



**Environment Group Research Report**  
**Proposed Plastic Bag Levy -**  
**Extended Impact Assessment**  
**Volume 2: Appendices**

2005  
Research Report 2005/06

# **Proposed Plastic Bag Levy - Extended Impact Assessment Final Report**

## **Volume 2: Appendices**

James Cadman, Suzanne Evans  
Mike Holland (ERMC)  
Richard Boyd (Metroeconomica)

AEA Technology Environment

Scottish Executive 2005  
Environment Group Research Report 2005/06

## Contact

Further copies of this report are available:

- On the Scottish Executive website at:

[www.scotland.gov.uk/publications](http://www.scotland.gov.uk/publications)

The views expressed in this report are those of the researchers and do not necessarily reflect those of the Scottish Executive Environment and Rural Affairs Department or Scottish Ministers

© Crown Copyright 2005

Limited extracts from the text may be produced provided the source is acknowledged. For more extensive reproduction, please write to the Environment Group Research Co-ordinator, Scottish Executive, Area 1-J (south), Victoria Quay, Edinburgh, EH6 6QQ

© Crown copyright 2005

ISBN: 0-7559-2686-2

Scottish Executive  
St Andrew's House  
Edinburgh  
EH1 3DG

Produced for the Scottish Executive by Astron B42644 08/05

Published by the Scottish Executive, August, 2005

Further copies are available from  
Blackwell's Bookshop  
53 South Bridge  
Edinburgh  
EH1 1YS

The text pages of this document are printed on recycled paper and are 100% recyclable.

# Acknowledgements

This report was commissioned by the Waste Strategy Team in the Environment and Rural Affairs Department at the Scottish Executive. The report was produced by AEA Technology Environment and associates.

The project managers for the Scottish Executive were:

Simon Stockwell, Tel 0131 244 0200, e-mail [Simon.Stockwell@scotland.gsi.gov.uk](mailto:Simon.Stockwell@scotland.gsi.gov.uk)

Gillian Smith, Tel 0131 244 0243, e-mail [Gillian.C.Smith@scotland.gsi.gov.uk](mailto:Gillian.C.Smith@scotland.gsi.gov.uk)

AEA Technology Environment is grateful for the direction and support received from the steering committee throughout this project:

- Scottish Executive Waste Strategy Team
- Carrier Bag Consortium
- Convention of Scottish Local Authorities (CoSLA)
- Friends of the Earth Scotland
- Scottish Retail Consortium
- Scottish Environment Protection Agency (SEPA)

# Glossary

ARA	Australian Retailers Association
BRA	Belgian Retail Association
BRC	British Retail Consortium
CBC	Carrier Bag Consortium
CoSLA	Convention of Scottish Local Authorities
Defra	Department for Environment, Food and Rural Affairs (London)
ERM	Environmental Resources Management
HDPE	high density polyethene (polyethylene)
INCPEN	Industry Council for Packaging and the Environment
KSB	Keep Scotland Beautiful
LCA	Life cycle assessment
LDPE	low density polyethene (polyethylene)
LEAMS	Local Environmental Audit and Management System
MCS	Marine Conservation Society
NO <sub>x</sub>	nitrogen oxides
ONS	Office of National Statistics
RMIT	Royal Melbourne Institute of Technology
SME	small-to-medium enterprise
SRC	Scottish Retail Consortium
SWAG	Scottish Waste Awareness Group
UCD	University College Dublin
VOC	volatile organic compound
WRAP	Waste and Resources Action Programme

# Contents

Appendix 1. International Context – Experience Elsewhere	7
Republic of Ireland	7
France	9
Australia	10
Belgium	11
Denmark	11
Switzerland	11
Canada	11
USA	11
Hong Kong	11
Taiwan	12
South Africa	12
Bangladesh	12
India	12
Appendix 2. Retail Context	13
B&Q	13
The Co-operative Group	14
Asda	14
IKEA	14
Lidl	14
Next	14
Appendix 3. Life Cycle Analysis Background Information	15
Further Environmental Life Cycle Information on the Various Bag Alternatives	34
Appendix 4. Distribution of Revenue by Local Authority	37
References	41



## Appendix 1. International Context – Experience Elsewhere

### Republic of Ireland

The Irish Government introduced the PlasTax on plastic bags (HDPE and degradable plastic) in spring 2002 at a time when 1.2 billion bags were being used annually. The PlasTax was introduced because of the same concerns as in Scotland, i.e. litter, resource use and respect for the environment [EuroCommerce, Pringle, Reusable Bags]. Recycling was not considered a viable option as the Republic of Ireland lacks the necessary infrastructure. It is estimated that plastic bags make up less than 1% of land litter in the Republic of Ireland, with less than 1% of all bags actually being littered [EuroCommerce].

The levy was set at €0.15 (£0.10) on most single-use bags sold to consumers at retail outlets of any kind, with the raised money being set aside for environmental improvement schemes. The levy is intentionally high so as to be off-putting to consumers – effecting change in consumer behaviour is one of its main objectives.

Some plastic bags are excluded from the levy:

- Those sold for over €0.70 (approximately £0.48), i.e. re-usable ‘bags for life’.
- For hygiene reasons, those meant to contain loose, unpackaged foods, such as fresh meat and fish, fruit and vegetables.

Key features of the Irish scheme have been:

- An education campaign prior to the introduction of the levy – TV and billboards with emotive angle [UCD].
- A clear driver – visible litter was cited as a problem in rural areas and was a serious concern to the tourism industry.
- Levy charged at point-of-sale.
- Minimal effort for compliance.
- Ability to track levy evasion.
- A significant levy charge that is high enough to be ‘off-putting’ to consumers – consumer apathy was seen as high.
- Availability of reusable bags.
- Levy applied to biodegradable bags too (not seen as an environmentally friendly alternative).
- An existing online levying system that major retailers were already used to.

The scheme operates as follows. Every quarter retailers send a direct debit slip to the Collector-General in Limerick. The Revenue Commissioners were provided with initial set-up costs of €1.2 million, earmarked for new computer systems and increased resources to administer the levy.

They also receive €300,000 per year for ongoing costs [UCD]. Payment is by electronic debiting of the retailer’s bank account. An online system for this, the Revenue Online System

(ROS), was in place prior to the introduction of the levy. There has been only one prosecution to date, this has explained by the practice of visiting any retailer not complying, their non-compliance verified and a warning issued. Only a few hundred out of around 50,000 retailers have been subjected to this process [communication from Terry Sheridan, the Department of Environment, Heritage and Local Government, Republic of Ireland].

In the first year of operation, the scheme raised some €10–12 million (£7–8 million) [DEH], which was substantially less than anticipated. Use of lightweight plastic carrier bags fell by around 90%, with a significant increase in the use of ‘bags for life’ [EuroCommerce]. Before the introduction of the levy, the expectation by retailers was that the reduction would plateau at around 95% of the consumption rate [EuroCommerce]. This level of reduction has been confirmed by the Department of Environment, Heritage, and Local Government, with revenue levels at €1 million per month. The funds have been used to support waste recycling and litter initiatives. Waste recycling infrastructure, ongoing running costs and dedicated staff to enforce legislation (e.g. to tackle illegal dumping) have been introduced.

A survey of retailers conducted a year after the levy’s introduction found that they felt the effects of the levy on them were generally positive or neutral [UCD]. The additional costs of implementation and bookkeeping were seen as modest and, in actual fact, they were generally less than the savings that retailers were enjoying from buying fewer lightweight plastic carrier bags. After an initial rise in theft, retailers reported that it had returned to levels before the introduction of the levy. A similar survey conducted with householders of varying social and economic standing gave a consistent response – the levy was a good thing overall for the environment and was not a problem for the consumers [UCD]. The Department of Environment, Heritage and Local Government plans to conduct a survey towards the end of 2005, three years after the introduction of the PlasTax.

However, concomitant with the massive drop in the numbers of shopping bags used was a significant increase in the numbers of plastic bin liners and refuse sacks purchased [WRAP 2004a]. The Department of Environment, Heritage and Local Government has confirmed that their sales have trebled. This increase is believed to be a direct consequence of people changing their habit of using their shopping bags a second time as free bin liners and instead purchasing tailor-made bin liners. A study by EuroCommerce questions where the environmental benefits are to be gained from this, though it goes on to state that most shopping bags are imported from Asia while rubbish bags are manufactured in Europe [EuroCommerce]. One environmental benefit would seem to be the reduced transport and distribution of the bin bags compared with the shopping bags. There are also potential commercial benefits to the EU bin liner manufacturing industry.

The levy is not imposed on paper bags in Republic of Ireland. LCAs have shown, however, that they are the least sustainable or environmentally friendly option for carrier bags, see Appendix 3. The numbers of paper bags used in Republic of Ireland has risen, this increase is reported to be mainly in ‘high street’ non-food retailers. There are also reports that two bags are often used together to prevent ripping. Such behavioural patterns will ultimately lead to a higher environmental burden. However, paper bags have not replaced plastic bags (reusable or disposable) as the preferred bag of choice.

On the issue of litter, reports suggest that plastic bags make up less than 1% of the waste stream by weight in total. It is also estimated that only around 1% of all plastic bags become litter. There is no direct data to hand to state whether or not the levy has had an effect on

litter, despite this being one of the key drivers for implementation [EuroCommerce]. If consumption is down by 90%, however, one can only conclude that it has.

The conclusions from the UCD study of the Irish plastics bag levy were that:

- Costs to the Government taxation system for set-up, advertising and administration are modest.
- Costs to retailers for collecting and processing the levy are also modest. They are readily subsumed into their accounting procedures and far outweighed by the money gained from buying fewer disposable bags and selling more bin liners.
- There has been a substantial reduction in the number of bags used (90%). This has resulted in a publicly perceived, but not proven, reduction in the amount of visible litter.
- There is widespread consumer support for the levy. There is no evidence that the unemployed or people on a low income feel disadvantaged by the levy.
- Awareness of environmental issues in general has been raised nationwide in Republic of Ireland.

The scheme has raised around 10% of the revenue originally anticipated due to its success in diverting the public away from using ‘disposal carrier bags’.

Further to the PlasTax levy on plastic carrier bags, the Irish government plans to extend its remit to a voluntary agreement with industry to phase out polystyrene packaging from fast food in favour of biodegradable alternatives. Under the Environment Ministry’s anti-litter strategy, other targets will include bank machine receipts and chewing gum. However, the introduction of compulsory levies, particularly for chewing gum, has been threatened if the voluntary agreements and measures are insufficient to achieve change. [ENDS Daily]

## France

An opinion poll of the French population in 2003 found that 50% wanted to keep free plastic bags while 47% were willing to have to pay for reusable bags. The French Retail Association and the public authorities agreed a plan to change the habits of consumers in France. In summary, this plan aims to:

- Increase consumer awareness at the point-of-sale.
- Offer alternatives such as reusable bags.
- Improve technology (recycling, degradability) and ecolabelling of bags.

Various French supermarket chains have devised their own methods for achieving these goals. These have included:

- Staff training.
- Offering reusable, biodegradable and paper bags as well as conventional plastic bags.
- Setting targets for reducing plastic bag use.
- Undertaking LCAs (Carrefour study).
- Collection of old lightweight plastic bags for recycling.

- Printing ecolabels on bags satisfying agreed criteria (NF Environnement – the French National Ecolabel<sup>1</sup>).
- Offering heavy-duty reusable bags to people who spend more than €10 on goods in one transaction.

A referendum was undertaken in Corsica as to which type of bags were preferred. This offers some interesting insight into consumer preferences when faced with a cost [Eco-emballages, EuroCommerce]. People voted as follows:

- 61% for reusable bags, sold for €1 and exchangeable for free when worn out.
- 19% in favour of paper bags, sold for 8 cents.
- 13.5% in favour of biodegradable bags, sold for 5–14 cents.
- 6.4% blank vote.

In response, all plastic bags in Corsica were replaced in the summer of 2003 by reusable and paper ones.

## Australia

The Australian carrier bag situation could be said to be more extreme than that in Scotland [Pringle, Reusable Bags]. Approximately 6.9 billion supermarket shopping bags are consumed each year in Australia [DEH, RMIT]; with a population of 20,281,168 [Aus Stats], this equates to 341 bags per person per year.

The Australian Government has been considering a levy on lightweight plastic HDPE bags similar to that in Republic of Ireland, with a levy of AUS \$0.25 (about £0.10) on each bag. A two-year deferral was agreed until the end of 2004 to see if voluntary reuse and charging schemes would be successful enough to reduce plastic bag consumption by 25% by the end of 2004 and then by 50% by the end of 2005. In the first six months, there was a 29% reduction in the use of lightweight plastic carrier bags [WRAP 2004c]. Other short-term and long-term plans will be put in place, e.g. education to promote a shift to using reusable bags and to improve recycling rates. The chief aim of any levy would be to reduce litter and increase public awareness of littering and environmental issues [EuroCommerce].

