SMALL WORLD CONSULTING

A carbon budget for the Lake District National Park

A report by Small World Consulting Ltd

Final Report

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Northwest Regional Development Agency

Liverpool City Council

nwIEP north west improvement and efficiency partnership

CLASP.

Low-carbon CO_2 Lake District

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Contents

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2 Introduction

In 2008, the UK government passed the Climate Change Act, introducing into law a national carbon budget. Through the Act, the UK committed to reducing carbon by 80% (from a 1990 baseline) by 2050, and at least 34% by 2020. The Committee on Climate Change advises government on setting the budget, and on measures to meet it.

Some of this budget can be met through policy and incentives put into place by national government and the EU – such as decarbonising electricity through renewables, carbon capture and nuclear power; tougher emissions standards for vehicles; carbon trading and so on.

However, the budget will not be met unless local areas act too, putting the right incentives, infrastructure and advice in place at a local level, to enable everyone to play their part in reducing carbon emissions.

The Lake District National Park Partnership, a partnership of twenty-three organisations, has collectively agreed to take action on climate change at a local level. The Partnership's Plan, The Management Plan for the Lake District National Park, commits to "mitigate against climate change in line with national carbon budgets", through;

- setting a carbon budget for the National Park and applying carbon reduction targets,
- gaining expertise on climate change management, through the creation of a leadership group on climate change within the Partnership,
- reporting to the Partnership on key areas for action in carbon reduction.

This report takes the first step. It measures the carbon footprint of the Lake District, suggests how to set a budget based on this data, and sets out a number of scenarios to meet the budget over a five-year period. Members of the Partnership can then use this information to develop a plan of action which will ensure year-on-year carbon reductions.

Comprehensive local responses to climate change – in the form of a local carbon budget or 'local carbon framework' – are a relatively new development. The Department for Energy and Climate Change, through its Local Carbon Frameworks programme, are encouraging local areas to plan in this way. This work for the Lake District will provide useful learning for other local areas.

2.1 About this report

This report estimates the carbon emissions from the Lake District National Park, using a consumption-based approach (see below). It covers the emissions of residents and visitors. There are 42,000 residents in the Park, and on average an almost identical number of visitors at any one time, of whom about 6% are from overseas.

The report sets out the following:

- the total carbon footprint of the Lake District National Park,
- the main sources of emissions from the Lake District National Park,
- where carbon savings could come from,
- scenarios for achieving the carbon budget,
- the methodology used and
- how this methodology can be applied in other local areas.

The report covers all the greenhouse gasses and the term 'carbon footprint' is used as a shorthand to mean the greenhouse gas emissions released both directly and indirectly within supply chains of goods and services.

3 The carbon footprint of visitors and residents

This report estimates GHG emissions from consumption by LDNP residents and visitors, including travel to and from the Park. The purpose is to enable the effective targeting of carbon management activities.

3.1 What is included and what is not

The assessment includes emissions resulting from everything residents do and buy in their personal lives and everything that visitors do and buy while in the Park, as well as their travel there and away. More specifically, the following is within the scope:

- all residents personal travel and visitor travel to, from and around the park,
- fuel and electricity consumed in homes and places to stay,
- emissions from food and drink and other purchases,
- emissions resulting from the use of services, including public services,
- the supply chains of all the above (e.g. fuel supply chains and embodied emissions).

The following is specifically excluded:

- business emissions including business travel (except when the business output is consumed by residents and visitors).

This report takes a consumption based approach. This means that supply chain emissions associated with the production of goods, services consumed by residents and visitors are included wherever those emissions actually take place. For example, emissions from the production and transport of foods eaten in the Park lie within the scope, whereas the 'footprint' of food produced within the Park but exported is not included in this analysis. To give another example, in a consumption based analysis, the carbon footprint of driving includes not only the direct emissions from the burning of fuel but also emissions resulting from the extraction, shipping and refining of the fuel, as well as a component for the manufacture of the vehicle itself. The adoption of a consumption based approach is particularly important when seeking to understand and manage the impacts of lifestyles and of service economies, since in these cases, supply chain emissions often dwarf the direct emissions that would be included in an assessment of only direct emissions.

In the Lake District, 'indirect' emissions from supply chains are greater than the direct emissions from energy use.

Note that the visitor economy, with its accommodation, catering and leisure services is included since the goods and services of businesses in the Park are consumed by visitors and residents. However, this analysis does not include other businesses within the Park except in so far as their products and services are consumed by residents and visitors. One important implication is that whilst the analysis looks at consumed food, it does not specifically analyse Lake District farming emissions, including, land-use emissions.

3.2 Emissions from land-use and land management

This report does not cover GHG emissions from land-use and land management, including agriculture. There are two reasons for this. Firstly, most emissions from land-use – such as agricultural emissions – are not within the scope of a consumption-based approach (except insofar as the products are consumed locally). Secondly, there are huge uncertainties surrounding estimates for carbon storage, sequestration and emissions from land. Reliable information specific to the Lake District is not currently available.

This is not to say that emissions from land-use and land management are insignificant. A huge amount of carbon and other greenhouse gases are stored in the landscape. Peatland and woodland are particularly important carbon stores. Land management practices and agricultural practices have a significant impact on carbon emissions. However, at present, it is very difficult to measure these impacts, and even more difficult to compare them to other management actions (such as transport, energy efficiency and so on).

The Lake District National Park and its partners are taking forward a number of initiatives to measure, manage and reduce carbon emissions from land management:

- The Carbon Landscapes Project: a partnership project to get baseline evidence of carbon fluxes and demonstrate types of land management and their impact on carbon within the Lake District (European Commission LIFE+ funding applied for).
- Carbon management toolkit for land managers and advisers: Putting together useful information on carbon and land management for anyone who influences land management.
- New Agri-environment schemes: Influencing new agri-environment agreements over the next 4 years to improve management of peat soils and vegetation for carbon.
- Woodland Delivery Plan: Developing a programme of priorities and opportunities for increasing woodland cover and managing existing woodland to deliver carbon and other public benefits.

Once there are more reliable figures for emissions from land-use and land management, they can be incorporated into the carbon budget in future years.

3.3 A best estimate

This report sets out to provide a broad perspective on the carbon issues and to clarify, in broad terms, the priorities from a carbon management perspective. The figures contained are best estimates.

Even where accurate data is available, all carbon footprints that seek to include supply chain emissions almost always contain considerable uncertainty. This report also relies upon estimates of consumption based on a range of data, including visitor surveys, which themselves contain considerable uncertainty.

(For more detail see the Methodology section in Appendix A).

4 Findings

4.1 Overview

The total GHG 'footprint'of residents and visitors is estimated at 2.3 million tonnes CO_2e. This figure includes visitors' travel to and from the Park, their consumption within the Park, and residents' travel outside the Park boundary. The figure is equal to around 0.3% of the GHG emissions from all UK consumption[1].

Visitors getting to and from the Park accounts for 41% of the total, almost two thirds of which results from flights. A typical visitor day has a footprint of around 104 kg CO_2e (including getting there and away), or 43kg (excluding getting there and away), a resident day has 47 kg CO_2e and an average UK person day has 38 Kg CO_2e.

Residents make up 31% of the total footprint and visitors, whilst in the Park, 28%.The carbon intensity of visitors once within the Park (per person day) is slightly lower than that of residents.

