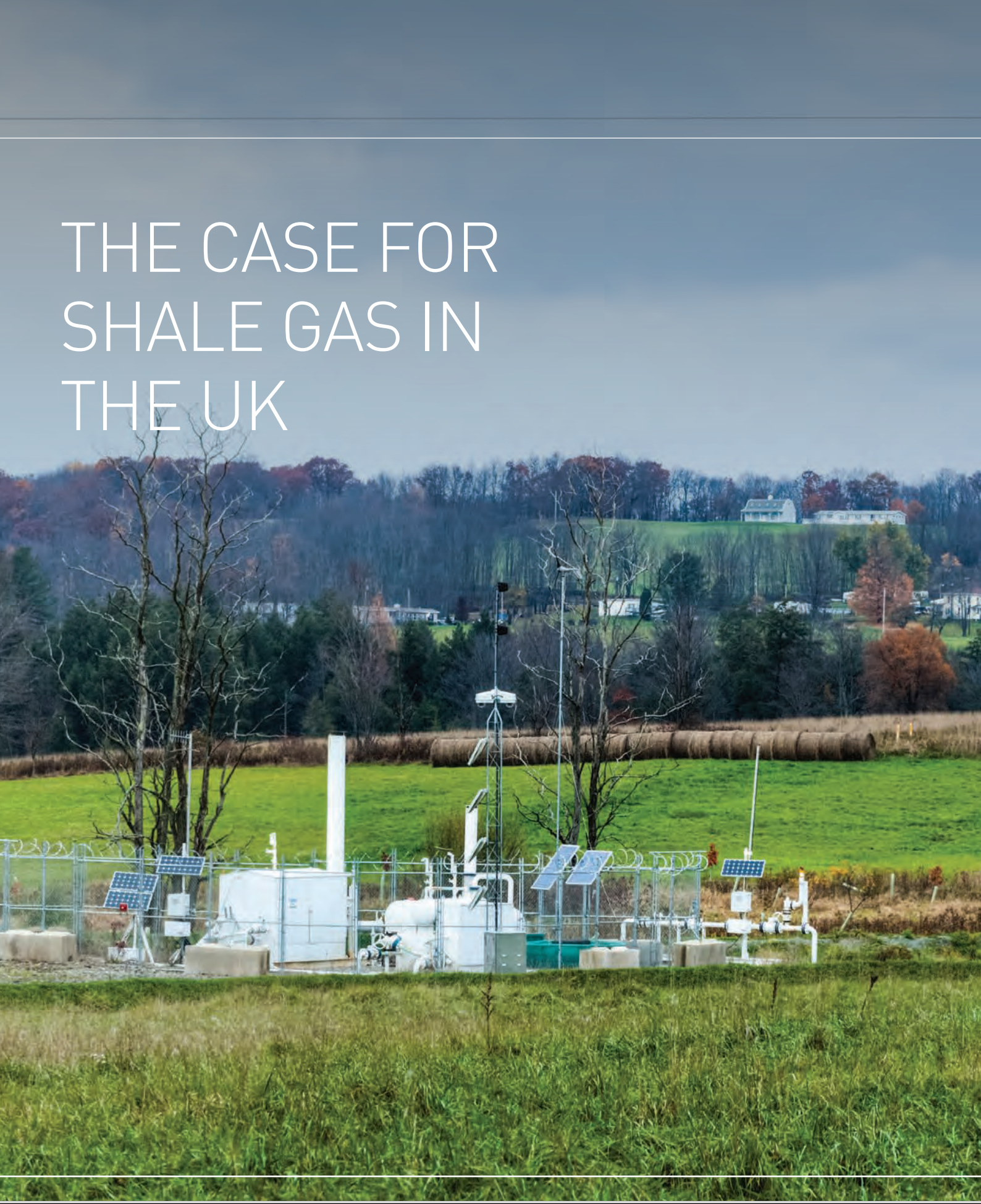
THE CASE FOR SHALE GAS IN THE UK



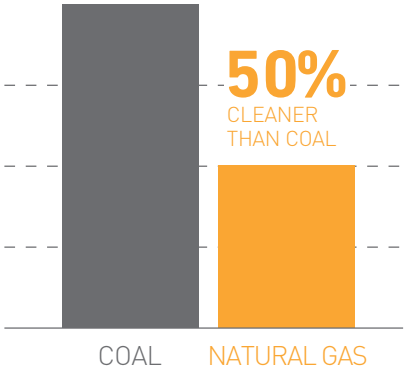
INEOS Shale

INEOS Shale

Extracting shale gas is fully consistent with tackling climate change and could have wider benefits for the UK:

