RESTARTING
UK SHALE GAS

Tim Worstall

NETZERO WATCH

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Introduction

There are arguments to be made against fracking for natural gas in British shales. There are arguments to be made in favour of doing so as well. The difficulty with the current debate on the matter is that the arguments in favour are good and true; the arguments against rather less so. To go further, some of those arguments against seem to have been cooked up simply to bias the case, rather than being accurate representations of the science, the economics or even the logic applicable. This short paper is an examination of those varied arguments and an outline of the conclusion that should be drawn from proper consideration of them all.

Britain is not going to be both fully powered by or entirely reliant upon renewables in this decade or any decade soon. There are future technologies that may largely or entirely solve that problem – nuclear fusion and space-based solar among them – but they are not yet ready for deployment. We cannot solve the problem of intermittent energy supply by adding more intermittent energy production. More wind turbines will not make up for the times when the wind doesn't blow. Solar, famously, does not work at night. More nuclear fission would help, but expansion of that technology will take a decade or more. What we need is a bridge energy supply, one that can be brought swiftly into action; one for which we already have the necessary infrastructure. Fracking the shales for natural gas is the one option that makes sense. Therefore we should do so.

The only viable alternative is to shiver in the dark as we nibble our limited supplies of raw food – not quite the point of having a civilisation in the first place.

Bad arguments against fracking

It won't make a difference

One argument made against shale gas is that even if Britain did start to develop a domestic industry, it would make little difference to the global price of natural gas. Numbers of pennies – even fractions of pennies – per therm are bandied about. The argument has one merit, which is that it is true.

But then so is it true that we shouldn't bother to farm for wheat in Britain because the amount produced makes very little difference – pennies or fractions of pennies per tonne – difference to the global price. This is not an argument that any should deploy within tractor distance of a farmer. It's also an argument that goes entirely against the more usual concerns about food miles – local production for local consumption and so on. It's also, given the experience of those two 20th-century unpleasantnesses over forced restrictions upon shipping and imports, strongly refuted by desires for security of supply.

The argument is also less true for natural gas than it is for wheat. As David Ricardo pointed out, all tradeable goods will be the same price the world over after allowing for transport costs. However, the transport costs of natural gas are quite high. Pipelines only go where pipelines go; they cannot be used over truly long distances. There is a significant cost associated with production of liquefied natural gas. The result is that drilling for gas leads to significantly cheaper prices near the place of production, rising the further one goes from the wellhead.

Such price differences can be, indeed are, substantial. At the moment of writing, the Henry Hub price (the US reference) is $5.84 per million British thermal units (MMBtu);[1] the UK price is $26 per MMBtu.[2] In more technical terms, natural gas is not fully fungible, given those transport costs and thus the division of the market into local and regional sections. In simpler terms, if gas were cheaply transportable, then the US price would not be so divergent from those in the UK, the rest of Europe or elsewhere.

Naturally, exactly the same factors apply when considering domestic-to-the-UK production: the costs of exporting mean that domestic prices would be more affected, thus also lower, than prices further afield.

Following Ricardo's analysis, some might argue that domestic gas should reach a global price because it can be exported (if we assume no logistical chokepoints). Except that's not how it works. In fact, the domestic price will rise to the global price *minus the transport costs*, which have to be paid in order to gain that global price. Meanwhile, competing foreign supplies will come at a price equal to the global price plus the transport costs into the UK. The result will be that the domestic price for all gas supplies declines to be the nett of the two effects. Add back in that there *are* logistical chokepoints, and any significant domestic production would certainly lower domestic gas prices. Put another way, the very fact that UK prices are currently five times higher than US ones shows that domestic production changes do not feed through, entirely or exclusively, into global price changes.

It is also possible to note that natural gas is, as a result of the Petroleum Act,[3] the property of the Crown. This means that fossil fuel extraction (as well as other activities such as operating offshore windfarms) leads to revenue flows into government coffers. This being the case, even if it were true that fracking produced no reduction in domestic prices because sufficient exports were made to pull them up to global values, the result would be a flood of cash into the Treasury. That resource rent, the money arising from the mere existence of the gas itself, would be flowing into British government coffers rather than, say, Norwegian or Russian ones. It is difficult to see why this would be an undesirable outcome.

In summary, the net effect will be that some shale gas would indeed be exported. This would produce revenue for the Treasury from foreigners. It is also true that much fracked gas would not be exported, meaning that the local-to-the-UK price would become lower than the international one. Partly because of the fact of the

increased supply itself, but also – and more importantly – that domestic production would remove those costs of international shipping and supply. And there would also be a substantial additional contribution to the UK Treasury too.

