

DERBYSHIRE AND DERBY MINERALS LOCAL PLAN

**Towards a Minerals Local Plan:
Spring 2018 Consultation**

**Background Paper
Gas from Coal**

December 2017

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1 Introduction and Background

- 1.1 This is one of a series of papers providing background, supporting information to accompany the preparation of the new Minerals Local Plan. The new Plan will include strategies and policies concerning the winning and working of hydrocarbon based energy minerals. This paper provides information about obtaining gas from coal measures, whilst corresponding papers focus on oil and gas from conventional sources and gas sourced from shale deposits. The production of separate papers reflects the issues that have been raised in previous consultation exercises and the views expressed to the County and City Councils in response to publicity for individual planning applications. Some of the issues and legislative provisions are common to all three forms of hydrocarbon developments and therefore there is some level of duplication in the papers but this is necessary to ensure that each one provides a comprehensive review of the issues for those who read them individually.

- 1.2 Oil and gas are important sources of energy in the UK where they are primarily used as fuel, although some components are also used as raw materials in the petro-chemical industry and in the manufacturing of drugs and plastics. Oil and gas are regarded as minerals and development proposals to extract them from sites in Derbyshire (excluding the Peak District National Park area) are the responsibility of Derby City Council or Derbyshire County Council as the respective Mineral Planning Authority. A corresponding paper provides information about the production of oil and gas from conventional sources (e.g. where the oil and gas reservoir is in sandstone or limestone) whilst this papers focuses on developments to obtain energy minerals from unconventional sources e.g. where the oil and gas reservoir is in coal). Another paper addresses the issues of obtaining gas from shale which is another source of unconventional hydrocarbons.

- 1.3 The process whereby organic substances are progressively converted to coal (coalification) also generates large quantities of gas which is trapped in the underground coal seams by water and ground pressure. Coal seam gas is present both as liberated gas in fissures and faults and as absorbed gas on the

inner surface of the coal and neighbouring rock. The most common gas found in coal seams is methane in a concentration of 90-95%. The methane is in a near-liquid state and contains very little of the heavier hydrocarbons such as propane or butane and no natural gas condensate. It is often called 'sweet gas' because of its lack of hydrogen sulphide.

- 1.4 The coal deposits bearing gas may be virgin coal seams, ones in the process of being mined, or old abandoned coal extraction areas. Gas from each of these may be suitable for the production of power in the form of electricity generation or it could be supplied to local industry for use in oilers and kilns. Using the gas from coal in this way helps prevent emissions to the atmosphere.
- 1.5 There are currently four main ways in which gas can be extracted from coal measures:
 - Extracting gas from operational mines.
 - Extracting gas from abandoned mines.
 - Extracting gas from untouched coal seams.
 - Extracting gas by underground coal gasification.
- 1.6 These systems differ from the historic method of producing gas from coal whereby the coal was processed in dedicated municipal gas works (town gas) and which provided virtually all the UKs' fuel and lighting gas up to the 1970s. Further details of these technologies are provided later in this paper.
- 1.7 The two main benefits of these systems are the alternative disposal of a problem gas whilst simultaneously harnessing it as an energy source. Gas in an active mine is a health and safety hazard to the workforce and to the integrity of the mine. Gas escaping to the surface from an abandoned mine could also be a danger to people and buildings.

2 National and Local Policy and Guidance

- 2.1 Government policy and guidance on the exploration and extraction of hydrocarbons is developing rapidly in response to the discovery of new

resources and the emergence of new techniques for working those resources. The Minerals Local Plan will have to take account of this emerging guidance and the policies that develop. The following section reviews the main publications which currently apply and the guidance they provide on future hydrocarbon developments.

2.2 National Planning Policy Framework

National guidance for the extraction of minerals, including hydrocarbons, is set out in the National Planning Policy Framework. In general terms, the NPPF states that, "Minerals are essential to support sustainable economic growth and our quality of life. It is important therefore that there is a sufficient supply of material to provide the infrastructure, buildings, energy and goods that the country needs. However, since minerals are a finite natural resource and can only be worked where they are found, it is important to make best use of them to secure their long-term conservation."

2.3 Specific but limited guidance on hydrocarbons is set out in Paragraph 147 of the NPPF which states that, "Minerals Planning Authorities should also...when planning for on-shore oil and gas development, including unconventional hydrocarbons, clearly distinguish between the three phases of development (exploration, appraisal and production) and address constraints on production and processing within areas that are licensed for oil and gas exploration or production...". In addition it states that mineral planning authorities should: "encourage underground gas and carbon storage and associated infrastructure if local geological circumstances indicate its feasibility; and encourage capture and use of methane from coal mines in active and abandoned coalfield areas".

2.4 When determining planning applications the NPPF states that "...mineral planning authorities should ensure that the integrity and safety of underground storage facilities are appropriate, taking into account the maintenance of gas pressure, prevention of leakage of gas and the avoidance of pollution."

2.5 National Planning Practice Guidance, March 2014 (NPPG)

In July 2013 the Department for Communities and Local Government published new guidance relating to onshore oil and gas developments (Planning Practice Guidance for Onshore Oil and Gas). This has now been superseded although most of the advice and guidance it contained has been incorporated into the National Planning Practice Guidance which contains guidance for oil and gas developments from both conventional and unconventional sources.

