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Material Health

A mass balance and ecological footprint analysis of the NHS in England and Wales

April 2004

www.materialhealth.com

Biffaward Programme on Sustainable Resource Use

This report forms part of the Biffaward Programme on Sustainable Resource Use. The aim of this programme is to provide accessible, well-researched information about the flows of different resources through the UK economy, based either singly, or on a combination of regions, materials streams or industry sectors.

Information about material resource flows through the UK economy is of fundamental importance to the cost effective management of resource flows, especially at the stage when the resources become 'waste'.

In order to maximise the Programme's full potential, data will be generated and classified in ways that are both consistent with each other, and with the methodologies of the other generators of resource flow/waste management data.

In addition to the projects having their own means of dissemination to their own constituencies, their data and information will be gathered together in a common format to facilitate policy making at corporate, regional and national levels.

Further information on the programme available at www.biffaward.org/studies.

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A full list of acknowledgments is available on www.materialhealth.com.

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Foreword

Economic, social and environmental factors are all inter-related and together influence the sustainability of our society. Economic growth and improved standards of living have sometimes been achieved at the expense of the environment or have resulted in social exclusion. Making sure that there is synergy rather than conflict between these factors will not only help towards resolving today's problems, but will also minimise those for future generations.

We recognise that the NHS, as a large organisation, will have a powerful role in helping to deliver a more sustainable future. Improving the social environmental and economic impact of day-to-day operations in the NHS will create the opportunity not only to treat people more efficiently but also to reduce the risk of ill health resulting from a degraded environment, unemployment, poverty and social exclusion.

As we move towards sustainability, we need to consider the role of the NHS as employer, health care provider, neighbour, estates and facilities manager, purchaser and good corporate citizen.

In this study we have for the first time an overall picture of the resources consumed in the delivery of healthcare in England and Wales. Quantifying the environmental impact ("ecological footprint") of the NHS allows us to see where improvements could be made, in terms of promoting more sustainable patterns of consumption and reducing the quantity of waste that is generated, whilst still improving the social and economic circumstances of the country' s population.

It is not the purpose of this report to make specific recommendations. Its aim is rather to stimulate a healthy and informed debate, involving society as a whole, which will lead to the formation of evidence-based policies, and help all of us understand the action needed to achieve the vision of a more sustainable future.

Sir Nigel Crisp

Chief Executive
Department of Health and NHS

Sir Liam Donaldson

Chief Medical Officer
Department of Health

Executive summary

This research and development project - *Material Health* - set out to determine the mass balance and ecological footprint of the NHS in England and Wales, and is an important step towards quantifying the environmental impact of the NHS. It also highlights areas, which can most readily be tackled, and will help a move towards a more sustainable future.

Key findings of the study are listed below

Mass balance analysis (pages 7 - 20)

In 2001, the NHS in England and Wales:

- Consumed an estimated total of **12,650 GWh of energy.** This is approximately 0.8% of all energy consumed in England and Wales.
  - 62% was produced from gas, and 4% from renewable electricity.
- Consumed approximately **1.3 million tonnes of products.**
  - 31% was medical & surgical equipment.
  - 73% of NHS spend was on clinical supplies.
- Consumed an estimated **53,256 tonnes of food.**
- Generated an estimated **384,698 tonnes of waste**, of which:
  - 261,086 tonnes was domestic. This represents 1% of all domestic waste generated in England and Wales.
  - 120,547 tonnes was clinical and 3,063 tonnes was special waste.
- Staff, patients and visitors **travelled 25 billion passenger kilometres**, of which:
  - 83% was by car & van and 70% by visitors.
- Consumed an estimated **49.8 billion litres of water**.
- Generated approximately **42.6 billion litres of sewage**.
- Occupied a physical land area of **33,654 hectares**.
  - 6% of NHS land is built land, of which 2% is car parks.
- Generated **3.18 million tonnes of emissions to air**.
  - 99.6% were CO_2 emissions.

Eco-efficiency can be calculated by dividing the resources remaining in the economy by resources consumed. In the case of the NHS, total stock build-up was 1,004,162 tonnes, while resource consumption was 1,388,860 tonnes (excluding water and energy consumption). **Therefore the NHS' eco-efficiency was calculated at 72%**. This means that for every tonne of material and product consumed by the NHS, 72% is retained while 28% is wasted. This compares positively to the UK's eco-efficiency of 52%.

Ecological footprint analysis (pages 21 - 26)

The ecological footprint is a sustainability indicator, which expresses the relationship between humans and the natural environment. The ecological footprint accounts the use of natural resources by an individual, organisation or region. It is a 'snapshot' measure and typically refers to average annual consumption. Results are usually presented on a per capita basis using a standardised unit of area - the global hectare (gha).

In 2001, the ecological footprint of the NHS in England and Wales was 4,964,825 gha (global hectares) or 0.09 gha per capita.

- **Products and waste was 58%** of the total ecological footprint (2,866,647 gha)
  - 31% was furniture, office & computer equipment.
- **Patient, visitor and staff travel was 22%** of the total ecological footprint (1,115,345 gha).
- **Direct energy was 17%** of the total ecological footprint (865,661 gha).
- **Food was 2%** of the total ecological footprint (97,217 gha).
  - 77% was animal-based food products.
- **Water and built land were both 0.2%** of the total ecological footprint (8,485 gha and 11,470 gha respectively).

Ecological sustainability of the NHS (pages 27 - 28)

In this study the ecological sustainability of the NHS has been reported in terms of environmental impact associated with the provision of healthcare services in relation to population served. **The ecological footprint of the NHS in England and Wales per capita is 0.09 gha, or 1.8% of the total ecological footprint per person.**

Scenarios (pages 29 - 40)

Scenarios were developed to meet a set of criteria and were included if they were relevant to current NHS sustainability issues; data on which they were based was sufficiently robust, and realistic implementation is feasible within current NHS activities and structures. Three scenarios were identified and footprinted accordingly: Solar water heating, domestic waste and transport.

For solar water heating, three scenario options are presented. All scenarios calculated can reduce the hot water ecological footprint of the NHS in England and Wales, by between 2 % and 63 %. Associated CO_2 emissions could also be reduced. However, none of the scenarios would reduce the amount of direct energy consumed, and would therefore not contribute towards meeting the NHS' energy reduction target of 15% on 2000 by 2010.

The waste scenarios presented focus on waste recycling, and best practice. The scenarios indicate that waste recycling alone will not reduce the quantity of domestic waste generated by the NHS. For this reason a third scenario was developed to calculate the impact of combining both waste recycling and minimisation. This scenario illustrates that a combination of both recycling and minimisation is necessary to reduce the amount of waste generated by the NHS.

Two scenario options are presented for staff, patient and visitor travel. The scenarios are based on best practice travel plans from NHS case studies, and applied to NHS transport figures. They predominantly focus on modal switching, and illustrate the effectiveness of modal switching and the importance of car sharing to reduce the NHS in England and Wales' ecological footprint.

The scenarios give a clear indication of the power of ecological footprinting in identifying and communicating suitable options for decreasing the environmental impact of an organisation.

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Introduction

Project context

The UK government is committed to protecting the environment and using natural resources prudently as part of its overall commitment to sustainable development. Sustainable development is about ensuring a better quality of life for everyone, now and for generations to come, and indeed the overlap between a sustainable society and a healthy society is considerable. The government is seeking to lead by example, by improving, in synergy, the environmental, social and economic performance of its departments and the public sector. Improving the resource productivity of the UK economy has been identified by the Government's Performance and Innovation Unit as a 'key to change' in achieving sustainable development (PIU, 2001). Resource productivity does not in itself provide an analytical tool, rather it is a concept within the context of sustainable development that can help us to think about what types of policy will work best in helping adapt the economy to environmental constraints, and how the interaction of public policy and private decisions can minimise the risks to the environment. Businesses and households have been identified in playing a lead role in making more productive use of natural resources.

The NHS is one of the largest single organisations in the world, and its activities have a profound social, economic and environmental impact on the UK. In many communities it is the major employer, and overall employs more than one million people. The annual budget is £60 billion, of which in excess of £11 billion is spent on purchasing goods and services. The environmental impacts of its operations are far-reaching: Resources are consumed on a grand scale to deliver effective and efficient healthcare; significant quantities of waste are generated; and carbon dioxide is subsequently released into the atmosphere as a result of energy consumption and travel. The link between public health and the environment is so important that the NHS has a clear responsibility to ensure that the environmental impacts of its activities are minimised, and furthermore that they do not adversely affect the health of the population that it exists to serve.

In April 2002, NHS Estates issued to the NHS the *New Environmental Strategy for the NHS,* together with a guidance document *Sustainable Development in the NHS,* and a software tool called NEAT *(NHS Environmental Assessment Tool).* The aim being to raise environmental awareness within the NHS; to estimate the environmental impact of NHS services and facilities; and in so doing, seek to establish an environmental improvement programme.

The Department of Health (DH) is actively working to integrate sustainable development into its policy making and operations.

The Department accepts its responsibility to reduce the adverse, and increase the beneficial environmental impacts of its activities, products and services through recognition and support of the link between public health and the environment, and the roles of purchasing, supply and building management.

In order to chart progress towards sustainable development, the government has defined fifteen headline indicators. The DH is directly responsible for performance against the indicator 'expected healthy years of life'. In addition, departmental activity has an indirect positive effect in moving at least five other indicators (economy, employment, poverty and social exclusion, education and crime) in the right direction. This responsibility, in relation to the NHS, is discussed in the *NHS Plan* (DH, 2000), which highlights the link between health, the provision of healthcare and sustainable development.

"Recognising that good health also depends upon social, environmental and economic factors, such as deprivation, education, housing and nutrition, the NHS will work with other public services to intervene not just after but before ill health occurs" (DH, 2000).

The Government's strategy for tackling health inequalities identifies a key role for the NHS as a 'good corporate citizen', whereby the NHS economy is used to support the regeneration of disadvantaged areas through employment and training, procurement and capital programmes.

A report by the King's Fund in 2002, *Claiming the Health Dividend,* also highlighted that the NHS can make better use of its resources to reduce inequalities, build stronger local economies and safeguard the environment for the benefit of whole communities. The report explores the relationship between health and sustainable development in terms of a virtuous circle, where patterns of behaviour that promote sustainable development have health benefits, and measures to improve health also contribute towards sustainable development.

Following on from *Claiming the Health Dividend,* the Sustainable Development Commission (SDC) is exploring ways of helping the NHS maximise its positive contribution to the environment, society and the economy. Its *Healthy Futures* programme is looking at how the NHS' food purchasing policies and capital development programme can promote improved health and sustainable development (SDC, 2003).

Within the wider context of sustainable development, therefore, the environmental impacts of the NHS need to be better understood. An excellent, and widely accepted, indicator of environmental impact is the ecological footprint. This research and development project - *Material Health* - set out to determine the mass balance and ecological footprint of the NHS in England and Wales, and is an important step towards quantifying the environmental impact of the NHS. It also highlights areas, which can most readily be tackled, which will help a move towards a more sustainable future.

Project background and scope

The *Material Health* project set out to collect data on the NHS in England and Wales in order to:

- **Carry out a mass balance analysis.**
- **Calculate an ecological footprint.**
- **Carry out a sustainability assessment.**
- **Develop improvement scenarios.**
- **Assess data quality and availability for a project of this nature.**

A mass balance analysis involves an assessment of the flow of resources into and out of an organisation, in this case the NHS in England and Wales. Mass balance analysis involves collecting data from a range of activities such as transport, energy use, materials and product consumption, waste production and water use. This information can be converted into a common currency of land and sea area (global hectares) - this is known as ecological footprint analysis.

Material Health is an attempt to try and better understand the environmental impact of the NHS in England and Wales, and also the implications of this impact. The environmental impact of any organisation would be interesting, and almost certainly worthy of study, but the environmental impact of the NHS in England and Wales is particularly significant because of the sheer scale of the organisation. A snapshot of the scale of services provided by the NHS is given in the adjacent box.

The NHS in England and Wales, in 2001: Some facts and figures

852,100	**Employees**
482	**Trusts**
33	**Ambulance trusts**
2,060	**Hospitals**
60,501	**Average number of hospital beds available per day**
46,306,000	**Outpatient attendances**
3,948,000	**Day case admissions**
15,279,000	**A&E attendances**
9,334	**GP practices**
10,463	**Community pharmacies**
19,365	**Dentists**
8,702	**Opticians**

Sources: Brinzer *et al.*, 2003; DH, 2001 & 2002; National Assembly for Wales, 2002; NHS Confederation, 2001 & 2002; NHS Estates, 2002 and ONS, 2001.

By gaining a deeper understanding of consumption patterns in the NHS, there is increased scope to improve resource efficiency and introduce more sustainable consumption patterns. Also, by linking consumption patterns to waste generation, there is greater opportunity to improve waste management, through minimisation, re-use and recycling. The mass balance and ecological footprint analysis of the NHS should be seen as a baseline study intended to deliver a platform from which further research and data analysis can take place. It is hoped that the findings will support evidence-based policy development that will, in turn, support the delivery of a more sustainable future for the NHS, and the UK as a whole.

Report structure

This report has been sub-divided into two main sections: Results and methodology.

The **results section** is presented first, and includes the following:

- The mass balance analysis, which details the flow of resources through the NHS in England and Wales.
- Vignettes, which illustrate case studies and points of interest.
- The ecological footprint analysis, which details NHS staff, patient and visitor impacts on the environment, and
- Discussion on a range of potential improvement scenarios based on specific issues in the NHS at this time. The scenarios are based on best practice and current trends, as well as targets, both general and specific to the NHS, for achieving sustainability.

The **methodology section** of the report details the research techniques used to obtain and collate data, the assumptions and analyses made during calculations of the mass balance and ecological footprint, and the background to the improvement scenarios. Discussion includes the principal sources of data, data quality and gaps in the availability and provision of data.

Results: mass balance analysis

What is a mass balance analysis?

A mass balance is a systematic methodology used for tracking the flow of materials through for example, a country, region, city or organisation. The outcomes of a mass balance analysis provide an opportunity for a better understanding of how and where to target activities to manage material consumption and minimisation (see Linstead & Ekins, 2001 and Linstead *et al.*, 2003).

The NHS mass balance is an estimated balance of resources in the NHS in England and Wales, during 2001. The following areas were analysed:

- **Direct energy:** Electricity, gas, fuel and any other source of energy consumed.
- **Products:** Finished products (including pharmaceuticals) consumed.
- **Food:** Food consumed.
- **Waste:** Domestic, clinical and special waste generated.
- **Transport:** Staff, patient, visitor and freight transport.
- **Water:** Water consumed and sewage generated.
- **Land:** Land use.
- **Emissions to air.**

Areas of interest have been presented in boxes, as vignettes, throughout the mass balance section. These include descriptions and interesting findings on pharmaceuticals, blood donation, food waste, medicinal waste in the community and CO_2 emissions associated with the transport of NHS product imports.

Wherever possible, and data permitting, findings have been presented by trust type. However, it must be stressed that the number of facilities per trust type vary, and this can skew a direct comparison of tonnes consumed or generated per trust type.

Figure 1 presents summary mass balance data for the NHS in England and Wales, by mass, in 2001. In order to create a complete mass balance, gases which are extracted from the air for the combustion of fuels and other uses, must be included (Biffaward, 2003). For this mass balance study, oxygen has been included and is reported in Figure 1.

Main data sources

Wherever possible, the mass balance analysis utilised primary data relating to the NHS in England and Wales. However, in some instances the data did not exist, and national UK data was used to derive figures for England and Wales. Below, is a brief description of the main data sources used for each component.

Energy

Data was obtained from NHS Estates and Welsh Health Estates Return Information Collection (ERIC) returns, and the NHS Purchasing and Supply Agency (NHS PASA).

Products

ProdCom (a database identifying the production, consumption, export and import of products in the UK) was employed, and the estimated consumption of products by the NHS in England and Wales was derived from this database. Primary data gathered from five case study facilities were also used (see Appendix A).

Food

Food data was available for food delivered by NHS Logistics and consolidated distribution arranged by NHS PASA. Food is reported in Department for Environment, Food & Rural Affairs (DEFRA) *Food Survey* categories.

Waste

The majority of waste data was obtained from NHS Estates and Welsh Health Estates ERIC returns.

Transport

Data was obtained from selected trusts, and in some instances proxied down from Department for Transport (DfT) figures, which collects data on travel per person by mode and by purpose.

Water

Water and sewage data was obtained from NHS Estates and Welsh Health Estates ERIC returns.

Built land

Total land area, including car parks, was derived from NHS Estates and Welsh Health Estates ERIC returns.

Air emissions

Data was derived from Department of Trade & Industry (DTI) using National Air Emissions Inventory (NAEI) conversions.

Note: Data obtained from ERIC data sources has been presented by trust type. If data was not obtained from ERIC, this representation was not possible, for example products.

Note: A detailed methodology explaining data, and assumptions used to derive figures of consumption, for the NHS in England and Wales can be found on pages 41-56.

Figure 1: Summary mass balance for the NHS in England and Wales, by mass, in 2001

Inputs (products)	tonnes
Medical & surgical equipment	416,426
Medical & surgical supplies	51,598
Kitchen equipment	11,780
Textiles	36,462
Printing & stationery	180,990
Building & engineering equipment	118,191
Laundry & cleaning equipment	69,865
Laboratory equipment	263,617
Furniture, office & computer equipment	186,676
Total	**1,335,605**

Inputs (food)	tonnes
NHS PASA contracts (supplier deliveries)	9,053
NHS PASA contracts (logistic deliveries)	13,314
Consolidated contracts	13,846
Ad-hoc purchases	17,042
Total	**53,256**

Inputs (water)	tonnes
Total	**49,849,628**

Inputs (energy)	tonnes
Brown grid electricity*	240,866
Gas	589,391
Oil	67,926
Coal	97,946
Renewable grid electricity*	39,538
Total	**1,035,668**

Inputs (oxygen)	tonnes
Total	**2,145,711**

Stock build up	tonnes
Total	**1,004,162**

Outputs (waste)	tonnes
Domestic waste	261,086
Clinical waste	120,547
Special waste	3,064
Total	**384,698**

Outputs (water & sewage)	tonnes
Leakage	7,163,788
Sewage	42,685,840
Total	**49,849,628**

Emissions to air	tonnes
Carbon Dioxide (CO_2)	3,169,176
Methane (CH_4)	172
Nitrous Oxide (N_2O)	54
Nitrogen Oxides (NO_x)	4,103
Carbon Monoxide (CO)	1,325
Volatile Organic Compounds (VOC)	198
Sulphur Dioxide (SO_2)	5,139
Particles (PM10)	925
Black Smoke (BSq)	287
Total	**3,181,379**

* Tonnes of oil equivalent.

Note: Data on fuels consumed, and associated CO_2 emissions, for transport was not available, therefore not reported.

Note: Oxygen input refers to the gas extracted from the air for the combustion of fuels. It does not refer to oxygen as a medical gas, which is included in 'medical & surgical supplies'.

Note: Information on how the individual input, stock and output components were derived is in the Methodology: Mass Balance section (page 41-56).

Direct energy

Brown grid

Energy supplied from fossil fuel sources, such as coal and gas, to the National grid.

Renewable grid

Energy supplied from renewable sources, such as wind, wave and solar, to the National grid. It is also commonly referred to as 'green grid'.

The NHS in England and Wales consumed an estimated total of 12,650 GWh of energy in 2001 - at a cost of £258 million. This energy was largely produced from gas (62%). Brown grid electricity supplied 22% of energy, while renewable electricity contributed the least, at 4% of the total amount of energy consumed.

Acute and other hospital trusts consumed 66% of the total direct energy, while Primary Care Trusts (PCT's) consumed only 0.04%. Large acute and teaching hospital trusts consumed the largest quantity of electricity, both at 19% each of total brown grid electricity consumed by the NHS in England and Wales. Acute trusts consumed the largest quantities of total renewable grid electricity (45%), oil (53%) and coal (53%). 'Other hospital trusts' consumed the greatest amount of gas (42%). PCT's consumed the smallest quantities of brown grid (4%) and renewable grid electricity (1.5%), gas (4.6%) and coal (2%).

Table 1 and Figure 2 provide a detailed breakdown of energy consumption, by fuel type. Quantities of energy sourced from onsite or local combined heat and power (CHP), central processing units (CPU) and other locally supplied electricity, steam and hot water are illustrated in Table 2. However, it must be stressed that the number of facilities per trust type vary and this can skew a direct comparison of energy consumed.

Table 1: Direct energy consumed by the NHS in England and Wales, by fuel type and trust type, in 2001 (GWh)

Trust type	Brown grid electricity	Renewable grid electricity	Gas	Oil	Coal	Total energy
Total direct energy	**2,801**	**460**	**7,809**	**897**	**682**	**12,650**
Acute	1,037	206	2,845	473	360	4,921
of which...						
Large	540	104	1,345	271	241	2,501
Medium	277	51	919	131	31	1,409
Small	220	51	581	71	88	1,012
Community	420	26	956	72	25	1,498
of which...						
Large	176	17	526	52	22	793
Medium	171	9	352	19	3	554
Small	73	**	77	1	**	151
Other hospital trusts	1,022	174	3,269	239	256	4,959
of which...						
Multi-service	381	26	1,193	138	106	1,844
Teaching	540	138	1,850	74	150	2,752
Specialist	58	5	123	9	**	196
Children's	29	**	54	0	**	83
Orthopaedic	14	5	49	18	**	85
Other trusts	210	15	377	50	30	682
of which...						
Ambulance	66	**	73	5	**	145
Mental health	136	15	280	43	30	503
Learning disability	8	**	25	1	**	34
PCTs	113	7	363	64	12	558
Other*	**	32	**	**	**	32

****** No data available. **Other*** Data that could not be assigned to a trust type.

Note: Energy sourced from combined heat & power (CPU), central processing units (CPU) and other locally supplied electricity, steam and hot water are included in the totals above. Table 2 illustrates the quantities of energy produced from these sources.

Sources: NHS Estates, 2002a, NHS PASA, 2002a and Welsh Health Estates, 2002.

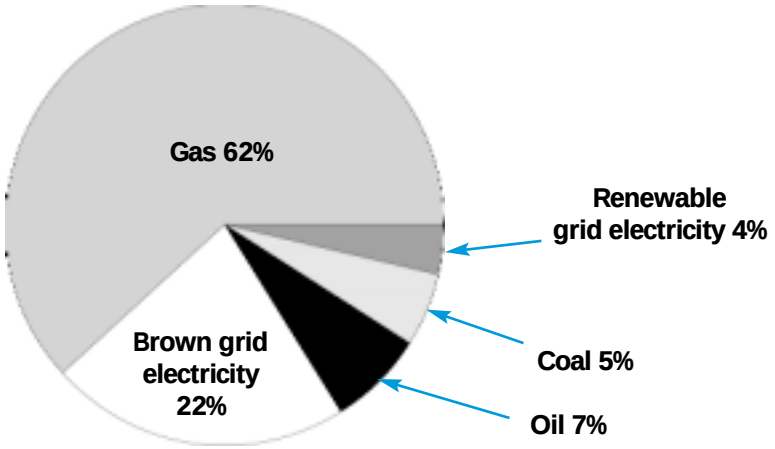
Table 2: Locally produced energy consumed by the NHS in England and Wales, by source, in 2001

Energy source	GWh
Total energy	**2,343**
Locally supplied electricity, steam & hot water	821
CHP units	803
CPU	719

Note: This data has been included in Table 1.

Sources: NHS Estates, 2002a and Welsh Health Estates, 2002.

Figure 2: Breakdown of energy consumption by the NHS in England and Wales, by fuel type, in 2001



Sources: NHS Estates, 2002a; NHS PASA, 2002a and Welsh Health Estates, 2002.

Products

In 2001, the NHS in England and Wales consumed an estimated 1.3 million tonnes of products (excluding construction materials (see Appendix B) and vehicles). Medical & surgical equipment had the highest total weight (416,426 tonnes, or 31% of total products consumed). Medical & surgical supplies, such as pharmaceuticals and gases, weighed 51,598 tonnes (4% of the total products consumed).

The NHS in England and Wales spent an estimated £11.6 billion on products in 2001, with highest spend on medical & surgical supplies (73% of total product spend). This is primarily due to the high cost of pharmaceuticals. Table 3 summarises product consumption and estimated expenditure, by the NHS in England and Wales, in 2001.

Table 3: Products consumed by the NHS in England and Wales, by type and spend, in 2001

Product type	Consumption (tonnes)	% of total products consumed	Expenditure (£000s)	% of total expenditure
Total products	**1,335,605**	**100%**	**11,593,979**	**100%**
Medical & surgical equipment	416,426	31%	1,865,001	16%
of which...				
Appliances	88,504	7%	326,896	3%
Orthotics	33,327	2%	60,000	1%
Ultrasound scanners	18,330	1%	33,000	<1%
X-ray equipment	443	<1%	33,025	<1%
Other medical & surgical equipment	275,822	21%	1,412,080	12%
Furniture, office & computer equipment	186,676	14%	331,667	3%
Laboratory equipment	263,617	20%	267,530	2%
Printing & stationery	180,990	14%	237,758	2%
Building & engineering equipment	118,191	9%	149,179	1%
Laundry & cleaning equipment	69,865	5%	79,889	1%
Medical & surgical supplies	51,598	4%	8,485,071	73%
of which...				
Pharmaceuticals	12,267	1%	8,067,789	70%
X-ray film & chemicals	11,449	1%	58,320	1%
Dressings	10,444	1%	106,964	1%
Medical gases	5,367	<1%	15,000	<1%
Other clinical supplies	12,072	1%	236,999	2%
Textiles	36,462	3%	163,199	1%
of which...				
Bedding & linen	24,476	2%	70,780	1%
Uniforms & clothing	11,985	1%	92,419	1%
Kitchen equipment & supplies	11,780	1%	14,684	<1%

Note: The above total does not include construction materials (see Appendix B) and vehicles owned or rented by the NHS in England and Wales.
Sources: Derived from Datta, 1999; DH, 2001 & 2001a and 2003; NHS PASA, 2003b & e; ONS, 2001 and TFR, 2002.

Pharmaceuticals

The estimated total weight of pharmaceuticals consumed by the NHS in England and Wales, in 2001, was 12,267 tonnes, with an average pharmaceutical unit (for example, a tablet) weighing approximately 1.46g. Pharmaceuticals were the single largest area of spend on products, over £8 million.

Over 601,000 pharmaceutical items were dispensed in the community as GP prescriptions, in England and Wales, in 2001. This equates to almost 900 tonnes, at an estimated cost of £6.2 billion. Table 4 provides a breakdown of pharmaceuticals dispensed in the community, by British National Formulary (BNF) chapter. The most common pharmaceuticals prescribed were for cardio vascular and central nervous system illnesses.

Table 4: Pharmaceuticals dispensed in the community as GP prescriptions in England and Wales, by BNF chapter, in 2001

BNF chapters	Cost (£000s)	Total items dispensed (000s)	Total weight of items dispensed (tonnes)
Total	**6,232,345**	**601,437**	**880**
Cardiovascular system	1,489,924	149,203	218
Central nervous system	1,059,977	112,800	165
Respiratory system	659,136	51,078	75
Gastro-intestinal system	597,741	46,548	68
Endocrine system	587,243	44,655	65
Musculoskeletal & joint diseases	235,296	29,120	43
Infections	223,304	42,574	62
Nutrition & blood	223,736	17,368	25
Malignant disease & immunosuppression	217,240	4,499	7
Skin	180,857	33,852	50
Obstetrics, gynaecology & urinary-tract disorders	161,339	14,430	21
Dressings	115,849	9,697	14
Immunological products & vaccines	110,071	12,881	19
Stoma appliances	108,064	2,163	3
Eye	90,178	13,657	20
Appliances	71,972	4,891	7
Ear, nose & oropharynx	54,228	9,273	14
Incontinence appliances	33,184	1,188	2
Other drugs & preparations	10,135	751	1
Anaesthesia	2,871	805	1
Preparations used in diagnosis	1	6	0.01

Sources: BNF, 2002 and derived from DH, 2001a & 2001b.

Blood donation

There are 1.9 million blood donors (5% of the population) on the National Blood Service register, donating over 2.4 million pints of blood per annum. At approximately 475ml per unit per donation, this equates to 1,140,000 litres of blood per annum. In 2000, over 93% of blood donations were used for clinical purposes, with red cell wastage of 0.56%.

National and Welsh Blood Services issued 2,359,599 red blood cell units, 420,069 units of fresh frozen plasma and 222,296 units of adult platelets in 2001. Vehicles used in the collection and distribution of blood products travelled approximately 653,254 kilometres, and consumed 76,000 litres of diesel. The National Blood Service (which operates in England and North Wales) makes about 200,000 deliveries per annum.

At Welsh blood collections in 2001, donors consumed 3,246 litres of orange juice and 2,688 litres of squash. Over 22,300 cups of hot drinks were served, 61kg of instant coffee and 56,700 tea bags, this was sweetened with 66,000 sachets of sugar. Donors also consumed almost 3 tonnes of biscuits.

Sources: Hancock, 2003; Hartley, 2003; National Audit Office, 2000; National Blood Service, 2001 & 2003 and Rutherford, 2003.

Construction materials

It was initially hoped that this study would be able to quantify construction materials consumed by the NHS in England and Wales in 2001, and calculate the ecological footprint associated with this construction. It became evident, mainly due to a lack of appropriate data that this would be difficult to achieve within the time frame of the project. However, an attempt was made to derive a total amount of construction materials consumed. The difficulties and outcomes of this attempt are described in Appendix B.

Further information on Private Finance schemes and the NHS is available at www.materialhealth.com

Food

Food consumption in the NHS has dietary and health implications. It was not within the remit of this report to investigate this issue. The data presented below, and analysed in this study, concentrated on the quantities of food consumed by staff, patients and visitors and does not make comment on diet or health implications thereof.

In 2001, the NHS in England and Wales consumed an estimated 53,256 tonnes of food, at an approximate cost of £250 million. Over two-thirds of all food procured by the NHS was through NHS PASA arranged contracts, while the remainder was independently sourced by individual trusts (the one area where there was no data). A breakdown of different food types consumed by the NHS in England and Wales are listed in Table 5.

The two largest categories of food consumed were milk & cream (14,110 tonnes, or 26% of total food consumed) and soft drinks & beverages (13,764 tonnes, or 26%). The third largest category was sugar & preserves, which accounted for 12% of total food consumed. The majority of the milk & cream category was composed of dried milk. Within soft drinks - squash, cordials & fruit drinks constituted 51%, or 13% of total food consumed. Fish, bread, eggs and alcoholic drinks were the lowest weights of foods consumed, ranging between 0.04% and 0.1% of total food consumed respectively.

