chips and fewer pellets being produced relative to the baseline. Recyclers who currently produce pellets will continue to do so. The analysis assumes that the Quality Protocol will result in between 1/6 and 1/3 being sold as chips. It assumes that between 5/6 and 2/3 will be used to produce pellets. The baseline assumes that, of the extra non-packaging plastics recycled, 1/10 are sold as chips and 9/10 are sold as pellets;²⁰
- recyclers who follow the Quality Protocol and would have sold chips in the baseline will be able to increase their prices by between £30 and £60 per tonne relative to the baseline;²¹
- it costs an extra £80 to £120 per tonne to produce pellets from chips (reference 5);
- 60kg and 230kg of CO₂ is emitted per tonne of chips and pellets produced respectively. Therefore selling a tonne of chips instead of a tonne of pellets reduces CO₂ emissions by 170kg or 0.17 tonnes;²²
- the analysis uses the shadow price of carbon (£26 per tonne of CO₂ for 2007 and in 2007 prices increasing by 2% a year (reference 7)); and
- all recyclers who would have produced chips in the baseline comply with the Quality Protocol.

19 View of the TAG.

20 The TAG developed the scenario that 1/3 would be chips and 2/3 pellets. This was seen as the upper limit of what is possible and so the benefits of a less optimistic scenario was investigated.

21 Provided by the TAG.

22 Provided by the TAG.

**Waste & Resources
Action Programme**

July 2008

The Old Academy
21 Horse Fair
Banbury, Oxon
OX16 0AH

Tel: 01295 819 900
Fax: 01295 819 911
Email: info@wrap.org.uk
www.wrap.org.uk

Helpline freephone
0808 100 2040



**Environment
Agency**

www.environment-agency.gov.uk

Tel: 08708 506 506

E-mail: enquiries@environment-agency.gov.uk

