West Midlands
Regional
Observatory

West Midlands Regional Energy Strategy Monitoring Report 2006

Document Information

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Date created:	2006-04-28
Status:	Version 2.0
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(A full set of Document Information is available at the back of this document).

1 Overview

The Observatory was commissioned by Energy West Midlands[1] to produce the first monitoring report for measuring progress towards the regional targets outlined in the West Midlands Energy Strategy, published in November 2004. The report provides the first comprehensive compendium of regional energy and emissions estimates. It identifies and analyses new data produced by the energy group within DTI and DEFRA, as well as regional surveys undertaken since the strategy launch, which provide information on renewable energy production, a key target for the strategy.

The primary objectives of the report are to update the baseline indicators, compare changes in energy consumption and emissions against the projected reductions required to meet the region's contribution to national CO_2 emissions targets. It also provides a detailed sectoral breakdown of the industry, commerce and public services' energy demands and emissions and a spatial analysis of the energy consumption arising from domestic and road transport demand within the different local authorities in the region.

The report begins by updating the main regional energy demands from industry, commerce and public services, domestic use and transport, presenting indicators by energy use, fuel type and CO_2 emissions. While CO_2 emissions targets are set as far ahead as 2050, the energy strategy emphasises the need for considerable progress by 2010. To measure this progress the strategy's projections have been updated and compared against current estimates of CO_2 emissions.

The report goes on to provide greater detail for the underlying indicators of regional energy consumption. For industry and for public and commercial services, this was undertaken using finer sectoral data for energy consumption and employment, while for domestic energy consumption new data made available by the energy unit in DTI has been used. This data includes average household consumption of electricity and gas at district level. Further work has been published that provides greater detail of domestic CO_2 emissions with which it has been possible to make more accurate assessments of the spatial variations of CO_2 and the causes of these variations. For road transport DTI data on total oil consumption by vehicle type was used and weighted according to population levels.

Finally the report draws together a broad range of data for measuring the region's progress towards its targets for renewable energy. Using data from OFGEM, supported by regional surveys undertaken by the Marches Energy Agency the report provides maps of the main sites as well as production and capacity levels for energy production from renewable sources.

1.1 Context

While debate continues as to the exact causal relationship between energy consumption and climatic change, there is growing evidence that most of the increases in the Earth's temperature over the last 50 years are attributable to human activities[2].

The Industrial Revolution marked a significant change in our agricultural and industrial practices, enabling the increasing capacity for ever greater levels of population growth and the ever increasing appetite for consumption that higher income levels brought.

How is the context of economic thinking critical to understanding the issues highlighted by the energy strategy? There are two important themes. Mainstream economics[3] suggests that the inherent efficiencies in production and the capacity of firms and consumers to substitute between inputs when relative costs make the decision to do so beneficial, ensure that resources are fully utilised. To many economists natural resources are simply another capital asset that can be substituted for alternatives if they become inefficient. In light of these assumptions mainstream economics considers there to be no limits to growth.

However, remove the assumption of perfect efficiency in the transformation of inputs into outputs and you have resultant by-products – waste, pollution, externalities. An alternative view is to consider the capacity of the system to absorb and dissipate the effects of these by-products. On a finite planet, there is only so much waste that can be tolerated before the system becomes critically degraded. This raises questions about the ability of the Earth to absorb the by-products of production and how this effect may limit long-term sustainable growth.

A second theme is the acknowledgement of limits for natural resources. Within mainstream economics the productive capacity of the economic systems increases to enable the sustainability of the growing populations and economic activity. However, the issue of 'peak oil' is presenting economies with a challenge to this fundamental idea of a progressive increase in economic capacity. Oil production cannot continue to grow ad infinitum – it is a finite resource. Though, oil will not simply cease to exists, its production follows a 'bell curve', so is increasingly plentiful on the upslope of the

curve, and increasingly scarce on the down slope. The peak represents the point when the endowment of oil has been 50% depleted.

To simplify, assume constant economic growth. If the peak of oil production occurs in 2005, the global oil production in 2025 will be the same as it was in 1985, but the population of the world will be much higher, and there would be greater levels of economic activity, with subsequent higher levels of oil dependency. Real price rises would not simply be temporary, where firms and consumers could adjust behaviour in light of the temporary oil price shocks. Rather they would persist, forcing firms and consumers to alter their behaviour radically.

The West Midlands region is rightly proud of its role at the vanguard of the technological advances achieved through the Industrial Revolution, but history's legacy of this leading role is a continuing relatively high representation of energy intensive industries.

The industrial landscape has changed significantly over the last few years, more markedly for the region than the picture nationally. The changing industrial structure brought about by global competitive pressures evokes strong emotions, but surviving industries, which have weathered the competitive storm, recognise their key role in achieving the region's aims for sustainable energy consumption.

Furthermore, while our estimates show consumption of energy in manufacturing to be declining, we are increasingly exporting our energy demands as a consequence of our increased consumption of packaged food and consumer goods, where the impact is indirect[4]. Energy used to produce the goods is outside the region, however increasing freight use to transport goods and our preparedness to drive to out of town superstores is contributing to increases in traffic and congestion.

Services and the public sector have grown significantly in importance to the regional economy, mirroring the changes nationally, although in some areas growth is more marked than the national average[5]. While less energy intensive, these sectors also have a responsibility for achieving efficiency commitments.

1.2 Summary of Energy Strategy

The West Midlands Energy Strategy was published in November 2004 and represents a clear statement of the Region's commitment to address the challenges posed by climate change.

The vision outlined is that:

By 2020 we will have delivered the West Midlands's commitment to the climate change challenge, having ensured a sustainable, secure and affordable supply of energy for everyone and strengthened the region's economic capability.

The Strategy has four headline objectives given below:

- Improving Energy Efficiency

This objective concerns both reducing the need for energy (for example, by designing houses that need less heating), and improving the efficiency with which it is used (for example, through more efficient boilers and better insulation). The aim is to make the West Midlands an example of best practice that the rest of the country can follow.

- Increasing the use of Renewable Energy Resources

Energy from renewable sources produces practically no net emissions compared with energy from fossil fuels such as gas and oil. Technological priorities and targets for installing renewable energy plants and systems need to be chosen to reflect the availability of resources in the West Midlands, suitability of the different technologies to meet the region's needs and their relative cost.

- Maximising Uptake of Business Opportunities

By becoming more energy efficient, businesses can improve their profitability. In addition, excellent business opportunities are emerging as a result of changes in the patterns of energy production, distribution and use. To help businesses take full advantage of these, the quality and effectiveness of business support needs to be improved. Harnessing research and development and innovation skills in the region will also be an important factor here.

- Ensuring Focused and Integrated Delivery and Implementation

Regional and local agencies have powers to directly influence patterns of energy use, for example through planning control, construction of new buildings, vehicle fleets and energy purchasing. Such decisions also give signals to the energy market, for example by favouring certain technologies and approaches. The aim of the Strategy is therefore to ensure that these direct influences and signals are correct and consistent. Regional organisations will need to provide the leadership and funding required for its effective delivery.

Recognising that there are signs of climate change[6], the strategy laid down clear targets and commitments for regional partners, highlighting the benefits that greater efficiencies in energy production and consumption can deliver. These benefits include:

- More profitable businesses through improved energy efficiency in industry and commerce;
- Fewer homes that are not heated adequately or affordably;
- Better air quality; and
- A dynamic business sector based on new energy technologies and services

This report is an update of the indicators of energy demand and supply. It contains a series of indicators that can be used to review progress and assess changes that have occurred since the launch of the strategy.

The Energy White paper[7] stressed the importance of localised decision making in energy policy. One of the main obstacles to the development of a robust evidence base is the lack of available regional and local energy data. Since publication of the strategy's estimated baseline indicators, there have been improvements in the breadth and detail of indicators published by DTI, DEFRA and other agencies.

To enable comparison over time we have sought to retain consistency in the methodologies used to update the indicators with those used in the initial strategy. There are differences however in some indicators resulting from both the access to previously unavailable data replacing the requirement for proxy indicators, and through the difficulties arising from replicating individual data sources.

While the indicators updated from the strategy provide a guide for assessing progress, we have supplemented these wherever appropriate to provide a more detailed evaluation of the underlying drivers and inter-linkages.

We would like to express our thanks to Rob Williams of Ecotec who provided the supporting data from the Energy Strategy as well as being available to consult on issues arising. We would also thank the Marches Wood Energy Network Ltd, the Forestry Commission and the DTI Energy Unit for the provision of data.

The next section presents some of the main headlines emerging from the report with a short explanation of the points raised and context.

1.3 Summary of key points

1.3.1 Industry

- Regional energy consumption by industry has fallen by 1.1% between 2002 and 2004, but CO_2 emissions are up slightly over the period
- Energy intensity for industry has improved from 2.21GWh/ GVA (£m) in 2002 to 1.97 GWh/ GVA (£m) in 2004

A detailed breakdown of regional industrial energy consumption is provided in section 2.5. The changing industrial landscape has resulted in a decline both nationally and regionally in the relative importance of traditional production industries to the total economy. While nationally industry's final energy consumption has risen by 1.2%, the region's energy demand is determined by the changes in the industrial base. Employment in the region's industrial sectors has fallen faster than the national average resulting in a reduction in the share of total energy consumed.

While total energy consumption has fallen slightly, the rise in CO_2 emissions are reflective of the changing fuel mix used by firms to produce goods. As table 6 illustrates the fuel inputs required differ across industries. Increased consumption of petroleum products and electricity within industry has resulted in the slight increase in estimated CO_2 emissions, offsetting falls attributed to reduced coal and gas consumption, as industries who rely more on these fuels reduce their share of employment.

Energy intensity has improved; the estimates can be interpreted in two ways. Firstly, the amount of energy used to generate £1 of GVA has fallen; alternatively one can say that the value of the output produced per unit of energy used has increased.

1.3.2 Commerce and public services

- Regional energy consumption by commercial and public services has increased by 5%, while CO_2 have risen by 3.6%
- Energy intensity has improved from 0.48 GWh/ GVA (£m) in 2002 to 0.37 GWh/ GVA (£m) in 2004

A detailed breakdown of regional commerce and public sector service energy consumption is provided in section 2.6. As with industry the changing employment environment in commerce and public services has contributed to the changing level of energy consumption.

While both still growing, between 2002 and 2004 public sector service employment growth in the region has been less than the national average but employment in commercial services grew at a faster rate than the national average.

The greater consumption of electricity and natural gas has resulted in estimated CO_2 emissions rising by 3.6%. Another indicator of energy demand in these sectors are the number and size of premises. As table 16 shows the number and average size of commercial premises, particularly retail has increased between 2002 and 2004

1.3.3 Domestic

- Domestic energy consumption has risen by 1.5% between 2002 and 2004, with CO_2 emissions increasing by 0.5% over the period
- Total dwelling stock has increased by 2.4% between 2001 and 2005
- Households in rural areas consume less natural gas, but have higher relative levels of consumption for petroleum products

A detailed breakdown of the different levels of domestic energy consumption within the Region is presented in section 2.7. Average gas consumption regionally has increased by 3.3% between 2002 and 2004 while between 2003 and 2004 average household electricity consumption rose by 1.4%.

Access to the gas network has the impact of increasing the level of electricity consumption in the more rural local authorities. Despite data limitations we found no significant statistical relationship between income levels or age of housing stock on energy consumption or energy efficiency. Analysis of domestic energy efficiencies identified different levels of performance between local authorities.

1.3.4 Transport

- Estimates of transport CO_2 emissions are up by 1.8% between 2002 and 2004 with a 10% increase in emissions from diesel offsetting a 6.5% decrease in emissions from petrol vehicles
- Numbers of car trips made in the region has increased from an average 413 trips in 2002 to 434 trips in 2004

Between 2002 and 2003 fuel consumption for personal transport in the Region fell at a slightly higher rate than nationally, with a fall of 1.4% compared to 1% for the UK while fuel consumption for freight transport increased by 4.3% in the Region compared to a 3.5% rise nationally.

Based on these trends continuing between 2003 and 2004 we estimate this translates into a 1.8% increase in CO_2 emissions between 2002 and 2004.

An important note is that the data used has been modelled by Netcen based on where the fuel was consumed. A comparison between local authorities in the region in section 2.8 indicates the effect the presence of major motorway and trunk roads in their boundaries has produced high traffic volumes and therefore high emissions.