Several towns in Australia (e.g. Coles Bay in Tasmania) have introduced voluntary bans on the use of plastic bags [NSW]. Retailers agreed with Planet Ark not to use plastic bags; instead, calico cloth bags were supplied to all residents, while visitors must pay for either a calico or a paper bag. If, for hygiene reasons, paper bags are not allowed, biodegradable starch bags are offered. Other towns are following suit.

A recent report from Nolan-ITU in Australia indicates that bag usage fell by 20.4% between 2002 and 2004 through the voluntary code of conduct agreed by retailers [Nolan-ITU]. This is broken down into supermarkets reducing usage by 25% and non-supermarket retailers reducing usage by 10–15%. However, the Australian Government is determined to continue this trend to the extent of phasing out plastic bag use completely by 2008.

---

<sup>1</sup> The criteria do not allow heavy metals (Cd, Pb, Hg) or white pigments in inks.

## Belgium

A levy was proposed in Belgium in 2004 but was resisted by the Belgian Retail Association. Its alternative proposal, which has been undertaken by Belgian retailers, was to raise the awareness of the consuming public of the need to use and dispose of lightweight plastic carrier bags responsibly and properly. Much as in France, the scheme also involves promoting and maximising reusable options as well as training staff.

## Denmark

A levy has been in place in Denmark since 1994. However, it is enforced on the retailer when they buy bags rather than on the final consumer. Therefore, the costs can be absorbed in the cost of products and, as such, consumer behaviour change is not the direct target as in the Republic of Ireland. Even so, use of paper and plastic bags has fallen by two-thirds [DEH, Reusable Bags].

## Switzerland

A levy scheme already exists in Switzerland, where bags cost around 10p, but most Swiss shoppers use their own bags [Reusable Bags].

## Canada

The Canadians have taken a different approach to most other nations in trying to solve the issue of plastic carrier bags. In many areas across the country, they have successfully instigated kerbside collection of all kinds of plastic films – not just carrier bags – including:

- Plastic pouches (milk, rice, soups, etc).
- Food and bread bags.
- Outer packaging for kitchen towels and toilet paper, etc.

These are collected along with other recyclable materials usually collected by municipal authorities such as glass, paper and metal [DEH].

## USA

The city of San Francisco is considering a levy of 17 cents on carrier bags, plastic and paper in order to reduce the problems of waste and litter of the 50 million or so bags used per year within the city. The aim is to encourage consumers to switch to more sustainable reusable bags and to recycle the plastic bags they do use, rather than disposing them to landfill [San Francisco Chronicle].

## Hong Kong

In Hong Kong, which probably has the highest use of bags per person, a scheme was implemented to encourage the reuse of bags. Retailers above a certain size are also prohibited from giving away free bags. Together, these actions are intended to educate the public on making more environmentally sensitive choices [DEH, Reusable Bags].

## Taiwan

Free lightweight plastic carrier bags have been banned from use in a phased approach since 2003. Initially, this applied to government agencies and schools, but was extended to shops and fast food outlets and finally to street food dealers. The ban has also been extended to disposable cutlery and dishes [DEH, Eco-emballages, Reusable Bags].

## South Africa

After initially wanting to ban plastic bags outright, all sides have negotiated a levy on bags, paid for by the consumer, akin to the Irish model [DEH, Reusable Bags]. Recycling rates for plastic bags are low in South Africa, less than 1% [FRIDGE], due to the restricted demand for recycled products and because collection is not economically viable.

## Bangladesh

Bangladesh's capital city Dhaka was flooded in both 1988 and 1998. An investigation found that, apart from the volume of rain, the main culprit was plastic bags that had blocked the city's drains and therefore impeded the flow of water away through the sewers to the rivers and out to sea. A ban was imposed in 2002 on all polyethene bags in the capital alone but is now being considered for nationwide implementation. [DEH, Reusable Bags].

## India

A similar situation exists in India as in Bangladesh, where littered plastic bags have caused the blockage of storm drains. To alleviate this problem, the authorities in Bombay banned the manufacture of plastic carrier bags in 2000 as well as imposing strict one month trading suspensions on any retailer caught using plastic bags [DEH].

## Appendix 2. Retail Context

We informed BRC and SRC of this study and attended a meeting at BRC to outline our objectives in more detail.

As mentioned elsewhere, BRC and SRC are investigating the development of a voluntary code of conduct, which they believe would be preferable to the introduction of a levy.

We also contacted a number of retailers in order to understand their views on the impacts of a levy. However, different types of retailers have different consumer patterns and needs, and it may not be possible to compare a supermarket's experiences directly with those of a DIY store.

In terms of system needs for compliance, larger retailers will find this easier, having computerised systems and greater resource available. Smaller retailers (e.g. newsagents, butchers, etc.) may well not have such systems and the levy would thus represent a greater burden to them. As a minimum, it is anticipated that retailers will need to have an auditable system recording carrier bags sales and to be able to account for bags in stock, reconcile sold versus stock remaining, submit records (quarterly in the Republic of Ireland) and submit payment. Some retailers have commented that, if they were forced to switch to paper bags, these would probably not be sourced from within the UK, as they are too expensive, but would come from the Middle East, which would increase environmental burdens through transportation.

### B&Q

In Scotland, B&Q stores are voluntarily undertaking a trial of charging customers 5p per plastic bag. The trial started on 29 October 2004 and was due to be reviewed in March or April 2005. B&Q also has stores in the Republic of Ireland and already has positive experiences of implementing the plastic bag levy there. To date, its experience in Scotland has been very positive and very similar to its experience in the Republic of Ireland in terms of influencing customer behaviour. Demand for plastic bags in its Scottish stores has fallen by 85% compared with 90% in the Republic of Ireland. Due to this success, B&Q is likely to carry on with the scheme – it has received very few complaints as well as some very positive press.

Alan Ferguson from B&Q, who is leading the trial, has had to personally deal with only four unhappy customers and he reports that complaints have been far outweighed by customers praising and supporting the stance taken by B&Q.

B&Q undertook the trial in Scotland to underpin its environmental and corporate social responsibility credentials, which are highly developed across the group.

B&Q gives the whole 5p per bag (less VAT) to Keep Scotland Beautiful to be used for anti-litter promotional campaigns in Scotland.

## The Co-operative Group

The Co-op Group changed to using biodegradable plastic bags (synthetic polymer with additives to initiate fragmentation) in response to customer demand to address packaging waste. This concern was highlighted in a customer survey, *Shopping with Attitude*, undertaken for the Co-op Group. The Group is against a levy on biodegradable, paper and cotton bags.

## Asda

A research project is being undertaken to promote ‘bags for life’ in Wales by Asda and the Wales Environment Trust. For the first six weeks of the project, all plastic carrier bags will be removed from Asda stores and replaced with stronger ‘bags for life’ at no charge. There will also be a simultaneous and intensive in-store ‘reuse’ campaign. In the following 4–5 weeks, the lightweight plastic carrier bags will be reintroduced and a small charge levied on the ‘bags for life’. The impact of the campaign will be monitored using Asda’s existing statistical systems and should be able to provide much useful information to the plastic bag levy debate. No further information on this project was available at the time of writing this report.

## IKEA

Prompted by Mike Pringle’s Bill, IKEA’s Edinburgh store started charging 5p for its lightweight plastic carrier bags at Easter 2004 [IKEA]. Any profit gathered from bags bought is ring-fenced for local charities to apply for – ideally with an environmental scheme in mind. Since the store started charging, bag use has fallen from 3 million per year to around 120,000–150,000 per year – a reduction of 95%. Concomitantly, this has raised some £6,000–£7,500 for charitable projects. The feedback from customers is largely good; most people are content either to pay or to use another bag (their own). Some have vocalised their approval, saying it is a good thing that IKEA Edinburgh charges for these bags, while very few have voiced their opposition. The store also makes its larger, more durable bags available for sale to customers. Sales of these bags have increased since they started charging for the HDPE carrier bags. IKEA say there is anecdotal evidence that behaviour has changed, as people have been seen to be bringing their already purchased ‘bags for life’ back to the store on subsequent occasions.

## Lidl

All Lidl’s UK stores charge 5p for its lightweight carrier bags in order to contribute to Lidl’s aim of reducing the costs of the items sold in its shops. Most other stores cover the cost of free carrier bags in the prices of goods sold.

## Next

Next in Republic of Ireland has switched to using paper bags rather than pass on the costs of the levy. Stores with the ‘Home’ brand have found a need to double bag larger bulkier items, especially in wet conditions. Next says it has incurred extra costs of around £1 million to pay for extra storage of paper bags.

We also contacted **Aldi** about its strategies for minimising plastic bag use, but it did not respond to our enquiries.

## Appendix 3. Life Cycle Analysis Background Information

### What we reviewed

#### LCAs of carrier bags:

- Ecobilan, 2004. Évaluation des Impacts Environnementaux des Sacs de Caisse Carrefour: analyse du cycle de vie de sacs de caisse en plastique, papier et matériau biodégradable. Rapport préparé pour Carrefour. ECOBILAN PwC, Paris, France.
- Franklin Associates, 1990. Resource and Environmental Profile Analysis of Polyethylene and Unbleached Paper Grocery Sacks. Franklin Associates Ltd, Kansas, USA.
- Fenton, R., 1991 The Winnipeg Packaging Project: Comparison of Grocery Bags. Department of Economics, University of Winnipeg, Manitoba, Canada.
- Nolan-ITU, 2002, Plastic Shopping bags - Analysis of Levies and Environmental Impacts. Report for the Department of the Environment and Heritage. Nolan-ITU Pty Ltd, Victoria, Australia.

#### Reviews of LCAs of carrier bags:

- EuroCommerce, 2004. The Use of LCAs on Plastic Bags in an IPP Context. EuroCommerce a.i.b.s., Brussels, Belgium.
- FRIDGE. Socio-economic Impact Assessment of the Proposed Plastic Bag Regulations. Report for the National Economic Development and Labour Council. Bentley West Management Consultants, Johannesburg, South Africa.

#### Findings of the carrier bag LCAs

The Carrefour LCA [Carrefour] showed that the **production** of base materials (chiefly plastic and paper) tends to give rise to the greatest environmental impacts<sup>2</sup> for all types of bag. Bag manufacture has significant effects (at least within the context of the lifecycle) on emissions of air pollutants. In contrast, the use of bags has very little impact on pollutant emissions. At the end of the lifecycle, disposal has a number of significant impacts on littering, generation of solid waste and greenhouse gas emissions. All these impacts can be reduced by not using a bag and through reusing bags. Carrefour found particular benefit from the use of bags that were robust enough to withstand several trips, rather than bags that could at best be expected to last one or two trips.

In the American Franklin report [ARA], paper bags are also shown to be the least environmentally preferable option. This was due to the greater amount of resources (materials and fuels for transport from greater weight per bag) that they require. Compared with lightweight plastic bags, paper bags:

---

<sup>2</sup> Environmental impact assessed in terms of energy use (non-renewable), water use, air pollution greenhouse gases, nitrogen oxides, sulphur dioxide, photochemical ozone creation potential (smog), water pollution (eutrophication), solid waste and possibility of littering.

- Use six times as much raw materials.
- Use three times the energy for manufacture.
- Are six times heavier for the same volume.
- Use ten times the storage/warehousing volume.
- Require seven times the amount of transport and associated emissions.

The Carrefour study draws the same conclusion, although the differences are less extreme for the base case than the North American study. It found that, compared with lightweight plastic bags, paper bags:

- Consume about the same amount of energy.
- Create about the same amount of photochemical oxidants.
- Consume three times the amount of water.
- Create 90% more greenhouse gas emissions.
- Create 80% nitrogen oxide (NO<sub>x</sub>)/sulphur dioxide emissions.
- 12 times the level of eutrophication (nitrate and phosphate pollution to water) and
- 80% more solid waste.

There is a popular misconception that paper bags are more environmentally friendly than plastic bags, with quotes such as *“paper carriers - 'eco-friendly' white and brown take-away style carrier bags with tape handles”* [Polybags]. The LCAs considered here indicate that this is not the case. The response from WRAP to the Scottish Environmental Levy Bill [WRAP 2004a] indicates that a levy that substituted current plastic bag use with free paper bags would be a step in the wrong direction.

The Carrefour study concludes that reusable plastic bags are better than all ‘single-use’ bags for all of the environmental indicators that were considered except littering risk. These results apply if reusable plastic bags are used four times or more and takes into account the fact that free, lightweight plastic carrier bags are often reused once at home. This conclusion is supported by two Australian studies [DEH, RMIT], which show that durable reusable bags have the lowest environmental impacts compared with all types of lightweight plastic carrier bags.

For littering risk, the Carrefour study estimates that paper bags will perform best, with a score superior to that of reusable bags from the perspective of persistence in the environment. Both types of bag scored the same for risk of intentional littering and being unintentionally carried away by the wind. Single-use plastic bags performed worse than both paper and reusable plastic bags in this category.

### **Rationale for using the Carrefour LCA study for analysis in this report**

In order to investigate the advantages and disadvantages of alternative policies on carrier bags, it is useful to be able to repeat LCA calculations using alternative assumptions. Within the scope of this project, it has not been possible to recreate a full LCA analysis and it is instead necessary to adapt information from the earlier studies. With this in mind, it is necessary to identify which of the LCAs provides information that is most relevant to Scotland.