'Earthquakes'

It is possible to insist that fracking, by its nature, creates earthquakes. Rock fracturing is an earthquake; fracking fractures rocks. QED. This is not a useful view, however. What matters is whether the process creates earthquakes *that are a problem*.

At which point, consider the chaos and destruction at Arnisdale on 24 September 2021. Or at Morvren on 16 September, Windermere on 8 September, and Arnisdale again on 3 September. These were the locations of tremors of magnitude 1.3, 1.0, 1.0 and 1.2 respectively.[4] This list represents only quakes at or above 1.0 in the month of September 2021. Note that these figures are on a logarithmic scale, so magnitude 2.0 is ten times the energy of 1.0, not merely twice. Setting a limit upon fracking of 0.5 on this same scale is therefore erring much too far on the side of caution. It's possible to believe that this limit was set on political grounds rather than safety. Or to go only slightly further, to think that it is a limit set so that trivial tremors will lead to the effective banning of fracking. There were, according to the British Geological Survey, three more natural tremors above magnitude 0.5 in that one month alone.

Fortunately, a better estimate of reasonable safety limits is available; one free from the corrupting influence of British politics and based upon actual science.[5] This research does agree that fracking might cause some tremors. It also thinks it reasonable to pause to see what's going on if it does so. But it finds that the correct 'amber light' warning level – at which drilling activity should be temporarily suspended – should be two magnitude units below the level of a risky or dangerous earthquake. For the UK that's somewhere in the 4.0–5.0 range; the high end would be perhaps a little uncomfortable, the lower something rarely felt outside the immediate area. That means that the requirement to stop fracking and check should be at somewhere between 2.0 and 3.0, not the 0.5 currently in place.

It's worth noting that the American experience of some 100,000 fracking wells has led to only one instance of a tremor larger than a 'microquake',[6] which is defined as 2.0 or less, the one incident being at 3.6.

We should also be clear that while fracking can, in common with all other industrial processes that impact the earth, cause seismic events. The chief culprit is the disposal of the wastewater from the fracking process into deep injection wells.

Moreover, the level of concern should be tempered by the knowledge that other human activities cause tremors too – the Three Gorges in China is known to be causing a swarm of them, including some significantly larger than merely 'micro'.[7] Mining causes them too. But more importantly, you will get tremors with

any form of deep injection,[8] notably – in something of a blow to other green plans – geothermal energy extraction and long-term carbon sequestration.

At which point we should be insisting upon a rational limitation upon earthquake activity. One that applies to all processes, not just those currently fashionable or unfashionable. It's even possible to imply that those insisting upon stricter limits for fracking as opposed to geothermal power or carbon capture might not be arguing with a pure heart.

It is the effects of the seismic events which is of concern, not the initial cause of them. Thus any process – mining, geothermal, fracking, things as yet undone or undiscovered – should be subject to the same seismicity standards. Rather than the current situation, where fracking is constrained by very much more restrictive rules.

Emissions

It is entirely true that the use of fracked gas will lead to emissions of carbon dioxide. This is less of a reason to oppose it than many seem to think.

Given the current state of technological development, and as noted above, we are not going to be 100% reliant on renewables in the next decade or three. That might well be a desirable goal – it could well be something we'll approach – but we cannot as yet cope with wind deficits, like the one experienced during 2021. The point being that however many turbines we have, we're still not going to get any electricity from them if the wind isn't blowing. It is therefore necessary for us to have either storage capability (suitable technologies don't exist; it's not just a matter of investment or political will) or some way of immediately generating the power we wish to dispatch. Even ideas like pumped storage – Dinorwig Power Station, for example – fail at grid scale because there just aren't that many places we can put such facilities. They are useful to have at the margins, no doubt, but not actually the solution to a days- or weeks-long winter high pressure area sitting over our isles.

The point from which we have to make a decision is not that we'd like to be 100% renewables. It's that we currently cannot be, so we require some form of dispatchable power. Of the varied alternatives, natural gas is the best available to us; this being why we are using it at the moment, of course, even though we're importing most of it.

