Discussion and conclusions

9.1 Importance of methane

Methane is a powerful greenhouse gas, twenty-three times more potent than carbon dioxide (over a 100 year lifetime) and with a relatively short atmospheric lifetime of just 12 years, meaning that emissions reductions are rapidly translated into atmospheric concentration reductions. Therefore mitigating methane is highly cost-effective, particularly in the short term. Despite this, there is currently a lack of policy specifically targeted at methane.

There is also a climate change imperative for reductions in methane emissions to be achieved sooner rather than later – the higher the concentration of methane in the atmosphere, the more slowly it is removed by natural processes due to feedback loops in the atmospheric chemistry of the gas. Therefore it is more effective to reduce emissions in the short term; failure to do so will increase the lifetime of methane in the atmosphere and make it an even more potent greenhouse gas.

Controlled properly, methane represents a valuable resource – it is a combustible fuel with a high calorific value. Once captured, combustion of methane produces the less potent carbon dioxide and energy, which can then be used for heating or electricity generation. Production of electricity from methane will offset electricity production from the more polluting national energy mix.

Hence, the chemistry and physical properties of methane make it an attractive option for emissions reductions within the framework of the basket of six greenhouse gases, providing both environmental and economic benefits. The question is how best to secure these reductions – what policies and technologies would be most effective?

9.2 Disparity of methane sources

This report has focused on the four major sources of methane in the UK: landfill, agriculture, gas pipes and coal mines. These are disparate in nature, differing in the way in which the methane is generated, control options available and the overall policy context.

Sources may be either biogenic (agriculture, landfill) or fossil fuel derived (gas leakage and coal mines). This has implications for how methane is classified (renewable or non-renewable) and therefore its eligibility for financial rewards such as ROCs. Furthermore, the source may be a single point and therefore inherently capturable (landfill, coal mines) or essentially diffuse (agriculture, gas leakage). To a certain extent, this determines whether the policy emphasis is on capture or reduction and whether the resource can be further exploited.

Each sector also has its own political history, with different players and sensitivities, and particular policy focus. All these factors together make identifying a single unifying methane policy a major challenge.

9.3 Methane trading

Although there are policies in place that will have the effect of reducing methane, these are not uniform across the four major sectors and are often focused on a different goal (*e.g.* diverting waste from landfill). Methane trading was a key option considered in this report as a possible means of unifying policy into a single coherent abatement mechanism. According to the main criteria necessary for an effective emissions trading scheme (Chapter 3), there are a number of drawbacks to implementing a UK methane trading scheme:

- *Commodity to trade*. This requires quantification of the methane available for trading which is most easily achieved through capture, but this is only possible in certain sectors.
- *A liquid market*. The methane market alone is too small to function efficiently since the volumes involved are too low. For methane to be traded it must be incorporated into a multi-gas trading scheme.

- *Suitable mix of players*. There is a wide variation in the size of players across the different sectors, from big oil companies to individual farmers, with a large number of small players, which would result in an inefficient market.
- *Additionality.* Mandatory requirements for methane reductions are already in place in several sectors so future reductions could not be considered additional and are therefore not tradable.
- *Monitoring, reporting and verification*. In the sectors where methane is capturable (landfill and coal mines) data quality is poor with no reliable baseline to provide certainty and allow for verification.
- *Conflicting policies*. Where methane is captured and used to generate electricity, it is financially advantageous to accrue alternative environmental rewards such as ROCs due to their high market value, rather than carbon credits. Since the savings cannot be counted twice, this undermines any potential trading market.

It is apparent that a separate methane market does not represent a viable option for the UK, nor would methane trading work as the sole approach to cover all sectors. However, trading methane certainly has potential for some sectors, as demonstrated by the successful trading in the UK Emissions Trading Scheme (UK ETS) by the coal and gas industry.

The possibilities for trading vary between sectors, as detailed below and summarised in Table 16.