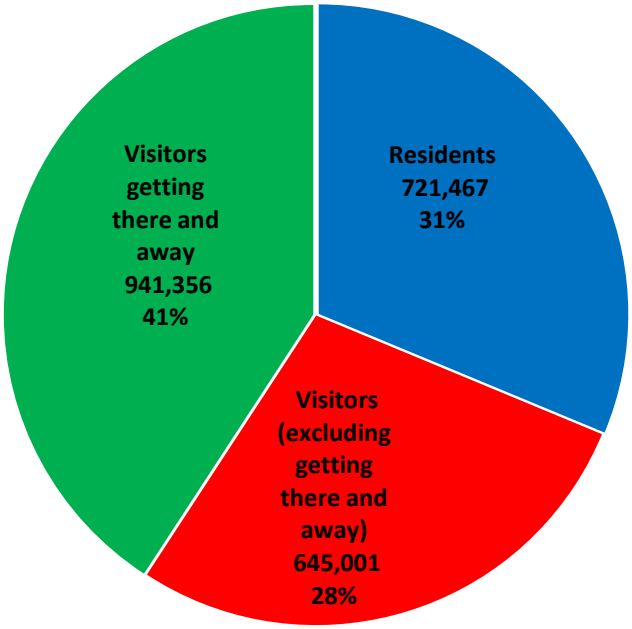

Figure 1: The greenhouse gas footprint of residents and visitors: 2.3 million tonnes CO_2e.

[1] Based on an estimate of 862 million tonnes for the UK from environmental input output analysis (see methodology, Appendix A).

Annual tonnes CO2e	Per person per year				Annual totals						
	Average UK per person	LDNP per resident	Visitors per person year (excluding getting there and away)	Visitors getting there and away	Residents	Visitors (excluding getting there and away)	Visitors getting there and away	Residents and visitors combined including getting there and away	%	Residents and visitors excluding getting there and away	%
Household Fuel (from staying in private homes)	1. 77	2. 07	. 02	-	86,873	782		87 655	4%	87 655	6%
Household Electricity (from staying in private homes)	1. 23	2. 2	. 01	-	92,595	541		93 136	4%	93 136	7%
Personal Vehicles - Fuel	1. 39	2. 65	3. 06	4.80	111,398	128,324	201 427	441 149	19%	239 722	18%
Personal Vehicle Wear and Tear.	. 67	1. 28	1. 83	2.87	53,723	76,798	120 547	251 067	11%	130 520	10%
Flights	1. 17	1. 17	.	14.03	49,034	-	589 004	638 038	28%	49 034	4%
Trains, Busses and Other Transport	. 39	. 39	. 13	0.72	16,223	5,334	30 378	51 935	2%	21 557	2%
Accomodation, Food & Drink	2. 28	2. 28	6. 05	-	95,668	254,100		349 768	15%	349 768	26%
Shopping (non food)	. 76	. 76	. 63	-	31,765	26,331		58 096	3%	58 096	4%
Construction	1. 05	1. 05	1. 05	-	44,087	44,073		88 160	4%	88 160	6%
Water and Sewage	. 32	. 32	. 32	-	13,383	13,378		26 761	1%	26 761	2%
Health, Education, Other Public Sevices & Administration	1. 5	1. 5	1. 5	-	63,173	63,153		126 326	5%	126 326	9%
Other expenses (inc financial services)	. 53	. 53	. 53	-	22,301	22,294		44 594	2%	44 594	3%
Leisure, Rectreation and Attractions	. 16	. 16	. 24	-	6,831	9,894		16 725	1%	16 725	1%
Other - Not Directly Consumed by Visitors	. 82	. 82	.	-	34,414	-		34 414	1%	34 414	3%
Total	**14. 03**	**17. 18**	**15. 36**	**22.42**	**721,467**	**645,001**	**941,356**	**2307 824**	**100%**	**1366 469**	**100%**

4.2 A breakdown by consumption category

Figure 2: The greenhouse gas footprint by consumption category (tonnes CO_2e).

Driving (including both fuel and vehicle wear and tear) and flying are the two biggest hitters, followed by accommodation, food and drink. After that comes household energy (both electricity and fuel).

4.3 Detailed composition of the footprint

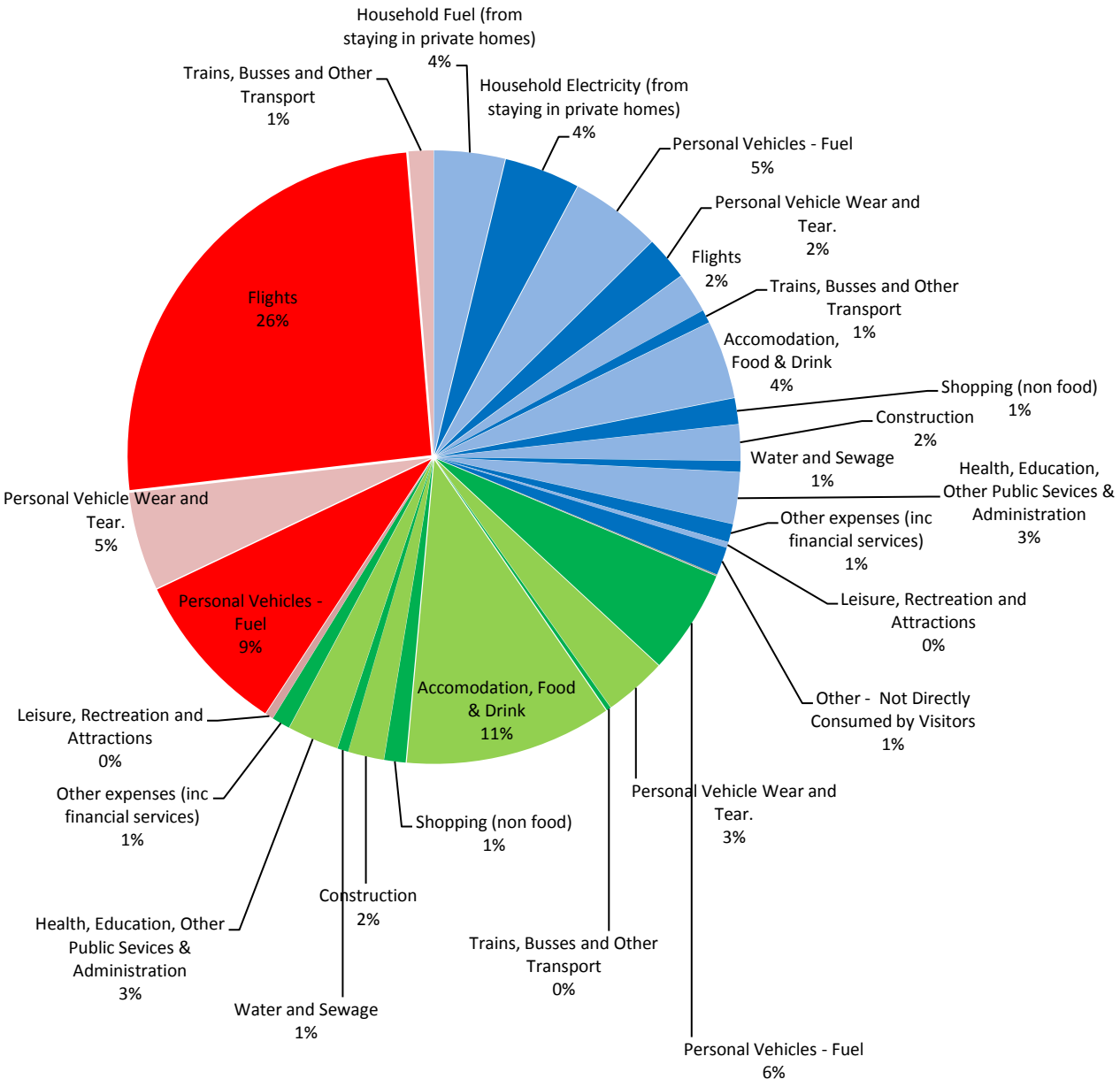

Figure 3: The greenhouse gas footprint of residents and visitors including travel to and from the park: 2.3million tonnes CO2e. (Residents: Blue, Visitors: Green, Getting there and away: Red).

