Derbyshire and Derby Minerals Local Plan 2022 – 2038

Background Paper: Gas from Coal

January 2023

Derby City Council

DERBYSHIRE County Council

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1. Introduction and Background

1.1 This paper provides information about obtaining gas from coal measures (an unconventional source of hydrocarbons), whilst corresponding papers focus on oil and gas from conventional sources and unconventional hydrocarbons derived 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 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. There are numerous methods of extracting oil and gas and each has different land use planning implications. This paper focuses on the issues involved in extracting oil and gas from coal.

Unconventional Hydrocarbons (Gas from Coal)

1.3 Hydrocarbon is a compound of hydrogen and carbon. Hydrocarbons are of great importance as they include minerals such as oil and gas which provide a significant proportion of our energy supplies. They are also used as raw materials for the petro-chemicals industry and in the manufacture of drugs and plastics. The geological conditions where these resources are found, and the methods used to extract them has resulted in two categories of hydrocarbons, conventional and unconventional. Further information regarding conventional hydrocarbons and unconventional hydrocarbons derived from shale, and the methods used to extract them, can be found in the following papers:

- *Derbyshire and Derby Mineral Local Plan (2022 – 2038): Pre-submission Draft Plan Spring 2023 Consultation: Background Paper Conventional Oil and Gas*

- *Derbyshire and Derby Mineral Local Plan (2022 – 2038): Pre-submission Draft Plan Spring 2023 Consultation: Background Paper Unconventional Gas – Shale Gas*

1.4 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.

1.5 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 boilers and kilns. Using the gas from coal in this way helps prevent emissions to the atmosphere.

How is the gas extracted?

1.6 There are currently four main ways in which gas can be extracted from coal measures:

- Extracting gas from operational mines (referred to as Coal Mine Methane).
- Extracting gas from abandoned mines (referred to as Abandoned Mine methane).
- Extracting gas from untouched coal seams (referred to as Coal Bed Methane).
- Extracting gas by underground coal gasification.

1.7 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 UK's fuel and lighting gas up to the 1970s. 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. Further details of these technologies are provided below.

Coalbed Methane (CBM)

1.8 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.

1.9 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.

1.10 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.

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

1.11 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.

1.12 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.

Underground Coal Gasification (UCG)

1.13 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 (Figure 1). 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.

1.14 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.

Figure 1: Schematic of UCG in a Coal Seam

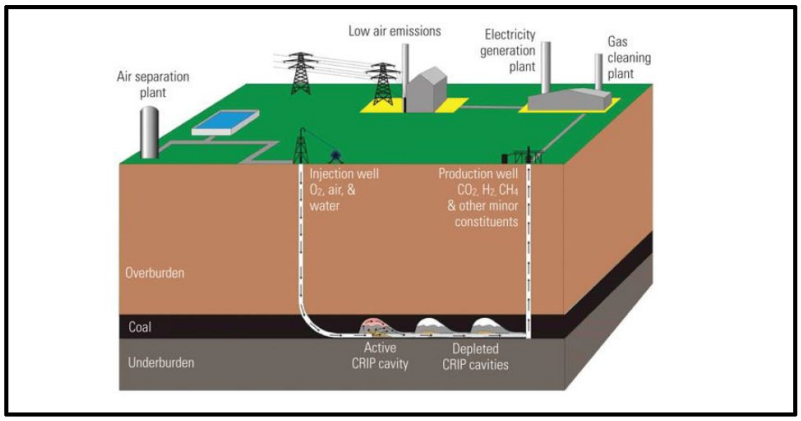


Image credit: Atkins (November 2015)[1]

[1] Atkins Underground Coal Gasification – Evidence Statement of Global Warming Potential (Version 7 28 November 2015 5142635, Page 3)
Underground_Coal_Gasification___Evidence_Statement_of_Global_Warming_Potential.pdf (publishing.service.gov.uk)

2. Geology

2.1 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.

2.2 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.

2.3 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, siltsones 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.

2.4 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.

2.5 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.

