Congleton Sustainability Group

Shale gas exploitation in Cheshire

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Shale gas is a high carbon fuel whose use is incompatible with the UKs climate change objectives.
Its extraction by fracking in and around Cheshire would require thousands of wells on hundreds of sites, each needing access roads and pipelines, using huge amounts of water, and leading to unacceptable industrialisation of a rural landscape.
Risk of air and water pollution and earthquakes would be unavoidable.
The government supports fracking, but the public quite rightly opposes it.

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Summary and main conclusions

The government has issued licences which, subject to planning and other permissions, would allow exploration for and extraction of shale gas throughout most of Cheshire using hydraulic fracturing, also known as fracking. If exploration shows that sufficient gas is available, production will probably begin around 2025 and continue until 2050 or later.

This study shows that the use of fracked gas is unlikely to be compatible with the UK's emissions reduction commitments under the Climate Change Act. It's use will conflict with climate goals unless two conditions are met.
First fracked gas leakage must be controlled. It is difficult to prevent gas escaping, and difficult to even know how much is escaping. According to US evidence enough of the powerful greenhouse gas methane may be escaping from fracking operations to more than double its effective carbon emissions. It is reckless to proceed with fracking when we cannot be sure that gas escapes can be reduced to the required, near zero, level.
Second, when the gas becomes available around 2025, it's carbon dioxide emissions from burning must be captured and stored. This will not be possible when it is used for heating houses. Nor is CCS likely to be fitted at power stations; it is an expensive process which is unlikely to be available in time as the government and the fossil fuel industry are conspicuously uncommitted.

Because of the necessary scale of the operation, extraction of natural gas by fracking in Cheshire would cause unacceptable industrialisation of the countryside, and unacceptable risks to the local environment. Gas can only be extracted from shale which has been shattered by fracking. Since a single well can only frack an area of about a third of a square kilometre, thousands of wells would be needed to extract gas from the shale seam under Cheshire. These wells would be grouped on hundreds of sites, each site at least the size of a football field, with an access road and a pipeline to take away the gas. The large number of wells and well sites multiplies all the local impacts of fracking: the amount of construction and drilling activity, the traffic, the amount of water used and waste water needing disposal, the access roads and pipelines, and the risks of water and air pollution and earthquakes.

Planning applications for fracking attract passionate opposition and the government knows from it's own polling that opposition to fracking is growing. It's reaction however is to try to force applications through by overruling local planners, while giving at best half hearted support to the much more acceptable and effective alternatives, energy efficiency and genuinely low carbon energy from renewables.

Full report

1.CSG and fracking

The government encourages fracking and insists that it does not compromise the UK's carbon reduction commitments under the Climate Change Act. But it's case is unconvincing, depending as it does on events which are uncertain, such as strict control of methane leakage and early implementation of carbon capture and storage. It will also make more gas available in the U.K. and elsewhere and increase worldwide emissions. For those reasons Congleton Sustainability Group (CSG) is opposed to fracking wherever it occurs. We also oppose it here in Cheshire because of its effects on our local environment.

2.Fracking in Cheshire East

Geological surveys suggest that local rocks may contain natural gas which could perhaps be exploited by fracking. The government have taken the first steps to bring fracking to Cheshire East, quite close to Congleton. Early in 2016 licences were issued to the company IGAS for exploration. The affected part of Cheshire East so far is all the land to the west of the north-south line marked 80 on the local Ordnance Survey map - this line goes through Jodrell Bank, Brereton Heath Country Park and Alsager, and is less than 4 kilometres from the western edge of the town of Congleton.

IGAS will need to apply to Cheshire East for planning permission before they can start drilling and fracking test wells. In other parts of the country applications have proved enormously controversial, and have attracted thousands of objections and very little visible support. The government has made it clear that if councils reject applications then these rejections will probably be reversed on appeal, which indeed occurred in October 2016 to applications in the Fylde in Lancashire. Councils therefore are under pressure from both directions. Some councils have rejected applications but one in North Yorkshire was recently approved.