2.6 The NPPG states that, as an emerging form of energy supply, there is a pressing need to establish through exploratory drilling, whether or not there are sufficient recoverable quantities of unconventional resources such as shale gas and coal bed methane present to facilitate economically viable full scale production. In terms of new guidance, the NPPG encourages mineral planning authorities to make appropriate provision for hydrocarbons in local mineral plans, based on emerging information, to allow them to highlight areas where proposals for extraction may come forward, as well as managing potentially conflicting objectives for the use of land.

2.7 Where mineral planning authorities consider it is necessary to update their local plan and they are in a Petroleum Licence area, the NPPG states that they are expected to include Petroleum Licence Areas on their policies maps and include criteria based policies for each phase; that is exploration, appraisal and production, setting clear guidance for the location and assessment of hydrocarbon extraction within those areas. Existing hydrocarbon extraction sites should be identified in local plans, through the local plan site allocation process, where appropriate, and mineral planning authorities may include specific locations should the oil and gas industry wish to promote specific sites. In contrast to the practice established for other minerals resources, the guidance does not advocate the creation of formal safeguarding areas for hydrocarbons due to the depth of those reserves, the ability to use drilling equipment and the small surface area required for the installations. It also does not repeat or expand on the requirement of the National Planning Policy Framework that minerals local plans should address constraints on production and processing within areas that are licensed for oil and gas exploration or production.

2.8 The NPPG provides a description of the different operations involved in the three phases, the technical issues associated with hydrocarbon working and the planning issues which arise from hydrocarbon developments. It includes an explanation of the role of the planning system in obtaining permission together with a summary of the role of the other official regulators also involved in the process.

2.9 With regard to the determination of development proposals, mineral planning authorities are advised to assess applications for each phase on their respective merits and applications for the exploratory stage of development should not involve the consideration of the potential impacts of extraction. Mineral planning authorities should take account of Government energy policy, which indicates a preference for energy supplies to be obtained from a variety of sources, including onshore oil and gas. Mineral planning authorities should use appropriate conditions, having regard to the issues for which they are responsible, to mitigate against any adverse environmental impact. The NPPG provides some examples of model conditions. It states that above ground separation distances would be acceptable in specific circumstances where it is clear that, based on site specific assessments and other forms of mitigation measures (such as working scheme design and landscaping) a certain distance is required between the boundary of the minerals site and the adjacent development. Operators and mineral planning authorities are also encouraged to seek appropriate restoration schemes for sites once mineral extraction is completed.

2.10 Appendix A of the guidance relates to shale gas, coalbed methane and underground coal gasification. The main aspects of this guidance are covered in the summary of the individual extraction methodologies below.

2.11 **National Energy Policy**

There have been several important stages in the evolution of current national energy policy. The Department of Trade and Industry paper, Meeting the Energy Challenge, 2007 states that England, Wales and Scotland's substantial remaining coal resources, including gas contained within the coal, have the potential not only to help meet our national demand for coal and to reduce our

dependence on imported primary fuels, but also to contribute to the economic vitality and skills base of the regions where they are found.

2.12 The draft National Policy Statement for Energy, published in 2009, built on the 2007 Energy White Paper. Together they formed an evolving international and domestic energy strategy in response to the changing circumstances in global energy markets. They set out to address the long-term energy challenges of security of supply, whilst acknowledging the implications of climate change. Whilst recent emphasis has been on the development of renewable energy supplies the Government recognised the important and continuing role that indigenous sources of coal, oil and gas will play in meeting national energy requirements. This was reaffirmed in the Overarching National Policy Statement for Energy (EN-1) July 2011 which provided further clarification of the Government's plans for a transition to a low carbon economy.

2.13 This policy is set against the background of changes in the sources of our energy requirements. By 2004 the United Kingdom became a net importer of natural gas and a net importer of oil in 2010. By 2020, it was then estimated that the UK is likely to be importing about three-quarters of its energy supplies.

2.14 On 27 June 2013 the Government announced its long-term infrastructure investment plans which included a package of reforms to facilitate shale gas exploitation. The announcement did not make any specific statements concerning the planning system but it did expand on the provision of community benefits from shale gas extraction (see separate background paper for further details). More recently the Government has introduced changes to the system of notifying landowners and tenants about the submission of hydrocarbon related planning applications which now only applies to the owners and tenants of land where surface operations are to take place. Notification is not now required for purely underground operations.

2.15 The infrastructure investment plan statement indicated that a key role for gas is consistent with the need to decarbonise our economy. It is regarded by the Government as the cleanest fossil fuel, and much of the new gas capacity

needed would be replacing the ageing coal capacity. Gas is also seen as important for balancing the increasing levels of intermittent and inflexible low-carbon energy on the system.

2.16 Energy Act 2013

The Energy Act received final assent on 18 December 2013. The Act has several objectives and in relation to hydrocarbons it seeks to make provision for the setting of a decarbonisation target range and duties in relation to it; or in connection with reforms to the electricity market for purposes of encouraging low carbon electricity generation, or ensuring security of supply. It is also about the designation of a strategy and policy statement concerning domestic supplies of gas and electricity. It does not actually prescribe a new strategy or policy at this stage but instead sets the procedural requirements for doing so. It is likely however that future policy and strategy will reflect the overall objective of the Act to reduce our carbon footprint and in turn this will affect the future demand for minerals including fossil fuels.

