Fracking, *Do Something!*

Action on unconventional gas

Sheet A1

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As we reach the limits to growth[1] the certainties that underpin the modern economic system are failing. As "easy to produce" oil and gas deplete the energy industry is seeking more extreme fuel sources, from deep ocean drilling to tar sands. "Unconventional gas" is a series of technologies that seek to get natural gas from hard to produce/unconventional sources of rock. This sheet looks at the legal and procedural issues related to the development of unconventional gas in the UK, and how the public can intercede at each stage in order to oppose these developments.

Let's jump ahead of ourselves towards one possible end of a campaign against fracking. A company sends in the earth movers to begin development of an unconventional gas production facility and someone decides to jump on the equipment. The police are called and they're charged with *aggravated trespass* under section 68 of the *Criminal Justice and Public Order Act 1994*[2], and removed from the site under the powers given to police in section 69. Aggravated trespass is defined section 68 as –

> A person commits the offence of aggravated trespass if he trespasses on land in the open air and, in relation to any lawful activity which persons are engaging in..., does there anything which is intended by him to have the effect –
>
> (a) of intimidating... them so as to deter them or any of them from engaging in that activity,
>
> (b) of obstructing that activity, or
>
> (c) of disrupting that activity.

The most important words in the above quote are "lawful activity". If the activity isn't lawful, then not only can a charge of aggravated trespass not be brought, but those involved have a legal defence for any "reasonable" action that they took to prevent such unlawful activities taking place.

However, it's not that simple in practice! Whether or not an activity is "lawful" depends upon the chain of events, documents, consultations and the issuing of various legal and procedural forms which demonstrates that the activity is legal – and the only way you're going to know about that is if you check with the relevant agencies first.

That's what this sheet is about. We'll look at:

- The process which should take place before an unconventional gas development gets built and becomes operational;
- Where the public should be involved in that process, and what they can do;
- How the various legal authorities make their decisions; and finally,
- We'll look at what the impacts of these developments are and how to tackle them.

Unconventional gas and the law

Whilst there's a lot of environmental law on the books in the UK, many of these laws are practically enacted in a way that is "seen to be done" rather than "done to be seen". Often you'll find that certain requirements are poorly or partially enacted, and are sometimes ignored.

Gas fracking (both shale and coal seam gas) and underground gasification represent a different problem because the law and official guidance hasn't yet caught up with their unique effects. That means the existing law and policy guidance doesn't automatically consider the peculiarities of these technologies. In the interim we have to use the guidelines which do exist more 'creatively' to stop or obstruct these developments.

Our job, as active citizens, is to use the tools that the system has created to influence the future course of development – even if that means stretching the law through direct action in order to get our point across. No complex system is able to govern itself precisely according to the rules; if it did chaos would be the result because rigid rules can never anticipate what can happen in a complex system. That means that the whole body of law and government guidance often has contradictory viewpoints on the same issue – and it's by using the contradictory checks and balances that we can get decisions made which favour the environment.

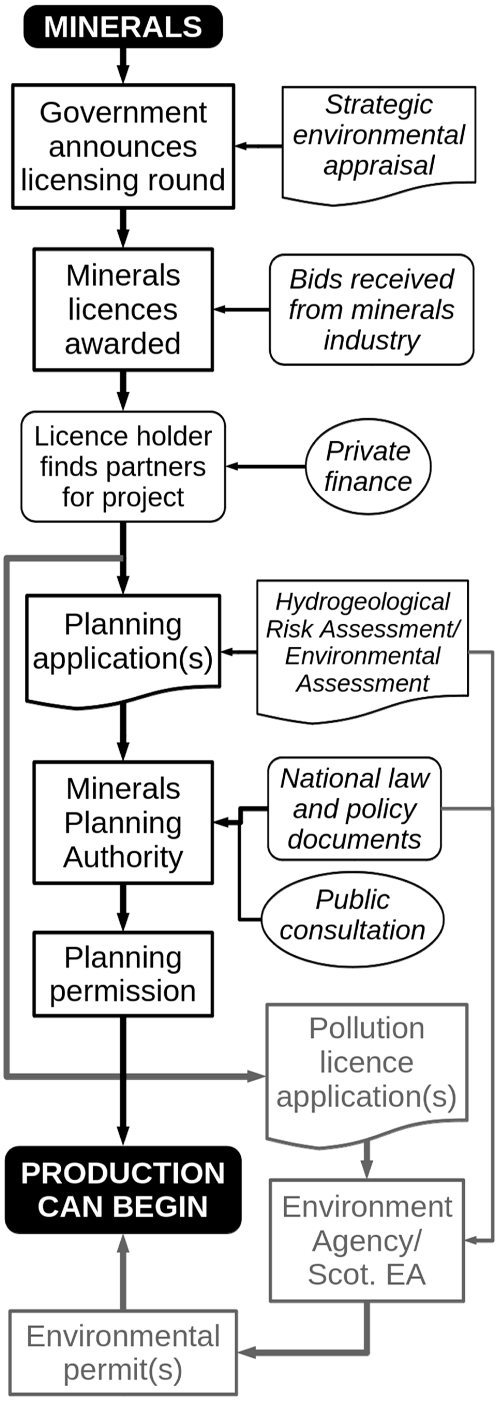
The problem for mainstream environmentalism is that, for at least the last ten or fifteen years, it's prime indicator of sustainability has been carbon – and this over-emphasis on carbon and climate change above all other issues has weakened the ability of the movement to tackle those issues which cut across many different and significant types of ecological impact. For example, the nuclear issue has divided the movement because the over-emphasis on carbon, and reducing carbon emissions, has overridden consideration of the other impacts inherent in running the nuclear fuel cycle.

Tackling unconventional gas requires a multidisciplinary approach. Just like the present difficulties with nuclear power, if we are to understand the effects of unconventional gas then we have to look at far more than the issues of carbon and climate change. That requires that we think more broadly about the using the law/legal tactics, and how we can use the law as a campaigning tool to change the way decisions are made.

