

## ‘We’re going all out for shale:’ explaining shale gas energy policy failure in the United Kingdom

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### ABSTRACT

In January 2014, then British Prime Minister David Cameron declared that his government was ‘Going all out for Shale.’ In November 2019, during an election campaign, Prime Minister Boris Johnson’s Conservative Government imposed a moratorium on hydraulic fracturing bringing to a halt industry hopes of developing shale gas in the UK. This paper explores what happened, integrating research employing a mixed methods research design including a review of the literature, expert interviews, household interviews, a series of nationally representative and local surveys, and a content analysis of political testimony. It starts with a brief history of the shale gas debate in the UK and social science research on the issue. It then examines the UK’s Shale Gas landscape, and in particular energy policy failure, by considering three issues: first, the framing of the shale gas debate in the national Parliament, exploring the arguments for and against it; second, changing public perceptions and attitudes towards shale gas development; and third, the attitudes and lived experiences of the communities most affected by shale gas exploration activities. These three dimensions are combined to explain the UK Government’s shale gas failure to-date. The paper concludes by identifying the lessons learnt from the Government’s initial policy failure, both in relation to further shale gas exploration, but also for other technologies required for a future Net-Zero energy system.

### 1. Introduction

As the ‘Shale Revolution’ gathered pace in North America in the 2010s, national governments across Europe saw domestic shale gas development as a solution to their persistent concerns about natural gas import dependence and their reliance on Russia in particular (Johnson and Boersma, 2013). However, the limited geological potential of shale gas in most European countries, combined with widespread popular reaction against the environmental impacts of hydraulic fracturing, quickly limited exploratory activities to Poland and the United Kingdom (UK) (Van de Graaf et al., 2017). Today, no shale gas exploration is underway in either country (Wachtmesijer et al., 2021). This paper

aims to explain the UK Government’s ‘shale failure,’ focussing on the issues that have prevented the nascent shale gas industry from conducting meaningful exploration of the country’s shale gas resource potential to date.

Most of the UK’s oil and gas activity is offshore, but there is a small onshore industry producing oil and gas by conventional means. Offshore gas production peaked in 2000 and the UK became a net importer in 2004. Since then, although gas demand has fallen, domestic production has fallen faster and import dependence has increased to a point where today the UK imports about half the gas it consumes (Bradshaw, 2018; Solman and Bradshaw, 2020). Thus, the need to bolster domestic gas production to reduce import dependence is a consistent theme of those

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promoting shale gas, although it is recognised that this would have no impact on the price that consumers pay for their gas (Kwarteng, 2022). In the early 2010s, this industry started exploring the prospects for shale gas production with little public reaction until April 2011. Then the initial hydraulic fracturing of the Preese Hall well by Cuadrilla Resources in the Fylde District of Lancashire in the northwest region of England triggered an earthquake measuring 2.5M<sub>L</sub> (the Richter magnitude). This event marked the beginnings of what started as a debate and soon became a drawn-out conflict over the desirability of shale gas exploration activity. This resulted in an energy policy failure on the part of the UK Government, as it was unable to bring about a successful shale gas exploration programme. It failed to bring about this programme even before drilling was brought to a halt in late 2019 by a moratorium that is now under review in mid 2022 as part of the UK Government's 'British Energy Security Strategy' (BEIS, 2022).

In the context of energy policy failure, it is important to ask whose failure and in what sense a failure when it comes to the status of the shale gas industry in the UK. The special issue editors (Sokolowski and Heffron, 2022) have offered a definition of energy policy failure; for them: "Energy policy failure is any energy policy which does not meet local, national, and international energy and climate goals across the activities of the energy life-cycle and where just outcomes are not delivered." This normative framing relates energy policy goals to climate change targets such as those found in the UNFCCC's Paris Agreement and the EU's 'Fit for 55' package. In the UK, post-Brexit, the relevant policy goals relate to the Climate Change Act (2008) that was revised in 2019 to set an economy-wide Net-Zero target for 2050.

While the compatibility, or not, of shale gas development with the UK's energy and climate goals plays a role in the shale gas conflict, our specific concern is with why the shale gas industry failed to progress its exploration programme despite the support of the UK Government. Moreover, while contested, for the UK Government, shale gas has potential to benefit communities through local payments and job creation, transfer technology, improve energy security and generate revenue for domestic firms (Sovacool et al., 2020). In this way, we have an example of policy failure where, in the eyes of its proponents, at least some energy and climate goals could be met by shale gas development; however, these goals compete with *other* goals concerning environmental safeguards, and justice issues, both of which have also been raised by the Government in rejuvenated discussions in early 2022. But it is also the case, as discussed below, that the compatibility of shale gas development with climate change goals is strongly contested. We will return to these issues at the end of the paper.

The paper is structured as follows. After this short introduction, there follows a brief history of the initial development of shale gas in the UK, focussing on key milestones, activities, and documents. Then, a short discussion of the funding of social science research on unconventional hydrocarbons in the UK introduces the core of the paper that reports on research into three dimensions of the UK's shale gas landscape: first, the political debate in Westminster; second, the public understanding of shale gas and changing attitudes towards its development; and third, impacts and responses from communities impacted by exploration activities. The final substantive section explains the UK Government's shale failure. While writing this paper, the shale gas landscape shifted yet again. The global gas price crisis and Russia's war in Ukraine has resulted in the UK Government asking the British Geological Survey (BGS) to review the current moratorium. According to the Government (Kwarteng, 2022), any decision to lift the moratorium will be based on the 'science,' but community acceptance is also a requirement for progress (Hands, 2022). Therefore, the paper concludes by identifying the lessons learnt from the Government's initial policy failure, both in relation to potential further shale gas exploration, but also technologies required for a future Net-Zero energy system, such as carbon capture and storage that is widely recognised as essential to achieving net-zero.

## 2. Background: A brief history of shale gas in the UK

There is not the space to provide a detailed history or extensive literature review of shale gas in the UK (see Williams et al., 2020). Fortunately, studies by Bradshaw (2017) and Skea (2018) provide analysis of the early years of debate. Bradshaw (2017, 190–193) includes a timeline of key events and publications from 2010 through 2015. Following the seismic event at Presse Hall, in June 2011, the UK Government imposed a moratorium on further drilling. It then commissioned a report (Green et al., 2012) that included recommendations to mitigate against further seismic events (the resultant 'traffic light system' was to prove critical). At the same time, the Royal Society and the Royal Academy of Engineers (2012, 4) produced a report on 'Shale Gas Extraction in the UK' that concluded: "The health, safety and environmental risks associated with hydraulic fracturing (often termed 'fracking') as a means to extract shale gas can be managed effectively in the UK as long as operational best practices are implemented and enforced through regulation." At the end of 2012 the UK Government lifted the moratorium on shale gas exploration using hydraulic fracturing. The final part of the puzzle was the publication of a series of four studies by the BGS assessing the shale gas potential of key regions in the UK. The most significant was the 'Gas-in-Place Assessment for the Bowland Shale' (Andrews, 2013). This part of northern England became the focus of shale gas exploration activities. Thus, notwithstanding the actions of the devolved governments (see Cotton et al., 2021), the shale gas conflict was really an 'English Affair.' Although their assessment suggested a significant potential resource base, the BGS stressed that only a programme of exploratory drilling and appraisal could produce a meaningful estimate of reserves. During the early stages of exploration, events in the UK were part of a wider EU shale gas landscape and existing EU legislation in relation to hydrocarbon development and environmental protection provided the underlying regulatory landscape (Hámor et al., 2021). However, in part due to lobbying by the UK government, Brussels fell short of imposing new binding directives in relation to shale gas development, preferring to rely on existing regulations.

The next few years saw a heated debate between a pro-shale national government and the onshore oil and gas industry, on the one hand, and environmental groups and local communities in potential drilling locations, on the other hand. This is examined in detail below. The Government claimed that the regulatory system was 'gold standard,' but never explained what this meant or how such an assessment had been arrived at. Research by Hawkins (2014, 2020) reveals a complex system of multiple actors at various scales with potential gaps in coverage. In the summer of 2013, then Prime Minister David Cameron stated: "If we don't back this technology, we will miss a massive opportunity to help families with their bills and make our country more competitive" (Energy Voice, 2013). Then in January 2014 he famously declared: "... we're going all out for shale" (Watt, 2014). In August 2015, the Government (DECC & DCLG, 2015) stated that: "... there is a national need to explore and develop our shale gas resources in a safe, sustainable and timely way ...."

Fast forward to the summer of 2019, Cuadrilla Resources was progressing a programme of drilling, hydraulic fracturing and appraisal at its Preston New Road (PNR) site in Lancashire following numerous delays due to planning refusals and legal review (Bradshaw and Waite, 2017). Cuadrilla started its main fracks on 15<sup>th</sup> August 2019 and suspended its operations prematurely on 26<sup>th</sup> August having paused on four occasions. During this period, the BGS recorded 134 seismic events—the largest measuring 2.9M<sub>L</sub> (Hayhurst, 2019, Kettlely et al. 2020).

Unfortunately for the UK's shale gas industry, as explained below, the political landscape had also shifted and during a national election campaign the Conservative Government of Boris Johnson imposed a new moratorium on shale gas exploration. On 4 November 2019, then Secretary of State for Business, Energy and Industrial Strategy (BEIS), Andrea Leadsom (2019) stated that: "On the basis of current scientific

evidence, Government is confirming today that it will take a presumption against further Hydraulic Fracturing Consents. This position, an effective moratorium, will be maintained until compelling new evidence is provided which addresses the concerns around the prediction and management of induced seismicity.” Boris Johnson won the election with significant gains across the north of England. Those who had protested shale gas heralded this as a victory but noted that it was not an all-out ban (Devine-Wright et al., 2021; Peters, 2019). In July 2020, the new Secretary of State at BEIS, Kwasi Kwarteng stated, when asked about fracking, that: “It’s not something that we are looking to do. We have always said that we would be evidence-backed, so if there was a time when the scientific evidence changed our mind, we would be open to that. But for now, fracking is over” (Cockburn, 2020). In May 2021, the opposition Labour Party sought to amend the Government’s Environment Bill to include a ban on fracking. The amendment was defeated, but Kwasi Kwarteng noted: “There is no new evidence to suggest that we should end the moratorium, so it stays—no more fracking” (Hayhurst, 2021). In the same debate, Lee Rowley—the anti-fracking Conservative MP for North East Derbyshire and now a minister in BEIS—observed “Fracking is over, the battle is won. The industry has packed up. It is gone.” Then, in the autumn of 2021 amid a global gas price crisis, some Conservative MPs, together with the industry, started to call for a re-assessment of the moratorium. This gained further traction after Russia’s invasion of Ukraine on 24th February. Against a determination to move away from reliance on Russia oil and gas imports—Russia accounts for less than 4 per cent of UK gas imports—and heightened concerns about energy security, the shale gas debate has once again ignited in Westminster and the media. As noted above, this has culminated in the Government asking the BGS to review the science to see if there is a case for lifting the moratorium. This recent activity is beyond the scope of this paper, but it does change the context within which we reflect on the findings of our research and their policy implications.

### 3. Social science research on the UK’s shale gas landscape

The first major social science research effort came from the EU Horizon 2020 research programme M4 Shale Gas: Measuring, Monitoring, Mitigating and Managing the environmental impact of shale gas (Horizon, 2020, 2021) that was part of a wider initiative that focused on earth and environmental science. The M4 Shale Gas (2017) project, which ran from early 2015 to the end of 2017, was distinct in having a social science element examining public understanding. It published several reports and papers and served as a focal point for research in the UK. The second significant event was a workshop in November 2015 in Washington D.C. supported by the US National Science Foundation (NSF) and the UK’s Natural Environment Research Council (NERC). A joint report was produced (Reible and Davies, 2016) that informed discussions in the UK between the Natural Environment Research Council (NERC) and the Economic and Social Research Council (ESRC).