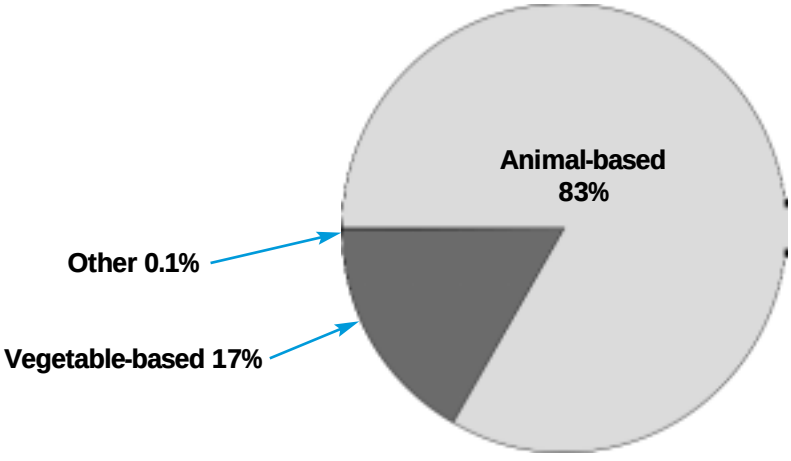
In order to calculate the environmental impact associated with food consumption, it is important to identify the main ingredient of the product - whether it is animal or vegetable-based. Animal-based products have a far greater environmental impact, as more processes are required (such as feeding an animal) to get a product to the 'table' (see page 24 for the ecological footprint associated with food consumption). Animal-based products made up 83% of all food consumed by the NHS in England and Wales, in 2001 (see Figure 3).

Table 5: Food consumed by the NHS in England and Wales, by type, in 2001

Food type	Tonnes	% of total food consumed
Total food	**53,256**	**100%**
Milk & cream	14,110	26%
Cheese	143	<1%
Meat	137	<1%
Fish	23	<1%
Eggs	39	<1%
Fats & oils	1,143	2%
Sugar & preserves	6,397	12%
Vegetables	1,148	2%
of which...		
Fresh vegetables (incl. potatoes)	1,102	2%
Processed vegetables	46	<1%
Fruit	252	<1%
Cereals	6,249	12%
of which...		
Bread	29	<1%
Other cereals (incl. wheat)	6,220	12%
Soft drinks & beverages	13,764	26%
Alcoholic drinks	49	<1%
Confectionary	4,869	9%
Prepared meals	1,725	3%
Other	3,206	6%

Note: Includes food consumed by staff, patients and visitors.
Note: Milk & cream includes dried milk.
Sources: NHS Logistics, 2003 & NHS PASA, 2003a.

Figure 3: Breakdown of food consumption by the NHS in England and Wales, by main ingredient base, in 2001



Note: Other includes pre-prepared meals, of which the contents is undisclosed.
Sources: NHS Logistics, 2003 & NHS PASA, 2003a.

Waste

This section focuses on waste generated by the NHS in England and Wales. It does not include health care waste generated in the community or home.

In 2001, the NHS in England and Wales generated an estimated 384,698 tonnes of waste (see Figure 4), of which:

- 261,086 tonnes was domestic waste.
- 120,547 tonnes clinical and 3,063 tonnes special waste.

Domestic waste

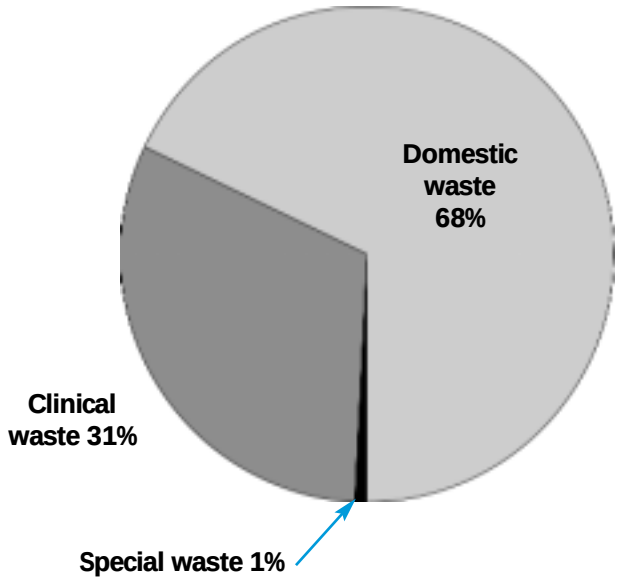
Domestic waste in this study includes general ward waste, such as newspapers, magazines, dead flowers, boxes, paper towels etc; waste from office areas, public toilets and corridors; and kitchen waste from main and ward kitchens. It excludes clinical and special waste (see Appendix C).

Table 6: Domestic waste generated by the NHS in England and Wales, by trust type, in 2003

Trust type	Tonnes	% of total domestic waste
Total domestic waste	**261,086**	**100%**
Acute	85,690	33%
of which...		
Large	42,697	16%
Medium	34,023	13%
Small	8,970	3%
Community	22,019	8%
of which...		
Large	12,930	5%
Medium	2,747	1%
Small	6,342	2%
Other hospital trusts	66,933	26%
of which...		
Multi-service	22,191	8%
Teaching	38,354	15%
Specialist	4,081	2%
Children's	1,624	1%
Orthopaedic	683	<1%
Other trusts	27,255	10%
of which...		
Ambulance	5,002	2%
Mental health	20,816	8%
Learning disability	457	<1%
Care trust	980	<1%
PCTs	59,189	23%

Source: NHS Estates, 2003 and Welsh Health Estates, 2003.

Figure 4: Total waste generated by the NHS in England and Wales, by waste type



Source: NHS Estates, 2002a & 2003 and Welsh Health Estates, 2002 & 2003.

In 2003, the NHS in England and Wales generated an estimated 261,086 tonnes of domestic waste at an estimated disposal cost of £15 million. This represents 1% of all municipal waste generated in England and Wales (DEFRA, 2003b and National Assembly for Wales, 2003). The greatest proportion of domestic waste was generated by acute trusts (33% of total domestic waste). PCT's and teaching trusts produced the second and third largest quantities of waste (23% and 15% respectively). In comparison, learning disability and orthopaedic trusts generated the least domestic waste (ranging between 0.1 to 0.3% of total domestic waste). However, it must be stressed that the number of facilities per trust type vary and this can skew a direct comparison of domestic waste generated (see Table 6).

Composition and management

Only 1.8% (4,748 tonnes) of domestic waste generated by the NHS in England and Wales, in 2001, was recycled. Multi-service trusts recycled the largest proportion of their domestic waste (3.5% of 22,191 tonnes). The lowest recycling rate was 0.5%, achieved by both medium community and children's trusts (see Table 7).

Table 7: Recycling of domestic waste generated by the NHS in England and Wales, by trust type, in 2003

Trust type	Tonnes	Recycled or reused (tonnes)	% recycling rate by trust type
Total domestic waste	**261,086**	**4,748**	**1.8%**
Acute	85,690	1,504	1.8%
of which...			
Large	42,697	775	1.8%
Medium	34,023	619	1.8%
Small	8,970	109	1.2%
Community	22,019	299	1.4%
of which...			
Large	12,930	174	1.3%
Medium	2,747	15	<1%
Small	6,342	110	1.7%
Other hospital trusts	66,933	1,306	2%
of which...			
Multi-service	22,191	767	3.5%
Teaching	38,354	455	1.2%
Specialist	4,081	57	1.4%
Children's	1,624	8	<1%
Orthopaedic	683	19	2.8%
Other trusts	27,255	318	1.2%
of which...			
Ambulance	5,002	49	1%
Mental health	20,816	230	1.1%
Learning disability	457	13	2.8%
Care trust	980	26	2.7%
PCTs	59,189	1,322	2.2%

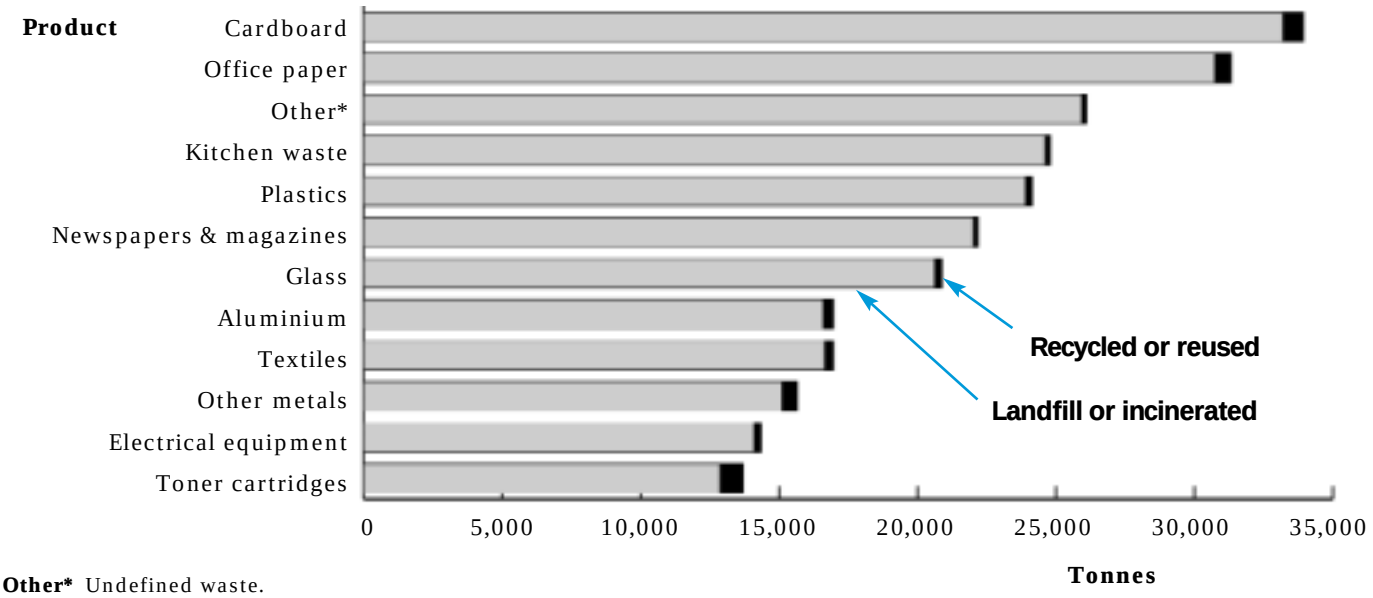
Sources: NHS Estates, 2003 and Welsh Health Estates, 2003.

The composition and management of the domestic waste generated by the NHS in England and Wales, in 2003 is illustrated in Figure 5.

Despite almost all components of the domestic waste having the potential to be recycled or reused in some way, 98% (256,338 tonnes) was landfilled or incinerated. Toner cartridges and metals (including aluminium) were the most recycled products, at 6% each of volume generated. Kitchen waste and newspapers & magazines were the least recycled products, at 0.8% each of volume generated (see Table 28).

A third of the total domestic waste generated was paper-based products (such as cardboard, office paper, newspaper and magazines (87,464 tonnes)).

Figure 5: Composition and management of domestic waste generated by the NHS in England and Wales, in 2003



Other* Undefined waste.
Sources: NHS Estates, 2003, NHS PASA, 2003d and Welsh Health Estates, 2003.

Paper and tissue products in the NHS

The Waste and Resources Action Programme (WRAP) is a major Government programme established to promote sustainable waste management by tackling the barriers to waste minimisation and increased recycling. One of WRAP's aims is to increase the market for recycled materials and as part of this initiative is investigating the procurement and use of paper and tissue products in the NHS.

The WRAP project team, in partnership with colleagues at the NHS Purchasing and Supply Agency, has commissioned a research study to examine the current position in relation to the procurement and use of recycled content in various paper and tissue products used in the NHS.

Specifically the project hopes to:

- Understand the scale of paper & tissue product procurement in the NHS.
- Examine the recycled content of current paper & tissue purchases.
- Identify opportunities to increase sales of products with higher recycled content.

Further information on this project can be obtained from WRAP's website www.wrap.org.uk.

Food waste

The NHS provides over 300 million meals each year at a cost of £500 million. It is therefore essential that food management in hospitals is effective. If it is not handled properly, there is potential to waste resources, which could be used to improve the quality, presentation and standards of food for all patients in hospital. A *Better Hospital Food* programme has been implemented to provide advice and support for hospitals with regards to meals. Further information on this initiative is available at www.betterhospitalfood.com.

Reducing food waste in the NHS

Food waste is a concern within the NHS. Of the 300 million meals served each year, an average of 10% is wasted. The percentage of food wasted varies from trust to trust. Of all meals served in children's trusts, 26% is wasted - this is the highest ratio of food wasted per meal served of all the trusts. Specialist trusts, at 6%, have the lowest ratio of food wasted. Table 8 shows the tonnage of meals served by trust type, in relation to the quantity and percentage of meals wasted. These figures illustrate the NHS' concern about food waste. In response, NHS Estates, in conjunction with the Hospital Caterers Association, have published a good practice guide - *Reducing Food Waste in the NHS* - which is an index of good practice guidance for the management of food waste in NHS hospitals (NHS Estates, 2000a).

Table 8: Meals served and meals waste in the NHS in England and Wales, by type, in 2001

Trust type	Total meals served (tonnes)	Total meals wasted (tonnes)	% of total meals wasted per trust type
Total meals	**54,646**	**5,440**	**10%**
Acute	20,911	1,959	9%
of which...			
Large	9,686	858	9%
Medium	5,973	565	9%
Small	5,252	536	10%
Community	10,961	1,140	10%
of which...			
Large	5,432	569	10%
Medium	4,515	444	10%
Small	1,014	127	13%
Other hospital trusts	19,961	2,129	11%
of which...			
Multi-service	7,647	790	10%
Teaching	7,488	719	10%
Specialist	424	24	6%
Children's	130	34	26%
Orthopaedic	4,272	562	13%
Other trusts	269	34	13%
of which...			
Ambulance	*	*	
Mental health	48	5	10%
Learning disability	221	29	13%
PCTs	2,544	178	7%

Note: Data represented in this table was included in the overall domestic waste generated as 'kitchen waste' (Figure 5).
Source: NHS Estates, 2002a and Welsh Health Estates, 2002.

Clinical and special waste

For the purposes of this study, clinical waste includes all waste as defined in *The Controlled Waste Regulations 1992* (SI 1992 no.588)(Crown, 1992) (see Appendix C). It does not include domestic or special waste. Further information on clinical waste and the NHS is available at www.materialhealth.com. Special waste includes all waste as defined in *The Special Waste Regulations 1996* (Crown, 1996) (see Appendix C). It does not include domestic or clinical waste.

In 2001, the NHS in England and Wales generated an estimated 123,611 tonnes of clinical and special waste, of which 120,547 tonnes was clinical and 3,064 tonnes was special waste. Large acute trusts generated the most clinical waste, over 30,000 tonnes (25% of total clinical waste). Teaching trusts generated the second highest, 28,000 tonnes (24% of total clinical waste). As with domestic waste, it is stressed that the number of facilities per trust type vary and this can skew a direct comparison of clinical and special waste generated. Table 9 shows a breakdown of clinical and special waste generated by the NHS in England and Wales, by trust type, in 2001.

Table 9: Clinical and special waste generated by the NHS in England and Wales, by trust type, in 2001

Trust type	Clinical waste (tonnes)	% of total clinical waste	Special waste (tonnes)	% of total special waste
Total clinical waste	**120,547**	**100%**	**3,064**	**100%**
Acute	53,290	44%	1,126	37%
of which...				
Large	30,694	25%	664	22%
Medium	16,093	13%	405	13%
Small	6,503	5%	57	2%
Community	9,488	8%	182	6%
Other hospital trusts	50,784	42%	1,197	39%
of which...				
Multi-service	18,825	16%	645	21%
Teaching	28,356	24%	436	14%
Specialist	1,930	2%	83	3%
Children's	1,079	1%	26	1%
Orthopaedic	594	<1%	7	<1%
Other trusts*	2,696	2%	502	16%
PCTs	4,289	4%	58	2%

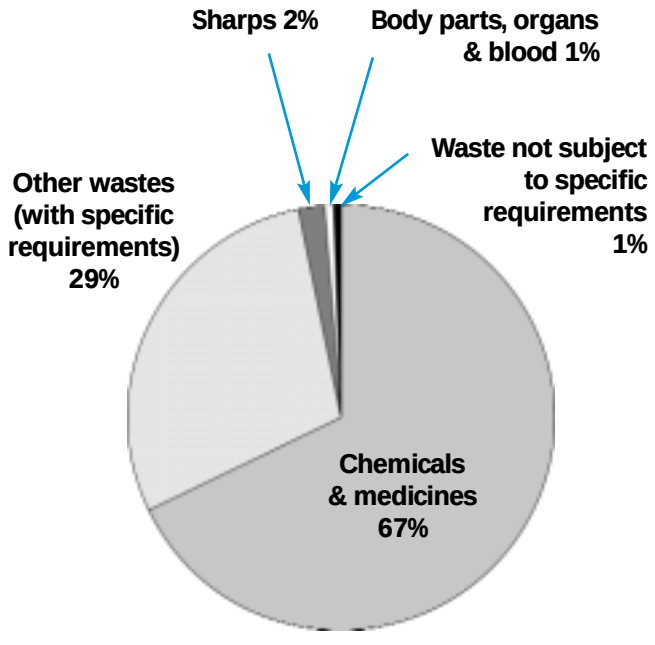
***** Other trusts include: Ambulance, mental health and learning disability trusts.
Source: NHS Estates 2002a and Welsh Health Estates, 2002.

Composition and management

The composition of clinical and special waste generated by the NHS in England and Wales was estimated using data reported by the Environment Agency's *Hazardous Waste Interrogator* (2003b). This breakdown is illustrated in Figure 6. It was estimated that chemicals and medicines represent 67% of all clinical and special waste generated, while body parts and organs constitute only 1%.

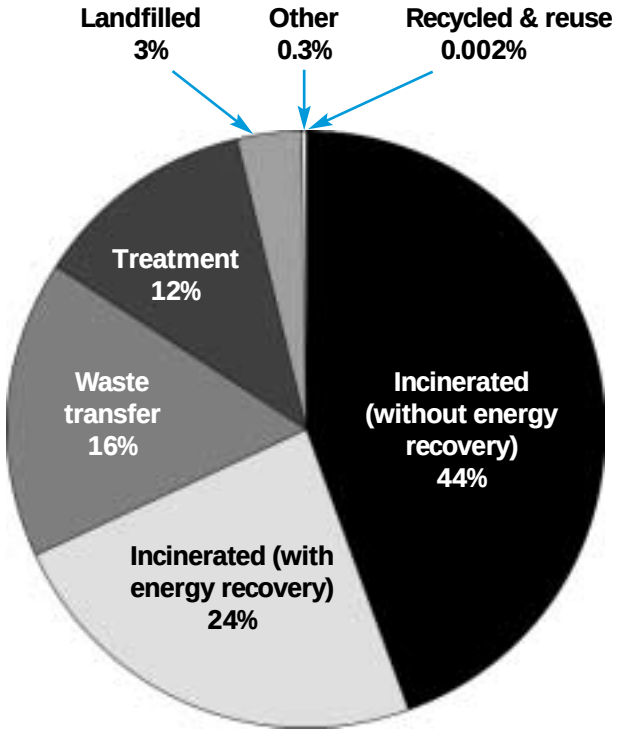
Incineration was the most common method for managing clinical and special waste, of which 45% was incinerated without energy recovery and 24% incinerated with energy recovery. Only 0.002% of clinical and special waste was recycled. This illustrates the complex nature (health and safety, and cost) of recycling this waste. In terms of waste management, it cost on average, £348 to dispose one tonne of clinical waste in 2001. Figure 7 illustrates the estimated breakdown of clinical and special waste, by management method, for NHS trusts in England and Wales in 2001.

Figure 6: Estimated composition of clinical and special waste generated by the NHS in England and Wales, in 2001



Source: Derived from Environment Agency, 2003a; NHS Estates, 2002a and Welsh Health Estates, 2002.

Figure 7: Clinical and special waste in the NHS in England and Wales, by estimated management method, in 2001



Note: National clinical waste management methods were assumed for the NHS. This assumption includes community clinical waste, which could be landfilled.
Source: Derived from Environment Agency, 2003a; NHS Estates, 2002a and Welsh Health Estates, 2002.

A waste of medicine

A wasted medicine is one that is prescribed but never used. Approximately 750 million prescriptions are issued by GP's and hospitals annually, with an annual growth rate of 10%. Of these prescriptions, 480 tonnes of medicines are wasted in England per annum, with a value of almost £100 million. This is an estimated wastage of 10-12% of medicines prescribed. It is also estimated that a fifth of all prescriptions are returned to pharmacies unopened, of this 80% are unused repeat prescriptions.

In 2001, households in England and Wales generated approximately 36,000 tonnes of clinical waste. This clinical waste includes both medication prescribed by the NHS and off-the-shelf purchases (non-NHS), such as aspirin.

Sources: CIPFA, 2002; CWN, 2000; Fox, 2003; Harris, 2002; Mansfield District PCT, 2003; NHS Wales, unknown; Northumberland Care Trust, 2003; ONS, 2002 and RPSGB, 1998.

Transport

Staff, patient and visitor transport

NHS staff, patients and visitors in England and Wales travelled an estimated 25 billion passenger kilometres (pass-km) in 2001. This represents 4% of total passenger kilometres covered in the UK (DfT, 2002c). Staff travel included both commuting and business travel. The most common mode of transport used was car & van, with almost 21 billion pass-km travelled (or 83% of total travel). 3% of staff, patients and visitors walked to and from NHS facilities, with only 0.03% of distance covered by bicycle. Of the 25 billion pass-km travelled, 70% was by visitors, 25% by patients and 5% by staff. Table 10 provides a breakdown of passenger travel associated with the NHS in England and Wales, by mode, in 2001.

Table 10: Travel by staff, patients and visitors associated with the NHS in England and Wales, by mode, in 2001

Mode	Pass-km ('000s)	% of total pass-km
Total passenger kilometres	**24,955,555**	**100%**
Car & van	20,763,443	83%
Bus & coach	1,071,904	4%
Motorbike	7,989	<1%
Rail	1,447,358	6%
Walk	677,718	3%
Cycle	7,456	<1%
Other	979,688	4%

Note: The Department for Transport's *National Travel Survey* (DfT) figures include data on travel per person by mode and by purpose, including staff commuting patterns.
Sources: DfT, 1999, 2001 & 2002c and Merry, 2002.

Ambulances

Ambulances (including air) travelled almost 264 million vehicle kilometres (veh-km) in England and Wales during 2001. Air ambulances contributed 0.3% to the total distance travelled by all ambulance types (see Table 11).

Freight transport associated with NHS imports

The total tonnage of products purchased by the NHS in England and Wales in 2001 was 1.3 million tonnes. These products were moved a total distance of 7.1 billion tonne-kilometres (t-km). Shipping accounted for 90% of all trade related transport, and road freight a large proportion of the remainder[1]. Total CO_2 emissions produced by freight transport for the NHS in England and Wales in 2001 was approximately 224,537 tonnes[2]. Table 12 shows the estimated distance travelled by the products to the UK and within the UK, by mode and associated CO_2 emissions.

Table 12: Products moved and associated CO_2 emissions for imports destined for the NHS in England and Wales, in 2001

Mode	tonne-km (000's)	% of total tonne-km	CO_2 emissions (tonnes)	% of total CO_2 emissions
Total	**7,078,707**	**100%**	**224,537**	**100%**
Road	707,871	10%	120,338	54%
Ship	6,300,049	89%	63,000	28%
Ferry	19,113	<1%	765	<1%
Rail	2,831	<1%	85	<1%
Air	70,787	1%	40,349	18%

Note: Due to rounding totals may not add up.
Source: Derived from HM Customs and Excise, 2003.

1 Each mode of transport produces differing quantities of carbon dioxide (CO_2) emissions. A lorry, for example, produces 17 times more CO_2 than intercontinental shipping, and long-haul airfreight releases 57 times more CO_2 than shipping.

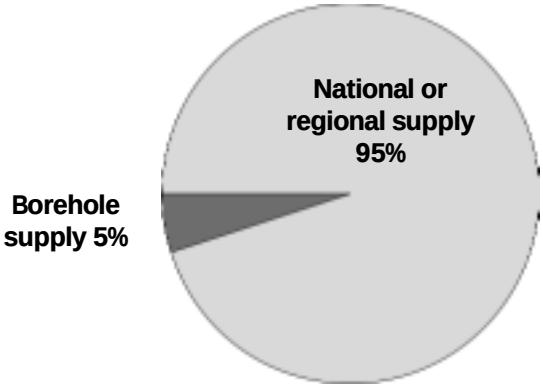
2 CO_2 emissions are allocated to the NHS by considering the tonnage of products that were required. Therefore, if the NHS consumes the product, they are responsible for the CO_2 emissions from freight to deliver it.

Table 11: Ambulance and air ambulance travel associated with the NHS in England and Wales, by mode, in 2001

Mode	Veh-km ('000s)	% of total vehicle-km
Total vehicle kilometres	**263,648**	**100%**
Ambulance	262,737	99.7%
Helicopter	911	<1%

Note: Distances travelled by ambulances (including air) were only available in vehicle-kilometres (veh-km) and not pass-km. For this reason, it is reported separately from Table 10.
Sources: Derived from Relf, 2003; DfT, 1999 & 2002; Kent Air Ambulance Trust, 2003; Wales Air Ambulance Charitable Trust, 2003 and Yorkshire Air Ambulance Trust, 2003.

Figure 8: Water consumption by the NHS in England and Wales, by source, in 2001



Source: NHS Estates, 2002a and Welsh Health Estates, 2002.

Water

In 2001, the NHS in England and Wales consumed an estimated 49.8 billion litres of water (49,850 megalitres). Large acute and teaching trusts consumed the largest quantities of water at 8,554 megalitres (17% of total water) and 8,146 megalitres (16%) respectively (see Table 13). It must be stressed that the number of facilities per trust type vary and this can skew a direct comparison of water consumption by trust type.

Sewage and leakage

The NHS in England and Wales produced approximately 42.6 billion litres of sewage (waste water) in 2001. Sewage also includes grey water produced from laundry and other washing activities. Large acute, teaching and multi-service trusts generated the largest volumes of sewage - 17%, 15% and 14% respectively of total sewage (Table 13). Of the total water supplied to the NHS in England and Wales during 2001 (49,850 megalitres), 86% leaves the facilities as sewage (see Table 13). The remaining 14% could have been lost for example, through leakage or released back into the water cycle during activities such as watering of the estates. Of the 49,850 megalitres of water consumed, 95% was delivered through national or regional suppliers, while the remaining 5% was sourced from boreholes (either owned or managed by the NHS or from another organisation) (see Figure 8).

Table 13: Water consumption and sewage generated by the NHS in England and Wales, by trust type, in 2001

	Water consumed			Sewage generated		
Trust type	**Volume (megalitres)**	**Tonnes**	**% of total volume**	**Volume (megalitres)**	**Tonnes**	**% of total sewage**
Total	**49,850**	**49,849,628**	**100%**	**42,686**	**42,685,840**	**100%**
Acute	16,988	16,988,184	34%	14,501	14,501,217	34%
of which...						
Large	8,554	8,554,384	17%	7,163	7,163,439	17%
Medium	4,991	4,991,285	10%	4,358	4,358,386	10%
Small	3,443	3,442,515	7%	2,979	2,979,392	7%
Community	9,743	9,742,622	20%	8,579	8,579,317	20%
of which...						
Large	4,643	4,642,580	9%	3,911	3,911,478	9%
Medium	3,735	3,734,769	7%	3,514	3,514,480	8%
Small	1,365	1,365,272	3%	1,153	1,153,359	3%
Other hospital trusts	16,196	16,195,611	32%	13,366	13,366,478	31%
of which...						
Multi-service	7,022	7,022,243	14%	6,027	6,027,195	14%
Teaching	8,146	8,145,502	16%	6,413	6,413,417	15%
Specialist	515	515,070	1%	467	466,642	1%
Children's	292	291,701	1%	268	268,311	1%
Orthopaedic	221	221,096	<1%	191	190,914	<1%
Other trusts	5,243	5,243,123	11%	4,731	4,731,338	11%
of which...						
Ambulance	1,784	1,783,713	4%	1,575	1,574,710	4%
Mental health	3,066	3,066,093	6%	2,871	2,870,846	7%
Learning disability	393	393,317	1%	286	285,783	1%
PCTs	1,680	1,680,087	3%	1,507	1,507,489	4%

Note: Tables may differ due to rounding.
Source: NHS Estates, 2002a and Welsh Health Estates, 2002.

Land use

The total physical land area occupied by the NHS in England and Wales, in 2001, was 33,654 hectares (ha), of which car parks represented 567 ha (2% of the total land area). Of all the trust types, PCT's occupied the largest land area 11,632 ha (35% of total land area), however, only 0.4% of their land area was taken up by car parks. In comparison, 17% of total land area occupied by children's trusts was car parks, even though this trust type occupied the smallest area of total land (0.04%) (Table 14).

Table 14: Land use, including car parks, by the NHS in England and Wales, by trust type, in 2001

Trust type	Car parks (ha)	Car parks as % of trust type land area	Total land area (ha)	% of total land area
Total land area	**567**	**2%**	**33,654**	**100%**
Acute	208	7%	2,851	8%
of which...				
Large	104	7%	1,412	4%
Medium	62	8%	815	2%
Small	43	7%	624	2%
Community	101	1%	7,741	23%
of which...				
Large	45	3%	1,737	5%
Medium	40	3%	1,255	4%
Small	15	<1%	4,748	14%
Other hospital trusts	165	6%	2,650	8%
of which...				
Multi-service	83	6%	1,462	4%
Teaching	71	7%	1,015	3%
Specialist	6	7%	85	<1%
Children's	2	17%	13	<1%
Orthopaedic	2	3%	75	<1%
Other trusts	52	1%	8,780	26%
of which...				
Ambulance	10	<1%	2,632	8%
Mental health	38	1%	5,891	18%
Learning disability	4	1%	258	1%
PCTs	41	<1%	11,632	35%

Note: Tables may differ due to rounding.
Source: NHS Estates, 2002a and Welsh Health Estates, 2002.

Emissions to air

In 2001, total emissions to air generated by the NHS in England and Wales were 3.2 million tonnes. Carbon dioxide (CO_2), at 3.16 million tonnes, was by far the largest gas emitted (99.6% of total emissions to air). Table 15 provides a breakdown of emissions to air, by type.

Based on the NHS in England and Wales' total emissions figure (over 3 million tonnes) it was calculated that 2.1 million tonnes of oxygen would have been required during the combustion of fuels consumed.

Table 15: Emissions to air from the NHS in England and Wales, by type, in 2001

Emission type	Tonnes	% of total emissions
Total emissions	**3,181,379**	**100%**
Carbon Dioxide (CO_2)	3,169,176	99.6%
Methane (CH_4)	172	0.01%
Nitrous Oxide (N_2O)	54	0.002%
Nitrogen Oxides (NO_x)	4,103	0.13%
Carbon Monoxide (CO)	1,325	0.04%
Volatile Organic Compounds (VOC)	198	0.01%
Sulphur Dioxide (SO_2)	5,139	0.16%
Particles (PM10)	925	0.03%
Black Smoke (BSq)	287	0.01%

Sources: Derived from DTI, 2003a, Forum for the Future, 2003 and NAEI, 2003.

Results: Ecological footprint analysis

The ecological footprint of the NHS in England and Wales

In 2001, the ecological footprint of the NHS in England and Wales was 4,964,825 gha (global hectares) or 0.09 gha per capita.

The ecological footprint of the NHS in England and Wales can be broken down into components for further analysis. The components analysed in this ecological footprint are:

- Direct energy
- Products & waste
- Food
- Staff, patient & visitor transport
- Water
- Built land

This breakdown enables a better understanding of which aspects of consumption have the largest and/or least impact on the environment.

What is an ecological footprint?