The good news is that in a recent paper, we showed that using gas is entirely consistent with beating the worst case scenario of climate change.[9] In fact, not just consistent with it – it is the use of gas that is enabling us to beat it. That worst projection is contained in what is called 'RCP 8.5' –a scenario in which emissions run away with us and the planet. Its crucial feature – plainly spelt out – is that we do not take advantage of shale gas and other unconventional fossil fuel resources, and that we turn back to coal for our energy needs, with soaring emissions the result. This is why frack-

ing is part of the solution of avoiding that outcome.

It is perhaps worth noting that Germany's insistence upon not developing a fracking industry, closing its nuclear power stations, and then ramping up electricity production from lignite is exactly what the RCP 8.5 scenario is warning against, not recommending. The same observation could be made about the UK's reopening of a coal-fired power station in the recent wind lull. These are the things we are being told not to do to avoid the disaster, not a plan to follow. Abundant natural gas over the period until we have the necessary technology to eschew fossil fuels is the solution. This being, as above, something explicitly stated in the assumptions used by the IPCC itself.

There isn't much gas to be fracked

One interesting attempt to denigrate the idea of fracking for natural gas is an insistence that there isn't much there to be fracked. The claim has been made several times that the UK's Bowland Shale, for example, is entirely different from the Marcellus in the US. It is said that it has been folded and shattered by geological processes so much that it is, effectively, already fracked. Therefore, there's not much gas down there and we should forget the whole thing.

This is to misunderstand two important points. The first is that we've had several announcements of reserves by various companies. The definition of 'reserve' is something horribly misunderstood as being 'the amount of something that's there'. That's not actually true. A reserve is a company – perhaps an organisation – stating that we can extract this much of the thing, using current technology, at current prices, and make a profit doing so. The reserve is, by definition, the amount that can be economically extracted at the present time, and this definition is defined in law.

It is therefore not possible to say that the reserves aren't there because the geology is different; the geology has already been incorporated into the amount being declared as a reserve. We really can be quite sure of this, for declaring a reserve when there isn't one is fraud, and people go to prison for it. We might even say that the only numbers we're certain of in this entire discussion are those for the reserves, because the people announcing them are the only ones with that legal obligation to tell the truth. No one else involved in the debate is so impelled – incentivised – to be quite so honest with their numbers.

The second point is that if there were really no gas down there, then there would be no need to ban fracking. A few test wells might be drilled – each one using an area half the size of a football field for a year or two perhaps – and then the lack of gas to be extracted would become clear. At which point people would stop spending money attempting to find the non-existent gas. The lack of gas to be fracked is a self-solving problem, in other words. A ban – or significant restrictions, or adequate safety rules, if you prefer – are only necessary if there is substantial gas to be extracted.

The water supply!

It is feasible that pumping varied chemicals into the ground will contaminate water supplies that are gained from that same ground in some manner. Many things are feasible in this world, but as a practical matter this is not a worry as far as shale gas extration in the UK is concerned.

The first point is that the water table – the aquifers that we draw drinking water from – in the UK is fairly shallow. From Groundwater UK:[10]

> An aquifer's primary functions are to store and transmit water. Most groundwater in an aquifer is slowly circulating in the upper 100 to 200 metres of the saturated zone. But fresh water can penetrate to depths of more than 2 kilometres although at such depths groundwater is generally mineralised with solutes, particularly sodium and chloride, and is too saline for potable use.

The UK simply doesn't use deep water. And, as it happens, the gas shales in the UK are mostly quite deep, typically several thousand metres below the surface. This means that they are several zones below any relevant water supplies.

There is also the issue that the law already bans fracking anywhere near likely water sources. Where there are artesian wells or water supplies, 'source protection zones' are set up. Fracking is not allowed in such areas. Further, given the shallow nature of the water supply, fracking is not allowed at depths of less – note *less* – than 1000 metres, or one kilometre.

The chemicals!

What about the chemicals that are used in the fracking mixture? There are stories (or perhaps rumours) from the United States of fracking mixtures being unregulated. However, in the UK anything used in a fracking application must be both listed and approved by the Environment Agency.[11] There is a list of materials that can be used, and all have been passed for their neutral effects upon water supplies.

For example, the mixture that Cuadrilla used near Blackpool is known and has been examined.[12] A part of that mixture was hydrochloric acid in a 10% solution. This might concern some, but then hydrochloric acid is used in water purification systems themselves, especially those that use reverse osmosis.[13] Something already used to purify water is not a concern when used a kilometre deeper than the usual water supplies.

