



Carbon Footprint of NHS Wales 2005-2009

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1. Executive Summary

1.1 Introduction

This report, commissioned by Welsh Health Estates on behalf of the Welsh Assembly Government (WAG), provides a baseline study of NHS Wales' carbon footprint from 2005 to 2009. The findings are intended to inform the development of an emissions reduction strategy for NHS Wales, which will contribute to the Assembly Government's commitment to reduce Wales' emissions in areas of devolved competence by 3% year-on-year, starting in 2011.

The footprint was calculated on a consumption basis, i.e. it includes both direct and embodied emissions, for the following sources:

- ▶ **Building Energy Use:** Electricity used by NHS Wales equipment and fuel consumed for heating and hot water;
- ▶ **Travel:** Emissions from NHS vehicles as well as patient, visitor, and business travel in vehicles belonging to third parties;
- ▶ **Procurement:** Emissions made by suppliers and the extended supply chains associated with NHS procurement.

Calculations were conducted by the Stockholm Environment Institute (SEI), following a method that is consistent with parallel studies that have been recently completed by NHS England and NHS Scotland. The method is also consistent with that of an ecological footprint for Wales recently calculated by SEI on behalf of the Assembly Government.

1.2 Key findings

The size of the footprint in 2009 was 828 kt CO₂e. (These units are used throughout the report. 828 kt CO₂e means greenhouse emissions with the global warming impact equivalent to 828 thousand tonnes of carbon dioxide. Greenhouse gases are explained further in Section 3.3.) This represents about 2% of the total consumption-based carbon footprint of Wales¹. This is broadly consistent with the equivalent proportions for England and Scotland.

The relative contributions of Building Energy Use (Energy), Travel and Procurement are shown in Figure 1.

The emission sources making the greatest individual contributions to the total, and therefore where emissions reduction measures should be prioritised, are summarised in Table 1.

¹ Based on the total carbon footprint for Wales in 2006, the most recent available figure. Note, this comparison is of consumption, not production, based figures, so is not directly related to national emissions figures described in the Welsh Assembly Government Strategy.

Figure 1: Overview of NHS Wales footprint 2009: main categories

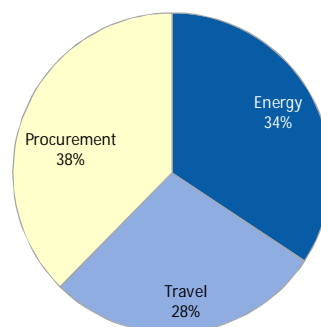


Table 1: Summary of top emissions categories

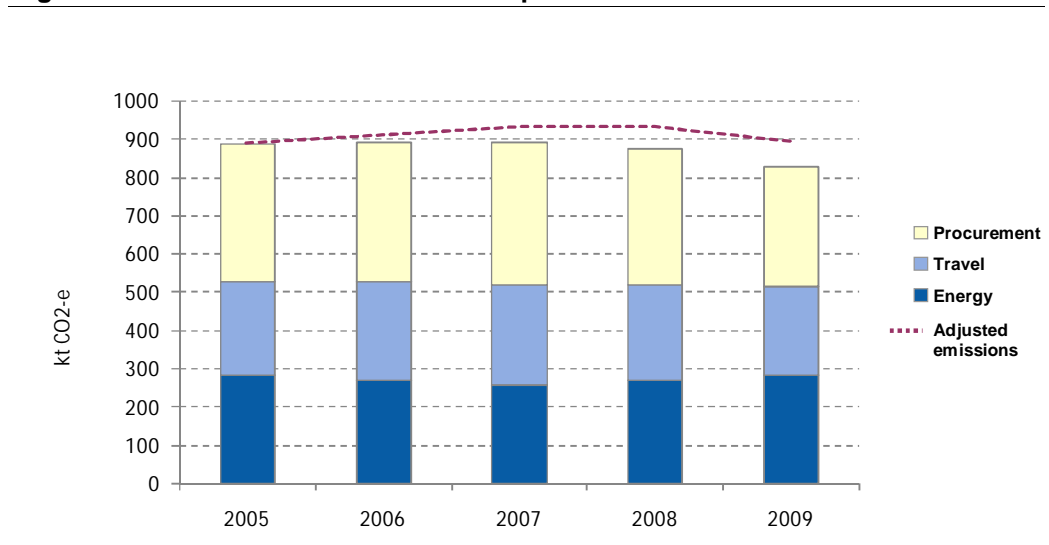
Emissions category	kt CO ₂ e	% of total
Natural gas consumption	177	21%
Patient travel	96	12%
Electricity consumption	91	11%
Procurement of pharmaceuticals	81	10%
Visitor travel	65	8%
Procurement of medical instruments / equipment	63	8%
Procurement of other manufactured products	53	6%
Staff commuting	37	4%
Business travel	35	4%
Procurement of business services	33	4%
Procurement of food and catering	24	3%

The footprint was approximately 7% smaller in 2009 than in 2005, primarily due to the improving efficiency of production in the wider economy. The change in emissions over the period that can be attributed to factors within NHS Wales' influence (an expansion of the service, offset by reduced energy consumption and business travel) was an increase of just 0.5%. The time series results are shown in Figure 2, in which the red dotted line represents the trend in emissions excluding external factors (i.e. what the emissions would have been if the efficiency of production in the wider

economy, national grid average emissions intensity, and average vehicle efficiencies had remained constant at 2005 levels).

Procurement emissions make up a significant proportion of the footprint. These are dominated by embodied emissions associated pharmaceuticals, medical instruments/equipment and other manufactured products.

Figure 2: Overview of NHS Wales footprint: time series



1.3 Recommendations

The recommendations made in reference to this study are as follows:

- ▶ **Develop a carbon reduction strategy for NHS Wales.** The strategy should build on the emissions baseline established in this study, and set ambitious but realistic targets based on assessment of the opportunities in each category. It should also set out in general terms how the targets will be met, and how performance will be tracked. This baseline study highlights the following key areas for the strategy to address:

 - **Control vs. influence.** The large contribution of Scope 3² to the overall total confirms that the opportunities for reducing emissions in this area must be an important part of NHS Wales' strategy. Through reducing emissions that fall within NHS Wales' influence as well as those under its direct control, the emissions reductions that can be achieved, and therefore NHS Wales' contribution to tackling climate change, will be far greater. These opportunities will be realised through working with suppliers to reduce their emissions, and encouraging behaviour change in the travel and commuting choices made by patients, visitors and staff.

² See Section 3.4 for an explanation of Scope 1, 2 and 3 emissions.

- **Focus.** The emissions reduction strategy should focus on the top 11 emission sources identified here, as these are where the biggest reductions are most likely to be available. Each category will require its own emissions reduction approach. Limiting the focus areas to these top 11 categories will ensure that management effort and investment is targeted cost-effectively. The top 11 categories are:
 - **Building Energy Use:** Natural gas and electricity consumption.
 - **Travel:** Patient travel, visitor travel, business travel and staff commuting.
 - **Procurement:** Procurement of pharmaceuticals, medical instruments / equipment, other manufactured products, business services, and food & catering.
- **Reducing building energy emissions.** There is an increasing trend in emissions from consumption of both gas and electricity from 2007 to 2009, which must be reversed if emissions reduction targets are to be met. Short term measures that will help achieve this will include encouraging behaviour change, and easily implemented energy efficiency technology such as smart meters, low energy lighting, and energy/ climate management systems. Medium to long term measures will include upgrading buildings to improve insulation, boiler efficiency, and incorporating on-site renewable energy generation.
- **Reducing travel emissions.** Travel emissions reduction measures could include incentive schemes for staff (e.g. car share and cycling schemes, personal carbon allowances, etc.), providing buses and/ or working with bus operators to address particular needs. Opportunities for improving the fuel efficiency of the ambulance fleet should also be explored.
- **Reducing procurement emissions.** The size of the procurement footprint depends on the size of the spend (i.e. how much is purchased/ consumed) and the specific breakdown of what is purchased. The emissions depend on each commodity's specific supply chain processes, and investigating each one of these in detail would not be cost-effective. Emissions reduction should therefore be led by making sensible procurement decisions that are likely to yield general emissions reductions, rather than waiting for hard quantitative evidence in each case. While emissions reductions can be estimated, it is unlikely that a detailed quantitative assessment of progress in each case will be possible.
- **Procurement case studies.** Further research should be undertaken into the specific supply chains of products in the top five categories. This should include an assessment of the world region of production, where applicable, and focus on specific case-studies from which general policies can follow.
- **NHS UK procurement policy.** NHS Wales' influence of supply chains is significant, but much smaller than its counterparts' in England and Scotland. Therefore, the impact of procurement policy would be much greater, particularly in relation to commodities that are common throughout England, Scotland and Wales, if the NHS were to implement a low carbon procurement policy throughout the UK.

- **Health board targets.** In order to track the individual performance of the health boards, the future emissions of the boards should be compared to their own specific baselines and targets. A comparison between the boards is not appropriate at this stage, because the boards vary considerably in many key characteristics. One way of making a meaningful comparison between the boards would be to normalise the emissions so that they are expressed as an intensity (i.e. emissions per x, where x represents a meaningful measure of performance) rather than an absolute value. If such a comparison is desired, a suitable performance measure should be developed.
- **Decision-making framework.** The strategy should also start to set out a decision-making framework for implementing emissions reduction policies where there is a risk that they could adversely affect other outcomes or performance indicators. For example, the framework should be able to help decision makers deal with complex issues where saving carbon might conflict with other priorities.
- **Update the carbon footprint in future years.** The quality of the data provided by NHS Wales was of a very high standard and in a suitable format to calculate the carbon footprint. One area where the data were weak, however, related to the travel patterns of patients and staff. Collecting suitable data will enable NHS Wales to track progress, assess the impacts of changing energy, travel and procurement trends, and further guide the implementation of strategy. It would best be achieved by collating new data annually, repeating the analysis and developing a standard reporting template that enables the most recent year's data to be seen in the context of previous years. The template should provide the practitioner the opportunity to comment on results and make new/amended recommendations. A full written report may not be required every year, but at suitable intervals, e.g. every three years.
- Key areas to consider to reduce the workload associated with data gathering and/or increase the usefulness of the data are:
 - **Data collection.** Develop data collection systems to facilitate the routine gathering of emissions-related data. For example, this could be integrated into the existing Estates and Facilities Performance Management System annual data gathering exercise.
 - **Energy data.** Take advantage of all opportunities that arise in future for automating more of the data collection process, e.g. through the introduction of new technology such as smart meters and improved software.
 - **Travel data.** Priority should be given to establishing good quality travel data that is specific to NHS Wales. This should include patient/ visitor and staff surveys to establish a more accurate baseline and geographical/ spatial analysis to identify potential solutions.
 - **Procurement categories.** Updating the procurement footprint analysis would be easier if the NHS Wales procurement records were available broken down by Standard Industry Classification 2003 (SIC03) code. Consideration should be given to developing a procedure for reclassifying purchases into the SIC03



categories that maintains consistency with, and benefits from the work undertaken in, this study.

- **Procurement case studies.** Future updates of the procurement footprint should be supplemented with case studies to track the progress of specific policies to reduce the impact of given products.
- ▶ **Raise awareness.** Raise awareness and obtain senior buy-in to the strategic priority of greenhouse gas reduction from all Health Boards and other relevant stakeholders. This process should be assisted by making this report publicly available and incorporating its findings into training and awareness initiatives.

2. Introduction

2.1 Scope of this report

This report provides an analysis of NHS Wales' carbon footprint from 2005 to 2009. The work was commissioned by Welsh Health Estates on behalf of the Welsh Assembly Government to enable NHS Wales to identify a broad range of emissions abatement opportunities, and provide the necessary baseline data for a carbon reduction strategy involving sensible timescales and targets for emissions reduction.

The carbon footprint calculations were conducted by the Stockholm Environment Institute (SEI), following a method that is consistent with parallel studies that have been recently completed by NHS England and NHS Scotland. The method is also consistent with that of an ecological footprint for Wales recently calculated by SEI on behalf of the Welsh Assembly Government.

The footprint is presented in three main categories: Energy, Travel and Procurement. This approach identifies emissions that are both under NHS Wales' direct control and within its influence:

- ▶ **Building Energy Use (Energy):** Electricity used by NHS Wales and fuel consumed for heating and hot water;
- ▶ **Travel:** Emissions from NHS Wales vehicles as well as patient, visitor, and commuter travel in vehicles belonging to third parties;
- ▶ **Procurement:** Emissions made by suppliers and the extended supply chains associated with NHS Wales' procurement.

