

Carbon Footprint Report



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Carbon Footprint Report

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1 Introduction

Climate change is one of the greatest challenges facing the modern world and therefore requires a unified effort to reduce the causes and limit the adverse effects (IPCC, 2007). There is no section of society which is exempt from this responsibility and therefore early action to assess contribution to greenhouse gas (GHG) emissions, and more importantly to reduce them, can only be seen as positive. It has been demonstrated that early action to tackle climate change can have significant economic benefits (Stern, 2007). It is also becoming apparent that as the profile of climate change grows in the public eye, so the consumers preference for “green products” increases. Therefore by taking early action on climate change a company can expect not only to reduce fuel bills, but also to improve their reputation with current customers and attract new customers from the increasing consumer group of ethical purchasers.

It is intended that this report will be the first stage in a company’s efforts to respond to the challenges of climate change. Action should be taken based on the findings of this report and used to implement a climate change strategy within the company. This should lead to enough positive outcomes to demonstrate that the challenge of climate change can become an equally large opportunity.

1.1 Company Name

Japanese Knotweed Solutions Ltd. (JKSL)

1.2 Company Activity

JKSL treats ground affected by Japanese Knotweed, a fast growing and hardy, invasive weed thought to cause damage to buildings. They provide both chemical treatment, using herbicides, and they physically dig up the weed and send it to landfill.

1.3 Aims of Assessment

This assessment is a complete evaluation of the GHG emissions released in a year, over which JKSL could have some influence. It is intended that the undertaking of such an assessment should have the following outcomes:

- Increase in marketability of brand through demonstrating the green credentials of the company.
- Understanding of greatest source of GHG emissions, leading to ability to reduce emissions and therefore reduce environmental impact;
- Financial saving through reduction in waste and more efficient operations.

2 Assessment Scope

This assessment is as comprehensive in its scope as is practicable, thus it includes as much of the lifecycle of the company in as much detail as possible, leaving out only those aspects for which it is not possible even to estimate the consumption or over which it was considered that JKSL had no influence.

The scope is not only comprehensive in the lifecycle stages covered by the assessment but also in the gases covered by the assessment. Because there are several gases that are responsible for global climate change, all of these gases have been included in the conversion factors.

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2.1 Included within assessment

This assessment includes all of the emissions associated with the running of JKSL. This includes all emissions for which JKSL is directly responsible, and also many of the emissions for which they have an indirect responsibility. In considering all of these direct and indirect emissions a lifecycle approach has been taken towards the accounting of them, i.e. the emissions are accounted for throughout the whole of their lifecycle, e.g. for electricity, not only are the emissions from burning the fuel to produce the electricity considered, but also the emissions from producing and transporting the fuel.

Aspects specifically included within the assessment are as follows:

- Electricity, gas and water usage for all operations of JKSL;
- Production of any office and maintenance materials;
- Production of pesticides and geotextiles, to control the Japanese knotweed;
- Carbon associated with the renting of machinery;
- Direct emissions from fuel used on site;
- Emissions from any transport for JKSL;
- Emissions related to services paid for by JKSL.

Some aspects were not specifically accounted for but were estimated within the conversion factors. These include the packaging and transport of products bought into the company.

2.2 Excluded from Assessment

Items were only omitted from the assessment if it was considered that their impact would be insufficient to affect the overall footprint of JKSL or if it was considered that JKSL could have no influence over the release of the emissions.

The following items have been specifically omitted from the assessment:

- Transport of any customers visiting the premises or events organised by JKSL;
- Commuting of staff from home to work;

3 Details of Assessment

The assessment of the carbon footprint of JKSL used a lifecycle analysis (LCA) methodology. This means that the whole lifecycle of the company and its products were considered. This extends from the lifecycle impacts of the raw materials bought into the company to the impact of services such as accountants.

The conversion factors are based upon a principle of input output analysis. This means that rather than directly measuring the emissions arising from the production of an individual item, the emissions of the whole sector to which that item belongs are divided by the financial output of that sector and therefore the cost of the individual item is used to estimate what proportion of the emissions from the whole sector can be attributed to it and therefore how much GHG was emitted in the production of the item. For more information about the derivation of input-output conversion factors, See Appendix A.