The data on car journeys has been sourced from the Department for Transport's National Travel Survey. The survey suggests that the number and average distance of car trips made by residents of the Region has increased. Caution should be taken when comparing to the fuel consumption data as this includes travel through the region by non-residents

Table 1 presents an update of the Strategy's baseline indicators (Energy Strategy pp19-20). Some of the baseline indicators have been revised due to a lack of comparable now and in the future

Table 1 Summary of Baseline indicators

Indicator	Baseline (Strategy)	Most up-to-date data (year)
Regional Indicators		
Total Carbon Dioxide Emissions	42.6 Mt/year (2002)	43.1 Mt/year (2004)
Energy Intensity	2.21 GWh/GVA (£m) (2002)	1.97 GWh/ GVA (£m) (2004)
Regional Electricity Consumption	32, 845 GWh/year (2002)	33,433 GWh/year (2004)
Industry		
Industrial Carbon Dioxide Emissions	12.92 Mt/year (2002)	12.94 Mt/year (2004)
Industrial Energy Intensity	2.25 GWh/GVA (£m) (2001)	2.09 GWh/GVA (£m) (2003)
Commercial and Public Sector Services		
Commerce and Public Sector Carbon Dioxide Emissions	5.6 Mt/Year (2002)	5.8 Mt/year (2004)
Commerce and Public Sector Energy Intensity	0.48 GWh/GVA (£m) (2001)	0.37 GWh/GVA (£m) (2003)
Public Sector Carbon Dioxide Emissions	1.71 Mt/year (2002)	1.68 Mt/year (2004)
Households		
Domestic Carbon Dioxide Emissions	12.6 Mt/year (2002)	12.7 Mt/year (2004)
Carbon Dioxide Emissions per Dwelling	5.7 t/year/dwelling (2002)	5.57 t/year/dwelling (2004)
Average SAP rating of homes	48.8 (2002)	
Homes not meeting Decent Homes Standards	828,000 (2001)	
Households in fuel poverty	15.2% (2001)	8.5% (2003)
Road Traffic		
Transport Carbon Dioxide Emissions*	11.4 Mt/year (2002)	11.6 Mt/year (2004)
Percentage of trips to work by car	77% (2002)	78% (2004)
Average annual mileage by car and no. of trips	3,588 miles and 413 trips (1999/2001)	3,636 miles and 434 trips (2003/2004)
Renewables		
CHP capacity	65 MW (2002) No new sites were identified	
Renewable Electricity Generation Capacity**	144.4 MW (2002)	174.5 MW (2004)
Generation of electricity from renewable sources**	609.4 GWh (2002)	651 GWh (2004)
Percentage of Electricity consumption from renewables	1.8% (2002)	1.9% (2004)
Renewable Heat Supplied	1,482 GWh (2002)	2,176 GWh (2004)
Amount of biofuel sold per year	1.7 m litres (0.1% of diesel sold)	3.3 m litres*** (0.14% of diesel sold) (2005)

* The method used is different to that in the strategy. Latest figure calculated using figures produced by DTI for 2003. Annual change 2002-2003 in vehicle energy use reapplied for 2003-2004 so figure is an estimate. ** Data source different to that in the strategy. Figures from RESTAT and revised for strategy baseline *** Provisional 2005

2 Regional Energy Use

The West Midlands Energy Strategy provides a series of indicators against which progress towards meeting stated targets can be measured.

There are two important points to note in this report when comparing against the indicators originally presented in the Energy Strategy itself:

- Revisions in the official data on both sector energy consumption by fuel type and employment mean that the baseline tables are also subject to revision;
- The original transport data included a regional estimate of petroleum products delivered for road transport purposes. It has not been possible to replicate the methodology used to produce this estimate, so we have used recently published data on regional transport energy consumption published by the DTI.

2.1 Regional Energy Use and Emissions

This section presents an update of the total energy consumption and emissions indicators at the regional level (Energy Strategy pp10-11). As outlined above the changing industrial base is an essential determinant in aggregate energy consumption and a further analysis of the changes in individual industrial and service divisions is provided to illustrate this.

Table 2 shows the latest indicators for final energy consumption between 2002 and 2004 for the West Midlands. Estimates for industry, commerce, the public sector and for domestic consumption were calculated using the methodology[8] outlined in the Energy Strategy's baseline chapter (Chapter 3, pp10-17). Figures for 2002 (published in the Energy Strategy) have been adjusted due to revisions in the previous years' energy data published in the latest Digest of United Kingdom Energy Statistics (DUKES 2005) and employment data published through the Annual Business Inquiry (ABI), released in December 2005.

Figures for industry, commerce and the public sector regional estimates are calculated by using the percentage of national employment, while for the domestic sector calculations were based on the region's share of national population (ONS Mid year population estimates). It is important to note that estimates using this weighting method assume uniformity in terms of the distribution of industrial sites, commercial properties and the type and size of housing. For example, in table 3 the regional share of heat sold may be distorted by large CHP sites that are outside the West Midlands but contribute to the national figure on which the regional estimate is based.

The transport figure has been calculated from the regional transport energy data published by DTI for 2002 and 2003. We were unable to replicate the methodology used previously to measure change in the indicator. The strategy estimated the region's road fuel use as a share of national fuel sales. The data used in this report for transport estimates in tables 2 to 5 and in section 2.8, allocates road transport energy demand by point of consumption.

While the published data may overstate consumption due to the presence of the motorway network and the impact of through transport, it has the advantage of enabling sub-regional analysis and is expected to be updated annually as part of improvements in regional data provision. There were no figures available for 2004 so for simplicity a constant annual percentage change for transport energy consumption was applied to calculate the provisional figures for 2004.

The next section provides an update of the region's energy consumption and CO_2 emissions arising from economic activity.

2.1.1 Regional energy consumption

Table 2 indicates that total energy consumption in the Region has risen by 1.2% between 2002 and 2004, although structural economic change has resulted in a fall in industry's final energy consumed.

The greatest share of energy continues to be consumed by the domestic sector, which accounts for 32% of the region's estimated energy consumption in 2004. As well as rising overall domestic consumption, the share of energy consumption in the Region attributable to the domestic sector is also rising.

Table 2 West Midlands Final Energy Consumption (GWh) estimates by user 2002 – 2004

	2002	2003	2004
Industry	45,980	46,272	45,501
Commerce, public sector	19,633	19,572	20,643
Domestic	51,290	51,637	52,009
Transport	46,682	47,012	47,461
Total	163,584	164,493	165,614

Sources: DUKES 2005; ABI; ONS Mid year population estimates; DTI energy trends (December 2005)

Table 3 shows final energy consumption by the fuel used. Coal and gas consumption have fallen, primarily reflecting the decline in employment in primary industries such as iron and steel and chemicals which, as table 7 highlights, are significant users of coal and gas respectively.

Table 3 Final energy consumption (GWh) by fuel type 2002 – 2004

	2002	2003	2004
Coal and manufactured fuel	5,469	3,870	4,604
Petroleum products*	61,012	61,789	63,166
Natural gas	62,025	63,486	61,460
Renewables and waste	751	759	766
Electricity	32,845	33,223	33,433
Heat sold	1,482	1,366	2,176
Total*	163,584	164,493	165,614

*Includes transport

Sources: DUKES 2005; ABI; ONS Mid year population estimates; DTI energy trends (December 2005)

The increasing share of commercial and public services in total energy consumption is reflected in the increase in electricity consumption, and importantly through energy provided by heat sold, most of which is consumed by industries, particularly chemicals while public administration is a major consumer (see table 7 below).

2.1.2 Regional CO_2 emissions

Table 4 shows the breakdown of CO_2 emissions by the sectors between 2002 and 2004. These estimates are calculated by applying DEFRA's published CO_2 conversion rates[9] to the fuel consumption estimates in table 3.

Table 4 West Midlands CO_2 Emissions Estimates 2002 – 2004

	2002	2003	2004
Industry	12,925	13,005	12,944
Commerce, public sector	5,633	5,614	5,837
Domestic	12,626	12,654	12,684
Transport	11,427	11,517	11,637
Total	42,611	42,791	43,102

Sources: DUKES 2005; ABI; ONS Mid year population estimates; DTI energy trends (December 2005); DEFRA

While industry has declined slightly in its consumption of total energy, CO_2 emissions arising from the sector have risen. This is due to the increased share of industry's energy arising from petroleum products and electricity. Combined these fuels account for 55% of Industry's energy in 2004, up from 49% in 2002 (see Table 11 below). There are slight increases in the commercial and public sector services as well as from domestic consumption. Emissions from transport have increased, due to higher levels of diesel consumption within the Region negating reduced petrol consumption reported by the DTI

Table 5 presents the total regional CO_2 emissions by fuel source. Emissions from electricity have increased, reflecting the increasing importance of commercial and public sector activity in non-domestic outputs, while coal and manufactured fuels have fallen by nearly 16% reflecting the reduction in primary industry like iron and steel. CO_2 emissions from road transport are higher, driven mainly by increases in freight fuel consumption within the region.

Table 5 CO_2 emissions by fuel type for West Midlands 2002 – 2004

	2002	2003	2004
Coal and manufactured fuel	1,641	1,161	1,381
Petroleum products	14,971	15,191	15,572
Natural gas	11,786	12,063	11,678
Renewables and waste	90	90	90
Electricity	14,123	14,286	14,380
Total	42,611	42,791	43,102

Sources: DUKES 2005; ABI; ONS Mid year population estimates; DTI energy trends (December 2005); DEFRA

The discussion in sections 2.5 and 2.6 below provides a more detailed breakdown of the industry, commercial and public sector services components underpinning tables 2 to 5.

2.2 Baseline Emissions projections - measuring progress

The West Midlands Energy strategy identified that, in order to achieve the 60% reduction in emissions by 2050, there needs to be an 11%-18% reduction in CO_2 emissions over and above natural progress. In order to apportion the emissions target to individual energy sectors, estimates were calculated for projected emissions for 2010 and 2020. In this report we have reported emissions against the 2010 target.

As in the strategy, we have calculated a simple estimate of final energy consumption using employment and demographic weights to compute the region's share of national final consumption. The emissions estimates were then calculated using conversion factors published by DEFRA.

While the strategy concedes that there may be compromises arising from the simplicity of the methodology (Energy Strategy, p38), through the course of preparation of the report we felt that this method would enable a degree of consistency with the strategy estimates.

Using the sectoral baseline predictions within the strategy (Table 9, Annexe A) we can provide comparison between predicted levels of CO_2 emissions and those estimated from the contemporary data. The annual projected rate of change in energy intensity[10] industry was estimated to be a reduction of 2.1% per annum, 2.4% per annum for the domestic sector and 1.9% for commercial and public services. These translated into a projected 0.6 Mt reduction in industry CO_2 emissions between 2002 and 2004, a reduction of 0.23 Mt from services and a further reduction of 0.65 Mt from households.

Table 6 provides the update of the projections with revised data for 2002, which has resulted in lower levels for the 2002 baseline emissions. We have calculated the required reductions and estimated the projected emissions levels necessary to meet the reduction targets - these are the figures in brackets. The projection to 2010 differs from the figures in the strategy as we have revised the 2002 baseline figures due to revisions in the official data.

In 2004, to meet industry's target for reduced CO_2, emissions needed to be below 12.3 Mt of CO_2. Estimates of industrial CO_2 emissions exceed these target levels, at 12.9 Mt. Both domestic and services- commercial and public sector- also exceed the projected emissions needed to meet the annual target set out in the strategy.

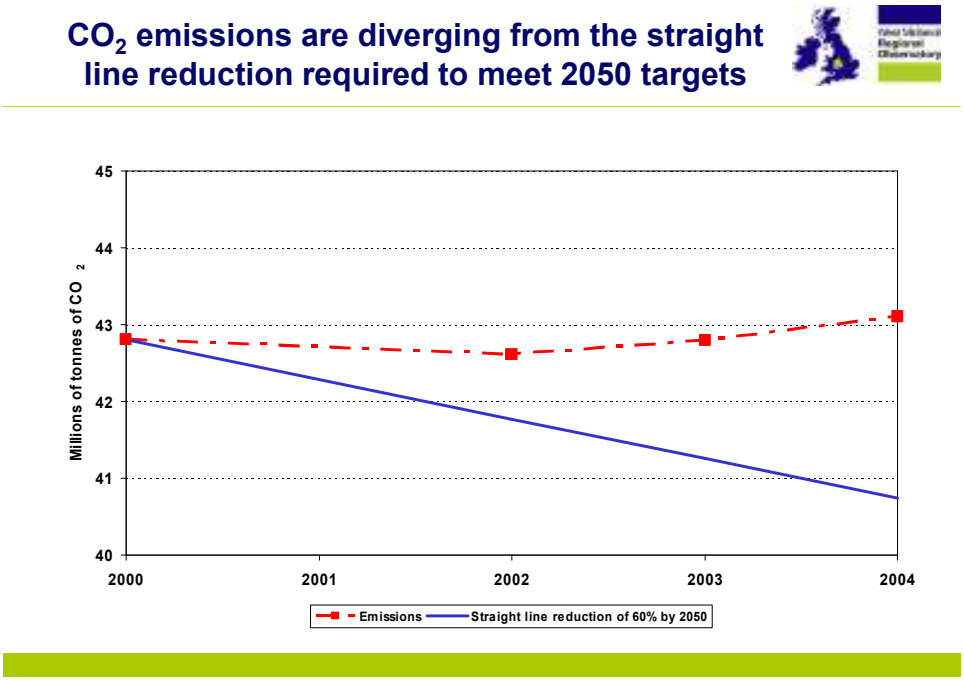
Table 6 Update of Energy Strategy CO_2 Emissions projections 2000 - 2010

	2000*	2002*	2003	2004	2010*
Industry	13,507	12,925	13,005 (12,635)***	12,944 (12,345)	10,607
Services	5,860	5,633	5,614 (5,520)	5,837 (5,406)	4,727
Domestic	13,274	12,626	12,654 (12,301)	12,684 (11,977)	10,033
Transport	10,158	11,427	11,517	11,637	10,138
Total	42,799	42,611	42,791	43,102	35,505

* Baseline projections recalculated using revised 2002 estimates. **The figures are the same as presented in the strategy; ** *Figures in brackets are the emission levels required to achieve the targets

Figure 1 highlights the degree to which total emissions for the region are diverging from the projected straight line reduction necessary to achieve the region's commitment to ensuring a 60% reduction in emissions by 2050.

Figure 1 CO_2 emissions in West Midlands – Baseline compared with trend reduction required to meet 60% reduction by 2050



The less marked reduction between 2000 and 2002 is due to calculation of the baseline estimates for the region using the national annual change. From 2002 we plot the data estimated in table 3. Our estimated sector emissions exceed those projected from the strategy baseline; however, there are clearly a number of drivers and factors excluded from the calculations that preclude a detailed analysis of the causes of the divergence. We suggest that the estimates highlight the importance of adopting a more sophisticated methodology in formulating projections as well as an audit of initiatives and interventions aimed at achieving emissions targets.

The following sections look at the individual divisions (industry, commercial and public services, domestic and road transport) more closely. Using the data in tables 2 to 5 as the basis of the analysis, improvements in regional and sub-regional data enable us to undertake a fuller analysis of the changes in energy consumption and emissions.

2.3 Economic sectors and the fuel input mix

An important element in energy consumption is the impact that the changing industrial mix has on energy use and subsequent emissions. Table 7 provides a breakdown of the industry-fuel mix for final energy consumption in selected West Midlands sectors in 2004.

