

Herefordshire's Carbon Emissions: 2005-2007

Scientific Basis

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Data Collection

The majority of data for this report was supplied by the Department for Energy and Climate Change (DECC). All the data from DECC is published online for use and methodologies for how the data were collected are also available. Relevant documents have been highlighted throughout the text. Throughout this report both 2005 data and 2007 data are used. 2005 figures are the baseline figures for setting the targets and monitoring progress.

In 2005 the methods for calculating the emissions data were changed and much improved from previous years. Therefore, data prior to the 2005 figures are not directly and accurately comparable to 2007 figures and are not used.

In this report, all data used are 2007 figures unless stated otherwise.

2008 figures were released in September 2008 and can be accessed on the DECC site at

http://www.decc.gov.uk/assets/decc/Statistics/climate_change/localAuthorityCO2/460-ni186-per-capita-co2-emissions.xls



Herefordshire's Carbon Emissions: Scientific Basis

1.0 Climate Change

Climate change is the result of an increased release in green house gases into the atmosphere. The greenhouse gases (GHGs) affect the radiative forces of the atmosphere, effectively trapping heat from solar radiation thus leading to warming of the troposphere.

Most of the observed increase in global average temperatures since the mid-20th century is **very likely** due to the observed **increase in anthropogenic greenhouse gas concentrations**.

(IPCC, Summary for Policymakers)

Examples of GHGs are Carbon dioxide (CO₂), Methane (CH₄) and Nitrogen oxides (NO_x). Carbon dioxide is currently the most important of the greenhouse gases as it is released in huge quantities from burning fossil fuels and changes in land use. The burning of fossil fuels is the primary cause of the increase in carbon dioxide in the atmosphere. Land use change is a smaller but still significant source of CO₂.

From burning fossil fuels:

- On average from 1960 to 2005 there has been a 1.4ppm increase per year of CO₂ in the atmosphere from burning fossil fuels¹. This is equal to 23.5 billion tonnes of CO₂ being released into the atmosphere every year.
- In recent years, from 1995 to 2005, there has been an average 1.9ppm increase per year of CO₂ in the atmosphere. This means that in 10 years, 264 billion tonnes of CO₂ have been released into the atmosphere.

Herefordshire Partnership signed up to reduce county carbon emissions as part of its Local Area Agreement in April 2008. National Indicators, in this case 186, allow areas to set targets and monitor their performance. Herefordshire Council, the lead organisation for this target, is thus committed to leading the local effort to reduce the county's carbon emissions per person as measured by NI 186 – 'Per capita CO₂ emissions in the LA area'

¹ [Summary for Policymakers](#), IPCC (2007)

2.0 Herefordshire's Changing Climate

Climate change is in no way restricted to developing countries. There will be changes here in Herefordshire too. The UK Climate Projections (UKCP09)² is a modelling programme which maps the changes that may occur in the LA area. The model area is based on 25km squares across the UK.

Herefordshire's climate change modelling results are below. It is possible to choose a Low, Medium or High emissions scenario, explained in detail here: [IPCC emission scenarios](#). A High emissions scenario was chosen for these projections, the likely climate change to be expected if we 'carry on as normal'.

- By 2050, temperature change of the mean daily maximum summer temperature is likely to be greater than a 3°C increase (Appendix A)
- By 2050 it is likely that there will be at least a 10% increase change in precipitation in the winter months (Appendix B)

These model scenarios point towards a warmer summer and a wetter winter. In Herefordshire the summer of 2007 may be an example of what might be to come in the winter months of 2050.

² <http://ukclimateprojections.defra.gov.uk/>

3.0 Herefordshire's Carbon Reduction Targets

Herefordshire has adopted an ambitious Local Area Agreement Target to reduce carbon emissions per head of population across the county by 13.1% in the 3 years from April 2008 to March 2011³.

The total 13.1% reduction requires a reduction of 1.2 tonnes/head from 9.3 tonnes (t) per capita to 8.1 tonnes per capita from energy use in homes, transport and business⁴.

2,000 people unplugging their mobile phone charger when not using it for one month can save one tonne of CO₂. An office of 200 staff all turning their computers off overnight for 10 weeks will also save one tonne of CO₂.

4.9% of this reduction is to be achieved by local measures over which the local authority has an influence, the rest by national measures. Reaching the 4.9% target will require a reduction of 0.5 tonnes CO₂/head from 9.3 tonnes per capita to 8.8 tonnes per capita emissions by the end of the financial year 2010-11.

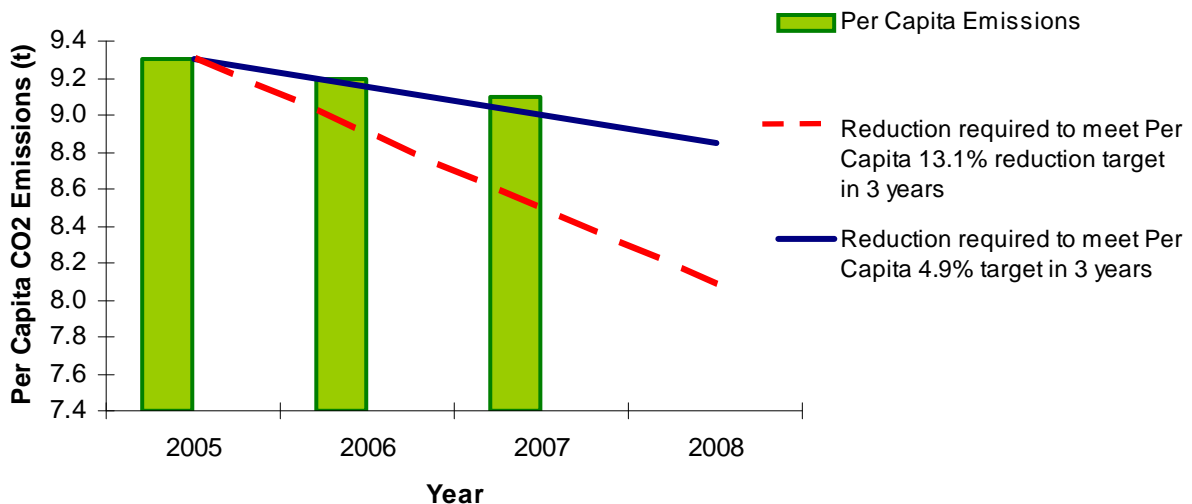


Figure 1. Herefordshire's LAA CO₂ reduction targets

³ Baseline is taken from the 2005 figures (DECC)

⁴ The national data set on which the target is based does not include emissions from livestock or landfill.

4.0 County Carbon Emissions

In 2009, the Department for Energy and Climate Change released data on the CO₂ emissions of each Local Authority Area. The data is split into 4 main sections, Industry and Commercial emissions, Domestic emissions, Transport emission and Land Use, Land Use Change and Forestry emissions (LULUCF), shown in figure 4 below.

