

**Coal Subcommittee
Country-Specific Profile
UNITED KINGDOM**

SUMMARY OF COAL INDUSTRY AND CMM RECOVERY/USE

Coal Industry

- Coal production in the UK has undergone a rapid decline in the last two decades. In 2003 deep mined production was 15.6 million tonnes and open cast 12.1 million tonnes. This represents less than a quarter of the level in 1980 and less than a third of the level in 1990. [1].
- This decline is likely to continue but at a slower pace in the next decade. A recent report [2], commissioned by the DTI, suggests that production could be sustained between 21-29 mt in 2010 and 15-21 mt in 2016.
- In 2003 the British market for coal was 62.6 million tonnes with imports providing the balance. British production, however, remains commercially competitive following the steep increase in the internationally traded price for coal. [3]
- Current deep mine production is centred on nine mines, owned mainly by UK Coal.
- In March 2004 the Coal Authority reported that there was 106 million tonnes of available coal in licensed, operating mines with a further 27 million tonnes conditional on further licences. The available coal in current opencast operations was 51 million tonnes with a further 154 million tonnes conditional on further licences. [3]
- Interest in further mining licences is very low [3] so it has to be assumed that, unless the situation changes radically, then the industry is unlikely to continue into the long term.
- Future production is very closely linked to its use in the UK power sector that takes 81% of its output. The implementation of the EU Large Combustion Plant Directive could reduce the burn of UK coal. Most UK coals have a medium sulphur content and will need to be blended with imported low sulphur coal to be burned in installations without FGD. The industry has had discussions with the Government however and feels that the method of implementation will now not impact their traditional markets significantly in the medium term. [4]

Overview of CMM potential

CMM from Abandoned Mines

The following data is from the DTI report on CMM [8].

The UK has some 900 abandoned coal mines of which around 400 are leaking methane into the atmosphere. Of those sites that have emissions that are capable of being controlled, some 80% of the emissions arise from an estimated 12 sites, of which an estimated 6 are being utilised. At the moment estimating the emissions from each mine is subject to a wide variance.

It is estimated that 52 k tonnes of methane are emitted annually from abandoned mine sites that have the potential to be controlled; this is equivalent to about 1 MtCO₂. These emissions represent just 2.5% of total methane emissions from all sources in the UK, or 0.17% of UK

total greenhouse gas emissions. Some 31 kt of methane emissions are already captured and used by the CMM industry. The 21 kt remaining un-captured emissions therefore represent approximately 1% of UK methane emissions, or 0.07% of the UK's total greenhouse gas emissions; approximately 0.5% of the reduction needed to meet the UK's Kyoto target.

Ref [8] estimates that even with possible future mine closures to 'top-up' the methane emissions, the national emissions will only remain at their present level for 2-10 years before then declining. These levels are likely to allow a total generating capacity of 20MWe or less for this time.

The estimates above are contested by the industry who point to the experience in Germany where upwards of 200MWe is now being generated as a result of including the technology [9]. They feel that if similar incentives were available in the UK then it would become economic to recover far more methane.

DEFRA (the ministry responsible for the UK inventory of greenhouse gasses) is currently undertaking a study to quantify CMM emissions for the UK inventory. It is not expected that this study will report until later 2005.

CMM from Operating Mines

UK Coal own most of the remaining deep mines in the UK. The company has a strong commitment to recovering methane and using it for energy wherever possible. The capacity is given in the list of projects below. One colliery not owned by UK Coal is Tower Colliery, owned by a staff buyout. This colliery captures methane to generate electricity (more information in the list of projects).

CBM from Virgin Coal Seams (VCBM)

A recent report published by the Department of Trade and Industry (DTI) [9] has concluded that there is a very substantial technical resource of coal bed methane in the UK but that the low permeability of the UK Carboniferous measures makes economic recovery extremely difficult in most areas.

The total technical resource is $2.9 \times 10^{12} \text{ m}^3$. This represents 29 years of current natural gas consumption. It is not possible to put a figure on the economically recoverable reserves at this time but they are thought to be very much smaller.

The highest gas contents of over 20M3 per Tonne can be found in South Wales and it is here where most commercial interest is centred.