2.2 Background

The Welsh Assembly Government underlined its commitment to reducing Wales' emissions in the agreement made in 2007 between the Labour and Plaid Cymru Groups in the National Assembly, entitled 'One Wales: A Progressive Agenda for Wales', and the Climate Change Strategy for Wales, released in October 2010. The Assembly Government has set a target of a 3% year-on-year reduction in greenhouse gas emissions in areas of devolved competence, starting in 2011³. In addition, it has committed to reducing all the greenhouse gas emissions in Wales by 40% by 2020⁴. This commitment is in parallel to the UK government's statutory commitment to reduce UK greenhouse gas emissions by at least 34% by 2020 and 80% by 2050 under the Climate Change Act 2008.

Delivering these emissions reductions will require action from government, the public sector, the private business sector, households and individuals. While the emissions from the public sector make up only a relatively small share of the emissions covered

³ The target refers to the 'basket of six' greenhouse gases defined in the Kyoto Protocol, and will be measured against a baseline comprising the average annual emissions between 2006 and 2010.

⁴ Against a 1990 baseline.

by the targets, the Assembly Government recognises that the public sector can influence wider emissions reductions through leading by example and procurement practices. Therefore, the public sector has a greater imperative than others, and emissions reduction must be a key consideration in all decisions relating to reshaping the sector going forwards.

Wales' contribution to climate change extends beyond its geographical boundaries. While the national targets relate to emissions occurring physically within Wales (known as production-based emissions), it is also important to reduce the emissions associated with supply chains that extend beyond Wales' borders (known as consumption-based emissions). The Assembly Government has also committed to monitoring and reducing Wales' consumption-based emissions.

As the UK's and Wales' biggest employer and currently accounting for approximately 25% of public sector emissions on a consumption basis⁵, the NHS has a very significant role to play. This consumption-based study of NHS Wales complements recent carbon footprint assessments for NHS England and NHS Scotland. The results provided in this report include the consumption-based emissions associated with NHS Wales.

This study is intended as a pre-cursor to inform the future development of NHS Wales' strategy for emissions reduction. It quantifies the main emission sources and sets a benchmark against which targets can be set and future performance measured.

⁵ Estimate based on NHS England data; NHS England Carbon Emissions: Carbon Footprinting Report 2008 (updated 2009), http://www.sdu.nhs.uk/page.php?page_id=93

3. Methodology

3.1 Overview

This study measures the carbon footprint of NHS Wales from a consumption perspective, which seeks to include all greenhouse gas emissions associated with the consumption of products and services by NHS Wales, wherever they occur geographically. Emissions produced throughout the industrial supply chain to provide goods and services purchased by NHS Wales, whether produced in the UK or abroad, are included.

The carbon footprint has been calculated in three main categories, each of which contains sub-categories representing groups of emission sources. The calculation methods used vary according to each category, to suit the data available to characterise each type of emission source.

Where possible, process data provided by NHS Wales were used, for example to reflect the actual quantities of energy consumed. Where such data were not available, the study draws upon proxy data that has been collated at a national level (e.g. for patient and visitor travel). Embodied emissions, i.e. the emissions generated in the NHS Wales' supply chains, are captured within the procurement category. These are calculated using emissions factors provided by Defra for standard procurement categories which have been derived from input-output analysis.

3.2 Consumption-based emissions

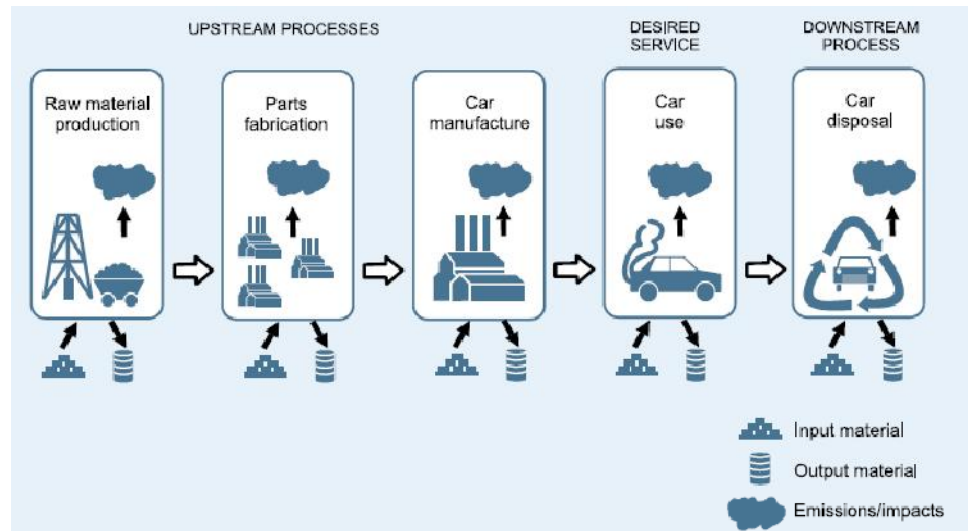
The full greenhouse gas impacts of an activity (e.g. heating a building or driving a vehicle) involve not only the direct emissions from the heating source or vehicle, but also the indirect embodied emissions associated with providing the raw materials, components, products and services consumed by the activity. Box 1 illustrates this through the example of purchasing a car. The same principle can be applied to the purchase of medical equipment, pharmaceuticals, and so on.

In the past, most studies have focused on measuring direct emissions; however measuring the indirect emissions enables NHS Wales to consider policy options that target not only direct emissions, but also emissions made in its supply chains, to reduce its full greenhouse gas impact, and make a greater contribution to reducing global greenhouse gas emissions.

Box 1: Emissions associated with the purchase of a car

The greenhouse gas impacts of a car are not only related to the emissions from driving it, but also to emissions associated with raw material extraction, manufacturing, distribution and disposal of the car.

In the production process there is a hierarchy of production layers, and each one of them needs inputs like materials and energy. The raw materials and parts to manufacture the car are purchased from a range of specialised industries upstream. It is likely that these also obtained materials from other industries and so on. The parts of the car are transported downstream to factories in order to put the car together and deliver it to retailers. All these steps use up resources and emit pollution in the process, which should be accounted for when calculating the full impact of the car.



Once the car is sold to consumers, additional resources are required and pollution is generated when people drive it. Whilst many consider only the emissions released while driving a car, this example demonstrates that there are numerous indirect environmental impacts hidden within the complex combination of production layers, sectors and countries involved in its delivery to the end user.

3.3 Greenhouse gases

Carbon dioxide is the greenhouse gas with the greatest overall climate change impact, because it is produced from anthropogenic sources in far greater quantities than any other. However, it is less potent on a weight for weight basis than other greenhouse gases, which are also produced, albeit in smaller quantities, by industrial processes. The Kyoto Protocol recognises six greenhouse gases of particular global importance, known as the 'basket of six'. The potency of these gases is described by their 'global warming potential' (GWP) measured in units of kt CO₂e (i.e. the thousands of tonnes of CO₂ emissions that would result in the equivalent global warming effect). The six gases and their respective GWPs are shown in Table 2.

Table 2: Greenhouse gases

Greenhouse gas	Chemical symbol	GWP
Carbon dioxide	CO ₂	1
Methane	CH ₄	23
Nitrous oxide	N ₂ O	310
Hydrofluorocarbons	HFCs	140 – 11,700
Perfluorocarbons	PFCs	6,500 – 9,200
Sulphur hexafluoride	SF ₆	23,900

The footprint presented in this report includes all the basket of six greenhouse gases, with the exception of travel emissions. Only the CO₂ emissions from travel have been calculated. Due to the predictable nature of the composition of exhaust gases from road vehicles, it is known that that CO₂ makes up in excess of 99% of greenhouse gas emissions from travel, and therefore this is seen as a reasonable exclusion.

The calculation methods are described in general terms in this section. A more detailed explanation of methods is provided in Appendix A.

3.4 Footprint boundaries

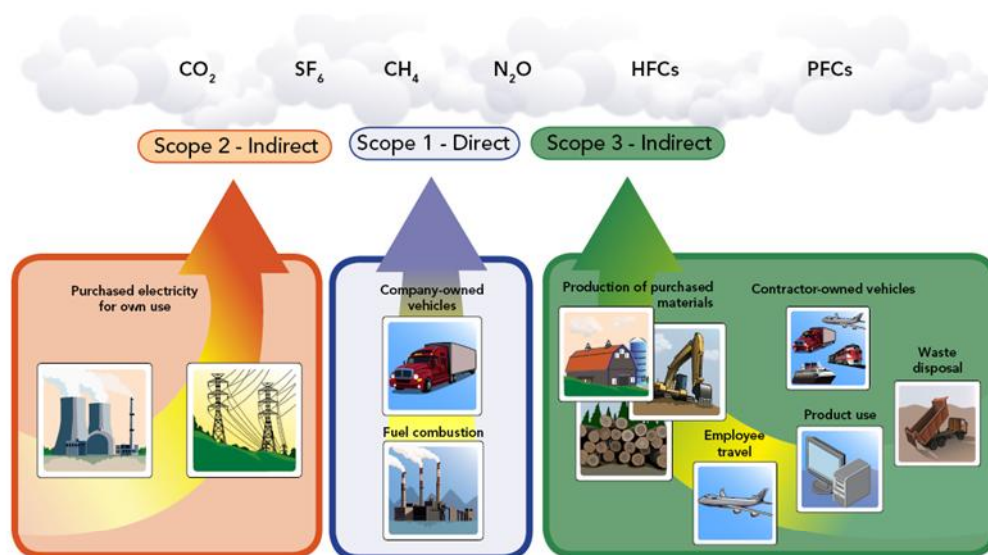
Throughout this report, results are grouped into the three main categories, Building Energy Use, Travel and Procurement described in Section 2.1, which is consistent with the carbon footprint reports for NHS England and NHS Scotland. The more widely used system of grouping emission sources under the Scope 1, 2 and 3 categories defined in the *Greenhouse Gas Protocol*⁶ is also referred to, and illustrated in Figure 3:

- Scope 1: Direct emissions from combustion of gas and other fuels by NHS Wales
- Scope 2: Emissions resulting from the generation of electricity and other energy purchased by NHS Wales
- Scope 3: Emissions made by third parties in connection with NHS Wales' activities.

The emission sources included within the calculated footprint are shown in Figure 4, which also shows how the categories used in this report correspond to the Greenhouse Gas Protocol's Scope 1, 2 and 3 categories.

⁶ Greenhouse Gas Protocol, World Resources Institute and World Business Council for Sustainable Development, <http://www.ghgprotocol.org/>

Figure 3: Greenhouse Gas Protocol Classification of Emission Sources



Source: Greenhouse Gas Protocol

3.5 Energy emissions

Energy emissions were calculated based on raw energy use data from NHS Wales, derived from the Estates and Facilities Performance and Management System (EFPMS) data returns multiplied by the appropriate emissions factors published by Defra.

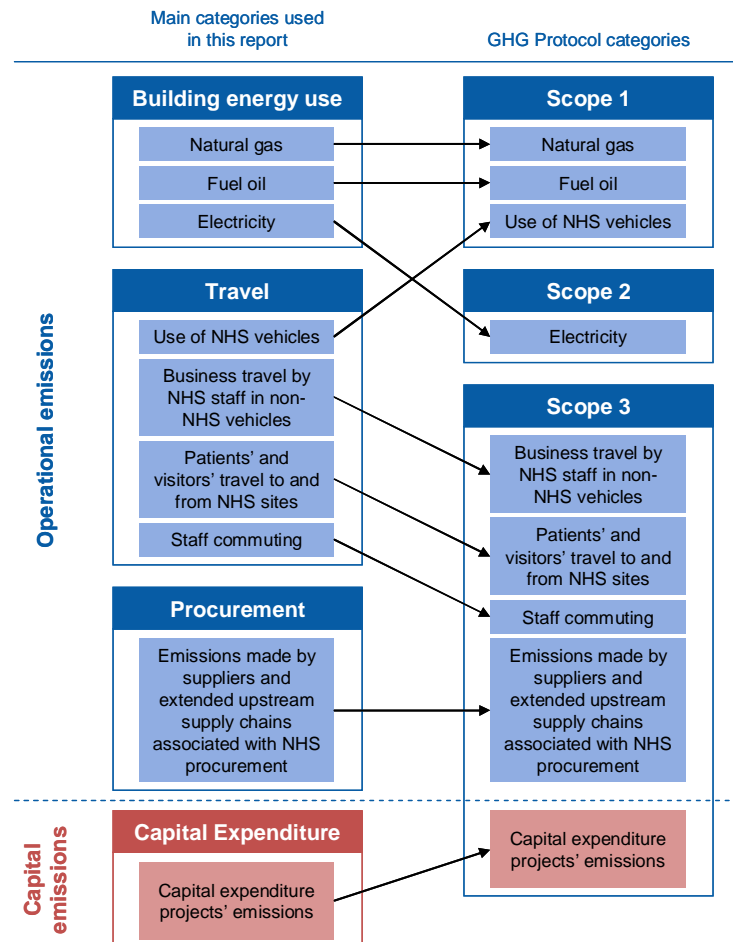
All the electricity consumed by NHS Wales was assumed to be representative of the grid average emissions intensity (i.e. t CO₂e per kWh) in each given year. Electricity is fed to the national grid from a mix of energy sources (e.g. nuclear, gas, oil, renewables). Because this mix has changed over time, the average grid intensity has also changed. BERR's records of the national grid electricity mix in each year were used, along with Defra's emissions intensity values for each energy source, to calculate the emissions factors for electricity.

