Review of England's Waste Strategy

Environmental Report under the "SEA" Directive

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ABBREVIATIONS

BAP	Biodiversity Action Plan
BAT	Best Available Technology
BPEO	Best Practicable Environmental Option
C&I	Commercial and Industrial (waste)
CDW	Construction & Demolition Waste
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EIA	Environmental Impact Assessment under Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999
MRF	Materials Recovery Facility
MSW	Municipal Solid Waste
MWDF	Minerals and Waste Development Framework
ODPM	Office of the Deputy Prime Minister
PPC	Pollution Prevention and Control
RIA / pRIA	Regulatory Impact Assessment / partial Regulatory Impact Assessment
RSS	Regional Spatial Strategies
SAC	Special Area of Conservation
SCP	Sustainable Consumption and Production
SEA	Strategic Environmental Assessment
SPA	Special Protected Areas
SSSI	Site of Special Scientific Interest
WCA	Waste Collection Authority (see glossary below)
WDA	Waste Disposal Authority (see glossary below)
WTS	Waste Transfer Station

DEFINITIONS

CO_2; CH_4	Carbon dioxide and methane, two important greenhouse gases
CO_2 equivalent and carbon equivalent	Emissions of greenhouse gases are expressed either as CO_2 equivalent or carbon equivalent, the former is a measurement on a molecular weight basis and the latter on an atomic weight basis. Carbon comprises 12/44 of the mass of carbon dioxide; thus to convert from CO_2 equivalent to carbon equivalent, multiply by 12/44 (the ratio of the atomic weights of carbon and carbon dioxide). Conversely, one tonne of carbon is equal to 44/12 tonnes of CO_2.
Global Warming Potential (GWP)	Each greenhouse gas has a different capacity to cause global warming, depending on its radiative properties, its molecular weight and its lifetime in the atmosphere. For example, methane is a more potent greenhouse gas than carbon dioxide. To express emissions of the different gases in a comparable way, a weighting factor called *global warming potential* is used. The heat-trapping ability of one metric ton (1,000 kilograms) of CO_2 is taken as the standard. The GWP of CO_2 is therefore 1. To compute the carbon dioxide equivalent of the emission of any gas, its emission is multiplied by the GWP.
Proximity	Suggests that waste should generally be disposed of as near to

Principle	its place of production as possible
Sustainable Development	Development which is sustainable is that which can meet the needs of the present without compromising the ability of future generations to meet their own needs
Sustainable waste management	Means using material resources efficiently, to cut down on the amount of waste we produce. And where waste is generated, dealing with it in a way that actively contributes to the economic, social and environmental goals of sustainable development
Waste arisings	The amount of waste generated in a given locality over a given period of time
Waste Collection Authority	A local authority charged with the collection of waste from each household in its area on a regular basis. It can also collect, if requested, commercial and industrial wastes from the private sector.
Waste Disposal Authority	A local authority charged with providing disposal sites to which it directs the Waste Collection Authorities for the disposal of their controlled waste, and for providing civic amenity facilities (i.e. facilities to which the public deliver bulky items of waste)

NON-TECHNICAL SUMMARY

Introduction

In England around 100 million tonnes of municipal, commercial and industrial waste is generated each year. This amount continues to grow year on year. While waste cannot be eliminated, its environmental impact can be reduced by preventing it wherever possible, and making more sustainable use of the waste that is produced.

In Waste Strategy 2000 ('*WS2000*') the Government set out its vision for waste management in England and Wales over the next 20 years, promising periodic reviews of that strategy. The first is occurring now and Government is consulting on revisions to the waste strategy in *Review of England's Waste Strategy: A Consultation Document*. The Consultation Document:

a) Sets out the progress made since 2000 in meeting the Government's objectives and implementing its policies; and

b) Consults on proposals to revise *WS2000* and the policies for implementing it.

It is proposed to publish the revised waste strategy in late 2006. This will consolidate current policies alongside the new proposals and will supersede *WS2000* entirely. The revised waste strategy will be designed to deliver the Government's objective for waste within its overall sustainable development strategy 2005, *Securing the Future*.

Assessment methodology

In line with Directive 2001/42/EC, Defra has conducted a "Strategic Environmental Assessment" (SEA) to inform its revised strategy. This includes an assessment (on a national scale) of the significant effects on the environment that are occurring as a result of its current strategy and which are likely to occur as a result of possible alternative scenarios that might arise from the waste strategy review.

The assessment has followed the process requirements of the SEA Directive which have been amplified in the Government's Practical Guide to the SEA Directive. In particular, the SEA Directive requires that the assessment should inform evolution of the decision-making, and this has been achieved by constant iteration between strategic decision-makers and assessors.

The Consultation Document containing the proposed options for the revised waste strategy, and this Environmental Report containing the environmental assessment, are consulted upon together. As required by the Environmental Assessment of Plans and Programmes Regulations 2004 (which implement the Directive), the SEA consultation process began with production of a scoping report which invited the Environment Agency, English Heritage, English Nature and the Countryside Agency to comment on the scope of the Environmental Report. In outline, the waste management alternatives described below cover the sectors of municipal solid waste, commercial and industrial, as well as construction and demolition wastes.

The environmental baseline

Key to the assessment process was establishing the existing environmental situation in England that could be altered by implementation of the revised waste strategy to be adopted at the end of this consultation. This was to identify any unacceptable situations occurring under *WS2000* and to provide a baseline for the assessment and future monitoring of the revised waste strategy. The information for the baseline was derived from a number of sources, including governmental and Non Governmental Organisations (NGOs).

The environmental impacts associated with waste arisings and their management were considered in relation to biodiversity, flora and fauna; landscape character; culture and heritage; water quality; soil resource and land contamination; air quality; climatic factors; resource utilisation and depletion; human health impacts and waste crime.

The environmental impact on a national scale that has been identified as being most significant is the generation of greenhouse gases (particularly methane), which are caused primarily by the degradation of plant and animal waste disposed to landfill. Waste sector emissions of all greenhouse gases accounted for approximately 2% of UK emissions of greenhouse gases in 2003, but have fallen from a contribution of 5% in 1990. Methane accounts for approximately 80% of waste sector emissions. Methane emissions from the waste sector have been cut by around two-thirds since 1990 and continue to fall, principally as a result of increased capture from landfills.

Notwithstanding the continuing and pressing need to manage waste in England in a more sustainable manner and to reduce the impact on the environment, the overall conclusion from the baseline is that, when viewed nationally, waste regulation has been effective in mitigating potentially acute effects to a satisfactory level.

The nature of materials handled in waste management means that pollution incidents can have important local consequences (e.g. in 2004 there were reported in England almost 80,000 fly-tipping incidents costing local authorities nearly £4m in remediation each month). However, the absolute number of serious incidents attributed to waste management has fallen since 2000. This leaves scope for further reductions in local environmental impacts which are best addressed by the licensing regime, effective site management and through the planning process (involving EIA), rather than through the national waste strategy.

The developing policy context

Both the proposed revisions to the waste strategy and this assessment take account of the developing policy context at international, EU and national level. Various policy instruments since *WS2000* link waste management firmly with sustainable use of resources and thus to the sustainable development, consumption and production agenda. This continues the shift away from earlier waste policy frameworks designed as 'end-of-pipe/end-of-life' solutions towards one that treats waste more as a resource. In particular, the Government's sustainable development strategy, *Securing the Future*, emphasises the need to produce less waste and use it as a resource wherever possible. The recent EU Thematic Strategy on Waste Prevention

and Recycling endorses the basic objectives of existing EU waste policy and sets a long-term goal for the EU to become a recycling society.

The Consultation Document addresses both the continued increase in waste arisings and the generation of greenhouse gases, among other issues. It has as its foundation the aim to reduce waste arising as a first priority, then to ensure that re-use/recycling of waste is pursued with energy recovery (e.g. by burning for electricity generation) being used in preference to landfill as a last resort. These priorities are consistent with and take forward the principles of the internationally accepted waste hierarchy.

Assessment of strategic alternatives

In order to assess and inform the strategic proposals, it was decided to develop and evaluate four strategic alternatives (presented as scenarios) to current policies which assess the proposals in their operation at each of the principal levels of the waste hierarchy. A base case of no policy change (i.e. continuing with existing waste management policy) was also developed against which the alternatives could be assessed.

The five scenarios are:

0. No change to existing waste management policy
1. Reduce the rate of arisings
2. Increase the rate of recycling
3. Increase the amount of energy generated from waste (Scenario 3A - enhanced rate; and Scenario 3B - further enhanced rate) and
4. Increase the amount of waste diverted from landfill.

The environmental performance of these scenarios was assessed against a set of indicators that were consistent with national and international environmental protection objectives and principles (e.g. Kyoto Protocol and the Government's 2005 sustainable development strategy).

Scenario 0 assumes that waste management practices will continue to evolve in line with existing policies which are expected to bring about beneficial change (e.g. diversion of waste from landfill) over the next few years. Scenarios 1 to 4 show the effects of doing more, or less, in each of the key levels of the waste hierarchy (e.g. increased recycling, increased diversion of waste from landfill). The extent of the scenarios was chosen to reflect the full range of likely significant effects on the environment associated with the proposals. Defra has used this assessment as a tool to help formulate the mix of waste management options across all levels of the waste hierarchy that the revised waste strategy will seek to achieve.

The environmental effects of waste management are largely dictated by the number and type of required waste management facilities. Defra has predicted the amount of waste management infrastructure required for each scenario using models that simulate the complex interrelationships between a number of economic and policy drivers.

The modelling outputs predicted the numbers of new waste management facilities and their associated greenhouse gas emissions in the years 2010 and 2020. Each set of outputs was then assessed using expert judgement backed by information derived for each "typical" facility type to identify the

likely environmental impacts on a national scale. This information included such factors as the area of land required and impacts on flora and fauna and habitats etc. A set of indicators was chosen and was a key tool in the assessment process. The detailed assessment tables against each of these indicators are set out in Appendix C of the Environmental Report. Each scenario's impacts were then compared to establish the differences in their relative performance. The relative differences are summarised in the table below and are set out more fully in the Environmental Report in the conclusions in Section 9 and also in Section 6.

Summary of conclusions

A number of overarching conclusions can be drawn from the assessment of growth in waste, the mechanisms for controlling it, and the options for treating the various types of waste, as undertaken in this SEA.

- All scenarios offer environmental benefits over Scenario 0 (No change to existing waste management policy). All scenarios require significant increases in waste management infrastructure, both landfills and waste treatment facilities. Between 667 and 976 additional waste management facilities (excluding landfills) are estimated to be required by 2020 (see the table below) This is particularly a consequence of the increase in facilities predicted across all scenarios to accommodate higher recycling rates. New landfill capacity would be required under all scenarios but the number of active landfill sites is expected to decrease.

- Scenarios and policies that focus on waste prevention (Scenario 1 – Reduction in waste arisings) offer greater overall benefit than the other scenarios in terms of the principal indicators used here. And scenarios that promote higher levels of recycling perform somewhat better in climate change terms than those that promote energy from waste. The carbon savings by 2020 (relative to the 2002/03 baseline) for Scenarios 1 and 2 (Enhanced recycling) are each estimated to be more than 6 million tonnes. This equates broadly to around 3% of current UK greenhouse gas emissions and exceeds the direct emissions currently attributable to the UK waste sector, but most of these savings will occur outside the UK as recycling displaces raw material extraction and production elsewhere in the world.

- We therefore conclude that the waste hierarchy provides a sound environmental guide to help inform the future waste strategy for England. Consequently, the revised waste strategy should focus on increasing the efficiency of our use of resources, with policies developed within the overall framework of the Sustainable Consumption and Production agenda.

Monitoring and mitigation

Some of the potential negative environmental effects of the scenarios at a national scale will be minimised through the existing planning and licensing processes. Additionally, further environmental benefits could be gained by, for example, co-locating facilities which would reduce the total land needed and the need to transport waste between different sites. As required by the Directive, this SEA has also described key aspects of a probable programme to monitor implementation of the waste strategy, and has proposed some additional mitigation actions that could be taken if required.

RELATIVE PERFORMANCE OF SCENARIOS – SUMMARY TABLE

Indicator	0: No change to existing policy		1: Reduction in waste arisings		2: Enhanced recycling		3A: Enhanced EfW		3B: Maximum EfW		4: Enhanced diversion from landfill	
	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020
Total MSW and C&I waste to landfill *[Annual waste landfilled (kte)]*	43,940	41,380	43,470	34,490	41,730	38,530	42,110	38,970	42,110	36,770	43,940	40,200
Proportion MSW recycled or composted *[Annual percentage]*	38%	57%	33%	50%	38%	59%	38%	52%	38%	51%	38%	56%
Proportion C&I wastes recycled *[Annual percentage, excl re-use]*	43%	45%	43%	45%	46%	49%	43%	45%	43%	45%	43%	44%
Number of non-landfill waste management facilities *[Relative to 2003]*	483	906	448	667	497	976	510	890	510	889	483	896
Number of landfills (i) operating in assessment yrs; (ii) commissioned since 2002/03	511 511	414 925	511 511	321 832	511 511	385 896	511 511	390 901	511 511	368 879	511 511	402 913
Total landtake of waste infrastructure (net of landfills closed since 2002/03*) *[Relative to 2003 (ha)]*	-2490	-6350	-2570	-11550	-2460	-7650	-2410	-7580	-2410	-8650	-2490	-6980
Carbon equivalent emissions *[Relative to 2003 (kte)]*	-2490	-5840	-2580	-6360	-2680	-6230	-2620	-5770	-2620	-5470	-2490	-6000

Note: This is an abbreviated version of the conclusions table that appears after Section 9 of the Environmental Report. Entries coloured green (dark shading) indicate where a scenario provides the greatest environmental benefit and entries coloured brown (light shading) the least environmental benefit.

* *Net means that landtake for landfills predicted to be closed since 2002/03 has been deducted.*

1 INTRODUCTION

1.1 The Government's strategy for waste management

The Department for Environment, Food and Rural Affairs (Defra) is responsible for the development and implementation of a policy for England for the management of wastes arising from domestic, commercial and industrial sites and premises.

The Government's vision for waste management in England and Wales over a 20 year period up to 2020 is set out in Waste Strategy 2000 (*WS2000*) which forms part of the waste management plan required under Article 7 of the EU Waste Framework Directive and the Environmental Protection Act 1990 (as amended in 1995). *WS2000* offered an overview of waste management policy, outlined the scale of the task and the tools that could be brought to bear on that challenge, and gave details of the actions stakeholders needed to take to meet the strategy's targets. The overall objective of *Waste Strategy 2000* is to reduce the impacts of waste management on the environment, while developing the economic benefit of using waste as a resource and meeting the requirements of European legislation.

Recent advances in waste management

In November 2002 the Cabinet Office Strategy Unit published a report entitled "*Waste not, Want not - A Strategy for Tackling the Waste Problem in England*"[1]. That report focused on municipal waste in the context of the need to meet the new biodegradable municipal waste reduction requirements set out in the EU Landfill Directive. The Government welcomed *Waste not, Want Not* and responded positively to each of its recommendations.

In addition to 'Waste Not, Want Not', there have been a number of other recent initiatives and developments, notably:

- the introduction of progressive increases in the Landfill Tax, up to £35 per tonne in the medium to long term, to incentivise alternative ways of managing and disposing of waste;
- a new system of tradable landfill allowances for local authorities to ensure that obligations under the landfill directive are met in the most cost efficient and effective way for England as a whole;
- challenging recycling targets for household waste, packaging materials and waste electrical and electronic equipment;
- better information and advice to households and businesses to support increases in active participation in recycling, composting and waste minimisation activities;
- work to improve the range and quality of recycled materials and products available and to help build demand for them;

[1] Available at http://www.strategy.gov.uk/downloads/su/waste/report/index.html

- a new spatial and strategic waste planning framework to reduce delays in getting planning permission for waste facilities;

- long-term strategies to improve data and research for all waste streams;

- new hazardous waste regulations to promote greater hazardous waste minimisation at source; and

- setting up the Aggregates Levy with the aim of reducing demand for virgin aggregates, thereby encouraging the use of recycled materials and addressing the environmental costs associated with quarrying (e.g. noise, dust and visual intrusion).

Waste not, Want Not and these other developments have led to a number of progressive and positive environmental benefits resulting from changed waste management practices, including:

- reduced landfilling of industrial and commercial waste;

- a doubling in 5 years of the amount of household waste that is recycled and composted;

- increased recovery and recycling of packaging materials;

- a significant increase in the amount of construction and demolition waste (CDW) that is recycled and reused; and

- the development of stronger markets for recycled materials.

Despite these positive trends, the total amount of waste generated in England continues to rise, with most of this continuing to go to landfill. Compared with many other European countries, England still produces more waste per head, and recycles less. The potential for encouraging more beneficial ways of using waste is considerable.

1.2 Review of Waste Strategy 2000

WS2000 included a commitment for a root-and-branch review in 2010 plus interim reviews in 2005 and 2015. The current review of *WS2000* is the first of these reviews (the 'Review'). The objective of the Review is to reflect on existing policies and delivery mechanisms and to consult on proposals for revisions to the national waste strategy for England (the 'revised waste strategy').

This Strategic Environmental Assessment (SEA) assesses and informs the accompanying consultation document, *Review of England's Waste Strategy: A Consultation Document* (the 'Consultation Document'), in which Government is consulting on revisions to the waste strategy. The Consultation Document:

a) Sets out the progress made since 2000 in meeting the Government's objectives and implementing its policies; and

b) Consults on proposals to revise *WS2000* and the policies for implementing it.

It is proposed to publish the revised waste strategy in late 2006. This will consolidate current policies alongside the new proposals and will supersede *WS2000* entirely.

To help inform the revised waste strategy, and to ensure that due regard is taken of the environment when decisions are made on future waste management policy, Defra has undertaken this SEA. This Environmental Report describes how the SEA was undertaken and the results of the assessment[2].

1.3 Outline of the proposals for the revised waste strategy

The proposals outlined below are those which are of most relevance to this SEA in that they may have significant effect on the environment. For the full proposals please see the Consultation Document. In summary, the key proposals are[3]:

1. Reduction in waste arisings: An increased emphasis on waste prevention compared with *WS2000*. The Government does not consider that there is sufficient information and evidence on which to base a single prevention target for all waste or for single major categories of waste, such as industrial and commercial waste, especially as these categories are very varied[4]. Nonetheless the Consultation Document sets out a range of suggested proposals in this area, including a proposed focus on specific sectors for targeted action, and asks stakeholders for their views on this policy direction, i.e. whether there should be greater effort to encourage waste prevention and minimisation relative to recycling.

2. Increase in the rate of recycling and composting: Targets are not proposed for all waste, or all C&I waste, on the grounds that there is insufficient information and evidence on which to base them. However, the following household and municipal targets are proposed:

(i) Higher household recycling and composting targets for 2010 and 2015 and a target for 2020 of 40%, 45% and 50% respectively. Government considers that these are

- [2] Note that this is not a Sustainability Appraisal. It was decided not to carry out a Sustainability Appraisal, partly because the accompanying partial Regulatory Impact Assessment includes an assessment of the broader impacts, costs and benefits of the proposals. Of course, the revised waste strategy is being developed within the broader sustainable development agenda.
- [3] Note that some of the content of the Consultation Document also addresses policy instruments not of direct relevance to this SEA, principally those which focus on particular delivery mechanisms – i.e. the means by which the outcome will be achieved. For example, the Consultation Document sets out proposals for simplifying the regulatory system through reforms to the permitting and exemption systems, better guidance and communication and risk-based enforcement. The accompanying pRIA assesses in more detail the mechanisms to deliver policy contemplated in the proposals for the revised waste strategy.
- [4] See chapter 2 of the Consultation Document, *Review of England's Waste Strategy: A consultation document,* Defra (2006), available at www.defra.gov.uk/environment/waste/strategy/review/ .

necessary if the Landfill Directive targets are to be met[5];

(ii) Targets for municipal waste recovery (i.e. recycling, composting and energy recovery) for 2010, 2015 and 2020 of 53%, 67% and 75% respectively. Again, Government considers that any revised targets would need to reflect what is needed to achieve the Landfill Directive targets and the higher recycling component of this[6].

3. Increase in the amount of energy recovery from waste: There is no individual target for energy recovery alone, but it is embraced in the proposed municipal waste recovery target set out in 2(ii) above.

4. Reduction in the amount of waste to landfill

(i) Meeting the Landfill Directive's UK targets for the reduction of biodegradable municipal waste to landfill. For the years 2010, 2013 and 2020 these are reductions to 75%, 50% and 35% respectively of the amount of that waste produced in 1995. These apply to the UK as a whole and national targets have been set within this: the Consultation Document proposes that these remain unchanged for England[7]. These will be facilitated in part by the proposals set out above; and,

(ii) New targets for the reduction of commercial and industrial waste to landfill of 37% in 2010 (i.e. landfilling as 37% of total C&I waste), 36% in 2015 and 35% in 2020. The Consultation Document considers that the landfill tax and tighter requirements on landfill will continue to drive reductions. These will be met by increased prevention, minimisation, re-use, recycling or energy recovery.

1.4 Consultation

Scoping report

A Scoping Report was written to seek the views of the relevant English Consultation Bodies. These bodies are the Countryside Agency, English Heritage, English Nature and the Environment Agency. It is appended as Appendix F. Advice from the consultation bodies was sought on the following topics:

- the proposed general approach to SEA;

[5] Note that WS 2000 set out targets for 2005 (25%), 2010 (30%) and 2015 (33%). It did not set out any such target for 2020.

[6] Note that WS 2000 set out targets for 2005 (40%), 2010 (45%) and 2015 (67%). It did not set out any such target for 2020.

[7] For England, the targets are those percentages of the amount of waste produced in England alone in those years.

- the proposed level of detail;
- relevant plans and programmes;
- baseline data;
- specific waste-related environmental issues;
- the strategic options and alternatives under consideration;
- the proposed environmental objectives, indicators and targets.

Written responses to the Scoping Report were received from the Countryside Agency and the Environment Agency, and these are summarised in Appendix G, together with a note on how these responses were dealt with in this assessment. A meeting was also held with English Nature, and various discussions had with English Heritage. Advice from these consultation bodies has informed the preparation of the assessment and, as appropriate, is referred to in this Environmental Report.

