GREATER MANCHESTER MINERALS DPD

EXAMINATION 21 NOVEMBER 2012

HEARING STATEMENT ON BEHALF OF FRIENDS OF THE EARTH

Appearances

Alex Goodman of counsel and Naomi Luhde-Thompson, Planning and Policy Advisor to Friends of the Earth and Tony Bosworth, Climate & Energy Campaigner at Friends of the Earth and Dr John Broderick, The Tyndall Centre for Climate Change Research, University of Manchester will be in attendance.

Appendices to this Statement

- Evidence of Tony Bosworth, Friends of the Earth
- Evidence of Dr John Broderick, The Tyndall Centre for Climate Change Research, University of Manchester: Report of the Tyndall Centre: *Submission to ECC Inquiry into The Impact of Shale Gas on Energy Markets*
- Minutes of meeting of Manchester City Council held on 11 July 2012 (PDF attached)
- Report of British Geological Survey Potential groundwater impact from exploitation of shale gas in the UK (PDF attached)

Summary

Matter 1: *Whether Policy 1 is consistent with the aims of the National Policy Framework*.

1. Policy 1's failure to address greenhouse gas emissions and climate change directly is inconsistent with section 19(1A) of the Planning and Compulsory Purchase Act 2004, inconsistent with section 1 of the Climate Change Act 2008 and inconsistent with national policy.

2. Policy 1 (as applied by policy 5) encompasses fracking within a generic policy which has been based on the experience of established extraction processes. It consequently fails to acknowledge the need for a more cautionary approach to the issues raised by the new processes involved in fracking. The major issues associated with fracking are the current scientific uncertainty as to its impacts; known impacts in relation to climate change; and potential impacts on groundwater. Policy 1 makes no provision for addressing or considering those issues.

Matter 2: *Whether there is a need for a new policy to deal with any future proposals for "fracking" or shale gas operations.*

3. National policy demands that sound science be used responsibly, which in this context entails a precautionary approach. National policy also demands that fracking be specifically acknowledged as a source of greenhouse gas production (and is a process which is therefore at odds with policy seeking to mitigate climate change). A new policy, or an addendum to Policy 5 is the appropriate means of dealing with the specific issues arising from fracking.

Matter 1

Achieving Sustainable Development/Mitigating Climate Change

4. Section 39(2) of the Planning and Compulsory Purchase Act 2004 makes it a statutory duty to act with the objective of achieving sustainable development. Section 1(1) of the Climate Change Act 2008 provides that it is the duty of the Secretary of State to to ensure that the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline[1]. Section 19(1A) of the Planning and Compulsory Purchase Act 2004 provides:

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

5. These objectives are adumbrated throughout the NPPF. Achieving sustainable development is summarised at paragraphs 6 and 7 and paragraph 151 of the NPPF re-states that Local Plans must be prepared with the objective of contributing to the achievement of sustainable development.

6. An aspect of achieving sustainable development which the NPPF expressly alights upon is the objective to "*mitigate and adapt to climate change including moving to a low carbon economy".* At paragraph 94 the NPPF encourages the development of *"proactive strategies to mitigate and adapt to climate change, taking full account of flood risk, coastal change and water supply and demand considerations."*

Using Sound Science Responsibly

7. The preamble to the NPPF states as follows:

> International and national bodies have set out broad principles of sustainable development. Resolution 42/187 of the United Nations General Assembly defined sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs. The UK Sustainable Development Strategy *Securing the Future* set out five 'guiding principles' of sustainable development: living within the planet's

[1] In order to achieve this, *the Committee on Climate Change has recommended a 60% cut by 2030, with average emissions in the power sector falling to 50gCO2e/kWh by that date.* In May 2011 the Government accepted the Committee's recommendation for the level of the 4th budget - a limit of 1950 $MtCO_2e$ over the years 2023-2027, amounting to an emissions cut of 50% on 1990. The Government has accepted that the aim should be to deliver this through domestic action, though the use of credits has not been ruled out.

> environmental limits; ensuring a strong, healthy and just society; achieving a sustainable economy; promoting good governance; and **using sound science responsibly.**

8. The meaning of the phrase "using sound science responsibly" as an aspect of sustainable development was elucidated in Planning Policy Statements 23 and 25. Paragraph A1 to Annex A to PPS 25: *The Government's Aims for Sustainable Development* stated:

> The Government set out five principles for sustainable development in its 2005 strategy for sustainable development *Securing the Future – UK Government Sustainable Development Strategy*. The fifth of these principles was:
>
> "• **Using Sound Science Responsibly** – Ensuring policy is developed and implemented on the basis of strong scientific evidence, whilst taking into account scientific uncertainty (through the precautionary principle) as well as public attitudes and values."[2]

9. While PPS 25 is replaced by the NPPF, its partner documents including *Planning Policy Statement 25: Development and Flood Risk Practice Guide* still incorporate repeated reference to the precautionary principle and this forms part of the process of using sound science responsibly.

The precautionary principle

10. The precautionary principle is a principle at the heart of environmental law to which the UK Government has committed since the UK signed the *Rio Declaration on Environment and Development* in 1992. This states (at Principle 15) that, *"where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation".* Article 191(2) of the Treaty on the Functioning of the European Union declares that EU policy on the environment "shall be based on the precautionary principle".