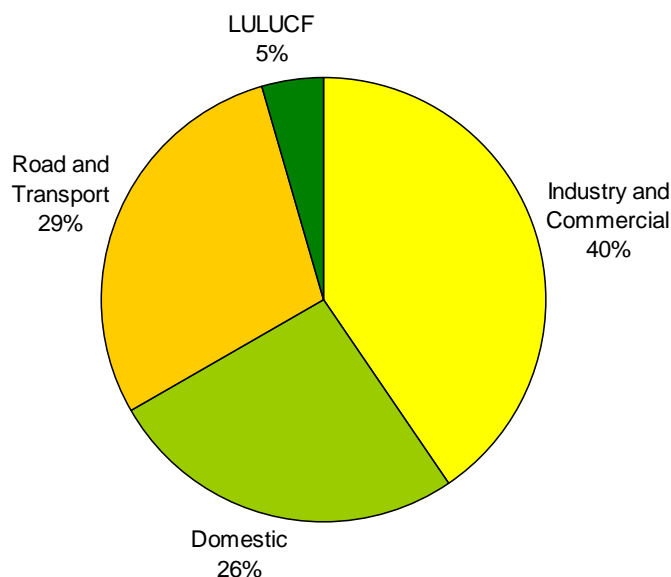


Figure 2. Herefordshire's CO₂ emissions by sector, 2007

In 2005, Herefordshire County produced 1,648,000 tonnes of CO₂.

- This is roughly equivalent to the CO₂ produced from flying **235,428 times** around the world.

In 2005, each person (per head) produced on average 9.3 tonnes of CO₂.

- Roughly, each person in Herefordshire flying **1.3 times** around the world would produce the same amount of CO₂.

The largest amounts of emissions in Herefordshire are released from the Industrial and Commercial sector, representing 40% of Herefordshire's total emissions. Emissions from road and transport follow, these includes emissions from both personal and freight transport.

The LULUCF (Land Use, Land Use Change and Forestry) sector contains all the emissions released into and removed from the atmosphere from land, soil and vegetation. Land use change could be from grassland to urban areas or from forest land to cropland. This is further explained in section 5.4.

4.1 Per Capita emissions

The NI 186 targets are set, and assessed, on per capita emissions for Herefordshire. There has been a decrease in CO₂ emissions by 0.18 tonnes per capita in the period 2005-2007. The reduction could be attributable to the increase in oil prices and/or the increased awareness of climate change.

Figure 3 below is a comparison between Herefordshire's per capita emissions and that of neighbouring counties. In the period 2005-2007, Herefordshire's per capita emissions are the highest in the area.

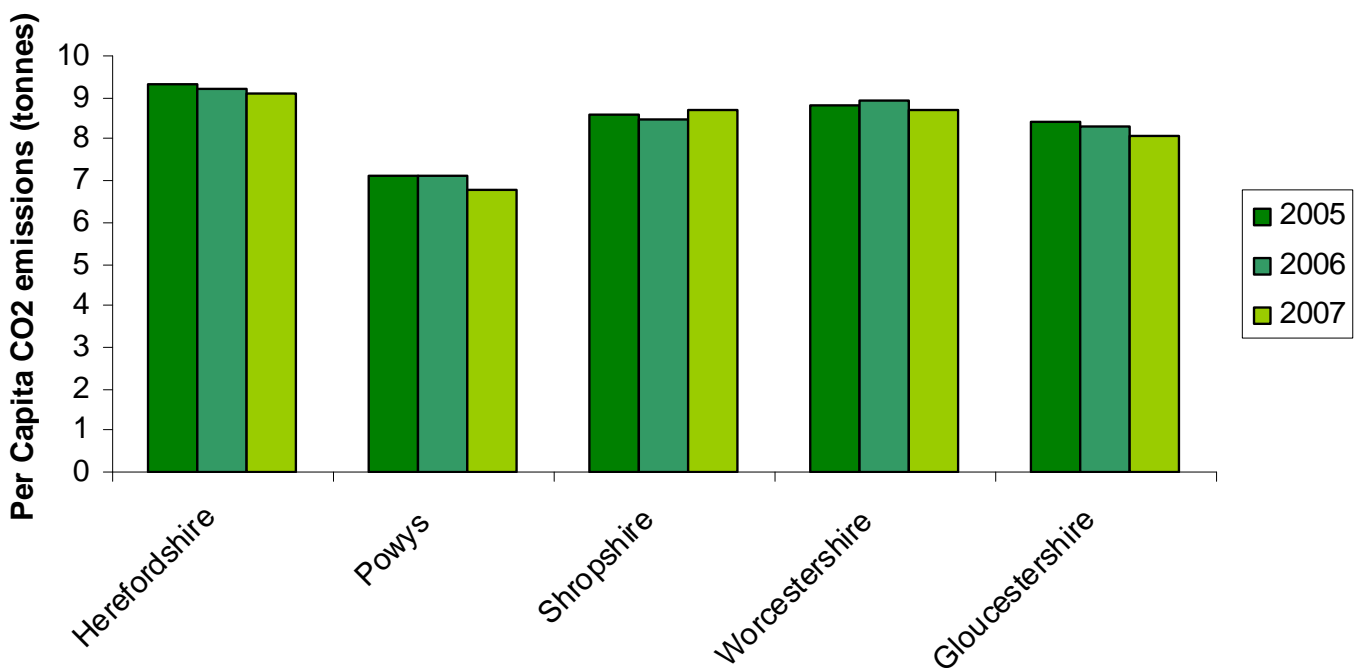


Figure 3. CO₂ emissions of Herefordshire and the surrounding counties

All the counties apart from Shropshire have seen a decrease their per capita emissions from 2005 to 2007. Although there has been a general pattern of a reduction in CO₂ emissions over the three years in Herefordshire, this decrease is not enough to meet the current NI 186 targets (figure 1).

4.2 Trends in county carbon emissions

Trends in Herefordshire's emissions over time may help to provide more evidence on the best ways to reduce carbon emissions across the county.

As already shown in figure 3, the CO₂ emissions in Herefordshire have been decreasing from 2005 to 2007. Table 1 below shows in detail how each sectors' emissions have changed over that period.

Table 1. Herefordshire's emissions over a 3 year period (CO₂ emissions Ktonnes)⁵

Year	Industry and Commercial	Domestic	Road and transport	LULUCF	Total	Per Capita emissions (tonnes)
2005	674	438	471	64	1,648	9.3
2006	671	440	460	71	1,641	9.2
2007	658	426	467	74	1,626	9.1

(DECC, 2010)

There has been a decrease in emissions both nationally and in Herefordshire. Herefordshire's emissions from homes and transport have fallen faster than the national average from 2005-2007 shown in table 2 below. However, emissions from industry and overall emissions have fallen less rapidly than the national average.