The ecological footprint is a sustainability indicator, which expresses the relationship between society's consumption of natural resources and the natural environment. Using area equivalence, it aims to express how much of nature's 'interest' we are currently appropriating. If more bioproductive land and sea is required than what is available, then it is possible to assume that the rate of consumption is not sustainable (Chambers *et al.*, 2000). As the ecological footprint analysis uses a common currency (global hectare (gha)), a broad range of impacts can be aggregated to derive ecological footprints for products, individuals, processes, organisations, regions and countries. It is a 'snapshot' measure and is based on a year-specific data set - 2001 for *Material Health*.

For further information and details on how the ecological footprint was calculated for this study see Methodology: Ecological Footprint Analysis (page 57)

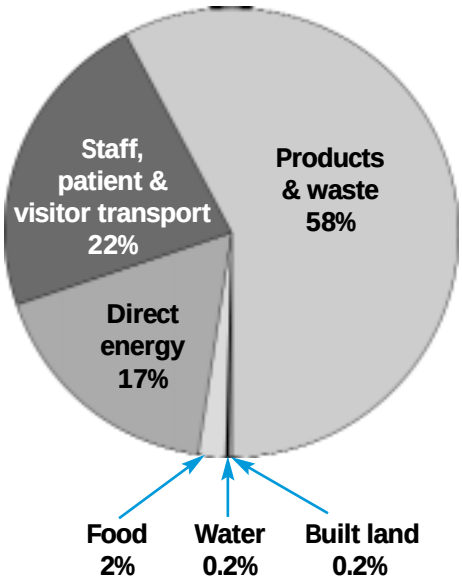
Table 16 and Figure 9 show a breakdown of the NHS in England and Wales' ecological footprint, by component in 2001. Products & waste was the most significant component, with an ecological footprint 2,866,647 gha (or 58% of the total ecological footprint). Staff, patient and visitor travel was the second largest component, with an ecological footprint of 1,115,345 gha (or 22% of the total ecological footprint).

Table 16: The ecological footprint of the NHS in England and Wales, by component, in 2001

Component	Ecological footprint (gha)	% of total ecological footprint
Total ecological footprint	**4,964,825**	**100%**
of which...		
Direct energy	865,661	17%
Products & waste	2,866,647	58%
Food	97,217	2%
Staff, patient & visitor transport	1,115,345	22%
Water	8,485	0.2%
Built land	11,470	0.2%

Note: Totals may differ due to rounding.

Figure 9: The ecological footprint of the NHS in England and Wales, by component, in 2001



Direct energy footprint

This component includes energy used by the NHS in England and Wales, for activities such as power, heating, cooking and lighting. The ecological footprint for direct energy in 2001 was 865,661 gha (or 17% of the total ecological footprint). Natural gas had the largest impact, contributing 44% to the direct energy ecological footprint, with electricity having the second largest impact, at 42%. Table 17 shows the direct energy ecological footprint for the NHS in England and Wales in 2001.

Table 18 shows the direct energy ecological footprint per trust type. Direct energy consumed by acute trusts was the biggest hitter, at 39% of the total direct energy ecological footprint. Teaching and multi-service trusts direct energy consumption were the second and third largest contributors to the total direct energy ecological footprint, at 21% and 15% respectively.

Table 17: The direct energy ecological footprint of the NHS in England and Wales, by fuel type, in 2001

Fuel type	Total consumption (GWh)	Ecological footprint (gha)	% of total direct energy ecological footprint
Total direct energy	**12,650**	**865,661**	**100%**
of which...			
Brown grid electricity	2,801	361,082	42%
Gas	7,809	382,805	44%
Oil	897	61,567	7%
Coal	682	60,206	7%
Renewables	460	0	0%

Note: The electricity ecological footprint takes into account losses associated with converting fossil fuels to electricity. An assumption for carbon released through the generation of electricity is based on the UK national grid mix of fuels.
Sources: NHS Estates, 2002a, NHS PASA, 2002a and Welsh Health Estates, 2002.

Table 18: The direct energy ecological footprint of the NHS in England and Wales, by trust type, in 2001

Trust type	Total consumption (GWh)	Ecological footprint (gha)	% of total direct energy ecological footprint
Total direct energy	**12,650**	**865,661**	**100%**
Acute	4,921	337,381	39%
of which...			
Large	2,501	175,361	20%
Medium	1,409	92,458	11%
Small	1,012	69,563	8%
Community	1,498	108,064	12%
of which...			
Large	793	54,008	6%
Medium	554	40,824	5%
Small	151	13,231	2%
Other hospital trusts	4,959	330,909	38%
of which...			
Multi-service	1,844	126,381	15%
Teaching	2,752	178,596	21%
Specialist	196	14,149	2%
Children's	83	6,410	1%
Orthopaedic	85	5,373	1%
Other trusts	682	51,604	6%
of which...			
Ambulance	145	12,481	1%
Mental health	503	36,826	4%
Learning disability	34	2,297	<1%
PCTs	558	37,703	4%
Other*	32	0	0%

Other* Energy consumed by trusts that could not be categorised under a trust type.
Sources: NHS Estates, 2002a, NHS PASA, 2002a and Welsh Health Estates, 2002.

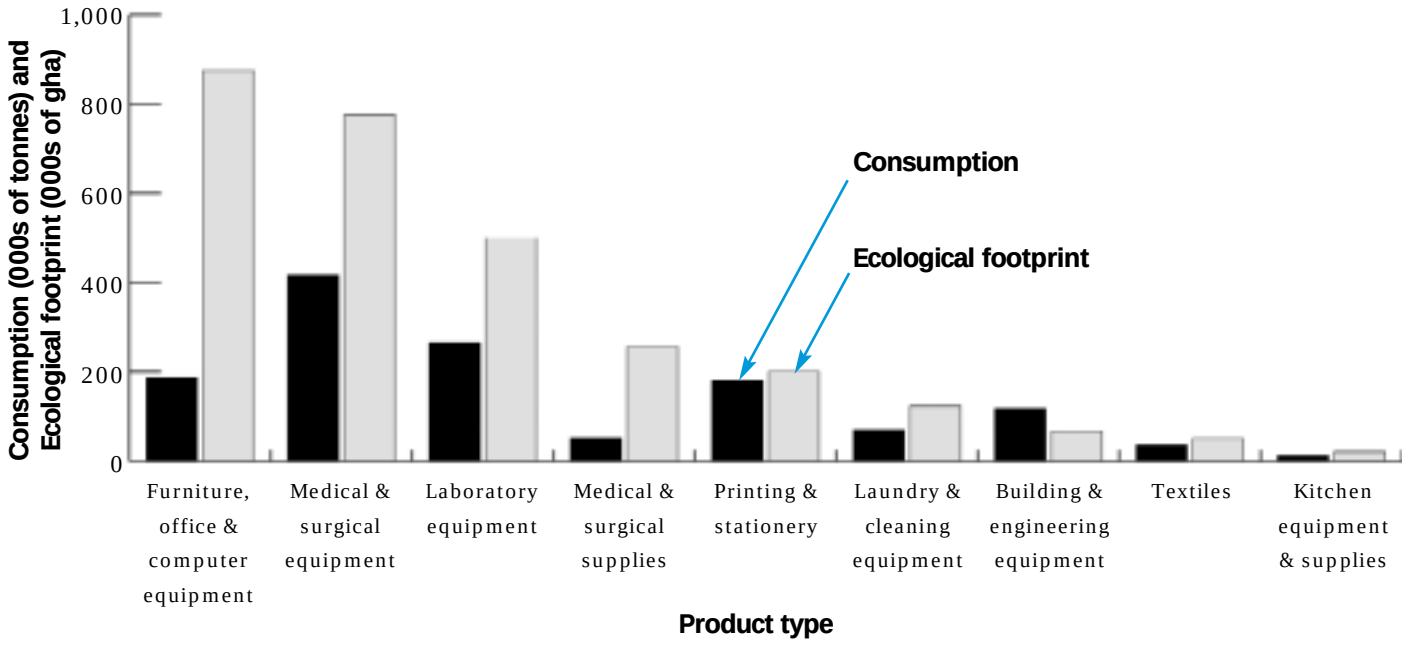
Products and waste footprint

This component includes all the products consumed by the NHS in England and Wales in 2001. It includes, but does not distinguish, the ecological footprint of products going to waste versus those being retained in stock (see the Ecological Footprint Methodology section for further information, page 60).

The ecological footprint for products and waste in 2001 was 2,866,647 gha. It accounted for 58% of the total ecological footprint. See Table 19 for a detailed breakdown of the products consumed and methodological issues related to disaggregation at this level.

Figure 10 shows the products with the largest ecological footprints compared to their tonnages consumed. Furniture, office & computer equipment had the largest ecological footprint (31%), followed by medical & surgical equipment (27%). The smallest component of the products & waste ecological footprint was kitchen equipment & supplies (excluding food), accounting for less than 1%.

Figure 10: The products & waste ecological footprint compared to tonnages consumed, by the NHS in England and Wales, in 2001



A detailed breakdown of the products & waste ecological footprint

This discussion is presented separately, as there is confidence in the calculation of the total products & waste ecological footprint, but less confidence in the detailed breakdown. This is mainly due to uncertainties in ProdCom statistics used for the initial analysis (see the Ecological Footprint Methodology section, page 60).

A breakdown is shown in Table 19, with an estimated ecological footprint for each product type consumed by the NHS in England and Wales in 2001.

Table 19: The products & waste ecological footprint of the NHS in England and Wales, by product type, in 2001

Product type	Consumption (tonnes)	Products & waste ecological footprint (gha)	% of total product & waste ecological footprint
Total products	**1,335,605**	**2,866,647**	**100%**
Medical & surgical equipment	416,426	774,858	27%
of which...			
Appliances	88,504	166,214	6%
Orthotics	33,327	61,857	2%
Ultrasound scanners	18,330	34,021	1%
X-ray equipment	443	827	<1%
Other medical & surgical equipment	275,822	511,938	18%
Furniture, office & computer equipment	186,676	875,445	31%
Laboratory equipment	263,617	500,116	17%
Printing & stationery	180,990	199,986	7%
Building & engineering equipment	118,191	66,625	2%
Laundry & cleaning equipment	69,865	123,202	4%
Medical & surgical supplies	51,598	255,942	9%
of which...			
Pharmaceuticals	12,267	48,409	2%
X-ray film & chemicals	11,449	131,348	5%
Dressings	10,444	42,524	1%
Medical gases	5,367	9,873	<1%
Other clinical supplies	12,072	23,789	1%
Textiles	36,462	49,774	2%
of which...			
Bedding & linen	24,476	45,068	2%
Uniforms & clothing	11,985	4,706	<1%
Kitchen equipment & supplies	11,780	20,698	<1%

Note: Totals may differ due to rounding. **Note:** The above total does not include construction materials (see Appendix B) and vehicles owned or rented by the NHS in England and Wales.
Sources: Derived from Datta, 1999; DH, 2001 & 2001a and 2003; NHS PASA, 2003b & e; ONS, 2001 and TFR, 2002.

Food footprint

The food ecological footprint includes food consumed within the NHS in England and Wales in 2001. Meal waste was not included (to avoid double counting). The ecological footprint for food consumed within the NHS in England and Wales in 2001, was 97,217 gha. It accounted for 2% of the total ecological footprint. A breakdown of the food ecological footprint, by food type, is shown in Table 20.

Animal-based food products were responsible for 78% of the food ecological footprint. Of this, milk had the largest ecological footprint, accounting for over 50% of the animal-based ecological footprint, and 41% of the total food ecological footprint. Fish accounted for 36% of the animal-based food ecological footprint. The plant-based food type with the largest ecological footprint was sugar & preserves, responsible for 8% of the total food ecological footprint.

Table 20: The food ecological footprint of the NHS in England and Wales, by food type, in 2001

Food type	Total consumption (tonnes)	Ecological footprint (gha)	% of the total food ecological footprint
Total food	**53,256**	**97,217**	**100%**
Animal-based	19,412	75,910	78%
of which...			
Milk	11,794	40,204	41%
Butter	1,965	1,232	1%
Cream	318	185	<1%
Cheese	143	12	<1%
Meat	137	3,362	3%
of which...			
Beef & veal	12	1,493	2%
Mutton & lamb	2	264	<1%
Pork	80	1,310	1%
Poultry	33	258	<1%
Other meat products	10	38	<1%
Fish	23	27,625	28%
Eggs	39	160	<1%
Soups, canned, dehydrated & powdered	145	91	<1%
Ice-cream and other frozen dairy food	60	38	<1%
Other foods	4,786	3,001	3%
Plant-based	33,844	21,307	22%
of which...			
Vegetable fats	1,139	1,433	1%
Sugar & preserves	6,397	7,795	8%
Potatoes	734	107	<1%
Other vegetables	414	39	<1%
Fruit	252	39	<1%
Bread	29	24	<1%
Other cereals	6,220	5,117	5%
Beverages	1,792	3,922	4%
Mineral water	1,500	171	<1%
Soft drinks	10,449	1,238	1%
Alcoholic beverages	49	16	<1%
Confectionery	4,869	1,405	1%

Note: Totals may differ due to rounding. **Note:** Milk includes dried milk.
Note: Categories do not exactly match Table 5 in the Mass Balance Analysis Results, due to different aggregations required to be consistent with *National Footprint Account* (Redefining Progress, 2002) conversion factors.
Sources: NHS Logistics, 2003 & NHS PASA, 2003a.

Staff, patient and visitor transport footprint

This component covers all modes of transport used by staff, patients and visitors associated with NHS activities in England and Wales in 2001. Freight transport was not included. It was accounted for in the products & waste and food ecological footprints. The calculation of the staff, patient & visitor transport ecological footprint takes into consideration the energy required for manufacturing, maintenance and fuel used for different modes of transport, such as cars, ambulances and trains. The staff, patient & visitor transport ecological footprint of the NHS in England and Wales in 2001 was 1,115,345 gha, and accounted for 22% of the total ecological footprint. Table 21 shows the breakdown of the staff, patient & visitor transport ecological footprint by mode.

The largest impact was car & van travel, which accounted for 971,366 gha (or 87% of the total staff, patient & visitor ecological footprint). This was predominantly due to visitor travel. Rail travel was the second largest component, which accounted for 4%. Ambulance travel (including rapid response and patient transport services) only accounted for 2% of the staff, patient & visitor transport ecological footprint.

Table 21: The staff, patient & visitor transport ecological footprint of the NHS in England and Wales, by mode, in 2001

Mode	Total passenger-km (000's)	Ecological footprint (gha)	% of total staff, patient & visitor transport ecological footprint
Total staff, patient & visitor travel		**1,115,345**	**100%**
of which...			
Total passenger-kilometres	24,955,555	1,092,039	98%
of which...			
Car & van	20,763,443	971,366	87%
Bus & coach	1,071,904	37,904	3%
Motorbike	7,989	310	<1%
Rail	1,447,358	39,629	4%
Walk & cycle	685,173	0	0%
Other	979,688	42,830	4%
Total vehicle-kilometres	263,648	23,306	2%
of which...			
Ambulance	262,737	22,836	2%
Air ambulance (helicopter)	911	470	<1%

Note: Distances travelled by ambulances (including air) were only available in vehicle-kilometres (veh-km) and not pass-km. For this reason, they are reported separately from other modes of travel.

Sources: DfT, 1999, 2001 & 2002c; Kent Air Ambulance Trust, 2003; Merry, 2002; Relf, 2003; Wales Air Ambulance Charitable Trust, 2003 and Yorkshire Air Ambulance Trust, 2003.

Water footprint

This component includes the energy required to collect, treat and supply the NHS in England and Wales with water. Water provided from private sources, such as boreholes, was also included.

The ecological footprint of water consumed by the NHS in England and Wales was 8,485 gha, and accounted for 0.2% of the total ecological footprint. Table 22 shows water supplied and sewage ecological footprints, by trust type. Large acute, multi-service and teaching trusts had the three largest impacts, contributing between 14% and 17% of the total water ecological footprint.

Table 22: The water ecological footprint of the NHS in England and Wales, by trust type, in 2001

Trust type	Water supplied (megalitres)	Water supplied ecological footprint (gha)	Sewage generated (megalitres)	Sewage ecological footprint (gha)	Total water ecological footprint (gha)	% of the total water footprint
Total	**49,850**	**4,953**	**42,686**	**3,532**	**8,485**	**100%**
Acute	16,988	1,688	14,501	1,200	2,888	34%
of which...						
Large	8,554	850	7,163	593	1,443	17%
Medium	4,991	496	4,358	361	857	10%
Small	3,443	342	2,979	247	589	7%
Community	9,743	968	8,579	710	1,678	20%
of which...						
Large	4,643	461	3,911	324	785	9%
Medium	3,735	371	3,514	291	662	8%
Small	1,365	136	1,153	95	231	3%
Other hospital trusts	16,196	1,609	13,366	1,106	2,715	32%
of which...						
Multi-service	7,022	698	6,027	499	1,196	14%
Teaching	8,146	809	6,413	531	1,340	16%
Specialist	515	51	467	39	90	1%
Children's	292	29	268	22	51	<1%
Orthopaedic	221	22	191	16	38	<1%
Other trusts	5,243	521	4,731	391	912	11%
of which...						
Ambulance	1,784	177	1,575	130	308	4%
Mental health	3,066	305	2,871	238	542	6%
Learning disability	393	39	286	24	63	<1%
PCTs	1,680	167	1,507	125	292	3%

Note: Totals may differ due to rounding.

Source: NHS Estates, 2002a and Welsh Health Estates, 2002.

Built land footprint

This component includes built and degraded land (for example, land occupied by buildings and car parks) used by the NHS in England and Wales. This is approximately 6% of total NHS in England and Wales land area. Built land used indirectly, such as for transport infrastructure and the premises of manufacturers and suppliers to the NHS are accounted for in the products & waste and staff, patient & visitor travel ecological footprints.

The built land ecological footprint for the NHS in England and Wales in 2001 was 11,470 gha. This accounted for 0.2% of the total ecological footprint of the NHS in England and Wales. Table 23 shows a breakdown of the built land ecological footprint by land use.

Table 24 shows the built land ecological footprint by trust type. This shows acute trusts to have the largest built land ecological footprint (35% of the total).

Table 23: The built land ecological footprint of the NHS in England and Wales, by land use, in 2001

Built land use	Total built land (ha)	Ecological footprint (gha)	% of the total built land ecological footprint
Total built land	**2,155**	**11,470**	**100%**
of which...			
Buildings	1,587	8,451	74%
Car parks	567	3,019	26%

Note: Totals may differ due to rounding.
Source: NHS Estates, 2002a and Welsh Health Estates, 2002.

Table 24: The built land ecological footprint of the NHS in England and Wales, by trust type, in 2001

Trust type	Total built land (ha)	Built land ecological footprint (gha)	% of the total built land ecological footprint
Total built land	**2,155**	**11,470**	**100%**
of which...			
Acute	753	4,008	35%
of which...			
Large	390	2,075	18%
Medium	224	1,195	10%
Small	139	739	6%
Community	406	2,161	19%
of which...			
Large	209	1,110	10%
Medium	157	834	7%
Small	41	217	2%
Other hospital trusts	620	3,298	29%
of which...			
Multi-service	320	1,702	15%
Teaching	256	1,360	12%
Specialist	24	130	1%
Children's	7	40	<1%
Orthopaedic	12	66	<1%
Other trusts	216	1,149	10%
of which...			
Ambulance	55	292	3%
Mental health	146	777	7%
Learning disability	15	80	<1%
PCTs	160	854	7%

Source: NHS Estates, 2002a and Welsh Health Estates, 2002.

Ecological sustainability

While ecological footprint analyses of regions and lifestyles are becoming more numerous, few studies have applied ecological footprinting to assess the sustainability of organisations. This is possibly due to the lack of, or difficulty in obtaining information on an organisation's consumption of resources. In addition, as ecological sustainability is the sum of a range of impacts and as such only emerges at a global level, there are difficulties in defining an ecologically sustainable organisation.

However, presentation of the ecological footprint for the provision of health care services, alongside the total England and Wales' resident's ecological footprint, illustrates the scale of the impact of those services compared with other areas of consumption. Presenting the ecological footprint of healthcare services alongside the average earthshare, illustrates the scale of the impact compared with globally available resources.

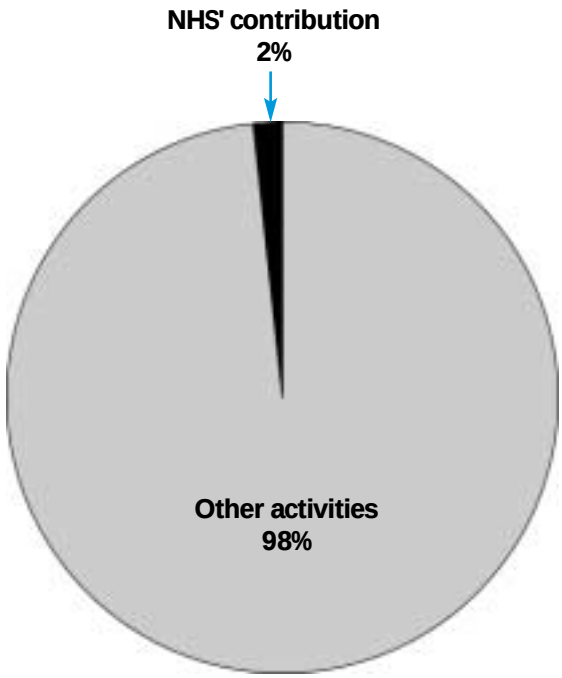
NHS' contribution to a person's ecological footprint

How much of the average England and Wales residents' ecological footprint is accounted for by NHS services in England and Wales? Derived from the UK *National Footprint Accounts* (Redefining Progress, 2002 and Barrett & Simmons, 2003), the ecological footprint per capita in England and Wales is 5.39 global hectares (gha). The ecological footprint of the NHS in England and Wales per capita is 0.09 gha or 1.8% of the total ecological footprint per person (see Figure 11).

Earthshare

The earthshare is the average amount of global resources available per capita. To calculate an earthshare, the total available land and sea area of the planet is divided equally among the current global population. It is estimated that the current earthshare is 1.9 gha (Loh, 2002). If everyone lived within their earthshare, we would achieve one-planet lifestyles.

Figure 11: The NHS' environmental impact contribution to the UK per capita ecological footprint, in 2001



NHS' contribution to a person's earthshare

Another possible sustainability indicator could be: How much each person served's earthshare is accounted for by NHS services in England and Wales. The earthshare is the average amount of global resources available per capita. According to the UK *National Footprint Accounts* (Barrett & Simmons, 2003 and Redefining Progress, 2002), the earthshare per capita is 1.9 gha. As shown above, the ecological footprint of the NHS in England and Wales per capita is 0.09 gha, which is equivalent to 5% of the earthshare (see Figure 12).

The ecological footprint as an indicator of eco-efficiency

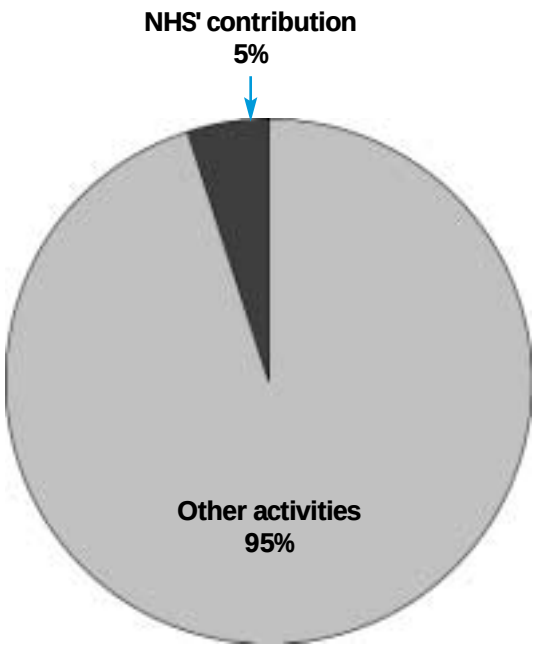
By linking the ecological footprint of the NHS with an appropriate measure of the service provision of the NHS in England and Wales - a normalisation unit, it is possible to derive an eco-efficiency indicator with which performance could be measured. Many different indicators could be used to fulfil this requirement, such as patients served, operations completed, bed-nights occupied, lives saved, etc. However, some of these are not appropriate throughout the NHS, and some are difficult to define. This study therefore uses 'patient episode' as a normalisation unit both relevant and widely applicable within the organisation. A total of 57,668,300 patient episodes occurred in England and Wales (including outpatients, inpatients and day cases) (Merry, 2002 and Morris, 2000).

$$\frac{4{,}964{,}825}{57{,}668{,}300} = 0.09 \text{ gha/patient episode}$$

Therefore, the eco-efficiency of the service provision of the NHS in England and Wales is 0.09 gha per patient episode.

This sort of indicator could be used to compare performance between different facilities or trusts. However, this has not been attempted here due to the widely diverse nature of facilities and service provision within trust types, and the danger of not comparing like with like leading to misleading results.

Figure 12: The NHS' environmental impact contribution to the per capita earthshare, in 2001



Mass balance eco-efficiency

Eco-efficiency is a concept that has traditionally been applied at the product or company level. The World Business Council on Sustainable Development described eco-efficiency as, *'...progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the earth's estimated carrying capacity'* (WBCSD, 1999).

Eco-efficiency can be calculated by dividing the resources remaining in the economy by resources consumed. In the case of the NHS in England and Wales, total stock build-up was 1,004,162 tonnes, while resource consumption was 1,388,860 tonnes (excluding water and energy consumption).

Using the above principles, the NHS in England and Wales' eco-efficiency was calculated at 72%. This means that for every tonne of product consumed by the NHS 72% is retained while 28% is wasted. This compares positively to the UK's eco-efficiency of 52%.

Scenarios

Identifying scenarios

Scenarios were developed to meet a set of criteria and were included if:

- Relevant to current NHS in England and Wales sustainability issues.
- Data on which they were based was sufficiently robust at the level of disaggregation presented. The assessment of the robustness of data was based on reliability, authority and impartiality of the source, availability of NHS specific data, and the level of proxying required.
- Realistic implementation is feasible within current NHS activities and structures.

Three scenario areas were identified and footprinted accordingly:

1. **Solar water heating.**
2. **Domestic waste.**
3. **Transport.**

As the scenario results and methodology are inextricably linked, they have been reported together in this section.

NOTE: The scenarios presented in this report are a summary. More detailed discussions on each scenario can be found on the project's website www.materialhealth.com.

Solar water heating

Energy efficiency has been, and continues to be, an NHS management concern, with targets and guidance notes being suggested and developed. In 1990, the Department of Health (DH) set an energy savings target of 20% for the NHS by 2000, which was largely achieved. A more recent target was set to further reduce, by 15%, the amount of energy consumed in the NHS in 2000 by 2010 (NHS Estates, 2001), which would lead to a reduction in costs and emissions of carbon dioxide.

One way to achieve energy saving targets within the NHS in England and Wales could be through careful building design. Solar heating is one such building design option, and in the NHS Estates' (2001) *Sustainable Development in the NHS* report, a number of hospital designs are highlighted that take solar heating into consideration.

Also, case studies in Russia, Poland and the United States suggest that hospitals can efficiently heat water using solar energy and make savings (EERE, 2003; EGCN, 2003 and Inforse, 1998). This also shows that solar energy can be used effectively in climates similar to the UK.

It is within this context, that solar energy used to heat water was considered as a scenario option. The following scenarios explore the possibilities of implementing solar energy to heat water as a way of reducing the environmental impact of energy use within the NHS in England and Wales. Three options are presented where every hospital installs either 70 or 300 square metres of solar panels, but with varying energy efficiency rates for heating and distributing water.

Scenario assumptions

Current situation

The NHS in England and Wales consumed 49,850 megalitres (Ml) of water and 12,650 GWh of energy in 2001. It has been suggested that approximately 35% of total energy consumption (or 4,428 GWh) is used for heating water in the NHS per annum - this includes energy for boiler systems and water pumps used to circulate water around facilities (NHS Estates, 2003).

Hot water consumption per hospital occupant was estimated at approximately 150 litres per bed per day (EGCN, 2003). Based on this estimate, it was possible to calculate how much hot water was used per annum using the following equation:

Hot water (litres/bed/day) * NHS occupied beds/day * Days/year
=
NHS hot water consumption (megalitres)
Therefore: 150 * 169,053 * 365 = 9,256 megalitres

It can therefore be estimated that hospitals in the NHS in England and Wales consumed approximately 9,256 Ml of hot water in 2001 (19% of all water use). For simplicity reasons, the results have also been presented on a per hospital basis by dividing total figures by the number of hospitals in the NHS in England and Wales. It should be noted that this assumes that all hospitals are comparable, not taking into account the diversity that exists between varying sizes and specialist hospitals.

In summary, the NHS in England and Wales used approximately 4,428 GWh of energy to heat 9,256 Ml of water in 2001. This equates to an efficiency rate of 0.48 kWh per litre of water. The cost of this energy can be estimated at over £90 million.

NHS water heating energy efficiency

By dividing the total energy used to heat water (4,428 GWh) by the total volume of hot water consumed (9,256 Ml), the NHS' water heating efficiency rate is calculated at 0.48 kWh per litre. This includes energy required to heat water, maintain its temperature, as well as energy required to circulate the water throughout the hospitals.

It takes 0.00116 kWh of energy to heat one litre of water up 1°C (ITGE, 2000). Water in the mains can vary from 4°C during the winter to 20°C in the summer. An average temperature of 12°C was assumed. This means that if water was heated to 60°C, an increase of 48°C would be required. Therefore, it takes 0.056 kWh to heat one litre of water up to an average temperature of 60°C once.

This effectively means that of all the energy used by the NHS in England and Wales to heat water (0.48 kWh per litre), 12% (0.056 kWh per litre) is used to heat water once, while the remaining 88% of energy is used to maintain the water at a hot temperature and to circulate it.

Solar water heating assumptions

Both solar energy and Solar Water Heating Systems (SWHS) were considered applicable options for heating water in the NHS. In conjunction with these options, it was assumed that:

1. 1,100 kWh of energy could be generated per square metre of solar panel per annum, at an installation cost of approximately £938 per panel, including a storage tank of 60 litres per panel (Goudsmit, 2003). It was assumed that, based on probable large scale installations, the NHS would receive a reduced installation costing per panel. However, this is not reflected in the scenarios, and it can therefore be assumed that spend suggested in the scenarios is an over-estimate.
2. Electricity use costs 7 pence per kWh (AES Solar Heating, 2003).
3. The efficiency rate of solar panels varies depending on the season, and ranges from 50% during winter to 80% during summer (DIYDATA, 2003). An average efficiency rate of 65% was used in all 3 scenarios. It must be noted that the quality of the solar panels can also affect the efficiency rate.

Scenario 1

What if 70 squared metres of solar panels were installed in every NHS hospital in England and Wales?

The following variables were assumed:

- Solar panels operate at an average efficiency rate of 65%.
- Water temperatures are raised from 12°C to 60°C (a 48°C increase).
- Of all the energy used to heat, keep hot and circulate the water (0.48 kWh/litre), 12% was used to heat the water once (0.056 kWh/litre).

This means that the NHS in England and Wales would be able to generate an estimated 103,103 MWh of energy per annum, enough to heat over 1,847 Ml of water once.