Though useful, the North American studies were not used because:

- Carrier bag consumption patterns in the USA and Canada may differ considerably from those in Europe due to differences in shopping behaviour (e.g. greater use of car transport).
- The studies lack a range of environmental indicators, focusing primarily on energy consumption.
- The studies are over 14 years old and lack the sophistication in modelling and data processing that has been developed recently in LCA techniques.
- Since the publication of the North American studies, there have been major improvements in manufacturing and action by industry to reduce pollutant emissions.

The Australian study (Nolan-ITU 2002) was not used because:

- It lacked a range of environmental indicators, focusing primarily on material consumption, energy consumption and litter.
- It lacked the data required for assessment of environmental impacts based on the scenarios outlined in this report.

The Carrefour study (Ecobilan 2004) was favoured because:

- It is European.
- It considers a suitable variety of bag options.
- It considers a broad range of environmental indicators, though there are some significant gaps in the data covered and indicators used.
- It provides sufficient information for each option and lifecycle stage to enable a summary assessment to be put together for the sensitivity analysis in this report.
- It is based on carrier bag consumption data which we considered reflected consumption patterns in Scotland better than the other studies.

However, its use in Scotland is subject to a number of caveats:

- The source of bags is specific to the Carrefour chain and is thus not the same as it would be in Scotland.
- The electricity mix assumed is different to that of Scotland, particularly for cases such as reusable bags, where production is confined to France. In these cases, the prime source of electricity assumed in the Carrefour LCA is nuclear.
- The main sources of data appear to be from analysis carried out during the 1990s. Given the pace of change in environmental regulation since then, it is possible that there has been a substantial reduction in some types of emissions and that there will be further action in the next few years. For example, the release of volatile organic compounds (VOCs) has fallen as a result of the Solvents Directive and emissions from fossil-based power stations are falling as a result of the revision to the Large Combustion Plant Directive. Major changes in vehicle technologies will have very little impact because the Carrefour study shows that transport of bags has a low level of impact compared with the manufacture of bags. With respect to water pollution, there are also changes (e.g. as a result of the Urban Waste Water Treatment Directive), which may be expected to influence results for eutrophication significantly.

- There are differences in the typical size of bag assumed for Carrefour and that used in Scotland. Results can be adjusted to account for this quite easily, however, as they will scale reasonably directly against the weight of the bags.
- The rationale for some aspects of the Carrefour analysis is unclear and possibly questionable. For example, it appears that greenhouse gas emissions of bags at the end-of-life are treated similarly irrespective of the nature of the raw material inputs. Emissions of carbon dioxide (CO<sub>2</sub>) from the decomposition of paper, for example, can be considered part of the carbon cycle and hence do not add to the total CO<sub>2</sub> load in the atmosphere. However, emissions of CO<sub>2</sub> from plastic bags are additional to the existing CO<sub>2</sub> load because they originate from fossil carbon, previously unavailable to the atmosphere.

The Carrefour study thus provides useful guidance for this work, but care needs to be taken in interrelating its results. For this reason, a number of sensitivities have been explored to test the robustness of the results of our study.

### **Key Assumptions made in the Carrefour Study in Relation to this Analysis**

*The functional unit used in the study is 9000 litres of shopping, estimated as the average household's annual requirement.*

This takes into account the different bag sizes and number of uses of the bag. We believe that the use of a functional unit based on volume is the most sensible functional unit for an LCA of carrier bags. However, it is important to check the functional units carefully before comparing the results reported here with those of other studies.

*The system boundary is defined to include all of the important stages of the lifecycle.*

This is defined to include production of base materials (paper, plastic, ink, pigment, glue, etc.), bag manufacture, disposal at end-of-life and the various transport stages in between. It does not include the impacts associated with building oil refineries, paper mills, etc., as these are assumed to be negligible when normalised over their service life. Transport from shop to home is also excluded, though this should be similar for all bag options given the adoption of a functional unit based on the volume of shopping.

*Bag materials are manufactured and bags are produced in Malaysia, France, Italy or Spain, depending on the type of bag and the location of the shops supplied.*

Less of an assumption than a statement of fact, this position creates difficulty for a Scottish analysis, since most plastic bags used in Scotland will not be manufactured and produced in these countries. Instead, it seems likely that most plastic bags will be manufactured and produced in China, where the energy mix is different to Europe and industry operates to different environmental standards. It is unlikely that most paper bags used in Scotland will be manufactured in Italy, as assumed by Carrefour – some will be manufactured in Scotland, others elsewhere in the world.

Given the importance of the two stages of material production and bag manufacture within the lifecycle, this issue is very important. However, it is useful that Carrefour considers production in a number of countries because it means that results reflect an average across the differing energy mixes and environmental standards in the countries considered. In other words, the Carrefour results are not likely to represent extremes, as would be the case were all bag manufacture assumed to take place in France, where electricity production is dominated by nuclear power to a far greater degree than in other countries.

*For the base case considered here, we take the Carrefour sensitivity run where 100% of bags of all types go to landfill.*

Over 88% of all waste went to landfill in Scotland in 2002/03, around 2% was incinerated and around 10% was recycled [SEPA]. Most recycled material consists of paper, glass and metal. We do not have evidence to indicate whether paper bags are more likely to be recycled than plastic ones. The assumption that 100% of bags go to landfill is slightly pessimistic. More recent figures show that recycling rates in Scotland increased in 2003/04 to an average of 12.3%<sup>3</sup>. However, it is believed that plastic carrier bags will still be going to landfill or incineration, even though there will have been an increase in the recycling of newspapers, glass jars, tins, paper bags, etc. This reflects the fact that there are currently few facilities for, and little uptake of, plastic carrier bag recycling.

It is unlikely that this situation will persist in Scotland given new environmental legislation such as the Landfill Directive that requires a move away from landfill and other measures to promote recycling. However, it is possible to adapt the analysis to alternative assumptions on waste management using the results of some of the sensitivity analysis presented in the Carrefour study.

*HDPE plastic bags, biodegradable plastic bags and paper bags are used once only.*

Reusing bags reduces lifecycle impacts. Many argue that HDPE plastic, biodegradable plastic and paper bags are all reused. Assuming they are all reused to the same extent (we have no convincing evidence to indicate otherwise), their relative environmental impacts will not change. However, if they are reused, they will start to compare more favourably with reusable LDPE plastic bags. Based on the Carrefour results, it appears that it is necessary to reuse an HDPE bag between two and five times in order for it to outperform LDPE bags, which are used four times. This level of HDPE reuse does not seem realistic.

*LDPE bags are used between 2 and 20 times.*

The Carrefour study provides results for reuse of LDPE bags 2, 3, 4 and 20 times. LDPE bags outperform other bags on most indicators after only around three uses and all other bags considered after four uses. Given that these bags are purchased with the objective of multiple usage, it is certainly not unreasonable to assume that they are used at least four times on average.

*Data from technologies used in the 1990s are representative of current manufacturing.*

A common problem with LCA is that it typically uses existing data to answer questions about future policies. It is necessarily assumed in this study that the environmental performance of the various technologies linked to bag production and disposal are the same now and for the next few years, as defined by the Carrefour study which used data taken largely from the mid to late 1990s. This position is taken against a background of steadily evolving environmental regulation in Europe.

*The environmental indicators selected by Carrefour reliably define the environmental risk posed by the different options.*

There are some significant omissions from the indicators considered in the Carrefour report, for example:

- Human health risks from exposure to fine particles.

---

<sup>3</sup> Personal communication from SEPA ahead of the publication of Waste Data Digest 5 containing data for 2003 and 2003/04.

- Ecological and health risks from exposure to heavy metals.
- Ecological risks from deposition of airborne nitrogen (eutrophication of terrestrial ecosystems; eutrophication of aquatic ecosystems is covered in the analysis).
- The quantity of materials such as paper and plastic (other than energy inputs) used to manufacture carrier bags.

While it would have been useful to have data on these aspects, the indicators used are probably sufficient to give reasonably good guidance on the merits of the different options.

Table A3.1 gives more information on the environmental indicators used by the Carrefour study.

**Table A3.1. Environmental indicators**

<b>Environmental indicator</b>	<b>Environmental issue</b>	<b>Performance of different bag types</b>
Consumption of non-renewable primary energy	The world contains limited resources of both minerals and fossil fuels (coal, oil and gas). The depletion of such resources is considered by some to be important when assessing the sustainability of any particular option.	Most energy is used in material manufacture, not in bag production or transport. A reusable plastic bag requires more energy to manufacture, but as it is used several times, there is an overall reduction in the impact compared with lightweight plastic bags.
Consumption of water	Pressure on water resources.	Paper bag manufacture consumes much larger quantities of water than the manufacture of other bag types. This mainly occurs during the production of the paper.
Emission of greenhouse gases	There is now an international consensus that emissions of greenhouse gases are responsible for ‘global warming’ or ‘climate change’. Global warming could lead to substantial changes in global temperatures, weather patterns and sea levels, with subsequent effects in a diverse number of areas, e.g. agriculture, water resources, human health and natural ecosystems.	The main sources of greenhouse gases in the bag LCA are carbon dioxide (CO <sub>2</sub> ) from the combustion of fossil fuels and methane (CH <sub>4</sub> ) from the decomposition of paper bags in a landfill site at their end-of-life. Most greenhouse gas emissions are associated with material manufacture. Paper bags have the largest greenhouse gas emissions, with higher emissions from paper manufacture, bag manufacture and from disposal to landfill.
Atmospheric acidification	Emissions of acidic gases (sulphur dioxide, nitrogen oxides and hydrochloric acid) into the air can have a number of environmental impacts at a local to regional level. These include effects on human health, sensitive ecosystems, soiling and deterioration of building facades, forest decline and acidification of lakes. These acidic gases are released mainly when fossil fuels are burnt.	Key lifecycle stages for atmospheric acidification are material manufacture for all bag types and bag production for paper bags. Impacts from paper bags are greater than those of other bag types.

<b>Environmental indicator</b>	<b>Environmental issue</b>	<b>Performance of different bag types</b>
Ground level ozone formation	Ozone at ground level (tropospheric ozone) is formed by reactions between NO <sub>x</sub> and hydrocarbons or VOCs. The chemical reactions involved are complex and depend on climatic conditions and relative concentrations of NO <sub>x</sub> and VOCs. It is therefore difficult to estimate the magnitude of this impact accurately from total emissions of VOCs and the results should be interpreted with caution.	The key lifecycle stage for ground level ozone formation is material production for all bag types except HDPE lightweight plastic carrier bags, which have much higher emissions in the bag production stage than other bag types.
Eutrophication	The release of compounds such as nitrates and phosphates or organic matter can lead to eutrophication of lakes and, in some cases, rivers and coastal marine waters. The accumulation of nutritive elements in the water leads to the growth of particular types of algae, the subsequent depletion of oxygen in the water, and a change in species living in the water (e.g. the disappearance of fish such as trout).	Paper bags potentially cause much more eutrophication than other bag types due to pollutants discharged to sewer at the material production stage.
Solid waste production	The amount of solid waste produced. This can be also a proxy indicator for environmental problems associated with solid waste disposal (e.g. ground water contamination from landfill sites), although it takes no account of the characteristics of the waste produced or the option selected for disposal.	The paper bag lifecycle produces the most solid waste, partly because more solid waste is produced during paper manufacture and partly because the bag creates a greater weight of solid waste at the end of its lifetime simply by being heavier than an equivalent plastic bag.
Risk of litter	At end-of-life, bags may contribute to litter problems.	Paper bags were assessed as making the least contribution to the litter problem and single-use HDPE bags the greatest.

## Interpretation of LCA results

Before examining the results and the sensitivity of the results to key assumptions, it is necessary to comment on the meaning of the results of the LCA. Most importantly, the LCA indicators do not reflect actual environmental harm, but instead the *potential* to cause harm. Whether this harm actually takes place depends on:

- **The location of activities and emissions.** What is the sensitivity of the receiving environment to each burden? Does a burden act locally (as in the case of eutrophication of waterways) or globally (as in the case of climate change)?
- **The nature of environmental legislation.** For example, how are liquid discharges from, for example, paper mills dealt with? How are landfill sites regulated with respect to methane emissions and leachate collection? How effective is regulation?

On this basis, the *actual* effect of a particular option on any environmental indicator may be very different to that implied by the results of an LCA.