Energy consumption data provided by NHS Wales for 2008 and 2009 were uplifted by 4%, to account for energy used by the very smallest sites that were omitted from these years' available data.

In order to keep the results consistent with the consumption-based approach, both the direct emissions from energy use and the upstream (embodied) emissions associated with energy supply are included.

Supply chain emissions associated with NHS Wales' procurement of gas, steam and hot water (emissions from production and distribution activities upstream in these commodities' supply chains) were calculated within the procurement analysis, and then re-allocated to Energy.

Figure 4: Footprint Boundaries



3.6 Travel emissions

NHS Wales' Trust Financial Returns (TFR) were used to derive expenditure on business travel, which was multiplied by the relevant emissions factors for each transport mode published by Defra.

No primary data were available relating to other emission sources from transport. Therefore, estimates of the UK national average travel (in terms of both mileage and transport mode) were used, derived from the National Travel Survey 2009. Estimates are available for travel, by the general population, for health reasons (both personal and on behalf of others), and for commuting.

UK average travel data were used, factored down to the population of Wales, to represent the total patient and visitor travel for NHS Wales. Similarly, the UK average travel for commuting was factored down to the size of the full-time equivalent NHS Wales workforce to represent total staff commuting.

The total distance travelled by each transport mode was multiplied by the relevant emissions intensity values for different vehicle types, extracted from the SEI-REAP⁷ model. As these are currently only available for 2004, a correction factor was applied of 1% per subsequent year to these intensity values to reflect the gradual improvement in average vehicle efficiency due to the renewal of the national fleet.

3.7 Procurement emissions

Procurement emissions are based on NHS Wales' Trust Financial Returns (TFR), provided by Welsh Health Supplies, which have been mapped across to the Standard Industry Classification 2003 (SIC03) codes. Expenditure on each SIC03 code was then multiplied by the relevant procurement emissions factor published by Defra. Emissions associated with procurement of business travel, gas distribution, hot water and steam were then re-allocated out of procurement into their respective categories (see above).

3.8 Emissions associated with capital expenditure

The carbon footprint of the capital spend programme (associated with new buildings and infrastructure) has been excluded from the other results presented in this report, which can be considered to represent the 'operational footprint'. It is difficult to assign the carbon footprint of capital for NHS Wales to the specific year where the expenditure occurs, partly because the buildings are designed to last for considerably longer. Therefore, the carbon footprint of capital has been considered separately. The methodology used to calculate these emissions is consistent with the calculations for procurement. Capital spend budgets were assigned to the construction sector.

⁷ <http://www.resource-accounting.org.uk/>

4. Results

4.1 Overview

This section highlights and illustrates the key results. Full results tables are provided in Appendix B.

The overall footprint for NHS Wales in 2009 was 828 kt CO₂e, equivalent to approximately 2% of the consumption-based footprint for Wales⁸. This broken down as follows:

- ▶ Building Energy Use: 34%
- ▶ Travel: 28%
- ▶ Procurement: 38%

This total includes the carbon footprint of one year and does not include the footprint associated with the capital spend programme. In 2009, the capital spend was particularly high and this would have increased the total carbon footprint by 14% to 942 kt CO₂e⁹.

Using the Greenhouse Gas Protocol categories, the breakdown is Scope 1, 20%; Scope 2, 11%; and Scope 3, 69%. These breakdowns are illustrated in Figure 5. The large contribution of Scope 3 to the overall total confirms that the opportunities for reducing emissions in this area must be an important part of NHS Wales' strategy. Through broadening the policy options to include reducing emissions that are not necessarily under NHS Wales' direct control, but fall within its influence, the emissions reductions that can be achieved, and therefore NHS Wales' contribution to tackling climate change, will be far greater. These opportunities will be realised through working with suppliers to reduce their emissions, and encouraging behaviour change in the travel and commuting choices made by patients, visitors and staff.

⁸⁸ Based on the total carbon footprint for Wales in 2006, the most recent available figure. Note, this comparison is of consumption, not production, based figures, so is not directly related to national emissions figures described in the Welsh Assembly Government Strategy.

⁹ The carbon footprint of the capital spend programme is described in Section 4.2.5.

Figure 5: Overview of NHS Wales footprint 2008: main categories

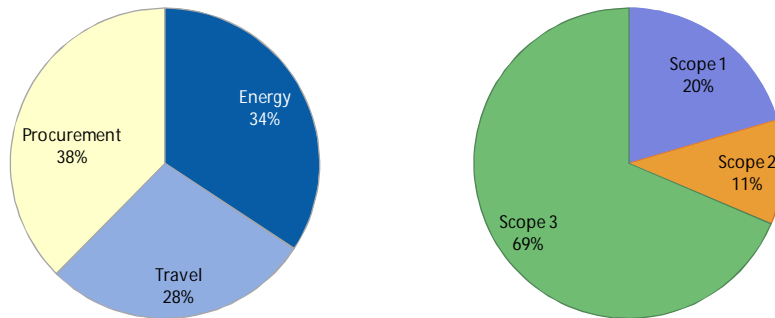
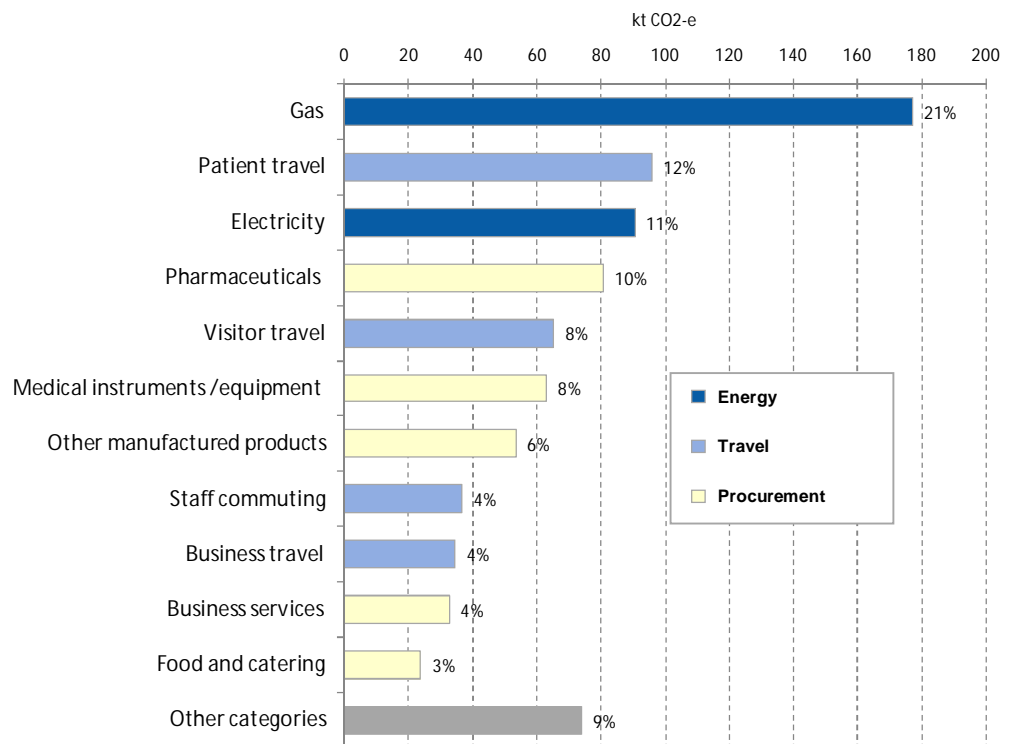


Figure 6 shows the contribution of each sub-category of emission sources to the overall footprint, ranked in order of magnitude. The percentage contribution to the total footprint is shown at the end of each bar. The biggest contributing categories, each contributing over 20 kt CO₂e, are shown, with approximately 10 further categories grouped into 'other'. The emissions reduction strategy should focus on the top 11 emission sources identified, as these are where the biggest reductions will be available. Each category is likely to require its own emissions reduction approach. Limiting the focus areas to these top 11 categories will ensure that management effort and investment is targeted cost-effectively.

Figure 6: Overview of NHS Wales footprint 2009: top 11 categories



The top 11 emission sources are:

- ▶ Natural gas consumption ;
- ▶ Patient travel;
- ▶ Electricity consumption;
- ▶ Procurement of pharmaceuticals: This is procurement falling under the NHS Wales categories 'Drugs' and 'Dressings';
- ▶ Visitor travel;
- ▶ Procurement of medical instruments / equipment: This is procurement falling under the NHS Wales categories 'Medical and surgical equipment', 'X-ray equipment', 'Laboratory equipment' and 'Other clinical supplies';
- ▶ Procurement of other manufactured products: This is procurement falling under the NHS Wales categories 'Uniforms and clothing', 'Bedding and linen', the majority of 'Other general supplies and services' and a proportion of 'Other miscellaneous';
- ▶ Staff commuting;
- ▶ Business travel;
- ▶ Procurement of business services: This is procurement falling under the NHS Wales categories 'Postage', 'Advertising', 'Other establishment expenditure', 'External general service contracts', 'Business rates', 'Rent', 'Building and engineering contracts', and proportions of 'Other general supplies and services', 'Computer hardware maintenance contracts & data processing contracts', and 'Other miscellaneous';
- ▶ Procurement of food and catering: This is procurement falling under the NHS Wales category 'Provisions and kitchen', and a proportion of 'Contract & hotel services'.

4.2 Trends

4.2.1 Overview

NHS Wales' total footprint remained reasonably constant between 2005 and 2008, showing a gradual downwards trend. A marked reduction in both procurement and business travel emissions in 2009 resulted in a more significant reduction in the size of the footprint in 2009. The overall footprint is estimated to have been 7% lower in 2009 than it was in 2005.

Table 3 summarises the changes in the footprint, the consumption data (GWh for energy, million km for travel and £million spent for procurement) and the intensities (kg CO₂e / unit of consumption) for each of the main categories.

The reasons for the reduction in overall emissions are a combination of factors within NHS Wales' influence and external factors:

Factors within NHS Wales' influence:

- ▶ GWh energy consumed
- ▶ Total travel mileages for patients, visitors and staff
- ▶ Size of procurement budget and on what it is spent

External factors:

- ▶ Changes in average national grid electricity production intensity
- ▶ Changes in average vehicle emission intensities
- ▶ Changes in the efficiency of production in the wider economy

Table 3: Summary of trends

		2005	2009	% change
Energy	kt CO ₂ e	284	284	0%
	GWh consumed	816	828	1%
	kg CO ₂ e / kWh	0.35	0.34	-1%
Travel	kt CO ₂ e	245	232	-5%
	Million km travelled	748	800	+7%
	kg CO ₂ e / km	0.33	0.29	-11%
Procurement	kt CO ₂ e	360	312	-13%
	£million ¹⁰ spent	733	747	+2%
	kg CO ₂ e / £	0.49	0.42	-15%
Total	kt CO₂e	889	828	-7%

In order to remove the effects of the external factors, and highlight impact of factors within NHS Wales' influence, the results were adjusted¹¹. These show what the emissions would have been if the external factors remained constant at 2005 levels. The adjusted results show the change in emissions from 2005-2009 would have been a marginal increase of 0.5%. This apparent stability masks some trends in the Energy, Travel and Procurement emissions that cancelled each-other out, shown in Table 4.

Between 2005 and 2008 the footprint reduced by about 2%. Whilst this reduction is real, it has to be recognised that changes within NHS Wales were not generally the cause. The adjusted results show that, if external conditions had remained the same

¹⁰ In 2004 prices. Figures corrected to remove inflation, in line with the Consumer Price Index.