The result was an £ 8 million multi-disciplinary research programme running from 2018 to 2022 entitled: ‘Unconventional Hydrocarbons in the UK Energy System: Environmental and Social Impacts and Processes’ (NERC, 2021). The programme is organised around five challenges, two of which involve social science: Challenge 1 on the Evolving Shale Gas Landscape and Challenge 5 on Socio-Economic Impacts that are addressed by three separate projects. Challenge 1 has coordinated the publication of eight benchmark documents that together review social science research on the UK’s shale gas landscape (UHUK, 2021). This paper draws on those reviews and new primary research from the Challenge 5 projects to explore the UK Government’s shale failure.

This paper integrates and synthesizes the findings from those social science projects. There is not space here to delve deeply into the theoretical and methodological underpinnings of each project, these are touched on below, but more detail can be found in the research papers published by each research team (for overviews, see: Devine-Wright et al., 2021; Evensen, 2018a, 2019b; Szolucha, 2018a,b; Williams and

Sovacool, 2019; Ryder and Devine-Wright, 2021; Sovacool et al., 2020). Collectively these studies employed a mix of methods including literature reviews, expert interviews, household interviews, a series of nationally representative and local surveys, social media analysis, and a content analysis of political testimony. They also speak to a range of theoretical approaches, including energy justice; however, it is not the intent of this paper to test explicitly the energy justice framing of policy failure proposed by the special issue editors (Sokolowski and Heffron, 2022), and we are also informed by other notions of policy failure (see Williams and Sovacool, 2020). However, we do explore connections between the shale gas conflict and issues of local justice, equity, and democracy and, where relevant, align our results with the dimensions of energy justice (Heffron and McCauley, 2017).

## 4. Findings

### 4.1. The political framing of the ‘shale gas debate’

As the shale gas debate evolved, clearly distinguishable pro- and anti-shale ‘discourse coalitions’ formed both within policy-making and legislative institutions and beyond (for details of the membership of these coalitions, see Cotton et al., 2014; Bomberg, 2017a,b; Williams and Sovacool, 2020). Within each coalition, actors coalesced around shared ways of talking and thinking about shale gas (‘frames’); but the two coalitions framed shale gas and hydraulic fracturing in sharply contrasting and often contradictory ways (on the concept of a frame see, Snow and Benford, 1988; Rein and Schon, 1993; Benford and Snow, 2000; for applications of this concept to the UK shale gas case see, Hilsen, 2014; Bomberg, 2017a,b; Stephan, 2017; Nyberg et al., 2018; Williams and Sovacool, 2019). In this section, we offer a summary of 9 key pro- and anti-shale development frames that were used in the Westminster policy debate. Table 1 presents an overview of these key frames (see Williams and Sovacool, 2019 for a more detailed account). We then offer an explanation as to why the pro-shale gas coalition faced difficulties in crafting resonant (i.e., powerful, compelling) frames that persuaded rival actors and wider audiences to see shale gas as they did. Here we identify four issues: namely, the lack of real-world, UK relevant evidence; the difficult in dislodging wider cultural memories and understandings about the impacts of fossil fuel extraction and regulatory failures; the inability to counter the ‘bad gas governance’ frame; and the failure of the ‘bridging fuel’ argument.

#### 4.1.1. Methods and data sources on the political framings

The arguments about the ‘framing of fracking’ put forward in this section are based on a range of methods. The analysis of the Westminster policy debate is based on a review of the literature on ‘framing fracking’ (Evensen, 2018b), and a large-scale analysis of policy documents and parliamentary debate alongside interviews with well-placed stakeholders. The analysis of wider public perception is also based on the literature, as well as interviews with local community members in the Fylde region of Lancashire and a nationally representative survey. The document analysis focused on 9 types of policy document, including parliamentary testimony, written ministerial statements and select committee reports (n = 1,557) (see Williams and Sovacool, 2019). The sample for the stakeholder interviews (n = 30) included experts, regulators, industry actors, policymakers and representatives, and environmental NGO actors with a range of positions on the issue (12 pro, 9 neutral and 9 anti). The local community interviews used purposive and snowball sampling strategies to identify 31 predominantly ‘campaigning public’ community members (Mohr et al., 2013) who were visibly active on this issue locally, from three distinct geographical areas in Lancashire (coast Fylde, rural Fylde, and the wider PEDL 165 region –Preston) and with a range of views on the matter (22 anti, 6 pro, 3 ambivalent) (Sovacool et al., 2020). The web-based survey was conducted in the autumn of 2019 and had a final sample of 2,148 that was closely representative of the UK population by country, region, age, sex, and

**Table 1**  
An overview of 'pro' and 'anti' shale gas policy frames and discourse coalition membership in the UK.

Frame	Description Discourse Coalition	Key Texts
Pro-shale gas frames		
Lower carbon fuel	Puts gas, including domestic shale gas, forward as an environmentally friendly alternative to coal	UK Gov, Shale industry, the Conservative Party, BEIS Mackay and Stone (2013)
Manageable risk	Considers hydraulic fracturing to be a low-risk activity that will be successfully managed by 'gold standard' regulations and experienced regulators	UK Gov, Shale industry, the Conservative Party, Royal Society, Royal Academy of Engineering, EA, HSE, PHE, most academic geologists Royal Society and Royal Academy of Engineering (2012)
Wealth and security	Emphasizes the economic and energy security benefits of domestic shale gas production	UK Gov, The Treasury, Shale industry, the Conservative party, some Labour MPs, GMB Union, IoD, Ernst and Young, Supply chain, HoL Economic Affairs Committee Institute of Directors (2013), EY (2014), HoL Economic Affairs Committee (2014)
Low impact development	Argues that shale development only generates short-term nuisance impacts (e.g. traffic) that are no different to any construction project	UK Gov, the Shale industry, MHCLG, IoD, UKOOG UKOOG (2017)
<b>Anti-shale gas frames</b>		
Industrialise the countryside	Attacks shale gas for despoiling the countryside/national parks	Campaign to Protect Rural England, some Conservative MPs with rural constituencies covered by licenses, local campaign groups Jones (2018), Rowley (2017)
Bad gas governance	Criticises the exclusion of local communities, lobbying, and lack of transparency in the dash for gas	CPRE, the Labour Party, the Green Party, some conservative MPs in response to NSIP and permitted development plans, local campaign groups CPRE (2018a, 2018b)
Dirty fossil fuel	Suggests that developing a domestic shale gas industry is incompatible with the UK's climate change targets and that shale gas should therefore be kept in the ground	FoE, Tyndall Centre, UKERC, increasingly the Labour Party, the Green party, HoC Environmental Audit Committee Broderick et al. (2011), HoC Environmental Audit Committee (2015)
Elusive threats	Views hydraulic fracturing as a novel and risky process, and questions the adequacy of regulations and the capacity of regulators	FoE, some public health experts (e.g., Medact), the Green Party, part of the Labour Party, HoC Environmental Audit Committee, local campaign groups McCoy and Saunders (2015), McCoy and Munro (2016)
No repeat revolution	Emphasizes differences in UK context that make a repeat of the US 'revolution' unlikely	Some think tanks (e.g. Chatham House), some large energy companies, some financial institutions Stevens (2012)

Source: Modified from Williams and Sovacool (2019).

income. The survey included a measure of how plausible respondents found several simple propositional statements that captured the key claims associated with the frames identified through the document analysis and stakeholder interviews.

#### 4.1.2. 'Pro-shale' frames

As noted above, the issue of shale gas did not emerge as the focus of sustained policy debate until 2011. The debate continued until the announcement of the moratorium in late 2019 and has recently resurfaced. Initial enthusiasm amongst pro-shale legislators was driven by hopes that the US shale 'revolution' could be repeated in the UK forming the basis of what we will call the 'wealth and security' frame. This frame focused on the economic and energy security benefits of a domestic shale gas industry (Solman and Bradshaw, 2020) and was underpinned by both a new sense of abundance encouraged by some large resource estimates (Andrews, 2013) and 'competitiveness anxiety' over energy-intensive industries resulting from widening gas price differences between the US and Europe caused by the US shale revolution. Another key pro-shale gas frame was 'low impact development' that envisioned a UK industry with a small surface footprint which would avoid any industrialisation of the countryside, causing only temporary nuisances typical of any construction project. The 'manageable risk' frame viewed the risks of hydraulic fracturing as low, manageable, and well understood; and emphasised the relative strictness of UK regulations, and the experience and competence of the UK regulators gained from regulating the offshore industry. Finally, the 'lower carbon fuel' frame presented gas, including domestic shale, as having a continuing and long-term role in the energy mix that was compatible with the UK's climate change targets and the low carbon transition more broadly. Notably, this included the 'bridging fuel' argument that exploiting domestic shale gas was a positive step towards a low carbon transition by replacing coal-fired power generation; even though the Government subsequently legislated for the phase out of unabated coal in power generation by 2025 and then brought that date forward to late 2024.

#### 4.1.3. 'Anti-shale' frames

Many of the anti-shale gas frames countered those above, framing a particular issue in an entirely contradictory way when compared to the pro-shale framing. For instance, the 'industrialise the countryside' frame envisioned a shale industry that would pepper certain parts of the English countryside with a high density and large number of heavily industrialised sites, fundamentally changing the rural character of such places. The 'elusive threats' frame questioned the adequacy of regulations and capacity of regulators to manage the risks of hydraulic fracturing, which was viewed as a novel, risky, and poorly understood process. The 'dirty fossil fuel' frame considered the development of a new, domestic fossil fuel industry as incompatible with efforts to mitigate the worst effects of climate change and as deeply irresponsible given that most global proven fossil fuel reserves are 'unburnable' (McGlade and Ekins, 2015, SEI et al., 2020). Finally, the 'bad gas governance' frame – which lacked a fully-formed pro-shale gas counterpart - argued that shale gas sites were being imposed on communities in an undemocratic fashion by untrustworthy companies and institutions.

#### 4.1.4. Why the 'pro-shale development' frames failed

Why did the pro-shale development frames fail to appeal sufficiently to wider public audiences? A key issue was the evident difficulty in crafting compelling frames about future impacts either in the absence of real-world evidence or based on extrapolating from other cases of questionable relevance, such as the US experience or other forms of development in the UK (Bomberg, 2017a,b; Williams and Sovacool, 2019). Nyberg et al. (2018) argue that, within sites of policymaking (select committee inquiries), the pro-shale gas coalition had some success in making futures seems more certain and real through processes of quantification using technical reports to quantify the size of resource or

economic benefits on offer. However, amongst broader public audiences such efforts were easily undermined by the anti-shale gas coalition pointing to questionable assumptions and extrapolations and offering alternative visions of what a shale industry would look and feel like based on the US experience. A lack of trust in the actors of the pro-shale gas coalition amongst local communities and sections of the UK public further undermined the extent to which their visions and projections were viewed as believable (Bomberg, 2017a,b). This dynamic undermined the ‘wealth and security’ frame. Relatedly, the ‘low impact development’ frame failed to convince sections of the public, and especially local communities, of the vision of a future shale industry that would have a light surface impact, avoiding the look and feel of industrialisation. References to forms of development of questionable relevance failed to dislodge images of the US industry and collective understandings and memories of what fossil fuel extraction looks and feels like from the minds of local community members.