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3.1 Uncertainties

Input-output assessment uses aggregated industry information based upon large sectors and statistics about their financial input and output and greenhouse gas emissions. Therefore the information used to estimate the emissions of specific items within the company are general averages and not specific. Therefore it is possible that over- or underestimation may have occurred. This footprint is an estimate of the emissions over which JKSL could have some influence, and should always be viewed in this way. As much data as possible has been included despite the inaccuracies, because it is considered to be preferable to consider all aspects of the company and to state openly the uncertainties than to leave out important parts of the assessment due to lack of data.

4 Results

The total GHG emissions released by JKSL in a year were approximately 441173 kgCO_{2e} (441 Tonnes or 223000 m³ CO_{2e}). This is about the same volume as 89 Olympic swimming pools and is equivalent to the emissions released by about 112 average cars driving for a year.

Figure 1 shows a breakdown of the sources of GHG emissions released by JKSL, The greatest source of emissions was the energy waste and water section; in particular, the emissions from using diesel on site. However there were several other significant sources of emissions which should be considered when deciding how to reduce the footprint of JKSL.

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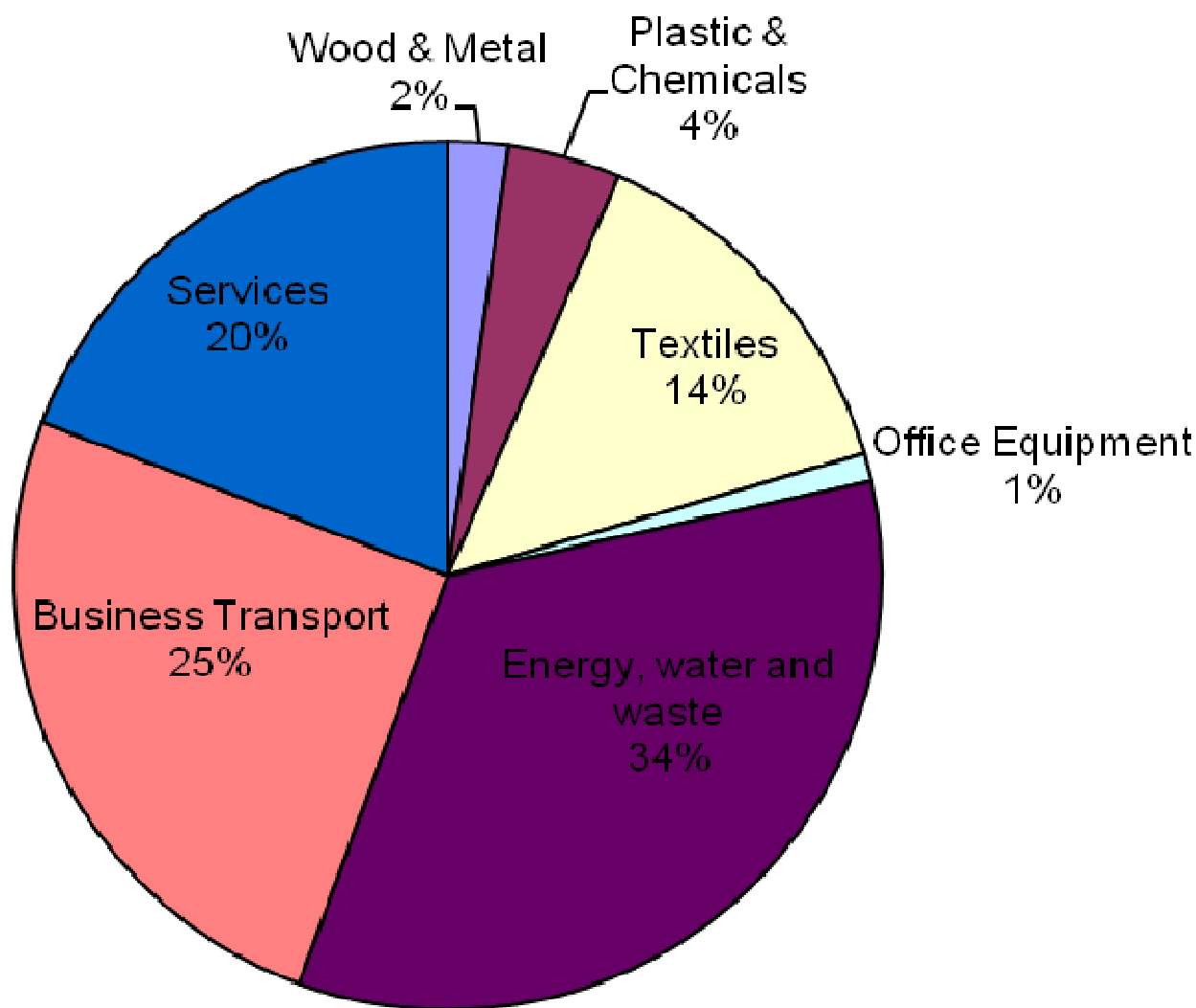