Good arguments in favour of fracking

A modern industrial society depends upon its energy supply. There are several levels of this security. One is the frequency of supply – the grid in the UK must work at close to 50 Hz. Variances from this figure will cause cascading failure, such failures being built into the structure of the grid to protect it from frequency variation. The blackouts following a lightning strike and a connector failure in

August 2019 were an example of this. The sudden loss of part of supply meant that the frequency varied 'too much', and parts of the grid were therefore closed to protect them. Part of the solution here is simply close management, as is already done, but the other part is to have some measure of quick-startup dispatchable power. In the absence – so far – of gridscale batteries, natural gas is the only real solution available.

The second security level is highlighted by our experience in recent weeks. Solar – in the absence of absurd subsidy levels, as happened in Spain, where shining grid-powered spotlights onto solar cells at night proved profitable – famously doesn't work at night. Wind power depends upon there being wind, and the UK is not a large enough area for us to be able to say that it will always be blowing at an electricity-generating speed somewhere. Nuclear is much less variable in output than we would like, we do not have the geology for much more pumped storage, and batteries of sufficient capacity and of a suitable price don't exist as yet, and so on. In order to keep the lights on, there needs to be some provision of dispatchable power.

During the recent wind lull, the UK turned on at least one coal-fired station again. This, as noted above, makes the mistake the IPCC specifically warns against, namely that we shouldn't return to coal if we are to avoid the worst effects of climate change.

The third and most commonly used form of energy security is that we, here, have some supplies of our own energy. Again, we see this currently, as Russian supplies are disrupted as a result of arguments over Nord Stream 2 and so on. Given that the European gas market is imperfectly connected, this currently resolves into extreme price changes – doublings or triplings – rather than interruptions of actual supply. But Britain is at the end of that system. In a true crisis, it'll be physical supply rather than just the cost of it which takes at least some of the hit. Having a domestic supply of at least some minimal size therefore seems prudent.

Fiscal policy

As is common with all natural resources, some part of the market price represents the effort expended in getting it to the consumer, and those who extract, transport, and process gas should therefore be able to make the profit due from their labour, capital and technology. However, another part is the result of the simple existence of the resource under some particular piece of land or seas. No-one created that value, and no-one will be dissuaded from creating more if it is taxed. Therefore, the taxing away of such resource rents is considered to be a good way for the state to obtain revenue without distorting incentives. This is one area where 'making the pips squeak' is good economics and, given that we have a shortage of such revenue at present, another source would undoubtedly be useful, although fracking would not produce a bonanza to match North Sea Oil.

We currently import much of the gas being used in the UK. Given that everybody else does indeed tax the existence of fos-

sil fuel resources, British homes are effectively heated, and British meals are cooked, by sending money to the Norwegian, Dutch and (to a small extent) Russian governments. The domestic production of shale gas would therefore represent a straight transfer from those foreign governments to our own. Even assuming no reduction in domestic gas prices as a result of the greater production, there would still be a substantial reduction in the demands upon the British citizenry.

We do not have to make the unlikely assumption that government will not expand if it has another revenue source for this to be true. At least some of what larger government does could be useful, after all. If we do stretch to that assumption, then the tax paid on that domestic resource would reduce the additional taxes likely to be imposed in order to pay for Covid, or anything else it chooses to.

It is quite deliberate to not include any estimates of revenue here. That would depend upon the volume of gas extracted while the base argument applies at any volume. Any fracking will produce revenue for the government.

It can be argued – and sometimes is – that without the technology to extract the resource then there is no value at all. So therefore the idea of a resource value, in and of itself, is false. It is also true that, whatever the technology available, there is no value without the existence of the resource to be exploited. Fortunately this philosophic debate is not one we need to solve here. Both standard economics and standard fiscal policy are that the government of the day and place has the right to some portion of the revenue stream from the exploitation of the resource. Which portion of the value should be ascribed to the technology and effort required to extract it, which to the mere existence in that place, is arguable. But theory would insist that some should be allocated to each.

Fracking is short to medium term

If we start to frack then we are not locking ourselves into a specific – emittive – technology for decades to come. That's simply not how the technology works.

Conventional hydrocarbons do indeed lock us in for those decades. It can take 10 to 15 years to bring a conventional field online. It might then produce for two to four decades. Obviously, specific fields differ, but a new field opened today could well be still supplying in half a century's time. Fracking doesn't work this way. The ghastly portmanteau term 'manufracturing'[14] attempts to encapsulate this difference. Fracking is much more like manufacturing than conventional resource extraction.