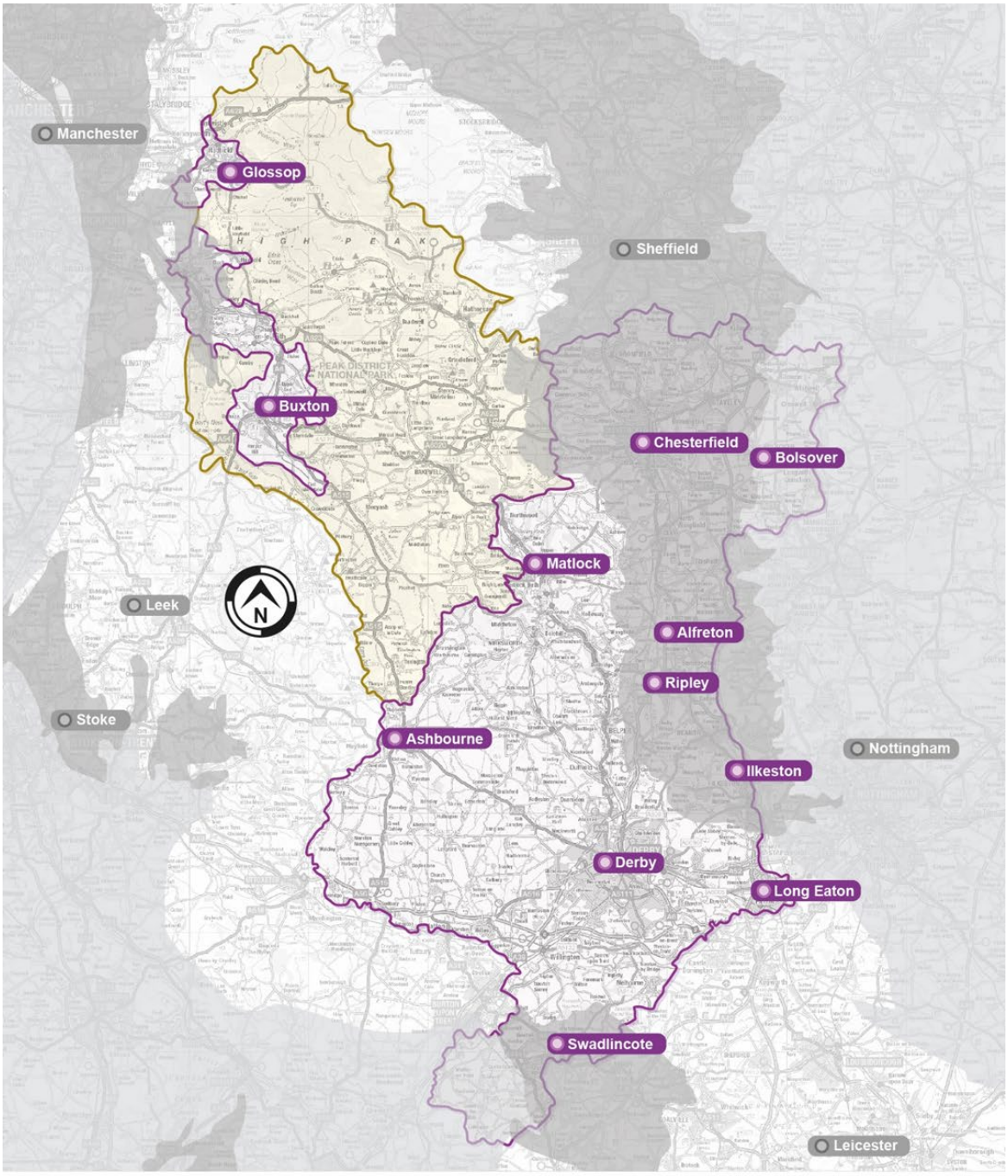
2.6 The South Derbyshire Coalfield is a north-west to south-east trending coalfield located to the south-east of Burton-on-Trent. It covers an area of 36km², and is contiguous to the west, beyond the Netherseal fault, with the East Staffordshire area of concealed coal measures. It is connected to the adjacent Leicestershire Coalfield to the east by the north-west trending Ashby anticline.

2.7 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.

2.8 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 (Figure 2). 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.

2.9 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.

Figure 2. Shallow and Deep Coal Resource in Derbyshire



3. National and Local Policy and Guidance

National Planning Policy

3.1 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 new 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. This review focuses on the aspects of guidance which are pertinent to town and country planning and the production of the minerals plan rather than the wider, more technical aspects.

National Planning Policy Framework (NPPF)

3.2 National guidance for the extraction of minerals, including hydrocarbons, is set out in the NPPF. In general terms, the NPPF states that, *"It is essential that there is a sufficient supply of minerals to provide the infrastructure, buildings, energy and goods that the country needs. Since minerals are a finite natural resource, and can only be worked where they are found, best use needs to be made of them to secure their long-term conservation*[2]*"* The policy advice[3] on mineral development generally is that mineral planning authorities should have planning policies that '*a) provide for the extraction of mineral resources of local and national importance*,' and '*f) set out criteria or requirements to ensure permitted and proposed operations do not have unacceptable adverse impacts on the natural and historic environment or human health, taking into account the cumulative effects of multiple impacts from individual sites and/or a number of sites in a locality.'* Paragraph 211 requires that '*when determining planning applications, great weight should be given to the benefits of mineral extraction, including to the economy.'*

3.3 Specific but limited guidance on hydrocarbons is set out in Paragraph 215 of the NPPF which states that, *"Minerals Planning Authorities should …when planning for on-shore oil and gas development, clearly distinguish between, and plan positively for, the three phases of development (exploration, appraisal and production), whilst ensuring appropriate monitoring and site restoration is provided for"*. In addition,

[2] Paragraph 209, NPPF (July 2021)
[3] Paragraph 210, NPPF (July 2021)

mineral planning authorities should: "*encourage underground gas and carbon storage and associated infrastructure if local geological circumstances indicate its feasibility*"; and *"encourage the capture and use of methane from coal mines in active and abandoned coalfield areas"*.

3.4 When determining planning applications the NPPF[4] 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."*

Planning Practice Guidance (PPG)

3.5 PPG[5] 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.

3.6 Where mineral planning authorities consider it is necessary to update their local plan and they are in a Petroleum Licence area, PPG[6] 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.

3.7 PPG[7] 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

[4] Paragraph 216, NPPF (July 2021)
[5] Paragraph 105, reference ID: 27-105-20140306, March 2014
[6] Paragraph 106, reference ID: 27-106-20140306, March 2014
[7] Paragraphs 092 – 103, Reference IDs: 27-092-20140306 – 27-103-20140306, March 2014

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 involved in the process.

3.8 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. PPG provides some examples of model conditions in Annex C[8]. 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. Annex A[9] 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.

National Energy Policy

3.9 There have been several important stages in the evolution of current national energy policy which, increasingly, have recognised the need to adapt to climate change whilst maintaining secure energy supplies. The Department of Trade and Industry (DTI) paper, Meeting the Energy Challenge, 2007[10] 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.

