

## Shale gas and fracking: examining the evidence

**Gwen Harrison and Stuart Parkinson summarise SGR's recent briefing which finds numerous causes for concern regarding the planned extraction of shale gas in the UK.**

Shale gas – extracted by the technique of hydraulic fracturing or ‘fracking’ – is being promoted by the UK government and parts of the energy industry as having a large potential to contribute to the country's energy needs. Claims have been made that it will bring down energy bills and increase energy security without significant environmental and health impacts. But there is much public concern that this will not be the case – and many argue that there are more sustainable options. With fracking for shale gas being relatively new, there are many gaps in the scientific literature regarding its impacts, and the public debate often relies on information from either anecdotal sources or the industry itself. However, an increasing volume of impartial, evidence-based information now exists.

In July, SGR and the Chartered Institute of Environmental Health (CIEH) published a joint briefing,<sup>1</sup> which drew on peer-reviewed literature to present a robust, fully-referenced overview. It challenged some of the commonly-repeated claims that, in many cases, fail to stand up to proper scrutiny. In this article, we summarise and update the key findings of the briefing.

### Fracking: the basics

Until recently, the technique of fracking has only been used in conventional wells (i.e. those within naturally porous rocks like sandstone, in which fluids can flow freely) to stimulate recovery when extraction becomes more difficult. Fracking for ‘unconventional’ gas or oil (i.e. that trapped in low permeability rocks such as shale) has only taken place on a large scale within the last decade in the USA. To date, only one UK shale gas well has been fracked: Preese Hall in Lancashire. While shale gas is chemically no different to natural gas extracted in other ways, the process of extracting it is very different, and requires huge numbers of wells (because the gas cannot travel large distances), and millions of gallons of water mixed with synthetic chemicals.

### Potential local environmental and health impacts

A report for the European Commission concluded that the cumulative risk of groundwater and surface water pollution and releases to air from fracking is high,<sup>2</sup> and evidence of fracking-related

contamination is well-reported in the scientific literature. For example, a recent study in Pennsylvania examining gas concentrations close to shale gas wells found methane in 82% of drinking water samples, with average concentrations six times higher for homes within 1km of a well.<sup>3</sup> UK regulations are more stringent than in the USA, making direct comparison difficult. Local environmental impacts may be less severe here. Nevertheless, it is virtually impossible to eliminate human error, poor well-construction, cement bond failure, etc., especially in such a new, complex and poorly-regulated industry (see below). Given the large number of wells proposed, failure of even a fraction could have significant impact. The reality is likely to lie somewhere between what proponents claim, and opponents fear.

Both Water UK (the water industry body) and the Chartered Institute of Water and Environmental Management have expressed concern over the requirement, during hydraulic fracturing, for vast quantities of freshwater.<sup>4,5</sup> Furthermore, fracking fluid returning to the surface is classed as radioactive waste and is therefore likely to require off-site treatment and disposal, placing a substantial burden on waste-water treatment infrastructure. Water and waste-water will require transportation to and from site, which could range from 14 to 51 daily vehicle movements per well pad for up to 3 years.<sup>6</sup>

There are concerns about the potential health impacts from fracking-related airborne pollutants, including methane, volatile organic compounds, particulate matter and nitrogen dioxide. A number of peer-reviewed studies have also suggested a possible link between fracking and various health impacts, including hormone disruption.<sup>7,8</sup> The Chief Medical Officer for New Brunswick in Canada published a report in 2012<sup>9</sup> which highlights the complete absence of any current substantive epidemiological study for populations exposed to shale gas extraction, suggesting that much more research is required before fracking can be deemed not to represent a threat to human health.

Both the European Union<sup>10</sup> and United Nations Environment Programme (UNEP)<sup>11</sup> have concluded that fracking may result in unavoidable environmental and health impacts even if the gas is extracted properly, and more so if done inadequately. They suggest that even if risk can be reduced theoretically, in practice many accidents from leaky or malfunctioning equipment and bad practices occur regularly.

### Regulatory regime

There is widespread concern that the current regulatory regime is inadequate to address the potential impacts of fracking, but the UK government has rejected many calls for it to be tightened. The Royal Society recommended that industry-specific regulations be developed,<sup>12</sup> but the UK government has rejected this. Professor Robert Mair of the Royal Society specifically stated a need for an “independent examination and onsite inspection programme”.<sup>13</sup> However, there is currently no legal requirement, or indeed resource, for the regulatory bodies to implement this. Neither are there any provisions within existing frameworks to require specific monitoring of fracking operations, i.e. periodic and regular sampling and analysis. This effectively allows the industry to decide monitoring frequency, scope and, critically, who carries it out. Proposed amendments to the Infrastructure Bill (see later) may go some way to addressing this.

The UK government has also created a conflict of interest by announcing its intention to allow local councils to keep 100% of business rates from shale gas operations, rather than the 50% that they were entitled to before,<sup>14</sup> thereby financially incentivising them to grant planning permission for shale gas operations.