11. The precautionary principle is now one element of the requirement in the NPPF to use sound science responsibly. The Interdepartmental Liaison Group on Risk Assessment (ILGRA), in its 2002 paper *The Precautionary Principle: Policy and Application*, made a number of important points including noting that the:

> – precautionary principle should be invoked when:

[2] The Greater Manchester Minerals Plan itself already includes reference to *Securing the Future – UK Government Sustainable Development Strategy* at paragraph 4.6.

> – there is good reason to believe that harmful effects may occur to human, animal or plant health, or to the environment; and
> – the level of scientific uncertainty about the consequences or likelihood of the risk is such that best available scientific advice cannot assess the risk with sufficient confidence to inform decision-making[3].

Precautionary action requires assessment of the costs and benefits of action, and transparency in decision-making.

12. The precautionary principle finds specific expression through international instruments to which the UK is a signatory including the Water Framework Directive and the Habitats Directive. The Water Framework Directive applies strict standards and controls in relation in particular to groundwater. Its approach to groundwater has been summarised as follows[4]

> The case of groundwater is somewhat different. The presumption in relation to groundwater should broadly be that it should not be polluted at all. For this reason, setting chemical quality standards may not be the best approach, as it gives the impression of an allowed level of pollution to which Member States can fill up. A very few such standards have been established at European level for particular issues (nitrates, pesticides and biocides), and these must always be adhered to. But for general protection, we have taken another approach. It is essentially a precautionary one. It comprises a prohibition on direct discharges to groundwater, and (to cover indirect discharges) a requirement to monitor groundwater bodies so as to detect changes in chemical composition, and to reverse any antropogenically induced upward pollution trend. Taken together, these should ensure the protection of groundwater from all contamination, according to the principle of minimum anthropogenic impact.

Scientific Uncertainty About Fracking

13. Friends of the Earth submits that emerging evidence indicates that there is risk of harmful effects to the environment from fracking. In particular, Friends of the Earth is concerned by well documented risks of groundwater contamination and from greenhouse gas (GHG) emissions.

14. In relation to groundwater contamination[5], The British Geological Survey (see attached doc Potential groundwater impact from exploitation of shale gas in the UK (Stuart, 2012)) concludes that "Groundwater may be potentially contaminated by extraction of shale gas

[3] The Interdepartmental Liaison Group on Risk Assessment (ILGRA), in its 2002 paper *The Precautionary Principle: Policy and Application*
[4] http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm
[5] European Commission report (August 2012) lists groundwater contamination as one of the 'high risk' concerns for the environment and human health from fracking - http://ec.europa.eu/environment/integration/energy/pdf/fracking%20study.pdf

both from the constituents of shale gas itself, from the formulation and deep injection of water containing a cocktail of additives used for hydraulic fracturing and from flowback water which may have a high content of saline formation water" (page 19). The BGS report states that "There are examples of surface water contamination from releases of fracturing water or flowback water. Documented instances of groundwater contamination from the U.S. are all related to the leakage of methane into groundwater." (page 20).

15. Concerns in the US where fracking is more widespread has led the US Environmental Protection Agency to produce a major study of the environmental and human health impacts which is due to be published in 2014. There is nevertheless already considerable evidence from the US of fracking leading to contaminated water supplies.

16. In relation to GHG emissions, it remains a matter of debate whether fracking is equivalent to, or worse than conventional gas because although the emissions caused in using the gas are equivalent, the production methods themselves contribute considerably to GHG emissions. Different studies have produced divergent results. A report by an expert from the Tyndall Centre attached summarises these current scientific uncertainties in greater detail (appended).

17. It is these concerns and uncertainties which lead FoE to remind the Secretary of State of the need to use sound science responsibly and to adopt a precautionary approach to fracking development.

Policy 1 as Drafted

18. Policy 1 (applied with Policy 5) of the submission draft GMMP anticipates that proposals for the extraction of shale gas will be permitted where impacts on thirteen specified factors can be controlled by conditions. Those factors make no reference to impacts on groundwater or on climate change which form the major scientific concerns around fracking.

19. FoE is concerned with the drafting of Policy 1 insofar as it relates to the consideration of climate change and the major scientific concerns on fracking. Nor is the broad sweeping application of a single policy to all technologies irrespective of the state of scientific

knowledge about their implications consistent with national policy and Policy 1 should be amended to that extent.

Proposed Changes to Policy 1

Policy 1
Key Planning and Environmental Criteria
All proposals for minerals working or the provision of minerals infrastructure will be permitted where *consistent with the objective of achieving sustainable development and the mitigation of and adaptation to climate change and where* any unacceptable impact*s are* ~~on the following criteria is~~ avoided or can be mitigated by planning conditions and/or obligations. *In particular proposals should not have adverse impacts in relation to the following factors:*
1. Controlled waters and flood risk management;
2. Landscape and visual intrusion;
3. Biological and geological conservation including European sites;
4. Historic environment and built heritage;
5. Best and most versatile agricultural land
6. Infrastructure
7. Traffic and access;
8. Amenity e.g noise, dust, vibration, and odours;
9. Air Quality
10. Land instability;
11. Potential land use conflict;
12. Design, phasing and operational details;
13. Aviation safety.