[8] Paragraph 139, Reference ID: 27-139-20140306, March 2014
[9] Paragraph: 128 Reference ID: 27-128-20140306, March 2014
[10] Meeting the Energy Challenge, A White Paper on Energy, DTI, May 2007

3.10 Energy policy since 2008 has been influenced by The Climate Change Act 2008 which set in legislation the UK's approach to tackling and responding to climate change. It introduced the UK's long-term legally binding 2050 target to reduce greenhouse gas emissions by at least 80% relative to 1990 levels and introduced 'carbon budgets' which cap emissions over successive 5-year periods which must be set 12 years in advance.

3.11 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 and in the Gas Generation Strategy 2012[11] which makes it clear that the Government expects gas to continue to play a major role in the UK electricity mix over the coming decades, alongside low-carbon technologies as the electricity system is decarbonised.

3.12 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. It was estimated that, by 2020, the UK is likely to be importing about three-quarters of its energy supplies.

3.13 In December 2013 the Government published its long-term infrastructure investment plans which included investment in gas, as well as low-carbon technologies, in order to replace the UK's ageing energy infrastructure and maintain secure energy supplies. The plan 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

[11] DECC, Gas Generation Strategy, December 2012

levels of intermittent and inflexible low-carbon energy on the system. Delivery of the plan, including the role that gas would play in the provision of national energy infrastructure, was subsequently set out in the National Infrastructure Delivery Plan (NIDP) [12], published March 2016.

Energy Act 2013

3.14 The Energy Act received Royal 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 the 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.

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

3.15 The 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 "*Affordable, reliable clean energy is critical to our economy, our national security, and to family budgets. We need secure energy so people can get on with their lives and businesses can plan for the future. Affordable energy so the people that foot the bill get a good deal, and clean energy to safeguard our future economic security and ensure we can meet our climate change commitments*." She added "*New nuclear and gas will be central to our energy secure future…'.* The WMS goes on "*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

[12] Infrastructure and Projects Authority 'National Infrastructure Delivery Plan 2016-2021'

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.

Paris Agreement, December 2015

3.16 In December 2015 the UK, as part of UN negotiations and along with other 190 other countries, drafted the Paris Agreement to tackle climate change. The Agreement, which came into force at the end of 2016, aims to limit global warming to well below 2°C and pursue efforts to limit it to 1.5°C. It also requires all parties to put forward their best efforts through the production of nationally determined contributions and to strengthen these efforts in the years ahead. There are requirements for Parties to report regularly on their emissions and on their implementation efforts, with a global 'stocktake' every five years to assess collective progress.

More information about the effect of climate change can be found in the following background paper:

Derbyshire and Derby Mineral Local Plan (2022 – 2038): Pre-submission Draft Plan Spring 2023 Consultation: Background Paper Unconventional Gas – Climate Change

Underground Coal Gasification

3.17 In 2015, BEIS commissioned a report[13] to provide it with evidence on the global warming potential that the production and use of syngas from UCG would have, based on the likely end uses of the syngas in comparison to conventional processes and sources of power generation, for heating and chemical feedstocks. Amongst other things, the report found that in terms of power generation, UCG syngas would result in significantly greater GHG emissions that the natural gas fed equivalent in a combined feed power station. The use of CCS was not found to significantly reduce the level of GHG emissions.

3.18 In response to a written parliamentary question, in 2016 the then Secretary of State for Environment, Food and Rural Affairs provided a written parliamentary answer (WPA)[14] which stated: '*The Government*

[13] Atkins on behalf of DECC: Underground Coal Gasification – Evidence Statement of Global Warming Potential (2015) Underground_Coal_Gasification___Evidence_Statement_of_Global_Warming_Potential.pdf (publishing.service.gov.uk)

[14] UK parliament written questions, answers and statements Coal Gasification question for DEFRA UIN 56962 tabled on 12 December 2016 Written questions and answers - Written questions, answers and statements - UK Parliament

has made a firm commitment to reducing the UK's carbon emissions, and our recent ratification of the historic Paris Agreement shows we are serious about global action on climate change.

The Department for Business, Energy & Industrial Strategy (BEIS) commissioned a report from Atkins into the greenhouse gas implications of underground coal gasification to inform Government policy about its development in the UK. The report was peer reviewed by academics and industry representatives. It finds that emissions from underground coal gasification would be too high to be consistent with our commitment to a low-carbon future. The Government is therefore minded not to support the development of this technology in the UK'.

DBEIS Written Ministerial Statement HCWS690 May 2018, - Energy Policy

3.19 This WMS was presented to Parliament in May 2018 by Greg Clerk Secretary of State for Business, Energy and Industrial Strategy. It states that there are potentially substantial benefits from the safe and sustainable exploration and development of our onshore oil and gas resources. It adds that *'The UK must have safe, secure and affordable supplies of energy with carbon emissions levels that are consistent with the carbon budgets defined in our Climate Change Act and our international obligations. We believe that gas has a key part to play in meeting these objectives both currently and in the future. In part as a result of the UK's diverse range of energy sources, which include natural gas, we have had competitively-priced energy since 1990 whilst reducing carbon emissions across the economy by 49% – a leading performance among developed nations. Gas still makes up around a third of our current energy usage and every scenario proposed by the Committee on Climate Change setting out how the UK could meet its legally-binding 2050 emissions reduction target includes demand for natural gas. As set out in the Clean Growth Strategy, innovations in technologies such as Carbon Capture Usage and Storage (CCUS) have the potential to decarbonise this energy supply still further and prolong its role in our energy mix.*

However, despite the welcome improvements in efficiency and innovation from companies operating in the North Sea, the ongoing decline in our offshore gas production has meant that the UK has gone from being a net exporter of gas in 2003 to importing just under 50% of gas supplies in 2017 and estimates suggest we could be importing 73%

of our gas by 2035[15]. Our current import mix, via pipelines from Norway and Continental Europe and LNG terminals that can source gas from around the world, provides us with stable and secure supplies.

