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Unconventional Hydrocarbons in the UK Energy System

Pathway to decarbonisation: is there a role for gas (and shale gas) in meeting the Government's 2050 net zero emissions target?

A summary of the findings of the 2nd UKUH Integration Event (January 2020)

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UKSGL Shale Gas Landscape

UKUH Unconventional Hydrocarbons in the UK Energy System

UKRI Natural Environment Research Council

UKRI Economic and Social Research Council

Executive Summary

The NERC-ESRC Unconventional Hydrocarbons in the UK (UKUH) Energy System Programme (the UKUH Programme) comprises five Challenges. The ambition of which is to deliver a holistic programme for researching the shale gas system in the UK from the resource potential through to potential environmental and social impacts. Challenge 1 is responsible for the coordination, integration and synthesis of the six research projects that comprise the other four Challenges. A series of workshops is one of the primary channels to integrate the social science and geoscience elements of the UKUH Programme. A second workshop of this integration series was held on 9 January 2020 in The Shard, London on the topic of 'decarbonisation'. This publication summarises the outcomes of this workshop.

This second Challenge 1 integration event comprised presentations in the morning focussing on the broader context of shale gas in the UK energy system. This was followed by an afternoon workshop where we looked to discuss the information and perspectives shared in the morning sessions to consider how to maximise the UKUH programme in the context of the current political environment and the path to net zero.

This workshop theme (decarbonisation) was chosen by the Challenge 1 team as the focus as it was deemed timely and important to all research projects within the UKUH Programme. It is intended that future workshop topics will be identified by other Challenge members.

1. Background to the UKUH Programme

In the summer of 2018, the Natural Research Council (NERC) and Economic and Social Research Council (ESRC) co- funded the Unconventional Hydrocarbon in the UK Energy System (UKUH): Environmental and socio-economic impacts and processesprogramme (http://www.ukuh.org/). The UKUH Programme aims to provide an independent scientific evidence base to understand potential environmental and socio-economic impacts of unconventional hydrocarbon extraction. Seven multi-institution consortium projects were funded to address the five key Programme Challenges identified by NERC and ESRC:

- Challenge 1: Assessing and monitoring the UK Shale Gas Landscape (UKSGL), led by Professor Richard Davies at Newcastle University.
- Challenge 2: An integrated assessment of UK Shale resource distribution based on fundamental analyses of shale mechanical and fluid properties, led by Professor Alastair Fraser at Imperial College, London
- Challenge 3: Impactofhydraulicfracturingintheoverburdenofshaleresourceplays:Process-basedevaluation (SHAPE-UK), led by Professor Michael Kendall at the University of Oxford.
- Challenge 4: Evaluation, Quantification and Identification of Pathways and Targets for the assessment of Shale Gas RISK (EQUIPT4RISK), led by Dr Robert Ward at the British Geological Survey (BGS).
- Challenge 5: This challenge comprises the following three projects focusing on the socio-economic impacts:
  - The social construction of unconventional gas extraction: Towards a greater understanding of Socio- economic impact of unconventional gas development, led by Professor Paul Stretesky at Northumbria University.
  - 'Fracking', Framingand Effective Participation, led by Professor Benjamin Sovacoolat the University of Sussex.
  - Understanding the spatial and temporal dynamics of public attitudes and community responses to shale gas: an integrated approach (ASSIST), led by Professor Patrick Devine-Wright at the University of Exeter.

Challenge 1 has responsibility for managing a flexible fund to support additional research to address research gaps that may be required in response to the changes in the political, economic, social, technological, environmental and legal landscape in the UK.

2. Background to Integration Events

The Challenge 1 team is responsible for the coordination, synthesis and integration of all research projects within the overarching UKUH Programme. One mechanism for achieving effective coordination between the different Challenges has been to develop a series of Integration Events; each one focusing on a specific theme or topic that is of concern or relevance to all Challenge projects. The Challenge 1 team aims to hold at least one Integration Event per year during the 4-year UKUH Programme. These events are open to all members of the UKUH Programme, including members of the UKUH advisory boards and Challenge 1's interdisciplinary research team as well as invited stakeholders. Academics or researchers from within the UKUH programme can nominate themes or topics for consideration for future Integration Events.

