10th July 2019

Minerals and Waste Joint Plan for North Yorkshire County Council, the City of York Council and North York Moors National Park Authority
Unconventional Oil and Gas

The High Court Judgement and Order and the implications for the joint plan

UKOOG Response

The responses made in this document are made on behalf of UKOOG, the trade body for the onshore oil and gas industry. The responses have been agreed by the four main PEDL holders that are impacted by the Minerals and Waste Joint Plan (the Plan)– Third Energy, INEOS, Cuadrilla and IGAS and should be read in conjunction with previous representations made to the Plan and responses made to the Inspector as part of the examination process.

Introduction

This document addresses the points raised by the Inspector with regards to the 6th March High Court Judgment by Justice Dove relating to a challenge by Clare Stephenson on behalf of Talk Fracking to paragraph 209(a) of the National Planning Policy Framework July 2018, the subsequent order to quash 209a and the Written Ministerial Statement (WMS) by the Secretary of State (SoS) for the Ministry of Housing Communities and Local Government (MHCLG) of May 23 2019.

In addition, this document addresses the request from the Inspector for any related scientific and/or legally relevant submissions, including providing a summary of the recent Committee on Climate Change Net Zero report.

EXECUTIVE SUMMARY

The recent Dove judgement opined on the lawfulness of the consultation process that the MHCLG carried out ahead of the decision by the SoS to adopt the revised NPPF. Scientific evidence challenging the role that onshore shale gas would play in assisting the UK to transition to a low carbon economy by 2050 had not been taken into account. As a result of that oversight the consultation process was found to be unlawful. Paragraph 209a, which advised that decision-makers should attach significant weight to that role when preparing development plans and determining individual planning applications was struck out.

Rather than address the procedural issue identified by the Court by instructing a fresh consultation process to examine the relative merits of the competing scientific evidence that had been put forward to support and challenge the UK Government's previously held national planning policy position that the production of an indigenous supply of onshore shale gas would have a lower carbon footprint than

imported liquefied natural gas and thus assist the UK in transitioning to a low carbon economy, the SoS elected instead to simply remove paragraph 209a from the revised NPPF.

The effect of this decision not to re-consult is that consideration of the strategic planning policy issue of whether or not the development of onshore shale gas would assist the UK in transitioning to a low carbon economy by 2050 and the required assessment of the science which surrounds it, has been deferred. The Court was not required to opine, and did not opine, on the relative merits of the scientific evidence. A review carried out by UKOOG of the Mobbs Report put forward by Talk Fracking, however, has revealed significant flaws in its author's interpretation and application of baseline empirical evidence that render its conclusions invalid. Until such time, therefore, as the validity of the competing scientific evidence is re-visited (presumably) in the context of the next review of the NPPF, the question of whether or not the production of onshore shale gas would facilitate the transition process and in doing so assist the UK in meeting its new statutory "net zero" climate change commitment remains undetermined in planning terms.

What remains clear, however, as evidenced by the terms of the most recent WMS issued on 23 May 2019 is that the UK Government remains committed to "the safe and sustainable exploration and development of [the country's] onshore shale gas resources." This together with the provisions of paragraph 209b of the revised NPPF, "**plan positively** for, the three phases of development (exploration, appraisal and production), whilst ensuring appropriate monitoring and site restoration is provided for" makes it clear that the Plan must continue to make provision for onshore petroleum development (our emphasis). A failure to do so would render the Plan inconsistent with the NPPF and the WMS and thus unsound.

The issue for the Inspector and the Joint Minerals Planning Authorities arising out of the Dove Judgement, therefore, is to what extent and in what circumstances the issue of climate change impact is properly addressed in terms of its current proposed development plan policies and supporting wording.

The response to climate change and in particular the relevance of research and actions required under the Climate Change Act 2008 as amended should be left to central government as is very clearly stated within the Act. There is still a strong and material case for shale gas as the recent WMS (23 May 2019) states *"We remain committed to the safe and sustainable exploration and development of our onshore shale gas resources".*

This point is reiterated by the recent recovering by the SoS for MHCLG of the Ellesmere Port and Woodsetts planning appeals for exploration development. The reason for recovering the appeals is common to both: *"The reason for this direction is that the appeal involves proposals for exploring and developing shale gas which amount to proposals for development of major importance having more than local significance. The Government has made clear in the WMS of May 2018 that it would consider carefully recovering appeals of this nature."*

UKOOG anticipates that as a result of the Inspector's invitation for parties to '*submit scientific or other evidence as a consequence of the judgement'*, that the Mobbs report ('How The Government Has Misled Parliament And The Public On The Climate Change Impacts Of Shale Oil And Gas Development In Britain' - A Report For Talk Fracking – February 2017) will be submitted to her by others. Given the

Judgement did not opine on the merits of the Mobbs report we urge caution in seeking to bring this forward in the current discussion of the Plan. Given the date of the report, dates of the examination and the fact this has not been referenced before, we consider it inappropriate and unnecessary to do so now.

UKOOG has reviewed the Mobbs report and concludes it to be an attempt to undermine the analysis and conclusions in the Mackay & Stone report, which the UK Government has used to justify their approach to shale gas, and specifically its role in the transition to a low carbon economy. We have provided an update of the scientific evidence around fugitive emissions. In summary we believe the Mobbs report is inaccurate and out of date (published February 2017).

The Committee on Climate Change found in its 2016 report "The Compatibility of Onshore Petroleum with Meeting the UK's Carbon Budgets" that the exploitation of shale gas on a significant scale would not be compatible with UK carbon budgets or the 2050 commitment to reduce emissions by at least [now 100%] unless three tests were satisfied.

In essence these tests are that:

* Well development, production and decommissioning emissions must be strictly limited;

* Gas consumption must remain in line with carbon budgets requirements, and

* Shale gas production emissions must be accommodated within carbon budgets.

The first test is addressed by both the Environment Agency through the issuing of Environmental permits and by the Health and Safety Executive through the Offshore Installations and Wells (Design and Construction Etc) Regulations 1996 (DCR). In addition, the existing Plan through policies require that emissions are strictly reviewed and mitigated (Policy D02).

So far as the second and third tests are concerned, it is clear from the terms of the main modifications that the need to consider climate change impact on a cumulative basis is also already addressed. Given the fact, however, that the second and third tests can only be reasonably and properly be applied in the context of applications for development involving the production of shale gas "on a significant scale" the main modifications already to the plan submitted need to be modified further to make it clear that operators will only be required to treat the issue of cumulative climate change impact as a relevant material planning consideration in the context of applications involving the third phase of shale gas development i.e. production.

However, we strongly believe that the Plan already adequately addresses climate change as amended by the main modifications:

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 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

We therefore believe that the deletion of para 209a from the NPPF has no impact on the Plan other than for it to be made clear in the wording of the Plan's supporting text that the issue of climate change impact and the extent or otherwise to which an individual development proposal might impact on the UK Government's ability to meet the second and third of the three tests set down by the Committee on Climate Change can only properly be considered in the context of an application involving the production of shale gas.

The judgement did not highlight any uncertainties in the scientific evidence on emission levels that the UK Government had previously relied upon. It simply ruled that the UK Government's failure to take account of the report which purported to challenge that evidence rendered the underlying public consultation exercise unlawful. It provides no justification for the proposed imposition of the 500m buffer zone.

The 2019 WMS endorses the UK Government's previous position, as set out in the 2015 WMS, that planning authorities must be able to put forward reasoned justification to support the imposition of a plan wide restriction, such as the proposed imposition of buffer zones. The evidence before the Inspector confirms that no reasoned justification for the imposition of the 500m buffer has been provided. Given the focus in the judgement on the issue of whether or not the development of onshore shale gas would facilitate the UK's transition to a low carbon economy, again the deletion of paragraph 209a has no impact on the issue as it is self-evident that the precise location of any such installation on the ground is irrelevant in terms of the impact or otherwise of potential emission levels on climate change carbon targets.

The JMPA's assertion that, even if the imposition of the buffer is ultimately found to be unjustified, the position can be rectified through a removal of the buffer following a review in 5 years makes no sense. If the imposition of a buffer zone is not justified at the point at which the policy is adopted, the availability of a review does not cure that lack of justification.

Since the last review of evidence in public by the Inspector in January 2019, the Committee on Climate Change has recommended the UK moves to a net zero target for emissions by 2050. A statutory instrument with respect to the Climate Change Act 2008 changing the target was approved by Parliament on 24 June 2019. However, the detailed response by Government is still awaited.

The CCC forecast that the UK would require 600 TWh (55bcm) of natural gas in 2050[i]. This requirement equates to a 32% reduction in UK gas demand from today. Based on forecasts by the Oil and Gas Authority (OGA) for the UK Continental Shelf (UKCS) natural gas production (i.e. offshore), the UK

would therefore be reliant upon imported gas to meet 86% of demand by 2050[i]. Such a level of imports represents a significant increase from today, where 50% of our natural gas is imported.

In their net zero report, the CCC states very clearly that **offshoring of emissions is simply not acceptable**: *"The design of the policy framework to reduce UK industry emissions must ensure it does not drive industry overseas, which would not help to reduce global emissions, and be damaging to the UK economy.*[i]*"*

Subsequently, UKOOG has clarified with the Committee on Climate Change that this statement includes the production of fossil fuels.

In addition, the Net Zero report and supporting documents identifies a significant and growing production emissions envelope for onshore gas production.

It is now beyond argument that the UK needs a secure long-term supply of natural gas to meet our net zero targets. It should be beyond argument that the UK sources natural gas not only from a diverse supply, but also gas **with the lowest emissions footprint** – i.e. that being domestically produced onshore and offshore natural gas. Not doing so will ensure that the CCC net zero recommendations are not met.

The degree to which the UK is reliant on more carbon intensive imports for future natural gas demand is almost entirely dependent on the future scale of the UK shale gas industry.

In conclusion the quashing of NPPF 209a has no material impact on the Plan which already adequately covers the issue. In addition, we strongly believe that it is the role of central government through the Climate Change Act and the role of the Committee on Climate Change to set policy and direction.

UKOOG DETAILED COMMENTS

1.0 The Dove Judgement

Talk Fracking made an application for judicial review (JR) of the adoption by the SoS MHCLG of paragraph 209(a) NPPF on 24th July 2018. It is worth noting there has not been any challenge to National Energy Policy contained within the 2015 WMS, nor the 2018 WMS.