Similarly, the ‘manageable risk’ frame failed to convince many that hydraulic fracturing was a mundane, low-risk activity; or that UK regulations and regulators were well-placed to manage it. Part of the issue here was again broader cultural understandings, memories, and experiences of regulatory failure, such as BSE, the 2007–2008 global financial crisis and the Grenfell Tower tragedy that proved difficult to dislodge. In contemporary context, the Government’s mishandling of the Covid-19 Pandemic and the failure of senior government figures to follow the laws they had instituted, likely serve to undermine their credibility to effectively manage risk. Whilst these disparate reference points may seem unconnected to hydraulic fracturing, local interviewees regularly raised them to express concerns about the various ways in which risks can overflow regulatory control. Again, this dynamic was exacerbated by a lack of trust in governing institutions and the industry, as well as perceptions of early instances of regulation in practice. Many of our local interviewees felt that their early experiences of UK regulation in practice at the Preese Hall and PNR sites undermined claims of ‘gold standard’ regulation that formed a key part of the ‘manageable risk’ frame. As Hawkins (2015, 2020) pointed out, there was a lack of clear definition of what was meant by ‘gold standard’ regulation. As is made clear below, there are obvious links here to the notion of procedural justice and concerns about whether processes are adequate and have been followed.

Furthermore, the pro-shale gas coalition failed to develop a fully-formed counter-frame to the ‘bad gas governance’ frame (Evensen, 2018b; Williams and Sovacool, 2019), and struggled to counter effectively its accusation that shale development was being imposed on unwilling communities whose opportunities to influence policy- and decision-making (especially in the form of rejecting shale sites locally) were increasingly constrained through, for example, reforms to and interventions in the planning system (Bomberg, 2017a,b; Williams and Sovacool, 2019). Whilst pro-shale Conservative-led governments adopted a rhetoric of localism in this period, beyond vague assurances that local communities would be able to ‘have a say’ (DECC, 2015), their approach tended to favour community benefits packages over greater and more meaningful community involvement in decision making (Cowell and Devine-Wright, 2018).

Finally, the lower carbon fuel frame and bridging fuel argument failed to convince both environmentally minded policy actors and the broader public that the development of a new domestic fossil fuel industry constituted a step in the right direction on climate change, instead being widely viewed as an act of ‘non-transition’ (Parkhill et al., 2013). The central thrust of the lower carbon fuel frame – that exploiting domestic shale gas was good for climate change – was widely seen to cut against the grain of common sense and was often met with nothing short of incredulity by our local interviewees. The ‘lower carbon fuel’ frame was further undermined by developments in the energy and climate policy sphere during this period (Stamford, 2020). In particular, the issue of ‘fugitive’ methane emission has gained prominence because of the shale gas revolution and is now the subject of the ‘Global Methane

Pledge.’ In the context of Sokolowski and Heffron’s (2022) definition of policy failure, the anti-fracking coalition saw shale gas development as bad policy that was incompatible with the Government’s own climate change policies. Increasing optimism about the economic competitiveness of renewable energy sources bolstered the sense amongst the anti-shale gas coalition that a domestic shale gas industry was unnecessary. The emergence of the notion of a ‘climate emergency’ in civil society encouraged a sense of urgency that was in tension with the kind of intermediate, transitional step envisaged by the term ‘bridging fuel’. The emergence of the ‘net zero’ policy discourse at least rhetorically ratcheted up climate policy ambition in ways that seemed at odds with a policy of encouraging a new fossil fuel industry as necessary, timely and responsible (Solman and Bradshaw, 2021).

In this section we have argued that there were four key factors that contributed to the UK Government’s shale failure. First, the pro-shale gas coalition struggled to make their projections of future benefits and visions of a domestic industry believable due to a lack of compelling UK-relevant, real-world evidence. Second, assurances of low and manageable risk were undermined by broad cultural understandings of risk and regulation; a lack of trust in the relevant agencies, companies, and institutions; and perceptions of early regulation in practice. Third, the pro-shale gas coalition failed to counter or respond adequately to the ‘bad gas governance’ frame, leading to the widespread perception that shale gas sites were being imposed on communities undemocratically. Finally, the argument that developing a domestic shale gas industry was climate-friendly was widely viewed as implausible and was further undermined by key developments in the climate and energy policy sphere during this period. Thus, somewhat ironically, had the shale gas industry developed in the UK, it might later have been considered a policy failure against the normative framing of ‘successful policy’ as being compatible with energy and climate goals. It is also worth noting that in the contemporary debate about the need to lift the moratorium, no substantive new arguments have been made by those supporting fracking. Whilst the stated reason for the UK government’s shift to a moratorium was scientific uncertainty over the probability and magnitude of seismicity, low levels of public acceptance were undoubtedly part of the policy failure story (Cabinet Office, 2016). This is the subject of the next section.

#### 4.2. Public understanding and attitudes towards shale gas in the UK

National-level data on public perceptions of shale gas have been collected in the UK since 2012. A decade later, several studies have continued to explore this issue, by examining both public awareness of shale gas and public support or opposition to it.

##### 4.2.1. Methods and data sources on public understanding and attitudes

This section draws on existing survey-based and experimental literature on public acceptance of shale gas as well as from five research initiatives investigating public perceptions of shale gas in the UK, including the Public Attitude Tracker (PAT) commissioned by BEIS, and research led by teams at the University of Nottingham, the University of Edinburgh, the University of Exeter, and the University of Sussex (for more background on the last four see Ryder et al., 2020). This body of research represents multiple quantitative and mixed methods designs, involving unique questionnaires with inputs from qualitative research, conducted with large-scale, nationally representative samples of participants.

##### 4.2.2. Public awareness of shale gas and the impacts of information provision

Survey-based research has found increasingly high levels of awareness of shale gas and fracking since 2014. When first collected through the BEIS PAT in June 2012, only 42% of survey respondents were aware of hydraulic fracturing. However, by March of 2014, self-reported awareness jumped to 75% and has remained consistent (between 74 and 87%) across multiple national surveys since then. It is important to

note that how ‘awareness’ is defined differs across studies, with nuanced findings on the relationship between awareness and support/opposition. Still, it is worth noting that BEIS PAT (2019) also found around half of the respondents say they know nothing more about shale gas beyond just hearing about it in passing (BEIS, 2019). The most recent BEIS PAT (2021) survey, conducted in autumn 2021, showed that 87% of respondents were aware of shale gas. Researchers have tied this increased awareness to increasing polarization of opinions on shale gas (Howell, 2018) and to respondents with less-nuanced, politically motivated beliefs about shale gas (Andersson-Hudson et al., 2019). Such findings reinforce the idea that attitudes towards fracking shape beliefs about its impacts, and not the other way around (Evensen and Stedman, 2017).

Early studies using nationally representative surveys found greater knowledge/familiarity to be positively associated with support for fracking in the UK (Andersson-Hudson et al., 2016; Stedman et al., 2016). However, the 2019 Sussex Survey (Martin et al., 2019) found very weak associations between multiple measures of self-reported familiarity, knowledge, and support/opposition. Similarly, in the Exeter ASSIST survey, there was a weak link between awareness and support or opposition. These findings challenge any simple causal link between knowledge and support for shale gas in the UK. An experimental study by Whitmarsh et al. (2015) found that support for shale gas increased when participants (particularly those who were initially ambivalent about the topic) were presented with additional information on the benefits of shale gas. Conversely, the 2019 Sussex survey found that when respondents who initially took no position on shale gas were asked to choose whether they were leaning towards support or opposition, more selected oppose than support. Relatedly, when the May 2021 ASSIST survey asked respondents to indicate support/opposition for shale gas extraction over a range of areas (five regional areas in the UK, within 3 miles of one’s home, and the UK generally), less than 9% said ‘don’t know’ across all areas.

Like the 2019 Sussex survey, other recent research suggests that providing positive information about the benefits of shale gas development does little to increase public support. The 2019 ASSIST survey found that most respondents’ opinions did not change after learning about a particular benefit tied to shale gas (provided by a question asking about the Treasury’s Sovereign Wealth Fund). In addition, the 2019 Sussex Survey polled respondents on their support/opposition—both before and after asking respondents to evaluate a series of randomized positive and negative claims about shale gas development that were discussed in the section above. The 2019 Sussex Survey data shows that on balance, after reviewing pro- and anti-shale gas claims,

respondents’ opposition to shale gas exploration increased slightly. The 2019 ASSIST survey found that participants who change their opinion about fracking after being informed about the Treasury’s Sovereign Wealth Fund were split—with 20% reducing their support for shale gas and 15% increasing it.

4.2.3. Public support and objections to shale gas

Public objections to shale gas have grown substantially, showing a steady trend in increased opposition and decreased support since 2014 (Ryder et al., 2020; BEIS, 2021a). For example, in the BEIS PAT Wave 8 (December 2013), more people reported supporting (28%) than opposing (21%) shale gas. At the same time, nearly half (48%) said they neither support nor opposed it. Yet over time support has dwindled while opposition has risen. In the BEIS PAT Wave 37 (March 2021), only 23% of participants said they supported shale gas while 36% reported opposing it and in the Autumn 21 survey, as they are now called, (BEIS, 2021b) those supporting shale had fallen to 13% and those opposed had increased to 45%. Those who neither support nor oppose are still a substantial percentage of the respondents but this has dropped from just under half to only 32%. This mirrors the trends we have seen as data has continued to be collected since 2013 (see Fig. 1). Studies also show that a substantial percentage of the public neither supports nor objects to shale gas. The BEIS PAT survey conducted in March 2021 (Wave 37) indicated that 32% of respondents neither supported nor opposed fracking, a slight increase from the four PAT survey waves across 2020, but in the Autumn 21 survey it was lower at 30%. Thus, the Government’s own surveys detail a dwindling and now very low level of public support, in the words of the survey, for “extracting shale gas to generate the UK’s heat and electricity.”

4.2.4. Explaining levels of public support

This corpus of research shows several demographic factors influence participants’ support or opposition to shale gas. Supporters are more likely to be male, Conservative Party voters, and those who see shale gas as a path to clean, affordable, and secure energy security. Those who oppose shale tend to have strong environmental values and have concerns about shale gas as it relates to seismic activities and environmental impacts such as water contamination and methane emissions. Reasons for support may also be linked to economic status or culturally specific understandings of risk (Thomas et al., 2017a). Howell (2018) found support to be rooted in economic reasons, and the 2015 BEIS PAT shows that the need to use all available energy sources is consistently the most frequently expressed reason for supporting shale gas exploration, but

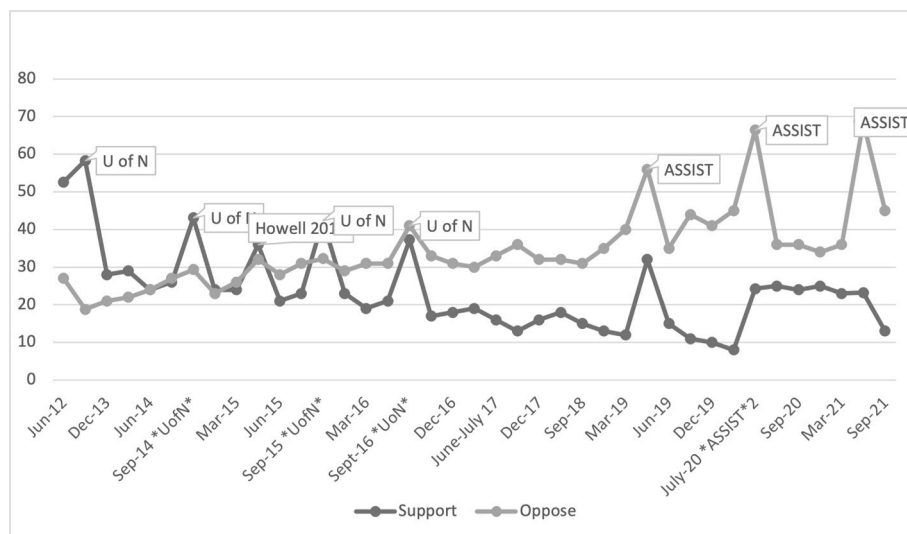


Fig. 1. Public support of shale gas exploration in the UK over time (with non-BEIS surveys highlighted).

that survey did not include options for participants to select any potential social impacts that might contribute to their support or opposition to shale gas. Across the same time, people who oppose shale gas development have expressed concern about environmental destruction or loss. Respondents indicated that contamination and seismic activity—the second most cited concern since September 2018—continue to be at the forefront of public concerns. For example, on a scale of 0–10 (not at all negative to very negative), respondents to the June 2020 ASSIST survey provided an average response of 8.4 to how negative they would perceive an earthquake from shale gas extraction that could be felt but that caused no damage.