The objectives of the Integration Events are to:

(1) bring UKUH researchers together to share information about current knowledge on a topic of shared relevance based on UKUH research and activities to date, and to encourage the exchange of perspectives, knowledge, understanding, and experiences; and

(2) map the range and breadth of issues and challenges relevant to the topic of the Integration Event and, if possible, to identify where current knowledge is well established, where there are knowledge gaps. The events will be used to identify where these gaps will be addressed by the UKUH Programme, and where future work (potentially supported by Challenge 1 flexible funds) should focus.

3. Integration Event 2: topic, attendees and programme

'Pathway to decarbonisation' was selected to be the topic of the second Integration Event in the series. The topic was identified by the Challenge 1 lead as timely and relevant to all Challenge projects.

In total the Integration Event was attended by 50 participants, comprising:

- 22academicsandresearchersfundedbytheUKUHProgramme
- 15 stakeholders of the UKUH programme including regulators, operators, members of government departments, town and country planners
- 8 members of the Programme's advisory board
- 3 members of the Interdisciplinary Research Team (IRT)
- 2 representatives from UKRI fundingbodies, NERC and ESRC.

The Integration Event support team comprised a researcher as well as Challenge 1 staff, with responsibility for organising, facilitating, and observing. The team captured some of the key points and actions raised by delegates at the event. These are presented in Section 5 of this report.

The Integration Event was held over one day (10 am - 3 pm) and was organised into two parts:

Part 1: The first half of the day was committed to knowledge transfer via plenary presentations, allowing Challenge researchers and invited speakers to present their current leading-edge research on different aspects around the topic of decarbonisation and the role of shale gas, and to engage in short question and answer panel discussions.

Specifically, attendees heard about the following topics in two separate sessions:

Session 1: The role of natural gas (and shale gas) in the UK Energy Landscape (presentations from Professor Mike Bradshaw, Warwick Business School; Dr John Broderick, Tyndall Centre; Professor Patrick Devine-Wright, University of Exeter; Dr Sua-Wai Wong, Cuadrilla; and, Mark Lappin).

Session 2: The environmental and economic impacts of shale gas exploitation (presentations from Professor Tina Hunter, University of Aberdeen; Professor Fred Worrall, Durham University; Dr Jacob Shaw, University of Manchester; and, Dr Laurence Stamford, University of Manchester).

The general format was for each speaker to have a 15-minute-long presentation and then at the end of each session the chair facilitated a panel Q&A of approximately 20 minutes.

Part 2: The afternoon's plenary discussion, facilitated by Dr Jen Roberts (Strathclyde University) and Professor Richard Davies (Newcastle University), was designed to maximise the opportunity for feedback from the large number of stakeholders in the room and comprised a discussion on the role of the UKUH Programme in the context of the current political landscape and the path to Net Zero. Attendees were asked to consider:

- Reflections with regards to personal, or experiences from other, shale gas (orother) projects.
- What the Programme or community might do, or do differently, considering recent policy changes?
- Whether there are any synergistic projects to link with the UKUH programme? Or new or complementary data?
- What are the potentia lroutes to impact for the UKUH Programme?

4. Summary of Part 1 of the Integration Event – Presentations

Three main topics were touched on during the Session 1 talks, namely gas in the UK energy system, energy security and Net Zero. The Session 2 presentations focussed on potential environmental impacts associated with shale gas extraction, transport of gas as well as best practice around monitoring of fugitive emissions. Findings of Life Cycle Analysis research was presented as well as a summary of the environmental regulations of shale gas in the UK.

