Scottish Environment LINK response to: "Talking Fracking" A Consultation on Unconventional Oil and Gas

Date: 30 May 2017

Scottish Environment LINK is the forum for Scotland's voluntary environment organisations, with over 35 member bodies representing a range of environmental interests with the common goal of contributing to a more environmentally sustainable society.

This response was compiled on behalf of LINK's Unconventional Fossil Fuel Subgroup and is supported by:

Buglife - The Invertebrate Conservation Trust
Cairngorms Campaign
Friends of the Earth Scotland
Froglife Scotland
Nourish Scotland
Planning Democracy
RSPB Scotland
Scottish Wild Lands Group
Scottish Wildlife Trust
Wildfowl and Wetlands Trust
WWF Scotland

General comments

In 2013 SE LINK members called for a precautionary approach to UOG extraction, and consequently supported the implementation of a moratorium on the industry in January 2015. Through our Unconventional Fossil Fuel Subgroup we participated in stakeholder processes with consultants carrying out studies into economic impacts (KPMG), seismic activity (BGS), decommissioning and aftercare (AECOM), climate change impacts (UKCCC) and transport impacts (Ricardo), and the public health impact assessment undertaken by Health Protection Scotland. We now welcome this opportunity to respond to the Scottish Government's consultation on Unconventional Oil and Gas, 'Talking Fracking'.

We wish to reiterate our serious concerns about the limitations of the research programme; specifically the lack of an overarching environmental study and the narrow approach of the economic study, both of which we raised at an early stage in the process.[1] It is apparent that these concerns have not been addressed, since the consultation document limits its consideration of environmental issues to climate change, induced seismicity and decommissioning; while the evidence presented on economic impact does not take account of environmental externalities nor consider the potential adverse impacts of UOG on other sectors of the economy in its scenarios, all of which would add further weight to the case against UOG. In our view the evidence base on which

[1] We raised these concerns with KPMG during the stakeholder engagement process, and subsequently wrote to Fergus Ewing, then Minister for Business, Energy and Tourism and Dr Aileen McLeod, then Minister for Environment, Climate Change and Land Reform on 14 April 2016

the Scottish Government intends to make a decision about the future of UOG is not comprehensive given these important omissions.

Summary of SE LINK view on UOG

It is clear that as evidence of the potentially harmful impacts of UOG extraction continues to mount, the industry remains unable to demonstrate its safety in relation to impacts on human health and the environment, as the precautionary principle demands. Further, in the context of the climate crisis, for a hydrocarbon rich country like Scotland to open up a new source of fossil fuels while it remains committed to continued exploitation of North Sea oil and gas reserves would be irresponsible and run counter to the Scottish Government's efforts to be a world leader on climate action. Scottish Environment LINK is therefore of the view that the Scottish Government should act to prohibit onshore oil and gas extraction because of the host of demonstrable risks to the climate, our environment and public health.

Community Considerations

Q1: What are your views on the potential social, community and health impacts of an unconventional oil and gas industry in Scotland?

- **Cumulative impact**

Like any industrial operation, UOG extraction would result in impacts at a community level. Key impacts involved in UOG operations include increased HGV movements and associated loss of amenity and increased danger on local roads; noise, light and air pollution and related health impacts; risks of spills and accidents on sites and associated health and safety impacts; and the visual impact of site and infrastructure development.

We are concerned that the consultation document fails to spell out and therefore underplays the potential community impacts, particularly in substantially underestimating the length of time of drilling operations. It is not clear where the estimate of 4 or 5 weeks to drill a well comes from: shale gas and coalbed methane operations planned by Cuadrilla[2] and Dart Energy[3] in Lancashire and Falkirk respectively have indicated that 3 months continuous 24 hour a day, 7 days per week drilling per well is likely, with longer for the first well at a pad. KPMG's central production scenario of 15 wells per pad could therefore involve around 45 months – nearly 4 years – of drilling; while the total drilling time required to achieve INEOS's vision for a 'typical shale gas community' of 200 wells in a 100km^2 area[4] could amount to an astounding total of around 600 months.

Pads may be developed concurrently, thereby intensifying, if shortening, the impact. As with drilling noise, air and light pollution and their associated health impacts, HGV movements associated with the drilling and fracturing processes, the risks of spills and accidents on site and visual impact from rigs would similarly be concentrated over a small geographical area. Far from

[2] Cuadrilla Bowland Ltd, (2014) *Preston New Road Non Technical Summary of Environmental Statement* https://cuadrillaresources.com/site/preston-new-road/

[3] Dart Energy, (2012) *Non-Technical Summary Proposed Development for Coalbed Methane Production* http://edevelopment.falkirk.gov.uk/online/applicationDetails.do?activeTab=documents&keyVal=M9I1L9HC4X000

[4] http://www.ineos.com/businesses/ineos-upstream/news/ineos-plans-25-billion-shale-gas-giveaway

Registered office: 2 Grosvenor House, Shore Road, Perth PH2 8BD, T. 01738 630804, information@scotlink.org
Advocacy office: Dolphin House, Hunter Square, Edinburgh, EH1 1QW, T. 0131 225 4345, advocacy@scotlink.org

the low impact activity the industry endeavours to paint[5] it's clear that should UOG go ahead under the scenarios outlined by KPMG and INEOS, the cumulative impact of operations have the potential to be extremely disruptive for communities.

- **Public health**

We note that a number of major health concerns have been raised in relation to the UOG industry, with a large and growing body of studies,[6] particularly from the US and Australia where the industry has been underway for some years, documenting potential risks and linking drilling activities to detrimental health outcomes. In our participation in Health Protection Scotland's Public Health Impact Assessment (PHIA) stakeholder workshop we highlighted our concern about key health risks linked to the UOG industry.[7]

The PHIA confirms that despite gaps in knowledge, it is possible to establish that a number of air and water-borne environmental hazards *"would be likely to occur"* as a result of unconventional oil and gas operations if they were to go ahead in Scotland, and that there is evidence that waterborne hazards are *"likely to impact negatively"* on the quality of groundwater drinking sources.[8] Excepting the established risk posed to workers from silica exposure, the PHIA further finds that there is insufficient evidence to assess the likelihood of hazards from the UOG industry resulting in adverse health effects, in particular noting: *"There was 'inadequate' epidemiological evidence upon which to draw conclusions on associations between UOG development and specific health outcomes, viz: reproductive and developmental health; childhood cancer; or neurological, cardiovascular or dermatological health outcomes."*[9]

