Carbon and Fracking Evidence

Report to inform Greater Manchester Spatial Framework –

Carbon and Energy Policy

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Executive Summary

National legislation and policy in England concerning plan-making provide clear duties on climate change mitigation and identify the links between shale gas development and its greenhouse gas emissions impacts. While decision-making on shale gas development has been controversial and highly politicised, plan-making has a legal duty to consider the contribution of the policy, as part of a whole, towards greenhouse gas emissions reductions. Recent tightening of emissions reduction targets in the Climate Change Act 2008, Manchester's own targets, and the shortening of the time available to deliver the necessary reductions are powerful imperatives to 'keep fossil fuels in the ground'. Planning authorities must justify and evidence their policy position, but they are clearly able to take a position that avoids the extraction of unconventional fossil fuels.

Greenhouse gas emissions impacts from shale gas production and consumption within Greater Manchester are assessed using the results from prior studies (CCC and scientific literature) and UKOOG production scenarios downscaled to the combined authority. The production scenarios for the Bowland Shale hold large uncertainty given the range of geological, economic and social factors that are attached to the feasibility and scale of extraction. However, all but the lowest shale gas production scenarios presented exceed both the natural gas requirement in a high decarbonisation demand scenario and the carbon constraint of a 15% p.a. Paris-aligned emissions reduction pathway.

A large amount of uncertainty attaches to the methane emission impact from the full life cycle of shale gas extraction, partly due to decisions made in regulation and enforcement, and partly due to the presence of random high volume leakage events, known as 'super-emitters'. Best estimates from the Committee on Climate Change (CCC) review of prior empirical work are combined with the GMCA production scenarios to determine the quantity of methane emissions this industry might produce to 2035. High and Central scenarios exceed the current estimate for total methane emissions from GMCA's existing energy system. Regulation as recommended by the CCC or production restrictions to within a Paris-aligned emissions reduction pathway reduce the total quantity, but all scenarios exceed a 15% p.a. reduction path over this period. These emissions would persist even if

Carbon Capture and Storage (CCS) technology were deployed for power generation or hydrogen production. Shale gas production would require additional emissions reductions elsewhere in the economy and the CCC has repeatedly argued that outside of the power sector UK policy is not on track to achieve either the original 80% reduction by 2050 or the recently adopted net zero target, both of which have slower rates of reduction than the GM Paris-aligned pathway.

Assuming that economically recoverable resources of shale gas are available, it will take time to proceed through the planning, construction and commissioning phases of multiple well pads. This reduces the time period over which shale gas can play a viable role as a bridging or transitional fuel, estimated as 2023 to 2028, before the total carbon dioxide emissions from combustion would exceed the GMCA emission pathway or methane emissions become unmanageable. Shale gas has only a small window of opportunity in providing a lower emission substitution, and that only for LNG. If Manchester collectively supports the achievement of the Paris Agreement, its future energy requirements will need to change rapidly, and a largely decarbonised electricity system will need to materialise. With much reduced natural gas demand, production from the UK Continental Shelf (including the North Sea) may provide a much greater proportion of demand limiting the necessity of imports. Imports are currently largely met by Norwegian production which is expected to have lower upstream emissions than shale gas, so the potential for reduction by substitution is limited.

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Introduction

This report provides further evidence to inform the current policy for ‘Carbon and Energy’ (Policy GM-S2) outlined in the draft Greater Manchester Spatial Framework 2019 (GMSF). Tyndall Manchester have previously delivered the SCATTER project which developed the carbon budgets for Greater Manchester discussed in the GMCA 5 Year Environment Plan that are compatible with the Paris Agreement (Kuriakose et al 2017). As another part of the SCATTER project, the consultancy Anthesis developed an energy system model for the Combined Authority and Local Authority scale that is applied within Section 3 to estimate future natural gas demand.

This report focusses on shale gas and its attendant carbon impact, however other forms of unconventional oil and gas extraction, for instance coal bed methane, may be pursued within the Greater Manchester area and there are many similarities from a climate change perspective. The three tests for onshore oil and gas production outlined by the CCC (2016), in summary that greenhouse gas emissions from production and combustion should be limited and managed within carbon budgets, frame the analysis. The report is structured as follows.

1. **Overview of legislation and policy regarding fracking in the UK**
   A summary of existing legislation and national policy precedents with regards to shale gas extraction and carbon emissions including Government strategy, policy and recent legal rulings, evidence from other minerals and local plans, and devolved nations’ planning policy where a similar approach to the GMSF has been adopted or is being considered.

2. **Potential carbon emissions from fracking within Greater Manchester.**
   A brief review of the life cycle emissions intensity of shale gas production and consumption. This is combined with developer production estimates in a quantitative model of expected carbon and methane emissions from future shale gas extraction and use in Greater Manchester.

3. Future energy requirements in the context of a moratorium on shale gas.

A quantification of Greater Manchester's future energy requirement for natural gas for to 2035, recognising the emissions reduction imperative of the Paris Agreement. The SCATTER project analytical tool, previously developed by Anthesis, is used here. The conditions under which a ban on fracking may result in increased use of more carbon intensive alternatives and the likely location and regulation of these emissions through the supply chain are considered.

4. Potential of large-scale Carbon Capture and Storage (CCS) deployment in the future within Greater Manchester

A review of CCS technology and an assessment of the potential mitigation opportunity both from a technical and viability perspective, with considerations of deployment of CCS within Greater Manchester within the timeframe of the plan to 2035, and the potential association with hydrogen production.

5. Consistency of Shale Gas Production with the Paris Agreement

A synthesis of the evidence gathered in the report with the prior research under the SCATTER project. This provides an expert narrative on the likely future impacts of carbon emissions from shale gas production and whether this is consistent with carbon targets and policies aligned to the Paris Agreement.

1 An overview of legislation and policy regarding shale gas in England

1.1 Relevant national legislation

1.1.1 Land use planning in England is governed by a suite of legislation concerned with plan-making and development control. The Town and Country Planning Act 1990 makes clear the meaning of development at section 55(1):

> "development," means the carrying out of building, engineering, mining or other operations in, on, over or under land, or the making of any material change in the use of any buildings or other land.[1]

Hydrocarbon minerals therefore fall within the ambit of this Act, and its development is controlled by minerals planning authorities in the first instance. In making decisions on development, the mineral planning authority must have regard to the provisions of the development plan and any other material considerations as set out at section 70 of the Act[2]. The 'statutory status of the development plan' remains 'the starting point for decision making'[3].

1.1.2 Development plan-making for minerals is regulated by the Planning and Compulsory Purchase Act 2004 as 'Development Plan Documents'. The Greater Manchester Spatial Framework is being prepared as a Development Plan Document at this time, and the consultation will therefore follow the relevant provisions of this Act and the regulations of the Town and Country Planning (Local Planning) (England) Regulations 2012[4]. Currently planning

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[1] Town and Country Planning Act 1990, Section 55 (1)

[2] Town and Country Planning Act 1990, Section 70 (amended, various)

[3] Ministry for Housing, Communities and Local Government, *National Planning Policy Framework 2019*, paragraph 12

[4] However, there is a move to consider the transformation of the Development Plan Documents into a Spatial Development Strategy in summer 2020.

authorities exercising their plan-making functions are generally required at section 39(2) to have regard to sustainable development:

> The person or body must exercise the function with the objective of contributing to the achievement of sustainable development.[5]

In exercising the function of plan-making, planning authorities must have regard to national policies and advice issued by the Government within this overarching context. At section 19 (1A), local plans must specifically aim to secure the mitigation of climate change as follows:

> Development plan documents must (taken as a whole) include policies designed to secure that the development and use of land in the local planning authority's area contribute to the mitigation of, and adaptation to, climate change.[6]

Adding up the impact of policies within the Development Plan Documents being prepared as the Greater Manchester Spatial Framework and ensuring that these policies amount to an overall mitigation of climate change impacts is a key legislative context for the proposed carbon and energy policy.

1.1.3 When preparing local plans (development plan documents), the European Strategic Environmental Assessment Directive transposed as The Environmental Assessment of Plans and Programmes Regulations 2004, requires local authorities at section 12 to publish an environmental report:

> (2) The report shall identify, describe and evaluate the likely significant effects on the environment of— (a) implementing the plan or programme; and (b) reasonable alternatives taking into account the objectives and the geographical scope of the plan or programme.[7]

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[5] Planning and Compulsory Purchase Act 2004, Section 39 (2)

[6] Planning and Compulsory Purchase Act 2004, Section 19 (amended by the Planning Act 2008)

[7] The Environmental Assessment of Plans and Programmes Regulations 2004, Section 12

In relation to climate change impact, the planning authority on adopting the local plan is required to report under section 16(4) of the regulations as to:

> (a) how environmental considerations have been integrated into the plan or programme; (b) how the environmental report has been taken into account;[8]

These environmental impacts, and considerations, and the extent to which they have been taken to account include the matter of climate change impacts. The evidence presented in Sections 2 to 4 of this report suggests that a restrictive shale gas policy should have a positive environmental benefit in this assessment.

1.1.4 Plan-makers, in line with the provision to assess how environmental considerations have been integrated into the plan, and how the policies overall contribute to the mitigation of climate change, should have regard to the Climate Change Act 2008. This was recently amended, setting a revised target for the year 2050 at section 1(1):

> It is the duty of the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least 100% lower than the 1990 baseline.[9]

This target is broken down into budgetary periods as set out at section 4(1):

> It is the duty of the Secretary of State—(a) to set for each succeeding period of five years beginning with the period 2008-2012 ("budgetary periods") an amount for the net UK carbon account (the "carbon budget"), and (b) to ensure that the net UK carbon account for a budgetary period does not exceed the carbon budget.[10]

In advising the UK Government on progress towards achieving the 2050 target and the interim budgets, the Committee on Climate Change

[8] Ibid, Section 16(4)

[9] Word in s. 1(1) substituted (27.6.2019) by the Climate Change Act 2008 (2050 Target Amendment) Order 2019 (S.I. 2019/1056), arts. 1, 2

[10] Climate Change Act 2008, Section 1(1)

(inaugurated by the Climate Change Act 2008) have expressed concern in their most recent report in July 2019 to Parliament that policies and other instruments will enable emissions reductions to be met:

> ‘The Government's own projections demonstrate that its policies and plans are insufficient to meet the fourth or fifth carbon budgets (covering 2023-2027 and 2028-2032). This policy gap has widened in the last year as an increase in the projection of future emissions outweighed the impact of new policies.’[11]

A clear direction of travel for plan-making policy in relation to the urgency of the mitigation of climate change, concerning the key areas of energy, housing and transport, emerges in this context. Plans created in 2020 for example, for a 15 year or 20 year timeframe will be guiding the approval of hydrocarbon minerals development that could be operational in 2030, by which point carbon emissions from the energy system ought to be very much reduced for compatibility with the Paris Agreement[12], rendering these developments redundant unless as yet unproven negative emissions technologies (NETs) are deployed at equivalent scale.

1.1.5 Shale gas development is specifically required to be assessed for its climate change impact. The Infrastructure Act 2015 at section 49 required the Government to request advice from the Committee on Climate with regard to the ‘likely impact of onshore petroleum on the carbon budget:

> (1) The Secretary of State must from time to time request the Committee on Climate Change to provide advice (in accordance with section 38 of the CCA 2008) on the impact which combustion of, and fugitive emissions from, petroleum got through onshore activity [F1in England] is likely to have on the Secretary of State's ability to meet the duties

[11] Committee on Climate Change, *Reducing UK emissions 2019 Progress Report to Parliament* (July 2019) Executive Summary, Page 11

[12] Alice Larkin, Jaise Kuriakose, Maria Sharmina & Kevin Anderson, ‘What if negative emission technologies fail at scale? Implications of the Paris Agreement for big emitting nations’, Climate Policy (2018), 18:6, 690-714

imposed by—(a) section 1 of the CCA 2008 (net UK carbon account target for 2050), and (b) section 4(1)(b) of the CCA 2008 (UK carbon account not to exceed carbon budget).[13]

In March 2016, the Committee on Climate Change reported that 'exploitation of shale gas on a significant scale would not be consistent with UK carbon budgets and the 2050 target'[14] unless three tests were met. These tests are:

- Test 1: Well development, production and decommissioning emissions must be strictly limited. Emissions must be tightly regulated and closely monitored in order to ensure rapid action to address leaks.
- Test 2: Consumption - gas consumption must remain in line with carbon budgets requirements. UK unabated fossil energy consumption must be reduced over time within levels we have previously advised to be consistent with the carbon budgets. This means that UK shale gas production must displace imported gas rather than increasing domestic consumption.
- Test 3: Accommodating shale gas production emissions within carbon budgets. Additional production emissions from shale gas wells will need to be offset through reductions elsewhere in the UK economy, such that overall effort reduce emissions is sufficient to meet carbon budgets.

Most relevant in land-use planning terms for national policy development are Test 2 and Test 3 as these are pertinent to understanding on an evidential basis the extent to which support for shale gas production is in line with other Governmental commitments concerning emissions reduction. Test 1 is relevant to the Environment Agency and planning authority role in terms of permit and decision notice conditions.

1.1.6 Further relevant considerations for shale gas development are found in the Petroleum Act 1998 section 5A (as amended by the Infrastructure Act 2015)

[13] Infrastructure Act 2015, Section 49

[14] Committee on Climate Change*, Onshore Petroleum: The compatibility of UK onshore petroleum with meeting the UK's carbon budgets*, Executive summary, Page 3

at section 50, whereby the Secretary of State may not issue an hydraulic fracturing consent unless the following conditions are met in particular:

- The environmental impact of the development which includes the relevant well has been taken into account by the local planning authority
- In considering an application for the relevant planning permission, the local planning authority has (where material) taken into account the cumulative effects of— (a) that application, and (b) other applications relating to exploitation of onshore petroleum obtainable by hydraulic fracturing[15]

On the 2 November 2019, the UK Government announced that it was 'ending support for fracking on the basis of scientific analysis'[16] following a report by the Oil and Gas Authority on the uncertainty with regards to predicting the magnitude and probability of earthquakes linked to hydraulic fracturing[17]. There is now a presumption against the issuing of hydraulic fracturing consents. UK Government Minister Kwasi Kwarteng also said:

> The Committee on Climate Change's advice is clear that natural gas will continue to have a key role to play as we eliminate our contribution to climate change by 2050, including for the production of hydrogen. However, following our action today, that gas will need to come from sources other than domestic fracking.[18]

While planning policy has not yet been amended, the general policy context clearly links the impact of gas exploitation to climate change mitigation.

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[15] Petroleum Act 1998 Section 5A (as amended by the Infrastructure Act 2015), Section 50

[16] Department for Business, Energy & Industrial Strategy, Oil and Gas Authority, The Rt Hon Kwasi Kwarteng MP, and The Rt Hon Andrea Leadsom MP, *Government Ends Support for Fracking*, (2 November 2019), Press Release

[17] Oil and Gas Authority, *Interim report of the scientific analysis of data gathered from Cuadrilla's operations at Preston New Road*, (commissioned February 2019), Report

[18] Ibid Fn16

1.1.7 In the international context of the Paris Agreement, ratified by the UK on 12th December 2015, there is an ambitious target to limit global warming at Article 2:

> 1. This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by: (a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;

Given this high-level political commitment to the Paris Agreement, there is clear context for climate policy, even at development plan document level, to be designed within this framing.

1.2 National planning policy

1.2.1 National planning policy guides the development of policies contained in development plan documents in England. In 2011, the then Coalition Government revised the suite of planning policy relevant to England, consolidating, shortening and revising to produce the National Planning Policy Framework (NPPF) in 2012[19] .Chapter 10 concerned ‘Meeting the challenge of climate change, flooding and coastal change’ and set out at paragraph 93 that:

> Planning plays a key role in helping shape places to secure radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to the impacts of climate change,

And further at paragraph 94 that:

> Local planning authorities should adopt proactive strategies to mitigate and adapt to climate change,[Fn16]

[19] Department for Communities and Local Government, *National Planning Policy Framework*, DCLG (2012)

Footnote 16 explicitly connected the local authorities' planning role to the Climate Change Act 2008 as follows:

> Fn16: In line with the objectives and provisions of the Climate Change Act 2008

As noted above, the Section 19(1A) duty[20] on development plan policies to contribute to the mitigation of climate change as a whole must therefore be seen in this context.