Finally, there is evidence that issues of trust and procedural justice, one of [Heffron and McCauley's \(2017\)](#) five forms of energy justice, are relevant in informing public perceptions of shale gas. Existing UK studies on shale gas reveal low levels of public trust in industry and government, as well as scepticism around the need for development ([Partridge et al., 2017, 2019](#); [Thomas et al., 2017b & 2018](#); [Szolucha, 2018, 2020a](#); [Williams et al., 2017](#); [Ryder et al., 2020](#)). These trust issues could be tied to fairness, justice and local democracy concerns that have emerged as relevant in research on shale gas discourse and community experiences with proposed shale gas exploration sites in the UK ([Bomberg, 2017a,b](#); [Evensen, 2018b](#); [Stephan, 2017](#); [Ryder and Devine-Wright, 2021](#); [Williams and Sovacool, 2019](#); [Szolucha 2018](#)). Given the dominance of these issues in public discourse and experience coupled with a lack of increase in support for shale gas through increased awareness, public 'education,' and a focus on economic incentives ([Howell, 2018](#); [ASSIST, 2019](#); [Thomas et al., 2017b](#)), there appears to be a clear disconnect between the focus of public perceptions and government and industry approaches to addressing public concerns. Thus, a key reason for policy failure here is the fact that Government's policies and approach failed to address the issues that were the root cause of a lack of public support for shale gas development.

In sum, UK public perceptions of shale gas show a clear trend of downward support over the past decade. Yet a large portion—around one-third—remain uncommitted to supporting or opposing shale gas, even as there appears to be strong opposition to the process and support has continued to decrease. This suggests that research on public support of shale gas remains inconclusive. Those who support it tend to lean toward the need for the use of all energy sources, the need to reduce reliance on fossil fuels, and the need to reduce dependence on foreign energy sources, while those who oppose it are concerned with environmental degradation and seismic activity and impacts. In the contemporary situation of heightened concerns about energy security, it is easy to understand why there is a constituency calling for the current moratorium to be lifted. Interestingly both those in support and opposition express concerns about how shale may impact climate change and show overall support for limiting shale gas exploration. This highlights the 'ambiguous' role that natural gas—as opposed to fracking—continues to play in discussions and policy making in relation to the low-carbon energy transition. We suspect that in part, the continued decline in public support is tied to issues of trust, fairness and procedural justice, issues which have not been addressed by industry and government in such a way as to instil confidence in the public. Thus, energy policy failure was as much a result of *how* the Government went about its business as it was the intent of the policy.

#### 4.3. Local impacts and responses

Two Challenge 5 projects examined the local context of shale gas development with a variety of stakeholders (residents, anti-fracking protesters, business owners, police, local planners, industry officials, academic experts, and government officials) using both qualitative and quantitative methods.

##### 4.3.1. Methods and data sources on local impacts and responses

Qualitative methods included ethnographic field work consisting of

qualitative semi-structured interviews, walking interviews, participant observation, and photo elicitation. Four local areas were chosen that were in the planning stages of commercial shale gas development or extracting shale gas as an exploratory activity using hydraulic fracturing (Great Altcar in Lancashire, Kirby Misperton in North Yorkshire, PNR in Lancashire & Woodsetts in South Yorkshire). In addition to these four areas, one of the projects examined three additional local areas engaged in conventional oil and gas development for comparison (Eberston Village in North Yorkshire, Ellesmere Port in Cheshire, and Albury in Surrey). While the specific aims of the two Challenge 5 projects were slightly different, the larger goal of both projects was to gain insight into the experiences of stakeholders living in areas where shale gas development was taking place or was planned. Importantly, as [Short and Szolucha \(2019\)](#) suggest, the community impacts of shale gas development begin at the planning stage, even before any oil and gas extraction occurs (see also [Ryder and Devine-Wright, 2021](#)). All data were collected between 2019 and 2021. It is noteworthy, that the imposition of the moratorium left some local planning decisions in stasis with outcomes still pending.

Quantitative data on the impacts and responses of different types of oil and gas development were collected through a random sample of households within three miles of planned or existing oil and gas extraction sites at Kirby Misperton, PNR, Eberston Village, Ellesmere Port and Albury. A total of 2300 questionnaires—300 to 500 in each location—were mailed or delivered by hand to households in each area. The householders determined who, in the household, filled out the survey. A total of 384 surveys were returned (19% response rate). The questionnaire asked for opinions about oil and gas development, the impact development on wellbeing and levels of trust in various institutional actors. Below we focus on (1) support for shale gas development, (2) concerns associated with shale gas development (3) and, residents' perceptions of being included as decision-makers in shale gas development across the seven locales.

##### 4.3.2. Local support for shale gas development

Qualitative research reveals that stakeholder opinions about shale gas development are varied (e.g., "I would oppose fracking regardless of where it would take place" [R268] vs. "It's going to have to happen so let's get on with it as there are large reserves in the area." [R165]). While strong opinions about shale gas development were not unusual, we also found that in some locations police, public officials, and some business owners were reserved in sharing those opinions because of a desire to appear neutral on the issue. As discussed below, many residents also believed that strongly held conflicting views about shale gas had a disruptive and harmful impact on their community. In response, some residents living near proposed hydraulic fracturing sometimes said that they hoped to avoid conflict by withholding their opinions on the topic (see also [Drummond and Grubert, 2017](#)). Nevertheless, a significant number of residents felt comfortable posting anti-fracking signs on their property to show their opposition (see also [Soyer and Ziyanak, 2018](#)). Moreover, dozens of local anti-fracking organizations were established in the communities we studied, including *Frack Free Kirby Misperton*, *Preston New Road Action Group*, *Rossendale Against Fracking*, *Preston Frackoff*, *Frack Free Forby*, *The Moss Alliance* and *Woodsetts Against Fracking*. Finally, anti-fracking protest encampments were built near PNR and Kirby Misperton.

Quantitative surveys can also evidence likely levels of support for hydraulic fracturing among residents living near potential development sites. As noted in [Table 2](#), relatively low levels of support were observed in five areas. These levels of support mirror national-level data that records low and declining levels of support for shale gas (see [Fig. 1](#)).

As [Table 2](#) shows, variation in local support for hydraulic fracturing ranges from a minimum of 5.6% (95% C.I. = 0.0,11.6) of respondents in Albury (a high-income community) to a maximum of 20.8% (95% C.I. = 9.8, 31.6) of respondents in Kirby Misperton (where shale gas development using hydraulic fracturing was planned but abandoned). While

**Table 2**  
Support for different types of oil and gas technology in five communities.

Hydraulic Fracturing				
% Nearby residents that say they “support” the use of technology in their community (n = 262)				
Kirby Misperton	Ebberston Village	Preston New Road Region	Ellesmere Port	Albury
(North Yorkshire)	(North Yorkshire)	(Lancashire)	(Cheshire)	(Surrey)
20.8%	15.7%	12.1%	14.1%	5.6%
$\chi^2 = 12.1$ (4 d.f. $p < 0.05$ )				
Conventional Drilling				
% Nearby residents that say they “support” the use technology in their community (n = 222)				
Kirby Misperton	Ebberston Village	Preston New Road Region	Ellesmere Port	Albury
(North Yorkshire)	(North Yorkshire)	(Lancashire)	(Cheshire)	(Surrey)
36.0%	32.4%	25.8%	77.3%	15.5%
$\chi^2 = 20.5$ (4 d.f. $p < 0.05$ )				

Note: Compared to those residents who say they do not support the use of the technology in their community.

location and support are statistically dependent (i.e.,  $\chi^2 = 12.1$ ; 4 d.f.;  $p < 0.05$ ) this association appears to be an artefact of extremely low levels of support for the use of hydraulic fracturing in Albury. When participants from Albury are excluded from the analysis there is little difference in levels of support across the remaining communities. Nevertheless, support for the use of hydraulic fracturing across the locations was significantly lower than support for use of more conventional oil and gas drilling technologies. That is, support for conventional operations range from a low of 15.5% (95% C.I. = 6.0, 24.9) in Albury to a high of 77.3% (95% C.I. = 59.8, 94.8) in Ellesmere Port (a lower socio-economic area). In short, it appears that support for hydraulic fracturing is relatively low in all the areas we surveyed and is much lower than support for other forms of oil and gas development.

### 4.3.3. Local perceptions of the impact of hydraulic fracturing

Local support and opposition to oil and gas development is complex and often uncovered negative concerns about the technologies being used (e.g., ‘[My community] is a lovely, clean and green area to live in and fracking is a noisy, polluting activity, which would detract massively from this peaceful community.’ [R111]). While qualitative research suggests that the immediate concerns of residents were generally limited to issues of health and wellbeing (Aryee et al., 2020), we found that residents often spoke about place-based disruptions, including complaints about truck traffic, noise, road and footpath blockages, excessive light, lower housing values and especially potential damage to property by seismic events (e.g., ‘I am more concerned [about fracking] since earthquakes occurred [R248]’; see also Ryder and Devine-Wright, 2021, Szolucha 2018).

Jobs and increased economic activity are the most common reasons local stakeholders provided in support for shale gas development (e.g., ‘It [shale gas development] would bring good, well-paid employment to [the town] instead of poorly paid seasonal work’, [128R] and ‘there can be significant economic benefits from such [shale gas] development’ [R134]. Nevertheless, some local business owners felt oil and gas companies are merely ‘another customer’ (Szolucha, 2021a,b,c). Further, business owners challenged the notion of regional economic benefits noting that skilled labour would be imported, and that development may not provide anticipated economic benefits (Szolucha, 2021a,b,c). In sum, locals give more reasons for opposing than supporting shale gas development. Fig. 2 provides an illustration of the diversity in local concerns about the different negative impacts of hydraulic fracturing and conventional drilling.

For the impacts of listed in Fig. 2, levels of concern about the use of these two technologies (conventional drilling and hydraulic fracturing) are different enough to be statistically significant ( $p < 0.05$ ; using t-tests for paired samples with a Bonferroni correction) in seven of the eight comparisons. For instance, over 60% of residents say they are ‘concerned’ or ‘extremely concerned’ about the impact of hydraulic fracturing on water quality while 30% of the same residents say they are ‘concerned’ or ‘extremely concerned’ about the impact of conventional drilling on water quality.