It is for this reason that the New York State Health Department recommended that hydraulic fracturing activities should not be allowed to proceed until further studies – in particular epidemiological research – had been carried out to enable a better assessment of the risks involved. This recommendation led to a ban on fracking in New York State. Health Protection Scotland, however, recommends a precautionary approach to UOG involving a number of mitigation measures by way of regulation, operational best practice and community engagement. We would question the wisdom of this approach, highlighting numerous challenges in the regulatory context around the scale and location of the industry, monitoring, lack of data, and inadequate resources and staffing in regulatory agencies.[10]

---

[5] UKOOOG (2017) *Developing Shale Gas and Maintaining the Beauty of the British Countryside* https://www.google.ie/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0ahUKEwjG2I-Eu8_TAhUnC8AKHX9WBiMQFggwMAI&url=http%3A%2F%2Fappgshalegas.uk%2Fwp-content%2Fuploads%2F2016%2F05%2FDeveloping_Shale_Gas_and_Maintaining_the_Beauty_of_the_British_Countrysi....pdf&usg=AFQjCNEHF2KNjRHoWjh33vJMOK-g-o65EA&cad=rja

[6] Concerned Health Professionals of New York, (updated 2016) *Compendium of Scientific, Medical and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Gas and Oil Extraction*) http://concernedhealthny.org/compendium/

[7] SE LINK (2016) *Submission to KPMG, BGS and AECOM on impacts of Unconventional Oil and Gas Extraction* http://www.scotlink.org/public-documents/link-unconventional-fossil-fuel-subgroup-submission-on-onshore-oil-and-gas-extraction/

[8] Health Protection Scotland (2016) *A Health Impact Assessment of Unconventional Oil and Gas in Scotland*. http://www.hps.scot.nhs.uk/resourcedocument.aspx?resourceid=3101 p i

[9] Health Protection Scotland (2016) p144

[10] Watterson and Dinan (2016) *A Rapid Evidence assessment of Regulation and Regulatory Practices involved in Fracking and its Public Health implications* http://www.regulatingscotland.org/report/frackingandregulation.pdf

Registered office: 2 Grosvenor House, Shore Road, Perth PH2 8BD, T. 01738 630804, information@scotlink.org
Advocacy office: Dolphin House, Hunter Square, Edinburgh, EH1 1QW, T. 0131 225 4345, advocacy@scotlink.org

We note – as does the consultation document and Energy Minister Paul Wheelhouse MSP in recent statements to Parliament[11] – that unconventional oil and gas resources are located in some of the most densely populated parts of the country, increasing the potential for exposure to hazards associated with fracking. Further, much of the potential resource is located in the former industrial heartlands of the central belt, where the socio-economic impacts of de-industrialisation are still felt and where restoration of scarred and polluted landscapes has had limited success to date, raising important questions of environmental justice.

Q2: What are your views on the community benefit schemes that could apply, were an unconventional oil and gas industry to be developed in Scotland?

- **Community benefit schemes**

We note that concerns have been raised in England where the UKOOG scheme is in place about unresolved questions over the definition of a community, whether communities with coalbed methane wells would be eligible, details of the scheme for horizontal wells and about conditions that restrict which operations trigger payments and mean that some communities may not receive anything.[12]

INEOS, the company with the largest onshore acreage in both Scotland and England, announced its own community benefit scheme in the summer of 2014, indicating that "*those living in an INEOS Shale gas community (100km square) would typically share £375 million over the life of the project*" and suggesting a total of £2.5bn – 6% of predicted revenue – would be shared with communities. [13] We are concerned that these numbers may be misleading, since INEOS appear to be basing its revenue predictions on UOG production in the Marcellus shale, which is inappropriate given the differing geology and costs of production in the Scottish / UK context as detailed below in answer to Q3. Doing so could result in vastly overestimated revenue and consequent community benefit.

We would also raise concerns about any conflation of payments or compensation agreed with landowners in order to access or use their land with the distinct concept of 'community benefit'. Operators in Scotland and England must purchase or negotiate the use of land for the surface operations involved in UOG extraction and might be expected to pay considerably for this. Further, in Scotland, as distinct from the rest of the UK, property owners retain the right to refuse permission to operators wishing to drill or frack for shale oil or gas underneath their homes. Operators would be expected – and potentially required by law – to pay some form of compensation to owners who agree to shale oil or gas extraction underneath their property.

As with the UKOOG scheme, INEOS's offer is voluntary, and if exploration proves unsuccessful, communities could be left with a legacy of numerous test wells and no community payments.

[11] Statement to Parliament on Unconventional Oil and Gas by the Minister for Business, Innovation and Energy, 30 March 2017 http://www.parliament.scot/parliamentarybusiness/report.aspx?r=10874

[12] 'Research raises questions over industry payments to shale gas communities' Ruth Hayhurt, Drill or Drop 13 April 2016 https://drillordrop.com/2016/04/13/research-raises-questions-over-industry-payments-to-shale-gas-communities/

[13] 'INEOS plans £2.5 billion shale gas giveaway' INEOS, 28 September 2014 http://www.ineos.com/businesses/ineos-upstream/news/ineos-plans-25-billion-shale-gas-giveaway

Registered office: 2 Grosvenor House, Shore Road, Perth PH2 8BD, T. 01738 630804, information@scotlink.org
Advocacy office: Dolphin House, Hunter Square, Edinburgh, EH1 1QW, T. 0131 225 4345, advocacy@scotlink.org

INEOS Director Tom Crotty has warned: *"We want to share the benefits but there is also sharing of the risk. So if you drill and there is nothing there, there is no gas and there is no money."*[14]

Economic Considerations

Q3: What are your views on the potential impact of unconventional oil and gas industry on Scotland's economy and manufacturing sector?

- **Limitations of Economic Impact Assessment**

The economic analysis commissioned by the Scottish Government and carried out by KPMG takes a very narrow approach towards assessing economic impacts and does not undertake a full cost benefit analysis. Therefore, the assessment does not encompass significant areas of economic activity which might experience negative impacts e.g. local agriculture, food and drink industries, tourism, 'brand Scotland', nor environmental externalities such as air and soil pollution, climate change costs etc. Nor it appears is the cost to the public purse of enforcing a robust regulatory regime included in the assessment. It is our view that this approach results in an overly positive portrayal of the economic impact of UOG. We expressed these concerns to Scottish Ministers and KPMG early in the process.