Please note: This sheet should be read alongside the Network's Sheet E11. *Fracking and Coalbed Methane: Unconventional gas in the UK*[3]. That sheet gives detailed technical information about unconventional gas processes; this sheet looks at how to take action against such developments by tackling "the system" that regulates them.

The diagram below shows how the regulatory process "should work" – in fact a number of problems have arisen with the regulation of recent unconventional gas developments. We'll work through the flow diagram looking at what should happen, and what has happened with recent applications.

How the process works



Stage 1. Oil and gas licensing

Unlike the USA, where the energy industry buys minerals rights directly from individual landowners, in UK the rights to the nation's fossil fuels are owned by the Government. The rights to energy minerals in Britain were nationalised in the 1930s – except for land held by manorial lords who inherit their titles[4]. This means that the Government – usually the Department of Energy and Climate Change (DECC) – issues licenses to exploit oil, coal and gas. But in isolated cases that might not be so if rights are held by a manorial landowner.

The Government runs oil and gas licensing in 'rounds'; one for off-shore development and a sepa-

Tracking down oil/gas licences and their owners

Whilst they may have dominated the news media, Cuadrilla isn't the only player. There are many other companies/interests that you should be keeping an eye out for. You'll find a list of all the major players in the Deloitte study on the *13th Oil and Gas Licensing Round*[5] (note that this list distinguishes the "owner" of the block from the "operator" who is employed to do the work). If you live in/near the blocks on the list, these are the names to look for.

Knowing what's going on is all a matter of finding your way around various information sources. By knowing what should be allowed, and where, you'll also know when things are happening without the appropriate permits.

Let's begin with the UK national map of *Petroleum Exploration and Development Licences* (PEDLs). The official map of PEDLs[6] is on the Department for Energy and Climate Change web site – `http://og.decc.gov.uk/assets/og/data-maps/maps/landfields-lics.pdf`

Areas licensed by the Government are shaded, and each has names and numbers to identify the licence number and the operator it has been registered to. The PEDL registry[7] is on the DECC site – `http://og.decc.gov.uk/en/olgs/cms/licences/licence_data/recent_licence/recent_licence.aspx`

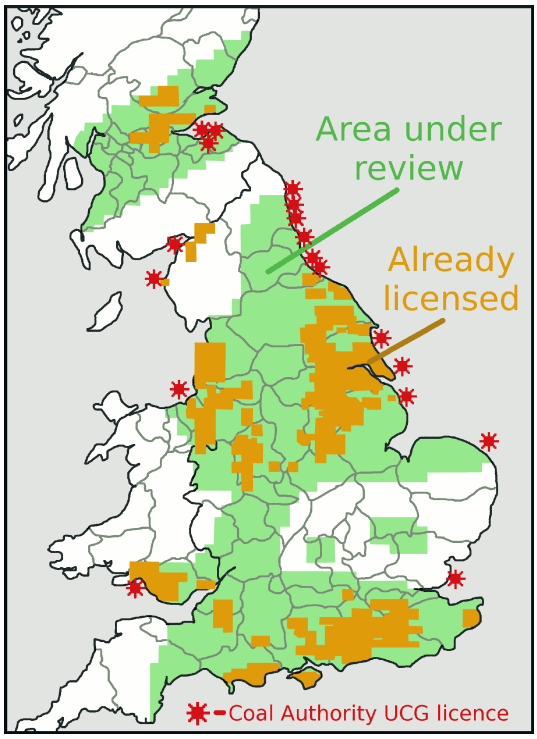
Look-up the licence's PEDL number in the "onshore" index and you'll get the details of who has the right to exploit it. The PEDL licence document contains the basic conditions under which the Government allows the exploitation of oil and gas resources. It contains next to no conditions relating to the operation of the extraction process, of the sites to be developed, or the allowed environmental impacts. The areas currently under offer are available from DECC's SEA documents[8] for the *14th Onshore Licensing Round* (or see the map on the next page).

What's not included on this list are the areas where mineral rights are held by manorial landowners[9], and which have been registered with the Land Registry before the legal cut-off date of October 2013. You can get that data from the Land Registry[10] for specific locations but you have to pay for it. Even so, the details of any agreements between landowners and exploration companies is a private contractual matter, not open for inspection by the public – you won't know about a development until the operator applies for planning permission.

Finally, underground gasification and coalbed methane require a separate authorisation from the Coal Authority. They don't have an on-line register of licences, so if you want to find the details of those you'll need to contact them about their register of licences[11] for a particular area.

rate process for developments on the land. The Government is currently offering licences under the *14th Onshore Oil and Gas Round* – as outlined in Sheet E11 (see map of "areas under review" below). As this is a Government policy decision, European law requires that a strategic environmental assessment[12] (SEA) of the likely impacts of this policy is produced. This was produced for the 14th Onshore Round, but the content of the report is highly flawed. For example, the anticipated number of wells to be drilled for the whole of the UK is less than that proposed by Cuadrilla to develop their licence in Lancashire.

Many of the areas already licensed for unconventional gas are the result of the *13th Onshore Round* (see map). These are the areas for which planning applications are being submitted at present to develop shale gas or coalbed methane facilities.



Note: There is no public involvement with the process of oil and gas licensing, or the content of the licences issued to individual companies. There is no consultation or public validation of either the SEA report or the terms of the individual licences which are awarded by the Government for the development of oil and gas minerals. Likewise the Coal Authority, which authorises operations which disturb coal seams, does not have to consult with the public over the terms of the licences that it issues to companies wanting to extract energy or gas from coal measures.

In 1998, the Aarhus Convention[13] – known formally as the *UN Economic Commission for Europe's Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters* – was agreed, later ratified by the UK government, and came into force in 2005. The purpose of the Convention is to guarantee certain minimum standards of public consultation on, and participation in, decisions on activities which have a significant impact upon the environment. Alongside other statutory national laws on public participation, the Convention has direct effect in the UK in order to guarantee a minimum entitlement to participation in policy formation and decision-making.