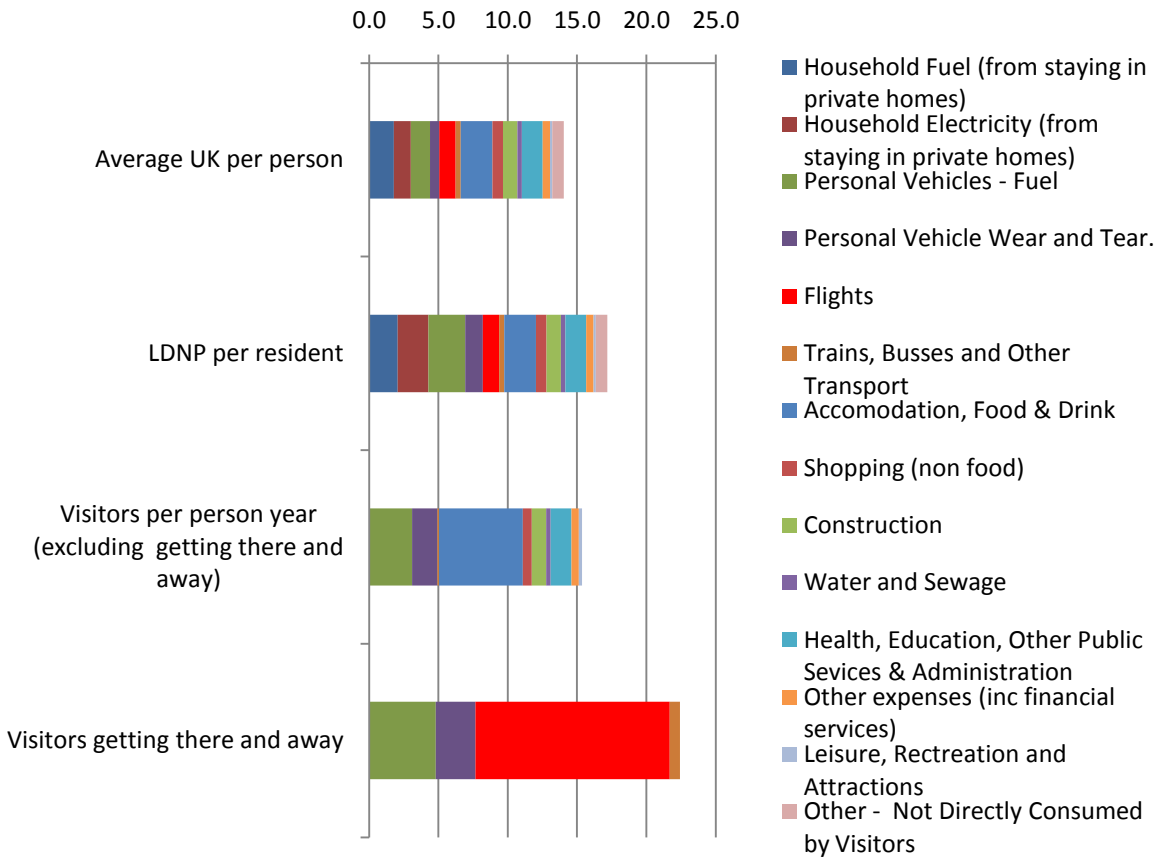

Figure 4: Average daily greenhouse gas footprint per resident, per visitor per UK person and 'getting there and away,[2] (tonnes CO_2e).

Visitors' emissions are dominated by air and road travel. Compared to the UK average, we think that Park residents drive more almost twice as much, consume 80% more electricity and household fuel emissions are 17% higher.

Below we set out the main sources of emissions, starting with the biggest categories.

4.3.1 Driving

All driving represents 30% of the total footprint. This can be broken down as follows:

Visitor Driving including getting there and away accounts for 23% of the total footprint with journeys to and from the Park making up 14% and driving in and around accounts for the remaining 9%.

Resident driving in and outside the park is 7% of the total. The available data suggests that Park residents drive around 90% more than the UK average. The figure includes commuting but not mileage whilst at work.

Nearly two thirds of the footprint of driving stems from fuel consumption (12% direct emissions from combustion ad 3% fuel supply chain emissions) and 8% from the embodied emissions in the manufacture and maintenance of vehicles themselves.

[2] The footprint of 'Getting there and away' is also per day of the visit.

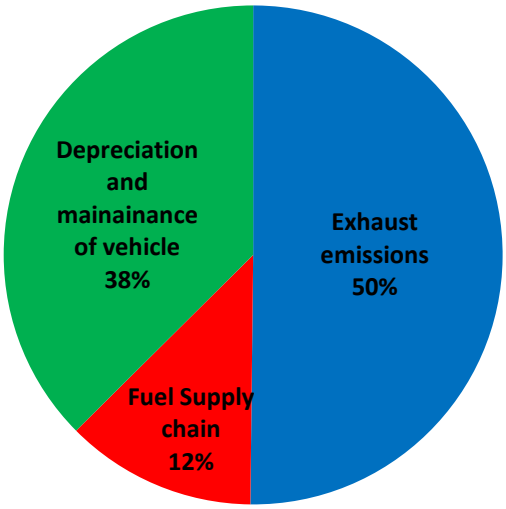

Figure 5: The greenhouse gas footprint of driving

4.3.2 Flights[3]

All flights make up 28% of the total footprint, and can be broken down as follows.

Visitor Flights account for 26% of the total Park footprint. Less than 5% of visitors have flown to get to the Park and for long distance flights we have attributed only a minority of those flights to the Park visit[4]. Of the footprint of overseas visitor flights, 28% of the footprint comes from visitors from Australia, 22% from USA v, 12% China and 10% Japan. Between them, these account for just 2.7% of all visitors.

Residents' flights, excluding those for business[5], make up 2% of the total, based on the assumption that residents fly as much as the UK average. Non-business fights make up 8% of the footprint of all UK consumption.

[3] The analysis includes a 1.9 mark factor to take account of high altitude emissions.

[4] The proportion of each flight allocated to the Park visit is based on the proportion of the total UK visit thought to be spent in the Park itself. See methodology.

[5] In a consumption based analysis such as this, emissions from business flights are attributed to the supply chains of the products and services of which they are a part, and ultimately to their consumers rather than to the people taking the flight.

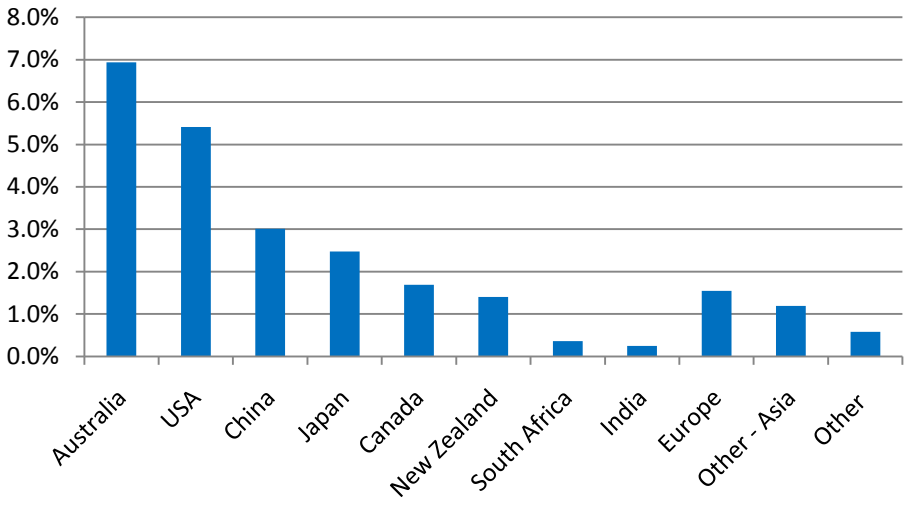

Figure 6: Proportion of total park footprint attributable to flights from different countries.

