‘All out for shale’

The mental health impacts of the government’s fracking policy: evidence from Lancashire, England

Ryan Waugh

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LUCSUS
Lund University Centre for Sustainability Studies

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Abstract:

Shale gas extraction commonly known as fracking had support from the UK government with their 'all out for shale' policy. Despite this industry has struggled to establish itself mainly due to strong opposition from communities concerned about environmental and health impacts. Most research into the impacts of fracking is concerned with either environmental degradation or physical health impacts which coincide with the start of exploratory drilling. Research suggests community impacts can start as early as the planning stage, when shale gas developments are proposed, however there is little evidence on the mental health impacts on individuals living close to fracking sites. This research aimed to investigate whether shale gas developments negatively impacted the mental health of residents living within Lancashire, England, where the only operational fracking site is based at Preston New Road. A relatively small sample of 41 was surveyed to gather data on their experiences at the planning and exploration stage of the development. Currently a moratorium is in place which has halted the development at the exploration stage. Utilising the six core impacts of fracking identified in Szolucha (2016) from her work on the human dimension of shale gas development, it was found 'social well-being and health' was the main concern at the planning stage this changed to 'democracy' at the exploration stage. Experience of Common Mental Disorders (CMDs) was used as a measure of mental health impacts, only 26.8% of respondents had previously experienced a CMD before being aware of fracking, with 58.5% stating they have experienced a CMD since fracking was announced. Of those experiencing symptoms 96% said that their symptoms continued when exploratory drilling started. The most common CMD experienced at the planning stage was generalised anxiety disorder. At the exploration stage low mood was experienced most. The sample also expanded on specific events which had impacted their mental health negatively, the most common theme was of policing and intimidation. The case was analysed through an environmental justice lens, utilising Schlosberg (2004) environmental justice framework. It was found that the distribution of burdens was unequal, that marginalised groups were not recognised and the interference in local democracy constituted procedural injustice. There is evidence for more research into the impacts of energy extraction developments on mental health. For future developments, be it extreme energy extraction or renewables key recommendations have been identified to limit the negative mental health impacts in communities affected by fracking.

Keywords: Shale gas developments, Fracking, Mental Health, United Kingdom, Environmental Justice

Word count: 11,169

Acknowledgements

The inspiration for this thesis and applying to the master's programme at LUCSUS was the conflict in Lancashire regarding shale gas developments (fracking) not far from where I live in Manchester. I learned a great deal from the communities fighting against these developments prior to applying to do the masters. It was my ambition to gain further knowledge and experience to be able to work to prevent negative impacts as seen in Lancashire in my future career. I would like to thank all those involved in the movement for their inspiration and contribution in helping me complete this thesis, I hope it is in some way beneficial to the movement.

I would also like to thank all staff at LUCSUS for sharing their experiences and knowledge so that I can better mine, I would especially like to thank Ellinor Isgren for her support as a thesis supervisor as well as my thesis peer group for their continued support and guidance. Not forgetting a massive thank you to my partner in crime Hanna Geschewski.

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List of Abbreviations

APMS	Adult Psychiatric Morbidity Survey
CCG	Clinical commissioning group
CMD	Common mental disorders
EEA	European Economic Area
EIA	Environmental Impact Assessment
Fracking	Unconventional shale gas extraction
GAD	Generalised anxiety disorder
HIA	Health Impact Assessments
IEM	Internal Energy Market
ML	Local magnitude
LCC	Lancashire County Council
LFS	Labour Force Survey
NHS	United Kingdom National Health Service
PNR	Preston New Road
SIA	Social Impact Assessments
UK	United Kingdom

1 Introduction

Hydraulic fracturing, or fracking and often referred to as extreme energy extraction, is the process for releasing hydrocarbons most commonly natural gas trapped within shale rock for extraction, and was first patented in the US in 1866 (Heinberg, 2013). Fracking was originally carried out vertically, but developments in the process by engineers in the United States then allowed for horizontal drilling. This has been common practice since the 1990s, which allowed producers to drill a larger area often under residential and commercial developments extending further to release the trapped gas ('Fracking', 2019; Heinberg, 2013). How fossil fuels are removed from shale rock is summarised in this definition from the UK Government's Department for Business, Energy and Industrial Strategy: "Hydraulic fracturing, known as fracking, is a technique used in the extraction of gas and oil from 'shale' rock formations by injecting water at high pressure. Shale gas is the same natural gas as is obtained from conventional gas fields, such as the North Sea" (UK Government, 2015). To the energy industry and some political parties, shale gas is seen as a 'bridge' fuel to a low carbon future, as methane when ignited produces less greenhouse gas emissions than traditional fossil fuels such as coal (Short & Szolucha, 2019) and the carbon footprint of extraction is also small compared to the extraction of coal or oil (MacKay & Stone, 2013).

Proponents of fracking believe it will bring energy security, cheap production of fossil fuels and economic benefits (Heinberg, 2013), and these claims are not without basis. Opponents, on the other hand, argue it is the unconventional extraction process of injecting millions of gallons of water, sand, silica and chemicals to create the fractures in the shale rock to release the natural gas (Finkel & Hays, 2016) that impacts the environment and physical health, through air pollution, water contamination and potential seismic activity (Aryee et al., 2020). Until recently the extraction of domestic shale gas was a government priority (Conservative and Unionist Party, 2017) despite little support from the general public, 16% in 2017 (Department for Business, Energy & Industrial Strategy, 2017). However, the Government's Minister for Business, Energy and Clean Growth recently declared "Fracking is over" in an interview on local news (Hayhurst, 2020).

With this process of extreme energy extraction struggling to establish itself in the UK, there is little research on its impact on communities where shale gas developments are proposed and drilled. The area for this study was easy to identify, despite many communities being impacted by the threat of fracking, there is only one site at Preston New Road in Lancashire, England which is at the exploratory drilling stage and is seen as the epicentre for the anti-fracking movement (Muncie, 2020). Within this thesis I intend to build on previous research looking at the human impacts of shale gas extraction

known as fracking with a focus on mental health of those living in the county of Lancashire and near to the Preston New Road (PNR) development which is driven by the 'all out for shale' policy of the UK government.

This research will be guided by the following questions:

Main research question: How has the UK government's 'all out for shale' policy impacted the mental health of individuals in Lancashire?

Sub question 1: Have those impacts changed as the shale gas development at Preston New Road progressed from the planning to explorations stage.

Sub question 2: How can these impacts be understood from an environmental justice perspective?

This study is not constrained to the immediate locality. The aim is to identify impacts felt by residents within the county of Lancashire. This is an exemplifying case which can be seen in the wider context of extreme energy extraction and its impact on communities' health and well-being.

This thesis sits within the field of sustainability science, one that is fundamentally about the interactions between nature and society (W. C. Clark & Dickson, 2003; Kates et al., 2001). Sustainability Science is problem-driven and aims to address the complex interactions of nature-society systems (W. C. Clark & Dickson, 2003), the complexities regarding this case require a trans-disciplinary approach. Fracking is typically seen as an environmental issue due to its impact on nature, rarely is the societal issues it creates explored. The thesis aims to look at the issue through an environmental justice lens while investigating the impact of fracking on an individual's mental health, as identifying an issue is the first step to solving it. I have identified some key recommendations to protect the mental health impacts in communities affected by fracking.

2 Background

The following section provides a background to shale gas developments in the United Kingdom. In the UK, fracking has come up against strong resistance from local communities where it has been proposed - no more so than in the county Lancashire in Northwest England (Vaughan, 2017). The industry has faced many blows, which have brought into question whether shale gas extraction will ever be established, supplying natural gas and providing the energy security promised. Those blows have mostly been down to the anti-fracking movement in Lancashire made up of several groups. Through protest and action these groups have delayed drilling and put a spotlight on the fracking process and its impacts on social well-being, health, community and the environment (Szolucha, 2016). Lancashire is significant in terms of community participation and mobilisation and one of the most active sites for protest (Muncie, 2020). Despite this the government has continued with the discourse domestic shale gas extraction would be good for the country.

2.1 Why measure mental health?

There is limited research and evidence of the health impacts, on whose who are exposed to fracking within their communities or while working in the industry. This is due in part to a time lag between environmental impacts and the ability to prove consequential human health impacts (Short et al., 2015). What is different about mental health is that the impacts can be felt before work has started on shale gas developments, with stress and anxiety being reported at the planning stage (Szolucha, 2016). Downey and Van Willigen (2005) found evidence that living near to industrial activity impacts the psychological health and well-being of residents, with proximity being a main factor and great impacts for minorities and poorer individuals .

Most relevant studies come from countries where this type of resource extraction is established, such as the United States and Australia; what is typically neglected is the psychological well-being and mental health of the individual and community (Illes et al., 2014). There is evidence from Lancashire that shale gas developments have impacted both proponents and opponents, with reports of some experiencing incidences of fear, anger, anxiety and sleep disturbance (Short & Szolucha, 2019; Szolucha, 2016). However, little empirical research has focused on the "psychological and behavioural health of persons and communities impacted by fracking" (Hirsch et al., 2018, p. 6). Clough and Bell (2016) recommend the psychological impacts of fracking be addressed by researchers and medical professionals, suggesting this can inform mitigation and adaption interventions prior to, during and after fracking. As Szolucha (2016, p. 19) puts it, we need to "avoid making the error of treating the 'absence of evidence of harm' as 'evidence for the absence of harm'". There is a need for a social

science contribution, most research focuses on potential environmental impacts of shale gas extraction, there is less attention from academics and researchers into the interconnected social and health impacts (Jacquet, 2014).

Typically, psychological impacts of fracking are not addressed in government and industry level risk assessments (Hirsch et al., 2018; Szolucha, 2016; Watterson & Dinan, 2016). Environmental Impact Assessments (EIAs) conducted on the impacts of fracking in Lancashire, touch on some social impacts but do not refer to any relevant social science literature or theory and lack primary and empirical research (Szolucha, 2016). Measuring social impacts such as mental health and well-being could be done through the process of Social Impact Assessments (SIA) or Health Impact Assessment (HIA) which are common place in countries such as Australia and Canada, however in the UK there is no statutory requirement for fracking projects (Szolucha, 2016). The EIAs that are being carried out in the UK for resource extraction projects, only give a small consideration to social and health impacts experienced. The problem with including social and health impacts within EIAs is that most agencies employed to carry these out, often have little or no experience of SIAs or HIAs. This is mainly due to the lack of regulation in the UK to complete these and when combined with EIAs, these issues are insufficiently considered (Sadler, 1996).

The development at Preston New Road was originally rejected by the Lancashire County Council (LCC) on grounds of visual impact and unacceptable noise (Vaughan, 2015) and now there is evidence that the noise pollution from shale gas developments is a source of psychological stress (Redmond & Faulkner, 2013). Poor psychological health has social and economic costs: a report from 2009-10 estimated the cost of mental health problems to be around £105 billion which included the costs of care, loss of output and human costs (Department of Health and Social Care, 2011).

2.2 Fossil fuel demand in the UK

In the UK there is still a great demand for fossil fuels, particularly natural gas. In 2018 and 2019, oil and natural gas surpassed all over energy types in the consumption of primary energy in the UK (Sönnichsen, 2020a). While there was growth in the consumption of renewables from 2018 to 2019, the fall in oil and natural gas consumption was far smaller (see Figure 1).