- *Landfill.* Methane is capturable, but does not count as additional since capture is already required for safety reasons and also covered at new sites by the Landfill Directive. A reliable baseline is difficult to define, partly due to the lack of data on landfill sites and partly due to the change in levels of methane emissions that occurs naturally over time. Any electricity generated from the captured methane will be eligible for ROCs, removing the incentive to trade.
- *Agriculture – livestock.* Livestock emissions are diffuse, with no easy means of capture and no accurate method for estimating a baseline. As small players, individual farmers would find it hard to compete effectively in a trading scheme – some form of aggregation would be necessary but this would introduce further complexity.
- *Agriculture – manure.* With appropriate management, emissions from manure are capturable, although there is little data currently available to determine a baseline of emissions. The methane captured would be additional since there are no other policies in this area, but the availability of ROCs may undermine the potential for trading.

Table 16: Potential for methane trading in each sector

	Is methane capturable & quantifiable?	*Reliable baseline?*	*Is methane additional?*	*Policy conflict?*	*Trading?*
Landfill	Yes	No	No	ROCs	No
Agriculture					
– livestock	No	No	Yes	No	No
– manure	Yes	No	Yes	ROCs	Possible
Oil & gas rigs	Yes	Yes	Yes	No	Yes
Gas pipeline	No	No	Some	No	Possible
Coal mines	Yes	No	Yes	No	Yes

Methane trading is unlikely to be an option for reducing livestock emissions

- *Oil & gas rigs.* Methane is capturable, additional and quantifiable with no policy conflicts, resulting in a high trading potential.
- *Gas pipelines.* In a sense, emissions from pipeline leaks are (re)captured by repairing the leak, since the methane is already captured within the pipe, but these emissions reductions are not easily quantified. For trading to be possible, a reliable baseline, through improved monitoring, needs to be established to enable quantification. Only those emissions not covered by Health and Safety legislation would count as additional.
- *Coal mines.* Trading potential for this sector is high, capture of emissions being reasonably straightforward and additional, with no policy conflicts. Methane from active mines has been successfully traded. However, there is huge uncertainty regarding emissions from abandoned mines, which could double the market size. Better quantification is required before any trading of these emissions can commence.

Given the forthcoming closure of the UK ETS in 2006, the future of methane trading is somewhat uncertain, awaiting the review of the EU ETS in 2006. It is essential that methane is incorporated into the European scheme in 2008, given its importance as a greenhouse gas. Even limited trading should be encouraged because of the potency of the gas. In addition, some consideration needs be given to the two year gap following the end of the UK ETS in 2006. The UK Government is faced with a choice of putting the process of methane reductions from trading on hold for this period or underpinning the savings achieved to date through legislation. Any policies must ensure that the methane reductions can still be classed as additional to allow trading of these emissions in the future.

Although the opportunities for methane trading in the UK are limited, mainly due to the presence of ROCs, there may be greater scope for trading in other countries. Under the EU ETS, the Joint Implementation and Clean Development Mechanism of the Kyoto Protocol open up the possibility of trading reductions secured through projects in other countries, which could help boost the market in the UK.

Despite the fact that methane trading does not represent the ultimate solution in terms of single coherent approach for reducing methane emissions, it still has a role to play as part of a synergistic policy package. However, the future of the market is dependent on inclusion in the EU ETS. Until this is certain, the potential of this policy option will be left hanging.

9.4 Recommendations

Based on the likely future emissions from each sector and the effect of planned policies and measures, annual methane emissions are expected to decrease by 16.5% by 2020.[136] However, additional policy measures have the potential to reduce this yet further, with a suite of policies to address the different requirements in each sector; these are illustrated in Table 17 and discussed on a sector by sector basis below.

Landfill

Reductions in methane emissions from landfill sites can be achieved by two routes: capturing any methane produced as a result of anaerobic decomposition of biodegradable waste and reducing the amount of biodegradable waste sent to landfill in the first place, as laid out in the EU Landfill Directive.