If this energy generated from the solar panels were also used to keep the water heated during the day, and circulate the water throughout the hospital at the current efficiency rate, then the volume of water supplied would be 222 Ml. This is approximately 2% of all hot water consumed by the NHS in England and Wales. The installation cost of such a system is £66,000, with savings of £3,504 per hospital per annum (a payback period of 18.7 years). Table 25 summarises the findings of Scenario 1.

Table 25: Estimated solar water heating results per annum, based on Scenario 1 assumptions

	per hospital	NHS in England and Wales
Energy generated (kWh)	**50,050**	**103,103,000**
Water heated once (litres)	896,525	1,846,841,414
Water supplied (litres)	107,583	221,620,970
Water tank size (litres)	4,200	
Installation cost (£)	65,625	135,187,500
Savings (£)	3,504	7,217,210
Payback period (years)	18.7	18.7

Scenario 2

What if 300 squared metres of solar panels were installed in every NHS hospital in England and Wales?

This would assume that:

- Solar panels operate at an average efficiency rate of 65%.
- Water temperatures are raised from 12°C to 60°C (a 48°C increase).
- Of all the energy used to heat, keep hot and circulate the water (0.48 kWh/litre), 12% was used to heat the water once (0.056 kWh/litre).

This means that the NHS in England and Wales would be able to generate an estimated 441,870 MWh of energy per annum, enough to heat 7,915 Ml of water once. If this energy generated from the solar panels were also used to keep the water heated during the day, and circulate the water throughout the hospital at the current efficiency rate, then the volume of water supplied would be 950 Ml. This is approximately 10% of all hot water consumed by the NHS in England and Wales.

The installation cost of such a system is £281,250, with savings of £15,000 per hospital per annum. As the efficiency rate of the panels remained as for Scenario 1 (65%), the payback period remains unchanged at 18.7 years. Table 26 summarises the findings for Scenario 2.

Table 26: Estimated solar water heating results per annum, based on Scenario 2 assumptions

	per hospital	NHS in England and Wales
Energy generated (kWh)	**214,500**	**441,870,000**
Water heated once (litres)	3,842,250	7,915,034,631
Water supplied (litres)	461,070	949,804,156
Water tank size (litres)	18,000	
Installation cost (£)	281,250	579,375,000
Savings (£)	15,015	30,930,900
Payback period (years)	18.7	18.7

Table 27: Estimated solar water heating results per annum, based on Scenario 3 assumptions

	per hospital	NHS in England and Wales
Energy generated (kWh)	**214,500**	**441,870,000**
Water heated once (litres)	3,842,250	7,915,034,631
Water supplied (litres)	960,562	1,978,758,658
Water tank size (litres)	18,000	
Installation cost (£)	281,250	579,375,000
Savings (£)	110,249	227,112,190
Payback period (years)	2.6	2.6

Scenario 3

What if 300 squared metres of solar panels were installed in every NHS hospital in England and Wales, but the efficiency at which water was heated and supplied was raised from 12% to 25%?

This would assume that:

- Solar panels operate at an average efficiency rate of 65%.
- Water temperatures are raised from 12°C to 60°C (a 48°C increase).
- The energy required to heat, keep hot and circulate the water was reduced from 0.48 kWh per litre to 0.22 kWh per litre.

This means that the NHS in England and Wales would be able to generate an estimated 441,870 MWh of energy, enough to heat 7,915 Ml of water once. If this energy generated were also used to keep the water heated during the day, and circulate the water throughout the hospital, then the volume of water supplied would be 1,979 Ml. This is approximately 21% of all hot water consumed by the NHS in England and Wales. Despite having the same number of solar panels (300 square metres) as in Scenario 2, more hot water can be supplied due to the increased efficiency with which water is heated and distributed. With a higher efficiency rate, the same volume of hot water supplied in Scenario 2 could be achieved in Scenario 3, but with 140 square metres of solar panels instead of 300 square metres.

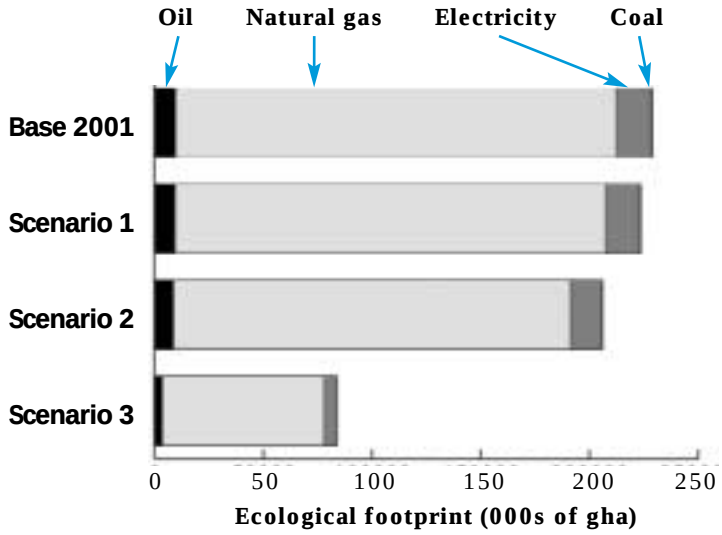
The estimated cost of such an installation is £281,250 with savings of £110,250 per hospital per annum. The efficiency rate of the panels remained the same as in Scenarios 1 and 2 (65%), but the efficiency at which water is heated, kept hot and circulated around the hospital has been improved. This efficiency increase has reduced the payback period from 18.7 years in Scenario 2 down to 2.6 years. Table 27 summarises the findings for Scenario 3.

Reduction of the ecological footprint

All three scenarios calculated can reduce the hot water ecological footprint of the NHS in England and Wales, by between 2% (5,332 gha) for Scenario 1 and 63% (144,938 gha) for Scenario 3 (see Figure 13). Associated CO_2 emissions could be reduced between 19,521 tonnes for Scenario 1 and 530,616 tonnes for Scenario 3. This reduction would lead to a reduction in the overall energy ecological footprint.

However, none of the scenarios would reduce the amount of energy consumed, and would therefore not contribute towards meeting the NHS' energy reduction target of 15% on 2000 by 2010. This is because the source of energy used to heat water has been shifted to solar, and this does not lead towards a reduction in the amount of energy consumed.

Figure 13: The ecological footprints of the NHS in England and Wales' energy use for heating water and scenarios 1, 2 and 3



Note: Ecological footprint contributions from renewable energy sources is zero for all four cases.

Waste

Waste has become one of the most important environmental issues on the political agenda. While no targets have been established for industrial and commercial waste, numerous targets have been set for domestic waste, mainly related to recycling and recovery. The 1989 *Community Strategy for Waste Management* set out four priorities for dealing with waste: Prevention, recycling, energy recovery, and optimisation of final disposal and regulation of transport. The strategy is embodied in the *Waste Framework Directive* (75/442/EEC), which also contains a number of supporting directives that address specific waste streams (Haq & Artola, 1996). With regard to packaging waste, the 2001 amended *EC Directive 94/904/EC on Packaging and Packaging Waste* (European Parliament, 1994) places an obligation on various parties in the 'packaging chain', and established two targets - an overall recycling target of 25-45% and an overall recovery target of 50-65% (DEFRA, 2003c).

With regards to waste management, the main focus for the NHS has been on reducing the volume of clinical waste. At trust level, NHS Estates encourages individual trusts to set waste reduction targets and to benchmark their performance (see *Healthcare Waste Minimisation: A Compendium of Good Practice* (NHS Estates, 2000)). In conjunction with this, the document *Sustainable Development in the NHS* (NHS Estates, 2001) highlights the need for the NHS to focus on minimising waste arisings, implement effective waste segregation, and to be able to choose from a variety of waste disposal options.

It is within this context, that waste was considered as a scenario option. The following scenarios explore the possibilities of implementing waste reduction and segregation as a way of reducing the environmental impact of waste generation in the NHS in England and Wales. Three options are presented:

1. What if best practice recycling rates were applied to all trusts?
2. What if a long-term target for recycling could be identified for all trusts?
3. What if best practice recycling rates were combined with a range of waste minimisation measures for all trusts?

Scenario assumptions

Current situation

The NHS in England and Wales generated 261,086 tonnes of domestic waste in 2001. This figure does not include domestic waste disposed in the clinical waste stream. It is suggested that 61% of clinical waste is domestic, implying that 73,500 tonnes of clinical waste generated by the NHS in England and Wales could be domestic waste (NHS Estates & NHSS, 1997). This equates to over £14.5 million being wasted per annum due to inadequate waste segregation.

Currently, 1.8% of domestic waste generated by the NHS in England and Wales is recycled or reused, of which 32% was cardboard & paper, 20% aluminium & other metals, 18% toner cartridges, 6% glass and 4% kitchen waste (see Figure 5 and Table 28). This provides enormous potential to reduce the domestic waste ecological footprint.

Waste recycling and segregation:

The *Healthcare Waste Minimisation: A Compendium of Good Practice* (NHS Estates, 2000) recognises NHS facilities that are achieving best practice or high standards in waste management. These case studies suggest that NHS facilities can effectively reduce the amount of waste disposed of through segregation and recycling, and make savings. Examples of best practice waste management initiatives include:

- Improved waste segregation - removal of confidential paper from clinical waste (30% reduction in clinical waste - Queen's Medical Centre).
- Recycling - cardboard (74% recycling rate - East Cheshire NHS Trust; 78% recycling rate - Birmingham Heartlands & Solihull NHS Trust).
- Recycling - paper (71% recycling rate - Bassetlaw Hospitals NHS Trust; 60% recycling rate - Central Manchester Healthcare NHS Trust).
- Recycling - glass (33% recycling rate - Birmingham Heartlands & Solihull NHS Trust).
- Recycling - toner cartridges (Macclesfield District General Hospital).
- Recycling - aluminium (Portsmouth NHS Trust; Parkside Health NHS Trust; Southend Community Care Services NHS Trust).
- Recycling and/or composting - kitchen waste (Portsmouth Healthcare NHS Trust)

Within the case studies, the hospitals that achieved high recycling rates, have done so within limited budgets and in many cases have made a marginal profit through the recycling market.

Waste minimisation:

One of the most effective methods of reducing waste is to ensure that few products as possible enter the waste stream. However, the majority of trusts within the NHS in England and Wales do not have targets for waste minimisation. That said, the *Healthcare Waste Minimisation: A Compendium of Good Practice* (NHS Estates, 2000) has identified facilities that implemented a range of waste minimisation approaches. Some of the approaches adopted include: Reducing food waste - meals and, reducing paper usage - office paper and reducing cardboard - packaging.

Table 28: Base case recycling rates for domestic waste generated by the NHS in England and Wales, by product type, in 2003

Product	Total domestic waste (tonnes)	Landfill/ incineration (tonnes)	Recycled (tonnes)	Base case recycling rate
Total waste	**261,086**	**256,338**	**4,748**	**1.8%**
Cardboard	33,941	33,199	743	2.2%
Office paper	31,330	30,739	592	1.9%
Other*	26,109	25,931	178	0.7%
Kitchen waste	24,803	24,609	194	0.8%
Plastics	24,150	23,901	250	1.0%
Newspapers & magazines	22,192	22,019	173	0.8%
Glass	20,887	20,622	265	1.3%
Aluminium	16,971	16,594	376	2.2%
Textiles	16,971	16,649	321	1.9%
Other metals	15,665	15,107	558	3.6%
Electrical equipment	14,360	14,099	261	1.8%
Toner cartridges	13,707	12,870	837	6.1%

Other* Undefined waste.
Sources: NHS Estates, 2003; NHS PASA, 2003d and Welsh Health Estates, 2003.

Waste assumptions

Best practice, recycling targets and waste minimisation options were considered applicable for the NHS in England and Wales. In conjunction with these options, it was assumed that:

1. On average, 0.48 tonnes of waste is generated per bed per annum (derived from Audit Commission, 1997).
2. Current waste recycling/reuse rates (base case) for the NHS in England and Wales in 2003, by product type are listed in Table 28.

Table 29: Best practice recycling rates applied to current NHS in England and Wales domestic waste, by product type, for Scenario 1

Product	Total domestic waste (tonnes)	Landfill/ incineration (tonnes)	Recycled (tonnes)	Scenario 1 recycling rate
Total waste	**261,086**	**150,105**	**110,981**	**43%**
Cardboard	33,941	8,485	25,456	75%
Office paper	31,330	9,086	22,245	71%
Other*	26,109	24,281	1,828	7%
Kitchen waste	24,803	24,555	248	1%
Plastics	24,150	21,494	2,657	11%
Newspapers & magazines	22,192	6,436	15,757	71%
Glass	20,887	6,684	14,203	68%
Aluminium	16,971	12,558	4,412	26%
Textiles	16,971	13,237	3,734	22%
Other metals	15,665	7,833	7,833	50%
Electrical equipment	14,360	11,344	3,016	21%
Toner cartridges	13,707	4,112	9,595	70%

Other* Undefined waste.

Scenario 1

What if best practice recycling rates were applied to all trusts?

This would assume:

- A recycling rate of 43% for domestic waste, derived from the best recycling rates achieved per product type, within the NHS (see Cartwright, 2001; NHS Estates, 2000 and Williams, 2003).
- Using the current NHS in England and Wales recycling rate for a product, if a best practice recycling rate was not identified, for example electrical equipment (Table 28).

This could mean that if the NHS in England and Wales adopted best practice, a substantial reduction in waste to landfill could be achieved. A total of almost 111,000 tonnes of waste could be diverted from landfill. The largest gains can be made in cardboard and paper. Table 29 summarises the findings for Scenario 1.

Scenario 2

What if a long-term target for recycling could be identified for all trusts?

This would assume:

- An overall average recycling rate of 62% for domestic waste. This figure was identified by averaging recycling targets identified by selected trusts for different material types (Cartwright, 2003; NHS Estates, 2000 and Williams, 2003).

This could mean that if the NHS in England and Wales adopted an overall average recycling rate of 62%, a total of more than 160,000 tonnes of waste could be diverted from landfill. As with Scenario 1, the largest gains can be made in cardboard and paper. Table 30 summarises the findings for Scenario 2.

Table 30: A total recycling rate average of 62% applied to current NHS in England and Wales domestic waste, by product type, for Scenario 2

Product	Total domestic waste (tonnes)	Landfill/ incineration (tonnes)	Recycled (tonnes)	Scenario 2 recycling rate
Total waste	**261,086**	**98,952**	**162,135**	**62%**
Cardboard	33,941	3,394	30,547	90%
Office paper	31,330	4,700	26,631	85%
Other*	26,109	18,276	7,833	30%
Kitchen waste	24,803	12,402	12,402	50%
Plastics	24,150	16,905	7,245	30%
Newspapers & magazines	22,192	4,438	17,754	80%
Glass	20,887	5,222	15,665	75%
Aluminium	16,971	8,485	8,485	50%
Textiles	16,971	11,879	5,091	30%
Other metals	15,665	4,700	10,966	70%
Electrical equipment	14,360	7,180	7,180	50%
Toner cartridges	13,707	1,371	12,336	90%

Other* Undefined waste.

Scenario 3

What if best practice recycling rates were combined with a range of waste minimisation measures for all trusts?

This would assume:

- Best practice recycling rates as in Scenario 1.
- A combination of waste minimisation and efficient disposal methods (see Envirowise, 2003).

This could mean the NHS in England and Wales could decrease the total amount of waste generated by 39% (to 159,380 tonnes total waste). As with Scenarios 1 and 2, the largest gains can be made in cardboard and paper. Table 31 summarises the findings for Scenario 3.

Table 31: Best practice recycling rates combined with waste minimisation initiatives, applied to current NHS in England and Wales domestic waste, by product type, for Scenario 3

Product	Total domestic waste (tonnes)	Landfill/ incineration (tonnes)	Recycled (tonnes)	Scenario 3 recycling rate	Scenario 3 waste minimisation rate
Total waste	**159,380**	**91,531**	**67,849**	**43%**	**61%**
Cardboard	33,941	8,485	25,456	75%	60%
Office paper	31,330	9,086	22,245	71%	60%
Other*	26,109	24,281	1,828	7%	60%
Kitchen waste	24,803	24,555	248	1%	71%
Plastics	24,150	21,494	2,657	11%	60%
Newspapers & magazines	22,192	6,436	15,757	71%	60%
Glass	20,887	6,684	14,203	68%	60%
Aluminium	16,971	12,558	4,412	26%	60%
Textiles	16,971	13,237	3,734	22%	60%
Other metals	15,665	7,833	7,833	50%	60%
Electrical equipment	14,360	11,344	3,016	21%	60%
Toner cartridges	13,707	4,112	9,595	70%	60%

Other* Undefined waste.

It is possible to estimate the scale of savings achievable through waste minimisatiom initiatives, as highlighted in Scenario 3.

Using average cost data for England and Wales (NHS Estates, 2002a and Welsh Health Estates, 2002), the total cost for disposing of 261,086 was estimated at £15.3 million. If nothing else changed, except waste generation was reduced in line with Scenario 3 (159,380 tonnes), the costs of domestic waste would decrease to £9.3 million, an estimated saving of £6 million.

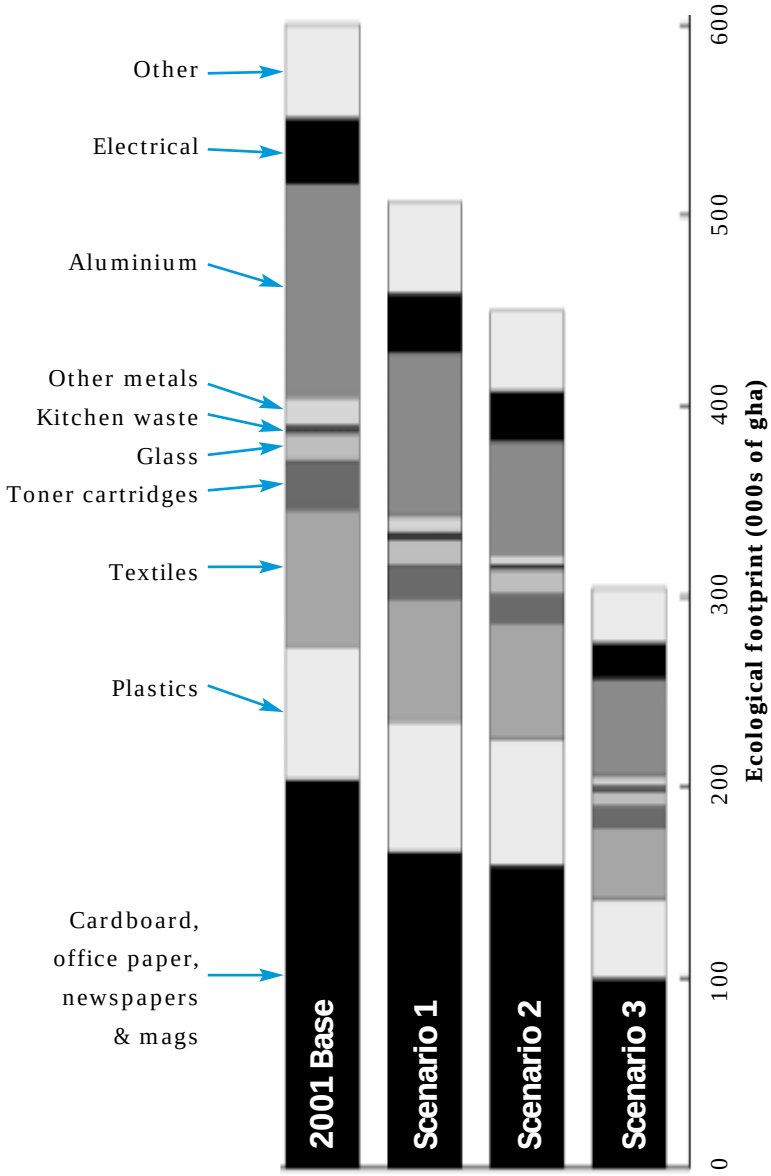
Note: Discussions on the current status of waste management in the NHS in England and Wales, and the actions implemented and recommendations put forward by selected best practice trusts are discussed at length on the *Material Health* website: www.materialhealth.com.

Reduction of the ecological footprint

All three scenarios reduce the domestic waste ecological footprint of the NHS in England and Wales - 16% for Scenario 1, 25% for Scenario 2 and 49% for Scenario 3. Scenarios 1 and 2 solely aim to increase recycling and reuse of discarded resources, whereas the role of waste minimisation is clearly illustrated in Scenario 3.

Scenario 3 assumes the same recycling rate as for Scenario 1, but in addition assumes a reduction in waste produced by 39% (leading to an ecological footprint reduction of 49%, compared to 16% in Scenario 1). The ecological footprint results for all the scenarios are shown in Figure 14.

Figure 14: The ecological footprints of the NHS in England and Wales' domestic waste base case and scenarios 1, 2 and 3



Staff, patient and visitor transport

Transport issues in the UK, particularly those connected to road traffic and congestion, are major topics of debate and concern. Forecasts made by the Department of Environment, Transport & Regions (now Department of Environment, Food & Rural Affairs) indicate an increased volume in the growth of motor traffic (excluding motorcycles) of 38% between 1996 and 2016. The last five years have seen the development of integrated transport strategies in an attempt to curb this increase, and its social, economic and environmental impacts. The *Transport Ten Year Plan* (DfT, 2000) sets detailed targets for modal shift to rail, bus, cycling and walking, while the *Planning and Policy Guidance Note 13 for Transport (PPG13)* (DETR, 2001) places the importance of travel plans on the delivery of sustainable transport objectives.

It is now also mandatory for all local authorities to produce a travel plan, and identify adoption potential amongst employers in their area, including hospitals.

The NHS has acknowledged its role in the development of local transport strategies. Hospitals are required to develop measures to control their transport impact as part of the NHS' *Control Assurance Scheme* (NHS Executive, 1999). In addition, *Sustainable Development in the NHS* (NHS Estates, 2001) outlines green transport and travel plans as one of three methods by which the NHS could reduce its contribution to local transport problems. This was taken further in the *New Environmental Strategy for the NHS* (NHS Estates, 2002) in which a target was set for all NHS sites to have green transport plans in place by October 2002. To date this target has not been met.

The NHS generates an estimated 25 billion passenger kilometres (pass-km), which is responsible for 22% of the ecological footprint. With this in mind, two transport scenarios were explored to reduce this ecological footprint through the adoption of sustainable transport practises in the form of hospital travel plans.

These were:

1. What if best practice rates of modal switch were adopted by staff?
2. What if best practice rates of modal switch were adopted by patients and visitors?

Scenario assumptions

Current situation

In 2001 staff, patient and visitor travel associated with the NHS in England and Wales totalled 25 billion passenger kilometres (pass-km) (excluding ambulance travel), of which 83% was by car or van (Table 10, page 17). According to ERIC, approximately 80 NHS trusts in England and Wales (17% of all trusts) implement green travel plans (NHS Estates, 2002a), with a number of case studies reported in the DfT's *Making Travel Plans Work* report (DfT 2002a & b).

Travel plans

A travel plan provides a strategy for an organisation to reduce its transportation impacts and to influence the travel behaviour of its employees, suppliers, visitors and customers. It involves the development of a set of mechanisms, initiatives and targets over the course of time and in accordance with the changing circumstances of the environment in which it works (Rye, 2002).

Trust travel plans

For the transport scenarios, eleven hospitals were selected as case studies (information and literature on their travel plans was accessible, and it is in no way an indication of their status as worst or best practice examples). Amongst other benefits of implementing travel plans, the trusts report a modal shift in travel behaviour and demonstrate opportunities that are feasible to increase:

- Walking - such as Good Hope Hospital NHS Trust; Plymouth Hospitals NHS Trust; Queen Victoria Hospital NHS Trust and York Health Services NHS Trust.
- Cycling - such as Addenbrooke's NHS Trust; Nottingham City Hospitals NHS Trust; Oxford Radcliffe NHS Trust; Plymouth Hospitals NHS Trust and Trafford Healthcare NHS Trust.
- Use of public transport - such as Plymouth Hospitals NHS Trust; Newcastle upon Tyne Hospitals NHS Trust; Nottingham City Hospitals NHS Trust and Queen Victoria Hospital NHS Trust.
- Car sharing, car pools and car park management - such as Addenbrooke's NHS Trust; Good Hope Hospital NHS Trust; Newcastle upon Tyne Hospitals NHS Trust; Oxford Radcliffe NHS Trust; Plymouth Hospitals NHS Trust and Whipps Cross University Hospital Trust.
- And decrease the use of single car occupancy.

Travel assumptions

While calculating the scenarios the following assumptions and issues were taken into account:

1. Passenger kilometres covered by staff travelling to work, patients and visitors equates to 98% of the total NHS in England and Wales passenger transport (this excludes staff business and ambulance travel).
2. Total passenger kilometres will remain the same, as people will not be expected to stop travelling. However, single car occupancy passenger kilometres will be reallocated to more sustainable modes using targets, which have been proved achievable within the NHS.
3. Site-specific characteristics are disregarded and all hospitals are assumed to have equal access to all modes of public transport, and are able to implement the same measures in the same way.
4. Current travel plan rates (base case) for staff commuting assumed for the NHS in England and Wales are listed in Table 32, and for patients and visitors, in Table 33.

Table 32: Base case rates for staff commuting for the NHS in England and Wales, by mode, in 2001

	Base case 2001	
Mode	**% of total**	**Pass-km per person**
Total	**100%**	**816**
of which...		
Walk	1%	9
Cycle	1%	9
Car/van driver	69%	563
Car/van passenger	10%	82
Other private	1%	4
Bus	1%	6
Rail	11%	91
Motorbike	1%	9
Other public	5%	43

Sources: DfT, 2002a & c.

Table 33: Base case rates for patient and visitor commuting for the NHS in England and Wales, by mode, in 2001

Mode	Patient base case 2001			Visitor base case 2001		
	Total pass-km	(% of total)	Pass-km per person	Total pass-km	(% of total)	Pass-km per person
Total	**6,190,972,742**	**100%**	**119**	**17,508,039,768**	**100%**	**336**
of which...						
Walk	170,585,122	3%	3	497,120,198	3%	10
Cycle		0%	0		0%	0
Car/van driver	2,588,034,105	42%	50	9,047,752,874	52%	174
Car/van passenger	2,182,288,872	35%	42	5,890,455,257	34%	113
Other private	207,916,647	3%	4	283,314,833	2%	5
Bus	476,703,628	8%	9	589,874,256	3%	11
Rail	394,897,243	6%	8	921,555,308	5%	18
Other public	170,547,125	3%	3	277,967,043	2%	5

Source: DfT, 2002c.

Scenario 1: Staff commuting

What if best practice rates of modal switch were adopted by staff?

Scenario 1 highlights what has been achieved in three hospitals that have all implemented a travel plan. The achievements of Addenbrooke's, Nottingham and Oxford are directly comparable with the average NHS staff commuter (Table 32).

While only 1% of NHS staff walk to work, all three hospitals have achieved significantly higher rates of walking, with the Oxford trust achieving 13%. At Addenbrooke's, 25% of all staff cycle to work, compared with an average NHS figure of 1%. In terms of car use, Addenbrooke's also achieved the lowest use, with only 43% of staff using cars, and 58% of these were car shares (see Table 34).

Table 34: Case study best practice travel rates applied to current NHS in England and Wales staff travel, by mode, for Scenario 1

Mode	Addenbrooke's NHS Trust, Cambridge		Queens Medical Centre, Nottingham		John Radcliffe Hospitals NHS Trust, Oxford	
	% of total	Pass-km per person	% of total	Pass-km per person	% of total	Pass-km per person
Total	**100%**	**816**	**100%**	**816**	**100%**	**816**
of which...						
Walk	7%	57	9%	73	13%	109
Cycle	25%	204	4%	33	12%	101
Car/van driver	34%	279	55%	452	58%	476
Car/van passenger	8%	69	11%	93	8%	69
Other private						
Bus	23%	188	19%	157	7%	60
Rail			1%	8		
Motorbike	2%	20				
Other public						

Sources: Addenbrooke's NHS Trust, 1999 & 2000; John Radcliffe Hospitals NHS Trust, 2003 and Queens Medical Centre, 2003.

Scenario 2: Patients and visitors

What if best practice rates of modal switch were adopted by patients and visitors?

How patients and visitors travel to a hospital has not been seen as such an important issue as staff commuting. Scenario 2 compares the ecological footprint for patient and visitor travel with Addenbrooke's. This is because Addenbrooke's is the only trust that has been able to include patients into their travel plan initiatives.

There is not a significant difference between the modal use travelled per person in the NHS in England and Wales and Addenbrooke's. However, the most notable difference is in car sharing. Even though more people travel by car to Addenbrooke's, a considerably higher proportion choose to car share. The NHS in England and Wales average is 34% car sharing, while at Addenbrooke's the figure is 56% (see Table 35).

Note: Discussions on the current status of staff, patient and visitor travel in the NHS in England and Wales, and the actions implemented and recommendations put forward by selected trusts are discussed at length on the *Material Health* website: www.materialhealth.com.

Table 35: Addenbrooke's best practice travel rates applied to current NHS in England and Wales (base case) patient and visitor travel, by mode, for Scenario 2

	Base case 2001		Addenbrokes NHS Trust, Cambridge	
Mode	**% of total**	**Pass-km per person**	**% of total**	**Pass-km per person**
Total	**100%**	**455**	**100%**	**455**
of which...				
Walk	3%	13	2%	9
Cycle			2%	9
Car/van driver	49%	223	34%	155
Car/van passenger	34%	155	56%	255
Other private	2%	9		
Bus	5%	20	6%	27
Rail	6%	25		
Other public	2%	9		

Note: Base case 2001 data for patients and visitors from Table 33 has been aggregated for comparison with Addenbrooke's.
Sources: Addenbrooke's NHS Trust, 1999 & 2000.

Reduction of the ecological footprint

Figure 15a shows the total base case ecological footprints of travel by visitors, patients (excluding ambulance travel) and staff commuting to work. These ecological footprints are influenced by two main factors: The modes of transport used and the number of people using them. For example, the total visitor ecological footprint for 2001 is far larger than patient or staff travel, due to the sheer number of visitors. The scenarios presented in Figures 15b and 15c include the base case data from Figure 15a, broken down by mode, to illustrate the ecological footprint reductions achieved by each scenario. A combination of the two scenarios result in an overall maximum reduction of the ecological footprint by 11%.

