Summary

This Impact Assessment details the impacts, costs and benefits of the policies brought forward under the *Waste Strategy for England 2007* (*WS2007*). The strategy sets out key new policies and actions and sets the framework for further policy development – it does not introduce any actions which would increase regulatory burdens. Where specific policy changes result from carrying forward the further policy development set out in *WS2007* they will be assessed in separate impact assessments.

The costs primarily relate to changes in waste management costs and the benefits relate to greenhouse gas impacts and/or reductions in levels of wider financial or public health risks.[1] The impacts assessed are broadly split between municipal waste, where the costs will, on the whole, be borne by local authorities, and commercial and industrial (C&I)/construction and demolition (C&D) wastes, where any financial costs are likely to be borne by waste producers and the waste management industry. Greenhouse gas benefits are accrued to society as a whole and, given the international nature of the climate change problem, both domestic and international greenhouse gas impacts are counted.

Table 1 below summarises the costs and benefits calculated for the main scenarios assessed. The strategy is a long-term strategy with key targets up to 2019/20, therefore the costs and benefits presented below are present values over the period 2006/07 to 2019/20. All scenarios are compared to a counterfactual of no change in current policy and are discussed in depth in Appendix 1. The competition and small firm impact tests on the proposals set out in *Review of England's Waste Strategy A Consultation Document* (published in February 2006)[2] suggest disproportionate impacts in these areas will be limited.

Table A.1: Costs and benefits of main scenarios 2006/07 to 2019/20

Scenario	Change in waste management costs (£m)	Change in greenhouse gas benefits (£m)
Increased waste prevention initiatives (industrial)	–270 to –690	1,130
Increased waste prevention initiatives (commercial)	–850 to –1,870	3,140
Extending sector-based producer responsibility agreements (commercial and industrial)	–480 to 350	560
Increase in landfill tax escalator announced in Budget 2007 (industrial and commercial)	–190 to –360	120
Increase in landfill tax escalator announced in Budget 2007 (municipal)	60 to 170	30 to 140

[1] Note on conventions: costs – positive costs represent increases in cost over the baseline, negative costs represent savings; benefits – positive benefits represent improvements (savings) over the baseline, negative benefits represent increased impacts over the baseline.

[2] The consultation document is available at http://www.defra.gov.uk/environment/waste/strategy

Key assumptions

Commercial and industrial wastes:

i. Where waste prevention is assumed to result in lower waste arisings these are assumed to be the result of improved resource efficiency, therefore reduced material costs are assumed to offset the initial costs of reducing waste.

ii. Landfill Directive Article 6 pre-treatment requirements are met increasing the costs of waste disposal.

iii. Through increased source separation of waste, waste prevention and recycling the landfill tax is assumed to divert waste prior to disposal thus avoiding the costs of pre-treatment of mixed wastes. This comes through in the reduction in treatment costs associated with the landfill tax increase. It can be seen as the benefits of improved resource efficiency that result from the tax.

iv. All costs are net of landfill tax.

Municipal Solid Waste (MSW):

v. Ranges of costs and benefits reflect uncertainty in likely future waste growth. Scenarios have been run with constant MSW growth to 2020 of 0%, 0.75%, 1.5% and 2.25% per annum.

vi. MSW growth is assumed to be exogenous. Lower arisings, owing to lower waste growth, do not produce benefits from waste prevention.

vii. All costs are net of landfill tax.

Contents

Introduction and summary

1. This annex sets out the final Impact Assessment of *Waste Strategy for England 2007*. This builds on the partial Regulatory Impact Assessment (pRIA)[3] issued in February 2006 which accompanied the consultation document on the review of *Waste Strategy 2000* and reflects both the responses to that pRIA and to the proposals set out in the consultation document itself.

2. This Impact Assessment details the impacts, costs and benefits of the policies brought forward under *WS2007*.

3. The consultation document:

   a. set out the progress made since 2000 in meeting the Government's objectives and implementing its policies with respect to waste; and

   b. consulted on proposals to revise the objectives of *Waste Strategy 2000* and the policy instruments to support delivery of the vision and outcomes for waste.

4. Over 4,000 participants submitted responses during the twelve-week consultation period.[4] The majority of responses were from action and environmental groups in the form of standard letters and e-mails expressing concern that energy from waste options should not detract from options higher up the waste hierarchy, with particular focus on waste prevention, higher recycling targets and greater use of fiscal instruments. A total of 585 submissions came from a mixture of individuals and organisations expressing broad support for the vision and approach set out in the consultation document with some caveats, notably the need for a greater focus on delivery.

5. Some 24 participants responded with comments on the pRIA, primarily expressing concerns regarding the assumptions and data used in modelling future trends and policy impacts. These assumptions and data have been reviewed and, where possible, updated with data that has become available since publication of the pRIA. In particular, carbon benefits and municipal waste management costs have been revised substantially in light of further Defra-funded research.

Policy proposals

6. The consultation document included a range of suggestions and proposals on which it sought views. The pRIA assessed the impacts, costs and benefits of the eleven main proposals (Options B to L) against the base case of continuing with current policies (Option A). The options focused on using existing policy instruments and spending programmes to improve waste management performance.

7. Option B was a proposal for simplifying part of the waste regulatory system, building on the work already underway within the Environment Permitting Review.[5] This proposal was broadly welcomed and is expected to reduce regulatory burdens. No new regulations on business are proposed.

8. Options C, D, I and K envisaged working with business on a voluntary basis (with some Government financial support) to improve resource efficiency, reduce waste and recover more value from the waste that is produced. Particular help was proposed for small businesses. *WS2007* places increased emphasis on resource efficiency.

[3] The pRIA is available at http://www.defra.gov.uk/environment/waste/strategy
[4] The consultation period ran from 14 February to 9 May 2006.
[5] Available at http://www.defra.gov.uk/corporate/consult/envpermitprog3/index.htm

9. Other Options (E, F, G, H, and J) were designed to help local authorities implement, as cost-effectively as possible, the requirements of existing European Directives. These options include new national recycling targets and help to increase energy recovery to meet the Landfill Directive and Packaging Directive targets. A new Waste Infrastructure Delivery Programme (WIDP) has been established to help bring forward the necessary investment to meet these requirements.

10. *WS2007* also includes increases in the landfill tax escalator, as announced in the Budget 2007, and announces a consultation on giving powers to local authorities to introduce household financial incentives. These are assessed as Option M.

11. Alternatives to the preferred options and sub-options were set out in the consultation document. Options were not preferred where, the costs did not justify the benefits; it was not yet possible to assess the costs and benefits, or where a new regulatory burden would be imposed without seeking a voluntary approach first. Accordingly, the strategy does not introduce any actions which would increase regulatory burdens. Proposals carried forward into *WS2007* do not impose any new burdens on local authorities. Future policy proposals brought forward when implementing the further policy development work outlined in *WS2007* that could increase regulatory burdens on the private, public or third sectors will be subject to their own Impact Assessment in due course.

Purpose and intended effect

Objective

12. *WS2007* supersedes England's previous waste strategy, *Waste Strategy 2000*. It sets out the Government's long-term vision for waste management in England agreed after consultation, together with key objectives and targets, measures to support achievement of the objectives and a high-level implementation plan.

13. The Government's overall objective for waste policy was set out in *Securing the Future*, the Government's sustainable development strategy. This objective is: '*Protection of human health and the environment by producing less waste and by using it as a resource wherever possible. Through more sustainable waste management – reduction, re-use, recycling, composting and using waste as a source of energy – the Government aims to break the link between economic growth and the environmental impact of waste*'.

14. *WS2007* sets out the following key objectives:

- decouple waste growth (in all sectors) from economic growth and put more emphasis on waste prevention and re-use;
- meet and exceed the landfill directive diversion targets for biodegradable municipal waste in 2010, 2013 and 2020;
- increase diversion from landfill of non-municipal waste and secure better integration of treatment for municipal and non-municipal waste;
- secure the investment in infrastructure needed to divert waste from landfill and for the management of hazardous waste; and

- get the most environmental benefit from that investment, through increased recycling of resources and recovery of energy from residual waste using a mix of technologies.

15. The overall impact of *WS2007* will be increased annual net reductions in global greenhouse gas emissions from waste management reaching a reduction of 16.5 to 21.5 million tonnes of carbon dioxide equivalent per year in 2020. This compares to current net savings of approximately 7.2 million tonnes of carbon dioxide equivalent in 2006/07. The additional greenhouse gas emissions reductions relate to an increase in diversion of waste from landfill of around 25 million tonnes of waste per annum. These benefits are before allowing for significant additional greenhouse gas benefits from the *waste prevention* measures in the strategy.

16. *WS2007* also responds to the requirement under Article 7 of the EU Directive on waste (2006/12/EC of 5 April 2006)[6] for a national plan for the management of waste and sets out its strategy for implementing its obligations under this and other European waste-related Directives, including those on hazardous waste, packaging and landfill.

Background

17. In 2000 the Government set out its strategy for waste management in England and Wales in *Waste Strategy 2000*. Much progress has been made as a result of this strategy, including a considerable increase in the recycling and composting of household waste and in the development of markets for recovered materials. At the same time, various EU Directives and national policies have been implemented – notably the EU Directive 1999/31/EC on the landfill of waste (the Landfill Directive) – which are radically altering the waste management landscape. The recent EU Thematic Strategy on Waste Prevention and Recycling and the Government's strategy for sustainable development, *Securing the Future*, are also impacting on this evolving landscape by placing waste management firmly within the context of sustainable resource use.

18. Against this background of an evolving and increasingly complex waste management landscape, *Waste Strategy 2000* was widely regarded as requiring and needing a new strategic focus to drive waste management through this evolving agenda. Therefore, in February 2006 the Government launched a consultation on a review of *Waste Strategy 2000*. This provided the Government with the opportunity to reflect on existing policies and delivery mechanisms, including those arising from the Government's response to the recommendations made in the Prime Minister's Strategy Unit report on waste, *Waste not Want not*, and to consult on proposals for a revised waste strategy to supersede *Waste Strategy 2000*.

19. The review revisited forecasts made since 2000 about costs, growth in waste and potentially achievable recovery and recycling rates in the light of new data, advances in technology and an improved understanding of the environmental, economic and social impacts of dealing with waste. These were set out in the pRIA accompanying the consultation document. The present Impact Assessment updates the pRIA in light of the consultation, further evidence, information and analyses and the proposals that *WS2007* now sets out.

[6] Directive 2006/12/EC of 5 April 2006 on waste. OJ L 114, 27.4.2006, p10.

Rationale for policy

20. The rationale for Government policy on waste (and the European policies which it must deliver) remains the reduction of the environmental and health impacts of waste, in particular:

- to reduce the impact of waste on climate change;
- to conserve limited natural resources; and
- to reduce risks to health and the environment from potentially harmful substances within waste.

21. Key issues to be dealt with include: a closer integration in policy between waste and sustainable consumption and production; the optimum framework of targets for recycling, composting and energy recovery; and integrating the management of municipal and non-municipal waste streams.

22. The Waste Strategy Board will have strategic oversight of the implementation of *WS2007* in line with the vision and key objectives set out therein. The Board will review the strategy and develop new policy actions as necessary to deliver the outcomes sought in light of progress on delivery and developments, new European developments and obligations and any other significant events. Progress on delivering the strategy will be assessed using a range of national level indicators and monitoring of the high-level implementation plan to ensure realisation of the benefits expected.

Consultation

Within Government

23. The consultation on the review of England's Waste Strategy and development of *WS2007* was overseen by a Programme Board which included representation from Department of Trade and Industry (DTI), Communities and Local Government (CLG), Cabinet Office and the Treasury (HMT), as well as Defra, the Environment Agency and the Waste and Resources Action Programme (WRAP). The consultation document, pRIA and supporting Environmental Report were circulated to departments and devolved administrations as part of the stakeholder consultation, and key departments were involved in the development of *WS2007* (including on policy development, drafting and review of relevant sections).

Public consultation

24. Defra consulted widely with interested parties on the scope and key issues for the review of the Waste Strategy. Stakeholder workshops took place in January, February and October 2005 and included representatives from other government departments, government agencies, local and regional government, the waste management industry, waste producers, small- and medium-sized enterprises (SMEs), financial institutions, consultancies, academia, environmental non-government organisations (NGOs), the third sector and consumer groups. Bilateral engagement and consultation were also carried out and views and papers submitted by interested parties were taken into account.

25. Defra subsequently published a consultation document on the strategy review with the aim of securing stakeholders' views on the vision and approach for waste and policy proposals and options that could contribute to attainment of waste objectives. This consultation commenced on 14 February 2006 and remained open for a period of twelve weeks.

26. Consultation specialists, Dialogue by Design, were commissioned to manage the public consultation process. This process was largely web-based but proactively managed with letters being mailed to all key stakeholders to raise awareness of the consultation process and invite participation. A 'stakeholder map' was developed and used during the consultation process to ensure that the full breadth of stakeholder interests was addressed.

27. A total of 4,017 participants submitted responses during the consultation period. Of these, 3,432 came from action and environmental groups in the form of standard letters and e-mails. The remaining 585 submissions came from a mixture of individuals and organisations (local authorities, professional institutions, trade associations, academics, consultants, financial institutions, the waste management industry and the third sector). The summary report on the consultation responses was published on the Defra website.[7]

28. Twenty-four participants responded with comments on the pRIA, primarily expressing concerns regarding the assumptions and data used in modelling future trends and policy impacts. A condensed summary of these responses is set out in Table A.2. Where possible assumptions have been updated for this Impact Assessment with data available since publication of the pRIA. In particular, carbon benefits and municipal waste management costs have been revised substantially in light of further Defra-funded research. This analysis is set out in Appendix 1.

Table A.2: Condensed summary of pRIA responses and comments

pRIA response	Comment
The pRIA focuses on policy outcomes rather than examining policy options. The purpose appears to be to elicit positive responses to non-specific official statements. Comparisons are not made between policies aimed at the same outcome, e.g. cap and trade systems versus targets	This is an overarching Impact Assessment. As detailed policy options are developed under the strategy they will be subject to their own Impact Assessments. However, the Local Authority Waste Recycling, Recovery and Disposal (LAWRRD) modelling already explicitly examines the interactions between policy options for Municipal Solid Waste (MSW)[8]
Maximum recovery, re-use and recycling commitment are being quietly discarded	The strategy aims to substantially increase recovery, re-use and recycling
It is not apparent how changing waste composition might change the environmental benefits of recycling	The assessment has been updated in light of research available since pRIA publication. Defra is funding longer-term research to better understand long-term trends in waste arisings and composition
MSW collection costs appear not to consider differences between different collection regimes	A revised collection cost model has been included in LAWRRD based on further Defra research available since pRIA publication

[7] Available at http://www.defra.gov.uk/environment/waste/strategy

[8] See Appendix 1, Part C for further information.

pRIA response	Comment
MSW capital and gate fee costs appear unrealistic, inter alia favouring energy from waste (EfW) options	A revised gate fee model has been included in LAWRRD based on further Defra research available since pRIA publication. Source data has been updated in light of further consultations and assumptions on industry inflation rates
Most large EfW (incinerators) are located in the most deprived areas. This is of great concern with regards to Equity and Fairness	Achieving the strategy objectives will require investment in diverse infrastructure, including EfW. Government offices will ensure that regional spatial strategies and local development plans conform with revised national guidance and that *WS2007* promotes best practice in stakeholder consultation
Prioritising economics as the driver in implementing the Landfill Directive detracts from the environmental benefits of recycling, e.g. glass being collected mixed which is suitable only for low grade applications. Benefits don't always have to be financial	*WS2007* has been informed by subsequent Defra-funded research on life cycle carbon impacts of waste management, which broadly supports the waste hierarchy and the benefits of source separating recyclates. This is reflected in the analysis here
The estimate of new facilities required (*ca.* 700) appears to be of the right order. However, has sufficient consideration been given to resourcing the development of this infrastructure? Any shortcomings will undermine the strategy	Defra has established the Waste Infrastructure Delivery Programme (WIDP) to provide direct support to infrastructure delivery. PFI criteria have been amended and consideration is being given to further financial support mechanisms
The pRIA states that options are not preferred where the costs outweigh the benefits. However, costs are better worked out than benefits, which consider only climate change impacts. The balancing of costs and benefits is deficient and pretty meaningless	The benefits analysis is based on the best available evidence and information. Climate change impacts are considered to be the most important environmental impacts at the strategic level. The Defra Data and Research and Development (R&D) strategies will improve the available evidence over time and inform further policy development and strategy implementation
The voluntary approach is not effective. There is a concern that the Government is not planning new regulations until voluntary approaches have been tried first. Particular comments have been made with respect to business waste targets	The counter view was also presented, in that voluntary approaches are more flexible and generally quicker to implement against a background of regulatory simplification. However, Defra will work with stakeholders to review progress on voluntary actions and consider proportionate regulation within the framework for strategy implementation as appropriate

The final strategy and the consultation options

29. The pRIA set out an assessment of the principal measures proposed within the consultation document together with a re-assessment of continuing with current policies as a baseline. These have been updated for the present Impact Assessment in light of the consultation responses and, where appropriate, in light of new data.

Costs and benefits

30. The costs and benefits of alternative scenarios have been assessed in Annex B. Where sufficient quantification is possible, estimates of the monetary cost and benefits of the options have been presented in this Impact Assessment. Where this is not possible, a more qualitative assessment of costs and benefits has been undertaken.

31. Monetised costs and benefits are based on 2005/06 prices. Total discounted costs and benefits are to society as a whole and summed from 2006/07 to 2019/20.[9] The base year for discounting purposes is 2006/07.

32. MSW costs have been estimated using Defra's LAWRRD model. Commercial, industrial and hazardous (CI&H) waste costs have been based on arisings data from the Environment Agency's Regional Economy – Environment Input – Output (REEIO) model and an assessment of treatment requirements, as set out in Appendix 1.[10]

33. The monetised benefits are presented in terms of carbon savings. These are based on an assessment of climate change impacts as a proxy for total environmental impact. These benefits accrue as:

- direct benefits of reduced landfill emissions; and
- off-set benefits of recycling, recovery and greater resource efficiency within product life cycles.

These benefits have been monetised using the social cost of carbon. Estimates presented in this impact assessment relate to the central estimate of the social cost of carbon. The methodology is set out in Appendix 1, Part D.

34. The evaluation has been substantially revised from that presented in the pRIA following further research on the life cycle greenhouse gas impacts of managing waste streams. However, these impacts remain strongly dependent on the nature of wastes, the treatment routes and how offsets are gained. The analysis should therefore only be viewed as providing a *broad* indication of the relative benefits of options. The evaluation for CI&H wastes is less robust than that for MSW as less compositional data is available.

35. More detailed evaluation of costs and benefits will be undertaken in separate impact assessments for those options taken forward as part of the strategy implementation.

[9] A discount rate of 3.5% has been used in accordance with Treasury Green Book guidance.
[10] See Appendix 1, Part D for more information on the REEIO model.

Qualitative assessment

36. For some impacts, it has been concluded that valuation is not possible at this time. It is important that the non-valued impacts are taken into account when assessing the different policy options, rather than conclusions being drawn solely from the monetary analysis and other quantified impacts. The following impacts have been subject to qualitative assessment where applicable:

- social impacts;
- disamenity impacts from waste management facilities and fly-tipping; and
- competition and small business.

37. Local and global impacts were considered in more detail in the Environmental Report which accompanied the strategy consultation. This considers impacts on biodiversity, flora and fauna, human health, water and soil, air quality, and on cultural heritage and landscape.

