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# **Stakeholder perspectives on shale gas fracking: a Q-method study of environmental discourses**

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Updated version forthcoming in *Environment and Planning A*.

## **Abstract**

The rapid expansion of shale gas exploration worldwide is a significant source of environmental controversy. Successful shale gas policymaking is dependent upon a clear understanding of the dynamics of competing stakeholder perspectives on these issues, and so methods are needed to delineate the areas of agreement and conflict that emerge. This empirical study, based in the United Kingdom, examines emergent perspectives on a range of environmental, health and socio-economic impacts associated with shale gas fracking using Q-methodology: a combined qualitative-quantitative approach. The analysis reveals three typologies of perspectives amongst key industry, civil society and non-affiliated citizen stakeholders; subsequently contextualised in relation to Dryzek's typology of environmental discourses. These are labelled A) "Don't trust the fossil fuels industry: campaign for renewables" (mediating between sustainable development and democratic pragmatism discourses); B) "Shale gas is a bridge fuel: economic growth and environmental scepticism" (mediating between economic rationalism and ecological modernisation discourses); and C) "Take place protective action and legislate in the public interest" (reflecting a discourse of administrative rationalism). The implications of these competing discourses for nascent shale gas policy in the UK are discussed in light of recent Government public consultation on changes to national planning policy.

## **1.1 Introduction**

The rapid development and deployment of hydraulic fracturing and horizontal drilling techniques in onshore oil and gas extraction (hereafter referred to in the popular shorthand 'fracking') is a growing source of global environmental controversy. In the European Union, shale gas development is an increasingly prominent aspect of energy politics, given its potential to provide security of supply benefits, mitigate global price shocks, ensure cheaper gas prices for consumers and greater diversity of supply (Pearson et al., 2012). EU interest is spurred by the US shale boom that has significantly lowered gas prices and substantially improved short-term domestic energy self-sufficiency to the point that only minimal US imports of Liquid Natural Gas are required for the foreseeable future (Rogers, 2011). European emulation of US success is limited, however, by the immaturity of industry geological knowledge of unconventional reservoirs, low levels of drilling investment, long lead times for construction (Gény, 2011), lack of domestic industry expertise and equipment, planning policy constraints, stronger environmental regulation, and growing public opposition spurred by environmental and social impact concerns (Cotton, 2013; Deutsche Bank, 2011; Moore, 2012; O'Hara et al., 2014). These environmental and social impacts are explored in the following two sections, followed by a discussion of these dimensions in the United Kingdom.

## **1.2. Environmental impacts**

Some of the most significant barriers to a European “dash for gas” are the associated environmental constraints and compliance costs. Potential environmental impacts include subsurface water contamination with thermogenic methane (Kargbo et al., 2010; Zobak et al., 2010), and risks from chemical additives to fracturing fluids which, although used in dilute concentrations, could have potentially adverse health effects (see in particular Colborn et al., 2011). These factors are exacerbated by growing public concern over air quality degradation and soil contamination from naturally occurring radioactive materials (Litovitz et al., 2013; Tillett, 2013; Witter et al., 2008; Zobak et al., 2010). The high water volumes needed to make gas wells productive (an average 15.91 million litres of water NaturalGas.org, 2013) lead to concerns that fracking will exacerbate risks to water-stressed regions (Rahm and Riha, 2012), and negatively impact upon water prices. Seismic risks such as those experienced in the Northwest of England in 2011 after shale exploration company Cuadrilla’s fracking activities have also generated (albeit dwindling) concern in news media and amongst environmental activist organisations (Marshall and Stephenson, 2012). At the local level, light and noise pollution affect residents, as well as secondary environmental effects resulting from traffic congestion generated by site activities (Banerjee et al., 2012).

Shale gas also has significant implications for global climate change. Natural gas produces approximate 45% lower CO<sub>2</sub> emissions per British thermal unit (Btu) than coal, alongside significantly lower levels of sulphur dioxide, nitrogen oxide, carbon monoxide, and mercury (Howarth et al., 2011; Kargbo et al., 2010). However, concern over fugitive methane emissions have been raised, as methane exacerbates the global greenhouse effect and diminishes local air quality (Howarth et al., 2011). Moreover, concerns over the negative impacts of unconventional fossil fuel resource extraction on renewables investment in Europe have been raised, particularly if abundant gas supplies adjust down market prices for energy (Moore, 2012; Stephenson et al., 2012).

### **1.3 Social impacts, energy governance and stakeholder perceptions**

In response to the environmental impacts of shale gas development there is the growing influence of social movements of opposition such Frack Off, alongside political debate from elected officials, environmental NGO and news media organisations on issues of environmental justice, regulatory frameworks, risk governance, property rights, community engagement and social sustainability in different national and regional policy contexts. Exploring these elements through empirical social science is a key research priority as the nascent UK shale gas industry emerges (it must be noted that there is a growing body of literature on the aforementioned emerging topics: Cairney et al., 2015; Cotton, 2013; Cotton et al., 2014; Jaspal and Nerlich, 2014; Jaspal et al., 2014; O’Hara et al., 2014; O’Hara et al., 2013).

When exploring the social science of UK shale gas development, much can be learned from the US experience. A range of qualitative and quantitative social research studies of stakeholder perceptions in the Barnett (Anderson and Theodori, 2009; Theodori, 2009; Wynveen, 2011) and Marcellus (Finewood and Stroup, 2012; Malin, 2013; Smith and Ferguson, 2013) shale basins reveal low levels of public risk tolerance over traffic congestion, water use and water contamination. However, even accounting for the differences between US and UK contexts, the heterogeneity of multiple and differentiated publics mean that the social and environmental impacts of shale gas exploration are experienced differently by different social groups and divergent attitudes inevitably emerge (see Schafft et al., 2013).

The competing framings of shale gas by multiple stakeholder groups aim to manage both scientific uncertainty around fracking safety, and decision-making uncertainty (in the UK specifically) around planning and regulatory frameworks, mineral rights, licensing, and taxation (Cairney et al., 2015). This differentiation is further influenced by linguistic and policy framing effects (see for example Scrase and Ockwell, 2010): such as how shale gas is valued economically and politically in comparison to coal, nuclear and renewables (Cotton et al., 2014; Truelove, 2012), or when policy-makers emphasise shale gas as a ‘resource extraction’ (Rabe and Borick, 2013) or ‘energy’ issue rather than an ‘environmental’ issue (Davis and Fisk, 2014). Geographical and cultural factors also have an effect, particularly population density, the local history of fossil fuel extraction (Brasier et al., 2011), and environmental and place identity disruption (Jaspal et al., 2014). Moreover, governance issues such as negative leasing and development experiences (Jacquet, 2012), the shifting responsibilities of environmental regulation between political scales (in the USA specifically between Federal and State levels of governance Davis and Hoffer, 2012), the absence or insufficiency of community consultation measures (Anderson and Theodori, 2009; Cotton et al., 2014; Jaspal and Nerlich, 2014), and the influence of compensation schemes (sometimes framed by anti-shale gas opponents as a form of bribery Cotton, 2013), similarly influence the heterogeneity of stakeholder perceptions of fracking risks and benefits.

Though longitudinal analysis of UK citizen perceptions of fracking show declining support overall (O'Hara et al., 2014; O'Hara et al., 2013), it is necessary to delineate the complex environmental and governance dimensions in UK shale gas development across a range of industry, non-industry, civil society and non-affiliated citizen stakeholder perspectives. This Q-methodological study aims to advance and innovate within this emergent literature on ‘shale gas in society’ in two ways. The first is to identify the ways in which shale gas is perceived by different stakeholder groups and to explore the relationships between the perspectives captured in this empirical study and the typologies of established environmental discourses (Dryzek, 1997). The second is to show if such stakeholder groups hold markedly different perspectives on certain environmental concerns (Barry and Proops, 1999) in order to stimulate broader debate on the democratic legitimacy, environmental impact and social acceptability of shale gas extraction activities.