**Table A3.2 Importance of site specificity in relation to the set of environmental indicators used by the Carrefour study**

LCA indicator	Site specificity of burden estimate generated by the LCA is dependent on:	Site specificity of impacts is dependent on:
Consumption of non-renewable primary energy	Assumed energy mix and efficiency of energy use.	Limited site dependency associated with security of energy supply.
Consumption of water	Regulation of water abstraction and use.	Availability of water resource. Proportion of water returned to rivers (etc.) and evaporated to atmosphere.
Acid rain (atmospheric acidification)	Assumed energy mix and efficiency of energy use.	Sensitivity of the receiving environment. More a problem for emissions from northern Europe than southern Europe.
Climate change (emission of greenhouse gases)	Assumed energy mix and efficiency of energy use. Assumption on waste management options used.	Impacts of climate change are not dependent on the site of emission release.
Air quality (ground level ozone formation)	Assumed energy mix. Regulation of emissions from industry and transport.	Complex ozone chemistry, reflecting relative concentration of NO <sub>x</sub> , VOCs, etc.
Eutrophication of water bodies	Regulation of industry alongside the water body.	Other nutrient loads to receiving water bodies (where emissions are direct to rivers, etc.). Level of treatment where liquid waste (effluent) is discharged to sewer.

LCA indicator	Site specificity of burden estimate generated by the LCA is dependent on:	Site specificity of impacts is dependent on:
Solid waste production	Efficiency of manufacturing processes. Extent to which bags are reused.	Fate of waste (reused, recycled, incinerated, landfilled, etc.). Regulation of each waste management option. Availability of waste management options.
Risk of litter	Littering behaviour. Rate of street sweeping Legislation on littering and responsibility for clearing it up.	Amount of litter generated. Public perception of littering. Residence time of litter. Visibility of litter.

A related issue concerns comparison of results between indicators. In real terms, a relatively small change in one indicator may well be more important than an apparently larger change in another one.

### Transport Impact

The environmental impacts of traffic are factored into several of the environmental indicators: non-renewable energy consumption, greenhouse gas emission, water consumption, atmospheric acidification and photo-oxidant formation. The Carrefour report shows that transport does not add significantly to impacts in these areas. It may be argued that the study should also have considered other transport impacts, congestion, noise and accidents. It may be thought that these impacts could be represented through changes in the number of vehicle kilometres travelled. This has not been done, as vehicle kilometres is too crude a measure for representation of impacts on congestion, noise or accidents, as each is more specific with respect to site and time of day than the other impact categories considered.

Further to this, analysis would require consideration of operating practice with respect to bag distribution. Putting these issues together, any quantified assessment of impacts on transport would be speculative. That said, from the data available we can be confident that scenarios 1A and 1B would increase transport impacts, whilst scenarios 2A and 2B would lead to a reduction. However, any change will be small in relation to the overall burdens imposed by traffic in Scotland.

### Analysis based on the Carrefour Study

For reasons given above, the Carrefour analysis was selected as the most suitable for the purpose of the extended analysis within this study. The starting point for this analysis is a series of tables in the Carrefour report that show the relative performance of different types of bag against each of the indicators considered. The base case taken here assumes that all bags are sent to landfill at the end of their service life (Table A3.3):

**Table A3.3 Relative performance of different types of carrier bag against environmental indicators<sup>4</sup>**

Indicator of environmental impact	HDPE bag (lightweight)	Reusable LDPE bag (used 2x)	Reusable LDPE bag (used 4x)	Reusable LDPE bag (used 20x)	Paper bag (single use)
Consumption of non-renewable primary energy	1.0	1.4	0.7	0.1	1.1
Consumption of water	1.0	1.3	0.6	0.1	4.0
Climate change (emission of greenhouse gases)	1.0	1.3	0.6	0.1	3.3
Acid rain (atmospheric acidification)	1.0	1.5	0.7	0.1	1.9
Air quality (ground level ozone formation)	1.0	0.7	0.3	0.1	1.3
Eutrophication of water bodies	1.0	1.4	0.7	0.1	14.0
Solid waste production	1.0	1.4	0.7	0.1	2.7
Risk of litter	1.0	0.4	0.4	0.4	0.2

The results given in Table A3.3 show that paper bags perform worse in all indicators except 'risk of litter'. Reusable bags perform best, provided that they are reused at least four times.

For each levy scenario, we multiplied the total number of bags of each type given in Table A3.4<sup>5</sup> by relative performance from Table A3.3. To allow the predicted change in bin liner consumption to be assessed, it was assumed that the life cycle impacts of manufacturing bin liners is the same as for HDPE carrier bags per unit weight<sup>6</sup>. This is an approximation, which may overestimate the environmental impact of bin liners, and hence underestimate the benefits of the four scenarios.

<sup>4</sup> Source: Table 18 of the Carrefour study. It is assumed that bags are disposed of to landfill at the end of their service life. For each indicator, results are normalised to the lightweight HDPE bag. . The lower the number, the better the environmental performance.

<sup>5</sup> This is the same as Table 4.2 in Section 4 of the main report.

<sup>6</sup> On average bin liners weigh 15g each and lightweight plastic carrier bags 8g each, so the environmental impacts of a bin liner were assumed to be 1.9 (=15/8) times greater than a lightweight plastic bag giving an approximate ratio of 2:1.

**Table A3.4 Estimated carrier bag consumption now ('business as usual') and for the four scenarios<sup>7</sup>**

	Total number of bags consumed under each scenario (millions/year) <sup>8</sup>				
	0	1A	1B	2A	2B
Plastic carrier bag (HDPE, lightweight)	775	78	287	78	287
Plastic reusable bag (LDPE, heavyweight)	8	23	19	29	23
Paper bag (single use)	39	213	161	4	14
<b>Total bags used</b>	<b>822</b>	<b>314</b>	<b>467</b>	<b>111</b>	<b>324</b>
<i>Bin liners</i>	<i>118</i>	<i>208</i>	<i>181</i>	<i>208</i>	<i>181</i>

The results were then normalised so that scenario 0 'business as usual' was set at zero. This allowed the percentage change from the current situation to be seen for the four scenarios (Table A3.5). This information was used to generate Figure 4.2 in Section 4.

**Table A3.5 Relative environmental indicators of levy scenarios**

Indicator of environmental impact	Scenario			
	1A	1B	2A	2B
Consumption of non-renewable primary energy	-31%	-21%	-52%	-37%
Consumption of water	16%	11%	-56%	-39%
Climate change (emission of greenhouse gases)	5%	4%	-55%	-39%
Acid rain (atmospheric acidification)	-17%	-12%	-54%	-37%
Air quality (ground level ozone formation)	-27%	-19%	-53%	-37%
Eutrophication of water bodies	124%	87%	-65%	-45%
Solid waste production	-4%	-3%	-55%	-38%
Risk of litter	-47%	-33%	-50%	-35%

A negative percentage indicates a reduction of burden and therefore an environmental benefit, while a positive number indicates the opposite – a net environmental disbenefit.

<sup>7</sup> Numbers calculated as described in Section 4.3.

<sup>8</sup> Example calculations. For lightweight carrier bags under scenario 1B:  $(30\% \times 775) + (70\% \times 10\% \times 775) = 287$ . For heavyweight carrier bags under scenario 2A:  $8 + [(775 - 78) \times 58\% \times 5\%] + [(39 - 4) \times 70\% \times 5\%] = 29$

## Sensitivity Analysis Based on the Carrefour Study

We were able to carry out a variety of sensitivity analyses taking account of differences in factors such as the potential differences in volume and weight of bags (see Table A3.6) and waste disposal option (drawing on tables from the Carrefour report).

**Table A3.6 Alternative data and assumptions on bag weight and volume**

	Bag weight (grams)		Volume of shopping/bag (litres)	
	Carrefour	Scotland	Carrefour	Scotland
Single-use HDPE	6	8	14	14
Paper bag	52	51, 99*	20.5	14**
Reusable LDPE bag	44	47	37	37
Bin liners		15		

\* Based on data from CBC for three types of paper bag: bag without handles (51g), a basic bag with handles (81g) and a higher quality bag with handles (166 g). The higher figure of 99g is an average of all three bag types. The lower figure assumes that only the lightest bags would be affected by the options considered.

\*\* This sensitivity assumes that people may be inclined to fill paper bags to something less than their true capacity, either so that the top can be folded over to make a handle or due to concern that it may split.

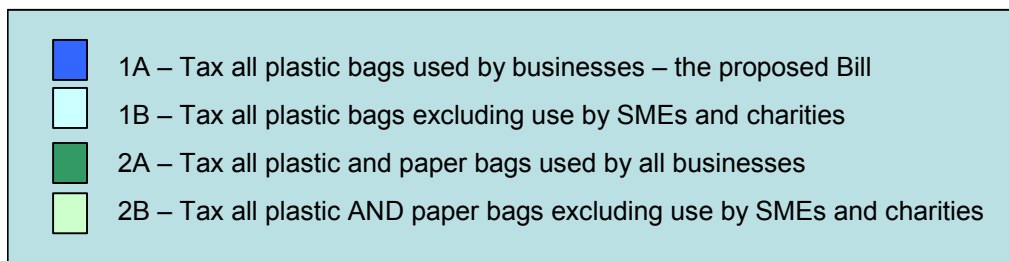
Figures A3.1–A3.6 show the relative performance of each scenario against the full set of environmental indicators for the following sets of assumptions:

- **Figure A3.1:** Base case using Scottish data on the number of each type of bag used and Carrefour assumptions on the weight and volume of shopping for each type of bag. It was also assumed that all bags are sent to landfill at the end of their useful life. (This is Figure 4.2 in the main report)
- **Figure A3.2:** As Figure 3.1, but assuming that paper bags weigh 99g instead of 52 g.
- **Figure A3.3:** As Figure 3.1, but assuming that paper bags are used to contain the same volume of shopping as plastic bags.
- **Figure A3.4:** As Figure 3.1, but assuming that plastic bags weigh 8g instead of the 6g assumed by Carrefour.
- **Figure A3.5:** As Figure 3.1, but investigating the combined effects of an increase in plastic bag weight from 6g to 8g (as in Figure A3.4) and reduction in the average volume of shopping carried in paper bags to 14 litres (as in Figure A3.3).
- **Figure A3.6:** As Figure A3.1, but assuming that waste management follows French practice with 51% of material sent to landfill and 49% incinerated. For paper bags, it is assumed that 45% would be recycled. Use of this scenario is designed simply to show the sensitivity of the overall results to a radically alternative position on waste management. It is not intended to represent future practice in Scotland under the Landfill Directive and other waste management legislation.

For Figures A3.2–A3.5, the change in performance is modelled simply by multiplying the results for the bag types affected by the relative change in weight or volume assumed. In Figure A3.4, for example, the performance of plastic bags is multiplied by a factor of 8/6.

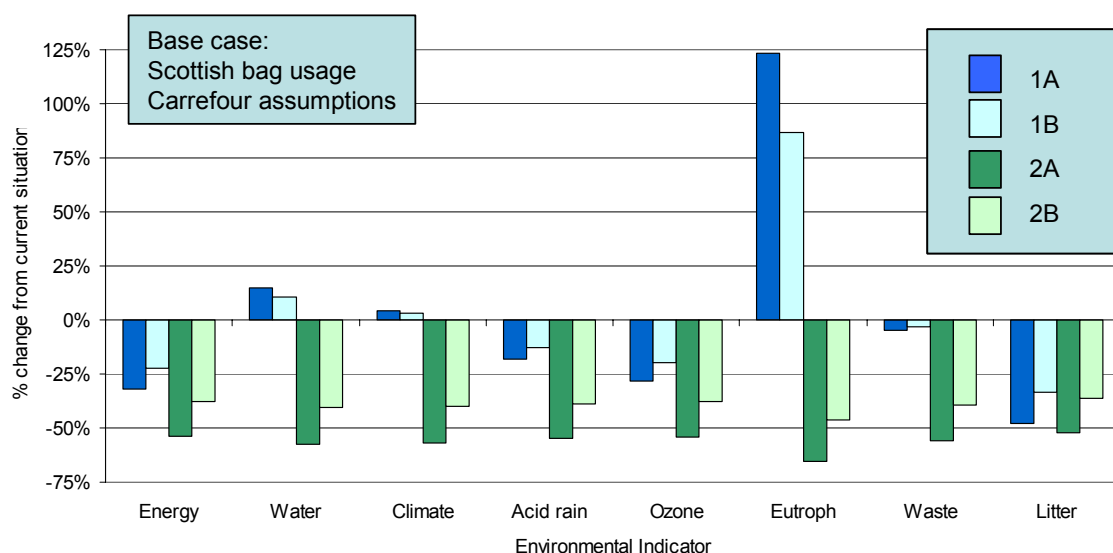
This assumes that impacts in all categories are scalable against the weight of bags. Although this is an approximation, it is likely to give reasonably good guidance on the sensitivity of results to the selected parameters.