The main barrier to exploiting this resource is the low gas permeability of the seams and it is felt that a technical breakthrough will be necessary in all but the most favourable areas to make recovery economically feasible. In addition, there has been recent interest from industry that has run into problems with obtaining planning permission.

Current and planned projects

CMM from Abandoned Mines

Alkane Energy plc

- Shirebrook – Methane is actively drained from the abandoned colliery and sold to Clarke Energy who use it to generate electricity for local use – c. 9 MW.
- Monkbretton – Methane is actively drained from the abandoned colliery and sold to Rexam Glassworks – c. 5 MW.
- Wheldale – Methane is actively drained from the abandoned colliery and sold to Scottish and Southern – c. 10 MW.
- Markham– Methane has previously been actively drained and sold to Coalite but as that company has closed a new customer is being sought – c. 2.7 MW.
- Alkane are currently looking at three new sites at Bevercotes – c. 4 MW, Whitwell – c. 2 MW, and Warsop – c. 2 MW, to carry out similar works and are currently seeking to source generating equipment.

Green Park Energy

- Hickleton – Methane is actively drained from the abandoned colliery and used to generate c. 5 MW of electricity which is fed into the grid.
- Green Park Energy are also looking at developing new sites at Grimethorpe and Brodsworth, which have planning permission and further new proposals at Frickley, Bentley and Houghton Main. They propose to develop 5 or 6 new sites in the next 12 months all approximately 5 MW with the potential for a further 5 MW at each site by the use of Heat Exchangers. Thereafter they propose to move into Coal Bed Methane production using more innovative technology than has previously been applied in the industry.
- Silverdale Colliery. Operated until recently by Green Gas Power Ltd who actively drained methane from the abandoned colliery and sold it to a local user via the North Staffs Gas Grid, a privately owned pipeline.

Warwick Energy

- Methane is actively drained from the abandoned Bentinck Colliery workings and producing c. 10.5 MW of electricity to the local network.

The Trade association has provided the following methane flows

ACMMO DATA FOR FLOWS AT OPERATING CMM (ABANDONED MINE) SITES

CMM Sites December 2003	Site Use	Methane Flow l/s	Electrical Generation MW	Mass Flow kt/y	CO₂e GWP 21
Shirebrook	Generation	372	5.3	7973	167400
Markham	Burner Tip	51	0	1093	23000
Silverdale	Burner Tip	200	0	4287	90000
Annesley Bentinck	Generation	140	2.0	3001	63000
Wheldale	Generation	409	5.8	8766	184000
Barnsley	Burner Tip	33	0	707	14900
Hickleton	Generation	250	3.6	5358	112500
TOTAL		1455	16.7	31185	654800

CMM from Operating Mines

UK Coal

UK Coal has a mixture of flares, generators and gas utilisation for boilers at the majority of its operating collieries. Dawmill and Ellington being the exceptions where insufficient methane is produced to warrant measures being introduced.

- Harworth Colliery – Has an 18 MWe gas turbine combined cycle generator which provides electricity for colliery use and a flare.
- Maltby Colliery – Has 3 generators, 2 flares and utilises gas for the boilers.
- Kellingley Colliery – Has 2 generators and a flare.
- Rossington Colliery – Has a flare.
- Thoresby Colliery – Has 2 generators and a flare.
- Welbeck Colliery – Has 2 generators, a flare and utilises gas for the boilers.
- Stillingfleet Colliery – Has 3 generators

Tower Colliery

Hyder Consulting in partnership with Tower Colliery installed 6 x 1.5 MW generators powered by methane drained from the active workings. The electricity generated is fed direct into the grid.

Upstream/downstream technologies

The UK has full capability in terms of exploration and geological expertise with a wide range of consultancy companies, many of whom have wide experience in other countries.

Challenges and/or priorities to greater CMM recovery and use

In the UK CMM recovery and use is primarily constrained by commercial and economic conditions. The following headings from the profile template are used to describe the UK situations.

Gas ownership

The Crown owns the methane when it is in the coal. It passes to the licensee when captured.

