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Paul Mobbs' newsletter of thoughts, ideas and observations on energy, economics and human ecology

<http://www.fraw.org.uk/mei/ecolonomics/>

ecolonomics@fraw.org.uk

Extreme energy and public health: How the Government engineered the denial of the health impacts of unconventional oil & gas

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I've spend the last few weeks writing a "complaint". The subject of that complaint was Public Health England's (PHE) recent report, Review of the Potential Public Health Impacts of Exposures to Chemical and Radioactive Pollutants as a Result of Shale Gas Extraction – draft for comment. As the title suggests, this was a report produced by PHE to identify the public health implications of shale gas.

Despite being a "draft", the report has been quoted by the Government and others as if it were authoritative. More importantly, upon a critical reading, the report doesn't establish any valid conclusions regarding the impacts of shale gas on public health.

This is a very complicated matter; as attested by the fact it took 95 pages and over 200 references – mostly to academic papers – to explain the situation to Public Health England. What I will do here is, firstly, outline why there is good evidence that extreme energy sources have serious implications for public health; then, secondly, outline the process by which PHE chose to ignore those impacts – in a way which could best be described as, "scientific misconduct".

There is plenty of evidence that the Government's "fracking" policy will damage health. Therefore the most significant issue to discuss is how the Government are manipulating evidence to say the opposite.

Introduction:

Why it's important to define our terms

Public Health England's (PHE) report on [shale gas and human health](#)¹ is, in global terms, quite significant. There have been few attempts to quantify the risks to public health from shale gas, coalbed methane, tar sands, etc. – in part because in those nations where it is being pursued, official inaction and/or obstruction [prevents such studies being carried out](#)². In the UK, the PHE review attempted to analyse the risks; it drew up a review of the available evidence which might help that process; and then it disregarded the substance of critical parts of that evidence to draw conclusions which fitted a national policy agenda – which strongly favours "extreme" unconventional oil and gas energy sources.

That, in a sense, was the conclusion of [my critical review of the PHE's report](#)³.

It's also interesting to compare the relative disconnect between PHE's review, and the Department for Energy and Climate Change's (DECC) recent strategic environmental appraisal (SEA) of the [on-shore oil and gas licensing policy](#)⁴. For example, DECC's SEA report notes that disposing of effluent underground through deep injection would not be legally possible in the UK; but in their review PHE appear to assume that deep injection of effluents would remove the problem. Perhaps the greatest flaw in PHE's review was that the most recent research identifies a broad range of public health issues [which must be addressed as part of this process](#)⁵ – but they did not consider the totality of those impacts as part of the technical discussion in their report.

The PHE review only considered "shale gas". That in itself was a significant flaw as a number of differ-

ent “extreme” energy sources are now being planned. The generic term “extreme energy” encompasses a variety of energy technologies – all of which, compared to their traditional counterparts, have a higher ecological footprint. In the UK context, the technologies which either are in the process of being [developed](#)⁶ or actively [explored for](#)⁷ are:

- [Tight oil](#)⁸ and [gas](#)⁹ – for example, Balcombe in Sussex, and other sites across southern England from Kent to Dorset, and in East Yorkshire and Humberside;
- [Shale gas](#)¹⁰ – so far that's mid-Lancashire, but it's also being planned elsewhere, from southern England to the Scottish border;
- [Coalbed methane](#)¹¹, or CBM (also called coal seam gas, or CSG, in Australia) – currently under-way in South Lancashire and in Scotland near Falkirk, but also planned across South Wales, the Marches, Kent and Yorkshire/the East Midlands; and finally,
- [Underground coal gasification](#)¹², or UCG – currently planned at various sites around the UK coastline, and in mid-Warwickshire.

Do these technologies have an impact upon health and the environment? The very simple answer to that is, “yes”. That's because each of these technologies involve the transfer of pollutants which were geologically isolated into the biosphere; and many of those pollutants have toxic consequences for the environment and human health. Therefore the impact of increasing environmental pollution will always be a statistically higher – a perhaps small, *but not zero* – chance of creating human health and ecological effects.

That's why the question, “do they cause health impacts” is the wrong question to ask. What we must ask is, “do the emissions to the environment have significant health impacts?” – in other words, will the impact of these pollutants be not only probable, but also distinctly identifiable as being the result of extreme fossil fuel operations?

That question defines the problem which has to be assessed as part of the permitting and regulation of these technologies. The reality is that, as yet, that question has no clearly defined answer.

What we can say in response to that question, heavily qualified depending which part of the system we're examining, is “probably” – the effect is clearly “non-zero”, but it's the probability and severity which has yet to be established by current research. Certainly, the evidence generated by recent research challenges the “low risk” prognosis stated in the conclusion to PHE's review.

The difficulty is that this is not the level of public discussion which we're having on this issue. Instead [public relations techniques](#)¹³ are being used to avoid addressing these central question of the “signifi-

cance” of impacts, and largely dismisses potential problems, by the use of media management (as seen so often in cases where ecologically indefensible processes have been [promoted by business interests in the past](#)¹⁴).