- Anthropogenic climate change must be addressed, which means moving away from burning fossil fuels and switching to low-carbon energy
- Decarbonisation, however, takes time and the UK will be using gas for energy (especially for heat) for a few decades while we make the transition to low-carbon energy. We will need gas as an industrial feed stock well beyond that
- If we extract domestic shale gas to meet our needs during this period, on the other hand, we will improve our energy security and benefit from investment, jobs and tax revenue
- By using gas to displace coal power generation over the next decade (while the UK is in the process of decarbonising electricity) the UK could actually reduce its emissions, because gas has about half the emissions of coal. The Intergovermentral Panel on Climate Change recognises the climate benefits of using gas over coal in this way
- Extracting shale gas is not about using more fossil fuel, but displacing coal, and using our own gas rather than imports, to deliver decarbonisation in the most effective way for the UK. Recent changes to UK government policy recognize this
- Gas is a flexible non-intermittent source of electricity as well as an important source of industrial heat. As such, coupled with abatement technology, it could play a vital long-term role in meeting our energy needs, alongside intermittent renewables and inflexible nuclear power
- If we don't extract shale gas we will be relying heavily on imported gas during this period, which means we will be exposed to energy shortages and price spikes, and other countries will receive the economic rewards associated with extraction. Furthermore, ethically, we know gas produced in the UK will be done to the highest safety, environmental and social standards; we can't say that about imported gas from outside Europe
- The UK is committed in law to decarbonisation and must meet increasingly strict carbon budgets that limit the burning of unabated fossil fuels: provided we stick to this framework, using shale gas is entirely consistent with decarbonisation
- Gas is a chemical raw material, it is used in the manufacture of wind farms and solar panels, as well as a range of energy efficiency technologies
- Mainstream scientific authorities, such as the Royal Society and Royal Academy of Engineering, have stated that, it is safe to extract shale gas provided it is properly regulated.

EMISSIONS BY FUEL TYPE



WE HAVE TO TACKLE CLIMATE CHANGE AS A MATTER OF URGENCY

1. It has been established beyond reasonable doubt that anthropogenic factors are a significant contributor to climate change as such pose a material threat to humanity. This must be addressed as a matter of urgency.[1] This requires that we move away from burning fossil fuels in meeting our electricity, heat, and transport needs, and instead invest in low-carbon alternatives (such as renewables and nuclear) to prevent global warming exceeding two degrees Celsius.[2]

2. While this is a challenge for the chemicals industry, we are committed to reducing our own emissions, as well as facilitating the development of renewables, and advancing decarbonisation across society. The chemicals industry makes green technologies such as insulation, lightweight vehicle components, fertilisers, biofuels, and the materials needed to manufacture renewable energy technologies, such as wind turbines and solar panels.[3] McKinsey and Company has calculated that the chemicals industry saves two tonnes of greenhouse gas for every tonne it emits, and has a vital role to play in delivering decarbonisation.[4]

WE HAVE FAR MORE FOSSIL FUEL THAN WE CAN AFFORD TO BURN UNABATED

3. Estimates vary depending on the assumptions made about external factors such as deforestation, and due to our evolving understanding of how the climate responds to emissions, but it is fair to say that the vast majority of fossil fuels in the ground must not be extracted and burnt unabated (i.e. without carbon capture and storage technology).[5] A study published in Nature, for instance, calculated that, globally, a third of oil reserves, half of gas reserves, and over 80% of current coal reserves should not be burnt unabated.[6]

BUT IT DOES NOT FOLLOW THAT INVESTING IN GAS IS BAD FOR THE CLIMATE

4. Given the above, it is easy to conclude that extracting shale gas (another fossil fuel) sounds like a bad idea for the climate. Shouldn't we be investing in low-carbon energy rather than more fossil fuels? Indeed, well-meaning organisations, such as Friends of the Earth, have reached this view.[7] But this does not bear scrutiny, and opposing gas (the fossil fuel that causes the least global warming) during a period of transition to low-carbon energy (when some fossil fuels have to be burnt to maintain modern economies and lifestyles) can actually result in more damage to the environment. This is because investment in gas helps reduce coal use during our transition to low-carbon energy, it is actually beneficial for the climate. Indeed, the Intergovernmental Panel on Climate Change recognises the importance of using gas rather than coal as a transition fuel in the short to medium term.[8][9] Similarly, even Friends of the Earth in their response to DECC's 2050 calculator tool recognise the need for gas in the energy mix well into middle of the century[10].