Figure 1: Breakdown of the Carbon footprint for JKSL

4.1 Energy and Waste emissions

Energy waste and water makes up a third of the total footprint of the footprint of JKSL. Two thirds of this comes from the burning of diesel on site. Therefore this is a particularly emitting part of the company’s operations and consideration should be given to reducing the use of this or increasing the efficiency of the operations. Electricity also contributed highly to this area of JKSL’s emissions. This arises from electricity use within the office and therefore energy conservation measures could help to reduce the footprint in this area.

The other significant source of emissions in this section of the footprint was waste. This arises mainly from sending the plant material and surrounding soil to landfill. The only option to avoid this would be to bury it but this would require more geotextiles, which already have a more significant impact than does the landfill waste and therefore there appears to be little which can be done about this apart from minimising the waste where possible.

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4.2 Business Transport

The second largest source of emissions for JKSL is business transport. This contributes to a quarter of the total carbon footprint of JKSL and therefore is a very important area to try and improve. The majority of the emissions in this section arise from driving to different sites to do the jobs. Attention should be given to the type of vehicle used for different journeys and whether the most appropriate vehicle is always used. The smallest most economic vehicle for the purpose should always be used where possible. The footprint can also be reduced by more economic driving.

4.3 Services

The footprint from services used by JKSL accounted for 20% of the total carbon footprint. This arises from the use of several different services but the most important contributors were hire of machinery which accounted for almost 40% and the use of hotel accommodation which was responsible for more than 25%. These are both essential parts of the company's operations and therefore difficult problems to address. The current practice of hiring machinery close to the site location is better than owning the machinery and transporting it around the country. However if it is possible to reduce the amount of machinery that is used or use more alternative methods to deal with Japanese Knotweed this may be helpful to reduce the footprint.

4.4 Textiles

The emissions from textiles arise mainly from the production of Geotextiles which are used to prevent Japanese Knotweed from growing again, particularly in instances where the waste is buried rather than transported to landfill. Therefore it is an essential material for the operations of JKSL. However it contributes to almost 14% of the total carbon footprint of JKSL and therefore it is essential that it is not wasted.

4.5 Other Emissions

Other sources of GHG emissions included the embodied emissions in materials bought by the company, such as office equipment, wood and plastic products and pesticides. The levels of emissions from these were much lower than those emissions from other sources and while it is still worthwhile to reduce these emissions as any reduction can be seen as positive, it would not be beneficial to spend a lot of time or money on reducing emissions from these aspects and the reduction of emissions from these sources should not be seen as a strong driver for policy change.

5 Recommendations

The next steps of a footprint assessment are to attempt to reduce the carbon footprint. There are several ways this can be addressed. There are quick, cheap, easily identifiable options which can be carried out straight away, but may not have the most impact on reducing the overall carbon footprint of the company. There are further studies which can be carried out to gain greater understanding of the larger emissions sources which will allow further emissions reduction actions. Some examples are given for each step to demonstrate ways in which the carbon footprint could be reduced, but it is by no means a comprehensive list.

5.1 First Steps

Diesel emissions from machinery on site were the most significant source of emissions. Therefore there should be some focus on reducing these early on.

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Because the level of emission is so high for these, an increase in the efficiency of the usage of machinery will have a significant effect on the emissions. Machinery should not be left idling for long periods of time if not in use and the smallest machinery to do the job should be used where possible.

Electricity and gas emissions were also important to JKSL and as many methods to reduce energy consumption are cheap and straightforward to carry out, some of them are listed here:

- Check that all machinery and office equipment are switched off when not in use;
- Install energy efficient light bulbs wherever possible and ensure that they are always switched off when a room is not in use;
- Ensure insulation and double glazing is installed in the building to minimise heat loss through the roof, windows and walls;
- Switch to a 100% renewable tariff;

More information about energy saving can be found through the energy saving trust, visit www.energysavingtrust.org.uk.

