Methane in the UK

The UK is party to the UN Framework Convention on Climate Change (UNFCCC), which came into force in 1994 and requires accurate reporting of emissions. The UK is committed to reducing greenhouse gas emissions to 12.5% below 1990 levels by 2010. As a UNFCCC signatory, the UK must monitor progress towards achieving these targets by compiling a UK inventory and publishing an annual inventory report which includes a break down of emissions by anthropogenic source. The National Atmospheric Emissions Inventory[62] provides detailed methane emissions data from 1990, enabling major trends and the relative contribution of different sources to be identified.

Reports have been published annually since 1995, although it is important to note that figures in these reports have been revised over time as monitoring and modelling procedures have been refined and become more accurate. Emissions data for 1990 have therefore altered over the course of the inventory development and baseline levels for Kyoto Protocol commitments have also changed.

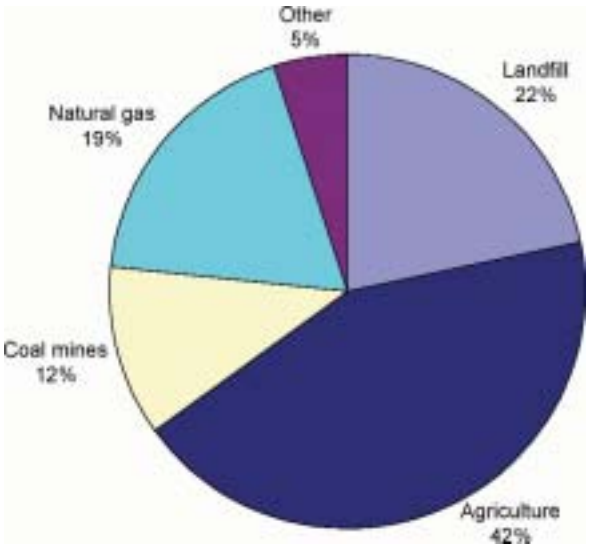

Figure 11: UK sources of methane, 2002

Source: Baggott, 2004[63]

4.1 UK methane sources

In 2002, 2.10 Mt of methane was emitted from anthropogenic sources in the UK.[63] This represents 6.9% of all UK GHG emissions. On a global scale, the UK is responsible for approximately 0.7% of all anthropogenic emissions of methane, from approximately 1% of the world's population.

The major sources of methane in the UK are agriculture, landfill waste, natural gas leakage and coal mining. Together these sources account for 95% of total anthropogenic emissions (Figure 11).

Agriculture is the dominant anthropogenic source of methane, responsible for 0.91 Mt(CH_4) of emissions in 2002. Of the total agricultural emissions, around 90% is derived from the digestive processes (enteric fermentation) in animals, whilst the remainder is from animal wastes. The second largest anthropogenic source of methane in the UK is the anaerobic decomposition of biodegradable waste in landfill, accounting for 0.46 Mt(CH_4) of emissions. Leakage from natural gas distribution and emissions from active coal mines account for a further 0.39 and 0.24 Mt(CH_4) respectively. However, it is important to note that the methane seepage is from active coal mines *only*; emissions from old unused mines are not included in the inventory. Inclusion of abandoned coal mines would add up to a further 0.3 Mt to UK methane emissions.[64] Other measurable sources of methane include manufacturing, transport and waste water handling, accounting for 0.10 Mt(CH_4) per year.

4.2 Historical trends

Historically, coal mines were the dominant source of methane in the UK. However, after the miners' strike in 1984, the coal mining industry declined and emissions from active mines fell as the number of working pits decreased (Figure 12). By 1990 landfill sites had become the primary source

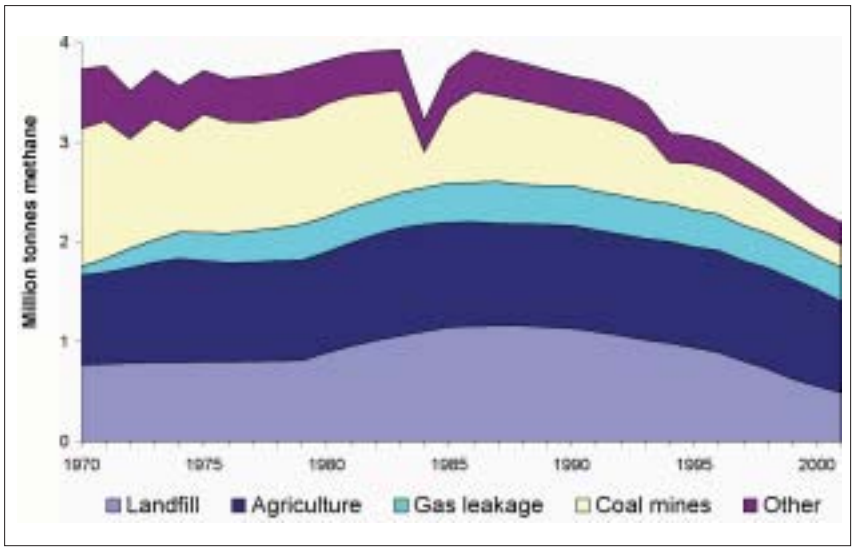

Figure 12: Long term trends in methane emissions, UK

Source: DEFRA, 2003[65]