**Key to Figures A3.1–A3.6:**

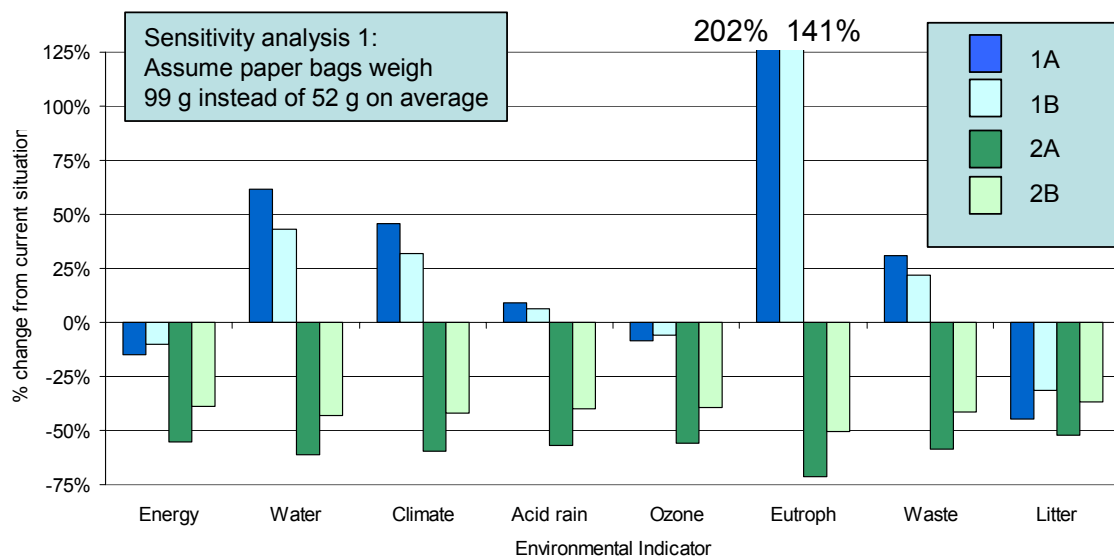


In all the Figures, an increased score shows increased environmental impact and a negative score shows reduced environmental impact.

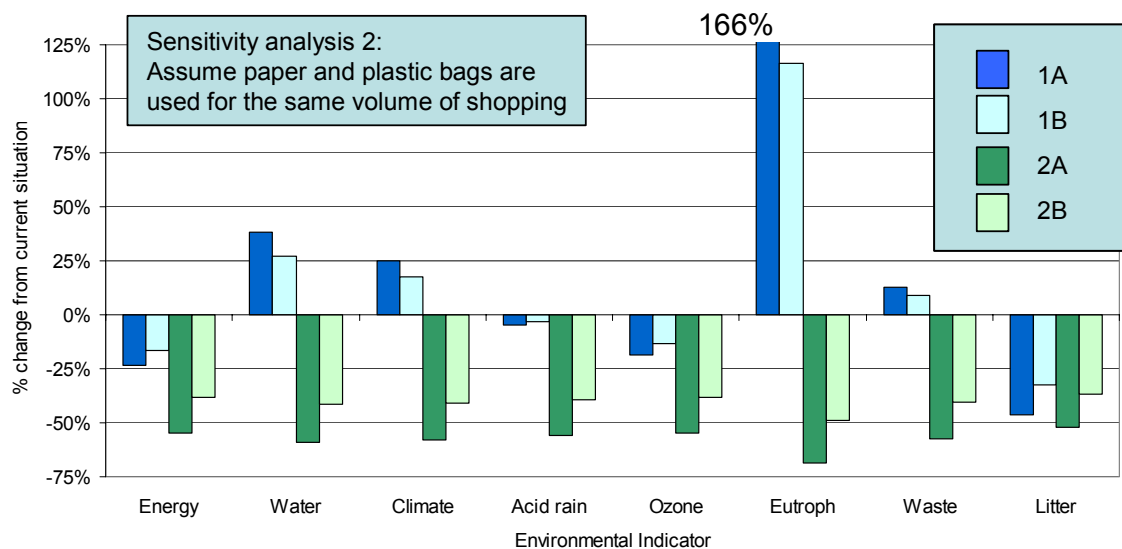
**Figure A3.1. Base case showing the relative change in each environmental indicator for the four levy scenarios compared with business as usual (scenario 0)**



**Figure A3.2 Sensitivity analysis 1: Testing the effect of an increase in the weight of paper bags**

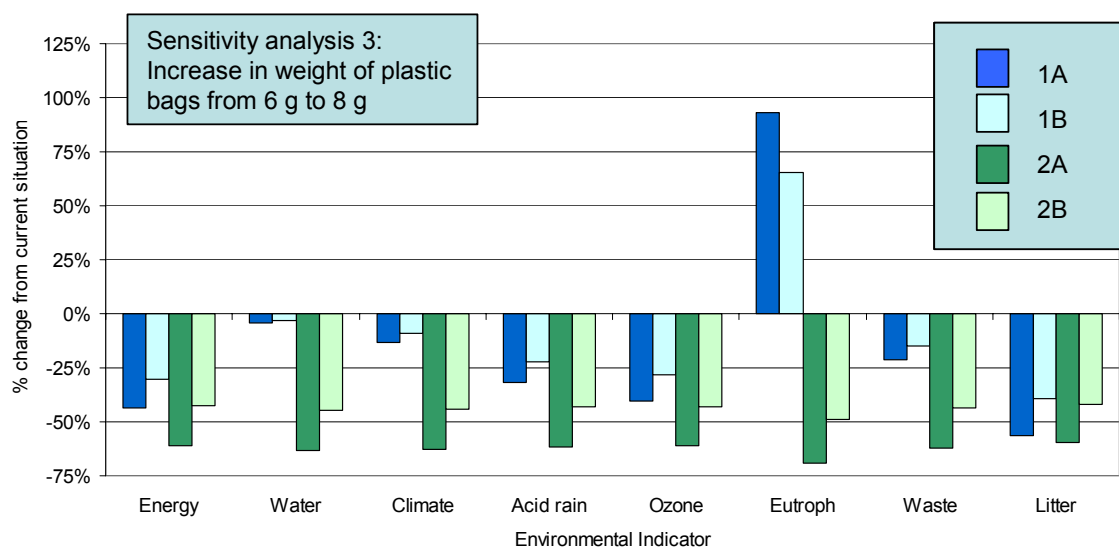


**Figure A3.3 Sensitivity analysis 2: Testing the effect of using paper and plastic bags to hold the same volume of shopping**



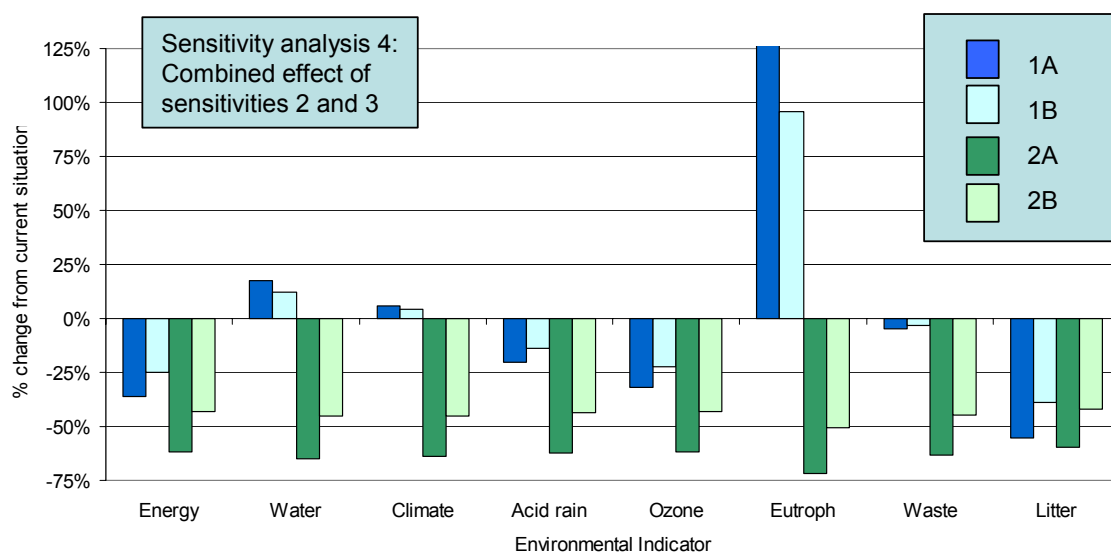
The Carrefour analysis assumes that paper bags hold 20 litres of shopping on average and that HDPE lightweight plastic bags hold 14 litres on average.

**Figure A3.4 Sensitivity analysis 3: Testing the effect of an increase in lightweight plastic bag weight, from 6g to 8g\***

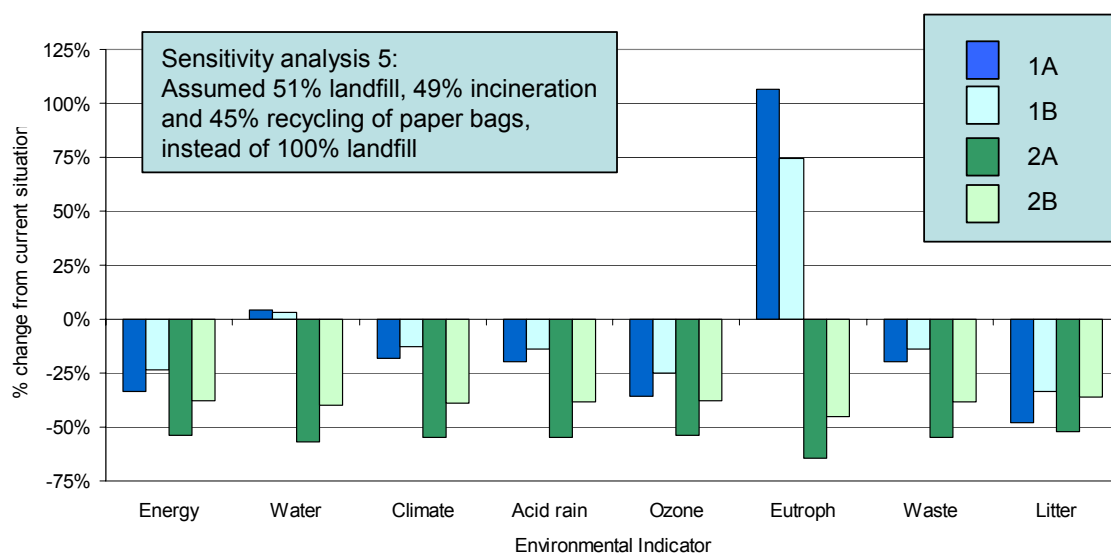


\* Latter figure seems more representative of Scotland.

**Figure A3.5 Sensitivity analysis 4: Testing the effect of combining sensitivity analysis 2 (using paper bags to carry the same volume of shopping as plastic bags) and sensitivity analysis 3 (increasing the weight of plastic bags to 8g)**



**Figure A3.6 Sensitivity analysis 5: assuming that waste disposal in Scotland is split across incineration, landfill and recycling in the same proportions as in France\***



\* The current situation in Scotland is that most waste (88%) is sent to landfill.

Figures A3.1–A3.6 show a consistent improvement in all environmental indicators for scenarios 2A and 2B. This is robust against all of the sensitivities examined. Scenarios 1A and 1B, which encourage paper bag use, lead to a lower level of environmental improvement in all categories and, for three indicators (water consumption, climate change and eutrophication) have a worse performance than the business as usual case.

Sensitivities that increase the impact of paper bags (assumptions of increased paper bag weight and reduced volume of shopping carried in paper bags relative to plastic bags) further worsen the performance of scenarios 1A and 1B (Figures A3.2 and A3.3). This is reasonably uniform across all indicators except ‘risk of litter’. Most notably, the indicators for acid rain and solid waste generation switch from a net improvement compared with the business as usual case to a net worsening.

Increasing the impact of plastic bags by assuming a greater weight than in the original Carrefour analysis and more in line with Scottish practice (Figure A3.4) improves the overall performance of scenarios 1A and 1B. However, they still score worse on eutrophication than the business as usual scenario due to the high level of paper bag usage in those scenarios.

Figure A3.5 demonstrates the potential for sensitivities to cancel each other out; in this case, the effect of increased plastic bag weight versus reduced volume of shopping in each paper bag. Both these assumptions seem more in line with Scottish practice. The overall effect is little different from the base case shown in Figure A3.1.

A radically alternative position on end-of-life waste management (Sensitivity analysis 5, Figure A3.6) moves away from 100% landfill to a mixed landfill/incineration/recycling position. This leads to a uniform improvement in the performance of scenarios 1A and 1B across all indicators, though it has almost no effect on scenarios 2A and 2B. The climate change indicator switches from worsening under scenarios 1A and 1B in the base case to a slight improvement.

## Conclusions from the LCA

The scenarios in which both paper and lightweight plastic bags are both levied (2A and 2B) show a uniform improvement in all environmental indicators by between roughly 30% and 70%. The most restrictive scenario (2A), where bags are levied at all outlets, gives a uniform improvement of around 16% relative to the business as usual case compared with scenario 2B, where SMEs and charities are exempted.

As noted above, the results of LCA provide an indication of *potential* risk rather than actual impact. When interpreting the results of the LCA, it is therefore necessary to consider that:

- The *actual* importance of the change in performance against each indicator (except climate change) will vary from place to place as noted in Table A3.2.
- Percentage change in any indicator is not a guide to the actual importance of impacts, a small percentage change in one indicator may represent a larger impact than a bigger percentage change in another indicator.