There have also been indications that the government may decide to bypass the local planning system entirely by defining fracking as a "nationally significant infrastructure project" under the 2015 Infrastructure Act.

3.What is fracking?

Fracking is a technique which has been developed in recent decades to extract gas or oil which is inaccessible by normal drilling, because it is locked tightly into seams of impervious rock. If the rock is shattered the gas or oil can escape from the rock and be collected. The rock can be smashed by injection of water and sand, supplemented by a mixture of chemicals, down the well at high pressure. The process is called hydraulic fracturing or more briefly fracking. Fracking became a practical way to extract gas when horizontal drilling was developed, since a much larger area of a horizontal rock seam could then be smashed from a single well. In the USA both oil and gas have been extracted by fracking, but in UK it is most likely to be used to extract gas from shale formations or from coal seams.

For conventional gas in a porous rock such as sandstone a considerable amount of gas can be extracted from a single well without fracking or horizontal drilling, because the gas moves easily within the rock; but gas in shale is tightly locked in the rock and can only be extracted from rock which has been fracked. Only an area of radius 1-2 kilometres can be fracked from a single location. **Many wells are therefore needed to exploit the shale seam which may extend across most of Cheshire.**

4.Exploitation of a shale gas seam.

There are four phases in the exploitation of a shale seam which needs to be fracked to release the gas which it contains; exploration, assessment, production and restoration. In the UK we are just entering the exploration phase, whereas the USA has been in the production phase for some time.

Exploration begins by preparing a site (called a well pad) the size of a football field or larger, to take heavy machinery and HGVs and to protect the underlying land from pollution, and providing suitable access. From a single pad a number of wells will be drilled and fracked to ensure that a viable amount of gas can be extracted. The Fylde applications were for 4 wells per site. From the planning application for one of the Fylde sites we see that drilling and monitoring may take 3 years; assuming the site didn't go into full production, restoration would be complete after 5-6 years.

In the assessment phase test wells are drilled and possibly more sites are developed to better estimate the yield and to plan the placing of the production wells which may extend over a considerable area. The assessment phase would surely take at least as long as the exploration, that is several years.

The objective of the production phase is to extract gas, which may involve fracking the shale seam over a wide area. Locally, 20 10x10km blocks (which is 2,000 square km, the size of Cheshire) have been licensed for exploration. The area extends as far as Chester, Nantwich and Manchester. If we assume that it is possible to drill 1.5 kilometres horizontally and frack a strip 150 metres wide, then the whole area could be covered by rows of wells with the rows 3 kilometres apart, and wells 150 metres apart in the rows. The spacing in the rows can be improved by drilling wells at an angle to vertical, so the same coverage can be achieved by up to 12 wells on each pad with pads at one kilometre intervals. This would result in around 30 well pads for each 10 kilometre block. Of course it is not possible to drill everywhere, for example because of dwellings (but it is permitted to drill under them), but there could be hundreds of well pads in the area, and more than 100 in Cheshire East alone.

Each site will need an access road for HGVs. A pipeline will also be needed to connect the site to the gas grid. Conceivably electricity could be generated on site, but then a connection to the electricity grid would be necessary. There will be less activity in the production phase since it is only necessary to collect the gas which flows from the wells. But if the flow declines a well may be fracked again and again, until eventually this fails to improve the yield.
Production will continue presumably until the gas runs out at that site, which may be perhaps 20 years (although the gas field as a whole may continue for much longer).

Restoration consists of capping wells and restoring the site, or more likely multiple sites and access roads, to their original state or some other state agreed with the planning authority. It doesn't of course involve restoring the whole environment (including the climate) to its original condition. Restored wells sometimes give trouble later on, for example by leaking methane. Of course nobody is keen to monitor and maintain old wells indefinitely, so leaks can remain undetected for some time.

5.Is fracking compatible with UK action on climate change?

