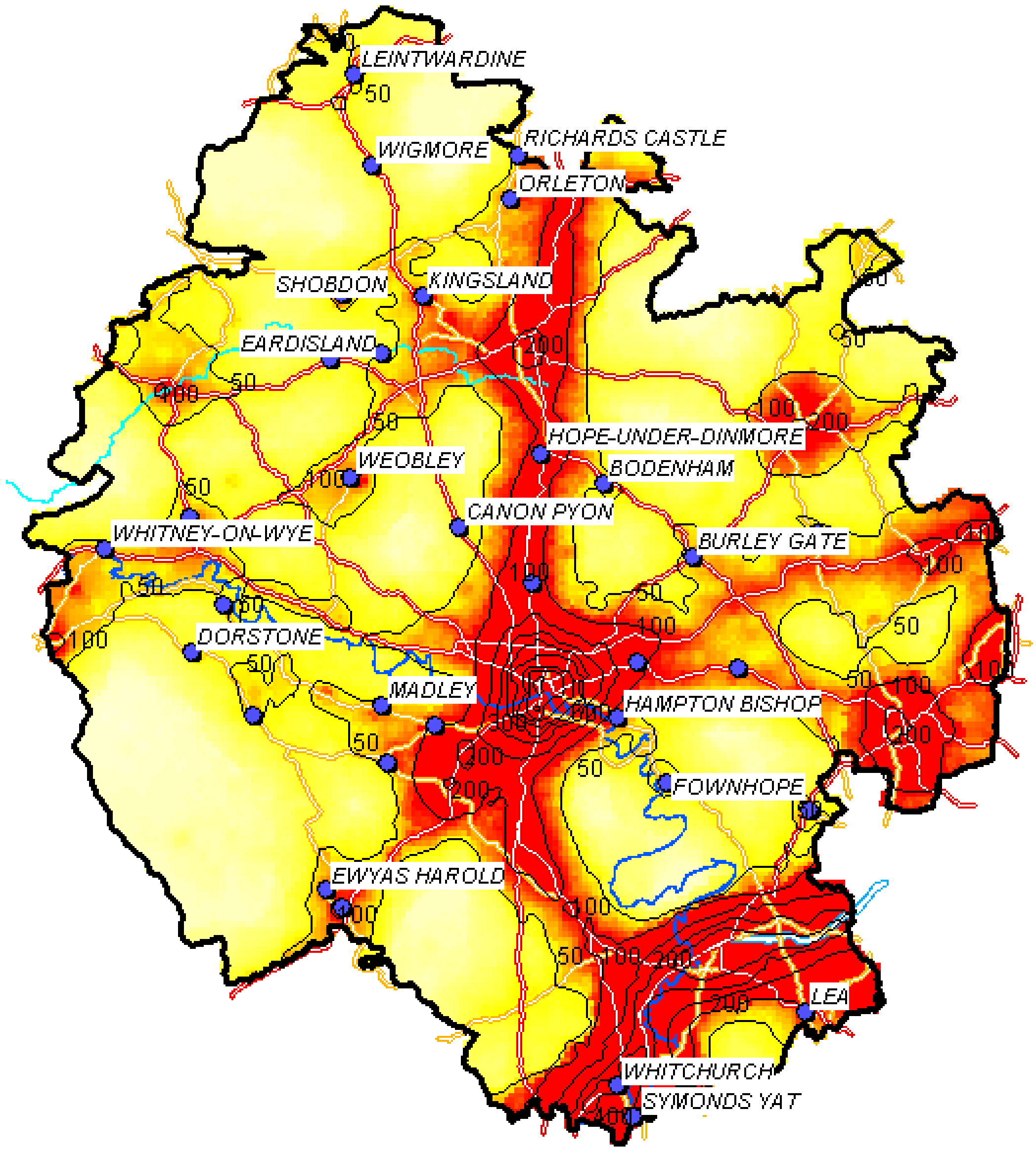
THE HEREFORDSHIRE partnership

HEREFORDSHIRE GREENHOUSE GAS INVENTORY

(REFERENCE YEAR 2002)



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HEREFORDSHIRE GREENHOUSE GAS INVENTORY

(REFERENCE YEAR 2002)

INITIAL REFERENCE PERIOD 2000 TO 2003 INCLUSIVE

SEPTEMBER 2005

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Executive Summary

This report provides a detailed analysis of the Greenhouse Gas emissions from Herefordshire for the reference year of 2002 - termed the baseline year. The report is a supporting document that underpins the Herefordshire Partnership Climate Change Strategy.

The report provides a projection - termed the business-as-usual case, through to 2050. This is used to establish the emissions reductions required to be secured in the four key time frames:

- **Current Kyoto period** ***2002-2010***
- **Revised Kyoto period** ***2011-2020***
- **Medium period** ***2021-2030***
- **Long term period** ***2031-2050***

The 2002 baseline emissions has been calculated using the methodology established by the UN Framework Convention on Climate Change (UNFCCC) and follows the Greenhouse Gas Emissions Inventory reporting requirements established under the Common Reporting Format (CRF) of the UN. The baseline has been computed for 2000, 2002 and 2003, which provides a measure of the current change in total emissions of greenhouse gases.

The total baseline greenhouse gas emissions are assessed (under the CRF) at a level of 742 thousand tonnes of carbon (equivalent) written as C_{-e}. This is equivalent to 2.72 million tonnes of carbon dioxide gas (equivalent) written as CO_{2-e}. Throughout this report the preferred measure of greenhouse gas emissions is the carbon equivalent C_{-e}. Frequently, emissions are referred to as carbon dioxide, or CO_2. Care must be taken to use consistent units since carbon equivalent only refers to the mass of carbon emitted, whereas carbon dioxide refers to the mass of carbon plus the mass of the two oxygen molecules. The difference between the two measures is the ratio of molecular weights, namely 44/12. Throughout this report the heavier carbon dioxide molecule is referred to as carbon dioxide gas (equivalent) of CO_{2-e}.

Using mid-year population statistics, the baseline total per-capita emissions of greenhouse gases were 15.37 tonnes CO_{2-e} gas per head per year. Of this total figure, the CO_2 gas emissions were equivalent to 9.47 tonnes per head.

Nationally, carbon dioxide is recognised as the most significant greenhouse gas. In the Herefordshire reference inventory of emissions, CO_2 emissions account for 1.67 million tonnes, or 61.4% of the total emissions of greenhouse gases. Nationally, CO_2 emissions account for over 80% of greenhouse gas emissions and the difference in Herefordshire is accounted for by the relatively high levels of agricultural bases emissions.

The "business-as-usual" projection assumes that agricultural and waste derived emissions will continue to decline, whereas, energy related emissions, that are almost exclusively carbon dioxide, will continue to exhibit a rise in line with recent trends.

The Herefordshire Greenhouse Gas inventory has been assembled for 2000, 2002 and 2003. This represents a 4-year period during which emission data for 2001, upon which some parts of the inventory relay, were withdrawn from publication by Defra because of an error.

The trend of Herefordshire emissions during the period from 2000 to 2003 shows a considerable reduction in both total Greenhouse gas emissions and CO_2 emissions. The data has been used to back-extrapolate the total emissions for Herefordshire to a 1990 reference year. In 1990, the total emissions of Greenhouse Gases were estimated to be 816 thousand tonnes of Carbon equivalent 2.99 million tonnes carbon dioxide gas. This process estimates that 1990 emissions were approximately 10% higher than the 2002 reference year. Using these estimates implies an average annual reduction in greenhouse gases of 22.5 thousand tonnes of $CO_{2\text{-}e}$ gas per year between 1990 and 2002. The vast majority of these estimated reductions have come about through reductions in emissions of methane and emissions of carbon dioxide from power generation adopting natural gas instead of oil and coal and by the loss of livestock following the foot and mouth outbreak in 2000-2001.

The Herefordshire Partnership Climate Change Working Group devised a “climate change” consultation game called Democs. The results of the Democs consultation have been used to assess the “informed” emission reduction objectives of Herefordshire. These results indicate that the informed objective of 355 participants in over 130 hours of participative consultation, that the Herefordshire Partnership should develop it strategy that sets out to secure a 60% reduction in greenhouse gas emissions by 2050 (the Democs C12 objective shown in Figure 4.1). The C12 objective matches one of the primary objectives set out in the 2003 Energy White Paper.

Emissions reduction targets based on the C12 objective have been established for 2010, 2020, 2030 and 2050. These are established by reference to the “business-as-usual” case, which is arrived at by projecting the 2002 baseline emissions.

The 2010 Emissions Reduction Target

Total greenhouse gas emissions relative to the “business-as-usual” trend, need to be reduced to 598 thousand tonnes of $C_{\text{-}e}$ (expressed as carbon) equivalent to 2.19 million tonnes of $CO_{2\text{-}e}$ gas by 2010.

This represents an additional reduction of 82.7 thousand tonnes of $C_{\text{-}e}$ (expressed as carbon) equivalent to 299 thousand tonnes of $CO_{2\text{-}e}$ gas. The action plan of the Herefordshire Partnership Climate Change Strategy is designed to secure emissions reduction of 18 thousand tonnes $C_{\text{-}e}$ per year to

2010, or 65.8 thousand tonnes of $CO_{2\text{-}e}$ per year relative to the 2002 baseline.

The 2020 Emissions Reduction Target

Total greenhouse gas emissions relative to the ”business-as-usual” trend, need to be reduced to 462 thousand tonnes of $C_{\text{-}e}$ (expressed as carbon) equivalent to 1.695 million tonnes of $CO_{2\text{-}e}$ gas by 2020.

This represents an additional reduction of 212 thousand tonnes of $C_{\text{-}e}$ (expressed as carbon) equivalent to 776 thousand tonnes of $CO_{2\text{-}e}$ gas relative to the projected “business-as-usual” case projected for 2020. The action plan of the Herefordshire Partnership Climate Change Strategy is designed to secure emissions reduction of 22 thousand tonnes $C_{\text{-}e}$ per year to 2020, or 77.6 thousand tonnes of $CO_{2\text{-}e}$ per year relative to the 2010 projected emissions.

The 2030 Emissions Reduction Target

Total greenhouse gas emissions relative to the ”business-as-usual” trend, need to be reduced to 372 thousand tonnes of $C_{\text{-}e}$ (expressed as carbon) equivalent to 1.363 million tonnes of $CO_{2\text{-}e}$ gas by 2030.

This represents an additional reduction of 292 thousand tonnes of $C_{\text{-}e}$ (expressed as carbon) equivalent to 1.071 million tonnes of $CO_{2\text{-}e}$ gas relative to the projected “business-as-usual” case projected for 2030. The action plan of the Herefordshire Partnership Climate Change Strategy is designed to secure emissions reduction of 29 thousand tonnes $C_{\text{-}e}$ per year to 2030, or 107 thousand tonnes of $CO_{2\text{-}e}$ per year relative to the 2020 projected emissions. The 2030 trend target represents the highest emissions reduction period.

The 2050 Emissions Reduction Target

Total greenhouse gas emissions relative to the ”business-as-usual” trend, need to be reduced to 326 thousand tonnes of $C_{\text{-}e}$ (expressed as carbon) equivalent to 1.195 million tonnes of $CO_{2\text{-}e}$ gas by 2050.

This represents an additional reduction of 329 thousand tonnes of $C_{\text{-}e}$ (expressed as carbon) equivalent to 1.206 million tonnes of $CO_{2\text{-}e}$ gas relative to the projected “business-as-usual” case projected for 2050. The action plan of the Herefordshire Partnership Climate Change Strategy is designed around an emissions reduction of 16 thousand tonnes $C_{\text{-}e}$ per year to 2050, or 60 thousand tonnes of $CO_{2\text{-}e}$ per year relative to the 2030 projected emissions.

The influence of each sector on total greenhouse gas emissions for the reference year was:

Structure of emissions 2002 (baseline)

- Energy (mostly CO_2 emissions) 54.7%
- Industrial Processes (mostly CO_2 emissions) 6.8%
- Agriculture (mostly methane emissions) 39.3%
- Land Use Change & Forestry (mostly CO_2 absorption) - 6.9%
- Waste Management (mostly methane emissions) 6.1%

Projected Structure of emissions 2010

- Energy (mostly CO_2 emissions) 61.0%
- Industrial Processes (mostly CO_2 emissions) 6.6%
- Agriculture (mostly methane emissions) 33.9%
- Land Use Change & Forestry (mostly CO_2 absorption) - 7.9%
- Waste Management (mostly methane emissions) 6.4%

Projected Structure of emissions 2020

- Energy (mostly CO_2 emissions) 63.5%
- Industrial Processes (mostly CO_2 emissions) 6.1%
- Agriculture (mostly methane emissions) 32.6%
- Land Use Change & Forestry (mostly CO_2 absorption) - 8.5%
- Waste Management (mostly methane emissions) 6.3%

Projected Structure of emissions 2030

- Energy (mostly CO_2 emissions) 65.8%
- Industrial Processes (mostly CO_2 emissions) 5.7%
- Agriculture (mostly methane emissions) 31.4%
- Land Use Change & Forestry (mostly CO_2 absorption) - 9.1%
- Waste Management (mostly methane emissions) 6.1%

Projected Structure of emissions 2050

- Energy (mostly CO_2 emissions) 70.1%
- Industrial Processes (mostly CO_2 emissions) 4.9%
- Agriculture (mostly methane emissions) 28.6%
- Land Use Change & Forestry (mostly CO_2 absorption) -10.2%
- Waste Management (mostly methane emissions) 5.7%

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A1, A2, A3, A4, A5 .... Democs Vote classes for react preference class
ACS ....Average Cold Weather Conditions - Power System Planning
AQMA.. Air Quality Management Area
Aquila ....Regional Power Distribution Compnay - Now Midlands Electricity
B6, B7, B8, B9, B10 .... Democs Vote classes for "Act winthin constraints" class
BAU ....Business as Usual - Emissions forward projections
biogas.......... Gas derived from anearobic digestion in the presence of no free oxygen
C11, C12, C13, C14, C15 .... Demics Vote Classes for "do what it takes" class
$C_2H_2F_4$ ....HFC - Hydroflourocarbon - Greenhouse Gas
CAP .... Common Agriculture Policy of the European Union
Carbon dioxide ....Greenhouse gas with a global warming potential of 1
Cardice .... Also known as Dry Ice - CO_2 greenhouse gas
CAS Number ..Chemical Abstracts Service - Unique numerical identifier for chemicals
CCWG .... Climate Change Working Group , Environment Ambition Group
CFCs .... Chlouro-flourocarbons - Greenhouse Gas and Ozone depleting gas
CH_4...........................Methane - Greenhouse gas with Global Warming Potential of 21
CO ....Carbon Monoxide - Indirect Greenhouse Gas affective air quality
CO_2 ....Carbon Dioxide
CO_2-e gas .... Carbon Dioxide Equivalent - expressed as a gas including the weight of oxygen molecules
CRF ....Common Reporting Format for Greenhouse Gas Inventories
DEFRA .... Department for Environment Farming and Rural Affairs
Democs ....Deliberative Meetinf of Citizens - The Climate Change Consultation
Dinitrogen monoxide .....N_2O - Greenhouse gas with Global Warming Potential of 310
Dinitrogen oxide ....N_2O - Dinitrogen monoxide
dry ice.. CO_2 - Greenhouse Gas
DTI ....Department of Trade and Industry
DUKES ....Digest of UK Energy Statistics - Published by the DTI
EAG....................................Environment Ambition Group - Herefordshire Partnership
Fire damp .... Methane - CH_4 - Greenhouse Gas
GWP...Global Warming Ptential - CO_2 = 1
HCFC 22 ....Hydrochlorofluorocarbon 22 - Greenhouse Gas also refrigerant
HCFCs .... Hydrochlorofluorocarbon - Greenhouse gases - refrigerants
HFC 134a............................Hydrofluorocarbon 134a - Greenhhouse Gas - refrigerant
HFC 23......................................Hydroflourocarbon 23 - Greenhouse Gas - refrigerant
HFCs .... Hydroflourocarbons - Greenhouse Gases - refrigerants
Hyponitrous acid anhydride.. N_2O - Greenhouse Gas
IPCC Guidelines................ International Panel on Climate Change - Greenhouse Gas Standards
kV ....Kilo Volt - 1000 volts
Kyoto Protocol. 1st Amendment to the UN Framework Convention on Climate Change
Laughing gas.. N_2O - Greenhouse Gas
LPG ....Liquid Petroleum Gas
LUCF .... Land Use Change and Forestry
Marsh gas .... Methane CH_4 - Greenhouse Gas
MDIs ....Metered Dose Inhalers
Methane .... CH_4 - Greenhouse Gas with Global Warming Potential of 21
methyl hydride... Methane - CH_4 - Greenhouse Gas
MPANs ....Number of Meter Points - Electricity Supply

MVA ....Mega Volt Amps - 1,000,000 Volt Amps
MW...Mega Watt - 1,000,000 Watts
N_2O ....Nitrous Oxide
NAEI.............National Atmouspheric Emissions Inventory - Reported under UNFCCC
Natural gas..Predominantly Methane - Greenhouse Gas
Netcen..National Environmental Technology Centre - Harwell
nitrogen (I) oxide ....N_2O - Nitrous Oxide
Nitrous oxide ....N_2O - Nitrous Oxide
NMVOC...Non-Methane Volatile Organic Compound
NO_x..Oxides of Nitrogen
NUTS4 ....Nomenclature of Units for Territorial Statistics - Local Authority Area
Perfluorocarbons.. Flourinatedcarbon
ppm .... Parts per million -
R 218... Perfluorocarbon - Greenhouse Gas
SF_6 .... Perfluorocarbon - Greenhouse Gas
SO_2............... Sulphur Dioxide - Indirect Greengouse Gas and Atmouspheric pollutant
t C-e ....Tonnes of Carbon equivalent (expressed as Cabon)
T1 ....
.... Transformer Number
TFA ....Trifuoroacetic Acid
Transco .... Transco Plc
UK-GHGI... UK Greenhouse Gas Inventory
UNFCCC ....United Nations Framwork Convention on Climate Change

1 Introduction

The Herefordshire Partnership Environment Ambition Group (EAG) is actively engaged in the development of a Herefordshire Climate Change Programme. A Climate Change Working Group (CCWG) was established in early 2003 as a sub-group of the EAG. The main aims of the group are to develop an appropriate climate change strategy set within the context, and needs, of rural Herefordshire by the end of 2005 for adoption by 31st march 2006.