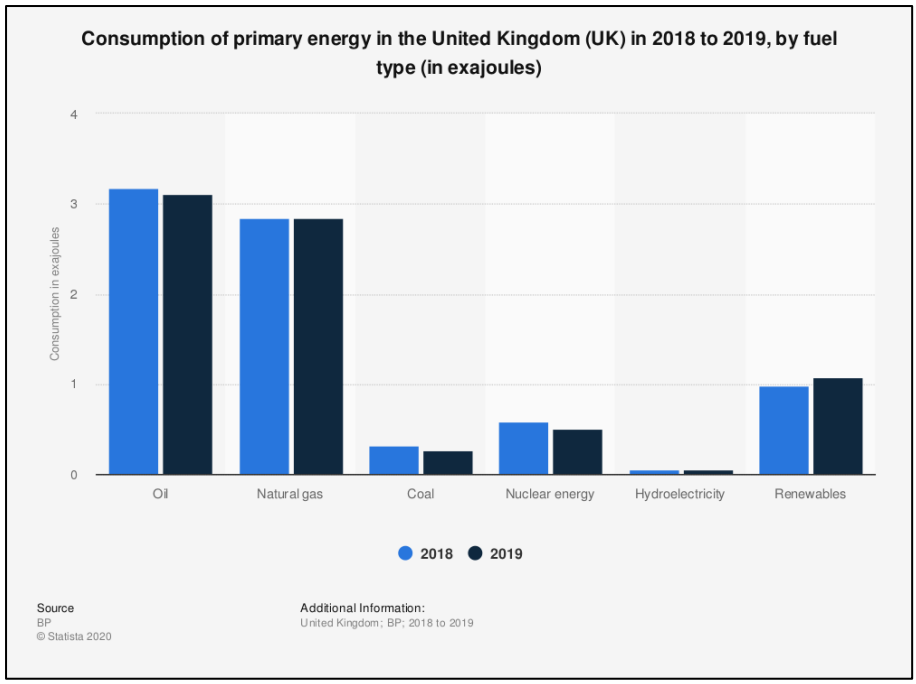

Figure 1. *Consumption of primary energy in the United Kingdom (UK) in 2018 to 2019, by fuel type in exajoules (Sönnichsen, 2020a)*

Natural gas consumption has fluctuated over the past fifteen years; however, it has declined from 102 billion cubic meters in 2004 to 78.8 billion cubic meters in 2019 (Sönnichsen, 2020a). While the UK still has capacity for the production of natural gas, this has steeply declined from 100.9 billion cubic meters in 2004 to only 39.6 billion cubic meters in 2019 (Sönnichsen, 2020b). Due to high consumption, the UK has a shortfall of 39.2 billion cubic meters in 2019 alone, which was made up by imports mainly from Norway the UK's main supplier of both natural gas and crude oil in 2019. Russia is the only other supplier of natural gas as its import is reliant on pipeline infrastructure (Sönnichsen, 2020c). In the UK government's guidance on fracking, it is estimated that by 2030 the UK will still have a demand for imported natural gas which will be around 72% of its usage (Department for Business, Energy & Industrial Strategy, 2019).

The UK is still heavily reliant on fossil fuels for energy production, with more being imported than domestically produced. However, this is not to say renewables are not a big part of its energy strategy. UK domestic generation of energy from renewables is growing: in the third quarter of 2019 for the first time ever, renewables including wind farms, solar, biomass and hydroelectric plants outperformed fossil fuels (Evans, 2019). However, the UK is still far off achieving its goal of being net-zero emissions by 2050. The Committee on Climate Change's (2020) 26/10/2020 14:39:00 'Reducing UK emissions' progress report, states the UK is not on track to meet the fourth and fifth carbon budgets for the period 2023-27 and 2028-32, as these were set against the previous 80% reduction in emissions by 2050. From 2020, in order to achieve net-zone emissions, a 100% reduction on 1990 levels, the UK needs to

achieve an average reduction of approximately 15.5 $MtCO_2e$ per year (Committee on Climate Change, 2020). The Committee on Climate Change has previously stated that shale gas should be part of the UK's journey to net-zone if combined with carbon capture and that there will still be a requirement for natural gas in a net zero economy (Department for Business, Energy & Industrial Strategy, 2019).

2.3 History of fracking in the UK

The process and use of domestically produced natural gas from shale rock was seen as an integral part of the UK's commitment on Climate Change, providing a bridge to a zero-carbon future due to fewer emissions associated with extraction (Department for Business, Energy & Industrial Strategy, 2019). Despite a 2013 report by the Committee on Climate Change which stated that "shale gas like other forms of gas, cannot be regarded as a low-carbon fuel source" (Committee on Climate Change, 2013, p. 10).

The House of Commons Library Briefing Paper on Shale gas and fracking (Priestley, 2020) gives a detailed insight into the history of fracking in the United Kingdom. Fracking has taken place in the United Kingdom since the 1970s. It was commonly used for the extraction of non-shale oil and gas offshore in the North Sea. Soon fracking vertically and then horizontally, out to sea was used for the extraction of oil and gas onshore, which was more environmentally sensitive than building offshore rigs. As Priestly (2020, p. 5) states, there are over 2,000 onshore fracking wells, with around 10% being hydraulically fractured to aid the recovery of gas, this is typically non-shale extraction from oil and gas fields. Despite knowledge of the gas trapped within shale rock since the 1800s, research into its potential did not happen until the 1980s. A repeal of taxation legislation in the 2000s exempting shale gas production from the Petroleum Revenue Tax opened up the market to private energy firms. By 2008 almost 100 licenses for shale gas exploration were awarded to private energy firms (Priestley, 2020).

Cuadrilla Resources, one of the main players within the market, had identified five potential shale gas developments in Lancashire. Other sites had also been identified in Yorkshire and Surrey by Cuadrilla and other energy extraction companies. In 2010, the first site was drilled at Preese Hall Lancashire (Figure 2), with two further sites being drilled in the county. In 2011, a high-volume hydraulic fracture treatment test was carried out at Preese Hall, the result being a crushed well due to seismic activity, a number of tremors were recorded, from 1.4 richter local magnitude (ML) to the strongest measuring 2.3 ML (Ainscough, 2019). It was the new Conservative and Liberal Democrat coalition government who placed a moratorium on fracking due to the associated tremors. A year later, in December 2012, a government consultation of shale gas extraction led the Secretary of State for Energy and Climate

Change to announce fracking could resume but with more strict controls and regulation (Priestley, 2020). The focus of this study is on Lancashire as the county was the first be drilled for shale gas and one of the biggest battle grounds for the anti-fracking movement. There are other proposed developments in the counties of Yorkshire and Surrey where shale gas potential was high. However, I will focus now on the events in Lancashire.

In February 2014, two applications were made for hydraulic fracturing in Lancashire. Cuadrilla Resources applied for planning permission to drill two sites in Lancashire, which would be the first drilling on British soil since before the first moratorium. Delay by opponents meant the local council could not rule on the planning applications until June 2015, decisions could only be made on planning grounds not the personal opinions of councillors or public opinion (Szolucha, 2016). Despite support from the Conservative led local council, both sites had their planning applications refused; Roseacre on traffic grounds and Preston New Road on noise and visual impacts (Vaughan, 2015).

Cuadrilla lodged appeals with the Secretary of State in September 2015, which the Government's Communities Secretary approved, but only for Preston New Road, overturning the original decision by the local council (Ainscough, 2019). Further delays were caused by opponents through protest and legal bids; the final High Court challenge in 2018 to stall the operation on safety grounds, was rejected by the court. Permission was finally granted to drill at PNR in July 2018. Soon after four small tremors were recorded in October 2018 and in November 2018, the 36th tremor spurred five local members of parliaments to call for halt in the process (Ainscough, 2019).

In December 2018, a 1.5 ML tremor was recorded, exceeding the government's limit on seismic activity of 0.5 ML. Despite breaching agreed safety limits, drilling continued in a second well on the site at PNR, until another tremor was recorded, this time of 2.9 ML the largest recorded associated with fracking in the UK ('Fracking', 2019). The Oil and Gas Authority suspended the process indefinitely and in a report from 2019 concluded "it is not possible with current technology to accurately predict the possibility of tremors associated with fracking" (Department for Business, Energy & Industrial Strategy, 2019). Cuadrilla started to remove equipment from the site at PNR in September 2019, as their license for fracking expired a month later, however the company are able to keep a presence at the site until 2023 ('Fracking', 2019). Despite calls from the industry to change the safety threshold for seismicity, the government ended support for fracking with a moratorium in November 2019, until it is claimed compelling new evidence is provided.

Figure 2. *Fracking sites in Lancashire (Vaughan, 2017)*

2.4 UK policy on fracking

2.4.1 'All Out for Shale' Policy

In a 2014 statement, the Conservative Party Prime Minister David Cameron declared that fracking was part of the UK's long-term economic plan, claiming it would result in more jobs, opportunities and economic security, stating "**that's why we're going all out for shale**" (UK Government, 2014). For local councils where fracking would take place there was a promise, they could retain 100% of the business rates collected from these developments, plus a one-off payment of £100,000, when a test well was drilled and a further 1% of extracted gas revenues (UK Government, 2014). Industry was promised more competitive tax than the rest of Europe and a rate even lower than the US, with simplified applications and regulations (UK Government, 2014). Typically, the Conservative Party supports the shale gas industry on the premise that it is less polluting than coal and can provide energy independence and economic benefits (Conservative and Unionist Party, 2017) while the leading opposition, the Labour Party have had a policy of an outright ban to avoid a lock-in to a fossil fuel dependent energy infrastructure (Labour Party, 2017, p. 21).

In a ministerial statement in January 2018, the Secretary of State for Business, Energy and Industrial Strategy detailed the government's position on fracking, stating shale gas still has the potential to bring substantial benefits and was an integral part of its Clean Growth Strategy, providing low carbon

technologies for heat and electricity generation, and that natural gas will still have a role to play the UK energy system (G. Clark, 2018a). This was followed shortly after with a joint statement with the Secretary of State for Housing, Communities and Local Government in May 2018, which reiterated the line fracking had the potential for substantial benefits and that the natural gas supplied would allow the UK to stay within the defined carbon budget agreed in the Climate Change Act, meeting the 2050 emissions reduction target and international obligations (G. Clark, 2018b). For communities, shale gas companies renewed their commitment to make set payments, which are claimed to be worth up to £10million per site, and the announcement of a Shale Wealth Fund to provide additional resources to local communities (G. Clark, 2018b).

2.4.2 Moratorium 2019

An effective moratorium on fracking has been in place since November 2019, announced by the government shortly after drilling at the PNR site in Lancashire, England caused seismic activity which exceeded government agreed safety levels. The second time one has been placed on the process due to seismic activity it has caused (Ambrose, 2019). In a statement from the Department of Business, Energy and Industrial Strategy, it was announced no further hydraulic fracturing consents would be issued, "until compelling new evidence is provided which addresses the concerns around the prediction and management of induced seismicity" (UK Government, 2019). This is not an outright ban but acts as a mechanism for the industry to provide more evidence that the process can be carried out safely without risk to the public in particular those living close to fracking sites. As recently as July 2020, planning applications for fracking were still being heard by Local Councils and exploratory drilling can be approved, as the moratorium only extended to extraction of natural gas from shale rock (Gye, 2020). British gas firms are currently planning to challenge the Department of Business, Energy and Industrial Strategy on what they call a 'de facto ban', calling the moratorium an "extreme example of asymmetric regulation" said Ian Roche, managing director of Aurora Energy in the Guardian (Ambrose, 2020). The moratorium in November also coincided with the announcement of a December General Election, where the Conservative Party won a majority led government.

2.4.3 Impact of Brexit

The UK's exit from the European Union has created all kinds of uncertainties, especially now as the UK is within a transition period due to end on the 31st December 2020 without a trade deal. There is concern Brexit will leave the UK short of energy, which has the potential to drive domestic production via renewable generation or domestic fossil fuel extraction. In the House of Lords (2018) report 'Brexit: energy security', it is claimed the changing UK-EU relationship, mainly due to leaving the EU's Internal

Energy Market (IEM) raises potential challenges for energy security. The report also found that the withdrawal will lead to less efficient energy trade and a possible spike in prices paid by consumers (House of Lords, 2018). The UK is currently importing over half of its gas supplies (UK Government, 2019) with the majority coming from Norway, despite Norway not being part of the European Union it is however part of the European Economic Area (EEA), which allows it membership of the IEM and it benefits from free movement of goods, common rules on competition and shared cooperative on research (Norwegian Ministry of Petroleum and Energy, 2019). The UK has ruled out remaining within the EEA, which has the potential to make the import of its natural gas needs from Norway difficult. Any potential difficulty importing the UK's energy needs or rises in consumer fuel costs has the potential to reopen the debate on domestic natural gas extraction as energy security and cheaper household bills were the main benefits sold to the general public. If the UK's exit from the EU reignites the possibility of a transatlantic trade deal, there is a possibility the UK will be opened up to the US's extreme energy extraction industry (Buranyi, 2020).