#### **1.4 Issues specific to the UK case study**

This empirical case study specifically concerns UK stakeholder perspectives. Unlike in the USA, the UK shale gas industry remains at the exploration rather than commercial exploitation stage. The slow development of the industry was partly due to seismic risk concerns following the May 2011 investigation of two seismic tremors experienced near Preese Hall, Lancashire in Northwest England. However, following a British Geological Survey report of resource estimates (Andrews, 2013), industry-prepared studies of the seismic risks (see for example Eisner et al., 2011; Green et al., 2012), and an influential Royal Society and the Royal Academy of Engineering report on engineering safety (Bickle et al., 2012), Government introduced new regulatory requirements for the mitigation of seismic and water contamination risks, whilst declaring open support for economic stimulate to industry development. This policy platform was labelled by Conservative Prime Minister David Cameron as ‘going all out for shale gas’ (Watt, 2014).

In economic terms, The Spending Round 2013 saw the announcement of industry tax breaks, a new regulatory framework, business rate cuts for local councils and community benefits packages for shale gas host communities (HM Treasury, 2013). The aim is to create

economic incentivisation at different scales of governance (for onshore oil and gas exploration companies, councils and affected site communities). This stimulated a flurry of applications for Petroleum Exploration and Development licences (PEDL) from exploration companies. Some, such as Caudrilla's oil exploration activities in the West Sussex town of Balcombe in Southeast England in July 2013 and iGas's exploration in Barton Moss in Salford, Greater Manchester, received significant protest opposition and media attention. Significant drivers of such protest were the perceived lack of opportunities for community consultation on development activities, and concerns that regulatory bodies and elected officials are not protecting constituents' interests in affected communities (Balcombe, 2012; Cotton et al., 2014).

Social opposition is compounded by complex and contradictory regulatory and planning frameworks affecting fracking activities. Regulation of shale gas involves operators competitively bidding for exclusive drilling rights. They must then acquire landowner and local authority planning permission. This has been recently controversial for exploration company Cuadrilla in and around the Northwester English city of Preston, where Lancashire County Council rejected recent applications due to "unacceptable" increases in noise and heavy traffic (Lancashire County Council, 2015). However, if developers can secure planning permission they must also ensure receipt of necessary environmental permits (from either the Environment Agency EA, Natural Resources Wales NRW, or the Scottish Environment Protection Agency SEPA). EA regulation covers groundwater (aquifer) protection, assessing and approving hydraulic fracturing fluid chemicals, the treatment and disposal of mining waste and NORM and the disposal of waste gases through flaring. Operators must also notify the Health and Safety Executive (HSE) of the well design and operation plans in advance of drilling. HSE inspects the well design in order to control well-related hazards. Following approval the operator then seeks final consent from DECC (DECC, 2013).

Though seemingly straightforward Turney (2013) notes that the National Planning Policy Framework creates complex in inconsistent policy guidance given the range of consent regimes involved, the different stages of development (exploration, testing, production, and remediation/aftercare) and the presumption in favour of sustainable development which could be easily contested given the environmentally controversial nature of the extraction technique. This is further complicated by the Infrastructure Bill which, in January 2015 (after data collection), was amended by MPs to ban fracking in places such as national parks, areas of outstanding natural beauty (AONBs) and groundwater source protection zones, as well as deposits at less than 1,000 metres underground. The Bill also changed trespass laws to streamline the underground access regime to allow fracking under people's homes without prior consent. This issue is exceedingly controversial, as the Infrastructure Bill changes to trespass laws were subject to "[a] full consultation on this policy and the legislation is entirely dependent on the outcome of that consultation" (Prime Minister's Office, 2014). In fact proposals to changes went ahead despite 99% of consultees objecting to the measures, thus creating the potential for significant democratic deficits akin to Swyngedouw's concept of post-political decision-making (see also Johnstone, 2014; Swyngedouw, 2007). Together, these facets have been subject to growing national-level debate on the political viability and public acceptability of shale gas risks and opportunities, prompting an urgent need for social scientific research into unconventional fuel-based energy policy development, and the ways in which the different actors (referred to as 'stakeholders' for the purpose of this study) involved construe the various interrelated socio-economic, health and environmental implications.

## 2.1 Methods

### 2.1.1 Q-methodology

In delineating stakeholder perspectives within controversial environmental management debates Stephenson's (1953) Q-methodology (hereafter Q-method) has particular value. It allows researchers to identify important criteria, explicitly outline areas of consensus and conflict and hence help to develop a common view toward policy-making (Steelman and Maguire, 1999). Q-method developed as a means to quantitatively map subjective attitudes and opinions, rendering them open to statistical analysis to enable social researchers to identify a number of idealised accounts or discourses around a topic (Brown, 1996). It must be noted that discourse in this context refers to shared ways of perceiving or discussing the issues under consideration (*ibid.*). Q-method therefore examines discourse at the micro-level: concerning shared conceptualisations, language use and communicative practices (Fairclough, 2003; Van Dijk, 2001). The methodology allows researchers to systematically identify groups of individuals with a common attitude structure by looking at patterns of response across individuals in order to reveal diversity amongst perspectives and consensus within a group regarding a contentious topic (McKeown and Thomas, 1988).

Unlike traditional survey techniques, Q-method reveals taxonomies of shared subjective constructions and provides an in-depth portrait of the typologies of perceptions that emerge, in contrast to a statistical model with predictive or explanatory powers over a population. The aim is not to estimate the sample or population statistics, but rather to explore potential connections which unaided perception may overlook (Brown, 1980). Q-method thus has particular value in relating the micro-level discourses from participant sorting of statements back to underlying macro-level environmental discourses: heterogeneous and shared ways of apprehending the natural world which inherently draw out contestation for capturing the terms of environmental policymaking (Dryzek, 1997).

### 2.1.2 Statement sampling

Q-method research begins through defining the domain of subjectivity (in this case the socio-economic, health and environmental issues surrounding fracking processes). Once the domain is established, the researcher collects a pool of statements termed the communication concourse, which captures the breadth of positions outline within public debate. This is then sampled to produce a smaller representative Q-set.

In this study, the communication concourse was constructed through quasi-naturalistic collection methods involving both primary and secondary data (McKeown and Thomas, 1989; Stainton Rogers, 1995) from a set more than four times the size of the aimed for Q-sample (178 statements). These statements were drawn from a mixture of interview data from a qualitative study of policy discourses in the United Kingdom (Cotton et al., 2014), alongside written and verbal statements from secondary sources intended to provide a breadth of personal and organisational perspectives. These include excerpts from newspaper articles, press releases from gas exploration companies, op-eds, Government statements, NGO publications, grassroots opposition websites, and online message boards.

Statement sampling to form the Q-set followed an unstructured sampling approach (Steelman and Maguire, 1999), based upon thematic analysis of the concourse using MaxQDA computer-aided qualitative data analysis software. There were three overarching themes to the statements, covering: environmental and health, economic, and social dimensions, with two further levels of sub-themes used to select specific statements from the concourse. Following Steelman and Maguire's (1999) method for unstructured sampling, statements were selected to represent the full range of views about each of these sub-themes. They were then edited from the original sources for clarity and brevity, whilst maintaining a balance of pro and anti-shale

gas perspectives. The final Q-set was checked to ensure a balance of appropriateness and applicability to the issue, intelligibility and simplicity and comprehensiveness (Stainton Rogers, 1995). See **Table 1** for details of the overarching themes, subthemes and sampled statements.