Petroleum Exploration and Development Licences

The DTI Oil and Gas Division license the extraction of oil and gas from the ground using Petroleum Exploration and Development Licences (PEDL), and these include methane from coal seams. Licences tend to be awarded in a series of "rounds", More information on this process and the location of existing licences can be accessed on the DTI web site [5].

Methane Drainage Licences

MDLs are used primarily for operating mines. An MDL grants permission to get gas "*in the course of operations for making and keeping safe mines whether or not disused*". It grants no exclusive rights, so it can overlap geographically with one or more PEDLs. MDLs generally

cover much smaller areas than PEDLs - typically each covers one mine, although the Coal Authority holds a licence that covers the whole country.

Coal Authority licensing arrangements

In addition to the DTI PEDL licence, certain rights will be required from the Coal Authority to enable a CMM or CBM project to proceed.

The Coal Authority is a body set up by the UK Parliament to undertake specific statutory responsibilities associated with:

- licensing coal mining operations in Britain
- handling subsidence damage claims which are not the responsibility of licensed coalmine operators
- dealing with property and historic liability issues, such as treatment of minewater discharges
- providing public access to information on past and present coal mining operations

If a CMM proposal involves the occupation of surface property, or a mine entry, owned by the Authority, a lease to occupy the property will be required. An Access Agreement is necessary where entry by drilling into coal or coal workings is required. In both cases, the Authority will require the proposer to provide a comprehensive risk assessment covering potential impacts of the proposed scheme including interaction with mine operators and surface safety considerations. Applicants will also be expected to be or become signatories to an "Interaction Agreement" that will cover liabilities for effects on other operations, such as water or gas migration, or subsidence.

Further information on Coal Authority rights can be found on their web site www.coal.gov.uk

Legal framework (e.g., licensing, royalties, PSAs, environmental standards, safety issues)

The Coal Authority has responsibility for environmental standards and safety through its licensing procedures. Other requirements see above.

Business taxes are payable. Currently based on a royalty on gas captured and charge on shaft, borehole, land, buildings and plant.

Climate change position (i.e., signatory to Kyoto Protocol)

The UK is a signatory to the Kyoto Protocol. The Government and the devolved administrations in Wales, Scotland and Northern Ireland, believe that the UK has much to gain from moving beyond its Kyoto target and doing more to cut emissions. They have therefore set a domestic goal of reducing carbon dioxide emissions to 20% below 1990 levels by 2010.

The difficulties in the assessment of the level of emissions from abandoned mines have resulted in CMM being excluded from the UK Inventory. As a result the abatement of CMM emissions does not assist us in meeting our Kyoto targets. The current DEFRA study aims to correct this so that CMM from abandoned mines can be included in the inventory. This study should complete in 2005.

Technical difficulties (e.g., aging or available equipment)

Generally speaking the difficulties are economic rather than technical.

R&D resources

The UK has a long tradition of coal and minerals related research in its Universities. Work on CMM and CBM is supported mainly by the Department of Trade and Industry Cleaner Fossil Energy Programme. More fundamental orientated work is supported by The Engineering and Physical Sciences Research Council (EPSRC).

Institutional issues

All distributed electricity generators claim to be disadvantaged by the current system of connection charges for access to the distribution network. Projects must pay not only for the physical connection but also for any network strengthening that may be necessary.

Distributed generation issues are recognised as a serious barrier to the take up of all small scale generation, in particular renewable projects, and a dedicated programme has been set up by the DTI to address these. [7]

End uses (power v. sale to pipeline)

There are examples of both pipeline and power sales in the UK. Pipeline sales are generally where the infrastructure was provided as part of the mining enterprise some years previously.

CMM gas is not of sufficient quality to enter the national natural gas network without upgrading. Upgrading is not generally thought to be economically viable [7].

VCMM may well be of adequate quality to enter the public distribution system but there is no experience of this

New projects tend to be power generation. The technology is usually standard modules of 1 – 2 MWe IC engines as used in the landfill gas industry. Landfill gas is a strong and growing sector in the UK with over 650MWe installed.

Prices and tariffs

Coal Mine Methane currently enjoys an exemption from the UK Climate Change Levy. This is a tax on fossil fuels that have not otherwise been taxed (as is the case with oil). When used for power generation it currently represents an incentive of £4.30 /MWe. This would be shared with the distribution company that accepts the power onto its system. The net benefit to the generator is likely to be closer to £3.0/MWe. This benefit is realised by the sale of Climate Change Levy Certificates.