Natural gas has been described as a bridging fuel, meaning that it can be used to transition from carbon intensive coal to zero carbon renewables. For example one kilowatt hour of electricity generated from coal causes the emission of 900 grams of carbon dioxide compared with 400 for gas and near zero for renewables. In the USA large emissions reductions were achieved when many coal power stations were replaced by gas (although that assertion disregards the effect of fugitive emissions of methane whose extent is unknown – see below).

Why would that not work here? The USA started the process maybe 15 years ago, when their electricity came mainly from coal, as much of it still does. We have still not started fracking but have few coal power stations left; probably by the time the first fracked gas appears there will be none, since they are due to be

phased out by 2025. Average emissions from electricity generation now are around 400grams per kilowatt hour so they would not be reduced by increased generation by gas which did not replace coal. To bring down electricity emissions towards zero, as we must to combat climate change, we need very low carbon sources such as renewables or nuclear, and we need them soon. Before long all coal power stations will be gone and we will need to start replacing gas fired stations; that is not likely to happen if we are going all out to produce more and more gas.

The government hopes fracking will begin to produce significant amounts of gas by 2025. Since the estimated life of a well is 20 years, gas production will still be in full swing as we approach 2050. Some of this gas will be used to generate electricity and we have seen that will emit 400 grams of CO2 per kilowatt hour; that is just not good enough. To meet our targets under the Climate Change Act we need by then to be producing electricity whose average emissions are close to zero. Some gas will be fed into the gas grid and burned for example to heat our homes producing emissions of more than 200 grams of CO2 per kilowatt hour; that is not good enough either, because home heating must also be practically zero carbon by then. So if we are burning gas at all we will need to find a way to avoid the greenhouse gases entering the atmosphere; we will look at this again under the heading of Carbon Capture and Storage below.

It is recognised by many in the USA that by locking into gas they may hamper the transition to zero carbon electricity from truly low carbon sources such as renewables and nuclear.

From a global point of view it is very clear that we cannot burn all the known reserves of fossil fuels which can be extracted easily without causing disastrous climate change. Where then is the sense in going after gas which is difficult to get because it is tightly locked into dense shale?

6.Fugitive emissions

Fugitive emissions is a very apt term. Gas is very difficult to contain, and once it escapes it is impossible to recapture. Some leakage is unavoidable. If we knew how much methane escaped into the atmosphere then the global warming effect could be calculated.

Natural gas is almost entirely methane together with traces of other hydrocarbons. Methane is an important greenhouse gas which is much more powerful than carbon dioxide. Burning methane releases carbon dioxide, but the total effect is the sum of the effect of this CO2 plus the effect of the escaped methane.

The problem with comparing the warming effect of methane and carbon dioxide is that methane stays in the atmosphere for a much shorter time. But conventionally we compare the cumulative warming of the gases over 100 years, in which case a certain mass of methane is 34 times as powerful than the same mass of carbon dioxide. Because a carbon dioxide molecule is nearly 3 times as heavy as a methane molecule the effect of a methane molecule is 12 times that of a carbon dioxide molecule.

When a methane molecule burns it produces one carbon dioxide molecule (and some water). Suppose we burn 100 methane molecules and 1 additional molecule (i.e. 1%) has escaped; the total warming effect is 100 + 12 = 112. So 1% of escaped methane causes 12% increased warming, 2% causes 24%, and so on.

The leakage of fracked gas is larger than that of conventional gas (which may also be significant) because it involves many more wells and more pipelines, and also because of possible escape of gas immediately after a fracking operation when a mixture of gas, liquids and debris flows back up the well. This escape can be largely avoided by using what are called green completions, in which the gas is separated and piped away, but green completion can only be used once a pipeline has been installed. Otherwise this gas is either flared off or worst of all simply vented to the atmosphere.

In the USA there have been suspicions about the extent of leakage from fracked wells but it has been taking a long time to measure this accurately. Recent results suggest at least 2% and possibly much more may be escaping. But the leakage rate isn't known accurately, it isn't consistent, possibly gas leaks are undiscovered for a long time and occasional large leaks can have a large effect. It is hard to believe that the problem will be solved soon; gas has been extracted and distributed for a long time. The leakage problem has always been present and you can never be sure that it has been solved.