**Table 1. Characterisation of concourse and selected Q-statements**

<b>Overarching theme</b>	<b>Sub-theme</b>	<b>Issue (Q-set statement number)</b>
Environmental and health dimensions	Water	<ul style="list-style-type: none"> <li>• Water use – (s3)</li> <li>• Groundwater contamination – (s27)</li> <li>• Naturally occurring radioactive materials – (s12)</li> </ul>
	Seismic activity	<ul style="list-style-type: none"> <li>• Risk of earthquakes (s24)</li> </ul>
	Climate change	<ul style="list-style-type: none"> <li>• Methane – (s5)</li> <li>• Carbon dioxide – (s15)</li> <li>• Comparison with other fossil fuels – (s1), (s15)</li> <li>• Comparison with renewables – (s4), (s10)</li> <li>• Transition fuels (s26)</li> </ul>
	Construction and production impacts	<ul style="list-style-type: none"> <li>• Flares/light pollution (s17)</li> <li>• Roads and transport – (s8)</li> <li>• Visual amenity/aesthetics (s32), (s9)</li> </ul>
	Health risks	<ul style="list-style-type: none"> <li>• Carcinogens (s40)</li> </ul>
Economic dimensions	Incentives	<ul style="list-style-type: none"> <li>• Industry (s16)</li> <li>• Local government (s21)</li> </ul>
	Gas supply/energy security	<ul style="list-style-type: none"> <li>• Fuel poverty – (s2), (s28)</li> <li>• Security of supply – (s6)</li> <li>• Rebound effects – (s31)</li> </ul>
	Skills and jobs	<ul style="list-style-type: none"> <li>• Local employment (s25)</li> </ul>
Social/governance dimensions	Trust	<ul style="list-style-type: none"> <li>• Industry (s14)</li> <li>• Government/regulators (s23)</li> <li>• Media (s34)</li> </ul>
	Public opposition	<ul style="list-style-type: none"> <li>• NIMBY – (s7), (s20)</li> <li>• Opposition/protest actions – (s29), (s37), (s38)</li> </ul>
	Distributive environmental justice	<ul style="list-style-type: none"> <li>• Fairness of risk/benefit distribution – (s18), (s36)</li> <li>• North–South divide in energy production/consumption – (s30)</li> <li>• Compensation to host communities – (s13)</li> </ul>
	Procedural environmental justice	<ul style="list-style-type: none"> <li>• Public participation in decision–making – (s22), (s35)</li> <li>• Access to information – (s19), (s39)</li> </ul>
	Sense of place	<ul style="list-style-type: none"> <li>• Disruption to place attachment – (s11), (s32)</li> <li>• Industrialisation of rural environments – (s9)</li> </ul>

### 2.1.3 Participant selection

Selection of participants (the p-sample) uses purposive sampling familiar to qualitative research, rather than pre-defined demographic characteristics in the manner of a social survey. Purposive sampling ensures that all groups who ex ante are expected to hold different opinions on the subject of study are represented (Stenner and Marshall, 1996). As a consequence of finite diversity, the number of participants does not have to be large (Addams and Proops, 2000) in order to gain statistical significance. Heterogeneity of perspectives is more desirable than proportionality (Brown, 1980). In this study, 28 participants produced usable q-sorts. The sampling strategy aimed to uncover a range of stakeholder interests. Onshore oil and gas industry bodies, protest organisations, scientific institutions, regulators, environmental management professionals, statutory bodies, and citizen stakeholders from both affected and unaffected regions were included (the latter with professional backgrounds ranging from law, medicine, education, public health, health and safety, and journalism). See **Table 2** for details of the statements and **Table 3** which breaks down the p-sample by organisational representation/occupation as appropriate. Please note that key personal details are excluded to preserve participant anonymity. Each participant was paid a small honorarium for taking part in the study.

### 2.1.4 Q-sorting

Participants were tasked with sorting the Q-set through rank ordering of statements according to a condition of instruction (referred to as Q-sorting, an individual complete set is a Q-sort). Q-sorts were administered online using the Qsoftware online program which mimics physical card sorting through a drag-and-drop interface. Participants were instructed to read all 40 statements and sort them first into three categories (agree, disagree, unsure – they were free to change the statement status in subsequent sorting process if desired). Statements were then sorted into a quasi-normal distribution from most unlike my position to most like my position along a scale from -4 to +4, where 0 is neutral, with a fixed number of statements in each column along the scale shown in **Table 4**. Sorting is a holistic process in which all elements are interdependently involved (Addams and Proops, 2000). The act of sorting reveals the individual respondents' personal subjectivity, whilst the forced quasi-normal distribution restricts the number of items that can be placed at the extremes of the scale.

### 2.1.5 Analysis

Data analysis involves sequential application of correlation, factor analysis and computation of factor scores. The approach is “qualiquantological” (Stenner and Stainton Rogers, 2004) in the sense that the statistical procedures serve to prepare the data in order to reveal their structure (Brown, 1993). However, the statistical analysis requires qualitative interpretation of the resultant outputs. This relationship problematizes the qualitative/quantitative relationship; and though statistical operations are used, reflexive reasoning about statement selection, factor labelling and qualitative interpretation are essential components of effective Q-method analysis (Eden et al., 2005).

Each Q-sort was inter-correlated using PQMethod 2.35 software. The resultant inter-correlation matrix was factor analysed (principal components analysis) and the resultant factor solution was rotated (varimax rotation). Scores for each factor were produced so that they could be re-expressed as idealised patterns of the Q-sorts that represent them (Addams and Proops, 2000). In other words, each factor is representative of a composite Q-sort (Webler and Tuler,

2006). The qualitative element of Q-method involves the production of a series of idealised accounts, each of which explicates the viewpoint being expressed by a particular factor. Interpretation involves first examining the z-scores of the distinguishing statements (measuring how far a statement lies from the middle of a distribution) as a measure of salience, and then generating a qualitative description of the factor in a narrative form. Each factor is given a label intended to “pinpoint a particularly salient characteristic of the factor type” (Brown, 1996). The narrative description then summarises the major points revealed through the statements associated with each factor in order to produce a bird’s eye picture of the different accounts produced through Q-sorting (Stainton-Rogers et al., 1989).

### 3.1 Results

Three statistically significant factors are discussed from the rotated solution, each with an Eigenvalue >1 and two or more participants loading on each factor (see **Table 3**). The three factor solution collectively represents 59% of the total cumulative variance. Q-statements are referred to in brackets, e.g. (s10). Those statements marked with an asterisk are significant at  $p < 0.01$ . The three accounts are labelled:

- A. Don’t trust the fossil fuels industry: campaign for renewables
- B. Shale gas is a bridge fuel: economic growth and environmental scepticism
- C. Place-protective action: legislate in the public interest

#### A. Don’t trust the industry: campaign for renewables

Factor A represents an account that could be considered resolutely anti-shale gas; grounded in environmental concerns over continued fossil fuel extraction. Advocates of Factor A emphasise that ‘going all out for shale gas’ will stifle investment in renewables (s10), rather than provide a successful bridge fuel between coal and renewables (s26\*). In this respect, shale gas is posited as an unclean fuel (s1\*). This framing is grounded in concern over its contribution to climate change through fugitive methane emissions (s5), its potential to generate groundwater contamination (s27), and (to a lesser extent) exacerbate problems of water over-use (s3). It is noteworthy that this concern with environmental degradation does not include concerns over traffic (s8), seismic activity (s24) naturally occurring radioactive materials (NORM) (s12) or light pollution (s17), in contrast to previous studies of stakeholder concerns on shale gas impacts (Cotton et al., 2014; O’Hara et al., 2014; Wynveen, 2011). However, Factor A presents a resolutely anti-fossil fuel and pro-renewables stance (s4, s32), exacerbated by a deep distrust of industry transparency around health risks (s14), of central government intentions to sponsor the industry (s16, s33), provide local economic benefits (s25) and concerns over the relaxing of laws around trespass to facilitate hydro-fracking under private property (s39).