¹¹ External factors fixed at 2005 levels.

between 2005 and 2008, NHS Wales' footprint would have increased by approximately 5%. However, changes within NHS Wales that occurred in 2009 (in particular, reduced procurement spend and business travel compared to 2008), cancelled out this rising trend and these changes did indeed lead to the 5% drop in both adjusted and absolute emissions between 2008 and 2009.

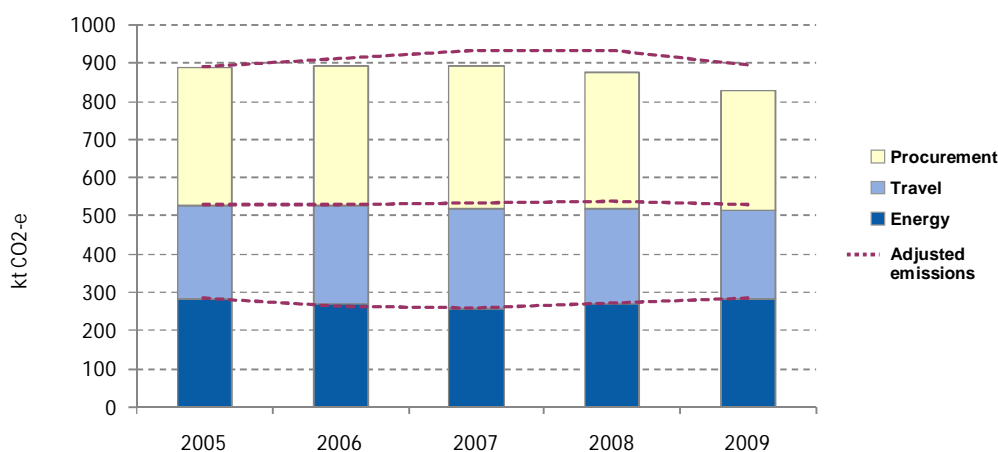
Table 4: Summary of trends (adjusted to exclude external factors)

Figures given in the table are % change in emissions relative to 2005

	2005	2006	2007	2008	2009
Absolute results					
Energy	0%	-5%	-10%	-5%	0%
Travel	0%	+4%	+8%	+2%	-5%
Procurement	0%	+2%	+3%	-2%	-13%
Total	0%	0%	0%	-2%	-7%
Adjusted results					
Energy	0%	-7%	-9%	-4%	0%
Travel	0%	+8%	+11%	+7%	0%
Procurement	0%	+6%	+12%	+10%	+1%
Total	0%	+2%	+5%	+5%	0%

These results are shown graphically in Figure 7, which illustrates how the different components of the footprint have changed over time. The adjusted results for Energy, Travel and Procurement respectively are shown as dotted lines.

Figure 7: Overview of NHS Wales footprint: time series



4.2.2 Building Energy Use

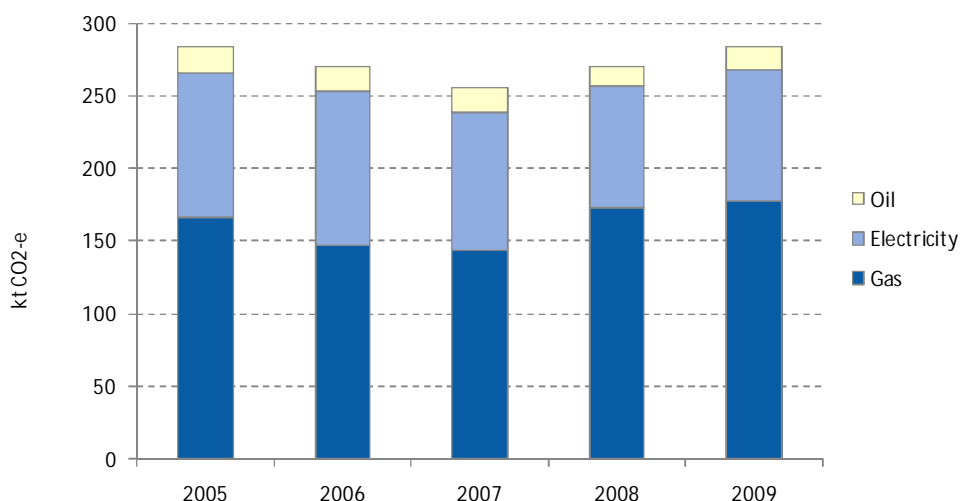
In 2009, 62% of the emissions from Building Energy Use were attributable to consumption of natural gas, 32% to electricity, and 6% to fuel oil.

From 2005-2009, there was a 2% increase in NHS Wales' consumption of gas, a 14% reduction in oil, and a 4% reduction in electricity use. NHS Wales' expenditure on gas distribution, steam and hot water increased by 14%.

The average grid intensity in 2009 was 6% lower than in 2005, principally due to the shift from coal to gas-fired power stations.

The combined effect of these factors is that NHS Wales' emissions from Building Energy Use were the same in 2009 as they were in 2005. However, there is an increasing trend from 2007 to 2009, which must be addressed if emissions reduction targets are to be met. The time series results are shown in Figure 8.

Figure 8: Time series of emissions from Building Energy Use



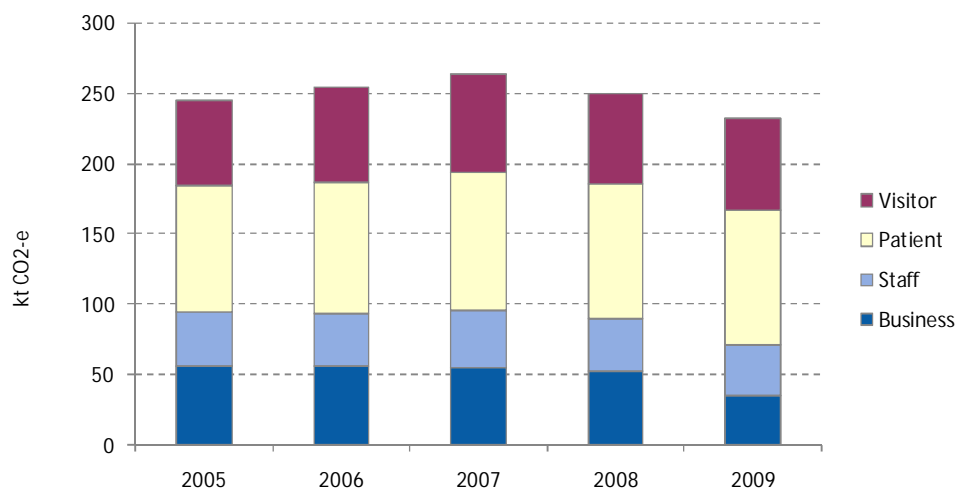
4.2.3 Travel

The mileage travelled by patients and visitors rose between 2005 and 2009 by 10% and 9% respectively. Total staff commuting miles dropped by 3%, because despite an increase in staff numbers of 7%, the assumed average commuting distance has dropped by 9%. Over the same period the study assumes that the efficiency of the national vehicle fleet improved by 1% each year. NHS Wales business travel reduced significantly between 2005 and 2009 by 38%, with the vast majority of this reduction (32%) occurring in 2009. The combined effect of the above is that the total carbon emissions from travel are estimated to have reduced by 5% from 2005 to 2009.

The Travel emissions show the opposite trend to Energy; travel emissions peaked in 2007, and declined back to below 2005 levels in 2009 (see Figure 9). While this appears positive, the travel figures are based on national (UK) trends, derived from the

National Travel Survey, so the trends in actual travel associated with NHS Wales may vary from this. At this point, specific NHS Wales data on patients', visitors', and staff travel are not available, but priority should be given to establishing good quality travel data that is specific to NHS Wales.

Figure 9: Time series of emissions from Travel



4.2.4 Procurement

Total NHS Wales expenditure peaked in 2007, but due to a reduction in spending since then shows only a marginal increase from 2005 to 2009 of 2% in real terms¹². Improvements in the efficiency of production in the wider economy meant that despite this increased expenditure, NHS Wales' procurement footprint reduced by 13%.

Figure 10 shows the time series results for Procurement, broken down into the top 5 categories, with all other procurement categories grouped into 'other'. The top five categories are:

- ▶ Pharmaceuticals
- ▶ Medical instruments/equipment
- ▶ Other manufactured products
- ▶ Business services
- ▶ Food and catering

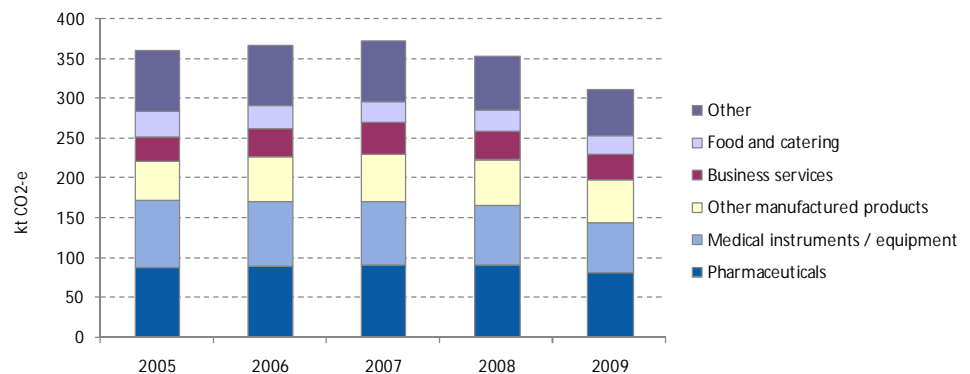
It is worth noting that the top three categories are products that can be readily sourced from either the UK or overseas. The embodied emissions associated with such products vary greatly depending on where in the world they are produced. The values

¹² Normalised to remove the effects of inflation, in line with the Consumer Price Index.

given here are based on the assumption that all procurement is sourced from within the UK.

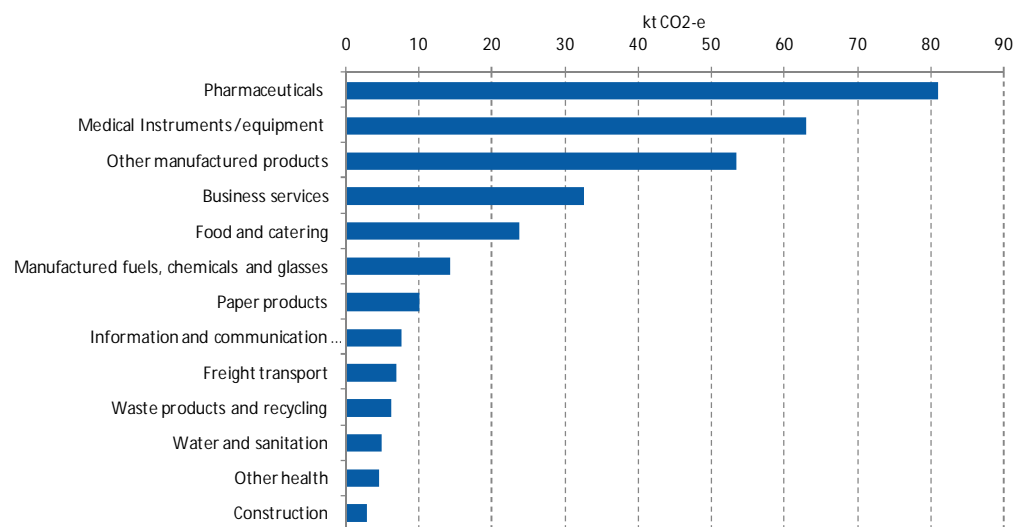
Further research should be undertaken into the specific supply chains of products in these categories, in order to identify procurement policies that can reduce their overall life-cycle impact. This would include an assessment of the world region of production.

Figure 10: Time series of emissions from Procurement



The full breakdown of procurement emissions in 2009 is shown in Figure 11, which uses the Standard Industry Classification 2003 (SIC03) categories. This classification system is used widely in econometric analysis and is the system on which the procurement calculations rely. It is therefore more transparent to report the procurement results using these categories. An alternative grouping of the procurement emissions is given in Appendix C, in which the emissions of each SIC03 category have been re-allocated back to the original NHS Wales procurement categories, which may be more useful to NHS Wales procurement staff.

Figure 11: Emissions from procurement by SIC03 category, 2009



[

Future updates of the embodied procurement emissions would be easier if the NHS Wales procurement records were available broken down by SIC03 code. Whilst it is unlikely that changing the entire procurement categorisation system for this purpose would be cost-effective, a procedure should be developed for reclassifying purchases into the SIC03 categories that maintains consistency with, and benefits from the work undertaken in, previous years.