Figure 15a: The total ecological footprints of the 2001 base case for staff, patient and visitor, travel

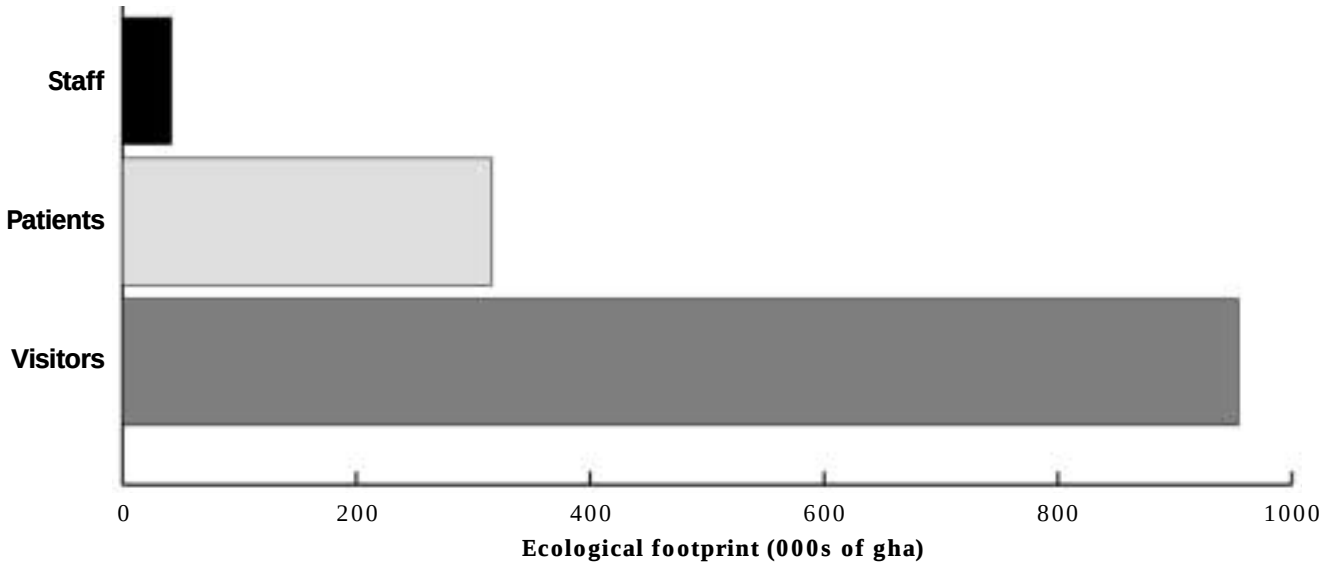
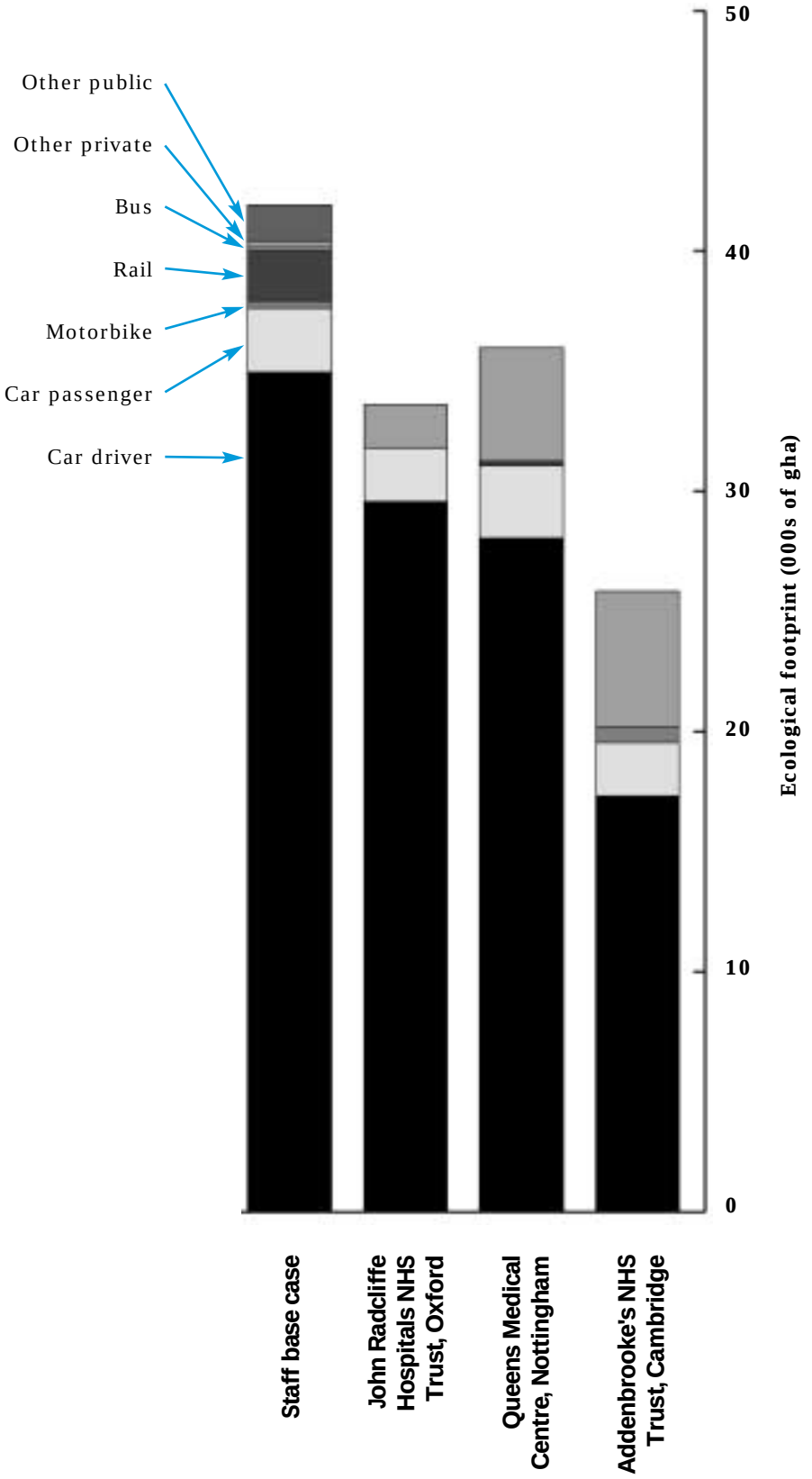


Figure 15b: The total ecological footprints of the 2001 base case and scenarios for staff travel

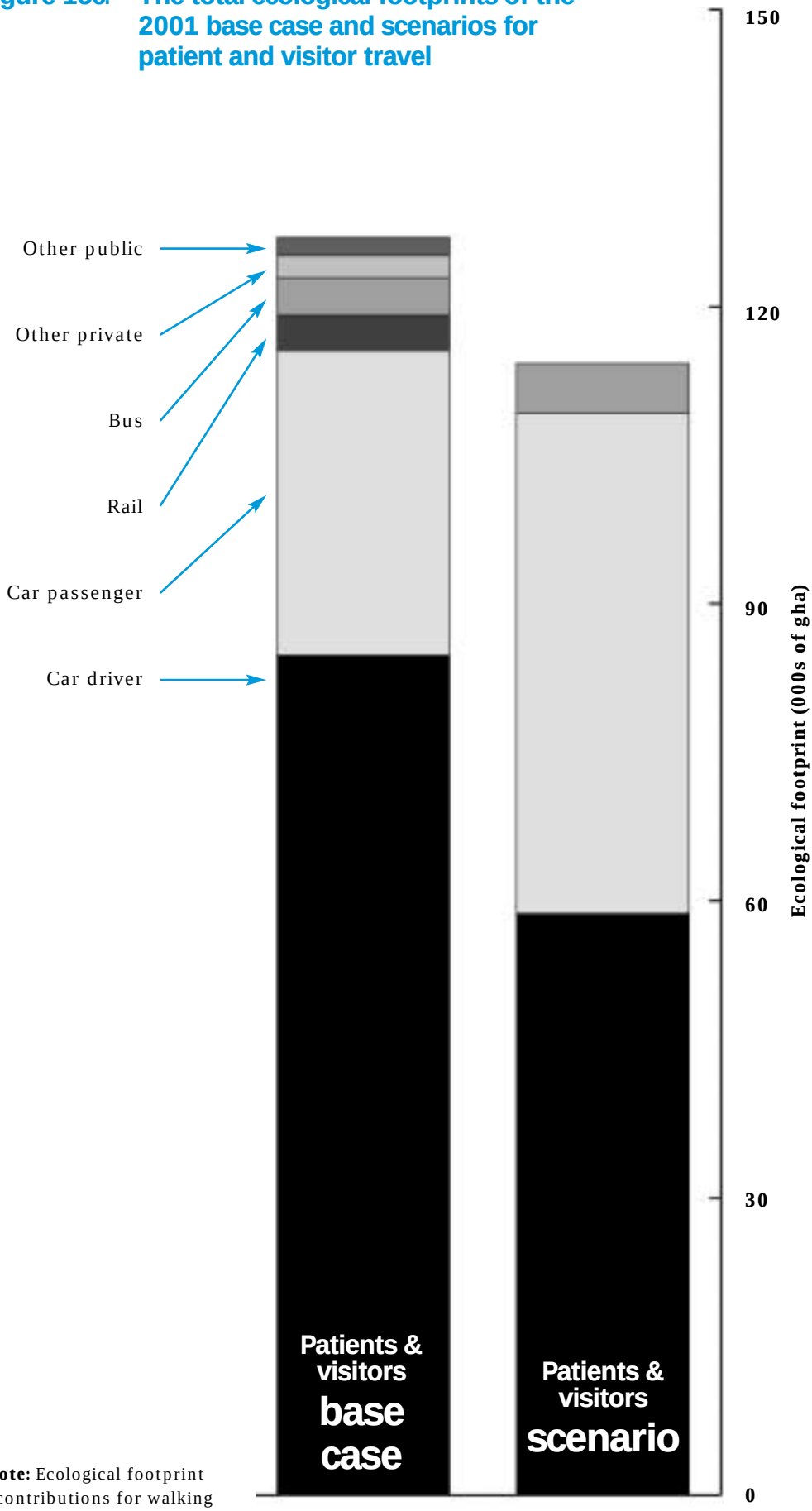


Note: Ecological footprint contributions for walking and cycling was zero for all four cases.

Figure 15b compares the 2001 base case ecological footprint of staff commuting with 3 case studies: Oxford, Nottingham and Addenbrooke's. Car drivers, assumed to be travelling alone, clearly dominate each commuting scenario, with Addenbrooke's reducing the base case by 50%. Also shown is the switch to buses, with increases from the base case ranging from 866% (Oxford) to 2,902% (Addenbrooke's). Unseen in Figure 15b (due to zero ecological footprints) are the simultaneous increases in walking and cycling, which range from 506% (Nottingham) to 1,391% (Addenbrooke's). Addenbrooke's also achieved the greatest overall reduction of the staff commuting ecological footprint (38%).

Figure 15c compares the 2001 base case ecological footprint of patient and visitor travel with Scenario 2. As with staff (Figure 15b) car travel dominates both the base case and scenario. Here, the split between car drivers, assumed to be travelling alone and car passengers, assumed to be travelling with one other person, are the biggest changes. The ecological footprint of car drivers was reduced by 31%, whilst that of car passengers rose by 64%, resulting in an overall reduction of 5%. Unseen in Figure 15c (due to zero ecological footprints) is the simultaneous increase in walking and cycling of 42%. Scenario 2 results in an overall reduction of the ecological footprint of patient and visitor travel by10%.

Figure 15c: The total ecological footprints of the 2001 base case and scenarios for patient and visitor travel



Note: Ecological footprint contributions for walking and cycling was zero for all four cases.

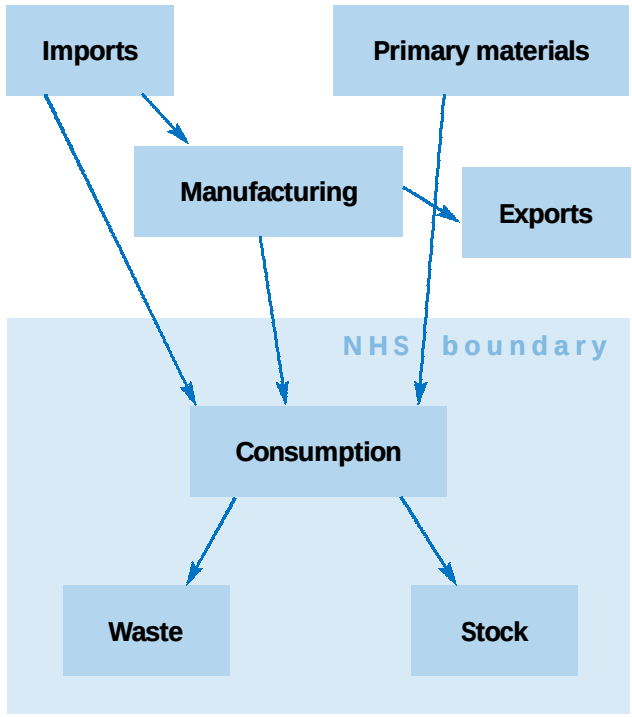
Methodology: Mass balance analysis

Project boundaries

NHS services in England and Wales extend beyond the physical boundaries of a hospital or GP surgery. Deciding where the responsibility of the NHS ends, in terms of products consumed and waste generated, is not always clear. For the purpose of this study, the boundaries:

- **Included:** NHS trusts (see Appendix D), the National and Welsh Blood Services and UK Transplant activities in England and Wales, but
- **Excluded:** Private healthcare services, administrative and logistical functions of the NHS, which are part of the Department of Health, such as NHS PASA and NHS Estates, veterinary practices and social work departments. It also excluded the activities of NHS Scotland and Health & Care Northern Ireland. Pharmaceuticals prescribed by the NHS and consumed or disposed of within the home were also excluded.
- It was assumed that anything consumed within the boundaries of a hospital or surgery, whether by staff, patients or visitors, was the responsibility of the NHS, and therefore included in the mass balance and ecological footprint.

Figure 16: The generic structure of material flows



A mass balance is a systematic methodology used for tracking the flow of materials through a country, region, city or organisation. The outcomes of a mass balance analysis provide an opportunity for a better understanding of how and where to target activities to manage material consumption and minimisation (see Linstead & Ekins, 2001, Linstead *et al.*, 2003 and ONS, 2003).

Conventionally, a mass balance requires several data points (see Figure 16) but finding information on the imports, production, exports and waste of all the materials and products likely to be consumed by an organisation such as the NHS is a difficult task, as the boundaries of the NHS differ from the common data reporting structure of a region. This is because the NHS is not directly involved with the extraction of primary materials or any kind of manufacturing. Consumption of materials is limited to finished products that eventually produce stock and generate waste. Figure 17 illustrates the 'flow' of products and data points assessed for this mass balance study.

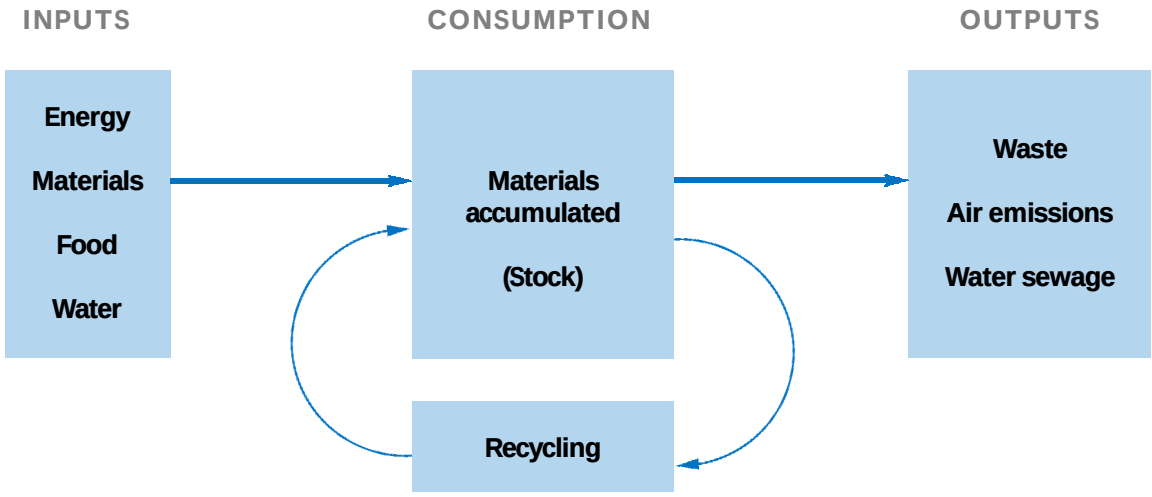
Data identification and collection

For this study, the NHS in England and Wales was analysed. The base year for data collection was 2001, and the common reporting unit was tonnes. Ideally, all data used in the study would have been primary data related directly to the NHS in England and Wales in 2001, and have been reported in tonnes. Unfortunately, not all data was available in this kind of detail, such as products. As a result, a proportion of data was calculated using assumptions and proxy factors, and is discussed in the relevant sections below.

Where 2001 data was not available, data was used from alternative years. Any financial data used covered the period April to March 2001-2002 or January to December 2001. Where data was not available in tonnes, conversion factors were applied.

The following discussions in this section identify the main data sources used for the mass balance analysis, provide details on how data gaps were addressed and rectified, and how figures reported in the results were derived.

Figure 17: An illustration of the 'flow' of materials through the NHS in England and Wales



Main data sources

The first step involved the identification of organisations and key individuals who had access to information regarding the NHS in England and Wales. Key contacts were made with NHS Purchasing and Supply Agency (NHS PASA) and NHS Estates. In addition, both primary and secondary data searches were carried out. Core data was obtained from:

- **Department of Health:** Expenditure data (DH, 2003), which was used as a proxy to derive product consumption. Data on consumption of pharmaceuticals was obtained from the *Prescription Cost Analysis* data sheets (DH, 2002 & a).
- **Estates Return Information Collection (ERIC):** NHS Estates (2002a & 2003), an executive agency of the DH, has developed a *Performance Management Framework*, which allows for the capture, analysis and monitoring of data relating to the non-clinical activities of all NHS trusts in England. The Welsh Health Estates (2002 & 2003) gather similar data for Wales and is presented in a similar format. Information is submitted by NHS trusts through a mandatory system known as ERIC (NHS Estates, 2003). ERIC was one of the most comprehensive, reliable and up to date sources for this study, and provided data on energy, waste, water and land use.
- **NHS Purchasing and Supply Agency (NHS PASA):** NHS PASA, an executive agency of the DH, provided data on purchasing of renewable energy, food, waste and contractor information. Their purchasing catalogue (NHS PASA, 2002) provided guidance for categorising products consumed by the NHS in England and Wales.

In addition to the above core data providers, detailed information on all components was obtained from five trust case studies. See Appendix A for further information on the methodology and data collected from these trusts. Specialist data was also obtained from the National and Welsh Blood Services, UK Transplant, ambulance and air ambulance trusts.

Data availability and quality

Overall, the quantity of data available on the NHS in England and Wales was impressive, but often the information was not in the required format (tonnes). It also varied in quality between components, as described below:

· Energy, water and land use:

Generally of good quality, readily available and required little manipulation.

· Products:

Varied from poor to very good. Most, if not all, data on product consumption (purchases) was available by spend, and not by weight. However, weight data for pharmaceuticals was very good.

· Food:

51% of data on food procurement was obtained. This data, which was of good quality, was used to make plausible assumptions to fill in data gaps.

· Domestic, clinical and special waste:

Varied in quality, with the most consistent and reliable data obtained from ERIC. Data provided by the Environment Agency was used to identify and estimate the composition and management of clinical and special waste.

· Transport:

A variety of sources, which varied in quality from poor to excellent, required the adoption of various assumptions and proxy measures.

An important part of the mass balance methodology was to fill in data gaps in both the NHS Estates' and Welsh Health Estates' ERIC returns. A procedure agreed with NHS Estates was adopted and used for direct energy, waste, water and built land. This methodology is described in detail in Appendix E, using built land as an example.

Application of proxy measures

As mentioned, on occasions it was necessary to 'proxy' data from a number of sources to derive appropriate figures for consumption by the NHS in England and Wales. In most instances a number of proxy methods were considered, often with the most appropriate being adopted on advice from the Advisory Group. Proxy measures applied to individual data sets are described in the relevant sections of the methodology below.

What is a proxy?

A proxy is normally used to compensate for a lack of raw data. It effectively scales down or up existing national or case study data to reflect the consumption of an organisation or region. Proxy factors used can include economic data, such as employment by sector, Gross Domestic Product (GDP), population, waste or expenditure data. A proxy is selected according to its relevance to the data being manipulated. Figures derived from a proxy will not be as accurate as primary data.

Calculation of the mass balance

Due to the differences in accessibility and quality of data for each of the components, the methodology adopted for data collection and manipulation varied greatly for each. For this reason, each component has been considered and described separately below.

Direct energy

Energy data was collected specifically to calculate the ecological footprint. However, as the consumption of energy is of interest, it is presented in the mass balance results (page 9), and therefore included in the mass balance methodology section. Energy data was collected for electricity, gas, oil, coal, renewable, combined heat and power (CHP), central processing units and locally produced energy.

Main data sources

Most energy consumption data (Gigajoules and spend) was obtained from the NHS Estates (2002a) and Welsh Health Estates' (2002) ERIC databases. NHS PASA (2002a) provided data on renewable energy for England. Welsh renewable energy data was derived from trust responses to a questionnaire. Table 36 provides details of the different ERIC energy categories, defining their boundaries and units of measurement.

Table 36: Definitions of ERIC energy categories

Name	Unit	Definition
Electricity	**GJ**	The total annual amount of energy used in GJ by the organisation site supplied by the national/regional electricity supplier, net of any energy that may have been supplied by the NHS Trust to other organisation sites. Include energy used to feed CHP plants.
Gas	**GJ**	The total annual amount of energy used in GJ by the organisation site supplied by the national/regional gas supplier, including LPG, net of any energy that may have been supplied by the NHS Trust to other organisation sites. Include energy used to feed CHP plants.
Oil	**GJ**	The total annual amount of energy used in GJ by the organisation site supplied by the national/regional oil supplier, net of any energy that may have been supplied by the NHS Trust to other organisation sites. Include energy used to feed CHP plants.
Coal	**GJ**	The total annual amount of energy used in GJ by the organisation site supplied by the national/regional coal supplier, net of any energy that may have been supplied by the NHS Trust to other organisation sites. Include energy used to feed CHP plants.
Electricity	**GJ**	The annual amount of energy in GJ used by the organisation site, which has been supplied by an organisation other than regional/national supplier sources (e.g. A neighbouring NHS Trust supplying electricity to the site from their central distribution system).
Steam	**GJ**	The annual amount of energy in GJ used by the organisation site, which has been supplied by an organisation other than regional/national supplier sources (e.g. A neighbouring NHS Trust supplying steam to the site from their incinerator or central boiler plant and distribution system).
Hot water	**GJ**	The annual amount of energy in GJ used by the organisation site, which has been supplied by an organisation other than regional/national supplier sources (e.g. A neighbouring NHS Trust supplying hot water to the site from their main distribution system).

Source: NHS Estates, 2002a.

Calculations and proxy measures used

All units of energy consumption were converted to GigaWatt hours (GWh). Following this, all data was organised into trust types as seen in Table 1 (page 9). It was assumed that all trusts consumed electricity, but this assumption does not necessarily apply to renewable energy, gas, oil and coal. Therefore, only existing data gaps in brown grid electricity consumption were filled using average figures for each trust type. This method - of filling in data gaps with average trust type data - was also employed for clinical and special waste, water and land use and was approved by NHS Estates (2003a) (see Appendix E for a detailed example of this method).

Products

Main data sources

The main data sources identified to derive figures for products consumed by the NHS in England and Wales were from the Department of Health (DH, 2001 & 2001a for prescriptions and 2003 for spend), NHS PASA (2002) for purchasing categories, Office for National Statistics (ONS, 2001) and Trust Financial Returns for product mass (TFR, 2002). The case studies (see Appendix A) were also key sources of information on product consumption, particularly pharmaceuticals.

Other data sources included the British Medical Association (BNF, 2002) for pharmaceutical categories and NHS PASA (2003b & e) for ultrasound equipment and medical gas. Confidential data was also obtained from NHS suppliers on footwear, ultrasound systems, scanners and photocopiers.

Calculations and proxy measures used

Products data was collected for the NHS in England and Wales on a National and case study level. National data covered NHS activities in England and Wales. In some instances only data for the UK was available (including Northern Ireland and Scotland). Most primary data was obtained from the case studies (see Appendix A).

1. National data

Very little data on product procurement or consumption was available by mass. As a result, data was derived from UK product (ProdCom) data using NHS in England and Wales expenditure data as a proxy.

What is ProdCom?

ProdCom (Products of the European Community) is a survey of manufactured produce regulated by the European Union (EU). The names and descriptions of the products covered are standardised so the comparability between member states is possible. Data is collected on value (sales) and volume (units) for over 4,800 products, assigned to 200 industries. Over 3,000 companies and 200 industries are surveyed yearly and another 47 are surveyed on a quarterly basis. The Office of National Statistics (ONS) is the UK government body which collects this information for the UK (HM Customs & Excise, 2003).

Expenditure data was obtained and derived for the NHS in England from the *Health and Personal Social Services Statistics* (DH, 2003) and for Wales from the *Health Authority Financial Return 25* (TFR, 2002). The latter had to be aligned with NHS in England expenditure categories. One of the main problems with the expenditure data was that the reporting categories were not disaggregated enough to identify detailed product types or categories (see Table 37). It was in response to this, and the need to estimate the mass of products consumed by the NHS in England and Wales, that expenditure data was correlated with national ONS ProdCom data.

Table 37: Expenditure categories for the NHS in England and Wales

Expenditure category	Spend (£000's)
Total expenditure	**11,873,979**
Appliances	326,896
Bedding & linen	70,780
Building & engineering equipment	149,179
Dressings	106,964
Furniture, office & computer equipment	331,667
Laboratory equipment (purchases)	267,530
Laundry & cleaning equipment	79,889
Medical & surgical equipment (purchases)	1,505,080
Medical & surgical supplies	251,999
Pharmaceuticals	8,067,789
Printing & stationery	237,758
Provisions & kitchen	294,684
Uniforms & clothing	92,419
X-ray equipment (purchases)	33,025
X-ray film & chemicals (purchases)	58,320

Sources: Derived from DH, 2001 & 2001a; NHS PASA, 2003 and TFR, 2002.

1.1. Correlating ProdCom and NHS expenditure categories

One of the first steps was to identify ProdCom categories and products that would be consumed by the NHS in England and Wales. In some instances ProdCom industry sectors were similar to some NHS expenditure categories. In these situations it was possible to get an indication of the type of individual products that could be included in the NHS expenditure categories (see example 1).

However, this process was not always as straightforward as medical & surgical equipment. For example, one of the most difficult categories to correlate was 'furniture, office and computer equipment'. It was difficult to ascertain which products within the ProdCom category PRA 2612 'other office & shop furniture' would have been purchased by the NHS in England and Wales.

Example 1: Medical & surgical and orthopaedic appliances

ProdCom sector PRA 3310 (ONS, 2001a) covers 'medical & surgical equipment' and 'orthopaedic appliances', which is very similar to the DH's 'medical & surgical equipment' purchasing category. As a result, it was assumed that the products under PRA 3310 are similar to those that the NHS would have purchased. Table 38 lists some of the products in PRA 3310, and how they were reclassified into NHS expenditure categories.

Table 38: An extract of products listed in ProdCom PRA 3310 and the NHS expenditure reclassification category

ProdCom code	ProdCom PRA 3310: Medical & surgical equipment and orthopaedic appliances	NHS expenditure categories
33100001	Full or partial dentures made from plastic (acrylic or synthetics)	Medical & surgical equipment
33100002	Full or partial dentures made from metal (chrome, stainless steel, gold, etc.)	Medical & surgical equipment
33100003	Other dental fittings, such as orthodontics (braces, etc.), gum-shields, bite raising appliances	Medical & surgical equipment
33101115	Apparatus based on the use of X-rays for medical, surgical, dental or veterinary uses	X-ray equipment
33101119	X-ray apparatus for industrial use INCLUDING - parts and accessories	X-ray equipment
33101135	Apparatus based on the use of alpha, beta or gamma radiations, for medical, surgical, dental or veterinary uses INCLUDING - radiography and radiotherapy apparatus - parts and accessories	X-ray equipment
33101139	Apparatus based on the use of alpha, beta or gamma radiations INCLUDING - parts and accessories	X-ray equipment
33101150	X-ray tubes INCLUDING - parts and accessories	X-ray equipment
33101170	X-ray generators, high tension generators, magnetic resonance generators, control panels and desks, screens and specialised furniture for X-ray work INCLUDING - parts and accessories	X-ray equipment
33101350	Instruments and appliances used in dental sciences INCLUDING - parts and accessories	Appliances
33101520	Ophthalmic instruments and appliances INCLUDING - parts and accessories - corneal trephines, keratomes, ophthalmoscopes, orthoptic or sight-testing apparatus	Appliances

Source: DH, 2003 and ONS, 2001a.

1.2 Proxying ProdCom data down to the NHS in England and Wales

Once all the products likely to be used by the NHS in England and Wales were identified, the next step was to derive a total UK volume. The calculation adopted by ProdCom (ONS, 2001) and Best Foot Forward to derive apparent consumption (net supply) in tonnes is the standard methodology agreed by Forum for the Future and the Biffaward Mass Balance programme (Biffaward, 2003). The formula is illustrated below:

Sales (S) + Imports (I) - Exports (E) = Net supply (N)

For example, below is the equation applied to 'PRA 33101230: Electro-diagnostic apparatus and apparatus for functional exploratory examination or for checking physiological parameters':

S + I - E = N
276 + 3,262 - 2,501 = 1,037 tonnes

Due to data gaps in ProdCom, there were instances where 'net supply' figures were negative. This can occur if 'sales' data was unavailable or suppressed, and there were more 'exports' than 'imports' (see example 2 as an illustration of this). In order to reduce the occurrence of negative figures, data gaps were, wherever possible, replaced with historical data by averaging data from the previous three years.

Example 2: PRA 33101739: Orthopaedic appliances and other fracture appliances INCLUDING - parts and accessories - orthopaedic made to measure footwear - orthopaedic appliances for animals

S + I - E = N
n/a + 1,187 - 1,551 = - 364 tonnes

Technically, it is impossible to consume -364 tonnes of products. In this instance, and in other similar instances, all negatives were assumed as zero. The assumption behind this was that the 'sales' figure (n/a) would be at least 364 tonnes.

In certain instances though 'net supply' was negative despite all the data being available. ProdCom 'PRA 33101210: Electro-cardiographs and parts and accessories' is such a case, as illustrated below:

S + I - E = N
3 + 613 - 778 = -162 tonnes

As mentioned earlier, negative 'net supply' figures were regarded as zero, but in this case the assumption behind this calculation was that 162 tonnes of this product must have been drawn up from the previous year's stock, since it is impossible to consume a negative tonnage.

Once all estimated individual ProdCom product tonnages were calculated for the UK level, they were grouped into NHS expenditure categories (see Table 37) and added to derive a total tonnage. Table 39, presents an extract of the tonnage data derived for the thirteen ProdCom products that make up the NHS expenditure 'appliances' category.

Table 39: An extract of tonnage data derived for the ProdCom categories that make up the NHS expenditure category 'appliances'

ProdCom product code	Sales (tonnes)	Exports (tonnes)	Imports (tonnes)	Net supply (consumption) (tonnes)
33101210	3	778	613	-165
33101230	276	2,501	3,262	1,037
33101250	0	358	1,286	928
33101350	7,151	776	12,588	18,963
33101520	31,984	3,043	4,519	33,460
33101579	n/a	18,189	29,660	11,472
33101653	1,108	9,222	57,344	49,230
33101655	154,476	12,704	5,433	147,205
33101690	16,980	28,852	2,635	-9,236
33101739	n/a	1,551	1,187	-364
33101890	n/a	85,123	2,355	-82,769
33109200	n/a	n/a	0	0
33208190	n/a	3,746	3,889	143
Total (1)	**211,977**	**166,842**	**124,772**	**169,907**
Total (2)				**262,437**

As can be seen in Table 39, two totals are presented (Total (1) and Total (2)). This is because there are two ways to derive a total for 'net supply' (consumption), and both produce different answers. The first method (Total (1)), involved adding all the sales, exports and imports data, and applying the formula mentioned earlier, as illustrated below:

S + I - E = N
211,977 + 124,772 - 166,842 = 169,907 tonnes

This first method (Total (1)) was not used, because by adding the sales, exports and imports, negative consumption figures are indirectly included.