2.17 Written Ministerial Statement November 2015, 'Priorities for UK Energy and Climate Change Policy'

This Written Ministerial Statement (WMS) was presented to Parliament in November 2015 by the Secretary of State for Energy and Climate Change. The WMS does not change national planning policy or guidance but it does set out Government thinking on the approach to energy supply. The Secretary of State stated that one of the greatest and most effective contributions we can make to emissions from electricity generation is by replacing coal fired power stations with gas. The programme was to be subject to consultation but indicated a restriction on the use of coal by 2023 and the possible closure of all coal fired power stations by 2025. This was subject to the development of the infrastructure to enable the shift to take place. This could have implications for the UK onshore oil and gas industry and the utilisation of indigenous resources.

2.18 Derby and Derbyshire Minerals Local Plan

The current Minerals Local Plan states that all proposals for the extraction of oil and gas will be considered against the general policies set out in the Plan, and the detailed criteria in Policy MP35 Oil and Gas which states that:

2.19 Proposals for the development of oil and gas, including facilities associated with the production, processing or transporting of oil or natural gas will be permitted only where they can be carried out in an environmentally acceptable way, and provided that:

- any irreparable damage to interests of acknowledged environmental importance is outweighed by a proven need for the development in its proposed location
- the proposal is consistent with an approved overall scheme for the appraisal of, or production from the area
- the proposed location of the development is the best having regard to geological, technical And environmental considerations
- satisfactory arrangements have been made for the avoidance of seepage pollution, the off-site disposal of drilling mud and other drilling residues and the flaring and disposal of unwanted gas.

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3 Regulatory System

3.1 Key Regulators

Anyone seeking to carry out operations for the extraction of hydrocarbons, including gas from coal, has to obtain approval from the appropriate regulatory bodies. The key regulators for all hydrocarbon extraction operations are:

- **the Department of Energy and Climate Change** – issues Petroleum Licences, gives consent to drill under the Licence once other permissions and approvals are in place, and have responsibility for assessing risk of and monitoring seismic activity, as well as granting consent to flaring or venting. Further details of the licensing regime are provided below.
- **Oil and Gas Authority** - as of 1 April 2015 certain function passed from the Department of Energy and Climate Change to the Oil and Gas Authority

(OGA) a newly created Executive Agency of DECC. It works with Government and industry to make sure that the UK gets maximum economic benefit from its oil and gas reserves. It is now responsible for regulating offshore and onshore oil and gas operations relating to licensing, exploration and production, fields and wells, infrastructure and carbon capture and storage licensing.

- **Minerals Planning Authorities** – grant planning permission for the location of any wells and well pads, and impose conditions to ensure that the impact on the use of the land is acceptable
- **the Environment Agency** – protect water resources (including groundwater aquifers), ensure appropriate treatment and disposal of mining waste, emissions to air, and suitable treatment and manage any naturally occurring radioactive materials, and
- **the Health and Safety Executive** - regulates the safety aspects of all phases of extraction, in particular responsibility for ensuring the appropriate design and construction of a well casing for any borehole.

Other bodies which may be involved in the consenting of the process include:

- **the Coal Authority**, whose permission will be required for drilling through a coal seam
- **Natural England**, who may need to issue European Protected Species Licences in certain circumstances
- **the British Geological Survey**, who need to be notified by licensees of their intention to undertake drilling and, upon completion of drilling, must also receive drilling records and cores, and
- **Hazardous Substances Authorities**, who may need to provide hazardous substances consents.

Additional consents and orders, such as stopping up rights of way or temporary road orders, may also be required.

3.2 Obtaining Planning Permission and Other Approvals

Apart from a few exceptions, all works associated with the extraction of hydrocarbons require planning permission. The process of obtaining planning permission to drill a well is the same whether the well is targeted at conventional or unconventional gas resources. The process involves three separate stages; exploration, appraisal and extraction, and all stages require separate planning permissions (although two or more of these phases are often combined in gas from coal developments).

- 3.3 The exploratory phase seeks to acquire geological data to establish whether hydrocarbons are present. The appraisal stage takes place when the existence of gas (or oil) has been confirmed, but where the operator needs further information about the extent of the deposit or its characteristics to establish whether it can be economically extracted. The production stage normally involves the drilling of a number of wells and may also involve the installation of ancillary equipment such as pipelines, processing facilities and storage tanks.
- 3.4 In order to undertake any works related to gas extraction an operator has to have a licence which is issued by the Department of Energy and Climate Change (now OGA). Licences are issued in competitive offerings (Licence Rounds) which grant exclusivity to operators in the licence area. The licences however do not give consent for drilling or any other operations.
- 3.5 The Department of Energy and Climate Change publication, Onshore Oil and Gas Exploration in the UK: Regulation and Best Practice, December 2015, contains the following checklist which identifies that before commencing drilling operations for all onshore oil and gas development the operator must have:
- obtained a petroleum exploration and development licence (PEDL) from DECC or petroleum licence (PL) from the Department of Enterprise, Trade and Investment (DETI)
 - secured a lease from the landowner
 - submitted relevant Petroleum Operations Notices (PON) to OAG/DETI
 - satisfied DECC/DETI that effective operational and environmental management systems are in place
 - secured planning permission from the MPA/LPA/DOE

- discharged any relevant conditions placed on the planning permission
- obtained a permit from the Coal Authority to drill into coal seams
- Informed the British Geological Survey of the intention to drill
- completed the necessary consultation processed with all the statutory/ relevant consultees
- obtained the necessary permits from the Environment Agency
- notified HSE/HSENI of the intention to drill (minimum 21 days' notice)
- provided HSE/HSENI with details of the proposed well design that have been examined by an independent and competent well examiner (minimum 21 days' notice)
- agreed data-reporting methods with OAG/DETI
- agreed a method for monitoring induced seismicity and fracture growth height with OAG/DETI, (where hydraulic fracturing is planned)
- received approval for an outline fracturing programme from OAG/DETI, (where hydraulic fracturing is planned).