of methane. However, emissions from landfill sites have decreased throughout the 1990s, mainly due to improvements in methane capturing technologies and improved landfill caps (Chapter 5). Since 1993, the agricultural sector has been the dominant source of methane in the UK. Emissions reductions within this sector have been small, so the relative importance of agriculture to total UK methane emissions has steadily increased.

Since 1990, the baseline year for the Kyoto Protocol, there has been a reduction in methane emissions from all methane-emitting sectors. Most notable is the drop in emissions from coal mines, which decreased by approximately 70% between 1990 and 2002 (Table 8). This is due to the decline in the number of operating mines in the UK. Emission reductions from active coal mines are deemed responsible for 37% of the total methane reductions and 12% of all greenhouse gas emissions reductions since 1990, according to the UK inventory. However, because emissions from abandoned mines are not included in the inventory, this is unlikely to be a true representation of 'real' methane emissions from this source.

Table 8: UK methane emissions from 1990-2002 (Mt CH_4)

	1990	*1995*	*2000*	*2002*	*% decrease 1990-2002*
Landfill	1.17	0.97	0.59	0.46	61%
Agriculture	1.03	1.01	0.97	0.91	13%
Natural gas	0.51	0.48	0.40	0.39	24%
Coal mines	0.82	0.50	0.27	0.25	70%
Other	0.13	0.10	0.10	0.10	22%
Total emissions	3.66	3.06	2.32	2.11	43%

Source: Baggott, 2004[63]

Significant reductions in methane emissions arising from landfill sites have also been achieved over the last decade. Between 1990 and 2002, emissions fell by 61%, accounting for 45% of the overall reduction in methane over this period. Since 1990, methane emissions in the oil and gas industry have declined by 24%. The smallest methane reduction was within the agricultural sector, where emissions fell by only 13% despite the well-publicised livestock farming crises of BSE and Foot and Mouth, which affected livestock numbers.

The significant reductions made by some sectors but not others pose questions to technologists and policy makers alike. Have landfill gas abatement technologies reached their potential, making further reductions expensive? Are the small reductions observed from the agricultural sector because it is inherently difficult to reduce emissions without reducing animal numbers and damaging the industry? And what policies should be implemented to maximise further emissions reductions at minimal economic and social cost? These issues are discussed on a sector-by-sector basis in Chapters 5 to 8.

4.3 Breakdown by region

In 1999, legislation was introduced to devolve power to the regions of the UK and led to the formation of the Scottish Parliament, National Assembly of Wales and the Northern Ireland Assembly. It is the responsibility of these devolved administrations to ensure that Kyoto targets are met in their areas. The UK Government is responsible for ensuring such targets are met in England and also retains some over-arching powers such as taxation measures that can be applied to the entire UK.

It is therefore useful to examine the regional spread of greenhouse gas production in the UK to provide data relevant to England and each of the devolved administrations. Disaggregated data

exist for the four home nations for 1990, 1995 and 1998 to 2000[66] (Table 9).

Table 9: Regional breakdown of methane and total GHG generation, UK, 2000

	Methane (%)	*All greenhouse gases (%)*
England	71.5	73.6
Scotland	11.6	10.9
Wales	8.6	8.0
Northern Ireland	5.9	3.2
Unallocated	2.4	4.2

Source: Salway, 2003[66]

The regional production of methane follows the same trends as total GHG emissions, as might be expected from simple farm area and population arguments. A regional breakdown by source presents a different picture, with agriculture being more predominant, and landfill less important, in the more sparsely populated nations with their mainly rural economy. Oil and gas emissions are concentrated in the more industrial nations, and coal emissions only from those nations with active coal mines (Figure 13).