Consultation on this Report

This Report is published for consultation with the accompanying Consultation Document[8] The consultation period commenced on 14 February 2006, and will last for 12 weeks until 9 May 2006.

Comments are welcomed on this Report. In particular, Defra welcomes views on the proposals to monitor the significant environmental effects of the implementation of the revised waste strategy, including any priority that should be given to the indicators identified, and whether alternative or further indicators should be used. Comments may be submitted online at www.defra.gov.uk/environment/waste/strategy/review/. Full information is provided there (and in the relevant section at the end of the Consultation Document) on how to respond, including in relation to confidentiality of responses if that is desired. Responses may also be submitted by post or e-mail – for details please refer to the Consultation Document. Responses should be received no later than 9 May 2006.

2 ASSESSMENT METHODOLOGY

SEA is a process of environmental assessment which is designed to ensure a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of development plans with a view to promoting sustainable development. SEA was introduced throughout the EU in Directive 2001/42/EC *"on the assessment of the effects of certain plans and programmes on the environment"* (commonly referred to as the SEA Directive) and is transposed into English law through the Environmental Assessment of Plans and Programmes Regulations 2004 (Statutory Instrument 2004 No.1633). These require a document such as this Environmental Report that presents the assessment procedure and its main findings.

- [8] See footnote 4 above.

Government has produced a Practical Guide[9] that provides advice on how to comply with the Regulations and the Directive in an environmental assessment. The assessment methodology followed in this SEA followed this advice in so far as it was practicable.

2.1 Scope of the assessment

The scope of the assessment was constrained due to a number of factors, partly related to the stated objectives of *WS2000* and the Review.

In particular, the *geographical scope* of the assessment is limited only to England because waste management in Scotland, Wales and Northern Ireland is a matter for the respective Devolved Administrations. The Welsh Assembly and the Northern Ireland Assembly published their national waste strategies in June 2002 and June 2005 respectively. The Scottish Executive jointly with the Scottish Environment Protection Agency (SEPA) launched a national waste plan in 2003 which implements the national waste strategy published in 1999.

The *temporal scope* of the assessment is restricted to the period up to 2020 to reflect the defined scope of *WS2000*. Particular consideration is given to the years 2010 and 2020 because important targets contained in existing waste policy and new proposed targets contained in the Consultation Document relate to these years. Also, a root-and-branch review of England's waste strategy is currently planned for 2010. The assessment recognises that any new waste management facilities would take time to build and, therefore, the two dates chosen adequately reflect the environment effects expected to arise from an evolving infrastructure base. It also recognises that some environmental impacts of landfill sites might extend into their post-closure phase.

The *technical scope* of the assessment is limited to consideration only of existing industrial scale waste management technologies and any that conceivably may become available before 2020.

The assessment combined quantitative and qualitative approaches. The former was informed by modelling input. The models are described further below and in more detail in Appendix D. The modelling input also informed the partial Regulatory Impact Assessment (the 'pRIA') of the strategy proposals[10]. The latter was a collation of expert opinion and informed by modelling work.

The assessment takes into consideration municipal solid wastes (MSW), commercial and industrial (C&I) wastes and construction and demolition wastes (CDW). There are various notable exclusions at this time:

- [9] *A Practical Guide to the Strategic Environmental Assessment Directive*. Office of the Deputy Prime Minister, Scottish Executive, Welsh Assembly Government, Department of the Environment Northern Ireland. Available at : http://www.odpm.gov.uk/pub/290/APracticalGuidetotheStrategicEnvironmentalAssessmentDirectivePDF776Kb_id1143290.pdf
- [10] The purpose of the pRIA, which is part of the accompanying consultation documents, is to assess the impacts, costs and benefits of the main proposals contained in the Consultation Document. The principal assessment of environmental impacts is contained within this Environmental Report.

(i) Radioactive wastes because these are managed according to separate regulations;

(ii) Agricultural wastes as the Government is bringing into force Regulations to bring agricultural waste within the controls of the Waste Framework and Landfill Directives. These regulations have been subject to recent assessment in a pRIA[11]. A full Regulatory Impact Assessment is being prepared.

(iii) Mining wastes, as specific proposals will await the anticipated EU Directive on Management of waste from extractive industries[12].

Finally, it should be noted that this is a high-level assessment which evaluates proposals in the Consultation Document for a revised national strategy. The policies resulting from the revised waste strategy will need to be reflected within regional waste strategies developed under Planning Policy Statement 10[13]. In turn, these regional strategies will require their own SEA.

2.2 Stages in the assessment

This SEA is being undertaken in the following stages, consistent with the guidance contained in the Practical Guide:

- Stage A: Setting the context and objectives, establishing the baseline and deciding on the scope
- Stage B: Developing and refining alternatives and assessing effects
- Stage C: Preparing the Environmental Report
- Stage D: Consulting on the draft plan or programme and the Environmental Report
- Stage E: Monitoring the significant effects of implementing the plan or programme on the environment

A scoping report was produced (see Section 1.3) that summarised much of the work in Stage A. This report (the environmental report) sets out the work to complete Stage A and undertake Stages B and C. Stage D provides for consultation on this report together with the proposals for the revised waste strategy, while Stage E will take place after the revised waste strategy has been adopted.

The work undertaken since the Scoping Report was published has comprised a number of activities, the main ones being the:

- [11] See http://www.defra.gov.uk/corporate/consult/agwaste-regs/consultation.pdf. And see further Chapter 5 of the Consultation Document.
- [12] The new EU Directive is expected to be enacted in early 2006, following its adoption by the European Parliament and by the Council. The Directive aims to prevent or reduce, as far as possible, any adverse effects on the environment and any resultant risks to human health. See further Chapter 5 of the Consultation Document.
- [13] The Government published its planning policy statement on Planning for Sustainable Waste Management (PPS 10) in July 2005, see http://www.odpm.gov.uk/index.asp?id=1143989

(i) Undertaking of a *context review* to establish how the revised waste strategy may impact on other plans and programmes in operation and vice versa. The results of this context review are summarised in Section 3 of this report and further details are provided in Appendix E.

(ii) Establishment of the *environmental baseline* in England and the identification of any key issues that arise from this due to current waste management activities. The baseline is summarised in Section 4 of this report and further details are provided in Appendix A.

(iii) Use of the context review and the baseline to derive the SEA objectives.

(iv) Compilation of a list of *environmental indicators* which are used in the assessment to measure the likely effects to the environment resulting from any proposed changes to *WS2000*. These indicators are described in Section 5 of this report.

(v) Validation of the match between the SEA objectives and those of the Review.

(vi) Identification and characterisation of a number of *strategic options for the management of wastes* in England that account for alternative ways of treating waste materials (e.g. increased use of energy from waste, enhanced rates of recycling etc). These strategic options and the assessment of their *likely significant environmental effects* against the environmental indicators are described in Section 6 of this report.

(vii) Development of plans for the mitigation and monitoring of environmental impacts arising from the implementation of the revised waste strategy - see Sections 7 and 8 of this report.

2.3 Appendices to this Report

The Appendices to this Report are as follows:

(i) Appendix A – Environmental Baseline;

(ii) Appendix B – Environmental Effects per Waste Management Facility Type;

(iii) Appendix C – Assessment Tables;

(iv) Appendix D – Modelling Approaches and Assumptions;

(v) Appendix E – Context Review;

(vi) Appendix F – Scoping Report;

(vii) Appendix G – Statutory Consultee Responses to the Scoping Report.

3 REVIEW OF OTHER PLANS AND PROGRAMMES ('CONTEXT REVIEW')

3.1 Overview

The SEA Directive requires this Environmental Report to include information on: the relationship [of the plan or programme] with 'other relevant plans and programmes'; the environmental protection objectives, established at international, [European] Community or [national] level, which are relevant to the plan or programme, and the way those objectives and any environmental considerations have been taken into account[14]. This is in addition to information on the existing state of the environment.

Therefore, development of strategic objectives that form the assessment framework at the heart of the SEA should be informed not only by the condition of the current environment (see Chapter 4 below on the environmental baseline) but also by the policy framework within which the strategy is being developed, including the environmental protection objectives of those policies[15]. This framework defines the legislative instruments which the strategy can use or must complement; obligations which policy must meet (e.g. on reducing atmospheric emissions of CO_2); as well as the targets which are set by the overarching legislation. It therefore defines an 'envelope' of requirements which the Waste Strategy must fulfil, and may identify other initiatives which offer synergies in addressing certain areas of policy.

3.2 The scope of the review

A Context Review was carried out to identify and describe other 'relevant plans and programmes' and their environmental protection objectives and to enable these to be taken into account. Given the national level of the proposals for the revised waste strategy, the Context Review focuses on international (global and European) and UK-wide legislation, policy and planning guidance. The full Context Review is attached in Appendix E. It lists the key plans and programmes reviewed with the main groups summarised below[16].

- The Kyoto Protocol on Climate Change and WHO guidelines, associated EU and national legislation on air quality and its impact on human health.

- The principal EU Directives including:

(i) those relating to environmental protection and quality (such as the Habitats, Birds and Noise Directives, and the Water Framework Directive); and

[14] See Annex I of the SEA Directive.
[15] See further Section 5 below for more detail on how the SEA objectives were developed.
[16] It is not an exhaustive list of all other legislation and strategies which have some impact on waste but is intended to encapsulate the key relationships. For the sake of brevity, some relationships are not included because the primary synergy is captured by other legislation described.

(ii) all principal waste-related Directives (Waste Framework, Landfill, Hazardous Waste, Waste Oils, etc.).

- Key EU and UK waste sector legislation and strategy on waste (including *WS2000*, *Waste Not Want Not*, the recent European Thematic Strategy on the Prevention and Recycling of Waste[17], and the principal regulations transposing the EU Directives into UK law).
- Other EU and UK national strategies and studies relevant to the sector, including those on sustainable development (*Securing the Future*), biodiversity, air quality and the health effects of waste management. *Securing the Future*, the UK Government sustainable development strategy[18] sets out the Government's objective for waste as part of the sustainable development agenda.
- A range of Planning Policy Guidance and Statements issued by ODPM[19].

The Context Review specifies the principal aims, objectives and mechanisms of each of these other plans and programmes, and identifies targets where appropriate. In some instances additional observations are made on any implications that the plan or strategy may have for the revised waste strategy and the approach taken in the SEA.

3.3 Summary of key messages and implications from other plans and programmes

The range of messages emerging from the Context Review (appended as Appendix E) reflects the breadth of documents reviewed. This is to be expected in the context of a high-level review of a national strategy. Table 3.1 below identifies the principal themes, including those which recur from document to document. Against each of these cross-cutting themes, e.g. reduction in greenhouse gas emissions, are displayed key policy or legislative instruments.

Formulation of the Context Review and Table 3.1 was necessary to:

- Show other plans and programmes relevant to the revised waste strategy;
- Bring out key environmental objectives within those relevant to the revised waste strategy; and, therefore
- Highlight key relationships between the proposals for the revised waste strategy and environmental considerations contained in the wider policy and legislative context.

[17] http://europa.eu.int/comm/environment/waste/strategy.htm

[18] *Securing the Future*, the UK Government sustainable development strategy, March 2005, available at: http://www.sustainable-development.gov.uk/publications/uk-strategy/uk-strategy-2005.htm.

[19] The main function of these documents is to guide consideration of planning applications at local level. However the SEA identifies a clear distinction between waste impacts, which can be assessed nationally, and the greater number that can only be considered at site level. These documents therefore provide the framework for controlling the impact of such development to limit point-source impacts and therefore indicate the link between the Waste Strategy and the spatial planning system.

Table 3.1: Summary of Principal Themes Identified in the Context Review[20]

Cross-cutting theme	*International / European Sources*	*UK / English Sources*
A. Waste and the Natural Environment		
Reduction of the output of greenhouse gases, focused on those human activities primarily responsible for emitting the component gases	Kyoto Protocol EU's Sixth Environmental Action Programme Atmospheric Pollutants Directive Waste Incineration Directive EC Ozone Depletion Regulations Air Quality Framework Directive	Waste Strategy 2000 Packaging Regulations UK Sustainable Development Strategy 2005 - *Securing the Future* (climate change is one of its four agreed priorities)
Effective protection of the natural environment, based on the Precautionary Principle or explicit processes of risk assessment as appropriate, and prioritisation of those techniques that entail the least environmental risk or offer the best prospect of good environmental stewardship	Birds / Habitat Directives Water Framework Directive EU's Sixth Environmental Action Programme Soil Protection Thematic Strategy Environmental Liability Directive … and addressed implicitly by all other EU waste-related Directives	Waste Strategy 2000 Sustainable Planning for Waste Management [various stated conservation objectives for the human and natural environments] UK Sustainable Development Strategy 2005 – *Securing the Future* Making Space for Water [issues of pollution and avoidance of flood risk] Delivering the Essentials of Life – Defra's 5 year strategy Biodiversity Strategy for England [protective measures] UK Air Quality Strategy Hazardous Waste Regulations Environmental & Health Effects of Waste Management Report [identifies range of adverse impacts from these facilities] PPS7 [strict controls on rural development] PPS9 PPS10 [specific mention of protecting Green Belts] Environmental Quality in Spatial Planning

[20] Source – Enviros/Scott Wilson

Cross-cutting theme	***International / European Sources***	***UK / English Sources***
Balance development controls against the severity of impacts and the need for development activities	Water Framework Directive	Sustainable Planning for Waste Management UK Sustainable Development Strategy [implicit in principle of using "sound science"] PPS1 [balance development and preservation]
Consistency with national policy encouraging optimal use of brownfield land	[Not appropriate as this is specific to UK policy]	Sustainable Planning for Waste Management PPS7 [protect land resources] PPS23 [use of former contaminated sites for waste facilities] MPG1 [scope to use former mineral sites for waste facilities]
B. Waste and Human Health		
Need to better understand the human health impacts of activities believed to have adverse effects, and to develop waste infrastructure so that the risks to health are controlled and minimised	Sixth Environmental Action Programme Key waste-related Directives such as the Landfill Directive	Waste Strategy 2000 Sustainable Planning for Waste Management [stated priority to avoid impacts] Waste & Resources R&D Strategy [mechanism to support further research into health impacts] UK Air Quality Strategy Environmental & Health Effects of Waste Management Report [review of evidence] PPS10 [identified as a specific objective]
C. Waste and Natural Resources		
Moving treatment processes 'up' the Waste Hierarchy (ie. a shift from disposal to re-use and reduction of absolute waste volumes)	[Not stated explicitly in this way as it is a UK concept, but implicit in many of the Directives as they affect the shift away from landfill] EU's Thematic Strategy on the Prevention and Recycling of Waste	Waste Strategy 2000 UK Sustainable Development Strategy 2005 PPS10 Both the above mention the issue in these terms, otherwise the tactics for achieving this objective are evident in the themes in sections C. and D. below
Need for sustainable use of resources including reducing greater substitution of virgin materials with recycled alternatives	EU's Sixth Environmental Action Programme EU's Thematic Strategy on the Prevention and Recycling of Waste EU's Thematic Strategy on the Sustainable Use of Natural Resources	Waste Strategy 2000 Waste Not Want Not Delivering the Essentials of Life [protection of resources] UK Sustainable Development Strategy 2005

Cross-cutting theme	***International / European Sources***	***UK / English Sources***
Use of waste materials as a resource (after treatment) including specific actions to increase recycling rates	Soil Protection Thematic Strategy Waste Incineration Directive Waste Framework Directive Batteries Directive EU Thematic Strategy on Waste Prevention and Recycling	Waste Strategy 2000 Packaging Regulations Our Energy Future [energy from waste] PPS1 [energy from waste] PPS22 [energy from renewable and other sources]
Effective mechanisms to intercept materials before they become waste including initiatives to encourage greater producer responsibility	EC Integrated Product Policy EU Thematic Strategy on Waste Prevention and Recycling EU Thematic Strategy on the Sustainable Use of Natural Resources	Waste Strategy 2000 [WRAP] Packaging Regulations Waste Not, Want Not
D. Controls & Processes		
Control of all activities likely to have adverse impacts on the natural environment and human health using strictly controlled licensing and monitoring which promote environmental best practice, and the importance of such systems to limit the impact of these activities in the foreseeable future (implicitly this also involves identifying the appropriate competent authorities for regulating and licensing the activities)	Addressed in terms of high-level principles by all relevant EU waste- related Directives EU Thematic Strategy on Waste	Waste Strategy 2000 [coordination of waste licensing with PPC regime] Packaging Regulations [controls on contents of metals and noxious materials] End of Life Vehicles Regulations PPS10 PPS23 [scope of planning and pollution control regimes]

Cross-cutting theme	***International / European Sources***	***UK / English Sources***
Specific controls on certain impacts that are particularly associated with waste management, including noise, dust, odours and vermin	Noise Directive Waste Incineration Directive	Sustainable Planning for Waste Management [specific requirements relating to noise, light and transport impacts and avoidance of flood risk areas] Biodiversity Strategy for England [limit incidence of leachate contamination, dust and other effect of landfill, etc.] UK Air Quality Strategy [issues concerning a range of standard pollutants] Environmental & Health Effects of Waste Management Report [contribution of waste facilities to specific problems, mainly related to air pollution]
Stipulation of a range of internationally binding standards or targets which address the movement, treatment and disposal of wastes (and the corresponding standards or targets as implemented in the UK)	UN Basel Convention EU Regulation on the Transfrontier Shipment of Waste Atmospheric Pollutants Directive Waste Oils Directive Sewage Sludge Directive Waste Incineration Directive Batteries Directive	Hazardous Waste Regulations Waste Strategy 2000 [recycling and landfill targets] Draft WEE Regulations Our Energy Future [targets] UK Air Quality Strategy [WHO targets]
Enhancement of treatment procedures, both to ensure appropriate pre-treatment of wastes and to ensure separate disposal (eg. of hazardous and non-hazardous materials)	Hazardous Waste Directive Landfill Directive Waste Incineration Directive Waste Oils Directive Batteries Directive EU Thematic Strategy on Waste	Waste Strategy 2000 [various changes consistent with the Waste Framework Directive relating to landfill, tyres, etc.] Packaging Regulations [limits on controlled metals, etc. in packaging materials] Waste Not Want Not update [possible future ban on incineration of recyclable materials] Restriction of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS) Directive

Cross-cutting theme	***International / European Sources***	***UK / English Sources***
Reduce the volume of material sent to landfill	Landfill Directive EU Thematic Strategy on Waste Directive on Packaging and Packaging Waste	Waste Strategy 2000 Household Waste Recycling Act UK regulations introducing the Landfill Tax Waste and Emissions Trading Act [which, inter alia, includes the Landfill Allowance Trading Scheme]
Improved waste collection processes to support recycling, or other initiatives that affect the ease and economics of waste collection	EU Thematic Strategy on Waste Directive on Packaging and Packaging Waste	Waste Strategy 2000 [WRAP] Packaging Regulations Draft WEE Regulations Household Waste Recycling Act
Clearer stipulation of criteria to be met when licensing new waste sites, and which are consistent with environmental and health protection objectives (see themes above)	Landfill Directive	End of Life Vehicles Regulations
E. Economic & Financial Aspects		
Use of economic instruments (and other mechanisms) to encourage a change in behaviour and attitudes, or to facility a change in waste treatment priorities	EU Thematic Strategy on Waste	Waste Strategy 2000 [Landfill Tax Escalator also green procurement principles] Waste Not Want Not Draft WEE Regulations [proposed clearing house] Waste Not Want Not [green procurement] Waste and Emissions Trading Act [which, inter alia, introduces the Landfill Allowance Trading Scheme] UK regulations introducing the Landfill Tax and Aggregates Levy
Notwithstanding its impacts, acknowledge the role of the waste sector as an employer	[Not addressed specifically as this lies outside the scope of waste-related EU legislation]	Sustainable Planning for Waste Management
Costs of treatment, disposal, remediation and rectifying impacts or pollution events lie with the body responsible for it (public sector waste authorities; private disposal contractors; treatment site and landfill operators; etc)	Environmental Liability Directive Waste Framework Directive	[Implicit in 'polluter pays' principles incorporated in a range of waste sector legislation]

Cross-cutting theme	***International / European Sources***	***UK / English Sources***
F. Information, Awareness, Responsibility & Involvement[21]		
Improve the range of information available about waste management and its impacts, and the media used to present and distribute it	EC Regulations on Waste Statistics	Waste Not Want Not & subsequent updates Waste & Resources R&D Strategy Waste Data Strategy Environmental & Health Effects of Waste Management Report [need for more research on health impacts]
Improve scope of public involvement in decision-making and awareness of their role in the waste strategy		Waste Strategy 2000 Waste Not Want Not & subsequent updates Delivering the Essentials of Life [suggested tactics for improved awareness and responsibility] PPS1 [encourage public involvement]
Integral role of local waste authorities in planning for waste management and in monitoring activities	[Not appropriate as this is specific to UK policy]	Waste Strategy 2000 Household Waste Recycling Act [source-separation requirements] PPS10 PPS23 [identifies boundary between planning and pollution control regime]
Integral role of the regional planning process and local spatial planning authorities in implementing policies that support strategic waste initiatives	[Not appropriate as this is specific to UK policy]	Waste Not Want Not [incorporating recycling facilities in new development] Sustainable Planning for Waste Management [need for local policy that supports national & regional] PPS10 PPS23 [identifies boundary between planning and pollution control regime]

[21] Note that producer responsibility is referred to in section B.

3.4 Development of waste policy context for England since *WS2000*

This section summarises key policy and legislative developments which have occurred since WS2000. These are relevant to the proposals for the revised waste strategy and its environmental protection objectives.

Much progress has been made as a result of WS *2000*, including a considerable increase in the recycling and composting of household waste and in the development of markets for recovered materials. Since then, diverse EC Directives and national policies have been implemented - notably EC Directive 1999/31/EC on the landfill of waste (the Landfill Directive)[22] - which are radically altering the waste management landscape.