Chapter 13 concerned 'Facilitating the sustainable use of minerals', setting out at paragraph 144 that planning authorities should 'give great weight to the benefits of the mineral extraction, including to the economy;' when determining planning applications, but also to 'ensure, in granting planning permission for mineral development, that there are no unacceptable adverse impacts on the natural and historic environment, human health or aviation safety, and take into account the cumulative effect of multiple impacts from individual sites and/or from a number of sites in a locality;'. Further, at paragraph 147, planning authorities should '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;'.

1.2.2 In 2015, the Government published a Written Ministerial Statement (WMS) to address the growing public controversy around shale gas extraction and to state their view:

> …that there is a national need to explore and develop our shale gas and oil resources in a safe, sustainable and timely way, and the steps it is taking to support this. This statement should be taken into account in planning decisions and plan-making.
>
> Exploring and developing our shale gas and oil resources could potentially bring substantial benefits and help meet our objectives for secure energy supplies, economic growth and lower carbon emissions.

> Having access to clean, safe and secure supplies of natural gas for years to come is a key requirement if the UK is to successfully transition in the longer term to a low-carbon economy. [20]

In general, this statement has been interpreted positively by industry, but several high profile planning committee decisions on applications, while taking this statement into account, have notwithstanding refused applications on visual, noise, transport, and most recently, climate change impacts grounds.

1.2.3 Following growing public opposition to unconventional gas development[21], in May 2018 the Department for Business, Energy and Industrial Strategy and the Ministry for Housing, Communities and Local Government published an updated Written Ministerial Statement:

> This Statement is a material consideration in plan-making and decision-taking, alongside relevant policies of the existing National Planning Policy Framework (2012), in particular those on mineral planning (including conventional and unconventional hydrocarbons).
>
> Shale gas development is of national importance. The Government expects Mineral Planning Authorities to give great weight to the benefits of mineral extraction, including to the economy. This includes shale gas exploration and extraction. Mineral Plans should reflect that minerals resources can only be worked where they are found, and applications must be assessed on a site by site basis and having regard to their

[20] Department for Energy and Climate Change & Department for Communities and Local Government*, Shale gas and oil policy statement by DECC and DCLG*, Policy Paper, August 2015

[21] Department for Business, Energy and Industrial Strategy, 'BEIS Public Attitudes Tracker: Wave 29 Key findings' (May 2019) on Shale Gas: "The proportion of people opposed to fracking increased from 35% in December 2018 to 40% in March 2019, reaching its highest point since this was first asked in December 2013. In March 2019, 12% of people said they supported fracking, 45% said they neither supported nor opposed it and 3% said they did not know."

context. Plans should not set restrictions or thresholds across their plan area that limit shale development without proper justification.[22]

The statement also promised a future consultation on the proposed revisions to the NPPF, alongside which this statement would sit.

1.2.4 The revised policy published in February 2019 stated:

> 209. Minerals planning authorities should:
>
> (a) recognise the benefits of on-shore oil and gas development, including unconventional hydrocarbons, for the security of energy supplies and supporting the transition to a low-carbon economy; and put in place policies to facilitate their exploration and extraction;

This paragraph is however now removed following the Stephenson case[23] and as of August 2019, reads as follows:

> 209. Minerals planning authorities should*:
>
> (b) 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;

This can be taken as the latest national policy consideration for the purposes of developing a local plan policy for onshore oil and gas.

1.2.5 Climate change planning policy in the revised 2019 edition has remained largely unchanged from the 2012 version, although renumbered (now Chapter 14):

> 148. The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical

[22] Secretary of State for Business, Energy and Industrial Strategy, 'Energy Policy: Written statement', (17 May 2018) HCWS690

[23] R (on the application of Stephenson) v Secretary of State for Housing, Communities and Local Government [2019] EWHC 519 (Admin)

reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

Planning for climate change

149. Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures[48].

Footnote 48 replaces previous Footnote 16 on referring to the Climate Change Act 2008 maintaining the link between planning and the objectives of the Act.

1.2.6 Planning practice guidance on identifying mitigation measures in plan-making, stresses the need for 'Robust evaluation of future emissions will require consideration of different emission sources, likely trends taking into account requirements set in national legislation, and a range of development scenarios.'[24] Evaluating development plan documents for emission impacts under Strategic Environmental Assessment requirements in the context of the recent amendment to the Climate Change Act 2008 in terms of heightening ambitions on emissions reduction are clearly supported by this practice guidance.

1.2.7 The definition of sustainable development has also been amended in the latest iteration of the NPPF to refer explicitly to the UN resolution 42/187 through Footnote 4 to paragraph 7:

The purpose of the planning system is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development can be summarised as meeting the needs of

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[24] Ministry for Housing, Communities and Local Government, *Planning Practice Guidance*, (MHCLG, 2014) Paragraph: 007 Reference ID: 6-007-20140306

> the present without compromising the ability of future generations to meet their own needs[Fn4].

Resolution 42/187 of the United Nations General Assembly at paragraph 3 states:

> Agrees with the Commission that while seeking to remedy existing environmental problems, it is imperative to influence the sources of those problems in human activity, and economic activity in particular, and thus to provide for sustainable development*;*

Planning authorities can therefore rely on their responsibility to exercise their functions with a view to achieving sustainable development in light of this policy guidance and explication, and for plan-making in particular to ensure that the policies (as a whole) contribute to the purpose and objectives of the Climate Change Act 2008.

1.2.8 In assessing whether or not a plan is 'sound' for the purposes of examination, four tests are required to be met as set out at paragraph 35 of the NPPF 2019:

> a) Positively prepared – providing a strategy which, as a minimum, seeks to meet the area's objectively assessed needs[Fn19]; and is informed by agreements with other authorities, so that unmet need from neighbouring areas is accommodated where it is practical to do so and is consistent with achieving sustainable development;
>
> b) Justified – an appropriate strategy, taking into account the reasonable alternatives, and based on proportionate evidence;
>
> c) Effective – deliverable over the plan period, and based on effective joint working on cross-boundary strategic matters that have been dealt with rather than deferred, as evidenced by the statement of common ground; and
>
> d) Consistent with national policy – enabling the delivery of sustainable development in accordance with the policies in this Framework.

Both paragraph 35(b) ensuring that evidence and reasonable alternatives have been taken into account, and paragraph 35(d) consistency with sustainable development are relevant to policy proposals concerning shale gas. Planning practice guidance refers to the climate change duty as 'a consideration when plans are examined'[25].

1.3 Appeals and cases

1.3.1 Climate change matters in relation to shale gas were explored during the public inquiry into the conjoined appeals of the Cuadrilla applications at Preston New Road[26] and Roseacre Wood[27] following Lancashire County Council's planning committee refusals in June 2015. The Inspector considered the submissions of the appellant and the evidence submitted by Friends of the Earth in relation to both shale gas proposals as follows in her Report:

> 12.673 The Appellants' position on climate change is that there would be a negligible and insignificant impact of GHG emissions attributable to the sites. They derive support from the WMS and national policy which recognise and support the contribution of gas, including new shale gas supplies. They submit that the proposals are in accordance with the

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[25] Ministry for Housing, Communities and Local Government, *Planning Practice Guidance*, (MHCLG, 2014) Paragraph: 002 Reference ID: 6-002-20140306

[26] Cuadrilla Bowland Limited, 'Exploration Site On Land That Forms Part Of Plumpton Hall Farm, West Of The Farm Bulidings, North Of Preston New Road, Off Preston New Road, Preston, Lancashire, LCC/2014/0096, APP/Q2371/W/15/3134386

[27] Cuadrilla Elswick Limited, 'Exploration Site On Agricultural Land That Forms Part Of Roseacre Hall, To The West, North And East Of Roseacre Wood And Land That Forms Part of the Defence High Frequency Communications Service (Dhfcs) Site Between Roseacre Road And Inskip Road, off Roseacre Road and Inskip Road, Roseacre and Wharles, Preston, Lancashire', LCC/2014/0101, APP/Q2371/W/15/3134385

Government's strategy for energy as set out in the Carbon Plan to, "reduce emissions from electricity generation through increasing the use of gas instead of coal…". (2.3, 2.127, 2.16)

> 12.674 For FoE, Professor Anderson puts forward three headline conclusions. First, he submits that under the UK existing carbon budget, gas can only have a marginal and rapidly declining role in generating electricity post-2030. Secondly, he contends that taking the Preston New Road and Roseacre Wood exploration works together as one "project", the emissions from the proposals as a stand-alone and non-productive project would be very high and, thirdly, he asserts that if the UK is to abide by the explicit commitment of the Paris Agreement, then there is no viable emission space within the UK's carbon budget for shale gas to fulfil even a transitional role.

She then concluded that in her view, these were matters for national energy policy[28]. At paragraph 29 of his Decision Letter, the Secretary of State appeared to endorse this approach:

> 29. How the Government may choose to adapt its energy policies is a matter for possible future consideration. If thought necessary, this could be addressed through future national policy. These are not matters that fall to be considered in these appeals.

These energy policy matters are relevant at the plan-making stage.

1.3.2 Chat Moss Peat works[29] was also brought up in the Preston New Road and Roseacre Wood appeals as it was calculated that the emissions from Chat Moss Peat works were less than the emissions from these appeals, as reported by the Inspector at paragraph 12.684:

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[28] The Planning Inspectorate, APP/Q2371/W/15/3134386, 'Report to the Secretary of State for Communities and Local Government', July 2016, Paragraph 12.677 and Paragraph 12.678

[29] The Planning Inspectorate, Decision concerning Land at Chat Moss Peat Works, off Cutnook Lane, Irlam

> FoE places weight upon the Secretary of State's 'in principle' approach to emissions and climate change in that case. It also draws attention to the fact that the anticipated greenhouse gas emissions of the Chat Moss scheme amounted to 181,500 tCO2e. The combined emissions for the appeal proposals, taking the lowest individual estimate, would be 236,000 tCO2e.

However, the Inspector considered that the circumstances of the Chat Moss Peat works case was different in that peat itself was considered 'unsustainable'[30], and concluded that the developments would:

> …be consistent with the NPPF aim to support the transition to a low carbon future in a changing climate. I do not consider that para 93 NPPF should be read in isolation, or applied out of context. Taking an overall view of national policy, there can be no doubt that shale gas is seen as being compatible with the aim to reduce GHG by assisting in the transition process over the longer term to a low carbon economy. I am satisfied that the Appellants have demonstrated, by the provision of appropriate information, that all material, social, economic or environmental impacts that would cause demonstrable harm would be reduced to an acceptable level and that the projects represent a positive contribution towards the reduction of carbon. The proposed development would be in accordance with JLMWLP Policy DM2 and relevant national policy.[31]

The Secretary of State agreed with the Inspector as is clear from his Decision Letter at paragraph 37:

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[30] The Planning Inspectorate, APP/Q2371/W/15/3134386 'Report to the Secretary of State for Communities and Local Government', July 2016, Paragraph 12.685

[31] The Planning Inspectorate, APP/Q2371/W/15/3134386 'Report to the Secretary of State for Communities and Local Government', July 2016, Paragraph 12.686

> 37. Overall, the Secretary of State agrees with the Inspector's conclusion at IR12.686 that the projects would be consistent with the NPPF aim to support the transition to a low carbon future in a changing climate.[32]

In contrast to policy making at plan level, development control decisions are made on individual merits, and these decisions demonstrated the tension between a new policy for shale gas (that had not been consulted on) that made a series of assumptions, and the relative weight that was then assigned to the impacts of the development, including on climate change.

1.3.3 Chester West and Cheshire Council's planning committee refused an application by IGas at Ellesmere Port, citing the following reason for refusal:

> In the opinion of the Local Planning Authority the proposed development to appraise for shale gas in this location will be contrary to the provisions of policy STRAT1 of the Cheshire West and Chester Local Plan (Part One), which states that inter alia - Proposals that are in accordance with relevant policies in the Plan and support the following sustainable development principles will be approved without delay, unless material considerations indicate otherwise. The proposal fails to mitigate and adapt to the effects of climate change, ensuring development makes the best use of opportunities for renewable energy use and generation.[33]

While no decision is yet forthcoming (September 2019), the appellant I Gas appears to contend that STRAT1 is 'contrary' to the NPPF's policy of providing 'great weight to the benefits of mineral extraction' and the

[32] Department for Communities and Local Government, 'Decision Letter Section 78 Appeals APP/Q2371/W/15/3134386 APP/Q2371/W/15/3130923, APP/Q2371/W/15/3134385, APP/Q2371/W/15/3130924', October 2016

[33] Island Gas Limited, 'Ellesmere Port Wellsite' Cheshire West and Chester Council Reference: Application No: 17/03213/MIN, Refusal of Planning Permission 26 January 2018

associated supportive written statement on shale gas[34]. The appellant also contends that the proposed development at Ellesmere Port would 'provide demonstrable benefits by helping to meet clear and continued demand for gas, whilst ensuring security of supply by not placing unrealistic expectations on foreign imported gas, conventional domestic reserves or UK storage facilities.'[35] The policy tension therefore remains in this appeal case between the assumption of need in policy, the evidence of need in relation to both national policy and individual applications, and greenhouse gas emissions reductions obligations.

1.3.4 Local development decisions, appeal decisions and national policy concerning shale gas have been the subject of judicial reviews. National policy, as set out above, has been materially changed as a consequence. In Stephenson vs SoS MHCLG [2019][36], Talk Fracking challenged the adoption of NPPF Paragraph 209(a) on the ground that evidence submitted to the consultation process on greenhouse gas emissions had not been taken into account as reported by J Dove at paragraph 63:

> Turning to Ground 1 Mr Wolfe submits that the scientific material provided in the form of the Mobbs Report was an obviously material consideration which needed to be taken into account by the Defendant in deciding whether or not to incorporate the substance of the 2015 WMS into the Framework. As is obvious from the history of the matter set out above the 2015 WMS, and in particular its reliance on transition theory being consistent with climate change, relied upon the conclusions of the MacKay and Stone Report to establish that the deployment of shale gas to bridge the gap in energy supply prior to a low carbon future would not prejudice the achievement of climate change goals. Mr Wolfe made a

[34] Island Gas Limited, 'Ellesmere Port Wellsite' Cheshire West and Chester Council Reference: 17/03213/MIN', Statement of Case on behalf of the Appellant (April 2019), Paragraph 10.5

[35] Ibid, Paragraph 10.10

[36] R (on the application of Stephenson) v Secretary of State for Housing, Communities and Local Government [2019] EWHC 519 (Admin)

> number of submissions in this connection. Firstly, even if all that the Defendant was proposing in the light of Dr Bingham's evidence was the copying across of the 2015 WMS, it was still necessary for the Defendant to consider whether the evidence base for the 2015 WMS remained valid. He submits that it is clear from the evidence that the Defendant gave no consideration at all to the disputed scientific material, and therefore left out of account what was an obviously material consideration.

In response to this contention, J Dove found that there had been flaws in the consultation process and at paragraph 68 set out his conclusion:

> …This is related to the fourth Sedley principle, in that having conducted a consultation exercise in which the Talk Fracking material was clearly relevant to the questions posed and which that principle required the Defendant to give conscientious consideration to, that consultation response must amount to a material consideration in the decision that is subsequently taken. Against the background of the nature and scope of the decision in respect of paragraph 204(a) of the draft revised Framework set out above and to be derived from the publicly available documentation it was unlawful to leave that material out of account...

There was agreement in the case that “obviously material” considerations must be taken into account, and the greenhouse gas emissions arising from shale gas development and causing climate change impact are unquestionably matters with which the planning system should engage. TalkFracking argued that some evidence, and the latest evidence, had not been taken into account and J Dove agreed that this material should have been taken into account.

1.3.5 It was also argued by TalkFracking that the Government’s policy was therefore not compliant with the tests set out by the Committee on Climate Change with regard to the impact of shale gas production on the achievement of the carbon budgets. Dove J however agreed with the Government that the proposed policy on shale gas did not negate the effect of other Government policy on climate change, or that this evidence should not be taken into account:

> 71. Mr Warren contends that the incorporation of paragraph 209(a) has no impact whatsoever on the pre-existing acceptance that the Government's obligation under the 2008 Act were to be mediated by the application of the CCC's three tests. The Defendant remains committed to meeting those three tests and nothing in the revision to the Framework alters the commitment to the tests being met. Prior to large scale extraction proceeding, he submitted, it would be necessary for those three tests to be passed. He further submitted that in the context of individual decisions by plan makers or decision takers it would be open to depart from the in principle support for fracking provided by paragraph 209(a) on the basis of the requirement, for instance in paragraphs 148 and 149 of the Framework in particular, for the planning system to take decisions which support reductions in greenhouse gas emissions and plan proactively for climate change. Thus, he submitted that in the context of individual decisions it would be open for the Claimant and other participants to place before the decision maker material like the Mobbs Report which supported the contention that shale gas extraction would have a deleterious impact on greenhouse gas emissions, and these could be weighed against the in principle support contained in paragraph 209(a) of the Framework.
>
> 72. In my view Mr Warren's submissions in connection with Ground 2 are clearly correct…

A planning authority would therefore be able on this basis (put forward by the Government and agreed to by J Dove) to consider the evidence on greenhouse gas emissions and weigh those against other statements of policy support on shale gas.