The development of oil and gas resources has a significant impact upon the environment – which is why European Union law requires the Government to produce a strategic environment appraisal of the impacts of such development on the environment. However, the fact that the Government does not formally consult the public about its oil and gas development policy in general, and the assessment and awarding of individual licences, is arguably a violation of the Convention. What's required is for those affected by these decisions to make formal complaints to the UNECE on the failure of the UK Government to consult on both the policy in general, and the awarding of licences. The Free Range Network would like to hear from anyone interested in making such complaints[14].

Stage 2. Exploration

The global minerals industry is structured in a way that spreads the risk of development. Minerals licences are looked upon as a form of "property", and having a licence makes the company that holds it worth investing in. Small companies often gain exploration rights and then raise the money from private backers to undertake exploration works. If they strike a significant resource they usually get bought out by the major global players in the minerals industry and make a lot of money; if not, then their investors lose (although in many states, investors often get tax concessions to cover such losses).

The development of unconventional gas in the UK is similar. There are a number of small players – for example Cuadrilla Resources, which has licences to exploit shale gas in Lancashire and elsewhere. Initially Cuadrilla raised the capital to undertake exploratory drilling works. When they "discovered" shale gas in Lancashire they announced this with a great fanfare to the world. That wasn't for the benefit of the public – it was to attract further investment from private energy investment companies around the globe. That new investment will allow them to undertake the next phase of works to develop the gas production infrastructure necessary to supply gas to the national grid. Ultimately, once they have an outfit that has a working gas production system and contracts to supply gas to the grid, that's when it might be sold to one of the large industry players who specialise in ongoing gas production.

From the point of view of campaigns, keeping tabs on who is who in the industry, and who is investing in who, enables you to see who has the power to develop a resource. If a company doesn't strike a large reserve as a result of exploration, it's unlikely that any large-scale development will take place. If a company discovers an economically viable quantity of gas and goes public, by keeping an eye on the media for news about financial backers you'll know that you're likely to see more local development in the future – and you can prepare for that eventuality.

Stage 3. Planning permission

Before development of a site for unconventional gas production can take place, planning permission has to be sought from the local minerals planning authority[15] – which is most cases is the local County Council or unitary authority for the area. The local authority has a statutory development plan, and this will contain policies relating to the regulation of minerals development in its area. In turn the policies of this document are considered alongside the national minerals policy guidance/policy statements produced by the English, Welsh or Scottish governments (there are subtle differences, so you'll need to check the policy for your national government).

The problem with the present structure is that unconventional gas development is so “new” that the existing planning guidance doesn't cover its impacts in detail; and existing local development plans will not have detailed policies to consider planning applications. In effect then, local authorities have to make up the policy as they go along – and that's an opportunity for local campaigners to influence how planners deal with these applications, and consider/assess the impacts of these developments.

Despite the many protestations we've seen in the media, there is usually no legal requirement for an environmental assessment of unconventional gas exploration. Provided that the area taken up by the site is less than one hectare, paragraph 2(d) of Schedule 2 of the Environmental Assessment Regulations[16] exempts deep drilling from environmental assessment. Unlike conventional development, which takes place on a large area, the limits for drilling mean that most developments won't qualify. However, that's not necessarily a problem. Environmental assessment is in any case quite restrictive because the form of the assessment is proscribed in law. In fact, local authorities are free to consider any “material consideration”, such as pollution of other hazards, as part of any planning decision[17].

Planning and pollution control are operated as separate systems, administered by separate public bodies: Planning is run by local authorities; pollution control is administered by the Environment Agency (EA) in England and Wales, and by the Scottish Environmental Protection Agency (SEPA) in Scotland. Whilst these systems are separate, it does not prevent planning authorities considering things like groundwater or air pollution. European laws on these issues apply to local councils just as much as the pollution regulators. For example, as a body with decision-making powers which affect groundwater, local planners are subject to the requirements of the European Groundwater Directive – even though the regulation of activities under the Directive is normally carried out by the pollution regulator.

At present, as part of the new review of “red tape” by the Con-Dem government, this planning guidance is under attack – and may be withdrawn in the very near future. Even if that happens, there are still plenty of decisions on these matters that have been handed down by the High Court in London and Edinburgh, and which local planning authorities should consider when determining planning applications. Unless national governments ban planning authorities from considering the environmental implications of development (which has all sorts of legal implications), irrespective of the lack of a formal environmental assessment local planners can still demand information on pollution/ecological matters.

Stage 4. Pollution permits

In theory, any time pollution enters the environment above a certain proscribed level, or in a certain place, it should first have a permit from the agency responsible for regulating that pollution. In reality, that's not the case so far in relation to unconventional gas development in the UK. As noted in evidence to a Parliamentary committee, the EA does not believe that it needs to regulate the exploration for shale gas[18]. And in Scotland, while SEPA has decided that permits are required for coalbed methane exploration[19], the terms of those permits relating to the pollutants in the fracking fluid used are “commercially confidential” – the public are not allowed to know either what is being put into groundwater, nor what levels are allowed for these pollutants.

It would take many pages to explain precisely why the EA have improperly interpreted/are not properly applying the law in relation to Cuadrilla's operations in Lancashire. What follows is just an outline to highlight the main points: Firstly, groundwater is protected in law by the Groundwater Regulations 1998[20]. This implements the EC Groundwater Directive[21] in UK law, creates an absolute ban on the discharge to groundwater of the most toxic, persistent and bioaccumulative “List 1” substances, and requires strict conditions to limit the release of “List 2” substances which have a harmful effect on groundwater. Secondly, under the Environmental Permitting Regulations (and the parallel “controlled activities” regulation in Scotland), shale gas/coalbed methane well drilling and fracking constitute a “groundwater activity”[22] because it involves either –

- “the discharge of a pollutant that results in the direct input of that pollutant to groundwater”,
- “the discharge of a pollutant in circumstances that might lead to an indirect input of that pollutant to groundwater”, or
- “any other discharge that might lead to the direct or indirect input of a pollutant to groundwater”

– and it is not reasonably exempted by any of the exclusion clauses.