7. Climate Change Committee report and Government response

The CCC is obliged by the Infrastructure Act 2015 to advise the government on the impact of fracking on the carbon budgets required by the Climate Change Act.

The CCC in its report specifies three tests to ensure that

- Fugitive emissions do not become unacceptably large
- Some fugitive emissions are inevitable, but they will be offset by additional savings elsewhere because they are not covered by the existing U.K. carbon budget
- Use of shale gas does not cause an increase in gas use not accounted for in the U.K. carbon budget

It also points out that UK shale gas may cause extra emissions outside the U.K. by increasing the amount of gas available worldwide.

The government responds that it "believes that the strong regulatory environment for shale gas development, plus the determined efforts of the UK to meet its carbon budgets, means that the three "tests" put forward by the CCC will be met. The necessary actions already underway….". Had the CCC believed this was clearly so they would presumably not have felt it necessary to specify the three tests. We can conclude that the CCC and the government have an unresolved disagreement on the impact of fracking on carbon budgets.

8.Carbon capture and storage

Burning gas to generate electricity in power stations causes CO2 emissions of about 400 grams per kWh, and burning gas to produce heat for example in our homes causes around 200 grams per kWh. Neither is acceptable except in the very short term so if gas is to continue to be used we need to prevent the CO2 from getting into the atmosphere by capturing and storing it. This is referred to as Carbon Capture and Storage or CCS.

There are several methods of capturing the CO2 from burning natural gas, but the main choice is whether to isolate it before the gas is burned or afterwards.

If the gas, which is methane, CH4, is burned first it is usually burned in air; the flu gases consist of CO2, other combustion products and water, plus the residue of the air. The CO2 is perhaps 10% of the flu gas. Some but not all of this CO2 can be separated and captured; the Carbon Capture and Storage Association says "up to 90%". There is some loss of efficiency, and extra expense involved. Carbon capture is only feasible where a large amount of gas is being burned, for example in power stations and industrial processes but not domestic central heating boilers. Storing the captured CO2 is discussed later, but we can note here that it involves further expense as well as the potential for some of the CO2 to escape.

It is sometimes suggested that methane, CH4, could be converted into hydrogen, H2, and there are industrial processes already in use to perform this conversion. The carbon which is removed is usually a stream of pure CO2, so no expensive process is needed to separate it from other gases. This CO2 would then need to be safely stored.

Burning the resulting hydrogen would produce only water and no greenhouse gases, so would be a clean fuel which could be used for heating homes and other premises, in industrial processes, as a transport fuel, or to generate carbon free electricity. It would require the present gas grid and gas appliances to be converted to transport and use hydrogen, a project of similar scale to the earlier transition from town gas to natural gas.

But in removing the C from CH4 you also remove 40% of the heating capacity, so along with the costs of the conversion process and the storage of the CO2 you end up with a fuel which costs at least twice as much per kWh as natural gas. As a result it makes little economic sense for any of the potential uses, and in particular would be no cheaper than electricity for heating houses.

The first thing to note about storing the carbon dioxide is that there is a lot of it. Since each molecule of CH4 when burned produces one molecule of CO2, then the volume of the carbon dioxide is the same as the original volume of the methane. The fact that not quite all of it is captured makes little difference. So it is going to take a lot of space and you need to be sure that it stays where it is put, essentially for ever (even longer than nuclear waste). In the UK it is usually proposed that it should be stored under the North Sea in the wells from which oil and gas has already been extracted.

There have been repeated attempts to demonstrate that large scale CCS is viable in the UK but in every case the government or the operator has pulled out before any CO2 has been captured or stored. We are asked to believe that it should work but that has not been shown.

But we also know that CCS does not eliminate all greenhouse gas emissions. At least 10% of CO2 escapes. In addition, and probably more significantly, the fugitive emissions of CH4 are unaffected. So overall fracked gas, even with CCS, is not a very low carbon fuel when compared with the nuclear and renewable alternatives.