1.3.6 It is also not uncommon to find policies that may pull in different directions, and that this conflict is up to the decision-maker to resolve as set out by J Dove at paragraph 73 of the judgement:

> As has been observed on many occasions, planning policies within local or national policy documents very commonly can be perceived to be pulling in different directions, often through recognising on the one hand the need for particular kinds of development to be met, and on the other the desirability of protecting the environment or safeguarding infrastructure capacity. The planning system exists to resolve those conflicts and seek to identify a decision best fitting the balance of considerations bearing in mind the interests that the planning system has to serve. I therefore accept Mr Warren's submission that in individual decisions on plans or applications the in principle support for unconventional hydrocarbon extraction, provided by paragraph 209(a) of the Framework, will have to be considered alongside any objections and evidence produced relating to the impact of shale gas extraction on climate change. These are conflicting issues which the decision-maker will have to resolve.

Taken together, the approach open to a planning authority is to assume that greenhouse gas emissions considerations are without doubt material, that it would not be open to refuse to consider any new material or evidence submitted on this matter, and that as plan-makers, authorities are able to depart from a position of policy support for shale gas in view of other climate change policy on the basis of evidence.

1.3.7 A number of decisions on shale gas development have been challenged in relation to greenhouse gas emissions and climate change impacts. North Yorkshire County Council’s decision to permit hydraulic fracturing at an existing well in Kirby Misperton was challenged by Friends on the Earth[37] on the basis that the Council had failed to take into account the emissions from the connection to the Knapton gas fired power station. In that case it was concluded that as the power station would not operate beyond existing permits, the Council was therefore entitled to conclude that the emissions in this specific case did not need to be further considered.

[37] R (FoE) v North Yorkshire CC [2016] EWHC 3303 (Admin) [2017]

1.3.8 The challenge brought against the Secretary of State with regard to the Preston New Road shale gas development[38] was that the increase or potential for increase in terms of greenhouse gas emissions had not been considered. J Dove found that there was no evidence that there would be an 'addition' to greenhouse gas emissions as it was merely a substitution.

1.3.9 While not concerning shale gas, but rather coal mining, the HJ Banks case[39] indicates the direction of travel for the consideration of life cycle greenhouse gas emissions from a fossil fuel extraction development. HJ Banks applied for a 3mt opencast coal mine development at Highthorn, which was approved by the planning authority, but subsequently called-in by the Secretary of State. The call-in letter specifically stated that the inquiry was to consider the matters of consistency with national planning policy on climate change and renewable and low carbon energy. The Inspector's Report (IR)[40] at paragraph C115 concluded that:

> I find that GHG emissions from the proposed development would adversely impact upon measures to limit climate change. Most of the GHG would be emitted in the short term, resulting in an adverse effect of substantial significance, reducing to minor significance in the medium term. GHG emissions in the long term would be negligible, but given that the effects of carbon in the atmosphere would have a cumulative effect in the long term, I consider that overall the scheme would have an adverse effect on GHG emissions and climate change of substantial significance, which should be given considerable weight in the planning balance.

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[38] Preston New Road Action Group v Secretary of State for Communities and Local Government [2018] EWCA Civ 9 (Frackman)

[39] HJ Banks & Company Ltd v Secretary of State for Housing, Communities and Local Government [2018] EWHC 3141 (Admin) (23 November 2018)

[40] Ministry of Housing, Communities and Local Government, 'Town And Country Planning Act 1990 – Section 77 Application made by HJ Banks & Company Ltd Land at Highthorn, Widdrington, Northumberland NE61 5EE Application ref: 15/03410/CCMEIA', Decision Letter and Inspector's Report (March 2018)

The Secretary of State agreed with the Inspector's conclusions at C115 in his Decision Letter[41]. HJ Banks challenged the Secretary of State's decision. J Ouseley found that although the Secretary of State's views 'have evolved' from the Kirby Misperton and Preston New Road challenges were the position was that 'emissions were unlikely to increase' it was perfectly open to the Secretary of State to take a different decision on this case at paragraph 121:

> The previous decisions give rise to no separate issue, and if the reasoning had been otherwise adequate, the reasons given by the Inspector and accepted by the Secretary of State relating to the earlier decisions would not have been unlawful.

The Decision Letter was quashed and as of September 2019, a new decision letter has yet to be issued. It is likely that the development will be refused as the UK Government's coal phase out policy remains in place, and the window for the justification of extraction is closing given the timeframes (the length of the project is now longer than the coal-phase out date).

1.4 Minerals Plans and Local Plans

1.4.1 Minerals plans in England have a range of adopted and proposed policies concerning shale gas. The Greater Manchester Spatial Framework (GMSF) is a joint development plan for Greater Manchester, that provides strategic policy coverage for Local Plans. The 2019 draft version of the plan was subject to public consultation between 21 January and 18 March 2019. The final stage of public consultation will take place in the Autumn of 2019 and this will be on the publication version of the GMSF.

1.4.2 The wording of the 'Carbon and Energy' Policy (GM-S2) as written in the current draft GMSF states that:

> The aim of delivering a carbon neutral Greater Manchester no later than 2038, with a dramatic reduction in greenhouse gas emissions, will be

[41] Ibid

> supported through a range of measures including:' 4. Keeping fossil fuels in the ground;[42]

The justification for this policy is that 'Greater Manchester seeks to promote investment in new zero-carbon technologies, to reduce the reliance on carbon based fuels to accelerate the speed at which such new technologies become financially viable and/or technically feasible. It is therefore considered prudent to not exploit new sources of hydrocarbons and keep fossil fuels in the ground so at this point in time Greater Manchester will not support hydraulic fracturing (fracking)'[43].

1.4.3. The Greater Manchester Authorities produced a 'Joint Minerals Plan' which was adopted in 2013[44]. This contains a policy on unconventional gas as well as identifying potential areas for future extraction. In March 2019 the Mayor of Greater Manchester launched the '5 Year Environment Plan'[45], which set out the long term vision for Greater Manchester to become 'Carbon Neutral' by 2038. This date is based on scientific work undertaken by the Tyndall Centre (Kuriakose et al 2017), which considered a carbon budget for Greater Manchester compatible with the international Paris Agreement.

1.4.4 The London Plan's proposed policy (as of September 2019) at SI11 takes a similar approach to shale gas development:

> Development proposals for exploration, appraisal or production of shale gas via hydraulic fracturing should be refused. [46]

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[42] Greater Manchester Combined Authority, '*Draft Greater Manchester Spatial Framework*', GMCA (2019), Policy GM-S2

[43] Ibid, Paragraph 5.12

[44] Manchester City Council, '*Greater Manchester Joint Minerals Development Plan*' (2013)

[45] Greater Manchester Combined Authority, '*5 Year Environment Plan*', GMCA (2019)

[46] Greater London Authority, '*Draft London Plan Consolidated Version*', GLA, July 2019, Page 369

A number of different matters are relied upon to justify the policy, including climate change, and the unlikelihood of applications coming forward within the plan area:

> 9.11.1 In line with the Plan's policy approach to energy efficiency, renewable energy, climate change, air quality, and water resources, the Mayor does not support fracking in London.
>
> 9.11.2 The British Geological Survey concluded in a 2014 report for the Department of Energy and Climate Change that "there is no significant Jurassic shale gas potential in the Weald Basin". It is highly unlikely that there is any site that is geologically suitable for a fracking development in London.
>
> 9.11.3 Should any London fracking proposal come forward there is a high probability that it would be located on Green Belt or Metropolitan Open Land. Furthermore, London and the south east of England are seriously water-stressed areas. Fracking operations not only use large amounts of water but also presents risks of potential contamination, presenting significant risks to London.
>
> 9.11.4 In addition to avoiding or mitigating adverse construction and operational impacts (noise, dust, visual intrusion, vehicle movements and lighting, on both the natural and built environment, including air quality and the water environment), any fracking proposal would need to take full account, where relevant, of the following environmental constraints:
>
> Areas of Outstanding Natural Beauty
> Sites of Special Scientific Interest
> Groundwater Source Protection Zone 1
> Special Protection Areas (adopted or candidate)
> Special Areas of Conservation (adopted or candidate)
> Sites of Metropolitan Importance for Nature Conservation
> Groundwater or surface water

Considering the statement of this policy in unqualified terms, the Court of Appeal held in the West Berkshire case[47] that planning policies can be expressed this way and do not need to admit exceptions in order to be lawful. Finalisation of the London Plan is due early in 2020. The Planning Inspectorate panel report in October 2019 recommended deleting the policy in its entirety at paragraph 515 of the report[48], stating that:

> Policy SI11, in relation to hydraulic fracturing, is unnecessary. Given national policy and the limitation it places on local decision making that would be a consequence, there is insufficient justification for it. The policy and the reasoned justification should be deleted in its entirety.

The report states that the policy is 'fundamentally inconsistent with national policy' and would be unlikely to apply in London in any case. Recent changes to the UK Government's position on hydraulic fracturing post-date this report, and could therefore indicate a greater consistency between a restrictive policy and national policy to date. In December 2019, the Mayor having considered the Inspector's recommendations, released the Intend to Publish London Plan[49] and has retained the S11 policy without amendments. In his response[50] accompanying this document the Mayor explains his position as follows:

> The Mayor does not consider that there is a fundamental inconsistency with national policy. The specific support for hydraulic fracturing was withdrawn from the 2018 NPPF following a successful High Court challenge. With regard to the provisions in the NPPF the decision of Dove J in the case of Stephenson V Secretary of State HCLG (7.3.19)

[47] R (West Berkshire District Council) v Secretary of State for Communities and Local Government [2016] EWCA Civ 441

[48] The Planning Inspectorate, *Report to the Mayor of London* (October 2019) and *London Plan Examination in Public Panel Report Appendix: Panel Recommendations* (October 2019), PR44

[49] Mayor of London, *Intend to Publish London Plan* (December 2019)

[50] Mayor of London, *Mayor of London – Response to Inspectors' recommendations*, (December 2019)

> held that the consultation in respect of fracking in the NPPF was unfair and unlawful as it did not respond to nor examine the most up to date scientific guidance in relation to the evidence base for the policy and its relationship to climate change effects.

Given the changes to the Climate Change Act 2008 to increase the level of mitigation of greenhouse gas emissions and the UK Government's recent announcement of a presumption against hydraulic fracturing consents, the Mayor takes both of these policy developments as lessening the weight to be given to planning policy statements that predate these legislative and policy changes.

1.4.5 Lancashire Minerals and Waste Local Plan (LMWLP) dated 2013 and found sound in line with the NPPF 2012, included the following development management policy at DM2:

> …In accordance with Policy CS5 and CS9 of the Core Strategy developments will be supported for minerals or waste developments where it can be demonstrated to the satisfaction of the mineral and waste planning authority, by the provision of appropriate information, that the proposals will, where appropriate, make a positive contribution to the:
>
> Local and wider economy
>
> Historic environment
>
> Biodiversity, geodiversity and landscape character
>
> Residential amenity of those living nearby
>
> Reduction of carbon emissions
>
> Reduction in the length and number of journeys made…

The inclusion of carbon emissions reduction as a 'positive contribution' was instrumental in ensuring that these issues formed part of the matters on which evidence was brought at the appeals on the Preston New Road and Roseacre Wood shale gas sites.

1.4.6 North Yorkshire County Council, City of York and North York Moors National Park's Minerals and Waste Joint Plan (Draft)[51] have taken the approach in the joint plan of directing shale gas development to the most suitable areas, and away from sensitive areas at Policy M16:

> Policy M16: Key spatial principles for hydrocarbon development
> Hydrocarbon development of the types identified below should be located in accordance with the following principles:
>
> a) exploration, appraisal and production of conventional hydrocarbons, without hydraulic fracturing; exploration for unconventional hydrocarbons, without hydraulic fracturing:
>
> Proposals for these forms of hydrocarbon development will be permitted in locations where they would be in accordance with Policies M17 and M18 and, where relevant, part d) of this Policy.

Alongside this, Policy M17 set outs criteria on transport, cumulative impact, and a 500m buffer from residential development as at 4(i):

> Proposals for surface hydrocarbon development, particularly those involving hydraulic fracturing, within 500m of residential buildings and other sensitive receptors, are unlikely to be consistent with this requirement and will only be permitted in exceptional circumstances.

In the course of the examination the Inspector has proposed modifications based on representations received:

> Policy M17 2(i):
>
> Hydrocarbon development will be permitted in locations where it would not give rise to unacceptable cumulative impact, as a result of a combination of individual impacts from the same development and/or through combinations of impacts in conjunction with other existing, planned or unrestored hydrocarbons development. **Applications should specifically address the potential for cumulative impacts of**

[51] North Yorkshire County Council, City of York and North York Moors National Park, *Minerals and Waste Joint Draft Plan,* November 2016

development upon climate change and, where appropriate, propose such mitigation and adaptation measures as may be available and are consistent with Policy D11.

Policy M17 4(iii) Proposals for substantial new minerals extraction and for the large-scale treatment as well, recovery or disposal of waste, **as for hydrocarbon proposals**, should be accompanied by a climate change assessment **as appropriate**.

This amended wording (in bold) appears to be accepted by the industry response to the Inspector's proposed main modifications. Concerning greenhouse gas emissions, policy D11 on Sustainable design, construction and operation of development sets out as follows:

Proposals for minerals and waste development will be permitted where it has been demonstrated that measures appropriate and proportionate to the scale and nature of the development have been incorporated in its design, construction and operation in relation to: i) Minimisation of greenhouse gas emissions by incorporating energy-efficient siting, design and operational practices including those relating to bulk transport of materials;

It is a policy limited to the site, rather than considering the life cycle impact on greenhouse gas emissions of hydrocarbon minerals development, such as the approach taken in the HJ Banks open cast coal mine case. Following the Stephenson case, the Inspector examining the plan issued a note in response to discussions over the 500m buffer policy[52]:

I have considered all the representations concerning the Stephenson judgement and the quashing of NPPF 209a. Due to the uncertainties arising from the scientific evidence, particularly over methane emissions from hydraulic fracturing, and the consequential uncertainties over the potential impact this could have on air quality in the vicinity of nearby

[52] The Planning Inspectorate, *Inspectors' response to Joint Authorities response to High Court Judgement*, (October 2019), INS 16

receptors, I am content that the retention of the 500m buffer zone in the Plan is sound.

The Stephenson case is clearly being interpreted as injecting more caution into planning policy formulation at local level. The final report on this plan will follow further public consultation and will be due later in 2020.

1.4.7 Minerals plans across England have taken a variety of different approaches, demonstrating that local context and the weight being given to different matters are producing a variety of policies. Any policy adopted would need to be rational, consistent, and justified, subject to consultation and strategic environmental assessment.

1.4.8 Local plans in the area of Greater Manchester have been reviewed and to date, there are no specific policies on shale gas as set out in Table 1:

Table 1 Local plan policies in the Greater Manchester area

Local Authority	Policy
Bolton	Link here
Bury	Local Plan policy Direction Document – Policy direction (IN2) to include no fracking position. No mention of carbon capture.
Manchester	Adopted Core Strategy (2011). No specific policies.
Oldham	Adopted Core Strategy (2011). No specific policies.
Rochdale	Adopted Core Strategy (2016). No specific policies
Salford	Revised Draft Local Plan (2019). No specific policies
Stockport	Adopted Core Strategy (2011). No specific policies
Tameside	Unitary Development Plan (2004). No specific policies
Trafford	Adopted Core Strategy (2016). No specific policies
Wigan	Adopted Core Strategy (2016). No specific policies but commitment to work with other authorities to identify sites/preferred areas for future mineral workings. Justification for minerals policy refers to potential working of coal bed methane (para 9.95).

1.5 Industry response

1.5.1 UK Onshore Oil and Gas (UKOOG), the trade association for the UK onshore oil and gas Industry, maintain a position that gas is an essential part of the ‘energy mix’, contributes to ‘energy security’ and cite support for shale gas development in planning policy. On the first two matters – justification of gas as part of the energy mix, and ‘energy security’ – the assessment on whether shale gas is required should be made on the basis of up to date, independent evidence, ensuring that all evidence on the matter is taken into account. Then it is a matter for the decision-maker to ‘weigh’ this evidence as appropriate against the national ‘in-principle support’ for shale gas. Clearly the planning authority must justify and provide evidence for its position, but it is able to take a different position.