In England, both the Government's recently revised core guidance[23] on environmental permitting, and the Environment Agency's own regulatory guidance on permitting[24], also indicates that these processes should be controlled by a permit – but so far the Agency has not moved to require operators (like Cuadrilla) to obtain them. As a result, as well as challenging the fracking companies directly, it is our view

that campaign groups should turn their attention to the work of the Environment Agency too – since they're arguably breaking their own and the Government's rules in not demanding that Cuadrilla apply for a pollution permit for their fracking activities.

In Scotland the situation is more bizarre. SEPA *have* issued licences for Greenpark Energy's coalbed methane exploration works; the problem is that those authorisations are, for the public, next to useless because the limits and permitted substances are commercially confidential. Taking the permit issued for Mouldyhills near Canonbie as an example[19], Schedule 4 states –

> The chemical composition of the fracture fluids to be discharged shall comply with the information supplied in Table 2.2: Vertical wells fracture foam composition, and Table 2.3: Lateral wells fracture foam composition, of the document 'CBM and Fraccing: Hydrogeological Risk Assessment' submitted with the application to this licence.

The problem is that, as part of their application to SEPA in November 2010, Greenpark asked that section 2.2 of the hydrogeological risk assessment report (see box for an explanation) – *which contains the all-important Tables 2.2 and 2.3* – be kept confidential. The same request was made in their application for the operations at Broadmeadows. The effect of this is that the licences have limits and parameters which are secret. In turn, whatever monitoring data is made public, there is no way for the information to be independently assessed against the licence because no one outside the company or SEPA is allowed to know what the relevant limits/parameters are!

If shale gas/coalbed methane operators are so confident about their process they would throw open all their research and data to public scrutiny. More significantly, we have to question the role of the EA/SEPA in evaluating whether or not data is legitimately "secret", or whether data must be disclosed in order to create confidence in the safety of the process, and of the monitoring processes required to demonstrate that safety. Rather like the "Halliburton loophole"[26] in the USA, if the industry has nothing to hide why does it ask for data essential to the transparent and independent evaluation of these projects to be hidden from public view?

Both the EA and SEPA should publicise applications for permits, but to know if there's an application pending takes a lot of effort. Whilst the Environment Agency has very formal public consultation guidelines[27], SEPA is a little more fragmented in its approach – each different legislative regime having slightly different considerations over the nature of public consultation. That's why it's important to get the details of local PEDLs, from the DECC web site[7], so that you can narrow down the likely identity of the companies involved.

To check for existing licences/permits in England and Wales is fairly simple – the Environment Agency's public register is available on-line[28]. SEPA still doesn't have a live on-line public register, and so

Hydrogeological risk assessments

The core of the safety argument relating to any activity which discharges pollutants to groundwater (e.g., landfill sites[25]) is the *hydrogeological risk assessment* – or HRA. HRA's are drawn up to look at the characteristics of the local geology, identify how groundwater moves through the rocks, and then assess what happens if you drop pollutants into that environment at a specific point and/or change the sub-surface flow of water.

Groundwater moves at different speeds depending upon the nature of the rocks, how fractured they are, and how the pressure changes underground. Any pollutants discharged can interact with rocks, and this can have the effect of absorbing or neutralising the compounds contained, or flushing out new pollutants as the discharges react with substances in the rock. How "good" the HRA is depends upon the extent to which data is collected, and how that data is modelled: Firstly, to understand how groundwater moves in the area; and then, what the effects of changing that system might be.

The difficulty is that all HRAs are based upon assumptions drawn from a very few data points (usually boreholes historically drilled in the area to study the geology) – and like any system that relies on very small samples of data there is a higher likelihood of error. For example, if there are only a few local boreholes to tell you how the rock strata are arranged beneath the surface, the assessment might assume factors to exist which do not, or omit unanticipated effects which were not highlighted due to the lack of geological data.

The Free Range Network have recently obtained a complete copy of the HRA produced for Greenpark Energy for their coalbed methane exploration near Canonbie – *the document submitted to SEPA, parts of which are "secret"*. We cannot see how SEPA accepted that any part of it should have been made secret; there is nothing in it that merits the secrecy clauses of permitting regulations being used to prevent public disclosure. However, what this secrecy has enabled is the operator to get a licence without a public and critical evaluation of their safety case.

The document is a "simple" HRA. It contains no detail or quantified assessment of how the pollutants will, over a long period of time, interact with the environment. The arguments used to support their claims are not backed up with detailed hydrogeological modelling of pollution dispersion, nor is there any detailed geological analysis to demonstrate that the existing or manufactured cracks and fissures in the rocks will not create avenues for pollution transport from the coal seams to the water aquifer above.

The basic flaw in the EA/SEPA evaluation of fracking is that they see the target shale/coal seam as an "impermeable" rock strata; and to a certain extent, that is correct. The issue is that hydraulic fracturing by its nature breaks-up the rock to create new paths for water migration – and that has the potential to turn a low permeability rock strata into a more permeable strata which is capable of leaching any pollutants it contains into the surrounding rocks.