Table 2. Percentage change in emissions from 2005 to 2007 of Herefordshire compared to the National Average

Percentage change in emissions between 2005 and 2007	National Average	Herefordshire
Domestic Emissions	-2.4%	-2.6%
Industrial and Commercial	-2.7%	-2.4%
Road and transport	-0.7%	-0.9%
Total Emissions	-2.1%	-1.4%

(DECC, 2010)

Greatest percentage decrease of CO₂ emissions – Domestic sector, 2.6%

Greatest weight decrease of CO₂ emissions – Industry and Commercial sector, 16.33 Kt CO₂

(Equivalent to the CO₂ saved if, in one year, 4409 companies (500 m² floor area) turned their heating down by 1° C

⁵ Data can be found at [Local and regional CO₂ emissions estimates for 2005-2007 for the UK](#)

5.0 Herefordshire Emissions Breakdown

Following the initial breakdown of the data into sectors, each sector contains information on a more detailed scale. More information is provided on where the emissions in each sector have come from.

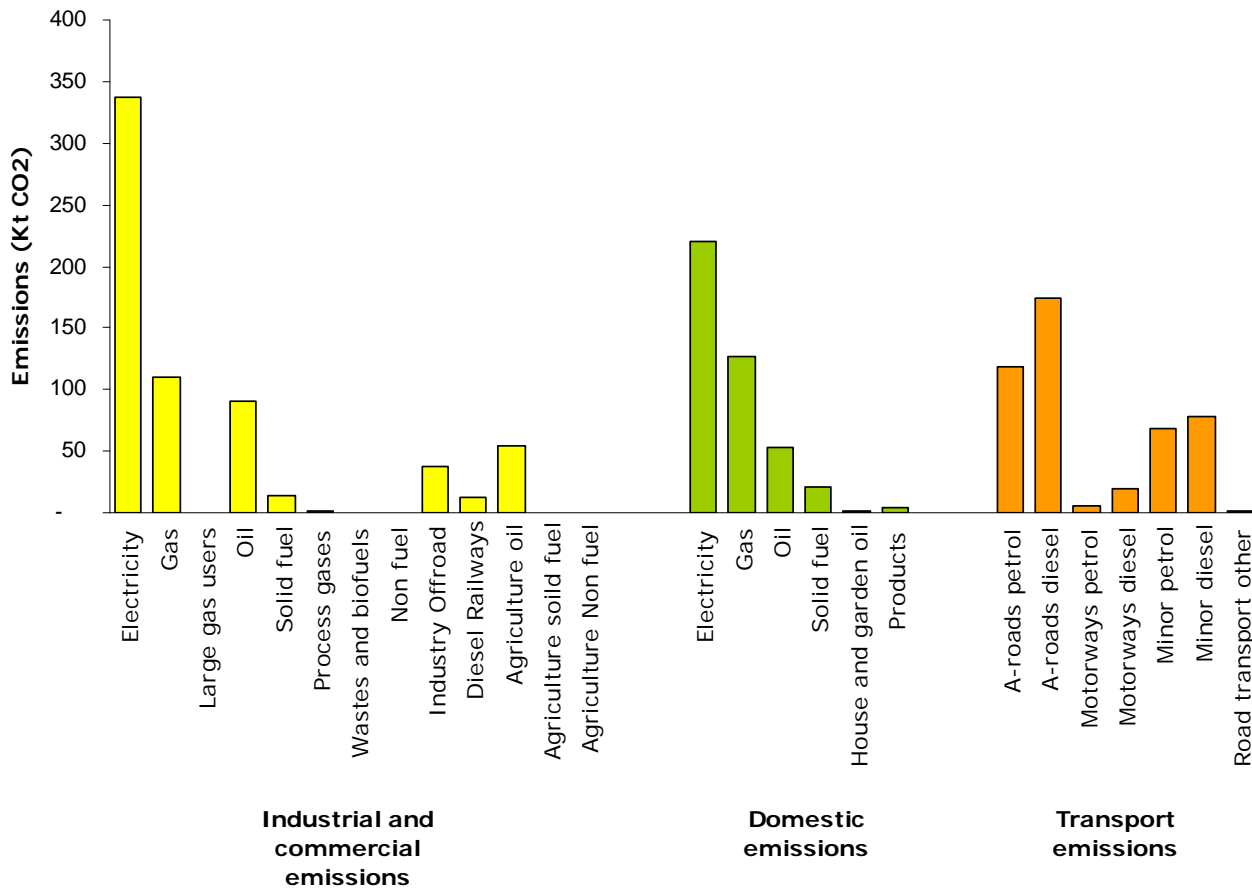


Figure 4. CO₂ emissions by source in 2007

More information on the 4 main sectors and the detailed breakdowns are provided in the following sections and the data is shown in tables 4-7.

A methodology describing how the amounts of emissions in each sector were calculated can be found here – [Local Authority CO₂ emissions estimates 2007: methodology summary](#).

In both the Industry and Commercial sector and the Domestic sector, CO₂ emissions from **electricity** represent 50% of the emissions.

5.1 Industrial and Commercial Emissions

The CO₂ from industrial and commercial sources was split into fuel sources, the figures are shown in table 4 on the next page.

Electricity use is the greatest source of CO₂ in the industry and commercial sector, responsible for half of the sector's emissions. It is also the only fuel type to increase its emissions over the 3 years from 2005-2007. The other fuel sources all show a reduction in emissions during that time.

The greatest percentage reduction was seen in oil use. Emissions in 2007 were 15.7% lower than in 2005. Industrial and commercial oil also provided the lowest reduction of CO₂ by weight, 17.4 Kt CO₂ over the 3 years.

Large industrial CO₂ emitters

The Environmental Agency (EA) regulates some industrial and commercial sites under the Environmental Permitting Regulations. These are businesses with the potential for releasing emissions that are potentially damaging to health and therefore need air quality controls. In terms of air pollution, high levels of Carbon dioxide, Dioxins, Nitrogen oxides, Particulates, and Sulphur oxide emissions are all regulated.

A tool on the EA website⁶ produces a map highlighting and identifying the regulated businesses - 'What's in Your Backyard?', an example of which is shown in figure 5. In Herefordshire, three industrial and commercial sites were identified as large CO₂ polluters, each producing over 10,000 tonnes of CO₂ per year (table 3)

Table 3. Herefordshire's top industrial and commercial CO₂ emitters

Operator	Site	CO ₂ emissions (tonnes)			
		2005	2006	2007	2008
Cadbury Ltd	Marlbrook		22,000	22,000	26,600
Cory Environmental (Central) Ltd	Himley Quarry Landfill	10,500	13,000		25,100
Dalkia Utilities Services Plc	Hereford		20,683	20,809	19,240

EA (2010)

⁶Environmental Agency air pollution map - ['What's in your Backyard?'](#)

The EA also regulates businesses in Herefordshire where the emissions are not high enough for the exact amount of emissions to be monitored. The levels of emissions are still regulated, and are therefore still thought to be a risk to health and the environment. Three regulated business classed as producing <10,000 tonnes of CO₂ per year were identified in Herefordshire (shown below).