The following text summarises the main points of the presentations and subsequent Q&A discussions:

The industry representatives indicated that the initial signs with regards to gas quality from the Bowland Shale are encouraging, however, it was noted by a number of delegates that there are numerous hurdles still to be overcome before commercial extraction could take place. It was noted that with the introduction of the Net Zero targets the goalposts have moved, and the Energy Industry needs to adapt to the demands of these new, stricter targets. Speakers argued that Net Zero should be achieved before 2050 in the UK and that the current allocation is not a fair allocation for developing nations. Scenarios that see Net Zero only being achieved beyond 2050, include huge negative emissions after 2050, in the order of gigatons a year. The problem is that there is no guarantee that this Carbon Capture Usage and Storage (CCUS) technology will be available at the scale required.

Whilst CCUS would allow the continued use of hydrocarbons, it is only 90% efficient and requires the use of greater amounts of fuel in order to power the process itself. In addition, the emissions inherent in the supply chain and leakage cannot easily be removed. Hydrogen offers an alternative to retaining a widely used gas in the energy system. This poses the question of whether it is produced using the steam reforming of methane or through electrolysis, powered by renewable electricity, which in turn leads to questions about the transportation and tradability of the gas internationally. Currently, there is an international gas market with the fuel being easily tradable, how easy would it be to get to a similar position with hydrogen? Alternatively, could bio-gas prove a more palatable option?

More generally, it was felt that the UK needs to make a conscious decision about the energy pathway that it is going to take and the compromises that are inherent within this active choice. As an example of how environmentalism may not be the only force at play, the ASSIST team found during their surveys that the public had varying preferences for gas based upon its geographical origins.

The issue of fugitive emissions is one that affects conventional gas industry as well as unconventional. The importance of collecting baseline data as well as monitoring 'decommissioned' wells was noted. Based on 103 'decommissioned' wells monitored (Boothroyd et al., 2016)[1], only 30% showed elevated methane emissions. Research carried out by Allen et al. [2] indicated a link between elevated methane concentrations and specific site activities.

In order to achieve Net Zero there are huge infrastructure requirements irrespective of the chosen pathway. The UKUH Programme has the potential for legacy impact if the Programme's learnings are used to inform the future use of the subsurface for energy extraction or storage.

[1] Boothroyd, I., Almond, S., Qassim, S., Worrall, F. and Davies, R. (2016). Fugitive emissions of methane from abandoned, decommissioned oil and gas wells. Science of The Total Environment, 547, pp.461-469.

[2] Allen, G., Shaw, J., Shah, A., Pitt, J., Ricketts, H., Williams, P., Ward, R. (2020). [online] Available at: http://www.bgs.ac.uk/downloads/start.cfm?id=3510 [Accessed 23 Jan. 2020].

5. Summary of Part 2 of the Integration Event – Facilitated discussion

Professor Richard Davies opened the plenary discussion. The aim was to discuss, with the broad range of stakeholders in the room, how the UKUH Programme should adapt to the recent hydraulic fracturing moratorium (as announced by the government on 2 November 2019). Professor Davies highlighted the need for the UKUH Programme to be agile and adapt to continue to deliver relevant and impactful research over the remaining two and a half years of the Programme. He introduced the idea of integrating the Programme's work through a geospatial analysis presented as a Geographical Information System (GIS). The purpose being to provide a visual representation of how a wide range of risk factors interrelate. For example, if the government decided to remove the moratorium, where should fracking (not) take place?

The following text outlines the key points and actions raised in the discussion:

Data availability

Compared to the Cheshire basin, the British Geological Survey (BGS) has more geological information for the areas East of the Pennines. There followed a discussion about the level of uncertainty of this data and the question of whether sufficient data can ever be collected in order to reduce uncertainty to an acceptable level? It was noted that the NERC funded UK Geoenergy Observatory (UKGEOS) project is on the point of commencing drilling activities in Cheshire. This research field site will give the research community new insights about the structural geology in the area of the Mersey estuary, the rocks' geomechanical properties, and the groundwater quality and flow in the area.

Data management is an important component of this Programme and there exists a need for all researchers and academics to share datasets, where appropriate. The Challenge 1 team will manage a GIS tool for sharing information about data sources.