This report establishes a reference Herefordshire Greenhouse Gas Inventory for the baseline year of 2002, and represents the concluding part of phase 1 of strategy development. A trial emissions inventory was established in 2004 based on data available for 2000. However, key data were unavailable to allow the full publication of the greenhouse gas inventory at that time.[1] A complete dataset is now available and has been used in the development of the inventory. The inventory provides a baseline to which subsequent changes in greenhouse gas emissions can be compared.

At the outset, it is important to emphasis that the inventory refers to a “basket” of six greenhouse gases of which carbon dioxide is only one, although generally recognised as the most important. Consequently, the inventory reflects the characteristics of rural Herefordshire, with its high quality woodlands and large area of farmlands both of which absorb carbon dioxide, widespread animal husbandry that contributes to greenhouse gas emissions through methane, scattered communities and major market towns and both local and through transport and waste processing.

The inventory is the “starting point” to which subsequent reductions or increases in emissions can be monitored, and by which action plans for emissions reductions can be set. This report presents a series of emissions reduction targets based on the pre-consultation and awareness raising exercise involving the use of an innovative consultation mechanism called Democs (Deliberative Meeting of Citizens). The Democs climate change game assembled the emissions reduction objectives of 310 individuals. The data collected from the Democs game has allowed the Climate Change Working Group to take into account the informed opinions of the Herefordshire public, including various countywide organisations and national agencies. A separate report is available detailing the results of the consultation exercise (August 2005).

1.1 Structure of the Greenhouse Gas Inventory

The Herefordshire Greenhouse Gas Inventory has been assembled to generally conform to the Common Reporting Format (CRF) of the United Nations Framework Convention on Climate Change (UNFCCC)[2]. The method allows greenhouse gas emissions to be gathered sector by sector. Each activity within a sector has an associated emission factor, and these are taken from the latest recommendations in the UK-GHGI report. When the data is combined, a reference emission for a “basket” greenhouse gasses is obtained. The method does not rely on scaling data between sectors form aggregate information such as employment profiles, as has been used in the West Midland Energy Strategy which can give rise to considerable errors, especially in rural areas such as Herefordshire.

[1] In particular, data on local electricity consumption for Herefordshire only became available in 2005 for the reference year of 2002.
[2] UNFCCC – UN Framework Convention on Climate Change http://unfccc.int/resource/convkp.html

1.2 The main sources of data

- The UK Greenhouse Gas Inventory[3] published annually 2 years in arrears.
- The June Agricultural census (published annually) by DEFRA[4], one year in arrears.
- The Digest of UK Energy Statistics, DUKES published by the DTI[5] annually in arrears.
- The Regional and Local Electricity Consumption Statistics published by the DTI.[6]
- The Regional and Local Gas Consumption Statistics published by Transco.[7]
- The Long Term Development Statement of the local electricity distribution company, (Formerly Aquila, now Midlands Electricity owned by ***e.on***) published annually one year in arrears, available on compact disc.[8]
- The Herefordshire and Worcestershire Joint Municipal Waste Strategy 2004-2034 adopted by Herefordshire Council in June 2004.
- The Environment Agency pollution inventory – Operational Waste sites and Waste Transfer Sites and point source IPPC authorised processes.[9]
- Biomass Resource Assessment Report (March 2004) developed by the CCWG from an activity part funded by the Government Office of the West Midlands.

The UK-GHGI utilises data from The National Atmospheric Emissions Inventory (NAEI)[10] maintained by AEA Technology on behalf of DEFRA, as well as the UK Digest of Energy Statistics (DUKES) maintained by the DTI. The UK-GHGI conforms to the International Protocol on Climate Change, (IPCC) Revised 1996 Guidelines for National Greenhouse Gas Inventories (IPCC, 1997a, b, c) and Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000).

The UK-GHGI is compiled and reported annually to fulfil the UK's reporting obligations under the UNFCCC. The UK-GHGI is the responsibility of Defra whereas DUKES is the responsibility of the DTI. In general, Defra refer to greenhouse gas emissions in tonne of carbon equivalent, whereas the DTI have adopted tonnes of CO_2 gas as their favoured unit. In addition, the Environment Agency has the responsibility to maintain the annual pollution inventory of authorised Integrated Pollution Prevention and Control (IPPC) processes covering some 12,000 industrial processes and operational waste sites throughout England and Wales. The IPPC data is used in the data structures that form the UK-GHGI. However, the favoured units of the Environment Agency were unclear and data could have been returned (by IPPC operators) as either carbon or carbon dioxide gas. Consequently some confusion existed over the precise units of the data used in the NAEI for 2001 as published in the summer of 2003. It was subsequently proven, during the course of this work that the NAEI had incorrectly assumed that the IPPC data were recorded as tonnes of carbon whereas they were in fact in units of tonnes of carbon dioxide gas.

3 http://www.naei.org.uk/
4 http://www.defra.gov.uk/esg/work_htm/publications/cs/farmstats_web/datamap_links/search_menu.asp
5 http://www.dti.gov.uk/energy/inform/dukes/dukes2004/index.shtml
6 http://www.dti.gov.uk/energy/inform/energy_trends/elec2003nuts4regionsexp.xls
7 http://www.transco.co.uk/
8 Available from 'The primary network manager', Toll End Road, Tipton, West Midlands DY4 OHH.
9 http://www.environment-agency.gov.uk/maps
10 The data for natural gas consumption generally supplied by Transco is included within the area-based data held in the NAEI.

The result was that the IPPC data from the Environment Agency used in the NAEI and the UK-GHGI included a significant error, equivalent to the difference in the relative mass of carbon and carbon dioxide gas – 366%. This meant that the point source emissions were vastly overstated for all IPPC process sites. This error did not apply to power generation sites that were reported separately in the inventory.

This error was reported by the CCWG to Defra, the Environment Agency and the NAEI maintained by AEA Technology in June 2004. They confirmed the existence of the error and removed the data from the NAEI inventory website pending corrections. After some time, the data were corrected but was never re-issued for 2001 only for 2002 onwards. Consequently, a corrected inventory for 2000 cannot be inferred and the new reference year of 2002 has been adopted.

1.3 Annual Completion of the Herefordshire GHGI

Data specific to Herefordshire is assembled under the Common Reporting Format of the UNFCCC and is available as a modified Excel Spreadsheet – entitled Herefordshire Common Reporting Format (HCRF). The annual completion of the data tables in the spreadsheet generates a rolling inventory of greenhouse gas emissions, which can be used to track changes in local emission categories.

The most appropriate time for completion of the HCRF depends upon the availability of input data, generally the process has to take place after: -

- The submission of the UK report to UNFCCC, nominally in April each year. The April 2004 submission was in respect of 2002. Each report provides a rolling history from the UK national reference year of 1990. The UK report provides a complete UK inventory and this is emulated by the Herefordshire inventory.
- The publication of the DEFRA June Agricultural Census, specifically relating to the population of farmed animals and land areas designations. The latest report used to establish the baseline emissions refers to June 2002.
- The updated UK Greenhouse Gas Inventory published on the National Atmospheric Emissions Inventory (NAEI) Website, specifically relating to area and point-source greenhouse gas and atmospheric pollutant emissions for Herefordshire. The latest data refers to 2002 and was published in December 2004. The NAEI is updated annually, but is running 2 years behind the submission of the report to the UNFCCC, so although the current UNFCCC report is applicable to 2002, the next set of Herefordshire-specific data from the NAEI for 2002 were not reported until 2004[11].

1.4 Modifications to the UNFCCC Common Reporting Format (CRF)

Additional sub-categories have been included in the CRF to reflect the rural nature of Herefordshire and the fact that Herefordshire is a small county sized sub-region of the UK. The modifications to the UNFCCC common reporting format do not alter the computation structure of the existing emissions categories within the inventory.

[11] All reporting years are calendar years.

1.4.1 Associated Emissions

Of particular importance is the fact that the inventory has been modified to account for the "association" of UK greenhouse gas emissions that take place outside Herefordshire, with activities that take place inside Herefordshire. This simply means that emissions outside Herefordshire arising from electricity consumed inside Herefordshire are included in the inventory. In a similar way emissions from activities which take place inside Herefordshire but which produce products that are consumed outside Herefordshire are also include in the Herefordshire Inventory.

A further category involves the transportation of Municipal Solid Waste generated inside Herefordshire to landfill sites outside the county, mostly to Hill & Moor near Pershore in Worcestershire.

The former is described as "imported" electricity, whilst the latter is referred to as "exported" waste. Emissions from both can be reduced through actions undertaken by the residents of Herefordshire as part of a climate change strategy.

The Herefordshire GHGI also allows for the identification of "green" electricity purchased under contract from suppliers outside the County as well as renewable electricity generated within the county that effectively displaces some or all of electricity imported into the county. This is included because it reflects the result of actions taken at the local level. At a national level, only the generators of renewable electricity are able to assert the emissions savings from their activities. However, after considerable discussions we have taken the view that if renewable energy is either generated or purchased inside Herefordshire then it displaces energy that would have emitted greenhouse gases and should be so reflected in the Herefordshire GHGI.

The UK-GHGI, and the Herefordshire-GHGI are founded on the same data sets as the National Atmospheric Emissions Inventory (NAEI), and is reported in accordance with the UNECE/CORINAIR format. Hence, the methodology used for the UK-GHGI is consistent with that of the NAEI except for certain sources and reporting conventions, which are specific to IPCC. These are highlighted where appropriate.

The Herefordshire GHGI should not be considered as data that can be integrated at a regional or national level, since this would give rise to double accounting of emission reductions associated with the use of renewable electricity and emissions from landfill sites.

1.5 Direct Greenhouse Gases

Direct Greenhouse gases are those that have a positive global warming potential. They are generally referred to as a "basket" of greenhouse gases defined in the Kyoto Protocol[12].

- Carbon dioxide CO_2 — *reported as tonnes Carbon*
- Methane HC_4 — *reported as tonnes Methane*
- Nitrous Oxide N_2O — *reported as tonnes Nitrous Oxide*
- Hydrofluorocarbons (HFCs) — *reported as zero*

[12] http://unfccc.int/resource/docs/convkp/kpeng.html

- Perfluorocarbons (PFCs) *reported as zero*
- Sulphur Hexafluoride (SF_6) *reported as zero*

1.6 Indirect Greenhouse Gases

Indirect Greenhouse gases are associated pollutants that in some cases, such as SO_2, have a negative global warming potential, but most of which have an adverse affect on air quality.

- Nitrogen Oxides (as NO_x)
- Carbon Monoxide CO
- Non-Methane Volatile Organic Compounds (NMVOC)
- Sulphur Dioxide SO_2

These pollutants are estimated using methodologies corresponding mostly to the detailed sectoral Tier 1/2/3 methods in the IPCC Guidelines.[13]

The UK inventories for 1990-2002 were submitted to UNFCCC in the Common Reporting Format (CRF) by DEFRA in April 2004 in accordance with a decision of the Conference of the Parties to the UNFCCC (FCCC/CP/1999/7). The Herefordshire GHGI has similarly been devised according to the CRF of the UNFCCC and is reported in the preferred tabular structure of the CRF.

Certain of the Indirect Greenhouse Gases are also important air quality gases, in particular nitrogen dioxide and sulphur dioxide. Herefordshire has a number of direct monitoring points for NO_2 and SO_2. In general the Herefordshire monitoring network indicates that the UK health bases standard for the annual mean objective is important in the A49 corridor in Hereford City (the Hereford City AQMA) and in Leominster town centre. In contrast to the general rising trend of NO_2 concentrations, SO_2 concentrations in Hereford show a falling trend.[14]

It should be noted that in the UK-GHGI, carbon dioxide emissions and removals are reported separately and that carbon dioxide removals are reported with a negative sign. Carbon dioxide removals are those associated with carbon absorbed into sinks such as woodlands, grasslands, crops, and other biomass. These are important considerations for Herefordshire and are therefore dealt with in detail in the report. However, under the CRF, carbon dioxide is reported as net emissions (=emissions +removals). This means that the totals reported for CO_2 and total greenhouse gas emissions weighted by global warming potential are reported on a different basis between the CRF and that for the UK-GHGI. Care has been taken to eliminate this potential source of confusion, and the only way in which carbon removals can be determined in the Herefordshire-GHGI is by reference to detailed local sustainable biomass information.

Most emission sources are reported in the detail required by the CRF, however, detailed sectoral breakdowns, in many cases, have been substituted by headline summaries derived from the NAEI. The main exceptions are the emissions of individual halocarbon species, which cannot be reported individually because some

[13] http://www.ipcc-nggip.iges.or.jp/

[14] Annual Air Quality Progress Report for Herefordshire – Environmental Health and Trading Standards July 2005

of these are considered by the NAEI to contain commercially sensitive data within the industries involved. Consequently, although emissions data can be added at any time in the future, currently, both solvents and Halocarbon data is omitted. The total global warming potential of these gases and hence the total global warming potential of all UK greenhouse gases, are reported in the NAEI which can be referred to if required. The background tables for Land Use Change and Forestry are not available from the UK-GHGI because the UK model used by the NAEI differs significantly from the IPCC default methodology. It should be noted, however, that the Herefordshire Partnership Climate Change Working Group consider that the emissions and removals of carbon dioxide resulting from Land Use Change and Forestry are an important component of the Herefordshire-GHGI. Consequently, the report 'Biomass Resources Assessment for Herefordshire'[15] has been used as the basis of the completion of the tables on Land Use Change and Forestry.

[15] A Biomass Resource Assessment for Herefordshire – March 2004 – EAG Herefordshire Partnership.

2 Definitions Units and Conversion Factors

Emissions of greenhouse gases presented in this report are given in Gigagrammes (Gg), tonnes (t), thousands of tonnes (kt) and Million tonnes (Mt). GWP weighted emissions are also provided. To convert between the units of emissions, use the conversion factors given in Table 2-1.

Multiplication factor	Abbreviation	Prefix	Symbol
1,000,000,000,000,000	10^{15}	peta	P
1,000,000,000,000	10^{12}	tera	T
1,000,000,000	10^{9}	giga	G
1,000,000	10^{6}	mega	M
1,000	10^{3}	kilo	k
100	10^{2}	hecto	h
10	10^{1}	deca	da
0.1	10^{-1}	deci	d
0.01	10^{-2}	centi	c
0.001	10^{-3}	milli	m
0.000,001	10^{-6}	micro	μ

Note: 1 kilotonne (kt) =10^{3} tonnes=1,000 tonnes 1 Gigagramme (Gg)=1 kt
1 Million tonne (Mt) =10^{6} tonnes=1,000,000 tonnes 1 Teragramme (Tg) =1 Mt

Table 2-1 Prefixes and multiplication factors

2.1 Conversion of carbon emitted to carbon dioxide emitted

Much confusion exists between carbon emissions designated as tonnes of carbon (i.e. excluding the mass of the oxygen molecules) and carbon dioxide (including the mass of the oxygen molecules). To covert emissions expressed in weight of carbon, to emissions in weight of carbon dioxide gas, multiply by the ratio of the molecular weights, namely 44/12 (3.67). The Herefordshire-GHGI generally adopts the convention of reporting in tonnes of carbon unless otherwise stated.

2.2 Conversion of Gg greenhouse gas emitted to Gg CO_2 equivalent

Gg (of GG) x GWP = Gg CO_2 equivalent (Gg CO_2–e)

The Global Warming Potential (GWP) of the greenhouse gas is defined in Table 2-2.

Greenhouse Gas (Gg)	GWP
Carbon Dioxide	1
Methane	21
Nitrous Oxide	310
HFCs	140 to11700
PFCs	6500 to 9200
SF_6	23900

Table 2-2 GWP of Greenhouse Gases on a 100-year Horizon

From Table 2-2 it can be seen that one tonne of methane (CH_4) emissions has the equivalent Global Warming Potential of 21 tonne of Carbon Dioxide (CO_2) over a 100-year time period. Similarly one tonne of nitrogen dioxide (N_2O) is equivalent to 310 tonnes of carbon dioxide.

2.3 Abbreviations for Greenhouse Gases and Chemical Compounds

Table 2.3 lists the abbreviated and full forms of the current Kyoto Protocol greenhouse gases.