A sceptic might believe that the purpose of CCS is not to sequester carbon at all, but to be used in arguments to support the continued use of fossil fuels which would otherwise be unsupportable.

9.The economics of fracking

Mineral rights are owned by the government rather than the landowner, but presumably the operator will have to pay the landowner for use of the land.
The government has ruled that the operator must also reward the community in which the fracking occurs; £100,000 per site (even if it doesn't go into production?) plus 1% of the revenue was proposed by the previous government. It was not totally clear who would receive the money on behalf of the community, but probably it would be the council. The May government has changed this so that money will go directly to the owners of affected houses, but not all the details are clear.

One assumes the operator will make profits and that workers will be employed. Probably many more workers will be needed in the preparatory phases than the production phase. It is not clear what proportion will be local workers. Presumably many workers with specialist skills will be brought in, and perhaps local workers will be trained. Not all the workers will be specialists.

There is some dispute about whether the consumer will pay lower gas and electricity prices, as happened in the USA. It is argued quite persuasively that we will not. Prices went down in the USA because they are isolated from world gas markets, whereas our gas supplies are integrated with Europe, Russia and the Middle East and our prices are set by that network. So UK gas production will have little effect on the gas price and we will still be at the mercy of fluctuation in gas price which is the main factor affecting energy bills.

It should be emphasised that fracked gas will be subsidised but not in the same way as renewables, where the subsidy is payed by the energy companies and passed on to the user. The government will reward fracking operators with tax breaks, funded by other taxpayers. And of course fossil fuels are further subsidised because energy suppliers and users don't pay the ever increasing costs of climate change caused by CO2 emissions.

10.Local environmental concerns

Possibly climate change is too distant to sway planning committees, because it doesn't seem to feature much in deliberations. Planning committees are supposed to take climate change into account in all planning applications, not just fracking, but local issues arouse more passions and are accorded much more weight; issues such as water and air pollution, noise, water use, HGV movements, local jobs, visual intrusion, industrialisation of rural areas, earthquake risks, effects on house prices or tourism.

11.Regulation

Scare stories abound about the side effects of fracking in the USA, including earthquakes, pollution of groundwater, water courses and drinking water, air quality close to wells and industrialisation of the countryside. Fracking in the US has been largely unregulated and unmonitored, but more recently studies have shown that there is cause for concern, although some scare stories are perhaps exaggerated.

The UK government is going to some trouble to assure the public that fracking is safe and indeed beneficial in the UK with the proposed regulation regime, but with limited success. It is not clear that any amount of regulation can sufficiently clean up the industry. There is also a problem of trust, since the government is in fact the regulator, but at the same time is demonstrably not impartial since it is the main proponent and cheerleader of fracking in the UK; fracking is government dogma and no criticism can be permitted.

12.Water issues

A lot of water is used, 2-5,000 cubic meters (a cubic meter weighs a tonne) for each fracked well, and there may be 10 or more wells on a site. All this water usually has to be brought to the site in tankers and accounts for many HGV movements at each site. 5,000 cubic meters is enough water for 400 homes for a year. A major fracking operation could put significant pressure on the water supply for the area, and may have to be transported a considerable distance.

The water is mixed with sand and chemicals, some of which are toxic and some of which the operators would like to keep secret. It appears that these chemicals will have to be approved by the Environment Agency but not necessarily disclosed to the public. It is important to prevent these chemicals from escaping, before and after they are mixed with water, because they could contaminate soil, groundwater or water supplies. Such escapes could happen when concentrated chemicals are being brought in, or when returned water is being taken away. Escapes could also occur where the returned water is stored on site (though unlike in the USA storage in open ponds on site will not be permitted), in passage up and down the vertical well, and from the shale seam into which they are injected.

This mixture is injected into the well to fracture the gas bearing shale; some will remain in the shale seam and some will return through the well to the surface. The vertical hole from ground level to the shale seam, which passes through water bearing strata, is reinforced with steel and concrete to prevent escape of fluid passing down and up. It has extra reinforcement near ground level where it passes through aquifers.