Visitor country of Origin	Proportion of all Park visitors	Proportion of all overseas visitors	Proportion of each flight attributed to the LNP visit	Proportion of the footprint of all visitor flights	Proportion of total park footprint attributable to flights
Australia	0.7%	11%	34%	28%	6.9%
USA	0.7%	12%	62%	22%	5.4%
China	0.6%	10%	34%	12%	3.0%
Japan	0.4%	7%	34%	10%	2.5%
Canada	0.3%	5%	62%	7%	1.7%
New Zealand	0.1%	2%	34%	6%	1.4%
South Africa	0.1%	1%	34%	1.4%	0.4%
India	0.1%	1%	34%	1.0%	0.2%
Europe	1.4%	24%	87%	6.2%	1.5%
Other - Asia	0.1%	2%	34%	5%	1.2%
Other	0.2%	4%	34%	2%	0.6%
Total	4.7%	78%			25%

Table 1: The Proportion of total park footprint attributable to flights from different countries

4.3.3 Accommodation, food and drink

This category includes all food eaten by visitors and residents, people staying in paid accommodation, but not in their own homes or with friends and family. It represents accounts for 15% of the total and can be broken down as follows.

Visitor accommodation, food and drink together account for 11% of the total. This includes food bought from pubs, cafes, restaurants and hotels, as well as the footprint of accommodation itself, and food from shops, which we estimate to be account for around one third of the 11%.

The greenhouse gas footprint of the UK hotels, pubs and catering industry, taken together, breaks down roughly as follows[6].

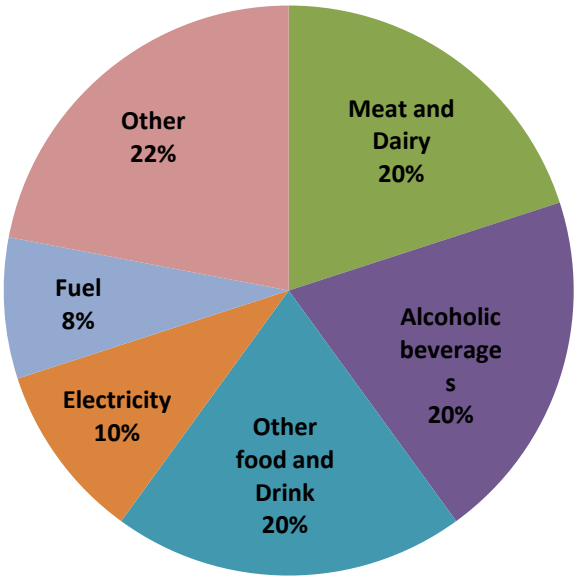

Figure 7: A rough breakdown of the GHG footprint of the hotels, pubs and catering industry in the UK.

Resident's food and drink (4% of total), includes food purchased from shops as well as any bought from hotels, pubs, restaurants and cafes. This is around 12% of the total footprint of residents.

4.3.4 Household energy[7]

Electricity and domestic fuel together make up 8% of the total footprint and break down as follows.

Residents' household electricity is 4% of the total picture, being 13% of residents' footprint and 79% higher than the UK average.

Residents' domestic fuel also comes in at 4% of the total footprint and 12% of the footprint of residents themselves, 17% higher than the UK average.

[6] The chart is drawn from a 2007 environmental input output model of the UK economy, based on 2004 data.

[7] In this analysis, where commercial accommodation is on a domestic tariff the emissions have been attributed to residents rather than visitors.

Visitor electricity and domestic fuel. A small proportion of visitor nights are spent staying with friends and relatives, giving visitors a small footprint for domestic electricity and fuel[8].

4.3.5 Non-food shopping

This category includes all inedible purchased items apart from cars. It makes up 6%, with only around 1% coming from visitors.

4.3.6 Other travel

This comes to 2% of the total footprint. A majority comes from visitors travelling to and from the Park and only about 10% comes from visitor travel during their stay. The low figures for use of public transport in the Park are probably a reflection of poor provision.

4.3.7 Leisure and recreation services and attractions

This represents around 1% of the total footprint.

4.3.8 Other

The footprint of a range of (mainly public) services has been assumed to be the same per person per year as the national average. These include the following.

- **Health, education, defence and other services** (for 5% visitors and residents together). Several stakeholders of this report, including the Lake District National Park Authority itself lie within this category. Also included in this section are proportionate allocations of emissions from national infrastructure and services, such as central government and defence.
- **All construction work within the Park (4%).** In the construction of buildings, the in-use energy considerations usually dwarf the embodied carbon in the buildings themselves and should be the primary consideration.
- **Water and sanitation (1%).**
- **Other services (2%).** This includes a range of mainly intangible services including financial and professional services.

4.4 The footprint excluding getting there and away

Whilst travel to and from the Park is clearly important, taking them out of the equation temporarily may allow impacts from residents and visitors during their stay to be seen more clearly. If this is done, it can be seen that accommodation, food and drink are proportionally almost as important as driving within the Park. Home electricity and fuel is almost half as important as each of these. The footprint of public services, including education and health and such organisations as the LDNPA itself are 9% of the total excluding travel to and from the Park. Construction within the Park is 6%. Non-food shopping, excluding cars, is 6%.

[8] When staying in paid accommodation, household energy is included as part of accommodation.

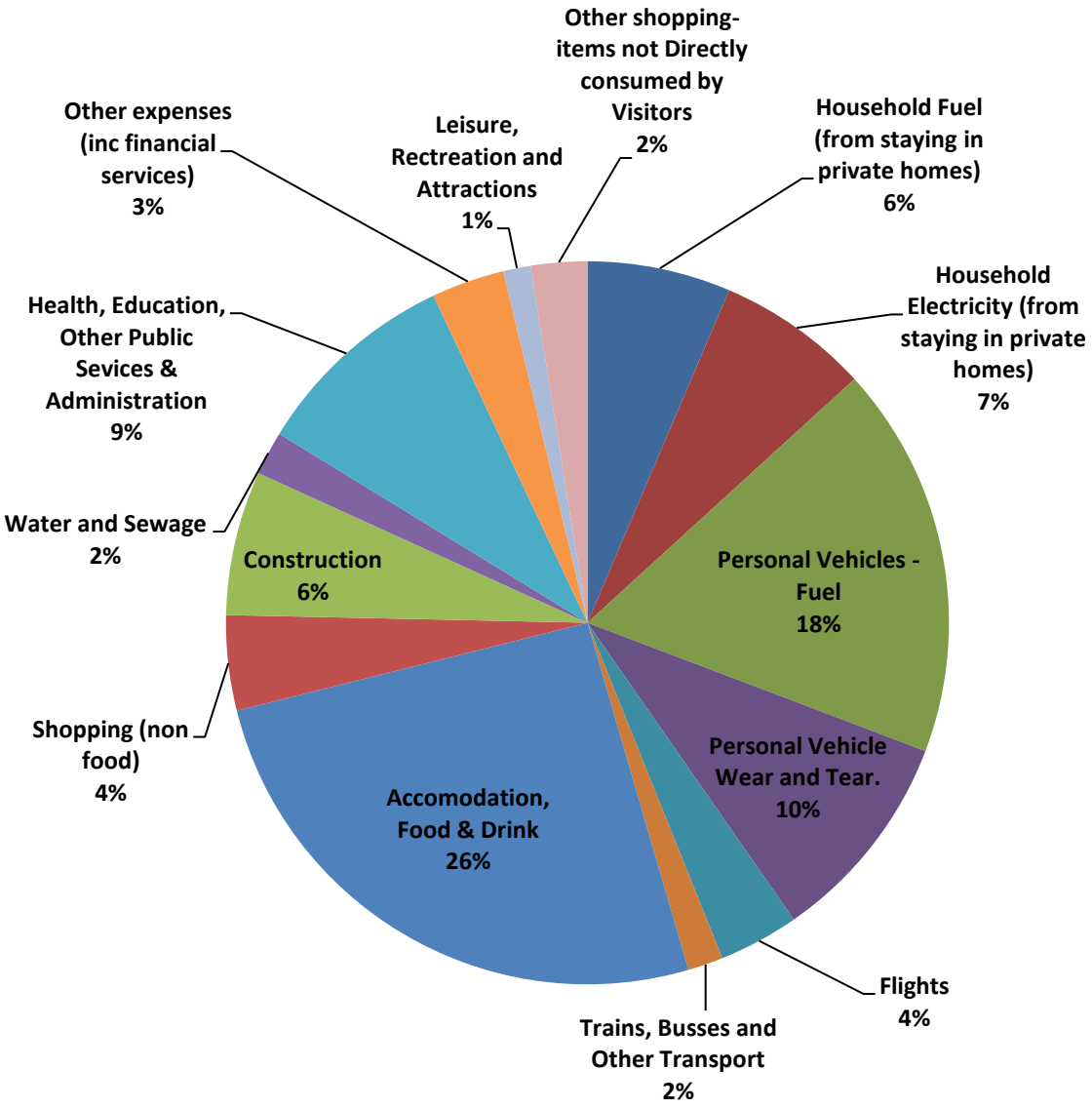

Figure 8: The greenhouse gas footprint of residents and visitors (excluding visitors getting there and away).