2.4.4 Impact of COVID-19

The recent Coronavirus outbreak put life as we know it on hold with lockdowns, home-working and social distancing becoming the norm. The impact of the virus has been devastating but allowed for a period of reflection with many now calling for governments to build back better. The result of national lockdowns has been a fall in GHG emissions, a country's individual reduction has been -26% on average (Le Quéré et al., 2020). Hydraulic fracking in the US has been hit hard by the pandemic, a drop in demand of oil and gas has meant operating sites have fallen by 56% (McGrath, 2020).

However, according to Bethany McLean, a journalist and business author interviewed for the BBC, the pandemic may not be the death of fracking, despite its poor economics; she believes politics may allow for a revival, with President Trump having little interest in banning the process (McGrath, 2020). Bailouts for fossil fuel industries are already being seen, with G20 countries favouring fossil fuels over a green recovery (Harvey, 2020). Energy Policy Tracker (2020) that tracks public money for energy recovery reports that 52% of all public money has been pledged to fossil fuels. In the UK that figure stands at 38.35% with clean energy receiving 14.1% of funds as of September 2020 (Energy Policy Tracker, 2020).

2.5 Environmental impacts

Potential and realised environmental impacts of fracking are many and so widespread that it would be difficult to cover all these in this thesis. Concerns regarding air and groundwater pollution from fracking

are most common (Gregory et al., 2011; Howarth et al., 2011; Meng, 2017). An average of 20 million litres of water is used to force fissures open in shale rock to release natural gas, this water contains over 200,000 litres of chemicals, many toxic, carcinogenic or mutagenic (Howarth et al., 2011). It is these chemicals that cause the concern for groundwater pollution, spills, well integrity failures and seismic activity can be routes for these to enter groundwater. Despite claims fracking has a greenhouse gas footprint lower than other fossil fuel extraction operations, it estimated that 3.6-7.9% of methane is leaked into the atmosphere over the lifetime production and with methane being a more potent greenhouse gas over a longer time period, fracking has the potential to surpass coal and oil in extraction associated greenhouse gas footprint (Howarth et al., 2011). Fracking operations require the removal of land cover, on average five acres, almost double that of conventional oil and gas sites, which intrude on rural, agricultural and forested landscapes (Meng, 2017).

The loss of grasslands and deforestation associated with fracking impacts animal life through a loss of habitat and plant species (Drohan et al., 2012). Methane leaks and land cover removal add to the process' overall impact on the climate and put in doubt the claims of natural gas being a low-carbon alternative to coal and oil. With the UK's shale gas industry still within its infancy, there has not been the same level of environmental impacts as the US, however seismic events have already been experienced in Lancashire. The first as result of drilling at the Preese Hall development in 2011, which had a magnitude of 1.5 ML leading to the first moratorium on the process (British Geological Survey, n.d.).

2.6 Physical health impacts

One of the most critical issues with fracking is the storage, treatment and disposal of the waste water used for the extraction process, this water typically contains thousands of chemicals, many not made public by the industry (Finkel & Hays, 2016). In a study by Colborn et al. (2011) in the US, they identified 632 chemicals used during fracking and determined the potential health risks of half of these. It was found that over 75% of those chemicals could affect skin, eyes, respiratory and gastrointestinal systems; those with the potential to affect the brain and nervous system were around 40 - 50% and around 25% had the potential for causing cancer (Colborn et al., 2011). Problems arise when failures occur such as well blowouts, spills, and well integrity failures which allow for these chemicals to be put out into the environment. In the US, the physical health impacts of fracking are no longer debated, instead the industry is now having to pay compensation to individuals experiencing impacts.

In an unprecedented case, the Parr family in Dallas, Texas, had 22 shale gas wells within 2-mile radius of their ranch, and the family, including an 11-year-old daughter, experienced symptoms including

nosebleeds, nausea, rashes and high blood pressure (Morris, 2014). Their case, first filed in 2011 brought substantial evidence that Aruba Petroleum, which operated the majority of wells, were responsible for the family's health problems and awarded $2.9 million in personal injury and property damage (CNN, 2014). It is generally accepted that individuals living in communities close to shale gas developments have experienced physical symptoms including increased rates of cancer. It is important to note that physical health symptoms are usually experienced after the process of extraction has taken place. There is a call from researchers for more epidemiological studies to assess the risk of shale gas developments on the physical health of those living in close proximity to shale gas operations (Finkel & Hays, 2016; Shonkoff et al., 2014).

3 Theoretical framework

Through looking at this case through an environmental justice lens, I aim to contribute to the discussion on the future of fracking and extreme energy extraction in the UK. Currently the discourse focuses on environmental risks and economics impacts (Griffiths, 2019) and less on the human dimension including mental health impacts. On the surface the impacts of fracking on local communities in the UK may not appear to be an environmental justice issue, typically environmental justice is concerned with unequal distribution of environmental negatives within a society (Schlosberg, 2013). Often those experiencing unequal environmental impacts are underprivileged, people of colour, indigenous and/or living in the global south (Schlosberg, 2013).

However, there are similarities to such cases with this case. Utilising an environmental justice framework in this case allows for a deeper understanding of the conflict between key players and the impact it has on the community. It is my belief that environmental injustices in this case have contributed to poor mental health of residents in Lancashire. If shale gas developments can be seen as an environmental injustice this could have implications for policymakers, local authorities and the industry players. From elements of radical justice tradition Schlosberg (2003, 2004) developed a framework focusing on three elements; distributive, recognition and procedural justice. Sometime later a fourth element was added: capabilities theory.

3.1 Distributional justice

Distributional justice is concerned with the "burdens and benefits related to environmental interventions" (Svarstad & Benjaminsen, 2020, p. 1) most commonly the risks and costs and natural resources and freedom (Schlosberg, 2007). To identify whether distributional justice is relevant to the case in Lancashire, Bell (2004) proposes two questions which should be answered, the most obvious being who, who shoulders the burdens and/or reaps the benefits here. Regarding the *who* it is important to recognise that some people will be more affected and have less ability to recover from the impacts of fracking, even in the small communities surrounding shale gas developments needs will vary among residents and this must be considered during the distribution of benefits and burdens so to limit for example, the negative impacts on mental health (Svarstad & Benjaminsen, 2020). Ideally in a case such as this, those responsible for any such burden would have a package in place which would cover costs or adequately compensate for these. Second, what is there to be distributed, from the shale gas developments in Lancashire.

3.2 Justice as recognition

Justice as recognition is concerned with "who is given respect (or not) and whose interest, values are recognised and taken into account" in environmental justice cases some individuals and groups will be dominated over, not recognised and disrespected by those in power or responsible for the environmental impact (Svarstad & Benjaminsen, 2020, p. 1). Schlosberg (2004, 2007) argues differing groups may receive different levels of recognition by those with power and that recognition of such groups by state and institutions decreases the injustices they can experience through increasing status and power. If marginalised groups are not fully recognised as being impacted there is a likelihood, they will not be incorporated in any strategies that limit burdens or distribute benefits.

Often those carrying out such research to map local concerns work for the state or institutions of power and may lack experience and local knowledge to fully recognise these groups (Svarstad & Benjaminsen, 2020). Hence to effectively recognise marginalised groups, there needs to be time spent with communities potentially impacted, surveys by external agencies does not allow for a level of trust to be built and find often hidden marginal groups. This can also be true of researchers and activists, who use their voices to speak for groups, rather than allowing for independent recognition, something I am aiming to avoid in this thesis. It is important to recognise that marginal groups will have limited or even struggle to access information related to an environmental conflict often relying on information from those in power; government, local authorities and corporations who have easy access to information regarding policy and legislation.

3.3 Procedural justice

Procedural justice is concerned with "who is involved and has influence in terms of decision-making" essentially who holds power in the case (Svarstad & Benjaminsen, 2020, p. 1). Often within environmental justice cases power struggles involve government, industry and community which is easily recognised in the case of fracking. Procedural justice is concerned with the power of stakeholders in the decision-making process and distribution justice is unachievable if there's an absence of inclusion in the democratic process (Schlosberg, 2007). Often the participation claimed by those imposing an environmental impact, is top-down and lacks an independent community voice (Svarstad & Benjaminsen, 2020). From the perspective of shale gas developments, procedural justice would be measured by looking at the ability of residents to access decision-making processes and their participation in making decisions which relate to their community. Conflicts often arise when a community feels there are few opportunities for meaningful involvement in these processes and differing views of environmental harms (Walker, 2012).

4 Methodology

To explore the impact of fracking on an individual's mental health at different stages of shale gas developments, I have used an online survey to attain quantitative and qualitative data from those living within Lancashire. To collect and analyse mental health impacts, respondents were asked to self-identify Common Mental Disorders (CMD) they have experienced. CMDs are used as a measure by the Office for National Statistics, the UK government's largest producer of statistics, in the Labour Force Survey (LFS) (Office for National Statistics, 2015) and Adult Psychiatric Morbidity Survey (APMS) (NHS Digital, 2016), which record mental illnesses among adults in the UK and it is used as a measure to assess the mental health of society; the reason for this being the opportunity for further study and comparison to local and national statistics on mental health.

For cases which may constitute an environmental injustice, it is important to hear from those affected by an environmental impact or conflict, in this case those impacted by shale gas developments. It was my intention to conduct interviews with residents in Lancashire living close to shale gas developments including PNR and Roseacre to understand the psychological impacts of these developments. However, due to the recent COVID-19 outbreak I was unable to travel to meet with such individuals. An alternative online survey was developed using the university's Sunet application which allowed for me to collect both quantitative and qualitative data. Some research has already been conducted into the human impacts of fracking in Lancashire, which found evidence of collective trauma and social harm (Short & Szolucha, 2019; Szolucha, 2016). The focus of the research on social harm looked at the impacts experienced during the exploration stage and calls for more studies on social impacts at different stages of extreme energy production. The aim of this study is to investigate the mental health impacts experienced by individuals living in affected communities at stages of the shale gas development in Lancashire.

4.1 Stages of fracking

It is widely accepted that there are four stages of shale gas and oil developments, which can be seen in the infographic produced by the Department for Business, Energy & Industrial Strategy (Department for Business, Energy & Industrial Strategy, 2019), depicted in Figure 3. This infographic focuses only on the technical aspects of a development, when looking at the human impacts of shale gas developments an additional stage relating to the planning process should be included. Currently in the UK, no development has reached the production stage, with some sites progressing to decommissioning and restoration after exploratory drilling. The reasons for this are site specific.

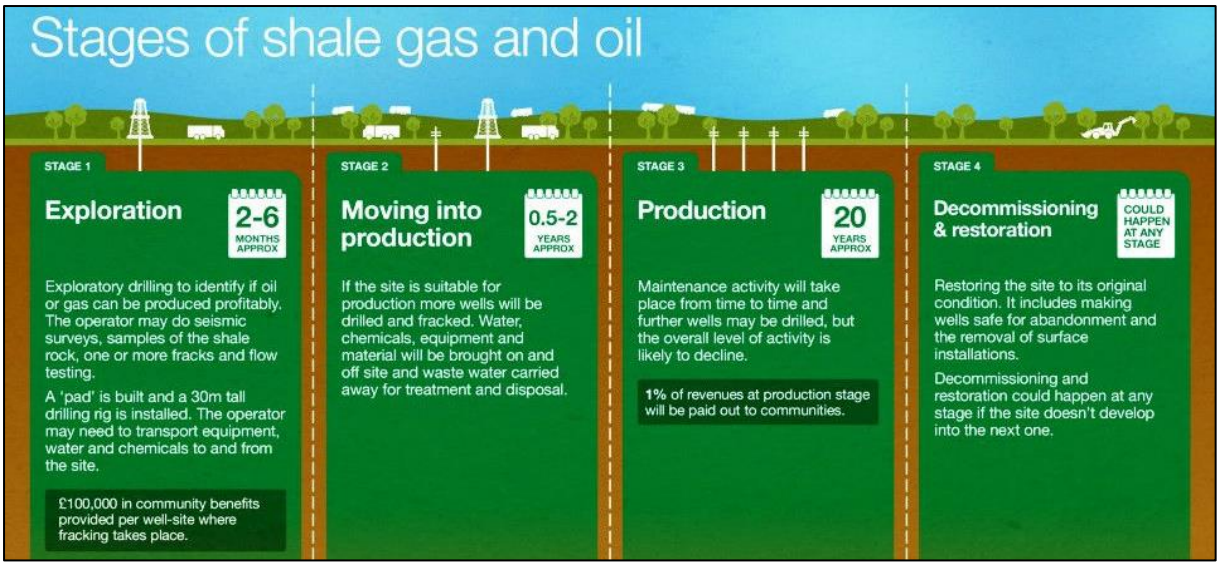

Figure 3. *Stages of shale gas and oil (Department for Business, Energy & Industrial Strategy, 2019)*

For the purpose of this research and any follow-up research I propose adding a planning stage prior to exploration and combining stage 2 & 3 which will be referred to as the extraction stage, as shown in Figure 4. With the current moratorium on fracking, there is the possibility developments will not reach the extraction / production stage and move to the decommissioning and restoration stage. In this thesis I have collected data regarding the impacts experienced during the planning and exploration stages (Figure 4). Stage one planning began in February 2014 when the shale gas company Cuadrilla lodges applications to drill at three sites in Lancashire including PNR. Stage two exploration began in January 2017 when work began on two horizontal drilling wells. The current exploration stage lasts until November 2019 when a moratorium was placed on fracking.