This makes interpretation of the results for scenarios 1A and 1B more difficult, as it necessary to consider the overall balance of those impacts that improve and those that worsen. The environmental performance relative to business as usual worsens in the base case or at least one sensitivity analysis for five impacts (water consumption, climate change, acid rain, eutrophication and solid waste generation). The significant changes for water consumption, acid rain and eutrophication are all very site-specific. Site specificity in relation to solid waste generation may be less important. In contrast, climate change effects are not specific to the site where the burden (greenhouse gas emission) is imposed.

An alternative way of looking at this problem is to consider whether the changes in environmental indicators are sufficiently large to warrant intervention, accepting that the total burdens imposed by carrier bags are only a small fraction of the total impacts of human activity. For those indicators that improve under scenarios 1A and 1B, the improvement relative to the base case varies from a few percent (e.g. solid waste arisings under the base case shown in Figure A3.1) to around 50% (risk of littering in all of the sensitivity runs). In contrast, the improvement for scenario 2B is uniformly more than 35% across the sensitivity runs and consistently better than scenario 1A for all indicators except ‘risk of litter’. The improvement in scenario 2A is uniformly more than 50% and, in all cases, superior to scenario 1A.

The purpose of Table A3.7 is to give some basis for comparison of the results given in this report with total burdens on the Scottish environment. The base case (results of which are shown in Figure A3.1) has been used to derive the figures shown in the Table – no account is taken of the differing results from the various sensitivity analyses that have been conducted. It is accepted that some (possibly large) proportion of the burdens referred to will take place in other countries, for example, as a result of the manufacture of plastic bags in China. However, we still consider it appropriate to compare against total *Scottish* performance against each indicator. Also, the figures given show the change in potential risk according to the LCA, rather than the change in actual impact (which is what we would ideally like to know).

Note that not all of the impact identified would be attributable to activities in Scotland, for example, for cases where plastic bags are made in China.

**Table A3.7 Estimated change in indicators in the base case shown in Figure A3.1 as a percentage of the total for each indicator for Scotland<sup>9</sup>**

Indicator	Scottish total	Best scenario	Worst scenario
Consumption of non-renewable primary energy	Total for Scotland = 232 TWh/year	Scenario 2A Reduction by 0.032%	Scenario 1B Reduction by 0.013%
Water consumption	Total for Scotland = 876 million m <sup>3</sup> /year (based on data in Scottish Executive 2001)	Scenario 2A Reduction of 0.007%	Scenario 1A Increase of 0.002%
Climate change	Scottish emissions in 2002 = 19.5 MtC eq/yr based on 100 year time horizon (AEA Technology 2004)	Scenario 2A Reduction of 0.016%	Scenario 1A Increase of 0.001%
Acid rain	Scottish emissions estimated from NAEI at 7,800 t eq H <sup>+</sup>	Scenario 2A Reduction of 0.015%	Scenario 1B Reduction of 0.004%
Air quality (ground level ozone)	Scottish emissions estimated from NAEI at 47,000 t ethene eq	Scenario 2A Reduction of 0.015%	Scenario 1B Reduction of 0.005%
Eutrophication of water bodies	Total burden annually from carrier bags = 0.45 t phosphate equivalent	Scenario 2A Reduction of 0.3 t	Scenario 1A Increase of 1.01 t
Solid waste production	Section 3.2: plastic carrier bags make up less than 1% of the waste stream. Local Authorities in Scotland collect 3.3 Mtonnes of household, commercial and industrial waste/yr.	Considering only end of life bags entering the waste stream: Scenario 2A Reduction of 0.2%	Considering only end of life bags entering the waste stream: Scenario 1B Reduction of 0.01%
Risk of litter	Carrier bags make up around 2% of litter on beaches (MCS survey)	Scenario 2A Reduction in total litter of 1%	Scenario 1B Reduction in total litter of 0.7%

AEA Technology (2004) Greenhouse gas inventories for England, Scotland, Wales and Northern Ireland, 1990-2002.

[http://www.airquality.co.uk/archive/reports/cat07/0411291128\\_Reghg\\_report\\_2002\\_Main\\_Text\\_Issue\\_1.doc](http://www.airquality.co.uk/archive/reports/cat07/0411291128_Reghg_report_2002_Main_Text_Issue_1.doc)

Scottish Executive (2001) Public Water Supplies in Scotland: Water Resources Survey 2000-2001.

<http://www.scotland.gov.uk/library3/environment/pwss01-02.asp>

<sup>9</sup> Where data are available for comparison. In other cases (shaded grey), the results in columns 3 and 4 simply show the best and worst performing scenario. Note that not all of the impact identified would be attributable to activities in Scotland, e.g. cases where plastic bags are made in China.

## Further Environmental Life Cycle Information on the Various Bag Alternatives

### Production and Disposal

In reality, the majority of lightweight plastic carrier bags, including the biodegradable variants, will be sent to landfill where they will be buried under predominantly anaerobic conditions.

In the case of starch-based biodegradable lightweight plastic carrier bags, they will take a long time to decompose if they are buried under two metres or more. Under such circumstances, they will give rise to methane instead of carbon dioxide, which is 23 times more potent for global warming<sup>10</sup> (therefore negating the carbon neutral status of the plant-based raw material). They may not even decompose significantly if the necessary microbes are absent due to the anaerobic conditions within the landfill. It should be noted that Scotland and the UK currently uses very few such starch-based biodegradable bags.

Likewise, the plastic (HDPE) with metal degradant additive bags have a slower rate of degradation when in a landfill rather than in the ideal conditions. In a landfill, they may take 1–5 years<sup>11</sup> to decompose (or even not at all due to lack of light and oxygen) [EuroCommerce, RMIT]. These kind of degradable bags are used in the UK by the Co-operative Group and Somerfield. It has been estimated that conventional HDPE bags take anywhere between 450 and 1,000 years to decompose [MCS 2005]; thus, within a century-long timescale, they can basically be seen as inert material [DEH].

Ethene, the monomer used to manufacture polyethene, is produced as a by-product of crude oil refining ('cracking') in the manufacture of vehicle fuels. Its production will not therefore drop. The resource argument would be that the ethene no longer wanted for polyethene bag manufacture could be used as a chemical feedstock for other uses.

### Import of Plastics in the Republic of Ireland

Table A3.8 shows Irish plastics import statistics [CSO.ie] for two previous years specifically for the import of polyethene<sup>12</sup>. The analogous UK imports of polyethene<sup>13</sup> amounted to 314,859 tonnes in 2003 [UK Trade Info].

**Table A3.8 Imports of polyethene to the Republic of Ireland\***

	<b>2002</b>	<b>2003</b>
Tonnes imported	25,943	23,583
Absolute change, year on year (tonnes)	n/a	-2,360
Percentage change, year on year	n/a	-9.1%

\* Based on CN Code 39232100 Sacks and bags of polymers of ethylene (including cones)

From these figures, it appears that the Irish PlasTax has had a relatively significant effect on the import of polyethene to the Republic of Ireland. Since the introduction of the levy in the

<sup>10</sup> IPCC report [www.ipcc.ch/pub/wg1TARtechsum.pdf](http://www.ipcc.ch/pub/wg1TARtechsum.pdf) The conventional 100-year horizon value is given.

<sup>11</sup> The EU standard for compostable plastics is 90% mineralisation (decomposition into carbon dioxide, water, trace minerals) within 180 days, i.e. half a year.

<sup>12</sup> Combined Nomenclature (CN) Commodity Code 39232100: Sacks and bags of polymers of ethylene (including cones). Ethylene = ethene.

<sup>13</sup> This is under the EU Community Code 39232100: Sacks and bags (including cones), for the conveyance or packing of goods, of polymers of ethylene.

spring of 2002, lightweight plastic carrier bag consumption has fallen by 90% and yearly import tonnages have decreased by almost 2,400 tonnes, or nearly 10%, from 2002 levels.

However, it is necessary to account for two mitigating factors:

- i) Other import-export statistics from the UK not tallying with the Irish statistics.
- ii) The rise in imports of polypropylene to the Republic of Ireland.

i) Statistics from HM Revenue and Customs [UK Trade Info] and separately from the CBC show a different picture for the import of polyethene to the Republic of Ireland.

- CBC calculated imports are given in Table A3.9. These show a very moderate decrease in polyethene imports to the Republic of Ireland.

**Table A3.9 Imports of polyethene to the Republic of Ireland [CBC]\***

	<b>2002</b>	<b>2003</b>
Tonnes imported [CBC]	26,161	25,911
Absolute change, year on year (tonnes)	n/a	-250
Percentage change, year on year	n/a	-1.0%

\* Based on CN Code 39232100 Sacks and bags of polymers of ethylene (including cones)

- Irish import tonnages from the UK [CSO.i.e.] do not tally with UK export figures [UK Trade Info] to the Republic of Ireland. In both 2002 and 2003, figures for UK exports are larger than those for Irish imports by 1,404 tonnes and 4,054 tonnes, respectively. Adding these differences to the total Irish import statistics gives alternative figures for Irish polyethene import to those given in Table A3.8. The revised figures are given in Table A3.10 and show a moderate increase in imports to the Republic of Ireland. One possibility is discrepancies in end-of-year recording of imports/exports between the two countries.

**Table A3.10 Imports of polyethene to the Republic of Ireland [CSO.ie and UK Trade Info]\***

	<b>2002</b>	<b>2003</b>
Tonnes Imported [CSO.ie and UK Trade Info] <sup>14</sup>	27,347	27,637
Absolute change, year on year (tonnes)	n/a	+290
Percentage change, year on year	n/a	+1.1%

\* Based on CN Code 39232100 Sacks and bags of polymers of ethylene (including cones)

Both alternative sources show there has been little change in Irish imports of polyethene since the start of the PlasTax. Due to the inconsistency between the results, we are unable to describe the true state of polyethene use in the Republic of Ireland.

ii) Over a similar time period, the imports of other polymers, namely polypropene (polypropylene) into the Republic of Ireland have increased<sup>15</sup> (see Table A3.11).

<sup>14</sup> Irish import data and UK export data were used. The specific tonnages imported to Ireland from the UK were subtracted from data from the Central Statistics Office Ireland [CSO.ie]. The export tonnages from the UK to Ireland were then added.

<sup>15</sup> CN Commodity Code 39232990: Sacks and bags (including cones) of plastics (excluding those of polyvinyl chloride and polymers of ethylene)

**Table A3.11 Imports of polypropene to the Republic of Ireland [UK Trade Info]\***

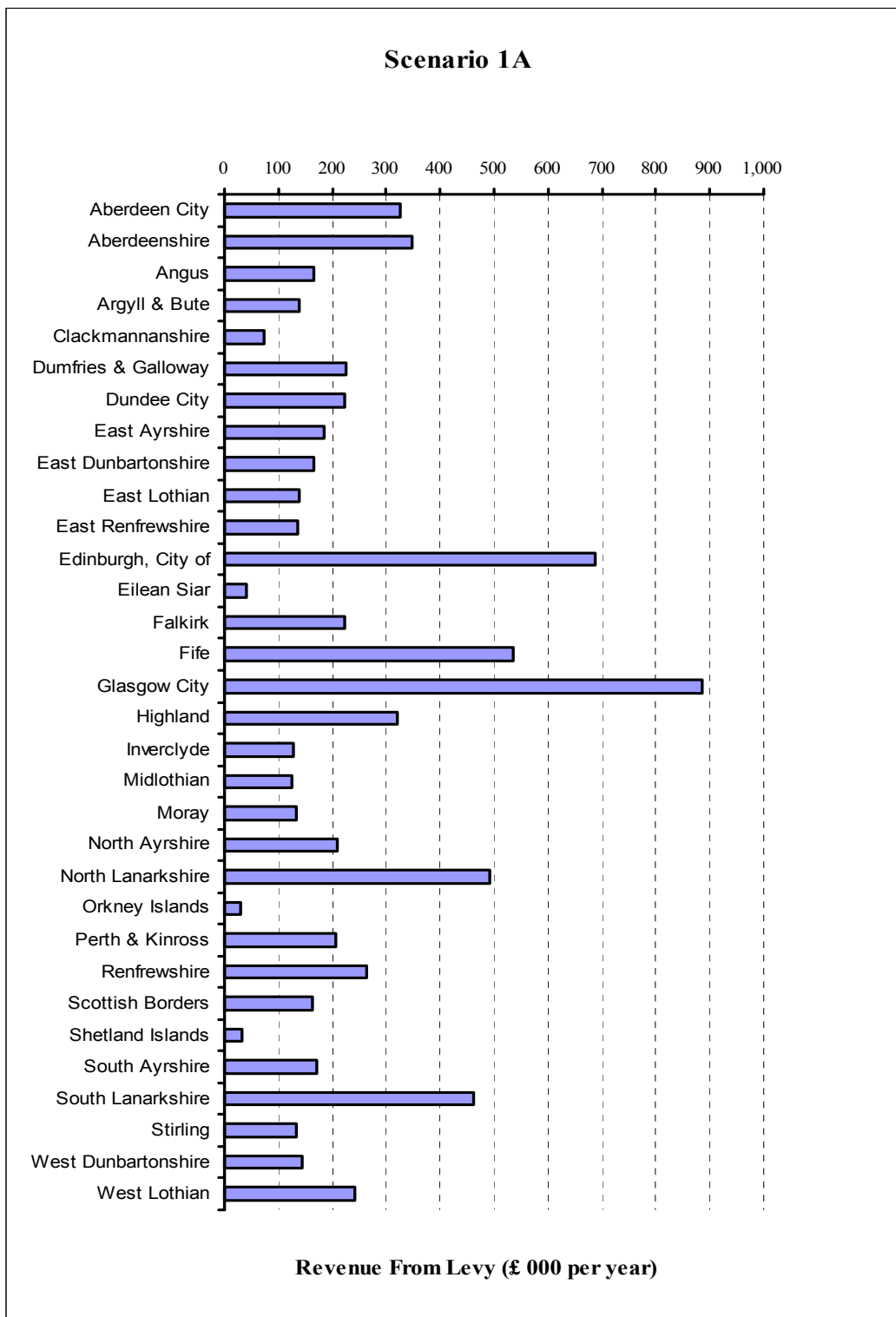
	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>Total</b>
Tonnes imported	4,628	5,083	6,822	<b>2002–2004</b>
Absolute change, year on year (tonnes)	n/a	+455	+1,739	+2,194
Percentage change, year on year	n/a	+9.8%	+34.2%	+47.4%