Type of greenhouse gas	Formula or abbreviation	Chemical Name
Direct	CO_2	Carbon dioxide
Direct	CH_4	Methane
Direct	N_2O	Nitrous Oxide
Direct	HFCs	Hydrofluorocarbons
Direct	PFCs	Perfluorocarbons
Direct	SF_6	Sulphur hexafluoride
Indirect	CO	Carbon monoxide
Indirect	NMVOC	Non-methane volatile organic compound
Indirect	NO_X	Nitrogen oxides (reported as nitrogen dioxide)[16]
Indirect	SO_2	Sulphur dioxide

HFCs, PFCs and SF_6 are collectively known as the ‘F-gases’ or Fluorinated gases.

Table 2-3 GWP Abbreviations for Direct and Indirect Greenhouse Gases

2.4 Carbon Dioxide

Scientific name: Carbon dioxide, CO_2
other names: CO2 gas. The solid form is also known as 'dry ice' or Cardice
CAS Number: 124-38-9

Carbon dioxide is taken up from the atmosphere by plants and ocean-dwelling plankton, making use of sunlight, by the process of photosynthesis. Animals and plants release carbon dioxide back into the atmosphere by the process of respiration. The average global atmospheric concentration of carbon dioxide is currently just below 0.037% by volume (370 ppm), having increased from about 0.028% (280 ppm) before the industrial revolution. The rest of the atmosphere is mainly nitrogen (approx. 78%) and oxygen (approx. 21%) with varying amounts of other trace gases. The carbon dioxide content of the air we exhale is much higher, about 4% by volume (40,000 ppm).

Carbon dioxide has many uses, such as a coolant, fire extinguishing gas and preservative. The gas is also used to provide the bubbles in fizzy drinks. A minor use of the solid (frozen) form is to produce smoke effects in TV, film and theatre.

At environmental temperatures, carbon dioxide occurs as a colourless gas, denser than air. It is essentially odourless, though it can have a slightly acidic smell at very high concentrations. It is slightly soluble in water, forming carbonic acid. Carbon dioxide also occurs as a white, intensely cold solid, which converts (sublimes) directly to the gas phase at room temperature.

[16] Although reported as Nitrogen Dioxide, NO*x* is not added to Nitrous Oxide emissions.

Carbon dioxide is released in large quantities from natural processes, notably respiration by living organisms. Releases from respiration are balanced by a similar quantity taken up by photosynthesis. These processes are part of the carbon cycle. Other natural sources of carbon dioxide include volcanoes, forest fires and evaporation from seawater.

Man made CO_2 releases account for about 4% of the total CO_2 currently being released to the atmosphere. Man made carbon dioxide is produced by combustion processes and released to the atmosphere in emissions from power stations, motor vehicles and other processes where fuels containing carbon are burnt.

The main impact of carbon dioxide on the environment is as a greenhouse gas, leading to global warming. The concentration of carbon dioxide in the atmosphere has increased by around 30% since the industrial revolution, mainly as a result of the use of fossil fuels. Carbon dioxide represents almost 80% of the total UK global warming emissions contribution, the other major contributions being from methane and nitrous oxide.

2.5 Methane

Scientific name: Methane, CH_4
Other names: Natural gas; methyl hydride; marsh gas; biogas; fire damp; R 50 (refrigerant)
CAS Number: 74-82-8

Over the last two centuries, methane concentrations in the atmosphere have more than doubled, largely due to human activities. However, recent concerns over the global warming impacts of methane (it has a much greater warming effect on the climate than carbon dioxide) have resulted in measures to reduce the human induced emissions. As the major constituent of natural gas, methane is burned to heat homes and other commercial buildings. It is also used as a fuel in power stations to produce electricity. Methane is used widely in the chemicals industry in the production of more complex chemical compounds.

Methane is a colourless gas, odourless at low concentrations, but with a sweetish chloroform-like odour at high concentration. It is highly combustible, and mixtures of about 5 to 15 percent in air are explosive. Upon release into the atmosphere methane is destroyed by reactions with other chemicals in the atmosphere, giving it a lifetime of about 10 years.

Methane occurs naturally in the environment. One of the major sources is from the decomposition of plant and animal matter by methane producing bacteria. These occur in air-less environments such as marshes and the guts of some animals (ruminants) and landfills.

Methane is also trapped in pockets with the earth's crust, and can be released during the mining of fossil fuels. In the UK the major sources of methane from human activity are waste disposal, agriculture, coal mining and leakage from the gas distribution system. In 1996, Landfill sites accounted for an estimated 46% (1996) of the UK's methane emissions. The second largest source of emissions was from the agricultural sector, principally from the grazing of livestock and animal wastes. Methane emission form coal mining have reduced significantly during the past 20 years, however, it still provides a significant contribution. Leakage in the pipelines and distribution systems of the gas network allow methane releases in to the environment. Offshore oil and gasworks contribute 2% of emissions; methane is also released by sewage disposal. On a global scale, the human activities that result in the most methane emission, in descending order of importance are; livestock farming, production of fossil fuels, wet rice cultivation, landfill and domestic sewage.

2.6 Nitrous Oxide

Scientific name: Dinitrogen oxide; N_2O
Other names: Nitrous oxide, dinitrogen monoxide; laughing gas; hyponitrous acid anhydride; nitrogen (I) oxide
CAS Number: 10024-97-2

Nitrous Oxide, otherwise known as dinitrogen oxide is a man-made and naturally occurring colourless gas. Dinitrogen oxide is a "greenhouse gas" - releasing it to the atmosphere causes global warming. It is also an ozone-depleting substance, causing damage to the ozone layer. It was used in the past in dentistry for its properties in pain relief.

The major release of dinitrogen oxide in the UK due to human activity is from agriculture, although road transport, power generation and the production of acidic chemicals also produce notable releases. It is also produced from a wide variety of natural biological sources in soil and water.

The third most significant global warming gas in the UK is nitrous oxide. Although emissions are far lower than those of either carbon dioxide or methane, the Global Warming Potential of nitrous oxide is much greater at 310, over 100 years, making it a powerful greenhouse gas. In the 19th Century it was termed 'laughing gas' after the amusing effects it had on people that inhaled it. It was even used for recreational purposes where the public would pay a small price to inhale a small amount of gas.

As a weak anaesthetic gas, nitrous oxide has been in use since the late 19th century in medicine and dentistry. It is used in the dairy industry as a mixing and foaming agent as it is non-flammable, bacteriostatic (stops bacteria from growing) and leaves no taste or odour. In motor sport in is used to speed engines and it is even used in diving to avoid nitrogen narcosis and other effects experienced in deep dives.

Under normal environmental conditions dinitrogen oxide (more commonly known as nitrous oxide) is a colourless gas with a slight sweetish taste and odour. It is non-flammable itself but will support combustion and is only slightly soluble in water. It has an anaesthetic and an analgesic property, offering pain relief when inhaled in sufficient amounts.

Nitrous oxide is produced both naturally - from a wide variety of biological sources in soil and water - and by a variety of agricultural, energy-related, industrial and waste management activities. Nitrous oxide is also produced naturally in soils through microbial processes of nitrification and de-nitrification. The two major sources of man-made nitrous oxide emissions in the UK are agricultural soils and the manufacture of adipic and nitric acids.

Lower level emissions arise from combustion processes in the power generation sector and from road transport. Of the emissions from agricultural soils the most significant sources are fertiliser application and leaching. Nitrous oxide emissions from adipic acid manufacture (a feedstock for nylon) and nitric acid manufacture depends on the production of these acids. Emissions from power generation have been relatively constant over the last few years. Emissions from road transport are increasing as a result of the increasing number of petrol driven cars fitted with 3 way catalytic converters, since the converters produce significantly larger emission of nitrous oxide. The contribution of road transport is minor but it is important because it is steadily growing in contrast to the other sectors, which are declining.

The main impact of nitrous oxide on the global environment is as a greenhouse gas, leading to global warming. Nitrous oxide is the third most important greenhouse gas in the UK, after carbon dioxide and methane. Although less emissions of nitrous oxide are emitted into the environment its Global Warming potential is 310 times that of CO_2, over 100 years.

2.7 HFCs (Hydrofluorocarbons)

Scientific name: Hydrofluorocarbons are a group of related chemicals of similar composition (e.g. 1,1,1,2-Tetrafluoroethane, $C_2H_2F_4$).
Other names: (e.g. HFC 134a, R134a, Refrigerant 134a)
CAS Number: (not available)

HFCs are man-made chemicals not found naturally in the environment. There was limited usage before the Montreal Protocol[17] and subsequent phase out of the related CFCs and HCFCs. Emissions of HFCs from the UK are rising as they continue replace CFC and HCFC usage. In 1997 the annual emission of HFCs was over 3 million kg, mainly from their use as refrigerants.

HFCs are mainly used as substitutes for CFCs and HCFCs (ozone depleting substances) that are being phased out under the 1987 Montreal Protocol. Major usage is as refrigerants in refrigeration and air conditioning equipment and as propellants in industrial aerosols and newer MDIs (Metered Dose Inhalers, e.g. for asthma). Minor uses include foam-blowing (e.g. making plastic foams for food packaging), solvent cleaning and in some fire extinguishing systems.

Hydrofluorocarbons (HFCs) are a group of compounds containing carbon, fluorine and hydrogen (unlike HCFCs, which also contain chlorine). They are generally colourless and odourless gases at environmental temperatures and for the most part chemically un-reactive.

Major releases of HFCs are from their manufacture and from the filling of and leakage from refrigeration equipment and from its end-of-life destruction. HFC 23 is also produced as a by-product in HCFC 22 manufacture. The other uses contribute relatively minor releases.

[17] http://www.unep.org/ozone/Treaties_and_Ratification/2B_montreal_protocol.asp

2.8 PFCs Perfluorocarbons

Scientific name: Perfluorocarbons (e.g. Perfluoropropane, Octafluoropropane, C_3F_8)
Other names: (e.g. Perfluoropropane, PFC 218, R 218, Refrigerant 218)
CAS Number: (not available)

PFCs are man-made chemicals not found naturally in the environment. There has been increasing usage in certain niche markets (such as refrigeration) since the Montreal Protocol and subsequent phase out of the related CFCs and HCFCs, which cause damage to the ozone layer. The semiconductor industry is currently taking action to attempt to reduce PFCs usage and emissions by seeking alternatives where possible and increasing recovery and recycling.

In 1997 the annual release of PFCs was 95,000 kg and this is expected to continue to decrease annually. Recent reports have linked the use of fluorinated organic compounds to the occurrence of traces of trifluoroacetic acid (TFA) occurring in rain. TFA is extremely resistant to further breakdown and is harmful to plants at higher concentrations.

Usage of PFCs is mainly in the electronics sector in semiconductor manufacture, however there is also significant usage as refrigerants (mainly in blends with HFCs and HCFCs). There is also some minor use as environmental tracer gases, in some fire extinguishing systems and in certain cosmetics and medical applications.

2.9 SF_6 Sulphur hexafluoride

Scientific name: Sulphur hexafluoride, SF_6
Other names: SF_6, Sulphur hexafluoride, Sulphur fluoride.
CAS Number: 2551-62-4

Sulphur hexafluoride is a man-made chemical not found naturally in the environment. Since it was discovered to be a strong greenhouse gas replacement substances have been sought. In the electricity industry its use in switchgear results in improved efficiencies and a consequent reduction in CO2 emissions resulting from less fuel use. It is also extensively recycled. Its use in training shoes is declining as alternative gases for the cushioning have been identified. Emissions of sulphur hexafluoride from the UK are expected to remain approximately constant at 50,000 - 60,000 kg/year to 2010.

The major use of sulphur hexafluoride is in the electricity supply industry, where it is used as an electrical insulator in transformers and switchgear, and in magnesium smelting because of its inertness. It also has some minor use in the semiconductor sector, as tracer gases for atmospheric analysis, in tennis balls, high performance vehicle tyres and in the cushioning soles of some trainers.

The major sources of sulphur hexafluoride release include leakage from electrical switchgear, from magnesium smelting processes and use in semiconductor manufacture (some recycling). There will also be some release of sulphur hexafluoride in the topping up of switchgear charges and in its manufacture, although there is no current manufacture in the UK. There are no natural sources of release to the environment. At environmental temperatures sulphur hexafluoride is a colourless, odourless, non-toxic gas of high chemical stability and inertness. It is also non-flammable and about 5 times heavier than air - one of the heaviest known gases.

3 The Reporting of Greenhouse Gas Emissions

The United Kingdom ratified the United Nations Framework Convention on Climate Change (UNFCCC) in December 1993, and the Convention came into force in March 1994. Parties to the Convention are committed to develop, publish and regularly update national emission inventories of greenhouse gases (GHGs).

The UK's inventory provides quantitative data for the UK's Climate Change Programme, most recently updated in Third National Communication published in October 2001 and currently under Government Review.

The programme sets out polices to ensure that the UK delivers its legally binding target under the Kyoto Protocol to reduce emissions of the basket of the six greenhouse gases to 12.5% below 1990 levels over the first commitment period 2008-2012[18], and to move the UK towards its domestic goal of a 20% reduction in carbon dioxide emissions below 1990 levels by 2010.

These twin goals are slightly different. The first relates to a "basket" of 6 greenhouse gasses whilst the latter set a goal for CO_2 only. While the latter, is important nationally, it arguably represents less of a challenge in the rural context, the former being a more difficult proposition for a county such as Herefordshire.

The Energy White Paper published in 2003 also announced that putting the UK on a path to cut CO_2 by 60% 2050 was a goal of UK energy policy.

The Herefordshire Greenhouse Gas Emissions are reported on the same structural basis as the UK national inventory, and are used to set out local policies to ensure the delivery of Herefordshire's objectives for emissions reductions.

3.1 Greenhouse Gas Emissions Targets and Democs

The Democs consultation used a voting scale to ascertain the player's initial preference for implementing emissions reductions. After completion of the game, a second vote took place that is termed an "informed" preference.

The voting system adopted by the Climate Change Working Group was devised to cover the extremes of possibilities, and is explained below:

	Vote or "preference" Class														
First Vote	**"React"**					**"Act Within Constraints"**					**"Do More"**				
Possible Responses			A					B					C		
Score position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score Shift	←	←	0	→	→	←	←	0	→	→	←	←	0	→	→
Interpretation	1990					Kyoto Targets					Energy White Paper Targets				

Table 3-1 Democs Vote Classes

[18] The commitment period, is now generally accepted as 2012 for the target date.

People were asked to mark their preference under one of the three headings or vote classes – "react", "Act within constraints" or "Do more". These three options covered the main classes of strategy approach, namely:

- **React** – do no more than forced to do when the problems associated with climate change force a change
- **Act Within Constraints** – do what we have to do under EU and International laws, treaties and conventions
- **Do More** – do more than committed to under existing EU and International laws, treaties and conventions

For the purposes of setting emission reduction paths within the strategy, the Climate Change Working Group interpreted these three voting regimes as:

- **React – Point A** - *Follow the 1990 to 2002 national emissions reduction trajectory*.

  There were substantial emissions reductions in this 12-year period arising from a number of policies, often not associated with the primary objective of reducing greenhouse gas emissions. Point A is essentially a business as usual case. A vote placed in box 1 to the left of point A is interpreted as a vote for doing nothing at all, similarly a vote placed in box 5 is interpreted as a vote for being just less than mid-way between points A and B.

- **Act Within Constraints – Point B** – *Set targets based on the First round Kyoto emissions reductions required under the European Burden Sharing Agreement for the qualifying period 2008 – 2012, taking into account the UK's stretched target for CO_2 emissions reductions.*

  Point B is essentially a vote for doing exactly that which, as a nation, we are legally required to do. Votes to the left of point B are votes for doing less than our legal obligations and votes to the right are votes for doing more than our legal obligations, but not excessively so.

- **Do More – Point C** – *Set targets based on the 2003 Energy White Paper for 2050 based on assessed atmospheric carbon dioxide concentrations of 500 ppm. This target is equivalent to a reduction in carbon dioxide emissions of 60% of 1990 levels by 2050.*

  Point C represents an emissions reduction trajectory as above. The extreme vote point at position 15 is interpreted as the reduction of emissions to zero by 2050.

A vote either side of the defined points on the Democs vote classes provides an assessment of a "felt-fair" conclusion of the player of the Democs game. In order to inform the emissions reduction targets or objectives we have adopted the 2nd or "informed" vote. The average for all the games played by the 310 consultees resulted in a vote point of 11.85. This is used as the guideline emissions reduction point from which the emissions reduction trajectories have been derived.

It should be noted that a vote point of 11.85 requires that the Climate Change

Strategy establish actions plans that result in:

- Doing More than our Legal Obligations
- Following an emissions reduction path just less than that defined in the 2003 Energy White paper.

The emission reduction trajectories are shown in section 4.

3.2 Herefordshire Sector Report

Herefordshire emissions arise from the following headline source categories, which directly map to the categories listed in the UNFCCC CRF, they are: -

- Energy
- Industrial Processes
- Solvents (zero – not currently reported for 2002)
- Agriculture
- Land-use Change and Forestry (LUCF)
- Waste

Table 3.2 shows the aggregate emissions by source category for the UK (1990 and 2000) and Herefordshire estimated emissions for 2000 and the refined baseline emissions for 2002.

From Table 3.2, the “energy” source category Herefordshire’s emissions accounts for 72.8% of the total, compared to a UK national figure of 84%. Of this figure, electricity consumption accounts for 47.7%, the remainder, 25.1% accounting for energy use in the form of heat. This reflects the rural, relatively non-industrialised, nature of the county. By contrast, agricultural emissions for Herefordshire are over 346% higher than the UK sector percentage. Similarly, the waste sector accounts for 3.72% of emissions compared to a national figure of just 1.7% in 2002. It is worth noting, that the waste sector is not dissimilar to other counties in England, it simply takes on a higher overall percentage because the industrial process sectors are smaller.