4.2.5 Capital Expenditure

The carbon footprint of the capital spend programme (associated with construction of new buildings and infrastructure) are considered separately from the other results presented in this report, which represent 'operational' results associated with running NHS Wales. A time series of the capital expenditure carbon footprint is provided in Figure 12, showing the increasing carbon footprint of capital from 2005-2009. Figure 13 shows the total carbon footprint of NHS Wales, including both operational and capital components.

Figure 12: Carbon Footprint of Capital Spend, 2005-2009

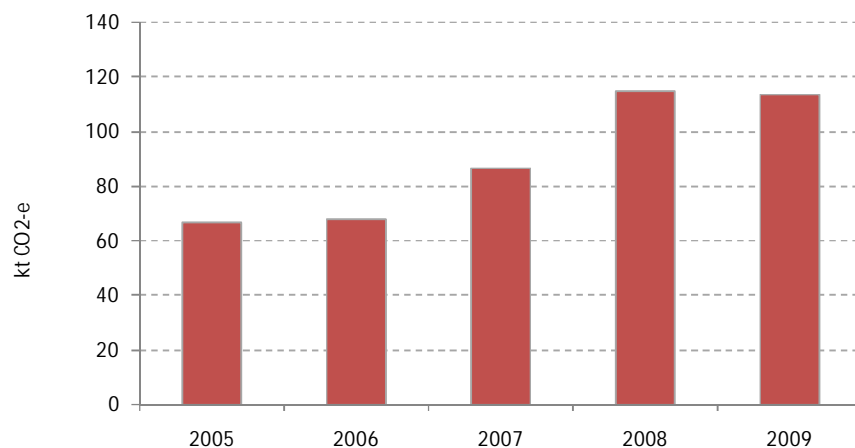
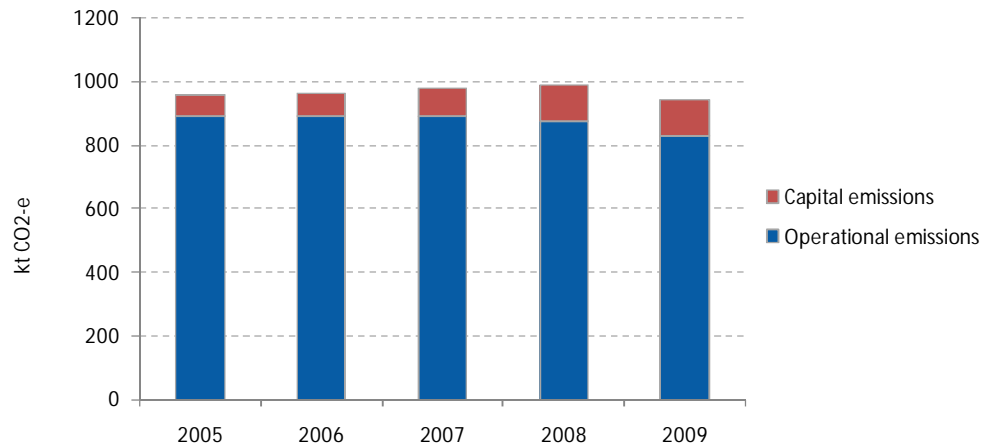


Figure 13: Operational and Capital Carbon Footprint of NHS Wales, 2005-2009



There was a substantial increase in capital expenditure by NHS Wales over the five year time series. The spend in both 2008 and 2009 was similar, at around £300 million a year. This is approximately double the spend in both 2005 and 2006. This increase in expenditure resulted in an increase in the carbon footprint. The capital carbon footprint in 2009 was 114 kt CO₂e, marginally lower than 2008, even though the capital spend was higher in 2009. The reason for this is an increase in carbon efficiency of the construction sector and its suppliers through changing practices and improved technology.

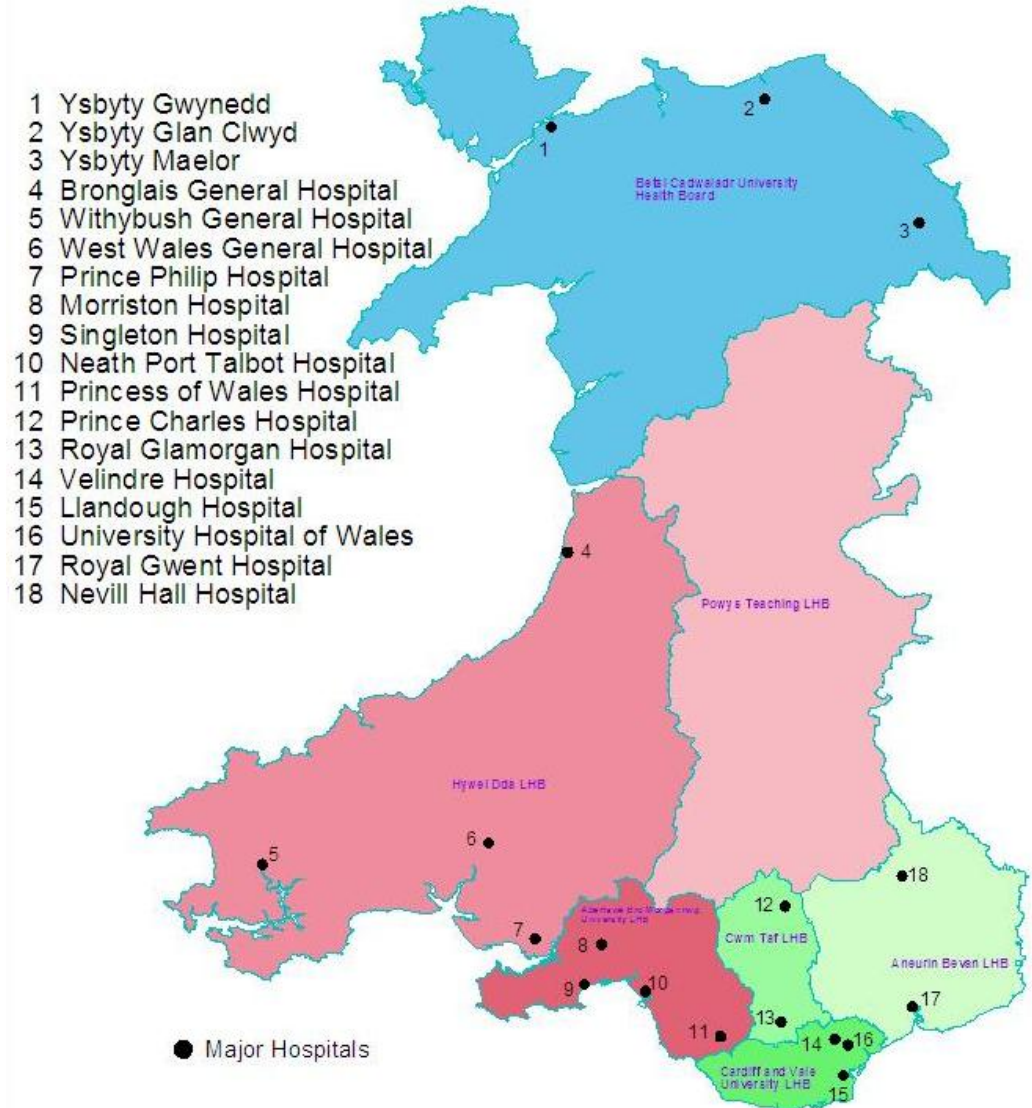
Figure 13 highlights the proportion that capital expenditure represents of the total carbon footprint. In 2009, it added an additional 14% to the operational carbon footprint. In 2005 and 2006 the proportion was considerably smaller (around 8%).

If the carbon footprint of capital was assigned to procurement then it would significantly increase the carbon footprint of this category. For example, in 2009 it would have been responsible for 34% of the carbon footprint of procurement. Including this within procurement would mean that in 2009 procurement would have been responsible for 45% (as opposed to the 38% presented above) of the total.

4.3 Breakdown by health board

Figure 14 illustrates the geographical areas covered by each of the health boards, along with the locations of the major hospitals in Wales. Figure 15 illustrates the breakdown of emissions by health board. In addition to the boards shown on the map, emissions are calculated for the Welsh Ambulance Services Ambulance Trust, and Velindre NHS Trust, a specialist cancer hospital located in Cardiff, both of which serve the whole of Wales.

Figure 14: Health board and hospitals map



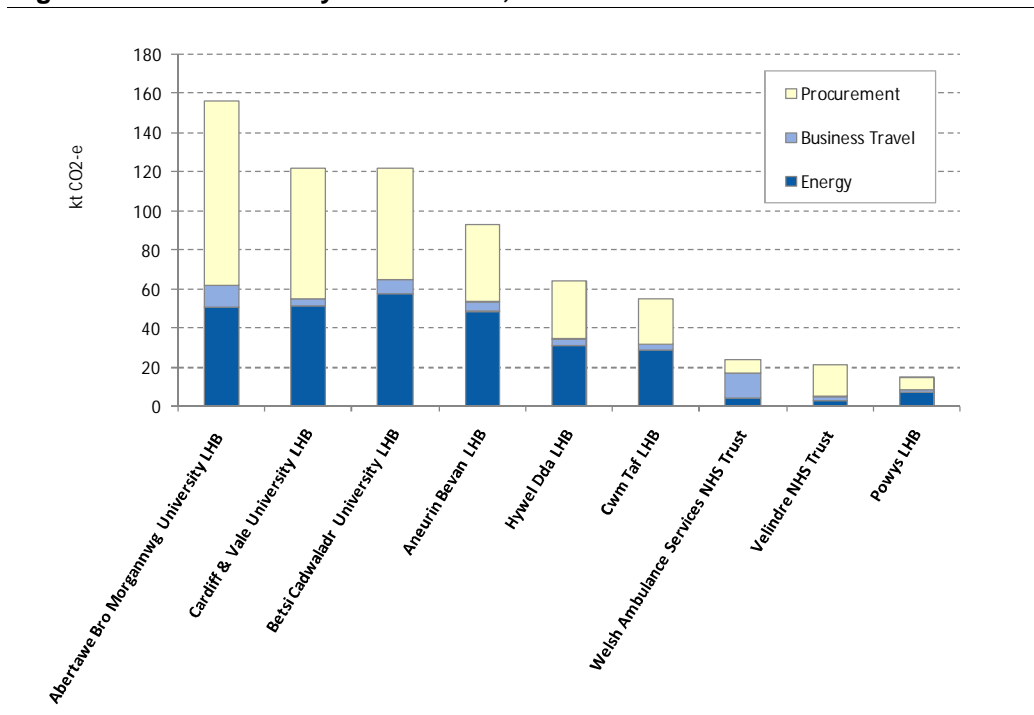
The boards vary greatly in size, population density, demographics, number of hospitals, and in other respects. For example, Abertawe Bro Morgannwg University LHB is a large health board covering a relatively densely populated, largely urban area with 4 major hospitals within its boundaries. It also hosts Welsh Health Supplies, which could account for its proportionally larger procurement emissions (see Figure 13). By contrast, Powys LHB covers a large geographical area, with a relatively small population and no major hospitals within its boundaries. Therefore, it is expected that there will be significant differences in the sizes and breakdowns of the LHBs' respective footprints.

It is not intended to make a comparison here between the performance of the boards in respect of their carbon footprints, other than to show the contribution each board

makes to the NHS Wales total. In order to track performance, the future emissions of the boards should be compared to their own specific baselines and targets.

The results shown in Figure 15 exclude travel emissions by patients, visitors and staff commutes, as these were derived from national averages which could not be scaled down without obtaining additional data. Business travel was, however, included as this was calculated from the expenditure data. The central segment of each column in the chart is therefore 'Business travel' rather than 'Travel' as in other charts in this report.