38. A qualitative assessment of the overall impact of the strategy objectives is given in the policy web in Appendix 2.

Waste Strategy 2007 (Option A)

39. *WS2007* consolidates *Waste Strategy 2000* policies and measures undertaken subsequently. This includes measures resulting from the progressive implementation of the Landfill Directive, the Pollution Prevention and Control Regulations 2000 and various Producer Responsibility Directives, such as on packaging and packaging wastes, end-of-life vehicles, and waste electrical and electronic equipment.

40. The strategy implies a continuing and complex evolution of the current waste management landscape. However, it does not introduce any new actions which would increase regulatory burdens over and above current policies. Future proposals brought forward under the strategy that may increase regulatory burdens on the private, public or third sectors will be subject to their own Impact Assessments in due course. These Impact Assessments would also assess the scope to simplify or remove existing regulatory requirements, in line with recommendations from the recent Hampton Review and the *Less is More* report from the Better Regulation taskforce.

41. The following sections consider other options set out in the consultation document and assess the impact of those to be taken forward in *WS2007*.

Simplifying the regulatory framework (Option B)

42. The current regulatory framework requires some businesses to operate with both a waste management licence and a pollution prevention and control (PPC) permit, sometimes for the same site. Work to create a common permitting and compliance framework by combining these regimes is already underway and an integrated regime is due to come into effect in April 2008. Consultations on detailed policy options around this new permitting regime have recently been conducted[13] and a further consultation on guidance is currently underway.[14] This includes a detailed assessment of costs and benefits in its own pRIA, and so is not considered further here. However, savings of around £90 million over ten years are forecast, through a reduction of the administrative burden on business and regulators and through wider economic benefits.

[11] Environmental Permitting Programme: 'Second consultation on proposals for creating a streamlined environmental permitting and compliance system' is available at: http://www.defra.gov.uk/corporate/consult/envpermitprog2/consultation.pdf

[12] See http://www.defra.gov.uk/corporate/consult/envpermitprog3/index.htm for further information.

43. In December 2006 Defra, with the Environment Agency and the Welsh Assembly Government, launched a review of the exemptions from waste management licensing. The primary objective of the review is to provide for a more risk-based approach to deciding which activities should be exempt in the future and which would be better regulated under a licence. The review will identify principles and criteria on which to make decisions about providing for exemptions, one of which will be to encourage re-use, recycling and recovery activities that pose a low environmental risk.

44. The exemption review will provide a new suite of exemptions from April 2009 and therefore the revised exemptions will become exemptions from the need for an environmental permit.

45. The results of the exemptions review are likely to lead to some activities that currently require a waste management licence becoming exempt in the future, while others that currently benefit from an exemption will require an environmental permit. The costs and benefits of such changes will be subject to separate consultation and impact assessment, which will take account of parallel projects such as the Environmental Permitting Programme, so that that regulatory control is more proportionate to the risk posed by the different waste recovery and disposal activities.

46. This review may particularly help smaller businesses (in the private or voluntary sector) as their activities are more likely to be in the lower risk categories.

Waste prevention initiatives (Option C)

47. The consultation document set out a number of approaches to encourage waste prevention as part of the wider sustainable consumption and production agenda. These included initiatives to:

a. identify and prioritise **products** with the most significant impacts;

b. extend product stewardship by producers and retailers, and reduce waste impacts through **eco-design**;

c. promote **re-use and remanufacture** with support from the Business Resource Efficiency and Waste (BREW) programme;

d. further **engage businesses** (including SMEs) to stimulate resource efficiency; and

e. provide advice to consumers (business and the public) on environmental impacts of products.

48. These initiatives are intended to prevent waste from being generated in the first place by looking across the life cycle of products and services, from design and production through to consumption and end-of-life management.

49. There was strong consultation support for all waste prevention measures, with clear emphasis on the need to target action on materials, products and priority sectors.

50. The Government is taking product policy forward under the sustainable consumption and production agenda, including a new products and material strategy planned for Spring 2008. These measures are aimed at reducing waste impacts throughout the production and consumption cycle over the long term. Their effect is likely to be gradual but cumulative. Their success will be measured by reduced waste in both the business (commercial and industrial) and local authority (municipal) sectors.

51. Current data indicate that the rate of municipal waste growth has been slowing since the turn of the millennium. This already suggests some decoupling from economic growth. Scenario 1 in Appendix 1 illustrates that if waste growth were to fall to 0% per annum then this would yield cost savings of £1 billion as a net present value over the strategy period compared with a central case of 0.75% per annum growth.[13]

52. Similarly, Scenario 7 in Appendix 1 illustrates that if waste prevention measures targeted at the industrial sector led to a reduction in overall industrial waste growth by 0.75% per year to 2020,[14] this would yield benefits of between £1.4 billion and £1.7 billion as a net present value. This would comprise both cost savings from reduced waste management infrastructure and the benefits from carbon savings from reduced emissions and energy and other resources saved, including the benefits of waste prevention where it is assumed that virgin material is not produced at the margin.[15]

53. The costs will comprise central government expenditure on programmes to identify priority products and support to assist businesses to 'design out' waste, and the costs to business in making the changes. Current Government expenditure (under the BREW programme) is planned to be around £40 million in 2007/08 to support such activities.

54. If similar schemes could be extended to commercial enterprises – reducing waste growth across the board, again by 0.75% p.a. (Scenario 8, Appendix 1), compared to the 'no policy change scenario' combined carbon benefits and waste treatment cost savings are estimated in the region of £4 billion to £5 billion.

Extending the sectoral approach (Option D)

55. This option considers extending the producer responsibility approach to arrangements (statutory or voluntary) with broad business sectors, which may cover reducing production waste, increasing recycling and recovery of business wastes, and increasing the recycled content of new products.

56. The approach builds on existing voluntary agreements with businesses and sectors, such as the sectoral plans developed by the Environment Agency with the chemicals and cement industries and the Courtauld Commitment with retailers, but includes the use of existing regulatory requirements, such as PPC, where appropriate. For example, the Environment Agency's corporate strategy (2006–11) sets a target to reduce waste disposal by PPC-regulated industry by 15%.

57. The consultation responses showed further strong support for the sectoral approach as providing a generally more targeted and sophisticated focus on business waste prevention and increasing recycling of waste that is produced. Views were mixed as to whether this should be regulatory or voluntary, with the latter generally being considered more flexible. Priority should be given to sectors with highest environmental impact and agreements should be accompanied by reduction targets wherever practicable.

[13] I.e. reducing MSW from a baseline of 32,070 million tonnes in 2019/20 to 28,890 million tonnes.

[14] I.e. reducing industrial wastes from a baseline of 69 million tonnes in 2019/20 to 66 million tonnes and preventing 24 million tonnes over the period from 2006/07.

[15] However, the potential for waste prevention across all business sectors is much greater. It is estimated that the cost of wasted natural resources to UK manufacturing industry is equivalent to around 7% of profit (*The Benefits of Greener Business*, Cambridge Econometrics and AEA Technology www.environment-agency.gov.uk/business). Energy efficiency improvements by business and industry could save £12 billion annually across the UK economy (*The Energy Review*, Performance and Innovation Unit report www.number-10.gov.uk/su/energy/1.html). The potential for realising these savings will be investigated further as part of the Sustainable Development Action Plan.

58. The Government has identified the food and retail and construction and demolition sectors as priority sectors. Overall, if agreements led to an increase in recycling of mixed commercial waste from 8% to 28% and an increase in food waste composting of 30% it is estimated that there would be a net benefit of between £200 million and £1.0 billion as a net present value (Scenario 9, Appendix 1). This includes both expected changes in waste management costs and carbon savings.

National household waste targets (Option E)

59. The consultation document proposed to set national household waste recycling and composting targets of 40% by 2010, 45% by 2015 and 50% by 2020. The consultation responses generally supported these targets or argued for higher ones. Many also argued for waste reduction targets.

60. *WS2007* confirms the proposed national recycling targets but, to give greater emphasis to waste prevention, also sets a new national aspirational target to reduce the average amount of household waste not re-used, recycled or composted from 370 kg per person in 2005/06 to 310 kg in 2010, 270 kg in 2015 and 225 kg in 2020 – a reduction of 50% from the 2000 level of 450 kg.

61. The level of these targets reflects the fact that there has been much lower and slowing household waste growth since 2000. Appendix 1 sets out scenarios for a range of levels of waste growth. The recent change in waste growth and the effect expected from the planned waste prevention policies (through actions by producers, local authorities and households) are intended to deliver no more household waste in 2020 than in 2005/06. This, together with 50% household recycling in 2020, will deliver the 225 kg per head target.

62. Scenarios 1 and 2 in Appendix 1 set out the costs and benefits of meeting Landfill Directive targets at different levels of waste growth and facility delivery through a cost minimisation approach subject to constraints.[16] Recycling levels are predicted to be in line with national targets. Stabilising waste growth is shown to deliver £0.9 billion of discounted cost savings between now and 2020 compared to waste growth at 0.75% per annum. Scenario 4 in Appendix 1 shows that higher recycling levels of 60% in 2020 could deliver discounted carbon benefits of between £0.5 billion and £2.1 billion at a discounted cost of between £0.6 billion and £1.1 billion compared to Scenario 1.

Local authority performance standards (Option F)

63. The consultation document set out alternative ways in which local authority standards could be set beyond 2007/08 to better incentivise recycling performance while giving authorities flexibility in achieving this. In particular, every local authority will have a role to play in increasing diversion of biodegradable municipal waste (BMW) from landfill in order to meet the requirements of the EC Landfill Directive.

64. Since the consultation document was published, the Government published a White Paper on the new local government performance framework – *Strong and Prosperous Communities.*[17] The White Paper sets out a radical simplification of the performance framework for those outcomes secured by local authorities working on their own or in partnership.

[16] A description of the LAWRRD modelling approach is given in Appendix 1, Part C.
[17] Available at: http://www.communities.gov.uk

65. The main feature of the new framework will be a set of national outcomes and 200 mandatory indicators, set by central government and to be announced in conjunction with the Comprehensive Spending Review 2007. Every local area – led by the local authority – will have to report against all 200 indicators and agree up to 35 of these as 'local improvement targets'. Each area will also have 18 Department for Education and Skills statutory improvement targets.

66. This new indicator set will replace the many local performance indicators currently set by central Government, including those for waste.

67. The consultation document invited views on whether the Government should set future waste statutory performance standards for local authorities and, if so, what changes should be made to the nature of the targets (their interactions with landfill diversion requirements and consistency with government policy) and the methodology for setting targets (whether to adopt the existing, differentiated approach based on previous performance or set a universal minimum target with/without the option to negotiate locally).

68. An overwhelming majority of respondents agreed that statutory performance standards were important and should be continued into the future.[18] Support was based on experience that targets:

- ensured that resources were allocated to recycling and a perception that targets had raised recycling rates in recent years;
- were essential to ensure investment can be committed at the waste collection authority level to reach and maintain high recycling levels; and
- have encouraged changes in collection methods which have led to implementation of high quality waste and recycling collection schemes.

69. The Government is developing proposals for local authority waste performance indicators to be enshrined in the new performance framework. The indicators will monitor local authorities' contributions to an overall waste outcome that leads towards a sustainable management of waste in England. The proposed indicators focus on the amounts of municipal and household waste produced, recycled and landfilled. It is envisaged that one focus for local improvement targets will be the authority's performance on the average amount of waste per household that is not recycled or composted. This would measure an authority's achievements in both reducing waste and in increasing recycling and composting the waste that is produced. The Government is considering setting a 'floor' target – a minimum level that all authorities should meet. The Government would then agree individual performance targets where appropriate, dependent on current performance and local aspirations in respect of both household and municipal waste. Consideration is also being given to how to include tonnages diverted from landfill via re-use and home composting in the new set of performance indicators.

70. The Government plans to publish the final agreed performance package later in 2007. Consequently, the revised strategy includes no specific proposal for local authority waste outcomes.

Greater recovery of energy from waste (Option G)

71. This option considered support for the greater recovery of energy from residual combustible wastes and to get the right balance between dedicated waste from energy facilities, co-firing with other solid fuels and use by large industrial users.

[18] This included 95% of disposal authorities, 87% of collection authorities and 83% of unitary authorities who replied to this consultation question.

72. This option drew the greatest number of consultation responses, including 3432 responses in the form of standard letters and e-mails opposing energy from waste (in particular incineration). Concerns generally relate to potential health impacts from emissions and risks of capital-intensive facilities diverting waste from recycling and other actions higher in the waste hierarchy. However, the potential health impacts from modern facilities are small compared with other potential hazards[19] and the balance of waste management options needs to be considered as part of an integrated approach to resource recovery.

73. The majority of the 356 non-standard responses, including those from local authorities, supported energy from waste within the waste hierarchy. The Government's view is that energy from waste makes a valid contribution to the treatment of residual waste.

74. *WS2007* envisages some increase in recovery of energy from waste in both the municipal waste and commercial and industrial waste streams (Scenarios 1 and 6 respectively in Appendix 1). This increase is needed for municipal waste to ensure that England meets its share of the Landfill Directive targets (in 2010, 2013 and 2020) and to divert waste from landfill that cannot be practically or economically recycled. The scale of required provision will depend in part on future waste arisings and the level of recycling achieved. The WIDP programme and other policies are designed to ensure future provision is adjusted to changes in these factors and provide flexibility for use of facilities by commercial as well as municipal waste.

75. The consultation drew general support for anaerobic digestion and advanced conversion technologies such as pyrolysis and gasification. This is supported by subsequent life cycle carbon impact analysis, which also demonstrates the benefits of recovering heat in addition to electricity (combined heat and power) and the utilisation of waste wood as a fuel.[20]

76. While the Government remains technology-neutral on energy from waste, *WS2007* seeks to further promote anaerobic digestion and the utilisation of wood waste, including support under the Renewables Obligation. It also seeks to support the market for solid recovered fuel (SRF) produced by mechanical biological treatment (MBT) plants. The Government has started work under the Waste Implementation Programme (WIP) to identify potential end users of SRF and to quantify the potential demand for it. Also, the Chancellor's 2007 Budget announced the Government's intention to review the classes of equipment that can qualify for enhanced capital allowances for good quality combined heat and power (CHP) to ensure that the scheme includes all necessary equipment for CHP facilities to use solid recovered fuel. This should encourage investment in markets for the outputs of new waste treatment facilities, including for SRF, allowing SRF to compete more fairly with other solid fuels.

Overarching procurement strategy for municipal waste (Option H)

77. The consultation document recognised that considerable further investment in waste management infrastructure would be required in order for local authorities to meet their Landfill Directive requirements. Consequently, it discussed the need for an overarching procurement strategy for municipal waste to strengthen central and regional coordination with clearer advice on procurement and funding options for local authorities, including collaborative options. This was supported by all sectors responding to the consultation.

[19] See *Review of the Environmental and Health Effects of Waste Management* (2004) at http://www.defra.gov.uk/environment/waste/research/health/index.htm

[20] *Carbon Balances and Energy Impacts of the Management of UK Wastes*, report by ERM (with Golder Associates) for Defra, Final Report, March 2007 is available at www2.defra.gov.uk/research/project_data

78. Since the consultation was completed, Defra has established the Waste Infrastructure Delivery Programme (WIDP) to monitor and support local authorities in infrastructure delivery.[21] WIDP aims, in particular, to provide local authorities with expert assistance and a comprehensive support package throughout the complex process of procurement, from the point of decisions on technology choice through the planning process to financing options, while ensuring that synergies with other waste streams are exploited and suitable new entrants are encouraged into the supply market. The Programme aims to accelerate infrastructure delivery by offering this support and will manage the Defra PFI process through a managed delivery pipeline. It will also analyse and monitor the capacity gap to ensure that robust evidence exists on which to take sound decisions. In addition it will raise awareness of, and establish market interest in, the potential for the use of SRF as part of an energy recovery process and raise public awareness of the options and issues relating to waste management infrastructure.

79. The costs of WIDP are the staff and other resources to provide the coordination and support for local authorities, to help them to deliver the estimated £11 billion worth of waste management infrastructure needed. These are estimated to be of the order of £3 million a year.

80. The benefits are to both local authorities and waste management companies. There should be cost savings in terms of bid and procurement costs as well as the costs of the contracts themselves. While these are difficult to quantify, in one recent case the total cost of a failed procurement exercise was estimated at over £50 million.[22]

81. There will also be benefits from faster delivery which will reduce the risk of the UK failing to meet its Landfill Directive targets.

Wider role for local authorities in non-municipal waste (Option I)

82. The consultation document sought views on expanding the role of local authorities in relation to business waste, particularly commercial waste and that from smaller businesses.

83. The potential benefits will be:

a. increased recycling and composting of commercial (and possibly) industrial waste;

b. cost savings to businesses (particularly smaller ones) and public sector organisations; and

c. cost savings to local authorities' waste management costs from potential economies of scale.

84. The environmental benefits of increased commercial waste recycling are illustrated by Scenario 8 in Appendix 1. While there is limited evidence to quantify the potential cost savings, there are examples of establishing recycling collection services for schools and offices that are no more expensive than the existing waste management services.[23]

85. **Option I1** envisaged this role being developed on a voluntary basis by local authorities with some financial support from central government, at least initially. This was generally supported by consultation respondents but with some reservations, notably about resources, infrastructure and staffing. Costs to local authorities (or central government) would comprise staff resources and overheads. These are estimated at £200,000–£250,000 per year for each authority or group of authorities.[24] If this option were undertaken across England costs could total £30 million per year.

[21] See http://www.defra.gov.uk/environment/waste/wip/widp/index.htm for further information.
[22] This included additional costs incurred in re-tendering and greater waste management costs due to facility delays.
[23] WRAP are currently piloting recycling services for small businesses which should provide further evidence of costs.
[24] Based on 4–5 staff at typically £50,000 per year (including overheads).

86. **Option I2** envisaged placing new duties on local authorities to offer a recycling service to businesses on a rechargeable basis. This should impose no additional costs on authorities. Equally, businesses would not be required to use the service, so no extra costs would be imposed on them. The implications of taking in additional waste streams on Landfill Allowance Trading Scheme (LATS) targets were raised by numerous consultees. The Government will consider this as part of its operational review of LATS in 2007. Respondents from the waste management companies were generally opposed to this approach – they indicated that they were better resourced to provide the required services.

87. The consultation document also set out a further alternative of setting recycling and composting targets for commercial waste on local authorities. This would result in additional costs on local authorities if the targets were set at a level which meant they could only be met by offering the service to businesses at a less-than-cost price. There is insufficient evidence at present to assess the relative costs and benefits of different target levels. This would need to be considered in more detail if this action were to be pursued.

88. *WS2007* promotes the voluntary approach in Option I1 and encourages local authorities to use their role as local community leaders in partnership with businesses, other local, sub-regional and regional public sector organisations and third sector organisations to achieve a more integrated approach to resources and wastes in their area. This includes support through WIDP to consider business waste when planning and procuring facilities. New duties on local authorities will be considered in light of progress with the voluntary approach.

Better collection and management of household hazardous waste (Option J)

89. The consultation document considered proposals to achieve improved collection and appropriate management of hazardous waste in the household stream.

90. As increasing volumes of household waste are collected separately for recycling there may be an increasing concentration of hazardous substances in the remaining waste. This may give rise to problems with treatment options for residual waste (e.g. in landfill leachate and through concentration in incinerator bottom ash). There are, therefore, potential cost and environmental savings from increased separate collection.