However, the Government believe that it is right to utilise our domestic gas resources to the maximum extent and exploring further the potential for onshore gas production from shale rock formations in the UK, where it is economically efficient, and where environment impacts are robustly regulated'.

The UK's Draft Integrated National Energy and Climate Change Plan (NECP) January 2019

3.20 In the context of planning ahead for withdrawal from the EU the draft stated that, *"On energy, the UK is seeking co-operation with the EU to support the delivery of cost efficient, clean and secure supplies of electricity and gas, based on competitive markets and non-discriminatory access to markets."* On climate change it stated *"that the UK recognises the shared interest in global action on climate change and the mutual benefits of a broad agreement on climate change co-operation."*

3.21 The paper provides a review of important statements on energy and climate change (for example the Clean Growth Strategy October 2017) which set the framework, objectives and targets. It reaffirms the need to ensure energy security and energy efficiency, the approach to decarbonisation and the policies and measures relating to these and other issues. Whilst it addresses a wide range of energy and climate change issues the only direct minerals reference is to unconventional gas resources, including shale gas development. It states "The UK Government is committed to a low carbon and affordable future for our energy. Gas, the least polluting fossil fuel, still meets a third of our energy demand and we will need it for many years to come. In May 2018, the UK Government reiterated its view that there are potentially substantial benefits from the safe and sustainable exploration and development of our onshore shale gas resources." The paper also reiterated Government statements that shale gas development must be safe and environmentally sound and the continued need for tough regulations for all on-shore and off-shore oil and gas developments to ensure on-site

[15] DBEIS factsheet 1: Shale gas and energy security 2018 Shale Gas and Energy Security: factsheet 1 (publishing.service.gov.uk)

safety, prevent water contamination, and mitigate seismic activity and air pollution.

The Climate Change Act 2008 (2050 Target Amendment) Order 2019

3.22 The amendment in this Order has the effect that the minimum percentage by which the net UK carbon account for the year 2050 must be lower than the 1990 baseline is increased from 80% to 100%.

3.23 In terms of meeting the carbon budgets, the first (2008-2012) was outperformed by 1% and the second (2013-20170 by 14%. The Government's energy and emissions projections 2018 (published April 2019)[16] predicted that the third (2018-2022) would be outperformed by around 3% but predicted a projected shortfall of around 6% and 10% against the fourth (2023-2027) and fifth (2028-2032) budgets respectively. These predictions were before the more stringent target amendments.

National Grid: Future Energy Scenarios July 2020

3.24 National Grid, which operates GB's electricity and gas networks, produce an annual report on Future Energy Scenarios which suggests four credible pathways for the future of energy to 2050. Each scenario considers how much energy we might need and where it could come from. Three of the four scenarios achieve the net zero greenhouse gas emission target by 2050 i.e. a 100% reduction compared to 1990 levels. The fourth scenario labelled 'Steady Progression' achieves a 68% reduction; the use of shale gas is only present in this scenario. The report notes that shale gas is not present in the three net zero scenarios due to reduced support from government and consumers.

HM Government, The Ten Point Plan for a Green Industrial Revolution, November 2020

3.25 This document sets out the Government's approach to tackling climate change via ten action points including the investment in clean technologies, power generation and the natural environment. Of particular relevance to hydrocarbons is the stated commitment to drive the growth of low carbon hydrogen (point 2). Hydrocarbons have traditionally used in the production of hydrogen at an industrial scale

[16] DBEIS, Updated energy and emissions projections 2018, April 2019 Updated energy and emissions projections: 2018 - GOV.UK (www.gov.uk)

although not in a low carbon form. Subject to CCS technologies being developed which would trap carbon emissions, there is potential for the continued use of conventional oil and gas in this industry.

3.26 The document also makes reference to a suite of more detailed strategies, including the Energy White paper (2020), the Hydrogen strategy (2021) and the Industrial carbonisation strategy (2021) all of which are likely to have relevance to the need for conventional oil and gas. One of the suite of documents referred to in the Ten Point Plan, the National Infrastructure Strategy, was also published in November 2020. Further information is set out in paragraph 3.28 below.

National Infrastructure Strategy (NIS), November 2020

3.27 Building on the themes set out in the Ten Point Plan, the NIS sets out the Government's proposals for investment in infrastructure over the next few years. One of the main tenets of the NIS is decarbonising the economy and adapting to climate change. Clean energy, including the prioritisation of low carbon hydrogen, nuclear or gas with carbon capture and storage (CCS) power sources are prioritised along with renewable energy sources. The NIS also indicates that the use of low carbon hydrogen is seen as a potential means of decarbonising heavy industry. Investment in methane reformation with CCS to produce 'blue' hydrogen would require a continued supply of natural oil and gas in order as feed material.