There is scepticism about the role of local government-level tax incentives, reflecting a strong element of community level distributive environmental justice, whereby compensation for locally affected site communities is desired though similar incentives to local councils are not (s13, s21). Advocates of Factor A support national-level public consultation exercises (s22) to alleviate or resolve these problems, thus representing the deliberative turn in environmental policy-making (Parkins and Mitchell, 2005) regarding the sustainability of shale gas. Failure to ensure social sustainability for local communities leads to proponents of factor A to advocate ‘uninvited’ forms of engagement (Macnaghten and Chilvers, 2012) such as direct action at the local level (s38), including active protest and blocking access to drilling sites (s29).

To summarise, Factor A illustrates the extent to which specific environmental, health, safety and social sustainability concerns can stimulate the mobilisation of social movements of opposition.

#### B. Shale gas is a bridge fuel: economic growth and environmental scepticism

Factor B presents shale gas as a bridge or transition fuel that can allow continued economic dependence on fossil fuel resources whilst simultaneously reducing greenhouse gas (GHG) emissions (Arthur et al., 2009; DECC, 2009) (s26\*). Advocates therefore deny a conflict of interest between shale gas and renewable energy development (s10\*, s4). This factor therefore reflects a deeper social discourse of ecological modernisation (Hajer, 1995), i.e. proponents assert the economic pragmatism of hydro-fracking in terms of improved resource extraction efficiency (s6\*), business growth and fossil fuel industrial development, the stimulation of local job creation (s25), community compensation, and local council incentives (s21\*). They assert that these benefits can be gained whilst maintaining relative environmental performance in relation to coal (s15\*). To this end, there is a strong emphasis upon firmly disputing claims around the negative environmental, health and social impacts, alongside a concern that the media is unnecessarily fuelling public concerns with these risks (s34).

More specifically, proponents of Factor B display deep environmental scepticism over the claimed impacts of shale gas extraction activities, specifically challenging concerns over the risk acceptability of fugitive methane emissions in relation to climate change (s5), seismic activity (s24\*), high volume water use (s3\*), and fears over water contamination with fracking chemicals and NORM (s27\*, s12\*), the latter implicated with elevated cancer risks (s40). Most significantly, advocates stress that fracking does not produce disruptive negative amenity value effects on local landscapes (s9\*), leading to a strong refutation that it would threaten a personal sense of place attachment, causing local residents to move away from affected areas (s11\*).

To summarise, Factor B specifically conflicts with Factor A on issues such as environmental impacts in relation to climate change and water, and on the social sustainability of economic incentives to local government and local job markets.

#### C. Place-protective action: legislate in the public interest

Factor C primarily concerns place protective action and legislative protection for householders. There is recognition of the socio-economic benefits of shale gas as a bridge fuel (s26\*) that has potential to ensure jobs (s25) and assist in alleviating fuel poverty (s28), though there is distrust of government incentives to the market (s16). Concern over environmental impacts is less pronounced than in Factor A, with the exception of climate change effects (s5). However, unlike the other two, Factor C expresses principal concern with citizen involvement in shale gas governance.

Of particular interest is opposition to recent proposed changes to UK trespass laws that threaten horizontal drilling and hydraulic fracturing under privately owned property (s39\*, more so than with Factor A), showing that private property interests should be upheld for affected residents. However, what distinguishes this from Factor A is a recognition of the role of place-protective action to halt shale gas development (s7\*, s32). It is clear, however, that proponents of Factor C reject the pejorative assumptions of this place protective action as simple NIMBYism, grounded in economic self-interest such as with potentially negative house price impacts (s20). As such, advocates of Factor C assert that fracking is not de facto unfair to local communities (s18). Though like the other two factors, there is recognition that local communities should have access to information about fracking activities that affect them (s19), there is less support for direct public participation in shale gas decision-making either at national (s22\*) or local (s35\*) levels of governance. In essence, this represents a mistrust of

citizen stakeholders' deliberative capacity (Dryzek, 2009) to make good decisions on a primarily technical activity.

To summarise, this factor can be interpreted as a call, not for greater citizen control and direct involvement of citizens in shale gas decision-making, but for stronger legal mechanisms to protect the interests of private property owners whilst advocating stronger levels of public trust in technical/technocratic authorities (such as regulatory authorities for example).

**Table 2. Q-Sort Values for Each Statement**

Statement	Factor		
	A	B	C
1. Shale gas is a clean fuel	-3	1	-1
2. Shale gas is good for consumers because it drives down gas prices	-1	1	2
3. The process of fracking uses too much water	1	-2	1
4. Commercial shale gas extraction is undesirable because it encourages continued reliance on fossil fuels	3	-1	1
5. Shale gas production is dangerous because it produces fugitive methane emissions which contribute to climate change	3	-2	2
6. Fracking is a useful technique because it allows energy companies to access difficult-to-reach resources of oil and gas that would otherwise go untapped	-1	3	1
7. Public opposition to shale gas is an example of Not-in-My-Back-Yard thinking	0	1	3
8. The increased road traffic to shale gas extraction sites is a serious environmental impact	0	-1	-1
9. Constructing a shale gas pad in a rural landscape will destroy the natural character of the place	1	-2	1
10. I am concerned that investment in shale gas will reduce investment in renewable energy resources	4	-3	3
11. If you were to extract shale gas close to where I live, I would move away from the area	-1	-4	-2
12. I am concerned that fracking wastewater produces an unacceptable level of radioactive waste	0	-2	0
13. Communities near to fracking sites should receive compensation paid for from the profits of the gas	2	2	-1
14. I trust the shale gas industry to tell the truth about the health risks of fracking	-4	1	0
15. Shale gas is better for the environment than coal because it has lower carbon dioxide emissions	0	2	0
16. The Government should provide tax incentives to the shale gas industry to stimulate investment	-3	0	-2
17. I am concerned about the light pollution from the shale gas extraction sites (from lighting and flaring of gas)	0	-3	-2
18. Shale gas extraction is unfair to locally affected communities close to the site	1	-1	-3
19. Locally affected communities should have access to information on the content of hydraulic fracturing fluids, risks, costs and benefits upon request	3	3	2
20. Affected residents are only concerned about the effect it has on house prices	-1	0	-1
21. Local councils should receive cash benefits for encouraging shale gas extraction within the region	-2	2	-3
22. There should be a national public consultation on whether or not we should commercially exploit shale gas	2	0	-2
23. I do not trust the regulator's ability to protect public health from the effects of fracking	1	-1	1