A good example would be the way in which the PHE report itself has been used since its creation. Last Autumn this report was launched in a blaze of publicity, and has since been quoted widely by governments and the unconventional gas industry; but rarely do those quotes allude to the fact that this report is titled as a “draft for comment”.

For example, the Energy and Business Minister [Michael Fallon stated](#)¹⁵ on the launch of PHE's report, “*I welcome this report which shows that the potential risk to public health from shale gas production in the UK is low.*” Likewise, the media coverage of the launch talked-up the report, but failed to [quote its “draft” status](#)¹⁶.

In terms of how PHE's report may be used to manage the media's view of extreme energy technologies, it's also important to understand how public health in England and Wales is run. PHE is a notionally 'independent' executive agency of the Department of Health, which makes decisions on public health for the Government. However, local authorities also have Environmental Health Departments (EHD), and there are also independent local Directors of Public Health (DoPH), who have responsibility to locally elected committees, who are there to ensure that public is not affected by pollution.

By bringing out their report early, arguably in support of this great media manage initiative over shale gas by the Government and the industry, PHE have tied the hands of EHDs and DoPH from forming their own independent views on the impacts of these technologies – irrespective of what later direct experience brings locally.

Over the next six sections I'll examine different aspects of how the PHE report examined the health impact of extreme energy technologies, and how and why they got their final conclusions wrong.

1. This issue is not about drilling and “fracking” gas wells, it's about whole systems

I look at extreme energy technologies as an 'engineering system'; a system of interlinked processes which each, individually, and often not on the same site, have distinct impacts upon the environment and human health. Collectively these processes can be assessed, along with their direct and indirect impacts – from air and water pollution, to damage to hedgerows and habitats, to increases in road accidents and local transport congestion.

The problem to date has been that the media coverage and environmental campaigns – which often interdependently feed each other to the exclusion of

the greater body of objective evidence – have identified the well site and water pollution from the leaking well as the main problem with “fracking”. And again, the label “fracking” is often used by the media to group together distinct forms of energy technologies, such as shale gas and coalbed methane, and even wholly different and unrelated technologies such as underground coal gasification.

If we objectively break down extreme energy processes into their constituent parts, and assess the impacts from each aspect of these processes, what we find is a subtly different set of ecological impacts from those which dominate the media agenda.

For example, in the US one of the most significant impacts of shale gas is the disposal of the [wastewater generated by the process](#)¹⁷ – and these impacts can [have regional implications](#)¹⁸. In contrast what we often see discussed are earthquakes, or the immediate pollution from the hydraulic fracturing process itself.

This is a complex issue. In that sense both government agencies and the industry, in their desire to claim safety; and campaign groups, by their desire to show harm – have failed to convey the complexity of how these technologies affect public health. And therein, they have not allowed the public to form a realistic view of what these processes entail.

The the summary of PHE's report states –

Most evidence suggests that contamination of groundwater as a result of borehole leakage is an area of concern, but that contamination of groundwater from the underground fracking process itself is unlikely. However, other impacts such as spills and accidents above ground, emissions to air etc. are also potentially significant.

It should be noted that “concerns”, even if significant, do not necessarily correlate to the evidence for harm. For example, although the media debate on hydraulic fracturing has been dominated by the issue of water pollution from the fracturing process, when we look at the entire “system” of unconventional oil and gas, other impacts become more significant within the totality of impacts from these processes.

The effects upon nature are a good example of the disconnect between the debate and the evidence. Although the well pads have a small footprint, the [total impacts upon nature conservation and landscape](#)¹⁹ are dominated by the pipelines which link pads to compressor stations and the distribution grid – perhaps requiring a kilometre or more of pipelines being installed across the landscape for each well pad which is constructed. What's also significant, even within a single elements of the environment – such as the surface waters/rivers – is that varying impacts occur at different stages of the production process.

In their review, PHE were far too focused on the direct impacts from well drilling and stimulation, and

did not consider the [wider concerns about water management](#)²⁰. For example, one of the papers rejected by PHE's review [considered wastewater disposal impacts in detail](#)²¹, and found that treatment works in Pennsylvania failed to contain/fully remove the contaminants found in the process water.

Therefore, to pre-judge which impacts are significant on the basis of “concerns”, rather than by “following the data”, reviewing a broad range of available research, demonstrates a systematic bias in the approach of PHE in reviewing evidence. The concentration on certain aspects of radioactive substances (e.g. radon), whilst ignoring recent research showing a far more widespread problem of radioactive waste generation from [wastewater management operations](#)²², also demonstrates a systematic bias. Arguably this is also reflected in PHE's rejection of a number of recent papers, based upon environmental sampling of operational US shale gas sites/areas, which conflicted with the conclusions of their report.

In addition, by not clearly identifying the sources of risk, the report also fails to evaluate unconventional oil and gas as an inter-related system; and instead tries to differentiate exploration from production. The summary of PHE's report states –

The risks from small scale drilling for exploratory purposes (e.g. single wells) are also clearly different from the risks from commercial scale operations. The potential health impact from single wells is likely to be very small, although the cumulative impacts of many wells in various phases of development in relatively small areas will need careful scrutiny.