The main growth in emissions between 2000 and 2002 occurs in both the energy and industrial process source categories. Both categories increased in 2002 because the error associated with the units of carbon and carbon dioxide was corrected in the National Greenhouse Gas inventory. No corrected data is available for 2001. On the basis that the original error would have existed in the data, the total emissions for 2000 would have been 1,290,000 tonnes of $CO_{2\text{-}e}$. Therefore this would represent a 1.98% reduction in overall emissions between 2000 and 2002, approximately equal to 1% per year.

The main source category showing a reduction in emissions was agriculture, which reduced by 35,600 tonnes of $CO_{2\text{-}e}$. This represents a reduction of 2.8% and results from the net loss of livestock due to the foot and mouth outbreak in 2001.

All expressed as Carbon unless otherwise stated	UK UNFCCC Reported Emissions Millions Tonnes Carbon-e				Herefordshire '000s Tonnes Carbon-e	
Source Category	**UK 1990**	**UK 2000**	**UK 2001**	**UK 2002**	**HR 2000**	**HR 2002**
Energy	164.6	150.9	154.9	150.3	415.2	405.9
Industrial Processes	15.7	8.6	7.9	7.0	55.9[19]	50.6
Solvents	-	-	-	-	-	-
Agriculture	14.6	13.5	12.7	12.8	327.5	291.9
Land-use Change and Forestry (emissions)	5.3	4.2	4.1	3.7	9.2	8.3
Land-use Change and Forestry (removals)	-2.9	-3.2	-3.2	-3.2	-61.0	-60.1
Waste	7.3	3.8	3.5	3.1	45.4[20]	45.0
Others	-	-	-	-	-	-
Total Emissions Only	207.9	180.8	183.0	176.8	844.0	793.5
Total (net Carbon – sum of emissions and removals)	205.0	177.6	179.9	173.7	792.2	741.8
Per Capita (tC/head)	3.65	3.02	3.08	2.99	4.57	4.54
Total net CO_2-e	751.6	651.2	659.6	636.9	2904.7	2719.9
Per Capita ($tCO_{2\text{-}e}$ gas/h)[21]	13.40	11.08	11.27	10.95	16.75	15.55

Table 3-2 Aggregate Emissions by Source Category - UK & Herefordshire

The background supporting schedules for Table 3-2 are included in Appendix 1. On a per capital basis, Herefordshire's greenhouse gas emissions were some 42 % higher than the average UK per capital emissions. This is primarily due to the relatively high emissions arising from agriculture and is characteristic of rural areas.

3.3 Other sector splits

It is considered important to provide cross-sector data analysis to highlight conventional sectors of interest. Some of these categories are included as sub-sectors under the CRF and data can be isolated. This is because it should be recognised that absolute energy consumption does not directly relate to absolute greenhouse gas emissions, in particular, domestic energy demand includes a variety of fossil fuels for direct combustion (space heating) and electricity, all of which have to be determined individually. Table 3-3 presents the cross-sector breakdown of Herefordshire's reference emissions, where the electrical energy consumption has been determined according to the procedure described in Appendix 1.

[19] There was an error in the data from NAEI due to confusion between $C_{\text{-e}}$ and $CO_{2\text{-e}}$ units. Figure reported as 25.9, estimated 2000 error-corrected figure is 55,900 $tC_{\text{-e}}$
[20] Based on 2002 figures returned to the Environment Agency plus 1% per year decay factor.
[21] CO_2-e as gas is C-e multiplied by 44/12, the ratio of molecular weights which accounts for the mass of the oxygen molecules.

All expressed as Carbon unless otherwise stated		UK UNFCCC Reported Emissions Millions Tonnes Carbon-e				Herefordshire Tonnes Carbon-e	
Source Category		**1990**	**2000**	**2001**	**2002**	**2000**	**2002**
Energy		**164.9**	**150.9**	**154.9**	**150.3**	**415,231**	**405,991**
a)	**Fuel Combustion**	**153.9**	**144.3**	**149.0**	**144.6**	**415,231**	**405,991**
	a. Energy	62.9	53.1	55.3	52.9	100,375	88,165
	b. Manufacturing & Const.	26.1	24.3	24.8	22.9	38,193	36,881
	c. Transport	32.3	33.7	34.8	34.9	155,987	157,332
	d. Commercial/institutional	8.3	32.4	33.3	7.0	41,593	42,830
	e. Domestic	22.2			24.1	67,823	69,955
	f. Others	2.1	0.8	0.8	2.8	11,260	10,828
b)	**Fugitive Emissions**	**11.0**	**6.6**	**5.9**	**5.7**	**0**	**0**
	a. Solid Fuel	5.5	2.8	2.0	2.0	0	0
	b. Oil & Gas	5.5	3.8	3.9	3.7	0	0
Industrial Processes		**15.4**	**7.9**	**7.5**	**7.0**	**61,974**	**50,568**
a)	Mineral Products	3.0	2.3	2.1	2.1	0	0
b)	Chemical Industry	8.4	2.1	1.9	1.2	0	0
c)	Metals production	0.9	0.9	0.8	0.4	2,727	2,727
d)	Food & Drink	0[23]	0[21]	0[21]	3.1	5,764	5,480
e)	Halocarbons & SF6	3.1	2.6	2.7	3.3	0	0
f)	Others (area based)[22]	0	0	0	0	53,483	42,361
Agriculture		**14.6**	**13.5**	**12.6**	**12.7**	**327,452**	**291,877**
a)	Enteric Fermentation	5.2	5.0	4.6	4.6	263,045	229,824
b)	Manure Management	1.1	1.0	1.0	0.9	64,407	62,053
c)	Agricultural Soils	8.3	7.5	7.0	7.2	0	0
d)	Field Burning	0.1	0	0	0	0	0
Land Use Change & Forestry		**2.4**	**1.0**	**0.9**	**0.5**	**-52,001**	**-51,727**
a)	Changes in Biomass	-2.6	-2.9	-2.9	-2.9	-57,873	-57,873
b)	Grassland Conversion	0.1	0.1	0.1	0.1	0	0
c)	Changes in Managed land	0	0	0	2.7	-3,315	-2,202
d)	Removals from soils	4.9	3.8	3.7	0.6	9,187	8,348
Waste		**7.3**	**3.9**	**3.5**	**3.1**	**45,412**	**45,083**
a)	Solid Waste Disposal	6.5	3.2	2.8	2.4	45,412	45,083
b)	Wastewater handling	0.5	0.5	0.6	0.5	0	0
c)	Waste Incineration	0.3	0.2	0.1	0.2	0	0
Total (Carbon-e)		**205.0**	**177.6**	**179.9**	**173.7**	**798,068**	**741,792**
Total (CO_2-e)		**751.7**	**651.3**	**659.7**	**636.8**	**2,926,249**	**2,719,904**

Table 3-3 Aggregate Emissions by sector – UK and Herefordshire

[22] Taken from NAEI Area Based emissions related to population density
[23] Included in chemical industry

Table 3-3 clearly illustrates the relative importance of the main sectors. Table 3-4 compares the UK and Herefordshire inventory percentages.

All expressed as Carbon unless otherwise stated	UK UNFCCC Reported Emissions % of Total				Herefordshire Tonnes Carbon-e % of Total	
Source Category	**1990**	**2000**	**2001**	**2002**	**2000**	**2002**
Energy	**80.5**	**84.9**	**86.1**	**86.5**	**52.0**	**54.7**
a) Fuel Combustion	**75.1**	**81.2**	**82.8**	**83.2**	**52.0**	**54.7**
b. Energy	30.6	29.9	30.7	30.5	12.6	11.9
c. Manuf. & Const.	12.7	13.7	13.8	13.2	4.8	5.0
d. Transport	15.8	19.0	19.3	20.1	19.6	21.2
e. Comm & instit.	4.0	18.2	18.5	4.0	5.2	5.8
f. Domestic	10.8			13.9	8.5	9.4
g. Others	1.0	0.5	0.4	1.6	1.4	1.5
b) Fugitive Emissions	**5.4**	**3.7**	**3.3**	**3.3**	**0**	**0**
a. Solid Fuel	2.7	1.6	1.1	1.2	0	0
b Oil & Gas	2.7	2.1	2.2	2.1	0	0
Industrial Processes	**7.5**	**4.5**	**4.2**	**4.0**	**7.7**	**6.8**
a) Mineral Products	1.5	1.3	1.2	1.2	0	0
b) Chemical Industry	4.1	1.1	1.1	0.7	0	0
c) Metals production	0.4	0.5	0.4	0.2	0.3	0.4
d) Food & Drink	0[25]	0[21]	0[21]	1.7	0.7	0.7
e) Halocarbons & SF6	1.5	1.5	1.5	1.9	0	0
f) Others (area based)[24]	0	0	0	0	6.7	5.7
Agriculture	**7.1**	**7.6**	**7.0**	**7.3**	**41.0**	**39.4**
a) Enteric Fermentation	2.5	2.8	2.6	2.6	33.0	30.9
b) Manure Management	0.5	0.6	0.6	0.6	8.1	8.4
c) Agricultural Soils	4.1	4.2	3.9	4.1	0	0
d) Field Burning	0.0	0	0	0	0	0
Land Use Change & Forestry	**1.2**	**0.6**	**0.5**	**0.4**	**-6.5**	**-7.0**
a) Changes in Biomass	-1.3	-1.6	-1.6	-1.7	-7.3	-7.8
b) Grassland Conversion	0.0	0.0	0.0	0.0	0	0
c) Changes in Managed land	0	0	0	1.6	-0.4	-0.3
d) Removals from soils	2.5	2.2	2.1	0.3	1.2	1.1
Waste	**3.7**	**2.2**	**1.9**	**1.8**	**5.7**	**6.1**
a) Solid Waste Disposal	3.4	1.8	1.6	1.4	5.7	6.1
b) Wastewater handling	0.2	0.3	0.3	0.3	0	0
c) Waste Incineration	0.1	0.1	0.0	0.1	0	0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 3-4 Aggregate Percentage Emissions by Sector– UK and Herefordshire

3.4 Detailed Sector Breakdowns - Energy

Greenhouse gas emissions associated with energy use can be separated into electricity use and thermal energy use. These two forms of energy are not the same because emissions associated with electricity consumption are up to 3 times those associated with thermal energy resulting from the burning of fossil fuels.

[24] Taken from NAEI Area Based emissions related to population density
[25] Included in chemical industry

3.4.1 Electricity Consumption

The electrical energy consumption in Herefordshire has been determined by two methods – method 1 provides a comparator set of data published by the DTI task group on NUTS4 areas in the West Midlands – method 2 uses published data on the distribution grid to arrive at an overall electrical energy consumption

3.4.2 Method 1 – DTI Aggregate data

Table 3-5 provides the summary data published by the DTI[26]. This is to be published annually. The data remains provisional but superior to all other sources.[27]

2002/03 Data	Domestic consumers		Commercial and industrial consumers		All consumers	
NUTS4 Area and Government Office Region	Sales 2002/3 GWh	Number of MPANs [28] ('000s)	Sales 2002/3 GWh	Number of MPANs ('000s)	Sales 2002/3 GWh	Number of MPANs ('000s)
Birmingham	1,852	408.5	1,695	33.6	3,547	442.1
Bridgnorth	124	22.3	86	2.8	209	25.1
Oswestry	82	15.9	79	1.7	160	17.6
South Shropshire	113	19.2	69	3.0	181	22.2
Cannock Chase	176	38.7	110	2.9	287	41.6
Malvern Hills	179	31.9	109	3.2	288	35.2
Bromsgrove	191	36.9	97	2.9	288	39.8
North Shropshire	131	22.2	158	2.9	289	25.1
Tamworth	147	30.4	178	2.1	325	32.5
Wyre Forest	197	41.8	143	3.2	340	45.0
Redditch	145	33.0	207	2.1	352	35.1
South Staffordshire	211	43.2	152	2.7	363	45.9
Shrewsbury and Atcham	202	41.9	168	4.4	369	46.3
Worcester	176	40.6	194	3.2	370	43.8
Lichfield	200	39.3	174	3.2	374	42.5
Newcastle-under-Lyme	221	52.2	201	3.6	422	55.8
North Warwickshire	136	23.5	291	2.2	428	25.7
Nuneaton and Bedworth	234	52.2	213	0.5	447	52.7
Stafford	257	52.9	194	4.7	450	57.6
Wychavon	266	48.7	205	4.8	471	53.5
Rugby	200	38.7	305	0.5	505	39.2
Stratford-on-Avon	300	49.1	275	4.4	576	53.6
Telford and Wrekin	283	64.8	410	4.9	693	69.7
Solihull	447	84.8	272	4.6	719	89.4
East Staffordshire	227	45.2	502	0.7	729	45.9
Warwick	277	55.7	454	1.4	732	57.0
Herefordshire, County of	420	76.0	312	9.5	732	85.4
Staffordshire Moorlands	193	40.9	549	4.1	742	45.1
Wolverhampton	453	103.2	372	8.3	826	111.5
Stoke-on-Trent	421	108.0	438	8.3	859	116.2
Walsall	494	108.0	435	8.2	929	116.2
Dudley	586	129.1	444	9.5	1,030	138.6
Sandwell	521	123.0	634	9.9	1,155	132.9
Coventry	558	129.2	945	8.4	1,504	137.6
TOTAL	**10,619**	**2,251.0**	**11,071**	**172.6**	**21,689**	**2,423.6**
Herefordshire %	**3.95**	**3.38**	**2.81**	**5.50**	**3.37**	**3.52**

Table 3-5 Electricity consumption data - NUTS4 Level

[26] http://www.dti.gov.uk/energy/inform/energy_trends/elec2003nuts4regionsexp.xls
[27] The West Midlands Regional Energy Strategy was published in November 2004 overestimated the regional electricity consumption by 29% when compared to the DTI NUTS4 data in table 3-4. This was mainly the result of a flawed methodology that used population scaling of national electricity consumption.
[28] Number of Metre Points

It can be seen that the domestic electricity consumption is estimated at 420 GWh sold through 76,000 metering points and commercial and industrial consumption was 312 GWh sold through 9,500 metering points. The total electrical energy sold inside Herefordshire was therefore, 732 GWh. Using the standard carbon dioxide emission factor recommended by Defra for use until 2010 (0.43 kg CO2 gas per kWh), total emissions associated with electricity consumption amount to 314,760 tonnes of CO_2-e gas, or 85,843 t C-e. In addition to the carbon emissions associated with electricity consumption, there are also emissions of other greenhouse gases, most notably methane and nitrous oxide associated with electricity generation and these are included in the emissions inventory.

The emissions associated with methane are based on overall emissions from the UK power generation system, namely 8,454 t CH_4 divided by to electricity sent out of 357,266 GWh. This equates to an emission factor of 0.000024 t CH_4/MWh[29] or 17.6 tonnes of CH_4 per year. When converted into carbon equivalent, the associated emissions are 100.6 t C-e per year, or 368.8 tonnes CO_2-e gas. This gives a total of 315,129 tonnes of CO_2-e gas.

3.4.3 Method 2 – Herefordshire Transformer Power Flow

It is advisable to make use of a second or comparator methodology for assessing key emissions groups like electricity consumption. The Herefordshire Greenhouse Gas Inventory makes use of a transformer power flow model that is referred to as method 2.

Herefordshire is supplied by a 132 kV power flow from either Bishops Wood or Gloucester. This power is stepped down to the 66/11 kV power distribution network through 20 sub-stations cited within Herefordshire and one shared sub-station in Tenbury – Worcestershire. Table 3.6 shows the actual power flow through each substation and the projected power flow through each sub-station until 2006/07.

Figure 3-1 shows the 66/11 kV distribution network for Herefordshire. Each network point represents a local transformer substation which steps the voltage down to 230 Volts 3-phase that is then distributed out to households, industrial and commercials customers. In total there are about 76,000 domestic customers and 9,500 industrial and commercial customers connected to the Herefordshire power network.

Table 3.7 shows that actual peak firm power capacity in Herefordshire was 232.2 MW in 2001/02, which supplies a peak power flow of 137 MW, giving a reserve margin of 69%. The peak power flow through Bishops Wood was 99.6 MW and the peak power flow from Gloucester was 37.4 MW. In addition, the power flow from Gloucester also includes a further 14 MW supplied by a 132/66 kV spur to the Transco gas pumping station near Ross-on-Wye, making the total power flow from Gloucester of 51.4 MW. The analysis excludes the dedicated power flow to Transco at Perterstow, since very little is known about the load duration and power flow characteristics of the site.

Method 2 determines the annual amount of electrical energy supplied through the various distribution transformers by the use of a load duration curve shown in Figure 3-3. The load duration curve defines the length of time that the overall power flow to

[29] Data for overall emissions taken from UK Energy and Mass balance C-Tech 2003, Capenhurst – http://www.capenhurst.com

Herefordshire through the main grid connection point is at least equal to a given level. Therefore, in this case, the area under the curve multiplied by the annual hours of operation and the peak power flow is equal to the total annual energy consumption.

Table 3.7 indicates that two methods are very close in predicting the emissions associated with power consumption in Herefordshire – 98.5% agreement.