Further details of this process are summarised below.

3.6 The submission of an application to the mineral planning authority triggers the need to determine if an Environmental Impact Assessment (EIA) is required. An EIA will be required if the scale of the proposed development exceeds certain thresholds, or if, depending on the nature, scale and location, the development may have significant environmental impacts. If an EIA is required, it must be completed by the applicant and submitted to the mineral planning authority before the authority decides on the application. Operators are encouraged to engage in pre-application discussions with the mineral planning authority where the need for an EIA and the matters to be addressed in it can be determined before an application is prepared and submitted. Government policy also encourages would-be applicants to undertake community engagement. Applicants are advised to inform local communities about their proposals and, where appropriate, amend those proposals in response to the feedback they receive.

- 3.7 Following a consultation in September 2013 and Government response in January 2014, changes were made to the system of how landowners and tenants should be notified by applicants of applications for onshore oil and gas development. The requirement to serve notice on individual owners and tenants of land on the above ground area where works are required was retained, but the requirement for owners of land beyond this area i.e. the owners of land where solely underground operations may take place, was removed. This was implemented by the Town and Country Planning (Development Management Procedure and Section 62A Applications) (England) (Amendment No.2) which came into force from 13 January 2014.
- 3.8 Once the LPA has granted planning permission to drill, and at least 21 days before drilling is planned, the Health and Safety Executive (HSE) must be notified of the well design and operation plans to ensure that major accident hazard risks to people from well and well related activities are properly controlled, and are subject to the same stringent regulation as any industrial activity. HSE regulations also require verification of the well design by an independent third party. Notification of an intention to drill has to be served to the environmental regulator under S199 of the Water Resources Act, 1991. OGA (or any successor) will then check that the other regulators have no objections before consenting drilling operations.
- 3.9 If the operator wishes to drill an appraisal well or propose to start production operations, they start again with the process described above; the landowner's consent, permissions and planning consent, which may require EIA and approval from the Environment Agency, the HSE, and finally a decision from OGA.
- 3.10 The Planning and other regulatory regimes are separate but complementary. The planning system controls the development and the use of the land in the public interest and, this includes ensuring that new development is appropriate for the location taking account of the effects, including cumulative effects, of pollution on health, the natural environment, general amenity and the potential sensitivity of the area or proposed development to adverse effects from pollution (see paragraphs 120 and 122 of the NPPF). The focus is on whether the development

is an acceptable use of the land, and the impacts of those uses, rather than the control of the processes involved and health and safety. The information above briefly outlines the regulatory responsibilities for these issues.

3.11 All planning applications have to be assessed on the individual merits of the case, taking account of national and local policy. This applies to all proposals for oil and gas extraction from both conventional and unconventional sources using traditional or new techniques. In the early part of 2013 media coverage of proposals for hydraulic fracturing for shale gas led to concerns that such developments would be dealt with by the fast-track route for nationally significant business and commercial development proposed in the Growth and Infrastructure Bill by submitting applications to the Planning Inspectorate rather than to local councils. However, on 19 July 2013 in a Ministerial Statement, Baroness Hanham confirmed that "... responsibility for the determination of planning applications for onshore oil and gas, including for the exploration of shale gas, will be with the local authority. Decisions will therefore continue to be taken in accordance with local plans and the National Planning Policy Framework."

3.12 The situation changed following the publication on 13 August 2015 of a joint statement from the Department of Energy and Climate Change and the Department for Communities and Local Government in which the new measures include:

- The Communities Secretary actively considering calling in on a case by case basis shale planning applications and considering recovering appeals
- Identifying councils that repeatedly fail to determine oil and gas applications within the 16 week statutory timeframe requirement (unless applicants agree to a longer period). Underperforming council's gas and oil planning applications could be determined by the Communities Secretary

- Adding shale applications as a specific criterion for recovery of appeals, to ensure no application can ‘fall through the cracks’
- Ensuring planning call ins and appeals involving shale applications are prioritised by the Planning Inspectorate
- Taking forward work on revising permitted development rights for drilling boreholes for groundwater monitoring.

3.13 Coverage of recent hydrocarbon operations in the press and media, especially those involving hydraulic fracturing, have focused on a number of important issues, including seismic risks and the chemical content of hydraulic fracturing fluid. The National Planning Practice Guidance states that whilst these issues may be put to the mineral planning authority, the responsibility for assessment rests with other regulators. Mineral planning authorities have to assume that these other regulators will carry out their duties and responsibilities. They do not have to undertake their own assessments and should rely on the assessments of these regulators. Prior to granting planning permission, however, the mineral planning authority will need to be satisfied that these issues can and will be adequately addressed by taking advice from the appropriate regulator.