The data presented in Table 7 presents the estimates for 2004 in greater detail for industrial and service sectors and fuel type used.

Table 7 Energy Consumption (GWh) by economic division and fuel type 2004

	Coal and manufactured fuel	Petroleum products	Natural gas	Renewables and waste	Electricity	Heat sold	Total
Iron and Steel	1,341	82	1,793	-	1,098	-	4,313
Non Ferrous Metals	541	165	1,053	-	2,453	-	4,212
Mineral Products	554	438	2,317	-	1,469	-	4,779
Chemicals	96	71	1,867	-	1,085	337	3,456
Mechanical Engineering	13	257	1,524	-	1,608	6	3,408
Electrical and instrument engineering	4	32	369	-	660	-	1,064
Vehicles	160	230	1,968	-	1,139	-	3,497
Food, beverages and tobacco	123	331	2,226	-	1,018	2	3,700
Textiles, clothing , leather and footwear	46	64	493	-	252	-	855
Paper, printing and publishing	75	40	863	-	770	9	1,757
Other industries	58	6,196	982	-	2,622	845	10,703
Construction	-	156	234	-	155	-	545
Unclassified	145	2,761	6	300	-	-	3,212
Total Industry	3,155	10,822	15,695	300	14,329	1,199	45,501
Public Administration	40	483	4,030	107	1,840	921	7,422
Commercial	2	413	3,497	-	6,315	-	10,227
Agriculture	6	273	200	73	356	-	908
Miscellaneous	5	402	1,660	18	-	-	2,086
Total Commercial and Public Services	53	1,572	9,387	198	8,512	921	20,643
Total Industry, Commercial and Public Services	3,208	12,394	25,082	498	22,841	2,120	66,144

Table 8 Proportion of fuel type use by economic division and total 2004

	Coal and manufactured fuel	Petroleum products	Natural gas	Renewables and waste	Electricity	Heat sold	Total
Iron and Steel	42%	1%	7%	0%	5%	0%	7%
Non Ferrous Metals	17%	1%	4%	0%	11%	0%	6%
Mineral Products	17%	4%	9%	0%	6%	0%	7%
Chemicals	3%	1%	7%	0%	5%	16%	5%
Mechanical Engineering	0%	2%	6%	0%	7%	0%	5%
Electrical and instrument engineering	0%	0%	1%	0%	3%	0%	2%
Vehicles	5%	2%	8%	0%	5%	0%	5%
Food, beverages and tobacco	4%	3%	9%	0%	4%	0%	6%
Textiles, clothing , leather and footwear	1%	1%	2%	0%	1%	0%	1%
Paper, printing and publishing	2%	0%	3%	0%	3%	0%	3%
Other industries	2%	50%	4%	0%	11%	40%	16%
Construction	0%	1%	1%	0%	1%	0%	1%
Unclassified	5%	22%	0%	60%	0%	0%	5%
Total Industry	98%	87%	63%	60%	63%	57%	69%
Public Administration	1%	4%	16%	21%	8%	43%	11%
Commercial	0%	3%	14%	0%	28%	0%	15%
Agriculture	0%	2%	1%	15%	2%	0%	1%
Miscellaneous	0%	3%	7%	4%	0%	0%	3%
Total Commercial and Public Services	2%	13%	37%	40%	37%	43%	31%

Source: DUKES 2005

Table 8 shows the percentage share of each fuel source consumed by individual sectors. The iron and steel sector is the major user of coal and manufactured fuels, while commercial services consumes high proportions of electricity. While industry is cited as a primary concern in achieving energy efficiency, public administration is a significant user of electricity. It also offers a source of potential demand for renewable energy and CHP technologies through heat sold[11], which although currently a small contributor, provides a greater share of the energy requirements than in other sectors.

Other industries[12] encompass those sectors not included in the defined industries and they represent a significant user of petroleum products.

Table 9 Comparison of employment shares by economic division 1998 and 2004 and share of total energy consumption from fuel type 2004

	Employment Share		Total Energy Share 2004
	1998	2004	
Iron and Steel	0.8%	0.4%	7%
Non Ferrous Metals	0.7%	0.4%	6%
Mineral Products	1.8%	1.1%	7%
Chemicals	0.6%	0.4%	5%
Mechanical Engineering	7.3%	5.1%	5%
Electrical and instrument engineering	2.5%	1.4%	2%
Vehicles	4.0%	2.9%	5%
Food, beverages and tobacco	1.7%	1.5%	6%
Textiles, clothing , leather and footwear	1.1%	0.5%	1%
Paper, printing and publishing	1.3%	1.0%	3%
Other industries	3.5%	2.6%	16%
Construction	4.1%	4.5%	1%
Total Industry	29.5%	21.9%	69%
Public Administration	23.0%	26.8%	11%
Commercial	42.4%	45.7%	15%
Agriculture	1.1%	0.9%	1%
Miscellaneous	4.1%	4.7%	3%
Total Commercial and Public Services	70.5%	78.1%	31%

Source: DUKES 2005; ABI

Table 9 shows the changing employment shares of each of the industrial and service sectors between 1998 and 2004, enabling comparison between the sector's relative importance in terms of employment and its share of energy consumption by fuel source. Total employment in industry has fallen, although there has been a slight growth in construction. Industrial energy demand continues to outweigh commerce and services, although this share, based on national data has fallen from 71% in 1998 to 69% in 2004.

The sectoral composition of the regional economy has changed over time, and will continue to change, and this will clearly impact both on the overall energy consumption of the regional economy, and the sources of that energy supply. This is examined in section 2.4 below.

2.4 Energy intensity

Economic activity is the transformation of inputs into outputs, and one of the principle drivers of sustainable economic growth is productivity. This section examines the productivity of energy consumption and examines if the region's economic sectors are becoming more productive in terms of the efficient use of energy.

2.4.1 GVA and Energy Consumption

Regional economies undergo continual change, with some industries declining while others expand in both relative and absolute terms. This structural change requires that any analytical approach to measuring changes in energy demand arising from industrial and commercial sources takes a number of factors into account:

- The impact of overall changes in employment or output on energy consumption – presuming no change in efficiency or the sectoral structure of the economy, energy consumption will be significantly dependent upon the gross size of the economy;
- The impact of changes energy demand associated with a changing industrial mix – the extent to which energy intensive activity (typically primary and manufacturing activity) is replaced in the economy by activity which is less energy intensive (typically in commercial and public sector activities);
- The effect on energy demand of real efficiency changes – of businesses and employers becoming more efficient in the way that they use energy, using less per employee or per unit of output.

Comparing ratios of the amount of energy consumed per common unit of output over a specified period enables the identification of trends. These demand ratios, traditionally termed energy intensities, take the general form of the ratio of final energy consumption of a sector to the gross value added (GVA) generated by that sector.

The use of GVA is important as in order to calculate an industry's change in energy intensity, it is necessary to have some common measure of output to compare with energy consumption. Physical outputs are not practical for two main reasons:

- Industrial firms may produce a variety of end products which do not use comparative inputs, so a single aggregate measure of output would mask underlying differences within the same sectors;
- The increasing importance of public sector and service industries preclude comparison by physical measures of output.

Gross Value Added provides a robust and consistent measure of output. While Gross Domestic Product measures the total expenditure on final goods and services in the national economy, production is measured by GVA. In the production approach value-added is defined as the revenue of firms minus the amounts paid to other firms to avoid the problem of double counting.

Energy intensity is calculated by dividing energy consumption by GVA; if GVA grows faster than energy consumption then energy intensity falls – since there is greater output per unit of energy input, implying greater energy efficiency.

Table 10 Energy intensities for industry, commercial and public sectors services in the West Midlands 1998 - 2003

	1998	1999	2000	2001	2002	2003
Industry	2.37	2.39	2.18	2.25	2.10	2.09
Commerce, public sector	0.57	0.54	0.50	0.48	0.40	0.37
Total	1.24	1.20	1.07	1.06	0.93	0.89

Source: DUKES 2005; ABI; ONS Regional Accounts

Table 10 shows an improvement in energy intensity over the last 6 years, indicating the each unit of energy used has generated a higher level of GVA, suggesting that the firms within the region are using energy more productively. However, this measure has little information content regarding energy efficiency without further detail of the underlying industrial structure.

Structural changes in the economy are major movements in the composition of the economy that can affect energy intensity but are not related to energy efficiency improvements. As we have indicated a shift in manufacturing from energy intensive sectors to less energy intensive sectors would cause a decline in the energy intensity index, but does not indicate energy efficiency.

2.5 Energy consumption and emissions for industry

The West Midlands continues to have a relatively high concentration of energy intensive industries, but growth in private and public services have reduced their share of the region's output and employment. In 1998 Manufacturing accounted for 28% of regional GVA, falling to 19.5% in 2003.

Employment in industry has declined by 158,000 between 1998 and 2004, a 24% fall compared to 17% nationally. The effect on the region has been more marked than nationally, due to the higher concentration of traditional sectors within the region

making it more exposed to national and global economic shifts. In all but one sector, iron and steel, the region has experienced a greater rate of decline in employment numbers than the respective sector nationally. This results in a smaller weighted share of the national energy consumption.

Table 11 Total industry energy consumption by fuel source 2002 - 2004

	2002	2003	2004
Coal and manufactured fuel	3,492	2,457	3,155
Petroleum products	8,625	9,686	10,822
Natural gas	18,839	18,864	15,695
Renewables and waste	302	300	300
Electricity	14,028	14,282	14,329
Heat sold	694	682	1,199
Total	45,980	46,272	45,501

Sources: DUKES 2005; ABI; DTI energy trends (July 2005)

The changing importance of sectors has altered the fuel input mix and therefore the sources of CO_2 emissions. This is presented in table 12

Table 12 Total CO_2 emissions for industry by fuel source 2002 - 2004

	2002	2003	2004
Coal and manufactured fuel	1,048	737	946
Petroleum products	2,175	2,452	2,763
Natural gas	3,580	3,585	2,983
Renewables and waste	90	90	90
Electricity	6,032	6,141	6,162
Total	12,925	13,005	12,944

Sources: DUKES 2005; ABI; DTI energy trends (July 2005); DEFRA

Emissions from petroleum and electricity used by industry have increased since 2002 mirroring the national picture. An analysis of the national consumption data indicates that other industries have increased petroleum consumption by over 90% since 2002. Included in these industries is recycling where employment has increased by 24% and while employment growth in recycling has not been as high as the national figure, the region's employment has increased 5% since 2002.

The data in the above tables has been calculated using the same method used in the strategy. Detailed sector emissions data have been published by DEFRA[13] using modelled estimates of CO_2 emissions. These are presented for industrial emissions in table 13.

Table 13 CO_2 emissions Industry sector breakdown 2003

	West Midlands	Share of UK Total
Industrial and Commercial - Electricity	5953	5.5%
Industrial and Commercial - Gas	5987	9.6%
Industry & Commercial - Oil	1673	4.5%
Industry & Commercial - Solid Fuel	370	2.5%
Industry & Commercial - Wastes And Biomass	394	17.2%
Industry Process Gases[14]	140	0.9%
Industry Non Fuel[15]	402	4.8%
Industry Off-Road Machinery	339	13.0%
Agriculture Oil	42	7.4%
Agriculture Solid	1	7.8%
Agriculture And Deforestation	73	6.9%
Railways	94	9.7%

Source: NETCEN (2005) Local and Regional CO_2 Emissions Estimates for 2003

The data shows emissions for more detailed industrial processes in thousands of tonnes of CO_2. It is clear that industrial and commercial electricity and gas account for a significant proportion of regional emissions. The region is the biggest source of UK total CO_2 emissions through commercial waste and biomass and off road machinery; emissions from 3 of the main urban areas, Birmingham, Coventry and Stoke on Trent account for 65% of the waste and biomass source while off road machinery is more evenly distributed across the region's authorities although Birmingham is the largest with 17.5% of the regional total of 339,000 tonnes of CO_2.

2.6 Energy consumption and emissions for Commerce and Public services

Services, both private and public sector, continue to become ever more important to the region's economy. Combined these sectors contributed 73% to the region's total GVA in 2003, up from 65% in 1998.

Whilst employment in private and public sector services has increased, growth in these sectors between 1998 and 2004 has been less marked in this Region than the national average. While the rate of growth in employment in the commercial services has slowed since 2002, public sector employment has continued to grow with nearly 40,000 jobs added since 2002 compared to 57,000 between 1998 and 2002. Despite the slowdown in commercial employment between 2002 and 2004, the Region's employment growth rate was higher than the national average[16].

Table 14 Commercial and public services final energy consumption by fuel source 2002 - 2004

	2002	2003	2004
Coal and manufactured fuel	41	44	53
Petroleum products	1,832	1,284	1,572
Natural gas	8,542	9,081	9,387
Renewables and waste	189	195	198
Electricity	8,275	8,295	8,512
Heat sold	753	672	921
Total	19,633	19,572	20,643

Sources: DUKES 2005; ABI; DTI energy trends (July 2005)

Energy consumption in these sectors is primarily gas and electricity to provide heat and light to commercial properties. The use of heat sold has increased by 22% over the period while energy from renewables and waste has risen by nearly 5%. The sector contributed nearly 14% of the region's CO_2 emissions in 2004.

Table 15 Commercial and public services CO_2 emissions by fuel source 2002 - 2004

	2002	2003	2004
Coal and manufactured fuel	12	13	16
Petroleum products	440	308	377
Natural gas	1,623	1,725	1,784
Renewables and waste	-	-	-
Electricity	3,558	3,567	3,660
Heat sold	-	-	-
Total	5,633	5,614	5,837

Sources: DUKES 2005; ABI; DTI energy trends (July 2005); DEFRA

The type of use and size of commercial properties will affect the energy consumed. Table 16 highlights the growing share of food and drink retail properties within the retail sector, up 9% from 2002, while office space has increased by 5%, with commercial office demand rising by 1,224 sites.