- **Economic impact**

UK Government commissioned research by the British Geological Survey attests that limited well and seismic data means it is unclear if the UOG industry would ever be commercially viable in Scotland.[15] This is backed up by the findings of KPMG's economic impact assessment, which makes the further point that current low oil prices make for an extremely challenging economic climate in which to develop the UOG industry. [16]

The central scenario outlined by KPMG indicates a very modest impact on the Scottish economy if the industry did go ahead: UOG could represent on average 0.1% of Scottish GDP, based on an estimated direct spend in Scotland of £2.2bn to 2062.[17] The total estimated GVA of £1.2bn over a 42 year period represents a tiny fraction of the annual GVA of the energy sector overall which in 2014 alone, following the crash in global oil prices, sat at £17bn.[18] Further, KPMG estimate that at peak the industry could involve a maximum of 1,400 direct, indirect and induced jobs in this scenario. Most of these jobs would be associated with the construction and development of well pads. Furthermore, the study notes that while jobs are created in Scotland, there is a risk they

---

[14] 'Fracking: communities may miss out on cash payments', The Telegraph, 10 March 2015

http://www.telegraph.co.uk/news/earth/energy/fracking/11462840/Fracking-communities-may-miss-out-on-cash-payments.html

[15] British Geological Survey and the Department for Energy and Climate Change (2014) *The Carboniferous shales of the Midland Valley of Scotland: geology and resource estimation*

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/360471/BGS_DECC_MVS_2014_MAIN_REPORT.pdf

[16] KPMG (2016)

[17] Figures cited in this response are based on the central scenario outlined in KPMG's report

[18] Scottish Government (2014) *Scottish Annual Business Statistcs 2014* http://www.gov.scot/Resource/0050/00504959.pdf

would be filled internationally[19] due to skills and experience in this industry largely coming from overseas, particularly in terms of drilling and hydraulic fracturing services.

However, modest as these predictions are, we note that a fundamental flaw in KPMG's economic scenarios in that the study relies on well production data from the Marcellus and Utica shales, albeit at the lower end of these, which are amongst the most productive shale plays in the US. Numerous expert commentators have raised caution in relying on US data to extrapolate production scenarios in Scotland and indeed across Europe, given the differing and more complex geological formations here, amongst other factors. Professor Roy Thompson of the University of Edinburgh has recently pointed out that comparing the complex geology of the Midland Valley with more geologically similar shales in the US results in a much less optimistic well output estimate, a change from the 3.16 billion cubic feet (bcf) used by KPMG to between 0.5-1 bcf over the lifetime of a well, raising again the question of whether the industry would be economically viable at all in Scotland.[20] Taking into account Prof Thompson's critique of KPMG's scenarios and reducing well output estimates by over a third clearly alters the economic scenarios outlined in the consultation document significantly and calls into question even those low estimates of jobs and GVA.

Taking into account the optimistic assumptions on gas yield and the lack of scrutiny of negative impacts in other sectors, it not clear there is any net positive case for proceeding with UOG at all.

- **Manufacturing , circular economy and just transition**

The consultation document highlights the role that natural gas liquids (NGLs) from shale gas production could play in the petrochemicals sector in Scotland, noting the decline in North Sea NGL production, and INEOS's recent move to import ethane from US shale gas to supply its Grangemouth plant. The two key plants mentioned in the consultation document – ExxonMobil's steam cracker at Mossmorran and INEOS's at Grangemouth – manufacture ethylene which is primarily used in the production of plastics. We would point to the contradictions in the present Government's welcome ambition to move to a circular economy and support for sustained or increased plastics manufacturing based on non-renewable feedstocks. While the primary focus of the recent Circular Economy Strategy is on the reduction of waste, it also aims for "*an increasing proportion of biological wastes to be used for production of high value materials and chemicals, maximising environmental and economic benefits and replacing non-renewable chemical feedstocks"*.[21]

Further we note that the Grangemouth and Mossmorran plants are in the top 5 carbon polluters in Scotland.[22] Given the challenges we face as a country in reducing our GHG emissions to meet legally binding climate targets, and the social and economic risks presented by the loss of heavy industry, the Scottish Government should be planning for a future for these plants that is not reliant on fossil fuels. The focus should be on developing a just transition strategy and industrial plan to facilitate climate-friendly job creation and protect the livelihoods of workers and communities currently dependent on high-carbon industries as an essential part of the transition to a low carbon economy.

---

[19] KPMG (2016), p 29

[20] 'Scotland's geology will not allow for successful fracking, says academic' The Times, 11 February 2017 http://www.thetimes.co.uk/edition/scotland/scotland-s-geology-will-not-allow-for-successful-fracking-says-academic-55db6tzjm

[21] Scottish Government (2016) *Making Things Last: A circular Economy Strategy for Scotland*, page 30 http://www.gov.scot/Resource/0049/00494471.pdf

[22] http://apps.sepa.org.uk/spripa/Search/ByPollutant/Results.aspx?Media=air&Pollutant=2&Year=2015&Sort=6

Registered office: 2 Grosvenor House, Shore Road, Perth PH2 8BD, T. 01738 630804, information@scotlink.org
Advocacy office: Dolphin House, Hunter Square, Edinburgh, EH1 1QW, T. 0131 225 4345, advocacy@scotlink.org

- **Adverse impacts on other sectors of economy**

UOG development could have a detrimental impact on local businesses, agriculture and tourism – industries with far greater value to the Scottish economy than the potential value presented by UOG – because of the health and environmental risks it poses as well as its visual impact. These impacts were not assessed in the KPMG study, and are therefore not taken into account in jobs and GVA figures. We note further that a Defra report and an investigation by journalists at the Ferret, have suggested that UOG could have an adverse impact on house prices, estimating house prices may be affected by up to 10%. [23]

- **Carbon bubble**

Finally we note that the 'stranded assets' / 'carbon bubble'[24] theory has gained widespread recognition, with Bank of England Governor Mark Carney warning investors that meeting a carbon budget to avoid 2°C warming would "*render the vast majority of reserves 'stranded' — oil, gas and coal that will be literally unburnable without expensive carbon capture technology, which itself alters fossil fuel economics*". Pursuing UOG production in the context of the carbon bubble therefore presents a certain risk for Scotland, as a country whose economy is already heavily dependent on hydrocarbons.