91. **Option J1** would be to specify a minimum level of service expected of local authorities to meet their current legal obligations. This would secure a minimum standard across the country for duties for which authorities have already received increased funding as part of the revenue support grant system.

92. **Option J2** would be to review and, if necessary, strengthen the legal requirements on local authorities to support the required minimum service level. If this resulted in proposals for further duties on local authorities these would need to be assessed before any such proposals were taken forward.

93. **Option J3** would be to extend the range of producer responsibility agreements or producer targets for recovery of specific household hazardous wastes, e.g. pesticides, cleaning agents or DIY chemicals. The costs and benefits of such an approach would need to be assessed for each product range before any such proposals were taken forward.

94. Broad support was received for extending producer responsibility agreements. *WS2007* seeks to take this forward on a voluntary basis and only if this looks likely to fail would the possibility of statutory approaches be considered at a later stage. Option J1 will also be pursued, with consideration of J2 only if J1 looks likely to fail.

Extend producer responsibility to priority hazardous waste streams (Option K)

95. Waste collection authorities are required to provide for the collection of hazardous household wastes. This proposal would seek to extend producer responsibility in respect of these wastes in order to achieve greater collection (avoiding inappropriate or illegal disposal) and increase recycling or energy recovery. A first candidate might be decorative paints including varnishes.[25] The approach would be to seek voluntary agreement with the producers.

Targeted action on illegal waste management (Option L)

96. This proposal would see more resources targeted at prevention of illegal waste activity and greater enforcement action. The consultation document sought views on what additional action might be necessary for more effective prevention and enforcement. It also asked whether existing powers should be extended for use by a wider range of authorities including waste disposal authorities. Following further investigation, the Government concluded that sufficient powers already exist in current legislation and so no further action on this point was necessary.

97. Respondents said that they would support more resources for enforcement, stronger penalties and education and information campaigns. The benefits of further action could include:

a. reduced levels of fly-tipping;

b. reduced harm to health and wildlife;

c. benefits to the amenity and liveability of area;

d. stronger deterrence; and

e. reduced competition from illegal operators.

The costs of additional action would include initial set-up costs for authorities who might need to expand and train enforcement teams. However, there would be offsetting benefits from reduced clearance costs.

98. It is not possible to quantify these costs and benefits at this stage. Any further regulatory proposals or increases in the use of existing powers would only be considered later after further assessment of the costs and benefits.

Household financial incentives (Option M)

99. The Budget 2007 announced annual increases in the standard rate of landfill tax of £8 per tonne from 2008/09 until at least 2010/11 and an increase of £0.50 per tonne in the rate of landfill tax for inert waste from 2008/09. These changes, in addition to the announcement on Enhanced Capital Allowances (ECAs) (see paragraph 76), have been incorporated into the 'no policy change' scenarios assessed separately in Appendix 1 for municipal and commercial and industrial wastes in Scenario 1 and Scenario 5, respectively. This is to highlight the fact that landfill tax has a significantly different impact on these waste streams.

[25] The pRIA discussed waste oils as a potential candidate, but the EC has since proposed the repeal of the Waste Oil Directive along with a requirement for Member States to give priority to regeneration. In view of this development and the current state of the oil market, the Government does not intend to bring forward a producer responsibility scheme for oil at this time.

100. The major driver on **municipal waste** is the LATS and the penalty it places on exceeding Landfill Directive targets for the landfilling of biodegradable municipal waste. The impact of increasing landfill tax is primarily to incentivise the further diversion of non-biodegradable materials otherwise not recycled. This results in a small (some two percentage point) increase in the recycling rate and associated carbon benefits to 2019/20 of around £30 million to £140 million for a cost of between £60 million and £170 million as a net present value, depending on the level of waste growth.

101. The strategy announces a consultation on proposals that would remove the ban on local authorities introducing financial incentives to encourage householders to reduce, home-compost and separate their waste. Initial Defra-funded research[26] suggests incentive schemes show that in some local authorities cost savings of up to £17 per household could be achieved with incentives together with a five percentage point increase in total national recycling and composting rate plus a 7% reduction in total national waste quantities. Further assessment, including an assessment of economic, social and environmental impacts, is contained in the consultation document.

Sectors and groups affected

102. *WS2007* sets out a new and more ambitious high-level direction for waste policies in England over both the medium and longer term to respond to the challenges of sustainable development, 'One Planet Living'[27] and climate change. Meeting these challenges will require behaviour change across all sectors and groups together with considerable future investment to achieve the desired environmental outcomes. Sectors and groups affected will include:

a. businesses, as consumers, producers and retailers of products and generators of waste;

b. the waste management industry;

c. domestic consumers, as purchasers and waste generators;

d. the third sector, as providers of services and in engaging communities in changing behaviour;

e. the public sector as a whole, as purchasers and waste generators; and

f. local authorities, as local community leaders, as responsible for waste management services in particular.

103. However, the strategy does not seek to impose new regulatory burdens without considering a voluntary approach first. Future proposals brought forward in implementing the strategy that may increase burdens on these sectors will be subject to their own impact assessments in due course.

Small Firms Impact Test (SFIT)

104. The advice of the DTI's Small Business Service was sought in the development of the consultation document on the review of England's Waste Strategy in order to consider the impacts of each option on small firms. During Stage 1 of SFIT we carried out sounding exercises with small businesses and representative bodies, such as the Confederation of British Industry (CBI) and the Federation of Small Businesses. Representatives of those organisations took part in the general stakeholder workshops during development of the consultation document. We also ran a workshop specifically looking at the position of small businesses which assisted in the formulation of the consultation document.

[26] *Modelling the Impact of Household Charging for Waste in England*, Eunomia, May 2007 is available at http://www.defra.gov.uk/environment/waste/strategy

[27] 'One Planet Living' is a concept from WWF and Bioregional.

105. We subsequently included an article on the review of the waste strategy in the Small Business Service's newsletter inviting SMEs to provide comments during the formal consultation. Comments were received from a number of SMEs and the Federation of Small Businesses.

106. *WS2007* does not introduce any new actions which would increase regulatory burdens. Where specific policy proposals resulting from carrying forward the further policy development set out in *WS2007* may increase regulatory burdens, these proposals will be subject to their own impact assessment in due course. However, some options are intended to assist small businesses in particular or will have the effect of helping them or reducing regulatory burdens on them. These include:

a. **simplifying the exemption system (Option B)**;

b. **waste prevention initiatives (Option C)** which seek to find ways to help small businesses improve their resource efficiency;

c. **overarching procurement strategy for municipal waste (Option H)** which may help smaller firms compete in the market;

d. **wider role for local authorities in non-municipal waste (Option I)** which will seek to improve availability of recycling services for small businesses in particular; and

e. **targeted action on illegal waste management (Option L)** which should include help small businesses to ensure their waste is dealt with properly and legally.

107. Appropriate representation will be sought from the SME community for the Waste Stakeholder Group which will have a remit to provide advice and input to delivery of the strategy, and future development of policy and strategy.

Competition assessment

108. The waste management industry is the market that is most directly affected. However, all businesses will be affected to some degree. The waste management industry is relatively concentrated, and is becoming more so.

109. The market is not expected to be significantly affected by the options being considered. Implementing an overarching procurement strategy (Option H) will have some effect on the operation of the waste management industry with a view to achieving a more effective and competitive market for municipal waste contracts.

110. For these reasons, having appraised the options using the competition filter, the view is that there is no need for a detailed competition assessment (see filter assessment at Appendix 3).

Other Impacts

111. The individual actions set out in the Strategy will have a range of social, environmental and economic impacts. The most significant of these have been discussed above. Other impacts are considered in the policy web in Appendix 2. This has been derived using the Defra policy tool 'stretching the web'.

112. The analysis shows the impact of the actions as broadly positive in aggregate, although costs to central government will increase over the base case through increased support to local authorities and programmes to improve resource efficiency and reduce waste from business and industry. However, it should be borne in mind that costs will rise significantly under the base case, particularly for local authorities in achieving higher rates of recycling and recovery of biodegradable waste in order to meet the requirements of the Landfill Directive. Costs to industry will also rise under the base case, but these increases may be mitigated by increased efforts on waste minimisation, recycling and avoided landfill disposal.

Equality and fairness

113. The programme set out in *WS2007* is expected to be broadly neutral in terms of equality and issues of fairness (including race, gender, rural communities and low income groups). This is illustrated in the policy web, Appendix 2. However, as detailed proposals are developed and implementation plans considered it will be important for service deliverers to consider the particular effects on different groups. For instance, as local authorities expand kerbside recycling services to increase recycling, they will need to consider how these are delivered in rural areas, in high rise flats, to disabled people, etc.[28]

Health impacts

114. Health impacts of waste management have been considered in the *Environmental Report* (Section 4) and its *Baseline Review* (Appendix A) that accompanied the consultation document.

115. The evidence is that waste management has, at most, a minor effect on human health, particularly when compared with other health risks associated with day-to-day living.[29] The programme set out in *WS2007* should not materially affect that conclusion. However, local impacts need to be considered in the planning and implementation of local strategies.

Enforcement, sanctions and monitoring

116. The consultation document proposed that an inter-departmental board be established to drive delivery of the strategy and monitor and review progress against performance indicators.

117. This proposal was widely supported. The Government is establishing the Waste Strategy Board with a remit to:

- drive delivery of this strategy across government;
- monitor and evaluate the implementation of the strategy;
- provide advice, support and direction to government and delivery organisations in achieving the sustainable management of waste; and
- develop new policy actions as necessary to deliver the ambitious outcomes we seek in the light of progress.

[28] With respect to these, the Household Waste Recycling Act 2003 requires that by 2010 all householders are provided with collection facilities for at least two materials, which sets a minimum floor for service provision. Also, rural funding for recycling is a consideration within the existing Revenue Support Grant to local authorities.

[29] *Review of the Environmental and Health Effects of Waste Management* (2004) is available at http://www.defra.gov.uk/environment/waste/research/health/index.htm

118. The Government wishes to see ownership of the strategy and its implementation by all groups with the Government open to challenge and accountable for its performance. A Waste Stakeholder Group will be established to provide advice and input to delivery of the strategy, and future development of policy and strategy. Project sub-groups of both the board and stakeholder group will be developed as appropriate to ensure delivery of specific aspects as required.

119. The overall progress of the strategy will be tracked using a range of national level indicators and monitoring of the high-level implementation plan. This will be shared with the Waste Strategy Stakeholder Group. The Waste Strategy Board will oversee the production of periodic reports on implementation of the strategy and the management and realisation of the benefits expected.

120. The Government will keep this strategy under review. In the light of progress in achieving its aims, new European developments and obligations, and any other significant events, it will consider the need for any revisions to the strategy.

Appendix 1: Future waste scenarios: forecasts, costs and benefits

Introduction

1. This Appendix provides an assessment of the impacts, costs and benefits of a range of future scenarios for the management of both municipal and commercial and industrial wastes. These scenarios build on the policy options set out in the partial Regulatory Impact Assessment (pRIA) issued as part of the waste strategy review consultation and reflect both the responses to that pRIA and to the proposals set out in the consultation document itself.[1]

2. Part A discusses scenarios for municipal solid waste (MSW). These have been assessed using Defra's Local Authority Waste Recycling, Recovery and Disposal (LAWRRD) model. This is a national model which works at waste disposal authority level to predict future facility requirements in response to different policy drivers, including local authority standards, landfill allowances trading and landfill tax pressures. This analysis has been updated with data available since publication of the pRIA. A key uncertainty considered is the impact of waste growth in meeting the Article 5 requirements of the Landfill Directive.[2] Alternative recycling and energy recovery scenarios have been evaluated in terms of costs, facility requirements and environmental benefits.

3. Part B discusses scenarios for commercial, industrial and hazardous (CI&H) wastes. The data presented are largely consistent with those presented in the pRIA, but now takes account of the changes in landfill tax in the Chancellor's 2007 Budget.

4. The climate change impacts of the scenarios have been quantified in terms of carbon savings, which are used as a proxy for total environmental impact. These benefits accrue as:

- direct benefits of reduced landfill emissions; and
- off-set benefits of recycling, recovery and greater resource efficiency within product life cycles

and have been monetised using the social cost of carbon.[3] The methodology is set out in Appendix 3.[4] The evaluation here has been substantially revised from that presented in the pRIA following further research on the lifecycle greenhouse gas impacts of managing waste streams[5]. However, these impacts are strongly dependent on the nature of wastes, the treatment routes and how off-sets are gained. The analysis should therefore only be viewed as providing a broad indication of the relative benefits between scenarios. The evaluation for CI&H wastes is less robust than that for MSW as less compositional data is available.

5. Note that the following conventions are used throughout this Appendix when comparing scenarios:

- costs: positive costs represent increases in cost over a baseline; negative costs represent savings; and
- benefits: positive benefits represent improvements (savings) over a baseline; negative benefits represent increased impacts over a baseline.

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[1] The consultation document and pRIA are available at http://www.defra.gov.uk/environment/waste/strategy

[2] Directive 1999/31/EC on the landfill of waste.

[3] Clarkson, R. and Deyes K. (2002) *Estimating the Social Cost of Carbon Emissions*, Government Economic Service Working Paper 140, Defra and HM Treasury (£35/t low cost of carbon, £70/t medium, £140/t high at 2000 prices, increasing at £1 per year in real terms)

[4] This provides a conservative estimate of benefits, as wider environmental improvements in virgin materials reduction, resource utilisation and non-greenhouse gas impacts of materials production and consumption are not included.

[5] *Carbon Balances and Energy Impacts of the Management of UK Wastes*, report by ERM (with Golder Associates) for Defra, Final Report, March 2006 is available at www2.defra.gov.uk/research/project_data
Environmental Benefits of Recycling: An international review of lifecycle comparisons for key materials in the UK recycling sector, WRAP, May 2006, is available at www.wrap.org.uk/applications/publications

Part A Municipal waste

6. Article 5 of Directive 1999/31/EC on the landfill of waste (the Landfill Directive) sets legally binding commitments to reduce biodegradable municipal waste (BMW) to landfill by 2010, 2013 and 2020.

7. *Waste Strategy 2000* set national targets for the recycling/composting of household waste to 2015 and provided the framework for the introduction of statutory performance standards for local authorities for 2003/04 and 2005/06. These have acted as major drivers in the management of the estimated 29 million tonnes of MSW generated per annum.

8. Progress with respect to MSW was reviewed in 2002 by the Prime Minister's Strategy Unit. This established the Waste Implementation Programme (WIP) in 2003 to provide additional support to local authorities in achieving the Landfill Directive BMW diversion targets. The Landfill Allowances Trading Scheme (LATS) was introduced under the Waste and Emissions Trading (WET) Act 2003 as the main statutory mechanism for achieving these targets. Additionally, the Household Waste Recycling Act 2003 requires that by 2010 waste collection authorities (WCAs) provide for the separate collection of at least two types of recyclable waste from households. As announced in the Budget 2007, the standard rate of landfill tax will be increased from £24 per tonne in 2007/08 by £8 per year until at least 2010/11, by which time it will have reached £48 per tonne. The lower rate applying to inactive waste will also increase from £2 per tonne to £2.50 per tonne in 2008/09.

9. Consequently, many of the key policy levers are very new and there is a limited evidence base on which to assess their impacts. But the policies and measures introduced since publication of *Waste Strategy 2000* have driven considerable change in local authority waste management, including a substantial increase in the recycling and composting of household waste, and in the development of markets for recovered materials. The interim *Waste Strategy 2000* target for the recycling/composting of 17% of household waste by 2003/04 has been achieved, as has the 2005/06 target of 25%. The following scenarios have been assessed against this evolving background and pressure to meet Landfill Directive targets.

MSW arisings

10. WasteDataFlow provides the most comprehensive evidence on the sources, quantities and fates of municipal waste collected by local authorities in England.[6] In 2005/06 local authorities collected 28.7 million tonnes of MSW. Of this, 25.5 million tonnes was household waste, the remainder being collected from sources such as industry, commerce, municipal parks and gardens. In total, 37% (10.7 million tonnes) of MSW had some sort of value (recycling, composting, energy recovery) recovered from it and 62% (17.9 million tonnes) was disposed of in landfill. Of the MSW disposed of in landfill an estimated 12.4 million tonnes was biodegradable.

11. Defra's municipal waste survey indicated a growth in waste between 1998/99 and 2003/04. Average growth for MSW was 2.0% per annum. Household waste grew at a slightly lower rate of 1.6% per annum, indicating some decoupling from economic growth.

12. WasteDataFlow figures for 2005/06 show that the rate of growth has slowed since the turn of the millennium. The longer term trend is still for waste growth with total MSW increasing by 0.5% per annum on average over the past five years.

[6] Municipal waste statistics 2005/06, Defra. See http://www.defra.gov.uk/environment/statistics/wastats/index.htm for further information.

13. WasteDataFlow results for 2006/07, expected in Autumn 2007, will provide useful evidence on whether the trends of recent years are to be sustained. However, past data currently provides insufficient evidence and understanding of recent trends on which to base future projections. Therefore four growth scenarios for MSW have been developed to assess a range of possible future outcomes to 2020:

i. 2.25% per annum reflecting recent trends in growth in consumer spending, representing a total growth of 11.4 million tonnes by 2020 (40% increase);

ii. 1.5% per annum in line with waste growth in the five years to 2004/05, representing a total growth of 7.2 million tonnes by 2020 (25% increase);

iii. 0.75% per annum, in line with current projections of household growth and reflecting more closely waste growth in the five years to 2005/06, representing a total growth of 3.4 million tonnes by 2020 (12% increase); and

vi. 0% growth, representing the possibility that waste growth will be decoupled from household and economic growth.

Scenario 1: MSW "No further policy change"

14. In this scenario local authorities continue to respond to current drivers, in particular Landfill Directive requirements and pressures to meet recycling performance standards (at least cost) against landfill tax rising to £48 per tonne in 2010/11.

15. Table A.3 summarises the LAWRRD model projections for the four waste growth rates discussed above. This assessment is based on current policy to maintain local authority performance standards for 2007/08 at 2005/06 levels while raising the minimum recycling floor to 20% (from 18%). In addition, locally published medium and longer term targets are assumed to impact on local authority decision-making.

16. In 2009/10, the projections indicate that household recycling/composting rates will increase to between 36% and 37% while, *at the same time*, energy recovery (including both energy from waste incineration and refuse derived fuels (RDF) from mechanical biological treatments (MBT) processes) will increase to around 13%. Overall, this represents a need for over 200 new facilities more than 2003/04 levels.[7] The amount of residual household waste (household waste that is neither recycled nor composted) is predicted to fall to between 330 kg and 350 kg per head. The results are driven by the economic pressure to avoid landfill allowances penalties (£150 per tonne) and market constraints in the delivery of major treatment facilities.

[7] Including a large number of materials reclamation facilities (MRF) and green waste composting (windrow composting) facilities.