### Climate change

Climate change is arguably the most important issue, and the discussion can be broken down into the following three aspects.

#### Comparative emissions

There is disagreement among scientists over the life-cycle emissions of shale gas versus conventional gas and coal, the discrepancy depending largely on fugitive emissions (unintentional methane leakage). A recent review<sup>15</sup> by the Department of Energy and Climate Change (DECC) concluded that emissions from UK shale gas should be comparable with conventional gas and lower than coal. However, there are several reasons why this may be an optimistic assessment, not least because it excluded post-production emissions, which may be considerable. It is also important to note that even the life-cycle carbon emissions of conventional natural gas are at least nine times that of any of the main renewable energy technologies.<sup>16</sup>

#### Diversion of finance away from renewables

The UK government's clear support for shale gas and, by contrast, reductions in its support for

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renewable energy and energy efficiency, may be deterring investment. A group of investors responsible for over £1 trillion recently wrote to Chancellor George Osborne arguing that “The UK has the potential to offer a safe harbour for renewable energy investors in Europe, but the delay in delivering a stable policy framework is weakening our prospects and holding back investment”.<sup>17</sup> Furthermore, Lord Browne of Cuadrilla – one of the companies at the forefront of fracking in the UK – has admitted that “In 2011, the UK spent over £4 billion supporting the production and consumption of oil and gas, more than is spent to support renewable energy”.<sup>18</sup>

## Total global emissions

Finally, but most importantly, shale gas exploitation is likely to increase global carbon emissions. Within a given country, coal may be substituted by shale gas. However, there is little to prevent this unused coal from being sold in international markets, thereby increasing carbon emissions elsewhere.<sup>19</sup> In the absence of a global constraint on emissions, leading analysts (including those from the Tyndall Centre and DECC<sup>20</sup>) warn that shale gas will be additional to, not instead of, coal, leading to an overall increase in carbon emissions and a consequent acceleration of climate change.

## Economic and social issues

Virtually all economic analysis – including that of Deutsche Bank, the International Energy Agency and DECC – refutes the claim that fracking will reduce energy bills in the UK.<sup>21</sup> Unlike the US, the UK is tied into the international market, where gas is sold to the highest bidder, regardless of its origin. Any increase in domestic gas production will therefore have little impact on the UK price. Furthermore, the development, or persistence, of gas-fired energy infrastructure in the UK locks us into its continued use, and ties us into an international gas market vulnerable to geopolitical and other disruptions to supply.<sup>22</sup>

Although fracking will generate jobs, job leakage is probable.<sup>23</sup> The job creation potential is also significantly less than that of the low-carbon energy sector, which itself may suffer from diversion of investment to shale gas.

The views of the public will be instrumental in deciding whether fracking goes ahead on any large-scale. Recent government opinion polling<sup>24</sup> puts public support for fracking at only 26%, the least popular of the energy sources on which it canvassed opinion.

## Can we manage without shale gas?

It was outside the scope of our report to carry out a detailed assessment of the alternatives to shale gas.

However, we noted both in the report and in a follow-up paper<sup>25</sup> that there is considerable potential in a combination of alternative options, such as:

- energy conservation measures in buildings to reduce demand for natural gas for space heating;
- expansion of the use of electric heat-pumps to provide space heating;
- renewable energy technologies – especially wind and marine – to supply electricity; and
- biogas to replace natural gas for heating and electricity.

## Update

Several key developments have occurred since our report was published:

1. Parliament’s Environmental Audit Committee has recommended a moratorium on fracking for shale gas to avoid breaching the UK’s carbon budget.<sup>26</sup>
2. Scotland and Wales have announced moratoria on unconventional oil and gas extraction while further research is carried out into potential safety and health impacts.
3. Recent debate on the Infrastructure Bill has focused on the possibility of a ban on fracking in National Parks and other sensitive areas totalling around 40-45% of the land in England offered for shale gas extraction.<sup>27</sup>

## Conclusions

The SGR briefing has found numerous concerns related to fracking for shale gas, especially:

- major shortcomings in regulatory oversight regarding local environmental and public health risks;
- the large potential for UK shale gas exploitation to undermine national and international efforts to tackle climate change;
- the water-intensive nature of the fracking process which could cause water shortages in many areas; and
- the complete lack of evidence behind claims that shale gas exploitation will bring down UK energy bills.

The briefing also points out that, despite claims to the contrary, evidence of local environmental contamination from shale gas exploitation is well-reported in the scientific literature.

The largest problem, however, remains climate change. Given that, even without shale gas, proven global reserves of fossil fuels are five times higher than can be burned without a 2°C global temperature rise being likely,<sup>28</sup> the exploitation of shale gas is very risky. In the absence of a global cap on emissions, the use of shale gas will be in addition to not instead

of coal, and will therefore result in an overall increase in emissions. Until such a constraint on emissions is in place, this problem remains unresolved.

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