1.6 Wales

1.6.1 Although a different jurisdiction in planning terms (planning is a matter devolved to the Welsh Government) it is worth noting that an alternative approach has been taken there to unconventional oil and gas, and indeed coal. This approach has been taken in order to achieve Wales’ decarbonisation targets and to increase renewable energy generation as stated at paragraph 5.10 of Planning Policy Wales 2019 :

> The demand for energy minerals has been largely based on power generation. The Welsh Government has set climate change targets for the reduction of greenhouse gas emissions and promoting decarbonisation. At the UK level coal powered generation is being phased out. This means moving away from the extraction of fossil fuel for use in energy generation. In the planning energy hierarchy, the extraction of minerals for the purpose of generating energy is undesirable as it is the most carbon intensive form of production. The purpose of this hierarchy is to encourage preferred generation proposals to come forward and to discourage proposals supported by the extraction of fossil fuels.[53]

While England’s planning policy does not make the same link explicitly between fossil fuel extraction and power generation, the Welsh policy describes a perfectly credible planning approach to linking plan-making and decision-taking on onshore oil and gas to the need to reduce greenhouse gas emissions as follows at Policy 5.10.11:

[53] Welsh Government, *Planning Policy Wales*, Edition 10 (2019), Paragraph 5.10

> The Welsh Government has set challenging targets for decarbonisation and increased renewable energy generation. The continued extraction of all fossil fuels, including shale gas, coal bed methane and underground coal gasification, are not compatible with those targets. The Welsh Government's policy objective is therefore to avoid the continued extraction and consumption of fossil fuels. When proposing the extraction of on-shore oil and gas, robust and credible evidence will need to be provided to the effect that proposals conform to the energy hierarchy, including how they make a necessary contribution towards decarbonising the energy system. In all other respects, minerals policies aimed at preventing and limiting the environmental impacts of extraction and ensuring restoration will apply.[54]

The policy reverses the justification of onshore oil and gas development in terms of a low carbon energy system that is in line with decarbonisation targets.

1.7 Conclusion

1.7.1 In summary, national legislation sets out the procedure for plan-making and decisions on development, attaching general sustainable development and specific climate change considerations to plan-making, and environmental considerations to shale gas development proposals. Material considerations, in the form of the National Planning Policy Framework 2019, link the national Climate Change Act 2008, in itself connected to the Paris Agreement via the Net Zero Amendment 2019[55], to plan-making and decision-taking. Evidence and assessment on the impact of shale gas at a national level in relation to climate change at a national level is found in the Committee on Climate Change's 2016 report and is relevant as a material consideration in plan-making and decision-taking on hydrocarbon minerals. The recent ruling in Stephenson vs SoS MHCLG [2019] indicates that a planning authority is to assume that greenhouse gas emissions considerations are without doubt material, and that it would not be open to refuse to consider any new material

[54] Ibid, Paragraph 5.10.11

[55] Climate Change Act 2008 (2050 Target Amendment) Order 2019

or evidence submitted on this matter. As plan-makers, authorities could therefore depart from a position of ‘in-principle’ support for shale gas in view of other climate change policy on the basis of evidence.

2 Potential greenhouse gas emissions from fracking within Greater Manchester

2.1 Exploration, production & decommissioning emissions from shale gas production

2.1.1 Shale gas production entails specific equipment and operations that differ from conventional high porosity oil and gas wells. As a result, the greenhouse gas emissions associated with the whole life cycle of production differ in some aspects.[56] A number of scientific studies have sought to estimate these emissions that are additional to those from the combustion of the gas. The figure below provides an overview of results from life cycles studies that have focussed on shale gas production. For context the Heath et al (2014) estimate of conventional natural gas is also included. The box chart shows the estimated range of uncertainty, with the horizontal bar representing each study’s central estimate where given. Central estimates are comparable between studies at approximately 65 gCO2e/MJ. However, the upper boundary for estimates is substantial and varies from 67 gCO2e/MJ (the CCC’s “Minimum Regulation” estimate) to 161 gCO2e/MJ (the output of a life cycle assessment model by Stamford & Azapagic, 2014). The CCC “Minimum Regulation” scenario suggests that the introduction and enforcement of new regulations may reduce

[56] For gas supply chains as a whole, a previous review found that exploration, production and distribution of the gas is responsible for between 6% and 46% of the total climate change impact of the gas (median 18%), with carbon dioxide from combustion contributing the remainder (Anderson & Broderick 2017, derived from Balcombe et al 2016).

the central estimate from 66 gCO2e/MJ to 58 gCO2e/MJ but the upper boundary is reduced by a much greater amount.

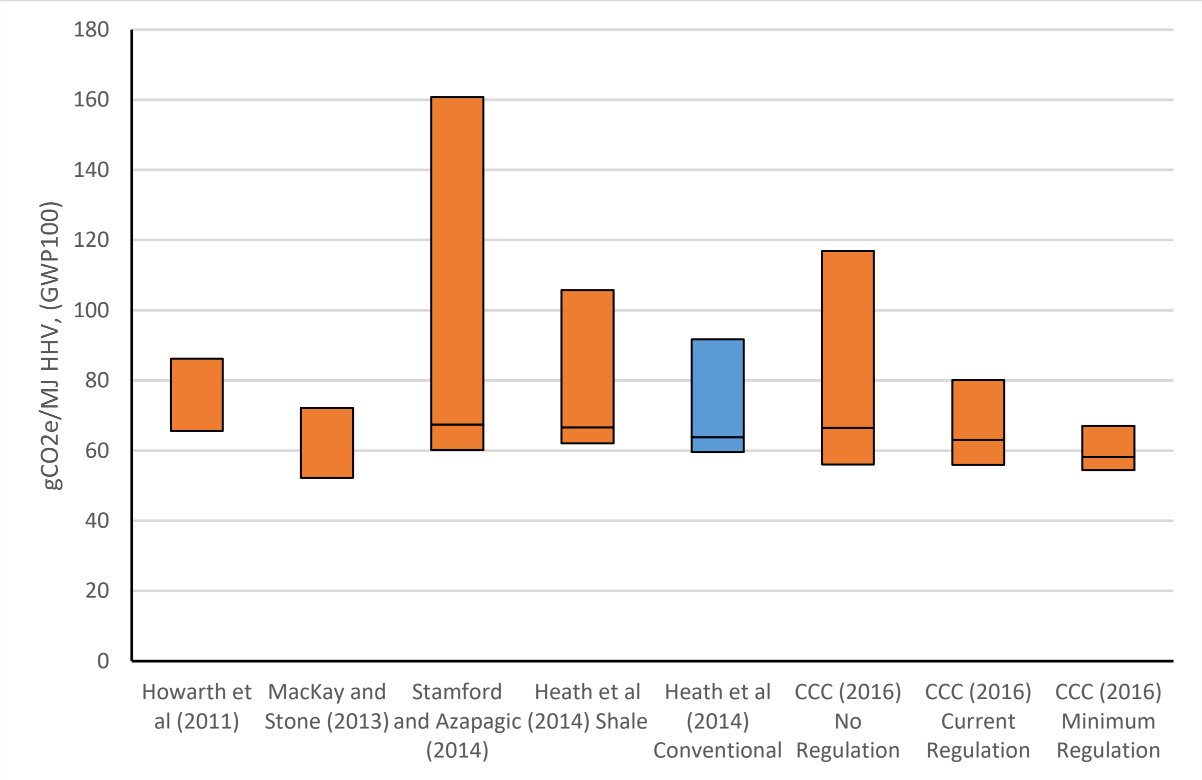


Figure 1 Total greenhouse gas emissions from supply chain and combustion. Full ranges are given with a bar for central estimates, mean or median according to study.

2.1.2 The above values include carbon dioxide emissions from the full life cycle of shale gas production and consumption, including; preparation of sites, construction of infrastructure, use of fuel for pumping and compression of gas, and the treatment of waste water. Identifying how much of these emissions would occur geographically at the well pad is not possible from the detail presented in the studies, neither is it necessarily determined at present. For instance, flowback water from the Cuadrilla Preese Hall site has previously been transported to Davy Hulme in GMCA for treatment. However, the Environment Agency (2019) has noted that five other sites are available for this purpose: FCC and Yorkshire Water's sites at Knostrop in Leeds; Northumbrian Water's Bran Sands in Middlesbrough; Castle Environmental at Longport in Stoke-on-Trent; and FCC Environment at Ecclesfield in Sheffield.

are available for this purpose so it cannot be assumed that production within GMCA would include this aspect of the lifecycle within the GMCA boundary.

2.1.3 In the context of this report, the implication is that some of these contributors to the life cycle carbon footprint could occur outside of GMCA both for shale gas and conventionally produced natural gas. The largest part of the footprint is carbon dioxide from combustion of the gas and these emissions are considered further in Section 3. After this, releases of methane are the largest component of the footprint that can be geographically isolated to the well pad and distribution of the produced gas. This is therefore the focus of this section.

2.1.4 Most research interest in the climate impact of shale gas has centred on the quantity of methane released to the atmosphere during well preparation, hydraulic fracturing and initial gas flow. This is because although methane is a relatively short-lived greenhouse gas with an atmospheric lifetime of approximately 12 years and does not accumulate like carbon dioxide[57] it causes a much greater intensity of warming, on an equivalent mass basis, during the time it is in the atmosphere. Its effect on global temperatures is best estimated as approximately 30 to 40 times that of carbon dioxide per tonne, over the 40 year stabilisation timescale relevant to the Paris Agreement (Allen et al 2016).

2.1.5 A frequently used "metric" for comparing different greenhouse gases is Global Warming Potential (GWP) which is evaluated over a specified time period, typically 20, 100 or 500 years. GWP does not estimate temperature change but consequently has the benefit of being solely dependent on the physical properties of the gas and not a climate model. There is no "correct" horizon

[57] A significant fraction of carbon dioxide emissions released today, 20 to 60%, will persist for a thousand years or more (Archer & Brovkin, 2008). This long lifetime is the basis for the carbon budgeting approach. Methane emissions are ultimately oxidised to carbon dioxide in the atmosphere, hence the warming effect is always greater than carbon dioxide for the same amount released.

from a physical science perspective, and 100 years appears to have been adopted through a process of “inadvertent consensus” (Shine, 2009).

2.1.16 For methane, the value of GWP 100, that a tonne of methane is multiplied by to give a “tonnes of CO2 equivalent”, tCO2e, has been estimated as 21 (IPCC 1995), 25 (IPCC 2007), 28 (IPCC 2014) and is currently thought to be 34 if all atmospheric processes and feedbacks are included (Gasser et al 2017). Different studies of emissions of shale gas use different GWP values so direct comparisons should only be made when normalised to the same value. Further, the inclusion of GWP20 which has much higher values up to 96 (Gasser et al 2017), can place additional emphasis on the amount of methane released in production in comparison to carbon dioxide. For the purposes of this study a value of 34 for GWP100 is used (Allen et al 2016) and other inputs to calculations are normalised on this basis.

2.1.7 Most experience of production of shale gas and oil has been in the USA and multiple studies have identified relatively high methane emissions in the scientific literature (for instance Howarth et al, 2011; Burnham et al 2013; Peischl et al 2015). Coincident top-down (atmospheric measurements allocated to sources) and bottom up (measurements of intentional and unintentional releases of methane at individual sites) measurements for oil and gas production in the Barnett Shale region have also found leakage to be two to five times larger than existing inventories (Zavala-Araiza et al 2015). Synthesising this work, the CCC (2016) estimate that leakage of methane could account for 0.2% to 4.9% of UK shale gas production. The range is large because of both the range of measurements made in the field and the dependency on the introduction and enforcement of regulations to limit emissions.

2.1.8 Research into natural gas production suggests that so called “super-emitters” account for much of the volume of leaked gas and their presence or absence in study samples for the range in uncertainty. Super-emitters are individual items of equipment or intermittent leakage events that disproportionately contribute to the total quantity of greenhouse gases released to the atmosphere, such that 5% of leaks may be responsible for 50% of total leakage volume (Brandt et al 2016). Attention has been drawn to this issue in the UK context by the Committee on Climate Change (CCC) who highlight that "The gap between top-down and bottom-up estimates for the US does, however, suggest there are risks of significant emissions from super-emitters." (CCC 2016, p47). Were such sources to be identified, it has been estimated that 65 to 87% of methane emissions from whole fields may be eliminated.

2.1.9 British Geological Survey atmospheric monitoring is ongoing at Cuadrilla's shale gas development at Preston New Road, Lancashire and methane leakage events recorded in December 2018 and January 2019 illustrate this episodic phenomenon (Allen et al 2019). The monitoring data did not show coincident elevated carbon dioxide levels suggesting that leakage was from a non-combustion source. The Environment Agency found Cuadrilla to have breached the conditions of their environmental permit and, after review of the site flare records, concluded that the nitrogen lift technique[58] deployed had inhibited combustion in the flare (EA 2019) leading to leakage of between 2.7 and 6.8 tonnes (equivalent to between 92 and 231 tCO2). Production is not recorded so a percentage estimate is not possible. This circumstance is illustrative of the interplay between shale gas producers, technology deployment, leakage events, and regulation that mediate the flow of greenhouse gases to the atmosphere.

2.2 Production scenarios

2.2.1 To estimate the additional quantity of methane emissions from shale gas development within GM, production estimates are first required. Future production estimates hold large uncertainty due to the range of economic, social, geological and technical factors that have a bearing on industrial development. Scenario methods, where the consequences of a range of assumptions are explored, are therefore appropriate. UK Onshore Oil and Gas (UKOOG), the organisation representing the industry, provide updated

[58] Nitrogen is pumped down into the bottom of the well bore to force the fluids used during hydraulic fracturing to the surface and enable the flow of gas.

estimates of the production from a programme of 100 wells developed in the Bowland Shale, the geological feature bearing shale gas in the North of England, based on the Cuadrilla's announcement of positive flow test results at one site, Preston New Road (2019). Three cases assuming different levels of well productivity (8 bcf, 5.5 bcf and 3 bcf per lateral) are proposed with the peak of production assuming 40 laterals at each well pad.

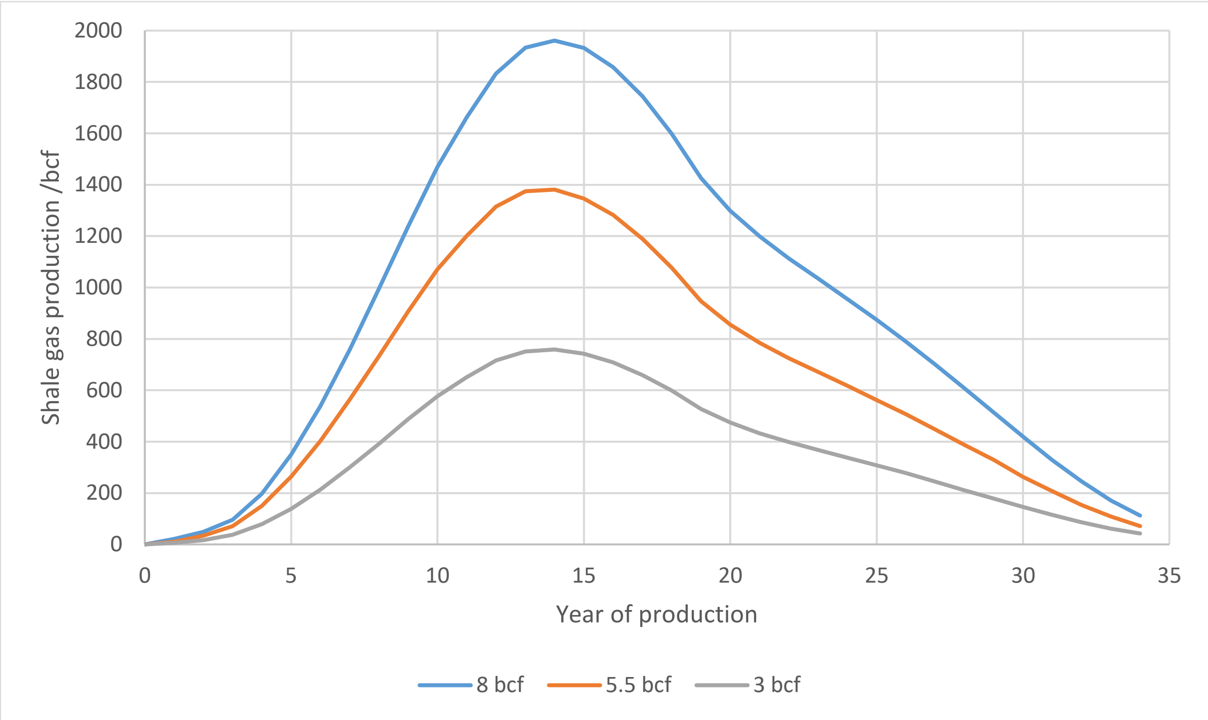


Figure 2 UKOOG (2019) Bowland Shale Production Scenarios

Well pad spacing

2.2.2 For the purposes of this study, production for the whole Bowland Shale must be scaled down to GMCA. Licences to explore and produce oil and gas onshore (Petroleum Exploration and Development Licences, PEDL) are issued by the UK Oil and Gas Authority (OGA). The area of GMCA (shown in red and blue in the figure below) that is both within the Bowland Shale and has a PEDL granted (shown in yellow in the figure below) is estimated at 634km^2 using the OGA GIS tool.