Table A.3: Impact of waste growth scenarios

	2009/10		2012/13		2019/20	
Landfill Allowances (kt)		11,200		7,460		5,220
			Waste growth = 2.25%			
MSW arisings (kt)		31,470		33,690		39,440
BMW to landfill (kt)		11,200		7,450		5,220
Household recycling/composting (kt)	37%	10,280	42%	12,800	49%	17,120
Residual household waste per head (kg)		350		330		340
Energy recovery (kt)	13%	4,050	19%	6,530	20%	8,060
Capacity of residual waste facilities (kt)[a]		6,300		12,510		18,160
			Waste growth = 1.5%			
MSW arisings (kt)		30,560		31,990		35,580
BMW to landfill (kt)		10,900		7,370		5,690
Household recycling/composting (kt)	36%	9,850	41%	11,740	44%	13,950
Residual household waste per head (kg)		340		320		330
Energy recovery (kt)	13%	3,990	20%	6,420	24%	8,530
Capacity of residual waste facilities (kt)[a]		6,300		11,910		16,410
			Waste growth = 0.75%			
MSW arisings (kt)		29,670		30,370		32,070
BMW to landfill (kt)		10,540		7,320		5,460
Household recycling/composting (kt)	36%	9,490	40%	10,820	42%	12,170
Residual household waste per head (kg)		330		310		310
Energy recovery (kt)	13%	3,930	21%	6,310	25%	7,860
Capacity of residual waste facilities (kt)[a]		6,300		11,310		15,210
			Waste growth = 0%			
MSW arisings (kt)		28,790		28,830		28,890
BMW to landfill (kt)		10,130		6,730		5,280
Household recycling/composting (kt)	36%	9,300	41%	10,450	43%	11,050
Residual household waste per head (kg)		320		290		270
Energy recovery (kt)	13%	3,860	21%	6,060	25%	7,080
Capacity of residual waste facilities (kt)[a]		6,300		11,310		13,710

[a] MBT compost with either RDF or residue to landfill, energy from waste, mechanical with residue to EfW and gasification/pyrolosis.

17. The projections further indicate that household recycling levels will need to rise to over 40% if the 2012/13 and 2019/20 targets are to be met. This equates to residual household waste levels of between 270 kg and 340 kg per head by 2019/20. In the long term, energy recovery rates of up to 25% are likely to be required, depending on growth rates. This is comparable with the best of current European performance and represents a need for between 300 and 500 new facilities compared to 2003/04. The results are driven by the economic pressure to avoid landfill allowances penalties (£150 per tonne) and market constraints in the delivery of major treatment facilities.

18. The annual and total waste management costs predicted by the LAWWRD model for the four growth scenarios are summarised in Table A.4. These are expressed in actual prices; actual prices net of (all) landfill tax; 2005/06 prices net of landfill tax; and 2005/06 prices net of landfill tax, discounted to 2006/07.[8]

19. LAWRRD indicates net discounted costs rising from £2.3 billion to £2.5 billion in 2009/10 to £2.5 billion to £2.8 billion in 2012/13, reflecting the progressive requirements of the Landfill Directive for diverting BMW from landfill and the continuing growth in waste arisings. The total discounted cost for the period 2006/07 to 2019/20 is estimated at £32 billion to £36 billion.

20. The monetised estimates of carbon benefits are also summarised in Table A.4. This indicates that benefits increase with increasing diversion from landfill with a total discounted benefit in the range £0.7 billion to £2.4 billion with low waste growth and £1.0 billion to £3.2 billion with high waste growth. The carbon benefits are related to the way in which waste is treated, once it has arisen. Since predicted future waste treatments are expected to be beneficial overall, the carbon benefits outlined in Table A.4 rise with higher levels of waste growth.

21. The range of monetised climate change benefit contrasts with the overall waste management cost of £32-£36 billion. However, this excludes daily fines which the European Commission may impose for any breach of the Landfill Directive targets, which is a major driver within current policy. In any case, a comparison of only the overall financial costs with the overall CO_2 benefits of the waste management of predefined arisings is not valid because substantial waste management costs would be incurred even if all waste were landfilled.

22. Budget 2007[9] announced annual increases in the standard rate of Landfill Tax of £8 per tonne from 2008/09 until at least 2010/11 and an increase of £0.50 in the rate of Landfill Tax levied on inert waste. In addition, it announced the intention to review the classes of equipment that can qualify for enhanced capital allowances (ECAs) for good quality heat and power (CHP) to ensure that the scheme includes all necessary equipment for CHP facilities to use solid recovered fuel.

[8] At 3.5% per annum in accordance with HM Treasury Green Book guidance.
[9] See http://www.hm-treasury.gov.uk for further information.

Table A.4: Predicted MSW management costs and carbon benefits

	2009/10	2012/13	2019/20	Total
		Waste growth = 2.25%		
Costs				
Actual Prices (£m)	£3,730	£4,690	£6,410	£65,090
Actual prices net of landfill tax (£m)	£3,090	£4,120	£5,940	£57,520
2005/6 prices net of landfill tax (£m)	£2,820	£3,530	£4,350	£47,650
Discounted net of landfill tax (£m)	£2,460	£2,770	£2,690	£36,160
Benefits				
Discounted carbon impact – low (£m)	£50	£80	£110	£990
Discounted carbon impact – medium (£m)	£90	£140	£190	£1,740
Discounted carbon impact – high (£m)	£180	£260	£340	£3,250
Total carbon impact (tonnes of CO_2)	–3,677,000	–6,722,000	–11,060,000	–87,302,000
		Waste growth = 1.5%		
Costs				
Actual prices (£m)	£3,660	£4,510	£5,870	£62,050
Actual prices net of LF tax (£m)	£3,030	£3,950	£5,390	£54,670
2005/06 prices net of LF tax (£m)	£2,770	£3,380	£3,950	£45,400
Discounted net of LF tax (£m)	£2,420	£2,660	£2,440	£34,570
Benefits				
Discounted carbon impact – low (£m)	£40	£70	£80	£830
Discounted carbon impact – medium (£m)	£80	£120	£140	£1,470
Discounted carbon impact – high (£m)	£160	£230	£250	£2,750
Total carbon impact (tonnes of CO_2)	–3,401,000	–5,918,000	–8,128,000	–72,048,000
		Waste growth = 0.75%		
Costs				
Actual prices (£m)	£3,600	£4,350	£5,470	£59,410
Actual prices net of LF tax (£m)	£2,990	£3,800	£5,020	£52,250
2005/06 prices net of LF tax (£m)	£2,740	£3,260	£3,670	£43,480
Discounted net of LF tax (£m)	£2,380	£2,560	£2,270	£33,210
Benefits				
Discounted carbon impact – low (£m)	£40	£60	£70	£750
Discounted carbon impact – medium (£m)	£80	£110	£120	£1,330
Discounted carbon impact – high (£m)	£150	£210	£210	£2,490
Total carbon impact (tonnes of CO_2)	–3,193,000	–5,294,000	–6,753,000	–64,153,000

Table A.4: Predicted MSW management costs and carbon benefits (continued)

	2009/10	2012/13	2019/20	Total
		Waste growth = 0%		
Costs				
Actual prices (£m)	£3,540	£4,240	£5,100	£57,360
Actual prices net of LF tax (£m)	£2,950	£3,730	£4,680	£50,640
2005/06 prices net of LF tax (£m)	£2,700	£3,190	£3,430	£42,200
Discounted net of LF tax (£m)	£2,350	£2,510	£2,120	£32,320
Benefits				
Discounted carbon impact – low (£m)	£40	£60	£60	£720
Discounted carbon impact – medium (£m)	£80	£110	£110	£1,290
Discounted carbon impact – high (£m)	£150	£210	£190	£2,410
Total carbon impact (tonnes of CO_2)	–3,192,000	–5,261,000	–6,120,000	–62,080,000

23. In the municipal sector, one of the principal impacts of Budget 2007 will be to incentivise the recycling and treatment of non-biodegradable materials that do not fall within the influence of the Landfill Allowance Trading Scheme. Table A.5 outlines the estimated impacts of Budget 2007 on waste management costs and greenhouse gas emissions at different rates of waste growth. The range of net impacts is estimated to be broadly neutral in the municipal sector with discounted costs are projected by the LAWRRD model to be between £60 million – £170 million and carbon benefits between £30 million and £140 million. Significant positive net benefits are expected to be seen in the CI&H sector (see Scenario 5 below, including Table A.20).

Table A.5: Scenario 1 – impact of Budget 2007

	2009/10	2012/13	2019/20	Total
		Waste growth = 2.25%		
Costs				
Actual prices (£m)	£160	£180	£170	£2,080
Actual prices net of LF tax (£m)	£0	£30	£50	£310
2005/06 prices net of LF tax (£m)	£0	£20	£40	£240
Discounted net of LF tax (£m)	£0	£20	£20	£170
Benefits				
Discounted carbon impact – low (£m)	£0	£0	£10	£40
Discounted carbon impact – medium (£m)	£0	£0	£10	£70
Discounted carbon impact – high (£m)	£0	£0	£20	£130
Total carbon impact (tonnes of CO_2)	–2,000	–36,000	–194,000	–1,106,000
		Waste growth = 1.5%		
Costs				
Actual prices (£m)	£160	£170	£130	£1,800
Actual prices net of LF tax (£m)	£10	£20	–£20	£120
2005/06 prices net of LF tax (£m)	£10	£20	–£10	£110
Discounted net of LF tax (£m)	£10	£10	–£10	£80
Benefits				
Discounted carbon impact – low (£m)	£0	£0	£0	£30
Discounted carbon impact – medium (£m)	£10	£0	£0	£50
Discounted carbon impact – high (£m)	£10	£10	–£10	£90
Total carbon impact (tonnes of CO_2)	–85,000	–56,000	57,000	–732,000
		Waste growth = 0.75%		
Costs				
Actual prices (£m)	£160	£170	£100	£1,680
Actual prices net of LF tax (£m)	£10	£40	–£20	£70
2005/06 prices net of LF tax (£m)	£10	£30	–£10	£70
Discounted net of LF tax (£m)	£10	£20	–£10	£60
Benefits				
Discounted carbon impact – low (£m)	£0	£0	£0	£40
Discounted carbon impact – medium (£m)	£10	£10	£0	£70
Discounted carbon impact – high (£m)	£10	£10	£10	£130
Total carbon impact (tonnes of CO_2)	–85,000	–114,000	–77,000	–1,094,000

Table A.5: Scenario 1 – impact of Budget 2007 (continued)

	2009/10	2012/13	2019/20	Total
		Waste growth = 0%		
Costs				
Actual prices (£m)	£150	£150	£110	£1,640
Actual prices net of LF tax (£m)	£20	£20	–£10	£180
2005/06 prices net of LF tax (£m)	£10	£10	£0	£150
Discounted net of LF tax (£m)	£10	£10	£0	£120
Benefits				
Discounted carbon impact – low (£m)	£10	£0	£0	£50
Discounted carbon impact – medium (£m)	£10	£10	£0	£80
Discounted carbon impact – high (£m)	£20	£10	£10	£140
Total carbon impact (tonnes of CO_2)	–123,000	–106,000	–60,000	–1,202,000

Scenario 2: Delay in MSW facility delivery

24. The projections in Table A.3 take into account existing and proposed waste management infrastructure identified through local authority surveys and assessment of current PFI applications. In Scenario 1 it is assumed that all facilities become available on their planned timescales. However, experience suggests that proposals are often delayed within the planning or implementation process. This scenario examines the impact if the proposed facilities were each delayed by one year.

25. The LAWRRD projections are given in Table A.6. These indicate that the 2012/13 Landfill Directive target could still be met though increased levels of recycling, composting, and additional MBT facilities producing RDF and stabilised residues to landfill. However, at high levels of waste growth, there would be great uncertainty about the achievement of very high levels of recycling as early as 2012/13. For example, at 2.25% p.a. waste growth, recycling rates would have to be 51% in 2012/13; this is nine percentage points higher than the equivalent figure in Table A.3.

Table A.6: Scenario 2 – impact of facility delays at different growth rates

	2009/10		2012/13		2019/20
Landfill allowances (kt)	11,200		7,460		5,220
			Waste growth = 2.25%		
MSW arisings (kt)	31,470		33,690		39,440
BMW to landfill (kt)	11,670		7,300		5,380
Household recycling/composting (kt)	36% 10,050	51%	15,420	51%	17,880
Residual household waste per head (kg)	350		280		320
Energy recovery (kt)	12% 3,860	15%	5,180	22%	8,560
Capacity of residual waste facilities (kt)[a]	5,100		10,060		16,710
			Waste growth = 1.5%		
MSW arisings (kt)	30,560		31,990		35,580
BMW to landfill (kt)	11,350		7,430		5,410
Household recycling/composting (kt)	35% 9,610	47%	13,570	48%	15,420
Residual household waste per head (kg)	340		290		300
Energy recovery (kt)	13% 3,830	16%	5,190	22%	7,720
Capacity of residual waste facilities (kt)[a]	5,100		9,860		15,510
			Waste growth = 0.75%		
MSW arisings (kt)	29,670		30,370		32,070
BMW to landfill (kt)	11,140		7,470		5,320
Household recycling/composting (kt)	34% 9,020	44%	12,000	46%	13,110
Residual household waste per head (kg)	340		290		290
Energy recovery (kt)	13% 3,790	17%	5,020	22%	7,100
Capacity of residual waste facilities (kt)[a]	5,100		9,860		14,710
			Waste growth = 0%		
MSW arisings (kt)	28,790		28,830		28,890
BMW to landfill (kt)	10,720		7,470		5,170
Household recycling/composting (kt)	34% 8,800	41%	10,700	43%	11,130
Residual household waste per head (kg)	330		290		270
Energy recovery (kt)	13% 3,750	17%	4,840	24%	7,040
Capacity of residual waste facilities (kt)[a]	5,100		9,660		13,910

[a] MBT compost with either RDF or residue to landfill, energy from waste, mechanical with residue to EfW and gasification/pyrolosis.

26. Table A.7 shows that the higher levels of recycling seen in these scenarios in 2012/13 and beyond would be expected to provide greater carbon benefits. Waste costs would be saved in the earlier years as the 2009/10 Landfill Directive target is more easily achievable despite the reduced infrastructure. Cost savings fall over time as additional recycling and composting plants are built to divert waste from landfill, meaning that some economies of scale would not be realised.

27. That the benefits might be expected to outweigh the costs of infrastructure delay is not surprising, given that recycling levels would have to rise by way of compensation and that the costs of delay do not take into account the very large risks associated with non-compliance with the Landfill Directive.

Table A.7: Scenario 2 – impact of facility delays at different growth rates on MSW management costs and carbon benefits

	2009/10	2012/13	2019/20	Total
		Waste growth = 2.25%		
Costs				
Actual prices (£m)	–£60	–£60	–£50	–£240
Actual prices net of LF tax (£m)	–£80	–£10	–£40	£60
2005/6 prices net of LF tax (£m)	–£70	–£10	–£30	£30
Discounted net of LF tax (£m)	–£60	–£10	–£20	–£10
Benefits				
Discounted carbon impact – low (£m)	£0	£40	£10	£230
Discounted carbon impact – medium (£m)	£0	£70	£20	£390
Discounted carbon impact – high (£m)	£0	£130	£30	£710
Total carbon impact (tonnes of CO_2)	42,000	–1,039,000	–283,000	–5,825,000
		Waste growth = 1.5%		
Costs				
Actual prices (£m)	–£110	–£20	£10	–£190
Actual prices net of LF tax (£m)	–£130	£10	£40	£10
2005/06 prices net of LF tax (£m)	–£120	£10	£30	–£40
Discounted net of LF tax (£m)	–£100	£0	£20	–£80
Benefits				
Discounted carbon impact – low (£m)	£0	£20	£20	£180
Discounted carbon impact – medium (£m)	£0	£40	£30	£300
Discounted carbon impact – high (£m)	–£10	£80	£50	£540
Total carbon impact (tonnes of CO_2)	43,000	–629,000	–491,000	–4,713,000

Table A.7: Scenario 2 – impact of facility delays at different growth rates on MSW management costs and carbon benefits (continued)

	2009/10	2012/13	2019/20	Total
		Waste growth = 0.75%		
Costs				
Actual prices (£m)	–£140	£0	£10	–£90
Actual prices net of LF tax (£m)	–£160	£0	£30	–£30
2005/6 prices net of LF tax (£m)	–£150	£0	£20	–£80
Discounted net of LF tax (£m)	–£130	£0	£10	–£130
Benefits				
Discounted carbon impact – low (£m)	£0	£10	£10	£90
Discounted carbon impact – medium (£m)	–£10	£20	£20	£150
Discounted carbon impact – high (£m)	–£10	£50	£30	£270
Total carbon impact (tonnes of CO_2)	109,000	–358,000	–323,000	–2,369,000
		Waste growth = 0%		
Costs				
Actual prices (£m)	–£140	–£50	£30	–£320
Actual prices net of LF tax (£m)	–£170	–£90	£30	–£540
2005/6 prices net of LF tax (£m)	–£160	–£80	£20	–£510
Discounted net of LF tax (£m)	–£140	–£60	£10	–£460
Benefits				
Discounted carbon impact – low (£m)	£0	£0	£0	–£20
Discounted carbon impact – medium (£m)	–£10	£0	£0	–£40
Discounted carbon impact – high (£m)	–£20	£0	£0	–£80
Total carbon impact (tonnes of CO_2)	118,000	–20,000	–24,000	583,000

Scenario 3: Household financial incentives

28. International evidence suggest that many of the countries achieving the levels of recycling/composting and reductions in waste indicated in table A.3 have done so with a supporting pricing framework on the individual.

29. The strategy announces a consultation on proposals that would remove the ban on local authorities introducing financial incentives to encourage householders to reduce, home-compost and separate their waste. Further information, including an assessment of economic, social and environmental impacts is contained in the consultation document.

30. A Defra-funded research project modelling the likely future impact of financial incentives shows that in some local authorities cost savings of up to £17 per household could be achieved with incentives. The report also predicts a five percentage point increase in the total national recycling and composting rate plus a 7% reduction in total national waste quantities.

Scenario 4: National household waste recycling and composting targets

31. Table A.8 shows a hypothetical situation in which authorities are constrained in their waste management choices through the modelling of a very high recycling pressure factor aimed at meeting a 60% household recycling target in 2020. In this scenario, fewer energy recovery facilities are needed in order to meet Landfill Directive targets but, at the same time, the marginal costs of recycling at such high levels are projected to push up the overall costs of municipal waste management. Table A.9 shows that, relative to the base case in Table A.4, costs are indeed significantly higher (between £590 million and £1,150 million), but with associated higher carbon benefits (valued at between £460 million and £2,130 million).

Table A.8: Scenario 4 – impact of higher recycling rates

	2009/10		2012/13		2019/20
Landfill allowances (kt)		11,200		7,460	5,220
			Waste growth = 2.25%		
MSW arisings (kt)		31,470		33,690	39,440
BMW to landfill (kt)		11,270		7,050	5,260
Household recycling/composting (kt)	40%	11,210	53%	16,040	59% 20,810
Residual household waste per head (kg)		330		270	270
Energy recovery (kt)	12%	3,700	14%	4,760	17% 6,600
Capacity of residual waste facilities (kt)[a]		4,700		10,010	14,010
			Waste growth = 1.5%		
MSW arisings (kt)		30,560		31,990	35,580
BMW to landfill (kt)		11,030		7,700	5,210
Household recycling/composting (kt)	39%	10,620	50%	14,390	59% 18,710
Residual household waste per head (kg)		320		270	240
Energy recovery (kt)	12%	3,670	15%	4,650	17% 5,950
Capacity of residual waste facilities (kt)[a]		4,700		8,810	12,210
			Waste growth = 0.75%		
MSW arisings (kt)		29,670		30,370	32,070
BMW to landfill (kt)		10,610		7,470	5,190
Household recycling/composting (kt)	39%	10,310	50%	13,520	59% 16,930
Residual household waste per head (kg)		320		260	220
Energy recovery (kt)	12%	3,680	15%	4,500	16% 5,290
Capacity of residual waste facilities (kt)[a]		4,700		8,410	11,210
			Waste growth = 0%		
MSW arisings (kt)		28,790		28,830	28,890
BMW to landfill (kt)		10,350		7,570	4,930
Household recycling/composting (kt)	38%	9,860	49%	12,660	59% 15,130
Residual household waste per head (kg)		310		250	200
Energy recovery (kt)	13%	3,620	15%	4,380	18% 5,120
Capacity of residual waste facilities (kt)[a]		4,700		7,410	9,810

[a] MBT compost with either RDF or residue to landfill, energy from waste, mechanical with residue to EfW and gasification/pyrolosis.