5 Managing a carbon budget for the Lake District

As the above analysis shows, **the total amount of CO_2e emitted by the Lake District is 2.3m tonnes CO_2e**.

The Lake District National Park Partnership has committed to reducing emissions by two per cent a year, in line with national carbon budgets. It is reasonable to expect around half of this reduction to come from national policy measures, such as decarbonisation of the electricity supply, the EU emissions trading scheme, the CRC energy efficiency commitment, and so on. [9]

This means that, to achieve the budget, the Lake District must find additional savings of at least 1% per year, or 23,000 tonnes through local action. Over a five year period this would equate to a fall in the annual footprint of 5% or 115,000 tonnes per from today's baseline.

5.1 Where can the savings come from?

There is a range of ways to achieve these savings. The highest potential comes from the biggest sources of emissions – such as travel to and from the Lake District, and travel within the area. Other significant savings can be made through energy efficiency, food sourcing and reductions in food waste, water efficiency and savings in the public sector.

Decisions on actions to be taken will be based on multiple criteria to take account of the full range of stakeholder interests. These include:

- the potential for carbon saving,
- costs or cost savings (e.g. resulting in lower food or energy bills),
- feasibility and capacity,
- potential to benefit the local economy – e.g. through encouraging local produce or diverting a higher proportion of visitor expenditure into the local economy,
- reputational benefits – popularity / acceptability, (brand image, marketing)
- other sustainability criteria.

Whilst it is not the place of this report to prescribe actions, there follows some discussion of the main options.

5.1.1 Driving

The key options to reduce the footprint of driving are to reduce the number of miles driven, shift to more efficient cars and, perhaps, improve the style of driving. If visitors can be persuaded to travel less and divert their expenditure into services on offer within the Park, the change is also likely to be accompanied by a marked increase in cash into the visitor economy. The footprint of travel to and from the Park can be reduced by increasing the average length of stay, if visitor days are unchanged. If visitor days were to rise as a result, the footprint per day would still be reduced by this action. Lift shares to work provide a way reducing resident car miles as well as saving money for residents. A culture of using smaller cars where

[9] For NI 186 two thirds of measures were agreed to come from national measures, leaving 0.66% per year from local. It is difficult to see such a high proportion of the emissions from consumption coming from national measures, especially since improvements large efficiencies in air travel are hard to foresee and the government targets do not take account of rising emissions imported through trade. We have therefore worked on 50% of savings on the emissions from consumption coming from local measures.

possible would also be helpful. Any changes leading to increases in the lifetime mileage of cars could also help.

5.1.2 Flights

Increasing the length of stay of overseas visitors, either within or outside the Park, is one way of reducing the footprint per visitor day. Another approach would be to alter the visitor mix, with a higher proportion coming from closer by. Expanding the capacity of regional airports will result in a significant rise in the Lake District's emissions.

5.1.3 Accommodation, food and drink, leisure activities and attractions

The emphasis of carbon management activities in the hotel, pub and catering industry in the Park should reflect where the emissions come from within that industry. Food and drink makes up around 60%, and key mitigation activities might include waste reduction (pre- and post- plate) and menu choice, emphasising seasonality, locality (especially for heavy products such as beer and milk), ensuring lower meat options are high quality and avoiding air-freight and hot-housing. Energy efficiency measures are important, and other actions to consider are ensuring that visitors have a sense of responsibility for energy management and consumption, and cutting out unnecessary laundry.

All of these measures have potential to improve both bottom line and reputation. Some tourism businesses in the Park are already strongly engaged with this agenda. A number have made use of the comprehensive carbon management tool which is available on the Cumbria Tourism Website. Others have engaged in studies using a similar approach to manage their impacts.[10] The activities of the Cumbria Green Business Forum within the Park demonstrates fertile ground for creating a core of lower carbon tourism businesses, together building and benefiting from the Park's potential reputation as a destination for sustainable tourism.

The above messages for carbon management in the catering industry also apply to home catering. Other tourist attractions and leisure activities can be included in initiatives to reduce carbon in accommodation and catering establishments.

5.1.4 Household energy

In terms of priority, simple home energy efficiency measures such as insulation, draft exclusion, efficient boilers and low energy lighting are the most cost effective. Savings from micro-renewables or even double glazing are more expensive and should not be prioritised at the expense of more basic measures.

5.1.5 Non-food shopping

Amongst residents this might be tackled through re-use schemes (such as Freegle and second-hand shops) and promotion of infrastructure for repairing goods. Interestingly, these add to prosperity in ways which are not reflected in standard economic measures.

5.1.6 Public service organisations

Stakeholder organisations can take simple steps to ensure that they understand, at least in broad terms, the indirect emissions in their procurement supply chains as well as their direct emissions. Reducing these may well also result in improved resource efficiency and savings.

[10] Examples include Langdale Leisure, who have undertaken a consumption based analysis three years running with the latest results estimating cuts of 13% per GDP, Windermere Cruises, Skelwith Fold caravan park, Elder Grove and Cote Howe bed and breakfasts.

5.1.7 Public transport

Interestingly, visitor car occupancy rates are thought to average 3.3 people per car. Once this is taken into account, although they may lead to improvements in the visitor experience, the carbon efficiency savings from using public transport compared to a fairly economical car are marginal. The same is not true of resident travel which would be improved by better bus and train infrastructure.

5.1.8 Construction

The primary carbon consideration in the choice of build materials should be energy performance. However, waste reduction, materials re-use and recycling are all important considerations in the way that buildings are built and refurbished.

5.1.9 Water and sanitation

United Utilities is responsible for the *efficiency* of provision. Visitors and residents are responsible for the *amount* of consumption. Both carbon and water footprint reductions can be made by addressing both sides of the equation.

The following table indicates a number of ways, not all realistic, in which savings might be made. The savings are rough estimates and the table is an illustration rather than a complete list.

Table 2: An illustration of potential carbon savings

Carbon Management Action	Saving on the total	Tonnes CO_2e
Cut home energy consumption by 10%	0.8%	18,079
Cut Domestic Food waste to 20% (from 25%)	0.4%	10,179
Increase length of stay of visitors by 10%. (without changing visitor days)	4.1%	94,136
10% carbon efficiency improvement in education, health and other public services	0.5%	12,615
Reduce travel by visitors whilst in the park by 10%	0.9%	21,046
Swap 10% overseas visitors for UK visitors	2.4%	55,377
Increase length of stay of overseas visitors by 10%(OS days stay the same)	2.3%	53,546
Improve personal water efficiency by 20%	0.2%	5,352
Improve car efficiency by 10%	1.4%	31,652
Ban cars in the park. Replace with busses and trains	9.3%	214,334
Additional renewables, generating 5MW (average output)	1.1%	25,386
Improve hotel, restaurant, café and pub carbon efficiency by 10%	1.1%	25,409
Ensure all beer comes from within the Park	0.4%	8,744
Reduce resident purchase of non food-or-car goods by 10% through promotion of Re-use and repair services.	0.3%	6,618
Total (including some double counting)	**25%**	**582,473**

5.2 Some scenarios for achieving the carbon budget

Based on the actions listed we have produced four purely illustrative scenarios, which bring about a 5% reduction through local action over five years.