The Landfill Directive[23] was transposed into domestic legislation by the Landfill (England and Wales) Regulations. These came into force in June 2002. The Landfill Directive's overall aim is "to prevent or reduce as far as possible negative effects on the environment, in particular the pollution of surface water, groundwater, soil and air, and on the global environment, including the greenhouse effect, as well as any resulting risk to human health, from the landfilling of waste, during the whole lifecycle of the landfill". It is intended to help continue drive waste up the hierarchy through waste minimisation and increased levels of recycling and recovery. The Directive introduced important changes only for landfill site operators but for all waste producers. For example co-disposal of hazardous and non-hazardous waste is now banned, and all waste landfilled has to be pre-treated.

In 2005, the EC Thematic Strategy on Waste Prevention and Recycling (the 'Thematic Strategy')[24]and the Government's new sustainable development strategy, *Securing the Future* were adopted. *Securing the Future*: sets out Sustainable Consumption and Production (SCP) as a priority action area[25]. The Thematic Strategy endorses the basic objectives of existing EU waste policy and sets a long-term goal for the EU to become a recycling society, organised around the maximum recovery of materials where this makes environmental and economic sense, and energy recovery where this is more efficient with high environmental reference standards. It highlights waste growth across Member States as a key problem with no reduction, in absolute terms, of amount being landfilled.

These policy instruments add to the evolving landscape by placing waste management firmly within the context of sustainable resource use. This continues the shift away from a waste policy framework designed as an end-of-pipe/end-of-life solution towards a framework that treats waste more as a resource.

- [22] For more details see http://www.defra.gov.uk/environment/waste/topics/landfill-dir/pdf/landfilldir.pdf
- [23] With the exception of Articles 5.1 and 5.2. These were implemented by the Waste and Emissions Trading Act 2003.
- [24] Published in December 2005. See http://www.europa.eu.int/comm/environment/waste/strategy.htm
- [25] See footnote 18 above. *Securing the Future* has four agreed priorities: sustainable consumption and production, climate change, natural resource protection and sustainable communities.

The Consultation Document[26] states that the environmental rationales for action set out in *WS2000* remain unchanged (these are: to reduce the impact of waste on climate change; to conserve limited natural resource and to reduce risks to health and the environment from potentially harmful substances within waste). It is considered that the environmental protection objectives of the proposals for the revised waste strategy are consistent with those set out in other relevant plans and programmes. In particular, the revised waste strategy is designed to meet the Government's objective for waste set out in *Securing the Future*. It also takes account of this overarching Sustainable Development Strategy, the SCP agenda and the Thematic Strategy on Waste Prevention and Recycling.

3.5 The role of the Context Review in this SEA

The themes identified in Table 3.1 above are reflected in the SEA both directly and indirectly, the latter in part because the assessment uses modelling input which also informed the parallel Regulatory Impact Assessment (RIA), which in turn evaluates the economic and social impacts of strategic policy directions and instruments contained in the revised waste strategy proposals.

- Some themes are reflected *directly in the assessment scoring*. These include the need to reduce landfill and most of the environmental protection themes listed in Part A of Table 3.1.

- Some themes are reflected *directly in the definition of scenarios*. These include all the themes in Part C of Table 3.1 which require a new mix of treatment techniques, favouring increased re-use and recycling rather than disposal.

- Some themes are reflected *implicitly in the assessment scoring*. These include the need to address human health concerns (Part B of Table 3.1) by awarding scores proportional to the risks apparent in each treatment or disposal technology. Similarly, some effects will vary from site to site, and the existence of effective licensing, monitoring, management and appropriate planning controls (see Parts D and E of Table 3.1) is implicit in the scenario assessments even if their effects cannot be identified in detail.

[26] See chapter 1 of the accompanying Consultation Document for more details on the context within which the revisions of the waste strategy take place.

4 ENVIRONMENTAL BASELINE

An important task in this assessment was to characterise the environmental baseline in terms of the current state of the environment and how it is being affected by ongoing waste management practices, as well as to identify any significant environmental effects that need to be addressed as a matter of priority in the Review.

The full details of the baseline are described in the Baseline Report that accompanies this document and is appended as Appendix A[27], and the main findings are summarised below.

Notwithstanding the continued and pressing need to manage waste in England in a more sustainable manner and to reduce the overall impact on the environment, the overall conclusion from the baseline is that, when viewed nationally, waste regulation has been effective in mitigating potentially acute effects to a satisfactory level. The environmental effects on a national scale that have been identified as being most significant are:

Emissions of CO_2: this is an important greenhouse gas. UK data for 2003 indicate just under 2 million tonnes are produced by the waste sector[28], 0.3% of UK emissions. Just over half of this results from recovery of energy from MSW, and a further quarter by the recovery of energy from other wastes; the rest results from the degradation of biodegradable waste materials in landfills and composting facilities. An additional but unquantified contribution comes from energy used in transporting waste to treatment and landfill sites.

Emissions of methane (CH_4): more significant in the waste context is methane. This greenhouse gas is 21 times more damaging than CO_2 to the global atmosphere. Large amounts are produced by the degradation of biodegradable waste materials in landfills and composting facilities. Some of the methane produced by landfills is collected for:

- Flaring - where CH_4 is converted to CO_2 which is less damaging to the atmosphere; and
- Electricity and energy generation – where again CH_4 is converted to CO_2.

UK methane emissions from waste activities comprise around 80% of all greenhouse gases generated by the sector. Of this total, 90% was emitted from landfill sites, representing just over 1% of total UK greenhouse gas emissions. They have declined significantly since 1990, but there is a need to ensure further reductions.

On a local level, other detrimental effects to the environment can be observed. The nature of materials handled in waste management means that pollution incidents can have serious local consequences. For example, there were reported in England in 2004/05 almost 80,000 fly-tipping incidents

[27] See this document for references to data sources.

[28] Source: http://www.airquality.co.uk/archive/reports/cat07/0509161559_ukghgi_90-03_Issue_1.1.doc. It is understood that the total figure excludes any offset benefits from energy generation from waste. Any reduction in consumption of fossil fuels will be reflected in reduced energy consumption and CO_2 emissions but the level of contribution cannot be determined from the existing data.

costing local authorities nearly £4m in remediation each month, and about half of the serious air pollution incidents reported to the Environment Agency related to the waste sector (with about half of these being associated with landfill sites). However, the absolute number of serious incidents attributed to waste management (across all media) has fallen since 2000. This leaves scope for further reductions but this is most directly addressed by the licensing regime, effective site management and through the planning process (involving EIA), rather than through the national waste strategy, and should be effective regardless of the amount of waste management infrastructure operating. Where issues of specific local significance have been identified in the baseline, these are highlighted so that guidance can be given to local planning authorities on how best to take environmental protection into account when making decisions in relation to proposed new waste management facilities.

A summary of the findings from the baseline is provided below, under the key headings under which the baseline information was assembled. The points below refer to certain indicators, research studies etc. which are discussed in more detail in the baseline report (see Appendix A) and which contains full references to the original sources. In a small number of instances full references are cited below where these refer to potentially significant impacts.

Biodiversity, flora & fauna

The impacts of waste infrastructure are expected to be localised around new sites. The planning system provides a hierarchy of controls which prioritise conservation at sensitive sites and within zones around them to mitigate such impacts.

Actual and potential risks are not currently measured at a national level on a systematic basis, however the SEA proposes two possible indicators (subject to discussions and agreement between stakeholders) which might assist in monitoring and controlling impacts during the development and operation of new facilities.

Landscape character

The nature of waste and its treatment means there is a range of physical and aesthetic impacts (visual intrusion, odour, increased traffic, etc.) which will result from new infrastructure located in rural areas, especially those noted for the quality of their landscape. Impacts will vary according to the type of waste facility and some, such as composting plants, may intrude less than others which have an emissions stack. Although impacts will be localised, the open aspect of rural areas can lead to visual intrusion over greater distances.

These impacts can be mitigated to some degree with good design, however the primary control remains existing legislation to protect landscape designations, and the planning controls which limit or mitigate development in proportion to the quality of the landscape asset.

Again these impacts are not measured nationally and on a systematic basis at present, however this SEA proposes a possible new monitoring indicator for this purpose.

Culture and heritage

The situation is largely the same as for landscape assets, although heritage sites cover less area and therefore any potential impacts from waste management are more localised. Again, the level of impacts is not currently measured nationally on a systematic basis; while the legislative regime and planning controls provide a mechanism for protecting sites from inappropriate development nearby and for preventing physical impacts and those which impair the setting of the site.

Water quality

The Environment Agency monitors all pollution incidents, and the most recent data for 2004 shows that waste management accounted for only 3% of the most serious events; this figure has declined slightly from the level when *WS2000* was published.

While there is a lower proportion of serious water contamination incidents than to other media, continuing risks to surface and groundwater need to be taken into account when assessing requirements for and location of new sites. The existing PPC regime remains the principal technical control to limit these risks, supported by parallel planning controls which treat impact on water resources as a material consideration in assessing development.

Although the nature and number of incidents is recorded, there is an acknowledged need for further research to assess the long-term effects of waste management activities on water resources, particularly in terms of materials leached from landfill sites.

Soil resource & land contamination

Waste related activities currently account for around a quarter of all serious land pollution incidents based on monitoring conducted by the Environment Agency. Although the number of incidents has fallen since 2000, current levels suggest that enforcement is essential to reduce the rate further and to deal any expansion of the waste management infrastructure. The most recent evidence suggests incidents are most common at waste transfer stations and metal recycling plants.

The land taken for landfill is recorded nationally, but that taken by other sites (including waste transfer stations, incinerators and treatment facilities) cannot be identified separately at present. Any expansion of waste infrastructure as a result of the review will be mitigated by adhering to current planning guidance which prioritises the use of previously developed land, and co-location of facilities with existing waste sites and other industrial land uses where feasible.

Air quality

All waste management operations will have some impact on local air quality, whether through transport impacts, fugitive emissions or process releases. These impacts generally diminish rapidly with distance from the site. In particular, significant releases of dust and odour can arise from composting operations and waste handling.

Waste management activities account for almost half of the serious air pollution incidents reported in 2004 as recorded by the Environment Agency.

The predominant pollutant in these cases was landfill odour, although other effects evident at several types of site included chemical odours and smoke. Half of all the events occurred at landfill sites, and where the principal cause (82% of incidents) was landfill gas, chemical odour and other fumes.

Contribution to ozone, CFCs and nitrous oxides are small, but may have local impact. At the wider scale it is not possible to separate any contribution to background levels from other sources.

Estimated emissions of dioxins and furans from management of MSW account for about 1% of the UK total, shared approximately between incineration and landfill gas combustion. Generation of dioxins linked to thermal treatment of waste has fallen significantly over the last 10 years with the introduction of control measures and new designs to limit emissions[29].

Emissions of mercury from waste activities have also fallen markedly as a result of improved control measures in thermal treatment processes, from 7.1 to 1.5 tonnes per year between 1990 and 2003. Waste incineration now accounts for about 20% of total UK emissions of mercury.

Climatic factors

Waste sector emissions of all greenhouse gases in 2003 are estimated to have been 40% of those in 1990. The contribution from waste management to UK total greenhouse gas emissions have fallen from around 5% in 1990 to less than 2% in 2003.

Methane is the most important of the greenhouse gases, and its emissions have been cut by around two-thirds since 1990 and continue to fall with increased deployment of capture technology. However emissions are nearly half a million tonnes per annum, and approximately 22% of total UK methane emissions, giving scope for further reductions by capture and diversion from landfill.

The sector currently contributes around a third of the UK's electricity generated by renewable, alternative and secondary sources, most of which is derived from landfill gas.

Waste activities make a very small contribution to UK CO_2 emissions (about 0.3%). However, increased resource efficiency and energy savings through waste prevention and recycling can make significant contributions to reducing climate change burdens throughout product lifecycles. This will have concomitant benefits through longer term reductions in landfill gas emissions. The waste prevention and recycling benefits have been studied in a separate report[30] which provides the basis for the analysis of climate change impacts in the Environmental Report.

Human health impacts

- [29] Defra (2004), Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes, (report prepared by Enviros Consulting and the University of Birmingham), p.254.
- [30] ERM (2006) Impact of Energy from Waste and Recycling Policy on UK Greenhouse Gas Emissions. Report for Defra.

A range of research studies have concluded that there is no conclusive evidence suggesting increased risk of respiratory conditions, birth defects, cancers and other health problems in those living in close proximity to landfill sites. Some empirical evidence suggests higher incidence of skin, eye and other conditions among those working at Materials Recovery Facilities, but currently there are no studies of the impact on those living nearby.

Similar conclusions have been reached from studies of the effects of large-scale composting facilities, and additional research has not revealed any indication of an increased risk in cancers or asthma.

There is no consistent evidence of a link between incineration and an increased risk of cancer and similar health problems, or to respiratory conditions[31]. A government-appointed committee has concluded that any potential risks resulted from prolonged residency near a MSW incinerator is extremely low and may be difficult to measure even with the most current techniques. There is also little evidence of respiratory problems linked to incinerators.

Most of the research to date has focused on older incinerators which were built before stricter emission controls were imposed in the late 1990s as a result of the Waste Incineration Directive and its transposition into UK law which had the specific aim of reducing emissions of potentially harmful materials and other particulate matter. These older facilities were either upgraded to meet the required standards, or closed down. Newer facilities, including those which may result from the review of waste strategy, will be built to meet the current standards.

A major study[32] of the potential health effects of treating and disposing MSW has concluded that the probable impacts of the emission of key pollutants is very small, compared to other potential hazards, and that in some instances health problems might be reasonably attributed to other local causes.

There is little evidence currently of impacts associated with other waste management facilities, although there is a clear requirement for further research, such as in relation to emissions to air and water from composting.

Waste crime

In 2004/05 there were reported in England almost 80,000 fly-tipping incidents costing £4m to remediate each month. There are regional variations with London and the South East, Yorkshire and Humberside faring worst.

Almost half of the incidents involved illegal disposal of household wastes. A quarter of incidents involved small-scale domestic waste, and a further 20% involved construction rubble.

Research conducted since the last survey of fly-tipping in 1998 suggests the problem has worsened in the intervening period. A monitoring system now exists in the form of the Environment Agency's Flycapture database. The Clean Neighbourhoods and Environment Act 2005 included measures to

- [31] Where apparently significant effects have been observed, these were often in relation to incinerators close to other sources of potentially hazardous emissions.
- [32] See footnote 29.

raise the maximum penalties for the main offence for illegal waste disposal. Fly-tipping of any kind is now an arrestable offence.

5 OBJECTIVES AND INDICATORS

Any strategy will have objectives of its own, whereas an SEA's objectives are focussed on enabling assessment of the likely significant effects of that strategy on the environment. Ensuring linkage between the two sets of objectives is clearly sensible. Choosing indicators against which to judge achievement of SEA objectives is also best if they reflect data currently collected (so as to contribute to construction of the environmental baseline) and will facilitate monitoring the effects on the environment of the strategy post-adoption. A number of indicators per SEA objective also improves the level of detail achieved in the assessment, although too many make the whole process unwieldy.

5.1 Background and definition

Defining the SEA objectives

The Practical Guide to the SEA Directive states that the Directive does not require objectives to be developed for the SEA itself, but they are widely used in SEA to ensure that the right level of consideration is achieved. It also states that the development of SEA objectives and indicators and the collation of baseline information inform each other[33]. It was decided in this SEA that SEA objectives would be useful and exactly this process was followed.

The objectives for this SEA have been defined in order that they are consistent with those in other areas of overarching government policy; to reflect priority areas of action in the waste sector; and be consistent with national and international environmental protection objectives (see the Context Review set out in Section 3 above and Appendix E). Specific, key external influences on the SEA objectives for this review are[34]:

- the objectives and guiding principles of the UK Government strategy for sustainable development 2005, *Securing the Future*[35];
- the overarching objectives of *WS2000* (see chapter 2 of that document) and the specific targets for landfilling, recycling and dealing with the principal waste streams which it introduced;
- commitments by the UK government to key EU and international legislation, including the Kyoto Protocol on climate change, the Waste Framework Directive, the Landfill Directive and the EU Habitats and Birds Directives;
- the role of national planning guidance (including PPS9, PPS10, PPS25, etc.) in managing the location and controlling the impact of waste management infrastructure at local level

[33] See Appendix 5 of the Practical Guide (footnote 9 above).

[34] Summaries of the key issues and objectives identified in all the documents and legislation mentioned below are included in the context review for the SEA, which is attached as Appendix E to this document.

[35] See footnote 18 above.

- the principal environmental impact areas identified in Annex 1 of the EU Directive on SEA and the corresponding UK Regulations.

Most SEA's, including this one, focus on evaluating effects on the natural and built environment. Nevertheless, the Practical Guide also identifies a link with Sustainable Development, which requires consideration of social and economic implications and it is reasonable to expect this to be reflected in a broad range of objectives.

This aim has been met by conducting this assessment in parallel with the pRIA which models the principal impacts, costs and benefits of the key proposals contained in the Consultation Document through cost-benefit analysis. The detailed environmental assessment is contained in this SEA. Consequently the objectives for this SEA are focused on protecting and enhancing the natural and human environment where possible, although human health impacts have been singled out as there are specific concerns associated with several types of waste management activity. Finally, the SEA objectives have been developed in line with the objectives of the revised waste strategy[36] (see Section 3 above).

Defining the indicators

SEA draws on information about the evolving state of the environment in two ways.

(i) The initial baseline defines current conditions, trends over the recent past, and performance against key targets to identify problems and therefore the priorities for policy actions. The baseline for the waste sector in England is detailed in Appendix A and Section 4 of this report summarises its main messages.

(ii) Performance of the waste strategy in meeting the SEA objectives is monitored using an appropriate set of indicators. Ideally many of these should be measured already and included in the baseline. However the limitations of current data and collection methods in the waste sector are acknowledged, and work is under way to improve the situation. Where indicators cannot be measured at present they could, if considered appropriate, form part of the plan for monitoring the effects of the revised waste strategy (see Section 8). Section 8 sets out some proposals for monitoring the environmental effects of the implementation of the revised waste strategy in the period to the next major review scheduled for 2010.

Whereas baseline data are collected periodically to review an SEA, indicator data needs to be collected regularly. For that reason it is important that the SEA Framework contains enough indicators that monitor performance against the objectives, but without proposing so many that data collection and analysis become burdensome.

[36] See chapter 1 of the accompanying Consultation Document for more details on the context within which the revisions of the waste strategy take place. See footnote 4 above.

5.2 Overview of consultation

A provisional set of objectives was defined in the draft Scoping Report for the SEA, which was sent by Defra to the statutory consultees[37] (see Section 1.3 above and Appendix F below). Appendix G summarises the principal comments received, and how they were incorporated into the development of objectives and indicators (where appropriate their impact on the scope of the context review – see Section 3 above – is identified). The objectives and indicators presented in the following sections of this chapter have been modified to reflect these responses where appropriate and therefore represent some of the final components of the Scoping Report for the SEA.

5.3 The SEA Objectives

Listing the objectives

Table 5.1 identifies the 13 objectives which have been defined for the SEA based on the approach and sources outlined above. The table identifies the broad nature of the indicator and the specific issues that are relevant to the assessment when considering the impact of strategy options. The right-hand column shows the indicators chosen to assess performance.

[37] For the purposes of this strategy which relates only to England these are Countryside Agency, English Heritage, English Nature and the Environment Agency.

Table 5.1: Mapping of SEA Objectives, Assessment Parameters and Performance Indicators.

SEA OBJECTIVES	**INDICATORS**
Topic: BIODIVERSITY, FLORA & FAUNA	
1. To maintain, restore and, where practical, to enhance or add to biodiversity and geodiversity interests	1. Percentage of waste management sites with a Local Biodiversity Action Plan in place 2. Percentage of sites with registered Environmental Management Systems 3. Land taken per facility (ideally also distinguishing between brownfield and greenfield, and agricultural quality of the latter)
Topic: POPULATION & HUMAN HEALTH	
2. Protect human health and where practicable enhance local environmental conditions 3. Reduce and prevent waste crime (including fly-tipping) 4. Decrease noise and general nuisance	4. Total number of incidents of fly-tipping cleared or investigated during the previous year, in each local authority area 5. Number of complaints gathered from the operation of waste management sites (This is intended as an indication of general nuisance and perception of waste sites as 'bad neighbours' as distinct from pollution reports – see below) [Note that the following two topics also monitor levels of pollutions recorded as part of the PPC regime, and which represent potential risks to human health.]
Topic: WATER & SOIL	
5. Prevent water pollution 6. Reduce contamination, and safeguard soil quality and quantity	6. Percentage of sites with EA discharge authorisations which exceeded the limits set in the previous year 7. Serious waste-related pollution incidents affecting water 8. Serious waste-related pollution incidents affecting land and soil 9. Eutrophication (phosphate or equivalent) attributed to waste management
Topic: AIR	
7. Prevent air pollution or limit it to levels that do not damage natural systems (including human health)	10. Serious waste-related pollution incidents affecting air 11. Annual concentrations of dioxins in air 12. Annual concentrations of mercury in air

SEA OBJECTIVES	**INDICATORS**
Topic: CLIMATE CHANGE	
8. Reduce greenhouse gas emissions (incl from transport to accommodate the Proximity Principle)	13. Emissions of specific greenhouse gases: [a] CO_2; [b] CH_4 14. Emissions of greenhouse gases (composite basket including CO_2, CH_4 and CFCs)
Topic: CULTURE, HERITAGE & LANDSCAPE	
9. To avoid damage to, and wherever practicable enhance, historic buildings, archaeological sites and other culturally important features. 10. To avoid damage to, and wherever practicable enhance, designated landscape features (e.g. Nat. Parks)	15. Proportion of new sites located within areas covered by principal landscape designations, or within a prescribed distance (ie. due to visual impacts of certain waste facilities)
Topic: RESOURCE DEPLETION & UTILISATION	
11. Enhance measures to reduce and improve utilisation of resources (ie. move treatment up the Waste Hierarchy)	16. Resource use – domestic material consumption and GDP 17. Electricity generated from waste(excluding landfill gas)
Topic: WASTE ARISINGS [principal streams]	
12. Reduce the amount of waste arising and to improve the amount that is recycled or re-used	18. Total municipal / household waste arisings 19. Household waste arising per person 20. % of municipal / household waste recycled or composted 21. Total commercial and industrial waste arisings 22. Commercial and industrial waste recycling rates 23. Construction & demolition waste arisings 24. Construction & demolition waste recycling rates
Topic: HAZARDOUS WASTE	
13. Reduce the amount and hazardousness of hazardous waste	25. Hazardous waste arisings 26. Proportion of hazardous wastes treated and diverted permanently from landfill 27. Hazardousness of waste

Checking the internal consistency between the SEA objectives

Figure 5.1: Cross-check of SEA objectives for consistency and conflicts.