Table 16 Number of Commercial and Industrial properties (Hereditaments) by bulk class 2002-2004 Source: ODPM

	2002	2003	2004
All Bulk Classes	133,328	134,450	135,168
Total Retail Premises	51,852	51,701	51,671
A1 (shops)	41,756	41,564	41,383
A2 (financial and professional)	4,362	4,307	4,195
A3 (food and drink)	4,709	4,940	5,132
AX (other)	746	773	873
Total Offices	27,119	27,981	28,416
Commercial Offices	22,392	23,220	23,616
'Other' Offices	4,727	4,761	4,800
Factories	32,797	32,900	32,924
Warehouses	21,560	21,868	22,157

The size of the site is an important determinant of energy use. Table 17 shows that, among all industrial and commercial properties average size has fallen slightly, due primarily a fall in the average size of factories, which represents the largest single type and the growing importance of food and drink retail. The average size of retail and food and drink sites has increased, whilst the average warehouse floor-space has also risen.

Table 17 Average floor-space of Commercial and Industrial properties in 000m^2 2002 - 2004

	2002	2003	2004
All Bulk Classes	0.535	0.534	0.531
Total Retail Premises	0.197	0.199	0.203
A1 (shops)	0.208	0.211	0.215
A2 (financial and professional)	0.155	0.153	0.156
A3 (food and drink)	0.128	0.132	0.133
AX (other)	0.267	0.265	0.273
Offices	0.287	0.285	0.283
Commercial Offices	0.257	0.255	0.254
'Other' Offices	0.431	0.432	0.426
Factories	1.058	1.041	1.013
Warehouses	0.865	0.881	0.897

Source: ODPM

2.7 Domestic energy consumption

There are 2,281,893 dwellings in the West Midlands Region. Between 2001 and 2005 the increase in dwelling stock was 2.4%.[17]

Table 18 Local authorities by domestic energy consumption (GWh) 2003

	Coal	Manufactured fuel	Petroleum products	Natural gas	Electricity	Total
Birmingham	4.6	11.8	78.3	7,264.1	1,853.2	9,212.0
Dudley	5.1	13.6	38.9	2,387.4	585.8	3,030.8
Sandwell	8.4	5.7	27.9	2,105.4	521.0	2,668.4
Coventry	4.6	12.4	34.6	1,986.5	557.1	2,595.1
Stoke-on-Trent	26.7	72.7	73.6	1,886.7	421.8	2,481.6
Solihull	2.6	2.6	34.4	1,745.7	437.7	2,222.9
Walsall	5.6	15.2	26.4	1,670.8	481.8	2,199.8
Wolverhampton	6.3	14.0	42.4	1,679.0	454.5	2,196.2
Herefordshire, County of	46.0	4.4	469.0	761.7	417.9	1,698.9
Warwick	4.6	3.3	66.2	1,160.3	276.4	1,510.9
Stafford	23.0	1.6	132.0	1,047.3	257.6	1,461.6
South Staffordshire	8.8	5.4	47.6	1,182.3	211.4	1,455.6
Telford and Wrekin	13.2	11.5	77.5	1,014.8	283.2	1,400.2
Stratford-on-Avon	27.2	2.0	233.5	743.4	302.5	1,308.4
Staffordshire Moorlands	18.2	13.3	89.6	967.5	193.1	1,281.8
Lichfield	8.7	9.7	56.3	968.0	200.7	1,243.4
Wychavon	18.5	1.3	183.2	760.1	267.5	1,230.7
Newcastle-under-Lyme	16.1	20.7	56.3	861.6	221.8	1,176.6
Bromsgrove	5.4	1.0	37.8	899.3	192.2	1,135.7
Shrewsbury and Atcham	22.0	4.1	199.5	583.7	201.9	1,011.2
East Staffordshire	13.8	6.7	73.9	630.3	226.8	951.6
North Warwickshire	19.7	18.0	36.0	728.5	136.7	938.8
Nuneaton and Bedworth	8.3	20.2	24.9	650.4	233.3	937.1
Malvern Hills	15.2	1.1	191.5	542.3	179.1	929.2
Cannock Chase	19.9	23.7	28.2	609.4	177.1	858.2
Wyre Forest	8.7	1.5	57.9	581.8	197.6	847.5
Rugby	6.4	3.8	63.7	567.1	199.2	840.1
Redditch	2.4	0.2	12.7	612.3	146.3	773.9
Worcester	1.8	4.9	37.3	482.7	177.2	704.0
Bridgnorth	15.7	2.0	104.1	400.8	123.5	646.1
North Shropshire	22.5	3.0	159.7	320.8	130.6	636.6
Tamworth	5.9	11.6	20.3	377.0	146.5	561.2
South Shropshire	24.3	2.9	172.4	185.6	113.2	498.4

Oswestry	18.2	3.0	87.2	162.1	82.4	352.9

Source: DTI Energy Trends December 2005

The highest energy consuming local authority areas account for 56% of domestic energy consumed in 2003. While electricity and gas are the principal sources of energy, Stoke-on-Trent continues to be a large consumer of domestic coal and manufactured fuels, possible a legacy of the local importance of coal.

Herefordshire consumes 15% of the region's total domestic petroleum energy, nearly twice as much as the second largest consuming authority. Table 19 shows that the degree of rurality[18] is an important determinant in fuel use. The rural areas use higher levels of petroleum products but lower levels of gas than urban areas. Limited access to the gas network and the greater use of oil fired heating in rural off-grid areas may be the main factors behind this fuel mix.

Table 19 Fuel source for domestic energy consumption rural-urban type 2003

	Coal	Manufactured fuels	Petroleum products	Natural gas	Electricity
Rural-80	2.7%	0.3%	20.1%	55.1%	21.8%
Rural-50	1.8%	0.8%	13.8%	65.1%	18.5%
Significantly Rural	1.1%	0.5%	7.0%	72.1%	19.3%
Other Urban	0.7%	1.1%	3.9%	71.7%	22.5%
Major Urban	0.2%	0.3%	1.2%	78.3%	20.1%
Large Urban	0.8%	1.7%	2.6%	75.7%	19.2%

Source: DTI Energy Trends December 2005

Figures published by the DTI enable us to do a more detailed spatial comparison for domestic gas and electricity consumption. Overall in 2004 average regional domestic consumption of both gas at 20,621 kWh and electricity at 4,683 kWh are close to the Great Britain averages of 20,398 kWh and 4,628 kWh respectively.

2.7.1 Domestic Gas

Overall, average domestic gas consumption rose between 2003 and 2004 from 20,163 kWh per household to 20,261 KWh.

Table 20 presents the ranking of the local authority districts in the West Midlands by average household gas consumption in 2004. Domestic gas consumption tends to be higher in some northern and eastern parts of the region (notably parts of Staffordshire) than in the west and south west (particularly Herefordshire and much of Shropshire). This may be to do with the number of properties in the rural west which are 'off-grid', but it does not explain many of the apparent differences.

Beyond this there is no clear pattern to the distribution – rural authorities feature significantly in both the higher and lower rankings in terms of consumption, and there is no obvious pattern of more or less affluent districts apparent. Factors which could be involved include the numbers of properties on the gas grid, the mix and size of properties in a district, relative affluence and size of household – but none of these factors appear to explain variations, and it is likely that many variables are at play in determining average household consumption.

Table 20 Local Authorities districts ranked by average household domestic gas consumption (kWh) 2004

Local Authorities	Average consumption per household
Lichfield	22,697
Solihull	22,671
Staffordshire Moorlands	22,563
Newcastle-under-Lyme	22,265
North Warwickshire	22,045
South Staffordshire	22,040
Cannock Chase	21,735
Bromsgrove	21,660
Stafford	21,638
Stratford-on-Avon	21,224
Warwick	20,882
Walsall	20,866
Birmingham	20,787
Wolverhampton	20,736
Stoke-on-Trent	20,606
Rugby	20,602
North Shropshire	20,562
Wyre Forest	20,548
Bridgnorth	20,388
Tamworth	20,226
Malvern Hills	20,096
Dudley	19,934
Nuneaton and Bedworth	19,805
Shrewsbury and Atcham	19,713
Sandwell	19,701
East Staffordshire	19,653
Wychavon	19,628
South Shropshire	19,562
Redditch	19,517
Oswestry	19,313
Telford and Wrekin	19,272

Worcester	19,185
Coventry	19,149
Herefordshire, County of	18,190

Source: DTI Energy Trends December 2005

Stratford-upon-Avon is one of the 10 largest consuming authorities, despite being predominantly rural. Possibly relative income is a factor for those who have access to gas. Taxable annual median earnings for the district were £16,900 in 2002-2003[19], putting it 7th in the region indicating that those who have access to gas consume relative high levels. Another indicator is housing type; nearly 70% of the dwellings are detached or semi-detached properties.

2.7.2 Domestic Electricity

While Stratford-upon-Avon is one of the largest 10 in terms of gas consumption, it is the largest authority in terms of average domestic electricity consumption. There is a clear urban-rural pattern between the highest and lowest consuming local authority areas, reflecting the lower penetration of the gas network in rural areas, and hence a greater reliance on electricity in many cases. Affluence is also likely to be playing a part here as well – since many of the higher consuming areas are not only more rural, but also more affluent, houses are likely to be larger, and the number and size of electrical appliances in each household is likely to be greater (even though they may be newer and a little more efficient).

In the lowest areas in terms of consumption are some of the more deprived parts of the region, underlining the importance of affluence – but these will also be the areas where connection to the gas grid is almost universal as they are urban areas, with household heating and cooking needs therefore much more likely to be met from gas than in rural areas.

Table 21 Local Authorities districts ranked by average household domestic electricity consumption (kWh) 2004

Local Authorities	Average consumption per household
Stratford-on-Avon	5,889
South Shropshire	5,785
Malvern Hills	5,548
Wychavon	5,466
Bridgnorth	5,463
Herefordshire, County of	5,432
North Shropshire	5,287
North Warwickshire	5,249
Bromsgrove	5,128
Solihull	5,127
Lichfield	5,082
Rugby	5,048
Oswestry	4,975
Warwick	4,956
East Staffordshire	4,944
South Staffordshire	4,885
Tamworth	4,850
Stafford	4,823
Shrewsbury and Atcham	4,736
Staffordshire Moorlands	4,735
Wyre Forest	4,705
Cannock Chase	4,573
Dudley	4,535
Nuneaton and Bedworth	4,531
Birmingham	4,531
Walsall	4,452
Telford and Wrekin	4,392
Redditch	4,387
Wolverhampton	4,370
Coventry	4,350
Worcester	4,349
Newcastle-under-Lyme	4,287
Sandwell	4,192
Stoke-on-Trent	3,934

Source: DTI Energy Trends December 2005

2.7.3 Domestic CO_2 emissions

This section of the report examines the source of CO_2 emissions arising from domestic energy consumption.

The estimates in tables 3 and 5 were calculated using the population share method adopted in the Energy Strategy. This assumes that the distribution of housing within the region's local authorities is the same across all of them, which is clearly an over-simplification. Given the underlying variations in housing typology between the local authorities, which will affect the level of emissions the following discussions uses data on domestic emissions by local authorities published by DTI. Table 22 presents the 10 local authorities whose domestic households generate the greatest levels of CO_2.

Table 22 Local authorities ranked by total CO_2 emissions from domestic sources (000 tonnes) 2003

	Domestic Electricity	Domestic Gas	Domestic Oil	Domestic Solid Fuel	Domestic Home And Garden Machinery	Total
Birmingham	997	1,467	13	7	4	2,489
Dudley	315	482	7	8	1	813
Sandwell	280	425	5	5	1	717
Coventry	300	401	6	7	1	716
Stoke-on-Trent	227	381	10	43	1	663
Walsall	259	337	4	9	1	611
Wolverhampton	245	339	7	9	1	601
Solihull	236	353	7	2	1	598
Herefordshire, County of	225	154	113	15	1	508
Warwick	149	234	15	3	1	402
Stafford	139	212	32	8	1	390
Telford and Wrekin	152	205	17	10	1	385
Stratford-on-Avon	163	150	56	9	0	379
South Staffordshire	114	239	11	5	0	369
Wychavon	144	154	44	6	0	348
Staffordshire Moorlands	104	195	20	12	0	332