- Brintons Ltd., Site No. 6,
- Cargill Meats Europe Sun Valley Foods Ltd.
- Dwr Cymru Cyfyngedig Ltd.
(2 sites)

Several poultry and intensive farming sites in Herefordshire have been identified under the Environment Agency (EA) air pollution regulations. These sites are being monitored for their NO_x emissions however not their CO₂ emissions.



Figure 5. Map of the locations of Herefordshire's top CO₂ polluters identified by the EA 'What's in Your

NO_x is an indirect greenhouse gas⁷. When NO_x gases react with U.V. light tropospheric ozone is formed which is a potential greenhouse gas. NO_x gases are also able to react with a variety of other molecules in the air which could create gas molecules capable of increasing the atmosphere's greenhouse potential.

In the county of Herefordshire, 55 poultry farms or intensive farming sites were registered in 2010. Individually, none of these businesses emit more than 100kg NO_x each, though the combined emissions could total up to 5.5 tonnes NO_x.

The emissions of NO_x gases are not included in NI 186, which only includes CO₂ and not other greenhouse gases. It would be useful in the future to undertake an assessment of emissions from livestock and farming as they may contribute a large amount of CO₂ and greenhouse gases to Herefordshire's total emissions.

⁷NO_x gas - <http://www.epa.gov/climatechange/emissions/downloads09/InventoryUSGhG1990-2007.pdf>

Industrial emissions

Table 4. Breakdown of Herefordshire's Industry and Commercial CO₂ emissions (Ktonnes)

Year	Electricity	Gas	Large gas users	Oil	Solid fuel	Process gases	Wastes and bio-fuels	Non fuel	Industry Off-road	Diesel Railways	Agriculture oil	Agriculture solid fuel	Agriculture Non fuel	Total
2005	315	125	-	108	14	1	1	-	37	13	60	-	-	674
2006	346	114	-	86	17	1	1	0	37	13	57	-	-	671
2007	337	110	-	91	14	1	1	0	37	13	54	-	-	658

Domestic emissions

Table 5. Breakdown of Herefordshire's domestic CO₂ emissions (Ktonnes)

Year	Electricity	Gas	Oil	Solid fuel	House and garden oil	Products	Total
2005	213	137	60	22	1	5	438
2006	219	134	62	20	1	5	440
2007	220	127	53	21	1	5	426

Transport

Table 6. Breakdown of Herefordshire's transport CO₂ emissions (Ktonnes)

Year	A-road petrol	A-road diesel	Motorway petrol	Motorway diesel	Minor road petrol	Minor road diesel	Road transport other	Total
2005	131	166	7	20	73	72	2	471
2006	124	166	6	19	69	74	2	460
2007	118	174	6	19	69	79	2	467

LULUCF emissions

Table 7. Breakdown of Herefordshire's Land Use, Land Use Change and Forestry CO₂ emissions (Ktonnes)

Year	Emission soils and deforestation	Emissions other	Removals	Total
2005	13	222	171	64
2006	14	223	166	71
2007	13	223	162	74

5.2 Domestic Emissions

The domestic sector emissions breakdown can be found in table 5.

Figure 6 below shows the differences between fuel use in Herefordshire and in the West Midlands as an average. There is a much greater use of electricity, oil and solid fuel in Herefordshire compared to the West Midlands area. These alternative fuels are used in the large areas in the county where homes are not connected to the gas network. The majority of homes in urban areas in the West Midlands have access to gas, therefore solid fuel and oil are not needed for heating providing a lower percentage of the domestic emissions.

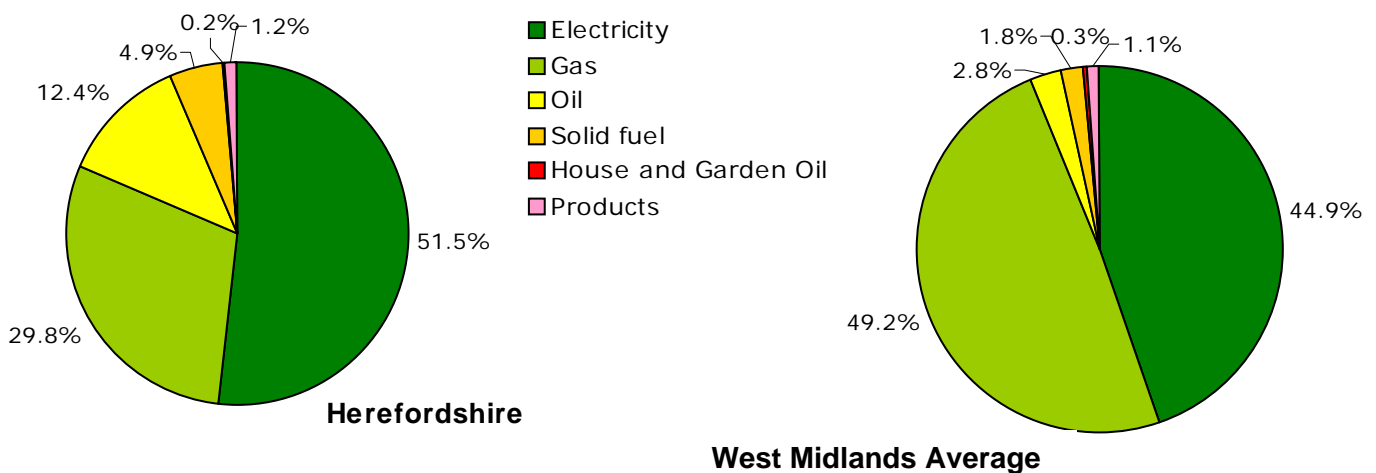


Figure 6. A comparison between Herefordshire's domestic emissions and the West Midlands' average.

From 2005 to 2007 there has been a decrease in CO₂ emissions from the domestic sector. The largest percentage decrease in the Domestic sector came from a reduction in Domestic oil use (11.76% decrease, saving 7 KtCO₂). The largest reduction of CO₂ emissions by weight in the Domestic sector came from Domestic gas where a reduction of 10.01 Kt CO₂ was observed.

The amount of CO₂ produced from domestic electricity use increased by 7 Kt CO₂ from 2005 to 2007. The sales of small domestic electrical appliances have been increasing year on year⁸. From 2005 to 2006 there was an increase of 2.7% in sales in the UK. Increased sales of electrical items may be increasing electricity use in the home, and the increase is forecast to continue.