The general infrastructure needed for fracking is that the country be piped for gas. It is, so that is done. The additional work to connect is simple enough: whatever few miles are required of pipe to get from the drilling site onto that gas network. There isn't anywhere, in England at least, where that distance is more than a handful of miles.

Then the actual well needs to be drilled. This is where the com-

parison with manufacturing applies. A fracked well takes some few millions to complete, not the billions of a conventional reservoir. It produces almost immediately and then production falls off steeply fairly quickly; a period of a few years at most. At which point the well can be re-fracked, drilled deeper through another layer of shale perhaps, or plugged and abandoned. In other words, it requires reasonably continuous work to keep it going for the long term. As with manufacturing, it requires a stream of inputs to continue.

The effect is that if we decide, having fracked, to stop doing so, we can close everything off in a handful of years. This is in stark contrast to conventional oilfields, where a decision to close would leave us with billions in sunk costs and stranded assets. This same point means that fracking does not lead to a technological lock-in. We can use it for as long as we need, for as long as it is convenient to do so, even as long as it is profitable. And then we can drop it.

This means that it is near perfect as a bridge technology. Once it is no longer needed, we can stop; exactly what we'd desire from such a technology.

Fracking would be quick to start

Given that there are no large infrastructure issues, fracking would be swift to bring online. All the technology has been invented – perfected even. It's possible that there might be minor modifications for the UK (say, metric rather than Imperial spanners, despite the recent announcement that the old ways are allowed again), but nothing that would cause any significant delay. The required pipeline network is, as noted above, already extant. Rigs exist and can be deployed, ownership of varied shales is already known, capital is available in large quantities. All that's required is the legal and planning structure to allow it to happen. Licence people to do it and it will be done, and rapidly.

We do actually need an interim technology

There are all sorts of exciting technical possibilities to address our energy needs. Green hydrogen from the electrolysis of water – if renewables become cheap enough – would entirely solve the battery and intermittency problem if deployed along with fuel cells. Nuclear fusion now, for the first time in 50 years, is said to be less than 50 years away. Mini-nukes, or China's work on thorium reactors, are interesting. Perhaps someone will be able to design machinery that can withstand decades in seawater, thus making tidal energy economic. The possibilities for the future are delightful, without going off into the dreamlands of space-based solar power and so on.

The problem with all of these technologies is that they're not available now. Which is when we need a dispatchable energy source. We cannot solve our current problems by expanding solar – that would take too long. The same is true of nuclear, or the rest of the technologies listed above. We can continue to maintain coal plants, but doing so takes us a step toward that RCP 8.5 future we're

all trying to avoid. Building more wind turbines does not solve a lack of wind – in the same manner that building more gas cookers won't prepare dinner if we've a shortage of gas.

The only speedy form of energy supply we've got to fill the gap until gridscale storage technologies are properly developed and deployed is natural gas. And, given the tight global market, the only reasonable source of that gas is our domestic shales.

How to make fracking happen

Fortunately not much needs to be done in order for fracking to take place. The infrastructure is already there – the country is piped for gas. Companies to bill consumers exist. We already have the technology to frack, both globally and within the country. Ownership rights are sorted; it is clear who may prospect and drill.

All that is required is the legal management regime to allow the beneficial activity to take place. Given that we have four parliaments in the UK, that should be enough politicians to be able to work on the point. There are really only two stages:

- Adopt a sensible earthquake warning limit.
- Add a carbon tax to fracked natural gas.

As noted above, the actual science these days is that there should indeed be a limit upon fracking with respect to earthquakes. But the 0.5 limit is ridiculous, and should be changed. Recent research suggests a better warning level is between 2.0 and 3.0. This is from slightly to rather above the level of quake that we get, entirely naturally and commonly, in the UK already. September 2021 did, after all, see several quakes above 1.0, and one of 1.3. These caused no damage, and were not even noticed by those without a seismograph. A pause limit for induced quakes above those we don't notice seems logically sensible, as well as being in accord with the science.

The addition of a carbon tax will seem a little strange, but it does in fact make sense. As the Stern Review took great pains to point out (as does the Nobel-winning work of William Nordhaus), our aim is to maximise human utility over time.[15] This requires those heroic calculations of the correct discount rate, and so on. But the base logic is inescapable. Things that are done now have benefits and costs now. Things that are not done now equally so. Further, things that are done now have costs and benefits in the future, as also do things not done now. We wish to prevent those things that have greater total costs than benefits, however they appear over time. But we also wish to not just allow, but actively to promote, those things that produce greater benefits – over time – than costs.