24. The seismic activity (earthquakes) caused by fracking are too small to be considered serious	0	2	0
25. Shale gas provides jobs, and the local economic benefit makes fracking worthwhile	-2	3	3
26. Shale gas is a suitable 'bridge fuel' that we can exploit whilst society develops renewable energy options	-2	4	2
27. I am concerned that shale gas will contaminate groundwater	2	-3	1
28. Shale gas is valuable because it can help to end fuel poverty for the poorest households	-1	0	2
29. Blocking access to fracking sites is an unreasonable form of protest	-2	1	0
30. Shale gas benefits rich energy consumers in urban areas at the expense of poor rural communities	0	-1	0
31. Shale gas creates undesirable 'rebound effects' such as the lowering of coal prices	1	0	1
32. I would prefer to see a shale gas well near my home than a wind farm	-3	1	-3
33. The Government is right to promote shale gas as it will benefit national economic development	-2	1	-1
34. Concern over the environmental impacts of shale gas has been overhyped in the media	-1	2	-2
35. Local communities should have the final say in whether shale gas companies can frack in their area	1	0	-4
36. Investment in fracking from global energy companies means that all the benefits go to international shareholders	0	-1	-1
37. Protests against shale gas are taken over by organised opposition groups that don't reflect the will of the local people	-1	0	0
38. Local people should stand up and protest against energy companies fracking in their area	2	-1	-1
39. Shale gas extraction companies should not be allowed to drill under private property without the owner's permission	2	0	4
40. Fracking should be halted because the chemicals used can potentially cause cancer	1	-2	0

**Table 3. Factor loadings**

Participant	Factor		
	A	B	C
<b>Industry stakeholders</b>			
1. Onshore oil & gas industry association senior executive	-0.2830	0.7347*	0.0220
2. Onshore oil & gas industry development manager	-0.3170	0.7649*	0.0294
3. Offshore oil & gas industry geologist	-0.2819	0.7012*	0.2788
4. Onshore oil & gas industry business manager	-0.2146	0.8747*	-0.0002
5. Onshore oil & gas energy consultant	0.0280	0.7988*	-0.0571
<b>Scientific, regulatory, governmental and non-governmental stakeholders</b>			
6. Geophysicist, British Geological Survey	-0.1565	0.8035*	-0.0548
7. Waste water engineer, utilities company	-0.0033	0.5636*	0.2018
8. Public health specialist, NHS <sup>2</sup>	-0.0293	0.4274	0.5391*
9. Community engagement consultant, renewable energy projects	0.6604*	0.3166	-0.0519
10. Waste and recycling officer, local council	0.5891*	-0.1333	0.4433
11. Health and safety data specialist	0.6319*	0.0010	0.2416
12. Water researcher, UNESCO	0.7238*	-0.4802	0.0311
13. Project manager, Environment Agency	0.6601*	-0.3547	-0.0456
14. Project manager, RSPB	0.6267*	-0.2168	0.0018
15. Economic development officer, local council <sup>1</sup>	0.5519*	-0.2092	0.2747
16. Environmental consultant, Atkins Global	0.4392*	0.0693	0.1433
<b>Citizen stakeholders</b>			
17. Anti-shale gas protestor <sup>1</sup>	0.7726*	-0.3457	-0.0013
18. Investigative journalist <sup>1</sup>	0.6765*	-0.3814	0.0950
19. Citizen stakeholder, journalist <sup>1</sup>	0.7837*	-0.3632	0.1322
20. Citizen stakeholder, managing director of SME <sup>1</sup>	0.4527	0.3562	0.4975
21. Citizen stakeholder, small business owner <sup>1</sup>	0.6933*	-0.5063	0.1211
22. Citizen stakeholder, solicitor <sup>2</sup>	0.3601	0.2436	0.5095*
23. Citizen stakeholder, retired <sup>2</sup>	-0.1051	0.0700	0.6487*
24. Citizen stakeholder, small business owner <sup>2</sup>	0.8472*	-0.1170	0.2204
25. Citizen stakeholder, teacher <sup>2</sup>	0.7563*	-0.3636	0.0192
26. Citizen stakeholder, trade union rep <sup>2</sup>	0.7812*	-0.0925	-0.1230
27. Citizen stakeholder, teacher <sup>3</sup>	0.6300*	0.0262	0.5611
28. Citizen stakeholder, engineer <sup>3</sup>	0.2113	-0.2862	0.6618*
Explanation of variance	29%	21%	9%

\*Represents a defining sort for the factor

<sup>1</sup> Lives in an area currently affected by current shale gas exploration activities

<sup>2</sup> Lives in an area potentially affected by future shale gas activities

<sup>3</sup> Unlikely to be affected by shale gas developments in the immediate future

**Table 4. Fixed Distribution for the Q-set**

<b>Statement score</b>	-4	-3	-2	-1	0	1	2	3	4
<b>Number of statements in column</b>	1	3	5	7	8	7	5	3	1

## 4.1 Discussion

In looking across these three factors to develop policy recommendations, it is necessary to attend to two dimensions of comparison:

1. Points of agreement across factors (suggesting areas of common grounds)
2. Points of disagreement across factors (suggesting areas of conflict and potential compromise).

I then examine the participant loadings on the three factors followed by discussion of the relationship between the microdiscourses of each factor and underlying environmental macrodiscourses, drawing upon Dryzek's typology of discourse perspectives.

### 4.1.1. Points of agreement

The analysis of z-scores reveals five statements that do not distinguish between any pair of factors, all of which are non-significant at  $p < .01$ . These statements are important because they reveal issues that provide a common foundation for building a shale gas management strategy that proponents of all three perspective could possibly find acceptable (Steelman and Maguire, 1999), and, where agreement cannot be reached, can form the basis of shared common ground amongst competing stakeholder interests. They are as follows:

1. road traffic (s8)
2. public access to information about shale gas activities (s19)
3. residents concern with potentially negative effects on property values (s20),
4. shale gas development causing individuals to move away from the affected area (s11)
5. the influence of external activists from outside organisations (such as Frack Off) taking over localised protest (s37)

It is notable that road traffic did not raise significant concerns amongst the stakeholder groups. Hydro-fracking processes likely increase costs of road maintenance as a result of increased heavy traffic for the movement of water, fracking chemicals and proppants, and also increase air emissions from exhaust fumes, creating negative environmental externalities for affected site communities (Argetsinger, 2011). The neutral or slight disagreement ranking for (s8) appears to contrast with previous studies such as Theodori's (2009) analysis of stakeholder perceptions of environmental impacts in the Barnett shale basin in Texas, that found that eight of the top ten problems noted by residents in early stages of development were related to traffic and damage to roads, environmental quality, and land use. The relative lack of concern may be indicative of its perceived relative low impact to industry stakeholders, and its low rank amongst environmental concerns from locally affected residents. However, care must be taken when interpreting such agreement on this impact as acceptance or toleration of the risks, as lack of stakeholder awareness or knowledge about the issue may be the underlying reason, particularly given the lack of commercial shale exploration examples to give context to the respondents' ranking of this issue.

A clearer consensus on the issue of public access to information is perhaps easier to explain. Agreement on access to information is uncontroversial in part because it is an institutionalised norm of democratic process in the United Kingdom. Freedom of Information is enshrined in law and forms a central component of Government and industry transparency and democratic accountability. This extends further to environmental policy and planning processes, for example the UK's commitment to Aarhus Convention principles which guarantee citizen stakeholders the right to receive environmental information that is held by

public authorities, including information on the state of the environment, on policies or measures taken, and on the state of human health and safety where this can be affected by the state of the environment (UNECE, 1998). Agreement around this statement is testament to the normalisation of transparency and accountability principles within UK environmental planning processes, and these findings indicate that it would behove onshore oil and gas companies to provide early and accessible information to affected residents in advance of pre-planning application consultation measures (particularly on the chemical contents of fracturing fluids, which are published through the relevant regulatory authorities [Environment Agency, Scottish Environmental Protection Agency, Natural Resources Wales] but can remain commercially sensitive DECC, 2014).