4 Licensing of Oil and Gas Exploration and Development

4.1 The Petroleum Act 1998 vests all rights and ownership of the petroleum resources (oil and gas) of Great Britain and the United Kingdom territorial waters in the Crown. The Secretary of State for Trade and Industry (DTI) (or successor) grants licences to persons that confer exclusive rights to ‘search and bore for and get’ these resources. The Department for Energy and Climate Change (successor to DTI) has a regular timetable of licencing rounds, with generally one onshore round per year. Licences are awarded to those bids promising to optimise the exploitation of the UK’s petroleum resources. This function has now passed to the OGA.

4.2 The main objectives of the licencing regime are to secure the comprehensive exploration and appraisal of UK oil and gas resources and the economic development of discovered reserves. The rights granted by landward licences do

not include any rights of access, and the onus is upon the licensee to obtain all the relevant authorisations and planning permissions from the respective authorities and landowners.

4.3 As a result of the long history of legislation, several types of onshore licence existed. To simplify things, the DTI in 1996 commenced the issue of Petroleum Exploration and Development (PEDL) Licences at the 8th Licensing Round. These carry a three-term lifetime: a six-year Initial Term allows completion of an agreed Work Programme, which is a pre-condition of entry into the five-year Second Term. Successful completion and approval of a development plan is a pre-condition of entry to the Third Term for production, which is granted for a period of 20 years, although the Secretary of State has the discretion to extend this period if production is continuing.

4.4 Following the announcement of a new round of licensing offers, applications are made for a PEDL over unlicensed areas (blocks) which correspond to the 10 km by 10 km Ordnance Survey grid. Many licences cover more than one block. Licensees are entitled to surrender a Licence, or part of the acreage covered by it, at any time after the Initial Term and the Work Programme have been completed, with a minimum relinquishment required at the end of the Initial Term. Details of the existing licence areas and those to be conferred under the 14th Onshore Oil and gas Licensing Round can be obtained via the following link: <https://www.gov.uk/government/news/new-onshore-oil-and-gas-blocks-to-be-offered>.

5 Geology

5.1 As this paper concerns gas which is contained within coal measures the following review relates to the geological conditions which created the coal measures and the location of the coalfields in and around Derbyshire.

5.2 The coal measures in Britain comprise a series of sedimentary rocks which were deposited around 300 - 330 million years ago during the Upper Carboniferous period. Carboniferous Britain and northern Europe formed a low-lying plain

backed by newly formed mountains to the south and a shallow sea to the north, beyond present day Scandinavia. Tropical waterlogged mires developed across Britain and Ireland, and whilst coal formed across the whole area, uplift due to tectonic activity and erosion has removed much of the coal bearing sequence.

- 5.3 In England and Wales coal-bearing rocks are almost entirely confined to the Pennine and South Wales coal measures groups of the Upper Carboniferous (Westphalian) age. Coal seams occur at fairly regular intervals, interbedded mainly with claystones, siltstones and sandstones. In parts of northern England, and notably in the Midland Valley of Scotland, older coals also occur in strata beneath Westphalian aged successions. In Scotland these occur principally in Limestone Coal and Upper Limestone formations, with locally thick coals present in the Passage Formation.
- 5.4 Coal-bearing strata occur at the surface in a number of discrete 'exposed coalfields' but also dip beneath younger rocks to form 'concealed coalfields'. Despite a long history of coal mining in Great Britain, considerable resources remain at depths readily accessible by underground mining methods and closer to the surface where they can be obtained by surface mining.
- 5.5 There are two coalfield areas within Derbyshire. The North Derbyshire Coalfield is the southern part of the much wider Yorkshire/Nottinghamshire/Derbyshire Coalfield stretching from southern Leeds in the north to the Nottingham area in the south. The South Derbyshire Coalfield is part of the Midlands Coalfield, which extends from Staffordshire in the west through southern Derbyshire into Leicestershire. The coal seams vary in thickness up to several metres and, in Derbyshire around 30 seams in all are substantial enough to be worked commercially.
- 5.6 The South Derbyshire Coalfield is a north-west to south-east trending coalfield located to the south-east of Burton-on-Trent. It covers an area of 36km², and is contiguous to the west, beyond the Neverseal fault, with the East Staffordshire area of concealed coal measures. It is connected to the adjacent Leicestershire Coalfield to the east by the north-west trending Ashby anticline.

- 5.7 Coals are known from the Lower, Middle and Upper Coal Measures. The main seams are the Upper Kilburn, Block, Little, Little Kilburn, (Over & Nether) Main, Little Woodfield, Lower Main, Woodfield, Stockings, Eureka, Stanhope, Kilburn, Fireclay and Yard. The seams in the South Derbyshire Coalfield are mainly high volatile and non-caking (unlike bituminous coals which when heated, soften and form a plastic mass that swells and resolidifies into a porous solid). There is very little variation in rank across the coalfield. Seams in the South Derbyshire Coalfield are fairly shallow, typically less than 450m in the deepest parts of the coalfield.
- 5.8 Within Derbyshire, the shallow coal measures occur in a substantial tract of the County in the area around Chesterfield, between Bolsover in the east and the Peak District National Park in the west, extending southwards, east of a line from Holymoorside to Belper, as far west as Ilkeston. Around Swadlincote, shallow coal deposits occur in the area from Burton-on-Trent and Repton Common in the north to Measham, in Leicestershire, in the south. Shallow coal deposits also occur in the north-west of the County mainly outside the National Park boundaries between Charlesworth and Whaley Bridge, but these are not, generally, of commercial quality.
- 5.9 There is also the underground coal resource; located to the east of the main Derbyshire shallow coal measures, below an area of Permian Limestone. Whilst there is no potential for surface extraction in this area (the thickness of the limestone beds would make this uneconomic), there may be some potential for either underground mining or alternative extraction methods such as coal gasification or coal bed methane extraction.