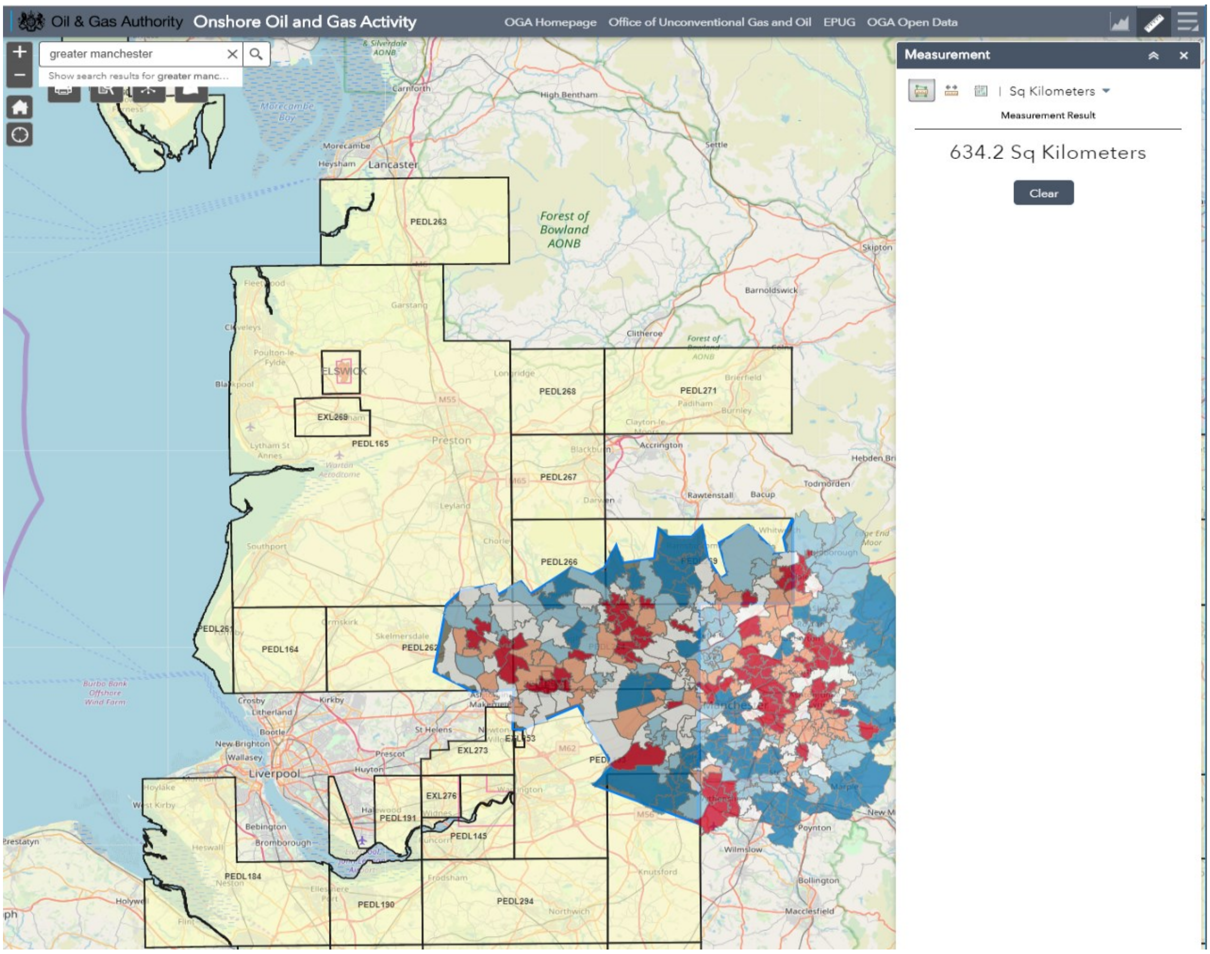


Figure 3 UK Oil & Gas Authority online tool screengrab showing PEDL areas (yellow shading) and GMCA (red and blue shading)

2.2.3 The location of well pads for production is clearly dependent upon both surface and subsurface considerations. Without specific industry proposals, or planning applications at specific sites for the period of the GMCA Spatial Framework, a generic well pad spacing is adopted. The mean maximum density of well pads for the Bowland Shale has been estimated as 26 per exploration block of 100km^2 (Clancy et al 2018). This accounts for existing development with a minimum set back of 152m from the borehole to other infrastructure and housing. On a per km^2 basis this would indicate a possible 163 well pads within GMCA, a number greater than the total proposed in the UKOOG scenario.

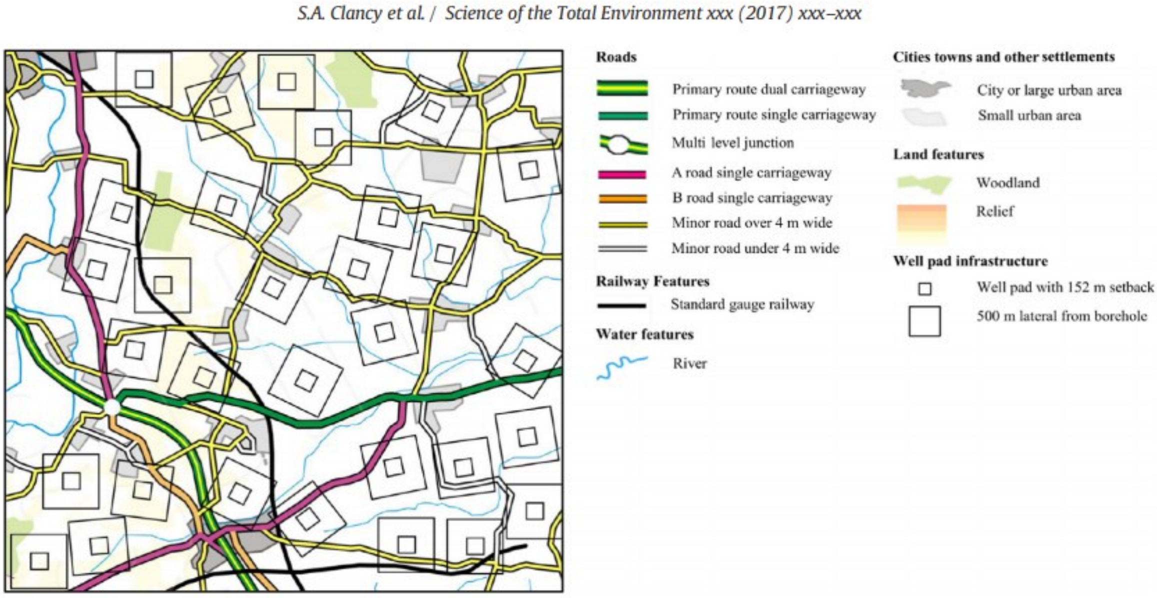


Figure 4 Illustrative example of well pad density estimation from Clancy et al (2017, Fig 3 in original document). Inner squares show recommended 152m setback, outer squares the potential extent of 500m lateral drilling. Block size is 100km2 with 31 well pads in this example.

2.2.4 There is reason to believe that this is substantially higher than feasible in GMCA. For context, existing conventional well pads in the UK were found to have a mean set back of 447m from housing, considerably greater than the 152m minimum assessed. GMCA also has a greater density of existing infrastructure than the other licence blocks elsewhere in the Bowland Shale region. The smallest number of well pads per block found by Clancy et al was five. Given the high density of existing infrastructure within GMCA this is assumed as a maximum. A pro-rata total of 32 well pads (634 km^2 relevant area / 100 km^2 per block * 5 well pads per block) would be accommodated on this basis, representing a third of the total development in the UKOOG Bowland Shale scenario. With this adopted as an upper value, a minimum is taken of one well pad per block for a total of 6 with a central value of half the maximum.

Laterals per well

2.2.5 Another significant variable introduced in the UKOOG scenarios is the number of lateral wells drilled per pad. All of the UKOOG scenarios assume 40 laterals per pad, however, this is acknowledged to be at the upper end of existing practice (UKOOG 2019). Whilst the above spacing considerations suggest a strong incentive to maximise wells per pad, a value of 20 is taken for the central scenario and 10 for the low case.

GMCA Scenarios

2.2.6 Three production scenarios are therefore summarised as below:

Table 2 GMCA Shale gas production scenario assumptions

Assumptions	High	Central	Low
Well pads in GMCA	32	16	6
Laterals per pad	40	20	10
Lateral productivity	8	5.5	3
Proportion of gas production of UKOOG Bowland Shale 5.5 bcf scenario	*45%*	*8%*	*1%*

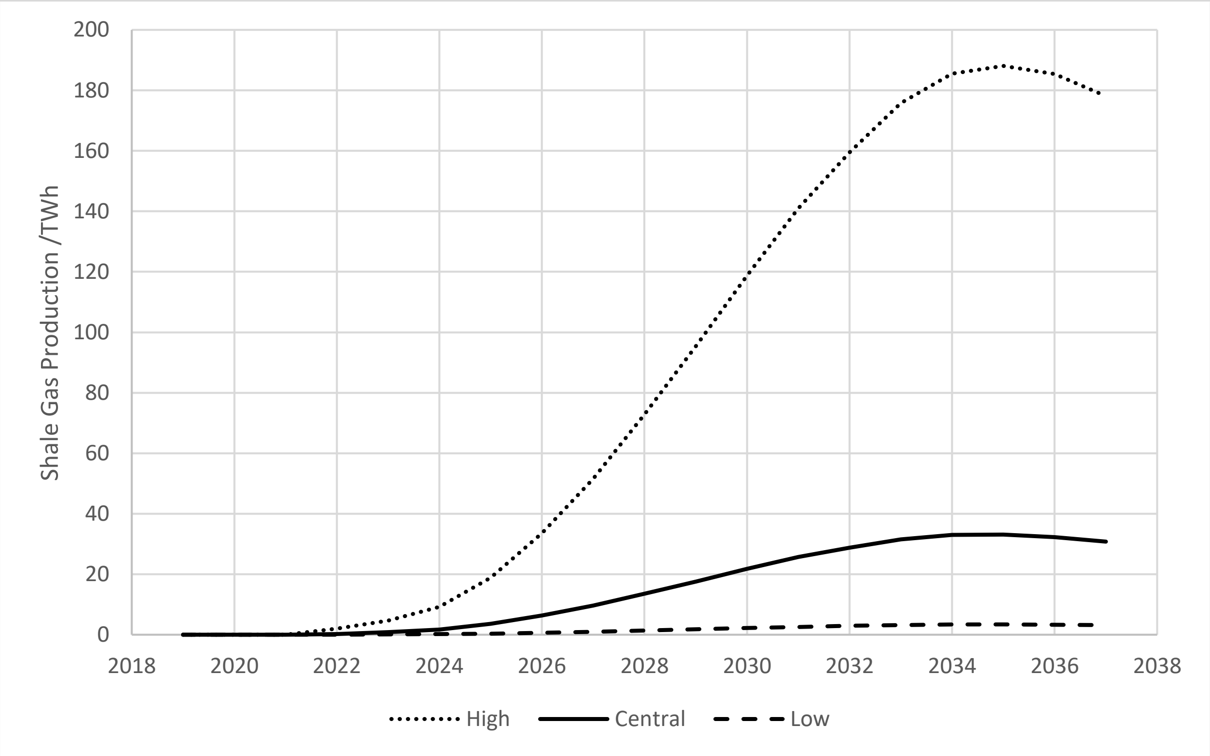


Figure 5 GM Shale Gas Production Scenarios

2.2.7 For context, the future gas demand in GM under high decarbonisation efforts has been estimated i) using the SCATTER calculator and ii) the total quantity of gas combustion that could be accommodated within the carbon budgets advised by the Tyndall Centre (Kuriakose et al 2017). These aspects are detailed further in Section 4, but the key finding is that the central production scenario exceeds both the SCATTER tool calculation of gas requirement and the carbon constraint. Additional greenhouse gas emissions are modelled in this light.

2.3 Potential scale of greenhouse gas emissions in Greater Manchester

2.3.1 There are two main elements to the greenhouse gas emissions of shale gas production and consumption in Greater Manchester, i) the methane leakages from the well pad and production activities and ii) the carbon dioxide from the transmission, distribution and combustion of the gas. The former part occurs within GM whether the gas is consumed locally or exported. The latter part is considered in Section 3 when the gas is consumed locally. There is a smaller element of carbon dioxide emissions from equipment manufacturing and waste processing that may occur outside of GM that is not estimated here.

2.3.2 Methane emissions within GM are here estimated by combing the locally scaled shale gas production scenario with the CCC's findings on methane leakage per unit of gas produced. To put this data into context requires knowledge of the existing level of methane emissions within GMCA. Unfortunately, BEIS LA emissions statistics do not provide non-CO2 emissions data at the regional level for comparison. The GM scale emissions inventory developed by Anthesis in SCATTER, includes direct methane emissions (Scopes 1 and 2) from energy sources but not for land use, agriculture and waste sectors, however, these latter sectors are a small part of GM's economic activity. The Anthesis inventory reports methane emissions as 472 ktCO2e (GWP100 of 28) but this is normalised to 573 ktCO2e (GWP 100 of 34) in light of best available scientific understanding and for consistency with other studies within this report. However, at a national level agriculture and waste dominate methane emissions and the Tyndall SCATTER report (Kuriakose et al 2017) advised further work to allocated these to a GM scale. This has not yet been developed so in the absence of a complete non-CO2 reduction plan an indicative 15% p.a. reduction in methane from fuel combustion is presented here (purple dashed line) as a prudent path.

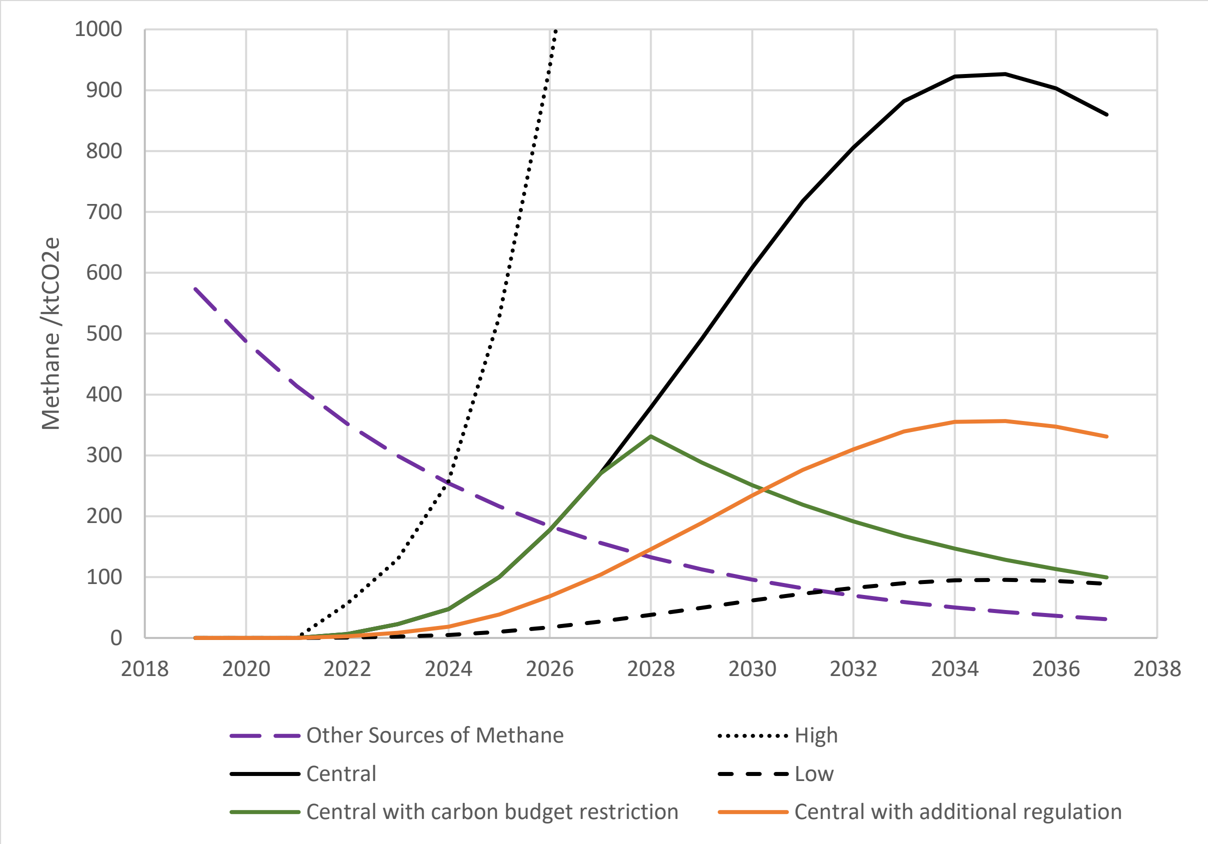


Figure 6 Methane Emissions from GM Shale Gas Production Scenarios

2.3.3 The above figure illustrates the potential growth in methane emissions from shale gas production under different scenarios. A leakage rate of 1.3% is assumed throughout, the central value that CCC (2016) estimate for current regulations. If additional regulations are introduced at the minimum necessary level the CCC advise, and compliant practices adopted and enforced, then a lower level, depicted in orange, would be expected for the central production scenario. The green line illustrates methane emissions from production of shale gas equivalent to the entire GMCA carbon dioxide budget when combusted.