The second method (Total (2)) involved adding all the net supply figures, but excluding the negative figures. This method was adopted throughout as it was assumed that it was technically impossible to consume a negative amount of products.

Once the total mass and expenditure of products most likely to be consumed by the NHS had been calculated for the UK using ProdCom, the next step was to scale the UK figures down to the NHS in England and Wales. Two proxying methods could be applied to the data. The first method (using a percentage expenditure proxy) was not used due to complications in original ProdCom data. However, this method is described, as it was the original method applied to the ProdCom data. Only once the complications in this method were identified, a second and more appropriate solution was applied (£ per tonne proxy).

The first method used NHS expenditure in England and Wales as a percentage of UK ProdCom expenditure (see example 3).

Example 3: NHS expenditure percentage proxy as applied to dressings

UK ProdCom expenditure on 'medical dressings' = £321,112

NHS in England and Wales expenditure on 'dressings' = £106,964

Therefore: 106,964 / 321,112 = 33%

This effectively means that the NHS in England and Wales, in 2001, purchased 33% of all medical dressings sold in the UK. This 33% was then used as a proxy to adjust the UK ProdCom figure (31,354 tonnes) to derive a figure for the NHS in England and Wales, as follows:

31,354 * 33% = 10,444 tonnes

In one instance, the application of a NHS in England and Wales expenditure percentage proxy was complicated. According to ProdCom the UK spent less money (£976,216 million) on 'medical & surgical equipment' and 'orthopaedic appliances' (PRA 3310) than the NHS in England and Wales (£1,505,080 million). Based on the formula described above, the UK volume of 'medical & surgical equipment' should be proxied by 154%, effectively increasing the UK tonnage from 327,480 tonnes to over 500,000 tonnes for the NHS in England and Wales.

This is not possible, but can be explained as follows: Due to the nature of the products in this section, there were significant data gaps in ProdCom, which resulted in an underestimate of expenditure and tonnage figures. As a result of this complication, it was decided that ProdCom data would not be proxied by NHS expenditure but as a percentage of UK expenditure.

The following - second method - was used instead to derive tonnage figures by calculating the value (£) for each tonne of products consumed in the NHS in England and Wales. The following £ per tonne calculation was applied (see example 4):

Example 4: £ per tonne proxy as applied to X-ray equipment

NHS in England and Wales expenditure on 'X-ray equipment' products = £33,025,000

UK ProdCom expenditure on 'X-ray equipment' products = £176,718,000

UK ProdCom tonnage of 'X-ray equipment' products = 2,369 tonnes

Therefore: 33,025,000 / (176,718,000 / 2,369) = 443 tonnes

Table 40: A summary of the results of the £ per tonne proxy for NHS in England and Wales

NHS product expenditure categories	UK ProdCom expenditure (£000s)	UK ProdCom tonnes	£ per tonne proxy	NHS in England and Wales expenditure (£000's)	NHS in England and Wales tonnes
Total	**45,184,833**	**29,058,724**	**129,424**	**3,526,190**	**1,335,605**
Appliances	969,336	262,437	3,694	326,896	88,504
Bedding & linen	564,411	195,179	2,892	70,780	24,476
Building & engineering equipment	5,297,623	4,197,176	1,262	149,179	118,191
Dressings	321,112	31,354	10,242	106,964	10,444
Furniture, office & computer equipment	20,001,515	11,257,713	1,777	331,667	186,676
Laboratory equipment	1,204,128	1,186,517	1,015	267,530	263,617
Laundry & cleaning equipment	1,652,244	1,444,917	1,143	79,889	69,865
Medical & surgical equipment	976,216	327,480	2,981	1,505,080	327,480
Medical & surgical supplies	366,052	25,331	14,451	251,999	17,439
Pharmaceuticals	**	**	**	**	12,267
Printing & stationery	11,818,920	8,996,961	1,314	237,758	180,990
Provisions & kitchen	1,299,919	1,042,785	1,247	14,684	11,780
Uniforms & clothing	252,805	32,785	7,711	92,419	11,985
X-ray equipment	176,718	2,369	74,603	33,025	443
X-ray film & chemicals	283,834	55,719	5,094	58,320	11,449

** UK ProdCom expenditure and volume data on pharmaceuticals is missing due to significant gaps in ProdCom. As a result, this category was calculated using case study data that was proxied up to the NHS in England and Wales level (see discussion on page 48).

Sources: DH, 2001 & 2001a and 2003; NHS PASA, 2003; ONS, 2001 and TFR, 2002.

This second method required certain underlying assumptions, such as an estimated average price paid for similar products within a category. For example, according to UK ProdCom data, it costs £10,242 to buy one tonne of dressing products (see Table 40). This is effectively an average figure for the UK. Based on the knowledge that the NHS in England and Wales spent £106,964 on dressings, and assuming the average £ per tonne cost for the UK, it was estimated that the NHS in England and Wales purchased a little over 10,000 tonnes of dressings in 2001.

2. Case study data

Case study data was obtained from primary information gathered during visits to case study trusts (see Appendix A). Initially it was hoped that case studies would have data on products consumed, which could be scaled up to the NHS in England and Wales. However, the data proved to be inconclusive. Hospitals and GP surgeries were not expected to have data in tonnes, and alternatives such as data from bills proved just as difficult to analyse. Data from bills seldom made the distinction between physical products and services. It was impossible to separate the two.

One product category that was easy to identify and calculate at this level was pharmaceuticals.

2.1. Calculating pharmaceuticals

The mass of pharmaceuticals consumed by the NHS in England and Wales could not be calculated using ProdCom data. Most of the ProdCom data was suppressed or unavailable, probably due to confidentiality issues. As an alternative, data gathered during the case study visits was used in conjunction with data obtained from the DH's *Prescription Cost Analysis* sheets for England and Wales (DH, 2001 & 2001a).

Information on the quantity of pharmaceuticals dispensed was available for all case studies from data reported to the DH. These reports did not provide data in weight so pharmaceuticals had to be weighed on site. This was feasible during the hospital case study visits. From this exercise it was possible to gather information on the top 50 most commonly dispensed pharmaceutical items, as well as the total number of pharmaceuticals dispensed by each hospital. The top 50 most common pharmaceuticals were weighed to derive an average weight per unit (such as a tablet).

Although handling the pharmaceuticals was possible, the weighing process was, to some extent, restricted. To derive the average weight of a pharmaceutical unit, all items would ideally have to have been removed from their packaging. Unfortunately, sealed packs, once opened could not be dispensed. As a result, some drugs had to be weighed with their packaging and divided by the number of units per pack.

In order to estimate the volume of pharmaceuticals dispensed by the NHS in England and Wales, data had to be proxied up using data gathered from the hospital case studies. With the hospital case study data it was possible to calculate the average weight of a pharmaceutical unit dispensed, and in turn estimate the total tonnage of pharmaceuticals dispensed for all case study hospitals. Based on a figure of 2,060 hospitals (Brinzer *et al.*, 2003) it was possible to estimate the total volume of pharmaceuticals dispensed by all NHS hospitals in England and Wales in 2001. By proxying data with hospital numbers, certain assumptions were involved. The volume of pharmaceutical prescriptions dispensed by all NHS hospitals in England and Wales was based on three case studies. This effectively assumed that all hospitals prescribed the same type and quantity of drugs despite differences in hospital size and speciality.

Prescription Cost Analysis data (DH, 2001 & 2001a) provided information on all prescriptions dispensed in the community (excluding hospitals) for England and Wales in 2001. With the average weight of a pharmaceutical item already calculated, it was possible to estimate the weight of all pharmaceuticals dispensed in the community through GP surgeries in England and Wales. Although data on community prescriptions was of good quality and from a reliable source, converting items to tonnes was difficult. The average weight of a pharmaceutical item had to be used even though it was derived from the hospital case studies. The assumption behind this calculation was that GP surgeries dispensed the same type of pharmaceuticals as hospitals, which is not necessarily the case.

Data on stock

What is stock?

Stock is materials and products retained in the NHS. This term describes products that were not discarded by the NHS in England and Wales during the study year. The products retained will consist of the following: Addition of resources to the built environment, for example new buildings; and resources incorporated into durable products that remain in use in the NHS in England and Wales beyond the timescale of the study year, for example medical and surgical equipment, vehicles and laboratory equipment. Stock change is the change in stock over a defined period of time within a defined boundary.

Although obsolete products are stored in hospitals, stock data was very poor. When medical products are replaced, old products are either stockpiled or exported to countries where the health system is in need of supplies, such as wheelchairs or medical beds. This is an ad hoc practice that is specific to individual trusts. Unfortunately, the composition of stock in the NHS in England and Wales is unavailable due to the lack of data and the inability to make any 'educated' assumptions on mass.

Food

Main data sources

The main data sources for food procured in the NHS in England and Wales were obtained from NHS Purchasing and Supply Agency (NHS PASA 2003). This data included:

- A list of the four food supply routes.
- A list of over 3,000 food items supplied through routes 2 and 3 (explanation below).
- Contract values for supply route 1.
- Estimates on food procurement expenditure.

Food supply routes

The four different supply routes for food products in the NHS in England and Wales are:

1. **Direct delivery (contracts arranged by NHS PASA):** Trusts purchase from nationally negotiated contracts, with products delivered directly to a trust by a supplier. Examples of this would be fresh fruit and vegetables, meat, bread, milk and sandwiches.
2. **Direct delivery (consolidated distribution arranged by NHS PASA):** Access to a range of temperature controlled products, both chilled and frozen, together with a range of ambient products. This is complementary to the NHS Logistics Authority 'stock', which is available via a consolidated distribution contract. Here the trusts order via NHS Logistics Authority, using the same system as route 3, but the orders are consolidated and delivered directly to a trust by a contractor.
3. **NHS Logistics Authority delivery (contracts arranged by NHS PASA):** The NHS Logistics Authority offers a delivered service from a network of warehouses. They handle some 31,000 product lines, of which approximately 1,100 are ambient food.
4. **Ad-hoc (contracts arranged by trusts):** Some trusts also purchase products not contracted through NHS PASA or delivered by the NHS Logistics Authority. These products might be purchased from a local contractor or simply an ad-hoc purchase.

Source: NHS PASA, 2003.

Calculations and proxy measures used

Data was available on food volume passing through routes 2 and 3. Table 41 highlights a section from this long list of food items. Each food item is assigned a National Product Code (NPC), a main description, secondary description, and food section type. The quantities relate to the 'unit of issue' detailed, so for example, item AAN013 is one case of 12 x 1 litre containers of orange juice.

The first calculation involved using the 11 months 'units of issue' figures to derive a 12 months figure for all food items listed, doing the following:

Item AAN013, one case of 12 x 1 ltr containers of orange juice (3531/11)*12 = 3,852 cases of 12 x 1 ltr containers supplied per annum

The second calculation involved identifying the food weight, and converting it into tonnes, as illustrated below:

Item AAN013, one case of 12 x 1 ltr containers of orange juice (12*1)*3852 = 46,224 ltrs supplied per annum (46224/1000) = 46.2 tonnes supplied per annum

By totalling all tonnes supplied per annum, per food type, the quantity of food supplied through routes 2 and 3 was calculated at 27,165 tonnes. This total only represents two of the four food supply routes, or 51% of total food procured by the NHS in England and Wales.

The final step for routes 2 and 3 data was to assign each food item to recognised National *Food and Expenditure Survey* (ONS, 2003) categories. Table 42 illustrates a section of the spreadsheets in which this process was made, and the alignment to the *Food and Expenditure Survey* categories.

Table 41: A section of the food item list supplied through routes 2 and 3, during 2002/3

NPC	Main description	Section	Secondary description	Units of issue (uoi)	11 months units of issue
AAN013	Soft drinks	Fruit juice	Orange juice 1 ltr	12 (case)	3,531
AAN020	Soft drinks	Fruit juice	Tomato juice 1 ltr	12 (case)	17
AAN023	Soft drinks	Fruit juice	Apple juice 1 ltr	12 (case)	286

Source: NHS Logistics, 2003.

Proxy data

Up to this point the calculations undertaken have involved the use of raw data concerning supply routes 2 and 3. To estimate the tonnage figures for food procurement through route 1, real expenditure data on contract values had to be used as a proxy. This was a complex exercise.

The first step was to calculate the value of each of the 70 contracts for one year only (a number of contracts extended beyond a year). The example below illustrates this process:

Table 42: A section illustrating the food categories and proxy calculations supplied through routes 2 and 3, in 2002/3

NPC	AAN013	AAN020	AAN023
Food & expenditure survey category	Soft drinks	Soft drinks	Soft drinks
Food sub-index	Squash, cordial & fruit drinks	Squash, cordial & fruit drinks	Squash, cordial & fruit drinks
Main description	Soft drinks	Soft drinks	Soft drinks
Section	Fruit juice	Fruit juice	Fruit juice
Secondary description	Orange juice 1 ltr	Tomato juice 1 ltr	Apple juice 1 ltr
Units of issue (uoi)	12 (case)	12 (case)	12 (case)
11 months units of issue	3,531	17	286
Total derived for 12 month period	3,852	19	312
Total quantity of food (tonnes)	46.22	0.22	3.74
Total proxied quantity of food (tonnes)	90.6	0.44	7.34

Note: The light blue areas show all calculations and processes described on page 49.
Sources: NHS Logistics, 2003 and NHS PASA, 2003.

Supplier X has a 48 month contract at a value of £500,000 so a 12 month contract is worth (500000/48)*12 = £125,000 per annum

Through this process, and adding up all the contractor totals, the total expenditure for all suppliers for one year to the NHS in England and Wales for route 1 was estimated at £47 million.

In order to derive a tonnage figure associated with this expenditure, a total expenditure figure for all four routes of supply was required. NHS PASA gave an indication of food expenditure through the four supply routes (see Table 43 (NHS PASA, 2003).

From this data it was possible to assume that the remaining 32% of food not accounted for would be procured through supply route 4 (ad-hoc), at an estimated £90 million. This implied that food supply routes 2 and 3 represented 51% of the total food tonnage supplied to the NHS in England and Wales. Therefore to account for the remaining 49% it was necessary to multiply the data by a factor of 1.9, arriving at a total of 53,256 tonnes (see equation below).

The multiplier was calculated firstly by adding the total expenditure for supply routes 2 and 3:

70 + 73 = 143

and calculating the remaining food expenditure for supply routes 1 and 4:

280 - 143 = 137

dividing the two to get the multiplier:

(137/143) + 1 = 196%

Table 43: Total estimated food expenditure for the NHS in England and Wales

Supply route	Estimated total expenditure (£ million)	% of total food expenditure
Total	**280**	**100%**
Route 1: Direct delivery (contracts arranged by NHS PASA)	**47**	**17%**
Route 2: Direct deliverty (consolidated distribution arranged by NHS PASA)	**70**	**25%**
Route 3: NHS Logistics Authority delivery (contracts arranged by NHS PASA)	**73**	**26%**
Route 4: Ad-hoc (contracts arranged by trusts)	**90**	**32%**

Waste

Main data sources

The main data sources used for domestic, clinical and special waste were the NHS Estates (2002a and 2003) and Welsh Health Estates (2002 and 2003) ERIC data. Data on waste composition and management methods were obtained from *Recycling Domestic Waste and Recycling in the NHS* (NHS PASA, 2003d) and the *Hazardous Waste Interrogator* (Environment Agency, 2003a).

Calculations and proxy measures used

1. Domestic waste

The main aim of gathering data on domestic waste in the NHS in England and Wales was to derive a total figure of waste generated in tonnes, to identify the management methods used and the composition.

The ERIC databases (NHS Estates, 2003 and Welsh Health Estates, 2003) provided detailed information on domestic waste generated in 2002/03 by trusts in tonnes, and waste recovered and recycled as a percentage of total generated. The two sources were combined to derive a total domestic waste figure for England and Wales. Although 2001/02 data was available, it was not mandatory for trusts to submit domestic waste data to ERIC at the time, thus waste data was likely to be an underestimate. Instead, 2002/03 data was used as it was considered to be more reliable, as during this period it became mandatory for trusts to submit data to ERIC.

The database also provided information on meals wasted (in conjunction with patient meals requested). For Wales, there was no data on total meals wasted, only on patient meals requested. Further information on the management of domestic waste in the NHS in England and Wales was obtained from a confidential report supplied by NHS PASA (2003d).

Table 44: ERIC definitions for domestic waste

Category	Unit	Definition
Domestic waste volume	**Tonnes**	The total weight in tonnes of domestic / commercial waste produced by the organisation site. Where the weight is not available from the supplier, an assessment should be made using available information e.g. average weight of bag x number of bags per annum. As a rough estimate 1 tonne waste = 10,000 ltrs of bin space (10 ltrs = 1kg).
Waste recovery/ recycling volume	**%**	Percentage of the total domestic/commercial waste volume that is recovered/recycled in line with targets laid down in the *Waste Strategy 2000* (DEFRA, 2000a).
Waste recovery/ recycling cost	**%**	Percentage of the total domestic/commercial waste cost that is attributable to recovered/recycled waste.
Total patient main meals requested	**Number**	Total sum of demand made for patient's meals (inpatient and day patient) ordered from wards and departments. A 'patient meal' is defined as either a breakfast, midday or evening meal order (or any substitute or alternative for any such meals) received from a patient (wards and departments) or the number of similar meals provided to wards and departments as an estimate of need where order systems are not in use.
Food waste (untouched meals)	**%**	For plated meal systems, this is the number (calculated over the full menu cycle or 7 days where no menu cycle is used) of untouched/unserved patient meals remaining at the end of the meals service period expressed as a percentage of the total number of meals provided and available at the commencement of the meal service period. For bulk systems use an apportionment of remaining meals based on visual inspection. The methodology for calculating this aspect is set out in the *Ward Food Wastage Survey* section of the completion notes (pages 12 to 13) or the appropriate section of the document *Catering in a Modernised NHS 2002*.

Source: NHS Estates, 2002a.

All ERIC data was reported by trust type. Some of the larger trusts in the NHS collect domestic waste figures from smaller acute trusts and include this in their own data. This resulted in gaps in the ERIC data. In addition, some trusts did not report domestic waste for the period studied. For this reason, it can be assumed that the figure derived for domestic waste is an underestimate (NHS Estates, 2003a). Table 44 lists the ERIC definitions used for domestic waste, costs, recovery/recycling, patient meals requested and wasted.

There were discrepancies between the information provided by NHS PASA (2003d), NHS Estates (2003) and the Welsh Health Estates (2003) on the quantity of domestic waste generated. It was felt that the total figure used should be that derived from the ERIC databases (NHS Estates, 2003 and Welsh Health Estates, 2003), as it was assumed to be the most reliable source due to its greater level of detail.

Waste management:

Once a total figure for domestic waste had been calculated, a model was constructed to derive recycling figures for each product type identified in the domestic waste stream. NHS PASA's (2003d) information on recycling (see columns 2 and 5 in Table 45) was combined with the ERIC data (final column) to derive a total figure for domestic waste recycled (4,748 tonnes). The results of this process are illustrated in Table 45.

The columns that follow columns 2 and 5 respectively, show data derived for the '% of material respondents claimed to recycle' and 'weighting system', It was assumed that respondents who claimed to 'recycle quite often' (A) undertook 70% of recycling in the NHS in England and Wales, and 30% was achieved by respondents who claimed to 'recycle sometimes' (B). The final two columns show the overall total recycling rate, and tonnes recycled of each product for the NHS in England and Wales. The following example illustrates the process that was applied to the product types in the domestic waste stream, which are represented in Table 45.

Worked example: Cardboard

The NHS PASA report claimed that 42.1% of all questionnaire respondents recycled cardboard 'often'.

Of all material recycled by those who recycle 'often':
42.1/211.7 = 20% was cardboard
(3rd column in Table 45)

70% of recycling was assumed to be undertaken by those who recycle 'often':

0.20 * 0.7 = 14% all cardboard waste produced, recycled by those who recycle 'often' (4th column of Table 45)
And
43.5% of all respondents recycle cardboard 'sometimes' (or 43.5/701.5 = 6% of all material recycled by those who recycle 'some' was cardboard)

30% of recycling was assumed to be undertaken by those who recycle 'some':

0.06* 0.3 = 2% of all cardboard waste produced, recycled by those who recycle 'some'.

Therefore, the number of respondents who 'never' recycle cardboard is:

100 - (42.1 + 43.5) = 14.4%

These calculations were then applied to the ERIC data for the total tonnes recycled: 4,748 tonnes. It was then possible to calculate the total percentage of cardboard recycled by the NHS in England and Wales:

(0.14 + 0.2) = 16%
or
(0.16*4748) = 743 tonnes

Table 45: Domestic waste recycling model, based on NHS PASA and ERIC data

Product	% all or most recycled (A)	% of material where respondents claimed to recycle often	Weighting system for A (70%)	% all or most recycled (B)	% of material where respondents claimed to recycle some	Weighting system for B (30%)	Total recycled (%)	Total recycled (tonnes)
Total	**212**			**702**				**4,748**
Cardboard	42	20	14	44	6	2	16	743
Office paper	34	16	11	29	4	1	12	592
Other*	2	1	1	74	10	3	4	178
Kitchen waste	1	1	1	86	12	4	5	194
Plastics	6	3	2	80	11	3	4	250
Newspapers/ magazines	2	1	1	73	10	3	4	173
Glass	7	3	2	76	11	3	6	265
Aluminium	18	8	6	49	7	2	8	376
Textiles	13	6	4	60	9	3	7	321
Other metals	31	14	10	42	6	2	12	558
Electrical	9	4	3	59	8	3	6	261
Toner cartridges	47	22	16	31	4	1	17	837

Note: Totals may not add up due to rounding **Other***: Undefined waste
Sources: Derived from NHS Estates, 2003; NHS PASA, 2003d and Welsh Health Estates, 2003.

By combining the composition data derived from the NHS PASA (2003d) report with the ERIC estimate of total domestic waste generated, it was possible to estimate the total tonnage of domestic waste by product type.

Worked example: Cardboard

261,086*13% = 33,941 tonnes of cardboard in the waste stream

743 tonnes of cardboard recycled in the waste stream, therefore

33,941 - 743 = 33,199 tonnes of cardboard disposed via landfill/incineration.

Table 46 presents domestic waste by product type (as a percentage of the total) and waste management method for the NHS in England and Wales.

An estimate for total tonnes of food wasted in the NHS in England and Wales was derived from ERIC (NHS Estates, 2002a and Welsh Health Estates, 2003), which provided information on meals requested by trusts and the proportion wasted. The two categories had different units of measurement: Patient meals (numbers) and meals wasted (%). The following example illustrates the process used to convert both categories into tonnes, and was employed across all trusts.

Worked example: Patient meals

The Selby & York PCT had a total request of 17,900 patient meals.

The weight of an average meal is approximately 300g.

Therefore, the weight of all patient meals requested was (17,900*300) = 5,370,000gm or (5,370,000/1,000,000) = 5.37 tonnes

The Selby & York PCT estimated their food wastage to be 25% of patient meals or

17,900*25% = 4,475 patient meals.

This is equal to (4,475*300gm) = 1,342,500gm or (1,342,500/1,000,000) = 1.34 tonnes

Data for Wales did not include figures on meals wasted. Due to this missing information, no specific meal data could be reported.

2. Clinical and special waste

To derive a total figure for clinical waste generated by the NHS in England and Wales, ERIC returns (NHS Estates, 2002a and Welsh Health Estates, 2002) data for all trusts was combined. However, this process did have its limitations, as data was missing in the Welsh returns for medium community trusts, ambulance trusts and primary care facilities (i.e. equivalent to England's PCT's).

To calculate a comparable Welsh figure, assumptions were applied to generate figures for missing data. The main assumptions for medium community and ambulance trusts was that these trust types would have produced, on average, similar quantities of clinical and special waste to those in England. An English average per trust type was used to fill in missing gaps in the Welsh data. For primary care facilities it was more difficult to derive a figure for clinical and special waste. For the purposes of this report, it was decided to use the approach of estimating what percentage the primary care facilities (12% based on England's data) would contribute to the overall total of clinical and special waste produced by the NHS in Wales. With this estimate it was possible to refine the assumptions based on advice from those within the sector (NHS Estates, 2003a).

It was difficult to find data on the breakdown and treatment of clinical and special waste. The only reliable data was provided by the Environment Agency's (2003a) *Hazardous Waste Interrogator*, which had data on the composition of clinical and special waste as well as how it was managed. These proportions were applied to the total clinical and special waste figure.

Table 46: Composition of, and waste management method used, for domestic waste generated by the NHS in England and Wales

Product	% of total	Total waste (tonnes)	Landfilled or incineration (tonnes)	Recycled (tonnes)	% of product recycled
Total waste	**100%**	**261,086**	**256,338**	**4,748**	**1.8%**
Cardboard	13%	33,941	33,199	743	2.2%
Office paper	12%	31,330	30,739	592	1.9%
Other*	10%	26,109	25,931	178	0.7%
Kitchen waste	10%	24,803	24,609	194	0.8%
Plastics	9%	24,150	23,901	250	1.0%
Newspapers/magazines	9%	22,192	22,019	173	0.8%
Glass	8%	20,887	20,622	265	1.3%
Aluminium	7%	16,971	16,594	376	2.2%
Textiles	7%	16,971	16,649	321	1.9%
Other metals	6%	15,665	15,107	558	3.6%
Electrical	6%	14,360	14,099	261	1.8%
Toner cartridges	5%	13,707	12,870	837	6.1%

Other*: Undefined waste.
Note: Totals may differ due to rounding.
Sources: Derived from NHS Estates, 2003; NHS PASA, 2003d and Welsh Health Estates, 2003.

Staff, patient and visitor transport

Main data sources

The main sources of data for the number of trips, average distance travelled and mode of transport used by patients and visitors, was obtained from the *National Travel Survey* (DfT, 2002c). This data is the most reliable and best available, and is considered one of the main primary sources for data on passenger transport in the UK. Data on staff travel was obtained from *Transport Statistics Great Britain* (2002d). Information on ambulances was derived from the Department of Health (Blackshaw, 2003), the Welsh Ambulance Service NHS Trust (Owens, 2003), selected ambulance trusts and the Air Ambulance Foundation (Relf, 2003).

Data provided by the ambulance trusts was used to derive an average figure for accident and emergency (A&E), passenger transport services (PTS) and first response vehicle travel to calculate total kilometres for all ambulance travel across the NHS in England and Wales. Not all ambulance trusts had data available for the study year and either had to provide data from previous years or only provided partial datasets. With this data, average distances were derived for each ambulance type, as presented in Table 47.

By multiplying the average distance figures presented in Table 47 by the number of ambulance vehicles in operation in England and Wales, it was possible to derive an estimated total distance travelled by the NHS ambulance fleet in England and Wales in 2001, as shown in Table 48.

Calculations and proxy measures used

The figures provided by the *National Travel Survey* (DfT, 2002c) for patient and visitor travel were multiplied by the England and Wales population figure (52,084,500 in 2001 (ONS, 2002a)) to derive total passenger kilometres (pass-km) travelled by patients and visitors.

Figures provided by *Transport Statistics Great Britain* (2002d) for staff commuting and staff business travel were multiplied by the number of employees in the NHS in England and Wales (852,110 in 2001 (Merry, 2002)), to derive a total for pass-km travelled by staff.

Table 47: Average distances travelled by selected ambulance trusts, by ambulance type

Ambulance type	Total distance travelled by case study ambulance trusts (km)	Number of case study vehicles	Estimated average distance travelled by case study ambulance trusts (km)
Total vehicles	**120,563,093**	**2,852**	**42,273**
Accident & emergency	52,824,450	1,033	51,137
Passenger transport service	44,451,293	1,404	31,660
First response	2,019,491	82	24,628
All vehicles	19,819,516	273	72,599
Support vehicles	1,448,343	60	24,139

Note: Totals may differ due to rounding.
Note: This also includes information on travel not related to a specific vehicle type.
Sources: London Ambulance Service, Welsh Ambulance Service, Westcountry Ambulance Services, Cumbria Ambulance Service, West Midlands Ambulance Service, East Midlands Ambulance Service, Mersey Regional Ambulance Service, North East Ambulance Service, Bedfordshire & Hertfordshire Ambulance and Paramedic Service, Sussex Ambulance Service and West Yorkshire Metropolitan Service.

Table 48: Total distance travelled by ambulance vehicles for NHS in England and Wales, in 2001

Ambulance type	Total number of vehicles	Estimated average distance travelled by case study ambulance trusts (km)	Total estimated distance travelled by all NHS in England and Wales ambulance trusts (km)
Total vehicles	**2,852**	**42,273**	**114,542,708**
Accident & emergency	1,169	51,137	61,520,984
Passenger transport service	1,588	31,660	50,209,882
First response	94	24,628	2,811,842

Note: Totals may differ due to rounding.

It was almost impossible to obtain data on distances travelled from all 17 air ambulance trusts. However, three trusts were able to provide comprehensive data: Yorkshire Air Ambulance Trust, Wales Air Ambulance Charitable Trust and Kent Air Ambulance. By combining data provided by the Air Ambulance Foundation, and the three air ambulance trusts, an average figure was derived for the total kilometres travelled by air ambulances in England and Wales for the NHS. A detailed breakdown of estimated individual air ambulance trust distances travelled can be found on the project's website www.materialhealth.com.

A number of assumptions were derived to establish the total distances flown by air ambulance trusts across England and Wales. One mission (flight) only accounts for the journey out to the accident scene, but does not include the journey to the hospital, or the return journey to base. In addition, it is not always known if a helicopter continues its journey to a hospital, but it is almost always certain the aircraft returns to base. In order to take account of this return journey, it was necessary to double the figure of missions flown.

If a trust was unable to provide total distance travelled by aircraft, the data was estimated using the following calculations: The average response time to an incident is 10 minutes. Total flying time was therefore calculated by multiplying the total number of missions flown by a factor of 10 (minutes). In addition, it was estimated that a helicopter flies at an average speed of 2 miles per minute when attending an incident. It was therefore possible to derive the total distance flown in miles (then converted to kilometres).

Freight transport

Information on the methodology used to derive freight transport can be found on the website www.materialhealth.com.

Table 49: ERIC definitions for water services

Category	Units	Definition
Water volume	**m^3**	The amount of water used in cubic metres for the organisation site supplied by the national/regional supplier or locally from another organisation (e.g. NHS trust). Exclude water supplied from a 'borehole' or water supplied to non-metered premises.
Water volume (borehole)	**m^3**	The amount of water used in cubic metres for the organisation site supplied from a borehole supply either owned or managed by the organisation or from another organisation. Exclude water supplied by the national/ regional supplier.
Sewage volume	**m^3**	The amount recorded as sewage in cubic metres for the organisation site taken by the national/regional supplier or other organisation (e.g. another NHS trust) or the organisations own sewage treatment plant.

Source: NHS Estates, 2002a.

Water

Main data sources

All water data was obtained from ERIC returns (NHS Estates, 2002a and Welsh Health Estates, 2002).

Calculation and proxy measures used

Table 49 provides details of the different water service categories used in the ERIC databases, and defines their boundaries and units of measurement.