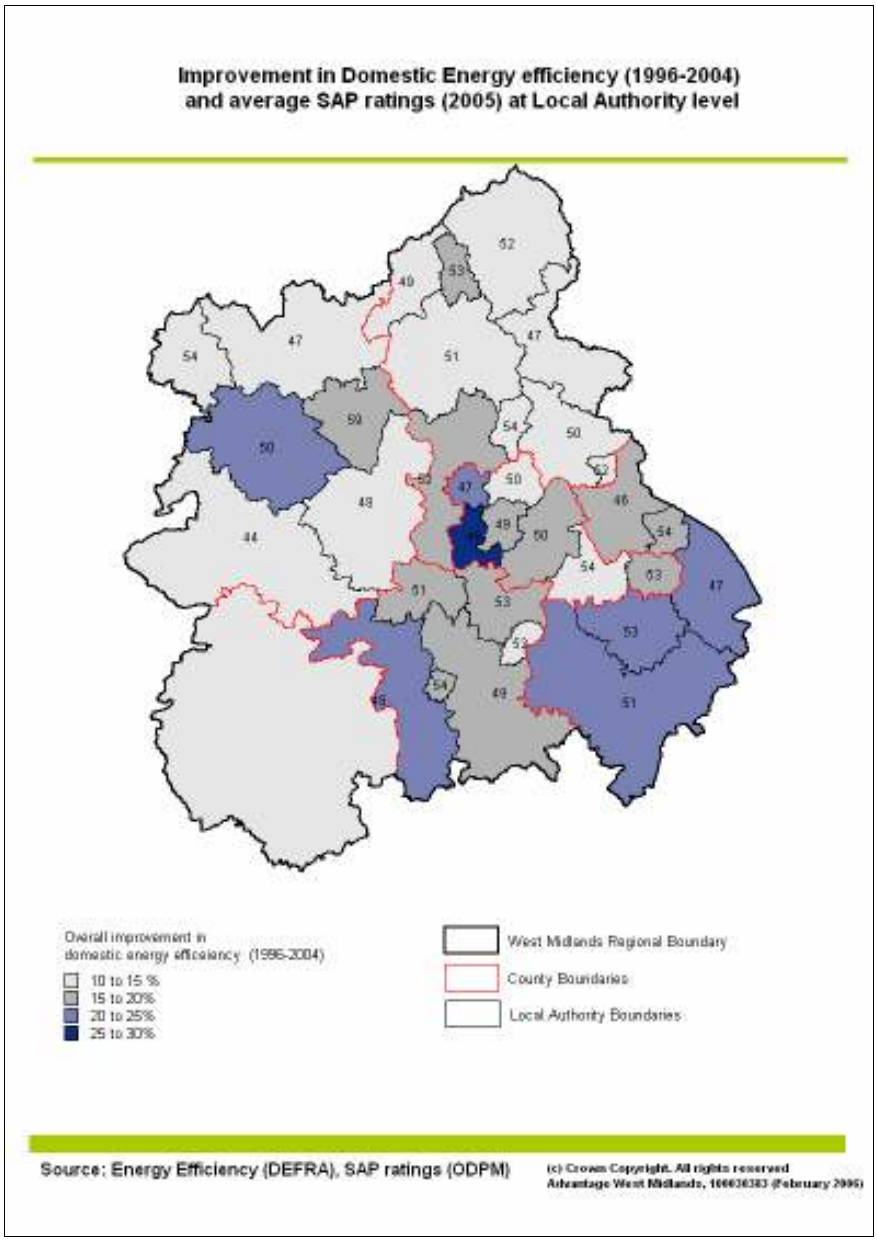
Lichfield	108	196	12	7	0	323
Newcastle-under-Lyme	119	174	11	15	0	320
Bromsgrove	103	182	8	2	0	296
Shrewsbury and Atcham	109	118	48	9	0	284
East Staffordshire	122	127	17	7	0	274
Nuneaton and Bedworth	126	131	3	12	1	273
Malvern Hills	96	110	46	5	0	257
North Warwickshire	74	147	7	14	0	243
Wyre Forest	106	118	14	3	0	241
Rugby	107	115	15	4	0	241
Cannock Chase	95	123	5	17	0	241
Redditch	79	124	3	1	0	206
Worcester	95	98	9	3	0	205
North Shropshire	70	65	39	8	0	182
Bridgnorth	66	81	25	6	0	178
Tamworth	79	76	4	7	0	167
South Shropshire	61	37	42	9	0	149
Oswestry	44	33	21	7	0	105

Source: NETCEN (2005) Local and Regional CO_2 Emissions Estimates for

The 10 local authority areas with the largest total CO_2 output account for 56% of the total emissions from domestic sources, with Birmingham (17% of the regional total) the largest single source (but unsurprising since it comprises nearly a fifth of the regional population). While the major and large urban centres contribute 9 of the 10, Herefordshire is an area with relatively high levels of emissions, nearly 100,000 tonnes more CO_2 emissions than the next authority, Warwick. Higher levels of electricity consumption combined with the highest level of emissions from domestic oil (113,000 tonnes per annum), means that Herefordshire accounts for 4% of the Region's total domestic CO_2 emissions.

2.7.4 Domestic Energy Efficiency

Figure 2 Local authorities' progress in achieving energy efficiency 1998 – 2004 and SAP rating at 2004



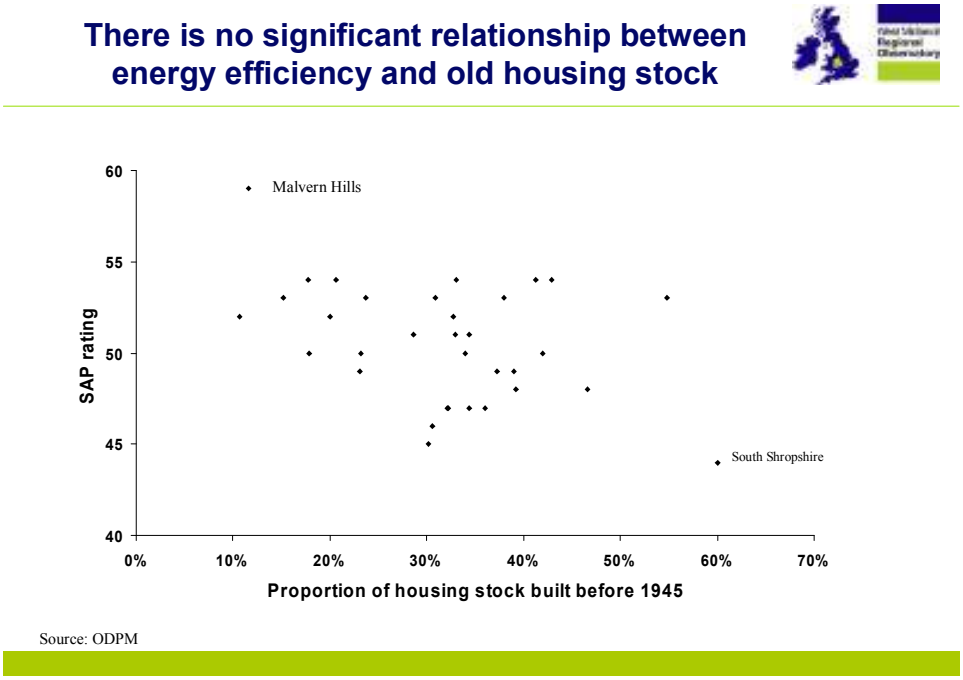
Source: ODPM; DEFRA

Figure 2 presents the different achievements in terms of energy efficiency improvements across the different authorities in the region. Dudley has made the greatest progress in terms of energy efficiency, but continues to be below the regional average SAP[20] rating of 48.8. Local authorities within Warwickshire achieved large improvements in energy efficiency, although Rugby continues to be below the regional average.

The colour shading on the map indicates the progress that the local authority has made in improving energy efficiency since 1996, with the darker shading representing a greater percentage improvement in the average SAP rating since 1996. The number is the average SAP rating for private sector dwellings in April 2004[21]

While there are many factors that can affect energy efficiency, one important determinant has been thought to be the age of the property, with older dwellings costing more to be brought up to contemporary standards. Rugby for instance has relatively more pre-1945 properties than other districts within Warwickshire and despite significant energy efficiency improvements is still below the regional average.

Figure 3 shows the relationship between age of housing stock and average SAP ratings.



What Figure 3 shows, however, is that once two 'outlier' districts are excluded, there is no clear statistical relationship between the percentage of housing stock built before 1945 and the district SAP rating, and hence that the age of housing stock, and certainly the proportion of pre-1945 housing in the stock of a district, has little direct bearing on that district's SAP rating.

Energy efficiency and housing type in the West Midlands has been examined in the recently published *Counting Consumption: CO2 emissions, material flows and Ecological Footprint of the UK by region and devolved country*[22] (March 2006). The report identifies household size as a key driver of regional energy demand. The report estimates that, if occupancy levels are as low as two by 2021, there would be a 13% increase in domestic energy demand in the region. We discuss the tools and methods adopted by the report in chapter 4 and we propose the adoption of the tools developed as part of a programme of future research.

2.8 Road transport

Our choice of where we live, work, shop and spend our leisure time influences the amount of energy we use in moving both ourselves and the goods and services we consume around the region.

While car use has increased, average fuel efficiency from new cars has improved by 10% since 1997[23]. The fuel consumption of cars can be affected by a number of factors, such as speed and congestion, while additional features such as air-conditioning and power steering, which add weight and use power from the engine to run, combined with the growing popularity of larger vehicles may offset at least some of the efficiency gains made through improvements in engine technology, the use of lighter materials in vehicle construction, and the increasing popularity of diesel engines.

The next two sections examine in turn energy consumption by personal transport and freight transport, looking at variations across the region at local authority level.

2.8.1 Private Transport

Within this report we have used data on road transport published by DTI. In the Regional Energy Strategy estimates of transport energy consumption were derived from an estimate of regional transport fuel sales. This data was not available for comparison, but the data used in this report provides a consistent data set for future comparisons and is published in both Energy Trends for sub-regions and at the regional level in the Regional Transport Statistics series published by the Department for Transport.

The data for private road transport is broken down into vehicle type – buses, motorcycles and cars – petrol and diesel. Private road transport demand for fuel was down 1.4% between 2003 and 2002, but still accounted for 62% of all fuel consumption in regional road transport in 2003.

Data from the National Travel Survey indicates that people in the region travelled further, averaging 3,636 miles between 2003 and 2004, up from 3,588 in 2002, and made an average of 434 trips annually[24].Tables 23 shows the ranking of the local authorities by total fuel consumed within the district for personal transport in 2003.

Table 23 Local Authorities ranked by total fuel consumed for personal transport (thousands tonnes of oil equivalent) 2003

Local Authority District	Total fuel consumed within LAD
Birmingham	274.5
North Warwickshire	121.2
Solihull	111.8
Herefordshire, County of	109.5
Stratford-On-Avon	103.9
Wychavon	103.7
Walsall	99.4
Stafford	97.8
South Staffordshire	94.7
Warwick	92.6
Lichfield	91.8
Sandwell	90.9
Bromsgrove	88.7
Stoke-On-Trent	85.1
Coventry	83.9
Dudley	82.2
Rugby	73.6
Newcastle-Under-Lyme	67.8
Telford and Wrekin	63.5
Wolverhampton	61.5
Shrewsbury and Atcham	56.7
Malvern Hills	56.3
Bridgnorth	44.2
Staffordshire Moorlands	43.2
East Staffordshire	40.9
Nuneaton and Bedworth	34.5
Cannock Chase	34.4
South Shropshire	33.4
Wyre Forest	33.3
North Shropshire	32.0
Worcester	25.6
Oswestry	21.9
Redditch	20.2
Tamworth	18.1

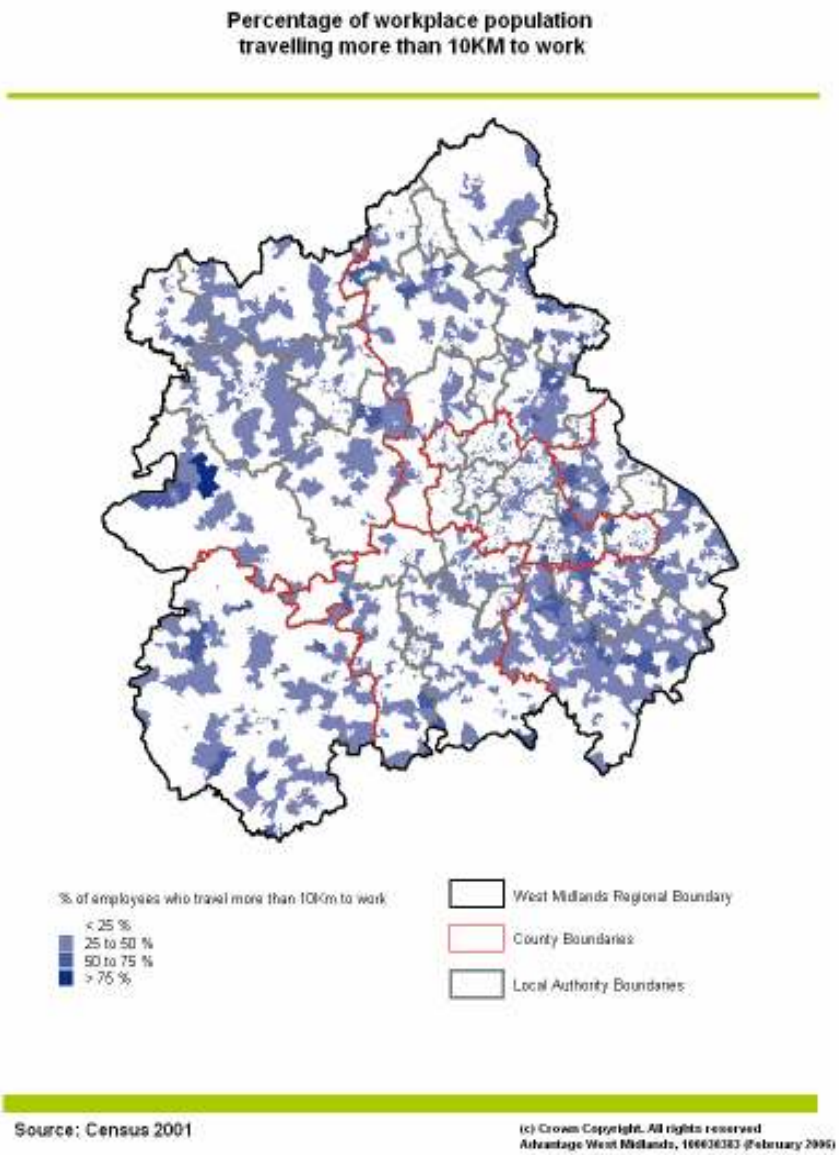
Source: DTI Energy Trends June 2005

Birmingham is by far the largest consumer of private transport energy, over twice as much as the second largest in both years. This is primarily due to the methodology adopted to measure energy consumption for road transport. The road transport fuel estimates are based on the point of consumption rather than where the fuel was actually purchased therefore indicating traffic density. This was to enable DTI to

produce comparable estimates to those already available for local and regional gas and electricity,

According to the National Traffic Survey[25], commuting and shopping accounted for 35% of all trips in the region between 2003 and 2004. Birmingham, with its concentrations of employment, retail and leisure facilities attracts people from neighbouring districts. Figure 4 shows the distribution of commuting patterns within the region. While the centre of Birmingham has pockets of commuters who travel more than 10km, there are a number of areas of concentrations in the more dispersed area, where, in light of the limited public transport links there will tend to be a greater reliance on cars.