2.3.4 In relation to Tests 1 and 3 that the CCC (2016) propose for onshore oil and gas development, respectively that well development, production and decommissioning emissions must be strictly limited and that shale gas emissions must be accommodated within carbon budgets, in all cases the 15% per annum reduction path for methane emissions is exceeded in the period 2024 to 2031. This occurs later if production rates are lower or releases of methane are better managed. In the high case, where more gas is produced than would be consumed locally, the level of methane emissions peaks at over 5 MtCO2e. This level may be considered nationally significant within the non-traded sector component of legislated carbon budgets; in 2030 the Central scenario has methane emissions of 600 ktCO2e, equivalent to 2% of the CCC’s total greenhouse gas estimate for UK industry on their cost effective path to an 80% reduction (CCC 2015). Comparable sectoral and methane specific estimates for the path to Net Zero have not yet been released by the CCC, but it is most likely they will be tighter and as such emissions from shale gas production more significant. These quantities are certainly locally significant in the context of GMCA making emissions reductions in line with the Paris Agreement temperature objectives.

3 Future energy requirements in the context of a moratorium on shale gas

This section quantifies GM's future requirement for natural gas to 2035, recognising the emissions reduction imperative of the Paris Agreement. The SCATTER project analytical tool, previously developed by Anthesis, is used here to model maximum effort to contribute to the Paris Agreement's objectives. It has been proposed by UKOOG that a ban on fracking may result in increased use of more carbon intensive alternatives such Liquified Natural Gas (LNG). The potential for this circumstance arising is considered along with the likely location and regulation of such emissions through the supply chain.

3.1 SCATTER Tool

3.1.1 The larger part of the SCATTER project was conducted by Anthesis Consulting to develop an emissions reduction analysis tool for local authorities. This was a separate activity to the downscaling of the Paris Agreement objectives to GM scale emissions budgets, conducted by the Tyndall Centre.

3.1.2 The emissions reductions analysis tool combines local authority scale emissions data with the functionality of the DECC 2050 Pathways Calculator. Specific control elements across the whole range of energy sectors, such as the extent to which public transport is switched to electric propulsion or how well our homes are insulated, are included in a dashboard. The tool does not specify particular choices or pathways but allows users to select a level of effort to be made in this range of energy sectors. Different combinations of choices in supply and demand technologies and policies are combined to calculate energy supply and demand at five year intervals. For this section of the shale gas analysis, the SCATTER tool was used to estimate natural gas demand for Greater Manchester to 2050.

3.2 Level 4 scenario assumptions

3.2.1 For the purposes of this report, it is assumed that Greater Manchester collectively, including businesses and citizens, not only using the powers of GMCA, acts on the overarching objective to support the Paris Agreement by remaining within carbon budgets advised by the Tyndall Centre in the SCATTER report 2018. As such the following choices are made in the SCATTER tool for the calculation of natural gas demand.

Grid Electricity

3.2.2 To give GMCA best chance of achieving goals it is assumed that grid electricity decarbonisation proceeds to at least the extent identified in National Grid FES 2019 'Two Degrees' and 'Community Renewables' Scenarios, reaching <50 gCO2/kWh by 2025 and <20 gCO2/kWh by 2035. This decarbonisation of grid electricity enables emissions reductions in sectors with otherwise diffuse sources of emissions such as road transport and housing. This assumption is represented by:

- Adopting the highest levels of ambition on all low carbon electricity supply options. This does not favour one source over another but leads to oversupply in the model beyond 2035 representing exports.
- Nationally 845MW storage and 1.27GW interconnection is delivered.
- Substantial demand shifting is assumed to reduce emissions from power stations at times of peak demand.

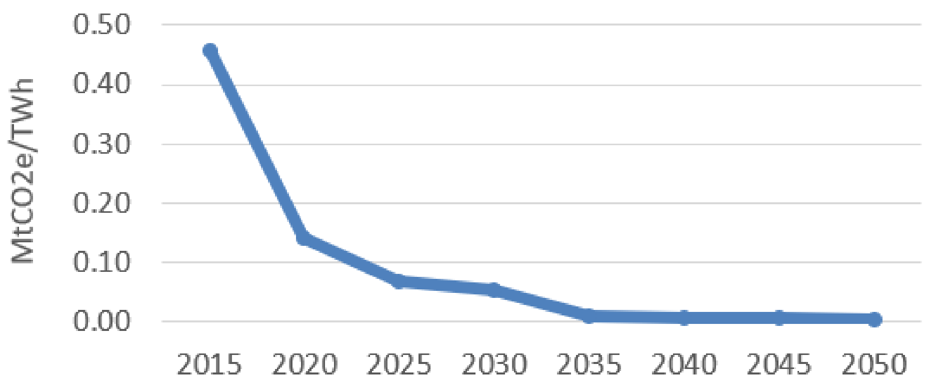


Figure 7 Emissions intensity of electricity generation (MtCO2e/TWh) in SCATTER Level 4 scenario

Demand

- Where there is the option to reduce demand, in all sectors, this is set to the most ambitious level.
- Domestic and commercial cooking are entirely electrified.
- Where domestic and commercial heating is not electric a mixed supply of gas/biogas; biomass; and heat from power stations is used.
- The energy intensity of industry is improved substantially, with some process electrified (39% by 2050); CCS captures 42% of emissions; process emissions reduced.

Oil and gas production

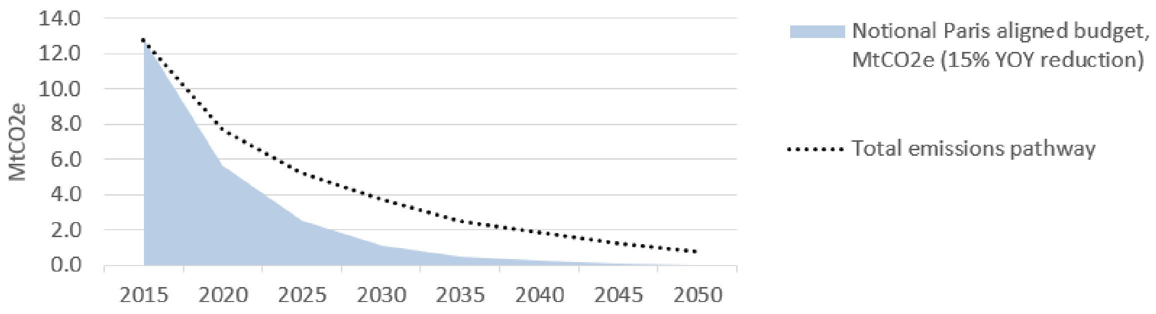
- These options have limited impact on natural gas demand.
- Petroleum refineries are taken to be on a path towards fossil fuels being eliminated by 2050.
- Indigenous fossil fuel production central case is used.
- The national gas grid is maintained.

Other

- CCS is included to mitigate emissions from the power sector but there is no Carbon Dioxide Removal (CDR) from the atmosphere.
- Waste reduction and proportion of waste recycled are set to the most ambitious levels.
- Land area given over to bioenergy and bioenergy imports are set at their maximum levels.
- Biomass is converted to a mixture of solid, liquid and gaseous fuels.
- Bioenergy imports increase but to the lowest level available (0.8TWh per annum in 2040)
- UK industry grows in line with current trends.
- Hydrogen production (from steam methane reforming and electrolysis) for road transport is yet to be explored.

3.3 Level 4 scenario results

3.3.1 The pathway, named "Level 4" scenario, produced by applying these assumptions to the Anthesis SCATTER tool, does not meet the Paris aligned carbon budgets for a number of reasons, as discussed in the GMCA 5 Year Environment plan. However, the remaining level of gas demand can be taken as indicative of substantial yet insufficient progress in the consuming sectors and as such an upper end of the path gas consumption that the city region should be planning for. Cumulative emissions for this path from 2015 to 2050 are 150 MtCO2e.



Emissions intensity of electricity (MtCO2e/TWh)

Figure 8 Comparison of total greenhouse gas emissions of Level 4 scenario with Paris Aligned carbon budget

The following figure shows the sectoral breakdown of emissions in the Level 4 scenario.

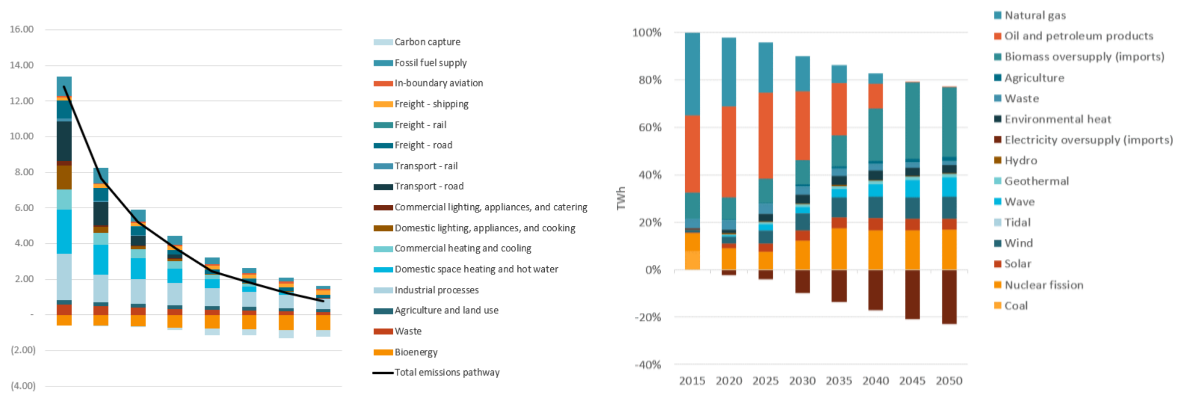


Figure 9 Sectoral breakdown of emissions in Level 4 scenario (left, MtCO2e) and total energy by source (right, TWh)

3.3.2 As can be seen in the right hand chart, natural gas consumption is reduced substantially from present levels, with the largest remaining consumers in 2035 being Industrial Processes and Domestic Space Heating and Hot Water.

3.3.3 The natural gas demand from the Level 4 scenario is then converted to an equivalent quantity of CO2 emission. This is presented as the blue line in the graph below in comparison to the three shale gas production scenarios. A green line shows the emissions pathway for the Paris aligned carbon budget.

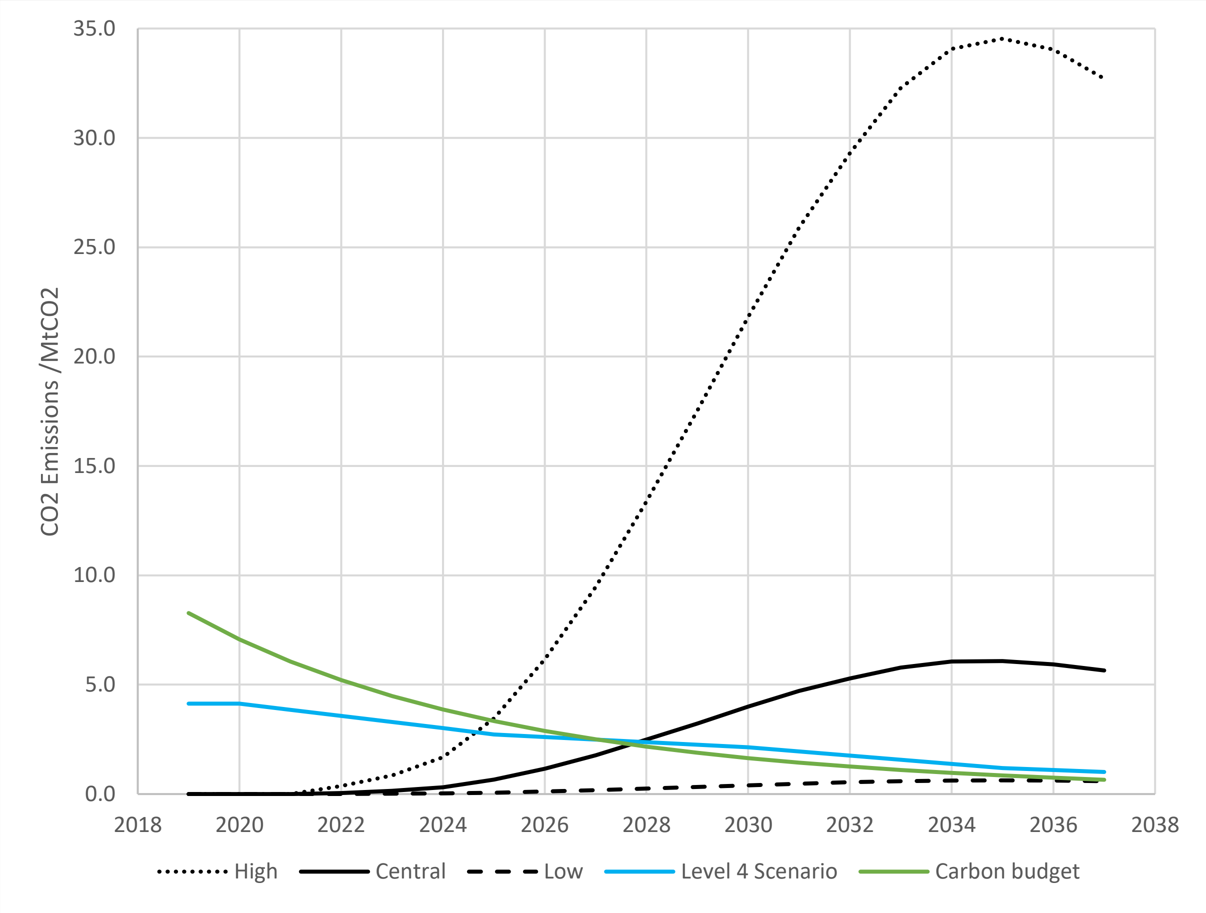


Figure 10 Comparison of shale gas combustion with SCATTER Level 4 scenario and Paris aligned carbon budget

3.3.4 We note that in the high and central production case the limiting factor in production and consumption of shale gas within GMCA is the level of demand. The Level 4 scenario demand for natural gas is met by the High production scenario in 2025 and the Central scenario in 2027. The Low scenario approaches the level of the Paris aligned carbon budget by the end of this period with emissions of 0.6 MtCO2 and 0.7 MtCO2 respectively. This suggests that displacement of alternative sources of gas to meet demand outside of GMCA is possible in all cases, as are market effects through the addition to global gas supply.

3.3.5 The next part of the report considers the potential upstream emissions from the sources of natural gas that may be displaced by the consumption of shale gas produced within GMCA by the rest of the UK. This will assess whether there is a potential emissions benefit through substitution.