Competition

With the exception of the benefit from the climate change levy, power from coal mine methane must compete with that from all other generators in the electricity market. This has proved difficult in recent times due to the low price of electricity on the wholesale market. In the past year however prices have risen and there is increased interest and activity.

Market access

There are no favourable terms for electricity or heat from coal mine methane.

Product support mechanisms

Carbon credits

- The first phase of the EU Emissions Trading Scheme (2005-8) only considers CO₂, not methane. The second phase will include methane. Difficulties in estimating baseline emissions have meant that CMM from abandoned mines is not in the UK GHG inventory, which it needs to be to enter into the EU ETS. Therefore a study is currently underway supported by DEFRA (Department of Food and Rural Affairs) which should report this year.
- One UK carbon credit trading company has started work on identifying sources that would be suitable for power generation. An important part of this concept is the verification methodology and this should be complete in late 2005. [10]. As a private company dealing with climate-concerned individuals and organisations it is independent of Kyoto and baseline measurements.
- CO₂ sequestration into the coal seam is often cited as a possible means of making VCBM carbon neutral. CO₂ sequestration technology is immature at present and its potential application in the UK cannot be assessed. However, there are vast areas of coal at depths below 1,200m that are possibly too deep for mining and in situ gasification. [12]

Scheme to encourage mitigation of CMM from abandoned mines

The most likely support measure for CMM in the near future is likely to be capital assistance for emissions abatement. This will be technology independent and will not distinguish between flaring and utilisation. [8]. It is currently being developed by the Coal Authority and DTI.

Energy Tax exemption

In recognition of the beneficial effects of using CMM for energy it is exempted from the UK Climate Change Levy. If used for power generation this exemption is worth £4.3 /MWe.

Definition for regulations and contracts (natural v. renewable resource)

CMM and CBM are regarded as fossil energy. They do not enjoy the premium price schemes offered to renewable energy. Many within the industry feel that CMM from abandoned mines should be treated on the same basis as renewable energy, as in Germany. However, Germany's feed-in tariff is not regarded as a form of State Aid by the European Commission, whereas the UK's Renewable Obligation is considered state aid (specifically the recycling of the buy-out fund, which is redistributed and returned by government to suppliers). The UK could not hope to obtain state aid clearance to support any technology (such as coal mine methane) under the Renewable Obligation which is not classified as renewable under the EC Renewables Directive 2001/77/EC. The difference between the way the UK supports renewables using the Renewable Obligation and the way the Germans support renewables via their EEG reflects the point that the German electricity market is less liberalised than that of the UK. The Renewable Obligation is market driven and hence is more cost-effective than feed-in-tariffs. The UK would not want to reverse the liberalisation of its electricity market in order to accommodate CMM.

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Key stakeholders in the CMM industry

Equipment Manufacturers

Siemens Industrial Turbomachinery Ltd; Hamworthy Combustion Engineering Limited; MAN B&W Diesel Ltd; Peter Brotherhood Limited

Developers

Alkane Energy plc; Clarke Energy Limited; Deutz UK Limited; Energy Developments (UK) Limited; Edinburgh Oil & Gas plc; First Energy Limited; Green Park Energy; Renewable Power Systems; Rolls-Royce Power Ventures Limited; Scottish and Southern Energy plc; UK Coal Limited; UK Onshore Gas Group / UK Methane Limited; Warwick Energy Limited

Engineering, Consultancy and Related Services

ACA Howe International Limited; AEA Technology Environment; Cadogan Consultants Limited; Celtic Energy Limited; EDECO Petroleum Services Limited; Harworth Mining Consultancy Limited; Knight Energy Services Limited; International Mining Consultants; PR Marriott Drilling Limited; Pipeline Services Limited; Reeves Wireline Services Limited; Schlumberger Oilfield Services Limited; Scientific Analysis Limited; Wardell Armstrong; WS Atkins Consultants Limited.