All water and sewage volumes were converted to litres. The data was organised into trust types, and it was assumed that all trusts consumed water from national supplies. However, this assumption did not always apply to water supplied from boreholes. Therefore, only data gaps in national water supplies and sewage volumes were filled using average figures for each trust type. The method applied for filling in data gaps for energy, clinical and special waste was adopted for water (see Appendix E).

Land use

Main data sources

Data on the land area occupied by the NHS in England and Wales was obtained from ERIC databases (NHS Estates, 2002a and Welsh Health Estates, 2002). Details included the gross internal site floor area (m^2), 'site footprint' (m^2), occupied floor area (m^2), site land area (ha) and total number of parking spaces.

Calculation and proxy measures used

Table 50 provides details on the different land use categories used in the ERIC database, defining their boundaries and units of measurement.

ERIC data provided by NHS Estates (2002a) and the Welsh Health Estates (2002) was combined to derive an initial total land area (29,431 hectares). Data gaps were then filled with average trust type data to derive a total land area of 33,654 hectares (see Appendix E).

To convert the data on the total number of car parking spaces available into the total land area taken up by car parks, a conversion factor of 12.5 m^2 per car parking space was employed. This figure was multiplied with the ERIC figures for number of car parking spaces available to derive a total land area occupied by car parks, for example:

NHS in England and Wales operates a total of 379,699 car parking spaces.

Therefore:
(379699*0.00125) = 567 ha of land owned by the NHS in England and Wales is taken up by car parks.

Table 50: ERIC definitions for land use

Category	Unit	Definition
Gross internal site floor area	**m^2**	The total internal floor area of all buildings including temporary buildings or premises or part therein, occupied or non-occupied, which constitute the site operated by the NHS trust and is either owned by the NHS trust or is defined within the terms of a lease, Service Level Agreement. [Not to be confused with an ecological footprint].
Site footprint*	**m^2**	The site footprint is the total ground floor area of all buildings or premises or part therein occupied and unoccupied, which is operated by the NHS trust and is either owned by the NHS trust or is defined within the terms of a lease, Service Level Agreement. [Not to be confused with an ecological footprint].
Occupied floor area	**m^2**	The gross internal floor area of all buildings or premises or part therein, which are in operational use and required for the purpose of delivering the function/activities of the NHS trust (i.e. occupied by the NHS trust), and either owned by the NHS trust or is defined within the terms of a lease, Service Level Agreement. [Not to be confused with an ecological footprint].
Site land area	**ha**	The total physical site land area operated by the NHS trust, which is either owned by the NHS trust or is defined within the terms of a lease, Service Level Agreement, or tenancy agreement. The units of entry are hectares to a maximum of four decimal places.
Total parking spaces available	**Number**	Total number of car parking spaces available for use within the organisational grounds. This should be the combined total number of disabled, patients, visitors and staff parking places for the whole site.

***** Not to be confused with an ecological footprint. Footprint here refers to the hectares occupied by a building (a term used within NHS).
Source: ERIC returns, 2002.

Methodology: Ecological footprint analysis

In order to calculate the ecological footprint of the NHS in England and Wales, two steps needed to be taken:

1. The *National Footprint Accounts* for the UK (Redefining Progress, 2002) were reallocated to policy relevant components using the Stepwise ™ approach (Lewan & Simmons, 2001 and Barrett & Simmons, 2003). This reallocation is compatible with that used by the European Common Indicators Programme (ECIP) .
2. The ecological footprint of the NHS in England and Wales was then derived.

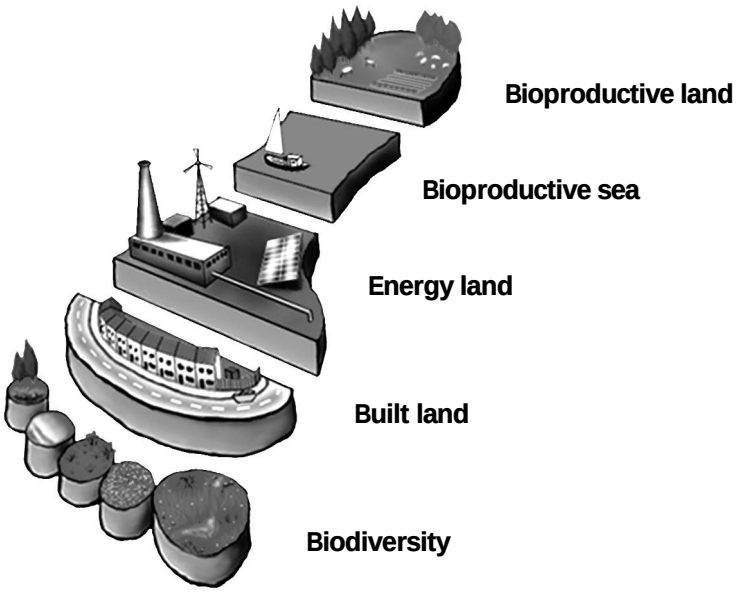
What is an ecological footprint?

An ecological footprint is the area required to provide the goods and services consumed by individuals, communities or organisations. It can also be derived for products or for particular activities. Using global hectares (gha), the ecological footprint expresses how much of nature's renewable resources (or the annual bioproductive 'interest') we are currently appropriating. If more of nature's interest is consumed than is available (i.e. nature's 'capital' is being reduced), then it is possible to assume that the rate of consumption is not sustainable (Chambers *et al.*, 2000).

For the purposes of calculating an ecological footprint, bioproductive land and sea is categorised into four basic types (see Figure 18):

- **Bioproductive land -** land required to produce crops, grazing (pasture) and timber (forest) etc. Use of these land types is usually calculated separately.
- **Bioproductive sea -** sea area required to provide fish and seafood.
- **Energy land -** 'new' forest required for the absorption of carbon emissions in order to stabilise CO_2 levels in the atmosphere. Calculations take into account the absorptive capacity of the oceans and discount it (Loh, 2002).
- **Built land -** such as buildings and roads. Once built on, land is no longer bio-productive in any year.

Figure 18: Area and sea types used to calculate an ecological footprint



In addition, a fifth type - biodiversity land - refers to the area of land and water that would need to be set-aside to preserve biodiversity. This area of land and water is allocated in proportion to the ecological footprint - for example, the larger the ecological footprint the larger the responsibility to maintain biodiversity.

The following examples illustrate how the four main types of bioproductivity are inter-related when an ecological footprint is calculated.

Example 1

A cooked meal of fish and rice would require bioproductive land for the rice, bioproductive sea for the fish, and forested 'energy' land to re-absorb the carbon emitted during processing and cooking.

Example 2

Driving a car requires built land for roads, parking and so on, as well as a large amount of forested 'energy' land to re-absorb the carbon emissions generated from petrol use. In addition, energy and materials are used for construction and maintenance of the vehicle.

A snapshot approach

An ecological footprint is a 'snapshot' methodology. It is based on a year-specific data set - 2001 for this study. An ecological footprint tells us how much bioproductive area would be required to support current consumption, and does not attempt to predict future or past impacts. It is likely that, due to technological changes and variations in consumption, the ecological footprint (and biocapacity) will change over time, hence the need to focus on one year.

Ecological footprinting and sustainability

A powerful use of the ecological footprint approach is in the assessment of sustainability. By comparing the ecological footprint (demand of natural resources) with biocapacity (the available supply) it is possible to assess the ecological sustainability of current consumption - if demand is greater than supply, the level of consumption is not sustainable. This is most usually calculated at the regional, national or global level and expressed on a per capita basis.

Biocapacity can be expressed as local biocapacity or as global average biocapacity - the latter is referred to as the average 'earthshare'. If everyone lived within his or her earthshare, this would attain a 'one planet lifestyle' - an environmentally sustainable earth. The earthshare is calculated by dividing the total amount of bioproductive land and water on the planet by the current global population. This gives the average amount of bioproductive land and sea available globally per capita. For example the per capita ecological footprint of the UK is 5.45 gha (Barrett & Simmons, 2003) and the latest calculations estimate the earthshare to be 1.9 gha per capita (Loh, 2002).

When analysing an organisation rather than a region, the issue of indirect consumption arises. For example, if a NHS patient in England and Wales has an operation where the surgeon uses rubber gloves, the resources needed to produce the rubber and energy used to manufacture and supply those gloves is part of the patient's ecological footprint. This indirect consumption is taken into account in this analysis, as all impacts incurred during the production of the items consumed by the 'end user' (NHS in England and Wales) are included (as far as available data allows).

If a NHS patient in England and Wales has an operation where the surgeon uses rubber gloves, the resources needed to produce the rubber and energy used to manufacture and supply those gloves is part of the patient's ecological footprint.

For the headline results of this study it was decided to present the ecological footprint results as a total for the NHS in England and Wales, and as an average per capita estimate using the population of England and Wales.

Deriving the ecological footprint results

Algorithms and conversion factors used in this study were chosen to be the same as or compatible with those used in regional studies completed by Best Foot Forward (such as BFF, 2002 and 2004). However, due to the difference in boundaries presented by analysing an organisation rather than a region, some conversion factors had to be altered to ensure consistency. This section outlines the details of the process, and data used to derive the ecological footprints for each component.

Confidence limits of results: Energy as a case study

In any analysis of this type, results will be sensitive to:

- Boundaries assumed within data sets.
- Errors or anomalies in original data.
- Choices made on assumptions and proxy measures used.

It is often extremely difficult to estimate these sensitivities due to: A lack of transparency about boundary assumptions made within data sets, undiscovered errors or anomalies in original data, a lack of sensitivity estimates of the original data, and a lack of possible alternative benchmark data for assumptions and proxy measures used.

This box illustrates how boundary issues and anomalies in original data may affect the ecological footprint calculations. There are no studies available to compare the NHS results against, but there are data relating to the whole health sector (i.e. more than just the NHS in England and Wales. This data also includes vets, social work and NHS administration etc.). This box therefore compares this study's results to others in relation to the whole health sector. The comparison reveals that all findings are roughly similar - therefore, these substantiate this study's results.

Continued overleaf...

Energy consumption and composition data collected for this study related to NHS trusts in England and Wales, and therefore excluded administrative and logistical functions such as NHS PASA and NHS Estates. The Stepwise™ ecological footprint model for the UK (see Barrett & Simmons, 2003) used to carry out the ecological footprint, is based on official European national data sets for energy consumption, which included healthcare (including veterinary services) and social work (European Communities, 2002). A comparison of these two datasets provided an estimate of how much energy was consumed by the whole health and social work sector and by the NHS trusts in England and Wales (that captured by this study).

An additional data set, produced by the REWARD programme (Environment Agency & AEA Technology, 2000) was used to benchmark the European data. Table 51 shows the relationship between data from the different sources.

These comparisons estimate that the NHS in England and Wales used 38% of gas, 59% of electricity and 47% of the total energy used by the health and social work sector in the UK.

The 'oil' and 'other' categories within the European Communities data were anomalous, as they show the NHS in England and Wales used more of these fuels than the whole health and social work sector in the UK. This may be due to differences between the data years (1995 and 2001), or other data boundaries used to generate the estimates, but may also simply be different estimates. The REWARD data estimated that the NHS in England and Wales consumed 53% of electricity used within the health and social work sector (of England and Wales).

When converted to an ecological footprint for total energy use, the European Communities data produced an ecological footprint per capita of 0.03 global hectares (gha). This ecological footprint was compared with the ecological footprint of direct energy consumed per capita for the NHS in England and Wales (0.02 gha). This data estimated that the NHS in England and Wales contributed 56% of the ecological footprint of energy consumed by the health and social work sector.

Table 51: Estimated energy use within the health and social work sector

Data source	Oil (GWh)	Natural gas (GWh)	Electricity (GWh)	Other (GWh)	Total energy (GWh)
European Communities:					
Health & Social Work, UK, 1995	694	20,528	5,555	28	26,805
REWARD Programme:					
Health & Social Work, England & Wales, 2000	-	-	6,167*	-	-
NHS Estates and Welsh Health Estates:					
NHS Trusts, England and Wales, 2001	897	7,809	3,261	682	12,650

* Converted from petajoules (original unit).

Sources: Environment Agency & AEA Technology, 2000; European Communities 2002; NHS Estates, 2002a and Welsh Health Estates, 2002.

Table 52: Estimated contribution of the NHS in England and Wales energy use to the UK health and social work sector, per capita

	% of Health & Social Work sector's electricity use (European Communities, 2002)	% of Health & Social Work sector's electricity use (Environment Agency & AEAT, 2000)	% of Health & Social Work ecological footprint of energy use per capita
NHS in England and Wales	**59**	**53**	**56**

If data were available for elements not covered by this study, and were added to the NHS data, it should match the overall data for the health and social work sector. In absence of these data points, it was only possible to compare the NHS in England and Wales' contribution to various energy components for the health and social work sector. The various comparisons are given in Table 52.

Direct energy footprint

Direct energy use was assessed by fuel type and relative carbon emissions for each source. The NHS in England and Wales uses grid electricity, gas, oil and coal (which emit carbon) and renewables (which were assumed to be carbon neutral).

CO_2 emissions associated with the direct energy consumed by the NHS in England and Wales in 2001 were calculated (Table 53), and the ecological footprint derived by calculating the global hectares of new forest required to assimilate these emissions. Renewable electricity supplied via the National grid was accounted as part of the renewable electricity data. The remaining national electricity only included fossil fuels and is referred to as 'brown grid' electricity. The ecological footprint conversion factor used for brown grid electricity is given as an example in Table 54.

Table 53: CO_2 emissions from the use of different energy sources

Energy source	CO_2 per kWh (kg)
Coal	0.3
Oil	0.25
Gas	0.19
Renewables	0

Source: DEFRA, 1999.

Table 54: Brown grid electricity conversion factor

	Brown grid electricity (per GWh)	Energy land
A	Carbon per GWh (tonnes)	131.47
B	Carbon responsibility* (%)	69%
C	World carbon absorption (tonnesC/ha/yr)	0.95
D	Equivalence factor	1.35
(A*B*D) /C	Ecological footprint (gha/GWh)	128.89

* CO_2 emissions assimilated by the sea are excluded from the ecological footprint, which leaves approximately 69% of emissions to be accounted.

Indirect energy use was accounted for in other components. For example, energy used to produce final products (known as embodied energy) was accounted for in the products and waste component, and energy use for transport was accounted for in the staff, patient and visitor transport component.

Products and waste footprint

Products

The *National Footprint Accounts* (Redefining Progress, 2002) assess the bioproductive land and energy land requirements of raw materials and final products separately. The bioproductive land requirements are all accounted for within raw materials home production and trade data. Additional embodied energy impacts, which occur during the manufacture and production of final products, are not identified separately, but aggregated as part of a national energy consumption figure adjusted for imports and exports.

The Stepwise™ methodology uses the same approach of assessing energy and bioproductive ecological footprints separately, but disaggregates raw materials and final products into more detailed components. However, consumption data for the NHS in England and Wales only relates to final products, and is taken from the mass balance analysis (see Table 3).

Data on products consumed by the NHS in England and Wales was originally derived from the UK ProdCom data series (ONS, 2001), before it was aligned to the Department of Health (DH) spending categories (see Methodology: Mass Balance, page 44). To calculate the ecological footprint of these products, in a manner compatible with the *National Footprint Accounts*, the original ProdCom data was initially used. A model was created to analyse each of the products and ProdCom sections identified.

The *National Footprint Accounts* (Redefining Progress, 2002) use the classification system known as the Standard Industrial Trade Classification (SITC) for final products, as opposed to ProdCom, which uses Standard Industrial Classification's (SIC). These two systems were aligned through the use of the nomenclature correlation tool supplied by HM Customs & Excise (2003).

Once all SIC coded products had been aligned with the SITC, the *National Footprint Accounts* (Redefining Progress, 2002) methodology could be applied to calculate the ecological footprint of each final product consumed. To enable this calculation, several further steps were necessary.

Firstly, assumptions were made regarding the origins of the final products consumed. Whether a final product is imported or home produced has implications for the energy ecological footprint. In the UK, for example, emissions of carbon per unit of energy are slightly lower than world average emissions. The bioproductive ecological footprint is not affected because even if home produced yields are used they are converted to global average yields in the conversion process to global hectares. Final products consumed by the NHS in England and Wales were assumed to have the same import/home produced ratio as for the UK. This ratio was calculated for each final product.

Secondly, assumptions had to be made to fill data gaps in the *National Footprint Accounts* (Redefining Progress, 2002). In a few cases correlated SITC code data was not identified in the *National Footprint Accounts* and no embodied energy data was given. Therefore, no energy ecological footprints could be calculated. To enable ecological footprint calculations for codes that did not have data, data for similar products was used. In most instances, data was filled using the embodied energy data for *National Footprint Accounts'* categories 'general industrial', 'miscellaneous manufacture' and 'precision instruments', all of which use 100 MJ per kg of final product.

Finally, an assumption had to be made regarding the embodied energy data for medical gases. Medical gases are an important consumption item for the NHS, and need to be included to produce an ecological footprint. The *National Footprint Accounts* (Redefining Progress, 2002) embodied energy data is inconclusive regarding these energy-intensive products. It was therefore assumed that a more realistic embodied energy figure for medical gases, based on other less energy-intensive products consumed by the NHS, needed to be used. According to the *National Footprint Accounts* (Redefining Progress, 2002) the embodied energy of medical gases, classified as 'inorganic chemicals', is 40 MJ per kg. This was thought to be an underestimate and the alternative data of 100 MJ per kg was used (the average embodied energy of the NHS category 'medical & clinical supplies'). No data was found to support this figure, but it was assumed that this still was an underestimate of the actual energy embodied in medical gases. The sensitivity of this assumption is shown in Table 55.

Table 55: The sensitivity of embodied energy assumptions for the ecological footprint of medical gases

Final product	Medical gases	Medical gases
SIC	24110	24110
SITC equivalent	52	74
SITC description	Inorganic chemicals	General industrial
MJ per kg	40	100
Ecological footprint (gha)	3,879	9,699

Bioproductive (crop, pasture, forest and sea) ecological footprints for final products are captured, where applicable, from within the *National Footprint Accounts* methodology.

A worked example deriving the crop area required for cotton (used for medical gauzes, bandages and dressings) is illustrated in Table 56 below. A proportion of the built land used for industrial and commercial premises was also allocated to the NHS in England and Wales, based on the tonnes of final products consumed.

Energy land ecological footprints are calculated from the embodied energy associated with final products, which includes energy inputs throughout the lifecycle of the product, including extraction and harvesting of the raw materials. Embodied energy figures used in the *National Footprint Accounts* (Redefining Progress, 2002) were applied to each of the final products consumed by the NHS in England and Wales (captured by ProdCom data) via the correlation of the SITC and SIC classifications. A worked example deriving the energy area required for cotton (used for medical gauzes, bandages and dressings) is shown in Table 57.

Table 56: The bioproductive ecological footprint of cotton used for medical gauzes, bandages and dressings

Classification and consumption data	SIC Code	17202020
	Description	Woven fabrics of cotton weighing 200g/m² or less, for medical gauzes, bandages and dressings
	UK production (tonnes)	6,811
	Imports (tonnes)	2,912
	Net supply (tonnes)	9,273
Cotton yields	National yield* (kg/ha/yr)	598
	World yield (kg/ha/yr)	598
Harvest	Multiple harvest adj.	1.03
	World seed factor	1
Waste factor	National extraction rate	1
	Import extraction rate	1
	National waste factor	1
	World waste factor	1
Ecological footprint factors	UK yield factor	2.44
	Crop equivalence factor	2.18
Ecological footprint results	Production (gha)	0*
	Import (gha)	35,362
	Net supply (gha)	35,362

* Although cotton medical gauzes, bandages and dressings may be manufactured in the UK, the raw cotton is not grown here. Therefore, all cotton is assumed to be imported.

Once the ecological footprints were calculated for all final products, they were combined to derive a total ecological footprint for final product consumption by the NHS in England and Wales.

Waste

Due to the fact that final products were accounted for when they entered the NHS in England and Wales, i.e. when they were consumed, it was unnecessary to calculate the ecological footprint of waste production as this would have led to double counting.

Table 57: The energy ecological footprint of cotton used for medical gauzes, bandages and dressings

Classification and consumption data	
SIC Code	17202020
Description	Woven fabrics of cotton weighing 200g/m2 or less, for medical gauzes, bandages and dressings
UK production (tonnes)	6,811
Imports (tonnes)	2,912
Net supply (tonnes)	9,273
Embodied energy	
MJ/kg	20
Carbon emissions	
Production (C tonnes)	2,509
Import (C tonnes)	1,151
Net supply (C tonnes)	3,661
Ecological footprint results	
Production (gha)	2,462
Import (gha)	1,130
Net supply (gha)	3,591

C = carbon
Note: *National Footprint Accounts* (Redefining Progress, 2002) conversion factors used.

Food footprint

The *National Footprint Accounts* (Redefining Progress, 2002) identify food at the raw material stage, for example wheat, potatoes and bovine meat. Food products, such as ice cream, soup and bacon are not identified. The energy embodied within food is also identified for traded products (imports and exports), with the same embodied energy data used for both imports and exports.

Table 58: The embodied energy estimates of food types

Food product type	MJ per kg
Cereals	4
Starchy root	2
Sugar & sweeteners	15
Pulses	5
Treenuts	20
Oil crops	7
Vegetable oils	21
Vegetables	1
Fruits	1
Stimulants	30
Spices	30
Alcoholic beverages	15
Meat	37
Edible offal	37
Animal fats	37
Milk	5
Eggs	1
Fish & seafood	40
Other aquatic products	40
Miscellaneous	17
Confectionery	43
Soft drinks	18

Sources: Derived from Redefining Progress, 2002 and Coley *et al.*, 1998.

The Stepwise™ methodology disaggregates these broad categories into final product categories - listed in the *National Food Survey* (ONS, 2003). The embodied energy associated with home production was assumed the same as that given in the *National Footprint Accounts* (Redefining Progress, 2002), with additional estimates from Coley *et al.* (1998) (Table 58).

Although the net consumption of food by the NHS in England and Wales was measured as final products, the ecological footprint calculations include the raw materials required to produce them (this is referred to as 'gross consumption'). This means that the ecological footprint includes the bioproductive and energy areas required to grow and harvest the raw materials, as well as the energy to process them into final food products.

The areas required for growing crops and rearing animals to supply the NHS in England and Wales with food, was calculated using global yield factors from the *National Footprint Accounts*, and converted to global hectares following the methodology of the *National Footprint Accounts* (Redefining Progress, 2002). An example of an ecological footprint calculation for imported beef is given in Table 59.

Table 59: Calculation of the imported beef ecological footprint

	Beef* (1 tonne)	Energy area
A	Carbon per tonne (tonnes)	0.681
B	Carbon responsibility	69%
C	World carbon absorption (tC/ha/yr)	0.95
D	Equivalence factor	1.35
(A*B*D)/C	Ecological footprint (gha/tonne)	0.668
	Beef (1 tonne)	**Pasture**
A	World yield (tonnes/ha/yr)	0.032
B	World waste factor	1
C	Equivalence factor	0.47
(1/(A*B))*C	Ecological footprint (gha/tonne)	14.92
	Beef (1 tonne)	**Crop area**
	UK imports as % of world production	0.10%
A	Feed (gha/tonne)	1.08
B	Fodder (gha/tonne)	1.95
A+B	Ecological footprint (gha/tonne)	3.03

Beef (1 tonne)		Energy	Bio-productive area	Total
A	Energy ecological footprint	0.668		
B	Pasture ecological footprint		14.92	
C	Crop ecological footprint		3.03	
A+B+C	Ecological footprint	**0.668**	**17.95**	**18.62**

Note: *National Footprint Accounts* (Redefining Progress, 2002) conversion factors used.

Staff, patient and visitor transport footprint

The *National Footprint Accounts* (Redefining Progress, 2002) do not identify transport impacts separately, instead the energy impacts are aggregated with total ecological footprint calculations. Transport uses infrastructure, such as roads and railways. A proportion of the UK's infrastructure, based on the use of the various modes of transport, by the NHS in England and Wales, was included in this component.

The staff, patient and visitor transport ecological footprint was disaggregated by mode. A range of transport modes and associated carbon emissions were considered, as listed in Table 60.

Table 60: Carbon dioxide emissions, by mode of transport

Mode	CO2/pass-km (kg)
Car	0.11
Motorbike & scooters	0.1
Rail	0.06
Bus & coach	0.05
Other private	0.11
Other public	0.09
Ambulance	**CO2/vehicle-km (kg)**
Air ambulance	0.22
	0.79

Sources: Derived from Cornwall Air Ambulance, 2003; Barrett & Simmons, 2003; DfT, 2002 & d, IPPC, 1996; Maritime Helicopters, 2003 and VCA, 2003.

Table 61: Calculation of the energy conversion factor for ambulance travel

	Ambulance (1 vehicle-km)	**Energy area**
A	Carbon per pass-km (kg)	0.059
B	Uplift factor* (%)	145%
C	Carbon responsibility (%)	69%
D	World carbon absorption (tonnesC/ha/yr)	0.95
E	Equivalence factor	1.35
((A/1000) *B*C*E) /D	Ecological footprint (gha/vehicle-km)	0.000084

* The uplift factor used to calculate the transport ecological footprint is adopted from Wackernagel & Rees (1996). Other sources suggest the uplift factor can range between 11% (derived from Hill *et al.*, 1995) and 93% (derived from Teufel *et al.*, 1993).

An example of an ecological footprint calculation for ambulance travel is given in Table 61. The 'uplift factor' (Wackernagel & Rees, 1996) is used to account for the indirect energy impacts associated with transport (such as maintenance and manufacture).

Water footprint

The supply and consumption of water is not identified in the *National Footprint Accounts* (Redefining Progress, 2002). For this reason, the ecological footprint of water was calculated by measuring the energy used to supply, collect and treat water, as well as post-consumer treatment and release back into the environment. Table 62 shows the ecological footprint calculations for the supply of water.

It has been argued (Chambers *et al.*, 2000) that water catchment area should also be included in water ecological footprints. Yet, including the catchment area would incur double counting of areas already included - crop land, energy land, pasture, forest and sea - because most areas also serve a water catchment function.

Table 62: Calculation of the water supply conversion factor

	Water supply (1 Ml)	Energy land
A	Carbon per megalitre (tonnes)	0.1
B	Carbon responsibility (%)	69%
C	World carbon absorption (tonnesC/ha/yr)	0.95
D	Equivalence factor	1.35
(A*B*D)/C	Ecological footprint (gha/megalitre)	0.099

Built land footprint

The *National Footprint Accounts* (Redefining Progress, 2002) include built land as a separate component, but it is not disaggregated into various uses. Built land includes all area that is built on, contaminated or degraded to the degree that it is rendered biologically unproductive.

Built land data for the NHS in England and Wales included the area that was occupied by buildings (including car parks) in 2001 (see Table 14). Other 'indirect' uses of built land, such as transport infrastructure and industrial and commercial premises used to supply products and services consumed by the NHS in England and Wales were accounted elsewhere.

To calculate each built land ecological footprint, a yield factor was applied to raw data to convert it into hectares of global average crop area (as in the *National Footprint Accounts* (Redefining Progress, 2002), it was assumed that most built land was once productive). A crop area equivalence factor was then applied to convert the data into global hectares. Table 63 shows the calculation for built land.

Table 63: Calculation of the built land conversion factor

	Built land (per hectare)	Built land
A	Built land (ha)	**1**
B	Crop yield factor	**2.44**
C	Crop equivalence factor	**2.18**
A*B*C	Ecological footprint (gha)	**5.32**

Appendix A: Case studies

The aim of the selected NHS Trust facility case studies was to collect detailed data on-site, which could be proxied up (bottom-up approach) to an England and Wales level to fill any data gaps. This data was also used to verify derived figures and other data sources.

Methodology

In order to develop a good understanding of how a hospital operates and who should be contacted for information, a site visit to University Lewisham Hospital was arranged. Different departments were visited and contacts were made with the following personnel:

- Supplies and services manager.
- Principle pharmacist.
- Catering manager.
- Director of facilities.

It was clear from the site visit that hospitals would have information on waste generated, energy usage and consumption of other products, although not necessarily in a useful format for a mass balance analysis. In addition, a lot of time would be required to gather records on expenditure in an attempt to derive data on consumption.

Case study selection

The next step was to identify potential case studies for the project. Seven hospitals, four GP surgeries and one new-build hospital were originally chosen as potential NHS Trust case studies. The selection process ensured that a wide range of hospitals and GP surgeries were considered. These criteria included:

- Size (patient numbers/employees).
- Geographical area.
- Star rating (for hospitals).
- Role/specialisation and age of buildings.
- Management performance indicators (for PCT's).

The Advisory Group provided advice on feasible GP surgeries. Selected case study Trusts were contacted and asked to take part in this study on a voluntary basis. Three hospital facilities and two GP surgeries volunteered their time and data. These were:

- St James Practice, Kings Lynn: West Norfolk Primary Care Trust.
- Wells Park Practice, Sydenham, London: Lewisham Primary Care Trust.
- Helston Community Hospital, Cornwall: West of Cornwall Primary Care Trust.
- Royal Oldham Hospital, Oldham: Pennine Acute Hospitals Trust.
- University Hospital Lewisham, Lewisham, London: Lewisham Hospital NHS Trust.

On average, 2-3 days were spent at each case study. Over 90 hours were spent on site collecting data and communicating with appropriate people in various departments in order to gather the best available information. A significant amount of data was gathered, covering: Expenditure data on items such as products, food; value of pharmaceuticals dispensed; and the cost of waste management and energy consumption.

Data collection

Direct energy: Energy data covered electricity and gas consumption. This information was easily accessible. Data from ERIC was obtained for all hospitals. GP surgery data was obtained from electricity and gas bills.

Products: This covered any product a facility was likely to use (excluding pharmaceuticals and food). Products included items such as furniture, paper or electronic equipment. This information was extremely difficult to obtain, as none of the case studies kept records on the volume (tonnes) of materials purchased. Expenditure records on all purchases were available and gathered.

Pharmaceuticals: Data on pharmaceuticals dispensed was available. For hospitals, the top 50 drugs dispensed were identified and their weights calculated. All GP surgeries had PACT quarterly reports covering the cost and number of items dispensed by the surgery, as well as averages for similar size surgeries across the country.

Waste: Domestic and clinical waste data for hospitals was obtained from ERIC returns. The GP surgeries studied did not have records on waste volumes generated, however estimates were derived using bin size and collection records.

Food: It was very difficult gathering data on the volume of food consumed in the case study facilities. Hospital data did exist on the number of food deliveries and value, but this was impossible to convert to tonnes.

Personal transport: Of all the hospitals visited, none owned their own fleet. All vehicles (including ambulances) were leased through councils or ambulance trusts, and in some instances private car hire was used. Where possible, a questionnaire was used to gather data on distance and modal use for staff travel.

Water: Water consumption and sewage data was obtained from ERIC returns for the hospitals, with GP surgery data obtained from water bills.

Built land: ERIC provided data on land area (including parking) covered by the hospitals. Some data for the GP surgeries was obtained from architectural documents.

Table A1 provides an indication of the type of data, and figures derived, for each case study facility.