The reason contaminated water returns to the surface is because it is forced out by the pressure applied by the fracking operation and the pressure of the gas released. The shale seam may also contain a great deal

of very salty polluted water, previously trapped in the shale but released by fracturing, which is also forced out. So water and gas are intermingled, with consequent difficulties in collecting both and separating them. The water from within the shale adds considerably to the amount of polluted water which needs to be safely disposed of.

Any earthquakes caused by the fracking stage may, among other effects, damage the well casing allowing contaminating water to escape, possibly contaminating groundwater. It was such damage that caused fracking at the well near Blackpool to be abandoned. See the section below on **earthquakes**.

The shale seam will normally be a very long way beneath the ground and far beneath any aquifers, so these should not be contaminated by fracking fluids which escape from the shale seam through new or pre-existing fissures.

The fluid which returns to the surface will have picked up more contaminants underground, including low level radioactivity, and will need to be captured and stored safely in tanks on site. It may then be taken away to be purified and disposed of safely, used in further fracking operations or injected far underground where it will remain. In the USA most of the waste water is disposed of by pumping under pressure into very deep wastewater disposal wells drilled for the purpose.

One operator, Ineos, has suggested that the waste water may be dumped at sea, presumably because it is unfit to be disposed of on land. How then can it be fit to be put in the sea, adding to already unacceptable pollution levels?

There have been cases in the USA where local people have alleged that water supplies have been contaminated with fracking fluid. There have also been claims of methane in the water, and there are pictures of water from the tap, and in streams, being set alight. The claims are generally disputed.

In the USA the EPA has tried to discover if drinking water is polluted in areas of shale gas extraction, whether this was present previously and whether it was caused by gas extraction. They have had very limited success. The gas companies have been obstructive and EPA doesn't have power to force them. So while the British government might assert that there is very little risk to drinking water, that is not at present demonstrated. One essential step is to always test the water supplies before gas exploration begins (which will probably be enforced in the UK).

13.Chemicals used in fracking fluid

In the USA additives to fracking water do not have to be disclosed either to the public or to regulators.

In the UK the Environment Agency will have to approve all additives, but these will not have to disclosed publicly, which is better but not much. It is not clear how the EA will decide what is allowed, or whether the rules will be the same everywhere. Will the EA have a list of acceptable substances or will it decide in individual cases when asked?

The government say that “As of December 2014, the only chemical additives that have been permitted by the Environment Agency in the United Kingdom were 0.075% of polyacrylamide friction reducers, 0.125% hydrochloric acid and in rare cases 0.005% biocide.” Which raises more questions than it answers. If those are the only chemicals which will be allowed it would surely say, so we presume they are not. Did the EA refuse requests to use other substances? Would it refuse on grounds of toxicity, in which case why is biocide allowed?

A Public Health England review requested by the government (PHE-CRCE-009) lists many of the substances which have been added to fracking fluid, their purpose and some of their other applications.

14.Air quality

There are certainly toxic gases involved in the extraction of natural gas. See for example this quote from from the US Environment Protection Agency website

The oil and natural gas industry "…….. is the largest industrial source of emissions of volatile organic compounds (VOCs), a group of chemicals that contribute to the formation of ground-level ozone (smog). Exposure to ozone is linked to a wide range of health effects, including aggravated asthma, increased emergency room visits and hospital admissions, and premature death.
In addition to helping form ozone, VOC emissions from the oil and gas industry include air toxics such as benzene, ethylbenzene, and n-hexane, also come from this industry. Air toxics are pollutants known, or suspected of causing cancer and other serious health effects."

So it seems that fracking could significantly affect the already poor air quality in the U.K. The situation in the UK will probably be worse than in the US; the ten times greater population density means that many more people will live close to fracking operation, and be exposed for example to cancer risk.

There are also pollutants arising from transport, notably diesel lorries, and from the operation of equipment such as drills and pumps.