Table A.9: Scenario 4 – impact of higher recycling rates on MSW management costs and carbon benefits

	2009/10	2012/13	2019/20	Total
		Waste growth = 2.25%		
Costs				
Actual prices (£m)	–£50	–£20	£190	£380
Actual prices net of LF tax (£m)	–£40	£40	£250	£1,110
2005/06 prices net of LF tax (£m)	–£30	£40	£180	£860
Discounted net of LF tax (£m)	–£30	£30	£110	£590
Benefits				
Discounted carbon impact – low (£m)	£20	£60	£80	£680
Discounted carbon impact – medium (£m)	£30	£100	£120	£1,160
Discounted carbon impact – high (£m)	£50	£190	£220	£2,130
Total carbon impact (tonnes of CO_2)	–376,000	–1,482,000	–2,044,000	–17,309,000
		Waste growth = 1.5%		
Costs				
Actual prices (£m)	–£60	£10	£350	£830
Actual prices net of LF tax (£m)	–£50	£30	£430	£1,380
2005/06 prices net of LF tax (£m)	–£40	£30	£320	£1,060
Discounted net of LF tax (£m)	–£40	£20	£200	£710
Benefits				
Discounted carbon impact – low (£m)	£10	£50	£80	£640
Discounted carbon impact – medium (£m)	£30	£80	£140	£1,090
Discounted carbon impact – high (£m)	£50	£140	£240	£1,980
Total carbon impact (tonnes of CO_2)	–352,000	–1,124,000	–2,249,000	–16,479,000
		Waste growth = 0.75%		
Costs				
Actual prices (£m)	–£70	£50	£490	£1,620
Actual prices net of LF tax (£m)	–£60	£80	£560	£2,210
2005/06 prices net of LF tax (£m)	–£50	£70	£410	£1,710
Discounted net of LF tax (£m)	–£50	£60	£250	£1,150
Benefits				
Discounted carbon impact – low (£m)	£10	£40	£80	£560
Discounted carbon impact – medium (£m)	£20	£70	£130	£940
Discounted carbon impact – high (£m)	£40	£130	£230	£1,710
Total carbon impact (tonnes of CO_2)	–322,000	–980,000	–2,134,000	–14,259,000

Table A.9: Scenario 4 – impact of higher recycling rates on MSW management costs and carbon benefits (continued)

	2009/10	2012/13	2019/20	Total
		Waste growth = 0%		
Costs				
Actual prices (£m)	–£70	£20	£530	£1,530
Actual prices net of LF tax (£m)	–£70	£10	£600	£1,900
2005/06 prices net of LF tax (£m)	–£60	£10	£440	£1,440
Discounted net of LF tax (£m)	–£60	£10	£270	£940
Benefits				
Discounted carbon impact – low (£m)	£10	£30	£70	£460
Discounted carbon impact – medium (£m)	£20	£50	£110	£780
Discounted carbon impact – high (£m)	£30	£100	£200	£1,420
Total carbon impact (tonnes of CO_2)	–219,000	–738,000	–1,864,000	–11,825,000

Part B Commercial, industrial and hazardous waste

32. The waste management landscape in England for CI&H wastes has evolved considerably since the publication of *Waste Strategy 2000*, particularly in response to the progressive implementation of the Landfill Directive, the Pollution Prevention and Control Regulations 2000, the Hazardous Waste Regulations 2005 and various Producer Responsibility Directives such as on packaging and packaging wastes, end-of-life vehicle and waste electrical and electronic equipment. The waste management landscape is therefore subject to a continuing and complex evolution.

33. Major issues in assessing CI&H wastes are the general paucity of waste-related data and the fact that many of the policy drivers are new (such as the landfill tax escalator) or, as in the scenario of landfill re-permitting, have yet to be implemented. An objective of current programmes is therefore to construct a more robust evidence base on which to build future policies. This includes both the Defra waste Research and Development strategy and the Waste Data Strategy.

CI&H waste arisings

34. The Environment Agency's 2002/03 Commercial & Industrial waste survey provides the most comprehensive and current evidence on the sources, quantities and fates of CI&H wastes in England. In addition, the Environment Agency's Special Waste Tracking System (SWaT) database provides time series information on hazardous wastes movements, although not disaggregated waste type (i.e. solid, liquid, sludges, etc.). The two datasets are not entirely consistent; therefore, unless otherwise stated, all CI&H data is derived from the 2002/03 survey.

35. The total CI&H waste stream is estimated at 67.5 million tonnes, comprising 39.3 million tonnes from industrial sources and 28.2 million tonnes from commercial sources. Summary totals and percentages classified by national waste group are given in Table 8 and Table 9.[10] These indicate that 42% of total arisings are recycled or re-used, a further 8% recovered or otherwise treated. Treatment and recovery have therefore overtaken landfill as the dominant method of CI&H waste management.

36. The Environment Agency survey indicates that 6.7 million tonnes (10%) of CI&H wastes are transferred, treated or managed by methods not recorded. For reporting purposes, this tonnage is generally reallocated proportionately between the other categories shown.[11] On this basis, 44% of waste is assumed to be landfilled and 51% recovered. In this assessment, the more conservative assumption is made of allocating the land spread, transferred and 'managed by methods not recorded' categories to landfill. On this basis, 53% of CI&H waste is deemed to be landfilled.

[10] These tonnages differ slightly from those published on the Agency website due to small differences in allocations between waste streams.

[11] This convention is used both in Environment Agency reporting and in the consultation document on the review of England's Waste Strategy.

Table A.10: CI&H waste arisings 2002/03, from EA waste survey (kt)

	Landfill	Land spread	Recycled	Re-used	Thermal	Transfer	Treatment	Unknown	Totals
Construction and demolition	1,335	4	250	117	–	23	–	43	1,772
Combustion wastes	4,163	–	4,048	1,489	3	3	8	33	9,747
Common sludges	188	381	96	120	12	20	83	177	1,077
Discarded equipment	76	–	170	36	1	10	1	25	319
Food wastes	555	1,005	978	890	586	185	339	1,071	5,609
Industrial sludges	417	414	163	236	5	12	339	9	1,595
Metallic wastes	167	–	2,758	134	–	69	5	109	3,242
Oils and solvents	68	3	227	39	97	66	191	81	772
Chemical wastes	1,168	398	483	548	524	80	325	170	3,696
Mineral wastes	1,594	6	240	643	–	9	10	31	2,533
General industrial wastes	4,766	8	242	421	169	274	63	268	6,211
General commercial wastes	11,609	–	431	18	401	943	2	760	14,164
Non-metallic wastes	620	76	3,201	1,270	92	69	–	118	5,446
Organic wastes	3	7	79	10	4	–	9	1	113
Paints, varnishes, etc.	81	5	35	4	10	46	36	5	222
Paper and card	902	15	8,027	40	80	194	–	371	9,629
Sorting residues	726	–	534	1	100	–	–	1	1,362
Totals	**28,438**	**2,322**	**21,962**	**6,016**	**2,084**	**2,003**	**1,411**	**3,273**	**67,509**

Table A.10: CI&H waste arisings 2002/03, from EA waste survey (kt) (continued)

	Landfill	Land spread	Recycled	Re-used	Thermal	Transfer	Treatment	Unknown	Totals
Construction and demolition	75%	–	14%	7%	–	1%	–	2%	100%
Combustion wastes	43%	–	42%	15%	–	–	–	–	100%
Common sludges	17%	35%	9%	11%	1%	2%	8%	16%	100%
Discarded equipment	24%	–	53%	11%	–	3%	–	8%	100%
Food wastes	10%	18%	17%	16%	10%	3%	6%	19%	100%
Industrial sludges	26%	26%	10%	15%	–	–	21%	–	100%
Metallic wastes	5%	–	85%	4%	–	2%	–	3%	100%
Oils and solvents	9%	–	29%	5%	13%	9%	25%	10%	100%
Chemical wastes	32%	11%	13%	15%	14%	2%	9%	5%	100%
Mineral wastes	63%	–	9%	25%	–	–	–	1%	100%
General industrial wastes	77%	–	4%	7%	3%	4%	1%	4%	100%
General commercial wastes	82%	–	3%	–	3%	7%	–	5%	100%
Non-metallic wastes	11%	1%	59%	23%	2%	1%	–	2%	100%
Organic wastes	3%	6%	70%	9%	4%	–	8%	–	100%
Paints, varnishes, etc.	36%	2%	16%	2%	5%	21%	16%	2%	100%
Paper and card	9%	–	83%	–	–	2%	–	4%	100%
Sorting residues	53%	–	39%	–	7%	–	–	–	100%
Average	**42%**	**3%**	**33%**	**9%**	**3%**	**3%**	**2%**	**5%**	**100%**

Table A.11: CI&H waste arisings 2002/03 by type, from EA survey (kt)

	Landfill	Land spread	Recycled	Re-used	Thermal	Transfer	Treatment	Unknown	Totals
Non-hazardous solid	25,715	619	20,028	5,032	1,226	1,704	232	2985	57,541
Non-hazardous sludge	161	145	309	59	244	123	421	87	1,549
Non-hazardous mixed	40	4	14	12	119	4	8	40	241
Non-hazardous liquid	108	31	38	0	3	4	39	5	228
Hazardous solid	745	0	288	60	389	17	57	40	1,596
Hazardous sludge	263	981	673	399	25	63	478	38	2,920
Hazardous mixed	969	3	108	50	67	59	47	3	1,306
Hazardous liquid	437	539	504	404	11	29	129	75	2,128
Totals	**28,438**	**2,322**	**2,1962**	**6,016**	**2,084**	**2,003**	**1,411**	**3,273**	**6,7509**

Source: Environment Agency 2002/03 Commercial and Industrial Waste Survey.

37. The data includes an estimated 3.6 million tonnes of hazardous waste, of which 1.56 million tonnes is landfilled. This includes 520 kt of hazardous liquid wastes. These wastes were banned from landfill following the survey in 2002/03 and are therefore excluded from this analysis.

38. While combustion residues are included in the aggregate Environment Agency data above, they are excluded from the following analysis. Such wastes principally comprise power station ashes and slags from metallurgical processes. Their arisings will be determined by structural changes within these industries outside the scope of the modelling presented here. However, as these wastes are currently subject to high levels of recycling or otherwise largely inert, their exclusion is unlikely to materially affect conclusions drawn from this analysis.

39. In addition, some 9 million tonnes of construction, demolition and excavation (CD& E) wastes are disposed of as waste to licensed landfill.[12]

CI&H waste forecasts

40. Baseline projections indicate CI&H waste arisings increasing from 57.9 million tonnes in 2002/03 to roughly 70.5 million tonnes in 2019/20. These projections are based on a sectoral growth model of the UK economy[13] which integrates a degree of decoupling between economic growth and waste growth based on the difference between modelled and empirical evidence from the 1998/99 and 2002/03 Environment Agency waste surveys.

41. The historic decoupling cannot be ascribed to particular factors, although Government-funded programmes such as Envirowise will have contributed. Specific economic and regulatory measures have since been introduced that will drive further decoupling, and must be considered in the baseline assessment. These include:

- Environment Agency targets on PPC regulated industries;
- chemical sector voluntary reduction target;
- impact of landfill tax; and
- Landfill Directive requirements.

Environment Agency targets on PPC regulated industries

42. The PPC regime places a statutory obligation on regulated industries to reduce waste. The Environment Agency has set a reduction target of 15% on these industries for the period 2002–07,[14] which covers some 11.5 million tonnes of waste (approximately 30% of all industrial waste). Current indications are that this target will be met. It is estimated that these wastes will reduce by 1.73 million tonnes per annum by 2007, representing a cumulative diversion of 5.2 million tonnes between 2002 and 2007.

[12] Some 90 million tonnes of C,D&E wastes are generated annually, but mostly recycled or used in quarry and landfill restorations.
[13] Cambridge Econometrics REEIO model, Appendix 2.
[14] Environment Agency's corporate strategy *Making it Happen 1*.

43. In addition to this the Environment Agency has rolled forward its target to reduce waste disposal by PPC regulated industries by a further 15% in its 2006/11 corporate strategy. It has also agreed a sector plan with the cement industry[15] with an aim to reduce the volume of cement kiln dust waste disposed, per tonne of cement manufactured, from 22.9 kt in 1998 to 7.5 kt in 2010, and to reduce all other waste disposal by 30% per tonne of cement manufactured over the same period. These further targets were presented as a scenario in the pRIA of the waste strategy review consultation. However, as they are now current policy these targets have been brought into the "no further policy change" scenario as they represent pre-existing plans.

Chemical sector voluntary reduction target

44. The chemical industry is a major producer of hazardous wastes. The Chemical Industries' Association (CIA) as part of its "Responsible Care" programme has established a goal of reducing hazardous waste per tonne of production by its members by 25% between 2000 and 2010. Based on sector growth projections, this represents a reduction of 122,000 tonnes per annum of hazardous wastes by 2010.

45. As a result of these further decoupling measures, total CI&H waste in 2020 (excluding combustion residues) is projected to be around 71 million tonnes, with the share of industrial waste falling from 51% in 2002/03 to 37% in 2019/20 (Table 10). Projections further indicate an average annual growth in commercial wastes of 2.6% and essentially zero industrial waste growth, reflecting the decoupling measures aimed at industrial waste and the expected continued shift towards a service based economy.

Impact of landfill tax

46. Budget 2007 accelerated the rate of increase of the landfill tax for active wastes from £3 per tonne per year (which took the rate to £24 per tonne on 1 April 2007) to £8 per tonne per year at least as far as 2010/11, which corresponds to a landfill tax of £48 per tonne in 2010/11.[16] This increase in the escalator is anticipated to provide a further stimulus to waste producers to reduce waste arisings and for the waste management industry to invest in recycling and alterative treatment facilities. Using the HM Customs and Excise landfill tax model,[17] the central estimate of this diversion is 3.9 million tonnes in 2010/11 (at £48 per tonne) and rising with waste growth to 4.5 million tonnes in 2020. This represents a cumulative diversion of 46.6 million tonnes between 2007 and 2020.

[15] See http://publications.environment-agency.gov.uk/pdf/GEHO1105BJVI-e-e.pdf for further information.
[16] See http://www.hm-treasury.gov.uk/media/73B/74/bud07_chapter7_273.pdf (p.187) for further information.
[17] HMCE model, Part D.

Table A.12: Projected CI&H waste arisings 2002–20 (kt/y)

Waste arisings 2002–20 (kt/y)*	2002/03	2009/10	2014/15	2019/20
C&D	1,780	1,610	1,420	1,330
Common sludges	1,080	1,000	930	980
Discarded equipment	340	370	410	480
Food	5,610	5,290	5,190	5,640
Industrial sludges	1,610	1,540	1410	1,490
Metallic wastes	3,240	3,470	3,310	3,590
Oils & solvents	790	910	970	1,150
Other chemical wastes	3,730	3,930	3,850	4,230
Other mineral wastes	2,530	2,080	1670	1,560
Other mixed wastes	20,370	20,910	22,000	24,400
Other non-metallic wastes	5,440	6,070	6,630	7,850
Other organic wastes	110	100	90	90
Paints, varnishes, etc.	240	240	230	260
Paper and card	9,640	11,420	13,330	16,250
Sorting residues	1,360	1,300	1,220	1,300
Totals	**57,870**	**60,250**	**62,670**	**70,590**
% Industrial waste	51%	47%	40%	37%

* Excluding combustion residues

Source: REEIO model.

Landfill Directive requirements

47. It is also relevant to consider the impact of the current requirements within the Landfill Directive on future waste arisings. The Directive introduces progressive restrictions on the landfilling of BMW and bans the landfill disposal of prescribed wastes, including:

- liquid wastes, both hazardous and non-hazardous;
- wastes that exhibit explosive, oxidising, highly flammable, flammable or corrosive properties;
- hospital and other clinical wastes arising from medical or veterinary establishments that are infectious;
- tyres, whole or shredded;
- untreated waste, unless the waste is inert where treatment is not feasible or is a waste for which treatment will not reduce the quantity of waste or the hazards to human health or the environment; and
- any other waste that does not fulfil the acceptance criteria determined in accordance with the Directive.

The ban on landfilling hazardous liquids was imposed in 2002. The other restrictions are required to be in place by July 2007.[18]

48. Waste acceptance criteria have been established for wastes consigned to inert and hazardous waste landfills. There are currently no proposals to introduce acceptance criteria for non-hazardous wastes, other than the Article 6 requirement for 'treatment' prior to landfill.[19] Treatment is defined as *physical, thermal, chemical or biological processes, including sorting, that change the characteristics of the waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery*.

Scenario 5: CI&H "No further policy change"

49. This scenario assumes no additional policy pressures on waste arisings or treatment method beyond those discussed above. However, implicit in this scenario is future compliance with the remaining requirements of the Landfill Directive, in particular Article 6 treatment requirements and the changes introduced in Budget 2007.

50. The impact of current drivers on each category of waste (hazardous solids, non-hazardous mixed wastes, etc.) has been assessed based on knowledge of the current treatment routes derived from the Environment Agency C&I Survey 2002/03 (as summarised in Table A.11) and judgement as to the proportions of additional waste that may require treatment by different methods.

51. For each category of material an assessment of future treatment methods has been made by treatment route and material type. An example is given in Table A.13 for non-hazardous solid waste for arisings in 2009/10.[20] Plant capacities have been assumed for different treatment options to enable assessment of the potential infrastructure needs in different scenarios. This is also indicated in Table A.13.

52. The comparable analyses for hazardous solid wastes and the aggregate analysis for sludges, mixed wastes and non-hazardous liquid wastes are set out in Table A.12 and Table A.13 respectively.

53. Table 16 summarises the resultant aggregate waste flows and facility requirements. This is an aggregate total for all waste streams excluding hazardous liquid wastes (which are assumed to be fully treated at present as a result of being banned from landfill in 2002).

54. The projections indicate that some 87 additional treatment facilities may be required by 2009/10 compared with 2002/03. These are predominantly merchant recycling facilities, for which an additional capacity requirement of 7.25 million tonnes/year is projected to be required, principally for metal scrap and mixed commercial wastes. Some of this capacity may be integrated with local authority recycling facilities for MSW. Similarly, it is indicated that some 2.0 million tonnes/year of additional thermal treatment capacity may be required, including for some hazardous wastes. It is unlikely that significant thermal treatment facilities dedicated to CI&H wastes will be brought forward, but again there may be opportunities to exploit capacity for non-hazardous wastes in municipal facilities and for all CI&H wastes in cement kilns.[21]

[18] Although by voluntary agreement the ban on tyres was brought forward to July 2006.

[19] Treatment of non-hazardous wastes for landfill, the Environment Agency, 2007. Available on http://www.environment-agency.gov.uk/business

[20] Which aggregates the commercial and the industrial components.