This conclusion misunderstands the basic application of [The Precautionary Principle](#)²³, which is at the root the European environmental law. Put simply, exploratory drilling is an unnecessary risk at this time. The tolerability of risk from exploratory drilling is *codependent*, not independent of the tolerability of risk from production operations. If we apply the precautionary approach then arguably the demonstrable impacts of unconventional oil and gas production are unacceptable due to the lack of evidence to prove their safety.

As outlined by PHE, exploration does have lower risk, but those risks are not “zero”. If it cannot be demonstrated that unconventional oil and gas *production* can take place without causing harm to the environment and human health, then production cannot be permitted. If production cannot be permitted because of its innate risks, then exploration cannot be permitted because it presents a positive risk to the environment which is currently unnecessary.

2. Failure to consult the public

After an initial read-through and analysis of Public Health England's report, I accessed the PHE web site to find details of the consultation – *there was no*

consultation listed. I sent an email to Public Health England querying the status of the report. The reply stated that the report was a “draft”, but that only submissions of new scientific information, not listed in the report, were sought as part of the consultation exercise. This response raises some serious questions regarding the legal responsibilities of Public Health England in regard to the formation of public health policy.

As a signatory to the United Nations Economic Commission for Europe's [Aarhus Convention](#)²⁴, any policy decisions or strategies with potential impacts upon the environment must be subject to an open process of public consultation. As an executive agency of the Department of Health, with independent responsibility for public health, PHE's national policy role falls within the requirements of the *Aarhus Convention*. In ruling upon the “safety” of shale gas development in England, PHE are engaging in a decision-making process which is related to the environment and human health, and therefore the Convention's requirements on public participation in that decision-making process must apply.

In addition to the issue of public consultation, we must also consider the way in which this consultation was carried out. There was no formal consultation listed, or publicity given, to enable the public to respond. No closing date for responses was given, just a sentence in section 13 of PHE's report stating, “PHE invites submission of additional relevant articles from the scientific literature for consideration”. Therefore the fact that this consultation was not given an appropriate level of publicity also breached Cabinet Office's [guidelines on consultation](#)²⁵.

3. Disposal of process effluent

The PHE review suggests flowback water might be disposed of through re-injection –

Some operators have disposed of flowback water by injecting it back into disposal wells which are typically depleted oil and gas wells located in areas that have porous and permeable rock strata.

As a waste material under the *Waste Framework Directive*, and given its level of contamination, unconventional oil and gas effluent cannot be re-injected into rock formations. It would be a breach of the *Groundwater Directive*, and the Environment Agency would not be allowed to license this activity. This position is confirmed in DECC's recent Strategic Environmental Appraisal (SEA) of the [14th Onshore Oil and Gas Licensing Round](#)²⁶.

Furthermore, PHE cannot assume that flowback water will be taken to existing treatment facilities. As DECC's SEA report also notes, the levels of contamination in flowback water creates problems at wastewater treatment works. That point is corroborated by another recent [study of the Marcellus shale](#)²⁷ – a paper which PHE rejected from their review.

Therefore, if the entire flow of wastewater from unconventional oil and gas operations must be treated on-site, this creates additional impacts which PHE should have considered. Firstly, this might give rise to gases or vapours which have a health impacts (for example, emission of [volatile organics compounds](#)²⁸, VOCs). Secondly, treatment processes are likely to give rise to a large quantity of waste sludge, which would have to be disposed of. Experience in the USA suggests this is a source of both toxic and “technologically enhanced” [naturally occurring radioactive materials](#)²⁹ – NORM and [TENORM](#)³⁰ (material of a far higher activity level than the “NORM” discussed in PHE's review). Finally, any on-site treatment gives rise to the potential for localised spills, or failure of treatment plants and the uncontrolled release of pollutants to the local environment; and in that sense both heavy metals and TENORM represent problems as any single pollution incident may have persistent impacts.

Another paper which PHE rejected, by Vidic, also highlights the points regarding the [problems of managing wastewater](#)³¹ –

Water management for unconventional shale gas extraction is one of the key issues that will dominate environmental debate surrounding the gas industry... As these well fields mature and the opportunities for wastewater reuse diminish, the need to find alternative management strategies for this wastewater will likely intensify. Now is the time to work on these issues in order to avoid an adverse environmental legacy similar to that from abandoned coal mine discharges in Pennsylvania.

The 2012 [paper by Rozell](#)²⁰, omitted from PHE's review, also notes the significance of wastewater management and surface treatment to the overall environmental impact of the process –

The study model identified five pathways of water contamination: transportation spills, well casing leaks, leaks through fractured rock, drilling site discharge, and wastewater disposal. Probability boxes were generated for each pathway. The potential contamination risk and epistemic uncertainty associated with hydraulic fracturing wastewater disposal was several orders of magnitude larger than the other pathways. Even in a best-case scenario, it was very likely that an individual well would release at least 200m³ of contaminated fluids. Because the total number of wells in the Marcellus Shale region could range into the tens of thousands, this substantial potential risk suggested that additional steps be taken to reduce the potential for contaminated fluid leaks.