Fracking is dealt with by separate policy

Matter 2: Need for a New Policy

20. Friends of the Earth submits that the issues arising from the untested nature of fracking are specific enough to merit a specific policy. Friends of the Earth's concern is particularly with the climate change and water quality implications of fracking. The following policy is proposed:

> *Planning permission for fracking or shale gas operations (including test drilling and extraction) will not be granted unless*
> *a) the Council is satisfied that all reasonable scientific doubt that there is any risk of adverse impacts including groundwater contamination has been eliminated*
> *b) the proposal will not compromise the Council's duties in relation to climate change mitigation and adaptation; and*
> *c) the proposal is environmentally acceptable, or it can be made so by planning conditions or obligations.*

The Mechanics of the Policy

21. The policy suggested by FoE is designed to incorporate the principles of using sound science responsibly as derived from kindred spheres where the precautionary principle is applicable.

Lessons from the Precautionary Approach under the Habitats Directive

22. The application of a precautionary approach has been successfully led by the Habitats Directive. While it is not suggested that the Habitats Directive has any application to the GMMP, the practices required by that Directive can provide a model or an analogy from which a precautionary policy can draw. Where development likely to have a significant effect on a site protected by the Habitats Directive is anticipated, the approach which is taken is that a developer is required to provide the information necessary to allow a planning authority to undertake an "appropriate assessment". In *Commission v Spain* [2011] EUECJ C-404/09 at §100 the European Court held

> An assessment made under Article 6(3) of the Habitats Directive cannot be regarded as appropriate if it contains gaps and lacks complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the SPA concerned (see, to that effect, Case C-304/05 *Commission* v *Italy* [2007] ECR I-7495, paragraph 69).

23. Article 6(3) of the Directive prohibits development until all reasonable scientific doubt as to any adverse effects of a development have been eliminated. In the leading case on the Habitats Directive, *Waddenzee* [2005] 2 CMLR 31the ECJ has specifically held that its interpretation of the Habitats Directive is an application of the precautionary principle (See paragraphs § 43-4).

24. Thus in other spheres where a precautionary approach applies, what is required is that:

    (a) The onus is on the developer to supply the information necessary to make an assessment of the risks and impacts of a proposal- this would include informing the local authority of the most up to date studies of the practice across the globe in the fair and balanced manner to be expected of any expert scientific report.
    (b) In the light of that information the local authority takes a decision on whether to consent to the proposal. Where impacts or risks are uncertain, it should refuse permission. That is the precautionary principle. To do otherwise is to gamble with the environment and to be scientifically irresponsible. There can be no objection to such an approach in the GMMP. Indeed the approach commended is consistent with national policy and any less stringent approach would be inconsistent with national policy.

25. FoE's proposed planning policy does not amount to a ban or moratorium on fracking: rather it requires a sound precautionary approach to decision-making. The amendments proposed by FoE enshrine the Government's policy to use sound science responsibly. In adopting such an approach the public can have confidence that decisions are being taken responsibly and concerns about risks to the environment and indeed risks to human health are effectively eliminated. FoE's approach represents the highest standards of policy making and is entirely justified.

26. The policy proposed by FoE in this instance falls well short of far more precautionary approaches taken across Europe, for example:

- Fracking is banned in France and Bulgaria.
- there is a moratorium (ie temporary ban) in the Netherlands pending further research into the environmental impacts, with a study due to start next year
- draft legislation to enforce a two year moratorium in the Czech Republic is working its way through Parliament
- in Austria, plans by oil and gas company OMV to explore possible shale gas reserves in Lower Austria were stalled in summer 2012 following strong opposition, and the subsequent introduction in September 2012 of tougher environmental legislation led OMV to abandon drilling in Austria
- Germany – fracking was stopped in North Rhine-Westphalia in November 2011, pending a study into the risks involved. The study, published in August 2012, concluded that there were numerous risks and uncertainties, and recommended no further drilling until further investigation. There is also a moratorium in the state of Thuringia.
- Switzerland: in April 2011 the Swiss Canton of Fribourg suspended all licenses for exploration of shale gas for an indefinite period.

27. The policy proposed by FoE has in substance received the support of Manchester City Council which on 11 July 2012 resolved that

> "Manchester City Council is committed to acting to mitigate the impacts of climate change, in line with the objectives of the Climate Change Act, and section 19 of the Planning and Compulsory Purchase Act 2004 (amended by Planning Act 2008) and calls on the Chief Executive to implemented a policy that supports the Friends of the Earth campaign that would ensure that planning permission will not be given for test drilling or extraction of shale gas (fracking) unless reasonable scientific doubt as to any adverse impacts can be excluded; the proposal is environmentally acceptable, or it can be made so by planning conditions or obligations".