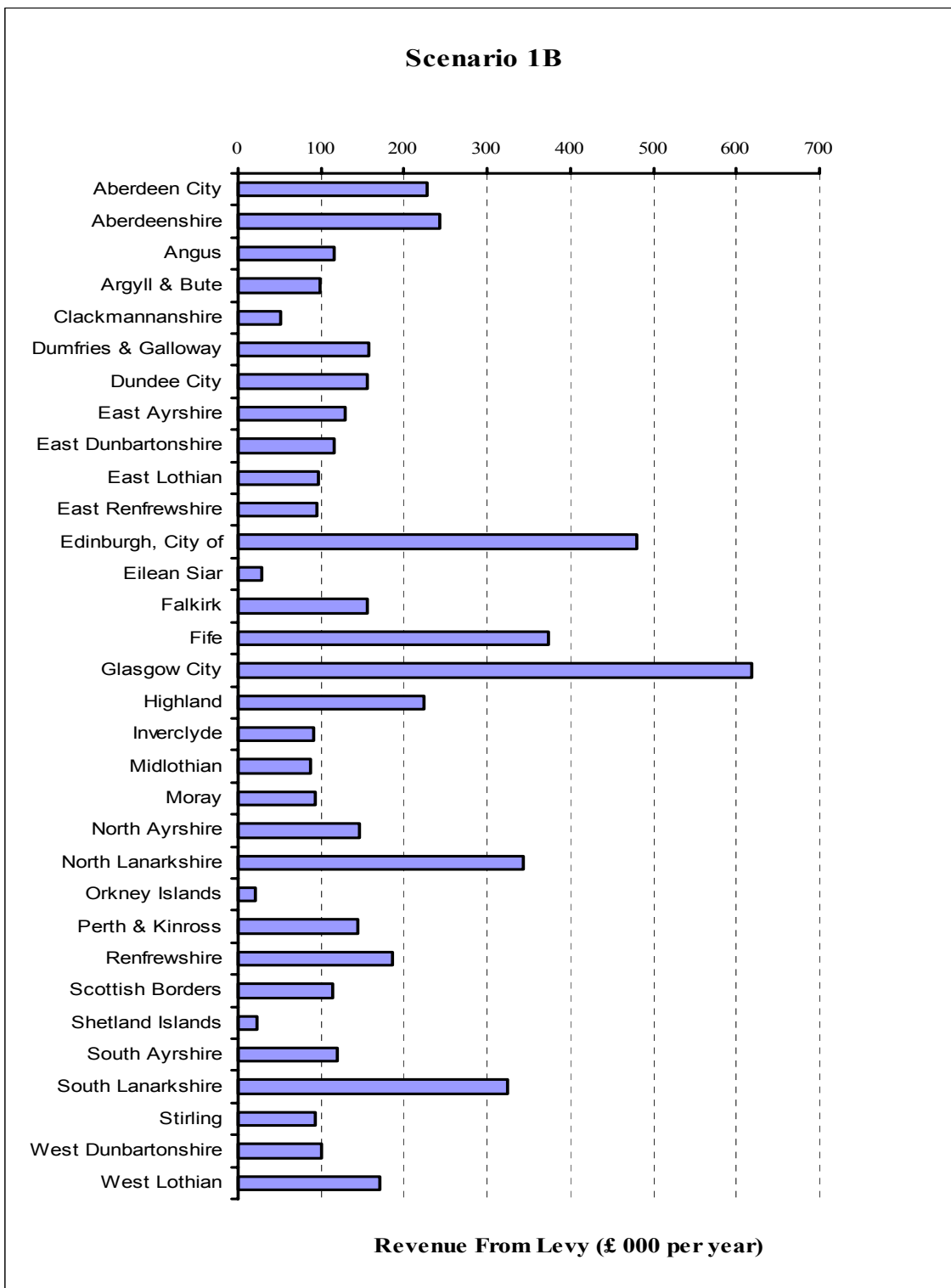
\* CN Code 39232990 (polymers other than polyvinyl chloride and ethylene)

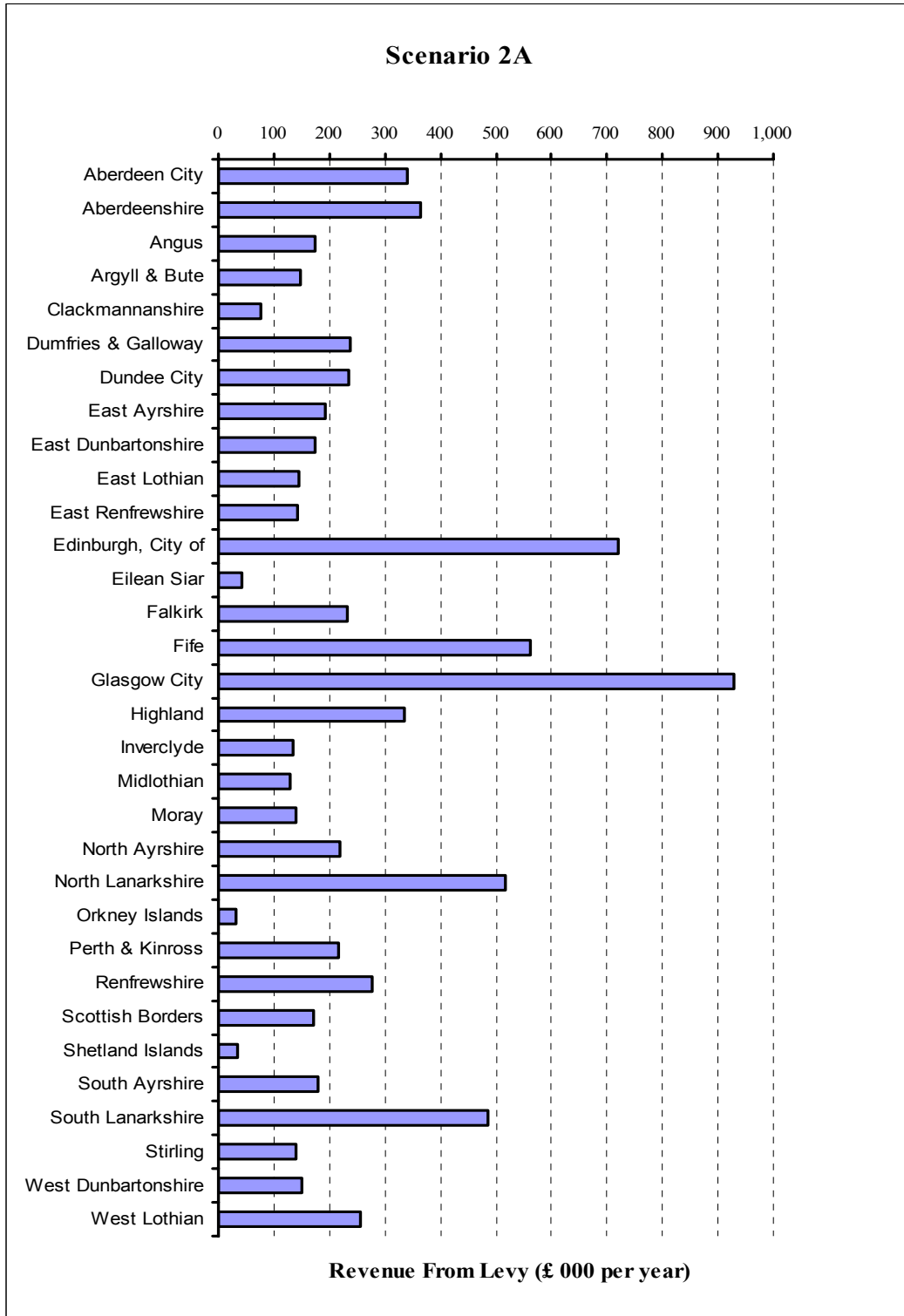
These figures show an increase in the use of plastic bags made from polymers other than polyethylene and PVC (i.e. polypropene) and suggest an increase in use of the stronger woven polypropene bags in the Republic of Ireland. Comparing the figures in Table A3.8 for 2003 with those in Table A3.11 shows that there has been an almost equal and opposite trade off (in tonnage terms) in switching from one bag type to another. But as polypropene bags are charged for, it is likely that they are reused several times for shopping before final disposal.

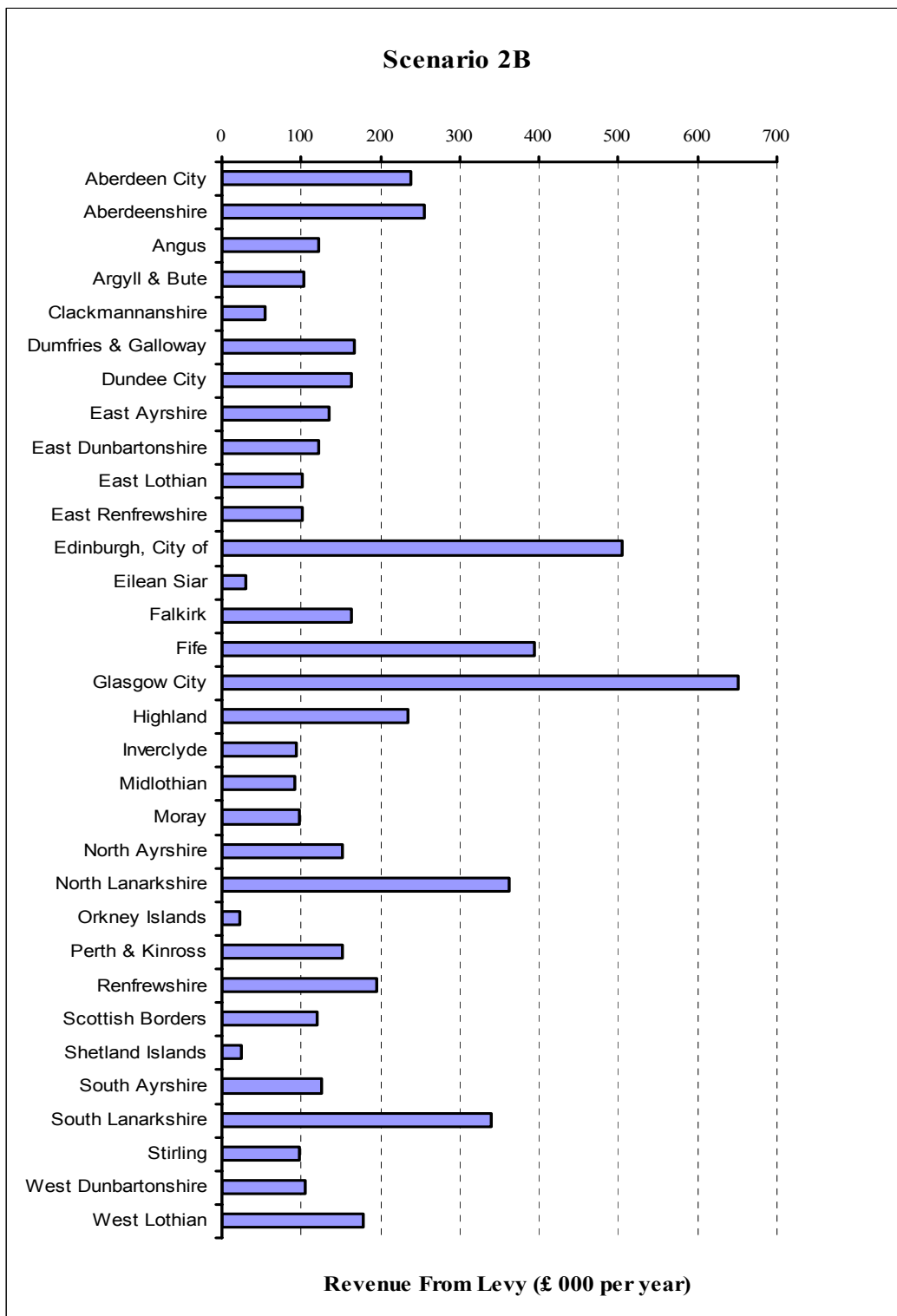
In summary, the exact position regarding the change in the import of plastics to the Republic of Ireland since the introduction of the PlasTax remains unclear.