[21] The cement industry is increasingly seeking to use waste-derived substitute fuels such as scrap tyres or substitute liquid fuels, where these cannot be technically and economically recovered or recycled further up the waste hierarchy, and has set targets within its Sector Plan of 10% fuel used to comprise waste materials by 2006 and 15% by 2010 (http://publications.environment-agency.gov.uk). See also Annex C14 related to waste oils.

Table A.13: Scenario 5 – allocation of non-hazardous solid wastes to treatment routes (2009/10)

	Arisings landfilled requiring treatment, kt/y	Waste minimisation	In-house re-use	Merchant recycling	Simple sorting	Complex sorting/treatment	Composting	Anaerobic	Solidification	Combustion	Pyrolysis/gassification	Plasma/vitrification (merchant)	No treatment (landfill)	Waste to landfill (including treatment residues), kt/y
Construction and demolition	1,164	7%									0%	0%	93%	1,080
Common sludges	228										0%	0%	100%	–
Discarded equipment	98			84%							0%	0%	16%	230
Food	1,784	20%					12%			5%	0%	0%	63%	30
Industrial sludges	244		20%								0%	0%	80%	1,280
Metallic wastes	200		2%	98%							0%	0%		190
Oils and solvents	–										0%	0%		30
Chemical wastes	1,246	10%	15%			25%			15%	25%	0%	0%	10%	–
Mineral wastes	1,078		29%	20%	29%						0%	0%	22%	630
General industrial wastes	4,555	5%	5%	8%	8%						0%	0%	75%	540
General commercial wastes	12,536	5%		8%	8%					10%	0%	0%	70%	3,760
Non-metallic wastes	607		21%	71%						3%	0%	0%	5%	10,030
Organic wastes	3			24%							0%	0%	76%	100
Paints, varnishes, etc.	17			30%		50%					0%	0%	20%	–
Paper and card	1,189	8%	4%	67%						4%	0%	0%	17%	10
Sorting residues	634									10%	0%	0%	90%	330
Sub-total (kt/y)	25,584	1,511	960	3,009	1,598	321	220	–	188	1,774	–	–		18,240
Additional treatment from existing plant and waste growth (kt/y)	25,063	224	3,715	19,725	142	26	18	0	15	1,197	0	0		3,162
Totals	**50,650**	**1,730**	**4,680**	**22,730**	**1,740**	**350**	**240**	**–**	**200**	**2,970**	**–**	**–**		**21,400**
% residues to landfill		0%	0%	15%	85%	65%	60%	30%	120%	25%	0%	30%	100%	
Average plant capacity				80	15	50	50	100	50	200	0	20		
Additional plants required		**–**	**–**	**35**		**6**	**4**	**–**	**3**	**8**	**–**	**–**	**–**	

Table A.14: Scenario 5 – allocation of hazardous solid wastes to treatment routes (2009/10)

	Arisings landfilled requiring treatment, kt/y	Waste minimisation	In-house re-use	Merchant recycling	Simple sorting	Complex sorting/treatment	Composting	Anaerobic	Solidification	Combustion	Pyrolysis/gassification	Plasma/vitrification (merchant)	No treatment (landfill)	Waste to landfill (including treatment residues), kt/y
Construction & demolition	32					76%					0%	0%	24%	20
Common sludges	–										0%	0%		–
Discarded equipment	16			100%							0%	0%		–
Food	–										0%	0%		–
Industrial sludges	24			10%					40%	50%	0%	0%		–
Metallic wastes	2					100%					0%	0%		10
Oils and solvents	8									100%	0%	0%		–
Chemical wastes	161	10%	12%			18%			12%	36%	12%	0%		–
Mineral wastes	164	10%				31%			20%		0%	0%	40%	50
General industrial wastes	49	10%	10%			15%				15%	0%	0%	50%	130
General commercial wastes	100	20%			30%	40%				10%	0%	0%		30
Non-metallic wastes	9		18%	82%							0%	0%		50
Organic wastes	–										0%	0%		–
Paints, varnishes, etc.	19					30%			30%	40%	0%	0%		–
Paper and card	9	10%	5%	80%						5%	0%	0%		10
Sorting residues	–										0%	0%		–
Sub-total (kt/y)	593	58	26	33	30	159	0	0	67	103	19	0		300
Additional treatment from existing plant and waste growth (kt/y)	800	4	66	316	7	33	0	0	14	361	0	0		186
Totals	**1,390**	**60**	**90**	**350**	**40**	**190**	**0**	**0**	**80**	**460**	**20**	**0**		**490**
% residues to landfill		0%	0%	20%	85%	50%	60%	30%	120%	25%	0%	30%	100%	
Average plant capacity				50	15	50	20	10	50	80		20		
Additional plants required		**0**	**0**	**10**		**1**	**0**	**1**	**2**	**3**	**0**	**0**	**0**	

Table A15: Scenario 5 – allocation of sludges, mixed wastes and non-hazardous liquid wastes to treatment routes (2009/10)

	Arisings landfilled requiring treatment, kt/y	Waste minimisation	In-house re-use	Merchant recycling	Simple sorting	Complex sorting/treatment	Composting	Anaerobic	Solidification	Combustion	Pyrolysis/gassification	Plasma/vitrification (merchant)	No treatment (landfill)	Waste to landfill (including treatment residues), kt/y
Construction and demolition	0			100%							0%	0%		–
Common sludges	426	10%		1%				40%		7%	0%	0%	42%	–
Discarded equipment	2			100%							0%	0%		230
Food	797	19%		19%			1%	47%		1%	0%	0%	13%	–
Industrial sludges	476	5%		12%				15%	4%		0%	0%	62%	260
Metallic wastes	–										0%	0%		350
Oils and solvents	79			68%						32%	0%	0%	1%	–
Chemical wastes	252	3%	5%	35%		8%		35%	8%	6%	0%	0%		20
Mineral wastes	14	3%				8%			6%		0%	0%	83%	80
General industrial wastes	188	10%	9%	17%	15%						0%	0%	49%	10
General commercial wastes	810	9%				1%		7%		9%	0%	0%	74%	120
Non-metallic wastes	71		2%	50%	2%						0%	0%	47%	630
Organic wastes	3			8%				92%			0%	0%		40
Paints, varnishes, etc.	91								17%	83%	0%	0%		–
Paper and card	61	1%		25%							0%	0%	74%	30
Sorting residues	–										0%	0%		50
Sub-total (kt/y)	3,271	320	30	440	30	30	10	770	60	220	–	–		1,820
Additional treatment from existing plant and waste growth (kt/y)	3,169	22	920	1,349	50	22	7	567	35	198	0	0		593
Totals	**6,440**	**340**	**950**	**1,790**	**80**	**50**	**20**	**1,340**	**90**	**420**	**–**	**–**		**2,410**
% residues to landfill		0%	0%	25%	90%	30%	60%	30%	120%	10%	0%	30%	100%	
Average plant capacity				50	15	50	20	100	50	80		20		
Additional plants required		**–**	**–**	**9**		**–**	**–**	**–**	**1**	**3**	**–**	**–**	**–**	

Table A.16: Scenario 5 – projection of waste arisings and facility requirements (aggregated CI&H wastes)

	2002/03	2009/10	2014/15	2019/20
Arisings (kt)[a]	56,300	58,490	60,840	68,530
		Waste treatment[b] (kt)		
Minimisation		2,130	2,300	2,580
Re-use	4,470	5,720	5,370	5,650
Recycling	17,620	24,870	27,540	32,080
Thermal	1,840	3,850	3,890	4,230
Treatment	980	4,440	4,190	4,510
Landfill[c]	31,400	24,890	25,120	27,970
		Treatment type by percentage of total waste		
Re-use	8%	10%	9%	8%
Recycling	31%	43%	45%	47%
Thermal	3%	7%	6%	6%
Treatment	2%	8%	7%	7%
Landfill[c]	56%	43%	41%	41%
Additional facilities required[d]		87	119	181

[a] Excludes combustion residues.

[b] Excludes hazardous liquid wastes.

[c] Includes additional residues landfilled from treatment.

[d] Estimated additional to plants in 2002/03.

55. Treatment costs associated with these additional treatment requirements have been estimated from data generated as part of the Environment Agency C&I Survey. These costs are summarised in Table 15. High and low estimates (£/t) are provided for each treatment option. These have been applied to the waste flow projections in Tables A.13 to A.16 for each successive year to derive a high and low estimate of the annual treatment costs.

Table A.17: Assumed costs for CI&H landfill and treatment (£/t – 2005/06 prices)

	Hazardous Mixed		Hazardous Sludge		Hazardous Solid		Non-Hazardous Liquid		Non-Hazardous Mixed		Non-Hazardous Sludge		Non-Hazardous Solid	
Landfill costs (£/t)	45		80		80		35		30		25		25	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Waste minimisation	0	20	0	20	0	20	0	15	0	20	0	20	0	20
In-house re-use	0	50	–	–	0	50	0	5	0	40	0	35	0	30
Merchant recycling	30	100	50	100	20	100	50	70	5	40	5	25	5	30
Simple sorting	–	–	–	–	10	30	–	–	5	20	–	–	0	5
Complex sorting/ treatment	30	100	–	–	20	80	15	30	5	30	5	25	5	30
Composting	–	–	–	–	5	35	–	–	5	35	5	35	0	35
Anaerobic treatment	–	–	5	55	5	55	5	15	–	–	5	30	10	40
Neutralisation/ precipitation of metals	–	–	15	40	–	–	–	–	–	–	–	–	–	–
Solidification	50	100	50	100	50	100	–	–	10	35	10	35	10	35
Thermal/combustion	45	140	150	400	45	140	80	120	30	80	20	80	20	80

Source: Estimates based on Environment Agency 2002/03 Commercial and Industrial Waste Survey.

56. The overall costs are summarised in Table A.18. These are expressed as 2005/06 prices and net of (all) landfill tax. Present values are discounted to a base year of 2006/07 at 3.5% per annum in accordance with Treasury Green Book guidance. Total costs and benefits are for the period 2006/07 to 2019/20.

57. The analysis indicates net discounted costs of CI&H management (including landfill residue disposal) of between £760 million and £1,760 million in 2009/10, and total discounted costs from 2006/07 to 2019/20 of between £9.6 billion and £22.4 billion. However, these values at best can only be regarded as indicative as costs and underlying modelling are based on broad assumptions, and hence are used here merely to provide a baseline for comparing other scenarios.

Table A.18: Scenario 5 – estimated CI&H management costs

	Gate fees	2009/10	2014/15	2019/20	Total
Actual prices (£m)	Low	1,910	2,230	2,610	29,450
	High	3,120	3,610	4,360	48,520
Actual prices net of LF tax (£m)	Low	920	1,020	1,270	14,210
	High	2,130	2,400	3,020	33,280
2005/06 prices net of LF tax (£m)	Low	840	840	930	11,950
	High	1,950	1,970	2,210	27,960
Discounted net of LF tax (£m)	Low	760	640	590	9,620
	High	1,760	1,490	1,410	22,470

58. The monetised estimates of carbon benefits accruing under this scenario are summarised in Table A.19. It should be, as above, that the main purpose of these numbers is to provide a baseline from which to compare other scenarios. They represent the net carbon dioxide equivalent impacts of waste treatment and are not the total benefits of waste policy going forward. They are the carbon dioxide equivalent impacts of expected patterns of waste treatment in the given year. This will include both the negative impacts of any uncaptured methane from landfilling of waste in that year, as well as any benefits in terms of off-setting primary material or energy production. That is, they are the net benefits of a snapshot of waste policy at a given time.

59. The potential greenhouse gas benefits of waste policy are more clearly revealed when comparing scenarios where the costs and carbon dioxide equivalent benefits of diverting waste away from landfill can be seen more clearly and are more easily compared.

60. Looking at the overall financial costs relative to the overall carbon dioxide equivalent benefits, is not a valid comparison, because, first, as highlighted above, the benefits of current landfill diversion are hidden, though cancelling out the impact of current landfilling; and second because some waste management costs would be incurred even if all waste were landfilled.

61. The net benefits of waste policy in this scenario do, however, show that, overall, and increasingly over time, we expect waste policy to reduce carbon dioxide equivalent emissions in the atmosphere.

Carbon dioxide equivalent savings are estimated at 7.9 million tonnes in 2009/10, which reflects the comparatively high rates of commercial and industrial waste re-use and recycling (39% in 2002/03 and to projected 53% in 2009/10).

62. The benefits increase marginally with increasing tonnage recycling to 2019/20, with a total discounted benefit estimated in the range £1.5 billion to £5.1 billion.

63. It should also be recognised that the environmental benefits of waste treatment are much broader than greenhouse gas emissions and hence this can only be seen as a partial assessment of the environmental impact of waste policy.

64. The carbon benefits of waste prevention initiatives are not included in this scenario as this case acts a baseline for comparison. Where other scenarios result in a reduction in waste arisings from the "no further policy change" forecast the benefits of not producing this waste are estimated. An estimate of the waste prevention benefits, and indeed the overall impact of waste policy, in the "no further policy change" scenario is not attempted, as a clear counterfactual in the absence of government intervention can not be readily identified.

Table A.19: Scenario 5 – monetised estimates/net carbon dioxide equivalent emissions

Discounted net carbon benefits (£m)	2009/10	2014/15	2019/20	Total
Low social cost of carbon	£102	£108	£118	£1,480
Medium social cost of carbon	£193	£193	£200	£2,690
High social cost of carbon	£375	£362	£365	£5,100
Net impact on global greenhouse gas emissions (mt CO_2 equivalent)	–7.9	–8.9	–10.4	–120.6

65. The impact of Budget 2007 is shown in Table A.20 below. This analysis shows the impact of moving from the landfill tax escalator of £3 per year per tonne (to a maximum of £35 per tonne) to an increase of £8 per year per tonne to at least 2010/11 when the tax reaches £48. To remain conservative this analysis lets the landfill tax plateau at this point.

66. Waste diversion due to the landfill tax is predicted using the HM Revenue and Custom's landfill tax model discussed in Part D. A total of 10% of the waste diverted by the tax is assumed to be prevented from arising, whereas the other 90% is spread proportionately across sorting and recycling treatments. As discussed below (paragraph 73) where waste prevention due to the tax results in lower waste arisings at the outset, no cost of waste reductions has been assumed in this modelling.

67. Table A.20 shows the change in expected treatment patterns that results from the tax increase. There are carbon savings from both increased recycling and waste prevention. These are valued at roughly £120 million based on the current mid-range social cost of carbon 2006/07–2019/20. There are also projected to be resource cost savings (i.e. net of tax) from reduced waste treatment (resulting from lower waste arisings) and a shift away from more expensive mixed disposal and sorting treatments that are modelled as a result of landfill pre-treatment requirements. Savings are estimated at £190 million to £360 million aggregated and discounted over the same period as carbon benefits.

68. The increase in the landfill tax is therefore expected to yield significant gains though improvement in resource efficiency. These gains are embodied within the "no change in current policy" scenario (Scenario 5).

Table A.20: Change from pre-Budget to post-Budget landfill tax rate

		2009/10	2014/15	2019/20
Minimisation (kt)		50	80	90
Re-use (kt)		100	110	100
Recycling (kt)		330	480	500
Thermal (kt)		–60	–70	–80
Treatment (kt)		–70	–90	–110
Landfill (kt)		–440	–620	–650
Additional facilities		2	4	4
	Discounted costs and benefits 06/07–19/20			
Costs (£m)	low gate fees			–£186
	high gate fees			–£359
Carbon benefits	low social cost of carbon			£49
	medium social cost of carbon			£82
	high social cost of carbon			£148
Total change in CO_2 equivalent emissions as a result of change in treatment relative to "do nothing" scenario (mt) 2006/07 to 2019/20				–4.73
Additional carbon benefits of waste prevention – medium social cost of carbon (£m)				£40
Estimated change in CO_2 emissions through change in tonnage of material embodied in waste compared to "do nothing" scenario (mt) 2006/07 to 2019/20				–2.04

Note that waste minimisation is assumed to reduce waste flows through all treatment routes (in extremis it obviates the need for other treatment routes). The carbon benefits of not producing waste are based on energy embodied in materials, converted to CO_2 emissions assuming Combined Cycle Gas Turbine (CCGT) as the marginal source of energy.

Scenario 6: Reduction in industrial waste growth by 0.75% p.a.

69. There was strong consultation support for all waste prevention measures, with clear emphasis on the need to target action on materials, products and priority sectors.

70. The Government is taking product policy forward under the sustainable consumption and production agenda, including a new products and material strategy planned for Spring 2008. These measures are aimed at reducing waste impacts throughout the production and consumption cycle over the long term. Their effect is likely to be gradual but cumulative. Their success will be measured by reduced waste in both the business (commercial and industrial) and local authority (municipal) sectors.

71. Table A.21 summarises the impact of targeting waste prevention measures at the industrial sector, leading to a reduction in waste growth of 0.75% per annum. This is projected to result in a landfill saving of 1.2 million tonnes per annum by 2019/20 (Table A.22). Waste minimisation is assumed to reduce waste flows through all treatment routes (in extremis it obviates the need for other treatment routes), including re-use and recycling, and therefore Table A.22 also indicates a reduction in the total number of future facilities required.

72. Where waste arisings are forecast to fall, it is assumed that the material which would otherwise have entered the waste stream is not produced. This yields carbon savings related to the energy embodied in producing materials that are no longer required. The increase in waste prevention is captured in this case in the waste arisings row of Table A.21 which feeds through to the waste minimisation row based on the difference in waste arisings between this and the "No further policy change" scenario (Scenario 5). But there is a net increase in carbon dioxide equivalent emissions due to the impact of reduced waste treatment. This is because recycling and re-use in the modelling show positive carbon dioxide emission benefits from off-setting primary production.

73. Note that where waste prevention is captured as reductions in waste arisings at the outset, no financial cost of waste prevention is assumed in this modelling, as, like energy efficiency, there are likely to be resource costs savings that offset the costs of improving resource efficiency.

74. In this context Table A.22 shows, overall, that reducing waste growth reduces total waste management costs by an estimated £270 million to £690 million and also reduces global greenhouse gas emissions, valued at roughly £1.1 billion over the same period.

Table A.21: Scenario 6 – reduction in industrial waste growth by 0.75% p.a.

	2009/10	2014/15	2019/20
Arisings (kt)[a]	57,090	58,750	65,530
	Waste Treatment (kt)[b]		
Minimisation	3,500	4,340	5,500
Re-use	5,460	4,980	5,090
Recycling	24,350	26,760	30,970
Thermal	3,790	3,770	4,090
Treatment	4,270	3,900	4,130
Landfill[c]	24,370	24,280	26,800
	Treatment type by percentage of total waste		
Re-use	10%	8%	8%
Recycling	43%	46%	47%
Thermal	7%	6%	6%
Treatment	7%	7%	6%
Landfill[c]	43%	41%	41%
Additional facilities required[d]	80	107	164

[a] Excludes combustion residues.

[b] excludes hazardous liquid wastes.

[c] includes additional residues landfilled from treatment.

[d] estimated additional to plants in 2002/03.