The JR was brought on 4 grounds:

- Ground 1 asserted that SoS MHCLG unlawfully failed to take into account material considerations, namely scientific and technical evidence, which had been produced following the adoption of the 2015 WMS;
- Ground 2 asserted that SoS MHCLG failed, in publishing NPPF 209(a), to give effect to the Government's long-established policy in relation to the obligation to reduce greenhouse gas emissions under the Climate Change Act 2008;
- Ground 3 asserted that, in adopting NPPF 209(a), SoS MHCLG unlawfully failed to carry out a Strategic Environmental Assessment (SEA).

- Ground 4 asserted that SoS MHCLG failed to carry out a lawful consultation exercise in relation to the revisions to the NPPF (published on 24th July 2018).

Ground 4

Ground 4 succeeded because Justice Dove concluded that the consultation exercise on the draft NPPF 204(a), which became NPPF 209(a), was unlawful.

The SoS MHCLG submitted that there was no policy being formulated or revised. There was, therefore, no breach of the Sedley principles. Justice Dove held that a reasonable reader/member of the public would have concluded that SoS MHCLG was inviting and intending to consider and evaluate consultation responses on the substance of the policy in draft NPPF 204(a). Justice Dove concluded that the design and process of the consultation was legally flawed.

Ground 1

Ground 1 is very closely allied to Ground 4. Having concluded that the public were engaged in the consultation on the basis that the merits of the policy itself was included as part of the consultation; Justice Dove held that the Mobbs report was relevant to the decision which was being advertised and that the SoS MHCLG failed to take it into account. The decision was therefore unlawful.

Justice Dove does not pass any judgment on the merits of the Mobbs report or any other evidence submitted as part of the consultation process (positive or negative). Rather, he concludes that, having led the public to believe that the substance of the policy was being consulted upon, it was material and relevant to the decision being advertised.

Grounds 1 and 4 focus entirely on the consultation process by which the NPPF was adopted and **not** the scientific or technical merits of the arguments in the Mobbs report.

Ground 2

Justice Dove accepted the SoS MHCLG submissions that the revisions to the NPPF had no bearing at all on the Government's commitment to satisfying the CCC's three tests. Those tests remain in place and will have to be passed prior to “large scale extraction” proceeding, to be consistent with the requirements of the Climate Change Act 2008. Ground 2 was therefore held to be unarguable.

Ground 3

Justice Dove set out that arguments in connection with whether or not the revisions to the NPPF should have been the subject of Strategic Environmental Assessment (SEA), which have been addressed in the case of ***Friends of the Earth v Secretary of State for Communities and Local Government*** [2019]. Further discrete points were raised in relation NPPF 209(a). However, none of the points raised disturbed the principle conclusion of the ***Friends of the Earth*** case that SEA is not required on the basis that the Framework is not "required by law".

2.0 Weight to Written Ministerial Statements

NPPF 209(a) required MPA's to 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. In the light of the judgment, weight cannot be afforded to NPPF 209(a). However, substantial weight can still be afforded to other parts of the NPPF;

- NPPF 203 provides that it is essential that there is a sufficient supply of minerals to provide the infrastructure, buildings, energy and goods that the country needs. Since minerals are a finite natural resource, and can only be worked where they are found, best use needs to be made of them to secure their long-term conservation;

- NPPF 204(a) provides that planning policies should provide for the extraction of mineral resources of local and national importance. "Mineral resources of local and national importance" are defined as minerals which are necessary to meet society's needs, including oil and gas (including conventional and unconventional hydrocarbons);

- NPPF 205 provides that, when determining planning applications, great weight should be given to the benefits of mineral extraction, including to the economy;

- NPPF 209b asks local authorities when planning for on-shore oil and gas development to 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;

There has not been any challenge to these parts of the NPPF.

The points above have been reiterated by the most recent WMS in May 2019.

The CCC Report on onshore petroleum in 2016 and the Government Response support the large-scale production of shale gas provided 3 tests are met. The Judgment does not materially impact on the degree of weight to be attached to the 2015 WMS. The 2015 WMS has been updated by the 2018 WMS and the 2018 WMS was not the subject of the legal challenge and remains a key aspect of National Energy Policy. It reflects longstanding Energy Policy, including that in National Policy Statement 1, which is not disputed. It must, therefore, as a matter of law remain a material consideration. The weight to be attached to it is a matter for the decision maker and the Courts will not interfere in such a planning judgment absent irrationality (per Sullivan J in ***Newsmith***). The Judgment does not render this key aspect of National Energy policy immaterial by extinguishing the weight which can be attached to it. Therefore, substantial weight should be afforded to the 2018 WMS:

- It provides that the UK must have safe, secure and affordable supplies of energy, with carbon emission levels that are consistent with existing carbon budgets (defined in the CCA 2008 and international obligations). Such national energy policy imperatives remain unchanged by the Judgment;

- In the light of the CCA (2008) and the PA (2016), the Government considers that gas has a key part to play in meeting such objectives (currently and in the future). That is because (as the WMS recognises): (i) gas still makes up around a third of our current energy usage; and (ii) in every scenario proposed by the CCC - setting out how the UK could meet its legally binding 2050 emissions reduction targets – includes demand for natural gas. They are not addressed in the Judgment at all and remain unchanged by it;

- The Government also considers that further development of onshore gas resources has the potential to deliver substantial economic benefits to the UK economy. But to achieve such benefits (strongly supported in all iterations of the NPPF), the Government recognises that they must work with responsible companies prepared to invest in exploration, to test the size and value of the potential reserves and to ensure that our planning and regulatory systems work appropriately. Again: such matters are not addressed in the Judgment at all and remain unchanged by it;

- The Government considers that this country has "world class regulation" to ensure that shale gas exploration can happen "safely". That is not addressed in the Judgment and remains unchanged by it;

- The Government expects MPA's to give "great weight" to the benefits of mineral extraction. That remains part of the NPPF which was not the subject of challenge. It remains National Energy Policy.

The 2018 WMS relies on longstanding national energy policy imperatives such as security of supply, affordability and economic growth. It expressly recognises our national and international commitments in respect of climate change. However, it also recognises the reality of the current energy market, which is heavily reliant on gas both now and in the foreseeable future (applying current CCC scenarios). Such material considerations are not (even arguably) reduced in weight due to this Judgment. In all the circumstances, therefore, the 2018 WMS is a material consideration of significant weight.

This view was reiterated by the WMS of May 2019:

- For the purposes of the National Planning Policy Framework, hydrocarbon development (including unconventional oil and gas) are considered to be a mineral resource.

- Specific policy on the planning considerations associated with their development is set out at paragraphs 203-205 and the remainder of 209 of the National Planning Policy Framework.

- In particular, paragraph 204(a) of the National Planning Policy Framework states that planning policies should "provide for the extraction of mineral resources of local and national importance" with paragraph 205 stating that "[w]hen determining planning applications, great weight should be given to the benefits of mineral extraction, including to the economy".

- The Written Ministerial Statements of 16th September 2015 on 'Shale Gas and Oil Policy' and 17th May 2018 on 'Planning and Energy Policy' also remain unchanged and extant.

- The Written Ministerial Statements sit alongside the National Planning Policy Framework. Planning Practice Guidance is also unaffected by the ruling.

- The Government remains committed to the safe and sustainable exploration and development of our onshore shale gas resources.

3.0 Climate Change

The Climate Change Act 2008 (as amended) required that the UK reduce its annual emissions by 80% from 1990 levels under a 2°C budget. This Act is the UK's nationally determined contribution to the Paris Agreement.

The Intergovernmental Panel on Climate Change ("IPCC") released a document in October 2018 which described the international action required in order to achieve the upper ambitions of the Paris Agreement, that being limiting global warming to 1.5°C above pre-industrial baselines.

Following the release of this document, Claire Perry MP requested that the UK CCC provide evidence and recommendations to the UK government on whether or not the UK should legislate for a 1.5°C emissions budget (i.e. a 'net-zero' target).

The CCC Report has been prepared by the CCC with a view to making recommendations for a new emissions target for the UK, having regard to the latest scientific evidence on climate change. The CCC Report seeks to advise the UK Government to put policies in place, as well as legislation where appropriate, in order to reduce greenhouse gas emissions ("GHGs") in the UK as a contribution to global climate change.

In seeking to achieve net zero GHGs by 2050, the CCC has forecast that the UK would require close to 600 terawatt hours ("TWh") (55 billion cubic metres ("bcm")) of natural gas (page 252 of the CCC Report). This requirement, under a scenario with a totally decarbonised economy, remains very significant and equates to a 32% reduction in UK gas demand from today.

The CCC has concluded that there should be a key role for hydrogen as a fuel source in heat, transport and industry and for natural gas directly in the power sector (with Carbon Capture Utilisation and Storage ("CCUS")). Use of hydrogen downstream will have 'zero combustion emissions', as the bi-product of the combustion of hydrogen is water, rather than CO_2.

The least cost option for hydrogen production is steam methane reforming of gas with CCUS, or more efficient auto thermal reforming of natural gas combined with CCUS. As the CCC Report notes on page 252 (first bullet)[i]:

"Significant reductions in natural gas consumption across buildings, industry and power in our net-zero scenarios are somewhat offset by new demand for gas to produce hydrogen."

If there was to be no continued onshore natural gas production, or exploration to assess the resource, under the UK continental shelf natural gas production (i.e. offshore) forecast by the Oil and Gas Authority (page 252 of the CCC Report)[i], the UK would be reliant upon imported gas to meet 86% of demand by 2050.

In 2017 the UK imported 475TWh of natural gas, and by 2050 the UK's import dependency is forecast under net zero conditions to be 515TWh (page 252 of the CCC Report), therefore representing a proportional and volumetric increase in natural gas imports from today.

The UK therefore has a choice – it can produce the resources needed to meet the energy demand of a net-zero economy domestically, or it can choose to import these resources, with consequent concerns over security of supply and an increasing carbon footprint.