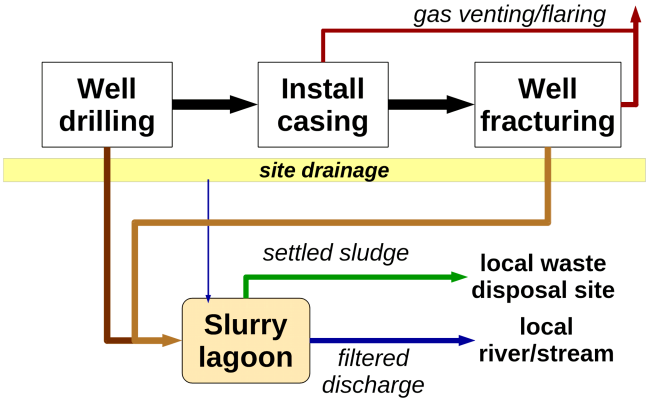
it's necessary to check with the register held at the local area office to find licences for any existing operations. How to look at and interrogate public registers is an issue in itself – far too complex to go into here. The Free Range Network may at some point in the future issue a briefing on this subject.

Stage 5. Production

Due to the popularity of documentaries such as *Gasland*[29] the public's view of shale gas is somewhat skewed towards certain aspects of fracking – primarily water pollution. And whilst *Gasland* shows dramatic footage of flammable drinking water, it's not very good at explaining the mechanics of unconventional gas exploration, development and operation. It's not that *Gasland* is wrong in what it presents; it's that to actively oppose unconventional gas it's necessary to have a more in-depth knowledge of these processes so that you can convincingly convey the issues to the media and the general public.

To make the production of unconventional gas easier to understand we'll break it down into three phases: Well development; well production; and gas processing. Note that whilst this information is generally correct for both shale gas and coalbed methane, it doesn't describe the issues that arise with underground gasification. We'll deal with that last.

(a) Shale gas/CBM well installation



Firstly, let's look at well development. Earlier, at 'Stage 2', we looked at how the company holding the exploration licence seeks private backers to provide the capital for development. That's the first stage in the development chain. The company will then outsource large parts of the expertise it requires to companies/partners hired under contract: One company might be involved in preparing the site; another will bring the drilling rig for the initial well bore; another will fracture the well and do initial tests; finally, if the gas is economic to extract, yet more companies will provide other elements of the infrastructure to develop the site and link it together with others in the area in order to produce gas for the national gas grid.

If you look at the diagram above you'll see that well drilling is the first operation after site preparation. The initial drilling is very similar to other types of deep drilling. Well drilling[30] is very much more advanced today than it was a few decades ago. It isn't just the drilling bit that's advanced. Drilling mud[31] – the slurry which lubricates the bit – used to be a mixture of clay and water. Today its a highly specialised compound, optimised to drill through certain types of rock more easily. It not only contains materials to lubricate and cool the drill bit, it also contains chemicals to dissolve the chunks of rock, keep minerals in solution, and allow the drilled material to be brought to the surface more easily. The cheapest drilling muds are usually oil based; more advanced muds, for use in areas of vulnerable groundwater, are made from synthetic oils or are water based, and for that reason are more expensive.

As drilling progresses the mud, containing ground and shattered rock, is pumped to the slurry lagoon. This allows the sediment load to settle out and the water may be recycled back to the drilling operation. At this early stage the impact of the material in the lagoon is related to the quality of the rock being drilled. In most cases this material could be disposed of to a local inert waste landfill site – and it may ultimately be buried on-site. It's only at later stages that more problematic pollutants are likely to enter the lagoon. The main problem the lagoon presents is the sediment load from the drilling operations – if it were to overspill and enter local waterways it would choke the aquatic ecosystem due to the excess sediment load (this happens far more often in other types of development, and from agricultural erosion).

The settled and treated discharge might be disposed of to a local watercourse, but often it's easier to tanker the material away to avoid setting up a treatment plant. For example, Cuadrilla have taken their waste water from Lancashire to Davyhulme sewage treatment works near Manchester (although because of the volumes involved and the levels of contamination, Cuadrilla now need to find another disposal option for the waste water they produce).

Next the well casing[32] is installed. As the well is drilled casings are driven deeper. Each separate string of casing fits inside another. At a meeting in Lancashire a Cuadrilla representative said that there were three layers of steel casing to protect the well. That's entirely true – *at the surface*. In reality each casing runs for a certain length and then stops, and the final casing will, at depth, only have one layer of steel a few millimetres thick. As the well is drilled and the casing installed, a cement slurry is forced under pressure between the casing and the drilled rock. This is intended to seal the hole so that fluid can't leak back up the well bore – but how well that functions depends on the quality of the cement job.

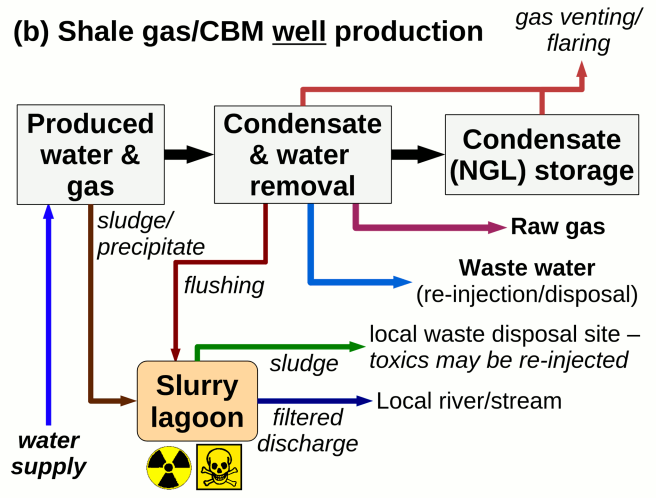
Then another specialist company will take over the well and conduct the fracturing operation[33]. Fracking is discussed at length in many other sources, and in our Sheet E11, so we won't go into detail here. The complication of fracking is that the chemicals used will contaminate the largely inert material in the slurry lagoon. This might create problems disposing of the material/waste water from the lagoon after fracking

operations have taken place.