Table A1: Activity data for individual NHS Trust case studies

Activity	St James Practice	Wells Park Practice	Royal Oldham Hospital	University Hospital Lewisham	Helston Community Hospitals
Number of beds	0	0	813	650	34
Number of staff	59	41	3,243	2,500	128
Electricity (GJ)	149	102	31,765	26,967	1,016
Gas (GJ)	384	312	75,960	82,217	4,434
Steam (GJ)	**	**	49,961	**	**
Water (m^3)	513	274	193,323	108,729	4,045
Sewage (m^3)	**	**	165,098	86,983	**
Household waste (tonnes)	36	18	650	403	17
Special waste (tonnes)	**	**	**	**	**
Clinical waste (tonnes)	6	2	592	513	8
Controlled waste (tonnes)	2	**	**	**	**
Pharmaceuticals (items)	183,453	63,494	11,758,205	19,534,264	245,139
Pharmaceuticals (tonnes)	0.27	0.09	7	16.77	0.71
Materials	**	**	**	**	**
Food	**	**	**	**	**
Transport vehicles	0	0	25	**	3
Transport (km)	**	**	**	**	**
Land area (m^2)	1,162	86	31,651	**	2,525

****** No data available.

Sources: Derived from DH, 2001; Helston Community Hospital, 2003; Royal Oldham Hospital, 2003; St James Practice, 2003 and University Hospital Lewisham, 2003.

Appendix B: Calculating construction materials

It was initially hoped that this study would be able to quantify the amount of construction materials used by the NHS in England and Wales in 2001, and calculate the ecological footprint of construction. It became evident, mainly due to a lack of relevant data, that this would be difficult to achieve within the time frame of the project. However, an attempt was made to derive a total amount of construction materials. A brief description of how this was achieved is outlined below.

Top-down approach

The Office for National Statistics (ONS) gathers ProdCom (Products of the European Community) data. ProdCom contains UK imports, exports and production data on all products and materials, including construction materials. Data for construction materials is available in the following categories:

- Quarry products.
- Wood products.
- Finishings, coatings, adhesives etc.
- Plastic products.
- Fabricated metal products.
- Cabling, wiring & lighting.
- Glass based products.
- Ceramic products.
- Bricks & other clay-based products.
- Cement, plaster etc.
- Stones & other non-metal mineral products.

Some of the construction materials and products listed above are likely to be accounted for more than once, thus leading to double counting. For example 'quarry products' include primary materials such as sand, gravel and clay, which are used to make 'bricks & other clay-based products'. The *Construction Industry Mass Balance* (Smith *et al.*, 2002) was used to identify primary and secondary construction materials, thus removing double counting.

With this data it was possible to estimate the total volume in tonnes of construction materials consumed in the UK for 2001 (ONS, 2001).

The Department of Trade & Industry's (DTI) *Construction Statistics Annual* (2002) provides a total value of all construction contracts (£29,643 million) in the UK broken down by sector, including the health sector (£1,162 million, or 3.9% of the total value). This percentage was applied to the total ProdCom construction material tonnages as a proxy to scale down the UK volume of construction materials to the NHS in England and Wales. The results provide an estimated 8.5 million tonnes of materials used for construction in the health sector in England and Wales in 2001. This figure is likely to be an overestimate, as the DTI's definition of 'health sector' includes more than just hospitals.

Construction associated with NHS hospitals

In order to calculate the total construction materials consumed by NHS hospitals and GP surgeries in England and Wales, a different approach (to that above) was required. Construction contracts specific to hospitals and GP surgeries, in 2001, were identified. Most of these were Private Finance Initiatives (PFIs), but the figures varied significantly, as it was difficult to distinguish between projects which were underway during 2001 and those which were and are yet to be approved. Table B1 illustrates the differences in data provided by different sources, along with an estimated volume of construction materials consumed in 2001.

Table B1: Tonnages of construction materials derived for hospitals in England and Wales, using different sources of data

Description	Value (£millions)		Construction materials (tonnes)	Source
	Public schemes	PFI schemes		
Value of approved hospitals since 1997	200	8,300	62,240,567	DH
Value of health construction contracts	813	349	8,508,652	DTI
Value of approved PFI projects in 2001	**	4,500	32,950,888	Audit Commission

** No data available.
Sources: Audit Commission, 2001; DH, 2003a and DTI, 2002.

It is unclear as to which source is the most valid, although the Department of Health (DH) states its figures are for all projects since 1997, which probably explains the large figure in spend and tonnes. A discrepancy is evident when comparing the Audit Commission's PFI projects approved for 2001 (valued at £4,500 million) with the DTI's figure, which encompasses much more than hospitals, of £349 million.

Appendix C: Clinical and special waste regulations

The Controlled Waste Regulations 1992:

Statutory Instrument 1992 No. 588 (Crown, 1992)

(2) In these Regulations-

*"**clinical waste**" means-*

(a) any waste which consists wholly or partly of human or animal tissue, blood or other body fluids, excretions, drugs or other pharmaceutical products, swabs or dressings, or syringes, needles or other sharp instruments, being waste which unless rendered safe may prove hazardous to any person coming into contact with it; and

(b) any other waste arising from medical, nursing, dental, veterinary, pharmaceutical or similar practice, investigation, treatment, care, teaching or research, or the collection of blood for transfusion, being waste which may cause infection to any person coming into contact with it;

Waste not to be treated as household waste

3. (1) Waste of the following descriptions shall not be treated as household waste for the purposes of section 33

(2) (treatment, keeping or disposal of household waste within the curtilage of a dwelling)-

(a) any mineral or synthetic oil or grease;

(b) asbestos; and

(c) clinical waste.

The Special Waste Regulations 1996:

Statutory Instrument 1996 No. 972 (Crown, 1996)

Meaning of special waste

2. (1) Subject to paragraphs (5) and (6), any controlled waste

(a) to which a six-digit code is assigned in the list set out in Part I of Schedule 2 to these Regulations (which reproduces the list of hazardous waste annexed to Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of the Hazardous Waste Directive); and

(b) which, subject to paragraph (3), displays any of the properties specified in Part II of that Schedule (which reproduces Annex III to the Hazardous Waste Directive), is special waste.

(2) Subject to paragraph (6), any other controlled waste which

(a) displays the property H3A (first indent), or subject to paragraphs (3) and (5), H4, H5, H6, H7 or H8 specified in Part II of Schedule 2, or

(b) is a medicinal product, as defined in section 130 of the Medicines Act 1968 (meaning of "medicinal product" etc.), of a description, or falling within a class, specified in an order under section 58 of that Act (medicinal products on prescription only), is special waste.

(3) For the purposes of paragraphs (1) and (2), waste displays a property mentioned in Part II of Schedule 2 as toxic, very toxic, harmful, corrosive, irritant or carcinogenic, if it is so classified or, being so classified, has a risk phrase assigned to it or is placed in a category by the approved classification and labelling guide, as the case may be-

(i) in the case of a substance which is both listed in the approved supply list and present at or above the concentration limit applicable under Part V of that List, on the basis of that list; or

(ii) in the case of any other substance, on the basis of the criteria laid down in the approved classification and labelling guide.

(4) Except in the case of a substance listed in the approved supply list and present at or above the concentration limit applicable under Part V of that List, the test methods to be used, for the purposes of deciding which (if any) of the properties mentioned in Part II of Schedule 2 to these Regulations are to be assigned to a substance, are those described in Annex V to Council Directive 67/548/EEC, as amended.

(5) Controlled waste which, apart from this paragraph, would be special waste is not special waste if it displays any of the properties H4 to H8 below the threshold shown as applicable to that property in Part III of Schedule 2 (which reproduces those thresholds set out in Article 1 of Council Decision 94/904/EC in so far as they are relevant).

(6) Household waste is not special waste.

Appendix D: NHS trust types

For the purposes of this study, trust types were identified according to classifications referred to in the NHS Estates' ERIC forms (NHS Estates, 2002a). For presentation purposes, some trust types were aggregated together to form overall categories. Table D1 lists the trust types, as presented in ERIC, under aggregated trust types, as used for this report.

Table D1: NHS trust type categories

Material Health aggregate trust type category	ERIC trust type category	Number of trusts
Total		**482**
Acute		**111**
of which...	Large	39
	Medium	35
	Small	37
Community		**73**
of which...	Large	29
	Medium	31
	Small	13
Other hospital trusts		**88**
of which...	Children's	4
	Multi-service	42
	of which...	
	Large multi-service	20
	Medium multi-service	16
	Small multi-service	6
	Orthopaedic	4
	Specialist	13
	Teaching	25
Other trusts		**59**
of which...	Ambulance	30
	Learning disability	4
	Mental health	25
Primary Care Trusts (PCT)		**151**

Source: NHS Estates, 2002a.

Appendix E:

Methodology used to fill ERIC data gaps: Land use as an example

It was agreed (NHS Estates, 2003a) that where data gaps existed in ERIC data, they should be filled. To achieve this, the data was filtered down into each trust type (see Appendix D), an average figure calculated, and then inserted into the data gaps.

Table E1 shows ERIC land use data, which has been converted into hectares and filtered down into children's services trusts. Data gaps exist in the gross internal site floor area, site footprint and site land area categories. An average figure was first identified for each category.

Table E1: Data gaps in ERIC land use data

Trust type	Gross internal site floor area (ha)	Site footprint (ha)	Occupied floor area (ha)	Site land area (ha)
Children's services	**	**	0.2525	**
Children's services	2.6474	0.8045	2.6474	1.491
Children's services	7.4934	1.4341	7.2694	2.1468
Children's services	4.7376	1.755	4.7376	3.53
Children's services	0.0369	0.0212	0.0369	0.13
Children's services	0.0226	0.0266	0.0266	**
Children's services	0.0491	0.0278	0.0491	0.089
Children's services	0.2577	0.1516	0.2554	2.18
Average	1.61	0.86	1.542	1.49

** Data gaps.
Sources: NHS Estates, 2002a and Welsh Health Estates, 2002.

Once all the data gaps were filled, a sum for each category was calculated (see Table E2).

The sum of each trust category was then entered into a separate table (see Table E3). This data was reorganised into a final table with more refined trust type categories that were consistent with the study's reporting categories.

Table E2: Example of land use data gaps filled with average figures

Trust type	Gross internal site floor area (ha)	Site footprint (ha)	Occupied floor area (ha)	Site land area (ha)
Total	**17.1079**	**5.2565**	**19.6806**	**13.384**
Children's services	1.61	0.86	0.2525	1.49
Children's services	2.6474	0.8045	2.6474	1.491
Children's services	7.4934	1.4341	7.2694	2.1468
Children's services	4.7376	1.755	4.7376	3.53
Children's services	0.0369	0.0212	0.0369	0.13
Children's services	0.0226	0.0266	0.0266	1.49
Children's services	0.0491	0.0278	0.0491	0.089
Children's services	0.2577	0.1516	0.2554	2.18

Note: Totals do not add up as this is an example section.
Sources: NHS Estates, 2002a and Welsh Health Estates, 2002.

Table E3: Final land use figures, as reported in the mass balance analysis

Trust type	Gross internal site floor area (ha)	Site footprint (ha)	Occupied floor area (ha)	Site land area (ha)	Total car park area (ha)
Total	**2,725**	**1,587**	**2,627**	**33,654**	**567**
Acute					
of which ...					
Large	475	286	456	1,412	104
Medium	293	163	280	815	62
Small	194	96	188	624	43
Community					
of which ...					
Large	226	163	210	1,737	45
Medium	160	117	156	1,255	40
Small	31	26	29	4,748	15
Other hospital trusts					
of which ...					
Multi-service	383	237	371	1,462	83
Teaching	514	185	498	1,015	71
Specialist	38	18	37	85	6
Children's	***17***	***5***	***20***	***13***	***2***
Orthopaedic	13	10	12	75	2
Other trusts					
of which ...					
Ambulance	49	45	47	2,632	10
Mental health	165	107	164	5,891	38
Learning disability	9	11	8	258	4
PCT's	158	119	152	11,632	41

Sources: NHS Estates, 2002a and Welsh Health Estates, 2002.

Conversion tables

Energy	Data	Unit
1 GigaWatt hour (GWh) is equal to:	85.98	Tonnes of oil equivalents
	3,600	Gigajoules
	1 million	KiloWatt hours (KWh)
	34,120	Therms (European)
	3,412 million	British thermal units (Btu)
	8,598,452,278,590	Calories
1 tonne of oil equivalent is equal to:	10,000,000	Kilocalories
	396.8	Therms (European)
	41.87	Gigajoules
	11,630	KWh
	39,680,000	British thermal units (Btu)

The following prefixes are commonly used:

Kilo (k)	= 1000	or 10^3
Mega (M)	= 1,000,000	or 10^6
Giga (G)	= 1,000,000,000	or 10^9

Length	Data	Unit
1 kilometre (km) is equal to:	0.621	Miles
	1,094	Yards
	1,000	Metres
1 metre (m) is equal to:	100	Centimetres
	39.4	Inches
1 mile is equal to:	1.609	Kilometres
	1,760	Yards
	1,609	Metres
1 passenger-km	one person travelling 1 km	
1 tonne-km	one tonne travelling 1 km	

Source: DUKES 1999

Weight	Data	Unit
1 tonne (t) is equal to:	1000	Kilogrammes
	1 million	Grammes
	0.984	Long ton
	1.102	Short ton

Volume	Data	Unit
1 litre (l) is equal to:	0.22	Imperial gallon (UK gal)
	0.26	US gallons

Area	Data	Unit
1 hectare (ha) is equal to:	10,000	Square metres
	2.47	Acres
	107,639	Square feet

Abbreviations

°C	degrees Celsius
A&E	Accident & Emergency
BFF	Best Foot Forward Ltd
BMA	British Medical Association
BNF	British National Formulary
CA	Controls Assurance
CHP	Combined heat & power
CIPFA	Chartered Institute of Public Finance & Accountancy
CIRIA	Construction Industry Research & Information Association
CO_2	Carbon Dioxide
CPU	Central processing unit
DEFRA	Department for Environment, Food & Rural Affairs
DETR	Department of Environment, Transport & Regions
DfT	Department for Transport
DH	Department of Health
DTI	Department of Trade & Industry
ERIC	Estates Return Information Collection
EC	European Community
ECIP	European Common Indicators Programme
EU	European Union
g	grammes
gha	global hectare
GJ	Gigajoules
GP	General practitioner (doctor)
GWh	GigaWatt hour
HTM	Health Technical Memorandum
km	kilometre
kWh	kilowatt hour
ltr	litre
m^2	square metre
m^3	cubic metre
NAEI	National Air Emissions Inventory
NHS	National Health Service
PASA	NHS Purchasing and Supply Agency
NPC	National Product Code
ONS	Office for National Statistics
PACT	Prescription Analysis and Cost
pass-km	passenger kilometre
PCT	Primary Care Trust
PFI	Private Finance Initiative
ProdCom	Products of the European Community
PTS	Passenger transport service
RSNC	Royal Society for Nature Conservation
SEI	Stockholm Environment Institute
SIC	Standard Industrial Classification
sq.m.	square metres
SITC	Standard International Trade Classification
SWHS	Solar Water Heating System
t	tonnes
™	Trademark
UK	United Kingdom
uoi	unit of issue
WEEE	Waste electrical & electronic equipment

Glossary

Note: Many of the descriptions have been taken from the Public Health Electronic Library's *Glossary of Terms* (PHEL, 2003).

Acute trust - a NHS trust which provides secondary care or hospital-based healthcare services. An Acute trust may cover one or more hospitals.

Ambient food - is food which can be stored at room temperature i.e. it does not need to be refrigerated.

Best practice - Producing the highest quality service, treatment etc., based on the best evidence currently available. The sharing of information between individuals and organisations is key to best practice.

Biologically productive areas - Are those areas of a country or region with quantitatively significant plant and animal productivity. Biologically productive areas of a country or region comprise its biological capacity. Arable land is potentially the most productive area.

British National Formulary (BNF) - is a joint publication of the British Medical Association and the Royal Pharmaceutical Society of Great Britain. The BNF provides key information on the selection, prescribing, dispensing and administration of medicines.

Carrying capacity - The number of people that an area can support given the quality of the natural environment and the level of technology of the population.

Clinical waste - is any waste which consists wholly or partly of: Human or animal tissues, blood or other bodily fluids, excretions, drugs or other pharmaceutical products, swabs or dressings, and syringes, needles or other sharp instruments (commonly referred to as 'sharps') which, unless rendered safe, may prove hazardous to any person coming into contact with it. And, any other waste arising from medical, nursing, dental, veterinary, pharmaceutical or similar practice, investigation, treatment, care, teaching or research, or the collection of blood for transfusion, being waste, which may cause infection to any person coming into contact with it (Crown, 1992).

Combined Heat & Power (CHP) - is an energy service provided by an on site generator plant (normally with heat recovery) that is either owned by an NHS Trust or is the subject of a lease and/or supply agreement with a third party company.

Conversion factor - A co-efficient used, in this case, to convert units to mass.

Community hospital - also sometimes called a 'cottage hospital', provide minor injury, rehabilitation and respite care. Minor surgery and maternity services may also be provided. It has an important role in providing care for older people. Increasingly community hospitals are run and managed by PCT's.

Degraded land - is a composite term; it has no single readily identifiable feature, but instead describes how one or more of the land resources (soil, water, vegetation, rocks, air, climate) has changed for the worse.

Direct energy - is energy consumed, as opposed to embodied or indirect energy.

Disaggregation - to separate into component parts.

Domestic waste - for this report, includes general ward waste, other than that categorised in clinical and special waste, such as newspapers, magazines, dead flowers, boxes, paper towels etc; waste from office areas, public toilets and corridors; and kitchen waste from main and ward kitchens.

Double counting - In a resource flow analysis, double counting can best be illustrated by using paper as an example. Paper will go through many stages of production until it becomes the final product we might read (a book) or use (office paper). Economic data can track these sequential processes and report the financial value of each stage. However, it is still the same paper, and for resource accounting purposes this presents a risk of double counting. For the purposes of this study, only the final product has been counted, all intermediate products have been removed.

Earthshare - The average amount of global resources available per capita. To calculate an earthshare, the total available land and sea area of the planet is divided equally among the current global population. It is estimated that the current earthshare is 1.9 gha (Loh, 2002). If everyone lived within his or her earthshare, we would achieve 'one planet lifestyles'.

Ecological footprint - The ecological footprint is a sustainability indicator, which expresses the relationship between humans and the natural environment. The ecological footprint accounts the use of natural resources. It is a 'snapshot' measure and typically refers to average annual consumption.

Embodied (incorporated) - When the mass of a material becomes incorporated with another material or materials during a manufacturing process and becomes a different material or product. Embodied energy in a commodity is the energy used (from all sources: Electricity, liquid and solid fuels to provide heat, light and/or power) during its entire life cycle for manufacturing, transporting, using and disposing.

Energy land - 'New' forest required for the absorption of carbon emissions in order to stabilise CO_2 levels in the atmosphere. Calculations take into account the absorptive capacity of the oceans and discount it. Energy land can also be calculated using a 'fuelwood equivalence' approach based on land required to replace fossil fuels with wood biomass.

Equivalence factors - The ecological footprint (as measured using global average yields) is normalised by applying equivalence factors. These are multipliers, which adjust different area and sea types according to their relative bioproductivity.

Global hectares (gha) - One global hectare is equivalent to one hectare of biologically productive space with world average productivity.

Incineration - A treatment technology used to destroy waste by controlled burning at high temperatures.

Inpatient - A patient who has been admitted to hospital for treatment and is occupying a hospital bed.

Mass balance - A study that quantifies the flow of a material or materials in a defined situation over a period of time. The underlying principle is the fundamental physical law that within a closed system the total mass is constant. There may be movement of mass and transformation of mass into different forms but it is not created or destroyed, therefore the mass into the system should equal the mass out of the system.

Medical equipment - is used to perform a medical service, and is not generally useful in the absence of illness or injury.

Medical supplies - are consumable, perishable or short-lived items essential for carrying out the treatment of a patient.

NHS Logistics Authority - Provide a range of supply chain services to support the NHS by providing the main supply channel for consumables. They are also the centre of the NHS supply chain expertise, providing development, support, e-commerce solutions and web-based management information.

NHS PASA - An executive agency of the Department of Health with a remit to modernise and improve the performance of purchasing and supply within the NHS for the benefit of patients and the public. The Agency arranges national contracts and framework agreements for the NHS in England.

NHS Trusts - Hospitals or other NHS services managed by their own board of directors. NHS trusts provide the majority of secondary care and specialist services in hospitals. Acute trusts provide acute care from one or more hospitals. Integrated service trusts provide acute and community health services, and in some cases mental health services. Mental health trusts cover mental health and in some cases people with learning disabilities. Some trusts also act as regional or national centres of expertise for more specialised care, while others are attached to universities and help to train health professionals. Community NHS trusts provide services in the community through health centres, clinics or in people's homes, although much of their work has been taken over by primary care trusts.

Normalisation unit - a figure or data that has been converted into something that can be compared for equivalence within a unique situation. For example, NHS managers could be interested in knowing the eco-efficiency associated with the delivery of health services per patient episode. Other normalisation units could be per staff number, bed-nights, operations, consultations and GP visits.

Orthotics - Appliances that are attached externally to a limb, to aid or correct the function of that limb.

Orthopaedics - the medical discipline devoted to the diagnosis, treatment, rehabilitation, and prevention of injuries and diseases of the body's musculoskeletal system.

Per capita - refers to per person served by the NHS in England and Wales.

Person served - those who have access, even if they do not use it, to NHS services.

Personal transport - Transport carrying passengers, as opposed to freight.

Pharmaceuticals - can be medicinal drugs or a compound manufactured for use as a medicinal drug.

Primary care - The frontline of the NHS is officially called primary care. The initial contact for many people when they develop a health problem is with a member of the primary care team, usually their GP. Many other health professionals work as part of this frontline team - nurses, health visitors, dentists, opticians, pharmacists and a range of specialist therapists. NHS Direct and NHS walk-in-centres are also primary care services.

Primary Care Trusts - are responsible for the planning and commissioning of health services for their local population. For example, PCT's must make sure there are enough GPs to serve the community and that they are accessible to patients. PCT's must also guarantee the provision of other health services including hospitals, dentists, mental health care, walk-in centres, NHS Direct, patient transport (including accident and emergency), population screening, pharmacies and opticians. In addition, they are responsible for integrating health and social care so the two systems work together for patients.

ProdCom - Is the European Union (EU) common basis by which industrial production statistics for mining and quarrying and manufacturing (section D of the NACE Rev. 1 (Statistical Classification of Economic Activities in the European Community)) are collected throughout the European Union. The ProdCom reports provide import, export and manufacturing sales data for 4,800 products for the whole of the UK by an eight-digit code.

Products - Materials in final processed form or created by the combination of two or more different materials. There are two main types of products: *Intermediate product:* A product that is further processed or incorporated into another product before being sold to the consumer. *Final product:* A product that does not require further processing and can be sold in its current form to the consumer.

Proxy - Is normally used to compensate for a lack of raw data. It is an estimation derived from an existing data set using a statistical modifier. For example, deriving local water consumption data by using average per capita consumption of a region in which the locality is part.

Recycling - Is the process of collecting, sorting, cleansing, treating and reconstituting materials that would otherwise become waste, and returning them to the economic stream as raw materials for new, reused or reconstituted products.

Resources - Energy, materials and products, water and land that have a useful purpose to humanity either in their original form or when embodied into a final product.

Reuse - Is the recovery or reapplication of a product for uses similar or identical to its original application, without manufacturing or preparation processes that significantly alter the original product.

Secondary care - Specialist care, usually provided in hospitals following a referral from a GP or a community health professional.

SIC (Standard Industrial Classification) - SIC was first introduced into the United Kingdom in 1948 for use in classifying business establishments and other statistical units by the type of economic activity in which they are engaged. The classification provides a framework for the collection, tabulation, presentation and analysis of data and its use promotes uniformity.

Special waste - is waste that is potentially hazardous or dangerous, which may require extra precautions during handling, storage, treatment or disposal. Controlled waste is defined as 'special' if it contains substances at or above a threshold level giving the waste one or more hazardous characteristics: Explosive, infectious, oxidising, teratogenic (causes birth defects), flammable and highly flammable, mutagenic (causes genetic changes), irritant, ecotoxic, harmful, toxic, carcinogenic, corrosive, and substances and preparations that - release toxic or very toxic gases, after disposal can produce a hazardous characteristic. This also includes all 'prescription only' medicines (Environment Agency, 2003).

Stock - Using a mass balance, this study calculated a figure for resources retained in the NHS for the study year, 2001. This is referred to as stock. This term describes products that are not discarded by the NHS during the study year. Examples of products that remain as stock could in include: Addition of resources to the built environment, for example, new buildings, and durable goods that remain in use in the NHS beyond the timescale of the study year, for example, computers, beds and medical equipment.

Travel plan - is a strategy for an organisation to reduce its transportation impacts and to influence the travel behaviour of its employees, suppliers, visitors and customers. It involves the development of a set of mechanisms, initiatives and targets over the course of time and in accordance with the changing circumstances of the environment in which it works (Rye, 2002).

Wastewater - The spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.

Yield factors - When calculating the biocapacity of an area, the land types and sea available is normalised to world average equivalents using locally derived yield factors. These are multipliers which express the extent to which local bioproductivity is more or less that of the world average for that land or sea type.

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Dr John Barrett is a research associate of the Stockholm Environment Institute at York. Previous to that he worked as an environmental consultant. His research has been concerned with the development of tools and methods to understand the impact of consumption patterns, in particular the application of material flow analysis, embodied energy analysis and the ecological footprint to regional decision making. His interests are in the development of scenarios applying both material flow analysis and ecological footprint. He is the principle investigator on seven projects, managing a research team within the field of sustainable consumption patterns. He is the author of a number of refereed papers and articles, as well as numerous reports and book contributions.

Nicky Chambers is Co-Director of Best Foot Forward. An environmental management and communication specialist, she has previously worked with industry and policy makers. Anticipating the need for resonant communication and robust metrics, she has been heavily involved with the development and promotion of resource efficiency indicators such as ecological footprinting since 1994. She has lead several regional resource flow and ecological footprint projects including *Island State, City Limits* and analyses for organizations, including *Ecological Footprint Analysis: Towards a Sustainability Indicator for Business.* She was co-author of *Sharing Nature's Interest.*

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Kevin Lewis is the senior researcher for Best Foot Forward. He is a principal specialist in ecological footprint methodology and has applied the concept in a wide variety of applications. He comes from an ecological background and for his degree specialised in and focussed on human interactions with the environment, using life cycle and ecological footprint analyses. He has worked on a number of important footprinting projects and has been involved in or produced a variety of publications, notably *Scotland's Footprint, City Limits, Island State, The Footprint of Wales, Sharing Nature's Interest* and *Ecological Footprint Analysis: Towards a Sustainability Indicator for Business* for ACCA.

Nicola Jenkin is a projects manager at Best Foot Forward. Her activities include the management of resource flow, mass balance and ecological footprint projects, research and editorial functions. Her main area of interest is in education and sustainable development in industry, business and local authorities, having developed a background in this field in South Africa. She had management and editorial roles in *City Limits, Scotland's Footprint* and Best Foot Forward's award winning *Annual Environmental Report 2002.*

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Further information

For this project, different research responsibilities were allocated between Best Foot Forward and the Stockholm Environment Institute. If you require further information on certain components within the report, please contact the relevant researchers, as listed below:

For **direct energy, domestic waste** (including the scenarios), **food, transport** (including the scenarios), **water and built land**, contact John Barrett (jrb8@york.ac.uk) or Nia Cherrett (nc1@york.ac.uk) at the Stockholm Environment Institute, York University.

For **products, clinical and special waste** and the **solar water heating scenario** contact George Vergoulas (george@bestfootforward.com).

For **ecological footprint** enquiries contact Kevin Lewis (kevin@bestfootforward.com).

For **general information** contact the Project Manager, Nicola Jenkin (Nicola@bestfootforward.com).

Other mass balance and ecological footprint studies

An ecological footprint of Liverpool: A detailed examination of ecological sustainability

www.york.ac.uk/inst/sei/footprint/liverpool.html

An ecological footprint of the UK: Providing a tool to measure the sustainability of local authorities

www.york.ac.uk/inst/sei/odpm/tool.html

City Limits: A resource flow and ecological footprint analysis of Greater London

www.citylimitslondon.com

Island State: An ecological footprint analysis of the Isle of Wight

www.bestfootforward.com

Material flow analysis and ecological footprint of York

www.yorkfootprint.org

Material Health: A mass balance and ecological footprint analysis of the NHS in England and Wales

www.materialhealth.com

Northern Limits: A resource flow analysis and ecological footprint for Northern Ireland

www.northern-limits.com

Scotland's Footprint: A resource flow and ecological footprint analysis of Scotland

www.scotlands-footprint.com

Sharing Nature's Interest: Ecological footprints as an indicator of sustainability

www.ecologicalfootprint.com

Taking Stock: A material flow analysis and ecological footprint of the South East

www.takingstock.org/lifestyle.asp

Due for release in 2005:

Stepping Forward: A resource flow and ecological footprint analysis of the South West

www.steppingforward.org.uk

Notes

Project Partners

Biffaward

www.Biffaward.org

In December 1997 Biffa Waste Services agreed to donate landfill tax credits to the Royal Society for Nature Conservation (RSNC) to administer under the fund name Biffaward. Grants made from the fund currently amount to more than £57 million, supporting many worthwhile environmental projects.

NHS Estates

www.nhsestates.gov.uk

NHS Estates is an executive agency of the Department of Health. It is responsible for strategy and policy in the healthcare, built environment and efm services. Work programmes include capital planning and construction, design of the built environment, strategic estate planning, operational management, standards of engineering, fire safety, the patient environment, food and cleanliness, key worker accommodation, workforce strategy and training for efm staff, property and environmental issues.

Royal Society for Nature Conservation (RSNC)

www.rsnc.org

The activities of the Royal Society for Nature Conservation (RSNC) have expanded over the last five years and they now administer more than £20 million a year in grants. They support local, regional and national environmental projects, carried out by charities and not-for-profit organisations. In addition to managing and administering several grant giving schemes, RSNC also coordinates the strategic activities of The Wildlife Trust throughout the UK.

Best Foot Forward Ltd

www.bestfootforward.com

Best Foot Forward Ltd (BFF) is a sustainability consultancy based in Oxford, specialising in mass balance, resource flow and ecological footprint analyses. BFF have developed the EcoIndex™ and Stepwise™ methodologies, based on ecological footprinting, which can be used to calculate the environmental impact and sustainability of a product, organisation, process, lifestyle or region. BFF's ecological footprint of the Isle of Wight was voted Overall Winner at the Biffaward Awards 2001, and their *Environment Report 2002* won an ACCA UK Award for the Best SME reporter in the Environmental Reporting Category. Some other publications include: *Scotland's Footprint; City Limits: A Resource Flow and Ecological Footprint Analysis of Greater London* and *Ecological Footprint Analysis: Towards a Sustainability Indictor for Business.*

Stockholm Environment Institute (York University)

www.york.ac.uk/inst/sei

Stockholm Environment Institute (York University) (SEI) was established in 1989 as one of the constituent centres of the Stockholm Environment Institute. It is located within the University of York as a self-funded research unit in the Biology Department. The centre has 22 core members of staff including four professorial research leaders. SEI is an independent, international research organisation committed to the implementation of practices supportive of global sustainable development. It conducts a comprehensive research, consulting and training programme which focuses on the links between the ecological, social and economic systems at global, regional and national and local levels. Some publications and project involvement include: *Taking Stock: A Material Flow Analysis and Ecological Footprint of the South East* and *A Material Flow Analysis and Ecological Footprint of York.*