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15 November 2012

Appendix 1

1. My name is Tony Bosworth, I am a Climate & Energy Campaigner at Friends of the Earth and I lead the organisation's work on shale gas.
2. I understand my duties as an expert witness to assist this inquiry and prepare this statement in accordance with those duties.
3. This statement is prepared as an appendix to Friends of the Earth's Hearing Statement relating to representations made to the proposed modifications to the Greater Manchester Minerals Plan DPD. The purpose of the statement is to give an overview of the current scientific understanding of the impacts of shale gas on climate change.
4. The impact of shale gas on climate change is an area where knowledge and understanding are evolving rapidly. In their recent report for the Government 'Shale gas extraction in the UK: a review of hydraulic fracturing' (June 2012)[6], the Royal Society and Royal Academy of Engineering concluded: *"Decision making would benefit from research into the climate risks associated with both the extraction and use of shale gas"* (page 5). While the authors did not say explicitly that the Government should not make any decisions about fracking before this climate impact assessment had been done, this is the implication.
5. Friends of the Earth (with WWF and RSPB) put this point to the Secretary of State Ed Davey in a letter on 7th September 2012. He replied: *"I agree that the climate impact of shale gas is as yet poorly characterised, that more research is needed, and that any reliance on shale gas must not be at the expense of our climate change targets"* (29th October 2012). However Mr Davey drew a distinction between exploration and production, suggesting any future research would be before any shale gas production.
6. The relative climate impact of shale gas compared to coal and to conventional natural gas has been the subject of vigorous academic debate in recent years. Figures depend on assumptions made about levels of fugitive methane emissions and the relative climate impact of methane.
7. A recent Friends of the Earth Europe report (Unconventional and unwanted: the case against shale gas, September 2012, p10) sums up the situation as follows:
    a. "*Some studies have suggested*[i] *that between 3.6 and 7.9 per cent of the total gas output of a shale gas well is lost through fugitive methane emissions*[7]*. This would mean that* "compared to coal, the footprint of shale gas is at least 20 per cent greater and perhaps more than twice as great on the 20-year horizon"[8].
    b. *In February 2012, one study that monitored emissions in air samples from a natural gas field near Denver found that about four per cent of the gas was lost to the atmosphere*[9]*, suggesting climate impacts have been underestimated*[10].

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[6] http://royalsociety.org/uploadedFiles/Royal_Society_Content/policy/projects/shale-gas/2012-06-28-Shale-gas.pdf

[7] Details about these climate figures can be found in the most recent US peer-reviewed science,.Howarth et al, "Methane Emissions from Natural Gas Systems", Background Paper Prepared for the National Climate Assessment, February 2012 (http://www.eeb.cornell.edu/howarth/Howarth%20et%20al.%20--%20National%20Climate%20Assessment.pdf)

Shindell et al "Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security", Science 335, 183 (2012)

Alvarez, R. Pacala, S. Winebrake, J. and al, "Greater Focus Needed on Methane Leakage from Natural Gas Infrastructure",13/02/2012 (http://www.pnas.org/content/early/2012/04/02/1202407109.full.pdf+html)

[8] Howarth, R. Ingraffea, A. Santoro, R. "Methane and the Greenhouse Gas Footprint of Natural Gas from Shale Formations", March 2011 (http://www.sustainablefuture.cornell.edu/news/attachments/Howarth-EtAl-2011.pdf

[9] http://thinkprogress.org/climate/2012/02/08/421588/high-methane-emissions-measured-over-gas-field-offset-climate-benefits-of-natural-gasquot/

c. According to the US National Academy of Sciences, "*Given limited current evidence, it is likely that leakage at individual natural gas well sites is high enough, when combined with leakage from downstream operations, to make the total leakage exceed the 3.2 per cent threshold beyond which gas becomes at least comparably worse for the climate than coal for at least some period of time*"[11].

8. The report 'Climate impact of potential shale gas production in the EU' (published September 2012) written by AEA Technology for DG CLIMA at the European Commission concluded: "*Drawing upon these studies, and their underlying data sources, a hypothetical analysis has been carried out of the potential lifecycle GHG emissions that may arise from shale gas exploitation within Europe. In our base case, which does not represent a preferred scenario, we have estimated the GHG emissions per unit of electricity generated from shale gas to be around 4% to 8% higher than for electricity generated by conventional pipeline gas from within Europe. These additional emissions arise in the pre-combustion stage, predominantly in the well completion phase when the fracturing fluid is brought back to the surface together with released methane. If emissions from well completion are mitigated, through flaring or capture, and utilised then this difference is reduced to 1% to 5%. This finding is broadly in line with those of other U.S. studies which found that generation from shale gas had emissions about 2% to 3% higher than conventional pipeline gas generation."* (page iv). The authors conclude given the varying results dependent on technology utilised, that *"In fact, for some pipeline sources emissions from shale gas may exceed emissions from importing conventional gas.*" (page iv). However, any relative intensity arguments miss the point about urgent absolute decarbonisation.

9. The view of the Department of Energy and Climate Change is partly set out in their written evidence to the Energy and Climate Change Select Committee inquiry into 'The impact of shale gas on energy markets'[12] (October 2012). In this, DECC quotes the International Energy Agency (IEA) conclusion in its 2011 report 'Are we entering a Golden Age of Gas?'[13] that emissions from shale gas extraction are higher than those for conventional gas extraction: *"The IEA estimates that, provided methane emissions from shale wells are minimised by using appropriate technology, shale gas will have well-to-burner emissions that are 3.5% to 12% higher than the equivalent for conventional gas."* (page 64)

10. The IEA's 2011 report 'Are we entering a Golden Age of Gas' contained a GAS scenario in which, by 2035, global demand for gas increases by over 50% from today's levels; and to help meet this, unconventional gas production more than triples to 2035, representing a third of total gas production by that date. IEA concluded that *"this emissions trajectory is consistent with stabilising the atmospheric concentration of greenhouse gases at around 650ppm, resulting in an average global temperature rise of over 3.5°C"*(page 8). This is clearly well above the 2°C maximum rise that the UK and other developed countries have said we must keep to. IEA has admitted: *"we are not saying that it will be a golden age for humanity - we are saying it will be a golden age for gas"*[14].