It should therefore be a priority for the UK to meet the UK's recognised natural gas demand from the sources with the lowest pre-combustion emission footprint. The CCC's assessment in its 2016 report was that UK shale would have a pre-combustion footprint of 28g CO_2/kwh. By comparison, LNG is forecast to have a pre-combustion footprint of 57g CO_2/kwh and long distance pipeline is forecast to have a pre-combustion footprint of 68.5g CO_2/kwh. These imported sources have a more carbon intensive footprint given the significant distance over which they must be transported. The principle of using locally sourced gas applies regardless of the formation being targeted or the technology used to extract it. Further, onshore gas raises no issues of security of supply, a longstanding concern in Energy and Planning policy statements. Appendix 1 outlines in detail where the UK gets its gas from and the relative carbon intensities of that gas.

UK shale would offer at least a 50% pre-combustion emission saving over LNG and long-distance pipeline and reduce the carbon footprint of the fuels the UK consumes.

This conclusion is mirrored in a recent report produced by the Department for Business, Energy and Industrial Strategy ("BEIS")[ii] which similarly concluded that onshore natural gas production would offer significant emission savings over LNG (see page 8 of the BEIS report). Again, the argument for developing local, lower pre-combustion emission gas sources is relevant regardless of the formation.

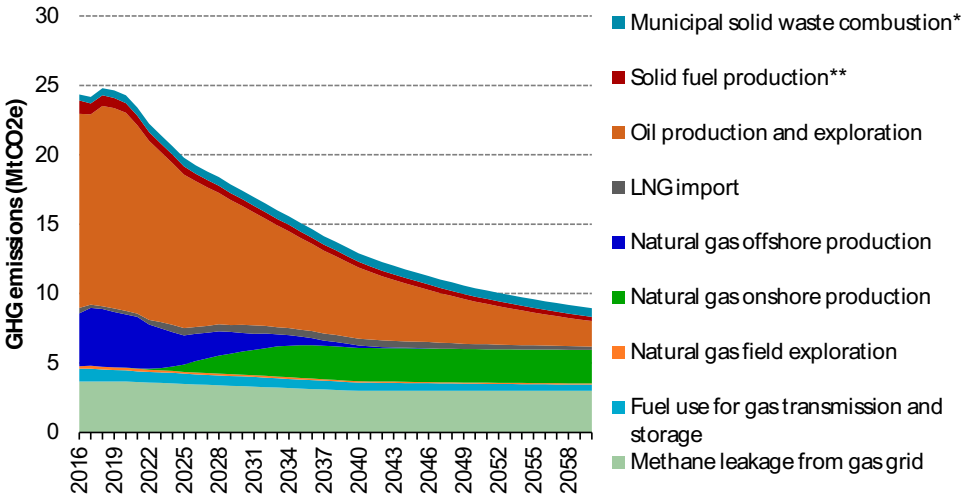
The CCC states very clearly as follows (first bullet point on page 106 of the CCC Report):

"The design of the policy framework to reduce UK industry emissions must ensure it does not drive industry overseas, which would not help to reduce global emissions, and be damaging to the UK economy."[i]

In addition to the details set out above in relation to pre-combustion emission gas sources, it is clear that the CCC recognises that an offshoring of oil and gas production is not constructive for domestic energy production. It is also clear that the only conclusion one can come to in this regard is that it should be a priority for the UK to source that natural gas from the sources with the lowest pre-combustion emission footprint. Otherwise, the CCC's recommendation to not offshore the UK's emissions cannot be met. This, of necessity, requires the consent of exploration development as a necessary pre-cursor to (i) understanding the nature and size of any resource and (ii) production.

The CCC Net Zero report does not direct decision makers to apply different statutory or planning principles and/or tests to those stipulated within the CCC's March 2016 report 'Onshore Petroleum: The compatibility of UK onshore petroleum with meeting the UK's carbon budgets'[iii].

Finally, the Net Zero supporting documents identifies a significant and growing production emissions envelope for onshore gas production, demonstrated in the following graph produced by the CCC[iv]:



2016 Report from the CCC

In 2016, the CCC released a document entitled 'The compatibility of onshore petroleum with UK carbon targets'[iii]. This report provided an assessment conducted under a 2°C scenario. However, the principles and tests stipulated therein apply equally to the net zero 1.5°C target. The CCC Report does not direct any other interpretation in this regard.

The tests (essentially) are:

Test 1: Well development, production and decommissioning emissions must be strictly limited.

Test 2: Consumption – gas consumption must remain in line with carbon budgets requirements.

Test 3: Accommodating shale gas production emissions within carbon budgets.

With regard to Test 1, UK onshore oil and gas operators have agreed to apply the Best Available Techniques ("BAT") for gas management. Following thorough analysis of gas management techniques for onshore oil and gas sites, the Environment Agency concluded that flaring was BAT for exploration sites and this is controlled by Environmental permit.

With regard to Test 2, under the net zero target proposed by the CCC, the UK would require a significant volume of natural gas throughout the transition to a low carbon economy and similarly at the outcome destination, no forecasts however have gas consumption rising relative to 2010 consumption.

With regard to Test 3, the requirement that the 'extra' emissions should be accommodated is for Government, and as explained above – it should not be achieved by offshoring industry.

The CCC's Net Zero report does not identify any amendment to or revocation of the CCC's comments in the 2016 report advising in respect of the need for exploration, which states:

"In order to start to ascertain the UK reserve, a period of exploration would be required to find the most productive areas in the shale formation. … If flow-rate levels consistent with commercial exploitation can be established over a number of exploration wells the industry might then move on to development well drilling and the production phase of operations."

The three tests set out within the CCC's 2016 report remain extant and relevant and for central government and to a lesser extent the Environment Agency to opine and regulate on.

Buffer Zones

The Joint Mineral Planning Authorities identified in previous submissions that their justification for a buffer zone is based on noise, light and landscape issues. These have already been adequately discussed. At no point has any justification for a buffer zone been made on the basis of climate change and no reference made, let alone weight, given to the Mobbs report by the Joint Authorities or anyone else.

Specific issues around climate change are not related to proximity to other development and those that are, are adequately controlled by other regulators:

Paragraph 183 of the National Planning Policy Framework July 2018 (Framework) and Paragraph 112 of Planning Guidance (ID: 27-120-20140306) are very clear about the different roles that mineral planning authorities (MPAs) and regulatory bodies have and that MPAs should assume that those regulatory regimes will operate effectively.

With respect to aspects relating to climate change, we draw to the Inspector's attention to the roles of those other regulatory bodies as follows:

The Environment Agency (EA)

The EA's remit concerns the protection of the environment and human health through the regulation of emissions to air, water and land.

Environmental regulation specific to climate change requires the following Environmental permits:

- Management of extractive waste – through a waste management plan.
- Industrial Emissions Directive – when the intention is to flare more than 10 tonnes of natural gas per day (generally applies to exploration phase only).
- Medium Combustion Plant Directive (as enacted by the 2018 amendment to the Environmental Permitting Regulations) – relating to combustion plant such as generators with lower thermal input.

Health and Safety Executive (HSE)

The HSE monitors shale gas operations from a well integrity viewpoint to ensure no leaks from wells – this is undertaken through the Offshore Installations and Wells (Design and Construction, etc.)

Regulations 1996 (DCR). The design and construction of the well is key to subsurface environmental protection. Through the use of multiple physical barriers of casing and cement, as well as utilising natural impermeable geology layers as protection, the well will prevent the migration of hydrocarbons or well fluids into the surrounding rock formation or ground water bodies.

Exploration versus Production

The CCC brings forward in their 2016 report an important point which is the need for exploration ahead of production and indeed the three tests are exclusively with respect to production. The CCC acknowledges the need for exploration and any emissions to be relatively small and manageable *"[exploration] emissions are generally small …", that "[small] volumes of gas may be generated during the development of the well, most of which is likely, at a minimum, to be burned in a flare."*

The need to plan separately for exploration is also highlighted in NPPF 209b *"Minerals planning authorities should: when planning for on-shore oil and gas development, clearly distinguish between, and plan positively for, the three phases of development (exploration, appraisal and production), whilst ensuring appropriate monitoring and site restoration is provided for;*

As highlighted above we believe that the current modified Plan adequately covers the climate change issues that the Joint Mineral Planning Authorities have an input to. However, in light of the evidence by the CCC and also guidance with respect to planning separately for the three phases it is considered that the wording to Policy M17 needs to be further modified to ensure that climate change issues relate solely to production. The proposed further changes are highlighted in red below:

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 for production activities should specifically address the potential for cumulative impacts of development upon climate change and, where appropriate, propose such mitigation and adaptation measures as may be available and are consistent with Policy D11, government policy and best available techniques from the Environment Agency.***

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 production proposals, should be accompanied by a climate change assessment as appropriate in line with government policy and Environment Agency Best Available Techniques***

The Mobbs Report

Given the judgement did not opine on the merits of the Mobbs report we urge caution in seeking to bring this forward in the current discussion of the Plan. The response to climate change and in

particular the relevance of research and actions required under the Climate Change Act 2008 as amended should be left to central government as is very clearly stated within the act.

As referred to above, the Mobbs report was submitted into evidence by Talk Fracking as part of the NPPF consultation and therefore no one has had an opportunity to submit relevant scrutiny of the report. UKOOG anticipates as a result of the Inspector's invitation for parties to '*submit scientific or other evidence as a consequence of the judgement'*, that the Mobbs report will be submitted to her by others. We have therefore submitted a review of the report at appendix 2.

In summary the paper is an attempt to undermine the analysis and conclusions in the Mackay & Stone report which the UK Government has used to justify their approach to shale gas, and specifically its role in the transition to a low carbon economy.

Mobbs puts forward a view on the carbon footprint of shale gas contrary to the currently held belief that shale gas in terms of emissions is better than coal and imports from Liquified Natural Gas and similar to non-shale oil and gas extraction.

Our review of the Mobbs report concludes that the analysis conducted by McKay & Stone still stands and agrees with the similar conclusions reached by The Committee on Climate Change[iii] Sustainable Gas Institute[v], Royal Society[vi] and the analysis for the Northern Territory[vii] which is in direct contrast to Mobbs' assessment. In addition, we also agree with the conclusions in 2017 in a report produced by the Tyndall Centre for climate research on behalf of Friends of the Earth that short distance unconventional gas (i.e. shale gas) would offer a life cycle emission saving over both LNG and long-distance pipeline gas[viii].