5.2.1 Scenario 1: A bit of everything.

In this scenario carbon savings are comprised of even reductions from most areas, including getting to and from the Park. This scenario might be realistic if all partners to the Lake District National Park Partnership were willing to contribute equally, should actions in their area emerge as the most appropriate.

Scenario 1: A bit of everything	Saving on the total	Tonnes CO_2e
Cut home energy consumption by 5%	0.4%	9,040
Cut Domestic Food waste to 22% (from 25%)	0.3%	6,108
Increase length of stay of visitors by 5% (without changing visitor days)	2.0%	47,068
5% carbon efficiency improvement in education, health and other public services	0.3%	6,307
Reduce travel by visitors whilst in the park by 5%	0.5%	10,523
Swap 2% overseas visitors for UK visitors	0.5%	11,075
Improve personal water efficiency by 5%	0.1%	2,676
Improve car efficiency by 2%	0.3%	6,330
Improve hotel, restaurant, café and pub carbon efficiency by 5%	0.6%	12,705
Reduce resident purchase of non food-or-car goods by 2% through promotion of Re-use and repair services.	0.1%	1,324
Total (including some double counting)	**5%**	**115,832**

5.2.2 Scenario 2: Focus on the big hits.

This scenario offers, perhaps, the simplest action plan by focussing only on the most significant areas: car and plane travel, hotels and catering. In narrowing the target, it also requires the strongest action in these areas.

Scenario 2: Focus on the big hitters	Saving on the total	Tonnes CO_2e
Increase length of stay of visitors by 5% (without changing visitor days)	2.0%	47,068
Reduce travel by visitors whilst in the park by 5%	0.5%	10,523
Swap 5% overseas visitors for UK visitors	1.2%	27,688
Improve car efficiency by 5%	0.7%	15,826
Improve hotel, restaurant, café and pub carbon efficiency by 8%	0.7%	15,245
Total (including some double counting)	**5%**	**116,350**

5.2.3 Scenario 3: Reductions to everything except travel to and from the Park.

This scenario looks at what might be required if it were decided not to seek any influence on visitor travel to and from. As with Scenario 2, because a large part of the potential is missed out, greater action is required from the remaining slices.

Scenario 3: Everything except getting to and from the park.	Saving on the total	Tonnes CO_2e
Cut home energy consumption by 10%	0.8%	18,079
Cut Domestic Food waste to 20% (from 25%)	0.4%	10,179
10% carbon efficiency improvement in education, health and other public services	0.5%	12,615
Reduce travel by visitors whilst in the park by 10%	0.9%	21,046
Improve personal water efficiency by 20%	0.2%	5,352
Improve car efficiency by 2%	0.3%	6,330
Additional renewables, generating 1MW (average output)	0.2%	5,077
Improve hotel, restaurant, café and pub carbon efficiency by 10%	1.1%	25,409
Local sourcing equivalent to all beer being local	0.4%	8,744
Reduce resident purchase of non food-or-car goods by 5% through promotion of re-use and repair services.	0.1%	3,309
Total (including some double counting)	**5%**	**116,141**

5.2.4 Scenario 4: focus on the visitor experience.

By focussing on the visitor experience, this scenario stands to make the Park look and feel most different, and is consistent with creating an exemplar low carbon destination with the greatest potential for reputational benefits for the visitor economy. This scenario would also be likely to have the greatest influence outside the Park's boundary. As with scenarios 2 and 3, stronger action is required within the limited areas that are targeted.

Scenario 4: Focus on the visitor experience	Saving on the total	Tonnes CO_2e
Increase length of stay of visitors by 5% (without changing visitor days)	2.0%	47,068
Reduce travel by visitors whilst in the park by 10%	0.9%	21,046
Improve personal water efficiency by 20%	0.2%	5,352
Improve visitor car efficiency by 5%	0.4%	8,205
Improve hotel, restaurant, café and pub carbon efficiency by 10%	1.1%	25,409
Ensure all beer comes from within the Park	0.4%	8,744
Total	**5.0%**	**115,824**

5.3 The virtuous circle

There are already examples of good practice amongst tourism businesses in the Park and with active 'green' groups for both businesses and individuals, there is clear evidence of goodwill amongst many to build momentum. The actions of people and businesses are often better rewarded when they are part of a coherent picture of change around which there can be a sense of identity and, in time, reputation.

The Lake District can become known as a 'carbon-careful' destination and this image chimes well with its intrinsic beauty. The Lake District is place that many people come to be refreshed and inspired. And for most, the Park's attraction will be enhanced by a reputation as an exemplar of lower carbon life. The area lends itself to longer stays, less dependent on daily car travel and more on activities that make the most of the unique surroundings. Furthermore, any diversion of expenditure from fuel to leisure will almost certainly feed better into the local economy. The opportunity, therefore, is to reduce the carbon, enhance the economy and improve quality of life.

5.4 A process from here

We outline here a simple process by which the carbon budget might be defined and managed in such a way as to accommodate stakeholder interests and maximise the value of the Park.

- **Agree a carbon budget** defined as percentage reduction over a set time period. We propose 1% reduction per year as being consistent with local measures supporting a reduction in line with UK targets for direct emissions. The budget should be normalised against visitor days and the resident population.
- **Acknowledge the breadth of other interests** from all stakeholders, including sustainability and other economic criteria. Capture these and bring them transparently into the decision making process. In this way any trade-off decisions can be explicitly explored.
- **Produce a list of strategic options** that take account of the sense of scale offered in this report as well as other criteria, which can be refined into an action plan, consistent with the budget whilst accommodating all stakeholder interests.
- **Develop action options capable** of delivering the budget whilst maximising value added to the Park across the range of criteria.
- **Develop simple success measures** The process used to estimate the carbon footprint of the Park has relied on extrapolations from top-down models and other data sets that, whilst chosen as offering the based route to a baseline estimate, will not, on the whole reflect the impact of mitigation actions. It will therefore be essential to develop a simple ways of estimating the effectiveness of actions and algorithms linking these to emission reductions.
- **Select actions** to accommodate stakeholder needs and aspirations in line with the carbon budget, and maximising the value of the Park.
- **Implement actions.**
- **Estimate performance against budget** by routinely assessing the impact of actions.

6 Appendix A: Methodology

6.1 The 'footprint' of consumption

Whilst the term 'footprint' is used in various ways, we are using it to mean the sum of the direct emissions and the indirect emissions that arise throughout supply chains of activities and products. The inclusive treatment of supply chain emissions, as presented here, differs from more standard 'production-based' emissions assessments but gives a more complete and realistic view of impacts of final consumption.

As an example, emissions resulting from the purchase of goods by residents and visitors would not feature in a production based emissions assessment, since all the emissions take place in the supply chains of the products rather than at the point of purchase. To give another example, in a consumption based assessment, the footprint of travel includes, on top of the direct vehicle emissions, those resulting from the extraction, shipping, refining and distribution of fuel, emissions resulting from the manufacture and maintenance of vehicles, and so on. Thus, in the case of car travel the final figure is typically around double that of the exhaust pipe emissions. In a third example, the footprint of electricity consumption includes components for the emissions associated with fossil fuel extraction, shipping, refining and transport to power stations, as well as those resulting from the electricity generation process itself. It is worth noting that the supply chain components are not included in standard conversion factors issued in Defra's *'Guidelines for Company Reporting on GHG Emissions'* (2009).

6.2 Boundaries of the study

The following is within the scope of this study:

- all residents personal travel and visitor travel to, from and around the park,
- fuel and electricity consumed in homes and places to stay,
- emissions from food and drink and other purchased items,
- the supply chains of all the above (e.g. fuel supply chains and embodied emissions)

The following is specifically excluded:

- Business emissions including business travel (except in so far as the business output is consumed by residents and visitors),
- bespoke treatment of impacts of land-use in the specific circumstances of the Park.