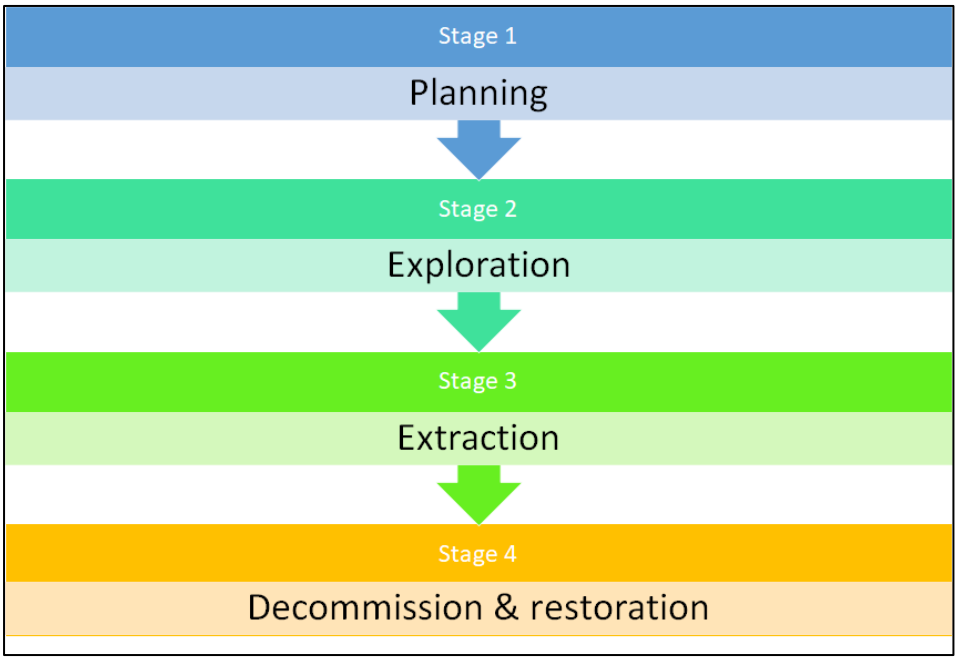

Figure 4. *Proposed stages of shale gas developments (Source: own creation)*

4.2 Data collection

In a study from the United States on the psychosocial impacts of fracking, Hirsch et al. (2018) found that the majority of research in this field was largely qualitative with only a few empirical studies. I decided to gather quantitative evidence from a larger sample of the mental health impacts experienced by residents living in Lancashire with a focus on the development at Preston New Road. The quantitative empirical data could then be used as a basis for future research, for example to monitor changes in mental health if a development were to reach the extraction stage.

To gather data, I utilised the networks I had acquired through my interest in the anti-fracking movement. There are a number of social media groups which I was a part of and contacted to collect data including 'Frack Free Lancashire – The Campaign' and 'Preston New Road Group' on Facebook, which have a combined membership of over 4.5k. There are eight smaller location specific anti-fracking groups in Lancashire these include Ribble Estuary Against Fracking (REAF), Residents Action on Fylde Fracking (RAFF), Frack Free Lancashire (FFL), Preston New Road Action Group (PNR), Roseacre Awareness Group, Singleton Against a Fracked Environment, Defend Lytham and 'Lancashire Nanas'. These groups were contacted by email including the Lancashire Friends of the Earth group who are actively involved in the anti-fracking movement. I was also helped by a prominent anti-fracking activist and Green Party candidate who put me in contact with additional contacts. Of all the networks available to me, these were all opponents of fracking in Lancashire. I had hoped to capture data from some proponents of fracking, so to capture their experiences as these may differ. However, I was unable to identify any active pro-fracking groups or individuals to contact, though my survey was designed to capture and compare impacts of proponents and opponents.

4.3 Data analysis

The survey was designed to capture the mental-health impacts at different stages of the fracking development with a focus on Preston New Road the only active site left in Lancashire, so I could capture impacts experienced during the planning and exploration stage and how these compare. Respondents' concerns regarding fracking have also been collected, using the six core impacts identified by Szolucha (2016), these are as follows: Social well-being and health; community impacts; policing and intimidation; democracy; relationship between gas company and local residents and gender relations impacts. Respondents were asked whether these concerns had changed as the development progressed from the planning stage to the exploration stage. This gave an understanding of the kind of impacts caused by shale gas developments that impact mental health. A comparison was made at different stages of the development. Respondents were given the opportunity to expand on their

experiences through open questioning. These answers were mapped against the six core impacts identified by Szolucha (2016).

Both concerns and experiences were compared to Schlosberg's three environmental justice elements to further understand the case and how environmental injustice can influence mental health. As mentioned, there is little research on the impacts of shale gas development on mental health and the quantitative data gathered can be used as a baseline for further study. This should allow for measuring a change in mental health impacts when the development at Preston New Road progresses past the exploration stage.

A systematic literature review was going to be part of the method and analysis for this research, however, as mentioned there is limited research related to the UK, with most studies on cases from the US. The concern was that these cases had distinct differences, making these not comparable. This was a concern shared in the study by Aryee et al. (2020) who concluded the differences in population density and geological variations meant studies from the US weren't easily replicated. They concluded the distress found in communities in the US was a result of direct harm and loss, as US shale gas extraction is established, whereas in the UK no development has reached an extraction/ production stage. For this reason, a literature review was not part of my methodology.

4.4 Ethical considerations

From early readings I was aware of a poor relationship between Cuadrilla, the police, local community and anti-fracking activists. There have been complaints regarding police brutality at protests, with one study finding that the actions of Greater Manchester Police violate civil and political rights recognised in the Human Rights Act, European Convention on Human Rights and the International Covenant on Civil and Political Rights (Short et al., 2015). There have been instances of intimidation by the industry, including demanding over £55,000 from one leading activist for the peaceful occupation of a field earmarked for fracking (Perraudin, 2016). Due to this, there was a concern the local community would approach any external researcher with an understandable amount of suspicion. This was an important consideration for designing my survey, particularly when deciding on what data to collect. I used the university's survey and reporting software Sunet rather than Google Forms, which gave an added level of data security and legitimacy.

5 Results

The following section analyses the case using Schlosberg's (2004) environmental justice framework and summarises the results from the sample surveyed.

5.1 Environmental justice

5.1.1 Distributive justice

The government attempted to address the impacts of fracking through their 'all out for shale' policy and distributive means. The policy stated local authorities could collect 100% of business rates, a one-off payment of £100,000 for test fracking and subsequent 1% share of revenues if gas was extracted. The important question here is whether these community 'benefits' outweigh the burdens of the environmental, physical and psychological health impacts associated with fracking. It is also important to acknowledge that this point only environmental impacts are considered by the government, as per shale gas policy only environmental impact assessments are conducted to identify impacts of shale gas developments which rarely examine health or social impacts.

Calculating whether the pros outweigh the cons is difficult, a study by Sovacool (2014) believes shale gas developments present "pernicious trade-offs and tough choices" for decision-makers but we shouldn't abandon fracking completely. However, this study does make clear that costs and benefits are not distributed evenly and occur at different stages in time, what can be seen in this thesis is that some negative impacts are more immediate such as the mental health impacts experienced by the community. It is the belief of Sovacool (2014) that due to the nature of fracking, the debate whether burdens and benefits can be distributed equally may be irresolvable, as each side will have data supporting their claims and rebutting claims they do not like. Whether the 'all out for shale' constitutes a distributive injustice that is difficult to say, ultimately it should be for those experiencing the burdens to decide whether the benefits they are offered are equal to or outweigh the burdens they will experience.

5.1.2 Justice as recognition

The 'all out for shale' policy does not appear to have considered the diversity of the community in Lancashire. One group to be ignored by industry and government, which I have aimed to give a voice to in this thesis, is those suffering with common mental disorders, who have not been part of any strategies to limit the impacts they face. Lancashire has a higher percentage of individuals experiencing CMDs than the national average (Figure 5). These have not been considered in any assessments prior to

planning the shale gas extraction in Lancashire, as only EIAs are required in the UK that limit the social and health impacts which can be explored. Misrecognition can also be seen in the decision to force shale gas developments within economically deprived areas in the North of England, rather than the more affluent South.

Cotton (2017) concludes that locations for developments are not merely decided on the basis of shale gas deposits, but includes an element of political judgement. This can be seen in a comment by the Conversation Peer Lord Howell, a former energy secretary, who made comments regarding where fracking should take place, describing the North as “desolate” and as an “unloved places that are not environmentally sensitive” (Cotton, 2017). This political judgement has since been contradicted in Lancashire by the levels of opposition and protest to fracking on environmental grounds (Griffiths, 2019). Griffiths (2019) concludes that fracking is an injustice due to misrecognition and devaluation of communities such as those in Lancashire.

5.1.3 Procedural justice

The planning reforms announced as part of the ‘all out for shale’ policy which aimed to speed up the process of application and approval for shale gas developments contribute to the procedural injustice experienced by the local community. The reforms particularly related to the Planning Act 2008, Localism Act 2011 and Infrastructure Act 2015 have removed power from local communities and seen decision-making powers returned to central government (Cotton, 2017). This is in contradiction to the localism agenda of the Conservative government (Randall, 2009). A number of studies have looked at the accessibility of local residents in Lancashire to engage in procedural processes, from policy to planning, including Cotton (2017) and Szolucha (2016).

In relation to public participation in Lancashire, the conclusion of Cotton (2017, p. 198) was that “powers are being taken away from local communities” which was prevalent before overturning the local planning decision. Despite these residents had some participation in the planning process and were able to submit objections, Short et al. (2015) summarised the five main objections from residents are as follows: heavy goods vehicle traffic; industrialising of the landscape; water pollution; pollution and air quality; noise and seismicity.

All objections have scientific basis and are documented impacts of shale gas developments in communities where the process is established such as the United States and Australia (Short & Szolucha, 2019). The subsequent overturning of a local planning decision at PNR which was rejected on the basis of noise and visual impact, further exacerbates a feeling of powerlessness and a feeling of being treated as ‘collateral damage’ has summarised in the study by Short and Szolucha (2019, p. 268).

5.2 Survey

The Adult Psychiatric Morbidity Survey also known as the National Study on Health and Wellbeing collects data every seven years "finding out how the everyday stresses, strains and joys affect the health of people living in England" (NHS Digital, 2016). Mental health is measured through the experiences of common mental disorders (CMDs) which includes: low mood; loss of interest and enjoyment of ordinary things; impaired emotional well-being and behaviour; impaired physical well-being and behaviour; generalised anxiety disorder; panic disorder; phobias and obsessive-compulsive disorder. Among 16-64-year olds in 2016, 23.1% of women and 14.6% of men have experienced a CMD and CMDs are more common among women in every age category (McManus et al., 2016).