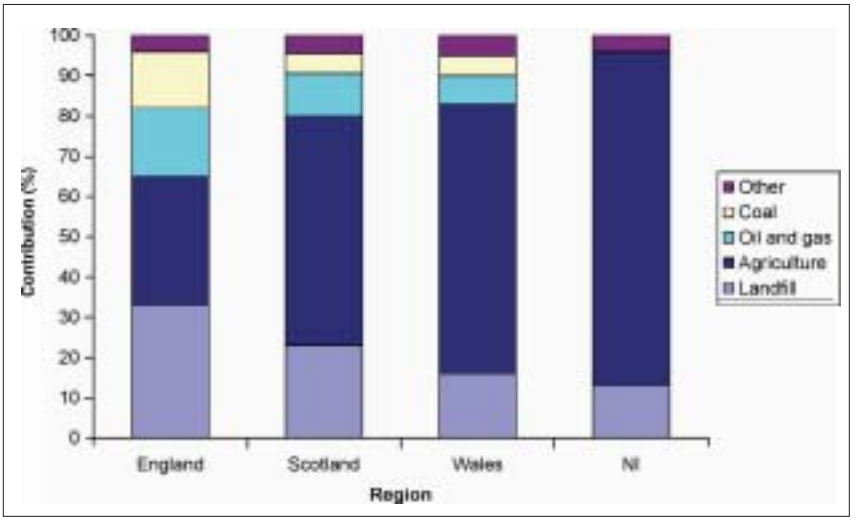

Figure 13: Methane emissions by source and region, 2000

Source: Salway, 2003[66]

4.4 Data uncertainties

Whilst the general trends in methane emissions data are widely accepted, there is less confidence surrounding the exact figures presented. The IPCC reports this to be a generic problem, hindering efforts to provide quantitative projections of future methane emissions.[1]

Since the UK's first submission to the UNFCCC in 1997, the emissions inventory has undergone substantial revision (including the 1990 baseline figure). A number of studies were commissioned with the aim of quantifying methane emissions more accurately. In particular, estimates for landfill emissions have been reduced significantly and figures for gas pipeline leakage have been increased. Despite these efforts, the uncertainty level for methane emissions data is ±14% overall,[63] and higher for individual sources. Variations in emissions estimates from landfill are ±48% and for gas pipe leakage between 17 and 75%, depending on the type of gas main and service. In the agricultural sector, animal numbers are accurately known (±1%), but the emission per animal error is estimated at ±20%. Similarly, the emission factor for coal mines is predicted with an uncertainty of ±13%.

Further revisions can be expected in the future, as methodologies for quantifying methane emissions are refined and uncertainty levels reduced. In addition, there are several outstanding issues to be addressed, such as the inclusion of abandoned coal mines, which may substantially affect emission totals.

The high levels of data uncertainty are a cause for concern, as it is becomes difficult to quantify emissions reductions. Furthermore, contradictions between the models on which UNFCCC submissions are based and real-world experience are possible. This is particularly important for methane trading, where baselines are set to produce overall GHG emissions reduction targets. Should a project be able to capture more methane than its targets because the targets set are found to be based on

Coal accounts for more than a third of UK electricity generation

inaccurate or uncertain data? If so, then that project will be financially rewarded for what is effectively 'hot air'. The presence of 'hot air' in trading systems can cause a collapse of the trading price and ruin the effectiveness of such a scheme for all participants, as discussed in Chapter 3. It is clear that if significant and sustained reductions in GHGs are to be achieved through trading then the accuracy of emissions quantification will need to improve across all sectors. This should be made a major focus of greenhouse gas abatement policy.

Table 10: UK GHG emissions 1990-2002 (Mt CO_2e)

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Total	% CH_4
1990	584.0	76.9	67.9	11.4	1.4	1.1	742.6	10%
1995	547.6	64.3	57.0	15.5	0.5	1.3	686.1	9%
2000	542.6	48.8	44.8	9.1	0.5	1.9	647.7	8%
2002	537.4	44.1	41.0	10.4	0.4	1.6	634.9	7%
Decrease 1990-2002	8%	43%	40%	33%	16%	–23%	15%	30%

Note: 1 Mt CO_2e = 21 Mt CH_4

Source: Baggott, 2004[63]

4.5 UK greenhouse gas emissions

Carbon dioxide makes up the majority of GHG emissions, although production has declined over the past 12 years by 8% largely due to the 'dash for gas': switching to cleaner natural gas combustion (for electricity generation) from the more polluting oil and coal. This has resulted in a cleaner energy supply, but there are signs that carbon dioxide emissions are now rising again due to increased energy consumption. In contrast, methane and nitrous oxide emissions have both declined by approximately 40% in the same period. This has resulted in an overall decrease in emissions from the basket of six greenhouse gases of 15% (Table 10).