## Appendix 4. Distribution of Revenue by Local Authority









## References

- Apgate Based on the Applegate database, [www.apgate.com](http://www.apgate.com)
- ARA Inquiry into Plastic Bag Tax (Assessment and Collection) Bill 2002 and Plastic Bag (Minimisation of Usage) Education Fund Bill 2002. Submission to Senate Environment, Communications, Information Technology and the Arts Committee, June 2003.  
[www.aph.gov.au/Senate/committee/ecita\\_ctte/completed\\_inquiries/2002-04/plastic\\_bags/submissions/sub245.pdf](http://www.aph.gov.au/Senate/committee/ecita_ctte/completed_inquiries/2002-04/plastic_bags/submissions/sub245.pdf)
- Aus Govt Department of the Environment and Heritage  
[www.deh.gov.au/industry/waste/plastic-bags](http://www.deh.gov.au/industry/waste/plastic-bags)
- Aus Stats Year Book Australia 2002, Population clock as of 10 March 2005, Australian Bureau of Statistics  
[www.abs.gov.au/Ausstats/abs@.nsf/0/1647509ef7e25faaca2568a900154b63?OpenDocument](http://www.abs.gov.au/Ausstats/abs@.nsf/0/1647509ef7e25faaca2568a900154b63?OpenDocument)
- BBC Tax on Plastic Bags Considered, BBC News, 6 May 2002.  
<http://news.bbc.co.uk/1/hi/uk/1969997.stm>
- BRC Communication from the British Retail Consortium, March 2005.
- Carrefour 'Évaluation des impacts environnementaux des sacs de caisse Carrefour. Analyse du cycle de vie de sacs de caisse en plastique, papier et matériau biodégradable', Report prepared for Carrefour, Ecobilan, February 2004.  
[www.ademe.fr/htdocs/actualite/rapport\\_carrefour\\_post\\_revue\\_critique\\_v4.pdf](http://www.ademe.fr/htdocs/actualite/rapport_carrefour_post_revue_critique_v4.pdf)
- CBC UK Carrier Bag Consortium Response to Consultation Document - an Environmental Levy Bill 'Carrier Bag Tax For Scotland', May 2004.  
[www.carrierbagtax.com](http://www.carrierbagtax.com)
- CSO.ie Central Statistics Office Ireland [www.eirestat.cso.ie](http://www.eirestat.cso.ie)
- CSO.ie2005 Population Statistics 1901–2002, Central Statistics Office Ireland.  
[www.cso.ie/statistics/popn1901to2002.htm](http://www.cso.ie/statistics/popn1901to2002.htm)
- Defra 2003 What Happens to Waste: Plastic and Plastic Bags  
[www.defra.gov.uk/environment/waste/topics/plastics.htm](http://www.defra.gov.uk/environment/waste/topics/plastics.htm)
- Defra 2005 Charting Progress - An Integrated Assessment of the State of UK Seas  
[www.defra.gov.uk/environment/water/marine/uk/stateofsea/chartprogress.pdf](http://www.defra.gov.uk/environment/water/marine/uk/stateofsea/chartprogress.pdf)

DEH	Plastic Shopping Bags – Analysis of Levies and Environmental Impacts, Prepared by Nolan-ITU in association with RMIT Centre for Design and Enomia Research and Consulting Ltd, December 2002. <a href="http://www.deh.gov.au/settlements/publications/waste/plastic-bags/analysis.html">http://www.deh.gov.au/settlements/publications/waste/plastic-bags/analysis.html</a>
Dixons	Dixons Group and Nelson Packaging Bag Environmental Award for UK's First Fully-Recycled Carrier Bag, Dixons News Release, 17 May 2004. <a href="http://dsgportal01.dixons.co.uk/wps/portal!/ut/p/_s.7_0_A/7_0_IQ/.cmd/ad/.c/6_3_1F3/.ce/7_1_25E/.p/5_1_1C5?PC_7_1_25E_contentID=6028520">http://dsgportal01.dixons.co.uk/wps/portal!/ut/p/_s.7_0_A/7_0_IQ/.cmd/ad/.c/6_3_1F3/.ce/7_1_25E/.p/5_1_1C5?PC_7_1_25E_contentID=6028520</a>
Eco-emballages	Presentation given by Breffini Bolze at IEG LCA meeting, Porto, September 2004.
ENCAMS	The Annual Local Environmental Quality Survey of England 2002/2003. <a href="http://www.encams.org/BestPractice/LEQSEReport.asp?Sub=1&amp;Menu=0.26.15.154.158">www.encams.org/BestPractice/LEQSEReport.asp?Sub=1&amp;Menu=0.26.15.154.158</a>
ENDS Daily	Environment Daily 1842, ENDS, 16 March 2005.
Envt Canada	Marine Debris in Canada: Facts and Figures. <a href="http://www.ec.gc.ca/marine/debris/ENG/facts.htm">www.ec.gc.ca/marine/debris/ENG/facts.htm</a>
ERM	Responses to the Irish Plastic Bags Levy, Environmental Resources Management.
EU Commission	<a href="http://europa.eu.int/comm/enterprise/environment/index_home/emantool_indic_prodrel_vappr/polymer.htm">http://europa.eu.int/comm/enterprise/environment/index_home/emantool_indic_prodrel_vappr/polymer.htm</a>
EuroCommerce	The Use of LCAs on Plastic Bags in an IPP Context, EuroCommerce (Verbrugghe), September 2004.
FRIDGE	Socio-Economic Impact of the Proposed Plastic Bag Regulations. <a href="http://www.nedlac.org.za/research/fridge/plastics">www.nedlac.org.za/research/fridge/plastics</a>
Galgani	Distribution and Abundance of Debris on the Continental Shelf of the Bay of Biscay and in Seine Bay, F Galgani <i>et al.</i> , <i>Marine Pollution Bulletin</i> , 1995, Volume 30, Issue 1.
Hansard 2004	Lords Hansard, 26 October 2004: Column 1163 <a href="http://www.publications.parliament.uk/pa/ld200304/ldhansrd/vo041026/text/41026-01.htm#column_1163">www.publications.parliament.uk/pa/ld200304/ldhansrd/vo041026/text/41026-01.htm#column_1163</a>
HM Treasury 2002	Plastic Bag Tax Assessment, December 2002.
IKEA	Personal communication from the assistant manager at IKEA Edinburgh.
INCPEN-ENCAMS	Litter Composition Survey of England April–July 2004. Commissioned by INCPEN, undertaken by ENCAMS. <a href="http://www.incpen.org/resource/userdata/ipu/encamsincpenreportfinal24jan2005.pdf">www.incpen.org/resource/userdata/ipu/encamsincpenreportfinal24jan2005.pdf</a>

Independent	Record Levels of Plastic Litter on Beaches. <i>The Independent</i> , 22 March 2005.
KSB	Local Environmental Audit and Management System (LEAMS) Annual Report. LEAMS Benchmarking Report 2003 – 2004.
MCS 2003	Beachwatch 2003 – The Annual UK Beach Litter Survey Report, Marine Conservation Society. <a href="http://www.adoptabeach.org.uk/GetInvolved/beachwatch2003.html">www.adoptabeach.org.uk/GetInvolved/beachwatch2003.html</a>
MCS 2004	Beachwatch 2004 – The Annual UK Beach Litter Survey Report, Marine Conservation Society. <a href="http://www.adoptabeach.org.uk/News/beachwatch04.htm">www.adoptabeach.org.uk/News/beachwatch04.htm</a>
MCS 2005	Long Term Impacts of Plastic Bags in the Marine Environment, Marine Conservation Society, 2005.
Nolan-ITU	Plastic Retail Carry Bag Use 2002–2004 Consumption, March 2005. Report by Nolan-ITU Pty Ltd for the Department of Environment and Heritage. <a href="http://www.deh.gov.au/industry/waste/publications/plastic-bags-consumption/pubs/plasticbag-use0304.pdf">www.deh.gov.au/industry/waste/publications/plastic-bags-consumption/pubs/plasticbag-use0304.pdf</a>
Nottingham	An Analysis of the Recycling of Low Density Polythene (LDPE) at Alida Recycling Ltd, Nottingham University Consultants Limited.
NSW	Plastic Bags. Briefing Paper No. 5/2004. Parliament of New South Wales, Australia <a href="http://www.parliament.nsw.gov.au/prod/parlment/publications.nsf/0/33469EB37225F1F8CA256ECF00077479">www.parliament.nsw.gov.au/prod/parlment/publications.nsf/0/33469EB37225F1F8CA256ECF00077479</a>
ONS	Family Spending: A Report on the 2002–2003 Expenditure and Food Survey, 2004. <a href="http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=361">www.statistics.gov.uk/StatBase/Product.asp?vlnk=361</a>
Polybags	<a href="http://www.polybags.co.uk">www.polybags.co.uk</a>
Pringle	An Environmental Levy Bill - Consultation Document. <a href="http://www.mikepringlemsp.com">www.mikepringlemsp.com</a>
Retail Research	Key Results of the European Retail Theft Barometer 2004. J Bamfield, 2004. Centre for Retail Research. <a href="http://www.retailresearch.org/theft_barometer/index.php">www.retailresearch.org/theft_barometer/index.php</a>
Reusable Bags	<a href="http://www.reusablebags.com/facts.php?id=9">www.reusablebags.com/facts.php?id=9</a>
RMIT	The Impacts of Degradable Plastic Bags in Australia. Final report to the Department of the Environment and Heritage prepared by ExcelPlas Australia, Centre for Design at the Royal Melbourne Institute of Technology (RMIT) and Nolan-ITU, September 2003. <a href="http://www.deh.gov.au/industry/waste/degradables/impact/index.html">www.deh.gov.au/industry/waste/degradables/impact/index.html</a>
San Francisco Chronicle	Bagging the Bags. <i>San Francisco Chronicle</i> , 28 January 2005. <a href="http://sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2005/01/28/EDGD5B10501.DTL">http://sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2005/01/28/EDGD5B10501.DTL</a>

SEPA	Waste Data Digest 4. 2002 and 2002/2003 data <a href="http://www.sepa.org.uk/pdf/publications/wds/wdd_4.pdf">www.sepa.org.uk/pdf/publications/wds/wdd_4.pdf</a>
Stats Scot	<a href="http://www.statistics.gov.uk/census2001/pyramids/pages/179.asp">www.statistics.gov.uk/census2001/pyramids/pages/179.asp</a>
Stats UK	<a href="http://www.statistics.gov.uk/census2001/pyramids/pages/uk.asp">www.statistics.gov.uk/census2001/pyramids/pages/uk.asp</a>
SWAG	Public Attitudes to Reduce Reuse Recycle in Scotland. Waste Aware Scotland.
Symphony Plastic Technologies	Briefing Note on Degradable Plastics. Symphony Plastic Technologies plc
UCD	Applying Environmental Product Taxes and Levies – Lessons from the Experience with the Irish Plastic Bags Levy, FJ Convery and S McDonnell, University College Dublin, June 2003.
UK Trade Info	<a href="http://www.uktradeinfo.com/index.cfm">www.uktradeinfo.com/index.cfm</a>
Waste Watch	What People Think About Waste 1999. NOP Research Group Ltd for Waste Watch. <a href="http://www.wasteonline.org.uk/resources/WasteWatch/1999WhatPeopleThinkAboutWaste_files/page3.html">www.wasteonline.org.uk/resources/WasteWatch/1999WhatPeopleThinkAboutWaste_files/page3.html</a>
WRAP 2004a	Response from WRAP to the Environmental Levy Bill, May 2004.
WRAP 2004b	Self-sustaining ‘Bag for Life’ Initiative, October 2004.
WRAP 2004c	Presentation to Retailer Meeting by WRAP, November 2004.
WRAP 2005	Carrier Bag Usage and Attitudes – Benchmark and Target Market Study, March 2005.

Note: All URLs accessed as of 30 May 2005.



Small changes in the way we perform everyday tasks can have huge impacts on Scotland's environment.

Walking short distances rather than using the car, or being careful not to overfill the kettle are just two positive steps we can all take.

This butterfly represents the beauty and fragility of Scotland's environment. The motif will be utilised extensively by the Scottish Executive and its partners in their efforts to persuade people they can do a little to change a lot.

100% of this document is printed on recycled paper and is 100% recyclable.

This document is also available on the Scottish Executive website: [www.scotland.gov.uk](http://www.scotland.gov.uk)  
Astron B42644 08/05

ISBN 0-7559-2686-2



9 780755 926862