6.3 Inclusion of the Kyoto Greenhouse Gases

This assessment considers the basket of gases that is covered in the Kyoto Protocol, expressed in terms of carbon dioxide equivalent (CO_2e), the sum of the weights of each gas emitted multiplied by their global warming potential (GWP) relative to carbon dioxide over a 100 year period.

6.4 GHG Protocol guidelines

We have followed the reporting principles of the *'GHG Protocol'* (GGP) published by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI) (Ranganathan *et al,* 2006).

The GGP provides a choice of three scopes for emissions reporting. Scope 1 covers direct emissions from company-owned vehicles and facilities. Scope 2 includes net emissions from energy imports and exports, such as electricity. Scope 3 includes other indirect emissions resulting from company activities, as detailed by the boundaries of the study. This report includes all Scope 1 and 2 emissions and comprehensive treatment

of Scope 3 emissions throughout supply chains of activities and purchases within the boundaries laid out above.

6.5 Treatment of high-altitude emissions

High-altitude emissions from aircraft are known to have a higher global warming impact than would be caused by burning the equivalent fuel at ground level. Although the science of this is still poorly understood, this study has applied an emissions weighting factor of 1.9 to aircraft emissions, to take this into account. This is the figure suggested in Defra (2009) *'Guidelines for Company Reporting on GHG Emissions'*. The figure can also be inferred from the Intergovernmental Panel on Climate Change's Fourth Assessment Review (IPCC 2007).

6.6 Reporting approach

The start point for this work is a model of GHG emissions per capita from UK consumption. For this we used an environmental input–output model (EIO) based on 2007 ONS combined use tables and UK environmental accounts. The specific model used was developed by Small World Consulting with Lancaster University (see below). The categorisation of emissions into 124 consumption categories was simplified into a 14 category model.

An estimate of the average visitor population (coincidentally, almost identical to the total number of residents; 42,000) was derived from the Cumbria Tourism 2009 Visitor Survey figures for UK and overseas visitors numbers and visitor days .

In the first instance the GHG footprint of consumption by residents and visitors whilst in the LDNP was obtained simply by multiplying average populations of each by the UK per capita consumption footprint estimates.

6.7 Environmental Input–Output analysis (EIO)

EIO combines economic information about the trade between industrial sectors with environmental information about the emissions arising directly from those sectors to produce estimates of the emissions per unit of output from each sector. The central technique is well established and documented (for example Leontief, 1986; Miller & Blair 1985, 2009). In the UK, the main data sources are the *'Combined Supply and Use Matrix for 123 sectors'* and the *'UK environmental accounts'* (ONS, 2009a; ONS, 2009b), both provided by the Office of National Statistics (ONS).

The specific model used for this project was developed by Small World Consulting with Lancaster University. This model takes account of such factors as the impact of high altitude emissions that are not factored into the environmental accounts and the effect of imports. We have also used price indices to take account of changes in the economy in the time lags that occur in the production of ONS data. In order to use more up to date (2007 rather than 1995) data, we have employed a simple algorithm for converting between basic and purchasers prices.

Three main advantages of EIO over more traditional process-based life-cycle analysis (LCA) approaches to GHG footprinting are worth noting:

EIO attributes all the emissions in the economy to final consumption. Although, as with process-based LCA, there may be inaccuracies in the ways in which it does this, it does not suffer from the systematic underestimation (truncation error) that process-based LCAs incur through their inability to trace every pathway in the supply chains (Lenzen, 2001; Nässén *et al,* 2007).

EIO has at its root a transparently impartial process for the calculation of emissions factors per unit of expenditure, whereas process-based LCA approaches entail subjective judgements over the setting of boundaries and the selection of secondary conversion factors.

Through EIO, it is possible to make estimates of the footprints resulting from complex activities such as the purchase of intangible services that LCAs struggle to take into account.

One of the limitations of EIO in its most basic form is that it assumes that the demands placed upon (and therefore the direct emissions from) other sectors by a unit of output within one sector are homogeneous. As an example, a basic EIO model does not take account of the carbon efficiencies that may arise from switching the expenditure on paper from a virgin source to a renewable source without reducing the actual spend. In this report, the carbon intensity per unit turnover of, for example, the hotels, pubs and catering establishments of the LDNP are assumed to be 'UK typical'. It is possible, with additional resource, to make bespoke adjustments to these generalities given relevant local data and a defendable basis for relating that data to emissions. A further assumption in the model used here is that goods from overseas are produced with the same carbon efficiency as they would have been in the UK. Overall, this assumption usually results in an underestimation of the footprint of purchased goods. A further omission for this and all EIO models that we are aware of is that the impact of land-use change around the world has not been taken into account. This would be likely to result in an increased assessment of the footprint of foods, especially animal products[11].

6.8 Adjustments based on bespoke national and local data

The result based on EIO and UK averages was then adjusted to take account of key differences in consumption patterns for both visitors and residents from the UK average, wherever available data provided a reasonable basis for doing so. Estimates were also added for visitor travel to and from the Park. Specifically, the following adjustments were made.

Visitor travel to and from the LDNP was estimated from data from Cumbria Tourism's 2009 *'Visitor Survey'* and 2010 *'International Visitor Survey'*. They gave the following data:

- Travel modes to and from the park by overseas visitors, day visitors and UK staying visitors
- Proportions of overseas visitors from different countries and sufficient information about the split between travel modes getting to and from the Park to allow a tolerable estimation of the all overseas visitor miles by different modes to and from the Park. (Distances from each country from Webflyer.com)
- Proportions of UK visitors from each UK region (allowing journey miles to be plotted using data from AA journey planner website).

In the case of overseas visitors, estimates of time spend in the Park were divided by estimates of the length of overseas visitor trips to give the proportion of each journey to the UK that should allocated to the Park visit. ONS Travel and Tourism data (ONS 2009b) gave information leading to estimates of the average length of stay in the UK by visitors from different parts of the world (Europe, North America and 'Other') and estimates of the lengths of stay in the park came from the Cumbria Tourism visitor surveys.

[11] 'How Low Can We Go?', WWF, 2010 estimates that emissions from red meat production outside Europe rises by a factor around five when land-use change is taken into account.

Residents' electricity and domestic fuel consumption. The per capita figures were scaled up from the UK average, using comparative data on actual consumption from NPA emissions estimates (2006), back-worked to consumption figures using Defra 2007 conversion factors and GB consumption data from the *'Sub-National Energy Consumption Statistics'* (DECC 2008).

Visitor travel around the park. This was estimated in two ways. Firstly, an estimate of total emissions from fuel transport in the Park was taken from 2006 National Park emissions data and the split between modes taken from the LDNPA's 2010 estimates of transport emissions to arrive at a figure for direct emissions from private vehicle use. Secondly, data on visitor spend per person on transport and primary modes used (both from 2009 *'Cumbria Tourism Visitor Survey'*) were combined with estimates of the costs of different modes (based on web research for real journeys in the Park and assuming UK typical car efficiency and £1.00 per litre for petrol in 2009) to achieve an estimate of the spend on different transport modes. The two approaches reassuringly concurred to within 5% and the latter was adopted.

Residents' travel was calculated using the LDNPA's (2010) estimates of the proportion of road emissions attributable to residents and multiplying this by the estimate of total direct emissions from road transport in the Park (NPA 2006 data – see above). The result is 1.9 times the UK average figure derived through EIO analysis. This does not seem surprising given the rural nature of the community. The figure was sense checked against data on Cumbria's direct emissions from personal road transport compared to the GB average as reported in the Sub-National Energy Consumption Statistics (DECC 2008). The figure for Cumbria was 50% higher than the GB average and since the Park is even more rural than Cumbria which is itself more rural than the UK average; the two sets of figures are reassuringly consistent provided we are correct to assume that rural communities are indeed associated with higher per capita transport emissions.

Accommodation, food, drink, leisure and recreation activities, and other purchased items were estimated from expenditure, using data from the Cumbria Tourism visitor surveys. The UK per capita average spend was assumed for residents, although it might have been reasonable to make adjustments using affluence data.