In 2013, [Vengosh produced a review](#)³² which identified the broad risks from surface spills into the aquatic environment. Their 2014 update provided far more detail on the hazards of wastewater manage-

ment, including the [significant hazards generated by NORM](#)¹⁸ –

Spills or leaks of hydraulic fracturing and flow-back fluids can pollute soil, surface water, and shallow groundwater with organics, salts, metals, and other constituents. A survey of surface spills from storage and production facilities at active well sites in Weld County, Colorado that produces both methane gas and crude oil, showed elevated levels of benzene, toluene, ethylbenzene, and xylene (BTEX) components in affected groundwater. Over time, metals, salts, and organics may build up in sediments, scales, and soil near wastewater disposal and/or spill sites...

Ultimately, these properties will determine the long-term environmental fate of such reactive contaminants; reactive constituents would be adsorbed onto soil, stream, or pond sediments and potentially pose long-term environmental and health risks...

The level of radioactivity found in sediments at one brine-treatment discharge site exceeded the management regulations in the U.S. for a licensed radioactive waste disposal facility... High NORM levels were recorded also in soil and sludge from reserve pits used in unconventional natural gas mining.

Returning to the DECC SEA report, the note regarding the problematic nature of produced water disposal to wastewater treatment works increases the likelihood that in-field treatment – or at least some level of pre-treatment – will be essential before disposal. Therefore, across the areas where unconventional oil and gas working is widespread, we can expect a number of such “brine” treatment plants to be constructed. Warner's 2013 paper outlines both the chemical and radiological impacts that these [plants have upon the environment](#)²¹ –

This study examined the water quality and isotopic compositions of discharged effluents, surface waters, and stream sediments associated with a treatment facility site in western Pennsylvania. The elevated levels of chloride and bromide, combined with the strontium, radium, oxygen, and hydrogen isotopic compositions of the effluents reflect the composition of Marcellus Shale produced waters. The discharge of the effluent from the treatment facility increased downstream concentrations of chloride and bromide above background levels. Barium and radium were substantially (>90%) reduced in the treated effluents compared to concentrations in Marcellus Shale produced waters. Nonetheless, ²²⁶Ra levels in stream sediments (544-8759 Bq/kg) at the point of discharge were ~200 times greater than upstream and background sediments (22-44 Bq/kg) and above ra-

dioactive waste disposal threshold regulations, posing potential environmental risks of radium bioaccumulation in localized areas of shale gas wastewater disposal.

DECC's SEA suggests that development is likely to follow patterns broadly similar to the US, and yet PHE have rejected a number of recent papers – based upon in-field sampling of the affected areas – which suggest that significant impacts accrue from the treatment and disposal of waste water. In general, PHE's review has failed to fully assess the risks from wastewater, and yet a number of different studies have highlighted wastewater as one of the most significant risks to the environment and public health from this process.

Furthermore, PHE have also neglected to discharge their legal responsibilities under European law as the review disregards the risk to public water supplies. The PHE report states that in the UK most drinking water is provided by public supplies – and therefore is extensively tested and, where necessary treated to meet required standards. The fact that public water supplies are treated and monitored is irrelevant. If water supplies are contaminated then they will have to have special treatment. This is a clear dereliction of the position outlined under the [general principles governing European environmental law](#)³³ –

Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay.

By advocating that any pollution could be treated, PHE are failing to enact the principle of pollution prevention at source, and that the polluter should pay. By failing to properly characterise the risk from wastewater production, treatment and disposal – as part of which they must take a precautionary approach – PHE have failed in their legal obligations to protect the environment and human health.

4. Faith in “regulation” and the assessment of public health

PHE's review does not adequately recognise the administrative restrictions which are being put upon the permitting of unconventional gas development – and therefore the likelihood that health and environmental impacts will be inadequately assessed, if at all, as part of those regulatory procedures.

The PHE report states –

A number of commentators in the USA and Canada have expressed concern that public health agencies are not engaged with industry and policy

makers over the regulation of shale gas extraction/exploitation. This should not be an issue in the UK as public health bodies play an important role in both planning and permitting of industry by acting as independent consultees in both these processes.

Recent revisions to planning and environmental permitting procedures militate against such action taking place – thus enabling precisely the same lack of health assessment as [was identified in the USA](#)³⁴.

The consideration of health and pollution issues at the planning stage has been administratively prohibited by the Department for Communities and Local Government (DCLG) – in their recent guidelines on onshore energy development. This began with the new [National Planning Policy Framework](#)³⁵, introduced in 2012, in which local planning authorities are expressly instructed not to consider the impacts of emissions/pollution upon the environment; and was reiterated in the DCLG's specific [planning guidance on on-shore oil and gas](#)³⁶, introduced in 2013.