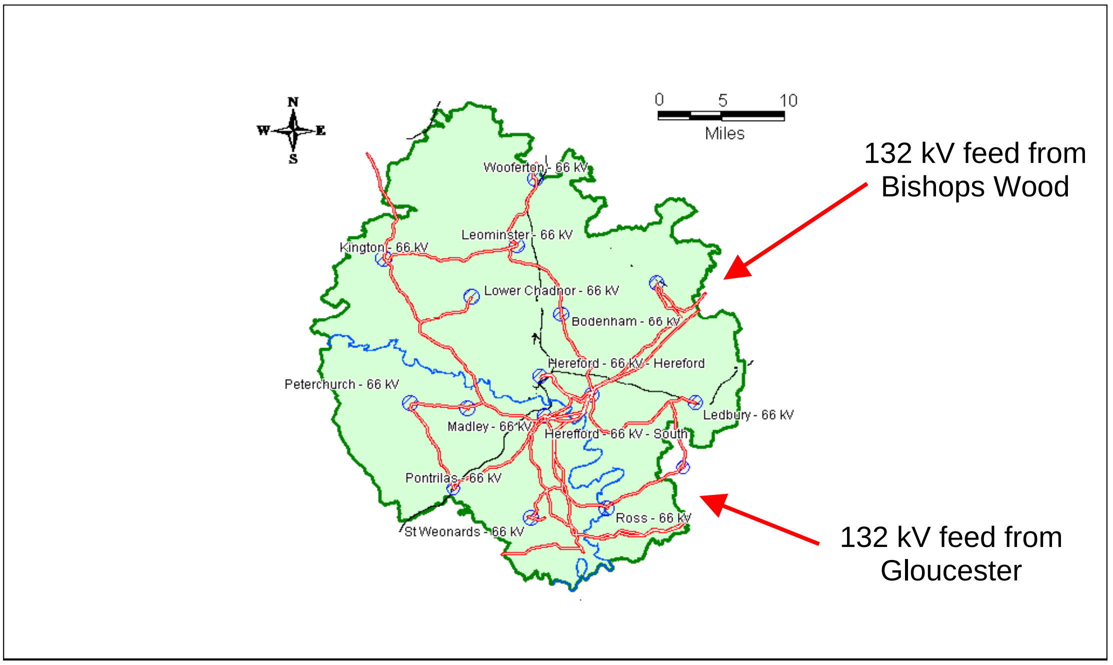

Figure 3-1 Herefordshire 66/11 kV Power grid

Substation	Voltage Level kV	Firm Capacity MVA	Demand (MVA) - Corrected to ACS[30] conditions					
			Actual			Forecast		
			2002	2003	2004	2005	2006	2007
Hereford (Bishops Wood)[31]	66.0	117.0	99.3	91.3	92.8	94.2	84.8	86.1
Bodenham	11.0	-	8.6	8.7	8.9	9.0	9.1	9.3
Bromyard	11.0	13.0	10.2	10.4	10.5	10.7	-	-
Dymock	11.0	-	4.5	4.6	4.6	4.7	4.8	4.9
Kenswick T1	11.0	6.5	-	-	-	-	-	-
Kington	11.0	9.8	9.8	10.0	10.1	10.3	10.4	10.6
Knighton	11.0	10.0	6.4	6.6	6.6	6.7	6.8	6.9
Ledbury T1	11.0	24.0	6.1	6.2	6.3	6.4	6.5	6.6
Ledbury T2	11.0	24.0	9.4	-	-	-	-	-
Lower Chadnor	11.0	-	4.8	4.9	5.0	5.0	5.1	5.2
Madley	11.0	9.8	6.9	7.0	7.1	7.2	7.3	7.4
Newent	11.0	-	9.1	9.2	9.4	9.5	9.7	9.8
Peterchurch	11.0	7.8	5.8	5.9	6.0	6.1	6.2	6.3
Pontrilas	11.0	-	4.2	4.3	4.3	4.4	4.5	4.5
Presteigne	11.0	10.0	8.6	8.7	8.9	9.0	9.1	9.3
Ross	11.0	21.0	18.6	18.9	19.2	19.5	19.8	20.1
St. Wenards	11.0	-	4.3	4.4	4.4	4.5	4.6	4.6
Hereford North	11.0	65.0	59.2	60.1	61.1	62.0	62.9	63.9
Hereford South	11.0	40.0	35.8	36.4	36.9	37.5	38.1	38.6
Tenbury (Worcestershire) [27]	11.0	9.8	9.9	10.4	10.6	10.7	10.9	11.1
Leominster	11.0	40.0	19.0	19.3	19.6	19.9	20.2	20.5
Bromyard	11.0	13.0	-	-	-	-	10.8	11.0
Total 66/11 MVA Installed	-	293.9	231.3	225.6	228.9	232.4	235.9	239.5
Total MW[32]	-	-	210	193	199	205	198	204
Average MW	-	-	145	136	139	143	140	144

Table 3-6 Peak Power Flow through Herefordshire 66/11 kV sub-stations

[30] ACS - Average cold weather conditions
[31] Excluded from totals since all 132/66 kV power flow is passed through 66/11 kV step down substations. There is one exception to this, namely the Transco sub-station at Peterchurch that draws a total of 14 MW for 2 centrifugal natural gas compressors. This data is excluded from the Aquila network diagramme and the analysis.
[32] MVA x power factor = MW. The average power factor is assumed to be 0.79 for the 66/11 kV and 0.8 for the 132/66 kV networks.

Substation	Average Load Duration (hrs)	Firm Capacity MVA	Demand (MVA) - Corrected to ACS conditions					
			Actual			Aquila Forecast		
			2002	2003	2004	2005	2006	2007
Annual Maximum Demand MW from Table 3-5	-	**232.2**	-	-	-	-	-	-
Percentage of Firm Capacity	-	-	61.9	58.9	60.7	62.5	64.4	66.4
Annual Minimum Demand MW	-	-	72.73	70.93	71.97	73.07	74.17	75.30
Percentage of Firm Capacity	-	-	31.3	30.5	31.0	31.5	31.9	32.4
Growth rate % per year	-	-	-	-4.87%	2.95%	3.08%	3.03%	3.08%
Average Demand MW	-	-	108.27	103.87	106.40	109.12	111.88	114.74
Average Load Duration (hours per year)	**5503**	-	-	-	-	-	-	-
Growth rate % per year	**-**	-	-	-13.35%	2.81%	2.58%	-16.30%	2.59%
Gloucester 132/66 kV Power Flow MW	**4772**	-	36.82	31.90	32.80	33.64	28.16	28.89
Energy MWh per year method (2)	-	-	**771475**	**723834**	**742054**	**761063**	**750051**	**769308**
Carbon tonnes method (2)	-	-	90473	84886	87023	89252	87960	90219
Associated Methane Emissions	-	-	18.52	17.37	17.81	18.27	18.00	18.46
Carbon-e tonnes method (2)	-	-	90492	84903	87041	89270	87978	90237
CO_2-e tonnes method (2)	-	-	331802	311312	319149	327324	322588	330870

Energy MWh from Table 3.4 method (1)	-	-	-	**732000**	-	-	-	-
Carbon tonnes method (1)	-	-	-	**85844**	-	-	-	-
Associated Methane Emissions method (1)	-	-	-	**17.57**	-	-	-	-
CO_2-e tonnes method (1)	-	-	-	**316114**	-	-	-	-
Ratio of methods (1) to (2) CO_2-e (%)	-	-	-	*98.5 %*				

Table 3-7 Comparison of electricity consumption by Methods (1) and (2)

Notes:
1) The average power factor is assumed to be 0.79 for 66/11 kV and 0.8 for 132/66 kV
2) The Load duration curve is shown in Figure 3.2 this is used to determine the average load hours per year
3) The Maximum and minimum demand is shown in Figure 3.3
4) The negative growth rate in 2002/03 was primarily due to a very warm winter period and a reduction in industrial power demand
5) The growth rates from 2003/04 onwards are estimates from Aquila.

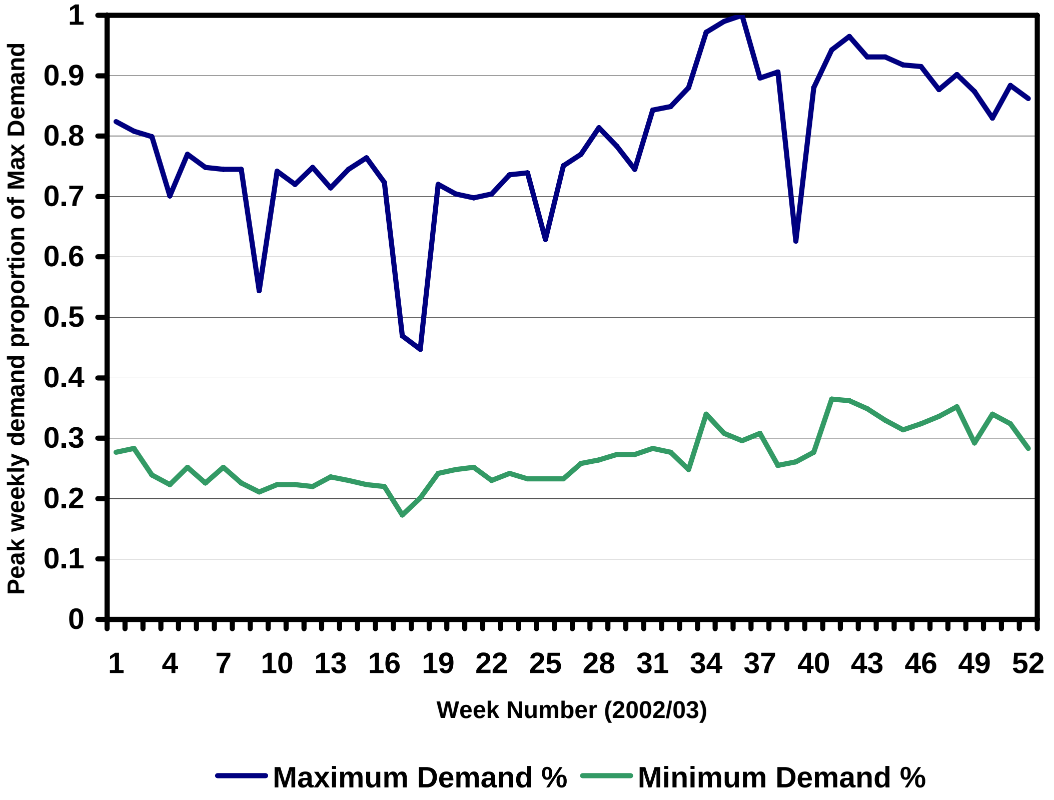

Figure 3-2 Maximum and Minimum Demand - Aquila Area

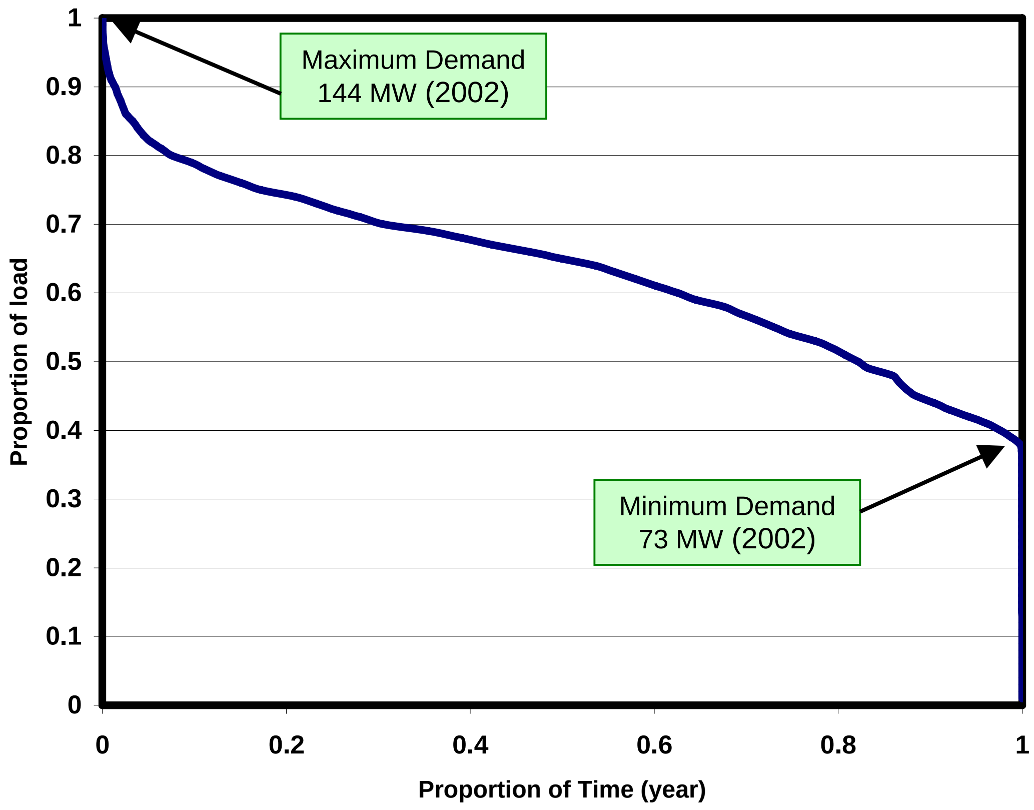

Figure 3-3 Annual Load-Duration Curve

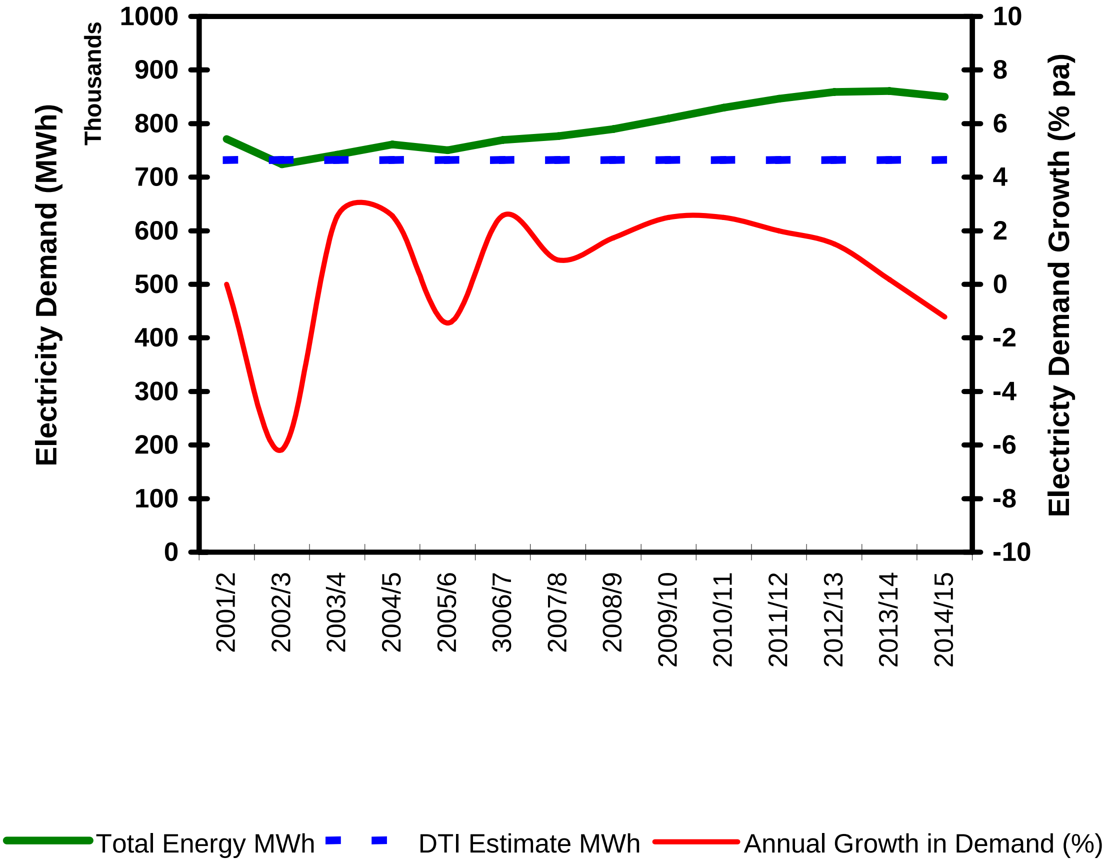

Figure 3-4 Business-as-usual forecast Electricity Demand

3.5 Sector CO_2 Emissions For Herefordshire (2003) – Defra Data[33]

Nationally, carbon dioxide (CO_2) is the main greenhouse gas, accounting for about 85 per cent of the total, and the vast majority of CO_2 emissions come from the burning of fossil fuels. In recent years, increasing emphasis has been placed on the role of regional and local government in contributing to energy efficiency improvements.

Defra commissioned Netcen[34] to compile data from the National Atmospheric Emissions Inventory (NAEI) with newly available local energy consumption data from the Department of Trade and Industry (DTI) to develop for the first time a nationally consistent set of CO_2 emission estimates down to local authority level, which attributes the emissions from electricity generation (about 30 per cent of total UK emissions) to the location of the customers rather than to the location of the power stations. This procedure follows that adopted for the Herefordshire Emissions Inventory but excluded the contributions from non-CO_2 greenhouse gases, which are included in the Herefordshire inventory.

33 Experimental Statistics on carbon dioxide emissions at Local Authority and Regional Level Defra Statistics Summary 21 October 2005 http://www.defra.gov.uk/environment/statistics/globatmos/galocalghg.htm

34 Netcen - http://www.netcen.co.uk/

This re-allocation of power station emissions is one of the key characteristics of this data set and this data provides reconciliation with the Herefordshire Emission Inventory. The general principle is that emissions are distributed according to the point of energy consumption (or point of emission if not energy related). Except for the electricity industry, emissions from the production of goods are assigned to where the production takes place – thus as with the national inventories, emissions from the production of goods which are exported will be included, and emissions from the production of goods which are imported are excluded. The Herefordshire Inventory is entirely consistent with this approach.