The carbon footprint of driving was the second most significant source of emissions for JKSL. This can be reduced most simply by driving more carefully. Gentle acceleration and braking, driving only for longer distances when it is essential and driving at slower speeds on the motorway can significantly increase the efficiency of a car without taking any other steps at all. Reducing the use of electrical appliances such as radios and air conditioning, and maintenance, such as keeping the tyres well inflated can all help too. The necessity of using a car for journeys should be thought about. This is particularly the case for commuting where often people drive by default when they could just as easily cycle or take a bus. The appropriateness of the vehicle used should also be considered: vans should only be used where there is a lot of equipment or materials to be transported, a car would be more appropriate for the transport of people.

Waste should be reduced as much as possible. Although it is not possible to reduce the amount of earth that has to be sent to landfill, other waste can be reduced and recycling can be carried out wherever possible. The amount of materials which are used unnecessarily could also be reduced e.g. the minimum amount possible of geotextiles should be used.

5.2 Further Assessments and Larger Changes

Some methods to reduce a carbon footprint can require more detailed examination of the company processes or a greater initial spend to achieve an overall increase in efficiency and therefore reduction in costs. Although they may require more time and effort it is often these which achieve the greatest results.

To reduce the diesel usage an assessment could be carried out into the availability of earthmoving equipment which will run from 'greener' fuels such as LPG. If it is available it would be beneficial to use this kind of equipment and run the machinery from LPG.

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Further assessment should be carried out to see if it is feasible and environmentally sound to use more herbicides and less earth moving equipment. From this assessment it appears that herbicides have a lower climate change impact, but if they have other detrimental environmental impacts or if they do not achieve the same result in eradication of Japanese Knotweed then it would be a hollow victory.

Other ways of reducing the carbon footprint of JKSL could include investment in greener technologies such as renewable energy generation and when new vehicles are bought, consideration should be given to the GHG emissions of the vehicle.

5.3 Stakeholder Engagement

To enable further reduction of its carbon footprint JKSL needs to seek the interest of its people. This includes its staff, suppliers and customers. It may not be possible to directly influence suppliers but materials can be sourced based upon their carbon footprint, and the reason for this decision should be communicated to the supplier. This would not only reduce the carbon footprint of JKSL but also make suppliers consider their own carbon footprint and how it is affecting their customers. Customer interest in the carbon footprint of JKSL could be beneficial in terms of marketing and staff interest will not only encourage them to work towards reducing the carbon footprint of JKSL but it may also give them greater job satisfaction and encourage them to reduce their own personal carbon footprint.

5.3.1 Communicating with Customers

To make full use of the potential of carbon footprints, it is essential that the efforts of the business to cut its impact are communicated to the customers. This can be done through marketing materials or by personal communication with existing customers. The carbon footprint measurement should be repeated on a regular basis, e.g. annually, and any reduction communicated to customers to demonstrate that action is being taken. Information could be provided about steps to reduce a carbon footprint and the steps that JKSL has taken to reduce their own carbon footprint, this could be made available on the website and any literature provided about JKSL's operations.

5.3.2 Communicating with suppliers

If different materials are used based upon the carbon footprint or if different suppliers are found, the reasons for the change should be communicated to both the original suppliers and the new suppliers.

5.3.3 Communicating with staff

It is essential to communicate the information about the carbon footprint of JKSL to the staff. A full understanding of what JKSL is trying to do will help them to understand the role that they have to play and it will also encourage them to take an interest in reducing the carbon footprint of JKSL.

This could be started by assessing their commuting emissions which were not included in this assessment. Having done this they could then be encouraged to find the most efficient, practical method of commuting to work. Incentives could be

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provided to encourage the staff to travel to work more efficiently and attention could be given when recruiting as to the distance staff are likely to travel to work.



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6 Appendix A: Methodology

The following appendix provides details of the methodology used to find the conversion factors which have been used in this study. The measurement of carbon footprints is still a science in its infancy and therefore the data is often not ideal, but is the best data currently available. This report does not claim to give anything but an estimate of the level of emissions being released by different sections of a business.