DECARBONISING WILL TAKE THE UK A FEW DECADES

5. Decarbonising electricity, heating, and transport is a huge undertaking that will take a few decades. The IPCC has said that the unabated use of fossil fuels will have to come to an end by 2100,[11] and the country with the most ambitious timeline, Denmark, plans to be free of fossil fuels by 2050.[12] The UK, for its part, is aiming to decarbonise electricity over the next fifteen years and reduce overall emissions by 80% (on 1990 levels) by 2050.[13][14] Even if we assume compliance with very ambitious timelines, it will take the UK at least four decades to decarbonise.[15]

DURING THIS TIME WE WILL CONTINUE TO NEED FOSSIL FUELS TO MEET OUR ENERGY NEEDS

6. Renewables currently meet less than 8% of the UK's energy needs, so, even if we make significant improvements in energy efficiency, we are going to need fossil fuels to maintain modern living standards during the transition to low-carbon energy.[16] Fossil fuels currently used to generate well over half of our electricity (with more coal used than gas),[17] and will continue to play an important role over the next fifteen years in providing heat and transport, which account for 80% of our energy use, and take longer to decarbonise.[18][19] Indeed, around 85% of homes have gas heating,[20] and UK industry relies heavily on gas for its processes, which accounts for 20% of national energy consumption.[21]

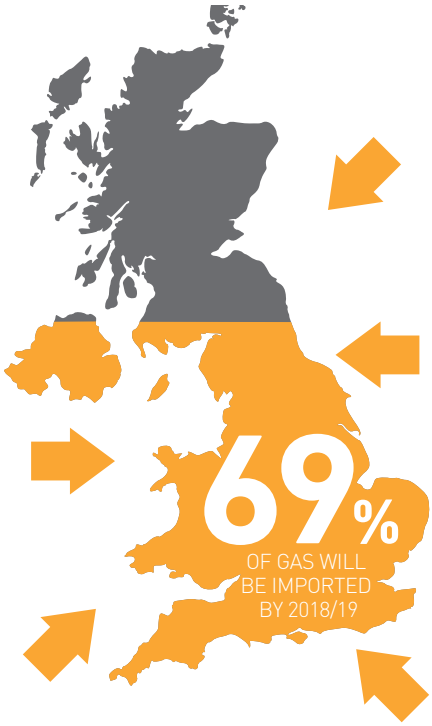
WE HAVE AN ENVIRONMENTAL RESPONSIBILITY TO USE GAS NOT COAL DURING THIS PERIOD

7. While it is true that we cannot burn the vast majority of fossil fuels, we do have to burn some over the next forty years and we have a choice about which ones we use. In fact, we have an environmental responsibility to choose gas over coal as far as possible, because burning gas creates half the CO2 and a quarter of the nitrous oxides.[22] This is recognised by the Intergovernmental Panel on Climate Change.[23] Coal is currently the biggest single cause of anthropogenic climate change, accounting for around 40% of global energy-related CO2 emissions.[24] Given that burning gas creates about half the emissions, global emissions would be around 20% lower if the world was using gas instead of coal.

IF WE ARE USING GAS WE SHOULD USE OUR OWN FOR ENERGY SECURITY REASONS

8. Given that we are going to be using gas as a transition fuel in the UK for the next 40 years, it makes sense to produce our own gas rather than increasingly rely on imports. As North Sea reserves declined, the UK became a net gas importer in 2004.[25] We now

import 54% of our gas: 58% of which comes from Norway, 16% comes from the Netherlands, and 20% is LNG, mainly from Qatar.[26] National Grid has estimated that without shale gas we will be 60% import reliant by 2020, and 90% reliant by the 2030s.[27] Our increasing reliance on imports has significant national security implications. For example, we import LNG from Qatar via the Strait of Hormuz waterway, which Iran controls and has previously threatened to block. Even in normal circumstances, when exports can leave Qatar, LNG cargoes (unless contracted) are delivered to the highest bidder. This flexibility can be good, but being heavily reliant on LNG leaves the UK exposed to shortages and price spikes.[28] Similarly, plans to source gas from Russia in the future could further undermine the UK's energy security.[29] Russia has a track record of using its position in the market for political purposes, and has cut off supplies to customers a number of times over the last decade.[30]



AS NORTH SEA RESERVES HAVE DECLINED THE UK HAS BECOME NET GAS IMPORTER AND DECC ESTIMATES THAT IMPORT DEPENDENCY WILL REACH **69%** BY 2018/19.