Q4 What are your views on the potential role of unconventional oil and gas in Scotland's energy mix?

- **Decarbonising our energy mix**

Burning fossil fuels is the key driver of the climate crisis, and ending the over-reliance of our energy mix and economy as a whole on oil and gas is essential in tackling it. The Scottish Government and Parliament recognise the need for de-carbonisation, having set an ambitious GHG emission reduction target of 80% by 2050 in the Climate Change (Scotland) 2009 Act, with the present Government committed to increasing this in response to the greater need for action driven by the global commitment to aim to keep warming below 1.5°C in the Paris Agreement.

The Scottish Government has recently set out its goal for half of all energy needs to be met by renewable sources by 2030, and a 2050 decarbonisation target in its new draft Energy Strategy.[25] This includes homes and heating which is currently heavily reliant on gas. These targets and the Energy Strategy are supported by additional new strategies for Local Heat, Energy Efficiency and District Heating, the Scottish Energy Efficiency Programme, the designation of energy efficiency as a National Infrastructure Priority, and proposals for an increased energy efficiency target. Further, the Strategy notes that gas use in Scotland is already in decline, with overall energy demand down by 15.2% in the past decade.[26]

---

[23] Defra (2014) *Draft Shale Gas Rural Economy Impacts paper*

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440791/draft-shale-gas-rural-economy-impact-report.pdf and 'Fracking could cut house prices 10%, say experts',

The Ferret, December 2015 https://theferret.scot/fracking-property-prices-scotland/

[24] SE LINK (2014) *Scotland and the Carbon Bubble* http://www.scotlink.org/public-documents/scotland-and-the-carbon-bubble/

[25] Scottish Government (January 2017) *Scottish Energy Strategy: the Future of Energy in Scotland*, p29 http://www.gov.scot/Resource/0051/00513466.pdf

[26] *Scottish Energy Strategy*, p53

We would point out that production scenarios outlined by KPMG have UOG production starting to come on stream gradually from 2026, with peak production not commencing until 2044, a mere 6 years before Scotland's energy system is supposed to be completely decarbonised.[27] It is difficult to see the sense in opening up a new frontier of fossil fuels given these timescales and the uncertainties in developing Carbon Capture and Storage, upon which both the Energy Strategy and the draft Climate Change Plan are over-reliant in the post 2030 period. Doing so while remaining committed to *"continuing to support the recovery of North Sea oil and gas"* – a stated objective of the present Government[28] – would be irresponsible and run counter to the Scottish Government's efforts to be a world leader on climate action.

Finally we note that the argument that UOG, burning cleaner than coal, can be climate-friendly is undermined by evidence of fugitive methane emissions from the industry that potentially increase its carbon footprint to as great as or even greater than that of coal.[29] Moreover, UOG cannot replace coal in Scotland's energy mix since the last coal power plant, Longannet, closed in spring 2016. It is also difficult to argue any potential carbon benefit of domestic UOG replacing LNG imports given that, as highlighted in the draft Energy Strategy, energy-rich Scotland is a net exporter of energy.[30]

- **Adverse impacts on renewables**

The International Energy Agency (IEA) is amongst leading commentators who have warned of the danger that pursuing UOG now could limit investment in the development of renewable energy. Crucially, even the (false) anticipation of abundant, cheap gas could also have a major impact on investment in renewable energy, locking in dependence on fossil fuels well beyond what our climate targets demand. Professor Paul Stevens of Chatham House has written: "*There is a real fear among many analysts that shale gas may substitute not for coal but for renewables…the anticipation of cheap natural gas could inhibit investment in renewables. But again, if the revolution fails to deliver a lot of cheap gas, by the time this is realised it could well be too late to revert to a solution to climate change based upon renewables."* [31]

The Government's official advisers on climate targets, the UK Committee on Climate Change (UKCCC) has also written of the dangers of a dash for gas in relation to renewables: "*The apparently ambivalent position of the [UK] 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 [is] damaging prospects for required low-carbon investments*".[32] Indeed, at a UK level Whitehall's enthusiasm for both shale gas and nuclear power have coincided with low renewables targets, lack of political support for renewables and no decarbonisation target for the electricity sector.

---

[27] KPMG (2016) *Economic Impact Assessment and Scenario Development of Unconventional Oil and Gas in Scotland* http://www.gov.scot/Resource/0050/00509321.pdf

[28] *Scottish Energy Strategy*, p31

[29] Friends of the Earth Scotland Supporter Briefing, 'Why we can't afford to frack the climate', spring 2017 https://stopfracking.scot/s/Why-we-cant-afford-to-frack-the-climate-Spring-2017.pdf

[30] *Scottish Energy Strategy*, p15-16

[31] Chatham House August (2012) *The 'Shale Gas Revolution': Developments and Changes* http://www.chathamhouse.org/sites/default/files/public/Research/Energy,%20Environment%20and%20Development/bp0812stevens.pdf

[32] UK Committee on Climate Change (12 September 2012) *The need for a carbon intensity target in the power sector* http://www.theccc.org.uk/wp-content/uploads/2013/02/EMR-letter-September-12.pdf

Registered office: 2 Grosvenor House, Shore Road, Perth PH2 8BD, T. 01738 630804, information@scotlink.org
Advocacy office: Dolphin House, Hunter Square, Edinburgh, EH1 1QW, T. 0131 225 4345, advocacy@scotlink.org

Environmental Considerations

Q5: What are your views on the potential environmental impacts of an unconventional oil and gas industry in Scotland?

- **Limitations of evidence base**

The lack of a comprehensive study on the environmental impacts of UOG extraction as part of the Scottish Government's evidence gathering programme under the moratorium is of serious concern. It is difficult to see how the Scottish Government can consider it is taking a fully informed decision with this crucial and damning part of the picture missing. Specifically, an assessment of the potential for air, water and soil pollution, impacts on biodiversity and wildlife and issues around water use and waste disposal in the Scottish context is absent from the evidence presented as part of this consultation process. In view of evidence of widespread environmental impacts of the UOG industry where it has taken place in the US and Australia, limiting the environmental considerations of the UOG industry to climate change, seismic impacts and decommissioning is unacceptable.

- **Pollution**

Evidence from the US and Australia where UOG is more developed, indicates that the industry presents serious environmental risks including water, air and soil pollution. Pollution sources include chemicals used in drilling and hydraulic fracturing fluids, many of which are known to be toxic to humans and animals, as well as the harmful substances naturally present in shale and coal that can be mobilised by drilling and fracking.