Energy White Paper (December 2020)

3.28 In December 2020 the Government published its Energy White Paper[17] entitled Powering our Net Zero Future; in terms of the way in which we produce and use energy it promotes a decisive shift away from fossil fuels, as far as it is possible to do so, to using clean energy technologies such as renewables, nuclear and hydrogen. Nevertheless, the paper anticipates that oil and gas will still form part of the energy mix in 2050 and therefore it is important to plan for their continued supply. A Government Written Ministerial Statement (WMS)[18] published in November 2019 stated, "*the Government continues to recognise the importance of natural gas as a source of secure and affordable energy as we aim to reach net zero emissions by 2050*". The Statement sets out

[17] DBEIS Energy White Paper Powering our Net Zero Future December 2020 Energy white paper: Powering our net zero future - GOV.UK (www.gov.uk)
[18] DBEIS WMS HCWS68 Energy Policy Update November 2019 Written statements - Written questions, answers and statements - UK Parliament

that the Committee on Climate Change (CCC) predicts that we will still be consuming about 70% of the gas that we consume today in 2050 under our net zero target as significant reductions across building, industry and power are offset by demand for gas to produce hydrogen and therefore, continued good access to natural gas from both domestic and international markets is seen as critical.

HM Government, Industrial Decarbonisation Strategy, CP399, March 2021

3.29 The strategy sets out the Government's policies and proposals for the decarbonisation of the industrial sector to enable the UK to meet its net-zero targets by 2050. Specifically, with regard to fossil fuels, including gas, the strategy sets out that the UK will need to replace them with low carbon fuels such as hydrogen, electricity and bioenergy, unless they (fossil fuels) are combined with carbon capture. To be on track to deliver net zero, we expect that the minimum, in all future scenarios, is 20 TWh per year of fossil fuel use would be replaced with low carbon alternatives by 2030. The strategy also explores options for the decarbonisation of the cement sector in dispersed locations, including a number of cement plants/kilns located within the Plan Area, through the use of a 'zero-carbon' fuel mix.

National Grid: Future Energy Scenarios July 2022 (FES 2022)

3.30 National Grid, which operates GB's electricity and gas networks, produce an annual report on Future Energy Scenarios. The Future Energy Scenarios (FES 2022) sets out four credible ways that the UK can achieve Net Zero by 2050, as well as the UK Government's commitment to a decarbonised electricity system by 2035. Each scenario considers how much energy we might need and where it could come from. Three of the four scenarios achieve the net zero greenhouse gas emission target by 2050 i.e. a 100% reduction compared to 1990 levels. The fourth scenario labelled 'Falling Short' achieves a 80% reduction (which appears to be an improvement son the predicted 68% reduction identified in the FES 2020); the use of shale gas is only present in this scenario.

Local Planning Policy

Derby and Derbyshire Minerals Local Plan

3.31 The current Minerals Local Plan, adopted in 2002, 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:

"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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4. Regulatory System

Key Regulators

4.1 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:

- **North Sea Transition Authority** - The NSTA regulates the licensing of exploration and development of England's onshore oil and gas resources. The NSTA issues well consents, development programme approvals, completion of work programme approvals and production consents. Before a company can carry out onshore exploration for oil and gas, a company needs to apply to the NSTA for a Petroleum Exploration & Development License (PEDL). As part of the NSTA's regulation of onshore hydraulic fracturing operations, it has stringent controls in place to ensure that operators manage the risk of induced seismicity from such operations. If hydraulic fracturing is proposed, operators are required to undertake detailed geological studies and submit a Hydraulic Fracture Plan (HFP) setting out how they will control and monitor the fracturing process and assess the risk of induced seismic events.
- **Mineral 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.
- **the Coal Authority**, is responsible for issuing licences for access to coal for CBM extraction and UCG. The Authority is also responsible for issuing licences should drilling go through a coal seam.

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

- **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.

Obtaining Planning Permission and Other Approvals

4.2 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).

4.3 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.

4.4 In order to undertake any works related to gas extraction an operator has to have a licence which is issued by the NTSA. 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.

4.5 The DBEIS Regulatory Roadmap England: Onshore Oil and Gas Exploration in the UK: Regulation and Best Practice, December 2015 (with updates to 2018), 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 the NTSA
- secured a lease from the landowner
- submitted relevant Petroleum Operations Notices (PON) to NSTA
- secured planning permission from the MPA/LPA/DLUHC
- 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 (BGS) of the intention to drill
- completed the necessary consultation process with all the statutory/ relevant consultees
- obtained the necessary permits from the Environment Agency
- notified HSE of the intention to drill (minimum 21 days' notice)
- provided HSE 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 NTSA
- agreed a method for monitoring induced seismicity and fracture growth height with NTSA, (where hydraulic fracturing is planned)
- received consent from DBEIS to drill and frack (where hydraulic fracturing is planned).

Further details of this process are summarised below.

4.6 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.

4.7 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 and has subsequently been incorporated into the Town and Country Planning (Development Management Procedure) (England) Order 2015 at Article 13(3).

4.8 Once the MPA 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. NTSA (or any successor) will then check that the other regulators have no objections before consenting drilling operations.

4.9 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 EA, the HSE, NSTA and DBEIS).

4.10 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 paragraph

185 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.

4.11 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.*"

4.12 The situation changed following the publication on 13 August 2015 of a joint statement from the Department of Energy and Climate Change (now DBEIS) and the Department for Communities and Local Government (now DLUHC) 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.

4.13 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. PPG 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.

5. Licensing of Oil and Gas Exploration and Development

5.1 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 NTSA which has published guidance[19] on the current licencing system.

5.2 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.

5.3 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.