KEY:
- √ Objectives are clearly mutually supportive (likelihood of synergistic benefits when combined)
- √ Objectives are consistent and may be mutually supportive
- ? Situation cannot be determined (in most cases it will depend on circumstances)
- (blank) No obvious relationship between the objectives
- X Objectives may conflict to some extent
- X Objectives conflict strongly - one or both could be revised to reduce the problem

		COL.											
BIODIV'TY	1. Maintain, enhance, restore biodiversity & geological assets	1											
POP. & HEALTH	2. Protect human health	√	2										
	3. Reduce / prevent crime		?	3									
	4. Decrease noise / nuisance	√	?	?	4								
WATER & SOILS	5. Limit water pollution to natural systems	√	√	?	√	5							
	6. Reduce contamination / safeguard soil quality	√	√	?	√	√	6						
AIR	7. Limit air pollution to natural systems	√	√	?	√		√	7					
CLIMATIC	8. Reduce greenhouse gas emissions	√				√	√	√	8				
HERITAGE & LANDSCAPE	9. Avoid damage to historic and archaeological assets			?	√			?		9			
	10. Avoid damage to valued landscape	√		?	√	?			?	√	10		
RESOURCE USE	11. Enhance measures to improve utilisation of resources	?		√			√	√	√			11	
WASTE ARISINGS	12. Reduce volume of waste and increase recycling / composting	?		√	√	√	√	√	√	?	?	√	12
HAZ. WASTE	13. Reduce volume and hazardousness of hazardous waste	√	√			√	√	√				?	
						30							

Figure 1 above maps the relationships between the SEA objectives. Each row represents one indicator and is mapped against the vertical columns which show another indicator.

This analysis indicates there are no apparent conflicts between the objectives, and in many instances there are strongly mutually supportive. A number of cells are marked '?' are instances where the level of consistency or conflict between the objectives cannot be determined in a national-level review. In virtually all such cases conflicts would result from unanticipated or unplanned environmental impacts which can be avoiding by applying local waste and spatial planning controls when reviewing planning applications for new infrastructure.

5.4 The indicators proposed for this SEA

Table 5.1 lists in outline the indicators proposed for monitoring the effectiveness of the revised waste strategy in the period to the next review in 2010. The sections below provide more information on each one, identifying the source and how it is used in the assessment.

BIODIVERSITY, FLORA & FAUNA

Indicator 1: Number of waste management sites with a Local Biodiversity Action Plan (LBAP) in place

Source: This indicator has been proposed by Green Alliance[38]. It has been retained on this basis – and included in the baseline also although data is not currently available to create a national picture. It would need to be considered in the context of monitoring the use of biodiversity action plans for other types of sites. It is proposed for consideration only for use at an aggregated national level, not at a local level as part of the planning process.

Use in SEA (Generic Indicator): It provides evidence that management and operational procedures are implemented at site level to obviate impacts on habitats and species (and in proportion to their importance). The parameter cannot be used in modelling the effect of different infrastructure deployment but provides a measure of sectoral performance and the likelihood that the objective of protecting and, where possible, enhancing biodiversity assets will be met[39].

Indicator 2: Number of waste sites with a registered Environmental Management System (EMS)

Source: As for indicator 1.

Use in SEA (Generic Indicator): As for Indicator 1, and again it is a measure of efforts taken to anticipate and prevent adverse impacts on a range of biodiversity assets. It could, possibly, be seen as a measure of competent,

- [38] See: http://www.green-alliance.org.uk/ourwork/PastAchievements/Waste/IndicatingRight/IndicatorsAndFinalReport
- [39] It is recognised that the Countryside Agency is encouraging the development of Geodiversity Action Plans, and these could be incorporated in a broader indicator subsequently. However it is not clear that these Plans are in development at present and they have been excluded from the indicators for this SEA on that basis.

regulated, effective management and operational procedures implemented to obviate or mitigate the potential localised impacts that vary from one treatment process to the next. The parameter cannot be used in modelling the effect of different infrastructure deployment scenarios but could potentially provide a more general view of performance once the revised waste strategy is in place. It is proposed for consideration by stakeholders.

Indicator 3: Total landtake of waste infrastructure

Source: Collated from modelling data and using estimates in the report *Planning for Waste Management Facilities*[40]*.* It is not collected systematically at present and aggregated on a national basis (see Section 8 below).

Use in SEA (Scenario Dependent): Lack of current data means that this parameter is not included in the current baseline, however typical values are used in assessing the impact of development scenarios. A distinction is made in the assessment tables and Table A between landtake for non-landfill facilities and for landfills. It was considered appropriate to take account also of landfills that were assumed, pursuant to the calculations applied, to have closed since 2002/03. As landfills close, they are restored to other uses, such as new woodland[41].

This indicator provides a direct measurement of the amount of land taken by new waste infrastructure. It is a relatively crude measurement insofar as it does not (and cannot necessarily) reflect issues of land quality, location relative to sites of landscape or nature conservation value, etc., which may be equally important considerations. However it represents a gross measure of impact, which is not measured systematically at present.

If a mechanism were to be created to do this it would be helpful to record facility type and nature of current land use (e.g. identifying relative proportions of greenfield and brownfield land take). Again, it is proposed only for consideration by stakeholders for use at an aggregated national level, not at a local level as part of the planning process. Potential sources of data include the Land Use Classification System and regional and local monitoring of development control decisions.

POPULATION & HUMAN HEALTH

Indicator 4: Total number of incidents of fly-tipping cleared or investigated during the previous year, in each local authority area

Source: Data are collected by the Environment Agency and can be accessed and analysed using the Flycapture resource[42]. However this is a new facility and does not yet contain a full year's history of incidents.

Use in SEA (Scenario Dependent): Fly-tipping data do not correlate with waste treatment facilities. However the parameter will be useful as an indirect

- [40] Research study by Enviros entitled *Planning for Waste Management Facilities* (ODPM, August 2004), available at http://www.odpm.gov.uk/pub/713/PlanningforWasteManagementFacilitiesaresearchstudyPDF1908Kb_id1145713.pdf
- [41] For further details see text included under Indicator 3 in the assessment tables contained in Appendix C below, and see Appendix D2 in relation to landfill number calculations.
- [42] See: http://www.environment-agency.gov.uk/apps/flycapture/login.jsp

measure of how well the strategy is working, and the extent to which capacity and financial measures such as Landfill Tax encourage legal and appropriate disposal of wastes.

Indicator 5: Number of complaints gathered from the operation of waste management sites

Source: Data are not currently collected, but this indicator proposed by Green Alliance (see footnote to indicator 1 for reference source) relates to the number of complaints received by a waste contractor divided by the number of sites as an indication of any 'bad neighbour' effects resulting from its activities.

Use in SEA (Scenario Dependent): This indicator cannot be separated out from existing Environment Agency sources and a new mechanism would need to be devised to do so. This would need to incorporate a means of substantiating complaints as justified. See further Section 8 below.

This indicator is subtly different from indicators 7 to 9 which are recorded by the Environment Agency in response to reports from site operators as well as some public complaints. It is expected that there will be a strong overlap between the two, but this cannot be calibrated. Moreover the Environment Agency-recorded data contain a large number of 'incidents' many of which might be complaints by members of the public.

WATER & SOIL

Indicator 6: Number of sites which exceeded their Environment Agency discharge authorisations in the previous year

Source: It is believed this information can be collated from incident records collected by the Environment Agency.

Use in SEA (Monitoring Indicator): This indicator is also subtly different from indicators 8 to 10 since it would help to define the number of sites that are causing incidents rather than the number of such events. As such it has no practical use in the SEA, but it is clearly valuable as another direct indicator of waste-related environmental problems, and an indirect indicator of the adequacy of site and operational management procedures.

Indicator 7: Number of serious waste-related pollution incidents affecting water

Source: Data are compiled by the Environment Agency from two sources[43]: [a] incidents reported by site operators under conditions in their PPC licences; [b] incidents reported by the public to the EA hotline service. The EA has procedures to prevent double counting of reports of the same incident through these routes[44]. Therefore the data represent the most reliable evidence of substantiated incidents (from a single source), which can be used to assess the potential impact of waste management activities.

- [43] See: http://www.environment-agency.gov.uk/yourenv/eff/1190084/pollution/296030/296054/
- [44] Note that the EA acknowledges that double counting can occur if a particularly serious incident contaminates more than one medium.

Use in SEA (Scenario Dependent): Data provide an overall indication of the incidence of pollution events associated with various categories of waste management facilities. The main issue is that waste facilities that can have different impact potential are grouped into broad categories making it difficult to identify clearly the environmental effect of each facility type. Nevertheless it provides a dataset enabling an estimation of the average number of incidents per facility site per year, which could be scaled up to give an indication of possible long-term shifts in incidents, as well as providing a broader indication of the relative levels of incidents associated with each of the main treatment techniques.

Incident data are grouped by severity into four categories[45]. Any reported incident must be assigned to a category. This SEA uses only the two most serious categories (1 and 2) which generally reflect permanent and long-term environmental damage and / or health impacts, and their moderate equivalents. Incidents with localised and short-term or non-permanent impacts (Category 3) are excluded, as are the bulk of the reported incidents that are considered by the EA to have no clear impact (Category 4). See the Baseline Document (Appendix A) for details of the incidents recorded.

For the purposes of future SEA work it would be useful if a more detailed level of data were supplied enabling analysis, for example, of the range of incidents associated with particular types of waste facility[46].

Indicator 8: Number of serious waste-related pollution incidents affecting land and soil

Source: As for indicator 7.

Use in SEA (Scenario Dependent): As for indicator 7, and the same issues about data collection and categorisation apply as the data are derived from the same monitoring scheme.

Indicator 9: Eutrophication attributed to waste management

Source: to be identified.

Use in SEA (Monitoring Indicator): This aims to measure the release of materials from waste management sites – particularly composting facilities – which represents a specific risk associated with these locations. Care will be needed to avoid double-counting with data collected for indicator 7, though this should be possible once more detailed data are available.

AIR QUALITY

Indicator 10: Number of serious waste-related pollution incidents affecting air

Source: As for indicator 7.

- [45] See section 2 of the baseline document (Appendix A) for details.
- [46] It is acknowledged that the EA produces a set of standard outputs to meet a broad range of requirements and cannot provide bespoke analysis, therefore provision of selected datasets may allow extra analysis to be undertaken by appropriate bodies.

Use in SEA (Scenario Dependent): As for indicator 7. The same issues about data collection and categorisation apply as these data are derived from the same monitoring scheme, but they can be used to scale the likely number of incidents per type of treatment plant in a typical year. Note that whereas other indicators measure specific pollutants with identified health implications (dioxins) or climatic impacts (CFCs, etc.) these data reflect a range of air quality incidents which are likely to include blown dust, smoke from combustion (likely to be unlicensed rather than from an incinerator stack) and odours from landfill and other sources.

Indicator 11: Annual concentration of dioxins in air

Source: Background levels are reported by the UK National Atmospheric Emissions Inventory (maintained by AEA Technology)[47], otherwise data are restricted to point-source estimates of the impacts of individual sites.

Use in SEA (Generic Indicator): Examples of site-specific levels are included in the assessments of the impacts of facility types, although they are not always present. Specific details of typical levels are included in the baseline dataset.

Indicator 12: Annual concentrations of mercury in air

Source: As for indicator 11.

Use in SEA (Generic Indicator): As for indicator 11.

CLIMATIC FACTORS

Indicator 13A: Carbon dioxide emissions

Source: Facility impact assessments prepared for the SEA, many of them drawing on the ODPM report (see indicator 3) and on the greenhouse gas inventories[48].

Use in SEA (Scenario Dependent): CO_2 is a key gas responsible for climate change for which reduction targets have been set under the Kyoto Protocol. Furthermore Annex I (f) of the SEA Directive (2001/42/EC) and Schedule 2 (6) (i) of the Environmental Assessment of Plans and Programmes Regulations 2004 require "*assessment of the likely significant effects on the environment (including climatic factors) of the plan / programme*".

For the purposes of this assessment, models were applied to estimate greenhouse gas emissions across the scenarios developed. The emissions of six green house gases (carbon dioxide, methane, nitrous oxide, PFCs, HFCs & CFCs and SF) were expressed as carbon equivalents. An emissions factor (kg/CO_2 equivalent per tonne of waste processed) was obtained for each material, such as for paper and card, kitchen waste or glass etc. The emissions factors were taken from a Defra commissioned study by ERM '*Impact of Energy from Waste and Recycling Policy on UK Greenhouse Gas Emissions'*[49]. The factors are based on a life cycle assessment and include

- [47] See http://www.naei.org.uk/pollutantdetail.php.
- [48] AEAT Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990 – 2003. See: http://www.airquality.co.uk/archive/reports/reports.php
- [49] ERM (2006), report for Defra.

not only the carbon costs of treating and transporting waste, but also the potential benefits where primary resource extraction or electricity generation are offset with energy recovery. These estimates have been used to compare the effect of the mix of treatment processes under each scenario on overall greenhouse gas outputs. For more details on the methodology applied see Appendix D3 below.

Indicator 13B: Methane emissions

Source: As for indicator 13A[50].

Use in SEA: As for indicator 13A.

Indicator 14: Greenhouse gas emissions

Source: As for indicator 13A/B

Use in SEA: As for indicator 13A.

CULTURE AND HERITAGE

Indicator 15: Proportion of new sites located within areas covered by principal landscape designations, or within a prescribed distance

Source: Not currently available at a national level. It is proposed for consideration (see Section 8) but not beyond utilisation of existing data and within systems already established. If considered appropriate as an indicator to monitor the effects of implementation of the new strategy, it would need to be considered alongside current monitoring at national level of landscape protection policies.

Use in SEA (Scenario Dependent): A potential high-level national measure of whether the revised waste strategy is having a cumulative adverse effect.

RESOURCE USE AND DEPLETION

Indicator 16: Resource use – domestic material consumption

Source: Consumption of a wide range of materials by UK industry and households is based on data collected systematically by all government departments. A subset of these parameters which monitor consumption of key resources are included in the UK Sustainable Development headline indicators[51].

Use in SEA (Monitoring Indicator): Domestic Material Consumption (DMC) is included here as a proxy for other consumption indicators which may be developed subsequently as part of the SCP (Sustainable Consumption and Production) agenda. It is not directly relevant as it omits impacts occurring overseas in product production and benefits from material exported for recycling.

[50] For details of calculation methodology see also:

- http://www.airquality.co.uk/archive/reports/cat07/0505171411_1_main02_pt1_d1_FD1.doc.
- [51] See: http://www.sustainable-development.gov.uk/performance/data.htm.

Indicator 17: Electricity generated from waste (excluding landfill gas)

Source: Data are collected by the DTI[52], drawing on other sources including PPC licensing and planning.

Use in SEA (Scenario Dependent): This indicator measures energy generated from combustion of biodegradable MSW. The DTI website provides details of electricity from waste activities in 1998 and 2002[53].

This parameter is included within one of Defra's indicators[54] and is therefore included in the baseline dataset for the SEA. Scenario assessments convert forecast levels of biodegradable MSW arisings into an equivalent level of generated electricity.

The contribution of landfill gas was excluded from this indicator because energy from landfill is "second best"; the revised waste strategy is aiming to avoid landfill rather than give energy recovery from landfill a higher priority. Such an indicator would not have been a measure of efficiency as regards the effort to move up the waste hierarchy.

WASTE ARISINGS

Indicator 18: Total arisings of municipal and household waste

Source: Waste arisings are collected systematically by EA and Defra from returns submitted by local waste collection authorities (WCAs). Data are reported nationally, annually, and are generally more reliable and complete than those for other waste streams[55].

Use in SEA (Scenario Input): A UK Government sustainable development strategy indicator and the principal indicator monitoring the effectiveness of the revised waste strategy, and achievement of its targets. For SEA it cannot be used to differentiate between options per se but provides the necessary baseline for future monitoring to assess the effectiveness of the revised waste strategy in moving waste management activities up the waste hierarchy.

Indicator 19: Household waste arisings per person

Source: As for indicator 18.

Use in SEA: As for indicator 18, and is a further UK Government sustainable development strategy indicator.

Indicator 20: Proportion of municipal / household waste recycled or composted

- [52] See: http://www.dti.gov.uk/energy/inform/energy_stats/renewables/dukes05_7_4.xls
- [53] However the source does not show the basis on which the data has been put together, merely "Actual generation figures are given where available, but otherwise are estimated using a typical load factor or the design". Moreover the data are only available for the UK and not separately for England.
- [54] Defra, Environment in your Pocket, 2005, page 60.
- [55] See: http://www.defra.gov.uk/environment/statistics/waste/kf/wrkf04.htm.

Source: As for indicator 18.

Use in SEA (Monitoring Indicator): As for indicator 18. In the longer term promotion of home composting may make it more difficult to assess the level of this form of treatment accurately. However this is only a measurement problem which reflects improved levels of composting, reducing arisings as measured by WCAs, and less need for centralised infrastructure to deal with some components of household waste.

Indicator 21: Commercial and industrial waste arisings

Source: Currently assessed through periodic surveys as some waste is collected by local authorities but much is collected and disposed by private contractors[56]. Ideally monitoring and reporting should become more systematic in the period to the next review of the waste strategy in 2010.

Use in SEA (Scenario Input): A further primary indicator of the effectiveness of the revised waste strategy as it identifies the volume of material handled by the waste management infrastructure and therefore the result of policy on consumption. It is also used as an input to the C&I model.

Indicator 22: Proportion of commercial and industrial waste recycled

Source: As for indicator 21.

Use in SEA (Scenario Dependent): As for indicator 21.

Indicator 23: Construction and demolition waste arisings

Source: Currently assessed through periodic surveys as material is collected and disposed by private contractors[57]. As with indicators 21 and 22, ideally monitoring and reporting should become more systematic in the period to the next review of the waste strategy in 2010. In conducting this assessment, use was made of ODPM statistics on arisings and use of CDEW as aggregate[58].

Use in SEA (Scenario Input): As for indicator 21.

Indicator 24: Proportion of construction and demolition waste recycled

Source: Some data as for indicator 23, however the AggRegain reporting system managed by WRAP (Waste and Resources Action Programme) is the main mechanism currently used to estimate volumes and types of materials being recycled.

Use in SEA (Generic Indicator): As for indicator 21.

HAZARDOUS WASTE

Indicator 25: Hazardous waste arisings

- [56] See: http://www.defra.gov.uk/environment/statistics/waste/kf/wrkf03.htm.
- [57] See: http://www.defra.gov.uk/environment/statistics/waste/wrconstruc.htm
- [58] ODPM Construction and Demolition Waste Survey: England And Wales 1999/2000

Source: Data on amounts of hazardous waste are obtained from the consignment notes that accompany each movement of this material. Data were collected by the Waste Regulation Authorities until the transfer of their functions to the EA in 1996[59]. There are difficulties in reconciling actual amounts, particularly where converting to tonnes from the volumetric and other measures used on the consignment notes. Data is improving in this area due to the new Hazardous Waste Regulations which require quarterly returns. The Consultation Document states that the comprehensive hazardous waste tracking system which will replace the Agency's Special Waste Tracking Database from next year will assist more accurate prediction of future waste arisings[60].

Use in SEA (Scenario Input): This provides a baseline for C&I modelling and in order to judge the efficacy of the revised waste strategy once adopted.

Indicator 26: Proportion of hazardous wastes treated and diverted permanently from landfill

Source: As for indicator 25.

Use in SEA (Monitoring Indicator): This indicator was an input to the assessment of impacts of generic waste treatment facilities but no distinction between scenarios was possible. Nevertheless, this and the other hazardous waste indicators will indicate whether legislative changes (i.e. the continuing effects of the end of co-disposal) and other initiatives to intercept hazardous materials before they are incorporated into packaging, etc., are effective. As stated above, hazardous waste data is increasingly available.

Indicator 27: Hazardousness of waste

Source: Currently being investigated, although it is unlikely this statistic will be formally reported at least in the short term. However it may be possible to generate a rough indicator from the proportion of hazardous wastes (by volume) that are sent to those treatment facilities that remove toxic and other fractions and which render the processed residues less hazardous for further transport, treatment, storage or disposal.

Use in SEA (Monitoring Indicator): As for indicator 26.

5.5 Other indicators rejected or proposed for future use

During the initial stage of the SEA a longer list of indicators was identified in the expectation that data sources might be available, and that parameters could be included in the baseline or used in the impact assessment. Subsequent research identified some were unsuitable. However a number of indicators which could not be calibrated easily at present had possible use in the future. These indicators are included in the list above and the monitoring requirements are outlined in Chapter 8 as part of a more comprehensive monitoring programme to evaluate the environmental impacts of the revised waste strategy over the period to the next review at 2010.

- [59] See: http://www.environment-agency.gov.uk/commondata/103601/i1_haz_waste_r8_dt_456798.xls.
- [60] See Chapter 5 of the Consultation Document.

The same research identified a number of other indicators for which there was no source evident currently or obvious collection source or agency. These indicators were excluded from the list during the SEA but are documented below as a record that they were considered as potentially useful. They could be returned to the list if an appropriate collection mechanism is identified subsequently.

Emissions of CFCs and ozone: reported nationally as background levels but difficult to attribute generally to waste activities, although some estimates may be available for individual sites at which level consideration of impacts is more appropriate. Note also that ozone levels can be the result of movements of major atmospheric systems, and there are also difficulties in distinguishing meaningfully between the contribution of traffic and sources resulting from other human activity.