Since the Kyoto base year of 1990, UK methane emissions have fallen by 1.57 Mt from 3.67 Mt to 2.09 Mt, equivalent to 33.0 Mt CO_2e. This is a drop of 43%, accounting for 30% of GHG emissions reductions since 1990, which dwarfs the 8% emission reductions of carbon dioxide over the same time period. Other greenhouse gases (N_2O, HFCs and PFCs) have achieved similarly high emissions reductions.

The reduction in methane emissions has been a major contributor to meeting targets as laid out by the Kyoto Protocol. However, because almost half of the reduction in methane emissions is due to the closure of coal mines and non-inclusion of emissions from abandoned mines, the 'real' reductions achieved may not be as significant as the UNFCCC submissions portray. This picture will change substantially once a methodology for the inclusion of emissions from abandoned coal mines is agreed and included.

So far, the UK is one of the few Annex I nations to have reduced greenhouse gas emissions over

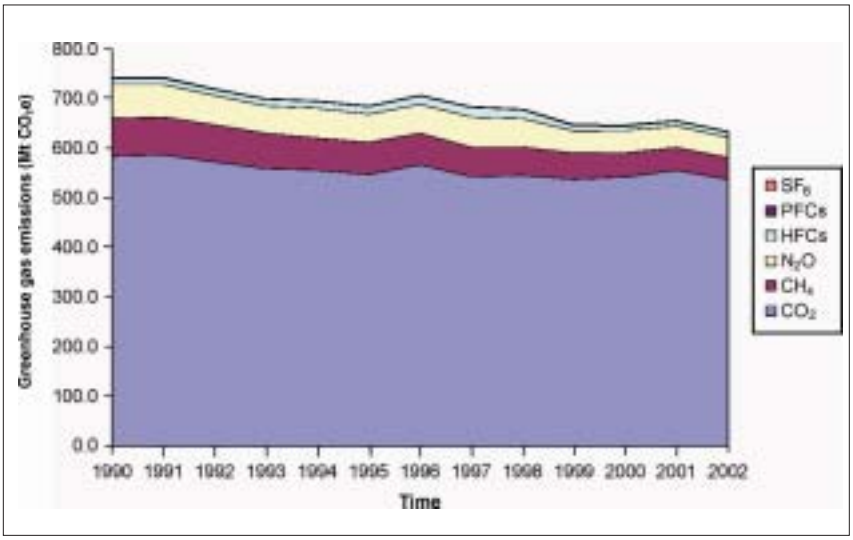

Figure 14: UK greenhouse gas emissions, 1990-2002

Source: Baggott, 2004[63]

the 1990 baseline (Figure 14). A 13% reduction in 2000[67] slipped to a 12% reduction in 2001.[68] Emissions in 2002 did, however, show a maximum observed reduction of 15%,[63] but are predicted to rise again in 2003 because of an increase in coal burning in power stations as opposed to gas, due to relative market prices. This has provoked considerable debate as to whether or not emissions reductions will be maintained in the long term and, in particular, whether the UK will meet its Kyoto commitment.

The basis for this scepticism lies in the manner in which emission reductions have been achieved to date. In particular, the majority of emission reductions witnessed over the last decade are not the result of targeted policy. Rather, carbon dioxide emissions were inadvertently cut by an economically-driven shift in the energy resource base, away from a coal intensive industry towards gas-fired and nuclear power. However, such good fortune is unlikely to continue indefinitely: the planned decommissioning of nuclear power stations, along with forecast economic growth and increases in road traffic, are expected to increase carbon dioxide emissions over the forthcoming decades. The UK Government maintain that the Kyoto target will be met, with baseline projections showing emissions to be around 15% below 1990 levels in 2010.[69] Further policy measures were introduced in the *Third National Communication*[11] which, if successfully implemented could increase the reduction to 23% by 2010.

However, there is mounting evidence that the UK's efforts to meet the greenhouse gas target are "slipping off track". In any case, DEFRA confess to having long-term concerns regarding UK's greenhouse gas emission trajectory. Baseline projections point to a rise in emissions in the post-2010 period, which by 2020 could leave the UK in breach of current and future rounds of Kyoto commitments.[69] With the stringent targets set in the 2003 Energy White Paper, the UK has reinforced its commitment to tackling climate change.

The recent increases in GHG emissions due to carbon dioxide need to be addressed by increased energy efficiency, an increase in renewable electricity and reducing consumption from the transport sector. However, due to its high GWP, further reductions in methane emissions still have a significant role to play in meeting short term targets, such as those agreed under the Kyoto Protocol, and may buy time for carbon dioxide abatement and renewable energy technologies to be developed.