9. Extracting domestic shale gas could have a transformational effect on our energy security. The British Geological Survey estimates that the Bowland and associated shales in England contains 1,300 trillion cubic feet of gas, and similar shales in central Scotland contains 80 trillion cubic feet.[31] It is vital to undertake exploration to quantify this more accurately, but if 10% of this could be extracted, these shale plays alone would produce enough gas to meet a significant fraction of the UK's needs for decades (based on current consumption of around 3 trillion cubic feet per year).[32]

USING OUR OWN GAS WOULD ALSO HAVE ECONOMIC BENEFITS

10. Using domestic shale gas to meet our needs, rather than relying on imports as we do currently, would also mean significant economic benefits for the UK in the form of tax revenue, jobs and investment. Exploration is necessary to quantify the benefits accurately, but it is clear that developing UK shale gas holds a lot of promise and could help replace jobs and tax revenues lost as a result of the decline in the North Sea.[33]

11. Assuming a recovery rate of 10% (and a gas price of $8 MMBTU), the UK may have over $1 trillion of recoverable shale gas.[34] Realising the value of this asset would significantly support businesses in the UK (and their many employees), and generate a large amount of tax revenue, which could be used to improve public services or reduce the deficit. Taxation of extraction is complex, but essentially amounts to extractors paying 30%-75% on profits (as well as other taxes), which could raise billions of pounds for the UK public.[35] [36]

12. Working on the assumption that 4,000 horizontal and fracked wells are drilled from 2016 to 2032, Ernst & Young have calculated that developing UK shale gas would mean £33bn worth of investment in the supply chain.[37] This would be spent on drilling, hydraulic fracturing, waste disposal, storage, transport, construction, security, and consultancy services such as environmental assessment. This would be hugely beneficial to UK businesses and it is estimated that it would create 64,000 skilled jobs in the supply chain.[38] And, if the UK is the first mover in Europe it has the potential to foster an industry that could become an important exporter of services in the future.

E&Y AND IOD ESTIMATE THAT MORE THAN 64,000 JOBS WILL BE CREATED BY THE SHALE GAS INDUSTRY

13. More widely, as well as generating public money, and creating investment and jobs in the supply chain, domestic shale gas could particularly benefit the UK chemicals industry, which uses gas as a raw material to make compounds and plastics. The products of the chemicals industry go into essential items from medicine and clothing, through to buildings, vehicles, computers, and green technologies, such as wind turbines and solar panels. The industry employs over 100,000 skilled workers, exports goods worth around £25bn, adds almost £9bn to the UK's GDP each year, and underpins the UK manufacturing sector.[39]

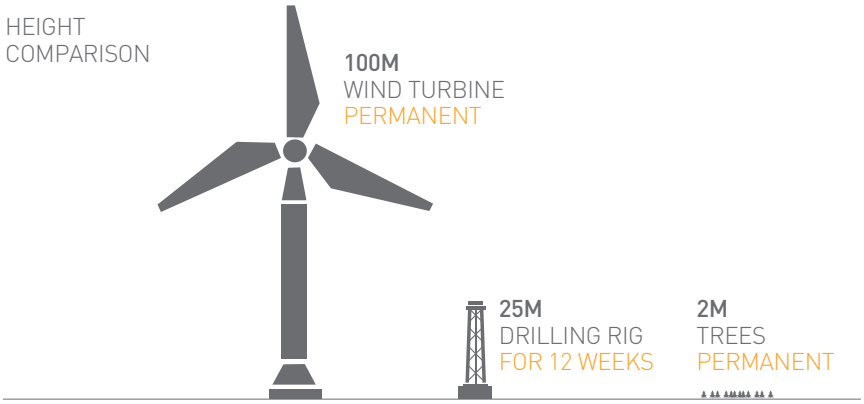
14. The availability of shale gas in the USA has attracted $138bn worth of investment in the chemicals industry, funding 225 new projects.[40] Meanwhile, in the UK, rising energy and feedstock costs have resulted in tens of plant closures since 2009, with no investment in new builds.[41] With gas feedstock from the North Sea running out, INEOS has itself

had to invest £450m on importing shale gas from the USA to sustain the Grangemouth petrochemicals facility.[42] [43] Developing domestic shale gas would help protect the future of the UK chemicals industry and attract investment. The Independent Expert Scientific Panel set up by the Scottish Government has noted that this 'could place Scottish plants at an advantage in an increasingly competitive world market'.[44]