Greenhouse gas emissions by sector: data are not strictly relevant to the SEA (or broken down to that level of detail) but provides an overall indicator of the contribution of waste activities to emissions, and the parameter is retained in the baseline dataset for this purpose.

Possible indicators of transport impacts of waste activities: these parameters are: [a] the ratio of total waste arisings to greenhouse gas emissions; [b] the ratio of fuel used to miles travelled by vehicles collecting and transporting waste to/from treatment sites; and [c] the ratio of fuel used to the volume of waste handled. These three parameters are among those proposed by Green Alliance and which may be published subsequently by ESA. Provided they deliver an accurate aggregate picture of UK waste activities (data are collected by surveying waste contractors) then they could be used to estimate the fuel efficiency of waste operations as an indicator of the Proximity Principle. Current data on greenhouse gas emissions are believed to include those from transport of waste materials in the broader "Transport" category, and these indicators might be used to measure this parameter. However this data is considered to be difficult to collect at present and therefore the indicators are not proposed at present.

6 ALTERNATIVE STRATEGIES FOR MANAGING OUR WASTES AND THEIR ENVIRONMENTAL ASSESSMENT

6.1 Alternative strategies for managing waste

A key aspect of the SEA process is to identify and assess strategic alternatives that are considered to be reasonable, realistic and relevant.

In the context of managing wastes, the alternative high-level strategies that could be adopted have previously been set out in Directive 75/442/EEC as amended (known as the Waste Framework Directive) in the form of the waste hierarchy (Figure 6.1) which comprises a structured and prioritised list of waste management techniques and approaches. Waste disposal in the form of landfill is at the bottom of the hierarchy (i.e. is the least preferable) and waste prevention or avoidance is at the top of the hierarchy (i.e. is the most preferable). Intermediate waste management approaches in the hierarchy include reuse and recycling.

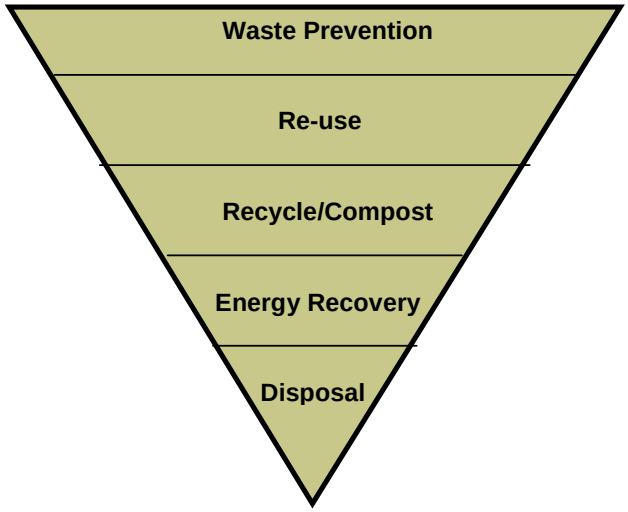

Figure 6.1: The waste hierarchy.

WS2000 has brought into being a number of policy drivers which are already beneficially altering the waste management landscape in the UK. The review of that strategy now being consulted upon has a principal aim of moving wastes up the "waste hierarchy".

Throughout the evolution of the Consultation Document it was recognised that any coherent and integrated waste management strategy would operate across the spectrum of the waste hierarchy, with different emphases at the various levels. In order to assess the inform the strategic proposals, it was decided to develop and evaluate 5 top-level strategic alternatives (scenarios) which reflect the range of possible combinations between the levels. These relate to each of the principal levels in the waste hierarchy and evaluate the proposals in their operation at each of these levels. The scenarios are:

0. No change to existing waste management policy[61]

1. Reduce the rate of arisings

2. Increase the rate of recycling

3. Increase the amount of energy generated from waste, and

4. Increase the amount of waste diverted from landfill.

Each of these scenarios is described below.

These scenarios take into account the assessment objectives set out in Section 5 as well as the objectives set out in, in particular, *'Securing the Future'*.

In developing them as "reasonable, realistic and relevant alternatives" for this assessment, in their detail it was recognised that a mix of facilities and technologies would be required, which must include provision for disposal of residual waste as well as other options further up the hierarchy. Thus, the scenarios differ in their emphasis on particular approaches, such as increased recycling in preference for disposal, but are not mutually exclusive.

Other objectives sought in defining the group of scenarios were to:

- Assess the full range of likely significant environmental impacts;

- Assist policy makers in identifying an optimal mix of waste management options across all levels of the waste hierarchy, and across the principal waste streams; and

- Present strategic options in a such away that the principal choices were communicated clearly to inform other stakeholders interested in the proposals of the revised waste strategy[62].

The scenarios are built around two types of variables, (i) different growth rates in arisings and (ii) different emphases on the various waste management options at the different levels of the waste hierarchy. Each scenario considers both the impacts on municipal wastes and C&I wastes.

An important input to the development of these scenarios was the infrastructure requirements in terms of the numbers of each type of waste management facility required for each. These requirements were specified separately for MSW and C&I wastes using the LAWRRD and C&I models which predict future waste arisings and processing requirements. These models and the modelling assumptions made with respect to each scenario are described in Appendix D.

- [61] Annex 1 of the SEA Directive requires a scenario which assesses the likely evolution of the relevant aspects of the current state of the environment without implementation of the plan or programme.
- [62] This selection of alternative scenarios is consistent with the approach taken by the Cabinet Office Strategy Unit in the report *Waste Not Want Not* (2002). This modelled the following alternative strategic approaches: Option 1 - status quo; Option 2 – high incineration (i); Option 3 – high incineration (ii); Option 4 – maximum recycling; Option 5 – reduction/recycle. This assessment included an evaluation of environmental benefits.

The LAWRRD and C&I models are each internally self consistent, but do not directly map directly onto each other because of, in particular, the different material compositions of the MSW and C&I wastes streams. From the outputs of both models, the following 8 generic facility types were identified:

- materials recovery facility (MRF)
- green waste composting (the example being a windrow composting plant),
- biowaste composting (the example being an anaerobic digestion plant),
- mechanical, biological treatment (MBT) plant,
- refuse derived fuel (RDF) plant,
- incinerator providing energy from waste (EfW),
- pyrolysis and gasification plant, and
- landfill.

Each of these facility types is described below in Section 6.3.

A scoping survey was made of alternative developmental technologies that could be implemented on an industrial scale by 2020 but none were identified. The waste treatment technologies and facilities listed above thus represent the main elements expected to be adopted in alternative strategy options for future waste management in the UK. As such, no reasonable, realistic and relevant alternatives were identified in addition to those indicated in the waste hierarchy.

Scenario 0: No change to existing waste management policy

WS2000 set out a framework for waste management that seeks to reduce total waste arisings, the amount of waste going to landfill and increase the amount of waste recycled and recovered. To achieve the reduction in waste landfilled, Government introduced the Landfill Tax which is now subject to progressive increases up to £35 per tonne in the medium to long term.

This scenario assumes that existing waste management policies remain in place and that waste arisings will increase in line with estimated projections based on current rates (i.e. MSW arisings to increase at a rate of 1.5% per year, and C&I wastes to increase by nearly 25% between 2002/03 and 2020).[63] This scenario is not therefore static but assumes a continuing and complex evolution of the waste management landscape, consolidating *WS2000* policies and measures undertaken to date. It 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 waste, end of life vehicles and waste electrical and electronic equipment.

[63] The Consultation Document (chapter 2) states that, on the basis of the data, analysis and modelling currently available, there is a need to plan for waste facilities on the basis of forecast waste arisings over the next 10 to 15 years as follows: total household waste is likely to grow at 1.5% a year nationally (taking account of predicted population growth of 0.5% a year); total industrial waste is likely to fall from the 2002 level by 5% by 2010 and then rise by 1% by 2015 and another 1% by 2020. This scenario is in line with these projections. It should be noted that there are significant limitations in the data and evidence available on which to base forecasts (particularly of commercial and industrial waste).

As regards MSW, many of the key policy levers in place are very new and there is a limited evidence base on which to assess their impacts. For example, the Landfill Allowances Trading Scheme has only recently been introduced and the landfill tax escalator was increased in 2005-06. The modelling predicts that this scenario is expected to deliver the following mix of waste management options:

(i) Municipal solid waste landfilling rates reduce to around 52% in 2010 (from around 75% in 2002/03) and around 26% in 2020.

(ii) Household[64] waste recycling and composting rates increase to around 40% by 2010 (from around 16% in 2002/03), and at least 45% by 2015 and 50% by 2020. These are the new national targets proposed in the Consultation Document[65].

(iii) Energy recovery rates increase to around 14% in 2010 (from around 9% in 2002/03) and 22% in 2020. Read against the predicted recycling and composting rates, these are broadly consistent with the increased national targets proposed for recovery (ie recycling, composting and energy recovery) of 53% in 2010 and 75% in 2020[66].

As regards C&I, the waste management landscape has also evolved considerably since *WS2000*. There is a lack of evidence on C&I waste streams on which to make predictions under this scenario (and all scenarios) with the Environment Agency's 2002/03 C&I waste survey providing the most comprehensive data. The arisings projections are based on a sectoral growth model of the UK economy 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. These indicate an average annual growth in commercial wastes of around 2.6% and essentially zero industrial waste growth. The modelling predicts that this scenario is expected to deliver:

(i) C&I landfilling rates reduce to around 40% in 2010 (from around 54% in 2002/03[67]) and around 38% in 2020. These are slightly higher than the targets proposed in the Consultation Document (landfilling as 37% of total C&I waste in 2010 and 35% in 2020). The more demanding targets set out in the Consultation

- [64] Note that this relates to "household" waste as distinguished from "municipal waste". Household waste includes waste from household collection rounds, waste from services such as street sweepings, bulky waste collection, litter collection, hazardous household waste collection and separate garden waste collection, waste from civic amenity sites and wastes separately collected for recycling or composting through bring or drop-off schemes, kerbside schemes and at civic amenity sites. Municipal waste includes household waste and any other wastes collected by a Waste Collection Authority, or its agents, such as municipal parks and gardens waste, commercial or industrial waste and waste resulting from the clearance of fly-tipped materials.
- Household waste is used here because WS2000 set targets relating to household waste and the Consultation Document proposes increasing those targets. This means that (i) and (ii) above cannot be directly compared. Municipal waste is applied elsewhere throughout the document, unless specifically stated otherwise.
- [65] WS 2000 set out targets for 2005 (25%), 2010 (30%) and 2015 (33%). It did not set out any such target for 2020.
- [66] WS 2000 set out targets for 2005 (40%), 2010 (45%) and 2015 (67%). It did not set out any such target for 2020.
- [67] Including additional residues landfilled from treatment.

Document are expected to be achieved as a result of the new policies proposed.

(ii) Recycling rates (excluding re-use) increase to around 43% by 2010 (from around 33% in 2002/03), and 45% by 2020.

(iii) Energy recovery rates of around 9% in 2010 (from around 3% in 2002/03) and 8% in 2020.

The additional infrastructure (for MSW and C&I waste) that would be required to support this scenario in the years 2010 and 2020 (relative to 2002/2003) is estimated to be:

Facilities relative to 2003	**2010**	**2020**
Material recycling facility	253	516
Anaerobic digestion	85	137
Windrow composting	91	141
In vessel composting	12	16
Incinerator	30	49
Pyrolysis	0	13
Mechanical/biological treatment	12	34
Non-landfill facilities - total	*483*	*906*
Operating landfills	-659	-756
Total	***-176***	***150***

The number of operating landfills in this scenario is anticipated to be 511 in 2010 and 414 in 2020[68].

This scenario is characterised by a significant reduction in the number of operating landfills and an increase in the number of recycling facilities of various types. These developments would be driven by the existing waste policies. It would take some time for these facilities to be built, therefore the total number of operating waste management facilities initially decreases by 176 in 2010 (ie fewer than at present as old landfills are closed) but later increases by 2020 to reach 150 more operating facilities than in 2003 as increasing amounts of waste are diverted to recycling facilities and away from landfill disposal.

Scenario 1: Reduction in waste arisings

The top tier in the waste hierarchy is the reduction in waste arisings (i.e. to avoid creating wastes in the first place). Consistent with recent developments in EU waste policy, the Consultation Document recognises that there is a need to put greater focus on waste prevention and embed waste prevention within the wider sustainable consumption and production

[68] See Appendix D for a description of the key assumptions underlying the modelling used here. In particular, the average annual input of new landfills is estimated to be 100 kte/yr. The average input of existing landfills is estimated to be somewhat smaller at 50,000 tonnes per year, with an estimated 1170 landfills in operation in 2002/03 for the purposes of this assessment. Environment Agency figures for numbers of operating landfills in England range between approximately 500 and 2000, depending on the categorisation used.

agenda[69]. It was therefore considered essential to include in the SEA this scenario to illustrate the environmental impacts of waste prevention[70].

Waste management policies to date have not been successful in actually reducing the total amount of waste generated but have had the effect of slowing the rate of growth. This scenario considers that both MSW and C&I waste arisings are pegged at 2002/2003 levels. In addition, this scenario also assumes that current waste management policies to increase recycling and divert wastes away from landfill would continue to apply.

In relation to MSW, the modelling predicts that this scenario is expected to deliver[71]

(i) Municipal solid waste landfilling rates reduce to around 56% in 2010 and around 32% in 2020.

(ii) Household[72] waste recycling and composting rates increase to around 33% by 2010 and 50% by 2020.

(iii) Energy recovery rates increase to around 15% in 2010 and 24% in 2020.

In relation to C&I, the modelling predicts that this scenario is expected to deliver:

(i) C&I landfilling rates reduce to around 40% in 2010 and around 38% in 2020.

(ii) Recycling rates (excluding re-use) increase to around 43% by 2010, and 44% by 2020.

(iii) Energy recovery rates of around 6% in 2010 and 5% in 2020.

The additional infrastructure that would be required to support these scenarios in the years 2010 and 2020 (relative to 2002/2003) is estimated to be:

Facilities relative to 2003	**2010**	**2020**
Material recycling facility	228	377
Anaerobic digestion	82	98
Windrow composting	84	87
In vessel composting	12	13
Incinerator	30	59
Pyrolysis	0	0

- [69] See the Executive Summary, Chapter 1 and Chapter 4 of the Consultation Document.
- [70] Including Scenarios 1 and 0 enables the environmental impact of two different waste growth scenarios to be compared. Given that Scenario 0 contains central waste growth projections which are considered realistic and that the policy objective is waste prevention it was not considered necessary to assess a scenario of even higher waste growth.
- [71] In this Scenario 1, the effect of waste reduction on the modelling assumptions results in some excess treatment capacity within the infrastructure already planned for by local authorities (since most local authority planning anticipates higher growth rates). The net effect is to reduce recycling rates over the modelling period as this excess capacity is utilised. In practice, some sharing of capacity between authorities is likely to occur, which would mitigate this tendency. The environmental benefits are therefore likely to be understated. See further Appendix D below.
- [72] See footnote 64 above.

Mechanical/biological treatment	12	33
Non-landfill facilities - total	*448*	*667*
Operating landfills	-659	-849
Total	***-211***	***-182***

The number of operating landfills in this scenario is anticipated to be 511 in 2010 and 321 in 2020[73].

This scenario requires the smallest infrastructure of any scenario considered at 2010 and at 2020, and is characterised by the fewest operating landfills in 2020 (825 fewer than in 2003).

Scenario 2: Increased rates of recycling

Below reduction in arisings in the waste hierarchy comes reuse and recycling of wastes (including composting). Recycling rates continue to increase in England for MSW and C&I wastes. The Consultation Document proposes national household waste recycling and composting rates of 40% in 2010, 45% in 2015 and 50% in 2020. These are higher than the current targets laid down in *WS2000* which are 30% in 2010 and 33% in 2015. It also recognises the need to put more emphasis on recycling of C&I wastes, but does not propose national recycling targets for C&I for the reason that the Government does not consider that there is sufficient information and evidence on which to base a recycling target for C&I waste (or indeed for all waste as a whole)[74].

Local authorities, in response to Government policy, promote household recycling of MSW through various schemes. Similarly, bodies such as the Waste and Resources Action Plan (WRAP) promote recycling of C&I wastes and CDW through various initiatives.

This scenario results from taking further steps to promote recycling and composting of household waste so as to achieve recycling rates of around 40% by 2010 and around 60% by 2020. These rates are higher than the proposed national targets and therefore serve as a useful illustration to policy makers of the option of even higher targets, should those be considered feasible or desirable[75]. In addition, the modelling predicts that this scenario is expected to deliver:

(i) Municipal solid waste landfilling rates reduce to around 52% in 2010 and around 26% in 2020.

(ii) Energy recovery rates increase to around 14% in 2010 and 19% in 2020.

This C&I estimation includes a projected increase in recycling of mixed commercial waste[76] from 15% to 35% together with an increase in

- [73] See footnote 68 above.
- [74] See chapters 1 and 2 of the Consultation Document.
- [75] Given the continued emphasis of policy towards increased recycling, and the clear environmental benefits of recycling, it was not considered necessary to include in the SEA a scenario which considered lower recycling rates than at present. Nor was a scenario with even recycling rates than Scenario 2 considered realistic for either MSW or C&I. In particular, Scenario 2 contains MSW recycling rates which represent considerable increases and the lack of data on C&I recycling rates in Europe meant that there is no reliable higher yardstick on which to base an assessment of a realistic alternative.
- [76] Mixed commercial waste is one of the component types of the C&I waste stream.

composting of food waste to 30% by 2020. The modelling predicts that this scenario is expected to deliver:

(i) C&I landfilling rates reduce to around 37% in 2010 and around 35% in 2020.

(ii) Recycling rates (excluding re-use) increase to around 46% by 2010, and 49% by 2020.

(iii) Energy recovery rates of around 8% in 2010 and 2020.

The additional infrastructure that would be required to support this scenario in the years 2010 and 2020 (relative to 2002/2003) is estimated to be:

Facilities relative to 2003	**2010**	**2020**
Material recycling facility	267	586
Anaerobic digestion	85	143
Windrow composting	91	143
In vessel composting	12	16
Incinerator	30	47
Pyrolysis	0	0
Mechanical/biological treatment	12	41
Non-landfill facilities - total	*497*	*976*
Operating landfills	-659	-785
Total	***-162***	***191***

The number of operating landfills in this scenario is anticipated to be 511 in 2010 and 385 in 2020[77].

As with Scenario 0 (No change in existing policy), this scenario is characterised by a significant reduction in the number of operating landfills but also a larger increase in the number of recycling facilities of various types. It would take some time for these facilities to be built, therefore the total number of operating waste management facilities initially decreases by 162 in 2010 (i.e. fewer than at present as old landfills are closed) but later increases by 2020 to reach 191 more operating facilities than in 2003 as increasing amounts of waste are diverted to recycling facilities and away from landfill disposal. This scenario requires the largest infrastructure (in terms of number of operating facilities, but not in terms of landtake) of any scenario considered at 2010 and at 2020.

Scenario 3: Increase the amount of energy generated from waste

Below reuse and recycling in the waste hierarchy comes energy recovery, known as energy from waste (EfW), which effectively uses waste materials as combustible fuel to be burnt to generate energy, either as electricity or as heat. Using waste materials as fuel can result in a number of environmental benefits, such as:

- minimising the requirement for landfill capacity;
- off-setting other fossil fuels that would otherwise be burnt; and reducing the emissions of methane from landfill.

[77] See footnote 68 above

Any energy that is recovered from biodegradable wastes can be regarded as renewable energy. For the purposes of this SEA, it was estimated that for every 100,000 tonnes of waste incinerated, approximately 7 MW of electricity can be generated[78]. Smaller scale EfW technologies include combustion of gases produced from anaerobic digestion plants, and from gasification and pyrolysis systems.

This scenario considers two possible rates for the increase in the amount of waste that is used to generate energy:

A. *Enhanced rates of diversion of waste to EfW.* This scenario results from policies to divert combustible MSW from landfill to EfW technology such as incineration or pyrolysis and gasification, and results in diversion of about 14% in 2010 and 26% by 2020 (as against approximately 9% in 2002/03). The C&I waste projection is based on an increase in the proportion of mixed commercial waste diverted to EfW to 30% by 2011/12. The proportion diverted to EfW does not change between 2010 and 2020 despite the increase in number of incinerators at 2020 because it is balanced by an increase in the total arisings and the proportion of waste being recycled. The total number of EfW plants built is considered to be constrained by planning issues.

   In relation to MSW, the modelling predicts that this scenario is expected to deliver:

   (i) Municipal solid waste landfilling rates reduce to around 52% in 2010 and around 26% in 2020.

   (ii) Household[79] waste recycling and composting rates increase to around 38% by 2010 and 52% by 2020.

   (iii) Energy recovery rates increase to around 14% in 2010 and 26% in 2020.

   In relation to C&I waste, the modelling predicts that this scenario is expected to deliver:

   (i) C&I landfilling rates reduce to around 37% in 2010 and around 36% in 2020.

   (ii) Recycling rates (excluding re-use) increase to around 43% by 2010 and 45% by 2020.

   (iii) Energy recovery rates of around 9% in 2010 and 2020.

B. *Maximum likely rate of diversion of waste to EfW.* This is the same as the scenario above for MSW because this is considered to be a realistic maximum for this waste stream given that the principal driver on local authorities is the achievement of their landfill allowances

[78] ETSU/DTI (1998) *An Introduction to Household Waste Management*. This was taken as a broadly representative figure. It probably over-estimates the amount of energy that can be extracted from MSW but, given that C&I waste from which energy is recovered generally has a higher calorific value – often due to a high paper content – it was considered that this figure would be broadly accurate when applied to MSW and C&I waste together, as it is here.

[79] See footnote 64 above.

under the Landfill Allowance Trading Scheme. Higher EfW rates would imply displacement of recycling by EfW in latter years. This is considered unrealistic given that this would further imply a loss of public service provision.

In relation to MSW, the modelling predicts that this scenario is expected to deliver[80]:

(i) Municipal solid waste landfilling rates reduce to around 52% in 2010 and around 26% in 2020.

(ii) Household[81] waste recycling and composting rates increase to around 38% by 2010 and 51% by 2020.