In summary our points on the Mobbs report are as follows:

- The specific promotion by Mobbs of top down analyses of fugitive emissions ignored the fact that those techniques at the time could not identify the source of methane they were analysing. More recent research identifying where sources of methane originate conclude that previous results from bottom up analysis still stand.
- The Howarth analysis is used almost exclusively by Mobbs. This analysis was regarded as an academic outlier by both Mackay and Stone and the Committee on Climate due to distortion of data. In addition, the data used was prior to the changes in US regulation in 2015.
- Mobbs criticises both the emissions and production data used by Mackay & Stone. Analysis of recent data actually shows that the MacKay & Stone report has overestimated the impact of emissions and underestimated the recoverable volumes per well (EUR).
- The 'Mobbs' report proposes the use of a higher and short term global warming potential for methane, which is inconsistent with the recommendations made in the net zero report from the UK Committee on Climate Change. For clarity, the CCC recommend the use of a GWP of x25 over 100 years (the standard for international and domestic emissions accounting) until the year 2024, where it will be upgraded to either x28 or x34.
- The Allen research is criticised because it was part funded by the industry but Mobbs ignores that the Howarth report was part funded by anti-fossil fuel groups.
- The 'Mobbs' report makes no attempt to review the analysis of data in the context of UK regulation and does not comment on the comparative emissions footprint of LNG.

Overall, the Mobbs report is agenda driven and poorly argued. It assumes the worst-case scenarios for gas management and estimated ultimate recovery volumes per lateral well. UKOOG actively welcome scrutiny of our operator's operations and of the many benefits of UK shale gas production they purport. However, the Mobbs report does not meet the required standards to justify an amendment to UK regulations or to UK government policy.

Appendix 1

The importance of indigenous production of methane for Net-Zero

Where we get our gas from today

Today, the UK consumes around 2.5 trillion cubic feet of natural gas per year, however it imports 50% of that demand. The majority of these imports come from Norway, however over the coming decades our import sources are very likely to be dominated by carbon-intensive and far afield gas sources, from Russia, Qatar and Peru. By 2035, the Oil and Gas Authority expect that 72% of our natural gas supply will be from overseas[ix]. European gas dynamics are changing with Norwegian gas production expected to fall by 25% in the coming years[x], the Netherlands moving to a gas import position for the first time and Europe becoming ever more dependent on Russia[xi]. **This is likely to mean that the UK's reliance on LNG will increase significantly**.

Over the last 6 years, the dominant source of LNG to the UK has been Qatar, however over the last 2 years in particular there has been increased diversification of LNG sources, as in shown in Chart 1. For example, in November 2015 the UK imported around 1 million tonnes of LNG, and of this supply, 90% came from Qatar, 5% came from Algeria and 5% came from Trinidad and Tobago.

By contrast, in December 2018, when the UK imported around 1.15 million tonnes of LNG, around 6% came from Qatar, 50% came from the USA, 30% came from Russia and the remainder was sourced from Trinidad and Tobago and Nigeria.

Independent consultants last October concluded in their gas security report to Government that "the main insight from this work is that price is the primary determinant of whether sufficient gas is available to meet GB demand" and that "**gas tends to flow to those who are willing to pay for it.**"[xii]

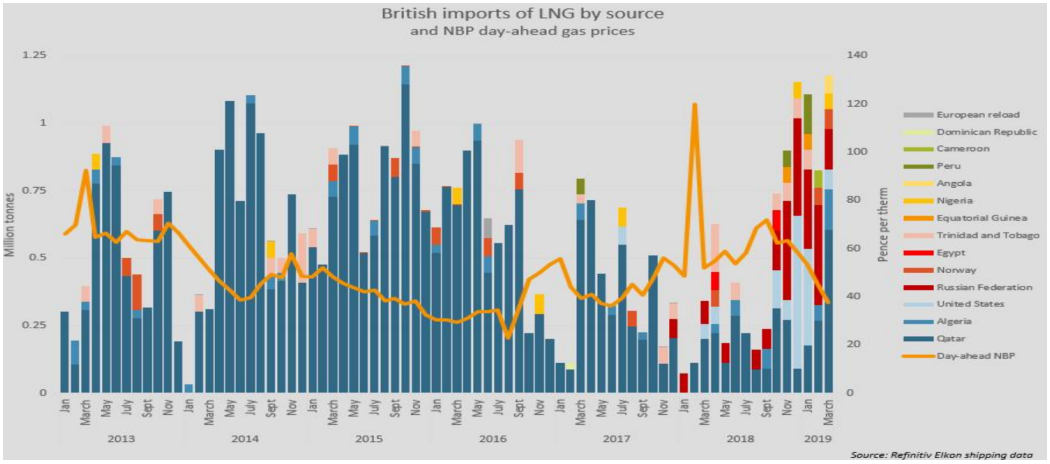


Chart 1: Historical sources of natural gas

Future Scenarios – Net Zero

The CCC forecast that the UK would require 600 TWh (55bcm) of natural gas in 2050. This requirement equates to a 32% reduction in UK gas demand from today[i]. Based on forecasts by the Oil and Gas Authority for the UK Continental Shelf (UKCS) natural gas production (i.e.

offshore), the UK would therefore be reliant upon imported gas to meet 86% of demand by 2050[i]. Such a level of imports represents a significant increase from today, where 50% of our natural gas is imported. The OGA forecasts are clearly based on what is known now, however the strategy of maximising economic recovery must not be underestimated.

In their net zero report, the CCC states very clearly that **offshoring of emissions is simply not acceptable**: *"The design of the policy framework to reduce UK industry emissions must ensure it does not drive industry overseas, which would not help to reduce global emissions, and be damaging to the UK economy.*[i]*"*

Subsequently, UKOOG has clarified with the Committee on Climate Change that this statement includes the production of fossil fuels.

It is now beyond argument that the UK needs a secure long-term supply of natural gas to meet our net zero targets. It should be beyond argument that the UK sources that natural gas not only from a diverse supply, but also **with the lowest emissions footprint** – that being domestically produced onshore and offshore natural gas. Not doing so will ensure that the CCC net zero recommendations are not met.

The degree to which the UK is reliant on more carbon intensive imports for future natural gas demand is almost entirely dependent on the scale of the UK shale gas industry and the successes of the MER program offshore.

The Climate Impact – imports versus UK Production

Appendix A outlines the current research with respect to carbon emissions and different types of methane supply (LNG, long distance pipeline and UK indigenous gas). The research predicts a significant range across each source dependent on assumptions of proximity to the UK and different operational parameters. Appendix A importantly also highlights the potential range of imports that will be available in 2050 – many of the lower emission sources will not be available.

What this research shows is that [using central forecasts] UK indigenous gas (including shale gas) emissions are at least half that of LNG or long distance pipeline.

The economic impact of imports

Developing domestic resources prevents the offshoring of the UK's environmental responsibility and economic opportunity. For example, the UK spends £7 billion a year (£13 million per day)[xiii] on natural gas imports.

In 2018, 20% of our LNG imports were sourced from the Yamal Peninsula in the Russian Arctic[xiv]. The UK paid £1 million per day to import Russian LNG, and no domestic tax receipts were generated, as is the case with all imported fuels.

From 2020 to 2050 under a 2°C carbon budget, the UK is forecast to import over 50 trillion cubic feet and 6.8 billion barrels of oil (while satisfying UK carbon targets). These imports would represent an offshoring in excess of £650 billion. Assuming under a net zero scenario the UK will be reliant on

imports of between 40 trillion cubic feet and 52 trillion cubic feet to fuel a net zero economy over the next 30 years, that will cost UK businesses and consumers in excess of £300 billion alone.

Appendix A – Carbon emissions – Gas Imports versus UK Production

Table 1: Pre-combustion footprints associated with each methane source from published research

GHG emissions per unit of thermal energy gCO2e/kWh(th)	LNG (source Mackay and Stone analysis[xv])	Long Distance Pipeline (LDP) (source Mackay and Stone analysis[xv])	United Kingdom Continental Shelf (North Sea) (Mackay and Stone Analysis[xv])	UK Shale Gas (forecast – Source CCC report on compatibility of onshore petroleum)[iii]
High	89	80	15	53 (71 if venting and very low EUR)
Central Value	57	68.5	13	28
Low	38	42	8	14

Published research indicates ranges of carbon emissions against each source of methane as highlighted in the table above. These ranges cover a number of different variables:

Liquefied Natural Gas (LNG)

LNG can have a variable emission footprint dependent on upstream practices and distance from production to consumption. Some examples are included below:

"Minimum" emission LNG

The primary example of this is LNG produced from the Norwegian continental shelf, using mains electricity in the terminal and to liquefy the natural gas. The electricity in Norway is 97% low carbon (mostly hydropower)[xvi].

Norway is also in a near-arctic environment, meaning the temperature difference between the surrounding environment and desired end temperature of LNG is less than in other countries.

The carbon impact of liquification is therefore smaller by comparison to alternatives.

The distance from Norwegian LNG terminals to UK terminals is also quite short (<1000 km), therefore the fuel demand for transport is relatively low and the risk of methane 'boil off' (where the methane returns to its gaseous state) is less so.

The upstream footprint of Norwegian LNG to the UK is therefore on the lower end of the scale.

However, the volume of Norwegian LNG imported into the UK is very small, and the Oxford Institute for Energy studies have forecast that the Norwegian continental shelf will have declined by 25% by 2030. By that time, Norway can supply, at maximum, 17% of European natural gas demand[xvii]. By 2050, Norway's offshore oil and gas production will be severely limited compared to 2018 production and is unlikely to contribute significantly to the UK's net-zero targets.

"Maximum" emission LNG

This is where natural gas is produced not using best available techniques increasing the production carbon intensity e.g. venting/high bleed pneumatic controllers (which are by comparison heavily controlled by regulation in the UK).

A good example of this is in Qatar where there are no specific limits or regulations on venting and flaring of natural gas, and companies are not required to report their methane emissions[xviii]. The opposite is true in the UK.

Qatari gas is then transported and frozen to -163°C. Ambient temperatures in Qatar regularly exceed 40°C, meaning the temperature difference between ambient and desired is higher than in other countries, e.g. Norway.

Similarly, the liquification process in Qatar involves the use natural gas fuelled electricity – the Sustainable Gas Institute (SGI) estimated that the liquification of natural gas in Qatar requires the equivalent of 12% of gas throughput to achieve the liquid state required[xix].