All expressed as Carbon unless otherwise stated	Herefordshire Tonnes Carbon-e (CO_2 Only)			
Source Category	**2000**	**2001**	**2002**	**2003**[35]
Energy	**415,230**	No Data Available	**405,991**	**391,919**
b. Fuel Combustion	**415,230**		**405,991**	**391,919**
a. Energy	100,375		88,165	87,041
b. Manufacturing & Const.	38,193		36,881	34,661
c. Transport	155,987		157,332	154,660
d. Commercial/institutional	41,593		42,830	34,661
e. Domestic	67,823		69,955	77,317
f. Agriculture/Forestry	11,260		10,828	3,579
c. Fugitive Emissions	**0**		**0**	**0**
a. Solid Fuel	0		0	0
b. Oil & Gas	0		0	0
Industrial Processes	**61,674**		**50,568**	**48,031**
g) Mineral Products	0		0	0
h) Chemical Industry	0		0	0
i) Metals production	2,727		2,727	2,727
j) Food & Drink	5,764		5,480	5,045
k) Halocarbons & SF6	0		0	0
l) Others (area based)[36]	53,483		42,361	40,259
Total (Carbon-e) (CO_2 only)	**476,904**		**456,559**	**441777**
Total (CO_2-e) (CO_2 only)	**1,748,648**		**1,674,049**	**1,619,849**
% Change Per Year	**0%**		**-2.1%**	**-3.2%**

Table 3-8 Herefordshire CO_2 Emissions (2003 Defra Summary Data)

[35] Data taken Experimental Statistics on carbon dioxide emissions at Local Authority and Regional Level Defra Statistics Summary 21 October 2005
[36] Taken from NAEI Area Based emissions related to population density

The data for CO_2 emissions for the period between 2000 and 2003 (4 years inclusive) shows that total emissions have reduced over the period by 129,000 tonnes of CO_2 (gas) or 35,182 tonnes of Carbon.

Figure 3-5 shows the BAU baseline projections for total greenhouse gas emissions and CO_2 emissions, each expressed as tonnes of carbon.

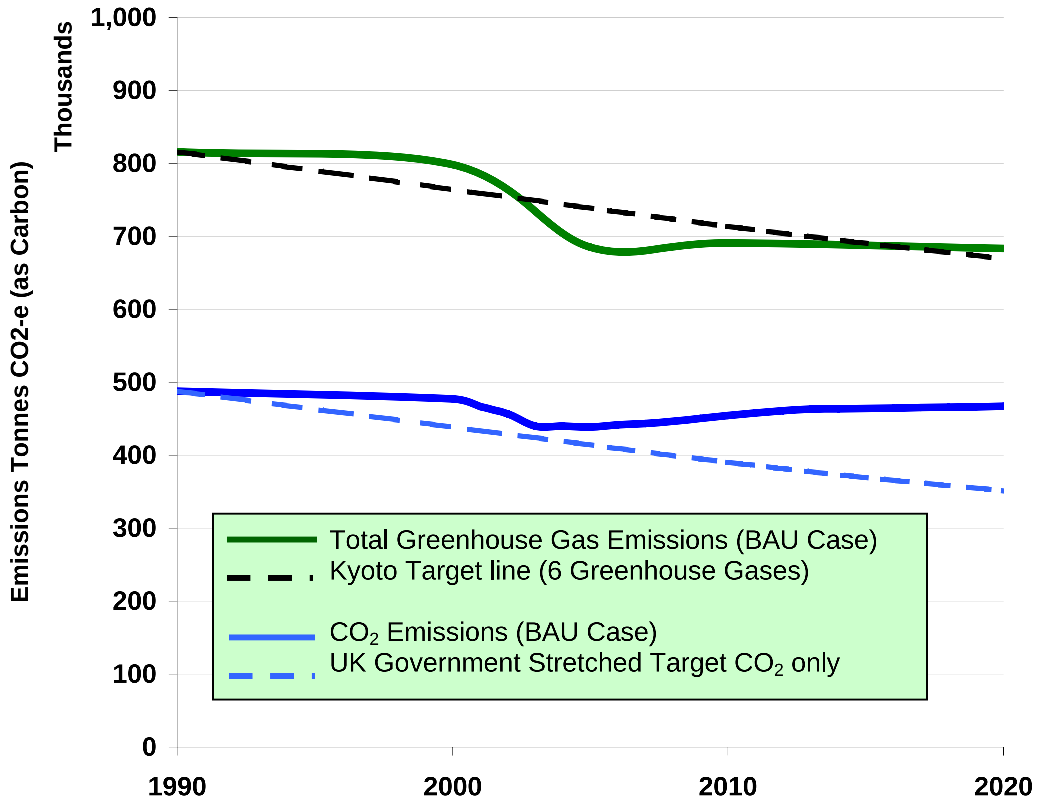

Figure 3-5 Total Greenhouse Gas and CO_2 Baselines

Figure 3-5 confirms that the dip in Herefordshire CO_2 emissions in the period between 2000 and 2003. Up to 2004, Herefordshire's CO_2 emission resulted in a close convergence with the UK Government stretched target of 20% reduction CO_2 emissions (relative to 1990) by 2010. However, by 2010, the Business-As-Usual (BAU) case indicates that Herefordshire's CO_2 emissions are likely to diverge from the UK Government stretched target.

Figure 3-5 also demonstrates a very similar trend fro total greenhouse gas emissions, which if the current trajectory were maintained through to 2020, would result in Herefordshire meeting the UK's Kyoto Protocol target for the 2008-2012 commitment period.

4 Emissions Targets

There are a number of government targets for greenhouse gas emissions reductions and this forms the backdrop to structuring the changes that will be required to secure the emissions reductions. Figure 4.1 illustrates the emissions reduction trajectories for a range of 2050 end-point reductions. The 2003 Energy White Paper recommended a target of 60% reduction in CO_2 emissions by 2050. This has been accepted by the UK Government and policies are established to secure this reduction.

The Business as Usual (BAS) case is estimated by changes occurring in the baseline emissions inventory between 2000 and 2002 (and 2003 based on Defra data for CO_2 only) and applying trend changes from forward projections of electricity consumption from Aquila Networks, targets for Herefordshire Council landfill set under the landfill Directive. The data is shown in Table 4.2.

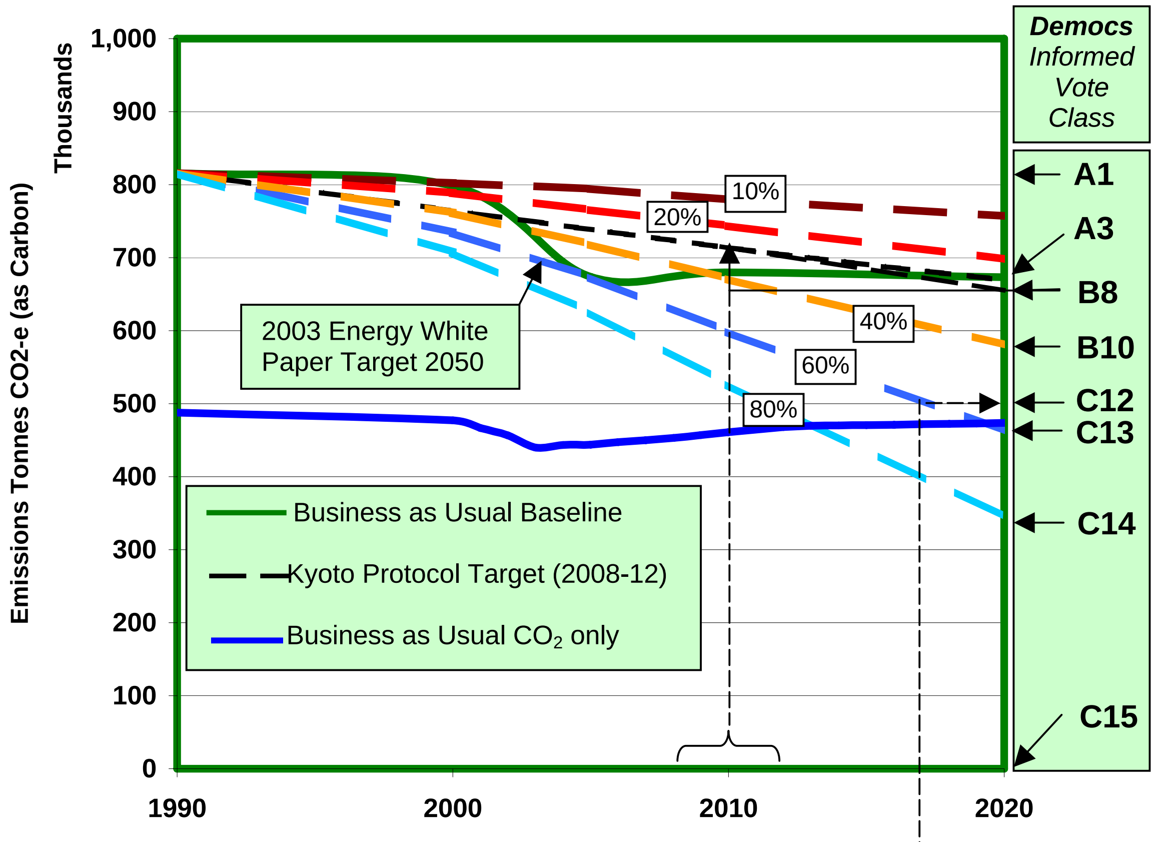

Figure 4-1 BAU and Emissions Reduction Targets

	Vote Class														
Second Vote	**React**					**Act Within Constraints**					**Do More**				
Possible Responses	**A**	**A**	**A**	**A**	**A**	**B**	**B**	**B**	**B**	**B**	**C**	**C**	**C**	**C**	**C**
Score position	**1**	2	**3**	4	5	6	7	**8**	9	**10**	11	12	**13**	**14**	**15**
Score Shift	←	←	0	→	→	←	←	0	→	→	←	←	0	→	→
Interpretation	Business as Usual					Kyoto Targets					Energy White Paper Targets				

Table 4-1 shows a summary of the sector emission reduction targets for the BAU case:

Source Category	Business As Usual (BAU) Projection				
	2002	2010	2020	2030	2050
Energy	405,991	415,490	428,216	436,996	464,945
Industrial Processes	50,568	44,864	41,273	38,028	32,440
Agriculture	291,877	230,863	219,473	208,502	187,738
Land Use Change & Forestry	-51,727	-54,036	-57,116	-60,353	-67,334
Waste	45,083	43,767	42,122	40,477	37,187
Total	**741,792**	**680,949**	**673,968**	**663,649**	**654,976**
Democs Score Position	**B10**	**B8**	**B6**	**A3**	**A2**

Table 4-1 Summary of Sector Emissions BAU Projection

The final row of the BAU projection indicates the Democs score position. It can be seen that the reductions in total emissions by 2002 (which are significantly due to reduced agricultural emissions) places the reduction trend around Democs score position B10 in Figure 4-1 which is at the top end of the Kyoto Protocol targets. Progressively, the BAU projection shifts towards the Business as Usual A3 and A2 end of the Democs scale, which is the Business as Usual range.

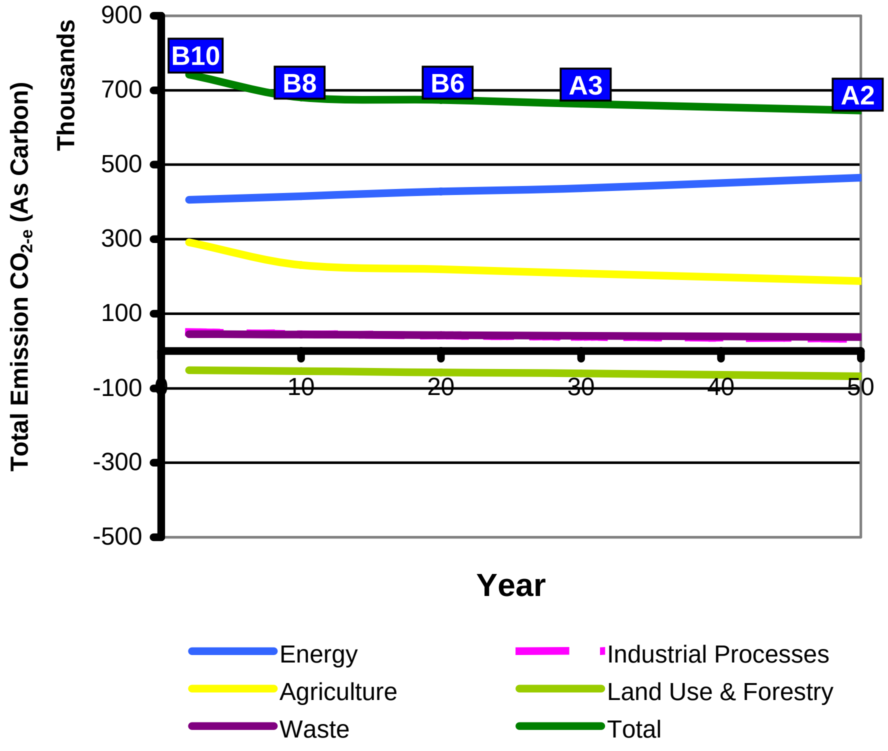

Figure 4-2 Forward Projection of Total Emissions

Table 4-2 shows a summary of the sector emissions reduction targets derived from the Democs consultation. The Democs consultation produced an informed vote class of 11.85, represented by a Democs score position of just less than C12. This translates into an emission reduction trajectory of 60%, the adopted Government 2002 Government White Paper Target for 2050.

Source Category	Democs Consultation Projection (C-e)				
	2002	2010	2020	2030	2050
BAU Projection	741,792	680,949	673,968	663,649	654,976
Democs Projection	721,960	598,235	462,272	371,631	326,310
Difference	**-19,832**	**-82,714**	**-211,696**	**-292,018**	**-328,666**
Yearly Savings (all sectors)	**N/a**	**-17,944**[37]	**-21,170**	**-29,202**	**-16,433**

Table 4-2 Summary of Sector Emissions Democs Projection

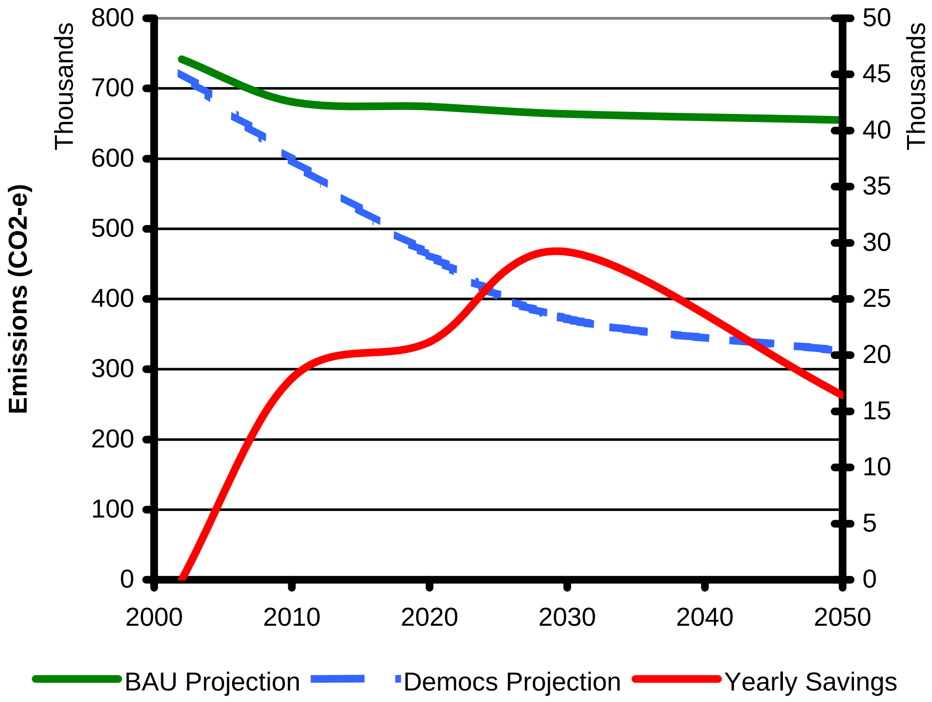

Figure 4-3 Annual Emissions Reduction Targets

The projected emissions reductions are based on standard diffusion curves. These have the result of clearly demonstrating that the greatest annual reduction in emissions will be around 2030, when Herefordshire will need to secure annual savings of 29,000 tonnes of C_{-e} (equivalent to 106,000 tonnes per annum of CO_{2-e} gas).

4.1 Emissions Target – 2010

Table 4.2 lists the overall and sector emissions projections for 2010, the mid point of the Kyoto first compliance period based on the Business as Usual case. The total greenhouse gas emissions are projected to be 680,949 tonnes

[37] 2010 reduction is relative to the 2002 BAU Baseline and not the 2002 Democs Projection.

of C_{-e}. Table 4-2 provides a BAU projection, which indicates a potential 8.4% reduction in emissions by 2010 (relative to 2002 baseline). Downward trends are projected for industrial processes, mainly from "areas based" emissions, agricultural emissions, mainly from enteric fermentation and manure management consequent upon the CAP reforms, land use and forestry, again connected with changes in the CAP and the growth of sustainable woodland management and waste resulting from the implementation of the Landfill Allowances Scheme implemented under the Landfill Directive. The emissions from energy related activities are expected to rise, being the combined result of increased emissions associated with energy use (exclusively electricity consumption), transport (road fuel consumption) and domestic fuel combustion (oil, gas, coal and LPG consumption). In contrast, emissions from manufacturing and construction sectors are expected to reduce along with emissions from commercial and institutional sectors, mainly because of measures already implemented or actions being undertaken.