Figure 4 Proportion of workplace population who travel more than 10KM to work 2001



We can explore this further by analysing the personal road transport data in more detail. While the data provided in tables 23 is an absolute measure of consumption, we present the data using adult population estimates for each local authority in Table 24. By dividing the data in Table 23 by the mid year estimates for the adult population in each authority, we can provide comparable figures.

Table 24 Local Authorities districts ranked by total fuel consumed for personal transport ((thousands tonnes of oil equivalent) per 10,000) 2003

Local Authority District	Total fuel consumed within LAD
North Warwickshire	24.3
Bromsgrove	12.2
Lichfield	12.1
Wychavon	11.1
Stratford-On-Avon	11.0
South Staffordshire	11.0
Rugby	10.3
Bridgnorth	10.0
South Shropshire	9.8
Stafford	9.8
Malvern Hills	9.4
Warwick	8.5
Herefordshire, County of	7.6
Shrewsbury and Atcham	7.4
Oswestry	7.2
Solihull	7.0
North Shropshire	6.8
Newcastle-Under-Lyme	6.8
Staffordshire Moorlands	5.6
Telford and Wrekin	5.1
Walsall	5.0
East Staffordshire	4.9
Cannock Chase	4.7
Stoke-On-Trent	4.4
Wyre Forest	4.2
Sandwell	4.0
Nuneaton and Bedworth	3.6
Birmingham	3.6
Coventry	3.5
Worcester	3.4
Dudley	3.4
Wolverhampton	3.2
Redditch	3.2
Tamworth	3.1

Source: DTI Energy Trends June 2005; ONS Mid year population estimates

The majority of private consumption within North Warwickshire arises from petrol car use, 1.9 tonnes of oil equivalent per head of the adult population. In light of the methodology used by DTI and the high density of motorways in the authority, this high level of personal consumption may be explained by the volume of traffic passing through the region.

Across all authorities private petrol car use accounts for the largest share of private fuel demand, with over 70% of personal transport energy consumption accounted for by petrol cars in all authorities. There is a rural-urban split identifiable, with rural districts having the greater percentage of private fuel consumption arising from petrol cars, with between 81% - 79% shares in the rural districts while the major urban areas were between 77% and the lowest authority, Birmingham at 73%.

2.8.2 Freight Transport

The data provided by DTI also presents energy consumption for road transport by freight vehicle type – Heavy Goods Vehicles, Light Goods Vehicles – petrol and diesel. The tables below compare the consumption between local authorities in terms of the total energy consumed.

Tables 25 shows the total fuel consumed by freight within the local authorities in 2003.

North Warwickshire is the authority with the highest level of consumption of fuel for freight transport in 2003. Notably the consumption of fuel by HGVs in North Warwickshire rose by 2% between 2002 and 2003, from 96,800 tonnes of fuel in 2002 to 99,000 tonnes in 2003. As with table 23 above, the total levels of consumption reflect total traffic levels, including local traffic.

Table 25 Local Authorities ranked by total fuel consumed for freight transport (thousands tonnes of oil equivalent) 2003

Local Authority District	Total fuel consumed within LAD
North Warwickshire	131.3
Birmingham	108.9
Stafford	90.7
Lichfield	87.4
South Staffordshire	87.4
Wychavon	77.6
Bromsgrove	68.7
Walsall	68.1
Stratford-On-Avon	65.4
Solihull	65.3
Herefordshire, County of	64.6
Rugby	64.2
Warwick	54.5
Newcastle-Under-Lyme	52.2
Sandwell	50.4
Malvern Hills	42.3
Stoke-On-Trent	33.8
Coventry	29.9
Shrewsbury and Atcham	28.8
Cannock Chase	27.8
East Staffordshire	26.8
Dudley	26.3
Telford and Wrekin	25.8
Staffordshire Moorlands	24.1
Bridgnorth	23.8
Wolverhampton	19.8
North Shropshire	19.7
Nuneaton and Bedworth	19.3
South Shropshire	18.5
Oswestry	12.9
Wyre Forest	12.2
Worcester	9.2
Tamworth	6.3
Redditch	5.6

Source: DTI Energy Trends June 2005

Table 26 shows the fuel consumption for freight in 2003 by comparable population figures.

Table 26 Local Authorities ranked by total fuel consumed for freight transport (per 10,000(thousands tonnes of oil equivalent)) 2003

Local Authority District	Total fuel consumed within LAD
North Warwickshire	26.3
Lichfield	11.5
South Staffordshire	10.2
Bromsgrove	9.5
Stafford	9.1
Rugby	9.0
Wychavon	8.3
Malvern Hills	7.0
Stratford-On-Avon	7.0
South Shropshire	5.4
Bridgnorth	5.4
Newcastle-Under-Lyme	5.2
Warwick	5.0
Herefordshire, County of	4.5
Oswestry	4.2
North Shropshire	4.2
Solihull	4.1
Cannock Chase	3.8
Shrewsbury and Atcham	3.7
Walsall	3.4
East Staffordshire	3.2
Staffordshire Moorlands	3.1
Sandwell	2.2
Telford and Wrekin	2.1
Nuneaton and Bedworth	2.0
Stoke-On-Trent	1.8
Wyre Forest	1.5
Birmingham	1.4
Worcester	1.2
Coventry	1.2
Tamworth	1.1
Dudley	1.1
Wolverhampton	1.0
Redditch	0.9

Source: DTI Energy Trends June 2005; ONS Mid year population estimates

North Warwickshire has the highest consumption of fuel per 10,000 of the adult population, and although more mixed than for private road use, rural areas have the highest consumption. Freight consumption tends to be more diesel than petrol. Furthermore, diesel Light Goods Vehicle use is relatively larger in those authorities with low overall freight consumption. In Redditch 56% of freight consumption comes from diesel LGVs compared to 22% in North Warwickshire.

2.9 Non CO_2 emissions

While carbon dioxide is recognised as the main human controlled greenhouse gas accounting for the greatest proportion of greenhouse gas emissions, which are believed to cause global warming there are other emissions harmful to humans and the environment. This section examines briefly the concentrations of these emissions within the region and identifies the main sources.

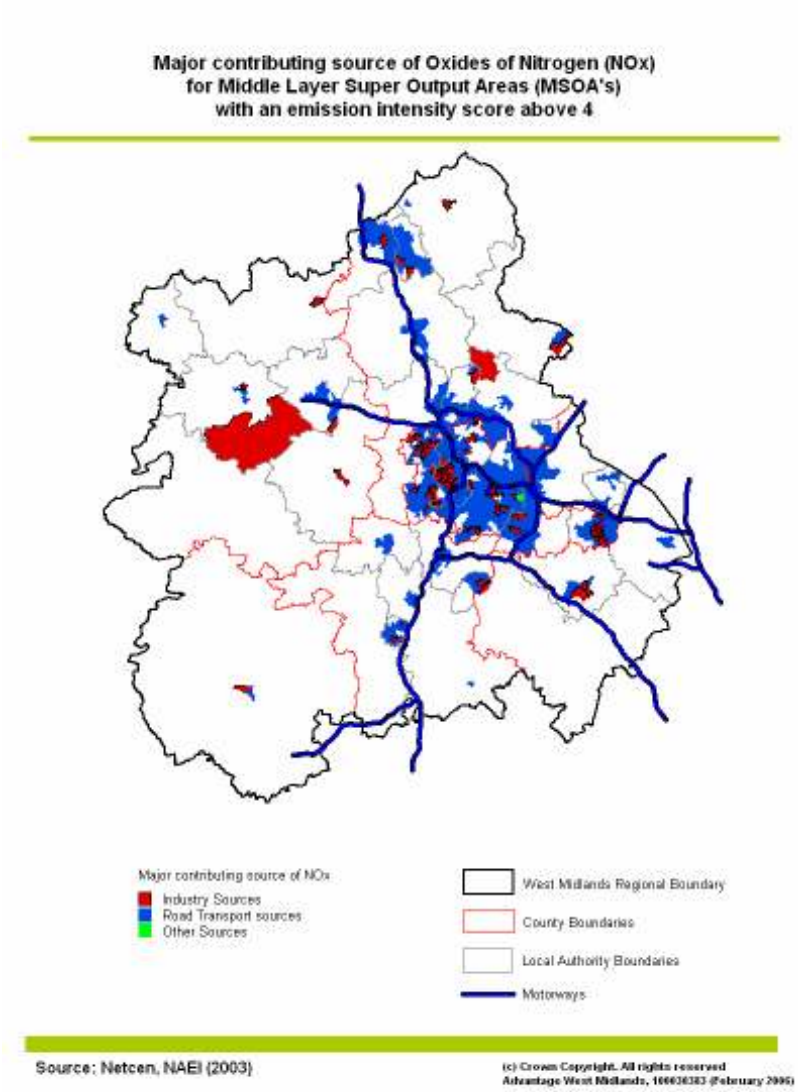
2.9.1 Nitrogen Oxides (NO_x) Emissions

Emissions of oxides of nitrogen are dominated by road transport, followed by power stations. Oxides of nitrogen are toxic to plants and nitrogen dioxide can cause breathing difficulties in humans. Oxides of nitrogen are one of the main precursors of ground level ozone, which can also affect breathing and damage crops and vegetation

Using data published by DEFRA measuring ambient air quality scores, we mapped the middle super output areas (MSOA) which had a higher than EU limit concentration of oxides of nitrogen. The scores are calculated by comparing annual mean NO_x concentrations for 2003 in MSOAs with the EU Limit Value of 40 micrograms per cubic metre (µg/m3) which comes into force in 2010.

A score of 5 or higher represents an MSOA that has exceeded this EU Limit Value. Figure 5 maps the areas that exceed the EU limit score value while the colour indicates the main source of this high concentration. The two major concentrations of red, indicating industrial sources show the two power stations in the region, Ironbridge in Shropshire and Rugeley in Staffordshire. Road transport, the large concentrations of blue within the major urban conurbation, bordered by the motorway network highlight the impact of road traffic on air quality in the major urban areas.

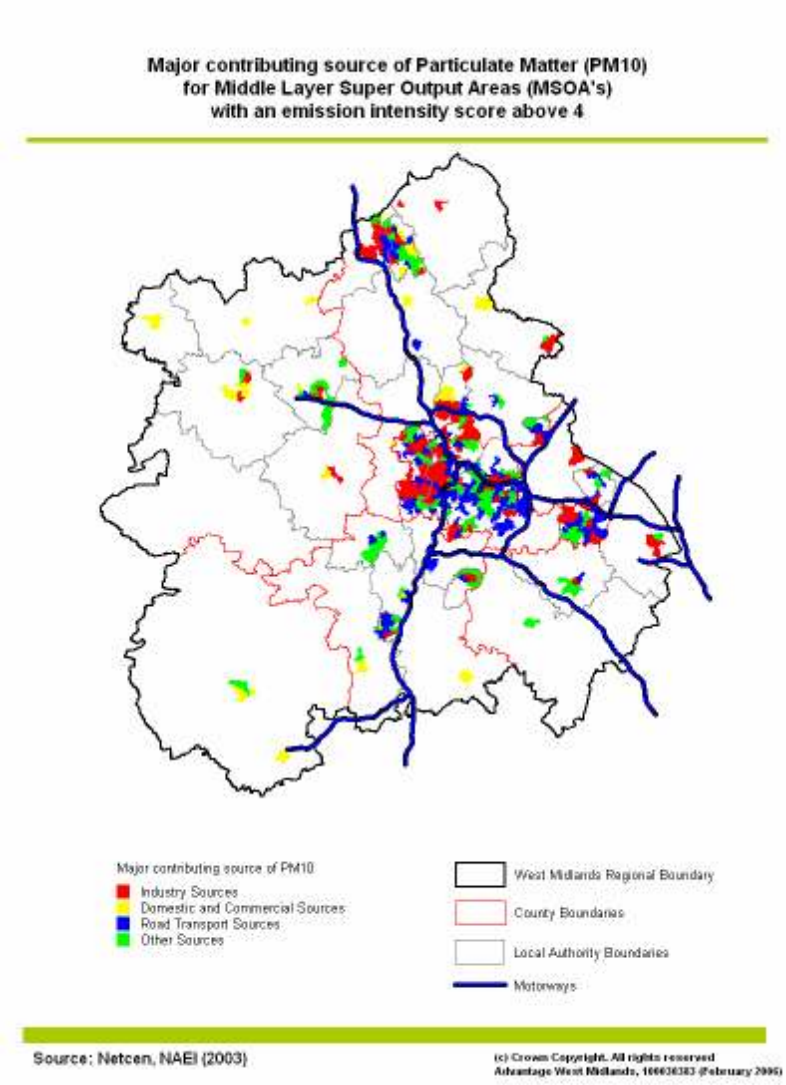
Figure 5 Greater than average levels of concentrations of Oxides of Nitrogen (NOx) by source 2003



2.9.2 PM_{10} emissions

PM10 particles (particles with a diameter of less than 10µg – a hundredth of a millimetre) pose potential health risks because they are small enough to penetrate deep into the lungs. The principal source of airborne PM10 matter in European cities is road traffic emissions, particularly from diesel vehicles. Figure 6 shows a more diffuse picture of PM10 emissions than with oxides of nitrogen, as unlike the individual gaseous pollutants which are single, well-defined substances, PM10 in the atmosphere are composed of a wide range of materials arising from a variety of sources.

Figure 6 Greater than average levels of concentrations of PM_{10} by source 2003



The 'other sources' include waste, other transport, agriculture and natural sources. The concentrations of domestic and commercial sources may be due to the use of coal for domestic or commercial heating. The spatial concentrations are quite small, so it is not possible to identify the fuel source for domestic consumption, which is available only at local authority level. Road transport sources can be identified as the main source around the motorway junctions and within the major urban centre.