(iii) Energy recovery rates increase to around 14% in 2010 and 26% in 2020.

The C&I waste projection is as for Scenario 3A but with an increase in the proportion of mixed commercial waste diverted to EfW to 50% by 2019/20. In relation to C&I, the modelling predicts that this scenario is expected to deliver:

(i) C&I landfilling rates reduce to around 37% in 2010 and around 33% in 2020.

(ii) Recycling rates (excluding re-use) increase to around 43% by 2010 and 45% by 2020.

(iii) Energy recovery rates of around 9% in 2010 and 13% in 2020.

The additional infrastructure that would be required to support these scenarios in the years 2010 and 2020 (relative to 2002/2003) is estimated as:

	Enhanced EfW		**Maximum EfW**	
Facilities relative to 2003	**2010**	**2020**	**2010**	**2020**
Material recycling facility	269	496	269	481
Anaerobic digestion	82	116	82	119
Windrow composting	91	133	91	126
In vessel composting	13	16	13	16
Incinerator	43	65	43	81
Pyrolysis	0	30	0	32
Mechanical/biological treatment	12	34	12	34
Non-landfill facilities - total	*510*	*890*	*510*	*889*
Operating landfills	-659	-780	-659	-802
Total	***-149***	***110***	***-149***	***87***

The number of operating landfills in the Enhanced EfW scenario is anticipated to be 511 in 2010 and 390 in 2020, and the number in the Maximum EfW scenario to be 511 in 2010 and 368 in 2020[82].

- [80] In relation to MSW, Scenario3B is the same as Scenario 3A. The reason is that higher EfW rates would imply displacement of recycling by EfW in latter years. This is considered unrealistic - see further Appendix D.2 below.
- [81] See footnote 64 above.
- [82] See footnote 68 above

This scenario is characterised by an increase in incinerators and a reduction in operating landfills, with a similar mix of other facilities, compared to Scenario 0 (No change to existing policy). It would take some time for these facilities to be built, therefore the total number of operating waste management facilities initially decreases to be fewer than at present as old landfills are closed but later increases to more than at present as larger amounts of waste are diverted to EfW and away from landfill disposal.

Scenario 4: Increased diversion from landfill

The landfill of waste represents the lowest rank in the waste hierarchy and Government is keen to promote the diversion of wastes to higher ranks, such as reuse and recycling through the application of policy instruments which include the Landfill Tax which is currently planned to be escalated over time.

This scenario results from additional policies being implemented after 2010 to further divert MSW and C&I wastes from landfill to other technologies so as to reduce the amount of waste disposed to landfill by 1179 kte/yr by 2020 compared to Scenario 0.

In relation to MSW, the modelling predicts that this scenario is expected to deliver:

(i) Municipal solid waste landfilling rates reduce to around 52% in 2010 and around 26% in 2020.

(ii) Household[83] waste recycling and composting rates increase to around 38% by 2010 and 57% by 2020.

(iii) Energy recovery rates increase to around 14% in 2010 and 23% in 2020.

In relation to C&I, the modelling predicts that this scenario is expected to deliver:

(i) C&I landfilling rates reduce to around 40% in 2010 and around 37% in 2020[84].

(ii) Recycling rates (excluding re-use) increase to around 42% by 2010 and 44% by 2020.

(iii) Energy recovery rates of around 6% in 2010 and 5% in 2020.

The additional infrastructure that would be required to support this scenario in the years 2010 and 2020 (relative to 2002/2003) is estimated to be:

Facilities relative to 2003	2010	2020
Material recycling facility	253	510
Anaerobic digestion	85	132
Windrow composting	91	137
In vessel composting	12	15

[83] See footnote 64 above.

[84] Note that the modelling done for this scenario does not predict a higher rate of diversion of waste from landfill compared to Scenario 0 – no change to existing waste management policy. This is explained in Appendix D.2 below.

Incinerator	30	49
Pyrolysis	0	19
Mechanical/biological treatment	12	34
Non-landfill facilities - total	483	896
Landfill	-659	-768
Total	**-176**	**128**

The number of operating landfills in this scenario is anticipated to be 511 in 2010 and 402 in 2020[85].

The infrastructure requirements for this scenario are broadly the same as those for Scenario 0 (No change to existing policy), although a few less landfills, MRFs and composting plants are required at 2020.

6.2 Assessing the alternative strategies

The environmental performance of each of these scenarios was assessed against the suite of indicators described in Section 5. The assessment tables are presented in Appendix C below. More detail is provided below on the assessment process. Three particular inputs into that assessment process were:

(i) estimated future waste infrastructure requirements;

(ii) the environmental effects associated with each type of waste management facility; and

(iii) estimated greenhouse gas emissions under each scenario.

This assessment has been undertaken in a comparative manner, with the likely impacts of each scenario arising in the years 2010 and 2020 compared to the impacts that arose in 2003 due to current waste management practices, as described in the environmental baseline (see Section 4). The date of 2020 was used because it marks the planned end of *WS2000* and 2010 was chosen as a reasonable date against which to assess environmental progress, given that it takes a number of years for new waste management infrastructure to be built and that the average operating life of a landfill is 10 years. A number of existing waste targets are centred on these years as well as a number of proposed targets contained in the Consultation Document.

An important input to the assessment was the infrastructure requirements calculated by the LAWRRD and C&I models for the MSW and C&I waste streams. In the assessment, the facility requirements for CDW were not explicitly considered because England already achieves a high rate of beneficial reuse of these wastes (around 90%) and WRAP is currently implementing a programme to improve this further.

For the generic facility types considered for the treatment and disposal of the MSW and C&I waste streams, the environmental effects of each were reviewed. The table presenting this assessment is shown in Appendix B below ('Environmental Effects Per Type of Waste Management Facility'). This assessment reviews the environmental effects associated with each type

[85] See footnote 68 above.

of facility in relation to noise; odour; dust; flora/fauna; soils; water quality/flow; air quality; and climate. This assessment is presented in Appendix B and some key points arising out of it are summarised in 6.4 below.

The environmental effects that would occur due to an entire waste management scenario were considered to be the combined impacts arising from multiple unit impacts in the combinations specified in the relevant infrastructure requirement. The identification and assessment of these environmental effects was largely a process of applying expert judgement and involved a combination of quantitative and qualitative methods.

Greenhouse gas emissions

The environmental effects due to greenhouse gas emissions (expressed in terms of tonnes carbon equivalents) are a key environmental impact and, given the importance that current policy (including the Government's sustainable development strategy) attaches to reducing them, it was considered essential to estimate these quantitatively under the different scenarios. Emissions were calculated using the LAWRRD and C&I models. The emissions of six greenhouse gases (carbon dioxide, methane, nitrous oxide, PFCs, HFCs & CFCs and SF) were expressed as carbon equivalents. The emissions factors were taken from a Defra commissioned study by ERM *Impact of Energy from Waste and Recycling Policy on UK Greenhouse Gas Emissions*[86]. These took account of direct emissions from waste management facilities and offsets to fossil fuel combustion, including net energy gains from recycling due to the reduced requirement for virgin materials and the reduction in fossil fuels needed for electricity generation resulting from combustion of waste for energy.

Each of the scenarios considered (including Scenario 0 – No change to existing waste management policy) delivers a net carbon saving to the environment relative to the 2002/03 baseline. This is because the direct emissions from the waste management facilities (an environmental burden) are less than the offset emissions (an environmental benefit) from the production of virgin material or the generation of energy[87]. The carbon savings for the scenarios (relative to this 2002/03 baseline) by 2020 are estimated to be around 6 million tonnes, with variations between the scenarios which are described in Table A below. This equates broadly to around 3% of current UK greenhouse gas emissions and exceeds the direct emissions currently attributable to the UK waste sector, *but* most of these savings will occur outside the UK as recycling displaces raw material extraction and production elsewhere in the world.

Note that greenhouse gas impacts of waste management 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 compared to the Scenario 0 "no change to existing waste management policy". The evaluation for C&I wastes is less robust than that for MSW as less compositional data is available. Moreover, the level of uncertainty in all modelling will grow over time. For example, new technology and innovation may impact on the future costs of policy

[86] See footnote 30 above.

[87] Waste prevention saves not only the emissions from the production of the virgin material but also the direct emissions associated with waste management facilities.

implementation, making it difficult for the analysis to adequately predict actual costs and benefits[88].

Further general comments

The geographical locations of the various plants and sites comprising each waste management scenario have not been specified but are assumed to be distributed around the English regions in proportion to waste arisings.

Certain types of impacts arising from various plant and sites remote from each other will be cumulative and synergistic. For example, the greenhouse emissions from two remote sites will result in a cumulative impact to the atmospheric conditions in England. In contrast, other impacts will not be cumulative. For example, the noise levels arising from two sites are not cumulative provided the two plants are sufficiently far apart (as would normally be the case when siting waste management facilities). These issues are described further below.

The outcomes of the assessment for each scenario are recorded in standard tabular format, and these are provided in Appendix C. These tables record for every indicator whether each scenario is considered to result in an environmental benefit or disbenefit and whether it is of major or minor significance. There are a number of key observations and conclusions that can be drawn from the assessments, and these are discussed in Section 9 and Table A below.

6.3 Cumulative and synergistic impacts of the scenarios

Annex II of the SEA Directive requires that assessment considers the likely cumulative environmental impacts of the plan or strategy that is being assessed, and the UK guidance extends this to include likely synergistic effects. These considerations are necessary because two impacts which are individually insignificant may combine to have a significant impact which may be adverse (cumulative) or beneficial (synergistic).

Both types of impact have been evaluated in this assessment, and this section summarises how they have been treated.

Cumulative impacts

The indicators used in the assessment (see Table 5.1 and the scenario evaluations in Section 6.1) distinguish between those parameters which can only be assessed at site-level and those which can be calibrated on a national scale (eg. for England in terms of the scope of this SEA).

Given the scale of infrastructure growth the greatest risk of localised cumulative impact is the possibility that co-locating waste sites, or building them in close proximity will create excessive impacts, such as:

- Noise – from site operations;
- Traffic – particularly if co-location results in greatly increased vehicle movements;

[88] See further Annex H of the accompanying pRIA.

- Dust and odour – the scale of operations and risks are directly linked;

- Pollutants – the greater and closer the scale of operations at two or more sites, the greater the risks that emissions will combine to exceed air quality thresholds within the surroundings.

Other factors contribute to the possibility these impacts will arise. Planning Policy Statement 10[89] advises that waste planning authorities should seek to co-locate waste facilities with other, appropriate land uses. This suggests new sites could be licensed in locations where waste impacts and non-waste impacts may be cumulative – eg. on trading estates. This situation is more likely to occur due to the need to maximise use of brownfield land.

The need to avoid siting new waste infrastructure within or close to designated sites may 'push' new sites towards inhabited areas (while admittedly supporting the Proximity Principle), and the extent of landscape designations in some parts of the country limits the choice of suitable sites.

The examples above illustrate local cumulative impacts which should be identified during the planning or PPC licensing processes, and in EIA, and which should be minimised with appropriate mitigation measures. If necessary this may mean waste sites cannot be co-located with each other or with other nearby land uses which generate similar impacts.

Additionally, certain impacts are likely over a much wider area:

- Contribution to CO_2 and CH_4 emissions from treatment and disposal at a national level from the network of sites forecast under each scenario;

- Contribution to greenhouse gas emissions from the transport of waste to / from treatment – this is bundled into an aggregate forecast of the additional generation of these gases as shown in Table A below;

- Growth in the number of sites, and therefore the aggregate land take, which will contribute to development pressures on land to different degrees in each region (again this is identified in Table A);

- The likely overall effect on waste crime (fly-tipping) and waste-related pollution incidents. However these impacts are more likely to be an indirect cumulative environmental effect of a combination of policies rather than impacts: policy to expand waste infrastructure (ease of access to disposal sites) and policy on financial measures (cost of disposal).

A number of the impacts were not amenable to quantitative analysis but expert judgement was used to evaluate the likely direction of the impact (e.g. to say whether conditions are likely to improve or worsen compared to situation in 2003). In some cases, it is possible to calculate the cumulative impact to provide a quantitative impact, such as in the case of land area taken for the waste management facilities. All of the scenarios assessed result in a decrease in (i) landtake and (ii) carbon equivalent emissions relative to 2002/03, both in 2010 and 2020.

- [89] See footnote 13 above.

The following estimates of future landtake per facility type were applied[90]:

- MRF – 2 ha
- Anaerobic Digestion – 3 ha
- Windrow composting – 3 ha
- In vessel composting – 3 ha
- Incinerator – 4 ha
- Pyrolysis – 2 ha
- MBT – 2 ha
- Landfill in 2002 – 25 ha
- Landfill in 2010/2010 – 50 ha[91]

Descriptions of how greenhouse gas emissions were quantified are outlined in section 6.2 above and described in more detail in Appendix D and in the accompanying pRIA.

All scenarios result in significant increases in waste infrastructure in 2010 and 2020 relative to 2002/03. However, in terms of the number of *operating* waste management facilities (which excludes landfills predicted to be closed after 2002/03), the results are as follows. All of the scenarios result in a *decrease* in 2010 in the number of *operating* waste management facilities relative to 2002/03. However, in all scenarios except for Scenario 1 (Reduction in waste arisings) this is followed by an *increase* in numbers of operating facilities with the result that 2020 numbers are higher than in 2002/03. Specifically, the growth in operating infrastructure forecast in Table A ranges from around 87 new sites across England in 2020 in Scenario 3B (Maximum Energy from Waste) to 191 in Scenario 2 (Enhanced recycling).

Synergistic impacts

There are opportunities to generate synergistic benefits. Synergistic benefits result from, in particular, co-location, economies of scale and shared facilities. Locating new facilities alongside existing facilities, or locating facilities for treating household waste alongside those treating C&I waste includes the following benefits:

- Potential reduction in the overall land taken by waste facilities. The unit impact assessments show that most waste facilities will occupy 2-3 ha., although large scale combustion plants may use 5 ha or more. It is expected that some reduction in land take is possible if plants are co-located e.g. facilities such as vehicle manoeuvring areas could be combined to some extent, and there may also be a reduction in the area of land needed for landscaping to limit the visual impact of the site.

- Environmental impacts would occur at fewer locations.

Additional synergistic benefits could result from developing facilities within industrial estates to maximise potential for recycling and re-use. This could

[90] These were derived from a combination of expert judgment and typical surface area figures provided in the research study by Enviros entitled *Planning for Waste Management Facilities* (ODPM, August 2004), see footnote 40 above.

[91] An estimated average annual input of waste for a future landfill was estimated to be 100kte. For a description of the estimates applied to forecast numbers of future new landfills see Appendix D below.

extend to purpose-designed 'eco-parks' which exploit synergies in the use of waste as a resource. Such considerations should be used to inform regional strategies and local planning decisions to foster facilities which deliver the optimal mix.

However, such synergistic effects largely operate at the local scale and hence have only a marginal impact on the environmental indicators considered here at the national level. Notwithstanding, the key requirement is to identify the optimum mix of treatment facilities and the benefits and impacts they involve.

6.4 Waste treatment technologies

The various treatment technologies and facilities were categorised as set out in the tables above, and these are described in more detail below in turn[92]. Each of these waste treatment technologies and facilities considered within the scenarios is briefly characterised in the tables below. For a summary of the environmental impacts associated with each facility type see Appendix B.

Materials recovery facility (MRF)
Description: 'Clean' MRFs accept co-mingled recyclables and 'Dirty' MRFs accept unsorted municipal and C&I wastes. Through a series of processes, MRFs sort materials into recyclate streams that can be sent onwards for recovery or treatment by other processes. Separation processes include hand picking, star screens, eddy current separators and optical sorting systems.
Materials input and output: Co-mingled recyclables are fed into the process, the outputs are sorted and segregated materials which are suitable for re-use or recycling. Residual waste (i.e. that which is unsuitable for recycling) is disposed of either to landfill or by incineration. 'Dirty' MRFs generally include more mechanical processing to separate unsorted streams primarily into a biodegradable waste stream which can be sent for aerobic or anaerobic digestion to produce a low grade 'compost' and other recovered material streams, which may include a refuse derived fuel.
Relationship to other processes: MRFs provide a sorting facility from which recovered materials can be transferred for recycling or treatment by other processes.
Key environmental impacts: Potential nuisance associated with the processing (noise, dust etc.) and transport of materials to and from the facility. Other impacts are dependent on the scale of the facility and extent of mechanical processing. Potential impacts can be mitigated using appropriate design and technology; the impacts and mitigation measures will be subject to planning and licensing controls.

Windrow composting (green waste composting) plant
Description: Composting is a process in which organic wastes are degraded by micro-

[92] It was considered that this categorisation enabled all major treatment types (present and likely to be used in the UK in the period up to 2020, on the basis of current knowledge) to be assessed in a manageable way. For regional or local planning purposes, it may be desirable to examine more detailed categories or specific facility types. However, this is not appropriate for this high-level assessment.

organisms at elevated temperatures under both aerobic and anaerobic conditions. In windrow composting, biodegradable green waste materials may be mixed with soils and other materials (e.g. straw and manure), layered into long piles (windrows) and allowed to degrade naturally for a period of several weeks. The windrow must be thoroughly mixed and aerated periodically, and moisture and temperature monitored to ensure the efficiency of degradation. The operation has traditionally been undertaken outdoors, but increasingly is undertaken indoors in order to improve control of fugitive emissions. At the completion of the composting period, the windrows are excavated and the compost graded pending final use.
Materials input and output: Feedstocks are typically civic amenity green waste and kerbside collected garden waste, although the biodegradable fraction of some commercial and industrial wastes, agricultural wastes and sewage sludges may also be suitable for this process. Kitchen and food wastes are not suitable since the temperatures reached may not be sufficient to neutralise pathogens. As a guide, 75,000 tonne of input material produces approximately 37,000 tonne of compost.
Relationship with other processes: Windrow composting requires source separated green waste or similar industrial or commercial feedstocks. Contaminants that may be present within the feedstock are generally screened out of the final product and sent for disposal.
Key environmental impacts: The main potential impacts are the generation of odour, dust and bioaerosols, which are predominantly released during windrow turning. Contaminated run-off from the composting area has the potential to cause pollution to surface and ground water. Such run-off has to be kept separate from uncontaminated surface water drainage.

Anaerobic digestion (AD) plant
Description: Anaerobic digestion is the biological treatment of biodegradable organic waste in the absence of oxygen, utilising microbial activity to break down the waste in a controlled environment. The anaerobic digestion process takes place within the digester which is a warmed, sealed, airless container. Bacteria within the digester ferment the organic feedstock and convert it into biogas. This gas can be used to generate heat and power via an engine or boiler..
Materials input and output: Feedstocks are typically biodegradable organic components of, household, commercial and industrial wastes, together with some agricultural waste and sewage sludges. Pre-treatment involves the separation of biodegradable organic waste from the mixed waste stream. As well as biogas, the process generates a solid digestate (which can be converted to a compost product) and liquor (which can be used as a liquid fertiliser).
Relationship to other processes: Anaerobic digestion plant treating municipal waste are usually integrated with MRFs or MBT plants as an alternative to in-vessel composting.
Key environmental impacts: The main potential impact is the generation of odour. However the process is totally enclosed so the risk of fugitive emissions is low; some odours may

be generated during the pre-processing of feedstock and during loading and unloading of the digester vessels.

Mechanical, biological treatment (MBT) plant
Description: MBT is a generic term for an integration of several processes and technologies. All MBT plants sort and treat mixed wastes using a combination of mechanical and biological means. The mix of technologies employed will depend upon the design objectives of the plant. These may include stabilising waste prior to landfilling; producing a segregated higher calorific value refuse derived fuel and/or producing a segregated organic-rich stream for further composting or AD
Materials input and output: MBTs accept mixed MSW and may separate it into a range of recyclables, refuse-derived fuel, soil conditioners and stabilised residual waste which may be disposed of to landfill..
Relationship with other processes: MBT is an intermediate treatment technology for processing mixed and residual wastes prior to landfill, EfW or other recovery.
Key environmental impacts: Nuisance associated with the processing (noise, dust etc.) and transport of materials to and from the facility. Other impacts are dependent on the design of the facility and the processing stages involved, but MBT plants generally require a biofilter or oxidation equipment to control the release of bioaerosols and odours from the biological treatment stage. Potential impacts can be mitigated using appropriate design and technology; the impacts and mitigation measures will be subject to planning and licensing controls

Refuse derived fuel (RDF) plant
Description: An RDF plant takes bulk waste and removes recyclable or non-combustible materials. The remainder is then dried and shredded, or processed into a uniform combustible material for use as a fuel. This fuel has a calorific value much higher than municipal waste. The RDF will often power a generator on site, and sometimes the fuel is sold to power other energy plants..
Materials input and output: The fuel product varies according to the process used. Biodegradable fuel product (BFP) and refined renewable biomass fuel (RRBF) are two such examples. Following pulverisation, and the removal of inert and compostable materials, fuel pellets are produced which are the final product. Contaminants are sorted and segregated into separate waste streams and can then be sent onwards for appropriate treatment.
Relationship to other processes: An RDF is usually combined with other facilities such as an MBT plant. Separation of contaminants in the fuel also supplies waste streams and recyclate destined for other methods of recovery and/or disposal to landfill.
Key environmental impacts: Nuisance associated with the processing (noise, dust etc.) and transport of materials to and from the facility. Other impacts are dependent on the scale of the facility. Transport impacts will be reduced if the combustion plant is co-located with the MBT plant.

Energy from waste incineration (EfW)
Description: An EfW plant is essentially a large furnace that burns at high temperatures to reduce combustible waste materials to a solid residue (furnace bottom ash and fly ash) and combustion gases. Incineration reduces solids content by approximately 70% by weight. Incinerators typically operate at temperatures between 850 and 1150°C. Heat from the combustion process is usually used to generate electricity, thus treating the waste as a renewable energy form.
Materials input and output: EfW plant are able to treat a wide range of municipal, industrial and commercial wastes. The bottom ash output may be used as aggregate or low-grade construction material, or alternatively landfilled. Fly ash and other flue residues are normally disposed of to landfill as hazardous waste.
Relationship to other processes: EfW plant are mostly applied to post-recycling mixed residual wastes, but may also be used to treat the output from MBT facilities
Key environmental impacts: Emissions to air include gaseous forms of heavy metals, dust and acid gases. There are strict limits on the emissions that can be discharged by EfW plants.