Data from the Lancashire borough's clinical commissioning groups (CCGs) which commission the NHS services for the area they are responsible for, found all but one borough has a higher number of residents experiencing CMDs, than the national average (Figure 5). This is not direct evidence fracking has impacted mental health in Lancashire but an important consideration. Four sites had already been developed and then decommissioned not reaching further than the exploratory stage when this survey was conducted. This evidence also came before the planning permission rejection and then overturning at the Rosearce and PNR sites and subsequent protests. But the evidence does suggest there are more people in Lancashire experiencing CMDs than the national average.

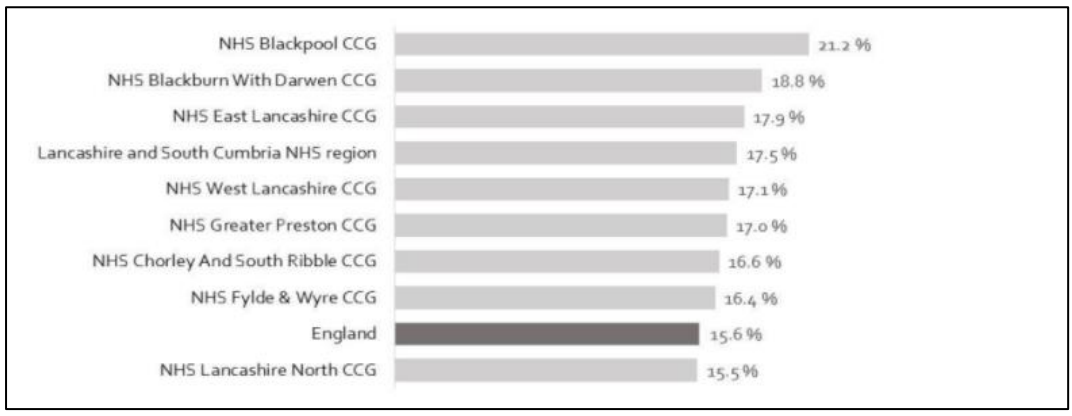

Figure 5. *Estimated prevalence of common mental health disorders by CCG in Lancashire, all people, 16-74, 2014/15. (Source: Gadsby, 2017)*

The survey sample consisted of 41 respondents all living within the county of Lancashire, a summary report of the finding for the survey can be seen in Appendices. The average age of respondents was typically middle-aged, over 75% were plus 55 years old (Figure 6).

Which age group describes you?

Which age group describes you?	Number of Responses
16 - 34	3 (7.3%)
35 - 54	7 (17.1%)
55 - 64	14 (34.1%)
65+	17 (41.5%)
Total	41 (100.0%)

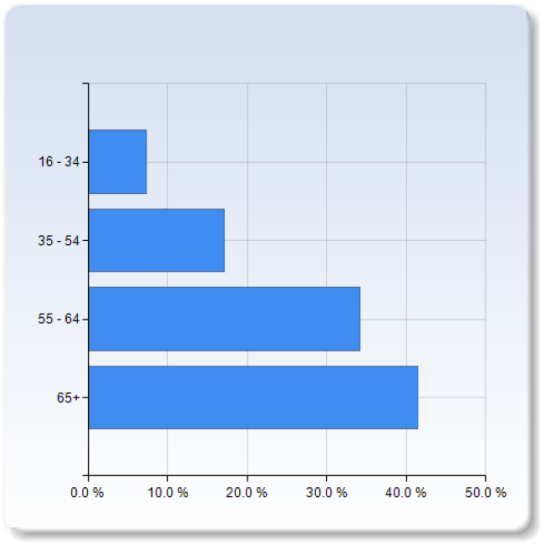

Figure 6. *Age distribution of respondents, percentage of sample (Source: own creation)*

Respondents' gender was again unbalanced with a larger majority self-identifying as female (plus 70%) (Figure 7). With the sample being found through opposition networks, it makes sense the majority would be female, there is evidence less women (31.5%) than men (58%) supported fracking in the UK (Andersson-Hudson et al., 2016). Szolucha (2016) also found that women took leading positions in the majority of the anti-fracking groups in Lancashire playing prominent roles throughout the planning process and in the protests and campaigning.

Which option describes you?

Which option describes you?	Number of Responses
Male	12 (29.3%)
Female	29 (70.7%)
Other	0 (0.0%)
Prefer not to answer	0 (0.0%)
Total	41 (100.0%)

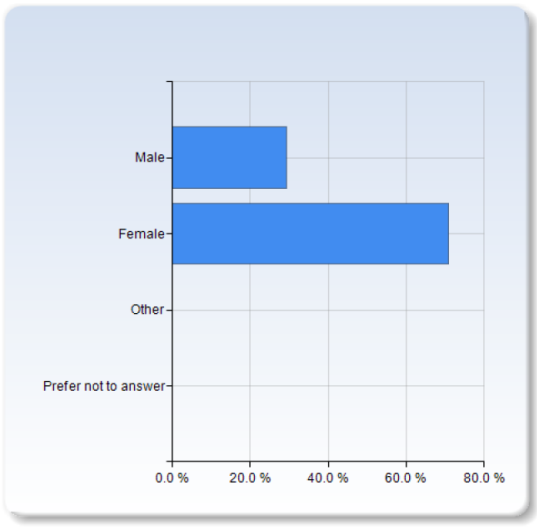

Figure 7. *Self-identified gender distribution of respondents, percentage of sample (Source: own creation)*

A defining question was whether or not fracking concerned them. Here a majority of 96.1% stated that fracking in the area concerned them with 2.4%, stating it does not or they are undecided, again not surprising due to the sample. In a study by Lai et al. (2017) it was found that those who opposed

fracking, experienced negative impacts on their psychological health and well-being compared to proponents of fracking who associated the process with benefits to self and community. That said, the study by Short and Szolucha (2019) in Lancashire, found that both opponents and proponents voiced negative impacts on their psychological health and wellbeing.

Of those who were concerned by the process, they were asked to check the potential impacted areas they were concerned about at two points in time, first when fracking was announced prior to the June 2015 planning permission rejection, where opposition activists were granted a brief reprieve and when exploratory drilling began after the local planning rejection was overturned. Almost half of all respondents (42.5%) stated their concerns had changed since the exploratory drilling started. A comparison of respondents' concerns prior to and after exploratory drilling can be seen in Figure 8.

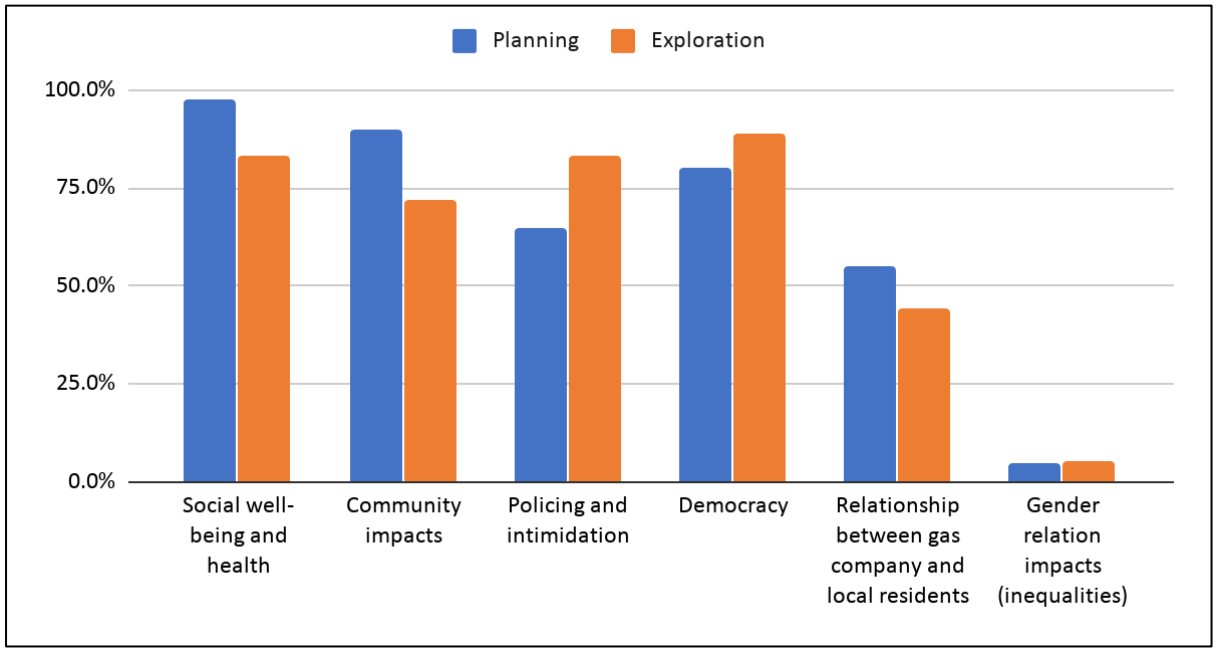

Figure 8. *Concerns for areas being negatively impacted by fracking at the planning and exploration stages. Percentage per concern shown at planning (stage 1) and exploration (stage2) (Source: own creation)*

What can be seen here is a change in respondents' concerns after the planning permission rejection by the county council, which was then overturned allowing for the development to proceed. A change in policing and intimidation and democracy can be seen, the respondents whose concerns changed will be aware of the decision to approve the development despite a local democratic decision to refuse this, also many will have seen a heavy police presence protecting the interests of the shale gas development, as protests were ramped up, as equipment was delivered to site.

One of the biggest contradictions in the overturning of the local planning decision was the UK government's commitment to the Northern Powerhouse. This was the government's attempt to address spatial disparities of the north-south divide allowing for devolved local governments to

counterbalance London (Lee, 2017). The Conservative Party has a poor record in the North of England, memories of economic and regional policies under Thatcherism, which devastated the northern industries including coal mining and ship building, are still present in the mind of northerners (Randall, 2009). The Northern Powerhouse was devised to address these, giving more economic and political power back to the north. The overturning of a local democratic planning decision contradicts the vision of a Northern Powerhouse creating distrust in the government and a belief that fracking would be pushed despite the consequences to local communities.

The police presence around the site at PNR increased as protests increased after the decision to overturn the local planning decision and arrival of equipment to the site. Short et al. (2015) found that of those attending direct action against fracking in the UK, 76% had interacted or witnessed interactions with the police or experienced or witnessed excessive use of force and 81% witnessed unnecessary arrests. There was a sense from protestors and residents that the police presence was there to protect the interests of Cuadrilla, not the people of Lancashire (Short et al., 2015).

Respondents were asked about their experiences of Common Mental Disorders for the periods: before being aware of fracking; when fracking was announced (before planning permission was rejected); and after exploratory drilling started. Only 26.8% of respondents had previously experienced a CMD before being aware of the plan to frack in Lancashire, with 58.5% stating they have experienced a CMD since fracking was announced, that is 32% of respondents experiencing a CMD having never experienced one prior. Of those experiencing symptoms 96% said that their symptoms continued when exploratory drilling started, so almost five years later those respondents are still suffering a CMD. At this point respondents are asked only if they have experienced symptoms and not whether these can be attributed to fracking, it is fair to assume that CMDs can be attributed to many factors.

Of the eight CMDs listed the most common experienced prior to exploratory drilling started were low mood and generalised anxiety disorder at 72% and 76% respectively (Figure 9). Again, both low mood and generalised anxiety disorder (GAD) were most commonly experienced after drilling started, however low mood topped the list with 76% and GAD with 72%. Anxiety may well have been higher prior to the start of drilling, as protestors continued to fight the threat of fracking, concerned what consequences of fracking may bring. This could explain the higher rate of low mood after the drilling started, a realisation the process has begun, and environmental impacts are being experienced (noise, traffic and land use change).