Hundreds of different chemicals are used in drilling and hydraulic fracturing operations, with different 'ingredients' used at different sites depending on geological and other factors. A 2011 study led by the Endocrine Disruptor Exchange found that of identifiable chemicals used in 944 industry products, more than 75% could affect the skin, eyes, other sensory organs, the respiratory and gastrointestinal systems; 40-50% could cause nervous, immune and cardiovascular system and kidney problems; 37% could affect the endocrine system; and 25% could cause cancer and mutations.[33] Carcinogenic BTEX chemicals (Benzene, Toluene, Ethylbenzene and Xylene) and radioactive materials (NORMs) are naturally occurring in shale and coal, and can be mobilised and brought to the surface during UOG operations.

Pollutant pathways include spills, accidents and leaks from drilling and completion equipment, fluid and waste storage facilities, pipelines and transportation, wellhead blowouts and the wells themselves, with causes including human error, equipment failure and weather.

A recent study which looked at new wells drilled between 2005-2014 in four US states found between 2-16% reported a spill each year, based on a total of 6,648 reported chemical spills at 31,481 wells.[34] It should be noted that this data does not include spills that happen off site (i.e. during transportation) and that states have different requirements in terms of the volume threshold for reporting spills. Ten percent of the spills were found to impact on groundwater, and the vast majority occurred during the early life of newly drilled wells.

---

[33] Colborn, T. et al., (2011), *Natural gas operations from a public health perspective* Human and Ecological Risk Assessment: An International Journal, 17 (5), 1039-1056.

[34] Patterson et al, (2017) *Unconventional Oil and Gas Spills: Risks, Mitigation Priorities, and State Reporting Requirements*, http://pubs.acs.org/doi/abs/10.1021/acs.est.6b05749

Damage to well integrity can occur during drilling and completion, production and after abandonment, and presents a further risk of groundwater contamination. Estimates put well failure on newly drilled wells at between 5-9%, and at upwards of 50% during their lifespan.[35]

In response to mounting evidence last year the US Environmental Protection Agency reversed its earlier position, and now concludes that UOG extraction has contaminated drinking water.[36] Health Protection Scotland's Health Impact Assessment says there is unequivocal evidence that air and waterborne hazards 'would be likely to occur' as a result of fracking, and there is evidence that waterborne hazards are 'likely to impact negatively' on the quality of groundwater drinking sources.[37] Researchers in the US carried out interviews with animal owners and their veterinarians living near gas drilling sites in 2012, and found instances of sudden death, reproductive abnormalities and other illnesses coinciding with spills and accidents at the nearby UOG operations. [38] While noting the limitations of their study, and highlighting the difficulties in obtaining comprehensive evidence of the impacts of UOG operations, the authors warn of the longer-term consequences of industry chemicals entering ecosystems and the food chain.

- **Biodiversity**

Direct risks to biodiversity from UOG development include: wildlife disturbance and ecosystem pollution; habitat loss and fragmentation. [39]

Wildlife disturbance could result from increased noise and light levels from extraction infrastructure and associated transport. Environmental impacts from high water usage (as per below) could include impacts on fish and other wildlife if water stress pressure is increased on rivers with low flows. Risks to biodiversity from water pollution (as per above) could in particular impact on species sensitive to degradation in water quality, such as fish and invertebrates. Consideration of water pollution must include species that may be vulnerable to elevated salinity of sediments, given the make up of produced water and flowback fluid. It is worth emphasising that some of the impacts and interactions between biodiversity and significant levels of onshore gas extraction are not well understood, which makes the lack of a comprehensive environmental study as part of this assessment more problematic.

Each well pad in a typical development requires up to 2 hectares of land, in addition to land for transport access, drainage and storage systems, pipelines and other associated infrastructure. This could lead to significant habitat loss and fragmentation at landscape level, depending on the sensitivity of the sites in question. It should be noted that in relation to habitat loss, protection of existing designated areas (such as SPAs and SACs) is not in itself sufficient to prevent habitat loss and fragmentation, or ensure compliance with EC wildlife law. Significant proportions of some

[35] Friends of the Earth England, Wales and Northern Ireland (2014) *Drilling without fail: A review of empirical data on well failure in oil and gas wells* https://www.foe.co.uk/sites/default/files/downloads/drilling-without-fail-review-empirical-data-well-failure-oil-gas-wells-46473.pdf

[36]Ecowatch (13 December 2016) *Final EPA Study Confirms Fracking Contaminates Drinking Water* http://www.ecowatch.com/epa-fracking-water-contamination-2144968213.html and Environmental Protection Agency (2016) *Study of Hydraulic Fracturing for Oil and Gas and Its Potential Impact on Drinking Water Resources* https://www.epa.gov/hfstudy

[37] Health Protection Scotland (2016) p 73

[38] Bamberger, M and Oswald, R E, (2012) *Impacts of gas drilling on human and animal health*, New Solutions, 22(1).

[39] More discussion and references in relation to the above can be found in Moore et al (2014) *Hydraulic fracturing for shale gas in the UK Examining the evidence for potential environmental impacts* http://www.rspb.org.uk/Images/shale_gas_report_evidence_tcm9-365779.pdf

Registered office: 2 Grosvenor House, Shore Road, Perth PH2 8BD, T. 01738 630804, information@scotlink.org
Advocacy office: Dolphin House, Hunter Square, Edinburgh, EH1 1QW, T. 0131 225 4345, advocacy@scotlink.org

Annex 1 habitats (see the Habitats Directive) are outwith designated sites e.g. blanket bog, which are present within areas proposed for licensing for onshore oil and gas extraction. Therefore, whilst a spatial assessment of potential licensing areas and their overlap with designated sites would be useful, sensitive ecosystems such as wetlands, saltmarsh habitat, peatlands and natural woodland would not be fully covered.

- **Water use**

Hydraulic fracturing requires the use of large volumes of water. Volumes used will vary between developments due to differences in geology, porosity of the shale or coal to be fracked, how often wells are fracked, lifetime of the well etc. A study by the US Geological Survey found that water usage in hydraulic fracturing had substantially increased in recent years (28 times more water than 15 years ago) and identified a strong correlation between the kind of fracturing used and water consumption, with horizontal wells generally consuming substantially higher volumes than vertical wells. [40] The highest yielding US shales – the Barnett, Marcellus and Fayetteville plays – tend to have a high percentage of horizontally fracked wells, and therefore higher than average water use.