From when the well bore enters rock strata which contain gas, natural gas will begin to flow back up the well. Initially much of that gas will be dissolved in the drilling mud, but as it comes to the surface the release of pressure will make it bubble out of solution (like opening a lemonade bottle, the pressure release creates gas bubbles). Any remaining gas is likely to diffuse out of solution once the drilling mud is settled in the slurry lagoon. We'll look at the significance of gas venting/flaring later.

Finally, there is an erroneous view that coalbed methane operations don't involve fracking; it does, but it's often a less intense operation because coal seams are more easily fractured, and the gas flows at higher rates, without the use of extreme pressures. Coalbed methane wells still use pressure, and they still require chemicals and a sand proppant to hold open the cracks created. Recent reports[34] from those parts of the USA with a high level of CBM sites, such as the Powder River Basin, are reporting similar kind of pollution incidents to those experienced in shale gas areas.

In terms of well safety, the probability that a single well will fail and leak contaminants into the environment is low. However, it is not possible to guarantee that *every well* will not leak. The issue about groundwater pollution is that you only need one or two wells out of a hundred to fail for pollution to become a problem. Experience from other activities, especially industrial processes and waste disposal[35], demonstrate that a very little pollution can go a very long way once it enters the groundwater.



When the well has been fracked, and it's established that gas production is economically sustainable, the well is capped. Then the well pad can be connected by pipelines to the processing site. Each well pad can have one or more wells. Where vertical drilling is used the pad might only have one or two; where horizontal drilling is used each pad might have up to twenty wells, fanning out in all directions.

Once gas production begins production water is circulated in the well to bring dissolved gas and gas bubbles to the surface. This will bring with it rock sludge and precipitated minerals which must be settled out of solution, and eventually dumped in the slurry lagoon. Next the water and gas are separated. Again, all the parts of the plant which treat process water will progressively silt up, and this is controlled by regular flushing of the pipework – the material once again ending up in the lagoon. Chemicals can be added to the process water to keep mineral precipitation and sludge fouling to a minimum, but the system still needs to be cleaned regularly.

At this stage the sludge and minerals brought to the surface will contain contaminants from deep rocks. This is likely to have high levels of heavy metals, and perhaps even radioactive elements such as uranium, thorium and radium. The problem can be worse for coalbed methane plants because coal seams – just like the carbon in a home water filter – can lock-up pollutants from groundwater, and these can be released as part of CBM operations. This can create a problem when disposing of the process waste from the lagoon. Often both the waste water from the process and the waste slurry are re-injected into deep rock strata via a disposal well. The problem here is that the large volumes of fluid involved can lubricate deep geological faults – and in the USA waste water deep disposal has been linked to the high level of earthquakes[36] from unconventional gas operations.

For unconventional gas processes the ubiquitous contaminant is 'BTEX'[37] (an acronym for benzene, toluene, ethyl benzene and xylene). This is a problem because it is highly mobile in groundwater. However, to date shale gas documentaries haven't examined the full hydrogeological realities of contaminant migration. Whilst BTEX and methane gas might be the initial problem because of its high rate of dispersion in groundwater, if BTEX is produced in groundwater/the biosphere from fracking operations that might be an indicator that a few years, or even decades later, other more problematic pollutants such as heavy metals might emerge.

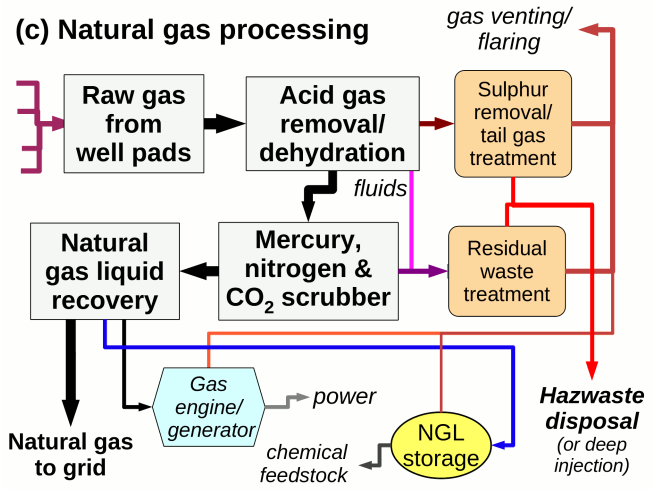
As part of de-watering, the produced water might contain a very light oil – similar to light sweet crude oil (a very valuable product). This can be skimmed-off and stored for transport to an oil refinery. As the gas is cooled further other light oils can condensate out of the gas. It is possible that, if high levels are produced, it will be removed and stored in 'condensate tanks' at the well site. If only low levels are produced it might not be economic to separate, and it might be re-injected with the waste water. Condensate[38] has become an issue in the US because, as a volatile mix of highly flammable hydrocarbons, it's been the cause of a number of fires at well sites[39]. It's also highly toxic if it spills and enters the local water environment.

Finally, all the pipework in the production plant must have safety valves to prevent over-pressures damaging the system. Some dissolved gas might diffuse out of the slurry lagoon. Also, during maintenance, gas might be flushed from the system. This

means that the site might have a high level of fugitive methane releases[40] – the main factor in recent research which shows that shale gas/CBM carbon emissions are as bad as/worse than coal. The gas industry criticised the first paper on this issue[41], but new research shows, as outlined in the revised paper[42] from the research group involved, that the methane emissions are far closer to those stated in the original paper than the levels claimed by the gas industry. Recent research from the US also indicates that conventional gas fields have high leakage rates[43], meaning that gas may not be the "bridge fuel" to a low carbon economy that many hope for (we must also ask, a "bridge" to what alternative?).

The usual practice is for the raw gas produced from a large number of well pads to be transported to a central gas processing facility. This is a more economic option than treating the gas at each pad location. The raw gas contains many chemical compounds which would damage the gas distribution system, as well as heavy metals and other contaminants which need to be removed.