11. In its 2011 report 'Shale gas: an updated assessment of environmental and climate change impacts'[15] the Tyndall Centre for Climate Change Research published calculations looking at the impact on climate change of burning the known global resources of shale gas. This concluded that *"the CO2 emissions from burning shale gas are estimated to occupy a*

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[10] http://www.nature.com/news/air-sampling-reveals-high-emissions-from-gas-field-1.9982

[11] Alvarez et al 'Greater focus needed on methane leakage from natural gas infrastructure' http://www.pnas.org/content/early/2012/04/02/1202407109.full.pdf+html

[12] http://www.publications.parliament.uk/pa/cm201213/cmselect/cmenergy/writev/isg/m01.htm

[13] http://www.worldenergyoutlook.org/media/weowebsite/2011/WEO2011_GoldenAgeofGasReport.pdf

[14] http://www.bbc.co.uk/news/science-environment-18236535

[15] http://www.tyndall.ac.uk/sites/default/files/coop_shale_gas_report_update_v3.10.pdf

substantial proportion, over a quarter, of a budget associated with a better than 50:50 chance of avoiding 2°C warming". (page 69). Tyndall add that this figure is likely to be a conservative estimate as firstly, it only calculates carbon dioxide emissions from combustion (and so does not include for example the impact of fugitive methane emissions); and secondly it uses estimates of global shale gas reserves from the US Energy Information Administration which do not include figures for Russia and Central Asia, the Middle East, South East Asia and Central Africa (page 68).

12. In their report 'Shale gas: an updated assessment of environmental and climate change impacts' Tyndall also assess the potential impact of shale gas on meeting the UK's legally-binding climate change targets. They conclude that emissions from using the UK's potential shale gas reserves could represent up 14.5% of the total UK greenhouse gas budget for the period 2010 to 2050 (page 67). Again, this only includes carbon dioxide emissions from combustion, and so does not include the impact of fugitive methane emissions.

13. The potential for UK shale gas is underpinning Government plans to build more gas-fired electricity generation. Friends of the Earth analysis of Government figures, reported in The Observer on Sunday 4th November 2012 'Huge scale of UK's 'dash for gas' revealed' [16], shows that in the last year the Government has quadrupled the amount of electricity it expects to be generated from gas in 2030. According to the Committee for Climate Change (Letter to Ed Davey, 12 Sept) *"extensive use of unabated gas-fired capacity … in 2030 and beyond would be incompatible with meeting legislated carbon budgets"*[17].

14. Shale gas advocates claim that its use has cut emissions in the US by replacing coal, and that we could replicate this in the UK. However analysis by Greenpeace in their report 'How the IEA and Harvard got it wrong on impact of shale on US emissions' (September 2012) [18] finds that renewables played a greater role than gas in emissions reductions in the US in recent years.

15. Analysis by Tyndall in 'Has US shale gas reduced CO2 emissions?' (October 2012)[19] shows that even if the US is using less coal because of more shale gas, millions of tonnes of unused coal are being exported to Europe and Asia, meaning the overall emissions benefits are overstated. The report finds that *"more than half of the emissions avoided in the US power sector may have been exported as coal. In total, this export is equivalent to 340 MtCO2 emissions elsewhere in the world, i.e. 52% of the 650 MtCO2 of potential emissions avoided within the US"* (page 2).

16. An additional problem with shale gas is not just its own direct climate impact, but also the potential negative impact on investment in renewables. Professor Paul Stevens of Chatham House sums this up in the report 'The Shale Gas Revolution: Developments and Changes' (2012)[20]: "*There is a growing fear that shale gas may substitute not for coal as many originally hoped, but for renewables"* (page 1).

17. PriceWaterhouseCoopers issue a similar warning at the global scale in their 'PwC Low Carbon Economy Index' (5th November 2012), warning that while shale gas "*may 'buy some time', it reduces the incentive for investment in lower carbon technologies such as nuclear*

[16] http://www.guardian.co.uk/environment/2012/nov/03/uk-dash-gas

[17] http://www.theccc.org.uk/news/latest-news/1215-ccc-writes-to-ed-davey-over-government-stance-on-unabated-gas-fired-generation

[18] http://www.greenpeace.org.uk/newsdesk/energy/investigations/how-iea-and-harvard-got-it-wrong-impact-shale-us-emissions

[19] http://tyndall.ac.uk/sites/default/files/broderick_and_anderson_2012_impact_of_shale_gas_on_us_energy_and_emissions.pdf

[20] http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/bp0812_stevens.pdf

and renewables, and could lock in emerging economies with high energy demand to a dependence on fossil fuels"[21].