Figure 15: Emissions by health board, 2009



4.4 Comparison against NHS England and NHS Scotland

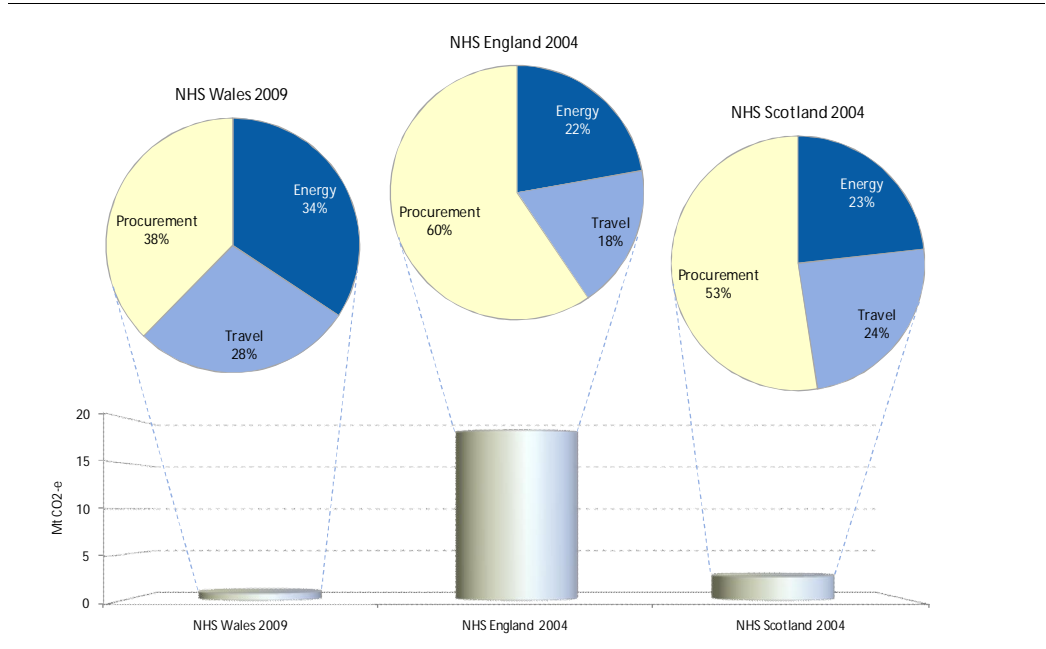
A comparison of the footprints of NHS Wales, NHS England and NHS Scotland is illustrated in Figure 16. In absolute terms, NHS Wales' footprint is significantly smaller than its two larger counterparts. The overall proportion of NHS emissions to national emissions is broadly consistent (2.1% for Wales; 2.6% for England; 3.6% for Scotland). The contribution of procurement to NHS Wales' footprint appears to be lower than for NHS England and Scotland. However, this is likely to be a result of a methodological difference, rather than a real difference, and should be treated with caution.

The procurement components of the England and Scotland studies were based on national data for government spend on the 'health' sector, rather than actual NHS procurement data. The Wales study is based on actual procurement data; it is the view of the authors that this could provide a more accurate representation of the emissions from procurement. The impact is that England and Scotland procurement emissions are likely to be overestimated relative to those for Wales. For example, the

England and Scotland results will include additional emission sources not included in the Wales study:

- ▶ Central NHS expenditure that benefits the whole of the UK, rather than a single country. This does not appear in the NHS Wales procurement accounts, so is excluded from this study. However, in the central data on which the England and Scotland studies were based, it is apportioned between the countries, and so was included in those studies.
- ▶ Emissions from the health care sector not attributable to the NHS, e.g. veterinary services;

Figure 16: Emissions of NHS Wales, England and Scotland¹³



¹³ Note, the results for England and Scotland are shown in Mt CO₂, rather than Mt CO₂e. If other greenhouse gases were included, the results for England and Scotland could be in the region of 15% higher.

5. Conclusion

5.1 Key messages

This study describes NHS Wales' carbon footprint covering the period 2005-2009. The footprint is calculated on a consumption basis including direct and embodied emissions associated with Building Energy Use, Travel and Procurement.

The size of the footprint in 2009 was 828 kt CO₂e. This represents about 2% of the total consumption-based carbon footprint of Wales¹⁴. NHS Wales' footprint is broken down as follows:

- ▶ Building Energy Use: 34%
- ▶ Travel: 28%
- ▶ Procurement: 38%

The emission sources making the greatest individual contributions to the total, and therefore where emissions reduction measures should be prioritised, are summarised in Table 5.

Table 5: Summary of top emissions categories

Emissions category	kt CO ₂ e	% of total
Natural gas consumption	177	21%
Patient travel	96	12%
Electricity consumption	91	11%
Procurement of pharmaceuticals	81	10%
Visitor travel	65	8%
Procurement of medical instruments / equipment	63	8%
Procurement of other manufactured products	53	6%
Staff commuting	37	4%
Business travel	35	4%
Procurement of business services	33	4%
Procurement of food and catering	24	3%

¹⁴ Based on the total consumption-based carbon footprint of Wales in 2006, the most recent available figure from SEI. As this is a consumption-based assessment, it is not directly comparable to production-based estimates of the national footprint for Wales.

The footprint reduced in size between 2005 and 2009 by 7%, most of which is attributable to the improving efficiency of production in the wider economy, and has generally been outside of NHS Wales' influence. Any changes in absolute emissions attributable to factors within NHS Wales' influence were small, because increases in some areas (e.g. gas consumption, procurement spend and patient travel) have been offset by reductions in others (e.g. electricity consumption and business travel).

Procurement accounts for a significant proportion of the footprint. Procurement emissions are often overlooked in carbon footprinting studies and reduction strategies; these results underline their importance. NHS Wales should seek to better understand where in these products' life cycles the emissions occur and develop practices to reduce them. Reference should be made to the NHS England carbon footprint report, which includes a section looking at these two product categories in more detail. It concludes that the carbon intensity of the products can vary considerably depending on where in the world they are produced, with products sourced from within OECD countries performing better than those outside the OECD.

Comparison of NHS Wales results with those for NHS England and NHS Scotland shows that procurement emissions may be less significant for NHS Wales. However, methodological differences in the studies may have over-estimated the contribution of procurement to NHS England and Scotland in relation to NHS Wales.

5.2 Developing a carbon reduction strategy for NHS Wales

Greenhouse gas management is an essential part of the NHS' future policy development. Developing a carbon reduction strategy, which will set out how NHS Wales will play its part in achieving the Assembly Government's ambitious emissions reduction targets, is now a high priority. It is expected that the strategy will make use of this study to establish the emissions baseline and identify priority areas for targeting emissions reduction efforts.

In the short term there will be numerous opportunities for reducing greenhouse gas emissions which do not conflict with other NHS Wales priorities and could even deliver synergies. For example, many of the measures that would normally be employed to reduce emissions will also reduce costs and will therefore help to achieve economic efficiency goals. Immediate policy decisions can therefore be targeted on the 'low-hanging fruit', or areas where:

- ▶ there is a clear potential for greenhouse gas emissions reduction at either no cost or a small initial outlay in return for significant longer-term savings; or
- ▶ measures to reduce emissions would also deliver other benefits as well.

The case for emissions reductions will not always be so straightforward. In future, as the low-hanging fruit are taken, decision makers will increasingly encounter areas where reducing greenhouse gas emissions could impact negatively on other priorities. In these cases there will be a trade-off to be made between the greenhouse gas savings a policy would produce and the other outcomes that it would deliver, measured perhaps in health benefits, cost or other social outcomes.

There is a risk that emissions reduction efforts could lose credibility if they are presented as taking priority over health outcomes. For example, although cost-positive in the long run, even the initial expenditure required to improve energy efficiency in some buildings could be portrayed as deferring spending that could save lives elsewhere.

These issues will need to be addressed in the near future, to enable the NHS to move forward with emissions reductions that are defensible and acceptable to all its stakeholders. This study is an essential pre-cursor to developing the parameters for such decisions for NHS Wales.

5.3 Recommendations

The recommendations made in reference to this study are as follows:

- ▶ **Develop a carbon reduction strategy for NHS Wales.** The strategy should build on the emissions baseline established in this study, and set ambitious but realistic targets based on assessment of the opportunities in each category. It should also set out in general terms how the targets will be met, and how performance will be tracked. This baseline study highlights the following key areas for the strategy to address:
 - **Control vs. influence.** The large contribution of Scope 3 to the overall total confirms that the opportunities for reducing emissions in this area must be an important part of NHS Wales' strategy. Through reducing emissions that fall within NHS Wales' influence as well as those under its direct control,, the emissions reductions that can be achieved, and therefore NHS Wales' contribution to tackling climate change, will be far greater. These opportunities will be realised through working with suppliers to reduce their emissions, and encouraging behaviour change in the travel and commuting choices made by patients, visitors and staff.
 - **Focus.** The emissions reduction strategy should focus on the top 11 emission sources identified here, as these are where the biggest reductions are most likely to be available. Each category will require its own emissions reduction approach. Limiting the focus areas to these top 11 categories will ensure that management effort and investment is targeted cost-effectively. The top 11 categories are:
 - **Building Energy Use:** Natural gas and electricity consumption.
 - **Travel:** Patient travel, visitor travel, business travel and staff commuting.
 - **Procurement:** Procurement of pharmaceuticals, medical instruments / equipment, other manufactured products, business services, and food & catering.
 - **Reducing building energy emissions.** There is an increasing trend in emissions from consumption of both gas and electricity from 2007 to 2009, which must be reversed if emissions reduction targets are to be met. Short term measures that will help achieve this will include encouraging behaviour change, and easily implemented energy efficiency technology such as smart meters, low

energy lighting, and energy/ climate management systems. Medium to long term measures will include upgrading buildings to improve insulation, boiler efficiency, and incorporating on-site renewable energy generation.

- It is important to ensure that new builds are designed to be energy efficient, for example through the construction, design, orientation, fabric, passive heating, shading and ventilation, renewable energy technologies, etc. Whilst schemes are currently in place for major new-builds and refurbishments to meet standards defined by the Building Research Establishment's Environmental Assessment Method (BREEAM), where possible buildings should be designed to exceed the minimum requirements.
- **Reducing travel emissions.** Travel emissions reduction measures could include incentive schemes for staff (e.g. car share and cycling schemes, personal carbon allowances, etc.), providing buses and/ or working with bus operators to address particular needs. Opportunities for improving the fuel efficiency of the ambulance fleet should also be explored.
- **Reducing procurement emissions.** The size of the procurement footprint depends on the size of the spend (i.e. how much is purchased/ consumed) and the specific breakdown of what is purchased. The emissions depend on each commodity's specific supply chain processes, and investigating each one of these in detail would not be cost-effective. Emissions reduction should therefore be led by making sensible procurement decisions that are likely to yield general emissions reductions, rather than waiting for hard quantitative evidence in each case. While emissions reductions can be estimated, it is unlikely that a detailed quantitative assessment of progress in each case will be possible.
- **Procurement case studies.** Further research should be undertaken into the specific supply chains of products in the top five categories. This should include an assessment of the world region of production, where applicable, and focus on specific case-studies from which general policies can follow.
- **NHS UK procurement policy.** NHS Wales' influence of supply chains is significant, but much smaller than its counterparts' in England and Scotland. Therefore, the impact of procurement policy would be much greater, particularly in relation to commodities that are common throughout England, Scotland and Wales, if the NHS were to work collaboratively towards implementing a low carbon procurement policy throughout the UK.
- **Health board targets.** In order to track the individual performance of the health boards, the future emissions of the boards should be compared to their own specific baselines and targets. A comparison between the boards is not appropriate at this stage, because the boards vary considerably in many key characteristics. One way of making a meaningful comparison between the boards would be to normalise the emissions so that they are expressed as an intensity (i.e. emissions per x, where x represents a meaningful measure of performance) rather than an absolute value. If such a comparison is desired, a suitable performance measure should be developed.

- **Decision-making framework.** The strategy should also start to set out a decision-making framework for implementing emissions reduction policies where there is a risk that they could adversely affect other outcomes or performance indicators. For example, the framework should be able to help decision makers deal with complex issues where saving carbon might conflict with other priorities.
- ▶ **Update the carbon footprint in future years.** The quality of the data provided by NHS Wales was of a very high standard and in a suitable format to calculate the carbon footprint. One area where the data were weak, however, related to the travel patterns of patients and staff. Collecting suitable data will enable NHS Wales to track progress, assess the impacts of changing energy, travel and procurement trends, and further guide the implementation of strategy. It would best be achieved by collating new data annually, repeating the analysis and developing a standard reporting template that enables the most recent year's data to be seen in the context of previous years. The template should provide the practitioner the opportunity to comment on results and make new/amended recommendations. A full written report may not be required every year, but at suitable intervals, e.g. every three years.
- ▶ Key areas to consider to reduce the workload associated with data gathering and/or increase the usefulness of the data are:
 - **Data collection.** Develop data collection systems to facilitate the routine gathering of emissions-related data. For example, this could be integrated into the existing Estates and Facilities Performance Management System annual data gathering exercise.
 - **Energy data.** Take advantage of all opportunities that arise in future for automating more of the data collection process, e.g. through the introduction of new technology such as smart meters and improved software.
 - **Travel data.** Priority should be given to establishing good quality travel data that is specific to NHS Wales. This should include patient/ visitor and staff surveys to establish a more accurate baseline and geographical/ spatial analysis to identify potential solutions. Note, while transport data are already included within the EFPMS, the reporting and quality / robustness of these reported data would need to be improved in order to be used in future updates to this footprinting study.
 - **Procurement categories.** Updating the procurement footprint analysis would be easier if the NHS Wales procurement records were available broken down by SIC03 code. Consideration should be given to developing a procedure for reclassifying purchases into the SIC03 categories that maintains consistency with, and benefits from the work undertaken in, this study.
 - **Procurement case studies.** Future updates of the procurement footprint should be supplemented with case studies to track the progress of specific policies to reduce the impact of given products.
- ▶ **Raise awareness.** Raise awareness and obtain senior buy-in to the strategic priority of greenhouse gas reduction from all Health Boards and other relevant



stakeholders. This process should be assisted by making this report publicly available and incorporating its findings into training and awareness initiatives.