3.4 Upstream emissions from alternative sources of gas

3.4.1 The natural gas presently consumed in GMCA has an emissions burden in production and consumption. Shale gas is not unique in this regard; Alvarez et al (2012) took measurements across ~30% of US onshore oil and gas production of all types and found leakage of ~2.3% methane produced, which is ~60% higher than the US Environmental Protection Agency inventory estimate. This quantity represents an additional 31% warming impact over the combustion carbon dioxide emissions for GWP100. As detailed in Section 2.1, there are variations in this additional warming between gas supply chains so it is therefore worth considering the alternative sources of gas to the UK and the potential for increases or reductions in upstream emissions through substitution.

3.4.2 In 2018 48% of UK gas supply was met by domestic production (UK Continental Shelf, UKCS, largely North Sea gas) and 52% net imports. There have been declines in UKCS production in recent years, with this proportion having dropped by 3% since 2014 (DUKES 2019). Of imports in 2018, 72% were from Norway, 15% as LNG from various sources and the remaining 13% from various continental European pipelines. Previous years have seen a greater proportion of LNG imports, to a maximum of 31% of imports in 2015, depending upon the relative prices of other supplies to the UK and Asian gas markets. Increased demand from China accounts for the recent shift to reduced LNG import (Bradshaw 2019).

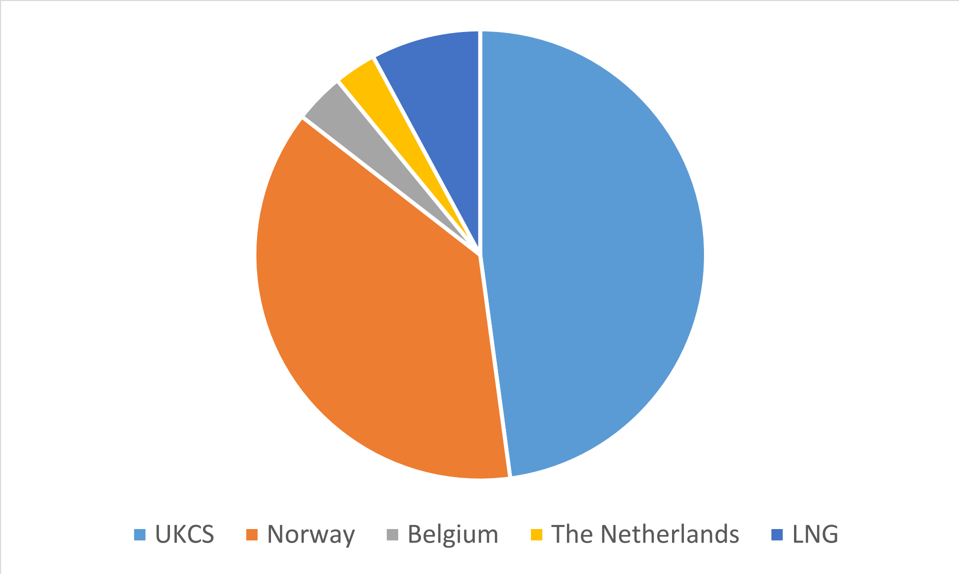


Figure 11 Sources of UK gas 2018 (net use in exploration and exports) Data: DUKES 2019

Relevant time period

3.4.3 This section considers the growth in shale gas production and the decline in gas consumption within carbon budget constraints implied by the Paris Agreement. In the near term, we must assume that existing sources of gas supply dominate as substantial shale gas production is not anticipated in the UKOOG scenarios until after 2023. In the longer term, the ultimate extent of gas consumption is bounded by the requirement to achieve zero, or near zero carbon dioxide emissions from the energy sector. The Tyndall Centre research for the SCATTER project indicates this should be by 2038 for the whole of the UK. The 2019 amendment of the Climate Change Act (2008) specifies this as 2050 and has an increased risk of exceeding the Paris 2 degrees warming objective due to its greater emissions to this point.

3.4.4 The GMCA scale shale gas production scenarios developed in Section 1.3 vary substantially in the total quantity of gas production, however, the time taken to exceed the demand in the Level 4 scenario and the Paris aligned carbon reduction pathway is similar for the High and Central scenarios, reaching these constraints in 2025 and 2028 respectively. The low scenario approaches but does not exceed these levels within the time period studied. However, the total GM carbon budget in the period beyond 2035 is very small and even low levels of production beyond this date will be problematic. Therefore, the period with greatest potential for a substitution effect, whilst maintaining production within GMCA’s constraints is from 2023 to 2028.

UK Continental Shelf

3.4.5 Considering future UK Continental Shelf (UKCS) production, the UK Oil and Gas Authority projects a decline of 5% per annum from current production from 37.8 bcm to 16.4 bcm in 2035. This is equivalent to reduction to 43% of current output. These projections are sensitive to assumptions about production costs, commodity prices and taxation regimes, but recent OGA projections have been pessimistic about UKCS production (OIES 2019) so we may anticipate production to be at least at this level.

3.4.6 It is typically assumed that the proportion of gas imports to the UK will rise in coming decades (CCC 2016, National Grid FES 2019). However, such conclusions either do not account for the energy system change resulting from carbon budgets in line with the Paris Agreement’s temperature objectives, or are reliant on global scale negative emissions technology. If the share of UKCS production available to GM is continued at the present rate, the rate of decline in production is less than the rate of reduction in gas demand in the SCATTER Level 4 scenario. Reductions in demand are modelled as 48% in 2025, 59% in 2030 and 77% in 2035 from a 2015 baseline. It is also important to note that this scenario results in emissions greater than the carbon budget recommended by Tyndall Manchester (2017) and so even greater reductions in gas consumption should be anticipated. This would lead to UKCS representing an increasing share of UK consumption and reducing the need for imports as outlined below. Were national efforts to reduce demand for natural gas in line with GMCA’s intention to contribute fully to meeting the Paris Agreement, the UK could be self-sufficient before 2035 from the continental shelf alone.

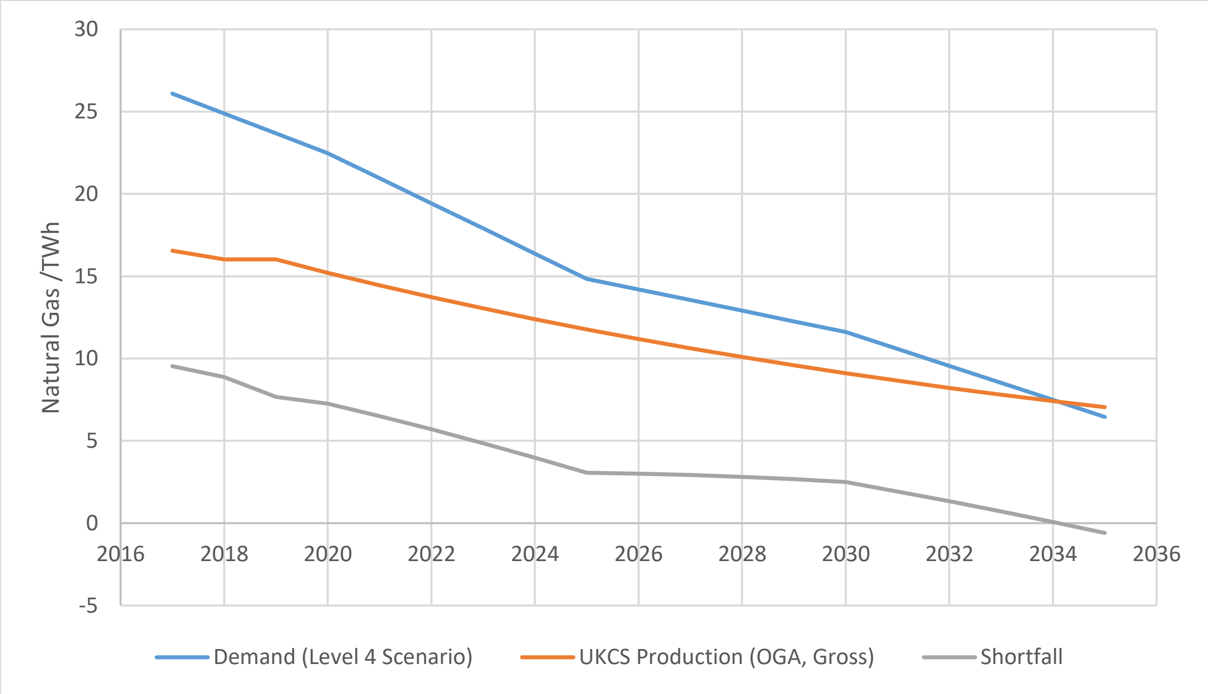


Figure 12 Estimated requirement for gas import; GM demand in comparison to pro-rata share of UKCS production

Potential Impact of Substitution

3.4.7 The analysis above suggests that in the period 2023 to 2028, assuming decarbonisation rates set out in the GM 5 Year Environment Plan, UKCS gas production can meet the bulk of demand. Substitution between UKCS and the nascent shale gas industry will largely be determined by the relative price of production net of any regulatory or fiscal support. Versus imports, UKCS gas offers the potential to minimise production emissions and include this source within our national inventory. It is not expected that shale gas production will have a lower emissions intensity than existing UKCS, therefore, if shale gas production is successful the primary consequence nationally would be is an increase in methane in the non-traded sector account to the extent that regulation is introduced, as per Section 2. This would necessitate greater reductions for sectors of the economy outside of power generation and energy intensive industry (CCC 2016).

3.4.8 For GMCA, the substitution with UKCS would tend to bring additional carbon dioxide and methane emissions from the production process within its boundary. The potential scale of methane emissions are also estimated in

Section 2 and are significant in relation to present local sources and future efforts at emissions reduction.

3.4.9 Considering the remaining 22% to 27% of demand in this period to 2035, imports are presently dominated by Norway (72%). The amount of LNG that is consumed in the UK is determined by relative price paid by UK market participants versus those in Asia because shipping enables it to be globally traded. These two sources are expected to be the dominant import sources in the future and are discussed further in relation to meeting remaining demand. If Norwegian CS production declines at a similar rate to the UKCS then it would be expected to meet the shortfall identified subject to being cheaper to supply to the UK than production further afield with LNG transport.

3.4.10 The CCC conclude that onshore shale gas production may have a lower emissions intensity than imported LNG provided that additional regulations are introduced and adhered to (CCC 2016). This is due to the additional energy required for liquefaction and regasification of LNG and the leakage of methane from handling and transportation (Tagliaferri et al 2017). The additional burden for LNG is thought to be approximately 20% over the total emissions from combustion and short-distance pipeline transport (Balcombe et al (2016). However, data quality for LNG is recognised as being low relative to other gas supply chains, particularly those in the USA resulting from intensive measurement campaigns. Data on the emissions intensity of Norwegian continental shelf production are limited, however, a recent life cycle assessment model indicates they are small relative to LNG but larger than UKCS production (Hammond et al 2017). Hammond et al 2017 find the additional upstream greenhouse gas emissions of each to be; UKCS 2 +/- 1 gCO2e/MJ, Norway 4 +/- 2 gCO2e/MJ, UK shale gas 14 +6 /-4 gCO2e/MJ, LNG 18 +/- 5 gCO2e/MJ (95% confidence interval).

3.4.11 The substantial uncertainty ranges in these estimates make a quantitative assessment of upstream emissions potentially misleading so a qualitative summary of potential impacts for different emissions accounting scopes is given below.

Table 3 Anticipated changes in greenhouse emissions for different scopes according to substitution.

Scope of emissions accounting	**Shale gas substitutes for UKCS**	**Shale gas substitutes for Norway CS**	**Shale gas substitutes for LNG**
Within GMCA boundary	Increase in methane emissions recorded as per Section 1.3	Increase in methane emissions recorded as per Section 1.3	Increase in methane emissions recorded as per Section 1.3
UK Carbon Budgets	Likely increase in methane emissions due to production method. Greater reductions are required from other sectors.	Increase in methane emissions recorded due to increased proportion of activity occurring within UK. Greater reductions required from other sectors.	Increase in methane emissions recorded due to increased proportion of activity occurring within UK. Greater reductions required from other sectors.
Global	If UK carbon budgets are maintained then no change. If UK carbon budgets not achieved then increase in emissions.	Under current shale gas production regulations, likely increase in methane emissions.	Possible decrease in methane emissions if additional regulation introduced and enforced in UK.

3.4.11 In conclusion, were additional regulations introduced and enforced at the national level to minimise methane emissions at the production site, and UK carbon budgets were strengthened to align with the Paris Agreement, then it is possible that shale gas production in GMCA may result in lower global methane emissions during the period 2023 to 2028 to the extent that it substitutes for the small proportion of imports that are LNG. However, the relative comparison with Norwegian continental shelf gas is more significant due to the greater volume presently consumed, the likely lower supply price and the greater expected disparity in additional emissions. Under the current UK shale gas regulatory regime, if GM pursues both natural gas demand reduction and shale gas production, then substitution for Norwegian continental shelf natural gas would be expected to increase greenhouse gas emissions within the GMCA boundary, require greater reductions from other sectors within the UK's carbon budget, and increase global methane emissions.

4 The role of CCS in GMCA's 2038 zero-carbon commitment

4.1 Context

4.1.1 Carbon Capture and Storage (CCS) technology is intended to prevent a significant proportion of the carbon dioxide from fossil fuel electricity generation, hydrogen production and other industrial processes from reaching the atmosphere. The carbon dioxide is captured and stored underground in depleted oil and gas fields or saline aquifers. The contribution of any technology, or indeed policy, to deliver on GMCA's pledge to achieve zero-carbon emissions by 2038, must be assessed not just against the end-point, but also the emission pathway underpinning it. Ignoring this latter evaluation risks seriously misleading policy and plays against GMCA efforts to reduce its emissions in line with the Paris 1.5-2°C temperature commitments.

4.1.2 The GMCA pathway, presented in Figure 8, requires annual reductions in emissions of 15% each year, beginning at the start of 2020. What is key to understand here is that any failure to deliver the necessary annual rate in the early years, substantially increases the rate required in subsequent years. Given how demanding 15% p.a. mitigation is, any failure will very quickly put the GMCA carbon budget beyond reach. It is within this backdrop of rapidly reducing emissions that any new technology needs to be considered.

4.2 CCS for power generation

4.2.1 The Sleipner gas and condensate field (in the Norwegian North Sea) has successfully captured and stored around one million tonnes of CO2 since its start of full-time operation in 1998. However, this example is very different from the capture and storage of carbon from fossil fuel power generation. Here there are no large-scale projects with any long-term experience of operation. As of 2019, the plant with the longest operation experience is the Boundary Dam project in Canada, a lignite fuelled power station. The particular generating unit fitted with CCS is relatively small at around 110 MWe (electrical), approximately one eighth of the size of GMCA's only major power station, Carrington, a gas-fired plant with a capacity of around 884 MWe. Moreover, Boundary Dam has had a suite of technical issues and increasing maintenance costs (IEA 2017). Whilst additional operational experience from both Boundary Dam and a newer cohort of CCS facilities will see the technology and costs mature, the roll-out of CCS on large power stations is not without significant operational and financial risks. This is particularly the case when retrofitted to existing stations, exacerbated when they have not been designed as ‘capture ready’, as is understood to be the case with the Carrington plant.

4.2.2 Another key issue when considering the appropriateness or otherwise of CCS power stations within the GMCA Paris aligned emission pathway, is the total life cycle emissions. Whilst carbon dioxide produced during combustion may have high levels of capture (perhaps 80 to 90%), significant quantities of emissions occur across the full fuel cycle and operation. A 2017 review of the life cycle emissions from different generating options, estimates a range for gas with CCS as 250-300 gCO2e/kWh, 50-60% lower than unabated gas (Gibon et al 2017). Consequently, whilst the addition of CCS to a gas fired power station more than halves total emissions, such a generating option still has significant levels of life cycle emissions, substantially in excess of the mean of <50 gCO2e/kWh outlined in the Section 3 pathways from the mid-2020s.

4.2.3 Bringing together the very limited operational experience of CCS on power stations, with no experience on designs the size of Carrington, and continued high life cycle emissions of gas with CCS, suggests that within GMCA, power generation with CCS can have no major role in delivering the requisite mitigation rates. Should a proposal be developed to retrofit CCS to Carrington, this would very likely not be completed and fully commissioned before the mid-2020s, at the earliest. Assuming that once such a substantial financial investment was made, the power station would likely have a higher load factor than a typical CCGT (gas-fired) power station, then it would be responsible for approximately 200,000 tonnes of direct carbon dioxide emissions annually[59]

[59] Assuming a load factor of 0.6 and direct CO2 emissions of 44 gCO2/kWh.

and a total greenhouse gas impact of nearly 1 million tonnes of CO2 equivalent.