Pyrolysis and gasification plant
Description: Pyrolysis is the thermal degradation of waste in the absence of air to produce gas (often termed syngas), liquid (pyrolysis oil) or solid (char - mainly ash and carbon). Pyrolysis generally takes place between 400-1000°C. The solid fraction may be subsequently fed into a gasification process. Gasification takes place at higher temperatures than pyrolysis (1,000-1,400°C) in a controlled amount of oxygen. The majority of the carbon content in the waste is converted into a gaseous form (syngas). For most waste feedstock, the gas produced will contain toxic and corrosive reduced species. The gas may therefore require cleaning before combustion.. The gases are burnt to produce heat, which is usually used to produce electricity. The char from either system can be further reacted with steam to produce syngas, and residual ash can be re-used or sent to landfill.
Materials input and output: Solid residues are disposed of to landfill, with some processes vitrifying the material and rendering them less susceptible to leaching. Lime and activated carbon are also outputs of the processes.
Relationship to other processes: The technology is currently being developed particularly for use in association with MBT facilities, but may have application to a wider range of industrial and commercial wastes.
Key environmental impacts: As per EfW, flue gases are subject to strict emission limits. Gasification and pyrolysis systems generally require some form of waste pre-treatment. These impacts are the same as with MRF and MBT plant.

Landfill

Description: Landfill can be the infilling of natural or man-made depressions in ground (such as old quarries) or landraise where waste is filled mainly above existing ground level to form a new land profile. Under the Landfill Directive there are three categories of landfill: inert, non-hazardous and hazardous. The Directive, transposed into UK law by the Landfill Regulations 2002 also stipulates, amongst other things, engineering requirements, permitted wastes, waste acceptance criteria and post-closure aftercare. Landfills generate leachate and landfill gas. The composition of each depends upon the range and quantities of wastes deposited, and the state of degradation within the landfill. Modern landfill sites usually include on-site leachate treatment plants, which provide treatment for leachate prior to its disposal off site. Landfill gas contains methane and carbon dioxide, and can be flared off or utilised for the production of electricity.
Materials input and output: Depending upon the category of landfill the input can be varied. Inert landfills are restricted to materials that meet strict criteria and may include some soils, clean rubble, certain industrial wastes and some construction and demolition wastes. Non-hazardous landfills accept mostly MSW and C&I wastes. Hazardous landfills can only accept hazardous wastes listed in the European Waste Catalogue Hazardous Wastes List.
Relationship with other processes: Landfill is usually the final disposal option of residual wastes left over from other material recovery or recycling techniques. There is a requirement that the energy contained in landfill gas is utilised, usually for electricity generation.
Key environmental impacts: The main impacts associated with landfill are noise, odour, leachate and emission of landfill gas to the atmosphere. Potential impacts can be mitigated using appropriate design and technology; the impacts and mitigation measures will be subject to planning and licensing controls

7 MITIGATION OF IMPACTS

7.1 General comments

Annex 1(g) of the SEA Directive establishes the need to define mitigation measures. It requires that the Environmental Report include information on "the measures envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan or programme".

Among the principal objectives of waste policy are encouraging a reduction in waste arisings in the medium / longer term, and reducing the hazardousness of wastes. These measures result in intervention earlier in the resource cycle before materials become waste and directly address Objectives 11 to 13 (resource depletion, waste arisings and hazardous waste respectively) in the SEA Framework (see Table 5.1). These and other measures will also indirectly contribute to others, such as Objectives 4 and 8 (waste crime and reducing greenhouse gas emissions).

Nevertheless all scenarios assessed in this SEA require an expansion of infrastructure for sorting, treating and disposing of wastes. This growth necessitates mitigation measures to reduce the perceived and actual risks, and incidence of pollution events as defined in the environmental baseline as the new sites are brought into use.

The potential environmental impacts from infrastructure growth are identified in more detail in the generic / unit impact assessments for waste facilities which make clear the need for measures at four stages:

- During the early stages of the spatial planning process, including preparation of regional spatial strategies (RSS's should include a concise strategy for waste management);
- During assessment of planning applications for new sites;
- During construction[93];
- During operation of the facility.

Table 7.1 summarises the mitigation measures proposed as a result of this SEA. For example, one mitigation measure which could be particularly important is the co-location of waste facilities[94]. Each measure is defined as either as an overarching principle or as a specific procedural requirement. It is not possible to be completely prescriptive; appropriate measures need to take account of local circumstances, the type of plant, and in some cases the need for mitigation (and even avoidance) must be proportional to the importance or value of the environmental resources that would be affected. Such pragmatic considerations are identified in the second column of Table 7.1.

- [93] Measures are also required for decommissioning of sites. Given the growth in infrastructure envisaged in the scenarios this will be largely confined to the closure and remediation of landfill sites, and appropriate procedures already exist as laid down by The Landfill (England and Wales) Regulations 2002 (which can be accessed at http://www.opsi.gov.uk/si/si2002/draft/20029590.thm) and are therefore not discussed further here.
- [94] See further section 6.3 above.

The third column in Table 7.1 proposes appropriate mechanism(s) for assessing the need for and implementing mitigation measures. These measures are set within the existing framework of planning controls and PPC/waste management licensing. In particular, the recently published Planning Policy Statement 10 (PPS 10)[95] and its accompanying Companion Guide[96] provide guidance to planning authorities and are helping the planning system deliver sustainable waste management.

Most of the mechanisms shown in the third column exist already. Proposed mitigation measures which build on, or are additional to, existing mechanisms would require further consideration and discussion between interested stakeholders.

The final column identifies how each measure would support the Objectives in the SEA Framework, distinguishing between those where there is an obvious and direct benefit and those that are implicitly supportive.

- [95] http://www.odpm.gov.uk/index.asp?id=1143989
- [96] See: http://www.odpm.gov.uk/pub/598/PlanningforSustainableWasteManagementCompanionGuidetoPlanningPolicyStatement10Pb_id1161598.pdf

Table 7.1: Summary of proposed mitigation measures[97]

Measure	Practical considerations	Mechanism	Objective
During planning / licensing			
Maintain existing controls which steer away from siting of facilities in areas covered by primary biodiversity / wildlife / geodiversity designations (SACs/SPAs, RAMSAR, SSSIs) or within the vicinity of these areas	• Width of buffer zone depends on importance and type of the designated site, the type of facility and its position relative to the site (ie. greater distance is needed if it lies upwind in prevailing direction)	• Development plan waste policies and local authority development control to prevent inappropriate or unsympathetic development. • EIA, where appropriate, of site application and obligation to implement an appropriate range of mitigation measures where development in / near sites is unavoidable or can be justified in terms of the overriding benefits	Direct: 1 Indirect: 4,5,6,7 & 9
In line with existing policies steer away from siting inappropriate facilities in areas covered by landscape designations (AONBs, National Parks, Heritage Coasts)	• Large area of these designations may create problems in providing facilities to serve the urban areas within them (this needs to be balanced siting facilities elsewhere and the traffic this would generate and its corresponding effects) • Visibility of site (and therefore impact) varies with type – MBT / incineration both have stacks which will have visual impact over long distances • Controls can be varied with status of the designation, reflecting differences between (e.g.) AONBs and	As above	Direct: 1 & 10 Indirect: 4,5,6,7 & 9

[97] Source – Enviros/Scott Wilson.

Measure	Practical considerations	Mechanism	Objective
	locally designated landscape areas. In the latter appropriate and proportionate mitigation measures are needed • There should still be opportunity to locate appropriate waste treatment facilities (eg composting on farms) within these areas providing the nature of the facility and its impacts do not damage landscape character and local setting.		
Avoid (as far as possible) locating facilities in conservation areas, in the vicinity of scheduled monuments, registered parks and gardens, and (as far as possible) close to listed buildings	• Spatial constraints not as great as for landscape areas as these assets are small in size, however they are much more numerous • Again, the nature of mitigation measures should be proportionate to the importance of the asset	• As above	Direct: 9 Indirect: 4,6,7 & 9
When reviewing possible locations for new waste facilities give due consideration to proximity to residential areas or other sensitive receptors as appropriate depending on the type of facility	• Sensitivity varies with type of site though this is desirable given perception of waste facilities as 'bad neighbours' and the requirement to take steps to prevent further growth in waste-related nuisance (see indicators table) • Needs to be balanced against proximity issues	• As above	Direct: 2 & 7
Prioritise locations which use previously developed land	• Consistent with broader land use planning guidance • Should provide scope to: – co-locate waste management facilities as appropriate (eg. MBT + EfW facility) – locate waste management facilities next to other land uses which are less sensitive to their impacts. • Possible indirect contribution to recycling of C&D wastes	• As above	Direct: [none] Indirect: 2,4,6,8, 10 & 12
Waste planning authorities should identify in development	•	• As above	Direct:

Measure	Practical considerations	Mechanism	Objective
plan documents sites and areas suitable for new or enhanced waste management facilities for the waste management needs of their areas. They will test the suitability of proposed sites against various criteria amongst which are consideration of the physical and environmental constraints on development, including existing and proposed neighbouring land uses, the cumulative effect of previous waste disposal facilities on the well-being of the local community, including any significant adverse impacts on environmental quality, and the capacity of existing and potential transport infrastructure to support the sustainable movement of waste.	• Consistent with broader land use planning guidance.	•	1,2,4,8,9 & 10 Indirect: 5 & 6
During construction			
Appropriate controls to limit the impacts of noise, dust, light and other basic 'nuisance' factors, including limits on hours of working.	• Varies with size and type of facility and proximity to sensitive receptors	• Development plan waste policies and local authority development control to prevent inappropriate or unsympathetic development. • Waste management or PPC licensing regime, where appropriate.	Direct: 2,4,5,6 Indirect: 7
Essential controls to limit release of pollutants and other hazardous materials stored / used on site at this time, and also for the storage and re-use of other materials (eg. topsoil for landscaping and recycled C&D wastes)		• As above	• Direct: 5,6 & 7 • Indirect: 2
Appropriate traffic management measures		• As above.	Direct: 2 & 4

Measure	Practical considerations	Mechanism	Objective
			Indirect: 8
During operation[98]			
Appropriate controls to limit the impacts of noise, dust, light and other basic 'nuisance' factors, including limits on hours of working	• Varies with size and type of facility and proximity to sensitive receptors	• As above.	Direct: 2,4,5,6 Indirect: 7
Operational controls on the handling, storage, preparation, processing / treatment and removal of waste materials and other resources used in treatment processes		• Waste management or PPC licensing regime, where appropriate.	Direct: 2,4,5,6 Indirect: 7
Require use of systems to trap and use landfill gases for energy generation (on or off-site)	• Needs some flexibility as infrastructure cost may be excessive for smaller sites • Flaring could be specified as a second alternative, and basic controls to limit fugitive emissions as the bare minimum requirement	• Development plan waste policies and local authority development control to prevent inappropriate or unsympathetic development • Waste management or PPC licensing regime, where appropriate.	Direct: 8
Require inclusion of technologies to scrub acid gas emissions in exhaust flues (specifically for incinerators, MBT and pyrolysis facilities)	• Other infrastructure will be needed to control / prevent emissions of dioxins, mercury and other materials	• Waste management or PPC licensing regime, where appropriate.	Direct: 8

[98] Although these points refer to activities once the site is operational, many must be anticipated in the planning application and appropriate physical or managerial controls implemented before operation begins.

8 MONITORING PROGRAMME

8.1 Introduction

This chapter summarises the monitoring proposals which arise from the SEA. It proposes several potential new indicators for monitoring the effectiveness of the implementation of the revised waste strategy. Some take forward existing obligations. However, others are subject to discussion and agreement by stakeholders and the relevant costs of benefits of each proposed indicator clearly need to be carefully considered. As part of the consultation process, Defra welcomes views on the proposals to monitor the significant environmental effects of the implementation of the revised waste strategy, including any priority that should be given to the indicators identified, and whether alternative or further indicators should be used.

As for mitigation measures above, any monitoring measures put in place need to take account of the existing framework of PPC/waste management licensing, development plan waste policies and local authority development control.

It is acknowledged that there is considerable scope to improve the quality of data relating to waste arisings and treatment. Defra recognises that a lack of information on specific waste streams, their growth rates, composition, life cycles and impact is hampering the development of waste strategy and the ability to measure and monitor progress effectively. Indeed, this environmental assessment has been subject to constraints of data availability.

The best data are available for the MSW stream due to the systematic reporting by Local Authorities, and the aggregation of this data by Defra. Data on non-municipal waste streams is poorer. Data on C&I and C&D have not always been collected systematically, instead being based on periodic surveys[99]. However, there is increasingly reliable data for hazardous waste, due to the mandatory requirement to record transport and treatment of these materials.

8.2 Action being taken to address the problem

In response to the Strategy Unit 2002 report *Waste Not Want Not* (see context review), Defra implemented a consultation programme to investigate the priorities for improving the quality and quantity of data on waste arisings. As a result, a number of strategies have been implemented, including the Waste & Resources R&D Strategy, and the Waste Data Strategy (being taken forward with the Environment Agency)[100]. Defra and the Environment Agency are taking forward this work stream to provide a sound evidence base for improved waste management policy development, implementation, monitoring and evaluation. One of the major objectives is to construct a more robust evidence base on which to build future policies.

- [99] The Environment Agency's 2002/3 Commercial & Industrial waste survey provides the most comprehensive and current evidence on the sources, quantities and fates of CI&H wastes in England.
- [100] Annex E of the Consultation Document provides more detail on the aims and scope of all the strategies on data supply which Defra is currently pursuing.

The Waste Data Strategy is a national three year strategy[101]. The short-term priority is to improve the quality and accessibility of the reported data. The monitoring proposals presented in this chapter anticipate this development and other initiatives which will improve the quality and quantity of data about the waste sector which should be available to support the mid-term review of waste strategy in 2010.

One strand of the Waste Data Strategy already in place is WasteDataFlow. This project has been established by Defra together with the Chartered Institution of Wastes Management Environmental Body CIWM (EB), was funded by Biffaward through the Landfill Tax Credit Scheme and is now being carried forward by Defra. This only covers the municipal waste stream. It is a web-based intranet for the provision of quarterly municipal waste data both to and from local authorities. As well as underpinning central government policy making, this tool will serve the needs of local authorities and of industry. The Municipal Waste indicators in Table 5.1 above are already built into WasteDataFlow, data quality permitting.

In January 2005 Defra completed a consultation on its proposals to address the shortcomings of waste data through a comprehensive programme to integrate data from various existing sources. This exercise focuses on the need for a central 'Hub', the Waste Data Hub, which aggregates data on the different principal waste streams, and which provides a variety of outputs and analytical tools. Also, Defra is working towards implementation of the Waste Data Hub system which will act as a central resource for aggregating, reporting and analysing waste data. The following data will be placed on a central 'hub' to be used by Defra and the Environment Agency, and with a view to publishing statistics when the data are deemed to be robust:

- Data collected by the Environment Agency including standard C&I returns under the waste management licensing and PPC regimes;
- Hazardous waste consignment notes;
- Municipal waste data from WasteDataFlow.

8.3 Recommendations

The SEA must include recommendations on monitoring the effects of the WS to assess the effectiveness of its policies. This process is built on the indicators defined in Table 5.1. Many of these are available now, e.g. the municipal waste indicators are already incorporated into the WasteDataFlow system. Other parameters will need new data collection and recording mechanisms and these could, where agreed by stakeholders, be incorporated into the development of *WasteDataFlow* or the Waste Data Hub system in due course, where they do not already envisage such data being collected.

It is recognised that Defra's Waste Data Strategy is addressing the problem. New systems recently implemented and being implemented are leading to improvements in the scope and quality of data. It is anticipated that the Waste Data Hub system will lead to improvements in the availability and quality of data on non-municipal waste streams. It is welcomed that non-

[101] For more information see http://defraweb/environment/waste/wip/data/index.htm

municipal waste streams are covered by this system as, to date, these have not received the same attention as municipal waste data.

In addition, Defra's waste R&D strategy and the developing SCP evidence base[102] will also be of value. Environment and health (risk assessment and impact management) is one of the research themes of the Waste R&D strategy, launched in 2004[103]. This provides a mechanism to co-ordinate further research on the impacts of these technologies. In particular, part of the budget has been allocated to address the key data gaps that exist for emerging technologies such as recycling operations, mechanical biological treatment (MBT), anaerobic digestion and composting.

Table 8.1 on the following pages draws together comments and observations from several of the proceeding sections to identify these requirements, specifically the type of data required and the likely sources.

The Table proposes the bodies which might beinvolved in reviewing data trends and acting on the results. In most instances these take forward existing current obligations; in other cases these remain proposals only and subject to discussion and possible agreement with the bodies involved.

The large number of gaps and concerns about data quality suggest it is necessary to prioritise the development of indicators. This SEA cannot examine the feasibility and costs of developing each indicator, however, some initial priorities can be suggested:

- First: improvement of indicators that exist already but where there are gaps or concerns about data quality. This should be more feasible and cheaper than developing completely new indicators, but the priority for developing these indicators should reflect their relative importance in terms of the environmental impacts of waste.

- Second: generate indicators from data sources that exist already but where the indicator is not currently compiled in a manner suitable for use as an indicator (eg. Indicator 6 - number of sites exceeding discharge authorisations).

- Third: indicators which depend on new data collection methods. These occur primarily in the Biodiversity, Water & Soil and Culture & Heritage and Human Health sections. Appendix A (the baseline) indicates the limited information about health impacts of waste activities at present.

The table contains the following columns:

- *Type / parameter*: distinguishes between the indicators ('I') used in the SEA and other parameters which were identified in the baseline ('B'). The former are identified by numbers and are consistent with the list in Table 5.1[104]. Improving the range and quality of indicators is the priority, and the indicators are potential parameters for a

[102] See Annex E to the Consultation Document for further details on these.

[103] See http://www.defra.gov.uk/environment/waste/wip/research/pdf/rdstrategy.pdf)

[104] Section 4.5 identifies a number of indicators that were considered potentially useful but for which there was little clear evidence that data were available currently or in the near future. These indicators are included in the table as indicator type 'I?' but are not numbered.

revised baseline to be produced for the next waste strategy review in 2010.

- *Available*: indicates current availability based on research for the SEA (in some cases data is believed to exist but it has not been possible to substantiate this during the assessment.
    - *Data quality, etc.*: identifies realistic priorities for improving the supply and quality of data.
    - *Data collection responsibility:* identifies current sources and proposes appropriate sources and mechanisms for new parameters.
    - *Responsibility for action:* proposes responsibilities for reviewing overall trends periodically within the waste strategy review cycle (ie. at least annually), and for reacting to incidents, usually at local level.

In addition to the priorities identified above, Table 8.1 identifies several others requirements:

- To extend the range of indicators beyond those which can be quantified easily. Some qualitative parameters, such as landscape impact, clearly lie outside the current scope of waste data collection but may be generated during the planning application process. They can offer a means of assessing the non-physical impacts of waste sites provided a mechanism can be developed for collecting this information.
- To improve the level of detail of data available to third parties (including Defra) to allow greater flexibility in analysis. It is understood that this will be addressed by the ongoing Waste Data Strategy.
- To generate new reporting mechanisms – eg. for the C&I and CDW streams where waste collection, treatment and disposal (and therefore the reporting / recording of these activities) lies primarily with private contractors. It is understood that this will be addressed by the ongoing Waste Data Strategy.

In determining priorities it will be necessary to judge the feasibility of developing each new indicator and its data sources in terms of cost and effort against the apparent significance of the impacts of waste on each objective and the associated indicators.

Table 8.1: Initial provisional monitoring programme for the revised waste strategy[105]

Type	Indicator	Available?	Data quality / improvement priorities	Potential sources of data	Bodies potentially involved
Biodiversity, flora & fauna					
I	1. % of waste mgmt sites with a Biodiversity Action Plan	Apparent gap	Would need to be collected systematically (is proposed by Green Alliance but not currently reported / aggregated) and considered in the context of monitoring the use of biodiversity action plans for other types of sites. Proposed only for use at an aggregated national level, not at a local level as part of the planning process.	Possible sources which could be explored: [a] Environmental Services Association , by aggregating reports submitted by waste contractors [b] EA, which is monitoring preparation of Local Geodiversity Action Plans (GAPs) and Corporate GAPs	Monitored periodically by CA / English Nature / Defra.
I	2. % of waste mgmt sites with registered Environmental Management System	Apparent gap	As above	As above	As above
I	3. Land taken by waste management infrastructure	Gap	SEA estimates level from unit land take per facility. Currently no national, aggregate data available (this indicator is proposed only for use at an aggregated national level, not at a local level as part of the planning process). Any estimate of landtake would ideally distinguish between greenfield and brownfield (and land quality for the former).	Land Use Classification System and regional and local monitoring of development control decisions.	Monitored periodically by Defra / EA/ regional planning bodies/waste planning authorities. In conjunction with the EA and in accordance with PPS 10.

[105] Source – Enviros/Scott Wilson.