18. Researchers from the Massachusetts Institute of Technology, reported in Jacoby et al 'The influence of shale gas on US energy and environmental policy' (2012)[22] modelled different scenarios for the development of US energy policy. They found that the use of shale gas suppresses the development of renewables. In one scenario a renewable fuel mandate is imposed and when shale gas is used, use of renewables does not go above the 25 percent minimum standard set in the scenario but when shale is removed from the market, renewables gain more ground. They conclude *"in treating the shale as a "bridge" to a low carbon future there are risks to the development of technologies, like capture and storage, needed to complete the task"* (page 1)

19. The Committee on Climate Change has expressed its concerns about the impact of a 'dash for gas' on the development of renewable energy in a letter to Ed Davey[23]: *"The apparent ambivalence of the Government about whether it is trying to build a low-carbon or a gas-based power system weakens the signal provided by carbon budgets to investors… damaging prospects for required low-carbon investments. This has been made clear to us in our extensive discussions with the energy and supply chain companies who it is hoped will fund the very significant investments needed in power generation over the next two decades, and who have suggested to us that the sector investment climate is currently very poor".*

20. The context for the development of shale gas reserves in the UK in relation to climate change is that the Climate Change Act and the Committee on Climate Change has set out how the UK needs to meet its budgets. The purpose of the Act is for the UK to play its part in preventing dangerous climate change – and to do this it is cumulative emissions from now to 2050 that matter, not simply the end point in 2050. As part of this budget setting process, the CCC have set budgets to 2027 (which the Government has accepted) so that the UK makes a 60% cut on 1990 levels by 2030. The CCC say this target is the "absolute minimum" compatible with its climate goals (which in themselves are compatible with a 60% chance of exceeding two degrees – a high level of risk to accept for something Government has said it must avoid). Within this the CCC says that decarbonisation of the electricity sector is an essential part of the most cost-effective path. They say this means cutting average emissions from around 500gCO2e/kWh now, to 50gCO2e/kWh in 2030. The CCC say that this means that unabated gas should account for no more than 10% of power generation in 2030, compared to over 40% today.

21. Friends of the Earth believes that this decarbonisation target can be met without the need for new nuclear power. As explained in our report 'A plan for Clean British Energy' (September 2012)[24], by 2030 renewables account for around 2/3 of power generation, over half of this being offshore wind.

[21] http://press.pwc.com/GLOBAL/News-releases/current-rates-of-decarbonisation-pointing-to-6oc-of-warming/s/47302a6d-efb5-478f-b0e4-19d8801da855

[22] http://globalchange.mit.edu/files/document/MITJPSPGC_Reprint_12-1.pdf

[23] http://hmccc.s3.amazonaws.com/EMR%20letter%20-%20September%2012.pdf

[24] http://www.foe.co.uk/resource/briefings/plan_cbe_report.pdf

Appendix 2

This statement is submitted by Dr John Broderick, The Tyndall Centre for Climate Change Research, University of Manchester and is the Submission to ECC Inquiry into The Impact of Shale Gas on Energy Markets, 8th October 2012.

Introduction

Tyndall Manchester has been investigating the climate change implications of shale gas developments for the past two years. We have raised concerns around the cumulative quantities of emissions that may be released by the extraction and combustion of shale gas and the implications for climate change mitigation of a widespread expansion of the industry in two reports. The most recent report (Broderick et al., 2011) contains research of relevance to two specific questions raised by the committee, namely:

i. What are the effects on investment in lower-carbon energy technologies?

ii. What is the potential impact on climate change objectives of greater use of shale gas?

This submission is a précis of the conclusions drawn by Broderick et al (2011) with additional material from a forthcoming report (Broderick and Anderson, 2012) examining the impact of shale gas on US energy system emissions. We conclude that the issues of lock-in to unabated gas generation, the importance of other drivers of US emissions reductions and the consequence of export of displaced fossil fuels, indicate that novel sources of gas production are problematic from climate change mitigation. It is clear that the production of fossil fuels of all sorts needs to be curtailed in the absence of strict and coordinated international greenhouse gas emissions caps.

Ultimately, the UK's international commitments, under the Copenhagen Accord and Cancun Agreements, cannot be reconciled with the large scale exploitation of shale gas, even with carbon capture and storage. In many respects the response of the UK Government to the prospect of indigenous shale gas production is a bellwether of the veracity or otherwise of the UK's commitments and leadership on climate change.

i) What are the effects on investment in lower-carbon energy technologies?

1. The Energy and Climate Change Committee (2011) has previously noted that a substantial move to exploit newshale gas reserves could attract investment that might otherwise go to renewable energy. The 2011 report states that "…shale gas has the potential to shift the balance in the energy markets that the Department has tried to create away from low carbon electricity generation".

2. In our updated report (Broderick et al. 2011) we estimated the potential scale of such a diversion by assessing the capital costs of gas powerstations burning the output of a mature shale gas industry (i.e. 9bcm/year sustained over a 20 year time period). We refer the committee to section 3.4 of Broderick et al. (2011) for full details and summarise the conclusions below.

3. In total, potential resource substitution was found to be £19bn to £31bn, depending upon the discount rate applied to future investment. The higher figure relates to a Treasury Green Book discount rate of 3.5%, arguably the most appropriate rate for assessing public policy.