This liquified natural gas then must be transported 11,000 km to the UK[xx] – this distance requires a greater proportion of fuel oil than local sources, and also increases the distance over which the methane can boil-off.

Some tankers have boil-off management technologies; however, these are not widespread in the sector and in many cases much of the boil-off gas is simply released to the atmosphere. As the Sustainable Gas institute noted '*there is limited transparency of the sources of these emissions and there is very little detail in particular on fugitive emissions*'[xx].

The CCC also noted in their 2016 assessment on the compatibility of onshore petroleum with UK carbon targets that '*There is a lack of transparency in the literature for LNG, so it is not possible to speculate how reliable the emission estimates are. Further work is required in order to improve our understanding of the emissions relating to LNG supplies*[iii].

The Oxford institute for Energy studies concluded that an LNG tanker of good quality would leak the equivalent of 0.15% of its LNG load per day. Assuming a travel time in excess of 14 days, that means around 2.1% of the useful load could be emitted to the atmosphere, the equivalent of around £300,000 worth of natural gas[xxi].

The SGI have also calculated that the equivalent of 1.5% of natural gas throughput is used to regasify LNG at ports, such as the Isle of Grain[xx].

Other LNG Considerations

Other consideration which varies across regions include

- The amount of processing required to make the gas suitable for liquification. Some gas sources require minimal processing (e.g. dry gas from the Marcellus shale), however other sources (such as Nigeria & Angola), can be rich in impurities including H_2S and CO_2 which are emissions intensive to remove and process. Water rich formations can also be more emissions intensive to manage.
- The SGI noted that emissions data on processing of various gas sources is very poor, and more work is required to understand how different variables affect emissions.
- Core data from the UK Bowland shale has demonstrated a world class resource, with low to no existence of H_2S and low volumes of CO_2
- The end use method for phase change (liquid to gas) will impact the overall emissions intensity. For example in the Mediterranean, warm sea water is commonly used in summer months to convert the LNG to natural gas for use in homes, whereas in the UK gas fired engines must be used to return the LNG to its gaseous state because the sea temperature is not at an adequate temperature. As stated above, the energy use to achieve this is the equivalent of 1.5% of overall LNG load.
- Calorific value of LNG: Some LNG tankers are richer in longer chain hydrocarbons e.g. propane, and therefore require dilution upon arrival in the UK. This process has been estimated to cost LNG operators £350 million per year for the UK alone, and can be emissions intensive. This is currently a topic of focus for the CCC, who commissioned an assessment on the opportunities for emissions reductions in the fossil fuel industry. Wider academia, such as the National Physical Laboratory are also undertaking assessments of LNG facilities.
- The LNG tanker must then return empty to the source country, which is a consideration rarely given much attention in literature. This journey will require more fuel use, and hence, more emissions.

Long Distance Pipeline (LDP)

LDP natural gas is from regions such as Algeria and Russia.

There are two key considerations for the emissions intensity of long-distance pipeline gas; age & quality of pipeline and distance travelled.

Nord stream 2 directly into Germany is likely to have less leakage than the pipes which transect Ukraine and have been there since 1950. Also, the greater the distance the greater the leakage. A recent Tyndall centre on climate change research paper concluded that a doubling of pipeline distance increases overall fugitive emissions by 40%[xxii]. Estimates have suggested that the leakage from Russian pipelines to Europe are in the range of 5 to 7 %[xxiii], by contrast the UK CCC have forecast a methane emission rate from UK shale to be 0.5% under the regulation applied in the UK[iii]. Similarly, the greater the distance the greater the amount of compression required – hence more energy to transport the gas.

UKCS

The pre-combustion footprint of the UKCS is very low. Although the emissions associated with the development of offshore natural gas appear high, the emissions relative to the volume of gas

extracted per well means the overall emissions footprint is low. The UKCS was one of the first offshore fields in the world to pioneer the capture and utilisation of associated gas from oil wells, meaning that gas is treated as a resource rather than flared or vented as a waste gas. Around 50% of the gas consumed in the UK is actually associated gas from oil wells, rather than gas from gas wells[xxiv].

Natural gas production in the UKCS has declined by 64% from 2001 to 2016[xxv], and although the MER process will ensure the reserves are exploited as successfully as possible, the total gas requirement under the CCC net zero forecasts cannot be met by the UKCS alone. This reality is even more pronounced in the colder times of the year where 63% of natural gas consumed in the UK is imported[xxvi].

UK Shale Gas

The most significant variable (at least for the UK) in terms of pre-combustion footprint is the estimated ultimate recovery (EUR) of the well –. The emissions associated with the drilling and initial testing requirements are relatively constant (although can vary slightly depending on the depth and length of the well). The CCC for their central forecast have an EUR of 1.6bcf for a 2km well. The Current UKOOG central forecast is for a 2.5km well to produce 5.5bcf and therefore the real pre-combustion emissions value is likely to be significantly below the central forecast from the CCC[xxvii]. Under a high EUR forecast, the CCC acknowledge that UK shale gas could have a pre-combustion footprint as low as 14 g CO_2/kwh[xxviii].

Subsequent analysis commissioned by the CCC for their net zero report concluded that UK shale could readily have a pre-combustion footprint of 13.8 g CO_2/kwh[1]. This would occur where techniques such as Leak detection and repair and Reduced emissions completions are applied, which of course the industry is already doing or has committed to. This pre-combustion value is comparable to the lowest value suggested by the CCC in their 2016 report.

Appendix 2 – Review of the Mobbs Report - Whitehall's Fracking Failures - How The Government Has Misled Parliament And The Public On The Climate Change Impacts Of Shale Oil And Gas Development In Britain - A Report For Talk Fracking

Summary

The report produced by Paul Mobbs is an attempt to undermine the analysis and conclusions in the Mackay & Stone report which the UK Government has used to justify their approach to shale gas, and specifically its role in the transition to a low carbon economy.

Mobbs puts forward a view on the carbon footprint of shale gas contrary to the currently held belief that shale gas in terms of emissions is better than coal and imports from Liquified Natural Gas and similar to non-shale oil and gas extraction.

This paper reviews the Mobbs analysis and brings up to date research completed since his report was published.

UKOOG agree with the conclusions reached by The Committee on Climate Change[5], Sustainable Gas Institute[43], Royal Society[44] and the recently completed analysis for the Northern Territory[45] which is in direct contrast to Mobbs assessment. In addition, UKOOG also agrees with the conclusions in 2017 in a report produced by the Tyndall Centre for climate research on behalf of Friends of the Earth that short distance unconventional gas (i.e. shale gas) would offer a life cycle emission saving over both LNG and long-distance pipeline gas[46].

In agreement with the groups above, the Tyndall paper states that for long distance natural gas pipelines, a doubling of distance will increase the emissions by 30-35%. It stands to reason that the UK should minimise the pipeline distance from well to wire, wheel or home.

Key highlights of our report include:

- A specific promotion by Mobbs of top down analyses of fugitive emissions ignored the fact that those techniques at the time could not identify the source of methane they were analysing. More recent research identifying where sources of methane originate conclude that previous results from bottom up analysis still stand.
- The Howarth analysis is used almost exclusively by Mobbs. This analysis was regarded as an academic outlier by both Mackay & Stone and the Committee on Climate due to distortion of data. In addition, the data used was prior to the changes in US regulation in 2015.
- Mobbs criticises both the emissions and production data used by Mackay and Stone. Analysis of recent data actually shows that the MacKay & Stone report has overestimated the impact of emissions and underestimated the recoverable volumes per well (EUR).
- The Allen research is criticised because it was part funded by industry but Mobbs ignores that the Howarth report was funded by anti-fossil fuel groups.
- The Mobbs report makes no attempt to review the analysis of data in the context of UK regulation and does not comment on the comparative emissions footprint of LNG.

Overall, the Mobbs report is an agenda driven and poorly argued report – which assumes the worst-case scenarios for gas management and estimated ultimate recovery volumes per lateral well. UKOOG

actively welcome scrutiny of our operations, and of the many benefits of UK shale gas production, however the report does not meet the required standards to justify an amendment to UK regulations or to UK government policy.

Introduction

In recent years there have been a number of peer reviewed studies undertaken in the UK concerning the impact of shale gas on emissions and UK carbon budgets. Principle among those is the MacKay and Stone report published in 2013 which forecast that shale gas could have life cycle emissions some 10% below the equivalent product from imported liquefied natural gas (LNG)[24]. UK shale would offer a pre-combustion emission saving of 50% when compared to LNG or long-distance pipeline imports[24]. The Committee on Climate Change report was produced in 2016 and stated that three tests needed to be met to allow shale gas to be consistent with the UK Climate Change Act (2008) and its carbon budgets[5].

A report by Paul Mobbs[1], 'Whitehall's fracking failures,' commissioned by 'Talk Fracking', was handed to the Archbishop of Canterbury on Tuesday 23rd May 2018. It criticised the peer reviewed work by Professor David MacKay and Dr Timothy Stone[24] produced in 2013, stating: "Our report proves that the MacKay-Stone report is riddled with false and out of date input data. The input data used in this report is clearly inconsistent with published, publicly available data. The inconsistencies should have been highlighted to Ministers by government advisors immediately upon publication[1]."

It is also unclear as to whether the Mobbs report has been peer reviewed. However it should be noted that the comments made in the paper are not new and have been expressed by the author in the past.

For reference this response has been written by UKOOG using referenced peer reviewed data. UKOOG is the representative body for the onshore oil and gas industry and as such is fully funded by members of the industry and was set up to reflect the views of the industry.

We make no comment about the political statements made in the report as this is for others to comment on. Our response concentrates on the factual information relevant to this area.

The Mobbs Report

The fundamental message from the Mobbs report is that emissions associated with shale gas extraction are higher and the extractable volumes are lower than is stated in the MacKay & Stone report. We believe that this contention is wrong, The report misinterprets information to achieve this conclusion.

Mobbs uses six major rationales

1) Shale gas should not be treated as a transition fuel
2) Bottom-up measurements are prioritised, when top-down should be used
3) The 2011 paper by Howarth and the 20 year Global Warming Potential (GWP) of methane should be used
4) The emission factor used by MacKay and Stone is incorrect

5) A University of Texas study by Allen in 2013 is industry influenced, functioned to exclude Howarth's data and used malfunctioning equipment

6) The Committee on Climate Change report production emissions (test 3) cannot be met[1]

This review will address each issue in turn.