The model draws its core methodology from Environmental Input-Output analysis (EIO). This approach is now well established and detailed explanations can be found in a variety of texts (e.g. Leontief 1986, Miller and Blair 1985)

The specific methodology and sources underpinning this model are outlined below:

- 1) The technical coefficients matrix (Leontief 1986) (A) has been derived from United Kingdom Input Output Analyses 2006. Table 3 'Demand for products in 2004 Combined Use Matrix'. (ONS, 2006) This matrix deals with the UK economy broken down into 123 industry groups. It is more usual to derive this matrix from use tables at basic prices. However, for the UK these have not been produced since 1995.

This process makes the assumption that the output stimulated in each sector per unit demand at purchaser's prices is homogeneous; independent of the purchaser.

The use of purchasers' prices rather than basic prices to determine the technical input coefficients allows the use of 2004 data rather than 1995 data. The trade-off is that it entails the assumption that demand at purchasers prices (including taxes, subsidies and distributors margins) is as good a guide to industry activity as demand at basic prices. Both of these values are surrogates for the stimulation of emissions-causing activity.

- 2) The Leontief inverse (L) of the technical coefficients matrix yields a matrix of coefficients of output in each sector at basic prices that is stimulated per unit final demand, also at basic prices.

$$L = (I-A)^{-1}$$

- 3) UK Environmental Accounts (ONS, 2007) give the greenhouse gas emissions in 2004 arising directly from 93 SIC sectors. These are mapped onto the 123 Input Output industry groups by a process of splitting out SIC code emissions into Input-Output industry groups in proportion to total output at basic prices and where necessary combining SIC codes into single Input-Output industry groups.
- 4) The additional radiative forcing that is thought to be caused by aviation, per unit of greenhouse gas emitted was factored in by applying a multiplier of 1.9 to the GHG emissions associated with the air transport sector. This simple mark-up factor is figure most recently recommended by Defra (2008) in the establishment of emissions factors for company reporting on greenhouse gas emissions. It represents a first approximation to a complex and as yet poorly understood set of scientific phenomena. The addition of this multiplier raises the direct greenhouse

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gas impact of the UK aviation transport to over 12% of the total GHG impact of UK industry.

- 5) UK output by sector at basic prices (ONS, 2006) has been combined with UK GHG emissions arising directly from each sector to derive a vector of coefficients of emissions per unit UK output from each sector at basic prices (G_{UK}).

For each industry,

$$G_{UK_i} = E_{D_i} / O_{BP_i} \quad i = 1, 123 \text{ (industries)}$$

where O_{BP} is the vector of UK output at basic prices

- 6) The matrix (E) of GHG emissions arising from each industry (i) per unit of final demand for each industry (j) at 2004 basic prices is calculated as follows

$$E_{ij} = L_{ij} \cdot G_i$$

- 7) Total emissions from each industry (i) arising from UK final demand for each industry (j) is given by

$$\underline{E_{Total_{ij}}} = E_{ij} \cdot F_{BP_i}$$

Where E_{Total} is the matrix of total emissions from each sector arising from final demand for each sector, and F_{BP} is the vector of final demand at 2004 UK basic prices.

Note that F_{BP} includes exports. To understand the impact of UK final, exports can be subtracted from each sector as a proportion.

- 8) To obtain F_{BP} , the final demand at purchasers prices is adjusted by subtracting distributors margins taxes and subsidies, based on the assumption that these are split between two domestic outputs at basic prices and imported products in the ratio of their respective monetary values

For industry i,

$$F_{BP} = F_{PP_i} - (D_i + T_i - S_i) \cdot (O_{BP_i} / (O_{BP_i} + B_i)) \quad \text{where } B \text{ is the vector of imports}$$

Where F_{BP} = Final demand at Basic Prices,

F_{PP_i} = Final Demand at Purchasers prices and

D, T, S, O_{BP} and B are the vectors of distributors' margins, taxes, and subsidies. Total output at basic prices and imports)].

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A key assumption here is that distributor's margins, tax and subsidies are applied to domestic production and imports at the same rates and can therefore be apportioned to according to monetary value.

The data is obtained from Tables 2 and 3 in the UK Input Output Analysis Tables 2006 Edition.

9) **Conversion of emissions factors to Purchasers prices.**

The majority of this conversion is done simply by dividing by the ratio of final demands at purchasers and basic prices. However, there remains the question of allocating emissions arising from distribution services to the sectors whose products use those sectors.