6 Exploration, Working and Reclamation

6.1 Coalbed Methane Developments (CBM)

Coalbed Methane is methane gas extracted from unworked coal seams. The process grew out of the need to remove gas from mines for safety reasons. It can be extracted in one of two ways.

- Drilling vertically into a coal seam, making use of pre-existing fracture patterns, or more likely
- Directional drilling along a coal seam.

6.2 The methane is absorbed into the solid coal matrix and is released when the coal seam is depressurised. Extraction is likely between 200 and 1500 metres, depending on coal permeability and other issues. At shallower depths the gas pressure in the coal is likely to be insufficient, whilst at depths greater than 1500 metres the pressure of overlying strata is likely to have reduced coal permeability, restricting the flow of methane. The usual spacing of vertical wells is one for every 500 to 1000 metres, though directional drilling of a number of wells from a single surface location offers one way of reducing the number of surface drilling sites and pipelines.

6.3 In both drilling techniques the coals may be fractured to improve flow rates. Wells are drilled into the coal seam; the well is then pumped to remove any water to enable the methane to be extracted. By removing the water the pressure in the seam is lowered which allows the methane to be released from the coal and flow up to the well surface for capture. Extracting coalbed methane does not detrimentally affect the physical properties of the coal, or prevent it from being worked at a later date.

6.4 As was previously recognised in MPS1 some CBM developments do not have the same discrete phases of exploration, appraisal and production as conventional oil and gas developments. Exploration and appraisal can be a single process. The same wells that have been used for exploration/appraisal will be used, as soon as possible, for production, though there may be a necessary delay because of the need for dewatering.

6.5 Development of a coalbed methane production area usually involves an incremental approach where groups of new wells will be added to a “hub” of wells already in production. This allows the knowledge gained in the drilling and

completion of wells to be used to the maximum effect in the drilling of adjacent wells.

6.6 The main environmental impacts associated with CBM development are similar to those for conventional oil and gas. However, particular attention should also be paid to the abstraction of any groundwater and its impacts, as well as the disposal of water produced during well stimulation and production of gas.

6.7 The NPPG states that extracting coalbed methane does not detrimentally affect the physical properties of coal, or prevent it from being worked at a later date. It indicates that the two key factors to consider when considering coalbed methane exploration/production are:

- Unlike underground coal mining, extraction of coalbed methane does not cause subsidence of the land surface;
- Removing the water is commonly required to initiate gas production. Such dewatering can take place over an extended period of time.

6.8 **Coal Mine Methane and Abandoned Mine Methane (CMM and AMM)**

Methane escapes from underground coal seams during mining operations, creating serious risks from explosions and other health hazards. In order to minimise these risks working mines are ventilated, and the methane is sometimes extracted and used for energy production, usually for the operation of the mine itself. On the abandonment or closure of the mine, if the workings do not become flooded, methane may accumulate in residual voids from which it can potentially be extracted. In some cases, methane escaping naturally from such voids may also cause a danger to property or health. In such cases it is necessary to vent the gas in a controlled manner. In either circumstance, it may sometimes be economic to recover and use the gas, for example for local electricity generation.

6.9 Gas from these sources typically has an oxygen content of 5-12% whilst the methane content ranges from 25-60%, although the air/methane proportion can

change suddenly, complicating its use in gas engines. Methane drained from working mines has been exploited in the UK since at least the 1950s. Gas from abandoned mines, known as Abandoned Mines Methane (AMM), typically contains no oxygen. The methane content ranges from 60-80% and is obtained from abandoned mines by applying suction to the workings.

6.10 Underground Coal Gasification (UCG)

Underground Coal Gasification (UCG) is an industrial process involving the controlled combustion of coal seams beneath the ground and the recovery of the resulting gas. The coal can be accessed by carefully controlled directional drilling of several wells that penetrate the coal seam from an appropriate distance. It requires a minimum of two wells; an access well to inject steam and air or oxygen to trigger and maintain the combustion of the seam and, a production well which recovers the resulting gas-water vapour mixture to the surface for treatment. Sometimes a separate ignition well is drilled, through which a small amount of gas is injected to initiate combustion.

6.11 The process converts the physical coal to a product gas (a type of synthetic gas). It involves the injection of oxygen and steam/water via a borehole which results in the partial combustion of the coal, producing a combustible gas mixture. In this process the coal face is ignited, and at high temperatures (1,500 kelvins) and high pressures, this combustion generates hydrogen, carbon monoxide, carbon dioxide, and minimal amounts of methane and hydrogen sulphide. This product gas is then extracted via the well for use as an energy source.

6.12 The NPPG states that the surface footprint for underground gasification projects depends on the scale of the proposal. It is likely to consist of:

- a minimum of one drilling pad
- facilities to provide steam and possibly oxygen to regulate the combustion reaction
- facilities to process the product gas (these could be located off site and the product gas transported to them via pipeline).