Action: Challenge 1 (C1) proposes to use a GIS to improve the integration within and between all the projects of the UKUH Programme. C1 will use this tool to demonstrate our knowledge of the UKs shale gas landscape and to facilitate discussions with stakeholders (specifically policy makers and regulators) to inform future energy decisions.

Regulating induced seismicity

Recognising the challenges associated with induced seismicity caused by fluid injection, much debate was had regarding the following OGA statement in response to what would be required to lift the moratorium in England "... further detailed geomechanical analysis would be needed before we could evaluate with confidence whether hydraulic fracturing could resume in the Fylde, or elsewhere, consistent with the government's policy aims".

The importance of analysing stress data to understand the geomechanics of the subsurface was raised as well as the need to undertake any future hydraulic fracturing in an area of low stress anisotropy.

The delegates in the room called for a need to standardise seismic thresholds across all subsurface activities. There is the risk that the TLS regulations will impact other industries which will be required if the UK is to meet its Net Zero targets, such as CCUS, geothermal etc.

There are questions for the UKUH Programme to tackle around the legal framework for shale gas extraction. The challenges faced by the shale gas industry have implications for other subsurface industries. It was noted that understanding how seismicity is felt at the surface is part of the Challenge 4 deliverables.

Action: C1 to engage with the Department for Business, Energy and Industrial Strategy (BEIS) on a regular basis, presenting the collated, robust scientific evidence from across the UKUH Programme.

Engaging with new stakeholders

The Programme recognises the need to continue to engage with a broad range of stakeholders and learn from the experiences of other subsurface industries. To this end the Programme will seek to engage with the Coal Authority: they hold significant amounts of subsurface data; they are operating successfully without the need to manage induced seismicity.

Action: C1 to engage with the Coal Authority.

Community engagement and public understanding of science

As reported in Williams et al.[3], the programme recognises that the deficit model (i.e. the assumption that absence of sufficient knowledge leads to public unease and the mitigation for this is to provide more data and information) is not an effective model on which to base science communication.

The attendees discussed at length what it would take for the shale gas industry to gain or regain its Social Licence to Operate (SLO). A key distinction was also drawn between local and national SLOs – an industry must make a broad philosophical case for why it is required in addition to convincing specific communities that they wish to host it locally. Are there any examples of when other industries have successfully regained their SLO, for example, the onshore wind industry? The group also discussed the possibility of looking to Australia, the Netherlands and Germany as analogues for regaining SLO. For example, in the Netherlands, compensation was effectively used to mitigate community concerns. There was a discussion around how compensation is best used by industry to gain an SLO, with the evidence from other industries suggesting that this needs to be done on an individual rather than community basis. However, some attendees felt that the use of compensation over simplifies the complex issues associated with hydraulic fracturing for shale gas.

Action: C1 to engage with the Programme's international stakeholders and project partners.

The future of gas in the UKs energy mix

The delegates recognised the need to examine both: shale gas's impact as part of the UK's gas future; and, no shale gas and what this would mean in terms of meeting our legal obligations with regards to Net Zero. Academics within the UKUH Programme are engaged with the UK Energy Research Centre (UKERC) and will continue to exchange knowledge on this issue.

Action: C1 to continue to engage with UKERC.

Environmental impacts

The morning's presentations highlighted the need for further methane monitoring and measurements across all gas infrastructure.

Action: The UKUH Programme to look for opportunities to fund additional supplementary research to inform the shale gas landscape, for example, through the C1 flex fund.

[3] Williams, L., Macnaghten, P., Davies, R. and Curtis, S. (2016). Framing 'fracking': Exploring public perceptions of hydraulic fracturing in the United Kingdom. Public Understanding of Science, 26(1), pp.89-104.

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About the Programme

The overarching objective of the research programme is to improve significantly the scientific evidence base on shale gas as a potential energy resource for the UK.

Contact Details

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FOR FURTHER INFORMATION
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