One of the key issues for this sector is data quality. There is uncertainty about the exact number of landfill sites in the UK and extent of capture at many of these sites, particularly older and closed sites. It could be that a significant source of methane emissions is being overlooked. A detailed inventory of all landfill sites is essential, providing information on the capture technologies employed at each site to give an indication of where further reductions could be made.

Table 17: Disparity of methane sources and appropriate mitigation measures

	Collectable	*Non-collectable*	*Possible measures*
Biogenic	Landfill Agricultural manure management	Agriculture livestock	Divert from landfill Societal trends
Fossil fuel	Coal mine methane	Gas pipe leakage	Carbon trading Direct policy measures
Possible measures	Flare Revenue streams: – use as heating fuel – generate electricity – ROCs or carbon trading	Reduce at source Carbon trading (if quantifiable) Direct policy measures	

In modern landfills, 85% of the methane can be captured[25] although the capture rate could be increased still further. Older landfill sites with less advanced capping technology have lower rates of capture. If such sites are found to be a significant source of emissions, investment will be needed to find solutions to improve capture at these sites. The prime economic policy instrument for improved methane capture at present is eligibility for ROCs through the generation of electricity from landfill gas.

The success, or otherwise, of the Landfill Directive will depend on effective alternative methods for the disposal of biodegradable waste. Whilst there is no lack of such options – composting, recycling, incineration – the main obstacle appears to be their implementation. An increase in composting or recycling requires individuals to change their waste disposal habits and, although composting and recycling rates have increased, it is unclear whether these are capable of increasing to the levels required by the Directive. Incineration is also unpopular amongst the UK public, with health concerns about dioxins and other emissions from waste incineration plants. Furthermore, electricity generation from incineration of waste does not qualify for ROCs.

Anaerobic digesters offer the best alternative at present, particularly as part of a mechanical biological separation scheme, with close to 100% methane capture and no atmospheric emissions. The gate fees for accepting the waste are a key economic driver for this technology. In addition, electricity generated from the methane is eligible for the strong financial rewards of ROCs. However, in order to encourage the initial uptake of this technology, it may be necessary to provide additional support in the form of grants and subsidies, since it is a relatively unproven technology in the UK.

The effectiveness of the Landfill Directive in achieving significant reductions in landfill methane emissions remains to be seen. There is some incompatibility with the UK Renewables Obligation, since a reduction in biodegradable waste going to landfill will reduce the profitability of methane capture and could theoretically make capture and use unviable. However, substantial amounts of methane will be produced from the biodegradable waste already present in landfill for many years to come, minimising any potential conflict.

Agriculture

The agricultural sector is the largest source of methane within the UK, but the hardest one in which to achieve emissions reductions, reflected in the lack of polices that target this source.

Strong regulation is required to reduce leakage from gas pipes

Livestock emissions

Some 90% of emissions are from ruminant mammals such as cows and sheep. These sources of methane are a multitude of mobile point sources rendering capture of the methane unfeasible. Reduction of methane at source is therefore the only sensible mitigation measure. However, the policy options available to achieve this are fraught with difficulty. Enforcing a reduction in livestock numbers would alienate the farming community whereas increasing productivity or reducing emissions per animal through dietary adjustments or genetic engineering is likely to be unpopular amongst the public.

Some decrease in the number of animals may occur as a result of reforms to the EU Common Agricultural Policy (CAP). The current societal trends towards organic produce and vegetarianism may also help reduce livestock numbers, but not by any significant amounts and this is also an area that would be difficult to legislate. Supporting moves towards more sustainable methods of farming could be of benefit over the longer term by reducing livestock densities.

It seems that it may be necessary to accept a certain level of methane emissions from agriculture if the UK is to retain a livestock farming industry.