- 6.13 Larger schemes would likely contain several drill pads but could share the other necessary facilities. Once all the coal along the length of the access well(s) has combusted, the development would have to move along the same coal seam or exploit another seam above or below the one previously combusted.
- 6.14 The technique has the potential to provide a clean and convenient source of energy from coal seams where traditional mining methods are impossible or uneconomic. In terms of environmental impacts; UCG eliminates the need for mining which can result in a number of environmental benefits, including the elimination of solid waste discharge and reduction in emissions as no coal is brought to the surface and the gas can be processed to remove its CO₂ content. The reduction of solid waste is a major advantage of UCG over traditional coal mining, where large quantities of coal ash, oxides and waste rock need to be dealt with. In the case of UCG, this waste is either avoided or contained underground.
- 6.15 The impact of UCG on ground-water systems has been highlighted as an environmental concern. Organic and often toxic materials remain in the underground chamber after gasification and therefore are likely to leech into the ground water, should inappropriate site selection occur.
- 6.16 A further potential environmental concern is that of substantial subsidence due to removal of the coal seam. While it may leave the ash behind in the cavity, the depth of the void left after UCG would be significantly more than other methods of coal extraction. Subsidence is likely to be more of a problem if gasification occurs in a shallow coal seam, closer to the surface but is less of a problem if the seam is deep.
- 6.17 The NPPG states that it is Government policy that any new coal-fired power station should demonstrate that it is “carbon capture ready” and that this applies to any new power station that uses coal as a fuel, whether directly in a pulverised coal power station or indirectly in an Integrated Gasification Combined Cycled Plant. For an Integrated Gasification Combined Cycle plant, the policy will apply regardless of where the syngas is generated, whether that is at an on-site of off-

site gasification unit. This applies to situations where underground coal gasification is used to produce syngas for power generation.

6.18 New power stations that use fossil fuel or fuel produced from fossil fuel, as in gasification will also be subject to the Emissions Performance Standard. This came into force through the Energy Act 2013 and places a limit on the amount of carbon dioxide that new fossil fuel power stations can emit.

7 Production, Consumption and Reserves

7.1 At present it is not possible to obtain figures for the amount of gas obtained from coal measures and therefore the following figures relate to gas production in general.

7.2 Global

In 2016, global production of gas was approximately 3.55 trillion cubic metres. Proved reserves of gas stand at some 186.6 trillion cubic metres; about 53 years of current production. These figures were obtained from the BP Statistical Review 2017.

7.3 National

Gross natural gas production in the UK rose 4% in 2016, to 41 million metric tonnes of oil equivalent, from 39.6 million mtoe the year before. Production of gas has now fallen by 62% from its 2000 peak of 108.4 million mtoe. At the end of 2016, proved reserves of gas stood at 0.2 trillion cubic metres.

7.4 Derbyshire

The 2004 DTI publication, UK Coal Resource for New Exploitation Technologies, identified two sites in Derbyshire that were extracting gas from abandoned mines at that time. One other site (Whitwell) received planning permission after the publication of the study:

- Shirebrook, gas extracted from a former colliery drift and was used to fuel an on-site power station used for electricity generation. Currently dormant.

- Markham, gas extracted from one of the former colliery shafts and used to supply gas for industrial heat applications at Coalite Chemicals and Coke Smokeless Fuels plant. Inactive since March 2007, unlikely to reopen as the seams have been flooded and the Coalite works have closed.
- Former Whitwell Colliery. Currently operational with planning permission until 2019 but production levels are now in decline.

7.5 Potential for the Extraction of Gas from Coal in Derbyshire

The British Geological Survey (Mineral Resource Information for Development Plans – Derbyshire: Resources and Constraints 1995) indicate that the prime requirement for coalbed methane prospects are unworked coal seams at depths between 200 and 1500 metres (as the low coal permeability and the high cost of drilling make deeper targets unattractive) and adequate levels of methane, which generally increases with rank. This publication drew on the research undertaken by several people, including those researching the potential for mineral extraction within Derbyshire which has been used in the sections below.

7.6 South Derbyshire Coalfield

There are no working mines within the South Derbyshire Coalfield and therefore no potential for CMM developments. According to independent reports collated by the British Geological Survey, AMM and CBM prospects are poor due to low measured seam methane contents of only 1.3m³/tonne of coal.

7.7 North Derbyshire Coalfield

In the north and east of Derbyshire, coal seams at depths of more than 200 metres are widespread. Information available from the British Geological Survey refers to studies from the early 1980s which concluded that the methane plus ethane content of coals in the Nottinghamshire part of the East Pennine Coalfield averaged 5.13m³/tonne and was close enough to indicate the level of potential in the Derbyshire part of the coalfield. BGS noted, however that past coal mining will have affected the coalbed methane prospectivity of the area as coal extraction has the effect of lowering the pressure on the strata both above and below the mined seam. Lowering the pressure causes gas to desorb from the

coal, often into the mine, from where it was vented to the atmosphere or used at the pithead. This downgrades the prospectivity of the seams close to the mined seam although it does increase fracturing in the overlying measures, improving the prospects of extracting gas. Former coal mining activity can also cause drilling problems (loss of circulation) if mud or water is used as a drilling fluid.

7.9 Widespread degasification is likely to have taken place on the exposed Coal Measures, due to centuries of mining, thus the most prospective part of the area is likely to be the concealed coalfield, or those areas between more recently closed deep mines. However, collieries have existed all along the eastern side of the concealed North Derbyshire coalfield, from Whitwell to Shirebrook, so any unmined areas are likely to be small.