Radon gas in the atmosphere is the second largest cause of lung cancer worldwide after smoking, causing or contributing to a significant number of deaths. Uranium and thorium decay radioactively, forming radium which then decays to form radon gas. Radon is itself radioactive with a half life of 3.8 days, and decays into several radioactive solids(dust), some of which are long lasting. Uranium and thorium occur in many rocks, and as a result in soils also; as they decay the resulting radon gas seeps out into the air. Because of its short half life, and because of dispersion, the level of radon outdoors remains low and causes little danger, but it can build up to dangerous levels in houses and other buildings in areas where the amount of uranium and thorium in rocks is high.

If there is radon in the shale it will be extracted along with the natural gas released by fracking. The amount will depend on the concentration of radioactive elements in the fracked rock, which varies from place to place. Radon can escape in all the ways described for other pollutants and so find its way into the atmosphere and into water supplies and then into homes. Gas supplied to homes will also contain radon, the amount depending on how much has decayed while in transit.

In Pennsylvania there is a long term problem with radon, and also an extensive gas fracking industry. Radon levels in houses are routinely monitored, for example when houses are sold, and have been observed to increase significantly since the onset of fracking in 2004, and to have increased more in areas with a high concentration of wells. Although it has not been demonstrated exactly how the increases occurred, fracking is by far the most likely cause.

In contrast Public Health England in its report to the government finds no cause for concern about radon released by fracking.

And for all we know the secret chemicals used in fracking may also give rise to air pollution, and we must trust the Environment Agency to protect us from these.

15.Earthquakes

There is no doubt that small earthquakes occurred when fracking the exploratory well at Preese Hall near Blackpool. The earthquakes were detected and geologists are sure that fracking was the cause. Fracking at the site was terminated as a result.

In the USA shale gas and oil extraction has been accompanied by a large increase in the number of small earthquakes. Before 2008 there were on average 21 earthquakes per year of greater than magnitude 3 in the eastern and central USA; by 2015 that average had risen to around 1000. The increase was entirely in areas where oil and gas was being extracted by fracking, and there is no doubt at all that the extra earthquakes are caused by oil and gas workings. Most were small quakes of magnitude 3 (M3) which would cause little or no damage, but quakes of up to M5.6 have been recorded. These are bordering on serious and caused significant damage to buildings. The most susceptible buildings are unreinforced brick structures, such as the average British house. No lives were lost in these quakes, although elsewhere in the world events of similar magnitude have caused significant loss of lives.

Actual fracking operations can cause earthquakes, as at Blackpool, but more and bigger earthquakes are caused by injecting waste water into disposal wells. The reason is that much more water is injected over time into a disposal well than is used in a fracking operation, and the increase in pressure in the well is therefore much greater. It is the pressure change in the vicinity of a fault that can cause an earthquake. It is also clear from the American data that some areas are much more susceptible than others to earthquakes caused by oil and gas workings, and that this is not necessarily predictable from their earthquake history. The fact that the UK is not particularly prone to earthquakes doesn't guarantee immunity.

So it is quite clear that shale gas extraction does cause earthquakes. The question is whether these earthquakes can be serious. Thorough geological surveys will be necessary in the actual locations where fracking occurs, but to further reduce the risk there are regulations to be observed when fracking is taking place. Under this “traffic light system” the operator must monitor seismicity and proceed with caution, or stop, according to the level detected.

The earthquake regulations are much more specific than those for other hazards.

16.Traffic

Fracking in Cheshire East will take place in a rural, farming setting. The area is served by several A roads but mostly by an extensive network of country lanes, bridle ways and footpaths. This network is used by rural workers and also extensively by cyclists, walkers and people accessing recreational facilities. An increase in heavy traffic will have a possibly disastrous effect

The many extra roads and tracks to service gas sites and pipelines will radically alter the nature of the countryside and disrupt its use for agriculture and recreation. Frequent HGV movements on unsuitable narrow country lanes would be particularly disruptive.

There will clearly be a lot of activity in preparing well pads and roads to service them, bringing in and taking away equipment and personnel, and constructing pipelines and it is hard to guess how much traffic that will generate.