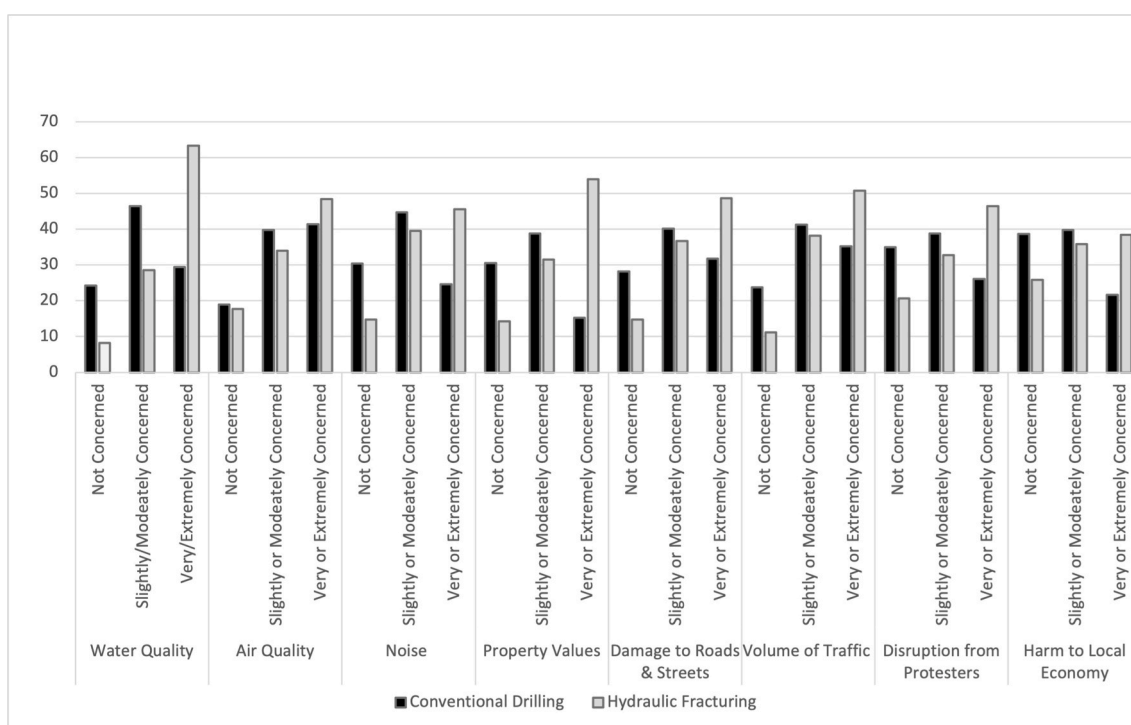


Fig. 2. Percent of residents by level of concern for eight perceived negative impacts often associated with hydraulic fracturing.



#### 4.3.4. Local responses to hydraulic fracturing

Our qualitative research finds that local responses are varied and motivated by numerous factors. One of the more extreme responses is direct action (Short et al., 2020). In four of the communities studied there were anti-fracking direct action protests. We find that protests and protesters were viewed by various local stakeholders in positive (e.g., ‘[I support] peaceful protests ... oppose any source of energy which is produced with profit in mind rather than concern for the environment and people’ [CR170]) and/or negative ways (e.g., ‘protesters are a nuisance’ [R249] or ‘anti-fracking protestors are a bunch of arseholes’ [R195]).

When it comes to protest, there is often significant media attention devoted to protesters residing at encampments. However, we found a significant percentage of long-term residents engaged in anti-fracking protest events. For instance, our quantitative survey finds that 17.4% (19 of 109; 95% C.I. = 10.3, 24.5) of residents living near Kirby Misperton and in the PNR region reported being involved in anti-fracking activities where there was a police presence, while 3.7% (4 of 109; 95% C.I. = 0.16, 7.2) of residents living near those two sites were involved in pro-fracking activities with a police presence. Thus, local opposition by residents living near the proposed or operating hydraulic fracturing sites does exist and often occurs with some frequency. In some cases, local organizations formed regional anti-fracking hubs, such as in the South Yorkshire area. In other areas there was less collaboration across regional groups (PNR and Great Altcar).

Many locals reported that the way in which shale-gas decisions were being made represented a threat to local democracy (on the wider issue of localism, see Cotton et al., 2021). When residents discussed the planning process, they often told us they were offended by the level of central government interference in local affairs (i.e., “I was disgusted when the home secretary over-ruled the local planning authority” [R334].) Many stakeholders also reported intense feelings of injustice at the oil and gas industry’s domination and control of the local planning process (Ryder and Devine-Wright, 2021). Furthermore, distributive and recognition justice concerns—two more forms of energy justice identified by Heffron and McCauley (2017)—also emerged in the communities, in terms of a lack of clarity around the distribution of local benefits, disproportionate burdens of risks associated with the proposed exploration, and a lack of acknowledgment or respect for locals and their place-based concerns (Ryder and Devine-Wright, 2021). Perceived assaults on local democracy in the case of hydraulic fracturing appear, therefore, to have significant procedural and environmental justice implications (see also Griffiths, 2019; Short and Szolucha, 2019).

Table 3 suggests that 35.1% of residents living near the proposed shale gas well in Kirby Misperton agree that there were adequate

**Table 3**

Percentage of residents who Agree/Disagree with the statement “There are adequate opportunities to provide input into oil and gas development in my community.”

Hydraulic Fracturing			
	Preston New Road Region (Lancashire)	Kirby Misperton (North Yorkshire)	
Disagree	53.6%	36.8%	
Neither agree/disagree	8.9%	19.3%	
Agree	16.1%	35.1%	
Don't Know	21.4%	8.8%	
	n = 57	n = 54	
Conventional Drilling			
	Ebberston Village (North Yorkshire)	Albury (Surrey)	Ellesmere Port (Cheshire)
Disagree	47.2%	42.9%	59.1%
Neither agree/disagree	22.5%	16.1%	9.1%
Agree	18.0%	17.8%	4.5%
Don't Know	12.4%	23.2%	27.3%
	n = 89	n = 56	n = 22

opportunities for input into the development and 16.1% of residents living near the experimental fracking well in the PNR region agree that they had adequate input into that development. Residents in communities using conventional oil and gas technology report feeling that they had more opportunities for input into the development decisions, suggesting that local perceptions may be unique to shale gas development using hydraulic fracturing.

Perceptions about levels of trust were shaped by the very first encounters between the industry and the community. Among the first steps taken by the companies intending to explore for gas was to organise a local exhibition where they presented their plans to the public (Cotton, 2017). Residents and other community stakeholders often disagreed on how informative these events turned out to be. Residents often said the timing of these events combined with the quality of information available at these events were critical in shaping their perceptions about trust. In one several community residents only discovered that shale gas exploration was being considered when the oil and gas company gained permission to close a popular footpath, posing ‘no trespassing’ signs along the way. This action occurred even before the company submitted their planning application (see Ryder and Devine-Wright, 2021). Events such as these led some stakeholders to feel that they were not being consulted on the plans in their community and that the oil and gas companies did not intend to take their views into consideration. Indeed, our local questionnaires suggest that in Kirby Misperton and the PNR areas 43.2% (45 of 104; 95% C.I. = 33.5, 53.3) of the residents surveyed would be less likely to trust information in a study of hydraulic fracturing if data from the oil and gas industry were used; 46.5% (46 of 99; 95% C.I. = 36.4, 56.8) disagree that the industry follows rules and regulations associated with hydraulic fracturing; 23.3% (29 of 91; 95% C.I. = 22.5, 42.5) report that the oil and gas industry has too much influence over hydraulic fracturing regulation; and 68.2% (71 of 104; 95% C.I. = 58.4, 77.0) disagree with the statement ‘I trust [company] to operate safely in my community’. In short, there were high levels of company distrust among the random sample of residents living near proposed shale gas sites. Again, this has contemporary resonance as one of the shale gas license holders is offering to drill a ‘test well’ to ‘prove’ that it is safe, a tactic that seems unlikely to work. At the same time, the BGS has been told that their evidence review should involve no drilling and should be ‘desk-based’ (Kwarteng, 2022).

Concerns about the impact of hydraulic fracturing on community cohesion emerged in the qualitative findings in both projects. That is, some residents (holding various opinions) reported that shale gas development had a polarising impact in their community (e.g., ‘Our community was ripped apart [and there was] irreparable damage to police and community relations’ [R308] or [Proposed development] caused division in the community [R333]). Others, however, suggested they became better acquainted with their neighbours and therefore had a stronger sense of community (Something that’s come out of the whole experience for us is that ... we’ve made some really good friends through the volunteer group, and that’s been positive and a nice thing).

#### 4.3.5. The impact of local responses

Key informants in the UK shale gas industry repeatedly said that citizen engagement was a key obstacle to shale gas progress because it held up the planning process. Even though the central government sought to circumvent this problem by calling in planning appeals for shale gas, delay played a critical part in the shale failure. Equally, while various court actions failed to stop developers, they succeeded in slowing the process of planning approval (Hawkins, 2020). In the end, however, local councillors responded to vocal constituents, at times opposing local projects despite their own political party supporting the practice. Even in the ruling Conservative Party, MPs in some shale gas constituencies, began to challenge government support for the industry.

## 5. Discussion: explaining the UK Government's energy policy 'shale failure'

As noted in the introduction, the UK Government went from the Prime Minister David Cameron declaring in early 2015 “we’re going all out for shale” to the reimposition of a moratorium on hydraulic fracturing in autumn 2019, to a declaration by a senior minister in July 2020 that “... for now, fracking is over,” which was reaffirmed by the same Minister in May 2021 “no more fracking.” Now, in April 2022, in the context of a cost-of-living crisis and Russia’s invasion of Ukraine, the same Minister has commissioned a review of the science to see if the moratorium might be lifted. There is no presumption that anything has changed, but notwithstanding the specific issue of induced seismicity, the wealth of evidence presented above suggests that the UK Government was never able to garner public support for shale gas development. Furthermore, significant opposition at the local level slowed the pace of progress and raised the profile of local concerns to strengthen national opposition in England and the protesters have made it clear that they would do so again (Pidd, 2022). Our research also reveals significant concerns about the efficacy of environmental regulations, issues of justice and distrust of government and industry actors. In fact, it is difficult to identify what went well for those in favour of shale gas development first time around. Consequently, the failure to deliver an exploration programme of the scale and pace needed to assess shale gas potential across the north of England was a clear policy failure for the UK Government in London. It also underscores the sociotechnical nature of failure, given that the drivers behind it were geological (earthquakes), environmental (compatibility with climate change legislation and local impacts), political (contestations in Parliament), economic (disagreements over benefits and the business environment), and social (strong opposition from some local groups).

In their study of the shale gas conflict in Lancashire, Bradshaw and Waite (2017) used a social-actuarial-political (SAP) risk and licensing model (Bice et al., 2017) as a heuristic device to organise evidence from the public enquiry in Lancashire in relation to Cuadrilla’s drilling licenses. The SAP model performs a similar purpose here by extending the notion of the ‘Social License to Operate’ (for a review see Santiago et al., 2021) to consider the need for political and legal (actuarial) licenses to enable new extractive activities. In their analysis they concluded that while it was clear that Cuadrilla did not have a social license to operate from communities in Lancashire, the company was able to proceed because of continuing political support in Westminster—that overturned the local decision against planning approval—and the fact that it was in regulatory (legal) compliance.