7.10 **Underground Coal Gasification (UCG)**

The 2004 DTI report states that the resource criteria for UCG includes coal seams more than 2m thick at depths of between 600m and 1200m. This would suggest that there is no potential in Derbyshire. However the BGS notes that there have been recent commercial-scale UCG operations in Australia at much shallower depths than those suggested by the DTI (up to 30m).

7.11 **UK Potential for CBM Production**

A 2010 DECC Report however, is more optimistic for the potential for CBM production than the 2004 Report, stating that, 'the UK has a very great potential for CBM production...'. The 2010 report suggests that, if 10% rather than 1% (as the 2004 Report suggested) of them could be developed then 3 years of UK consumption could be supplied from CBM.

7.12 **Carbon Dioxide Sequestration**

Carbon dioxide sequestration onto coal is a technology that has been proposed as a greenhouse gas mitigation option. Carbon dioxide has an affinity to be absorbed onto coal and this affinity is greater than that of methane. Therefore the carbon dioxide could be used to enhance coalbed methane production by displacing the methane from sorption sites on the coal. Again however, the issue of coalbed permeability needs to be overcome; in addition, the most preferential

area for carbon dioxide sequestration occurs at depths in excess of 1200m, ruling out any potential in Derbyshire.

Glossary of Hydrocarbon Related Terms

Hydrocarbon – in organic chemistry a hydrocarbon is an organic compound of hydrogen and carbon. The majority of hydrocarbons found on earth naturally occur in crude oil, where decomposed organic matter provides an abundance of carbon and hydrogen which, when bonded can catenate (linkage of atoms of the same element into longer chains) to form seemingly limitless chains. The number of carbon atoms in a hydrocarbon compound determines its physical properties. For example, simple compounds such as methane have boiling temperatures below 0 degrees Centigrade and are therefore gases under ambient conditions. Larger, more complex hydrocarbon compounds are liquids under ambient conditions, whilst even larger compounds with a high molecular weight can form waxy solids.

Conventional Hydrocarbons - are oil and gas where the reservoir is sandstone and limestone.

Unconventional Hydrocarbons - refers to oil and gas which comes from sources such as shale or coal seams which act as the reservoir.

Crude Oil - is the term for unprocessed oil as it comes out of the ground. Crude oil varies in viscosity, from a water level of consistency to almost a solid. Typically, crude oil consists of 84% carbon and 14% hydrogen.

Total Resources – the estimated total volume of oil and gas physically contained in the rock. One measure of total resources used commonly, including by the British Geological Survey, is the Gas in Place (GIP) which is an estimate of the total amount of gas that is trapped within shale rock.

Reserves – the amount of resources that are deemed to be technically and commercially recoverable.

Technically Recoverable Resource – the estimated volume of oil or gas that it possible to extract from the total resource if not constrained by economics (and therefore larger than the reserves estimate).

Petroleum – literally translates from Greek origins as 'rock oil'. The name petroleum covers both naturally occurring unprocessed crude oil and petroleum based products that are made up from refined crude oil. In base form it is a naturally occurring, yellow-to-black liquid found in geological formations beneath the earth's surface. After water, it is the second most abundant liquid on earth. Petroleum consists of hydrocarbons of various molecular weights and other liquid organic compounds. Petroleum is a fossil fuel and is formed when large quantities of dead organisms, usually zooplankton and algae, are buried beneath sedimentary rocks and subjected to intense heat and pressure.

Fossil Fuels – are formed by natural processes such as anaerobic decomposition of buried dead organisms. The age of fossil fuels is typically millions of years, and sometimes exceeds 650 million years. Fossil fuels contain high percentages of carbon and include coal and natural gas.

Coalification – the formation of coal from a variety of plant materials via biochemical and geochemical processes.

Natural Gas - is a form of fossil fuel and is formed when layers of buried plants and animals are exposed to intense heat and pressure over thousands of years. The energy that plants originally obtained from the sun is stored in the form of chemical bonds in natural gas. Most natural gas was formed by one of two mechanisms: biogenic and thermogenic.

Biogenic Gas is created by methanogenic organisms in marshes, bogs and shallow sediments.

Thermogenic Gas is also created from buried organic material but deeper in the earth at greater pressure and temperature. Natural gas is found in deep underground rock formations or associated with other hydrocarbon reservoirs in coal beds and as methane clathrates (chemical substance consisting of a lattice that traps or contains molecules).

Barrel of Oil Equivalent (BOE) – a term used to summarise the amount of energy that is equivalent to the amount of energy found in a barrel of crude oil. There are 42 gallons (USA gallons) in one barrel of oil, which will contain approximately 5.8 million British Thermal Units (MBtus) or 1,700 kilowatt hours (kWh). The term is used frequently when exploration and production companies are reporting the amount of reserves they may have and allows an assessment of the total amount of energy that a firm has access to, without breaking it down into barrels of crude oil, or the cubic feet of natural gas.

Porosity – or void fraction is the measure of the void spaces in a material, and is a fraction of the volume of voids over the total volume, between 0 and 1 or as a percentage between 0 and 100. The porosity of coal bed reservoirs is usually very small, ranging from 0.1 to 10%.

Adsorption Capacity – the adsorption capacity of coal is defined as the volume of gas adsorbed per unit of coal, usually expressed in SCF (standard cubic feet, the volume at standard pressure and temperature conditions) gas/ton of coal.

Fracture Permeability – acts as the major channel for gas to flow. The higher the permeability, the higher the gas production.

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