According to this study, average (median) consumption is 15.3 million litres per oil well and 20 million litres per gas well fracked between January 2011 and August 2014, with upper end usage reaching 36 million litres. Given that Scottish shales are thought not to be comparable with the higher preforming US shales, water usage may be expected not to reach the upper end volumes. However, it is worth noting that Cuadrilla's proposals at Roseacre Wood and Preston New Road in Lancashire are at the high end of average US water usage in hydraulic fracturing, 22.4 - 28 million litres of freshwater per well, for each of the 4 wells at both sites.[41]

While Scotland does not presently suffer from prolonged periods of water stress, we are vulnerable to "*localised and short-term dry periods which can cause environmental problems, and put stress on public water supplies and private abstractions… in addition, climate change is likely to bring uncertainty and, with a projected decrease in summer rainfall, may exert pressure in areas that have not yet experienced water scarcity*."[42]

- **Waste production, treatment and disposal**

A further important environmental impact of UOG extraction relates to waste disposal. Flowback is the contaminated water that returns to the surface after hydraulic fracturing takes place. It consists of both fracking fluid and water produced from the shale formation. Initial flowback consists largely of the components of the injected fracking fluid (which may include substances harmful to human health and the environment), but as gas and oil production rates decline, flowback generally consists of produced water, which is likely to be highly saline and contain heavy metals, BTEX compounds, Naturally Occuring Radioactive Material (NORM) and other substances, depending on the specific geology.

High levels of flowback are consistent with (but not necessarily indicative of) high volumes of fracking fluid and high levels of oil and gas production. Flowback levels start high but drop off and level out over the lifetime of a well, as gas flow declines. With CBM, the initial de-watering process

[40] Gallegos et al 2015 *Hydraulic fracturing water use variability in the United States and potential environmental implications*

http://onlinelibrary.wiley.com/doi/10.1002/2015WR017278/full

[41] Cuadrilla Roseacre Wood Environmental Statement, Scheme Parameters B7.1

[42] SEPA, (2014) *Consultation on Scotland's National Water Scarcity Plan* https://consultation.sepa.org.uk/water-unit/water-scarcity-plan/

used to depressurise the coal seam and release gas, results in high volumes of produced water containing NORMs, BTEX and other contaminants and with high salinity, whether or not hydraulic fracturing is subsequently used. A study by Duke University found that volumes of flowback from shale oil and gas wells in the US between 2005 and 2014 were 84% of the volume used in the hydraulic fracturing process.[43] Again, while the US experience should be used with caution, the limited UK experience of shale gas fracking demonstrates high volumes of flowback requiring specialist treatment and disposal. [44]

Big questions remain about the safe treatment and disposal of UOG wastes despite over 20 years of industry experience abroad. Hazardous practices commonly used in the US and Australia including evaporation ponds, spreading on roads for dust suppression, and re-injection into wells may not be permitted in Scotland, but it is not clear how the industry would treat to a high enough standard and safely dispose of the vast volumes of waste it may be expected to produce. Treatment methods of waste fluids depend on the precise 'recipe' used in fracking and drilling fluids at a particular site, and the geological formation at that site. UK experience is of course limited, but not reassuring so far: results from treatment trials that Cuadrilla conducted on waste from its Preese Hall site have not been made publically available;[45] Cuadrilla dumped NORM liquid waste from Preese Hall into the Manchester Ship Canal (a practice that would be banned under revised Environment Agency regulations); and Dart Energy proposed to dispose of NORM liquid waste, untreated, in a stream feeding into the Forth, while NORM sludges were to be transported to Aberdeen for disposal.

The capacity of waste treatment and disposal facilities in the UK that are or could be equipped to deal with hazardous waste from the industry is limited and likely to come under increasing pressure as North Sea Oil and Gas decommissioning gets underway, and if anticipated changes to the OSPAR Convention that would prevent the current practice of disposing of NORM waste from offshore oil and gas at sea are implemented.

The UK 'Strategy for the management of Naturally Occurring Radioactive Material (NORM) waste' describes the problem: "*There is some evidence that onshore treatment and disposal of produced water is becoming an issue for some industries (particularly oil and gas production) who generate NORM waste which cannot be classed as exempt radioactive waste. Information obtained by the data collection process is that, within the UK, there are only three facilities permitted to store NORM wastes and two facilities permitted to discharge liquid NORM radionuclides. Another issue is that NORM wastes produced during oil and gas production tend to contain organic hydrocarbons and inorganic heavy metals such as cadmium and, particularly, mercury. Thus, liquid NORM waste treatment often requires use of a combination of different processing techniques to remove the*

[43] see https://www.sciencedaily.com/releases/2015/09/150915135827.htm, Kondask and Vengosh (2015) *Water Footprint of Hydraulic Fracturing* http://pubs.acs.org/doi/10.1021/acs.estlett.5b00211

[44] The only real life data from hydraulic fracturing in the UK, at Cuadrilla's Preese Hall site, demonstrated approximately 70% flowback rates. See Alan Watson rebuttal of evidence 2.6 http://programmeofficers.co.uk/Cuadrilla/Proofs/NWFOE/FOE2.4.pdf

[45] Alan Watson Proof of Evidence at the Public Inquiry into Cuadrilla's application for Hydraulic Fracturing at Preston New Road and Roseacre Wood, para 3.6 http://programmeofficers.co.uk/Cuadrilla/Proofs/NWFOE/FOE2.1.pdf

organic and inorganic elements."[46] Further, *"stringent regulatory controls…incur high costs…as a result of [which], market barriers to new treatment and disposal providers are high."*[47]

- **Seismic impacts**

Research for the Scottish Government by the British Geological Society confirms that hydraulic fracturing operations can cause earthquakes, with the highest magnitude event caused by UOG operations recorded reaching 4.4M_L.[48] While the report indicated that the risk of 'felt' earthquakes was low, even smaller tremors can damage well integrity and thereby increasing the risk of pollution.