Table A.22: Scenario 6 – difference from Scenario 5

		2009/10	2014/15	2019/20
Minimisation (kt)		1,370	2,040	2,920
Re-use (kt)		–260	–390	–560
Recycling (kt)		–520	–780	–1,110
Thermal (kt)		–60	–120	–140
Treatment (kt)		–170	–290	–380
Landfill (kt)		–520	–840	–1,170
Additional facilities		–7	–12	–17
	Discounted costs and benefits 06/07 – 19/20			
Costs (£m)	low gate fees			–£273
	high gate fees			–£687
Carbon benefits	low social cost of carbon			–£52
	medium social cost of carbon			–£94
	high social cost of carbon			£176
Total change in CO_2 equivalent emissions as a result of change in treatment relative to "do nothing" scenario (mt) 2006/07 to 2019/20				4.28
Additional carbon benefits of waste prevention – medium social cost of carbon (£m)				*£1,220*
Estimated change in CO_2 emissions through change in tonnage of material embodied in waste compared to "do nothing" scenario (mt) 2006/07 to 2019/20				*–62.79*

Note that waste minimisation is assumed to reduce waste flows through all treatment routes (in extremis it obviates the need for other treatment routes). The carbon benefits of not producing waste are based on energy embodied in materials, converted to CO_2 emissions assuming CCGT as the marginal source of energy.

Scenario 7: Reduction in commercial waste growth by 0.75% p.a.

75. This scenario presents the impact of reducing the rate of growth of commercial wastes. As described above, expectations of a continued shift in economic activity from industry to commerce means that commercial waste is also expected to be an increasing problem.

76. While waste prevention policies are likely to be more difficult to implement in the commercial sector due to the greater prevalence of small firms and proportionately smaller costs of waste disposal and treatment, this scenario models the same reduction in growth rates as the industrial context above. This is therefore an illustrative scenario to show the potential benefits of waste prevention in the commercial sector.

77. Tables A.23 and A.24 show the magnitude of savings available from preventing waste growth. Reducing waste reduces both costs of waste treatment and material use, (including the energy used in making materials). This translates to financial savings of £850 million to £1.9 billion and carbon savings valued around £3.1 billion over the period 2006/7 to 2019/20.

Table A.23: Scenario 7 – reduction in commercial waste growth by 0.75% p.a.

	2009/10	2014/15	2019/20
Arisings (kt)[a]	55,370	54,860	58,830
	Waste treatment (kt)[b]		
Minimisation	5,130	8,030	11,910
Re-use	5,670	5,290	5,510
Recycling	23,510	24,790	27,410
Thermal	3,580	3,400	3,500
Treatment	4,280	3,910	4,080
Landfill[c]	23,330	22,210	23,410
	Treatment type by percentage of total waste		
Re-use	10%	10%	9%
Recycling	42%	45%	47%
Thermal	6%	6%	6%
Treatment	8%	7%	7%
Landfill[c]	42%	40%	40%
Additional facilities required[d]	67	83	117

[a] Excludes combustion residues.

[b] excludes hazardous liquid wastes.

[c] includes additional residues landfilled from treatment.

[d] estimated additional to plants in 2002/03.

Table A.24: Scenario 7, difference from Scenario 5

2009/10	2014/15	2019/20		
Minimisation (kt)		3,000	5,730	9,330
Re-use (kt)		–50	–80	–140
Recycling (kt)		–1,360	–2,750	–4,670
Thermal (kt)		–270	–490	–730
Treatment (kt)		–160	–280	–430
Landfill (kt)		–1,560	–2,910	–4,560
Additional facilities		–20	–36	–64
	Discounted costs and benefits 06/07–19/20			
Costs *£m*	low gate fees			–£854
	high gate fees			–£1,865
Carbon benefits	low social cost of carbon			–£94
	medium social cost of carbon			–£172
	high social cost of carbon			–£328
Total change in CO_2 equivalent emissions as a result of change in treatment relative to "do nothing" scenario (mt) 2006/07 to 2019/20				7.25
Additional carbon benefits of waste prevention – medium social cost of carbon (£m)				£3,310
Estimated change in CO_2 emissions through change in tonnage of material embodied in waste compared to "do nothing" scenario (mt) 2006/07 to 2019/20				–173.32

Note that waste minimisation is assumed to reduce waste flows through all treatment routes (in extremis it obviates the need for other treatment routes). The carbon benefits of not producing waste are based on energy embodied in materials, converted to CO_2 emissions assuming CCGT as the marginal source of energy.

Scenario 8: Increased recycling and composting of C&I wastes

78. The consultation responses showed further strong support for the sectoral approach as providing a generally more targeted and sophisticated focus on business waste prevention and increasing recycling of waste that is produced. The prevention benefits are highlighted above, and therefore show that priority should be given to sectors with most significant environmental impact and agreements should be focused on reduction targets wherever practicable. However, where this is not feasible changes in waste treatment practices can also have significant benefits. This scenario examines the benefits of improvements in the patterns of waste treatment.

79. The Government has identified the food and retail and construction and demolition sectors as priority sectors. Tables A.25 and A.26 indicate the impacts – if agreements led to an increase in recycling of mixed commercial waste from 8% to 28% and an increase in food waste composting of 30% then overall re-use and recycling rates would exceed 55% by 2009/10 and approach 60% by 2019/20. Depending on the relative costs of recycling, composting and landfilling, this could potentially reduce costs by up to £476 million or increase costs by up to £345 million. The impact on CO_2 emissions, however, is expected to be universally positive with the higher recycling and composting scenario delivering carbon savings values in the range £320 million to £1 billion over the same time period (see Table A.26).

Table A.25: Scenario 8 – increased recycling and composting of C&I wastes

	2009/10	2014/15	2019/20
Arisings (kt)[a]	58,490	60,840	68,530
	Waste treatment (kt)[b]		
Minimisation	2,130	2,300	2,580
Re-use	5,720	5,370	5,650
Recycling	27,450	30,350	35,270
Thermal	3,850	3,890	4,230
Treatment	4,180	3,940	4,270
Landfill[c]	22,650	22,670	25,160
	Treatment type by percentage of total waste		
Re-use	10%	9%	8%
Recycling	47%	50%	51%
Thermal	7%	6%	6%
Treatment	7%	6%	6%
Landfill[c]	39%	37%	37%
Additional facilities[d]	126	163	231

[a] Excludes combustion residues.

[b] excludes hazardous liquid wastes.

[c] includes additional residues landfilled from treatment.

[d] estimated additional to plants in 2002/03.

Table A.26: Scenario 8, difference from Scenario 5

		2009/10	2014/15	2019/20
Minimisation (kt)		0	0	0
Re-use (kt)		0	0	0
Recycling (kt)		2,580	2,810	3,190
Thermal (kt)		0	0	0
Treatment (kt)		–260	–250	–240
Landfill (kt)		–2,240	–2,450	–2,810
Additional facilities		39	44	50
	Discounted costs and benefits 06/07–19/20			
Costs (£m)	low gate fees			–£476
	high gate fees			£345
Carbon benefits	low social cost of carbon			£323
	medium social cost of carbon			£554
	high social cost of carbon			£1,015
Total change in CO_2 equivalent emissions as a result of change in treatment relative to "do nothing" scenario (mt) 2006/07 to 2019/20				–28.38
Additional carbon benefits of waste prevention – medium social cost of carbon (£m)				n/a
Estimated change in CO_2 emissions through change in tonnage of material embodied in waste compared to "do nothing" scenario (mt) 2006/07 to 2019/20				n/a

Note that waste minimisation is assumed to reduce waste flows through all treatment routes (in extremis it obviates the need for other treatment routes). The carbon benefits of not producing waste are based on energy embodied in materials, converted to CO_2 emissions assuming CCGT as the marginal source of energy.

Part C – The Local Authority Waste Recycling Recovery and Disposal (LAWRRD) Model

80. Defra's Local Authority Waste Recycling Recovery and Disposal (LAWRRD) model was developed for Defra by AEA Technology as a replacement for the Strategy Unit (SU) model created as part of the Cabinet Office SU report *Waste not Want not*. Its purpose is to predict local authorities' waste management costs, material flows and facility choices in response to different policy levers, including EC Landfill Directive targets, taxes and recycling performance standards.

81. LAWRRD is a costs-driven, bottom-up model. It models waste management by taking input data on waste arisings, numbers of actual or planned facilities from each local authority in turn and then summing the relevant outputs to develop a picture representing England as a whole. The existing and proposed waste management infrastructure has been identified through local authority surveys and assessment of current PFI applications.

82. Each local authority is assigned to one of up to three 'typologies' (urban, suburban and rural). The typologies allow user input of waste composition, growth rates, local gate fees and 'pressure factors' reflecting political and practical weighting against certain options (e.g. anti-incineration and non-achievement of targets). The assignment of typology is determined by the socio-economic and demographic characteristics of each area. The typology approach allows for the introduction of local variations in the model that cannot be reflected when the country is, in effect, treated as a single waste disposal authority, as in the SU model.

83. The model works by simulating the decision processes of each waste disposal authority. Each year, the costs of adding different waste management facilities at various operational scales is compared with the cost of making no change to the existing suite of facilities. The cost of each option includes the gate fees, costs of residue treatment and disposal, taxes, the trading of landfill allowances, fines and 'pressure' factors.

84. Having identified the lowest cost additional plant (or found that 'no change' is cheapest), the model then adds a facility of the selected type to the existing options for that local authority and then repeats the process for the next authority and so on until all authorities have been assessed in that year. LAWRRD then repeats the calculations with increasing incomes and penalties for LATS until a balance point is reached in allowance trading. This then represents the most economic outcome for England as a whole for that trading year (i.e. it allows some authorities to select larger facilities in order to trade the excess allowances generated if economic to do so). The model then proceeds to the next year. It does not allow for banking or borrowing of allowances.

85. By basing decisions on economic costs, the model simulates the main driver for local authority decision-making. The LAWRRD model includes waste industry capacity constraint curves to ensure that the number of facilities predicted by LAWRRD do not exceed industries' ability to deliver.

86. LAWRRD considers the material flows and costs from collection of recyclates and residual waste via civic amenity (CA) sites, 'bring' and direct recycling and kerbside collection options. The waste management options in the model are placed in a hierarchy,[22] in which recyclates are removed at the top of the hierarchy, leaving residues for treatment in the lower levels. The waste flows are illustrated in Figure A2.

[22] The hierarchy of treatment options is, in descending order: MRF; Dirty MRF; green waste composting; biowaste composting; bio-mechanical treatment with refuse-derived fuel production; MBT with compost/RDF production; MBT with compost produced going to landfill; EfW combustion; advanced conversion technologies (e.g. pyrolysis and gasification which also recovery energy); and residues to landfill.

87. LAWRRD modelling was used in the preparation of the waste strategy review consultation document and accompanying pRIA to project required national recycling targets and associated costs. LAWRRD has since been updated to reflect the latest information on waste arisings and development plans within individual authorities. The calculations of both waste collection costs and gate fees have also been extensively revised in the light of further research and in consultation with stakeholders. The revised capital cost and gate assumptions used in this work are presented in Table A.27.

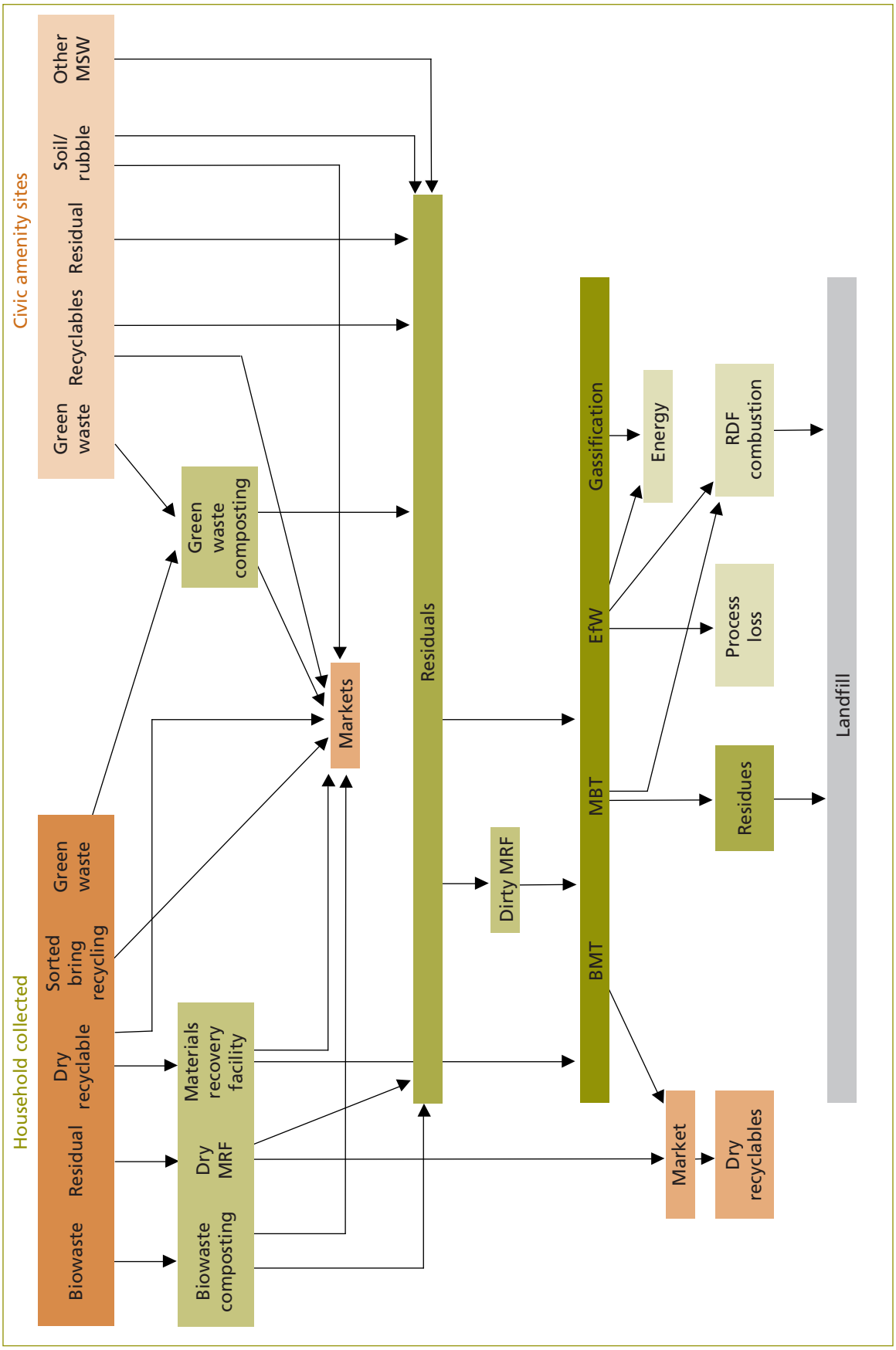


Figure A2: Waste flows in LAWRRD

Table A.27: LAWRRD assumed capital and gate fee costs[a]

Facility type	Plant scale (kt/y)	Capital cost 2007/08 (£m)	Gate fees 2007/08 (£/t)
Materials recovery facilities (MRF)	10	2.10	62.52
	40	6.00	41.20
	100	16.50	37.74
Dirty MRF	70	5.70	80.79
	150	10.80	68.09
	250	16.50	66.16
Green waste composting	10	2.30	40.27
	30	4.90	30.75
	50	7.70	28.24
Biowaste composting/anaerobic digestion	20	7.30	65.37
	50	14.70	52.49
	150	28.80	37.90
Mechanical with residue to EfW	50	29.40	103.93
	100	44.40	84.46
	200	67.10	70.40
Mechanical biological treatment (MBT) with refuse derived fuel (RDF)	50	29.40	98.80
	100	44.40	79.32
	200	67.10	65.27
MBT compost and residue to landfill	50	19.80	89.21
	100	29.90	74.27
	200	44.80	64.32
Energy from Waste (EfW)	100	64.70	78.42
	200	104.70	58.52
	400	149.10	37.77
ACT gasification/pyrolysis	30	21.70	93.57
	50	27.90	69.22
	150	67.20	51.56

[a] Gates fees are based on discounted capital costs, operating costs, residue disposal costs and revenues net of landfill tax. Capital costs are discounted over typical operating lives for each type of plant, and differ according to typology to reflect land costs.

Part D – Commercial and industrial waste forecasting

REEIO

88. Predictions of commercial and industrial (C&I) waste growth have been derived using the Environment Agency's Regional Economy–Environment Input–Output (REEIO) model, originally developed by Cambridge Econometrics for the Environment Agency and the Regional Development Agencies. The model integrates economic growth of industrial sectors (50) with a set of key environmental pressures, including waste.

89. Defra commissioned Cambridge Econometrics to develop the REEIO model into an England-wide model for predicting C&I waste growth based on evidence from the two Environment Agency surveys of C&I waste in 1998/9 and 2002/03.

90. As REEIO only looks at sectoral shift as a driver it is likely to over-predict future waste arisings as other factors (including improvements in resource efficiency) act to reduce waste per unit of activity. By examining the difference between the actual level of waste in 2002/03 and a projection from REEIO based on the 1998/99 data, Cambridge Econometrics were able to establish an estimate of the scale of this over-prediction. These adjustment factors are incorporated within the model on the assumption that pressures to reduce waste will continue.

91. The model assumes overall economic growth of 2.5% per year in terms of gross value added, but with services generally growing more quickly than manufacturing and different sectors within services and manufacturing also growing at different rates.

92. By integrating sectoral growth data with detailed waste data from the Environment Agency, REEIO could therefore be used to forecast waste arisings by industry type and also by material. This provided the baseline projections of waste arisings used in this pRIA.

HMRC landfill tax model

93. HMRC's landfill tax model was developed with the primary purpose of predicting levels of landfilling under various tax rate scenarios, and hence deducing future levels of tax receipts. The model also predicts the amount of waste diverted from landfill when the landfill tax increases, but it does not identify where that waste ultimately goes. The latter can only be derived from a full cost curve based model.

94. The model combines forecasts of the total level of waste with estimates of the own price elasticity of demand for landfill[23] and marginal cost estimates of the cost of alternative treatment technologies to examine landfill diversion resulting from the landfill tax escalator.

95. The model has been used here with output from the REEIO model to estimate the impact of future landfill tax on commercial and industrial waste diversion from landfill.

[23] Taken from previous Defra studies, e.g. Aspinwall (1999) and Enviros (2001 and 2002).

Part E – Environmental modelling

96. Environmental benefits are presented here in terms of climate change impacts, expressed as carbon savings. These benefits accrue as:

- direct benefits of reduced landfill emissions; and
- off-set benefits of recycling, recovery and greater resource efficiency within product life cycles.

97. This analysis enables an estimate of the environmental impacts to be monetised using the social cost of carbon. This has been applied both to the evaluation of the MSW options and, more crudely, to the evaluation of CI&H options. The method is set out below.

98. The evaluation here has been revised from that presented in the pRIA following further research on the life cycle greenhouse gas impacts of managing waste streams. These impacts are strongly dependent on the nature of wastes, the treatment routes and how off-sets are gained. The analysis should therefore only be viewed as providing a broad indication of the relative benefits between scenarios. The evaluation for CI&H wastes requires bolder assumptions than that for MSW as less compositional data is available.

Emission factors for waste treatment processes

99. Environmental impact factors have been derived from a Defra-commissioned study by ERM, *Carbon Balances and Energy Impacts of the Management of UK Wastes*, and a comparison with WRAP's report '*Environmental Benefits of Recycling: An international review of life cycle comparisons for key materials in the UK recycling sector.*[24] Disamenity impacts were not considered as estimates only exist for landfill.[25]

100. The total environmental impact was proxied by the emissions of six greenhouse gas emissions (carbon dioxide, methane, nitrous oxide, PFCs, HFCs and CFCs, and SF) expressed as carbon dioxide equivalents. The emission factors are summarised in Table A.28. These are based on a life cycle assessment and include not only the carbon costs of treating and transporting waste, but also the potential benefits where primary resource extraction or electricity generation are off-set with energy recovery (the off set is against combined cycle gas turbine (CCGT) electricity generation). The impact of waste prevention is calculated based on the embodied energy in primary material (again assumed to be produced using CCGT), and therefore inherently assumes the offsetting of virgin production.