How the gas processing is organised is largely a balance between the efficiency of centralisation versus the ever greater costs of burying more and more pipelines to transport the raw gas from the pads to the processing site. Note that the issue of pipeline construction is rarely touched upon. However, in a highly developed landscape such as the UK, the level of pipeline construction required to develop a gas field will have a significant impact upon agriculture, hedgerows and local hydrology.



The first stage in gas processing is acid gas removal. This is involves removing sulphur compounds from the gas, as well as drying the gas to remove water vapour. The waste produced by this process may be a dry power, but if waste re-injection is used a highly acidic liquid is more likely to be produced. Mercury is a gas at the relatively high temperatures of the deep well. As the produced water is cooled it condenses to form a liquid metal. The gas might also contain high levels of carbon dioxide, nitrogen, and even helium. High levels of inert gases have to be removed in order that the gas supplied to the grid contains the right amount of methane per volume of gas, as dictated by the standards set by the national gas grid operators. As part of this process petroleum gases – such as propane and butane – might be produced, as well as more highly volatile natural gas liquids; although if it isn't economic to separate them they might be left in the gas.

The important thing to understand is that there are no standard results from unconventional gas processes. Natural variability in the rock strata influence not just how much gas is produced, but also how much contamination might be produced along with the gas. For example, how much mercury is produced varies between rock strata, and might even vary from well to well. Likewise the level of sulphur and oil condensate. Just as the fracking fluid mix has to be optimised for each well site, so the choice as to how to treat or process the raw gas might depend upon how conditions across the gas field vary.

Waste disposal is an issue that is also affected by local circumstances. In areas where there is already a high level of hazardous waste landfill sites (e.g., Lancashire) the disposal of waste materials to landfill is a simple, if expensive option. In contrast, areas like the South East have a shortage of landfill, and this makes the re-injection of toxic materials more likely. The problem is that if the re-injection of waste gives rise to pollution of groundwater, or worse of pollution directly entering the biosphere, increasing the level of the toxicity of the injected waste may store up greater problems for the future.

Another factor that's become more of an issue in the USA is natural gas prices. As gas prices have fallen it's become common to see more electricity generating plants developed at gas processing sites. Electricity traded on the open market can, at times of shortage, be worth more than natural gas. The problem is that as the processing operations become more intensive, so the noise produced can increase (unless expensive noise abatement measures are adopted). The fact that more gas is burnt on site also makes the plant a greater source of air pollution.

Perhaps the greatest issue yet to be properly exposed in relation to unconventional gas is air pollution[44]. As noted above, methane releases have a large effect on the carbon footprint of the process. But with the methane comes a variety of other volatile organic compounds[45] (VOCs) which can contribute to the formation of smog. Even where these gases are flared, the gas flare can also lead to the formation of secondary pollutants, such as sulphur compounds, and of nitrogen oxides which also increase air pollution – unless a more expensive catalytic oxidation process (rather like the catalytic converter on cars) is used to burn the gas.

The health impacts of the air pollution caused by unconventional gas processes are only just being assessed[46]. The results to date indicate that for those areas already subject to pre-existing high levels of air pollution[47] – such as the North West, Midlands and South East of Britain[48] – adding yet more

pollutants could have the potential to worsen air pollution further. As recently noted by the OECD[49], air pollution is today becoming the one of the greatest single impacts of industrialisation on the human population of the planet, as well as causing damage to both natural ecosystems and agricultural crops.

Underground coal gasification (UCG)

UCG, despite the protestations of the industry, is still a largely experimental process. Whilst it has been used in a few locations around the world over the last sixty to seventy years, it still not a 'perfected' technology. UCG works by gasifying – in effect, "burning" the coal in an atmosphere starved of oxygen – to produce a gas composed mainly of hydrogen, carbon monoxide and methane. However this process has proved extremely difficult to control, and for a variety of reasons it can give rise to problematic pollutants which can enter groundwater.

One of the main centres for developing UCG today is Queensland in Australia[50]. Whilst the Queensland State Government initially supported the setting up of three pilot projects in 2009, the result to date do not give confidence in the ability of the industry to control this process. Of three pilot plants set up in Queensland, two have failed: In July 2010 the State ordered Cougar Energy to stop and not recommence underground burning of coal at its Kingaroy plant, following water quality tests in groundwater monitoring bores close to the plant (monitoring showed widespread BTEX contamination in the local environment); more recently an incident at Carbon Energy's plant near Dalby led to the State issuing an order to shutdown the plant and not recommence operations (the detailed reasons for this closure have yet to emerge).

In the UK, it's reported that the Coal Authority have issued up to 18 licences[58] to allow the development of UCG pilot plants (see map earlier). So far only one has been proposed for development, in Swansea Bay[51]. Britain, contrary to the popular myth, has mined much of its conventional coal resources. What's left is very deep, and UCG is the industry's last hope of "extracting" the financial value of the coal resource. However, results from the recent tests in Australia, and in fact from the pilot plants which were set up and abandoned in Britain during the 1950s, demonstrate that this technology is extremely volatile. Any hope that UCG would allow "business as usual" to continue, by opening up the world's remaining coal reserves for exploitation, is looking extremely tenuous.

The challenge to the environment movement

Over the last eight pages we've taken a very general run through the regulatory issues related to unconventional gas, as well as the impacts of these processes. In Sheet E11[3] we concluded by looking at the impact of shale gas on the Britain's energy security – and found that it made very little difference because what's dominating the energy market today is not just a shortage of new supplies, it's the depletion of many of our existing energy sources. That raises a problematic issue about how the environment movement deals with unconventional gas, and the energy and resource question in general.

Thirty years ago what dominated the environmental debate was the idea of "limits to growth"[52] – the fact that industrial and economic growth would eventually be choked off by a shortage of resources. In the 1990s environmentalism became "politically acceptable" because it dropped this fundamental objection to growth economics, and instead opted for green consumerism and sustainable consumption as the solution to our problems. In fact, the "limits" issue never went away[53]; as demonstrated by recent scientific studies, it's been inexorably growing as a problem[54], ignored not just by mainstream society but also by large sections of the environment movement who felt it easier to convey a more pro-consumption message as part of their work.