⁸Information on the UK small domestic electrical appliance market - www.researchandmarkets.net/.../small_domestic_electrical_appliances_market.pdf

5.3 Transport emissions

The CO₂ emissions from transport are calculated by recording the vehicle types and number of vehicles passing monitoring points on major trunk roads in the LA area⁹. A map of these monitoring points for the year 2008 can be found at the end of the document (Appendix C)

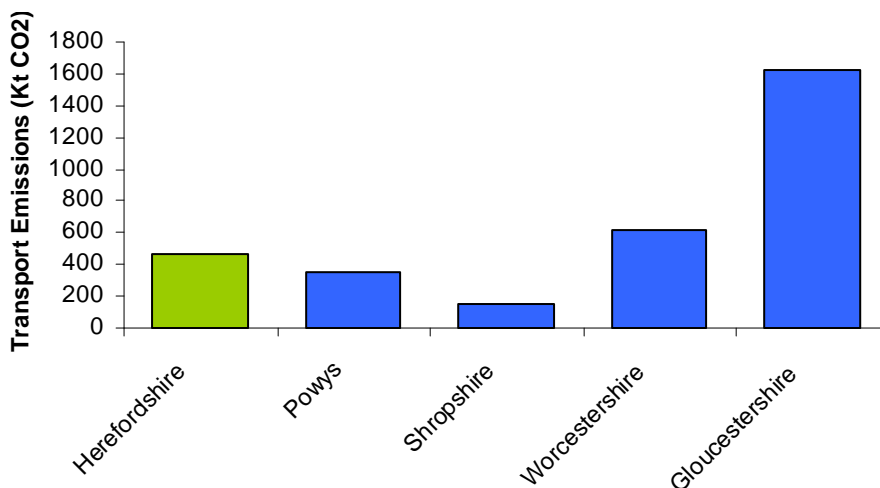


Figure 7. Transport sector total CO₂ emissions, 2007

In terms of total emissions (figure 7), Herefordshire has relatively low amount of CO₂ emitted by transport in comparison to neighbouring Gloucestershire. However it should be taken into account that Worcestershire and Gloucester especially are bisected by the M5, a major motorway connecting Bristol and Birmingham and is used by commuters from the West Midlands travelling to Birmingham. Although motorways are excluded from NI186 their presence influences mileage driven on the wider network by commuters. This may partly explain the high level of emissions in Worcestershire and Gloucestershire. Herefordshire has a short stretch of motorway in the south east area of the county, the M50, however, as shown in figure 9, use of the motorway accounts for a very low level of Herefordshire's CO₂ emissions.

When the transport emissions are shown per capita, as in figure 8, the CO₂ emissions in Worcestershire, Gloucestershire and Herefordshire become more even.

⁹ See Methodology for more information - [Local Authority CO₂ emissions estimates 2007: methodology summary](#)

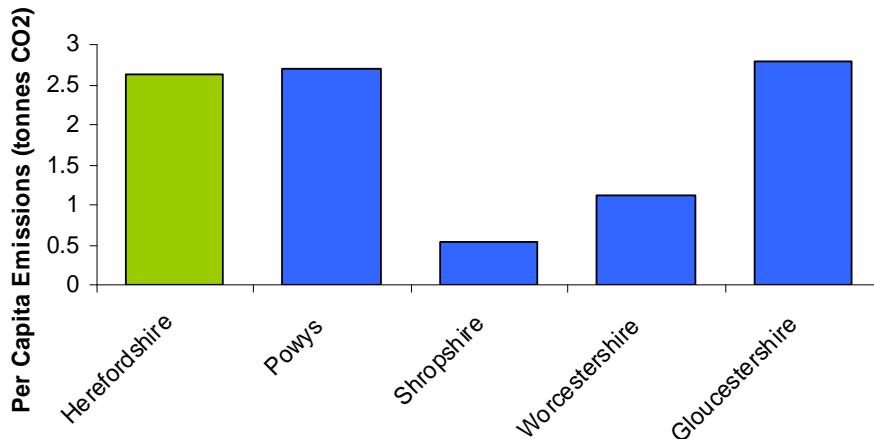


Figure 8. Transport sector Per Capita CO₂ emissions, 2007

This indicates that although there is a lower population in the County in comparison to Gloucestershire and Worcestershire, there are a lot of journeys made, or longer journeys made. Powys is a very rural LA, not unlike Herefordshire, and the high per capita emissions are likely to be reflective of the long journeys people have to make to work or for other reasons. There may be a similar pattern in Herefordshire.

A more detailed break down of the transport emissions in Herefordshire show on which road type the highest level of emissions are produced (figure 9).

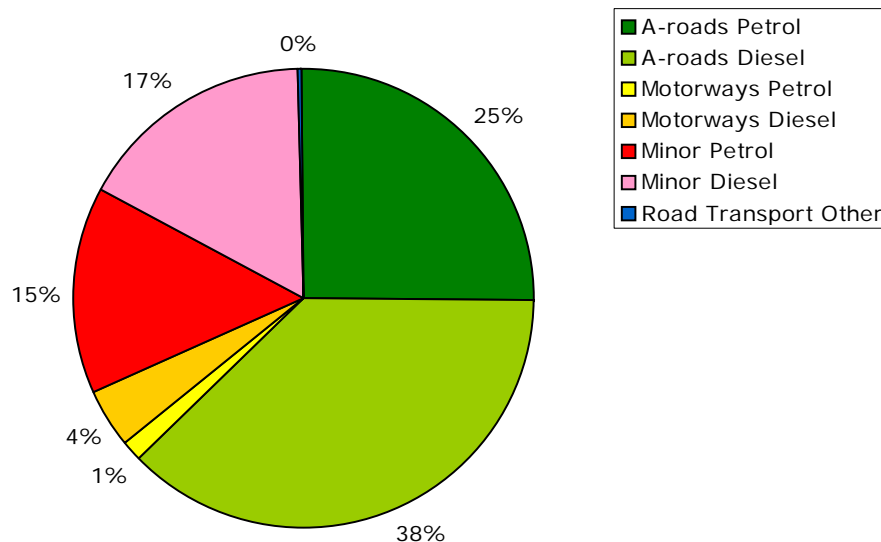


Figure 9. Breakdown of Herefordshire' transport CO₂ emissions

The majority of journeys, 63% of CO₂ emissions, were made on A-roads. This percentage of journeys is almost double the amount of journeys made in the West Midlands as an average (34%). The county of Herefordshire is made up of the central city of Hereford surrounded by a number of market towns, Ledbury,

Leominster, Ross-on-Wye, Bromyard and Kington. Herefordshire has a limited rail network within the county which means that the main option for most people is to travel by car, and the market towns and the city are all connected by A-roads. The majority of jobs in the county are found in the market towns and the city, so those living in rural villages may often need to commute to work.

Motorway travel only accounts for a very small percentage of the transport emissions (5%). The M50 is a relatively new motorway and only covers a short distance in Herefordshire.