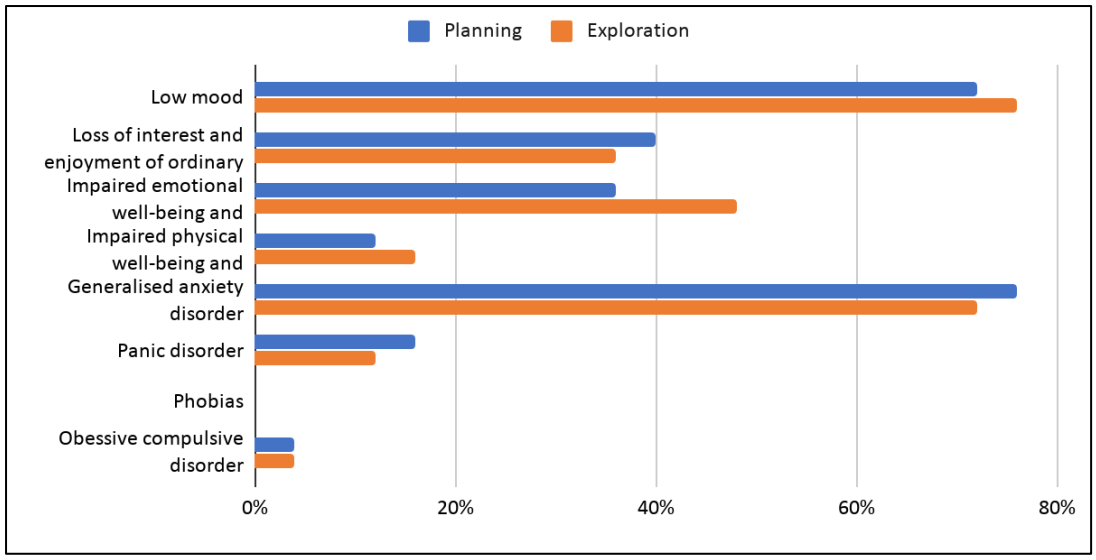

Figure 9. *Common mental disorders experienced at the planning and exploration stages. Percentage per CMD shown at planning (stage 1) and exploration (stage2) (Source: own creation)*

What was worrying about those experiencing symptoms 76% said they had not sought medical help. This may be in line with the current trend for not seeking help and the stigmatisation of mental health alternatively respondents may have felt their symptoms were not severe enough to justify professional help. 100% of respondents reporting a CMD over the planning and exploration stages of fracking at PNR stated fracking in Lancashire had caused or worsened their symptoms.

Finally, respondents were asked whether there were any events related to the shale gas developments, which had had a negative impact on their mental health. This was an open-ended question which allowed for respondents to detail their experiences, all but three respondents could attribute something related to the development which negatively impacted their mental health. Most of the responses could be categorised into the types of impacts identified by Szolucha (2016) the percentage of these can be seen below in Figure 10. Over half of respondents made some mention of a policing and intimidation event which had negatively impacted their mental health.

"The absolutely dreadful policing of peaceful protest. Very frustrating to see people supposedly charged with the protection of the community but actually doing the polar opposite." (Respondent 4)

"Aggressive policing. General sense of corruption between the police and Cuadrilla." (Respondent 20)

Second highest core impact mentioned was social well-being and health (23.1%) the majority of concerns were related to the commencing of drilling at the site and the perceived environmental degradation which in turn would impact human health and well-being.

"The start of the frack, sadness as the flaring causes cancer in USA, also impact of methane in atmosphere affecting climate." (Respondent 8)

"I worry about the countryside being polluted." (Respondent 23)

A fifth of respondents made mention of a democratic event having impacted their mental health negatively, more specifically the overturning of the local planning decision by the government which ignored legitimate planning concerns raised by residents and the local council. This is in line with the findings of Aryee et al. (2020), that found a significant proportion of residents living close to developments in the UK, reported high levels of stress due interactions with decision makers and the industry. This links back to the environmental justice framework where the issues of policing and intimidation and democracy can be seen as procedural injustices and social well-being and health as distributive injustice.

"I have felt both powerless and enraged and have felt unseen and unheard. The folly and dangers of fracking, its effect on the land and the overriding of people has meant I have alternated between apoplectic rage and despair. The enforcement of fracking by large contingents of police has filled me with a feeling of injustice." (Respondent 9)

"The overturning of LCC decision to not allow fracking which is undemocratic caused me to question everything I had always believed in regarding the Government and their adherence to democracy and their role in protecting the electorate from harm. This caused anger, but also a sense of bewilderment, betrayal and anxiety and led to obsessive thoughts and behaviour" (Respondent 36)

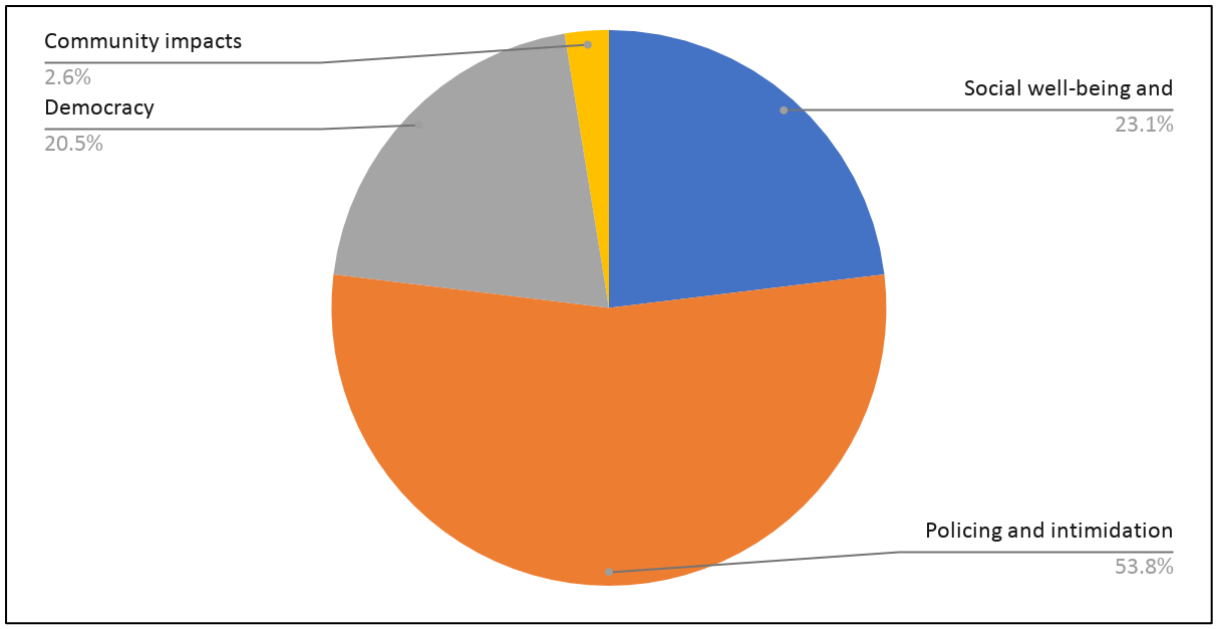

Figure 10. *Specific impacts mentioned which negatively impacted the respondents' mental health. (Source: own creation)*

6 Discussion

The issues surrounding fracking were a big inspiration for me to go into further study. Living within the region that has been impacted by the process of shale gas developments, I was concerned about the perceived environmental and social injustices and I hold a particular interest in mental health having lived with a mental health condition most of my adult life. My research methods were designed to build on previous work and be used to continue to evidence the mental health impacts of the developments through the stages of fracking. Fracking may have halted once again at the exploration stage with its future in the UK in doubt however there are lessons to be learnt and recommendations to be made for future energy extraction or production developments including renewables.

6.1 Environmental Impact Assessments

One of the biggest failures in the shale gas development process has been the lack of assessment on the possible health and well-being impacts on communities. A failure of developers and government to identify potential health and well-being impacts meant it impossible to mitigate against these. The EIA used did touch on some social impacts but in no way enough detail and psychological impacts were not explored (Szolucha, 2016). Had alternatives such as a Health Impact Assessments or Social Impact Assessment been carried out, they may have noted that Lancashire has a higher than average rate of people experiencing poor mental health and the potential for the developments to further impact on this. The evidence suggests the development at Preston New Road has had a significant impact on local residents' mental health this being mainly down to failures addressing the concerns of residents. For future developments, be it extreme energy extraction or renewables, their needs to be clear guidance from the government that social and health impacts are to be considered currently there is no legislative framework for institutions or industry to examine these.

6.2 Local democracy

Democracy was a major concern of respondents as being negatively impacted by fracking, this increased from the planning stage to the exploration stage due to the overturning of the local planning decision by the central government. Of those residents who experienced a CMD, many stated that the overturning of the local planning decision was a defining factor that impacted their mental health. In the case of any future energy extraction or production developments to mitigate against any potential mental health impacts on local residents, local democracy must prevail and local planning decisions adhered to.

6.3 Policing and intimidation

Similar to democracy, policing and intimidation also increased in concern from the planning to exploratory stage (Figure 8). Policing and intimidation were also high on the list of events having a negative impact on mental health. The situation in Lancashire was unprecedented, not many local planning decisions have been overturned by central government and with an established and mobilised opposition it was likely they would voice their concern through protest. What was just as unexpected as the overturning was the level of policing which was seen in the county. In future one would hope that concerned residents would be able to express their anger without the fear of police brutality and intimidation, which would go some way to limit mental health impacts.

6.4 Mental health support

What can be seen from the relatively small sample is the majority have experienced some CMD and they attribute these to fracking and these impacts are experienced before environmental and physical health impact, often from the moment a shale gas development is proposed. Lancashire has a higher than average rate of individuals who experience CMDs (Gadsby, 2017), pushing an industry that has documented environmental and physical health impacts does not bode well for the community. In the UK, mental health services have been starved of funding over the past 10 years, under austerity measures imposed by the Conversation government and accessing support is harder than ever (Ryan, 2020). According to the UK's Department of Health and Social Care (2011), one in four people experience mental health problems with half of all adults experiencing one episode of depression in their lifetime. The issues surrounding mental health support or a lack thereof, are far too many to address in this thesis but is important to acknowledge on top of societal drivers of poor mental health, future energy extraction according to this research will impact mental health of individuals negatively and support is urgently needed to address this in the UK.

6.5 Further research

The majority of research I have found related to mental health and shale gas developments in the UK have called for further research into the impacts on communities (Aryee et al., 2020; Short & Szolucha, 2019; Szolucha, 2016). Full scale extraction and production may not now take place at PNR or within the UK, however these developments will go through the decommissioning and restoration stage. This still has the potential to have impacts on communities, and residents will want to see land used for these developments returned safely to its previous state. I would recommend mental health impacts are continued to be monitored through research, to measure an improvement or decline. There is always

the potential that the industry gets a reprieve from the UK government to some of the issues highlighted regarding Brexit and the recent pandemic, this is further reasoning for continued research.

6.6 Limitations

The online survey was developed as an alternative to interviewing, where I had hoped to identify a small sample of residents living close to PNR and attain an in-depth understanding of the impact the development has had on their mental health. I developed a different approach with the online survey mainly due to the limitations caused by the pandemic. Based on the finding of Hirsch et al. (2018) in which they concluded that the majority of research into this field was qualitative, I believed it could be valuable to collect quantitative data on the numbers of individuals and symptoms they experience. A larger, truly representative sample would have been preferred but given the short turn around and the inability to travel during the pandemic I was restricted to online contacts. As mentioned, with environmental justice cases a certain level of trust needs to be built for individuals being studied to volunteer their experiences, having no face to face contact likely impacted the ability to build a trusting relationship with those I wished to study. There is also evidence of avoidance Aryee et al. (2020) found when requesting interviews some said of others, that their stress was too high, and they wished not to talk about it, also that proponents of fracking were likely to deny any stress. It is possible mental health impacts are underreported in this study and others.

I collected location data with the aim of utilising this to calculate the distance of respondents from shale gas developments in Lancashire, particularly the main active site PNR. This would enable an analysis of whether distance from a development was a factor in the CMDs experienced, also helping to clarify which development a respondent was closer to and at which stage the development is at. However, there was concern from residents regarding the reason for collecting this and given what I knew of the mistrust and intimidation of activists, this was made optional. A standard disclaimer was provided and information regarding my credentials as a student and researcher were given to further reassure respondents. It was important respondents felt confident they could not easily be identified, and that data would not be shared or accessible. Unfortunately, due to the small sample and a lack of location data provided this was not possible but something to consider for further research.