PHE also identified environmental permitting procedures as an opportunity to consider health impacts. These procedures are also being streamlined in order to expedite the development of unconventional gas. In July 2013 the Treasury issued a new framework for the [permitting of shale gas developments](#)³⁷. This set a target for the Environment Agency to process permit applications for shale gas within 2 weeks. In August 2013, as required by the Treasury statement, the Environment Agency issued a new draft technical guidance for [consultation on the new permitting process](#)³⁸. This mentions “human health” at various points in the text. However, there is no specific process outlined for the assessment of human health impacts as part of this expedited permitting process – nor any proposals for how appropriate health assessments might be compiled within the 2 week deadline.

During 2013, the European Parliament sought to extend the mandatory requirements for environmental assessment under EU law to all oil and gas activities. Although approved by the Parliament and Commission, the proposal was [defeated in the Council of Ministers](#)³⁹ – primarily because of objections from the UK and Poland, the two states with a political imperative for developing unconventional gas production. This measure would have been beneficial both to the permitting and planning permission processes, because it would have supplied precisely the information required to consider the impacts upon human health and the environment.

The UK government's strong opposition to these measures – combined with the “pro-development” stance taken in the revisions to planning and environmental permitting outlined above – demonstrates that the public can have no certainty in administrative processes.

A key conclusion of PHE's review is that –

Currently available evidence indicates that the potential risks to public health... are low if the operations are properly run and regulated.

This is an inference, unsupported by the evidence presented in their report. At no point is a case made that the UK's regulatory structure is any more effective than that in the USA, Canada or Australia.

In the USA, there has been a long history of regulatory ineptitude over the [broad impacts of unconventional gas](#)⁴⁰; due primarily to the close political ties between the fossil fuel industry and the regulatory process. This is described in the [paper by Bishop](#)⁴¹, rejected by PHE; and in [Colborn's 2011 paper](#)⁴², cited in the PHE review, which stated –

The cumulative effect of these exemptions and exclusions has been to create a federal void in environmental authority over natural gas operations, leaving the responsibility primarily up to the states... In short, their focus has not typically been on health and the environment.

For PHE to imply that regulatory failures would not be replicated in Britain, they must demonstrate that these same types of political interference would not occur here. That is difficult when we consider:

- The heavy-weight political project to support the fast expansion of unconventional oil and gas in Britain, [in particular from the Treasury](#)³⁷, whilst at the same time the Treasury is forcing cuts to [essential environmental health services](#)⁴³ such as [air pollution monitoring](#)⁴⁴;
- The [high-level political connections](#)⁴⁵ between the unconventional oil and gas [operators and the present administration](#)⁴⁶, and the [access this gives to decision-makers](#)⁴⁷;
- The current pressures upon the Environment Agency to reduce the [permitting period to two weeks](#)³⁸, alongside the restrictions on local planning authorities with regard to [the issues relevant to planning decisions](#)³⁶;
- The recent efforts by the UK to prevent the imposition of [new EU environmental assessment regulations](#)³⁹ on unconventional oil and gas operators, which would have ensured adequate information on impacts would have been [provided to local decision-makers](#)⁴⁸; and
- The apparent bias in recent reports on unconventional oil and gas [commissioned by the Government](#)⁴⁹, including – as I argue here – Public Health England's own review.

Given the current political environment, PHE cannot assume that the same problems which have plagued regulation in the USA [would not occur here](#)⁵⁰. For example, the economic pressures to develop by state authorities noted in Colborn's 2011 paper, quoted above, have [parallels with current UK](#)

policy⁵¹. In particular the [cash incentives offered to local authorities](#)⁵² who allow these developments in their areas, and the apparent willingness of national politicians to dismantle legislative or regulatory barriers to enable that agenda to happen. At the same time, this is taking place in a political environment where few openly challenge the [questionable economics](#)⁵³ and [investment returns of the process](#)⁵⁴. For example, that current US corporate losses and asset write-downs of unconventional fossil fuels could be [as high as \\$35 billion](#)⁵⁵.

However, let us take PHE at their word – and assume for a moment that political interference was not an issue. *Is there evidence to demonstrate that regulation of the industry would be effective?*

In Britain a large proportion of our environmental laws have their basis in European law. As part of their [review for the European Commission](#)⁵⁶, AEA Technology considered the effectiveness of current EU environmental regulations in managing the impacts from the unconventional oil and gas industry. Their conclusion was that there were –

Inadequacies in EU legislation that could lead to risks to the environment or human health not being sufficiently addressed.

PHE cited that report a number of times in their review, and yet appear to have failed to take the gaps in regulation identified in AEA's review into account when formulating their conclusions.

At a more general level, there are still doubts about the effectiveness of regulation given the pressures and risks involved in these processes. This was explored in a [United Nations Environment Programme \(UNEP\) study](#)⁵⁷, which concluded –

Hydrologic fracking may result in unavoidable environmental impacts even if unconventional gas is extracted properly, and more so if done inadequately. Even if risk can be reduced theoretically, in practise many accidents from leaky or malfunctioning equipment as well as from bad practises are regularly occurring. This may be due to high pressure to lower the costs or to improper staff training, or to undetected leaks leading to contamination of the ground water.

