

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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Executive Summary

The NERC-ESRC Unconventional Hydrocarbons in the UK (UKUH) Energy System Programme (the UKUH Programme) offers a holistic strategy for researching the shale gas system in the UK - from the resource potential through to environmental and social factors. The UKUH Programme comprises five Challenges. Challenge 1 (C1) is responsible for the coordination, integration and synthesis of the six research projects that comprise the other four Challenges. One of the primary channels to integrate UKUH Programme research is a series of workshops organised under C1. The second workshop of this integration series was held on 9 January 2020 on the topic of 'decarbonisation'. The event explored current perspectives on the carbon intensity of UK shale gas, and the potential role of UK shale gas in delivering net zero.

The event resulted in the following actions for the UKUH Programme:

- Develop a GIS database to improve the integration within and between all the projects of the UKUH Programme. The aim of which will be to illustrate current knowledge of the UK's shale gas landscape and to facilitate discussions with stakeholders (specifically policy makers and regulators) to inform future energy decisions.
- C1 to continue recurring engagement with key stakeholders including:
 - the Department for Business, Energy and Industrial Strategy (BEIS) to present the robust scientific evidence from across the UKUH Programme;
 - newly identified stakeholders, such as the Coal Authority;
 - international stakeholders and project partners;
 - the UK Energy Research Centre (UKERC).
- To seek opportunities to fund additional supplementary research to inform the shale gas landscape, particular around methane monitoring and measurements.

Throughout the plenary discussion, the threats and challenges to developers obtaining a Social Licence to Operate (SLO) were discussed in detail. The delegates recognised that there is value in the social scientists and geoscientists within UKUH working together to determine how other industries have gained or regained a SLO. The Programme's researchers recommend this as a topic for a future Integration Event.

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 processes programme (<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: Impact of hydraulic fracturing in the overburden of shale resource plays: Process-based evaluation (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', Framing and Effective Participation, led by Professor Benjamin Sovacool at 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 manages a flexible fund to support additional research to address research gaps that may be required in response to changes in the political, economic, social, technological, environmental and legal landscape in the UK during the course of the 4-year UKUH Programme.

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:

- 22 academics and researchers funded by the UKUH Programme;
- 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 UKUH’s funding bodies, NERC and ESRC.

The Integration Event support team comprised Challenge 1 staff and an external facilitator, namely Dr Jen Roberts (University of Strathclyde). The support team were responsible for organising and delivering the event, as well as capturing and reporting on the key points raised during the event and any outcomes or actions. These are presented in Section 5 of this report.

The Integration Event was held from 10 am - 3 pm on Thursday 9th January 2020. The day was organised into two parts:

Part 1: The morning 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 for Climate Change Research; Professor Patrick Devine-Wright, University of Exeter; Dr Sua-Wai Wong, Cuadrilla; and, Mark Lappin, Energy Consultant).

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 (University of Strathclyde) and Professor Richard Davies (Newcastle University), was designed to maximise the opportunity for feedback and discussion between delegates on the topic at hand. The opening discussions were focused on the role of the UKUH Programme in the context of the current political landscape and the path to Net Zero.

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

Session 1 talks explored the role of natural gas in the UK energy system now and into the future, with particular focus on energy security and pathways to Net Zero. Session 2 talks presented new research around emissions intensity of onshore gas extraction and transport, with focus on monitoring of fugitive emissions, as well as a summary of the environmental regulations of shale gas in the UK.

The main points of the presentations and subsequent Q&A discussions were:

- 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 rely heavily on negative emissions technology (NETs) after 2050, on the order of gigatons a year, yet there is no guarantee that NETs or Carbon Capture Usage and Storage (CCUS) technology will be available at the required scale by this time.
- Whilst CCUS would allow the continued use of hydrocarbons on the path to Net Zero, the energy penalty associated with carbon capture infrastructure must be reduced. In addition, the emissions inherent in the supply chain and leakage cannot easily be removed¹. 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. Further, not all natural gas is equal in the eyes of the public; surveys led by the ASSIST team² found that public preferences vary based upon the geographical origins of the natural gas.
- 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)³, only 30% showed elevated methane emissions. Research carried out by Allen et al.⁴ indicated a link between elevated methane concentrations and specific site activities. In general, it was felt that fugitive emissions of natural gas in the UK are not yet well understood.
- 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.

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), to provide a visual representation of how

¹ Committee on Climate Change. (2020). Net Zero - The UK's contribution to stopping global warming - Committee on Climate Change. [online] Available at: <https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/> [Accessed 28 Jan. 2020].

² 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

³ 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.

⁴ 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].

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? [Note: this raises the follow up question of what is meant by acceptable, e.g. ‘acceptable’ to the public? Or ‘acceptable’ in terms of predicting the maximum magnitude of induced seismicity?].

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 the UKUH 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 current knowledge of the UKs shale gas landscape and to facilitate discussions with stakeholders (specifically policy makers and regulators) to inform future geoenergy 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 current Traffic Light System (TLS) regulations will impact other subsurface industries which are deemed necessary to meet Net Zero, 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.⁵, 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 around seismicity associated with onshore gas industry associated with the Groningen field. 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. Clearly there was much to discuss on this, with some delegates proposing the SLO as a topic for a future Integration Event.

Action: C1 to engage with the Programme's international stakeholders and project partners. The Programme will consider convening the next Integration Event on the topic of SLO and bringing in international partners to add to the debate as well as stakeholders working on other geoenergy research topics or operators within the extractive industry.

The future of gas in the UK's 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 gaps in current knowledge around emissions accounting of onshore gas operations, and of natural gas more widely. This is important for understanding the role of gas for Net Zero. There is a need for further methane monitoring and measurements across all gas infrastructure, and this work must be conducted while liaising with operators, to understand the emissions data site activities.

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.

6. Conclusion and Recommendations

The UKUH Programme's 2nd Integration Event focused on 'pathway to decarbonisation' and was well attended by a broad mix of researchers, academics, regulators, operators, members of government departments, town and country planners as well as members of the funding bodies, NERC and ESRC.

Throughout the morning session, a number of invited speakers were asked to present their research and knowledge on two broad topics: a) the role of natural gas (and shale gas) in the UK energy landscape and b) the environmental and economic impacts of shale gas exploitation in order to provide insights on recent research and understanding

⁵ 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.

for the plenary discussion which followed. The plenary discussion in the afternoon resulted in several actions which will be taken forward by the UKUH Programme. Key actions included:

- the development a GIS database to improve the integration within and between all the projects of the UKUH Programme;
- continuation of knowledge exchange with key stakeholders including BEIS, other extractive industries, international project partners and other UKRI funded programmes and projects;
- C1 to investigate ways of funding a UKUH collaboration to monitor and measure methane emissions from onshore gas operations; and
- convening a 3rd Integration Event to explore how industry has tried to obtain a Social Licence to Operate.

One further key message from the Integration Event is that the UKUH Programme has the potential for significant legacy impact. We will continue to work with stakeholders and funders to ensure that the Programme's learnings can inform the future use of the subsurface for energy extraction or storage.

Finally, the Challenge 1 team would like to thank all delegates for their contribution to delivering effective knowledge exchange between UKUH team and the Programme's stakeholders at this Integration Event.

Acknowledgements

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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.

More information can be found at www.ukuh.org

Contact Details

If you have any comments or questions, in the first instance please contact:

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