1) Shale gas as a transition fuel

Mobbs suggests that former SoS, Ed Davey, misled Parliament in his statement in 2013 when he said that "*gas is the cleanest fossil fuel, [and] is part of the answer to climate change, as a bridge in our transition to a green future, especially in our move away from coal".*

Gas is the cleanest fossil fuel, with a combustion emission factor half that of coal per $kwh_{(e)}$[24]. In 2012, which was the most up to date set of annual figures on consumption used by Mr Davey, coal was the fuel source for 40% of UK power generation[2]. Since 2012, coal use has been driven out of the UK power sector with the primary vehicle being the UK carbon price floor of £18/ tonne CO_2. The transition from coal to natural gas and renewables has been a very effective mechanism. Collectively, the uptake of renewables and natural gas has prevented 1.6 billion tonnes of CO_2e from being emitted from the power sector since 1990[48]. This has reduced UK CO_2 emissions to their lowest level in 125 years[23].

The energy transition has decarbonised the UK power sector emissions from over 550g CO_2/kwh in 2012 to a 12-month average of 300g CO_2/kwh in 2015/2016[33,34]. In 2016/2017, the UK achieved power grid intensity of around 250 g CO_2/kwh, making it the 7th least carbon intensive grid globally[38]. This is a great achievement for a modern industrialised nation. By comparison, Germany, Holland and Italy all have power sector carbon intensities greater than 400 g CO_2/kwh[38].

Natural gas is a critical fuel source for the UK, and together with oil it provides 75% of final energy demand. By comparison, wind and solar power provides less than 3% of UK energy demand. Renewables do provide around 30% of UK power demand, however the 320 Twh power demand is reflective of less than 20% of total energy demand. Gas has for example been the most important fuel for decarbonisation to date, being responsible for 5 times the cumulative carbon saving of wind and solar power since 1990[48].

Given this rapid decarbonisation, coal no longer represents a large proportion of the UK power mix, meaning there is less of a bridge to traverse[2]. Furthermore, the total removal of coal does not mean that natural gas will not be part of the transition to a green future. Production of shale gas could hasten the process of coal removal from the UK power sector before the target close date of 2025, and , if coal was to be completely removed in 2019 and replaced by natural gas, the UK would save 16 million tonnes CO_2e per year[5]. Similarly, the cumulative demand for natural gas will exceed 1300 billion cubic metres between now and 2035 while satisfying carbon targets[5], and under the National Grid Gone Green Scenario (where the UK meets all carbon targets) 800bcm of natural gas must be imported during this period[3]. Between 2020 and 2050, the UK will have to import between 900 bcm and 1450bcm to meet demand if UK shale gas is not developed[3]. As natural gas in the UK's local gravity (i.e. UK, Norway, Holland) depletes further, a greater proportion of these imports will be more carbon intensive than UK shale gas, such as Russian pipeline gas and LNG[3]. It is for these reasons that UKOOG believe natural gas to be pivotal in the transition to a low carbon future and that shale gas produced

domestically will satisfy carbon targets, reduce import dependency and form part of the 'Clean Growth Plan'.

The National Grid Future energy scenario 2017 clearly states that '**Gas is critical to security of supply now and as Britain continues the transition to a low carbon future. It will have a long-term role as a flexible, reliable and cost-effective energy source**'

When coal has been removed from the system in the UK, given all the forecasts for gas consumption and the forecast decline in North Sea production there will be a clear choice between domestically produced shale gas and imported gas. It makes logical sense that a properly regulated shale gas industry will produce gas with less emissions than gas that has to be liquefied, transported across oceans and continents to then undergo regasification in the UK. This was the central tenet of the MacKay & Stone report.

It is UKOOG's considered perspective that if the UK can be seen to meet its strict carbon targets with carbon intensive gas imports, such as LNG – then it can certainly meet them through the use of lower carbon domestic shale gas. Failure to develop domestic resources is a guarantee that the UK offshores its environmental responsibility and economic opportunity to meet our domestic energy demands.

2) Bottom up vs top down measurement of methane

Methane emissions in the UK from the energy sector are 13% of total annual anthropogenic (originated by human activity) methane emissions under the most recent BEIS analysis[4]. The two largest sources of anthropogenic methane in the UK are animal agriculture (51%) and waste management, (33%)[4].

The Mobbs report criticises the use of bottom up measurement of unconventional oil and gas infrastructure as opposed to top-down measurement. MacKay and Stone utilise bottom up investigations in their studies as do the Committee on Climate Change, (CCC) in its report[5, 24].

Mobbs claims that the CCC did not investigate the 'flaws' in the MacKay and Stone report to include the appropriateness of bottom-up measurement against top-down[1], but this is incorrect[5]. The CCC report justifies the utilisation of bottom up measurements because at the time of publication the top-down studies did not have sufficient resolution to identify the sources of emissions[5]. Also, the CCC stated clearly it would "keep top-down measurements under review to ensure that our estimates from onshore evidence reflect the available evidence as best as possible"[5]. The bottom up analyses used were also not only 'inventory' analysis, but involved the application of facility wide instrumental technologies.

For clarity, the definitions of 'top down' and 'bottom up' have been muddled in some academic papers. UKOOG believe it is more appropriate to refer to emissions assessment on a component, site and multi-site basis.

This is a large flaw in the Mobbs report; it is not in doubt that global atmospheric methane emissions have risen since 2009[25], but the inability for quoted studies to quantify the proportion of methane emissions and attribute them to specific sources promoted much uncertainty in methane apportionment to hypothesised sources. Some studies conducted do suggest that in some regions of the US, poor regulatory standards have resulted in methane emissions which exceed EPA estimates of

1% upstream leakage rates, such as in North Dakota[6]. This was identified by the presence of ethane in the atmosphere which is not known to be emitted from biogenic sources (produced by plants and animals) and must be from thermogenic sources (from hydrocarbon reservoirs)[6].

Earlier studies were incapable of identifying proportional methane sources (i.e. how much methane came from biogenic and thermogenic)[6]. Mobbs cites a paper which 'postulated' that US shale gas could be a factor in increased methane emissions globally, but the paper clearly states 'we cannot readily attribute it (methane) to any specific source type'[35]. The Environmental Defence Fund, one of the world's largest environmental NGOs, has conducted over 16 studies on methane emissions over the past seven years[26]. This organisation identified an inability to differentiate methane sources and specific thermogenic sources[26]. As regions of shale gas production in the US typically have long histories of other hydrocarbon production, there is large potential for thermogenic gas emissions from conventional sources, natural seeps and coal mines, all of which can distort results[6, 26].

An analysis of UK decommissioned sites sought to address a baseline of potential thermogenic emission source to inform further analysis.

A study was undertaken of 103 decommissioned onshore oil and gas wells in the UK and on average they emitted 15 kg CH_4/year, the equivalent emissions of about 1/8 of a dairy cow[39]. By comparison, an analysis of decommissioned wells in Pennsylvania demonstrated an annualised average flux of 100 kg CH_4/year, which is almost 7 times as much as a decommissioned well in the UK emits[39]. The disparity in annualised emissions is clear evidence of the differences in the management of emissions to air and of regulatory standards.

It is also useful to use information and data from offshore sampling campaigns to enable both comparison to onshore as well as comparison to other countries. In 2013, a detailed top down analysis took place over the North Sea in which methane and its respective isotopes were recorded[40]. The isotopic 'character' of the methane detected enables scientists to show where the methane was sourced from (be that biogenic or thermogenic)[40]. The measurement devices detected a significant methane plume across the North Sea and 'had isotopic analysis not been conducted the likely conclusion would have been a gas field source of CH_4', the 'simplest conclusion'[40].

In reality, the majority of the methane was biogenic (therefore not from North Sea O&G production) and was being blown in from mainland Europe[40]. This 'cautionary tale' from UK data collection is one which the onshore oil and gas industry will apply to further work to ensure methane emissions from other larger UK sources (such as agriculture and waste management) are not incorrectly linked to UK shale gas development.

When analysis of methane emissions in the UK was extended to downstream, Durham University researchers concluded that the fugitive emissions from the National Transmission System (NTS) amounted to 0.29% of UK annual greenhouse gas emissions[41]. The researchers also concluded that this rate of emission was 'at the lower end of corresponding US studies'[41].

The scientific restrictions associated with earlier top down analyses were not included as a possibility in the Mobbs paper and assuming all the methane increase is from shale gas emissions alone is a poor representation of the facts.

Much of the research work included in the Mobbs report was conducted before the Environmental Protection Agency (EPA) Natural Gas star program mandated the use of emission mitigation techniques across the US, with Reduced Emissions Completions (REC) a legal requirement in only some states by 2012[30]. In 2015, the EPA introduced federal regulations making reduced emissions completions mandatory for all new gas wells in the USA from 2015 onwards[30]. The impact of this methane mitigation is reflected in recent top down studies. A 2015 Environmental Defence Fund sponsored study of the Barnett shale, one of the largest gas producing regions of the US, found a natural gas leakage rate of 1.1%[7]. This is complementary to the EPA 'Inventory of U.S. Greenhouse Gas emissions and sinks 1990-2016' report, which presented a 1.2% leakage rate from US natural gas systems.

Work conducted in 2013 with National Oceanic and Atmospheric Administration (NOAA) top down data raised concerns over the federal inventory underestimation of methane emissions in the US from fossil fuels and animal agriculture by a factor of two[16]. A study in 2015 using NOAA data (collected using the same technique), was conducted in the Hayesville, Fayetteville and Marcellus shale regions. These regions represent over 50% of US natural gas production, and the analysis revealed an average leakage rate of 1.1%. The report concluded 'national average CH_4 loss rate from shale gas production may be lower than values extrapolated from earlier studies'[8].

More recent studies of energy emission values reflects two important factors; 1) the improvement in regulation and technology over a short period of time and 2) that the deployment of top down measurement does not necessarily mean higher emissions will be measured[8].

In a recent top down study of methane emissions from Pennsylvania's Marcellus shale (a region which represents 20% of US gas production, an emission factor of 0.4% from the natural gas wells and surrounding infrastructure was calculated[42]. Such a study highlights that when appropriate technology is applied to apportion methane emissions to their actual source, the results are conclusive and affirm the sound environmental credentials of shale gas production.