If we look at the political environment surrounding unconventional oil and gas in the UK, it has some similarities to the situation in the USA, and [more recently Australia](#)⁵⁸, where regulation has failed because of historic political pressures. Even without political pressure, sources cited in the PHE review, and other studies, note that the inherent risks of these processes mean that pollution is inevitable.

Therefore PHE's inference that “such problems may not be replicated in the UK” cannot be objectively supported. To do so, given the evidence of the political pressures for deregulation, is irrational.

5. PHE's “low risk to health” statement

The summary of the PHE report states –

Although shale gas extraction and related activities have the potential to cause pollution to air, land and water, the currently available evidence indicates that the potential risks to public health from exposure to the emissions associated with shale gas extraction are low if the operations are properly run and regulated.

The concept that “risks are low if the operations are properly run and regulated” echoes the position of the Royal Society/Royal Academy of Engineering report, published in 2012. The problem with this statement is that it is a logical tautology – *it is unconditionally true for all conditions which meet the terms of its application*. It is similar, for example, to the conclusion of the [Royal Society/Royal Academy of Engineering report](#)⁵⁹ –

The probability of well failure is low for a single well if it is designed, constructed and abandoned according to best practice.

This is an objectively true statement – a single well may have an arguably low probability of failure. However, when we multiply that risk by hundreds or thousands of wells, if unconventional oil and gas production goes ahead, then the likelihood of well failure and leakage is a positive and knowable quantity – as discussed in a [variety of reports](#)⁶⁰, and acknowledged by PHE when quoting [MIT's review](#)⁶¹.

The question is, apart from the Royal Society/Royal Academy of Engineering report, what evidence did PHE review which gave unconventional oil and gas operations a low risk? The Royal Society report was cited four times in PHE's review. Only two other reports were cited more than that:

AEA Technology's 2012 [report for the European Commission](#)⁵⁶ was cited six times. The summary of that report states (*my emphasis in bold*) –

*The study authors duly acknowledge the limits of this risk screening exercise, considering notably the absence of systematic baseline monitoring in the US (from where most of the literature sources come), the lack of comprehensive and centralised data on well failure and incident rates, and the need for further research on a number of possible effects including long term ones. Because of the inherent uncertainty associated with environmental risk assessment studies, expert judgement was used to characterise these effects. **The study identified a number of issues as presenting a high risk for people and the environment.** These issues and their significance are summarised in the following table...*

The table then divides different impacts into “per site” and “cumulative” impacts: Of the ten “per site” criteria screened for, two were “high impact”, one

was “high/moderate”, five were “moderate”, one was “moderate/low”, and one was “low”. Of the ten “cumulative” criteria eight were “high”, one was “moderate” and one was “low”. Clearly, AEA Technology did not take the opinion that the risk, either on a per site or cumulative basis, was “low”.

Next, the 2012 “progress report” by the [US Environmental Protection Agency](#)⁶² was cited seven times. What is important is that this report devotes itself entirely to the issue of water pollution – not to the pollution of media or human health. What’s also significant is that the USEPA report did not state any judgement as to impacts of exposure to the chemicals used in hydraulic fracturing fluids, or those found in hydraulic fracturing wastewater, or their potential impacts on drinking water resources.

Another report, cited four times in the PHE review, was produced by the Chief Medical Officer of the New Brunswick Department of Health. The [conclusions to that report state](#)⁶³ –

Some of the key findings are summarized below and include a lack of participation from Public Health in other jurisdictions’ regulatory regimes where industry exists; lack of information needed to assess toxicity risks; lack of accurate exposure and health data; lack of standard methods for preventing and mitigating social impacts; lack of health status studies before and during gas development; and a lack of systematic health impact assessments. A lack of information about the extent, locations and rate of development makes it very difficult to forecast local effects of specific projects and to assess the potential for cumulative effects over time... Although the public has voiced a preoccupation with health concerns, there has been a notable lack of participation by Public Health agencies in many of the ongoing initiatives to regulate the industry elsewhere.

It should also be noted that the point in the New Brunswick report, “*lack of participation from Public Health in other jurisdictions’ regulatory regimes*”, was also mentioned in the PHE review in relation to the [paper by Goldstein](#)⁶⁴. PHE rebut this claim, stating the PHE in England and Wales are routinely involved with permit applications relating to environmental discharges – but as outlined above, there are substantial reasons to disregard this claim.

Another US-based human health assessment report, which PHE cites three times in their review, was produced by the Colorado School of Public Health for the Garfield County Commissioners. The [executive summary of the draft report states](#)⁶⁵ –

The Human Health Risk Assessment used information from a variety of sources to conclude that natural gas processes release chemicals that are known to impact health; chemicals emitted into the air from natural gas processes are more likely

to impact health than chemicals released into the water or the soil; exposures from air emissions are likely to be highest during well completion activities; and residents living near a well pad (defined as within ½ mile) are more likely to experience health effects than residents living farther away from a well pad (defined as greater than ½ mile).