5.4 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

[19] OGA Consolidated Onshore Guidance Version 2.2 June 2018 consolidated-onshore-guidance-compendium_vfinal12062018.pdf (nstauthority.co.uk)

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 are shown on Figure 3 below.

6. Exploration, Working and Reclamation

6.1 The production of oil and gas is subject to the same planning controls which are applicable to any other mineral development. PPG provides a comprehensive summary of the latest planning procedures relating to the winning and working of oil and gas from both conventional and unconventional sources and the inter-relationship of the planning regime with other regulatory systems which have a role in the overall determination of such proposals (see Regulatory System above).

6.2 The three phases of all hydrocarbon extraction operations are exploration, appraisal and production. Planning permission is required for each phase, although some initial preparatory work may have deemed planning consent. The provisions of the Town and Country Planning (General Permitted Development) (England) (Amendment) Order 2016 allows during a period not exceeding 28 consecutive days the drilling of boreholes for the purposes of (a) carrying out groundwater monitoring; (b) seismic monitoring or (c) locating and appraising the condition of mines, which in each case is preparatory to potential petroleum exploration. This right is subject to a number of exceptions (for example where drilling would be carried out within a National Park or protected groundwater source area) and a number of conditions (including no operations between 6pm-7am, and notification to the Environment Agency). This work can be carried out to establish baseline information on the groundwater environment without the need for planning permission, although other regulatory consents, such as a PEDL, would still be required.

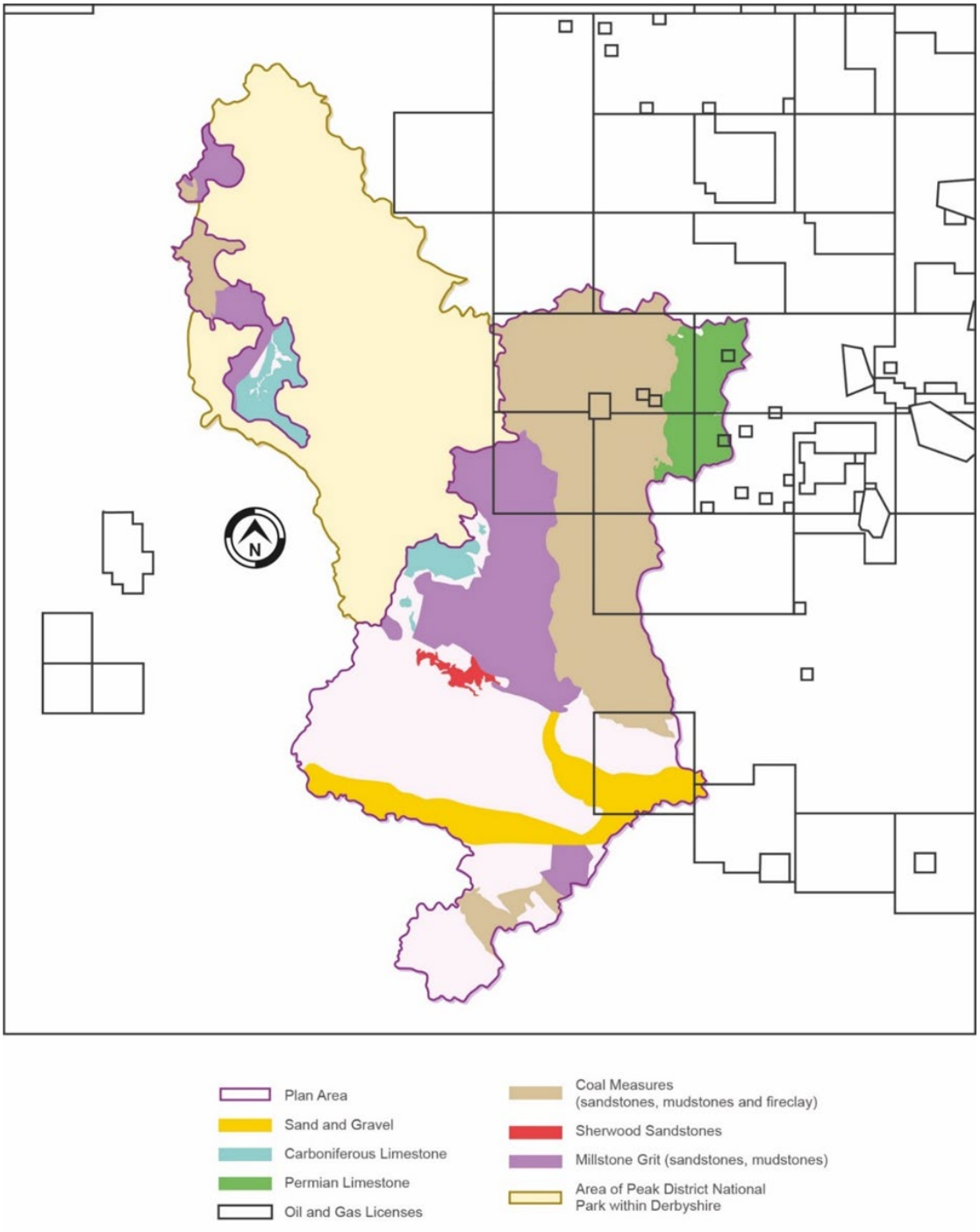
Coalbed Methane Developments (CBM)

6.3 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.

6.4 Development of a CBM 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.

6.5 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.

Figure 3: Current PEDL areas within the Plan area



6.6 PPG states that extracting coalbed methane does not detrimentally affect the physical properties of coal or prevent it from being worked at a later date[20]. 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.