Type	Indicator	Available?	Data quality / improvement priorities	Potential sources of data	Bodies potentially involved
Population and human health					
I	4. No. of fly-tipping incidents	Available (EA *Flycapture* database)	Dataset has level of detail allowing analysis at national / regional / local level and by nature of incident. Main need is to ensure local authorities input consistently and regularly	Local Authorities via *Flycapture*	National: Defra through long-term policy review Local: Local authorities, EA
I	5. No. of complaints about waste mgmt activities	Apparent gap	Needs a system to systematically record complaints and a means of substantiating them as justified. Was proposed by Green Alliance and has been reported by some contractors, but there is no aggregated statistic on incidents. Ideally any mechanism will need to record type of site, nature of complaint, proximity of complainant, duration, operator of site, etc.	Parameter is subtly different from pollution incident records (see below) and responsibility therefore lies either with local authorities or with waste contractors. Possible use of Environmental Services Association annual survey to aggregate data at national level for use as baseline parameter & indicator	National: EA through periodic review of incident levels / trends Local: local authorities assisted by legal system and waste management/PPC licensing regimes
B	Human health problems attributed to waste mgmt activities	Gap	Available data is largely based on research studies of certain types of facility, and individual sites or pollution incidents. The current situation outlined in the baseline indicates a need for further study to further improve understanding, such as in relation to emissions to air and water from composting. Environment and health (risk assessment and impact management) is one of the research themes of the Waste R&D strategy, launched in 2004[106]. This provides a mechanism to co-ordinate further research on the impacts of less-researched technologies. No indicator is proposed at present as it is not considered feasible at present to measure and identify a single parameter for health impacts when these vary according to the facility and emission. In the future, with more comprehensive data, it may be possible to develop one.		National: Defra Part of the Defra waste R&D budget has been allocated to address the key data gaps that exist for emerging technologies such as recycling operations, mechanical biological treatment (MBT), anaerobic digestion and composting.
Water and soil					
I	6. % of waste mgmt sites which exceeded	Apparent	Availability of data is being checked but ideally the data needs to define overall	EA through PPC licensing regime and	EA through PPC licensing

[106] See http://www.defra.gov.uk/environment/waste/wip/research/pdf/rdstrategy.pdf).

Type	Indicator	Available?	Data quality / improvement priorities	Potential sources of data	Bodies potentially involved
	permitted discharge authorisations set in the previous year	gap	trend, type of site, frequency of incident, severity relative to authorisation, type of materials, etc.	licensees' reporting obligations	regime
I	7. Serious waste-related incidents affecting water	Aggregated data available	Ideally data for individual sectors could be broken down to a level allowing detailed analyses (eg. type of contaminant by type of facility)	EA through PPC licensing regime and 'hotline' service for reports from the public. Some incidents may be reported to local authorities (but mechanisms exist to prevent double counting)	As above
I	8. Serious waste-related incidents affecting soil resources	Aggregated data available	Ideally data for individual sectors could be broken down to a level allowing detailed analyses (eg. type of contaminant by type of facility)	EA through PPC licensing regime and 'hotline' service for reports from the public. Some incidents may be reported to local authorities (but mechanisms exist to prevent double counting)	As above
I	9. Incidence of eutrophication of surface water attributed to waste mgmt activities	Gap (no source identified - may have to rely on anecdotal evidence	Requires attention to analysis of water incidents to identify this particular type of incident and the intensity of effect. This assumes it will be possible to separate waste-related impacts from those of other activities (eg. farming)	As above. Also from systematic water quality surveys by EA	As above
I?	Soil conditioner produced from waste treatment and / or area improved using this resource	Gap	Data are not collected currently on the volume of material produced, where it is used and the benefit it delivers. This indicator is not used in the SEA, but it is retained here as a record so that it might be considered as part of the next review of the waste strategy and therefore it may be necessary to set up a mechanism for collecting and reporting data in the intervening period		

Type	Indicator	Available?	Data quality / improvement priorities	Potential sources of data	Bodies potentially involved
B	Chemical / biological quality of the water environment	Available for individual. water courses	Provides an overall indication of water quality only, though could be used to detect impacts on surface water close to waste mgmt sites. There is no measurement of the overall impact of waste mgmt activities on water quality, which can be inferred instead from the incidence of pollution events.	EA monitoring network	
Air quality					
I	10. Serious waste-related incidents affecting air quality	Aggregated data available	Data collated by the EA already shows the nature of the pollutant and the type of facility.	EA through licensing regime and 'hotline' service for reports from the public. Some incidents may be reported to local authorities (but mechanisms exist to prevent double counting)	As above
I	11. Annual concentration of dioxins in air	Available at national level only	The priority is to monitor at site level. At a national level waste is considered to contribute only about 1% of UK dioxin emissions (see Appendix A).	National: NAEI already provide Local: operators through PPC obligations (possibly with one-off surveys?)	EA through PPC regime
I	12. Annual concentration of mercury in air	Available at national level only	As above	As above	As above
B	Incidence of poor air quality days	Available nationally / regionally	Improvement requires a significant extension of monitoring sites and is therefore not feasible. The cumulative effect of waste mgmt cannot be identified and therefore provides only a very broad indication of overall trend	NAEI	
Climatic factors [see footnote[107]]					

[107] Table 5.1 lists the indicators used in the SEA, with CO_2 and CH_4 emissions referenced as indicators 13A and 13B respectively, and a composite indicator (greenhouse gas emissions) referenced as no.14 as this is the primary outputs from the LAWRRD and REEIO modelling undertaken for WSR2006, It is

Type	Indicator	Available?	Data quality / improvement priorities	Potential sources of data	Bodies potentially involved
I	13. CO_2 emissions attributed to waste	Available for UK and England only and some estimates available for individual facility types	Main requirements: [a] estimate the contribution to transport emissions from movement of waste. [b] estimate (or better still measure) emissions for all types of facility	National: AEA Technology (in preparing UK submission under the Kyoto Protocol) – note that data are estimates not measurements. Local: site specific monitoring is requirement of PPC licence	Defra/EA
I	14. Methane (CH_4) emissions attributed to waste	As above	As for [b] and [c] above (methane is the main GHG produced by waste management but there is no hidden transport impact)	As above	As above
I?	GHG emissions per tonne of waste handled	Available by aggregating sources	Available at UK and England level as GHGs and total wastes reported this way. Comments in main report identify problems in interpreting this statistic	Waste arisings: Defra GHGs: As above This is a proposed Green Alliance statistic but it is not currently reported as a national aggregate, and any figures published by individual contractors are likely to be unrepresentative	Defra or UK government if this statistic can be estimated reliably and then used a headline indicator for Sustainable Development

anticipated that improvements in data collection will enable the separate forecasting of CO_2 and CH_4 in the future as Indicators 13 and 14 respectively (and that the interim composite indicator – currently no.14 – would be eliminated),

Type	Indicator	Available?	Data quality / improvement priorities	Potential sources of data	Bodies potentially involved
I?	Fuel used divided by [a] miles travelled by waste vehicles; [b] vol. of waste handled	Gap	Issues are frequency of reporting and (as the data are collected by survey) completeness. These parameters are proxies for estimating impact of waste activities on vehicle emissions. Ideally data would distinguish between waste collection and transport to treatment, and onward transport to reprocessing or final disposal – this would require improved data collection procedures	One of several indicators proposed by Green Alliance to be prepared by contractors collecting (and disposing?) of wastes	Not yet determined
B?	Emissions of CFCs, O_3 and NO_x	As above	National background levels are monitored by NAEI but there is no evidence that waste mgmt makes a substantial contribution, and it cannot be separated from other sources.		
Culture, heritage & landscape					
I	15. % of waste mgmt sites lying within areas of landscape quality national designations	Gap	To be considered alongside current monitoring at national level of landscape protection policies. Would need both a retrospective survey of existing facilities (recognising some sites will have to serve towns within AONBs) and monitoring of new sites. It is not suggested that any indicator is needed beyond utilisation of existing data and within systems already established.	Retrospective survey: not identified but could be analysed by EA / CA using REGIS data	CA / EA to review trends periodically.

Type	Indicator	Available?	Data quality / improvement priorities	Potential sources of data	Bodies potentially involved
Resource utilisation & depletion					
I	16. Domestic material consumption (and its relation to GDP)	Available but only for UK	Not strictly related to waste policy.	Included here as a proxy for other consumption indicators which may be developed subsequently as part of the SCP (Sustainable Consumption and Production) agenda.	This is compiled and published by ONS (Office for National Statistics)
I	17. Electricity generated from waste (excluding landfill gas)	Available	Ideally specify for England alone, but data indicate generation capacity by source. Also need to measure levels of energy recovery from C&I as well as MSW wastes.	Collected by DTI	Not an indicator where problems are expected although attention is needed to identify the volume of C&I wastes incinerated
Waste arisings [three principal streams]					
I	18. Arisings of municipal and household wastes	Available	Data already collected systematically each quarter. Defra is working on improving and refining this system to improve the quality and completeness of returns.	No need to add to existing processes. Source data: Local authorities reported to and aggregated by Defra/EA	Possibly Defra / EA as part of periodic review of trends and policy
I	19. Arisings of household waste per person	Available	As above.	As above	As above
I	20. % of household and municipal waste recycled / composted	Available	As above	As above	As above
I	21. Commercial and industrial waste arisings rates	Available	Currently assessed through periodic surveys, however data on C&I waste is not as good as data on MSW. And intensifying focus on the need to increase diversion of all waste streams from landfill suggests a need for regular reporting (ie.	Waste Data Strategy Hub proposal includes an initial requirement for reporting on arisings quarterly[108]	Defra through periodic review of policy

[108] See: http://www.defra.gov.uk/corporate/consult/wip-data/index.htm.

Type	Indicator	Available?	Data quality / improvement priorities	Potential sources of data	Bodies potentially involved
			at least annually) which is being addressed (see right).		
I	22. Commercial and industrial waste recycling rates	Available	As above	As above	As above
I	23. Construction and demolition waste arisings	Available	Currently assessed through biennial surveys, supplemented by data from WRAP's Aggregain database.	Some information is collected by ODPM	Defra through periodic review of policy
I	24. Proportion of construction & demolition waste recycled	Available	England data are available for 1999, 2001, and 2003 from 2003 ODPM survey report for use of this material as aggregate only.	ODPM through biennial survey and supplemented by WRAP, through the Aggregain database. ODPM also have collected some data for use as aggregate only.	ODPM/Defra and EA, including through periodic review of policy and the Waste Data Strategy.
Hazardous waste					
I	25. Hazardous waste arisings	Available	Dataset available to allow more detailed analysis (eg. hazardous waste by type of facility), otherwise data are adequate. Propose that data should be grouped into the 20 primary categories defined in the European Waste Catalogue .	Source: consignment notes required by PPC licensing regime Aggregation and additional sorting / preparation of data (in the future): EA	Defra/EA

Type	Indicator	Available?	Data quality / improvement priorities	Potential sources of data	Bodies potentially involved
I	26. Proportion of hazardous wastes treated and permanently diverted from landfill	Now available	Annual data recently available . Second comment above applies also.	As above	EA and local authoritiesfor site specific issues
I	27. Hazardousness of waste	Gap	The review of the waste strategy has as an objective the reduction of the hazardousness of waste. This will be delivered by intercepting and excluding such materials early in the resource cycle before they become waste materials. At present there is no clear method of measuring or estimating the success of this policy, but an indicator is clearly necessary. Hazardousness of residual materials will also be reduced by increased treatment of these wastes, measured by indicator 29.)		Defra through periodic review of strategy & trends

9 CONCLUSIONS

The scenarios assessed

1. A range of proposals and options have been set out for consultation as part of a review of Waste Strategy 2000. These proposals have been informed by a strategic environmental assessment, summarised in this Environmental Report. This report also included an assessment of the current state of the environment. This baseline assessment encompassed a review of the current impacts on the environment associated with waste arisings and their management.

2. The SEA has been undertaken in accordance with Directive 2001/42/EC (the SEA Directive) and has followed guidance set out in the Government's Practical Guide to the SEA Directive.

3. In order to assess and inform the strategic proposals, it was decided to develop and evaluate four top-level strategic alternatives (presented as scenarios) to current policies which assess the proposals in their operation at each of the principal levels of the waste hierarchy.

4. A base case of no policy change (i.e. continuing with existing waste management policy) was also developed against which the alternatives could be assessed. It should be noted that this scenario (Scenario 0) itself implies continuing evolution of the waste management landscape with respect to today.

5. The scenarios examined are:

    0. No change to existing waste management policy

    1. Reduce the rate of arisings

    2. Increase the rate of recycling

    3. Increase the amount of energy generated from waste, and

    4. Increase the amount of waste diverted from landfill.

Environmental indicators

6. The scenarios have been assessed in terms of 27 environmental indicators developed for this SEA. These encompass the general themes of: Biodiversity, fauna and flora; Population and human health; Water and soil; Air; Climatic Factors; Cultural Heritage; Resource depletion and utilisation; Waste Arisings and Hazardous waste. The assessment results are set out in the tables included in Appendix C of the Environmental Report.

7. For the majority of the indicators, assessment revealed little difference between the scenarios. We conclude that only a limited range of indicators are material to this assessment of policy options – at the national level. However, these may be highly relevant at the regional or local level, and therefore should be considered in undertaking environmental assessments for waste strategies at those levels.

8. The principal indicators where the assessment has shown a significant difference in the intercomparison at a national level are:

    - Quantities of waste arising

- Quantities of waste landfilled
- Recycling rates
- Land take
- Greenhouse gas emissions
- Electricity generation.

9. Table A below summarises the scenarios in terms of the principal indicators. It also includes the parameter of predicted future numbers of waste management facilities. Models were used to estimate arisings and numbers and types of waste management facilities under each of the scenarios. For each facility type, the environmental effects were reviewed. The estimated greenhouse gas emissions associated with each scenario were also predicted. The environmental effects that would occur under each scenario were considered to be these combined impacts which were assessed using a combination of quantitative and qualitative methods. These impacts are shown in Table A.

10. The figures presented in Table A are those derived from the modelling work and applied to the environmental assessment. Entries in Table A coloured green (dark shading) indicate where a scenario provides the greatest environmental benefit and entries coloured brown (light shading) the least environmental benefit.

All scenarios show overall benefit relative to current position

11. All scenarios have relative advantages in terms of individual indicators, but, as a broad conclusion, all scenarios show significant overall environmental benefit over Scenario 0 (no change to existing waste management policy) although Scenario 0 itself does show significant overall environmental benefit relative to the position in 2002/03 (particularly in terms of increased carbon saving, increased recycling rates and reduction in amount of waste to landfill - for both MSW and C&I waste) resulting from existing policies and requirements to meet EU directives.

Reducing waste arisings provides most environmental benefit

12. Scenario 1 (Reduction in waste arisings) provides the greatest benefits and least overall impact on the environment. It results in the fewest facilities that need to be built in future and the lowest amount of waste disposed to landfill. Additionally, it provides the greatest carbon saving and lowest land take of all the scenarios evaluated. This reconfirms the importance of waste prevention at the top of the waste hierarchy.

Greenhouse gas impacts

13. Every scenario will be accompanied by a *significant reduction in greenhouse gas emissions* relative to 2002/03. This reduction increases over time, largely due to the reduction in the landfilling of municipal waste and consequent landfill gas emissions. The largest benefit is gained by policies aimed at waste prevention (Scenario 1) where there are additional greenhouse gas savings resulting from a reduction in primary materials extraction and processing.

14. The carbon savings by 2020 (relative to the 2002/03 baseline) for Scenarios 1 and 2 (Enhanced recycling) are each estimated to be more than 6 million tonnes. This equates broadly to around 3% of current UK greenhouse gas emissions and exceeds the direct emissions currently attributable to the UK waste sector, but most of these savings will occur outside the UK as recycling displaces raw material extraction and production elsewhere in the world.

15. The increased Energy from Waste scenarios (3A and 3B) indicate somewhat reduced greenhouse gas savings compared with Scenario 2 (Enhanced recycling). This is consistent with a greater energy saving being achievable through the recycling of most wastes.

16. The increased Energy from Waste scenarios (3A and 3B) also indicate a somewhat reduced greenhouse gas saving in 2019/20 compared with Scenario 0 (no change to existing waste management policy). The reason is that increasing energy from waste displaces some of the recycling included in Scenario 0 in meeting the landfill allowance targets in relation to municipal waste. However, these scenarios show a significant increase in energy recovery and reduced requirements for land take.

Facility impacts

17. All scenarios lead to a larger and more diverse waste management *infrastructure*. Between 667 and 976 additional waste management facilities (excluding landfills) are estimated to be required by 2020.

18. In all scenarios there is an ongoing requirement *for new landfill capacity*. Scenario 0 (No change to existing policy) has the highest demand by 2019/20 (a cumulative number of 925 new landfills over the period assessed), and Scenario 1 (Reduction in waste arisings) the lowest (832 new landfills over the period). In all scenarios there is an urgent need to plan for new landfills, both in the immediate term and the longer term. The number of active landfill sites is, however, predicted to decrease.

19. *The proportion of waste recycled is increased* in all scenarios compared to 2003. The largest increase is associated with Scenario 2 (Enhanced recycling) which achieves 59% for MSW and 49% for C&I by 2019/20. This increase in the rate of waste recycling could be expected to bring about additional benefits from a reduction in the consumption of primary resources and thus achieve higher sustainable development gains.

However:

20. Higher recycling is associated with the largest waste infrastructure in 2020 requiring an additional 976 facilities (relative to 2002/03, and excluding landfills).

21. This predicted increase in waste management infrastructure also results in an *increase in total landtake*. Landfill sites account for most of this landtake. However, as landfills close and are restored, it is estimated that the landtake of operating waste management infrastructure decreases. This is observed for all scenarios. Scenario 0 (No change to existing waste management policy) predicts the lowest decrease (relative to 2002/03) of 6,350 hectares. The greatest decrease is associated with Scenario 1 (Reduction in waste arisings) which predicts a decrease of 11,550 hectares.

Synergistic impacts

22. There are opportunities to generate synergistic benefits. These result from, in particular, co-location, economies of scale and shared facilities. There are also potential benefits in that environmental impacts would occur at fewer locations. However, such synergistic benefits largely operate at the local scale and hence have only a marginal impact on the environmental indicators considered here at the national level. Notwithstanding, the key requirement is to identify the optimum mix of treatment facilities and the benefits and impacts they involve.

Pollution incidents

23. Other things being equal, the number of serious pollution incidents to land and water can be expected to increase proportional to the level of waste management infrastructure increase which is observed across all scenarios. Of particular relevance are the number of both operational and closed landfills, but odour, noise, air and water impact can arise with all waste handling infrastructure. These are major considerations which will inform the current Environmental Permitting Programme (expected to go to public consultation in early 2006) and review of licensing exemptions. However, we conclude that there is an ongoing need to adopt Environmental Management Systems (EMS) and other best practice to avert or minimise adverse impacts.

Consistency with the waste hierarchy

24. The overall conclusion of this environmental assessment is that all scenarios offer environmental benefits over Scenario 0 (No change to existing waste management policy). All scenarios require significant increases in waste management infrastructure, both landfills and waste treatment facilities. This is particularly a consequence of the increase in facilities predicted across all scenarios to accommodate higher recycling rates.

25. Scenarios and policies that focus on waste prevention (Scenario 1) offer greater overall benefit than the other scenarios in terms of the principal indicators used here. And scenarios that promote higher levels of recycling perform somewhat better in climate change terms than those that promote energy from waste.

26. We therefore conclude that the waste hierarchy provides a sound environmental guide to help inform the future waste strategy for England. Consequently, the revised waste strategy should focus on increasing the efficiency of our use of resources, with policies developed within the overall framework of the Sustainable Consumption and Production agenda.

Table A Comparison of scenario performance

Indicator	0: No change to existing policy		1: Reduction in waste arisings		2: Enhanced recycling		3A: Enhanced EfW		3B: Maximum EfW		4: Enhanced diversion from landfill	
	2009/10	2019/20	2009/10	2019/20	2009/10	2019/20	2009/10	2019/20	2009/10	2019/20	2009/10	2019/20
Total MSW arisings *[Annual arisings (kte)]*	31,780	37,000	29,940	30,040	31,780	37,000	31,780	37,000	31,780	37,000	31,780	37,000
Total C&I waste arisings *[Annual arisings (kte)]*	68,860	82,290	65,910	65,830	68,860	82,290	68,860	82,290	68,860	82,290	68,860	82,240
MSW landfilled *[Annual waste landfilled (kte)]*	16,430	9,800	16,720	9,540	16,430	9,770	16,430	9,680	16,430	9,760	16,430	9,460
C&I wastes landfilled *[Annual waste landfilled (kte)]*	27,510	31,580	26,750	24,950	25,300	28,760	25,680	29,290	25,680	27,010	27,510	30,740
Total MSW and C&I waste to landfill *[Annual waste landfilled (kte)]*	43,940	41,380	43,470	34,490	41,730	38,530	42,110	38,970	42,110	36,770	43,940	40,200
Proportion MSW recycled or composted *[Annual percentage]*	38%	57%	33%	50%	38%	59%	38%	52%	38%	51%	38%	56%
Proportion C&I waste recycled *[Annual percentage, excl re-use]*	43%	45%	43%	44%	46%	49%	43%	45%	43%	45%	43%	44%
Number of non-landfill waste management facilities *[Relative to 2003]*	483	906	448	667	497	976	510	890	510	889	483	896
Number of landfills (i) operating in assessment yrs (ii) commissioned since 2002/03	511 511	414 925	511 511	321 832	511 511	385 896	511 511	390 901	511 511	368 879	511 511	402 913
Total landtake of waste infrastructure (net of landfills closed since 2002/03)[109] based on landtake for (i) non-landfill facilities, *plus* (ii) landfills, *minus* (iii) landfills closed since 2002/03 *[relative to 2003 (ha)]*	-2490 1210 25,550 29,250	-6350 2200 46,250 54,800	-2570 1130 25,550 29,250	-11550 1650 41,600 54,800	-2460 1240 25,550 29,250	-7650 2350 44,800 54,800	-2410 1290 25,550 29,250	-7580 2180 45,050 54,800	-2410 1290 25,550 29,250	-8650 2200 43,950 54,800	-2490 1210 25,550 29,250	-6980 2170 45,650 54,800
Carbon equivalent emissions *[Relative to 2003 (kte)]*	-2490	-5840	-2580	-6360	-2680	-6230	-2620	-5770	-2620	-5470	-2490	-6000
Electricity generation from waste (excl. landfill gas) *[MW]* • Biodegradable MSW[110] • Total – all MSW and C&I	 198 595	 357 890	 194 575	 315 755	 198 595	 305 810	 198 775	 419 1215	 198 775	 425 1450	 198 595	 372 910

[109] See further Appendix C (Assessment tables) – Indicator 3. 'Net' means that landtake for landfills predicted to be closed since 2002/03 has been deducted from the total.

[110] This line was inserted on 24.02.06, when the reference "relative to 2003" for this indicator was also removed.