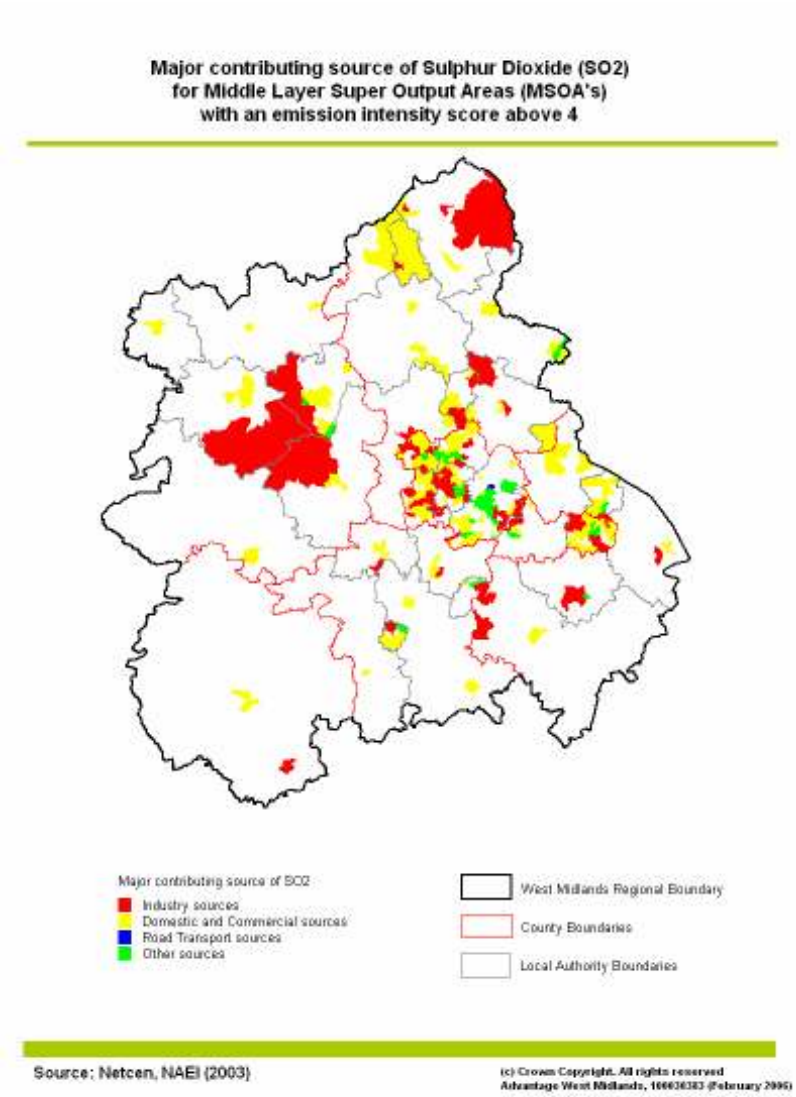
2.9.3 Sulphur Dioxide (SO_2) Emissions

The principal source of SO_2 is power stations burning fossil fuels that contain Sulphur. Emissions of SO_2 from industry result from the combustion of coal and oil, some refinery processes and the production of sulphuric acid.

Figure 7 highlights the main areas of high concentrations of SO2. There is a large concentration of SO2 near the Ironbridge and Rugeley power stations, as well as smaller pockets on the major urban fringe and in the Stratford-upon-Avon and Warwick districts. The high concentration in the Staffordshire Moorlands arises from the heavy use by industry of coal; in 2003 the industry in the area 7,400 tonnes of oil equivalent.

As with industry there are pockets of high concentrations arising from domestic and commercial sources, which may be due to higher levels of domestic and commercial heating using domestic oil or manufactured fuels. Stoke on Trent, which has the largest spatial concentration of SO2 consumed the largest amount of domestic manufactured fuel, 6,300 tonnes of oil equivalent in 2003, more than 3 times the next highest Cannock Chase at 2,000 tonnes of oil equivalent

Figure 7 Greater than average levels of concentrations of Sulphur Dioxide (SO_2) by source 2003



2.10 Summary of the baseline indicators

Table 27 Summary of baseline indicators

Indicator	Baseline	Most recent data
Regional Indicators		
Total Carbon Dioxide Emissions	42.6 Mt/year (2002)	43.1 Mt/year (2004)
Energy Intensity	2.21 GWh/GVA (£m) (2002)	1.97 GWh/ GVA (£m) (2004)
Regional Electricity Consumption	32, 845 GWh/year (2002)	33,433 GWh/year (2004)
Industry		
Industrial Carbon Dioxide Emissions	12.92 Mt/year (2002)	12.94 Mt/year (2004)
Industrial Energy Intensity	2.25 GWh/GVA (£m) (2001)	2.09 GWh/GVA (£m) (2003)
Commercial and Public Sector Services		
Commerce and Public Sector Carbon Dioxide Emissions	5.6 Mt/Year (2002)	5.8 Mt/year (2004)
Commerce and Public Sector Energy Intensity	0.48 GWh/GVA (£m) (2001)	0.37 GWh/GVA (£m) (2003)
Public Sector Carbon Dioxide Emissions	1.71 Mt/year (2002)	1.68 Mt/year (2004)
Households		
Domestic Carbon Dioxide Emissions	12.6 Mt/year (2002)	12.7 Mt/year (2004)
Carbon Dioxide Emissions per Dwelling	5.7 t/year/dwelling (2002)	5.57 t/year/dwelling (2004)
Average SAP rating of homes	48.8 (2002)	
Homes not meeting Decent Homes Standards	828,000 (2001)	
Households in fuel poverty	15.2% (2001)	8.5% (2003)
Road Traffic		
Transport Carbon Dioxide Emissions*	11.4 Mt/year (2002)	11.6 Mt/year (2004)
Percentage of trips to work by car	77% (2002)	78% (2004)
Average annual mileage by car and no. of trips	3,588 miles and 413 trips (1999/2001)	3,636 miles and 434 trips (2003/2004)
Renewables		
CHP capacity	65 MW (2002) No new sites were identified	
Renewable Electricity Generation Capacity	144.4 MW (2002)	174.5 MW (2004)
Generation of electricity from renewable sources	609.4 GWh (2002)	651 GWh (2004)
Percentage of Electricity consumption from renewables	1.8% (2002)	1.9% (2004)
Renewable Heat Supplied	1,482 GWh (2002)	2,176 GWh (2004)
Amount of biofuel sold per year	1.7 m litres (0.1% of diesel sold)	3.3 m litres*** (0.14% of diesel sold) (2005)

* The method used is different to that in the strategy. Latest figure calculated using figures produced by DTI for 2003. Annual change 2002-2003 in vehicle energy use reapplied for 2003-2004 so figure is an estimate. ** Figures from RESTAT *** Provisional 2005

3 Renewable Energy Supply

Renewable energy can be thought of as energy that occurs naturally and repeatedly in the natural environment. Sources of renewable energy are continuously available, offering the potential for achieving sustainability in energy supplies. As highlighted in section 1.1, this is an increasingly important issue as fossil fuel reserves pass their peak, whilst demand for energy continues to climb. The major advantage of increasing the use of renewable energy is that it produces practically no net CO_2 emissions compared to energy from fossil fuels.

3.1 Generation of electricity from renewable sources

In terms of resource availability it was estimated[26] that the region has the potential for 2,993 GWh of generation from renewable energy sources by 2010, with 45% of this coming from wind, 26% from waste, 21% from landfill gas, 4% from biomass, 2% from sewerage gas and 1% from photovoltaics and hydro-electricity. However, there may be a slower progress in the supply of renewables, as it has been identified[27] that most of the energy from waste resources in the region have already been tapped, leaving onshore wind and biomass resources as the most important options for increasing renewable supplies within the Region. Both of these options may require significant investment in electricity network infrastructure.

Table 28 Generation of electricity from renewable sources (GWh) 2002- 2004

West Midlands Generation				
	Hydro	Landfill Gas	Other biofuels	Total
2004	1.9	250.7	398.4	651
2003	1.8	224.6	354.8	581.2
2002	2.4	207.5	399.5	609.4
Share of UK total				
	Hydro	Landfill Gas	Other biofuels	Total
2004	0.04%	6.3%	12.1%	4.6%
2003	0.1%	6.9%	12.5%	5.5%
2002	0.1%	7.9%	16.6%	5.5%

Source: RESTATS

Table 28 shows the level of generation of electricity from renewable sources between 2002 and 2004 in the Region, and the region's share of the national total. The largest increase regionally has been from landfill gas, although the region's share of the UK has fallen over the same period. Generation from biofuels has fallen slightly, but there has been a 21% fall in electricity generated from hydro in the Region. Wind was identified as the largest contributor to the region's renewable commitments as it is likely to be the cheapest renewable energy technology[28]; however there were no identified wind-power sites in the region generating electricity in 2004.

Figure 8 Location of renewable sites by type 2005

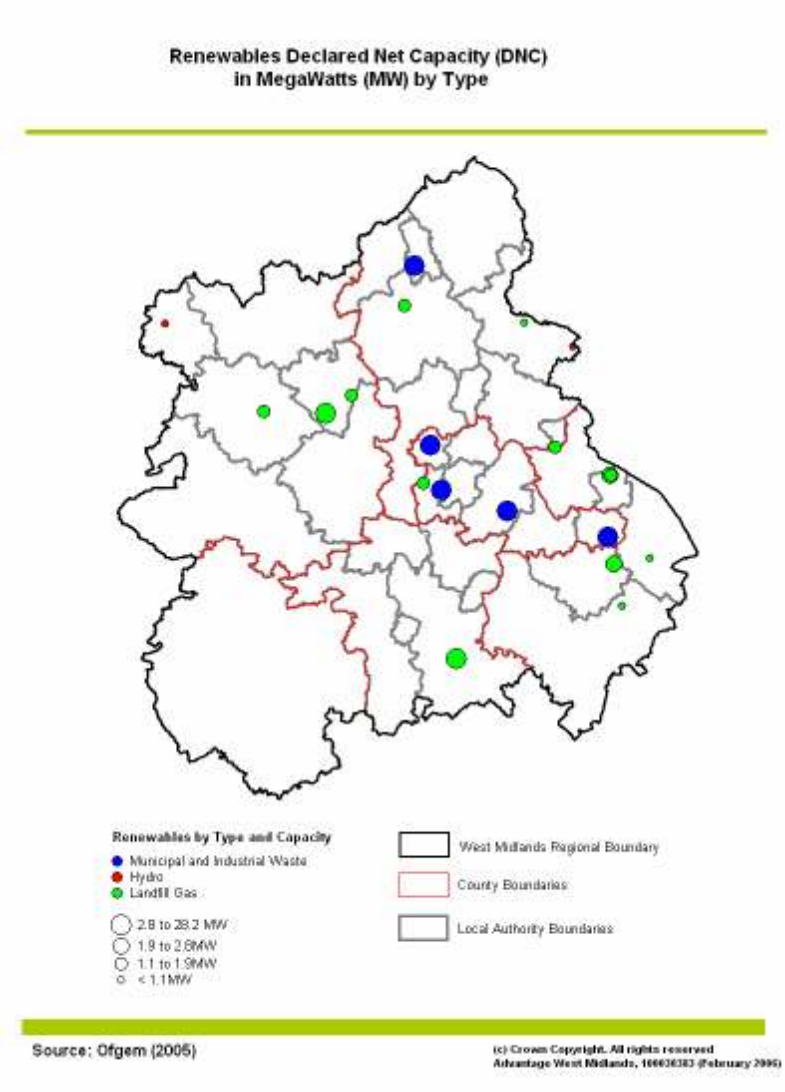


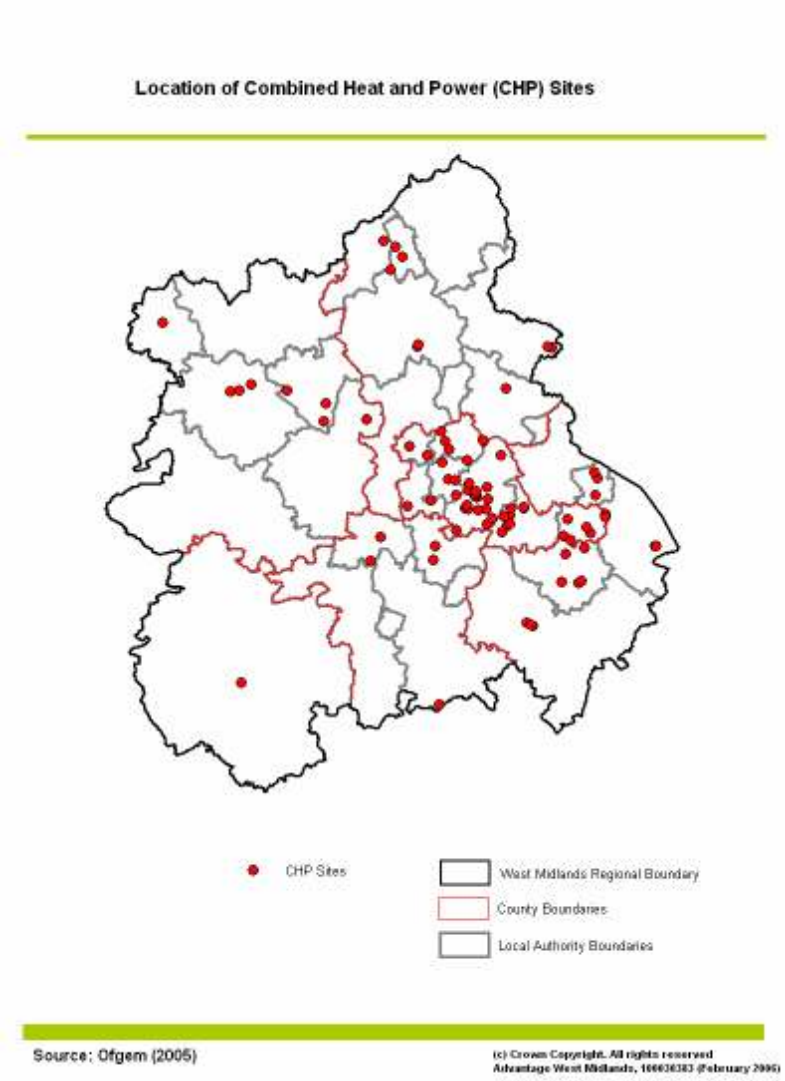
Figure 8 maps the location of the Region's renewable sites which have a generating capacity of greater than 50KW. The relative area of the map symbol indicates generating capacity. The largest number of sites are generating electricity from sewage gas and are located widely across the region, while landfill gas sites tend to be located in the south and south west of the region. The cost of access to the electricity grid may be a factor behind the absence of renewable generating sites in the west and south west of the region.