But we can estimate HGV movements for bringing and taking away fracking water. As we have seen, each fracked well needs 2-5000 cubic metres of water. A very large, 6-axle articulated tanker carries up to 40,000 litres, or 40 cubic metres, so 50-125 loads would be needed, plus perhaps 25-60 to take away returned water. More trips would be necessary if smaller tankers were used, for example because of the narrow lanes. So we could perhaps guess 75-250 per well. Since there might be 10 or more wells on a site, up to 2500 trips might be necessary to each site.

So perhaps an estimate of 400,000 traffic movements over the life of the gas field would be the the right order of magnitude. Most would be in the construction phases and many would be on narrow country lanes.

17.Planning

Planning permission is required for each of the three phases of a well, exploration, appraisal and production.

The government's Planning Practice Guidance for Onshore Oil and Gas describes the planning process for drilling an exploratory well (it doesn't seem to define the process for appraisal or production wells). A simplified description of the sequence is as follows:

DECC Issues a Petroleum and Exploratory Development Licence.
Operator consults local communities, planning authority, Environment Agency, Natural England and English Heritage.
Operator undertakes Environmental Impact Assessment if required! (Why would it not be required?)
Operator submits and planning authority decides the planning application.
Health and Safety Executive is informed.
Environment Agency issues permits.
DECC grants consent for the well.
The operator is then free to start work on an exploratory well.

The Guidance is clear that further planning applications are needed for the appraisal and production phases, but a procedure is not defined.

If at any stage it is decided to abandon a site, the operator must restore the site to a state agreed by the planning authority (but not necessarily to its original condition).

18.Public opinion

Various public opinion polls, including a series of polls conducted by the government, show that the public is opposed to fracking and that over the past 4 years or so the opposition has grown steadily, although almost half still have no opinion on the subject. By comparison the same polls show overwhelming support for renewables, including strong support for on-shore wind and solar. Ironically the government is now completely out of step with public opinion in promoting fracking while doing everything it can to discourage new solar and on-shore wind. The ostensible reason for limiting renewables is the cap on subsidies for renewables; there is no cap on subsidies for fossil fuels.

19.Opposing fracking

The straightforward way to oppose fracking is through the planning process.

The public are opposed to fracking, as even the government admits, and judging by the protests this opposition increases wherever fracking is proposed. (The government plans to force it on us, in the apparent belief that when we see how benign it is we will change our minds). So it is very likely that any application will attract many objections in the hope of influencing the planning committee. We can also expect national organisations such as Friends of the Earth, and Frack Off to take an interest. Most but not all planning applications so far have been refused, so it is hard to guess what might happen.

The government is determined to establish a fracking industry, and will not submit to being frustrated by local planning decisions. So expect refusals to be overturned on appeal, and even that the planning system will be bypassed altogether.

It would be ambitious to try to influence the government, but we could try talking to our MP.

It is likely if opposition through the planning process is unsuccessful that some people will be prepared to take direct action, as they did at Balcombe and Barton Moss. There were protests and attempts to deny Cuadrilla access to the site at Balcombe, and people were arrested. Cuadrilla were drilling for oil and had not requested permission to frack, although people obviously thought they might. Protestors were also arrested at Barton Moss near Salford where IGAS were drilling to explore for shale gas, but had not requested permission to frack either. On the Fylde recently protesters who have obstructed operations have been threatened with civil action to recover the costs of delays – perhaps more scary and less glamorous than going to gaol.

For a comprehensive guide to opposing fracking see the Stop Fracking Action Pack issued by Friends of the Earth.

20.What is CSG?

CSG has been active in Congleton for a number of years, involved in a number of environmental initiatives including Congleton apple juice and cider made from donated apples, the sale of which finances many of our activities. A main objective has been to combat climate change and we have devised a Green Living course which we has been successfully run several times to help Congleton people to reduce their carbon footprint.
CSG has recently established the Old Sawmill Community Hub, and is involved in the Congleton neighbourhood plan, scrutiny of planning applications, Congleton in Bloom, community gardening, Eco-schools, community energy and cycling provision.