Though Factor C directly concerned the NIMBY phenomenon, it was clear that none of the accounts identified citizen stakeholders as solely self-interested place-protectionists motivated by the threat of falling house prices (s20). This was further supported by agreement that shale gas construction would not disrupt a personal sense of place attachment to local communities/sites/places to the point that proponents of any of the factors would move away from the affected area (s11). Together these (s20) and (s11) are important because they show that the purely pejorative connotations of NIMBY labels attached to local opposition activists are absent within these accounts – there is, in essence, agreement that affected citizen stakeholder opposition is not solely motivated by self-interest. Moreover, the issue around environmental activists ‘taking over’ local opposition movements (s37) also has little purchase across the three factors. The statement originated from a piece in *The Telegraph*, which ran editorials emphasising how certain activists involved in protests in Barton Moss in Salford “have no connection to the area”, but are rather “militant activists...portraying themselves as representing local opinion” (Sawer, 2013). This implies that localised grassroots activism provides legitimate grounds for protest, whereas as national movement of activists to sites of protest does not. The national opposition movement No Dash For Gas argued that Sawer employs the language of ‘outsiders’ parachuting in and not taking local issues and needs into account as a discursive strategy that “perniciously uses xenophobic connotations around ‘foreigners’ and ‘outsiders’ who seemingly have no place in one which is not ‘their own’ to justify this position.” (No Dash For Gas, 2013). This statement relates back therefore to NIMBY labels, as the definition of a ‘legitimate’ stakeholder interest is demarcated spatially in discourse by actors with partisan stances within the debate (as is clear in *The Telegraph* piece).

The relative consensus on (s11), (s20) and (s37) reflects upon broader research into the NIMBY phenomenon that shows how the term itself as a blanket label for opposition fails to resonate with the experiences of residents within environmental opposition movements (Bunningham, 2000; McClymont and O'Hare, 2008; van der Horst, 2007). Together this provides further evidence that the term is an unhelpful framing device in shale gas planning and should be dropped from industry and Government vernacular (see also Cotton, 2013).

#### **4.1.2. Points of disagreement**

Points of disagreement can be found by examining the variance across Factor z-scores for each of the statements. It is important to note these key areas of disagreement as they represent the issues that motivate social movements of opposition, and point to inter-stakeholder conflict. Seven areas of disagreement are identified:

1. Investment in shale gas conflicting with investment in renewables (s10)

2. Trust in the shale gas industry to be transparent about health effects (s14)
3. The ‘cleanliness’ of shale gas (s1)
4. The role of shale gas as a bridge fuel (s26)
5. Local economic benefits and job creation (s25)
6. Cash incentives to local councils (s21)
7. Local community control over shale gas siting decisions (s35)

These seven key areas of disagreement are indicative of entrenched value conflicts over the social and environmental acceptability of potential shale gas exploitation. We can see that most of the key areas of discursive conflict on these seven statements emerge between Factors A and C (in agreement) and B in opposition, based upon competing discursive framings of shale gas in broader policy debates. For example significant conflict between “unclean” (A and C) and “clean” (B) (s1) framings, mirrors previous qualitative research findings around competing discourse coalitions emerging in relation to the ethical dimensions of shale gas – how cleanliness is means through which the moral ordering of society occurs, creating a key area of conflict between opponents of shale gas that posit the emergent industry as unethical for extracting “dirty” fuels (Cotton et al., 2014; see also Jaspal and Nerlich, 2014). The discursive divide between A and B on issues of cleanliness are contiguous with disagreement on the level of trust in the industry on key health risk (s14): A significantly untrusting of industry and B slightly trusting, and C neutral. The cleanliness concept then also relates to conflicts over how shale gas is perceived as an opportunity to bridge or transition current energy systems from fossil-fuel dependence to renewable alternatives (s26). This is due to the ways in which energy investment is perceived, either as a zero-sum game whereby shale gas stifles renewables investment (A and C), or where no conflict of interest is expected (B) (s10). This means that central Government involvement at local scales of governance, such as by creating supply-push incentives to local councils to stimulate investment through cash incentives (s21) and job creation (s25), remains a deeply contentious issue; one that will likely exacerbate inter-stakeholder conflict. It would therefore behove central Government organisations to better communicate the economic impact of predicted UK shale resources on renewable energy development - presenting possible investment and renewables construction scenarios under different resource extraction conditions (including local market incentives and laissez fair approaches) as a means to ameliorate this potential conflict.

Finally, it is notable the only significant area of disagreement between Factors A and C regards the role of citizen stakeholders in having the final say in decision-making processes over siting (s35), with A advocating citizen control and B preferring to leave these decisions ‘to the experts’. This can be interpreted as A and C broadly agreeing on the terms of environmental and economic sustainability in relation to fuel exploration and development, but disagreeing on the governance solution. The former position advocates a democratic solution involving direct citizen participation, and the latter a technocratic solution involving expert input and legal protection to ensure environmental justice.

#### **4.2 Environmental discourses**

In terms of specific policy implications, it is worth noting that the conflicts emerging between factors are reflective of deeper emergent environmental discourses within public debate. We can therefore typify each account specifically in relation to established typologies of environmental discourses – i.e. shared ways of viewing the world that become mobilised in debates over environmental policy-making processes (Dryzek, 1997; Hajer, 1995; Litfin, 1994). Factor A could be interpreted as mediating between a sustainable development discourse emphasising the need for environmental protection to ensure social sustainability and wary of

the economic incentives, health and environmental impacts; and a democratic pragmatism discourse around industry transparency and emphasis upon interactive political relationships of dialogue, debate and right-to-know legislation which engage citizens in shale gas policy. Similarly Factor B could be interpreted as mediating between ecological modernisation and economic rationalism discourses. The former emphasises the market benefits of cheaper gas resources to national economic growth and job creation, and the latter emphasises the twin benefits of greenhouse gas emission reduction alongside local economic development and lower levels of ecological and health impacts. Factor C in turn represents an administrative rationalism discourse, wary of leaving these decisions in the hands of citizen-stakeholders but nonetheless calling for environmental protection measures enshrined in law and based upon the technocratic authority of experts (for further discussion of these discourses see Dryzek, 1997 in particular).

#### **4.3 Participant loadings on factors**

It is important to note that the microdiscourses illustrated in the factors represent segments of subjective communicability and it is inadvisable to simply extrapolate these factors to representing the perspectives of particular demographic segments of society (Brown, 1980). However, as a point of reflection, the differences in participant loadings on the individual factors and the stakeholder affiliation of each of the Q-sorters are worthy of brief discussion. Factor B is highly correlated with all industry stakeholder perspectives (n=5). Factor A is highly correlated with the diverse range of non-industry stakeholder perspectives (n=8), and the majority of (n=8) citizen stakeholders. Factor C is correlated with citizen stakeholder (n=3) and non-industry stakeholders (n=1). The samples are small and non-representative of groups within civil society, though the clear distinctions between Factors A and C when contrasted with B and the relative homogeneity in stakeholder participant loadings within those factors can be interpreted as necessitating further qualitative and quantitative social research to explore whether these accounts can be “scaled up”, and hence are representative of an entrenched division between industry-affiliated and non-industry-affiliated stakeholder perspectives. Such research has implications for long-term industry-community engagement with shale gas development.

#### **5.1 Conclusions**

Collectively, these deeper discourses represent fundamental conflicts over how shale gas is imagined, constructed and negotiated by different stakeholders. The factors outlined and the similarities and differences between them are indicative of how future discursive conflicts will emerge in public dialogue, protest action and industry-community relations close to shale gas sites as the contentious nature of the extraction process, the ethics of the fuel itself and the processes of governing and incentivising site selection emerge in energy politics. I concur with the findings of Steelman and Maguire (1999), Addams and Proops (2000), Weimer (1999) and Curry et al. (2012) in suggesting that Q-method is a useful tool for identifying how stakeholders view and talk about the issues surrounding controversial environmental policy processes, identifying latent discourses within and across different stakeholder groups, and revealing a more nuanced picture of competing perspectives than those traditionally presumed by policymakers.