Today the "limits" issue is once more challenging the environment movement[55]. That's in part because ecological limits are now destabilising the human system – most notably the plateau in oil production since 2005, which alerts us to the imminent decline in production over the next few years[56]. The economic crash of 2008 did more to reduce global carbon emissions than any "planned" measures implemented by governments or the UN. In fact, if we look at the historic data, we've emitted a third of the carbon over the entire Industrial Revolution *since* the world's government's agreed that action was urgently needed in 1992 – and 20 years of conference and campaigns since have not addressed that problem.

It is not possible to deal with unconventional gas just as a "carbon" issue. That's because the ecological impacts of the process are more problematic that simply the emission of yet more carbon into the atmosphere. In any case, proposal such as underground gasification claim to be developing carbon capture to work with the process. Whilst that may get rid of the carbon objections, it does nothing to address the environmental pollution that is the likely result of using these technologies.

For the environment movement today, "limits to growth" isn't just a challenge because its throwing desperate measures such as unconventional oil and gas into the energy mix; its a challenge because the movement's infatuation with carbon as the prime indicator of human sustainability has robbed it of its incisive critique of the human situation – and of the measures which need to be taken to address that. Unconventional gas represents a multi-disciplinary issue that requires those interested to be aware of many aspects of public/legal administration and environmental pollution – certainly beyond those factors/issues that have formed the centre of consumer-oriented lobbying over the last decade or so.

To address the issues raised by unconventional gas, and other such extreme technologies which are designed to liquidate the value the last of the world's fossil fuel resources, we have to engage with the full spectrum of ecological impacts. The same process is

taking place within the nuclear debate too, as problems with uranium supply resurrect the thorny issues of fast reactors and the thorium fuel cycle. That's because the process driving this – the need to maintain growth of the globalised economic process – can no longer operate using conventional technologies due to the ecological limits now obstructing our future development. Accepting that fact, and finding solutions to this predicament, involves addressing the same questions which drove the environment movement 30 to 40 years ago.

Get involved and get active

As the applications begin to roll in as a result of the 13th Onshore Oil and Gas Round, campaigns are springing up around the UK to oppose unconventional gas development. As the Government issues new exploration licences in 2012, yet more areas of Britain will potentially be affected. Whilst the shale gas bubble has to some extent burst in the US – the effect of a fall in natural gas prices – in Europe the hype of the potential of unconventional gas continues. To tackle this we need not just active communities – we need *informed* communities.

The first step is to find out if you are "on the map". As outlined in the box on page 2, you can use DECC's onshore licences map[6] to find if you are in a licensed area. Next, use the map to get the PEDL number, and then use DECC's licence database to get the name of the operator. If you then feed the name(s) of the licence holder and "*PEDLXXX*" (replacing 'xxx' with the licence number) into Google you're likely to find something about the operator, or perhaps even reports on the exploration work that has already taken place. It's more likely you're in one of the areas being reviewed for the current 14th Onshore Round – as shown in the map on page 3. This means that you might be subject to such developments in the future, and so now is the time to get organising to be ready if anything kicks off.

Next, you need to learn more about the issues. In this sheet we've outlined the legal procedural issues; in Sheet E11 we've outlined the technical/energy issues raised by unconventional gas. The index pages for both these sheets contain a directory of web sites, reports, videos and other information that extends the information contained in the sheets –

- *Sheet A1* – `http://www.fraw.org.uk/fwd?a1`
- *Sheet E11* – `http://www.fraw.org.uk/fwd?e11`

If you are concerned and want to become more active you should network with other groups working on the issue. The best sources of information are:

- *Frack Off!* – `http://frack-off.org.uk/`
- For regular news subscribe to the *No Shale Gas UK* email list – send an email to `no_shale_gas_uk-subscribe@lists.riseup.net`

In those areas where activities have already started groups are already at work. You'll find details of the groups opposing unconventional gas development in the 'links' sections of the web sites above.

The important thing, especially in those areas currently under review, is not to wait for things to happen. You can help the situation nationally by working locally to highlight the issues and development a movement against unconventional gas. That might dissuade operators from setting up locally, but the more important effect will be to create a mass of people nationally switched onto the issues – not just the problems with this technology, but also the energy and economic trends which are forcing the industry to adopt such extreme solutions to the maintenance of "business as usual".

The next best step is to contact and lobby local politicians and council officers, especially those in the planning authority, to make sure that in the event of an application coming in you have the contacts to do something about it. In particular ask the minerals planning authority, even before they've registered an application, what policies they have on this, and how they would handle such an application if one were to be presented to them. Also don't forget the local Environment Agency/SEPA offices. If you have to deal with pollution applications in the future, begin to learn about the work of your local regulators, and how their offices function, so you're ready for the time when you have just a few weeks, or days, to respond to an application (also, in getting to know your regulator's local offices, you might come across other local problems that need some attention).

What's next?

We'll know more about how things are likely to develop once the Government announce the results of the 14th Licensing Round later in 2012. If there are a lot of areas licensed, we can expect a long haul ahead; if it's only a few, then it means that even the industry doesn't hold out much hope.

In America, the US EPA are carrying out a 2 year study of the effects of fracking[57] – due to report in 2014. As the effects of past developments – from shale gas in the USA to coalbed methane and underground gasification in Australia – emerge there's more and more evidence entering the public domain on the problem created by these technologies.

If we can develop a network of well-informed people before the industry roll out new developments in Britain, then we have a greater change of success. That, ultimately, is the purpose of the work by the Free Range Network on the unconventional gas issue. Keep checking out web site for further work around this issue – `http://www.fraw.org.uk/`

Produced by the Free Range 'Energy Beyond Oil' Project – `http://www.fraw.org.uk/projects/energy_beyond_oil/`