7 Conclusion

From this research there is evidence that fracking in Lancashire, driven by the government's 'all out for shale' policy has impacted the mental health of residents. Despite this coming from a relatively small sample, this acts as an exploratory study on a subject with little evidence, which raises key questions for further research. The evidence I have gathered does show that residents have experienced common mental disorders (CMDs) and attributed these to fracking. From analysis of the case through an environmental justice lens, there are issues related to the distributive, recognition and procedural justice. There are links between the impacts identified by the sample, as having impacted their mental health negatively and the environmental justice framework. Such as the uneven distribution of environmental, social and health burdens linked to Szolucha (2016) social well-being and health impact concern. Including the procedural injustice of limiting powers of local authorities with regards to shale gas developments and overturning of local planning decisions by government, which link to the policing and intimidation and democracy impacts experienced by the sample.

It is important that research into this field continues, despite the moratorium on shale gas extraction, exploratory drilling can still take place and applications for shale gas developments are still being heard by local planning committees. Even if an outright ban on the process were to be called today, these sites still need to go through a decommissioning and restoration stage, how and when this is done can further impact the community negatively. There is a need for policymakers, planners and local authorities to be considering mental health impacts of similar energy extraction or generation developments, as early as the planning stage to mitigate against these if possible. Through the use of environmental justice theory and the identified injustices related to shale gas developments, a case can be built for further research into environmental injustices and their impact on mental health.

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9 Appendices

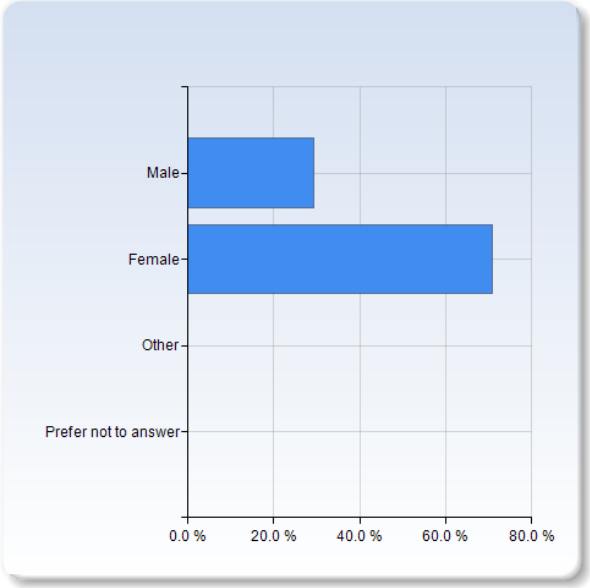
9.1 Survey results

Impact of fracking policy on mental well-being

Answer Count: 41

Which option describes you?

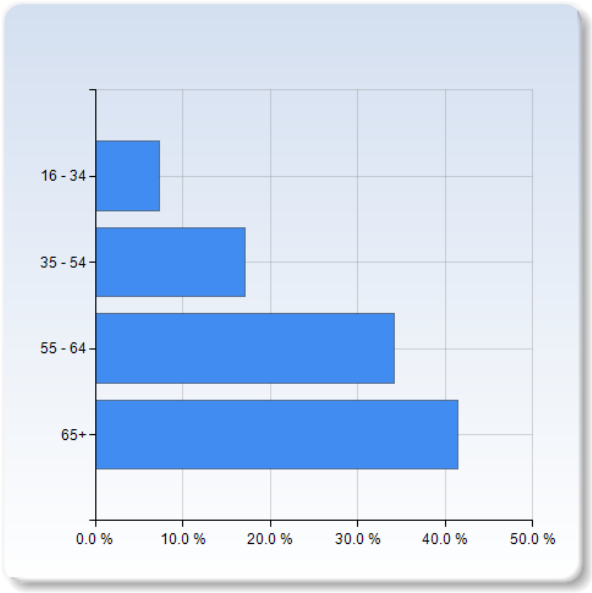
Which option describes you?	Number of Responses
Male	12 (29.3%)
Female	29 (70.7%)
Other	0 (0.0%)
Prefer not to answer	0 (0.0%)
Total	41 (100.0%)



	Mean	Standard Deviation
Which option describes you?	1.7	0.5

Which age group describes you?

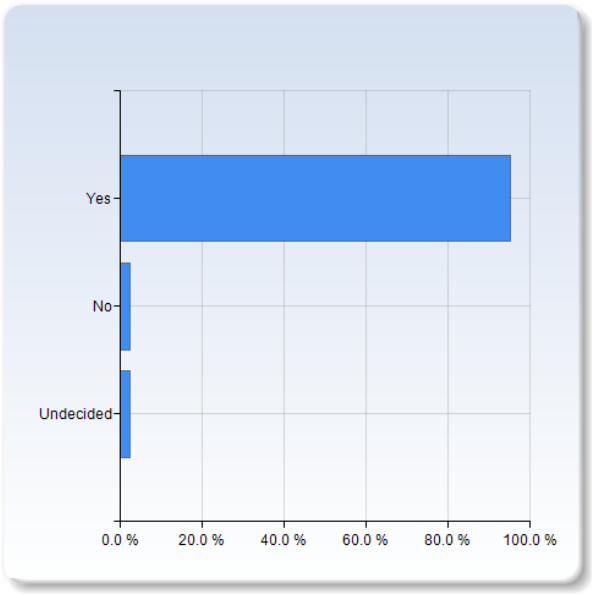
Which age group describes you?	Number of Responses
16 - 34	3 (7.3%)
35 - 54	7 (17.1%)
55 - 64	14 (34.1%)
65+	17 (41.5%)
Total	41 (100.0%)



	Mean	Standard Deviation
Which age group describes you?	3.1	0.9

Does fracking within Lancashire concern you?

Does fracking within Lancashire concern you?	Number of Responses
Yes	39 (95.1%)
No	1 (2.4%)
Undecided	1 (2.4%)
Total	41 (100.0%)



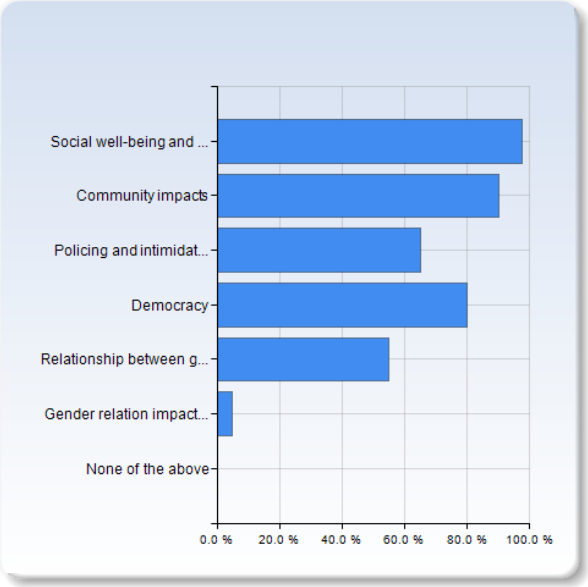
	Mean	Standard Deviation
Does fracking within Lancashire concern you?	1.1	0.3

In a study titled 'The human dimensions of shale gas developments in Lancashire, UK' by Anna Szolucha, six core areas were identified as being impacted by fracking in Lancashire.

Which of the following were you concerned about being negatively impacted by fracking, when it was announced fracking it would take place in Lancashire (prior to the June 2015 planning permission rejection)?

***you may tick multiple answers**

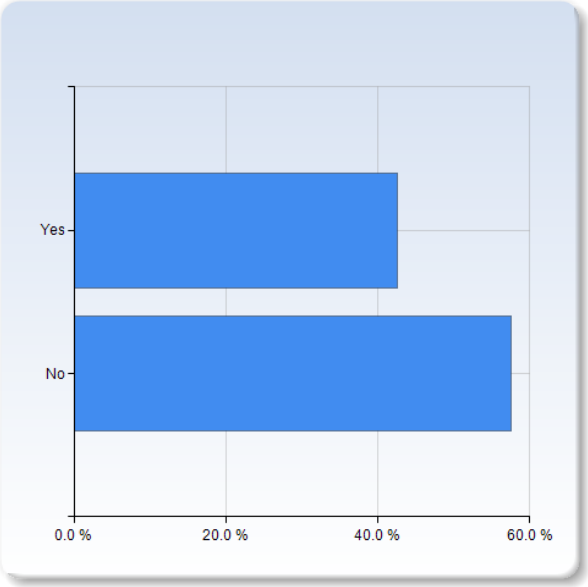
In a study titled 'The human dimensions of shale gas developments in Lancashire, UK' by Anna Szolucha, six core areas were identified as being impacted by fracking in Lancashire. Which of the following were you concerned about being negatively impacted by fracking, when it was announced fracking it would take place in Lancashire (prior to the June 2015 planning permission rejection)? *you may tick multiple answers	Number of Responses
Social well-being and health	39 (97.5%)
Community impacts	36 (90.0%)
Policing and intimidation	26 (65.0%)
Democracy	32 (80.0%)
Relationship between gas company and local residents	22 (55.0%)
Gender relation impacts (inequalities)	2 (5.0%)
None of the above	0 (0.0%)
Total	157 (392.5%)



	Mean	Standard Deviation
In a study titled 'The human dimensions of shale gas developments in Lancashire, UK' by Anna Szolucha, six core areas were identified as being impacted by fracking in Lancashire. Which of the following were you concerned about being negatively impacted by fracking, when it was announced fracking it would take place in Lancashire (prior to the June 2015 planning permission rejection)? *you may tick multiple answers	2.8	1.4

Have your concerns changed since exploratory drilling started at Preston New Road?

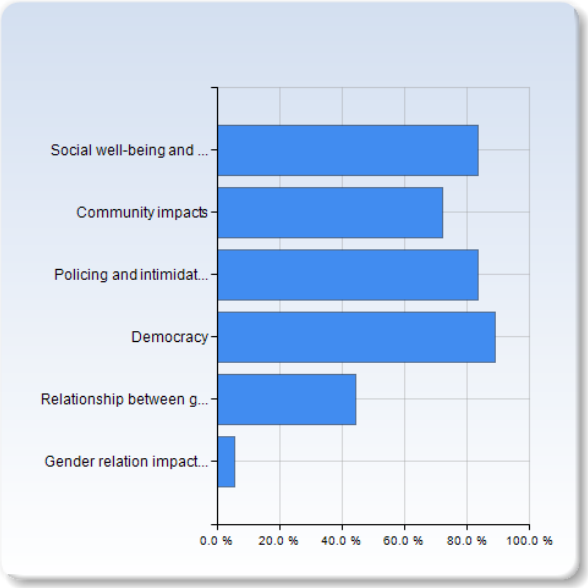
Have your concerns changed since exploratory drilling started at Preston New Road?	Number of Responses
Yes	17 (42.5%)
No	23 (57.5%)
Total	40 (100.0%)



	Mean	Standard Deviation
Have your concerns changed since exploratory drilling started at Preston New Road?	1.6	0.5

If yes, which concerns you most now?

If yes, which concerns you most now?	Number of Responses
Social well-being and health	15 (83.3%)
Community impacts	13 (72.2%)
Policing and intimidation	15 (83.3%)
Democracy	16 (88.9%)
Relationship between gas company and local residents	8 (44.4%)
Gender relation impacts (inequalities)	1 (5.6%)
Total	68 (377.8%)



	Mean	Standard Deviation
If yes, which concerns you most now?	2.9	1.4

Have you previously (prior to being aware of fracking in Lancashire) experienced common mental disorder symptoms*?

