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Our coal industry is in tatters and the gas is running out. Is there an alternative? Incredibly, there really is

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Beneath swathes of the UK lie billions of pounds worth of shale gas. And now we can get to it. David Rose reports on how the recession (and wind turbines) may soon be just a bad memory



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Locked within the fissures inside that rock is an immense quantity of natural gas - virtually pure, unadulterated methane, of a quality so high it could be pumped direct to domestic and industrial users

Here are two visions of the future.

The first one lies at the end of a muddy track in the village of Banks, a 20-minute drive from Preston, Lancashire. It consists of a derrick about 60ft high, a few temporary buildings, a generator and some specialist machinery in a fenced square compound.

Powering the derrick and the drill at its centre is an eerily quiet electric motor. Today, on the first Friday of October, the bit it turns at the end of the drill pipe lies about a mile beneath our feet, boring steadily downwards at a rate of up to 500ft a day, depending on the hardness of the strata. It's heading for a thick deposit of carboniferous shale, a rock made from the compressed mud which lay on a prehistoric seabed more than 300 million years ago, its upper edge some 7,500ft below the dark green fields of ripening cauliflower that surround the compound.

Locked within the fissures inside that rock is an immense quantity of natural gas – virtually pure, unadulterated methane, of a quality so high it could be pumped direct to domestic and industrial users, and to electricity generating stations.

Once the drill reaches the shale, the gas is released by a process known as 'fracking' – hydraulic fracturing, the pumping of a mixture of water and sand to widen the fissures and keep them open. Normally, you only have to frack an area once: after that, the gas tap stays open.

'The installation you see here is only temporary,' says Eric Vaughan, a veteran of drilling for gas from shale in America and the chief operating officer at Cuadrilla, the firm that runs the site.

'If we go into production, we'd have up to ten wells radiating horizontally for distances of up to six miles from the bottom of this hole – what we call a pad. The derrick would be gone. All that would be left would be a bunch of tanks and a small building at the wellhead. There'd be miles between each pad. If you were standing here, you'd be lucky to spot another one.'



Drilling through more than 8,000ft of rock at a test-drilling site in Lancashire. It is no exaggeration to state that shale gas could transform the prospects for the entire British economy

Cuadrilla, an independent British company formed in 2007 whose backers include the former BP chairman Lord Browne, was awarded gas-exploration rights to a rectangular 750-square-mile licence area, running east from Fleetwood on Morecambe Bay to the Forest of Bowland, and down to a line near Southport.

According to Peter Turner, Cuadrilla's geologist, this one shale 'sub-basin' contains about 200 trillion cubic feet of gas.

Even if only ten per cent turns out to be commercially recoverable this would still be enough to meet Britain's gas supply needs for around 15 years. In time it may be enough to offset the rapid decline in gas from the North Sea, and to remove any need for imports.

Cuadrilla's forecast, based on analysis at two test sites and results from earlier 'dry' holes made by firms which were looking for conventional oil and gas, is scientific and credible, says Nigel Smith of the British Geological Survey. But it is also only the beginning.

'The Lancashire licence area is just one part of a shale formation of a similar type that stretches across the Pennines to Lincolnshire, north through to Yorkshire, then up to Teesside and Northumbria. It's also found in the Scottish Midlands valley,' says Smith.

Still more lies beneath South Wales, near Bristol, and in Somerset.

'There's a huge amount more, at least four times as much, offshore,' he adds.

It is no exaggeration to state that shale gas could transform the prospects for the entire British economy – turning the country into a major energy exporter for many decades, reducing costs to consumers, and attracting new industry through abundant cheap power.

'We don't want any subsidies. This is a sustainable business', says Vaughan.

Shale gas production could create thousands of jobs directly, and provide many billions in tax revenue – as it is already doing in Texas, Pennsylvania and several other states in America.

It could also fill the looming black hole in Britain's electricity generating capacity, the result of old coal and nuclear power stations being decommissioned: burnt in modern 'combined cycle' plants, shale gas plants would emit only 37 per cent of the carbon dioxide produced by their coal- or oil-fired predecessors.



The drill as seen from the surrounding cauliflower field. Shale gas production could create thousands of jobs directly, and provide many billions in tax revenue

One such plant is currently being built at a cost of £500 million at Hoo St Werburgh in Kent. It will produce 1,000MW, enough to power a quarter of the homes in London.

The second vision is taking shape at the end of the Thames Estuary, where the foundations are being laid for the 217 turbines of the London Array, the world's biggest offshore wind farm.

Covering 90 square miles, this too will have the capacity to generate 1GW (one billion watts). The turbines' construction has been priced at £2 billion, four times as much as the Kentish gas plant, although this does not include the cost – perhaps a further £500 million – of connecting them to the National Grid, via 300 miles of undersea high-voltage cables.

Without the labyrinthine system of 'green' taxes and Government subsidies known as the Renewables Obligation, which is already adding an estimated £100 to the cost of every British household's electricity bill, and an average 20 per cent to the charges paid by businesses, the wind farm could never be built, because it would be hopelessly uneconomic.