Universities/Research Establishments

British Geological Survey; Cranfield University; Imperial College of Science, Technology and Medicine (ICSTM); Loughborough University, Loughborough University Consultants Limited; University of Cardiff, Department of Earth Sciences; University of Nottingham, School of Chemical, Environmental and Mining Engineering;

Miscellaneous

The Association of Coal Mine Methane Operators; Climate Care

Financing

Private sector investment

CMM projects are normally developed by private capital. Recent conditions have meant a downturn in activity due to poor projected returns.

Multilateral agreements

The UK contributes to a number of IEA activities in this area, most notably the Greenhouse Gas Programme.

Incentives (e.g., subsidies, taxes)

In recognition of the beneficial effects of using CMM for energy it is exempted from the UK Climate Change Levy. If used for power generation this exemption is worth £4.3 /MWe. In addition, a scheme is being developed to encourage mitigation of CMM from abandoned mines. This will be technology independent and will not distinguish between flaring and utilisation. [8]. It is currently being developed by the Coal Authority and DTI.

Current cooperation among countries (e.g., existing bilateral agreements or grants)

The main focus of international collaboration has been to date has been via the Technology

Transfer and Exports Promotion part of the DTI's Cleaner Coal Technology Programme. This has supported (part-funded) bilateral technology transfer projects with China, India and Russia, including visits and missions (inward and outward). The Chinese projects have looked at CMM from abandoned mines, CMM from working mines, and CBM from virgin coal. The one current Chinese project is looking at CMM and the Clean Development Mechanism. There is one current project with India is looking at the potential in India for UK technologies and practices. A similar project is just starting in Russia. Most of these projects involve Wardell Armstrong, a UK CMM consultant, as well as technology providers and other UK players and host country participants. Via this programme, the UK also contributes to the Alberta Research Council project on enhanced coalbed methane (ECBM) in Canada. collaborates with other countries from time to time. Eg Canada for methane extraction from coal seams. For details of the DTI Cleaner Coal Technologies Programme see the web site www.dti.gov.uk/cct, the summaries of these projects are also available on the site as PDFs. This programme has been running since the late 1990s, but is to be replaced in 2005 by the UK's Carbon Abatement Technology Strategy, which will focus on reducing CO2 emissions from large scale power generation using more efficient plant and carbon dioxide capture and storage.

What the UK is looking for

The UK has a strong consultancy, project development and academic base in all aspects of methane control and use, particularly from operating and abandoned mines. It seeks to use these to develop commercial activities in other countries. The UK wishes to broaden its appreciation and knowledge of the following areas:

- Use of market-based instruments to reward the environmental performance of GHG mitigation activities, ie emissions trading, the Clean Development Mechanism etc
- Emissions and resource estimation
- Emissions monitoring.

Types of outreach

Summary of outreach strategy or plan

The UK has supported a series of bilateral technology transfer projects to develop and disseminate best practice for methane utilisation from coal in China, and also in India and Russia, via the DTI Cleaner Coal Technology Programme (www.dti.gov.uk/energy/coal/cfft/cct). This Programme has established translation and dissemination activities in China (using CCII - www.coalinfo.net.cn/cnuk/eindex), India (using TERI) and Russia (using Uglemetan - www.dti.uglemetan.ru/). CMM-related work of the Programme has been included in these dissemination activities.

Modes of vertical communications to policy makers

The Chinese activities of the DTI Cleaner Coal Technology Programme have come under two Memoranda of Understanding, one with MOFTEC and one with MOST.

Conclusions and observations

- In policy terms in the UK, CMM is regarded as an environmental issue that must be regulated and solved, rather than an energy opportunity. It is classed as fossil energy and this precludes it from the advantages shared by renewable energy. This situation is unlikely to change in the near future.

- In terms of support for CMM use, the beneficial environmental effects of using CMM for energy are recognised and hence it is exempted from the UK Climate Change Levy tax. In addition, a new scheme is being developed to encourage emissions abatement for CMM from abandoned mines.
- For CBM the low permeability of UK Carboniferous measures is a severe constraint.
- The economics of CMM utilisation for power generation over the past few years have been difficult due to low wholesale energy prices but there are signs of some improvement.
- The UK has a strong consultancy, project development and academic base in all aspects of methane control and use.

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