It is important to remember that the transport recorded for an area is not all generated within the local authority area in which it was recorded. For example, recorded CO₂ emissions in Herefordshire on the M50 are not only made by those living in Herefordshire; many journeys may be made by people travelling from the Midlands towards South Wales. There also applies nationally and in Worcestershire and in Gloucestershire where many routes are used regularly by long distance commuters.

5.4 LULUCF emissions

Land Use, Land Use Change and Forestry emissions (LULUCF) are based on both the release of CO₂ into the atmosphere, a positive value, and the uptake of CO₂ from the atmosphere, a negative value. There are 4 main land categories by which all the land in the UK is classified, 'Forest land', 'Cropland', 'Grassland' and 'Settlement'. Any land types that cannot be classified under these groups are listed as 'Other', including open water areas, bogs etc.

Carbon dioxide is released from vegetation and soils, where a land category changes, for example, from Forest land to Cropland, to Grassland, to Settlement. CO₂ from the atmosphere can be absorbed by afforestation or the change of settlement land to grassland for example.

The table 10 below lists the main activities contributing to the CO₂ emissions and removals in the UK. They are listed with the major activities at the top.

Table 8. UK CO₂ emissions and removals from LULUCF activities, 2007

LULUCF Activity	2007 UK total CO ₂ (ktonnes) emission (+) or removal (-)
Land converted to Forest land (afforestation)	- 14329.7
Land converted to Cropland (soil)	+ 14075.2
Land converted to Grassland (soil)	- 8727.0
Land converted to Settlements (soil)	+ 6188.1
Harvested wood products	- 1291.8
Cropland remaining Cropland (lowland drainage)	+ 1128.5
Cropland remaining Cropland (yield improvement)	- 639.9
Liming of Cropland	+ 470.1
Grassland remaining Grassland (peat extraction)	+ 430.4
Liming of Grassland	+ 269.7
Land converted to Cropland (other)	+ 243.4
Wildfires on Forest land	+ 166.6
Land converted to Grassland (deforestation to grass)	+ 98.9
Land converted to Settlements (deforestation to settlement)	+ 70.4
Land converted to Settlements (other)	+ 66.8
Land converted to Grassland (other)	- 33.4

A more [detailed report](#) is available on the DECC website, describing in detail the sources of emissions and removals, and graphs showing the LULUCF emissions across the UK.

The LULUCF emissions are broken down into detail where the emissions are shown as well as the removals. Herefordshire's LULUCF emissions are shown in figure 9.

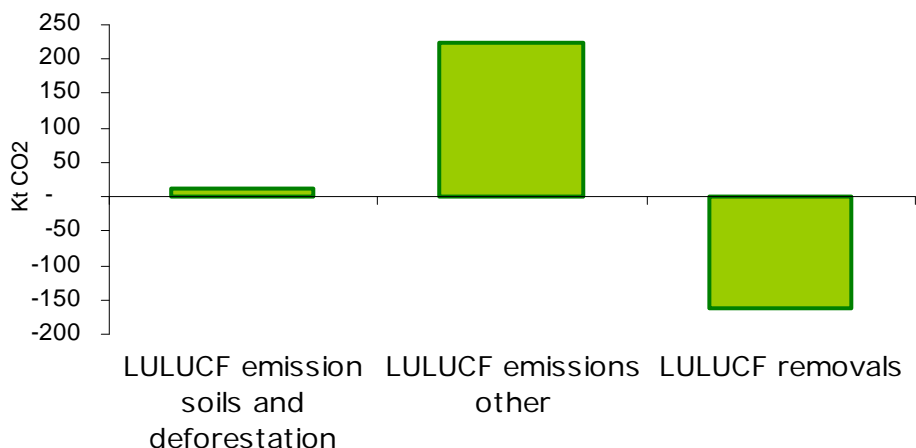


Figure 9. Herefordshire's LULUCF emissions, 2007

Herefordshire has a large farming community and is therefore expected to have a large amount of CO₂ emissions from Land Use, Land Use Change and Forestry. Farming practices such as liming the soil, ploughing and cultivating, as well as land use change from grassland to cropland for example all produce emissions. In this way, Herefordshire is similar to Shropshire (figure 10).

Powys is also a very rural LA. The DECC data shows that Powys has a very similar amount of LULUCF emissions as Herefordshire and all the neighbouring counties, however there is also a very large amount of CO₂ removal within the LA. Over twice as many tonnes of CO₂ are removed in Powys as in each of the other surrounding counties.

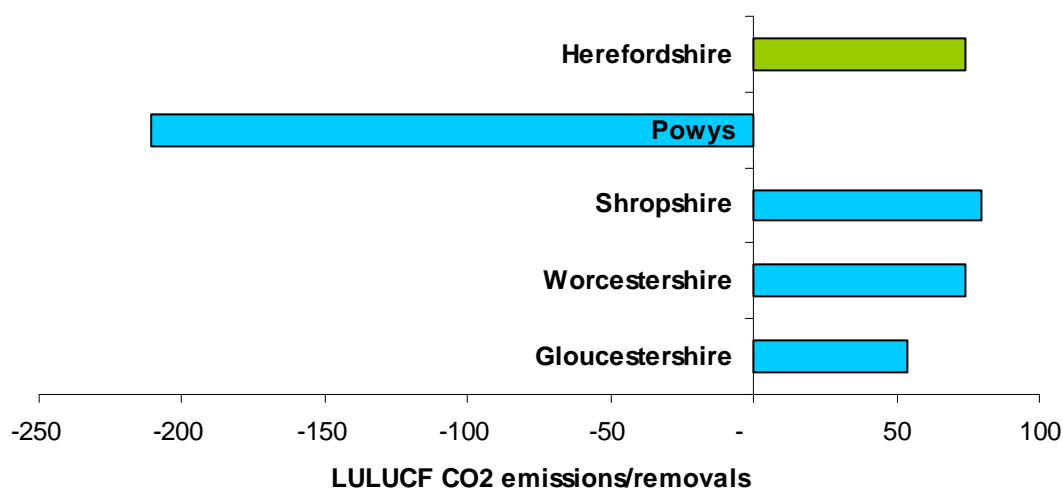


Figure 10. LULUCF emissions of Herefordshire and the surrounding counties, 2007

Summary

Data provided by DECC for the year 2007 is the most up-to-date evidence available for the CO₂ emissions in Herefordshire. They give some indication of the potential levels of CO₂ emissions in more recent years where data is not yet available. 2008 figures are likely to be released in autumn 2010.

Although there appears to be a downward trend in emissions, which can be expected to continue as a result of the recession, the decrease is unlikely to be sufficient to meet current targets.

If CO₂ emissions are not drastically reduced over the next few years there is likely to be a change in Herefordshire's climate (as described in section 2.0 and shown in the appendices). If business continues as usual without substantial reductions in emissions, by 2050 there could be irreversible changes in Herefordshire's climate, affecting food production and other services in the county.