Using the Democs target of a 60% reduction trajectory the total greenhouse gas emissions would need to be reduced to 598,235 tonnes of C_{-e} (or 2,193,528 tonnes of CO_{2-e} gas) by 2010. This represents an additional reduction of 81,438 tonnes of C_{-e} (or 298,598 tonnes of CO_{2-e} gas) compared to the BAU projection for 2010. The action plan of the Herefordshire Partnership Climate Change Strategy is designed to secure emissions reduction of 17,944 tonnes C_{-e} per year to 2010, or 65,800 tonnes of CO_{2-e} per year relative to the 2002 baseline.

All expressed as Carbon unless otherwise stated	Herefordshire BAU Projections (Tonnes C-e)					
Source Category	***1990***	**2000**	**2002**	**2010**	**Change TC-e**	**%** [38]
Energy			**(1)**	**(2)**	**(2-1)**	**(2-1)/(1)**
a) Fuel Combustion	***424,444***	**415,231**	**405,991**	**415,490**	**+9,499**	**+0.24**
b.Energy (electricity)	*102,602*	100,375	88,165	97,325	+9,160	+10.4
h.Manuf. & Const.	*39,040*	38,193	36,881	32,458	-4,423	-12.0
i. Transport	*159,448*	155,987	157,332	165,816	+8,484	+5.4
j. Comm & instit.	*42,516*	41,593	42,830	33,133	-9,697	-22.6
k. Domestic	*69,328*	67,823	69,955	84,621	+14,666	+20.9
l. Others	*11,510*	11,260	10,823	2,136	-8,687	-80.2
b) Fugitive Emissions	***0***	**0**	**0**	**0**	**0**	**0.0**
a. Solid Fuel	*0*	0	0	0	0	0
b Oil & Gas	*0*	0	0	0	0	0
Industrial Processes	***63,349***	**61,974**	**50,568**	**45,514**	**-5,054**	**-9.9**
a) Mineral Products	*0*	0	0	0	0	0
b) Chemical Industry	*0*	0	0	0	0	0
c) Metals production	*2,788*	2,727	2,727	2,727	0	0
d) Food & Drink	*5,892*	5,764	5,480	4,617	-863	-15.7
e) Halocarbons & SF6	*0*	0	0	0	0	0
f) Others (area based)[39]	*54,670*	53,483	42,361	37,524	-4,837	-11.4
Agriculture	***334,717***	**327,452**	**291,877**	**230,863**	**-61,014**	**-14.8**
a) Enteric Fermentation	*268,881*	263,045	229,824	175,537	-54,287	-23.6
b) Manure Management	*65,836*	64,407	62,053	55,325	-6,728	-10.8
c) Agricultural Soils	*0*	0	0	0	0	0
d) Field Burning	*0*	0	0	0	0	0
Land Use Change & Forestry	***-53,155***	**-52,001**	**-51,727**	**-56,013**	**-4,286**	**-8.2**
a) Changes in Biomass	*-59,157*	-57,873	-57,873	-60,277	-2,404	-4.2
b) Grassland Conversion	*0*	0	0	0	0	0
c) Changes in Managed land	*-3,389*	-3,315	-2,202	-2,017	+185	+8.4
d) Removals from soils	*9,391*	9,187	8,348	8,207	-141	-1.7
Waste	***46,420***	**45,412**	**45,083**	**43,767**	**-1,316**	**-2.9**
a) Solid Waste Disposal	*46,420*	45,412	45,083	43,767	-1,316	-2.9
b) Wastewater handling	*0*	0	0	0	0	0
c) Waste Incineration	*0*	0	0	0	0	0
Total	***815,774***	**798,068**	**741,792**	**679,621**	**-62,121**	**-8.4**
Target Democs			721,960	598,235	-143,557	-19.4

Table 4-3 BAU Greenhouse Gas Emissions by Sector (C-e) - 2010

[38] Figures in **red** indicate projected rising emissions
[39] Taken from NAEI Area Based emissions related to population density up to 2002

4.2 Emissions Target – 2020

All expressed as Carbon unless otherwise stated	Herefordshire BAU Projections (Tonnes C-e)					
Source Category	*1990*	2002	2010	2020	Change TC-e	% [40]
Energy			(1)	(2)	(2-1)	(2-1)/(1)
a) Fuel Combustion	*424,444*	**405,991**	**415,490**	**428,216**	**12,726**	**+3.06**
b.Energy (electricity)	*102,602*	88,165	97,325	92,685	-4,640	-4.76
m. Manuf. & Const.	*39,040*	36,881	32,458	32,441	-17	0.0
n.Transport	*159,448*	157,332	165,816	186,846	21,030	+12.7
o.Comm & instit.	*42,516*	42,830	33,133	33,441	308	+0.93
p.Domestic	*69,328*	69,955	84,621	84,679	76	0.0
q.Others	*11,510*	10,823	2,136	2,129	5	0.0
b) Fugitive Emissions	*0*	**0**	**0**	**0**	**0**	**0.0**
a. Solid Fuel	*0*	0	0	0	0	0
b Oil & Gas	*0*	0	0	0	0	0
Industrial Processes	*63,349*	**50,568**	**44,864**	**41,273**	**-3,591**	**-9.3**
g) Mineral Products	*0*	0	0	0	0	0
h) Chemical Industry	*0*	0	0	0	0	0
i) Metals production	*2,788*	2,727	2,727	2,727	0	0
j) Food & Drink	*5,892*	5,480	4,617	4,610	-7	0
k) Halocarbons & SF6	*0*	0	0	0	0	0
l) Others (area based)	*54,670*	42,361	37,524	33,396	-4,128	-11.0
Agriculture	*334,717*	**291,877**	**230,863**	**219,473**	**-11,390**	**-4.9**
e) Enteric Fermentation	*268,881*	229,824	175,537	166,955	-8,582	-4.9
f) Manure Management	*65,836*	62,053	55,325	52,517	-2,808	-5.1
g) Agricultural Soils	*0*	0	0	0	0	0
h) Field Burning	*0*	0	0	0	0	0
Land Use Change & Forestry	*-53,155*	**-51,727**	**-54,036**	**-57,116**	**-5,860**	**-10.5**
e) Changes in Biomass	*-59,157*	-57,873	-60,277	-63,307	-3,080	-10.5
f) Grassland Conversion	*0*	0	0	0	0	0
g) Changes in Managed land	*-3,389*	-2,202	-2,017	-2,017	0	0
h) Removals from soils	*9,391*	8,348	8,207	8,208	0	0
Waste	*46,420*	**45,083**	**43,767**	**42,122**	**-1,645**	**-3.8**
d) Solid Waste Disposal	*46,420*	45,083	43,767	42,122	-1,645	-3.8
e) Wastewater handling	*0*	0	0	0	0	0
f) Waste Incineration	*0*	0	0	0	0	0
Total	*815,774*	**741,792**	**679,621**	**673,431**	**-6,190**	**-0.9**
Target Democs		721,960	598,235	462,272	-135,963	-20.0

Table 4-4 BAU Greenhouse Gas Emissions by Sector (C-e) – 2020

[40] Figures in **red** indicate projected rising emissions

4.3 Emissions Target – 2030

All expressed as Carbon unless otherwise stated	Herefordshire BAU Projections (Tonnes C-e)					
Source Category	***1990***	**2010**	**2020**	**2030**	**Change TC-e**	**%** [41]
Energy			**(1)**	**(2)**	**(2-1)**	**(2-1)/(1)**
a) Fuel Combustion	*424,444*	**415,490**	**428,216**	**436,996**	**8,780**	**+2.05**
b. Energy (electricity)	*102,602*	97,325	92,685	82,302	-10,383	-11.2
r. Manuf. & Const.	*39,040*	32,458	32,441	32,441	0	0
s. Transport	*159,448*	165,816	186,846	202,328	15,482	+8.3
t. Comm & instit.	*42,516*	33,133	33,441	33,441	0	0
u. Domestic	*69,328*	84,621	84,679	84,679	0	0
v. Others	*11,510*	2,136	2,129	2,129	0	0
b) Fugitive Emissions	*0*	**0**	**0**	**0**	**0**	**0.0**
a. Solid Fuel	*0*	0	0	0	0	0
b Oil & Gas	*0*	0	0	0	0	0
Industrial Processes	*63,349*	**44,864**	**41,273**	**38,028**	**-3,245**	**-7.8**
m) Mineral Products	*0*	0	0	0	0	0
n) Chemical Industry	*0*	0	0	0	0	0
o) Metals production	*2,788*	2,727	2,727	2,727	0	0
p) Food & Drink	*5,892*	4,617	4,610	4,610	0	0
q) Halocarbons & SF6	*0*	0	0	0	0	0
r) Others (area based)	*54,670*	37,524	33,396	30,691	-2,705	-8.1
Agriculture	*334,717*	**230,863**	**219,473**	**208,502**	**-10,971**	**-4.9**
i) Enteric Fermentation	*268,881*	175,537	166,955	158,793	-8,162	-4.9
j) Manure Management	*65,836*	55,325	52,517	49,709	2,808	-5.3
k) Agricultural Soils	*0*	0	0	0	0	0
l) Field Burning	*0*	0	0	0	0	0
Land Use Change & Forestry	*-53,155*	**-54,036**	**-57,116**	**-60,353**	**-3,237**	**-5.6**
i) Changes in Biomass	*-59,157*	-60,277	-63,307	-66,545	-3,238	-5.1
j) Grassland Conversion	*0*	0	0	0	0	0
k) Changes in Managed land	*-3,389*	-2,017	-2,017	-2,017	0	0
l) Removals from soils	*9,391*	8,207	8,208	8,208	0	0
Waste	*46,420*	**43,767**	**42,122**	**40,477**	**-1,645**	**-3.8**
g) Solid Waste Disposal	*46,420*	43,767	42,122	40,477	-1,645	-3.8
h) Wastewater handling	*0*	0	0	0	0	0
i) Waste Incineration	*0*	0	0	0	0	0
Total	*815,774*	**679,621**	**673,431**	**663,649**	**-10,309**	**-0.15**
Target Democs		598,235	462,272	371,631	-90,641	-20.0

Table 4-5 BAU Greenhouse Gas Emissions by Sector (C-e) - 2030

[41] Figures in **red** indicate projected rising emissions

4.4 Emissions Target – 2050

All expressed as Carbon unless otherwise stated	Herefordshire BAU Projections (Tonnes C-e)					
Source Category	***1990***	**2020**	**2030**	**2050**	**Change TC-e**	**%** [42]
Energy			(1)	(2)	(2-1)	(2-1)/(1)
a) Fuel Combustion	*424,444*	**428,216**	**436,996**	**464,945**	**27,949**	**+6.4**
a.Energy (electricity)	*102,602*	92,685	82,302	65,701	-16,601	-20.2
b.Manuf. & Const.	*39,040*	32,441	32,441	32,441	0	0
c.Transport	*159,448*	186,846	202,328	246,878	44,550	+22.0
d.Comm & instit.	*42,516*	33,441	33,441	33,117	-324	-1.0
e.Domestic	*69,328*	84,679	84,679	84,679	0	0
f. Others	*11,510*	2,129	2,129	2,129	0	0
b) Fugitive Emissions	*0*	**0**	**0**	**0**	**0**	**0.0**
a. Solid Fuel	*0*	0	0	0	0	0
b Oil & Gas	*0*	0	0	0	0	0
Industrial Processes	*63,349*	**41,273**	**38,028**	**32,440**	**-5,588**	**-14.7**
s) Mineral Products	*0*	0	0	0	0	0
t) Chemical Industry	*0*	0	0	0	0	0
u) Metals production	*2,788*	2,727	2,727	2,727	0	0
v) Food & Drink	*5,892*	4,610	4,610	4,610	0	0
w) Halocarbons & SF6	*0*	0	0	0	0	0
x) Others (area based)	*54,670*	33,396	30,691	25,103	-5,588	-18.2
Agriculture	*334,717*	**219,473**	**208,502**	**187,738**	**-20,764**	**-9.9**
m) Enteric Fermentation	*268,881*	166,955	158,793	143,646	-15,147	-9.5
n) Manure Management	*65,836*	52,517	49,709	44,092	-5,617	-11.3
o) Agricultural Soils	*0*	0	0	0	0	0
p) Field Burning	*0*	0	0	0	0	0
Land Use Change & Forestry	*-53,155*	**-57,116**	**-60,353**	**-67,334**	**-6,981**	**-11.5**
m) Changes in Biomass	*-59,157*	-63,307	-66,545	-73,525	-6,980	-11.5
n) Grassland Conversion	*0*	0	0	0	0	0
o) Changes in Managed land	*-3,389*	-2,017	-2,017	-2,017	0	0
p) Removals from soils	*9,391*	8,208	8,208	8,208	0	0
Waste	*46,420*	**42,122**	**40,477**	**37,187**	**-3,290**	**-8.1**
j) Solid Waste Disposal	*46,420*	42,122	40,477	37,197	-3,290	-8.1
k) Wastewater handling	*0*	0	0	0	0	0
l) Waste Incineration	*0*	0	0	0	0	0
Total	*815,774*	**673,431**	**663,649**	**654,976**	**-8,146**	**-1.22**
Target Democs		462,272	371,631	326,310	-45,321	-12.1

Table 4-6 BAU Greenhouse Gas Emissions by Sector (C-e) - 2050

[42] Figures in **red** indicate projected rising emissions

Appendix 1 Common Reporting Format Tables

CRF Table 1.S.1 Energy – Fuel Combustion Activities

GREENHOUSE GAS SOURCE AND SINK CATEGORIES Reference Year 2002 April 2005	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	Tonnes C-e						
Total Energy Sector	**405614**	**17.96**	**0.00**	**4750.59**	**14346.73**	**5063.62**	**474.69**
A. Fuel Combustion Activities (Sectoral Approach)	**405614**	**17.96**	**0.00**	**4530.21**	**10316.44**	**4729.56**	**474.69**
1. Energy Industries	**87788**	**17.96**	**0.00**	**0.00**	**56.17**	**3086.45**	**17.23**
a. Public Electricity and Heat Production	87750	17.96	0.00	0.00	56.17	3086.45	17.23
b. Petroleum Refining	0	0.00	0.00	0.00	0.00	0.00	0.00
c. Manufacture of Solid Fuels and Other Energy Industries	39	0.00	0.00	0.00	0.00	0.00	0.00
2. Manufacturing Industries and Construction	**36881**	**0.00**	**0.00**	**236.68**	**20.46**	**155.39**	**140.19**
a. Iron and Steel	0	0.00	0.00	0.00	0.00	0.00	0.00
b. Non-Ferrous Metals	0	0.00	0.00	0.00	0.00	0.00	0.00
c. Chemicals	0	0.00	0.00	0.00	0.00	0.00	0.00
d. Pulp, Paper and Print	0	0.00	0.00	0.00	0.00	0.00	0.00
e. Food Processing, Beverages and Tobacco	0	0.00	0.00	0.00	0.00	0.00	0.00
f. Other *(please specify)*	0	0.00	0.00	0.00	0.00	0.00	0.00
3. Transport	**157332**	**0.00**	**0.00**	**3979.18**	**8733.58**	**1074.55**	**62.24**
a. Civil Aviation	0	0.00	0.00	0.00	0.00	0.00	0.00
b. Road Transportation	143289	0.00	0.00	3098.57	7390.70	867.44	13.45
c. Railways	9.34	0.00	0.00	35.20	9.34	4.70	3.88
d. Navigation	0	0.00	0.00	0.00	0.00	0.00	0.00
e. Other Transportation *(please specify)*	14034	0.00	0.00	845.41	1333.54	202.42	44.91
e.1 Agricultural Transport Machinery	5157	0.00	0.00	328.47	111.27	0.00	15.87
e.2 Other Industrial Mobile Machinery 2000	8876	0.00	0.00	516.94	1222.28	202.42	29.04

Table 1.S.1 continued…

CRF Table 1.S.1 Energy – Fuel Combustion Activities - Continued

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
Reference Year 2002 April 2005	Tonnes C-e						
4. Other Sectors	**123613.2**	**0.0**	**0.0**	**314.3**	**1506.2**	**413.2**	**446.0**
a. Commercial/Institutional	42829.9	0.0	0.0	112.2	193.4	177.2	255.0
b. Residential	69954.8	0.0	0.0	199.3	1214.4	236.0	191.0
b.1 Coal	6443.1	0.0	0.0	13.31	410.5	103.5	172.35
b.2 Oil	26192.2	0.0	0.0	67.48	5.1	4.1	18.01
b.3 Gas/LPG	37117.9	0.0	0.0	112.24	20.0	14.9	0.00
b.4 Wood (biomass)	0.0	0.0	0.0	3.65	502.1	27.4	0.19
b.5 Garden Machinery	201.6	0.0	0.0	2.65	276.8	86.1	0.05
c. Agriculture/Forestry/Fisheries	10828.5	0.0	0.0	2.8	98.4	0.0	0.0
5. Other *(please specify)* [43]	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
a. Stationary	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b. Mobile	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B. Fugitive Emissions from Fuels	**0.0**	**0.0**	**0.0**	**220.4**	**4030.3**	**334.1**	**0.0**
1. Solid Fuels	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
a. Coal Mining	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b. Solid Fuel Transformation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c. Other *(please specify)*	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2. Oil and Natural Gas	**0.0**	**0.0**	**0.0**	**220.4**	**4030.3**	**334.1**	**0.0**
a. Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b. Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c. Venting and Flaring	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c.1 Venting	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c.2 Flaring	0.0	0.0	0.0	0.0	0.0	0.0	0.0
d. Other *(please specify)*	0.0	0.0	0.0	220.4	4030.3	334.1	0.0
Vehicle Cold Start emissions	0.0	0.0	0.0	220.4	4030.3	334.1	0.0
MEMO ITEMS: [44]	**CO_2**	**CH_4**	**N_2O**	**NO_X**	**CO**	**NMVOC**	**SO_2**
International Bunkers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aviation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Marine	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Multilateral Operations	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO_2 Emissions from Biomass	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[43] Military Fuels should be included under this category – not known.
[44] These items are not reported in the energy totals of the inventory.