Depreciation and maintenance of cars. Emissions from this have been assumed to be in the same proportion to vehicle fuel consumption as is the case nationally.

Visitors not buying certain items. Some types of goods were assumed not to be bought or directly depreciated by Park visitors. These included, for example, domestic appliances and power tools.

6.9 Other Emissions Factors.

Where consumption estimates were based upon expenditure, the carbon intensity of activities and purchases have been taken from the EIO model.

Where emissions estimates have been based upon physical consumption, the direct components associated with fuel combustion, from electricity generation and from most transport have been calculated using conversion factors provided by Defra in their *'Guidelines for Reporting on GHG* Emissions' (2009). However, the Defra figures do not take account of supply chain emissions other than those produced at the point of electricity generation, and these need to be considered separately and we have referred, again to the EIO model.

6.10 Data Sources

The main sources are listed in Appendix C.

6.11 Uncertainties

The complexity of supply chains and the difficulties in obtaining accurate data dictate that footprinting can only offer a best estimate rather than an exact measure, and the figures in this report should be viewed in that context. We have operated from the principle that it is more informative to make best estimates of even the most poorly understood components of the footprint, and to discuss the uncertainty openly, than to omit them from the analysis.

Overall, the results in this report should be viewed as offering a broad guide to the size and relative significance of different components.

6.11.1 Uncertainties over data

Sources of error were numerous but the largest are thought to be as follows. Much of the data was drawn from visitor surveys, in which responses may have been systematically inaccurate, the sample group not fully representative and sample sizes were not always ideal. Estimates of direct emissions within the Park, supplied by the National Park Authority, are based on a series of assumptions. As this report neared completion a new estimate of visitor days for 2009 was made, and the figure is around 50% higher than that used throughout this report.

6.11.2 Uncertainties over conversion factors

The areas in which the relationship between consumption and footprints is best understood are gas and electricity consumption. There is relatively good consensus over conversion factors to within around 5% in these areas. The next most certain group of conversion factors are those for travel and transport. In this category, there is uncertainty over the impact of high altitude emissions and the embodied emissions in the manufacture and maintenance of vehicles, roads and other infrastructure.

Supplies and services are the areas of greatest uncertainty. As an example, credible process based life cycle analyses of a particular specification of paper typically differ by factors of around 50% depending on the specific practices employed in the particular mill in which it was manufactured. It would also be possible for two detailed studies of exactly the same process to arrive at significantly different estimates, depending on the precise assumptions made. The EIO approach that we have adopted overcomes the truncation error that process-based approaches incur, but does suffers its own series of problems, most notably errors of generalisation – the failure to look at the particular circumstances of a supply chain rather than an industry average.

7 Appendix B: Repeating the process elsewhere

Within resource constraints, this work has been carried out in such a way as to make the process both repeatable elsewhere and improvable, building upon this work. The advantages of repeating the exercise elsewhere using the models already created through this project would be efficiency (the re-use of effort already expended) and, given the commonality of method, the ability to make direct comparisons with the Lake District.

Our approach has been to derive a 'first impression' using a 'top down' input output model and to refine this estimate by substituting impact estimates in key areas, using a mix of national and sub-national datasets, nationally recognised emissions factors, local data and a few defendable algorithms for linking the available data to estimates of consumption.

To repeat the process for another location will require putting local data into the model.

Estimating the GHG footprint of residents

In the first instance, the impact of residents in another location could be estimated, by simply putting the following data into the existing model.

- The population
- Fuel and electricity consumption data
- If possible, a reasoned basis for estimating use of different forms of public and private transport, either in absolute terms or by comparison with the UK average.

It is possible to take account of other per capita differences from the UK norm, provided relevant and reliable data can be found. Ideally a future exercise would reflect specific characteristics of the local population not otherwise reflected. (To give one simple example, it may be desirable to include affluence data into the analysis, and this is an area for potential development).

Estimating the footprint of visitors.

At its simplest, the impact of visitor travel to and from any area can be repeated using the modelling undertaken here provided there is adequate information about visitor numbers, lengths of stay, places of origin and travel models. The quality of the result will clearly depend on the quality of the data.

The impact of visitors whilst in the area is perhaps the most difficult to estimate, because it depends hard-to-obtain knowledge about what people do and buy on their trip as distinct from in their normal lives. The models created by this project will make it relatively easy to make use of the best available data, once it has been identified. In the absence of any defendable data, various simple assumptions could be made about visitor lifestyles.

Refining the model

In the future it is straightforward to use improved input-output data if it becomes available (perhaps from a multi-regional model or one that factors in land-use change), to refine specific modelling assumptions documented in this report and to use updated and additional national, sub-national and local data.

8 Appendix C: Main data sources and references

Cumbria Tourism, 2009 Visitor Survey	Visitor expenditure breakdowns, travel modes, regions of origin, lengths of stay and proportion from overseas.	http://www.cumbriatourism.org/research/
Cumbria Tourism, 2010, International Visitor Survey	Overseas visitor countries of origins and lengths of stay, daily expenditure breakdowns and travel modes.	http://www.cumbriatourism.org/research/
Cumbria Tourism 2008, 'Tourism Volume and Value 2000 – 2008', (Produced by 'STEAM' 2008)	Tourism revenue figures for Cumbria and LDNP. Visitor numbers and visitor days.	http://www.cumbriatourism.org/research/
Defra/ DECC 2010. 'Guidelines for Company Reporting on GHG Emissions.'	Direct emissions factors for transport and energy.	http://www.defra.gov.uk/environment/
Defra 2007. 'Guidelines for Company Reporting on GHG Emissions.'	Direct emissions factors for transport and energy – used to back-work consumption figures from emissions 2006 estimates for the Park.	
Lake District National Park Authority (2010) 'Where's the Carbon?' Summary Findings.	The proportion of road emissions attributable to residents.	
Lenzen, M., 2001. Errors in Conventional and Input-Output-based Life-Cycle Inventories. *Journal of Industrial Ecology,* 4(4):127-148		
Leontief, W., 1986. *Input-Output Economics (2nd ed).* New York: Oxford University Press		
Miller, R.E. and Blair, P.D., 1985, 2009. *Input-Output Analysis: Foundations and Extensions.* Englewood Cliffs, NJ: Prentice Hall.		

Northwest Development Agency Cumbria Market and Destination Profile.	Tourism revenue figures for Cumbria and LDNP.	
National Parks Authority, 2010. *CO2 emission estimates, sector and fuel details for the National Parks (revised)*. (Data for 2006)	Carbon emissions from electricity energy consumption. Population of the LDNP	Circulated by Becky Willis. Supplied to NDA by AEA Technology
Office of National Statistics, 2009a. *Input Output Supply and Use tables, 2007.*	UK Environmental Input Output Analysis	http://www.statistics.gov.uk/about/methodology_by_theme/inputoutput/latestdata.asp
Office of National Statistics, 2009b, Transport Travel and Tourism 1999 - 2008 Overseas Travel & Tourism, Quarter 2 2009. Tables 1 and 6.	Lengths of stay in the UK of visitors from different countries of origin. Used to determine proportion of international travel attributable to the Park visit.	http://www.statistics.gov.uk/downloads/theme_transport/MQ6-Q2-2009.pdf
Office of National Statistics, 2010, Sub National energy consumption statistics for2008.	Used for comparing LDNP and Cumbria consumption per capita with national average.	http://www.decc.gov.uk/en/content/cms/statistics/regional/regional.aspx
Office of National Statistics, 2009b. *Environmental Accounts, Total GHG Emissions by 93 Economic Sectors, 1990 to 2007*.	UK Environmental Input Output Analysis	http://statistics.gov.uk
Ranganathan, J., Corbier, L., Bhatia, P., Schmitz, S., Gage, P. and Oren, K., 2006. *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (revised edition).* Washington, USA: World business council for sustainable development and World Resources Institute.		
UNFCCC, 1998. *Kyoto Protocol to the United Nations Framework Convention on Climate Change.* Kyoto: United Nations		