Electricity use is a major contributor in CO₂ emissions in both the Industrial and Commercial sector and the Domestic sector. Changes need to be made to reduce use and /or substitute electrical energy from fossil fuels with a greater proportion from renewable sources. As this is the greatest source of CO₂ emissions, this may be an area where a large reduction could be made.

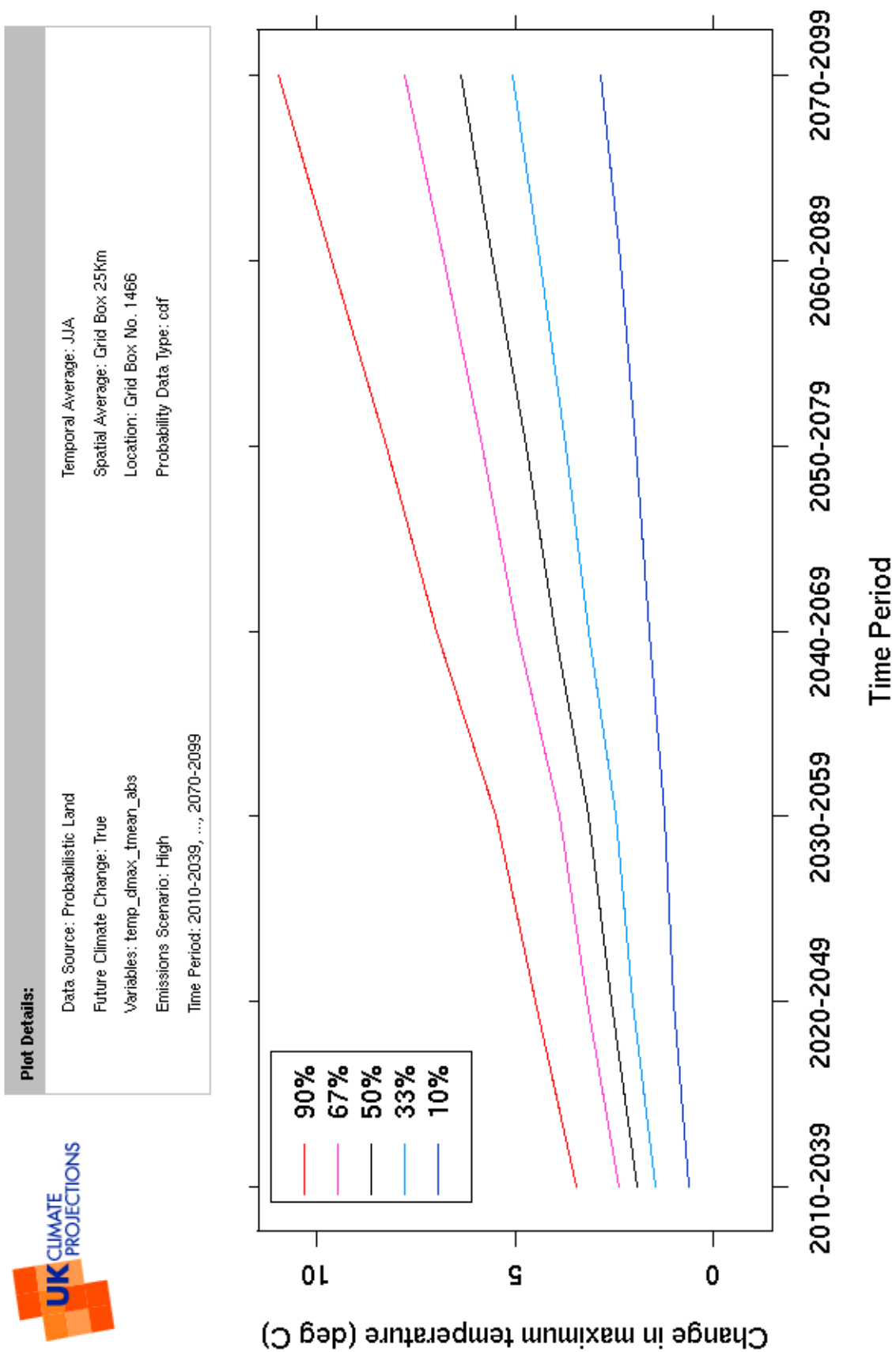
A large proportion of CO₂ emissions released are through personal choice¹⁰. In Herefordshire, domestic heating and electricity use are controlled by individuals, as well as transport use and travel around the county. Behavioural change must lead to a reduction in energy use and a use of alternative renewable energy sources.

Although the data provided by DECC has been improved from pre-2005 data due to changes in data collection, it still should be noted that there are a great number of assumptions made in finalising the figures. More information can be found on the statistics pages of the [DECC website](http://actonco2.direct.gov.uk/home.html). There are revisions and updates of the figures throughout the year, as well as background information on the data and how they were calculated.