A combination of events in 2019 changed the shale gas landscape. At the national party-political level, the cross-party consensus around the need to address climate change was reinforced by the approval of amendments to the Climate Change Act (2008) to set a Net-Zero Emissions target for 2050. This was closely followed by Cuadrilla starting its fracking operations at PNR. As we know, those operations triggered seismic events prompting a suspension of drilling activity and an enquiry by the Oil and Gas Authority resulting in the reimposition of the moratorium. The timing could not have been worse for the industry as growing local opposition in Conservative constituencies was challenging the Government’s support in the run up to a general election. Having won the 2019 election, with notable victories across northern England, the Government repeatedly made it clear that it was no longer interested in shale gas development. Thus, the industry had failed on all three counts, it never had a social license, nationally or locally, it no longer had a political license in terms of support in Westminster, and it faced a major barrier to regulatory compliance in relation to the management of induced seismicity. Equally, returning to energy justice, as we have flagged in our discussions above, the Government’s approach to supporting shale gas exploration failed in terms of procedural, distributive, recognition and restorative justice. All these issues made support for the industry an electoral liability. We must see what happens next, but our

research findings suggest that lifting the current moratorium would simply result in a resurrection of the shale gas conflict, with, as the Government itself admits, no prospect of the industry addressing the short-term challenges of energy security and affordability that the country faces.

## 6. Conclusions: implications for net-zero policy making

Multiple lessons emerge from the UK Government’s shale failure that we believe are generalizable to other countries and energy policy-making. They would also need to be addressed if the moratorium were lifted and shale gas exploration were to resume.

The first is the power of frames and public discourse. Relatively little shale gas infrastructure has been deployed in the UK; instead, there has been a battle of visions, ideas, and frames about the role such development could, ought, and should play in UK society. The ability of advocates to sell successfully their ideas about shale gas, especially within Parliament, and opponents to undermine them and counter with their own frames, certainly shaped the fate of the shale gas industry in ways perhaps as significant as technology and standards. This adds a new element of ‘energy policy failure’ to the categories already described by Sokolowski and Heffron (2022): *discursive*. Discursive failure occurs when the proponents of a particular policy fail to produce resonant arguments in favour of that policy (i.e., their arguments are not widely viewed as compelling). Discursive struggles are ultimately a matter of trying to define the reality of a policy problem – to create a widely shared understanding of the policy problem and its solution (Hajer, 1995), and shared interpretations of what constitutes relevant and compelling evidence. Such discursive dominance is usually achieved by trustworthy actors communicating credible and acceptable claims to audiences (this could be publics or smaller groups depending on the policy issue), thus creating a degree of consensus over how to understand the issue and the way forward. In the absence of such discursive dominance—the case with shale gas in the UK—policy debates are likely to become deadlocked between sharply contrasting understandings of the issue and what should be done about it. Ultimately, discursive failure can shape a lack of support for a particular way of understanding an issue (shale gas) and its attendant favoured policy approach amongst audiences (as expressed through, for example, party political disagreement or a lack of public support).

In this way, new energy technologies or resources such as shale gas may possess ample or at least debatable potential technically, but ‘fail’ to achieve social momentum and positive discourse among local actors, the mass media, and even some arenas of policy debate, such as Westminster. This suggests that progressing towards a net-zero energy system requires the construction of persuasive frames to support the critical technologies and investments needed to deliver deep decarbonisation.

Second, we have the ways shale gas decisions were made in England, matters of procedural justice, with the national government pushing ahead exploration despite local concerns, for example, local council decisions denying planning approval being over-ruled by ministers in central government. This created contestations over scales of governance and reminds us that sometimes *how* a certain technology is implemented in terms of its governance or politics can be just as salient as the type of technology being chosen. In the case of the UK, the impact of these political decisions appears to have created intense distrust among some segments of the population that may have ultimately contributed to shale’s failure. The contradiction between a national government that championed devolution and localism and its willingness to undermine local decision making was clear for all to see. This had the unintended consequence of making shale gas a focal point of campaigns for greater local democracy. This suggests that energy policies can again ‘fail’ for reasons other than those related to their sustainability in climate change terms. Equally, a lack of internal consistency or obvious contradiction—such as developing a new fossil fuel resource to address climate change—can contribute to policy failure. Both findings

underscore other non-technical elements to energy policy failure that are perhaps even more difficult to predict yet alone manage.

Third, the UK case brings to light the power of opposition movements – including coalitions of broader social movements and place-based local action groups – against a particular energy source. There is some evidence that anti-fracking protests were successful in raising the profile of shale development as an issue in the UK (Mazur, 2016) and arguably in starting to turn broader public attitudes against shale development (Howell, 2018; O'Hara et al., 2015). Furthermore, local opposition succeeded in slowing down exploratory activities through the planning system, which resulted in controversy dragging on for years with little to show for it by way of progress towards a production-phase industry of any scale. Persistent local opposition also pressured MPs with proposed or actual sites in their constituencies into lobbying the government for stronger regulations and better local community benefits (see Williams et al., 2020). The mix of local opposition groups and environmental NGOs, which both played key roles in the campaign against a shale industry in the UK, speaks to ideas of cosmopolitan energy justice, as anti-shale campaigners linked local issues of environmental impact and local democracy to the global challenge of climate change and the stated need to 'strand assets' leaving fossil fuels in the ground and would doubtless do so again in the context of a 'climate crisis.'

Finally, our study reveals contestations within attempts at promoting more sustainable or just energy policy pathways. As noted above, it would be difficult to claim that the UK Government's position on shale gas development is the result of a willingness to listen to both national and local concerns about the negative environmental and social impacts of such activities and their incompatibility with the country's climate change goals. In other words, as recent events have demonstrated, it is clearly not the case that the Government has finally accepted that shale gas development is a bad idea. In context of the current review, Kwasi Kwarteng has said: "it is absolutely right that we explore all possible domestic energy sources". There was a good deal of political expediency surrounding the Government's 2019 decision to impose the moratorium, and there is around the decision to review it. It is noteworthy, that the Government's 2021 Net Zero strategy (HM Government, 2021) makes no mention of shale gas and highlights the need to transition away from natural gas.

The path to a net-zero energy system will require public acceptance of a wide range of large-scale energy infrastructures—a social license to decarbonise—some of which raise similar challenges around seismic activity as shale gas (e.g., carbon capture and geothermal energy, Cox et al., 2021). Activities such as the recent UK-wide citizens' assembly on climate change have created public expectation of greater participation in decision making. The shale gas conflict—which may not be over—not only demonstrates a lack of consent, but the need to build consensus around decision-making practices nationally and in the locales potentially impacted by new infrastructure development. Without transparent and just decision-making processes, it is difficult to see any successful path forward for a new energy policy. If the result is a more contested future, failure and justice are less absolutes, and instead comparative elements that may be strategically debated or selected on a multitude of differing criteria. The implication is that while a net-zero society may be lower in carbon, it may not necessarily have less 'failure' or more 'justice' per se.

#### CRediT authorship contribution statement

**Michael Bradshaw:** Conceptualization, Writing – original draft, Writing – review & editing. **Patrick Devine-Wright:** Methodology, Investigation, Writing – review & editing. **Darrick Evensen:** Methodology, Investigation, Writing – review & editing. **Owen King:** Writing – review & editing. **Abigail Martin:** Methodology, Investigation, Writing – review & editing. **Stacia Ryder:** Methodology, Investigation, Writing – review & editing, Visualization. **Damien Short:** Methodology, Investigation, Writing – review & editing. **Benjamin K. Sovacool:**

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#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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#### References

- Andersson-Hudson, J., Knight, W., Humphrey, M., O'Hara, S., 2016. Exploring support for shale gas extraction in the United Kingdom. *Energy Pol.* 98, 582–589. <https://doi.org/10.1016/j.enpol.2016.09.042>.
- Andersson-Hudson, J., Rose, J., Humphrey, M., Knight, W., O'Hara, S., 2019. The structure of attitudes towards shale gas extraction in the United Kingdom. *Energy Pol.* 129, 693–697. <https://doi.org/10.1016/j.enpol.2019.02.056>.
- Andrews, I.J., 2013. In: *The Carboniferous Bowland Shale Gas Study: Geology and Resource Estimation*. British Geological Survey for the Department of Energy and Climate Change, London. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/226874/BGS\\_DECC\\_BowlandShaleGasReport\\_MAIN\\_REPORT.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/226874/BGS_DECC_BowlandShaleGasReport_MAIN_REPORT.pdf). (Accessed 4 June 2021).
- Aryee, F., Szolucha, A., Stretesky, P.B., Short, D., Long, M.A., Ritchie, L.A., Gill, D.A., 2020. Shale gas development and community distress: evidence from England. *Int. J. Environ. Res. Publ. Health* 17 (14), 5069. <https://doi.org/10.3390/ijerph17145069>.
- ASSIST, 2019. In: UK National Survey of Public Attitudes towards Shale Gas, 2019. UKUH, Newcastle. <http://www.ukuh.org/media/sites/researchwebsites/2ukuh/survey.pdf>. (Accessed 9 June 2021).
- BEIS, 2019. Energy and climate change public attitudes tracker: Wave 29. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/800429/BEIS\\_Public\\_Attitudes\\_Tracker\\_Wave\\_29\\_key\\_findings.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/800429/BEIS_Public_Attitudes_Tracker_Wave_29_key_findings.pdf). (Accessed 9 June 2021).
- BEIS, 2021a. Energy and climate change public attitudes tracker: Wave 37. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/985092/BEIS\\_PAT\\_W37\\_Key\\_Findings.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/985092/BEIS_PAT_W37_Key_Findings.pdf). (Accessed 9 June 2021).
- BEIS, 2021b. BEIS public attitudes: energy infrastructure and energy sources autumn 2021. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1040725/BEIS\\_PAT\\_Autumn\\_2021\\_Energy\\_Infrastructure\\_and\\_Energy\\_Sources.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1040725/BEIS_PAT_Autumn_2021_Energy_Infrastructure_and_Energy_Sources.pdf). (Accessed 23 December 2021).
- BEIS (Department of Business, Energy and Industrial Strategy), 2022. British energy security strategy. <https://www.gov.uk/government/publications/british-energy-security-strategy>. (Accessed 8 April 2022).
- Benford, R.D., Snow, D.A., 2000. Framing processes and social movement: an overview and assessment. *Annu. Rev. Sociol.* 26, 611–639. <https://doi.org/10.1146/annurev.soc.26.1.611>.
- Bice, S., Brueckner, M., Pfoor, C., 2017. Putting social license to operate on the map: a social, actuarial, and political risk and licensing model (SAP Model). *Resour. Pol.* 53, 46–55. <https://doi.org/10.1016/j.resourpol.2017.05.011>.
- Bombardier, E., 2017a. Fracking and framing in transatlantic perspective: a comparison of shale politics in the US and European Union. *J. Transatl. Stud.* 15 (2), 101–120. <https://doi.org/10.1080/14794012.2016.1268789>.
- Bombardier, E., 2017b. Shale we drill? Discourse dynamics in UK fracking debates. *J. Environ. Pol. Plann.* 19 (1), 72–88. <https://doi.org/10.1080/1523908X.2015.1053111>.
- Bradshaw, M.J., 2017. Unconventional gas in the United Kingdom. In: Grafton, R.Q., Cronshaw, L.G., Moore, M.C. (Eds.), *Risks, Rewards and Regulation of Unconventional Gas*. Cambridge University Press, Cambridge, pp. 167–196.
- Bradshaw, M.J., 2018. In: *Future UK Gas Security: A Position Paper*. UKERC & Warwick Business School, Coventry. <https://ukerc.ac.uk/publications/future-uk-gas-security-a-position-paper/>. (Accessed 15 April 2022).
- Bradshaw, M.J., Waite, C., 2017. Learning from Lancashire: exploring the contours of the shale gas conflict in England. *Global Environ. Change* 47, 28–36. <https://doi.org/10.1016/j.gloenvcha.2017.08.005>.
- Broderick, J., Anderson, K., Wood, R., Gilbert, P., Sharmina, M., Footitt, A., Glynn, S., Nicholls, F., 2011. In: *Shale Gas: an Updated Assessment of Environmental and Climate Change Impacts*. Tyndall Centre, University of Manchester. <https://www.researchgate.net/publication/271111111>.