Current concerns over disparities between public consultation responses to shale gas planning policy through the Infrastructure Bill (advocating protection of trespass laws and greater clarity on planning processes and public engagement with site selection) and current pro-shale gas rhetoric within policy (which has instead amended trespass laws and remains ambiguous on shale gas’s relationship to sustainable development within the National Planning Policy Framework Turney, 2013) have recently dominated the broader political discourse over

shale gas development. The competing rationalities and underlying environmental discourses revealed through this study highlight the contested nature of the policy terrain, the lack of consensus on key environmental, social, economic and governance issues. Together, these discourses collectively reinforce the need for Government to provide broader, open dialogue on shale-gas's place in energy policy, in contrast to the current public consultation measures that have been heavily criticised as a means to justify a predetermined policy outcome without sufficient deliberative democratic input.

## References

- Addams H, Proops J, 2000 *Social Discourse and Environmental Policy: An Application of Q Methodology* (Edward Elgar, Cheltenham)
- Anderson B J, Theodori G L, 2009, "Local leaders' perceptions of energy development in the Barnett shale" *Southern Rural Sociology* **24** 113-129
- Andrews I J, 2013, "The Carboniferous Bowland Shale gas study: geology and resource estimation", (British Geological Survey for the Department of Energy and Climate Change, London)
- Argetsinger B, 2011, "Marcellus Shale: Bridge to a Clean Energy Future or Bridge to Nowhere-Environmental, Energy and Climate Policy Considerations for Shale Gas Development in New York State, The" *Pace Environmental Law Review* **29** 321-343
- Arthur J D, Bohm B, Coughlin B J, Layne M, 2009, "Evaluating implications of hydraulic fracturing in shale gas reservoirs", in SPE Americas E&P Environmental and Safety Conference (San Antonio, Texas)
- Balcombe P C, 2012, "Fracking Poll Results", (Balcombe Parish Council, Balcombe, West Sussex)
- Banerjee A, Prozzi J P, Prozzi J A, 2012, "Evaluating the Effect of Natural Gas Developments on Highways" *Transportation Research Record: Journal of the Transportation Research Board* **2282** 49-56
- Barry J, Proops J, 1999, "Seeking sustainability discourses with Q methodology" *Ecological Economics* **28** 337-345
- Bickle M, Goodman D, Mair R, Roberts R, Selley R C, Shipston Z, Thomas H, Younger P, 2012, "Shale gas extraction in the UK: a review of hydraulic fracturing", (Royal Society and Royal Academy of Engineering, London)
- Brasier K J, Filteau M R, McLaughlin D K, Jacquet J, Stedman R C, Kelsey T W, Goetz S J, 2011, "Residents' perceptions of community and environmental impacts from development of natural gas in the Marcellus shale: a comparison of Pennsylvania and New York cases." *Journal of Rural Social Sciences* **26**
- Brown S, 1993, "A Primer on Q Methodology" *Operant Subjectivity* **16** 91-138
- Brown S R, 1980 *Political Subjectivity: Applications of Q Methodology in Political Science* (Yale University Press, New Haven)
- Brown S R, 1996, "Q Methodology and Qualitative Research" *Qualitative Health Research* **6** 501-512
- Burningham K, 2000, "Using the language of NIMBY: a topic for research, not an activity for researchers" *Local Environment* **5** 55-67
- Cairney P, Fischer M, Ingold K, 2015, "Hydraulic fracturing policy in the UK: coalition, cooperation and opposition in the face of uncertainty", in Political Studies Association Annual International Conference (Sheffield)
- Colborn T, Kwiatkowski C, Schultz K, Bachran M, 2011, "Natural Gas Operations from a Public Health Perspective" *Human and Ecological Risk Assessment* **17** 1039-1056

- Cotton M, 2013, "NIMBY or Not? Integrating Social Factors into Shale Gas Community Engagements" *Natural Gas & Electricity* **29** 8-12
- Cotton M, Rattle I, Van Alstine J, 2014, "Shale gas policy in the United Kingdom: an argumentative discourse analysis" *Energy Policy* **73** 427–438
- Curry R, Barry J, McClenaghan A, 2012, "Northern Visions? Applying Q methodology to understand stakeholder views on the environmental and resource dimensions of sustainability" *Journal of Environmental Planning and Management* **56** 624-649
- Davis C, Fisk J M, 2014, "Energy Abundance or Environmental Worries? Analyzing Public Support for Fracking in the United States" *Review of Policy Research* **31** 1-16
- Davis C, Hoffer K, 2012, "Federalizing energy? Agenda change and the politics of fracking" *Policy Sciences* **45** 221-241
- DECC, 2009, "The UK Low Carbon Transition Plan: National Strategy for Climate and Energy", (Department of Energy and Climate Change, London)
- DECC, 2013, "Onshore oil and gas exploration in the UK: regulation and best practice", (Department of Energy and Climate Change, London)
- DECC, 2014, "Fracking UK shale: water", (Department of Energy & Climate Change, London)
- Deutsche Bank, 2011, "European Gas: A first look at EU shale gas prospects", (Deutsche Bank, London)
- Dryzek J S, 1997 *The Politics of the Earth: Environmental Discourses* (Oxford University Press, Oxford)
- Dryzek J S, 2009, "Democratization as Deliberative Capacity Building" *Comparative Political Studies* **42** 1379-1402
- Eden S, Donaldson A, Gordon W, 2005, "Structuring Subjectivities? Using Q Methodology in Human Geography" *Area* **37** 413-422
- Eisner L, Janska E, Matousek P, 2011, "Seismic Analysis of the events in the vicinity of the Preese Hall well", (Seismik report for Cuadrilla Resources, London)
- Fairclough N, 2003 *Analysing Discourse: Textual Analysis for Social Research* (Routledge, London)
- Finwood M H, Stroup L J, 2012, "Fracking and the Neoliberalization of the Hydro-Social Cycle in Pennsylvania's Marcellus Shale" *Journal of Contemporary Water Research & Education* **147** 72-79
- Gény F, 2011 *Can unconventional gas be a game changer in European Gas Markets?* (Oxford Institute for Energy Studies, Oxford)
- Green C A, Styles P, Baptie B, 2012, "Preese Hall shale gas fracturing: Review and recommendations for induced seismic mitigation", (Department of Energy and Climate Change, London)
- Hajer M, 1995 *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process* (Clarendon Press, Oxford)
- HM Treasury, 2013, "Harnessing the potential of the UK's natural resources: a fiscal regime for shale gas", Ed H Treasury (London)
- Howarth R, Santoro R, Ingraffea A, 2011, "Methane and the greenhouse-gas footprint of natural gas from shale formations" *Climatic Change* **106** 679-690
- Jacquet J B, 2012, "Landowner attitudes toward natural gas and wind farm development in northern Pennsylvania" *Energy Policy* **50** 677-688
- Jaspal R, Nerlich B, 2014, "Fracking in the UK media: Threat dynamics in an unfolding debate" *Public Understanding of Science* **23** 348-363
- Jaspal R, Turner A, Nerlich B, 2014, "Fracking on YouTube: Exploring risks, benefits and human values" *Environmental Values* **23** 501-527

Johnstone P, 2014, "Planning reform, rescaling, and the construction of the postpolitical: the case of The Planning Act 2008 and nuclear power consultation in the UK" *Environment and Planning C: Government and Policy* **32** 697-713