CRF Table 2 (1) Sectional Report Industrial Processes

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [45]		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
Reference Year 2002				P[46]	A[47]	P	A	P	A				
April 2005	Tonnes			C-e (Tonnes)				Tonnes					
Total Industrial Processes	**50,568.48**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4,277.14**	**10,009.51**	**1,927.54**	**145.26**
A. Mineral Products	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1. Cement Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Lime Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Limestone and Dolomite Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Soda Ash Production and Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Asphalt Roofing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Road Paving with Asphalt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Chemical Industry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1. Ammonia Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Nitric Acid Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Adipic Acid Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Carbide Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Metal Production	**2,727.27**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**48.10**	**0.00**
1. Iron and Steel Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Ferroalloys Production	2,727.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.10	0.00
3. Aluminium Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. SF_6 Used in Aluminium and Magnesium Foundries	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[45] The emissions of HFCs and PFCs are to be expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of the common reporting format.

[46] P = Potential emissions based on Tier 1 approach of the IPCC Guidelines

[47] A = Actual emissions based on Tier 2 approach of the IPCC Guidelines

Table 2 (1) continued…
CRF Table 2 (1) sheet 2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs(1)		PFCs(1)		SF_6		NO_x	CO	NMVOC	SO_2
Reference Year 2002				P	A	P	A	P	A				
April 2005	C-e Tonnes			C-e (Tonnes)				(Tonnes)					
D. Other Production	**5,480.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1. Pulp and Paper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Food and Drink [48]	5,480.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1. By-product Emissions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Production of HCFC-22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Fugitive Emissions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF_6	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1. Refrigeration and Air Conditioning Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Foam Blowing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Fire Extinguishers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Aerosols/ Metered Dose Inhalers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Solvents	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Semiconductor Manufacture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Electrical Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[48] CO_2 from Food and Drink Production (e.g. gasification of water) can be of biogenic or non-biogenic origin. Only information on CO_2 emissions of non-biogenic origin should be reported. This data is taken from the Environment Agency IPPC database.

CRF Table 1A(a) Sectoral Background Data for Energy

GREENHOUSE GAS SOURCE AND SINK CATEGORIES Reference Year 2002 April 2005	AGGREGATE ACTIVITY DATA		IMPLIED EMISSION FACTORS			EMISSIONS		
	Consumption		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
	(TJ)	[49]	(t/TJ)	(kg/TJ)	(kg/TJ)	Tonnes	Tonnes	Tonnes
1.A. Fuel Combustion	**2,693,707.06**	GCV	-	-	-	**87,749.55**	**17.96**	**0.00**
Liquid Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Solid Fuels	2,693,707.06	GCV	32.58	6.67	0.00	87,749.55	17.96	0.00
Gaseous Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Biomass	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1. Energy Industries	**2,693,707.06**	GCV	-	-	-	**87,749.55**	**17.96**	**0.00**
Liquid Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Solid Fuels	2,693,707.06	GCV	0.03	0.01	0.00	87,749.55	17.96	0.00
Gaseous Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Biomass	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
a. Public Electricity and Heat Production	**2,691,171.47**	**GCV**	-	-	-	**87,749.55**	**17.96**	**0.00**
Liquid Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Solid Fuels	2,693,707.06	GCV	0.03	0.01	0.00	87,749.55	17.96	0.00
Gaseous Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Biomass (Heat Production)	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Green electricity purchased (Herefordshire Council)	-2,535.59	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Biomass electricity generation	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Bio-diesel used for power generation	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
b. Petroleum Refining	**0.00**	**GCV**	-	-	-	**0.00**	**0.00**	**0.00**
Liquid Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Solid Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Gaseous Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Biomass	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
c. Manufacture of Solid Fuels and Other Energy Industries	**0.00**	**GCV**	-	-	-	**0.00**	**0.00**	**0.00**
Liquid Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Solid Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Gaseous Fuels	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00
Biomass	0.00	GCV	0.00	0.00	0.00	0.00	0.00	0.00

[49] Activity data should be calculated using net calorific values (NCV) as specified by the IPCC Guidelines. If gross calorific values (GCV) were used, please indicate this by replacing "NCV" with "GCV" in this column.

CRF Table 1A(a) sheet 2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	AGGREGATE ACTIVITY DATA		IMPLIED EMISSION FACTORS [2]			EMISSIONS		
Reference Year 2002	Consumption		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
April 2005	(TJ)		(t/TJ)	(kg/TJ)	(kg/TJ)	(Gg)	(Gg)	(Gg)
1.A.2 Manufacturing Industries and Construction	**0.00**	NCV	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Liquid Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Solid Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Gaseous Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Biomass	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
a. Iron and Steel	**0.00**	**NCV**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Liquid Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Solid Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Gaseous Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Biomass	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
b. Non-Ferrous Metals	**0.00**	**NCV**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Liquid Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Solid Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Gaseous Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Biomass	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
c. Chemicals	**0.00**	**NCV**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Liquid Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Solid Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Gaseous Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Biomass	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
d. Pulp, Paper and Print	**0.00**	**NCV**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Liquid Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Solid Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Gaseous Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Biomass	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
e. Food Processing, Beverages and Tobacco	**0.00**	**NCV**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Liquid Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Solid Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Gaseous Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Biomass	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00
Other Fuels	0.00	NCV	0.00	0.00	0.00	0.00	0.00	0.00

CRF Table 4 Sector Report For Agriculture

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH_4	N_2O	NO_x	CO	NMVOC
	C-e (tonnes)				
Total Agriculture	**11,770.65**	**144.17**	**0.00**	**0.00**	**0.00**
A. Enteric Fermentation	**10,944.02**	**0.00**	**0.00**	**0.00**	**0.00**
1. Cattle	7,445.10	0.00	0.00	0.00	0.00
Dairy Cattle	3,798.30	0.00	0.00	0.00	0.00
Non-Dairy Cattle	3,646.80	0.00	0.00	0.00	0.00
2. Buffalo	0.00	0.00	0.00	0.00	0.00
3. Sheep	3,426.12	0.00	0.00	0.00	0.00
4. Goats	4.48	0.00	0.00	0.00	0.00
5. Camels and Llamas	0.00	0.00	0.00	0.00	0.00
6. Horses	0.00	0.00	0.00	0.00	0.00
7. Mules and Asses	0.00	0.00	0.00	0.00	0.00
8. Swine	42.31	0.00	0.00	0.00	0.00
9. Poultry	0.00	0.00	0.00	0.00	0.00
10. Other *(please specify)*	26.00	0.00	0.00	0.00	0.00
Deer	26.00	0.00	0.00	0.00	0.00
B. Manure Management	**826.64**	**144.17**	**0.00**	**0.00**	**0.00**
1. Cattle	668.24	0.00	0.00	0.00	0.00
Dairy Cattle	428.95	0.00	0.00	0.00	0.00
Non-Dairy Cattle	239.29	0.00	0.00	0.00	0.00
2. Buffalo	0.00	0.00	0.00	0.00	0.00
3. Sheep	73.77	0.00	0.00	0.00	0.00
4. Goats	0.00	0.00	0.00	0.00	0.00
5. Camels and Llamas	0.00	0.00	0.00	0.00	0.00
6. Horses	0.00	0.00	0.00	0.00	0.00
7. Mules and Asses	0.00	0.00	0.00	0.00	0.00
8. Swine	84.62	0.00	0.00	0.00	0.00
9. Poultry	0.00	0.00	0.00	0.00	0.00

CRF Table 4 sheet 2

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH_4	N_2O	NO_x	CO	NMVOC
	C-e (tonnes)				
B. Manure Management (continued)	**0.00**	**144.17**	**0.00**	**0.00**	**0.00**
10. Anaerobic Lagoons	0.00	0.00	0.00	0.00	0.00
11. Liquid Systems	0.00	144.17	0.00	0.00	0.00
12. Solid Storage and Dry Lot	0.00	0.00	0.00	0.00	0.00
C. Rice Cultivation	0.00	0.00	0.00	0.00	**0.00**
1. Irrigated	0.00	0.00	0.00	0.00	0.00
2. Rain fed	0.00	0.00	0.00	0.00	0.00
3. Deep Water	0.00	0.00	0.00	0.00	0.00
D. Agricultural Soils	**0.00**	**0.00**	0.00	0.00	**0.00**
1. Direct Soil Emissions	0.00	0.00	0.00	0.00	0.00
2. Animal Production	0.00	0.00	0.00	0.00	0.00
3. Indirect Emissions	0.00	0.00	0.00	0.00	0.00
E. Prescribed Burning of Savannas	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
F. Field Burning of Agricultural Residues	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1. Cereals	0.00	0.00	0.00	0.00	0.00
2. Pulse	0.00	0.00	0.00	0.00	0.00
3. Tuber and Root	0.00	0.00	0.00	0.00	0.00
4. Sugar Cane	0.00	0.00	0.00	0.00	0.00
G. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

CRF Table 4F Sectoral Background Data for Agriculture

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION						IMPLIED EMISSION FACTORS		EMISSIONS	
	Crop production (tonnes)	Residue/ Crop ratio	Dry matter fraction	Fraction burned in fields	Biomass burned (tonne / dm)	Nitrogen fraction in biomass of residues	CH_4 (kg/t dm)	N_2O (kg/t dm)	CH_4 (tonnes)	N_2O (tonnes)
1. Cereals		**N/a**	**N/a**	**0.00**	**0.00**	**N/a**	**0.00**	**0.00**	**0.00**	**0.00**
Wheat	215,007.10	N/a	N/a	0.00	0.00	N/a	0.00	0.00	0.00	0.00
Barley	58,818.57	N/a	N/a	0.00	0.00	N/a	0.00	0.00	0.00	0.00
Maize	15,736.50	N/a	N/a	0.00	0.00	N/a	0.00	0.00	0.00	0.00
Oats	28,905.76	N/a	N/a	0.00	0.00	N/a	0.00	0.00	0.00	0.00
Rye	0.00	N/a	N/a	0.00	0.00	N/a	0.00	0.00	0.00	0.00
Rice	0.00	N/a	N/a	0.00	0.00	N/a	0.00	0.00	0.00	0.00
Oilseed Rape	10,324.13	N/a	N/a	0.00	0.00	N/a	0.00	0.00	0.00	0.00
2. Pulse		**N/a**	**N/a**	**0.00**	**0.00**	**N/a**	**0.00**	**0.00**	**0.00**	**0.00**
Dry bean	11,694.50	N/a	N/a	0.00	0.00	N/a	0.00	0.00	0.00	0.00
Peas	5,696.13	N/a	N/a	0.00	0.00	N/a	0.00	0.00	0.00	0.00
Soybeans	0.00	N/a	N/a	0.00	0.00	N/a	0.00	0.00	0.00	0.00
3 Tuber and Root		**N/a**	**N/a**	**0.00**	**0.00**	**N/a**	**0.00**	**0.00**	**0.00**	**0.00**
Potatoes	262,588.50	N/a	N/a	0.00	0.00	N/a	0.00	0.00	0.00	0.00
Sugarbeet	87,377.40	N/a	N/a	0.00	0.00	N/a	0.00	0.00	0.00	0.00

CRF Table 5 Sectoral Report for Land-use Change and Forestry

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	Net CO_2	CH_4	N_2O	NO_x	CO
	C-e (tonnes)						
Total Land-Use Change and Forestry	**8,347.80**	**-60,074.59**	**-51,726.79**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Woody Biomass Stocks	**0.00**	**-57,872.76**	**-57,872.76**				
1. Tropical Forests	0.00	0.00	0.00				
2. Temperate Forests	0.00	-59,307.00	-59,307.00				
3. Boreal Forests	0.00	0.00	0.00				
4. Grasslands/Tundra	0.00	0.00	0.00				
5. Other *(please specify)*	0.00	1,434.24	1,434.24				
5.1 - Harvested Wood	0.00	1,434.24	1,434.24				
5.2 - Non forest trees	0.00	0.00	0.00				
B. Forest and Grassland Conversion	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
1. Tropical Forests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Temperate Forests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Boreal Forests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Grasslands/Tundra	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Other *(please specify)*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.1 - Trace emissions from burning forests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Abandonment of Managed Lands	**0.00**	**-2,201.83**	**-2,201.83**				
1. Tropical Forests	0.00	0.00	0.00				
2. Temperate Forests	0.00	0.00	0.00				
3. Boreal Forests	0.00	0.00	0.00				
4. Grasslands/Tundra	0.00	-2,201.83	-2,201.83				
5. Other *(please specify)*	0.00	0.00	0.00				
D. CO_2 Emissions and Removals from Soil	**8,347.80**	**0.00**	**8,347.80**				
Cultivation of Mineral Soils	0.00	0.00	0.00				
Cultivation of Organic Soils	0.00	0.00	0.00				
Liming of Agricultural Soils	8,347.80	0.00	8,347.80				
Forest Soils	0.00	0.00	0.00				
Other *(please specify)*[3]	0.00	0.00	0.00				
E. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	0.00	0.00	0.00	0.00	0.00	0.00	0.00

CRF Table 5.A Sectoral Background Data for Land-use Change and Forestry

GREENHOUSE GAS SOURCE AND SINK CATEGORIES			ACTIVITY DATA: Area of forest/biomass stocks (ha)	ACTIVITY DATA: Average annual growth rate (t dm/ha)	IMPLIED EMISSION FACTORS: Implied carbon uptake factor (t C/ha)	ESTIMATES: Carbon uptake increment (Tonnes C)
Tropical	Plantations	*Acacia spp.*	0.00	0.00	0.00	0.00
		Eucalyptus spp.	0.00	0.00	0.00	0.00
		Tectona grandis	0.00	0.00	0.00	0.00
		Pinus spp	0.00	0.00	0.00	0.00
		Pinus caribaea	0.00	0.00	0.00	0.00
		Mixed Hardwoods	0.00	0.00	0.00	0.00
		Mixed Fast-Growing Hardwoods	0.00	0.00	0.00	0.00
		Mixed Softwoods	0.00	0.00	0.00	0.00
	Other Forests	Moist	0.00	0.00	0.00	0.00
		Seasonal	0.00	0.00	0.00	0.00
		Dry	0.00	0.00	0.00	0.00
Temperate	Plantations		0.00	0.00	0.00	0.00
			0.00	0.00	0.00	0.00
	Commercial	Evergreen	14,619.00	5.04	2.52	36,835.28
		Deciduous	15,210.00	2.19	1.09	16,626.94
	Other *(specify)*		0.00	0.00	0.00	0.00
		Energy Grasses	116.00	19.50	9.75	1,131.00
		Mixed Woodland	3,685.00	3.61	1.81	6,656.66
			Total annual growth increment Tonnes C			61,249.88
			Total annual growth increment Tonnes CO_2			224,582.89

CRF Table 5.A Sectoral Background Data for Land-use Change and Forestry – continued

	Amount of biomass removed (kt dm)	Carbon emission factor (t C/t dm)	Carbon release (Tonnes C)
Total biomass removed in Commercial Harvest		0.00	
Traditional Fuel wood Consumed		0.00	
Total Other Wood Use		0.00	
	Total Biomass Consumption from Stocks [1] (tonnes C)		0.00
	Other Changes in Carbon Stocks [2] (tonnes C) CO_2		0.00
Net annual carbon uptake (+) or release (-) (tonnes C)			61,249.88
Net CO_2 emissions (-) or removals (+) (tonnes CO_2)			224,582.89

CRF Table 5.A Sectoral Report for Waste

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2[(1)]	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	C-e (Tonnes)						
Total Waste	**2,149.35**	**2,044.45**	**0.00**	**1.30**	**12.01**	**0.00**	**0.00**
A. Solid Waste Disposal on Land	**2,149.35**	**2,044.45**		**1.30**	**12.01**	**0.00**	
1. Managed Waste Disposal on Land	1,862.65	355.42					
2. Unmanaged Waste Disposal Sites	150.33	689.02		1.30	12.01	0.00	
3. Other *(please specify)*	136.36	1,000.00		0.00	0.00	0.00	
B. Wastewater Handling		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
1. Industrial Wastewater		0.00	0.00	0.00	0.00	0.00	
2. Domestic and Commercial Wastewater		0.00	0.00	0.00	0.00	0.00	
3. Other *(please specify)*		0.00	0.00	0.00	0.00	0.00	
C. Waste Incineration	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
D. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

(1) Note that CO_2 from Waste Disposal and Incineration source categories are only be included if it stems from non-biological or inorganic waste sources.