In terms of the impacts of US oil and gas operation on human health, this is a ground breaking study. However, it should be noted that this study is the “second draft”; and more importantly, *there will be no final draft*. Garfield Commissioners voted in May 2011 to terminate the contract to produce the health impact assessment. According to [media reports](#)⁶⁶, the motivations behind the termination of the study were wholly political, and were the result of industry lobbying. Also, an investigation by [US National Public Radio](#)⁶⁷ (NPR) also heard anecdotal reports from local residents of the health impacts described in the health risk assessment report.

With regard to the predicted impacts of unconventional oil and gas developments noted above, a number of recent papers examine increasing evidence for health impacts. Within the US health community, there were recent articles in the [American Journal of Nursing](#)⁶⁸ (rejected by PHE’s review) and [Public Health Quarterly](#)⁶⁹, outlining the various health effects observed by health professionals in areas affected by unconventional oil and gas development. Another significant research project, part-funded by the USEPA, was [carried out by Colborn](#)⁴². The PHE review cited this paper twice, but they did not quote the findings of that study in their report –

Industry representatives have said there is little cause for concern because of the low concentrations of chemicals used in their operations. Nonetheless, pathways that could deliver chemicals in toxic concentrations at less than one part-per-million are not well studied and many of the chemicals on the list should not be ingested at any concentration. Numerous systems, most notably the endocrine system, are extremely sensitive to very low levels of chemicals, in parts-per-billion or less. The damage may not be evident at the time of exposure but can have unpredictable delayed, life-long effects on individuals and/or their offspring. Effects of this nature would be much harder to identify than obvious impacts such as skin and eye irritation that occur immediately upon contact. Health impairments could remain hidden for decades and span generations. Specific outcomes could include reduced sperm production, infertility, hormone imbalances, and other sex-related disorders. Further compounding this concern is the potential for the shared toxic action of these contaminants, especially those affecting the same and/or multiple organ systems.

Recent studies have found evidence for [endocrine disrupting effects](#)⁷⁰ from discharges, as well as evidence for birth defects near to oil and gas production sites. It is known that compounds such as folic acid reduce the risk of neural tube defects in developing foetuses. Evidence from recent papers suggest that certain compound in the emissions from unconventional oil and gas sites, perhaps certain VOCs, have the opposite effect, promoting [neural tube defects](#)⁷¹.

Unlike respiratory irritants, which act at parts-per-million levels, endocrine disrupting chemicals can act at parts-per-billion concentrations – as outlined by Colborn's study above. For example, McKenzie's studies have found evidence for birth defects occurring near unconventional gas fields in [Colorado](#)⁷² and [Texas](#)⁷³. McKenzie's 2012 paper was cited in the PHE review. However, its effects were dismissed not because of the evidence of effects, but because in Britain we choose to assess the impacts to exposed populations in a different way.

If we look at the public health sources cited multiple times in the PHE review, each depicts either: A deep uncertainty over the relationship between unconventional oil and gas operations and public health; or it assesses the potential risks and concludes that these are likely to be high. Therefore, to present a review of evidence which highlights many uncertainties and risk factors, and then state that there is a "low risk", is arguably irrational.

6. How PHE skewed evidence

PHE's report states that –

There is, to date, little peer reviewed research but experiences from countries with commercial scale operations, particularly the USA, demonstrate that good on-site management and appropriate regulation of all aspects of the operations, from exploratory drilling to gas capture and use and storage of fracking fluid, is essential to minimise the risk to the environment and public health.

On-line searches for papers/articles on "shale gas"

Date range	Pubmed	Science Direct	Google Scholar
01/01/2014 – 23/4/2-14 (pro-rata annual total)	39 (125)	46 (147)	2,980 (9,541)
01/01/2013 – 31/12/2013	52	218	16,100
01/01/2012 – 31/12/2012	15	61	13,800
01/01/2011 – 31/12/2011	10	176	12,700
01/01/2010 – 31/12/2010	0	6	9,690

Search conducted on 23rd April 2014. Figures in brackets adjusted pro-rata for full year equivalent. Pubmed search: 'text word', "shale gas"; 'date-publication', as listed. Science Direct search: 'full text', "shale gas"; 'journals' & 'open access articles' selected; date restriction as listed. Google Scholar search: 'text', "shale gas"; date restriction as listed.

As part of their review, PHE set a cut-off date of December 2012. Papers received after this date, it would appear from the description of the method used, were considered separately. In my view this explains the conclusion drawn in the above extract; in December 2012 *there were comparatively few peer-reviewed papers on this subject.*

In the table at the foot of the page, I show the total count of matches produced from on-line searches for the term "shale gas", carried using three academic sites – *Pubmed, Science Direct and Google Scholar.* The purpose of this was to provide a general comparison of the levels of publication around this issue in each year. These results indicate that publication levels in 2013 were much higher than in 2011/12 – and in the first 3¾ months of 2014 (when this sample was taken) the publications listed on *Pubmed* already exceed those of 2012.

Given the numbers of papers produced since PHE's December 2012 cut-off the scope of PHE's review must be considered to be flawed. More research was published during 2013 than in 2011 or 2012. To have such a restrictive scope for the review, given the amount of research which was in preparation, means that this whole process was arguably premature – and restricts the base of knowledge PHE have to draw upon in order to form their conclusions.