For emissions, that calculation of the costs is the 'social cost of carbon', the $80 per tonne CO_2-e (carbon dioxide equivalent) that the Stern Review settles upon. We need to encourage (not just permit) any emissions that have a total benefit greater than this cost, and prevent any where the benefits are lower – this is how we maximise human utility over time. This is the whole and entire logic of a carbon tax. Dissuade, through the price system, emissions that make us in

aggregate poorer and allow at least, even if not encourage, those that make us (again in aggregate) richer.

By placing the carbon tax, at that $80 per tonne CO_2e rate, upon fracked natural gas, we make sure that only those amounts, those uses, which do make us collectively richer in fact take place. Which is, of course, what we desire. Uses that make both us and the future poorer will be priced out of the market. Again, as we desire. This is good economics, and it's exactly what we have been told to do about emissions for some decades.

It is also less of an imposition than it might at first seem. As we have seen, all natural gas in the UK is already owned by the Crown. Thus it is the government that gets the royalty payment from the exploitation of any shales. However, the carbon tax is incident upon those royalties; that's just the way that the two payments interact. A higher carbon tax will reduce royalty payments to the resource owner, up to the point that the carbon tax can entirely replace, or even produce a negative royalty. At this point, of course, the resource owner does not allow the exploitation. This works in exactly the same manner as the well-known interdependence of business rates and commercial rents: the higher the rates, the lower the rent, and vice versa.

The nett effect here is that it doesn't matter what we call the taxation of the fracked gas. Whether it's a royalty upon the resource rent or a carbon tax on the likely emissions, the recipient of the revenue is the Treasury. How much can be taxed out of the gas supply that results is determined by such things as the cost of capital, of technology, market prices of the gas itself and so on. Having already assumed, as standard economics tells us should be done, that resource rents should be fully taxed, there is no room here for a carbon tax to be additional to that resource rent taxation. In the jargon, the carbon tax would be incident upon the tax collection from the resource rent. As one income flow into the Treasury increases, the other decreases, and on a likely one-to-one basis too.

The advantage of it being a carbon tax rather than a resource rent is that we are now incorporating into the taxation system that very thing that so concerns us – climate. It is, of course, the government that gains the carbon tax payments. And it is the government that gains the royalty payments. The tax's name makes no difference to who gains the revenue. However, by having the tax set to the level of the social cost of carbon – while the royalty can float free as a percentage of revenue perhaps – we ensure that only gas that adds to human utility over time is extracted. For we've a minimum tax rate, at the wellhead, which ensures that only gas that adds to human joy gets extracted.

By adopting good precautionary geophysics – setting the pause at that sensible level – plus good climate economics – tax at the social cost of carbon – we combine the best of the current science to create the correct, and scientific, management regime for the exploitation of Britain's gas shales. Beyond that, a reduction in the bureaucratic hurdles placed in operators' way will end the energy crisis sooner, but these two steps are the sine qua non.

This is the plan. We recommend it to the House.

Notes

1. https://www.cmegroup.com/markets/energy/natural-gas/natural-gas.html.
2. https://www.cmegroup.com/markets/energy/natural-gas/uk-nbp-natural-gas-usd-mmbtu-icis-heren-front-month.html.
3. Currently, the 1998 version, but the Crown has owned fossil fuels in the UK for decades.
4. http://www.earthquakes.bgs.ac.uk/earthquakes/recent_uk_events.html.
5. https://pubs.geoscienceworld.org/ssa/bssa/article-abstract/110/5/2411/583699/Risk-Informed-Recommendations-for-Managing?redirectedFrom=fulltext.
6. https://www.science.org/lookup/doi/10.1126/science.1225942..
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11. https://consult.environment-agency.gov.uk/onshore-oil-and-gas/onshore-oil-and-gas-regulation-information-page/user_uploads/2017-ea-environmental-controls-factsheet-2.pdf.
12. https://www.whatdotheyknow.com/request/content_of_chemicals_in_cuadrill.
13. https://www.researchgate.net/post/What-is-the-actual-use-of-HCl-in-water-treatment.
14. https://www.forbes.com/sites/timworstall/2015/06/12/probably-the-biggest-macroeconomic-change-of-our-times-fracking-for-tight-oil/.
15. https://www.lse.ac.uk/granthaminstitute/publication/the-economics-of-climate-change-the-stern-review/.

For further information about Net Zero Watch and the Global Warming Policy Forum, please visit our website at www.netzerowatch.com.

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