- search.manchester.ac.uk/portal/files/56662898/FULL\_TEXT.PDF. (Accessed 14 April 2022).
- Cabinet Office, 2016. State of the UK Shale Industry by 2020 and 2025. London.
- Campaign for Rural England (CPRE), 2018. In: Fracking to Be Fast-Tracked. London. [www.cpre.org.uk](http://www.cpre.org.uk). (Accessed 14 April 2022). <https://www.oldsite.cpre.org.uk/what-we-do/energy-and-waste/fracking/update>.
- Cockburn, H., 2020. Climate crisis: 'Fracking is over' in UK, energy minister says. The Independent. <https://www.independent.co.uk/climate-change/news/fracking-ban-uk-kwasi-kwarteng-climate-change-methane-shale-gas-a9575906.html>. (Accessed 3 June 2021).
- Cotton, M., 2017. Fair fracking? Ethics and environmental justice in United Kingdom shale gas policy and planning. *Local Environ.* 22 (2), 185–202. <https://doi.org/10.1080/13549839.2016.1186613>.
- Cotton, M., Rattle, I., Van Alstine, J., 2014. Shale gas policy in the United Kingdom: an argumentative discourse analysis. *Energy Pol.* 73, 427–438. <https://doi.org/10.1016/j.enpol.2014.05.031>.
- Cotton, M., Gonzalez, A., Dickie, J., 2021. Briefing: shale gas governance: devolution and localism. Newcastle: UK shale gas landscape. Briefing 3 (accessed 17 June 2021). <http://www.ukuh.org/media/sites/researchwebsites/2ukuh/89490%20Governance%20Devolution%20and%20Localism.pdf>.
- Cowell, R., Devine-Wright, P., 2018. A 'delivery-democracy dilemma'? Mapping and explaining policy change for public engagement with energy infrastructure. *J. Environ. Pol. Plann.* 20, 499–517. <https://doi.org/10.1080/1523908X.2018.1443005>.
- Cox, E., Pidgeon, N., Spence, E., 2021. But they told us it was safe! Carbon dioxide removal, fracking, and ripple effects in risk perceptions. *Risk Anal.* <https://onlinelibrary.wiley.com/doi/10.1111/risa.13717>.
- CPRE, 2018. In: CPRE Briefing: Response to Written Ministerial Statement on Fracking (May 2018). London. <https://www.cpre.org.uk/resources/cpre-briefing-response-written-ministerial-statement-fracking-may-2018/>. (Accessed 14 April 2022).
- DECC, DCLG, 2015. Shale gas and oil policy statement. <https://www.gov.uk/government/publications/shale-gas-and-oil-policy-statement-by-decc-and-dclg>. (Accessed 23 December 2021).
- DECC, 2015. DECC responds to recent coverage on shale regulation. <https://www.gov.uk/government/news/decc-responds-to-recent-coverage-on-shale-regulation>. (Accessed 17 June 2021).
- Devine-Wright, P., Ryder, S., Dickie, J., Evensen, D., Varley, A., Whitmarsh, L., Bartie, P., 2021. Induced seismicity or political ploy?: using a novel mix of methods to identify multiple publics and track responses over time to shale gas policy change. *Energy Res. Social Sci.* 81, 102247.
- Drummond, V., Grubert, E., 2017. Fault lines: seismicity and the fracturing of energy narratives in Oklahoma. *Energy Res. Social Sci.* 31, 128–136. <https://doi.org/10.1016/j.erss.2017.05.039>.
- Energy Voice, 2013. In: UK Should Accept Fracking or Miss 'massive Opportunity', Warns Prime Minister. Energy Voice. <https://www.energyvoice.com/oilandgas/42075/uk-should-accept-fracking-insists-prime-minister/>. (Accessed 3 June 2021).
- Evensen, D., 2018a. Review of shale gas social science in the United Kingdom, 2013–2018. *Extr. Ind. Soc.* 5 (4), 691–698. <https://10.1016/j.exis.2018.09.005>.
- Evensen, D., 2018b. The Extractive Industries and Society yet more 'fracking' social science: an overview of unconventional hydrocarbon development globally. *Extr. Ind. Soc.* 5, 417–421. <https://doi.org/10.1016/j.exis.2018.10.010>.
- Evensen, D., Stedman, R.C., 2017. Fracking as promoter and destroyer of 'the good life'. *J. Rural Stud.* 11, 1. <https://doi.org/10.1016/j.jrurstud.2017.02.020>.
- EY, 2014. Getting ready for UK shale gas. London. [https://www.ukoog.org.uk/images/ukoog/pdfs/Getting\\_ready\\_for\\_UK\\_shale2\\_gas\\_FINAL2022.04.14.pdf](https://www.ukoog.org.uk/images/ukoog/pdfs/Getting_ready_for_UK_shale2_gas_FINAL2022.04.14.pdf). (Accessed 14 April 2022).
- Government, H.M., 2021. Net-zero strategy-build back greener. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1033990/net-zero-strategy-beis.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf). (Accessed 24 December 2021).
- Green, C.A., Styles, P., Baptie, B.J., 2012. In: Preese Hall Shale Gas Fracturing: Review and Recommendations for Induced Seismic Mitigation. Department of Energy and Climate Change, London. <https://www.gov.uk/government/publications/preese-hall-shale-gas-fracturing-review-and-recommendations-for-induced-seismic-mitigation>. (Accessed 4 June 2021).
- Griffiths, J., 2019. Fracking in the UK: expanding the application of an environmental justice frame. *Local Environ.* 24 (3), 295–309. <https://doi.org/10.1080/13549839.2019.1566891>.
- Hajer, M., 1995. *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process*. Clarendon Press, Oxford.
- Hámor, T., Bódis, K., Hámor-Vidó, M., 2021. The legal governance of oil and gas in Europe: an indicator analysis of the implementation of the hydrocarbons directive. *Energies* 14 (19), 6411. <https://doi.org/10.3390/en14196411>.
- Hands, G., 2022. In: Government Plans for Fracking: Response to an Urgent Question. BEIS, London. <https://www.gov.uk/government/speeches/urgent-question-response-on-fracking>. (Accessed 8 April 2022).
- Hawkins, J., 2015. Fracking: minding the gaps. *Environ. Law Rev.* 17 (1), 8–21. <https://doi.org/10.1177/1461452914563217>.
- Hawkins, J., 2020. Briefing: the shale gas legal landscape. Newcastle, UK shale gas landscape. Briefing 2. <http://www.ukuh.org/media/sites/researchwebsites/2ukuh/89490%20Legal%20Landscape.pdf>. (Accessed 17 June 2021).
- Hayhurst, R., 2019. PNR tremor tracker 2019. Drill or Drop? <https://drillordrop.com/2019/08/16/pnr-tremor-tracker-2019/>. (Accessed 3 June 2021).
- Hayhurst, R., 2021. MPs reject Labour call for full ban on fracking in England, Drill or Drop? <https://drillordrop.com/2021/05/26/mps-reject-labour-call-for-full-ban-on-fracking-in-england/>. (Accessed 3 June 2021).
- Heffron, R.J., McCauley, D., 2017. The concept of energy justice across the disciplines. *Energy Pol.* 105, 658–667. <https://doi.org/10.1016/j.enpol.2017.03.018>.
- Hilson, C., 2014. Unconventional gas and statutory climate duties: their significance for planning law in the United Kingdom. *J. Plann. Environ. Law* 9, 952–960.
- Horizon, 2020. 2021. M4 shale gas. <https://ec.europa.eu/inea/en/horizon-2020/projects/h2020-energy/shale-gas/m4shalegas>. (Accessed 4 June 2021).
- House of Commons, Environmental Audit Committee (HoC EAC), 2015. Environmental risks of fracking. London. <https://publications.parliament.uk/pa/cm201415/cmselect/cmenvaud/856/85602.htm>. (Accessed 14 April 2022).
- House of Lords, Economic Affairs Committee (HoL EAC), 2014. The economic impact on UK energy policy of shale gas and oil. London. <https://publications.parliament.uk/pa/ld201314/ldselect/ldeconaf/172/172.pdf>. (Accessed 14 April 2022).
- Howell, R.A., 2018. UK public beliefs about fracking and effects of knowledge on beliefs and support: a problem for shale gas policy. *Energy Pol.* 113, 721–730. <https://doi.org/10.1016/j.enpol.2017.11.061>.
- Institute of Directors (IoD), 2013. Getting shale gas working. London. <https://www.iod.com/news/news/articles/Getting-Shale-Gas-Working>. (Accessed 14 April 2022).
- Johnson, C., Boersma, T., 2013. Energy (in)security in Poland the case of shale gas. *Energy Pol.* 53, 389–399.
- Jones, C., 2018. In: The Implications of Fracking in UK Gas Import Substitution. Friends of the Earth, London. [https://cdn.friendsoftheearth.uk/sites/default/files/downloads/FOE-Frack-Import-Report\\_0.pdf](https://cdn.friendsoftheearth.uk/sites/default/files/downloads/FOE-Frack-Import-Report_0.pdf). (Accessed 17 April 2022).
- Kwarteng, K., 2022. In: Scientific Review of Shale Gas Launched. BEIS, UK. <https://www.gov.uk/government/news/scientific-review-of-shale-gas-launched>. (Accessed 8 April 2022).
- Leadson, A., 2019. Energy policy update: statement made on 4<sup>th</sup> November 2019, UK parliament. <https://questions-statements.parliament.uk/written-statements/detail/2019-11-04/HCW568>. (Accessed 27 May 2021).
- Mackay, D., Stone, T., 2013. In: Potential Greenhouse Gas Emission Associated with Shale Gas Extraction and Use. DECC. <https://www.gov.uk/government/publications/potential-greenhouse-gas-emissions-associated-with-shale-gas-production-and-use>. (Accessed 14 April 2022).
- Martin, A., Axsen, J., Williams, L., Sovacool, B., 2019. UK Public Views on Energy Transitions, Unpublished Raw Data. University of Sussex, Science Policy Research Unit.
- Mazur, A., 2016. How did the fracking controversy emerge in the period 2010–2012? *Publ. Understand. Sci.* 25 (2), 207–222. <https://doi.org/10.1177/0963662514545311>.
- McCoy, D., Munro, A., 2016. In: Shale Gas Production in England: an Updated Public Health Assessment. Medact, London. <https://www.medact.org/2016/resources/reports/shale-gas-production-in-england/>. (Accessed 14 April 2022).
- McCoy, D., Saunders, P., 2015. In: Health and Fracking: the Impacts and Opportunity Costs. Medact, London. <https://www.medact.org/2015/resources/reports/health-and-fracking/>. (Accessed 14 April 2022).
- McGlade, C., Ekins, P., 2015. The geographical distribution of fossil fuels unused when limiting global warming to 2°C. *Nature* 517, 187–190. <https://doi.org/10.1038/nature14016>.
- Mohr, A., Raman, S., Gibbs, B., 2013. Which publics? When? Exploring The Policy Potential of Involving Different Publics in Dialogue around Science and Technology. <https://nottingham-repository.worktribe.com/output/1005108>. (Accessed 16 June 2021).
- NERC, 2021. Unconventional hydrocarbons in the UK energy system: environmental & socio-economic impacts & processes. <https://nerc.ukri.org/research/funded/programmes/unconventional-hydrocarbons/?page=1#collapse2>. (Accessed 3 June 2021).
- Nyberg, D., Wright, C., Kirk, J., 2018. Fracking the future: the temporal portability of frames in political contests. *Organ. Stud.* 1–22. <https://doi.org/10.1177/0170840618814568>.
- O'Hara, S., et al., 2015. In: Public Perception of Shale Gas Extraction in the UK: Two Years on from the Balcombe Protests. University of Nottingham, Nottingham. <https://betersociety.net/images/Public%20Perceptions%20of%20shale%20gas%20in%20the%20UK%20sept131015MH.WKJA-H.pdf>. (Accessed 14 April 2022).
- Parkhill, K., Demski, C., Butler, C., Spence, A., Pidgeon, N., 2013. *Transforming the UK Energy System: Public Values, Attitudes and Acceptability Synthesis Report*.
- Partridge, T., Thomas, M., Harthorn, B., Pidgeon, N., Hasell, A., Stevenson, L., Enders, C., 2017. Seeing futures now: emergent US and UK views on shale development, climate change and energy systems. *Global Environ. Change* 42, 1–12. <https://doi.org/10.1016/j.gloenvcha.2016.11.002>.
- Partridge, T., Thomas, M., Pidgeon, N., Harthorn, B., 2019. Disturbed earth: conceptions of the deep underground in shale extraction deliberations in the US and UK. *Environ. Val.* 28 (6), 641–663. <https://doi.org/10.3197/096327119X15579936382482>.
- Peters, J., 2019. The fracking ban: what does it mean? Friends of the Earth. <https://friendsoftheearth.uk/climate/fracking-ban-what-does-it-mean>. (Accessed 4 June 2021).
- Pidd, H., 2022. 'We're ready': UK anti-fracking activists prepare to fight resurgence plans, 11 March The Guardian (accessed 14 April 2022). <https://www.theguardian.com/environment/2022/mar/11/anti-fracking-uk-activists-fight-resurgence-plans>.
- Reible, D., Davies, R., 2016. In: Joint US-UK Workshop on Improving the Understanding of the Potential Environmental Impacts Associated with Unconventional Hydrocarbons. Royal Society of Chemistry, NERC, NSF, Swindon. <https://nerc.ukri.org/funding/application/currentopportunities/us-ukworkshop/final-report/>. (Accessed 3 June 2021).
- Rein, M., Schon, D., 1993. Reframing policy discourse. In: Fischer, F., Forester, J. (Eds.), *The Argumentative Turn in Policy Analysis and Planning*. UCL Press, London, pp. 145–166.