Underground Coal Gasification

6.7 PPG states[21] 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.

6.8 Larger schemes would be likely to 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.

6.9 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.

[20] PPG, Annex A Shale Gas Paragraph 136 Reference ID: 27-136-20140306 March 2014
[21] Annex A – Shale Gas: Paragraph 227, Reference ID: 27-227-20141017, October 2017

6.10 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.

6.11 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.

6.12 PPG states[22] that it is Government policy (as set out in the Overarching National Policy Statement for Energy (EN1)) 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 were underground coal gasification is used to produce syngas for power generation.

6.13 It goes on to say that 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.

[22] Annex A – Shale Gas, Paragraph 229, Reference ID: 27-229-20141017, October 2014

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.

Global

7.2 In 2021, global production of gas was approximately 4.03 trillion cubic metres, up from 3.86 trillion cubic metres in 2020[23]. Proved reserves of gas (at end of 2020) stood at some 188.1 trillion cubic metres; about 48.8 years of current production[24].

National

7.3 Gross natural gas production in the UK during 2021 was 32.7 billion cubic metres (a decrease of 16.9% on 2020 levels)[25]. At the end of 2020, proved reserves of gas stood at 0.2 trillion cubic metres[26].

Derbyshire

7.4 In the recent past AMM has been extracted from the former coal mines at Markham, Whitwell and Shirebrook. However, production is presently minimal and the potential for further extraction is considered to be low.

Potential for the Extraction of Gas from Coal in Derbyshire

Coal Mine Methane

7.5 There are no working mines within the Plan Area and therefore no potential for CMM developments.

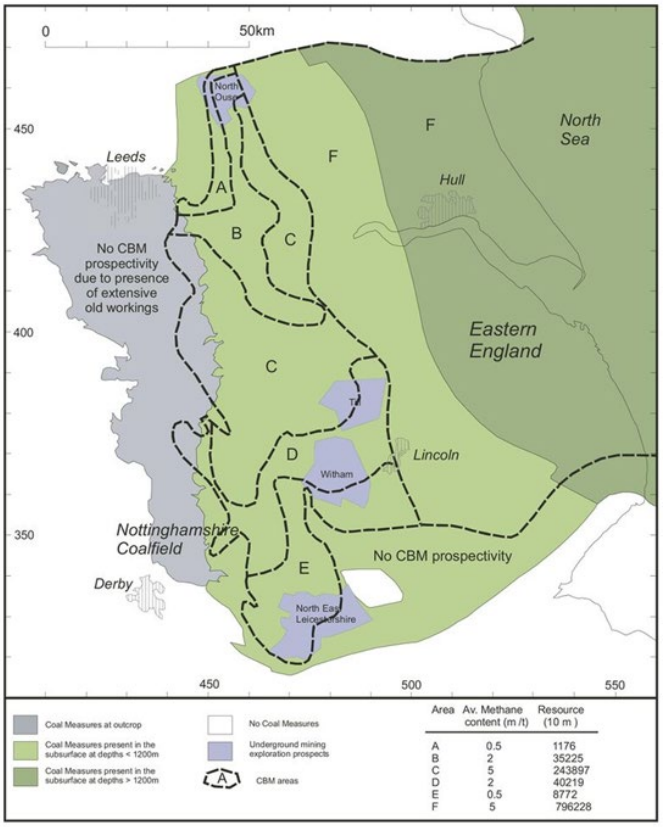
Coal Bed Methane

7.6 The prime requirements for CBM prospects are unworked coal seams at depths of between 200 and 1500 metres together with good methane content of the coal. Whilst such factors are present in the Derbyshire coalfield, past coal mining will have affected the prospectivity of the area as coal extraction has the effect of lowering the pressure of the strata

[23] BP Statistical review of World Energy 2022 , 71st Edition Statistical Review of World Energy 2022 (bp.com)
[24] BP Statistical Review of World Energy 2021 70th edition, https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/natural-gas.html.html#natural-gas-reserves
[25] BP Statistical review of World Energy 2022, 71st Edition Statistical Review of World Energy 2022 (bp.com)
[26] https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf

which causes gas to desorb from the coal. Former coal mining activity can also cause drilling problems (loss of circulation) if mud or water is used as a drilling fluid. 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. Research by the British Geological Survey (BGS)[27] and a Department of Energy and Climate Change (DECC) paper[28] both indicate that the CBM prospects of both the North and South Derbyshire Coalfields are poor due to relatively low seam gas contents and uncertainty over the permeability of the coals. There have been no proposals for extracting hydrocarbons via CBM technology in Derbyshire and there is no known commercial interest at present.

Figure 3: Location of Coal Bed Methane Areas in North Derbyshire Coalfield



[27] British Geological Survey: UK Coal Resource for New Exploitation Technologies Final report. 2004
[28] Department of Energy and Climate Change (DECC) The Unconventional Hydrocarbon Resources of Britain's Onshore basin's – Coalbed Methane (CBM) 2013

Figure 4: Summary Map showing Unconventional Hydrocarbon Potential, including South Derbyshire Coalfield