MSW Assessment

101. The LAWRRD model (Part C) produces output for the total amount of tonnages managed through nine different technology types and landfill. The environmental impact of each of these waste management options is dependent on the composition of the waste input.

102. In order to estimate the environmental impact of each of the scenarios modelled, the LAWRRD output was apportioned between the different elements of the waste stream.

[24] See http://www.wrap.org.uk/applications/publications for further information.
[25] See http://www.defra.gov.uk/environment/waste/landfill/pdf/landfill_disamenity.pdf for further information.

Stage 1

103. Initially, the LAWRRD output was divided up by material for the recycling and composting options based on expert judgement of the average composition of each of these routes. The assignment of components is given in Table A.29.

104. The modelling ensured that a cap was placed on the tonnage of each material recycled/composted equal to the total amount of that material in the waste stream (with excess tonnage apportioned proportionally across the other elements of the waste stream).

Stage 2

105. The composition of residual waste was calculated based on the amount of material initially in the waste stream minus the material recycled and composted in Stage 1. Again, the modelling ensured that a cap was placed on the tonnage of each material managed equal to the total amount of that material in the waste stream (with excess tonnage apportioned proportionally across the other elements of the waste stream).

Stage 3

106. The emission factors were combined with the LAWRRD output divided up by material to provide the total carbon dioxide equivalent emissions for each of the options. To allow for the fact that there may be diminishing returns to recycling at higher rates of recycling (primarily as a result of lower quality/grade material as an input) a slightly lower adjusted set of emissions factors for the benefits of recycling were used in Scenario 4.

Stage 4

107. The carbon dioxide equivalent emissions were converted to carbon equivalents (using a conversion factor of 12/44) and multiplied by Government's estimate of the social cost of carbon,[26] adjusted for relative price changes[27] and discounted[28] in order to compare the benefits over time to the related costs.

108. Landfill emissions are treated slightly differently than in the pRIA. As emissions are released over time, it is appropriate to value the emissions in the year that they are released. To proxy this we assume that, for a mixed bundle of wastes, the mean emission takes place ten years after landfilling. This time delay is then accounted for in the costing and discounting calculations.

CI&H Assessment

109. There is relatively little information on the composition of CI&H wastes. For the purposes of this assessment, the crude assumption was made that CI&H waste can be described in aggregate by a single composition, given in Table A.30.

110. Table A.30 also includes the emissions factors for these materials when processed by each of the treatment types examined in the CI&H waste analysis.

111. In the absence of better information, the benefits of re-use were equated to those for recycling. The benefits of waste prevention are as described above.

[26] Clarkson R. and K. Deyes (2002) *Estimating the Social Cost of Carbon Emissions*, Government Economic Service Working Paper 140, Defra and HM Treasury.

[27] See http://greenbook.treasury.gov.uk/chapter05.htm for further information.

[28] See http://greenbook.treasury.gov.uk/annex06.htm for further information.

112. The emissions factors for specific waste types were weighted by the estimated composition of CI&H waste to estimate an aggregate emissions factor for each treatment type. Applying this to the tonnages of material processed by treatment type gives an estimated level of carbon dioxide emissions from the treatment bundle in the scenario concerned.

113. The net changes in tonnes of carbon (converted from the change in carbon dioxide equivalent emissions) are monetised using the current Defra/HMT guidance on the social cost of carbon. The impacts of methane from landfill are also treated as discussed in paragraph 108.

114. Both the financial impacts and monetised carbon impacts are presented as present values, in which future costs and benefits are discounted in line with the HM Treasury Green Book.

Table A.28: Emission factors for waste treatment processes (kg carbon dioxide equivalents/tonne of waste processed)

Waste fraction	kg CO_2 saved per tonne of waste treated[a]					Embodied fossil energy (kg CO_2 saved per tonne waste prevented)
	Recycling	Eμw	AD	Composting	Landfill	
Paper and Card	713	93	121	–57	–687	2,556
Kitchen/food waste		89	65	–35	–258	2,428
Garden/plant waste		121	70	–57	–135	89
Other organic	–44	271	330	–34	–230	
Wood	5	577			–298	256
Textiles	1,284	–245			–233	19,294
Plastic (dense)	1,012	–1,139			–10	12,778
Plastic (film)	782	–1,012			–10	10,222
Ferrous metal	1,340	786			–10	1,917
Non-ferrous metal	11,026	–23			–10	16,100
Silt/soil	–16	–35			–10	4
Aggregate materials	4	–35			–10	102
Misc combustibles	–58	–242			–305	102
Glass	574	–45			–10	1,406
Estimated impact of materials not covered in ERM study (municipal and C&I)	259	–97	13	–7	–81	2,860

[a] Impact of other treatments as in pRIA – http://www.defra.gov.uk/corporate/consult/wastestratreview/partialRIA.pdf – p.58.

Table A.29: Assignment of waste components to recovery streams

	Paper/card	Kitchen waste	Garden waste	Textiles	Misc. combustible	Ferrous metals	Non-ferrous metals	Glass	Plastic dense	Plastic flim
CA site recovery and recycling	22%			1%	13%	54%	1%	10%		
Bring recycling	56%			3%		1%	1%	39%	1%	
MRF	64%			3%		2%	1%	26%	4%	1%
Green waste composting			100%							
Biowaste composting/digestion		30%	70%							

Table A.30: Assumed CI&H waste composition and aggregate carbon dioxide equivalent

Estimated composition of C&I waste			kg CO_2 saved per tonne waste treated			Embodied fossil energy (kg CO_2 saved per tonne waste prevented)
Material	kt	Proportion	Recycling/ composting	Thermal	Landfill	
Paper and card	12,030	21%	713	93	–687	2,556
Kitchen/food waste	4,760	8%	–35	89	–258	2,428
Garden/plant waste	3,520	6%	–57	121	–135	89
Other organic	2,180	4%	–34	271	–230	
Wood	1,350	2%	5	577	–298	256
Textiles	440	1%	1,284	–245	–233	19,294
Plastic (dense)	1,240	2%	1,012	–1,139	–10	12,778
Plastic (film)	1,670	3%	782	–1,012	–10	10,222
Ferrous metal	3,120	5%	1,340	786	–10	1,917
Non-ferrous metal	750	1%	11,026	–23	–10	16,100
Silt/soil	1,240	2%	–16	–35	–10	4
Aggregate materials	1,110	2%	4	–35	–10	102
Misc. combustibles	9,820	17%	–58	–242	–305	102
Glass	1,880	3%	574	–45	–10	1,406
Other[a]	13,500	23%	214	–112	–71	2,595
Total	58,590	**Aggregate emissions factors**	**461**	**–25**	**–257**	**2,408**

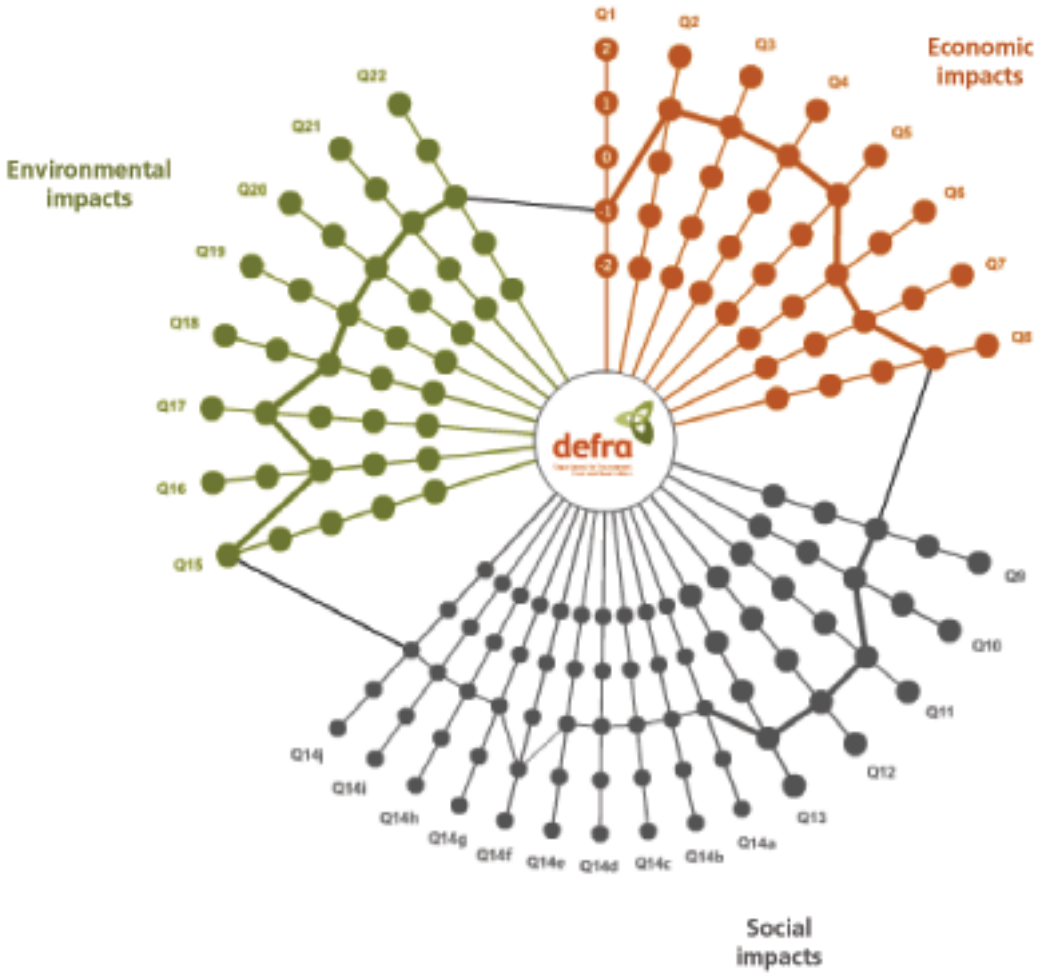
[a] Estimate of CO_2 impact based on composition of C&I waste.

Appendix 2: Policy web

1. The policy web is a tool for illustrating graphically the overall social, environmental and economic impacts of the proposals considered as part of the review of the Waste Strategy. Brainstorming sessions were held to first create a web for the overall policy proposals – generating the policy's 'score' for each question in the pRIA – and then to stretch the web as far as possible by examining the proposals for how they might be adapted to further mitigate negative impacts and increase positive ones.

2. The decision to create a policy web for the entirety of the waste strategy review proposals – as an aggregate of various policies and not for each individual policy – was taken in line with guidance from the Cabinet Office on the Sustainable Development Strategy RIA. It is worth noting that the policy web encapsulates a wide range of policies, considered from a strategic perspective, and that any future proposals brought forward under this strategy that may increase regulatory burdens on the private, public or third sectors will be subject to their own Impact Assessments in due course.

Figure A.1: Policy web



3. The questions listed below represent each 'spoke' of the policy web. Negative (-1) or positive (+1) impacts and neutral (0) impacts resulting from a balancing exercise between negative and positive effects are briefly outlined below.

4. Again, this analysis is concerned with the impact of the proposals over and above the impact of ongoing changes to the waste management landscape inherent in the base case (no policy change). The balance of some impacts is relatively small compared with these ongoing changes, notably, for example, in terms of additional investment requirements.

5. No comments were received on the policy web from the stakeholder consultation. However, it has been reviewed in light of the general consultation responses.

Economic impacts

Q1. Will the proposal result in receipts or savings to the Government? [-1]

A1. Some additional government (initial or lasting) financial support will be necessary to improve resource efficiency and reduce waste, to assist businesses to 'design out' waste and to support local authorities with an estimated £40 million per year across England.

Q2. Will the proposal affect the costs, quality or availability of goods or services? [+1]

A2. A number of proposals are intended to improve products, recycling and waste management services procurement, and to assist the market for recycled materials.

Q3. Will the proposal result in new technologies? [+1]

A3. New technology and innovation are expected following clearer indication from the Government of the direction that waste management should take.

Q4. Will the proposal result in a change in the investment behaviour both into the UK and UK firms overseas and into particular industries? [+1]

A4. The waste strategy review delivers a clear message from the Government to the waste management industry regarding the types and scale of investment required. Proposals are included to help local authorities implement existing requirements cost effectively and to promote investment by industry in resource efficiency as part of the sustainable consumption and production agenda.

Q5. Will it impact on the levels of competition within the affected sector? [+1]

A5. Changes due to policies within the current baseline are having significant impacts both on waste producers and the waste management industry. However, the market is not expected to be affected significantly by the options being considered.[29]

Q6. Will the proposal impact on the public sector, including the resources of front-line delivery staff? [0]

A6. Current policies are driving significant change in local authority service provision, particularly with respect to waste collection. The proposals here imply only a marginal increase in additional staff resources and overheads, for example through a wider local authority role with respect to non-municipal waste.

[29] Only to a limited degree relative to the major changes implicit in the baseline. Simplification of the regulatory framework and clearer indication of policy direction and targets should increase market confidence, attracting new waste and resource management companies into the field.

Q7. Will the proposal impact on business, charities and voluntary organisations? This could be in the form of a change in prices, outputs, levels of employment or competitiveness? [0]

A7. Costs of waste management are increasing due to pressure within the current baseline. The proposals are aimed at inducing cost savings through increased resource efficiency while at the same time reducing regulatory burdens on business. Third sector organisations will be impacted in their capacity as waste producers, but are anticipated to have a greater role as providers of services and in engaging communities in changing behaviour.

Q8. Will the proposal impact on consumers? [+1]

A8. The proposals imply behaviour change both in procurement and in the disposal of residual wastes. This should result in some mitigation of the cost increases implicit in the base case.

Social impacts

Q9. Will the proposal influence health-related behaviour or affect demand for health services? [0]

A9. The rationale for Government policy includes reducing the health impacts of waste. Proposals include taking a more risk-based approach to the exemption and licensing of waste management activities and options for the better collection of household hazardous wastes (Option J). While the evidence is that impacts on health are small there may be local impacts of additional waste management facilities, and these will need to be considered within local plans and strategies.

Q10. Will the proposal influence safety at work or affect the likelihood of accidents in the community? [0]

A10. There are concerns over accident rates associated with waste management, and particularly with kerbside collection operatives. Major programmes are already in place to improve operator training and certification. The Waste Industry Safety and Health Forum (WISH) monitors and reviews action on these issues.

Q11. Will the proposal affect the rate of crime or crime prevention or create a new offence/opportunity for crime? [+1]

A11. As waste management costs increase, fly-tipping and other illegal waste activity may increase. The waste strategy therefore includes a strategy to tackle illegal waste activity (including more targeted action to prevent illegal waste activity and strengthen enforcement) (Option L).

Q12. Will the proposal affect the levels of skills and education? [+1]

A12. The waste strategy review proposes additional waste management and skills training at all levels, including schools education, to raise waste awareness and affect behaviour change.

Q13. Will the proposal affect the provision of facilities or services that support community cohesion or in other ways affect the quality of life in the local community? [+1]

A13. Local environmental quality will improve as a result of action on fly-tipping and increased environmental awareness.

Q14. Could the proposal result in any changes in or a differential impact on any of the following?:

a. race equality [0]

b. rural communities [0]

c. human rights [0]

d. gender equality [0]

e. disabled people [0]

f. children and young people [+1] – educational impact of learning about recycling, re-use and general environmental awareness through schools programmes

g. older people [0]

h. income groups [0]

i. devolved countries [0] – separate arrangements apply to other parts of the UK[30]

j. particular regions of the UK [0]

Environmental impacts

Q15. Will the policy option lead to a change in the emission of greenhouse gases? [+2]

A15. Greenhouse gas emissions constitute the main global environmental impact of waste management (Annex K). The proposals in the waste strategy review are designed to further mitigate these impacts through measures on waste prevention and increased resource efficiency, and to reduce impacts through product life cycles, in line with policies towards sustainable development.

Q16. Will the policy option be vulnerable to the predicted effects of climate change? [0]

A16. No. The proposals are intended to assist progress towards climate change targets.

Q17. Will the policy option lead to a change in the financial costs or the environmental and health impacts of waste management? [+1]

A17. See above. The proposals are intended to deliver overall benefits relative to the current base case.

Q18. Will the policy option impact significantly on air quality? [0]

A18. The proposals do not impose additional air quality impacts relative to the current base case. However, local impacts will need to be considered with respect to individual waste treatment facilities.

Q19. Will the policy option involve any material change to the appearance of the landscape or townscape? [0]

A19. Increased collection facilities, including kerbside collection containers and bring banks, and major waste management facilities may have a visual impact which needs to be considered at the local planning stage.

[30] See *Wise About Waste*: The National Waste Strategy for Wales, Welsh Assembly Government, June 2002, available at http://www.wales.gov.uk/about/strategy/strategypublications/?lang=en; *Towards Resource Management: The Northern Ireland Waste Management Strategy 2006–2020*, Environment & Heritage Service – Northern Ireland, October 2006, available at www.ehsni.gov.uk/waste/strategy/ni.htm; *The National Waste Plan*, SEPA, 2003 available at http://www.sepa.org.uk/nws/

Q20. Will the proposal change the degree of water pollution, levels of abstraction of water, or exposure to flood risk? [0]

A20. No.

Q21. Will the policy option disturb or enhance habitat or wildlife? [0]

A21. No. However, local impacts will need to be considered with respect to individual waste treatment facilities.

Q22. Will the policy option affect the number of people exposed to noise or the levels to which they are exposed? [0]

A22. No. However, local impacts will need to be considered with respect to individual waste treatment facilities.

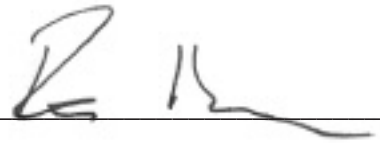
Appendix 3: Competition test

Competition filter test questions

Question	Answer
Q1: In the market(s) affected by the new regulation, does any firm have more than 10% market share?	Yes
Q2: In the market(s) affected by the new regulation, does any firm have more than 20% market share?	No
Q3: In the market(s) affected by the new regulation, do the largest three firms together have at least 50% market share?	No
Q4: Would the costs of the regulation affect some firms substantially more than others?	No
Q5: Is the regulation likely to affect the market structure, changing the number or size of firms?	Limited
Q6: Would the regulation lead to higher set-up costs for new or potential firms that existing firms do not have to meet?	No
Q7: Would the regulation lead to higher ongoing costs for new or potential firms that existing firms do not have to meet?	No
Q8: Is the sector characterised by rapid technological change?	No
Q9: Would the regulation restrict the ability of firms to choose the price, quality, range or location of their products?	No

Appendix 4: Ministerial declaration

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

Signed 

Date 23 May 2007

Ben Bradshaw
Minister of State
Department for the Environment, Food and Rural Affairs

Contacts:

Samuel Thomas	samuel.thomas@defra.gsi.gov.uk	020 7082 8583
James Vause	james.vause@defra.gsi.gov.uk	020 7082 8590

Environmental Policy Economics, Defra, Zone 4/F8, Ashdown House, 123 Victoria Street, London SW1E 6DE