4. Table 3.11, reproduced below, illustrates the scale of potential wind energy foregone if capital is diverted to shale gas. Given the need for climate mitigation, the costs of CCGTs with carbon capture and storage (CCS) was also considered. CCS has an energy penalty in operation, in the order of 10% to 20% hence 7GW capacity could be sustained with 9bcm/year gas, and substantially increases capital costs. In the absence of large scale demonstration plants there are considerable uncertainties in the technology's cost and efficiency parameters.

Table 3.11: Investment equivalents in gas and renewable capacity

	10% Discount rate		3.5% Discount rate	
	8GW CCGT	7GW CCGT +CCS	8GW CCGT	7GW CCGT +CCS
Onshore wind (GW)	12.5	16.5	16.8	20.8
Onshore wind (3MW turbines)	4,172	5,503	5,594	6,925
Offshore wind (GW)	7.0	9.2	9.4	11.6
Offshore wind (5MW turbines)	1,401	1,849	1,879	2,326

5. The potential scale of displacement is comparable to the 2020 ranges in UK Renewable Energy Road Map; 10-13 GW onshore wind and 11-18 GW offshore (potentially 40 GW).

6. If the cost of CCS is included and a 3.5% public discount rate used, then the equivalent 21 GW of onshore wind capacity could generate up to 27% more electricity per annum considering representative capacity factors of 70% for gas and 30% for wind. 12GW of offshore turbine capacity would be expected to generate 5% less electricity than the equivalent gas infrastructure.

7. So as not to renege on UK climate change commitments, it is imperative that investment is directed towards very low and zero carbon energy infrastructure. Construction without CCS would place much greater pressure on other parts of the economy to decarbonise and risk gas infrastructure worth £19 to £26bn becoming 'stranded assets'. However, as we describe below it cannot be assumed that CCS will provide sufficient levels of abatement for gas-fired electricity to continue to be a major energy source in the long term.

8. Our analysis considered only capital costs, not operating costs; a simplification that significantly favoured gas over wind as the latter has much lower operating costs as a percentage of total costs. The levelised cost estimates for gas CCGT (Parsons Brinkerhoff, 2011), with 10% discount rate, suggest that fuel costs account for 88% of the total cost per MWh of electricity. In contrast, the operating costs for wind generation make up only 6% of total costs (Arup 2011). Costs of transmission and distribution infrastructure for both gas and electricity were also excluded.

ii) What is the potential impact on climate change objectives of greater use of shale gas?

9. Much of the discussion on the climate change impact of shale gas centres on its relative emissions intensity compared with other fuel sources. This issue is of interest, but must not distract from the most climatically relevant issue of absolute quantities of emissions from the global energy system.

10. There are important concerns about the possibility of additional climate change impacts from gas produced by hydraulic fracturing; this remains a contentious topic in the academic literature. Life cycle analysis studies include inter alia emissions from energy required to produce and distribute the gas, for instance those embodied in water transported to the well pad, and releases of methane itself to the atmosphere both deliberately and inadvertently during the full fuel production, transmission and distribution cycle.

11. Methane is a more potent GHG than CO2 but with a shorter atmospheric life span, with the potential to substantially influence the conclusions drawn by a given study. A conversion factor is required to relate the climate change impact of fugitive methane emissions to the carbon dioxide emissions from other activities and a number of different metrics are available to compare the impact of different greenhouse gases. A gas's contribution to global warming depends upon its absorption of infrared radiation, its longevity and its ability to influence other atmospheric components physically and chemically. The most widely used metric is the Global Warming Potential (GWP) which is the ratio of the change in radiation balance from a pulse release of a given gas, integrated over a specified future time

period, against the same change for a release of the same mass of carbon dioxide. GWP is frequently used in climate policy as a way of comparing well mixed, long lived greenhouse gases like carbon dioxide, nitrous oxide and methane. Typically a one hundred year time period is used for the calculation and revised estimates of GWPs are prepared as atmospheric science progresses. Whilst, these conversion factors are not inherent properties of the gas, their selection can have significant impacts on the conclusions drawn by research and policy.

12. There has been some dispute in the scientific literature of the appropriate GWP timescale to use when comparing conventional with unconventional gas production techniques. There is also a shortage of independent primary research on the actual quantities of such emissions, and many studies use the same underlying empirical data that is recognised to be limited in scope and applicability. Our previous research provides a fuller discussion of this topic (Broderick et al. 2011, Section 3.2.4) as well as an estimate of the additional emissions due to hydraulic fracturing. This estimate is compared with others in a review prepared for the European Commission DG Clima (AEA 2012). A recent comparative statistical approach has concluded that it is difficult to distinguish between the life cycle emissions impact of different gas production and distribution methods and that attention should be paid to energy system impacts (Weber & Clavin 2012).

13. Regardless of the unavoidably contextual framing of life cycle GHG impact, either per unit of gas produced or per unit of electricity generated, the direct carbon content of shale gas means that its widespread use would is incompatible with the UK's international climate change commitments.

14. The absolute necessity of decarbonisation means that technologies with orders of magnitude lower emissions are required to provide energy to UK households and industry in the short to medium term. The Committee on Climate Change (2008) has advised "that any path to an 80% reduction by 2050 requires that electricity generation is almost entirely decarbonised by 2030". Decarbonisation of the electrical supply is an effective way of rapidly reducing emissions. Renewable supply technologies, with very low associated emissions, are available now and are compatible with existing infrastructure. The efficiency of transport and heating can be improved through the deployment of new electric vehicle and heat pump technologies respectively.