The only hydraulic fracturing activities in the UK to date, at Preese Hall, caused two earthquakes measuring 2.3M_L and 1.5M_L and led to the suspension of Cuadrilla's operations at that site. A further 48 seismic events were recorded in the area over a two month period following the injections that caused the quakes.[49] Doubt has been cast over the findings of the DECC commissioned review of the incident that well casing deformity from the quakes had not resulted in loss of integrity of the well: a Greenpeace Energy Desk investigation found that Cuadrilla has had to repeatedly address problems at the well, and independent engineers have indicated that what happened at the site could indeed amount to well failure with the risk of leakage.[50]

Furthermore, the practice of re-injecting waste fluids for disposal is understood to be responsible for a substantial increase in seismic activity in some US states: "*almost a millenium's worth*" of quakes in only 2 years in previously geologically stable Oklahoma has been linked to re-injection of waste fluids from the oil and gas industry, [51] including a quake of 5.7M_L that destroyed 14 homes.[52]

Heavy faulting and historical mine workings in the central belt, along with lack of comprehensive catalogues and seismic monitoring network,[53] and a lack of certainty about industry waste disposal methods, means that a clear picture of the risks of UOG induced seismic activity is still lacking following the Scottish Government's evidence gathering programme.

[46] DECC, (July 2014) *Strategy for the management of Naturally Occurring Radioactive Material (NORM) waste in the United Kingdom,* Annex B, B37 https://www.gov.uk/government/consultations/strategy-for-the-management-of-naturally-occurring-radioactive-material-norm-waste-in-the-united-kingdom

[47] DECC, Consultation on a UK NORM Waste Strategy 3.52 https://www.gov.uk/government/consultations/strategy-for-the-management-of-naturally-occurring-radioactive-material-norm-waste-in-the-united-kingdom

[48] British Geological Survey (2016) *Unconventional Oil and Gas Development: Understanding and Monitoring Induced Seismic Activity*, http://www.gov.scot/Resource/0050/00509318.pdf

[49] Green, Styles and Baptie, *Preese Hall Shale Gas Fracturing: Review and Recommenations for Induced Seismic Mitigation* (2012) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48330/5055-preese-hall-shale-gas-fracturing-review-and-recomm.pdf

[50] http://energydesk.greenpeace.org/2015/06/15/energy-files-cuadrillas-preese-hall-fracking-well-had-to-be-plugged-again-after-more-issues/

[51] http://www.theguardian.com/environment/2016/jan/10/fracking-earthquakes-oklahoma-colorado-gas-companies

[52] British Geological Survey (2016)

[53] British Geological Survey (2016)

Q6: What are your views on the potential climate change impacts of unconventional oil and gas industry in Scotland?

As noted above in response to Q4, burning fossil fuels is the key driver of the climate crisis, and ending the over-reliance of our energy mix and economy as a whole on oil and gas is essential in tackling it. The Scottish Government and Parliament recognise the need for de-carbonisation, having set an ambitious GHG emission reduction target of 80% by 2050 in the Climate Change (Scotland) 2009 Act, with the present Government committed to increasing this in response to the greater need for action driven by the global commitment to aim to keep warming below 1.5°C in the Paris Agreement.

For a hydrocarbon rich country like Scotland to open up a new source of fossil fuels would be irresponsible and run counter to the Scottish Government's efforts to be a world leader on climate action.

In addition to our comments at Q4 we would add the following:

- **UKCCC tests for UOG development**

The UKCCC has warned that pursuing UOG in Scotland would make it more challenging to meet Scotland's climate targets under the present Act.[54] The Committee sets three tests for UOG development, each of which it is hard to envisage being met:

i. Well development, production and decommissioning emissions must be strictly limited, including:
- the need to strengthen regulation before production commences
- use of methane-limiting technologies
- the need for a methane monitoring regime
- decommissioning liability for emissions with producer

We note that the regulatory requirements outlined by the UKCCC could prove too costly and impractical for the industry to proceed on a commercially viable basis, particularly considering that an effective methane monitoring regime should include baseline monitoring ahead of planning permission. Further, methane-limiting technologies such as Reduced Emissions Completions ('green completions') require sites to be connected to pipelines in advance of well completion, which is not always viable, particularly in exploration and appraisal stages.[55]

ii. Fossil fuel consumption must remain in line with the requirements of Scottish emissions targets. Further:

- 'unabated consumption of all fossil fuels [must] decline over time'
- 'there is no case for higher levels of gas consumption'
- there may be benefits if replacing imported LNG
- if Carbon Capture and Storage is not widely deployed, meeting 2050 climate targets will require elimination of almost all fossil fuel use in power generation, transport and buildings
- wide deployment of CCS could provide a way to consume some fossil fuels in a low carbon way

[54] UK Committee on Climate Change (2016) *Scottish Unconventional Oil and Gas: Compatibility with Scottish Greenhouse Gas Emissions Targets* http://www.gov.scot/Resource/0050/00509324.pdf

[55] Howarth, Santoro and Ingraffea, (2010) *Methane and the greenhouse-gas footprint of natural gas from shale formations A letter* http://www.eeb.cornell.edu/howarth/Howarth%20et%20al%20%202011.pdf

The draft Energy Strategy highlights that Scotland is energy-rich and as a net exporter of energy it is therefore not reliant on LNG imports. In setting 2050 decarbonisation targets, the Strategy is highly over-reliant on Carbon Capture and Storage technology becoming viable on a large scale in the post 2030 period. There is a crucial interplay between the timescales involved in commercial scale UOG production and the timescales for testing CCS technology that risks locking-in gas use beyond the point we can sustain unabated gas consumption and meet our climate obligations. As noted above, KPMG's production scenarios would see UOG come on stream gradually from 2026, with peak production beginning in 2044, and continuing to 2062. The Scottish Government's draft Climate Change Plan, on policies and proposals to meet carbon targets between 2017-2032, notes that 'from the late 2020s Carbon Capture and Storage has the potential to remove CO_2 from the atmosphere'.[56] It would be a remarkably risky strategy to allow UOG production to proceed ahead of securing the viability of CCS on a large scale. We note that not only is the viability of CCS on a large scale doubtful but pursuing this technology could direct investment away from more credible and economical solutions. The Scottish Government's strategy on this front is to 'seek to influence the UK Government's CCS strategy so that it is aligned with Scottish energy priorities'. Yet, having cancelled a £1bn grant competition at the end of 2015, after almost 10 years the UK Government's approach to CCS appears to be going in the opposite direction of the Scottish Government on this point. Meanwhile, the only two projects in contention for that grant award are no longer being developed following the cancellation of the prize, demonstrating the technology's heavy reliance on taxpayer support.

iii. Unconventional oil and gas production emissions must be accommodated within Scottish emissions targets.