The next section examines in more detail the region's existing capacity for renewables from different sources. While RESTATS provides a good central source for data on renewable energy sources, we have drawn on a number of different sources that have provided a focus on the West Midlands region.

3.1.1 Combined Heat and Power

Combined heat and power, or CHP, is a technology that is efficient and is already established in the region. On-site or near-site heat generated by electricity production can be highly efficient, and the electricity produced can either be used by the host producer to offset energy consumption which would otherwise draw on the grid, or fed into the electricity grid to supply off site consumption. With the additional benefits of reduced emissions and the enhanced security and diversity of energy supply, CHP technologies offer a significant potential for meeting the energy strategy targets.

Figure 9 Location of CHP sites in the West Midlands



As indicated in table 2, the amount of energy generated by heat sold has increased in the region by 47% between 2002 and 2004, driven mainly by increasing utilization of CHP in the commercial and public services sectors. As has been noted already, the regional figures may be distorted by larger CHP sites outside the region which are included in the national figure. Figure 9 shows the regional distribution of CHP sites. The sites are clustered around the urban areas, where in addition to relatively lower costs of connecting to the electricity network compared to rural areas, there is a greater concentration of the main consuming sectors.

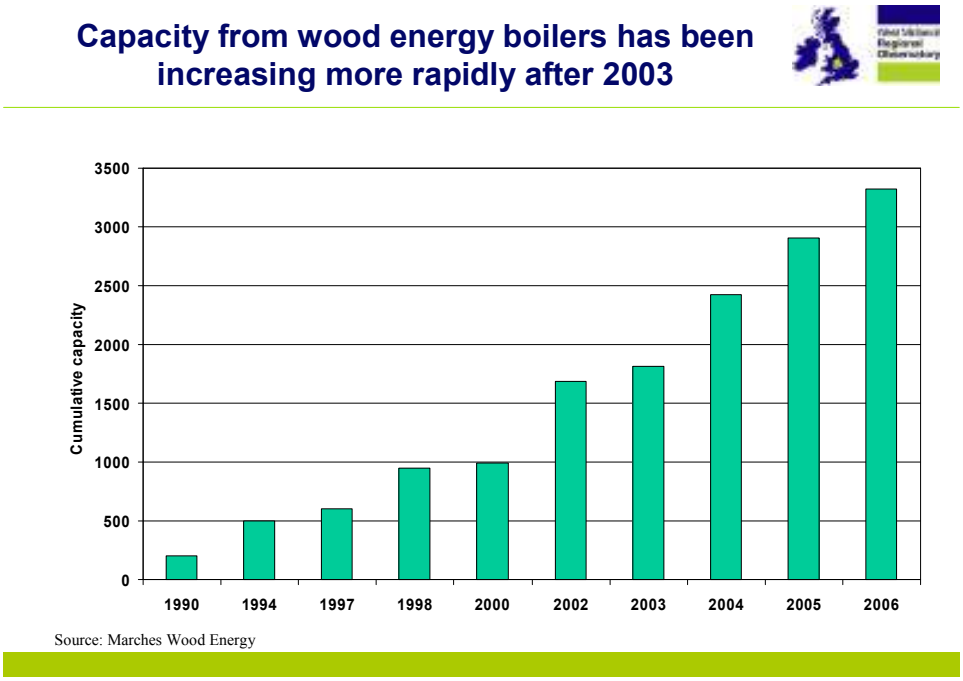
3.1.2 Wood energy

Energy generated from wood has a number of advantages for the commitment of the region to meet carbon emissions targets, as a driver to enable competitiveness and in reducing pressure on landfill.

The Wood Energy Strategy for the West Midlands highlights the benefits of wood as an energy source, including its small amount of net CO_2 emissions, its relative cost against fossil fuels and the associated landscape benefits that may result from bringing neglected woods back into management.

In addition to employment benefits arising from a greater use of locally sourced wood, the Wood Strategy also highlights the competitiveness factors such as the lower disposal costs for wood users and the reduced pressure on the region's landfill sites.

Figure 10 Cumulative wood boiler capacity (kW) 1990 - 2004



While the market for wood used for energy generation is still embryonic, estimates from DEFRA indicate that the overall sustainable timber production in the West Midlands is around 230 km^3 per annum, whilst the total amount of wood processed in the region amounts to some 425 km^3 per annum.

Figure 10 shows the growth in wood fired boiler capacity since 1990. While growth in total capacity was progressive between 1990 and 1997, a step change in capacity occurred before 2001 and since then total capacity has been growing at an increasing rate, with cumulative capacity currently standing at 3,325 KW, produced by 23 sites across the region.

As highlighted in section 2.6, the drivers for critical mass, increased volumes and subsequent economies of scale in the market can be influenced by public sector management adopting wood as a viable alternative fuel. Public administration is a growing sector in the regional economy and already exhibits a greater use of heat sold than other sectors.

3.2 Biofuels for transport

Liquid biofuels are defined as liquid fuels that are derived from crops and waste cooking oil, primarily for use in road transport. As indicated in the introductory paragraph of this chapter as fossil fuel supplies become scarcer and likely to rise in price as demand continues to grow, biofuels may become an increasingly economically viable source of fuel.

The main reasons for the encouragement of development in biofuels are that they can be used in existing engine technologies as a way to reduce carbon emissions and can contribute to reductions in our reliance on fossil fuels. Assuming existing technological conditions, which preclude large scale production, expansion in biofuels is likely to be driven by the expansion of the number of small-scale producers.[29]

Given the localised and small scale nature of its production and distribution, data on biofuels is limited. An audit of the region's bioenergy capacity[30] provides a good source of reference. On the supply side for liquid biofuels, the key findings were:

- Biodiesel produced in the Region comes from processed Waste Vegetable Oil. Existing processors are capable of producing between 7 million and 15 million litres per annum, much of which is used internally. Small scale diversification opportunities exist for farmers if capacity is allocated to grow oilseed rape specifically for biodiesel with supplies preferably confined to local markets to minimise net losses arising from transporting the fuel (so called 'fuel miles');

- Although a feasibility study to examine the cost-benefits of producing bioethanol from orchards in Herefordshire has been undertaken by Herefordshire Sustain, and potential exists for a market for sugar beet and fruit crops, at present there is no infrastructure for bioethanol production in the Region;
- Due to its two large biofuel processing plants the West Midlands accounts for 50% of the UK's current production capacity, but the majority of production goes out of the Region;
- While there are a number of filling stations selling biodiesel at a 5% blend throughout the Region - fuel that can be used in every diesel vehicle - there continues to be a lack of awareness among motorists. A regional programme to help filling station owners promote the fuel and inform potential users about how they can use the fuel is being developed to help grow the number of filling stations stocking the fuel, and increase demand in the Region.

4 References

[1] Energy West Midlands was formed as one of the priorities of the Energy Strategy; a partnership of regional organisations and the DTI; it provides leadership and champions energy issues in the West Midlands and seeks to influence national, regional and local policies, plans and actions. www.energywm.org.uk

[2] See research published by Intergovernmental Panel on Climate Change www.ipcc.ch

[3] The Circular Flow model represents a 'closed system'; in the production side all inputs are converted via the transformation processes into outputs with no wastage. A production plan is defined as 'technologically efficient' if there is no way to produce more outputs with the same level of inputs or to produce the same output with less inputs. The upshot of this axiom is that there can be no wastage within the system, otherwise given perfect knowledge producers would move to an efficient technology as they are driven to optimise output and maximise profit.

[4] See Ecological Budget (2006) *Counting Consumption: CO_2 emissions, material flows and Ecological Footprint of the UK by region and devolved country*. A computer model (REAP) has been developed to enable local authorities and regional organisations to calculate their consumption of resources from wherever they are sourced. Further information can be found at www.wwflearning.org.uk/ecobudget

[5] Analysis of Office for National Statistics Regional Accounts data for industry GVA in the region and employment data from the Annual Business Inquiry.

[6] For an overview of research on climate change see Intergovernmental Panel on Climate Change (www.ipcc.ch); Tyndall Centre (www.tyndall.ac.uk); Hadley Centre (www.metoffice.com/research/hadleycentre)

[7] Energy White Paper – Our Energy Future: creating a low carbon economy www.dti.gov.uk/energy/whitepaper/

[8] The methodology used in the energy strategy is to apportion the national energy consumption by industry of each fuel source (DUKES Table 1.1) by the Region's share of employment in each sector for industry, commercial and public services (data was sourced from the Annual Business Inquiry). So if employment in iron and steel in the region was 10% of the national employment in that industry, then the region's share of energy consumption by each fuel source is 10% of the national total. For domestic the method apportions the national figure according to the regional population as a percentage of the national population

[9] Guidelines for Company Reporting on Greenhouse Gas Emissions which can be found at www.defra.gov.uk/environment/business/envrp/gas/index.htm

[10] These are based on the energy intensity indices from 'Long Term reductions in greenhouse gas emissions in the UK' IAG report, February 2002. (http://www.dti.gov.uk/energy/greenhousegas/index.shtm)

[11] Heat sold is defined as heat that is produced and sold under the provision of a contract. The heat sold figures have been derived from two sources covering CHP plants and community heating schemes without CHP plants. Data for heat sold were supplied by CHP plants to the Combined Heat and Power

[12] A full classification of the sectors used for energy data can be found in the Digest of United Kingdom Energy Statistics 2005 p 24. Other industries encompass those manufacturing sectors not counted in the main classification. It also includes recycling of metal and non-metal waste and scrap.

[13] For detailed information on data quality and methodology of these indicative estimates, please read the accompanying Netcen report. http://www.defra.gov.uk/environment/statistics/globatmos/galocalghg.htm

[14] Process gases are non combustion gases emitting CO_2 through production particularly in iron and steel

[15] Non fuel CO_2 produced through production of cement and sinter

[16] Annual Business Inquiry.

[17] Data excludes Warwick due to errors in the data
[18] The Local Authority Classification was introduced in 2005 as a DEFRA initiative acknowledging the fact that many statistics are only available at LA level. It is a graded system, and gives six Urban or Rural classifications. These are defined as follows:

1. Major Urban: districts with either 100,000 people or 50 percent of their population in urban areas with a population of more than 750,000.

2. Large Urban: districts with either 50,000 people or 50 percent of their population in one of 17 urban areas with a population between 250,000 and 750,000.

3. Other Urban: districts with fewer than 37,000 people or less than 26 percent of their population in rural settlements and larger market towns.

4. Significant Rural: districts with more than 37,000 people or more than 26 percent of their population in rural settlements and larger market towns.

5. Rural-50: districts with at least 50 percent but less than 80 percent of their population in rural settlements and larger market towns.

6. Rural-80: districts with at least 80 percent of their population in rural settlements and larger market towns.

An introductory guide to the new methodology can be accessed at http://www.statistics.gov.uk/geography/downloads/Introductory_Guide.pdf
[19] Data sourced from Inland Revenue
[20] The Standard Assessment Procedure (SAP) for energy rating of dwellings is a calculation of a building's energy efficiency. SAP ratings are scored on a scale from 1 to 120 where 1 is the worst and 120 the best.
[21] Data available at www.neighbourhood.statistics.gov.uk
[22] The report was published as part of the launch of Ecological Budget UK, a colborative project between Biffaward, WWF, the Stockholm Environment Institute and the Centre for Urban and Regional Ecology.
[23] DTI (2006) Our Energy Challenge: Securing clean, affordable energy for the long term p27
[24] Regional transport statistics 2005 Department for Transport
[25] Regional transport statistics 2005 Department for Transport
[26] Halcrow Renewables Study 2001
[27] Tyndal Centre (2002) Renewable Energy and Combined Heat and Power Resources in the UK
[28] Oxera Environmental & ARUP Economics and Planning (2002) Regional Renewable Energy Assessments
[29] The Opportunities from Liquid Biofuels: A practical guide for arable farmers and rural businesses in the English Marches.
[30] Marches Energy Agency (2005) An audit of existing and proposed 'bioenergy' installations and infrastructure in the West Midlands Region.

Full Document Information	
Title:	Energy Strategy Monitoring Report
Alternative title:	
Creator:	Brian MacAulay, Economic Analyst, WMRO
Publisher:	West Midlands Regional Observatory
Contributor:	Tim Gebbels, Chief Executive, WMRO Chris Owen, Senior Intelligence Analyst, WMRO
Addressee:	West Midlands Regional Observatory Level L1, Millennium Point Curzon Street Birmingham B4 7XG
Date created:	2006-03-15
Date available:	2006-05-01
Date valid:	2006-05-01
Status:	V1.1, full document sent to Energy West Midlands
Subject category:	Agriculture, environment and natural resources; Energy and Fuel; Energy Conservation; Fossil Fuels; Renewable Energy; Environmental Protection; Pollution
Subject keywords:	Energy, regional, strategy, monitoring, fuel, CO_2 emissions, targets, industry, domestic, transport, commercial, West Midlands
Description:	A report monitoring regional progress against the targets established in the West Midlands Regional Energy Strategy.
Coverage, Geographical:	West Midlands Region
Format:	Electronic, PDF and MS Word
Rights:	None asserted
Cost:	None
Access restrictions:	None
Language:	English
Identifier:	None assigned
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