Kargbo D M, Wilhelm R G, Campbell D J, 2010, "Natural Gas Plays in the Marcellus Shale: Challenges and Potential Opportunities" *Environmental Science and Technology* **44** 5679-5684

Lancashire County Council, 2015, "Agenda and minutes of the Development Control Committee, Wednesday, 28th January, 2015 10.00 am.", <http://council.lancashire.gov.uk/ieListDocuments.aspx?CIId=118&MIId=4340&Ver=4>

Litfin K T, 1994 *Ozone Discourses: Science and Politics in Global Environmental Cooperation* (Columbia University Press, New York)

Litovitz A, Curtright A, Abramzon S, Burger N, Samaras C, 2013, "Estimation of regional air-quality damages from Marcellus Shale natural gas extraction in Pennsylvania" *Environmental Research Letters* **8** 014017

Macnaghten P M, Chilvers J, 2012, "Governing risky technologies", in *Critical Risk Research: Practices, Politics and Ethics* Eds S Lane, F Klauser, M Kearnes (Wiley Blackwell, London)

Malin S, 2013, "There's no real choice but to sign: neoliberalization and normalization of hydraulic fracturing on Pennsylvania farmland" *Journal of Environmental Studies and Sciences* 1-11

Marshall T, Stephenson M, 2012, "Shale: no great shakes?" *Planet Earth* 20-21

McClymont K, O'Hare P, 2008, "'We're not NIMBYs!' Contrasting local protest groups with idealised conceptions of sustainable communities" *Local Environment* **13** 321-335

McKeown B, Thomas D, 1988 *Q Methodology* (Sage, London)

McKeown B, Thomas D, 1989 *Q Methodology: Quantitative Applications in the Social Sciences* (SAGE Publications, London)

Moore S, 2012 *Gas Works? Shale gas and its policy implications* (Policy Exchange, London)

NaturalGas.org, 2013, "Water requirements of shale production", <http://www.naturalgas.org/shale/waterrequirements.asp>

No Dash For Gas, 2013, "No Dash For Gas Response to Telegraph Piece Today", <http://www.nodashforgas.org.uk/>

O'Hara S, Humphrey M, Andersson J, Jaspal R, Nerlich B, Knight W, 2014, "Public perception of shale gas extraction in the UK: the turn against fracking deepens", (University of Nottingham, Nottingham)

O'Hara S, Humphrey M, Jaspal R, Nerlich B, Knight W, 2013, "Public perception of shale gas extraction in the UK: The impact of the Balcombe protests in July-August 2013", (Nottingham University, Nottingham)

Parkins J R, Mitchell R E, 2005, "Public Participation as Public Debate: A Deliberative Turn in Natural Resource Management" *Society and Natural Resources* **18** 529-540

Pearson I, Zeniewski P, Graceva F, Zastera P, McGlade C, Sorrell S, Speirs J, Thonhauser G, 2012, "Unconventional Gas: Potential Energy Market Impacts in the European Union", (European Commission Joint Research Centre, Institute for Energy and Transport, Petten)

Prime Minister's Office, 2014, "The Queen's Speech 2014", (Prime Minister's Office, London)

Rabe B G, Borick C, 2013, "Conventional Politics for Unconventional Drilling? Lessons from Pennsylvania's Early Move into Fracking Policy Development" *Review of Policy Research* **30** 321-340

Rahm B G, Riha S J, 2012, "Toward strategic management of shale gas development: Regional, collective impacts on water resources" *Environmental Science & Policy* **17** 12-23

Rogers H, 2011, "Shale gas—the unfolding story" *Oxford Review of Economic Policy* **27** 117-143

Sawer P, 2013, "Fracking protests head north as activists mass on proposed Manchester shale gas exploration sites" *The Telegraph*, 21/12/2013

- Schafft K A, Borlu Y, Glenna L, 2013, "The relationship between Marcellus Shale gas development in Pennsylvania and local perceptions of risk and opportunity" *Rural Sociology* **78** 143-166
- Scrase J I, Ockwell D G, 2010, "The role of discourse and linguistic framing effects in sustaining high carbon energy policy—An accessible introduction" *Energy Policy* **38** 2225-2233
- Smith M F, Ferguson D P, 2013, "'Fracking democracy': Issue management and locus of policy decision-making in the Marcellus Shale gas drilling debate" *Public Relations Review* **39** 377-386
- Stainton-Rogers W, Hevey D, Ash E, 1989 *Child Abuse and Neglect* (Batsford Ltd. and Open University Press, London)
- Stainton Rogers R, 1995, "Q Methodology", in *Rethinking Methods in Psychology* Ed R Smith (Sage, London)
- Steelman T A, Maguire L A, 1999, "Understanding Participant Perspectives: Q-Methodology in National Forest Management " *Journal of Policy Analysis and Management* **18** 361-388
- Stenner P, Marshall H, 1996, "A Q methodological study of rebelliousness" *European Journal of Social Psychology* **25** 612-636
- Stenner P, Stainton Rogers R, 2004, "Q methodology and qualiquantology: the example of discriminating between emotions.", in *Mixing methods in psychology* Eds Z Tod, B Nerlich, S Mckeown, D Clark (Routledge, London)
- Stephenson E, Doukas A, Shaw K, 2012, "'Greenwashing gas: Might a 'transition fuel' label legitimize carbon-intensive natural gas development?'" *Energy Policy* **46** 452-459
- Stephenson W, 1953 *The study of behavior: Q-technique and its methodology* (University of Chicago Press, Chicago)
- Swyngedouw E, 2007, "Impossible "sustainability" and the postpolitical condition", in *The sustainable development paradox: urban political economy in the United States and Europe* Eds R Krueger, R Gibbs (The Guildford Press, New York) pp 13-40
- Theodori L, 2009, "Paradoxical Perceptions of Problems Associated with Unconventional Natural Gas Development" *Southern Rural Sociology* **24** 97-117
- Tillett T, 2013, "Summit discusses public health implications of fracking" *Environmental Health Perspectives* **121** a15
- Truelove H B, 2012, "Energy source perceptions and policy support: Image associations, emotional evaluations, and cognitive beliefs" *Energy Policy* **45** 478-489
- Turney R, 2013, "Fracking and the National Planning Policy Framework", (Landmark Chambers, London)
- UNECE, 1998, "Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters", in *Fourth Ministerial Conference: Environment for Europe*, United Nations Economic Commission for Europe, Aarhus, Denmark
- van der Horst D, 2007, "NIMBY or not? Exploring the relevance of location and the politics of voiced opinions in renewable energy siting controversies" *Energy Policy* **35** 2705-2714
- Van Dijk T A, 2001, "Critical discourse analysis", in *The handbook of discourse analysis* Eds D Schiffrin, D Tannen, H E Hamilton (Blackwell, Oxford) pp 352-371
- Watt N, 2014, "Fracking in the UK: 'We're going all out for shale,' admits Cameron" *The Guardian*
- Webler T, Tuler S, 2006, "Four perspectives on public participation process in environmental assessment and decision making: Combined results from 10 case studies" *Policy Studies Journal* **34** 699-722
- Weimer D L, 1999, "Comment: Q-method and the isms" *Journal of Policy Analysis and Management* **18** 426-429

Witter R, Stinson K, Sackett H, Putter S, Kinney G, Teitelbaum D, Newman L, 2008, "Potential exposure-related human health effects of oil and gas development: A white paper" Colorado School of public health

Wynveen B J, 2011, "A thematic analysis of local respondents perceptions of Barnett Shale energy development" *Journal of Rural Social Sciences* **26** 8-31

Zobak M, Kitasei S, Copithorne B, 2010, "Addressing the Environmental Risks from Shale Gas Development", (Worldwatch Institute, Washington DC)