The summary of the PHE report states –

Public Health England anticipates a low risk to public health from direct releases of chemicals and radioactive material if shale gas extraction is properly operated and regulated. Shale gas developers and operators, through the planning and environmental permitting processes, will be required to satisfy the relevant regulators that their proposals and operations will minimise pollution and risks to public health. PHE will provide support by responding to requests to assess impacts on health in specific cases.

Arguably, once again, that is an inference which could not possibly be drawn from the evidence reviewed by PHE – and certainly not if we look at the larger body of evidence which has emerged since December 2012.

The recent article in the [British Medical Journal](#)⁷⁴ perhaps states this more elegantly –

The review appropriately acknowledges differences in geology and regulation between the United States and the United Kingdom. Yet, in a leap of faith unsubstantiated by scientific evidence, its authors suggest that many of the environmental and public health problems experienced in the US would probably not apply to the UK. Unfortunately, the con-

clusion that shale gas operations present a low risk to public health is not substantiated by the literature.

Today there is a wide range of research available – from the USA, Canada and Australia – which raise concerns about the impacts of unconventional oil and gas operations. Not only directly through the exposure of the population to pollution, but also indirectly through increases in traffic accidents or unwelcome [changes to the local economy](#)⁷⁵. Furthermore, given the amount of data available on the excessive [climate impacts of these operations](#)⁷⁶, and the identified effects of [climate change upon human health](#)⁷⁷, embracing all of these is the longer-term issue of how higher carbon emissions today will have [severe impacts upon society in the future](#)⁷⁸.

Conclusion: What next for extreme energy and public health?

An obvious question which arises with regard to Public Health England's questionable conclusions on shale gas is, "why?". What might PHE's motivations be for producing such a biased conclusion to the review report?

As part of the House of Commons Health Select Committee's recent review of PHE, specific comments were made as to the procedure behind the compilation of the report, and whether it [represented PHE's core interests](#)⁷⁹. Before viewing the Select Committee's comments, my attention was drawn to emails from the Department for Energy and Climate Change, released following a [freedom of information request](#)⁸⁰. The content of these emails demonstrate a high level of co-ordination between the actions of Government departments and the gas industry. PHE's work appears to fit well with the stated approach of the Government and industry group, of using "academic sources" to promote their policies on unconventional oil and gas.

Public Health England, as a quasi-independent body making judgements on behalf of the Secretary of State for Health, must act in a fair and unbiased way – a principle enshrined in both PHE's [Code of Conduct](#)⁸¹, and the [Civil Service Code](#)⁸² it is based upon. The House of Lords, in a 2001 ruling, updated the definition of bias in public office with its "[Porter test](#)"⁸³ –

The question is whether the fair-minded and informed observer, having considered the facts, would conclude that there was a real possibility that the tribunal was biased.

Evidence to the House of Commons Health Select Committee, suggesting the review was conducted outside the ordinary management systems of PHE, creates a concern about the motivations for commissioning this review. And evidence for close co-ordi-

nation between Government, the industry and regulatory bodies in the [formation of policy and information](#)⁴⁶, may suggest the possibility that PHE may be one of the "academic community" identified. That in turn, along with the evidence of other regulatory bodies being pressured to [tow-the-line on shale gas policy](#)⁴⁷, presents a possibility of "predetermination" in PHE's conclusions – violating their status as an independent expert panel whose role is to impartially advise.

In my view, in evaluating the evidence reviewed by Public Health England, it is not possible to relate the conclusions of their report on shale gas to the evidence reviewed during its production. Although there are arguable flaws in some of the sources chosen, these cannot explain the apparent disconnect between the range of information studied, the conclusions of a number of those sources, and the emphasis within the conclusions of PHE's report.

Arguably they have not carried out the study in an impartial manner, and have represented a biased conclusion, by virtue of the fact that:

- ◆ They have failed to produce evidence to support their claim of a "low risk", when in fact many of the papers they review suggested that the risks were presently indeterminate, significant but unquantifiable, or "high";
- ◆ In setting such an early cut-off date for evidence, their conclusions must be considered premature, and cannot be considered to objectively represent the evidence available today;
- ◆ They have failed to provide a clear discussion of the reasons why so many of the papers from 2013 (listed in section 13 of their report), which contradict many aspects of their conclusions, were rejected as not relevant to their conclusions; and
- ◆ They have failed to substantiate their claim that regulation can be effective, and can overcome the political influences which have prevented effective regulation of the industry elsewhere.

Consequently, Public Health England must retract this report immediately.

If they wish to issue a new report, in order to comply with the Aarhus Convention, there must be an consultation on the basis of the report from the start, involved the public and leading expert groups/NGOs – and the final draft report must be subjected to an open public consultation.

If the report, as it currently stands, is not withdrawn, then in my view the public have a right to take action against the Board and senior management of Public Health England – as well as the Secretary of State for Health on whose behalf PHE takes decisions on public health matters.

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