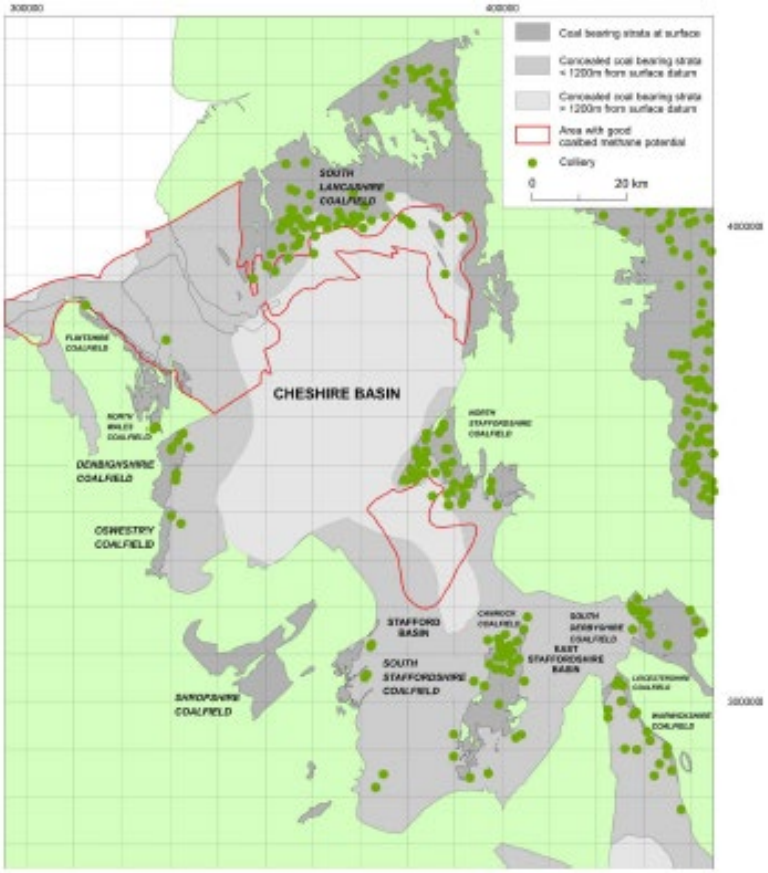


Fig. 29 Midlands and NW England – summary map of unconventional hydrocarbon potential

Image credit: DECC, (2013), page 31, 'The Unconventional Hydrocarbon Resources of Britain's Onshore basins – Coalbed methane (CBM)

Figure 5: Location of Underground Coal Gasification Resources in Eastern England including North Derbyshire

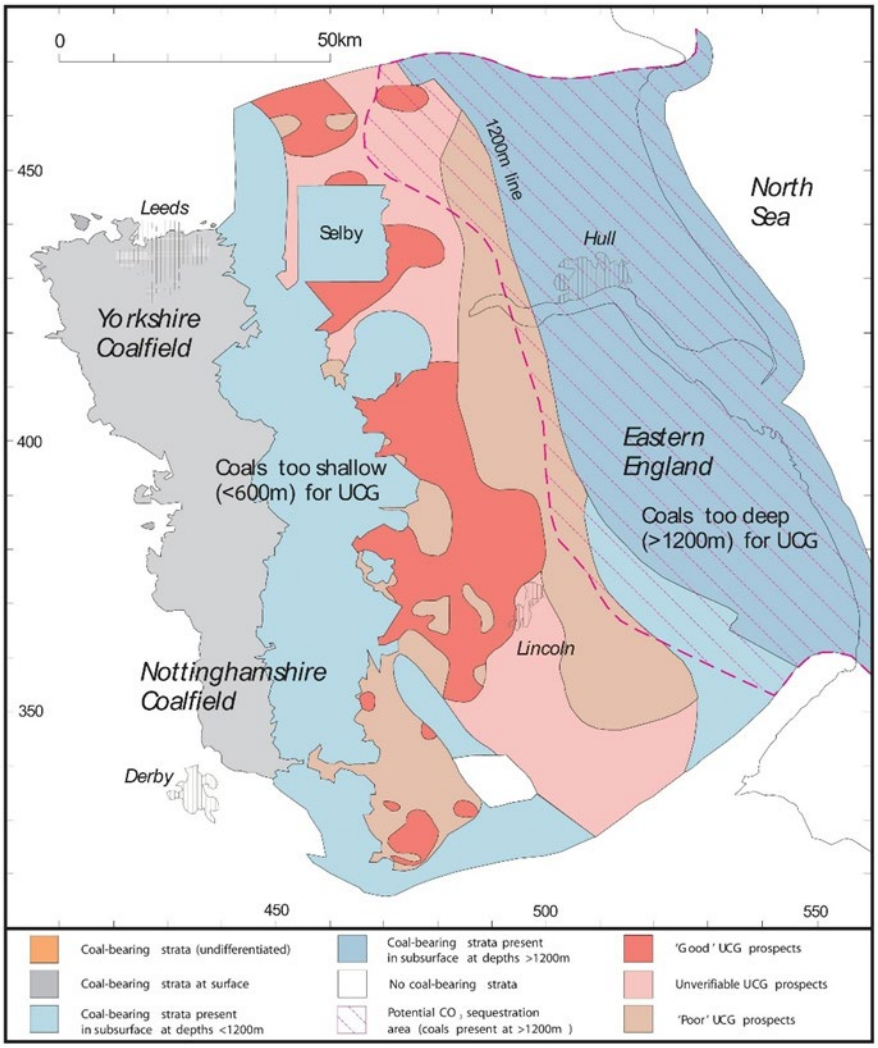


Image credit: Earthwise, British Geological Society[29]

[29] http://earthwise.bgs.ac.uk/images/5/5c/YGS_CHR_13_CANN_FIG_07.jpg previously published in S. Holloway, N. S. Jones, D. P. Creedy, K. Garner 'Can new technologies be used to exploit the coal resources in the Yorkshire–Nottinghamshire coalfield?'