Appendix A

Methodology

Methodology

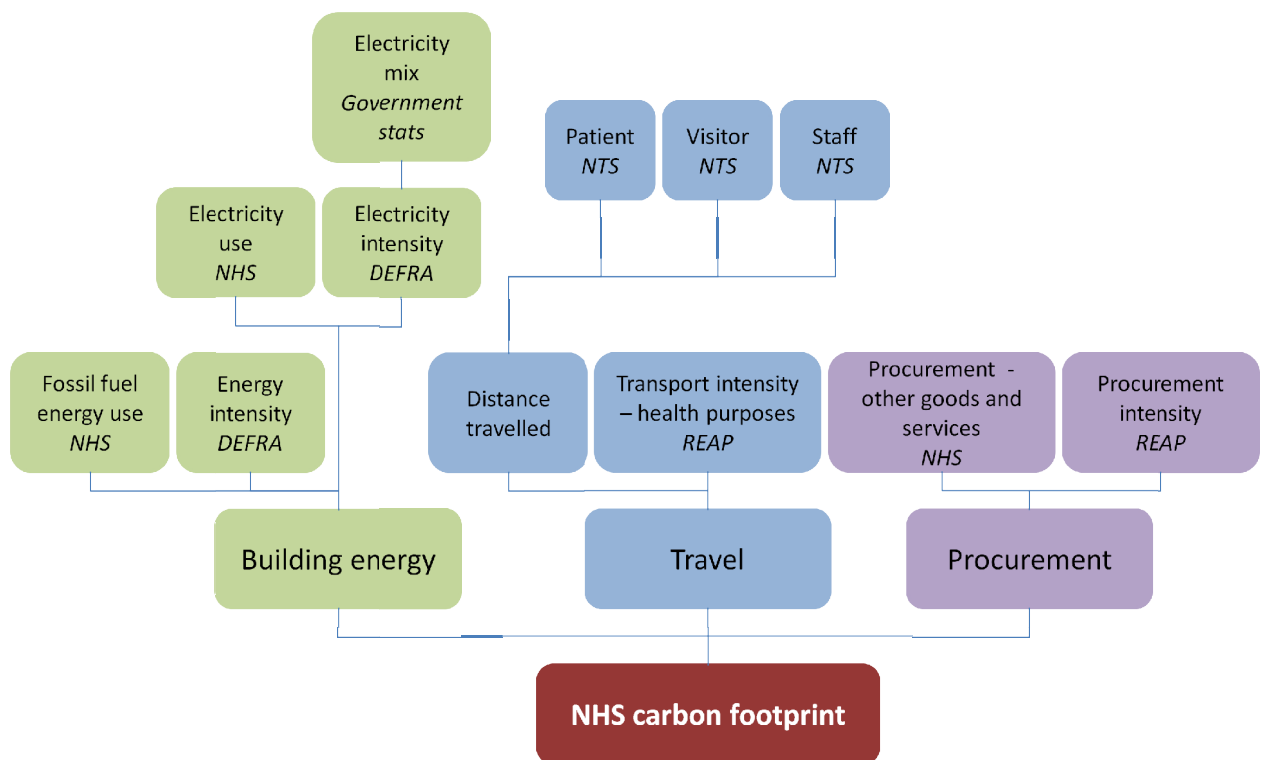
NHS greenhouse gas emissions are calculated using a top-down approach complemented with bottom-up data where available. Based on input-output analysis, a top-down approach, the greenhouse gas emissions associated with the procurement of products by the NHS can be calculated, i.e. embodied emissions of the goods and services consumed by the government in order to provide health services. These include direct and indirect emissions.

Direct emissions occur on-site and are internal to the provision of health services. Indirect emissions occur off-site through the pollution and resource consumption caused in the production of goods and services consumed by the NHS. The sum of these direct and indirect emissions is termed the total emissions.

Data sources

In order to provide a carbon footprint of the NHS there are three sources of greenhouse gas emissions that need to be measured: emissions from building energy use, emissions from travel and emissions of other procurement products (Figure A1)

Figure A1: Basic components of the carbon footprint of NHS Wales



Input-output analysis can calculate all the embodied (or supply chain) emissions associated with energy, travel and procurement. However, direct emissions from building energy use are replaced using bottom-up data specific to the NHS. National Travel Survey data is used to estimate staff, patient and visitor travel distances not included in the input-output analysis. Input-output analysis provides relatively highly aggregated results and provides UK average emissions for product groups.

Table A1 presents the data and data sources required to calculate these emissions.

Table A1: NHS greenhouse gas emissions and data sources

<i>Emission type</i>	<i>Data description</i>	<i>Data sources</i>
Energy emissions	Direct (fossil fuel) energy use by NHS Wales estate	<ul style="list-style-type: none"> NHS Wales EFPMS system
Energy emissions	Electricity use by NHS Wales estate	<ul style="list-style-type: none"> NHS Wales EFPMS system
Energy emissions	Energy intensity i.e. tonnes GHG per kWh energy use	<ul style="list-style-type: none"> Defra energy conversion factors, DEFRA (2010) http://www.defra.gov.uk/environment/business/reporting/conversion-factors.htm
Energy emissions	Electricity intensity i.e. tonnes GHHG per kWh energy use	<ul style="list-style-type: none"> Defra electricity conversion factor weighted by efficiency, DECC (2010) http://www.decc.gov.uk/en/content/cms/statistics/source/electricity/electricity.aspx
Energy emissions	Electricity mix, %	<ul style="list-style-type: none"> DUKES data for Wales, http://www.berr.gov.uk/files/file49480.pdf
Travel emissions	Patient, visitor and staff travel, km	<ul style="list-style-type: none"> National Travel Survey, http://www.dft.gov.uk/pgr/statistics/datatablespublications/nts/ Population, http://www.statswales.wales.gov.uk/ReportFolders/reportfolders.aspx?IF_ActivePath=P,345,1851,1856 Full time equivalent staff statistics, http://www.statswales.wales.gov.uk/TableViewer/tableView.aspx?ReportId=1275
Travel emissions	Transport intensity i.e. tonnes CO ₂ per km travelled	<ul style="list-style-type: none"> REAP CO₂ conversion factors
Procurement emissions	Procurement on all goods and services, £	<ul style="list-style-type: none"> NHS Wales TFR3 accounts
Procurement emissions	Procurement intensity i.e. tonnes CO ₂ per £ spent	<ul style="list-style-type: none"> REAP GHG conversion factors for the UK

Calculation of procurement emissions: a top-down approach

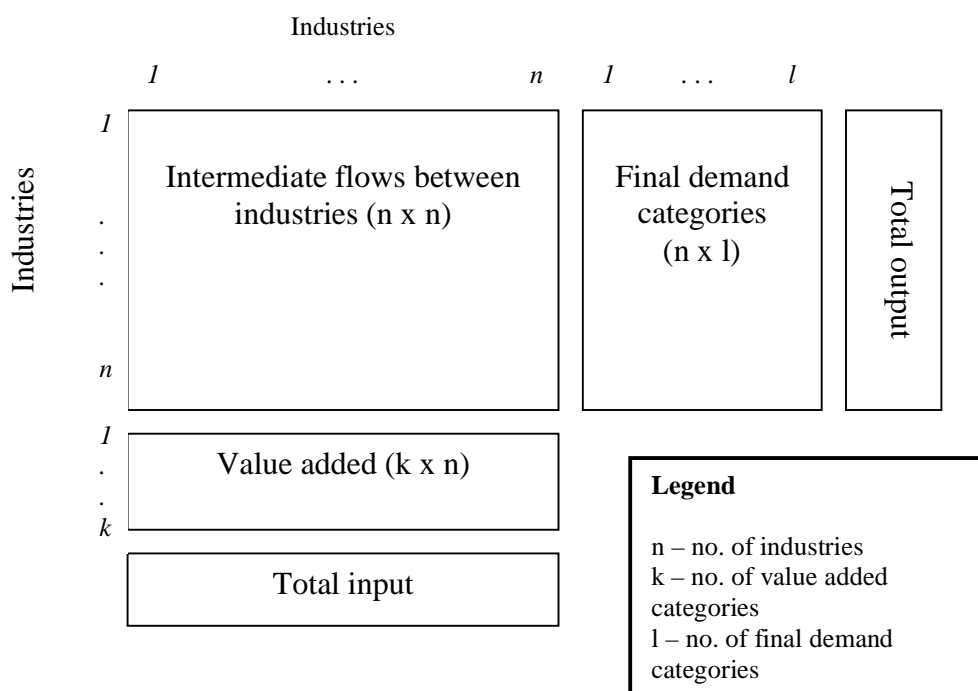
For calculating the carbon footprint of the NHS the Resources and Analysis Programme (REAP) developed by the Stockholm Environment Institute has been adapted (Wiedmann and Barrett, 2005). This is based on environmentally-extended input-output analysis (for a guide to input-output analysis see Miller and Blair, 1985 ; Leontief, 1970 ; Leontief, 1986).

Input-output tables describe the flow of goods and services between all the individual sectors of an economy over a stated period of time, commonly a year. The sectors of an economy range from agricultural and manufacturing industries (for example meat production and chemical production) to transport, recreational, health and financial services.

The table describes the monetary transactions occurring between the industrial sectors, value added and final demand categories. Sectors exchange goods and services e.g. steel bought by the vehicle industry or meat bought by the catering industry. There are sales to external purchasers, such as households, the government and foreign trade. Also in producing goods and services sectors pay for other items such as labour, capital and imported goods, known as value added.

Figure A2 shows how an input-output table is presented, with the main component being a transactions matrix of the industrial sectors. Each row of the table indicates the distribution (sale) of an industries output to other domestic industries and to final demand. Each column shows the amounts of inputs purchased from other industries and value added categories.

Figure A2: General structure of an input-output table



Initially developed to analyse the interdependencies of industries in an economy, input-output analysis has since been extended to account for environmental impacts, such as pollution and resource consumption. Energy use or pollution emitted by industrial sector (in physical units) from Environmental Accounts makes it possible to calculate the direct and indirect environmental impacts of the consumption of goods and services by final demand.

Based on the assumption that each unit of a sector's product or service delivered to other production sectors or final consumers produces the same amount of pollution (for example greenhouse gas emissions) per unit of sectoral output, sectoral greenhouse gas intensities (expressed in tons of greenhouse gas per unit of sectoral output) can be calculated and used for the estimation of all greenhouse gas emissions triggered throughout the supply chain by final demand as recorded in the input-output tables. The greenhouse gas intensities of final products (for 123 products groups) can be extracted and these multiplied by corresponding expenditure figures derived from NHS Wales expenditure accounts to calculate the emissions associated with NHS procurement.

Calculation of travel emissions: a bottom-up approach

The indirect or supply chain emissions associated with the procurement of vehicles is calculated in the procurement section. Direct emissions from fuel use by patients, visitors and staff have been estimated using data from the National Travel Survey.

The estimated distance travelled to and from NHS services by staff, patients and visitors, is calculated in kilometres, and multiplied by conversion factors provided by SEI REAP. Conversion factors are the carbon emissions produced per unit of output, in this case kg CO₂ per km. These are added to the top-down data on NHS travel.

Calculation of energy emissions: a bottom-up approach

Indirect emissions associated with, for example gas distribution, are calculated in the procurement section. Direct emissions from on-site energy use are calculated from specific information regarding the energy use of NHS buildings from NHS Wales EFPMS. These are multiplied by conversion factors provided by Defra. The conversion factors, in kg CO₂ per kWh are converted into kt CO₂/ GWh. These are added to the top-down data on NHS energy use.

Methodological comparison with NHS England and Scotland carbon footprints

The main difference between these studies is the procurement data. NHS Wales provided detailed expenditure accounts for 2005 to 2009. NHS England and Scotland were unable to provide expenditure accounts and therefore these data had to be extracted from UK and Scottish input-output tables, which publish accounts for government spending on the health sector ('Health and Veterinary services'). However, this is less accurate than accounts directly from the NHS.