- Ryder, S.S., Devine-Wright, P., 2021. Environmental justice implications & conceptual advancements: community experiences of proposed shale gas exploration. *Environ. Polit.* <https://doi.org/10.1080/09644016.2021.1996728>.
- Ryder, S.S., Devine-Wright, P., Evensen, D., 2020. Briefing; public perceptions of shale gas exploration in the UK; A summary of research, 2012-2020. <http://www.ukuh.org/media/sites/researchwebsites/2ukuh/89490%20Public%20Perceptions.pdf>. (Accessed 9 June 2021).
- Santiago, A.L., Demajorovic, J., Rossetto, D.E., Luke, Hannabeth L., 2021. Understanding the fundamentals of the Social Licence to Operate: its evolution, current state of development and future avenues of research. *Resour. Pol.* 70, 101941 <https://doi.org/10.1016/j.resourpol.2020.101941>.
- SEI, I.I.S.D., ODI, E.3G., UNEP, 2020. The production gap report: 2020 special report. <http://productiongap.org/2020report>. (Accessed 16 June 2021).
- Shale Gas, M.4, 2017. M4 shale gas: measuring, monitoring, mitigating and managing the environmental impacts of shale gas. <http://www.m4shalegas.eu>. (Accessed 4 June 2021).
- Short, D., Szolucha, A., 2019. Fracking Lancashire: the planning process, social harm and collective trauma. *Geoforum* 98, 264–276. <https://doi.org/10.1016/j.geoforum.2017.03.001>.
- Short, D., Stretesky, P., Szolucha, A., 2020. Briefing: anti-'Fracking' activism and local democracy. Newcastle, UK shale gas landscape. <http://www.ukuh.org/media/sites/researchwebsites/2ukuh/89490%20Unconventional%20Hydrocarbons.pdf>. (Accessed 17 June 2021).
- Skea, J., 2018. *The United Kingdom: to develop or not to develop? One nation or localization?* In: Gamper-Rabindran, S. (Ed.), *The Shale Dilemma: A Global Perspective on Fracking and Shale Development*. University of Pittsburgh Press, Pittsburgh, pp. 137–177.
- Snow, D.A., Benford, R.D., 1988. Ideology, frame resonance, and participant mobilization. *Int. Soc. Mov. Res.* 1, 197–217. <https://doi.org/10.1007/s00425-012-1590-5>.
- Sokolowski, M.M., Heffron, R.J., 2022. Defining and conceptualising energy policy failure: the when, where, why and how. *Energy Pol.* 161, 112745 <https://doi.org/10.1016/j.enpol.2021.112745>.
- Solman, N., Bradshaw, M., 2020. In: Briefing: Shale Gas and UK Energy Security. Newcastle, UK Shale Gas Landscape, Briefing 1. <http://www.ukuh.org/media/sites/researchwebsites/2ukuh/89490%20SGUK%20Energy%20Security.pdf>. (Accessed 17 June 2021).
- Solman, N., Bradshaw, M., 2021. Brexit, net-zero and the future role of natural gas in the UK. Newcastle, UK shale gas landscape. Briefing 8. <http://www.ukuh.org/media/sites/researchwebsites/2ukuh/89490%20Brexit%20Net-Zero%20and%20Future.pdf>. (Accessed 24 December 2021).
- Sovacool, B.K., Williams, L., Martin, A., Axsen, J., 2020. Humanizing hydrocarbon frontiers: the "lived experience" of shale gas fracking in the United Kingdom's Fyde communities. *Local Environ.* 25, 944–966. <https://doi.org/10.1080/13549839.2020.1849076>.
- Soyer, M., Ziyank, S., 2018. The battle over fracking: the mobilization of local residents. *Qual. Rep.* 23 (9), 2222–2237.
- Stamford, L., 2020. In: Briefing: Shale Gas and the UK's Low Carbon Transition. Newcastle, UK Shale Gas Landscape, Briefing 2. <http://www.ukuh.org/media/sites/researchwebsites/2ukuh/89490%20SGUK%20Low%20Carbon%20Transition.pdf>. (Accessed 17 June 2021).
- Stephan, H.R., 2017. The discursive politics of unconventional gas in Scotland: drifting towards precaution? *Energy Res. Social Sci.* 23, 159–168. <https://doi.org/10.1016/j.erss.2016.09.006>.
- Stevens, P., 2012. In: *The 'Shale Gas Revolution': Developments and Changes*. Chatham House, London. <https://www.chathamhouse.org/2012/08/shale-gas-revolution-developments-and-changes>. (Accessed 14 April 2022).
- Szolucha, A., 2018a. Mistrust and earthquakes: why Lancashire communities are so shaken by fracking tremors. *The Conversation*. <http://theconversation.com/mistrust-and-earthquakes-why-lancashire-communities-are-so-shaken-by-fracking-tremors-108108>.
- Szolucha, A., 2021aa. Watching fracking: public engagement in postindustrial Britain. *Am. Ethnol.* 1–15. <https://doi.org/10.1111/amet.13049>, 0(0).
- Szolucha, A., 2021ba. Futures of fracking and the everyday: hydrocarbon infrastructures, unruly materialities and conspiracies. *Ethnos* 1–21, 0(0).
- Szolucha, A., 2021c. Shale gas development in England: social impacts and comparisons. Self-published. [https://books.google.co.uk/books/about/Shale\\_Gas\\_Development\\_in\\_England.html?id=ZJdCEAAQAQ&redir\\_esc=y](https://books.google.co.uk/books/about/Shale_Gas_Development_in_England.html?id=ZJdCEAAQAQ&redir_esc=y).
- Thomas, M., Pidgeon, N., Evensen, D., Partridge, T., Hasell, A., Enders, C., Bradshaw, M., 2017a. Public perceptions of hydraulic fracturing for shale gas and oil in the United States and Canada. *Wiley Interdiscip. Rev. Clim.* 8 (3), e450.
- Thomas, M., Partridge, T., Harthorn, B.H., Pidgeon, N., 2017b. Deliberating the perceived risks, benefits, and societal implications of shale gas and oil extraction by hydraulic fracturing in the US and UK. *Nat. Energy* 2 (5), 17054. <https://doi.org/10.1038/nenergy.2017.54>.
- UHUK, 2021. In: *Unconventional Hydrocarbons in the UK Energy System*. <http://www.ukuh.org>. (Accessed 4 June 2021).
- UKOOG., 2017. UKOOG Annual Report 2017. London. <https://www.ukoog.org.uk/images/ukoog/pdfs/UKOOG%20Annual%20Review%202017%20-%20web3.pdf>. (Accessed 28 June 2022).
- Van de Graaf, T., Haesebrouck, T., Debaere, P., 2017. Fractured politics? The comparative regulation of shale gas in Europe. *J. Eur. Publ. Pol.* 25 (9), 1276–1293. <https://doi.org/10.1080/13501763.2017.1301985>.
- Wachtmesier, H., Kuchler, M., Höök, M., 2021. How many wells? Exploring the scope of shale gas production for achieving gas self-sufficient in Poland. *Nat. Resour. Res.* 30 (3), 2483–2496. <https://doi.org/10.1007/s11053-021-09858-w>. (Accessed 4 June 2021).
- Watt, N., 2014. In: *Fracking in the UK: 'We're Going All Out for Shale,' Admits Cameron*. *The Guardian*. <https://www.theguardian.com/environment/2014/jan/13/shale-gas-fracking-cameron-all-out>. (Accessed 3 June 2021) (
- Whitmarsh, L., Nash, N., Upham, P., Lloyd, A., Verdon, J.P., Kendall, J.M., 2015. UK public perceptions of shale gas hydraulic fracturing: the role of audience, message and contextual factors on risk perceptions and policy support. *Appl. Energy* 160, 419–430. <https://doi.org/10.1016/j.apenergy.2015.09.004>.
- Williams, L., Sovacool, B.K., 2019. The discursive politics of 'fracking': frames, storylines, and the anticipatory contestation of shale gas development in the United Kingdom. *Global Environ. Change* 58, 101935. <https://doi.org/10.1016/j.gloenvcha.2019.101935>.
- Williams, L., Sovacool, B.K., 2020. Energy democracy, dissent, and discourse in the party politics of shale gas in the United Kingdom. *Environ. Polit.* 1–25 <https://doi.org/10.1080/09644016.2020.1740555>.
- Williams, L., Macnaghten, P., Davies, R., Curtis, S., 2017. Framing 'fracking': exploring public perceptions of hydraulic fracturing in the United Kingdom. *Publ. Understand. Sci.* 26 (1), 89–104. <https://doi.org/10.1177/0963662515595159>.
- Williams, L., Martin, A., Sovacool, B.K., 2020. Briefing: a brief history of the UK's debate over shale gas, 2009-2019. Newcastle, UKSGL. Briefing 6. <http://www.ukuh.org/media/sites/researchwebsites/2ukuh/89490%20SGUK%20Political%20Debate.pdf>. (Accessed 17 June 2021).