As well as being more expensive, the turbines will not last nearly as long: about 20 years, half the time of the gas-fired power station.

A gas plant, moreover, will produce electricity 24 hours day; the turbines won't. British windmills can be expected to generate power only 27 per cent of the time. That figure falls to just ten per cent in the calm conditions of a bitter Arctic high, such as that which covered the entire UK, causing record low temperatures, for several weeks last December.

However, this is the vision supported by many environmentalists and the Liberal Democrat Energy and Climate Change Secretary Chris Huhne. And there is a large and vociferous body of opinion that wants Lancashire's gas to stay in the ground – forever.

So who's right?

For an answer we need to look at what has happened in the United States. In the past five years shale gas production there has risen from one per cent to 20 per cent, while prices have fallen dramatically. Shale gas fields, among them the booming Marcellus field under Pennsylvania and New York states have brought employment, tax

income and wealth, as well as reducing the need for energy imports.

Overall, the effect of the discovery of an estimated 3,000 trillion cubic feet of gas from shale is transforming the U.S. energy economy, a development with important geopolitical consequences.

The Congressional Research Service recently estimated that America now has the biggest fossil fuel reserves in the world – more than Saudi Arabia, Iraq or China. The wholesale price of gas has roughly halved, to about \$6 per thousand cubic feet – against \$10.5 in Britain. As recently as 2003, America was building port facilities to cope with gas imports. They may now be used to send gas from shale abroad. And the same could happen here.



An operator at the test site. Shale gas could turn the country into a major energy exporter for many decades, reducing costs to consumers, and attracting new industry through abundant cheap power

A few highly publicised incidents have caused concern among some environmental groups in the U.S., though.

‘Every method of producing energy carries risks,’ comments Dr Benny Peiser, director of the Global Warming Policy Foundation (GWPF).

Coal mines trap and kill workers; oil rigs blow up; nuclear plants succumb to tsunamis.

In Norway, wind farm blades have wiped out whole colonies of Europe’s largest bird of prey, the white-tailed eagle, and the giant offshore farms now planned – some of which will be 600ft high – may be still more devastating to avian life. Set against this, how do the risks of shale fracking compare?

One of the most controversial issues has been the use of chemicals in the ‘fracking fluid’, the water used to open the fissures in the shale, about a third of which will eventually flow back up the well to the surface.

Some U.S. firms have been reluctant to disclose the substances used, inviting the charge that underground aquifers and rivers may become polluted. In one notorious incident in the town of Dimock, Pennsylvania, in the heart of the Marcellus field, fracking fluid leaked into several households’ private wells.

‘But that was because the company wasn’t using proper pipe lining,’ says Chris Carney, who has lived in Dimock for most of his life and until last year represented the town and surrounding district as a Democratic member of the U.S. Congress.

‘There was a row of houses along one of the local roads which had their wells polluted, so I guess they’re having to get water from somewhere else. But if it’s done right, fracking has little impact.’

In contrast to the leaky well in Dimock, Cuadrilla's holes in Lancashire come with a thick, multiple-layer cement lining.

'In engineering terms, you could say that's overkill,' says Cuadrilla's Eric Vaughan.

A recent study by Duke University shows that in wells built to a similar standard, no leaks of water or gas have taken place.

As for the additive to the fracking fluid, Vaughan says, 'We use only one chemical – 0.4 gallons per 1,000 gallons of water of polyacrylamide, a substance which makes water less sticky'.



Anti-fracking protesters outside the Department of Energy and Climate Change, Whitehall, London. But if Britain were to rely on wind power, how would we fill the energy deficit?

Classed officially as a 'non-hazardous chemical', this is also used in drinking-water treatment plants and soft contact lenses. But in Lancashire, he insists, the fluid will not leak. The local drinking water aquifers lie more than 7,000ft above the level where fracking would take place.

Also in Dimock, a documentary film, *Gaslands*, suggested that the gas itself had entered the drinking water supply, with a now famous scene in which a householder lights a flame when he turns on his kitchen tap.

'That has nothing to do with fracking,' insists Carney. 'As everyone round here knows, some of the water has methane in it that comes from coal measures much closer to the surface – lighting your water was something you could do long before the first gas drill.'

Scientific tests confirmed this: the gas coming out with the water has a different chemical signature to that produced from the shale.

Finally, there is the question of earthquakes.

In April, Cuadrilla suspended fracking at a well a few miles north of Banks where it had already reached the shale level after two tremors, the first registering 2.3 on the earthquake magnitude scale, the second 1.5, were detected.



© David Parker

Energy and Climate Change Secretary Chris Huhne's department must now rule on whether it is safe to let fracking continue

Last week, it submitted a report on these incidents to Chris Huhne's Government department, which must now rule on whether it is safe to let fracking continue.