Mobbs identifies the need for emission 'fingerprinting'- that is to assess methane source provenance. In April 2016, a methane isotopic identity analysis was conducted by Schaefer et al in a joint study involving the National Institute of Water and Atmospheric Research, the National Oceanic and Atmospheric Administration (NOAA) and the University of Colorado[27]. This study reconstructed the global history of CH_4 emissions over a 17 year period (1999-2016)[27]. The conclusion was that isotopic evidence revealed thermogenic methane was not the dominant cause in post-2007 methane growth, contradictory to many national and international emissions inventories[27]. A large increase in biogenic methane had been the primary driver of increased atmospheric methane abundance[27]. The final comment being that 'mitigating methane emissions must be balanced with food production requirements'[27].

A Bristol University study in September 2016, which addressed the same issue, was not included in the Mobbs paper which could have further identified what was causing the 'large increases in methane emissions' which Mobbs correctly says must be avoided[1]. Using global measurements of atmospheric methane data collected by the US NOAA, these samples were analysed to ascertain the $^{13}C/^{12}C$ isotope ratio of methane[9]. This data allows for source apportionment. The results conclusively state that an overall shift towards a more negative per mill value from 2007-2014 is reflective of the increase of

biogenic methane emissions[9]. **The authors also explicitly rule out US shale production as the causal factor in 'significant increases in global methane abundance'** given its methane isotopic enrichment value or 'distinct fingerprint'[9]. If there had been dominating emissions proportions of isotopically enriched gas (shale gas) in the atmosphere, this would have been identified, even on a local level[9]. It was not.

This data clarifies there is no industry attempt to 'exploit doubt' in measurement techniques as Mobbs suggests[1]. In reality, UKOOG members encourage the application of rigorous measurement technologies which are capable of identifying and apportioning any recording emissions appropriately.

3) The Howarth 2011[10] paper on the GHG footprint of shale gas in the US

The source data for the 2011 Howarth paper was an IHS report and EPA powerpoint[11]. The author of the IHS report sent out an immediate response to the Howarth paper which stated that the dataset used by Howarth had been totally distorted[11]. This was because the Howarth 2011 paper did not take into account the impediment of gas flow to the surface caused by flowback fluid, and the paper assumes the initial production rate to be a) continuous during well completion flowback and b) vented to the atmosphere[11]. This is an example of modelling of methane emissions as opposed to actually measuring methane emissions.

The CCC reveal that average measured well completion emissions to be 2% of that of average modelled emissions, with Howarth's example 12 times as large as the largest measured well completion emissions[5]. The CCC also demonstrated that the average measured well completion methane emissions from US studies were 0.175% of that of the modelled estimates in the Howarth study[5].

Under the 2011 Howarth analysis, the only difference between conventional gas fugitive emissions and unconventional gas fugitive emissions is a function of well completion[10]. Therefore, it stands to reason that if well completion emissions are managed, there is minimal difference between the two sources. The assumption that well completion flowback emissions are consistently vented across the US is incorrect, given the financial incentives to capture and utilise such gas[13]. As stated previously, the US EPA mandated the use of Reduced Emissions Completions on all new gas wells from 2015[30].

In the UK, Howarth's emission scenario could never be the case given that **venting of natural gas during the flowback period is strongly discouraged under UK law** and Reduced Emissions Completions are already considered 'Best Available Technique' by the Environment Agency[31]. Typically, the Environment Agency will award a permit under the agreement that venting of natural gas will only take place where it is necessary for safety reasons.

In a rebuttal response to criticism of his 2011 paper, Howarth stated that the modelling of well completion emissions was correct because 'a Shell engineer stated Shell never flares gas during well completion in its Pennsylvania Marcellus operations'[12]. This is an anecdotal, wholly inadequate and scientifically dubious justification of emissions potential literature. **Critically, no measurement of well completion flowback practice has been able to replicate the modelled emissions estimates in Howarth's analysis[5]**.

This is why Howarth's work was not added as part of the MacKay and Stone paper; the dataset was distorted and the practice implied is not applicable to the UK context.

Mobbs lays claims about the 'large methane emissions' associated with UK shale gas production but neglects to provide evidence of the source or mechanism which causes such emissions. Failure to do so exemplifies a lack of understanding of the UK regulatory framework and of UK onshore oil and gas operations in general.

The Mobbs report states that given the 'critical tipping points', we must avoid large changes in the emissions of critical greenhouse gases such as methane[1]. Methane emissions in the UK have decreased by 54% in 25 years, with 94% of reductions driven by improvements in energy supply and waste management[2]. At present, UK energy sector methane emissions are responsible for 1.3% of total UK GHG emissions, and total anthropogenic UK methane emissions are responsible for less than 0.15% of global GHG emissions[2].

The Global Warming Potential (GWP) of methane is 25 times that of CO_2 over 100 year time periods[13] given its potency over short time periods when compared to CO_2 (GWP of 1) [13]. Over 20 year timescales this increases to a GWP of 84 as the warming potential of methane is more pronounced over shorter time periods. The Mobbs paper states that the reason for using the GWP-20 figure is to avoid large emissions, but using the 20 year scenario hides the shorter atmospheric residence time of methane, which does not exceed 20-25 years[13]. Over longer time periods, CO_2 accumulates in the atmosphere, whereas methane does not. This is not a rationale to allow increased methane emissions, but the 100 year timeframe allows the display of the shorter residence time of methane in the atmosphere[13]. The CCC report uses the 100 year GWP stating that it is 'the international standard, and the domestic standard used for carbon budgets and the 2050 target'. The committee on climate change has consulted on whether or not to modify the global warming potential of methane.

To be so heavily reliant on one author and one paper estimate (Howarth 2011)[10] to justify an entire paper as Mobbs does is considered to be poor science[1]. This is especially more pronounced given Mobbs' apparent disincentive to include the subsequent Howarth paper in 2014 as part of the basis for the argument made[14]. This 2014 Howarth paper proclaimed that not only was unconventionally produced shale gas worse than coal, but it also claimed that conventionally produced gas was worse than coal![14]

This 2014 Howarth paper concluded that 'both shale gas and conventional gas have a larger GHG than do coal or oil for any possible use of natural gas'[14]. This paper did not receive the same attention and promotion from shale gas critics. The reason being that it did not differentiate one gas source being more preferable than the other in terms of its comparison to coal[14]. This paper is typically not used by critics of shale gas as the 'bogeyman' of unconventional gas production, well completion flowback emissions, (compared to conventional production) was removed as the alleged dominant causal factor in nullifying the shift from coal to gas[14]. Howarth's view has been heavily discredited and is typically regarded to as an academic outlier – critically because no subsequent study has been able to replicate the results (aside from those with the same author).

The claim that methane emissions from shale gas production nullifies the shift from coal to gas is a total misrepresentation of the peer reviewed evidence, and contrary to the conclusions which the

CCC[5], Sustainable Gas Institute[43], Royal Society[44] and the recently completed analysis for the Northern Territory[45] arrived at.

The life cycle emissions of different gas sources was also examined in 2017 by Friends of the Earth who commissioned the Tyndall centre for climate research to conduct a review of natural gas in Europe[46]. A conclusion of the study was that short distance unconventional gas (i.e. shale gas) would offer a life cycle emission saving over both LNG and long-distance pipeline gas[46]. Therefore, in agreement with the groups above. The paper states that for long distance natural gas pipelines, a doubling of distance will increase the emissions by 30-35%. It stands to reason that the UK should minimise the pipeline distance from well to wire, wheel or home, which means developing UK shale gas.

4) Criticism of the MacKay and Stone calculations

The Mobbs report claims that the MacKay & Stone report used low fugitive emissions and high gas production figures, thereby distorting the emissions per unit of production[1]. Mobbs claims that the MacKay and Stone report underestimated the emission factor by a factor of four[1].

The criticism is that the MacKay & Stone projections are based on emissions 'at least half of what is seen in the field' and well productivity twice that found in the USA[1]. These are both incorrect.

Firstly as regards emissions, the mechanism for large methane emissions, which Mobbs does not make clear, is based on assumptions of large well completion flowback emissions. As explained previously, these are mitigated with 'REC' or 'flareless' completions, which will reduce emissions by up to 98%[5]. This is 98% of measured well completion emissions; the maximum recorded to date is of 537,000 m^3 [5].

The Mobbs report also claims the central estimate for Estimated Ultimate recovery (EUR) numbers used in the MacKay and Stone report of 3 billion cubic feet/well is incorrect[1]. It also sources a US report which claimed lower range of gas production of 0.04 to 2.6 bcf/well[1]. This report is sourced from 2012, when innovation for shale production was in its adolescence. Using out of date EUR's is a common thread in academic studies where they have not engaged with industry, or researched up to date information. The same mistake was made in the Cardiff Business School analysis commissioned by Friends Of the Earth[49].

The increase in EUR (production of US wells) since the beginning of the shale revolution has exceeded all expectations. This has been the result of technical innovations, specifically the marriage of multi-stage high volume hydraulic fracturing and directional drilling, the latter of which was pioneered in the UK. A 2015 report had an average EUR in 2015 of 3.45 bcf[28]. Research conducted by the University of Oklahoma in May 2016 revealed a survey average shale well EUR of 5.1 billion cubic feet (bcf), and in the Marcellus shale an average EUR of over 8 bcf was recorded[32]. Mobbs' criticism is therefore out of date and does not account for the incredible results of innovation in drilling and stimulation practices in unconventional formations in the US.

UK exploration will have to take place to measure precise flow rates and therefore to calculate the emission factor. Considering the UK will utilise best available methane mitigation techniques and replicate best available extraction technologies from the US, it is difficult to understand the rationale

behind this assumption of a higher emission factor, considering these facts. Also, given that UK shales are up to 9 times thicker than US shales, there is potential for increasing the EUR per well if multi-lateral technology is developed[17]. A UKOOG analysis using the core and flow data from Preston New Road in Lancashire concluded that an unhindered shale well would on average produce 5.2 bcf over 20 years[50] – significantly higher than the Mobbs paper proposes.

Critically, Mobbs make no comment on the relative emissions intensity of LNG. The carbon footprint of LNG is very uncertain, and the CCC and Sustainable gas institute comment that 'generally lacking in transparency and most of the source data is not publicly available'. For the Mobbs paper to assess one comparison without assessing the reliability of the other is evidence of a biased view.