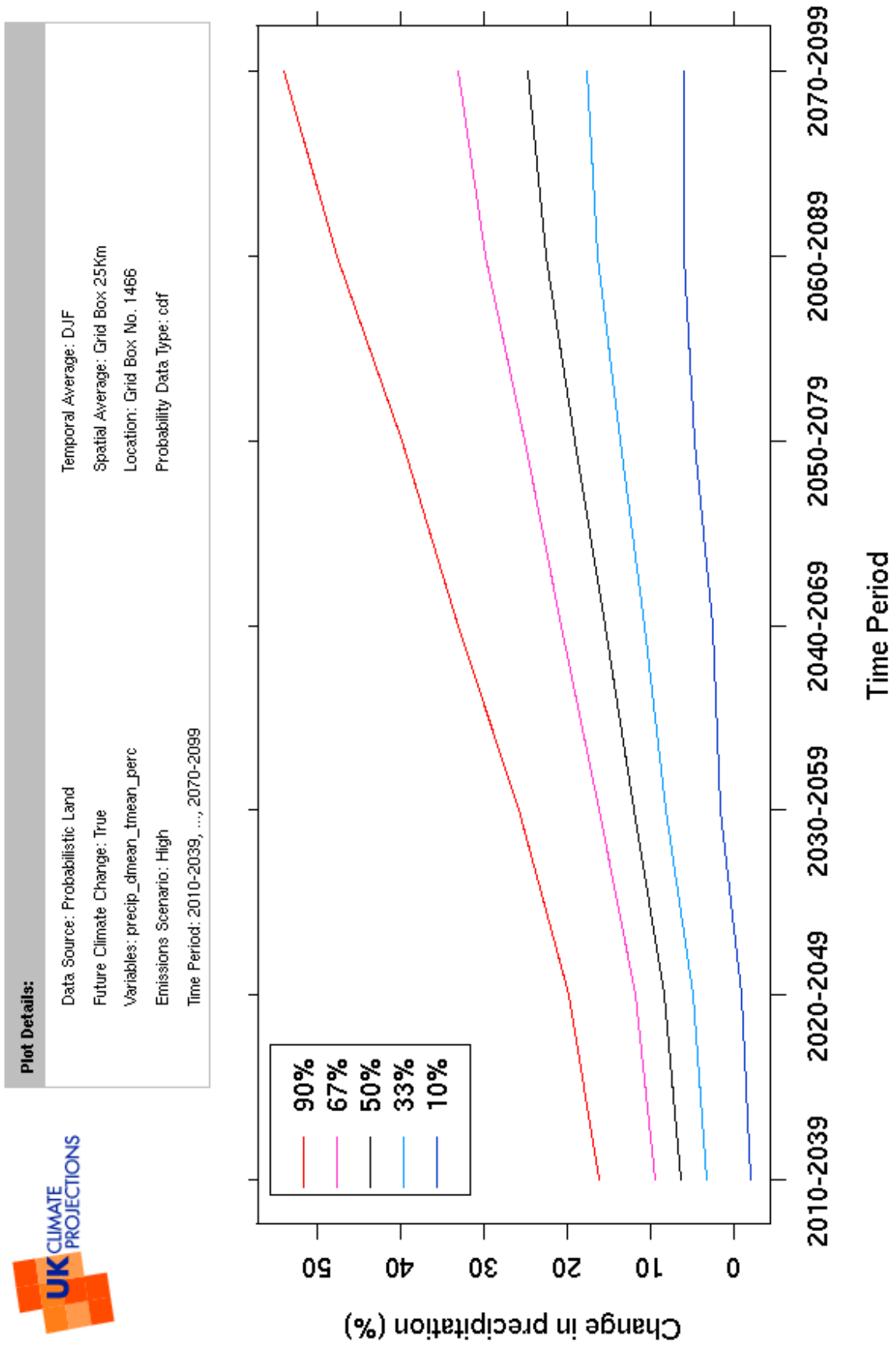
¹⁰ <http://actonco2.direct.gov.uk/home.html>

APPENDIX

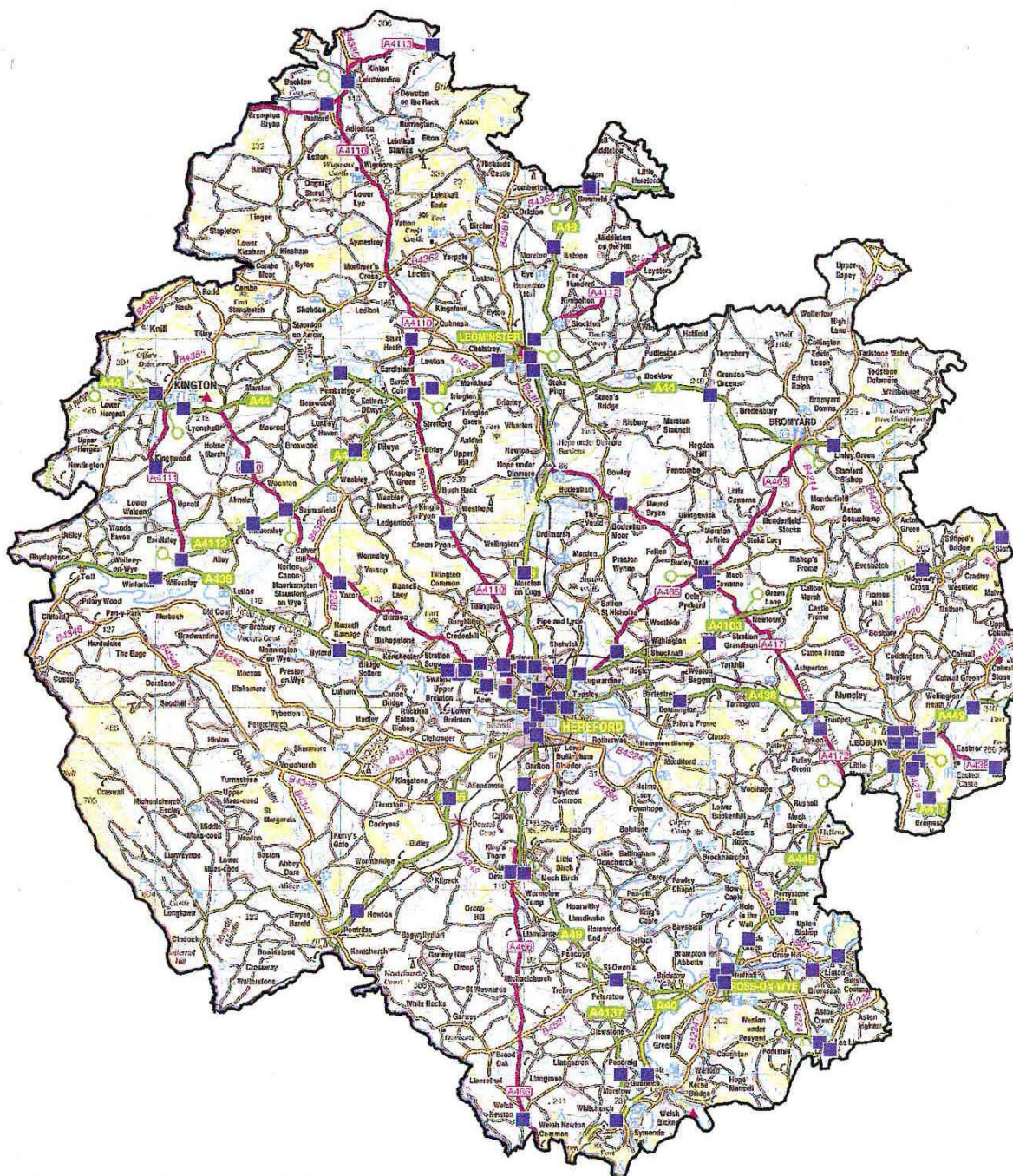
A. Change in the daily maximum summer temperature



B. Change in precipitation in the winter months



C. Map of transport monitoring points



Various factors are used to estimate the level of CO2 emissions. They are modelled using a series of assumptions such as that the number of vehicle kilometres by vehicle type (collected through the DFT sites), the

fuel type and regulatory emission standard of the vehicles and how the emissions vary by average speed. All these factors are considered to provide a county estimate.

DFT Monitoring Site. Used to provide annual average daily traffic flows by vehicle type. For minor roads regional average flows by vehicle type are applied. Different emission factors are estimated for the following categories of vehicle:

- Passenger cars
- Motorcycles
- Light goods vehicles
- Rigid heavy goods vehicles (HGVs)
- Articulated HGV's
- Buses / coaches



Map illustrating Department for Transport monitoring sites used to estimate Herefordshire's road transport CO2 emissions.



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