Also, any updates in data sources have been incorporated, for example Defra's energy conversion factors were updated in 2010, and now include all greenhouse gases and the updated National Travel Survey.



Appendix B

Results tables

Results Tables

Direct energy consumption, GWh

	2005	2006	2007	2008	2009
Gas	552	491	510	527	579
Oil	64	59	59	48	56
Coal	-	-	-	-	-
Renewables	-	0	0	0	0
Total	616	550	570	575	636

Carbon intensity of direct energy production, kt CO₂/ GWh

	2005	2006	2007	2008	2009
Gas	0.21	0.21	0.20	0.21	0.21
Oil	0.28	0.28	0.28	0.28	0.28
Coal	0.35	0.35	0.32	0.33	0.33
Renewables	0.01	0.01	0.01	0.01	0.01

Electricity consumption, GWh

	2005	2006	2007	2008	2009
Electricity	32	28	27	24	30
Green tariff electricity	168	174	174	152	161
Total	200	202	201	176	192

Carbon intensity of electricity production by source, kt CO₂/ GWh

	2005	2006	2007	2008	2009
Gas	0.47	0.46	0.47	0.47	0.47
Oil	-	-	-	-	-
Coal	0.97	0.97	0.91	0.92	0.91
Nuclear	0.26	0.26	0.26	0.26	0.26
Renewables	0.03	0.03	0.03	0.03	0.03
Others	0.43	0.43	0.41	0.42	0.42



National Grid electricity mix, % share

	2005	2006	2007	2008	2009
Gas	46%	41%	50%	50%	50%
Oil	0%	0%	0%	0%	0%
Coal	20%	26%	16%	16%	16%
Nuclear	22%	20%	18%	18%	18%
Renewables	4%	4%	4%	4%	4%
Others (CHP?)	8%	10%	10%	10%	10%

Procurement, £million 2004 prices

Summary of expenditure derived from NHS Wales procurement records

	2005	2006	2007	2008	2009
Travel	-	-	-	-	-
Patient	-	-	-	-	-
Visitor	-	-	-	-	-
Staff	-	-	-	-	-
Business	56.47	58.67	61.17	59.86	41.61
Building energy use	-	-	-	-	-
Electricity	-	-	-	-	-
Gas	17.60	15.21	12.91	20.65	18.17
Oil	-	-	-	-	-
Coal	-	-	-	-	-
Renewables	-	-	-	-	-
Procurement	-	-	-	-	-
Pharmaceuticals	151.64	162.58	172.87	179.86	167.47
Medical Instruments /equipment	175.78	178.34	180.63	177.82	158.93
Freight transport	8.40	8.39	8.26	8.23	5.45
Business services	133.93	165.82	195.76	181.37	168.61
Paper products	14.58	14.31	14.04	12.09	11.00
Other manufactured products	65.57	75.37	84.44	84.44	81.63
Manufactured fuels, chemicals and glasses	12.22	15.23	18.29	17.41	16.33
Food and catering	27.13	25.65	23.95	24.58	22.23
Construction	8.90	10.03	11.10	8.56	7.81
Information and communication technologies	20.12	20.85	21.65	21.09	17.62
Water and sanitation	7.72	6.96	6.41	5.89	5.07
Waste products and recycling	7.46	7.69	7.94	7.38	6.53
Other procurement	-	-	-	-	-
Other health	25.38	21.86	18.49	17.52	18.03
	732.90	786.98	837.88	826.73	746.50

Patient, visitor, staff travel, km

	2005	2006	2007	2008	2009
Patient	353,225,237	382,403,504	392,065,681	391,450,422	388,282,118
Visitor	241,969,779	279,193,191	284,993,751	263,283,820	263,647,331
Staff	152,871,921	155,804,608	163,781,632	154,081,824	148,249,208



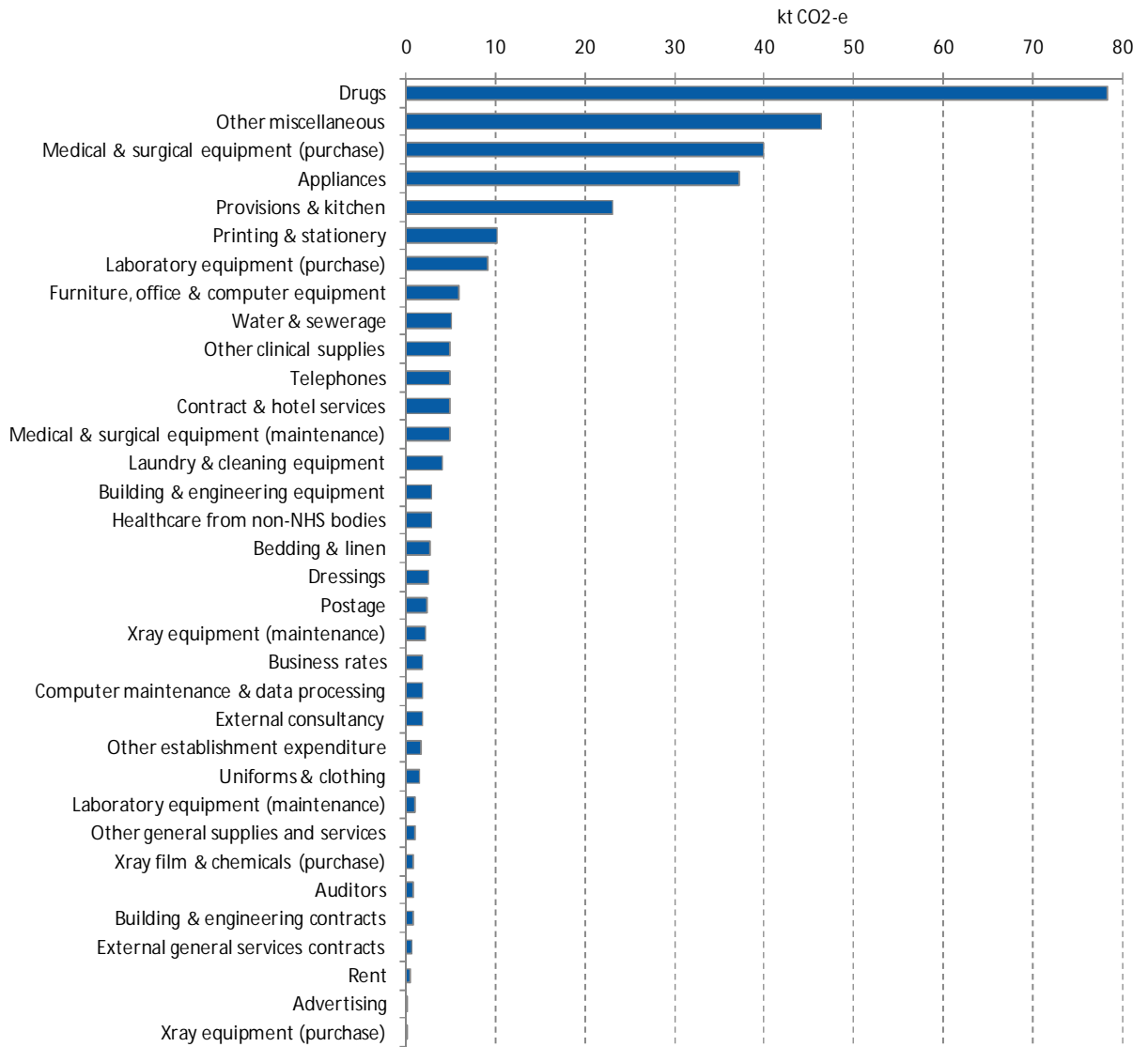
Collated results

	2005	2006	2007	2008	2009
Baseline total, kt					
Total	889.42	893.19	891.69	874.95	827.87
Scope emissions, kt					
Scope 1	187.67	173.40	176.08	173.94	169.29
Scope 2	99.77	106.75	94.87	84.28	90.68
Scope 3	601.99	613.04	620.74	616.73	567.90
Travel, energy and procurement emissions, kt					
Travel	245.39	255.03	264.18	250.04	232.43
Energy	283.92	270.78	255.52	271.05	283.93
Procurement	360.11	367.38	372.00	353.86	311.52
Sub-sector emissions, kt					
Travel	245.39	255.03	264.18	250.04	232.43
Patient	89.41	93.29	97.33	95.65	96.01
Visitor	61.25	68.11	70.75	64.33	65.19
Staff	38.70	38.01	40.66	37.65	36.66
Business	56.03	55.62	55.44	52.40	34.56
Building energy use	283.92	270.78	255.52	271.05	283.93
Electricity	99.77	106.75	94.87	84.28	90.68
Gas	166.15	147.39	144.11	173.18	177.31
Oil	18.01	16.63	16.54	13.58	15.93
Coal	-	-	-	-	-
Renewables	-	0.00	0.00	0.00	0.00
Procurement	360.11	367.38	372.00	353.86	311.52
Pharmaceuticals	87.81	89.97	91.43	90.91	80.90
Medical Instruments /equipment	84.13	81.42	78.66	73.86	62.97
Freight transport	11.13	11.29	10.73	10.68	6.96
Business services	30.05	35.37	39.92	36.47	32.60
Paper products	16.05	14.85	13.80	11.56	10.20
Other manufactured products	49.69	55.34	60.02	57.51	53.36
Manufactured fuels, chemicals and glasses	11.88	14.50	17.00	15.77	14.40
Food and catering	31.63	28.86	26.27	26.55	23.83
Construction	4.07	4.34	4.55	3.33	2.87
Information and communication technologies	10.17	10.16	10.17	9.55	7.69
Water and sanitation	8.27	7.30	6.60	5.93	4.98
Waste products and recycling	7.92	7.87	7.86	7.17	6.21
Other procurement	-	-	-	-	-
Other health	7.31	6.10	4.99	4.57	4.54
Total	889.42	893.19	891.69	874.95	827.87



Appendix C
Procurement emissions by NHS Wales
categories

Procurement emissions by NHS Wales categories, 2009





Appendix D

Glossary

Glossary

Units and technical terms

CO ₂	Carbon dioxide.
CO ₂ e	Carbon dioxide equivalent. The greenhouse gas emissions with an equivalent global warming impact to a unit of carbon dioxide.
kt CO ₂	Kilotonnes of carbon dioxide. Thousands of tonnes of carbon dioxide.
kt CO ₂ e	Kilotonnes of carbon dioxide equivalent (see above)
kWh	Kilowatt-hours. A unit of energy consumption.
MWh	Megawatt-hours. Equal to one thousand kWh.
GWh	Gigawatt-hours. Equal to one thousand MWh.
GHG	Greenhouse gas.
Greenhouse gas	Any greenhouse gas of anthropogenic origin. Typically refers to the six greenhouse gases included in the Kyoto Protocol's 'basket of six': carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide (N ₂ O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF ₆).
GWP	Global Warming Potential. A measure of how much a given mass of greenhouse gas is estimated to contribute to global warming. It is a relative scale which compares the gas in question to that of the same mass of carbon dioxide (whose GWP is by convention equal to 1).
Scope 1	A category of greenhouse gas emissions defined in the Greenhouse Gas Protocol, which includes all greenhouse gases directly emitted from sources owned or controlled by the organisation or activity in question.
Scope 2	Under the Greenhouse Gas Protocol, this category includes emissions made at the site of production of energy (electricity, steam, heat) purchased by the organisation or activity in question.
Scope 3	Under the Greenhouse Gas Protocol, this category includes all other emissions indirectly associated with the organisation or activity in question. Examples include business travel, patient and visitor travel, embodied emissions in procured products and services, etc.
Direct emissions	Greenhouse gas emissions occurring on-site or from sources (e.g. combustion engines) owned or controlled. Equivalent to Scope 1.
Indirect emissions	Other associated emissions. Equivalent to Scopes 2 and 3.
Embodied emissions	The cumulative emissions that occur at each stage in the life cycles of procured products and services. These include, for example, emissions made in extracting raw materials, the manufacturing of basic components, the assembly and distribution of products, as well as the supply chains on which each life-cycle stage depends. Equivalent to supply chain emissions or procurement emissions.

Organisations and acronyms

BERR	Department for Business, Enterprise and Regulatory Reform.
DECC	Department of Energy and Climate Change.
DEFRA	Department for Environment, Food and Rural Affairs.
DUKES	Digest of United Kingdom Energy Statistics
EFPMS	Estates and Facilities Performance Management System.
NHS Wales	National Health Service Wales.
REAP	Resources and Energy Analysis Programme.
TFR3	The Trust Financial Returns used in this study to calculate procurement emissions.
WAG	Welsh Assembly Government.


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