Manure management

Options for reducing methane emissions from animal manure are more straightforward, the most favourable being the use of anaerobic digesters. A strong economic driver is already available through eligibility for ROCs. The main focus here needs to be on raising awareness about this technology amongst the farming community and encouraging its uptake through grants and subsidies and the formation of farming co-operatives with shared digester facilities.

Oil and gas industry

Natural gas leakage

Once again, poor data quality is a key issue for this sector. At present, estimates of methane emissions from pipeline leaks are very poorly quantified, with errors of ±40%. This represents one of the main barriers to trading at present, with a risk of trading apparent reductions due to statistical error rather than 'real' savings. Improved monitoring and data collection are required to establish the extent of this problem.

Due to the relatively low price of gas, there is little economic incentive to repair leaks and reduce emissions. Programmes such as the USA's Natural Gas STAR programme help to reduce emissions through market-based activities that benefit both the industry and the environment. However, stronger measures are needed to achieve significant reductions, with Ofgem overseeing tighter regulation on pipeline leakage and the setting of mandatory standards. Any such legislation would remove the possibility of trading from this sector, but it is questionable as to whether the industry should be rewarded for carrying out necessary repairs anyway.

Venting from rigs

Reducing methane emitted as a result of rig flushing is straightforward through flaring or

sequestration of the captured methane. The primary economic incentive for achieving these reductions to date has been through the trading of methane on the UK ETS. This raises the question of what will happen once the UK ETS is closed. Clearly, it is not desirable to have technologies ready to be implemented in the UK, yet no policy or financial drivers to encourage this until methane can be traded on the EU ETS in 2008. An interim policy measure is required to reward any greenhouse gas emission abatement that occurs in the period to 2008. However, if trading of these emissions is to continue in the future, any measures must ensure that the methane reductions can still be classed as additional.

Coal mine methane

A major issue for this sector is emissions from abandoned mines. Estimates of these emissions vary by a factor of 10 and so could represent a significant, but unrecognised, source of methane emitting to the atmosphere. Reliable inventory information and international agreement on how to classify methane from abandoned coal mines are a priority to put this source into perspective and assist in future policy decisions on its status.

Once a source is identified, coal mine methane is straightforward to capture and therefore easily quantified, making it an ideal candidate for trading, as demonstrated by successful trading in the UK ETS. Methane from both active and abandoned mines should be traded. The value of carbon credits should provide a sufficient driver for investment in the capital equipment required to capture the coal mine methane. Without ROCs, there is currently little incentive to use the captured methane to generate electricity since flaring is the cheapest option and all that is required for trading (the trading value determined by offsetting the methane saved against the carbon dioxide produced). Flaring is also the method favoured by present policy, which focuses on the most cost-effective control of emissions from active mines. Environmentally, energy recovery is the preferred choice, but this requires more active support from the Government.

As with emissions from oil and gas rigs, once the UK ETS has closed, it is recommended that interim support policies are introduced to support emissions reductions until methane trading is incorporated into the EU ETS. Once again, these measures must ensure that any methane reductions can still be classed as additional if trading is to occur in the future.

9.5 Conclusions

Reductions in methane emissions represent a rapid and cost-effective option for lowering greenhouse gas emissions. It is essential that these reductions are realised now, before atmospheric concentrations of methane rise and its potency increases.

Although methane trading is at first sight a highly attractive option for mitigating methane emissions, in practice most methane generating sectors are excluded due to other policy instruments (no additionality), other economic drivers (more attractive), small players (reduces liquidity) and poor quantification of emissions (introduction of hot air). Only coal mine methane and emissions from oil and gas rigs are currently viable sectors for exploiting the methane trading opportunity and this is dependent on incorporation into the European Emissions Trading Scheme in 2008.

A synergistic package of polices is required in each sector to secure the significant potential reductions and in nearly all cases improved data collection is necessary. Technological development and social and economic policy all have an integrated role to play. Methane abatement has been overlooked in the past, but it is a crucial component in mitigating climate change and should be an early focus of any strategy to reduce greenhouse gas emissions.