In the UK Input Output tables, three distributor sectors require special treatment, since the products they deal with are not counted as inputs and only the marginal increase in their value is counted as outputs for those sectors. These sectors are 'Motor Vehicle Distributors', 'Wholesalers' and 'Retail'. The emissions associated with these three sectors have been aggregated and redistributed between industries they serve in proportion to the distributor's margins that are associated with their products.

The core assumption here is that emissions arising from distribution services are in proportion to the margins they generate for the products of each other industry.

10) **Allowing for price changes since 2004.**

For the purposes of assessing an organisation's greenhouse gas impact by analysing its expenditure, the realism of results can be improved by factoring in price changes since the input output tables were produced. This can be done simply by applying an overall figure, or better still, by dividing emissions factors per pound sterling of expenditure by a sector specific cumulative inflation figures between 2004 (the date of the IO tables) and the date of the assessment. In this model we use the UK Consumer Price Index (overall index), comparing June 2004 with May 2008. (ONS 2008). This gives a price increase (and therefore decrease in GHG per £) of around 11%.

A drawback of input-output modelling is that the data is almost inevitably out of date by at least two years as the input output tables are not published by the national office of statistics for two years. The application of price indices mitigates this weakness. Note that it does not take account of changes in the basic structure of the input output tables that may have occurred since their production, and this remains an issue to be remembered when interpreting results.

The model does not reflect changes in the greenhouse gas efficiency of industries since the datasets were produced (in this case 2004).

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11) Addition of direct emissions from an organisation.

The input output greenhouse gas model as presented so far provides an estimate of the indirect greenhouse gas emissions that are triggered globally by an organisation's expenditure, broken down by 123 industrial sectors. Direct emissions from the organisation are not so far included. These could be crudely factored in within the EIO framework, by simply multiplying the turnover of the organisation (excluding tax on products, and subsidies) by the direct emissions factor for that sector (UK GHG emissions for the sector divided by the total UK output at basic prices). However this does not give a very accurate estimation of the direct emissions release by the company. Therefore at this point conventional lifecycle analysis methods are used as they provide reasonable data for direct emissions. Therefore for direct emissions arising from the burning of petrol, diesel, LPG, natural gas and coal, the conversion factors from Defra (2008) were used. Indirect emissions from all of these were obtained using input output analysis as described above.

12) Detailed Transport Assessment.

Because Transport contributed to a large proportion of the carbon footprint if JKSL, the transport emissions were assessed using lifecycle analysis to allow a more specific detailed assessment to be carried out, enabling the individual vehicles to be itemised to assess which were the greatest emitters. The data for this came mainly from Defra (2008), with the figures being rounded up based upon a lifecycle study carried out by E. Dudek for Small World Consulting Ltd.

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7 Appendix B: References

Defra, (2008). *Guidelines to Defra's GHG Conversion Factors for Company Reporting*. Available from: <http://www.defra.gov.uk/environment/business/envrp/pdf/conversion-factors.pdf> [accessed 15 Jan, 2008].

IPCC. (2007). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge, United Kingdom and New York, USA: Cambridge University Press.

Leontief, W. (1986). *Input-Output Economics*, Oxford: Oxford University Press.

Miller, R. and Blair, D. (1985). *Input Output Analysis, Foundations and Extensions*. Englewood Cliffs, USA: Prentice-Hall Inc.

ONS (Office for National Statistics). (2006). *United Kingdom Input-Output Analyses: Input-output Supply Use Tables, 2004*. Available from: http://www.statistics.gov.uk/about/methodology_by_theme/inputoutput/latestdata.asp [accessed 19 Sept, 2008].

ONS (2007). *Environmental accounts: Emissions; Greenhouse gases, 93 industries 1990 to 2005* [online]. National statistics online. Available from: <http://www.statistics.gov.uk/statbase/Expodata/Spreadsheets/D5695.xls> [accessed 25 January 2008]

ONS (2008) *Consumer Price Indices*. Available from: <http://www.statistics.gov.uk/statbase/TSDdownload2.asp> [accessed 24 September 2008].

Stern, N.H. (2006). *The Economics of Climate Change: The Stern Review*. London: The Stationary Office (on behalf of HM Treasury).