***Common Mental Disorders (CMD) comprise different types of depression and anxiety. Symptoms of depressive episodes include low mood and a loss of interest and enjoyment in ordinary things and experiences. They impair emotional and physical well-being and behaviour. Anxiety disorders include generalised anxiety disorder (GAD), panic disorder, phobias, and obsessive-compulsive disorder (OCD). Symptoms of depression and anxiety frequently co-exist, with the result that many people meet criteria for more than one CMD.**

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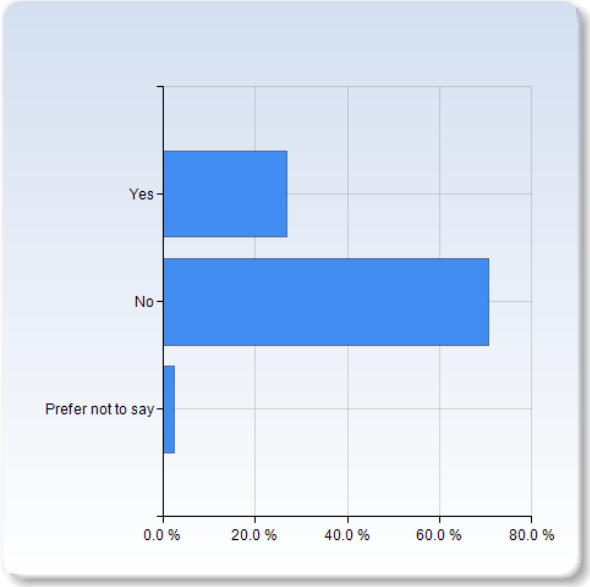
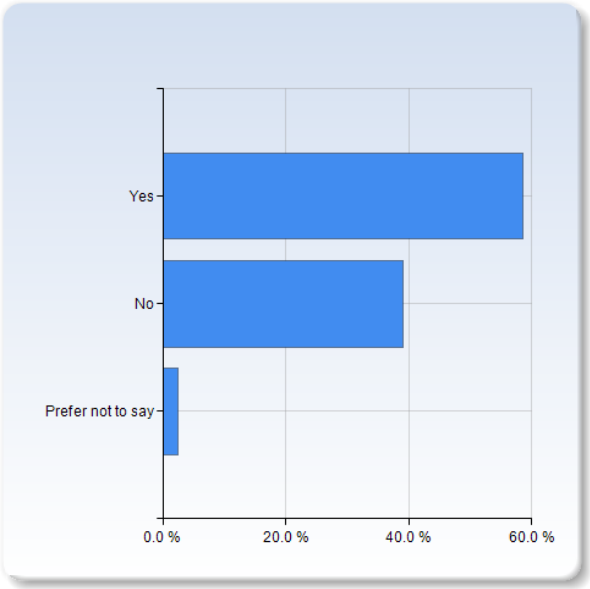
Yes	11 (26.8%)
No	29 (70.7%)
Prefer not to say	1 (2.4%)
Total	41 (100.0%)



	Mean	Standard Deviation
Have you previously (prior to being aware of fracking in Lancashire) experienced common mental disorder symptoms*? *Common Mental Disorders (CMD) comprise different types of depression and anxiety. Symptoms of depressive episodes include low mood and a loss of interest and enjoyment in ordinary things and experiences. They impair emotional and physical well-being and behaviour. Anxiety disorders include generalised anxiety disorder (GAD), panic disorder, phobias, and obsessive-compulsive disorder (OCD). Symptoms of depression and anxiety frequently co-exist, with the result that many people meet criteria for more than one CMD.	1.8	0.5

Have you experienced any common mental disorder symptoms since fracking was announced?

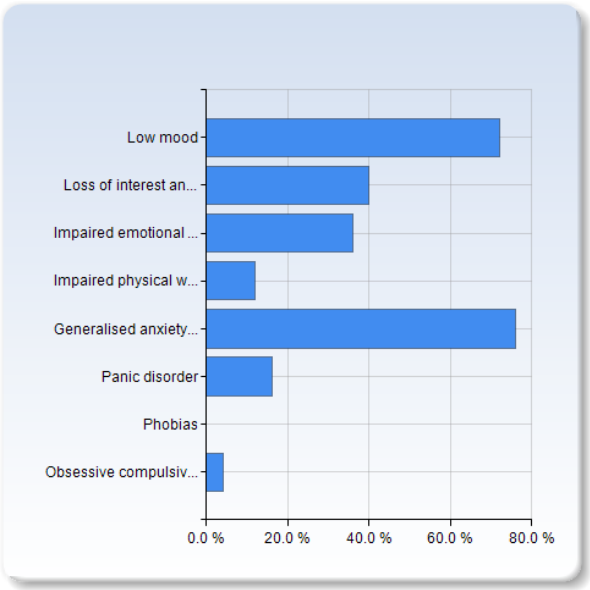
Have you experienced any common mental disorder symptoms since fracking was announced?	Number of Responses
Yes	24 (58.5%)
No	16 (39.0%)
Prefer not to say	1 (2.4%)
Total	41 (100.0%)



	Mean	Standard Deviation
Have you experienced any common mental disorder symptoms since fracking was announced?	1.4	0.5

If yes, which symptoms have you experienced.

If yes, which symptoms have you experienced.	Number of Responses
Low mood	18 (72.0%)
Loss of interest and enjoyment of ordinary things	10 (40.0%)
Impaired emotional well-being and behaviour	9 (36.0%)
Impaired physical well-being and behaviour	3 (12.0%)
Generalised anxiety disorder	19 (76.0%)
Panic disorder	4 (16.0%)
Phobias	0 (0.0%)
Obsessive compulsive disorder	1 (4.0%)
Total	64 (256.0%)

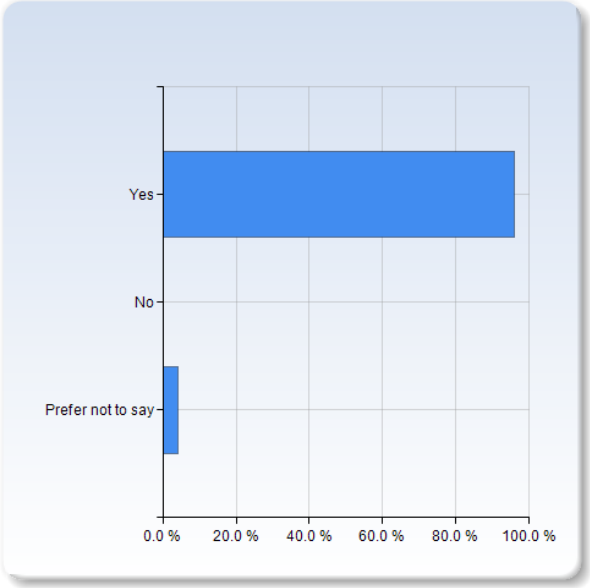


	Mean	Standard Deviation
If yes, which symptoms have you experienced.	3.2	1.9

Have you experienced Common Mental Disorder symptoms* since exploratory drilling started at Preston New Road?

*Common Mental Disorders (CMD) comprise different types of depression and anxiety. Symptoms of depressive episodes include low mood and a loss of interest and enjoyment in ordinary things and experiences. They impair emotional and physical well-being and behaviour. Anxiety disorders include generalised anxiety disorder (GAD), panic disorder, phobias, and obsessive-compulsive disorder (OCD). Symptoms of depression and anxiety frequently co-exist, with the result that many people meet criteria for more than one CMD.

Have you experienced Common Mental Disorder symptoms* since exploratory drilling started at Preston New Road? *Common Mental Disorders (CMD) comprise different types of depression and anxiety. Symptoms of depressive episodes include low mood and a loss of interest and enjoyment in ordinary things and experiences. They impair emotional and physical well-being and behaviour. Anxiety disorders include generalised anxiety disorder (GAD), panic disorder, phobias, and obsessive-compulsive disorder (OCD). Symptoms of depression and anxiety frequently co-exist, with the result that many people meet criteria for more than one CMD.	Number of Responses
Yes	24 (96.0%)
No	0 (0.0%)
Prefer not to say	1 (4.0%)
Total	25 (100.0%)



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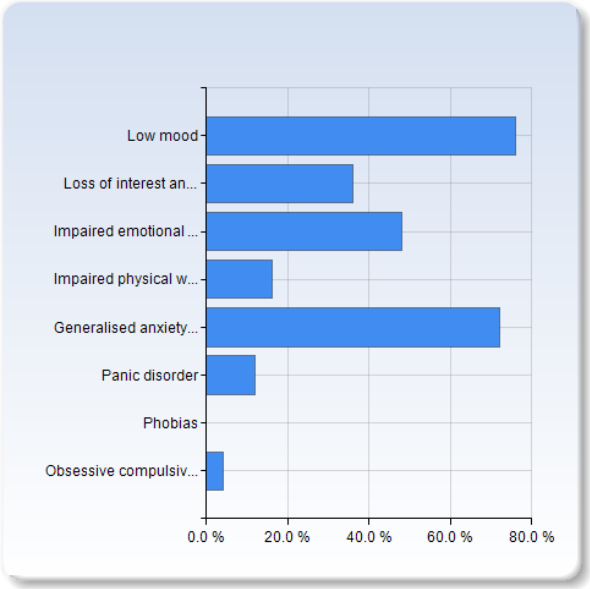
	1.1	0.4

If yes, which symptoms have you experienced?

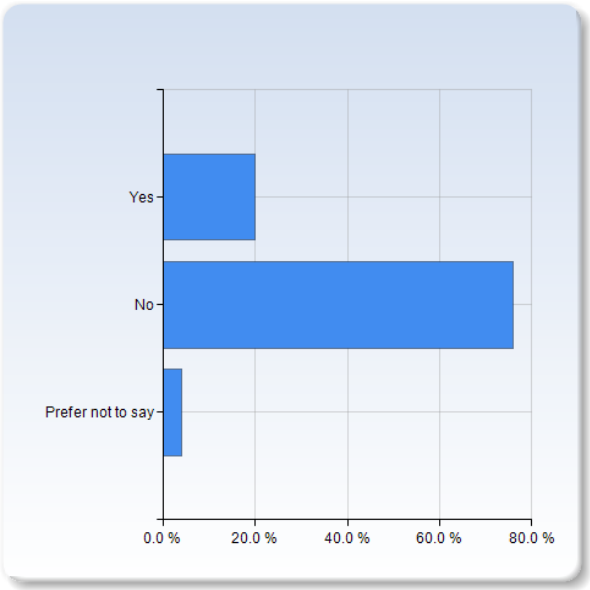
If yes, which symptoms have you experienced?	Number of Responses
Low mood	19 (76.0%)
Loss of interest and enjoyment of ordinary things	9 (36.0%)
Impaired emotional well-being and behaviour	12 (48.0%)
Impaired physical well-being and behaviour	4 (16.0%)
Generalised anxiety disorder	18 (72.0%)
Panic disorder	3 (12.0%)
Phobias	0 (0.0%)
Obsessive compulsive disorder	1 (4.0%)
Total	66 (264.0%)



	Mean	Standard Deviation
If yes, which symptoms have you experienced?	3.1	1.8

Have you sought help from a medical professional for common mental disorder symptoms?

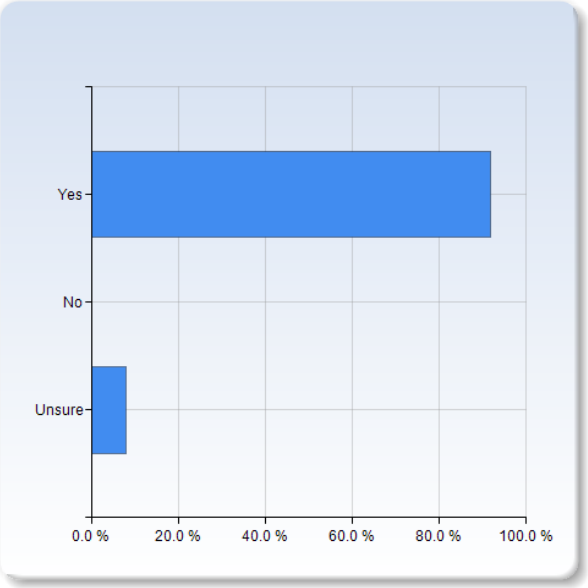
Have you sought help from a medical professional for common mental disorder symptoms?	Number of Responses
Yes	5 (20.0%)
No	19 (76.0%)
Prefer not to say	1 (4.0%)
Total	25 (100.0%)



	Mean	Standard Deviation
Have you sought help from a medical professional for common mental disorder symptoms?	1.8	0.5

Do you feel the government's fracking policy in Lancashire has caused or worsened your Common Mental Disorder symptoms?

Do you feel the government's fracking policy in Lancashire has caused or worsened your Common Mental Disorder symptoms?	Number of Responses
Yes	23 (92.0%)
No	0 (0.0%)
Unsure	2 (8.0%)
Total	25 (100.0%)



	Mean	Standard Deviation
Do you feel the government's fracking policy in Lancashire has caused or worsened your Common Mental Disorder symptoms?	1.2	0.6