15. Understanding timescales is pivotal from a cumulative emission (carbon budget) perspective. The CCC argues that the transition to a very low carbon grid, with an intensity of the order of 50g CO2/kWh, should take place by 2030. Scenarios described by the MARKAL economic optimisation model identify this point as being on the way to a zero carbon grid soon after. It is worth noting that the CCC acknowledges a low probability of keeping below 2°C of warming on the basis of their budgets, this is despite their assumption of unrealistically early global peaking dates (~2016).

16. Accounting for an emissions floor for food production and making fair (but still very challenging) allowance for emissions from non-Annex 1 nations, Anderson and Bows (2011, C+6 scenario) find that complete decarbonisation of Annex 1 energy systems must be accomplished rapidly (i.e. within a decade) for even a 50% chance of avoiding 2°C of warming.

17. It is sometimes argued that shale gas could be burned safely in the short term, however this is not the case. Given that shale gas is yet to be exploited commercially outside the US, limitations on the availability of equipment mean that it is very unlikely it could provide other than a marginal contribution to UK supply before 2020. However, gas fired power stations produce emissions of approximately 440gCO2e/kWh of electricity and typically have a lifespan of over 25 years. Therefore, unless allied with carbon capture and storage (CCS) technologies, as yet unproven at a large scale, all new powerstations intended to burn shale gas would need to cease generating within five to fifteen years of construction, and at the latest be decommissioned by 2030. Green Alliance scenarios (2011) indicate that if there is a second "dash for gas", emissions from the grid could still be 302gCO2e/kWh in 2030 necessitating 95% deployment of CCS to meet our fourth period emissions budgets (2023-2027). In this respect, the "golden age" may turn out to be a gilded cage, locking the UK into a high carbon future

18. Even CCS is problematic when such low carbon electricity is required. At commercial scale CCS will be significantly less than 100% effective at capturing carbon dioxide. Moreover, it will always add costs to electricity production by reducing the efficiency of the power station requiring additional energy input in transportation and injection of the captured carbon dioxide. Best case emissions performance for gas CCS is in the range 35-75gCO2/kWh (80-90% capture efficiency on 55% efficient CCGT with 10% energy penalty for capture).

19. CCS therefore also increases the net quantity of upstream emissions of gas or coal production and transport; reduced efficiency means that greater quantities of fuel must be used for equal electricity output, increasing emissions over and above those from the fuel combustion. For unconventional gas production these have the potential to be significant if mitigation is not in place; Broderick et al (2011) estimate up to an additional 17gCO2e/MJ of gas produced, equivalent to an additional 120gCO2e per kWh of electricity generated depending upon mitigation during production.

20. With regards to using shale gas for heating purposes, the CCC (2008) note that as the grid decarbonises it is "more carbon efficient to provide hot water and space heating with electricity than with gas burned in a condensing boiler". Non-energy uses accounted for less than 1% of total UK demand for natural gas in 2010 (DUKES 2010). It is therefore reasonable to assume that new gas production in the UK will be combusted and, in the absence of carbon capture and storage, released to the atmosphere.

21. Shale gas has the potential to contribute substantial additional emissions to the atmosphere. Global estimates of reserves suggest this may be up to 30% of a global emissions budget with a 50% chance of avoiding dangerous climate change (Broderick et al. 2011, Section 3.3.2).

22. Substitution between fuel sources cannot necessarily be assumed to reduce emissions in absolute terms. Our forthcoming report (Broderick and Anderson, 2012) explores the CO2 emissions consequences of fuel switching in the US power sector using two simple methodologies. The analysis presented is conditional upon its internal assumptions, but provides an indication of the scale of potential impacts. It suggests that emissions avoided at a national scale due to fuel switching in the power sector may be up to half of the total reduction in US energy system CO2 emissions of 8.6% since their peak in 2005. Since 2007, the production of shale gas in large volumes has substantially reduced the wholesale price of natural gas in the US. The suppression of gas prices through shale gas availability is a plausible causative mechanism for at least part of this reduction in emissions. Although we were not able to isolate the proportion of fuel switching due to this effect other studies note that between 35% and 50% of the difference between peak and present power sector emissions may be due to shale gas price effects. Substantial increases in renewable generation and capacity appear to have had an effect of similar magnitude through policy and cost competitiveness. Air quality regulations, energy efficiency and demand management, and the impact of the recession are cited to have played a considerable part in driving this change.

23. It is essential to note that there has also been a substantial increase in coal exports from the US over this same time period. Without a meaningful cap on global carbon emissions, the exploitation of shale gas reserves is likely to increase total emissions. For this not to be the case, consumption of displaced fuels must be reduced globally and remain suppressed indefinitely, in effect displaced coal must stay in the ground. Our calculations suggest that more than half of the potential emissions avoided in the US power sector may actually have been exported as coal. Summing the quantity of implicit emissions exported over the period 2008 to 2011 suggests that approximately 340 MtCO2¬ of the 650 MtCO2 of potential emissions avoided may be added elsewhere. It is clear that the production of fossil fuels of all sorts needs to be curtailed in the absence of strict and coordinated international GHG emissions caps.

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