4.2.4 Using the end-user approach of the BEIS LA data set underpinning the SCATTER project, the direct CO2 emissions would be allocated nationally and not be attributed solely to GMCA. The larger component, the upstream emissions from gas production, would be allocated to where they take place. If this gas were to be sourced from shale gas production within GMCA then the methane emissions from production would occur within the GMCA boundary as per the analysis in Section 2.3.

4.2.5 Setting the life cycle emissions of a CCGT power station with CCS against the GHG emissions intensity required of electricity generation of around 50g CO2e/kWh by 2025 (in the Level 4 scenario for GMCA's energy system, see Figure 9 Section 3), suggests that Carrington, even with CCS, is likely only to operate as a peaking power station. This conclusion is reinforced by comparing the carbon intensity, across time, of power generation assumed in the National Grid FES Two Degrees scenario and considering CO2 only, rather than total life cycle CO2e. Gibon et al (2017) do not state quantities for each element of the life cycle. However, one underlying paper, Singh et al (2011), does estimate the total carbon intensity of a CCGT with CCS for each element. Its headline emissions level is at the lower end of Gibon et al's analysis, at around 125 gCO2/kWh, but offers a breakdown of 25 gCO2/kWh CCS plant infrastructure, 56 gCO2/kWh for upstream gas production, 44 gCO2/kWh for direct CO2 emissions.[60] The National Grid Two Degrees scenario describes a grid average of 39 gCO2/kWh in 2025, reducing to 15 gCO2/kWh by 2035. These data are all indicative given that such a plant has not yet been build and operated. Nevertheless, they are based on reasonable assumptions, and until such a time that a lower direct CO2 emissions plant and lower methane emitting gas

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[60] The difference is accounted for by the higher emissions from upstream gas production taken by Gibon et al in light of further measurement campaigns in the USA. Singh et al assumes the CCS plant is located in Norway and use European gas production data from a 2007 database. The direct CO2 emissions are likely to be consistent.

production supply chain has been demonstrated they provide adequate estimates of emissions.

4.2.6 In short, retrofitting the GMCA Carrington gas-fired power station with CCS, whilst at face value offers lower emissions generating capacity, in reality, it would lock-in significant investment to a power station that could only ever have occasional use. Operating a large CCGT with CCS for just a few tens or hundreds of hours each year would be energetically and financially inefficient or require even greater emissions reductions from the non-power sectors of the economy that are already lagging behind.

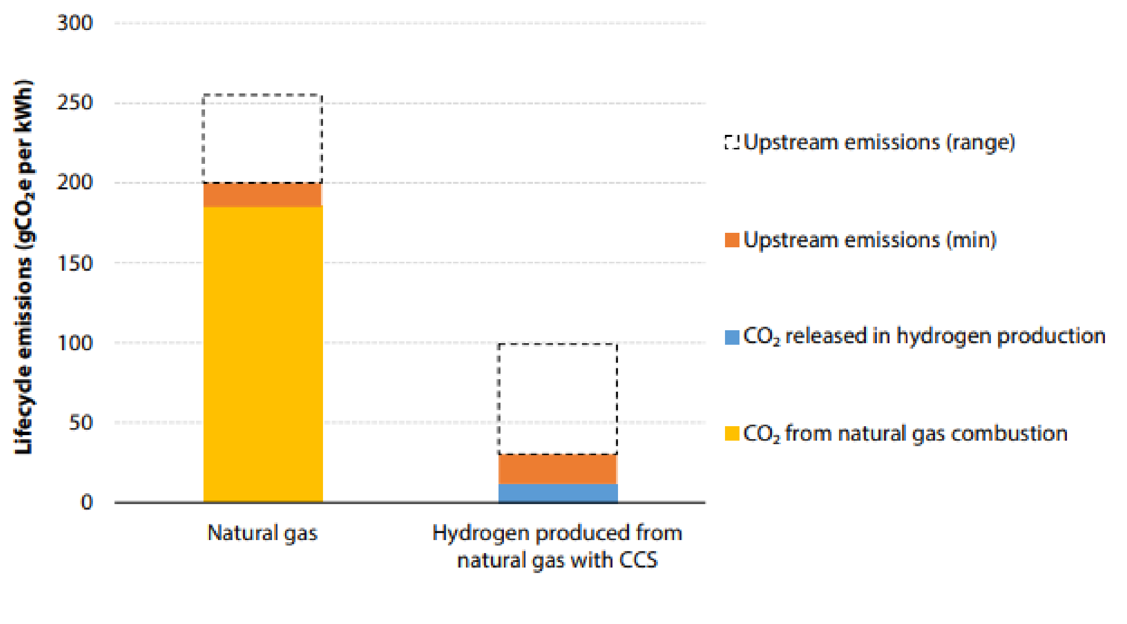
4.2.7 A potential opportunity for the longer-term operation of Carrington, could be its future conversion to some form of sustainable biogas. This would introduce further technical challenges in ensuring either the biogas was cleaned to a level equivalent to that of natural gas, or that the capture facility could deal with additional contaminants. Beyond this, there are already competing demands on the limited sustainable biomass resources as feedstocks for advanced biofuels for aviation, shipping and long-distance haulage.

4.2.8 In summary, the conversion of Carrington to include carbon capture and storage will incur both considerable expense and a significant risk that within a decade it may no longer be viable within increasingly tight emission constraints. Any decision to proceed with a CCS retrofit will need to consider these concerns against the costs and risks of alternative energy supply and demand side options.

4.3 CCS in hydrogen production

4.3.1 Another theoretical merit of CCS is that it could be used to remove and store the carbon component of natural gas leaving hydrogen as a zero-carbon fuel. The process currently used for doing this is Steam Methane Reforming (SMR). The hydrogen could then be used in domestic heating systems or, potentially, in power stations. Whilst ostensibly this is an attractive option, it suffers the same shortcomings of CCS on power stations. Even with high levels of capture of CO2 during the production of hydrogen, the upstream emissions from extracting natural gas limit any significant role such a technology could play within GMCA’s zero carbon by 2038 emissions pathway.

4.3.2 The Leeds City Gate H21 project estimates emissions as 86 gCO2e/kWh for the full H2 life cycle (27 gCO2/kWh for CO2) whilst a recent review for BEIS noted H2 life cycle emissions of between 37 and 45 gCO2e/kWh (E4Tech 2018). The net reduction estimated by the CCC (2018) is of 60% to 85% when compared with burning natural gas directly (CCC 2018). In figure 3.1 of their 2018 report the range of upstream emissions considered was 15-70 gCO2e/kWh, however the 2016 work on shale gas indicated a range of 22 to 90 gCO2e/kWh, under current regulations. This therefore suggests a higher overall life cycle impact and lower proportionate emissions reductions, at least until new regulation is introduced and enforced. Were the shale gas production to be located within GMCA then responsibility for these upstream emissions would be within the GMCA region, as per the analysis presented in Section 2.3.



Source: CCC analysis based on Element Energy (2018) *Hydrogen for heat technical evidence project*, CCC (2016) *Onshore Petroleum.*
Notes: Assuming 80% HHV efficiency for hydrogen production and a 95% CO_2 capture rate, with upstream emissions from natural gas production ranging from 15-70 gCO_2e/kWh.

Figure 13 Lifecycle emissions of natural gas and hydrogen from SMR (Reproduced from CCC, 2018 Figure 3.1)

4.3.3 Furthermore, there are a range of technical issues in using existing gas infrastructure for transporting hydrogen rich gas. Recognising this, the Leeds City Gate project will test different blends. This has the advantage of reducing some of the handling and piping issues associated with hydrogen, but does so at the expense of delivering only marginal reductions in the carbon intensity of the gas supply. Full transfer to 100% hydrogen and production by electrolysis using zero carbon electricity is ultimately necessary for this energy vector to play a major role in the 2030s and beyond.

4.3.4 Whilst this analysis concludes that there is no major role for CCS in power generation under the Paris aligned carbon budgets outlined in the SCATTER project, it is however judged to be a key mitigation technology in the elimination of process emissions from the cement industry. This is a much simpler activity whereby the CO2 emissions from the lime roasting process are directly captured at the plant. There are not substantial upstream CO2 emissions, as for instance with fossil-fuelled power generation, that are compounded by the efficiency losses of the capture process.

4.3.5 In summary, the potential role of hydrogen produced through steam methane reforming of natural gas with CCS, even if technically and economically viable, would be limited. The principle constraints would be timescale for delivery set against the 2038 zero-carbon date, and the upstream emissions arising from the volume and regulation of production within local and national emissions frameworks. A significant investment in shale gas and SMR capacity could facilitate only limited operation if it were to fit within GMCA's 2038 commitments. Consequently, there is significant risk of an insufficient payback period and hence such investment becoming a stranded high-carbon asset.

5 Consistency of Shale Gas Production with Paris Agreement

5.1 Shale gas is natural gas produced from shale formations through a process of hydraulic fracturing ('fracking'). It is a high carbon energy source, 75% by mass carbon, and consequently combustion generates carbon dioxide. The methane that constitutes the majority of shale gas, is also a greenhouse gas and emission from production are described in Section 2.

5.2 If monitored effectively, the GHG emissions from shale gas production in GMCA ought to be reported in our national emissions inventories. In principle, if the carbon budgets arising from the Climate Change Act (2008) are adhered to then there should be no net increase. However, this relies on the possibility of delivering additional emissions reductions elsewhere and enforcement of the carbon budget. The CCC's 2019 Progress Report to Parliament concluded that the UK is not currently on course to meet the fourth and fifth carbon budgets covering the period 2023-2027 and 2028 to 2032). In 2018 they noted that "…progress in the power sector masks a marked failure to decarbonise other sectors. In the last five years, this failure has become more acute, as emissions reductions in these sectors have stalled." (CCC 2018, p11). They conclude in 2019 that the policy gap has widened further and the regulatory landscape is far from that necessary to achieve net zero by 2050. The GMCA emissions path towards zero in 2038 with steeper near term reductions is more challenging still. In light of this, it cannot be assumed that additional shale gas emissions will be offset by greater reductions elsewhere.

5.3 When assessing the potential role of shale gas within the GMCA region, it is necessary to consider how any development must comply with both the GMCA 2038 zero carbon date and the supporting emission pathway. The arguments made in Section 4 as to why any source of natural gas, even with CCS, can only have a short-term role in the GMCA energy-supply portfolio, are similarly valid for shale gas. In some respects the prospects for shale gas are still less promising than those for natural gas. Assuming that economically recoverable resources of shale gas are available, it will take time to proceed through the planning, construction and commissioning phases of multiple well pads. This reduces the time period over which shale gas can play a viable role as a bridging or transitional fuel, estimated as 2023 to 2028, before the total carbon dioxide emissions from combustion would exceed the GMCA emission pathway or methane emissions become unmanageable (Section 1.3). These are upper limits as a significant part of the GMCA carbon budget will also be taken up by ongoing use of petrol and diesel in transport, particularly for freight transport.

5.4 As discussed in Section 4, the rollout of CCS technology for power and hydrogen production, must similarly fit within the carbon constraints that define the GMCA energy transition. Substantial, persistent consumption of gas in these sectors is not likely because they are not zero carbon; both have residual direct CO2 and indirect upstream methane emissions. The arguments made here apply equally to the rest of the UK. The enthusiasm for CCS evident in the CCC's 2019 Net Zero report, derives from the much larger carbon budget assumed and less stringent emission pathway that underpins their analysis. As has been detailed elsewhere (Kuriakose et al 2017), the CCC position falls short of a full and equitable interpretation of the Paris Agreement by not prioritising the global carbon budget for developing countries, and relies very heavily on the success of speculative global-scale negative emission technologies to remove CO2 from the atmosphere.

5.5 Within GMCA's carbon budget, with annual emissions reducing at approximately 15% each year, any new fossil fuels would have to replace existing gas supplies. The potential for substitution effects will be between conventional gas from the UK Continental Shelf and Norway, and LNG from various sources. In all cases, if imports are substituted then additional emissions reductions would need to be found from other parts of the UK economy.

5.6 Ostensibly shale gas produced in the GMCA region, that could not be accommodated within the city-region's Paris-based carbon constraints, could be sold on to international gas markets. However, this would only be a reasoned route if all other nations and sectors shared similar 1.5-2°C commitments and that shale gas production fit within their carbon constraints. DECC's Chief Scientific Advisor reviewed this topic in 2013 concluded that "If a country brings any additional fossil fuel reserve into production, then in the absence of strong climate policies, we believe it is likely that this production would increase cumulative emissions in the long run. This increase would work against global efforts on climate change." (MacKay & Stone 2013, p.33). This was echoed by a later review by the CCC for the Scottish Government (CCC 2016) that, whilst noting limitations in the strength of the evidence, for abundant gas supplies they found that "…net impacts on global emissions tend not to be negative (i.e. emissions down), but are either very small or positive (i.e. emissions up); net impacts depend on the strength of climate policy".

5.7 In light of the rapidly dwindling carbon budget for 1.5 -2°C, GMCA's explicit and Paris-based leadership on climate change puts shale gas beyond reach both as an indigenous energy source and also as an export commodity. Furthermore, there is an additional risk that GMCA's current 2038 zero-emission date, and accompanying pathway, will need to be tightened. As it is, the GMCA commitments are, to some reasonable degree, insured against a tightening of UK emissions, as they are already more progressive than those proposed by the CCC and adopted by government. However, across various civil society groups there is an increasingly vociferous call for much earlier zero carbon dates (typically 2025-2030); this is an issue that GMCA should at least reflect on prior to making major infrastructure decisions. The role of gas, whether from conventional or shale production, is very limited within any reasoned 1.5-2°C emission pathway for the UK.

6 Conclusion

6.1 This report provides the background legislative and policy context for the draft policy for ‘Carbon and Energy’ (Policy GM-S2) contained in the draft Greater Manchester Spatial Framework 2019 (GMSF), demonstrating that the policy is a justifiable option. The most recent case concerning national planning policy on shale gas, indicates that greenhouse gas emissions considerations are without doubt material, and the latest evidence should be brought to bear. Climate change duties attendant on plan-making also provide a general context for this policy option, as an area where the GMCA can secure an emissions reduction contribution in relation to other policies that need ‘emissions space’.

6.2 An evidence-based approach is essential for the development of sound local plan policy. Evidence presented within this report on the impact of shale gas supports GMCA’s policy option, whilst recognising the uncertainty of attendant extraction and production emissions, together with the timing of targets on emissions reduction, and the availability of mitigation technologies in particular carbon capture and storage.

6.3 A large amount of uncertainty attaches to the methane emission impact from the full life cycle of shale gas extraction, partly due to decisions made in regulation and enforcement, and partly due to the presence of random high volume leakage events, known as ‘super-emitters’. Best estimates from the Committee on Climate Change (CCC) review of prior empirical work are combined with the GMCA production scenarios to determine the quantity of methane emissions this industry might produce to 2035. High and Central scenarios exceed the current estimate for total methane emissions from GMCA’s existing energy system. Regulation as recommended by the CCC or production restrictions to within a Paris-aligned emissions reduction pathway reduce the total quantity, but all scenarios exceed a 15% p.a. reduction path over this period.

6.4 Emissions from the operation of the well pad, and from the transmission, distribution and combustion of the gas within the context of more stringent emissions reductions such as the commitments made by the GMCA in the Environment Plan, the Paris Agreement and the tightening of the 2050 target in the Climate Change Act 2008, mean that these emissions become even more significant. If demand is driven down by the rapid decarbonisation of the electricity system, and as the industry does not expect production at a substantial scale before 2023, the window for shale gas to provide a meaningful source of supply is becoming narrower. Existing sources of supply such as the UK continental shelf (UKCS) and Norway may well provide the flexibility needed in the next 10 years in the journey towards a largely decarbonised electricity sector.

6.5 Alongside the short time frame of 2020 – 2030, the roll out of carbon capture and storage on large power stations has significant operational and financial risks and is also time-constrained. There is little prospect of the relevant power station within the Greater Manchester area being retrofitted and the investment is highly likely to be uneconomic. The lifecycle emissions of this infrastructure in combination with shale gas production lead to the same concerns about limited emissions space and the relevant time periods.

6.6 While gas is needed within the electricity generating infrastructure of the Greater Manchester area in the next 10 years, declining demand points to an economic reason to avoid further gas infrastructure lock-in, and to avoid creating new incumbents with a short shelf life. Politically, the Paris Agreement and increasingly urgent public demand to act on climate change are reflected by the local democratic impetus behind this policy option.

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