5) Criticism of Allen[15] paper

A report by Dr. Allen et al. of the University of Texas in date concluded an unconventional gas pad emission factor of 0.42% of gross gas production, lower than EPA estimates[15]. Through the direct measurement of well completion flowback fitted with REC, emissions during this period were shown to be 2% of the 2011 EPA national emission inventory estimates[15].

This study has been criticised in the Mobbs paper because of its apparent links to the oil and gas industry. In fact, Mr. Allen 'served as a consultant' for the Eastern Research Group and Exxon Mobil in 2012 and is on the current advisory board for the EPA[15]. There is no evidence of industry interference and again any accusation is anecdotal. In fact, work published by Howarth in 2014 on the GHG impact of natural gas was directly funded by the Park foundation. This foundation openly opposes the utilisation of shale gas[18].

Mobbs suggests that Allen's paper was used to 'justify excluding Howarth's data'[1]. **The MacKay and Stone report presents that distortion of the data, assumption of venting and a well emission factor 14 times the average of measured studies comfortably justifies the exclusion of the 2011 Howarth modelling estimate[24].**

The Mobbs report also stated that Allen had used malfunctioning equipment (the Hi-Flow device), which should make the whole study invalid.

A follow-up analysis of the Hi-Flow device suggested that it was possible that this particular piece of equipment failed under high flow rates[19]. However, **it was not the only measurement technique used in the Allen research**[15]. The Hi-flow device was only used to measure normal operation emissions, which have the lowest potential for methane emissions of any period[20]. During the measurement of 27 well completions, 4 well workovers and 9 liquid unloadings, (periods which have the greatest potential for methane emissions), direct flow rate and composition data was measured with other methane quantification instruments[15]. There has been no criticism of methane emissions measurement using these techniques during these periods and there is good agreement within these techniques and the Hi-Flow analyser. The Mobbs report therefore suggests that a series of instruments all failed at the same time, which is at the very least extremely unlikely.

Mobbs claims that the EDF 'rejected the study's findings' – however in correspondence with the EDF UKOOG confirmed that this was not the case.

UKOOG are very enthusiastic to pursue in depth analysis of the footprint from our operator's operations. Of all industries regulated by the Environment Agency in England, the UK onshore oil and gas industry is one of (if not the) best performing sector in terms of regulatory compliance. What the UK onshore oil and gas industry is doing and will continue to do is prove and improve its environmental performance. Doing so will enable the regulators, policy makers and consumers to be confident that the credentials of the fuel source they are consuming are clear, transparent and available. Such benefits are not awarded to imported fuels.

6) The Committee on Climate Change (CCC) report

A report was published by the Committee on Climate Change (CCC) in 2016 which projected emission scenarios using US data and set three tests which must be met in order for shale gas to meet carbon targets.

These tests are;

1. **Well development, production and decommissioning emissions must be strictly limited**
2. **Gas consumption must remain in line with carbon budget requirements**
3. **Production emissions must be accommodated within carbon budgets**

The Mobbs report does not appear to question that the industry will meet tests 1 and 2. This is because the majority of the requirements under test 1 are already met under the current strong regulatory regime, such as the application of reduced emissions completions[21]. As shale gas will displace imports rather than add to current UK usage, test 2 will be met. The decarbonisation of the UK economy, and gas use directly will be regulated under the requirements of the Climate Change Act (2008)[37].

Data used in this CCC analysis was predominantly sourced from the Sustainable Gas Institute (SGI) report conducted by Imperial College London[20]. In conducting their review of methane emissions, the SGI applied methods 'based on the approach developed by the UK Energy Research Centre (UKERC) Technical and Policy Assessment (TPA) team at Imperial College London[20]. UKERC carries out 'world class research into sustainable future energy systems'[29].

Under high productivity central emissions scenarios forecast by the CCC, around 11million tonnes of CO_2e is emitted in 2030 as production emissions[5]. Around 70% of these emissions in this projection are CO_2 emissions associated with the processing of the natural gas. Around 30% of this projection is reflective of fugitive methane emissions[5]. UKOOG believe that the net emission impact is significantly lower than 11 million tonnes for three reasons:

- Low processing emissions – provisional data from the Preston New Road site has demonstrated a world class resource, with low impurity content. The lack of impurities means that the processing requirements are reduced, which means processing emissions are reduced.
- Low methane emissions
- High EUR- The CCC forecast an EUR of 1.66 bcf per lateral. UKOOG's assessment concluded that the EUR from an unhindered shale gas well could be 5.2 bcf – over three times as much.

In the CCC assessment, it was concluded that under the central scenario of the regulatory standards applied in the UK – the emissions intensity of UK shale gas would be 28 g CO_2/kwh. For the reasons outlined above, the pre-combustion footprint could be around 20 g CO_2/kwh. By comparison – the Mackay and Stone Analysis concluded that LNG and long distance pipeline gas would have a pre-combustion footprint of between 57.5 and 86 g CO_2/kwh. UK shale gas could therefore offer at least a 50% pre combustion emission saving over Liquified Natural gas and long distance pipeline gas.

Under the regulation required by the CCC, which the industry has agreed to implement, UK shale gas production will result in an emission factor of 0.5% of production, and as low as 0.3%[5]. Given that the UK is the third largest importer of LNG in Europe, the emissions savings both now and in the future are profound[47]. Compared with a UK economy solely reliant on LNG imports over the next 20 years, UK shale would offer an emissions saving of 117 Million tonnes CO_2e.

It is therefore important to state that these surplus emissions (11.2 Mt CO_2e), which must be accommodated in the UK carbon budgets, are not reflective of a higher life cycle emission source. As the CCC state: "Even tightly regulated oil and gas production will lead to some emissions. Domestic onshore production in the place of imports would mean production emissions occur in the UK rather than overseas. Onshoring of production means onshoring of emissions related to production"[5]. This clarifies that the onshoring of domestic production in a nation with a 50% import dependency will increase emissions "even if it leads to no greater consumption of oil or gas in the UK and even if the overall GHG footprint of UK production is lower than imported gas".

In essence the carbon accounting system directly incentivises the UK to import the energy it needs, even if these imports are higher carbon. If, for example, the UK was to shut down all production from the UKCS and import all the oil and gas it needs over the next 3 decades, the emissions of the UK would be reduced by around 17 Million tonnes per year. This is because the emissions associated with production and processing are offshored.

- **The incentive to import higher carbon fuels is a very important distinction not made clear in the Mobbs paper.**
- **The committee on climate change are clear that we will continue to need natural gas in the coming decades to heat our homes, provide power for our everyday appliances and for industry.**
- **The government has frequently emphasised that we cannot offshore and export our plastic for management (to countries with weaker environmental standards, so why should the same not be said of our carbon emissions?**
- **If we neglect to develop our own domestic natural gas resources we will lock ourselves into reliance on higher life cycle emission sources from the four corners of the earth, such as LNG, as will be the case in the republic of Ireland, France and regrettably, Scotland.**

How UK regulation differs

One of the fundamental flaws of the Mobbs report is that it attempts to transpose situations in other countries which produce natural gas at different scales onto a different regulatory system that exists here in the UK. If one refers to the Oil and Gas Climate Initiative methane management proposals, the

United Nations led Climate and Clean Air Coalition's guiding principles for reducing methane emissions, and the IEA's golden rules for shale gas development – they are in effect a direct mirror image of the present UK's regulatory environment.

Examples of how UK regulation will manage and measure greenhouse gas emissions

- Well designs submitted to the HSE will require the highest standards of well integrity to minimise methane emissions.
- During well completion flowback, reduced emissions completions are already considered a best available technique in a UK context. This methane management technique will be mandatory on all production sites and will reduce methane emissions by up to 98%. The venting of methane during well completion is actively discouraged through strict regulation.
- The use of open pit lagoons to store fluids. This has the potential for not only fugitive emissions but also the endangerment of wildlife. As a result this practice is not allowed in the UK, where all fluids have to be contained within double skinned tanks sitting on protective bunds.
- In some countries methane rich flow back fluids have been used as dust suppressants on roads. Again this is a practice that is not allowed in the UK. Flowback fluid stored in specially designed tanks will be managed in order to mitigate against large methane emissions.
- When referring to direct measurements of methane from onshore US production or exploration sites conducted by academics or the EPA (US Environment Protection Agency), the largest source of methane from onshore gas pads is 'pneumatic devices'[1]. In the US, 'high bleed' pneumatic devices have been and are standard practice – these devices use natural gas from the well to operate valves and other components as part of the processing period. This gas is then vented to the atmosphere. Over the past decades, the UK has displaced these devices with **'zero bleed' pneumatic controllers**, which use compressed air or nitrogen as a medium, instead of natural gas. These devices, therefore, do not pose a greenhouse impact given the inert nature of the medium. Therefore, many data collection campaigns conducted in the US are simply inapplicable to the UK, given the different regulatory standards and use of different equipment.
- Most of the studies from other countries lack the original baseline data for comparison with the current position making it impossible to identify if there is an issue or not. In the UK, baseline monitoring, operational monitoring and post decommissioning monitoring are all standard practice and are now covered additionally by the Infrastructure Act 2015.
- At Cuadrilla resources Preston New Road site, there are 5 separate methane monitors which will provide data before, during and after operations. This data is made publicly available on the British Geological Survey Website as well as Cuadrilla's E-Portal. The on-site monitoring equipment operates at a frequency of 1 Hertz (i.e. a measurement is taken every second)

Independent reports have also commented on the risk of this transposition:

- **Independent Panel of Experts report for the Scottish Government:** "Evidence from active shale and CBM (Coal Bed Methane) sites come particularly from the USA and Australia. Caution is required when trying to extrapolate evidence because these developments occur under very different regulatory and economic conditions than are likely in the UK. Therefore conclusions drawn from these studies should be only be applied to the UK or Scotland very carefully … The

contrasts in geology and source material are such that fugitive emissions profiled from the US cannot be assumed to represent the Scottish situation."

- **The Committee on Climate Change:** "We have taken... the measured range taken from the recent bottom-up emission measurement campaigns. These have shown a large range in the measured results and only represent a small dataset when compared to the scale of the industry in the US, so there is still a large degree of uncertainty around them. It is also uncertain how applicable these emissions estimates are to any future industry in the UK."

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