As regards this test we would note that the UKCCC is clear in its advice that even if fossil fuel consumption does not increase as a result of UOG development, and even if production emissions are strictly regulated, 'domestic production of unconventional oil and gas will lead to some additional Scottish emissions.' Further, the Committee emphasises that 'the high level of ambition embodied in Scottish annual emissions targets means that finding offsetting elsewhere in order to accommodate even moderate additional emissions from UOG production...would be challenging.'[57] Given that the Scottish Government has struggled to meet annual targets under the current Climate Act, and is proposing more ambitious targets in a new Act, it is likely to be even more challenging going forward. Any UOG production therefore would be competing for a dwindling carbon budget with either North Sea Oil and Gas reserves, which the present Government is committed to continued exploitation of, or other sectors of the economy.

Q7: What are your views on the regulatory framework that would apply to an unconventional oil and gas industry in Scotland?

It is clear from the vast number of recommendations across the 6 studies commissioned by the Scottish Government that a regulatory system appropriate to the risks and challenges presented by the UOG industry is not in place here in Scotland.[58]

[56] Scottish Government (January 2017) *Draft Climate Change Plan: The draft third report on policies and proposals 2017-2032*, 2.2.4 http://www.gov.scot/Resource/0051/00513102.pdf

[57] UKCCC (2016) *Scottish Unconventional Oil and Gas: Compatibility with Scottish Greenhouse Gas Emissions Targets*, pg 11 & 12

[58] An *Overview of the Curent Regulatory Framework* (2016) is at http://www.gov.scot/Resource/0050/00509369.pdf and a *Summary of Observations on Regulation from Independent Research* from the Note of a Workshop on UOG Regulation held in

If UOG is to go ahead in Scotland, it must be regulated to a very high standard in an effort to mitigate the worst risks and impacts, with new regulatory requirements introduced to fill the gaps identified in the six reports and the Scottish Government's additional work on regulation. The regulatory regime must include clear and comprehensive guidance for regulators[59], and the Scottish Government must ensure that regulatory bodies have the capacity and capability to appropriately consider applications.

We are aware that some of the regulatory recommendations are likely to present serious challenges to the industry, not least in terms of the cost of implementing effectively, including for example, comprehensive baseline monitoring and the provision of adequate financial guarantees to cover clean up. Further, some recommendations are likely to be impractical during exploratory and appraisal stages such as 'green completions' to limit methane emissions, and avoiding the transportation of water to site by road, since these require sites to be linked up to gas and water networks, and the additional infrastructure this requires, before a site has been determined to be commercially viable.

Additional cost to industry should by no means be seen as an argument for less stringent regulation – instead it is an indication of the costs that must be considered when determining whether the industry is viable. Implementing and enforcing a comprehensive, gold standard regulatory system would also place a significant burden on local authorities and SEPA at a time when the capacity of regulators is under pressure from cuts. As well as a significant need for capacity building, additional staff may be needed, such as the enforcement officer recommended by Ricardo AEA to ensure that mitigation measures are enforced and managed through the life of a project[60].

Further, it is not at all clear that even a comprehensive, gold standard regulatory approach would be enough to mitigate the risks posed by the industry: the UN Environment Programme concluded that *"hydrologic fracking may result in unavoidable environmental impacts even if UG is extracted properly, and more so if done inadequately…[and]…even if risk can be reduced theoretically, in practise many accidents from leaky or malfunctioning equipment as well as from bad practises are regularly occurring."*[61]; while a review of regulation in the UOG industry finds that *"the evidence base for robust regulation and good industry practice is currently absent. There are multiple serious challenges surrounding location, scale, monitoring and data deficits facing regulators overseeing onshore UGE and fracking in the UK."*[62]

Should the UOG industry be allowed to proceed, Environmental Impact Assessment will have a crucial role to play in determining the suitability of individual unconventional oil and gas development proposals, and we agree with the Independent expert Scientific Panel that "the

---

October 2016 at http://www.gov.scot/Resource/0051/00510364.pdf includes recommendations from across the 6 studies commissioned by the Scottish Government.

[59] Health Protection Scotland are quoted in the note of the Unconventional Oil and Gas Regulation Workshop (http://www.gov.scot/Topics/Business-Industry/Energy/onshoreoilandgas/EvidenceGathering/RegulatoryWorkshop) as recommending "the development of clear guidance for regulators in relation to the specific application of legislation to UOG activity", and set out a list of health-related issues that this should address; we would expect guidance to cover these as well as the issues raised the other reports on unconventional oil and gas.

[60] http://www.gov.scot/Topics/Business-Industry/Energy/onshoreoilandgas/EvidenceGathering/RegulatoryWorkshop

[61] United Nations Environment Programme (2012) *Gas Fracking: Can we safely squeeze the rocks?* https://na.unep.net/geas/getUNEPPageWithArticleIDScript.php?article_id=93

[62] Watterson and Dinan (2016)

Environmental Statement and the EIA process, when applied to unconventional gas development, must be comprehensive with total awareness of all possible short and long-term, local and regional impacts."[63] Given the importance of EIA in regulating the environmental impacts of UOG extraction, we are very concerned that EIA is currently not applicable to all unconventional oil and gas operations. Should the industry be permitted to go ahead, EIA must be mandatory for all UOG developments.

A choice for Scotland

Q8: Overall, and in light of the available evidence, what do you think would be the main benefits, if any, of an unconventional oil and gas industry in Scotland?

It is not clear as to whether there are any benefits at all from developing a UOG industry in Scotland. The economic case for doing so is poor (as outlined in response to Q3) while the potential risks in terms of public health, community impacts, climate change, environmental pollution etc considerably outweigh any perceived benefit.

Q9: Overall, and in light of the available evidence, what do you think would be the main risks or challenges, if any, of an unconventional oil and gas industry in Scotland?

As highlighted in answer to questions 1-7, the key risks of allowing the UOG industry to develop in Scotland are in relation to climate change, public health, environmental pollution and disturbances for local communities.

Q10: If you have any other comments on the issues discussed in this consultation, please provide them here.

N/A

For more information contact:

Mary Church, Leader of the Unconventional Fossil Fuels LINK Subgroup
mchurch@foe-scotland.org.uk

www.scotlink.org
www.savescottishseas.org

[63] Scottish Government, (2014) *Independent Expert Scientific Panel Report on Unconventional Oil and Gas* http://www.gov.scot/Resource/0045/00456579.pdf