According to Nigel Smith from the British Geological Society, quakes rated 2.3 or greater have been occurring for hundreds of years due to mining, and continue to occur wherever coal is dug. Because the earthquake scale is exponential, tremors of this magnitude are about 1,000 times weaker than those which could be expected to start causing damage to buildings, and most people will simply not notice them.

'I suppose the people who are against the gas need to ask themselves a question,' says Smith.

'Are they ready to give up their cars and central heating?'

Indeed, Tim Yeo, chairman of the Commons Energy and Climate Change Select Committee, says: 'I don't share the concerns some have raised. I'm satisfied that, properly regulated, fracking is safe, and having seen it in action in Texas, I can say that once in production shale gas is pretty inoffensive.

'I've seen farm buildings that are more intrusive than a typical well-head. This could be a real gamechanger for the UK.'

Ribble Estuary Against Fracking (REAF) was founded just two months ago and its headquarters are situated in a large but cosy conservatory attached to a comfortable bungalow opposite the track that leads to Cuadrilla's drilling site.

'This has all just been rolled out without being looked into properly and we were never consulted,' says the conservatory's owner, Doreen Stopworth, a retired antique dealer.

'Fracking has never been carried out on this scale before, and they haven't looked into the environmental or economic impact. If they go into full production, there'll be lorries along the road out here bringing in sand, water and concrete and taking waste water out. It will change the face of Lancashire.'

REAF, says her colleague, Eve McNamara, an accountant, already has 20 active members and a further 30 supporters. Last month, the national Campaign Against Climate Change (CACC) and other green groups joined REAF to spend a weekend under canvas in a field near the Lancashire test site.

According to McNamara, the 'dash for gas' is a 'desperate grab for the last remaining fossil fuels,' when the country should be concentrating on renewables – ie, wind. But REAF, she says, is not calling for an outright ban, only a moratorium, until their concerns about the dangers of the fracking process have been investigated.

What if...

...Britain had a cheap energy bonanza? *Live* imagines a very optimistic scenario

2012

Amid Commons uproar, Energy and Climate Change Secretary Chris Huhne stalks away from the Government front bench as Parliament votes to cut windfarm subsidies in favour of shale gas.

2013

Blackpool turns on the gas taps. A 2.6 magnitude earthquake – the biggest fracking tremor ever recorded – makes the Earth move for protesters, but does no damage. The Government approves five new licences.

2014

The £2 billion London Array wind turbine field comes on stream, but in a six-week cold snap fails to generate a single kilowatt. Anti-fracking groups are ousted by groups campaigning for shale gas production under the name Fracking Marvellous.

2015

As North Sea production falls to less than half its peak, the new FTSE 100 company British Shale says proven UK reserves have reached 600 trillion cubic feet. Energy bills plummet as Scottish Power starts the great electricity price war. Employment in the shale-gas regions soars.

2019

The Government debates whether to move Sterling on to the Shale Standard, while Mercedes-Benz relocates factories from Stuttgart to Stockport. The RSPB wins a campaign to demolish the London Array, to allow the return of seagulls to Kent and Essex.

But the big environmental pressure groups now supporting REAF don't merely want a moratorium on fracking – but a permanent ban.

'From a climate change point of view, it should be left in the ground,' says the CACC's Phil Thornhill.

'There are other arguments against shale gas but ultimately the global one is the clincher, even if the other issues were all resolvable.'

But if Britain were to rely on wind power, how would we fill the energy deficit?

'We need to do a lot of research into ways of reducing demand,' he says.

So what's happening down this muddy track in a field in Lancashire will lead to perhaps the most pressing policy question British governments have to face. A forthcoming paper to be published by the GWPF by Professor Gordon

Hughes of Edinburgh University, an electricity energy expert, provides some sobering background.

Because wind power is intermittent, Prof Hughes writes, it has to be supported by other sources when the wind doesn't blow. That can't come from the new generation of low-carbon, dual-cycle gas plants, because this technology has to be kept running all the time.

Hence, the gap must be filled either by nuclear or by much higher CO2 emitters such as coal, oil or old-fashioned, less-efficient types of gas turbine.

Of course, the gas to power such plants would have to come from somewhere – if not from British shale, then from Russia or the Middle East. A decision to exploit the UK's reserves, however, would bring our dependence on such politically unstable regions to an end.

According to Hughes, to meet the government's 2020 target for renewable generation means building windmills with a total capacity of 36GW, along with a further 13GW of new gas plants. He estimates the capital cost of this at £120 billion.

However, as he says, this relies on the hope that the cost of building windmills will fall. At current prices, revealed to Live by the pro-wind pressure group Renewables UK, the capital investment required in the next nine years would be closer to £200 billion.

It is still two years before gas will be pumped out of the ground beneath the cauliflower field in Lancashire, says Eric Vaughan. Cuadrilla will have to submit detailed plans to the Government and local planning authorities, taking into account the issues raised by REAF.

'Once we got the go-ahead, we could be in production within six to eight months,' he says.

'No doubt they can expect mounting opposition at every stage,' says GWPF's Dr Benny Peiser.

'Let's hope at least that people come to appreciate just how much is at stake.'