EXTRACTING SHALE GAS COULD BENEFIT LOCAL COMMUNITIES TOO

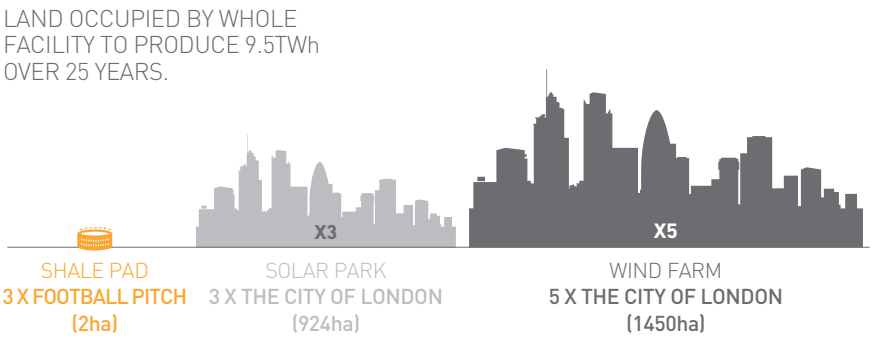
15. Given the position of shale gas basins around the country, extraction could be particularly beneficial for regional economies, helping rebalance the UK away from service industries and the City of London. In addition to jobs and investment, local areas also stand to benefit from a share of production revenues, which might be worth hundreds of millions of pounds.[45] This could make a material difference to community services and homeowners in an area.

16. It is sometimes claimed that extracting shale gas would 'industrialise the countryside' and cause serious disruption,[46] but this is not the case. Shale gas extraction uses significantly less land than other energy sources. A typical site might drain 10 to 15 square kilometers of shale and at its peak (during fracking) use a few acres, shrinking down to roughly the size of two football pitches when producing.[47] To create the same amount of energy, a wind farm or solar park would have to be hundreds of times larger.[48] The number of sites located in an area would depend on the geology and local factors, but advances in shale gas extraction technology have made it possible to drill a larger number of horizontal wells (branching out in different directions) from the same pad, dramatically reducing surface footprint.[49] Using this method, modern pads can typically drain gas from many square miles, meaning that even a large area can be developed with a few tens of sites. These sites would themselves only take up a fraction of a percent of the area drained (assuming a 3.5 acre site).[50] [51]



17. Development has some local impact, but disruption is relatively minor and largely temporary. A 25m drilling rig is on site for about 12 weeks, then the site is stripped back, leaving only a few water tanks and two-metre tall well-heads, which can be recessed below ground level or concealed behind trees and hedges.[52] Over its lifetime a site creates less than half the traffic of a wind farm or solar park, with about two truck movements a week on average.[53] This is more concentrated during the first few years of production (when there are about five movements a day, which is equivalent to a supermarket), and is heaviest over the 12 weeks when the site is constructed and dismantled (when there about 25 movements a day, which is equivalent to a small building site).[54] [55]

18. Setting up a site takes about 6 months, including a few weeks of drilling and a few weeks of fracking, but after this the site produces gas discreetly for around 20 years.[56] Like any development, a shale gas site will only be permitted if it meets planning and environmental standards. The industry is committed to building a mutually beneficial relationship with communities and the UK already has a number of conventional developments such as Wytch Farm (the largest onshore oil development in Western Europe) where this has been achieved very successfully.[57] It is not widely reconised that there are currently 120 active onshore oil and gas sites (with 250 operating oil and gas wells) in the UK.[58]



SHALE GAS SHOULD NOT UNDERMINE DECARBONISATION IN THE UK

19. We have a legal framework in place to ensure that investment in domestic gas does not displace low-carbon investment in the UK or lead to greater fossil fuel use. The UK government is required by law to deliver 80% emissions reductions (from a 1990 base level) by 2050, and must conform to strict Carbon Budgets set

every five years by the Independent Committee on Climate Change.[59] The Government's current projections assume coal will be phased out in the 2020s,[60] and we will use a declining amount of gas as a transition fuel (a certain amount of which is permitted within our carbon budgets), while promoting investment in low-carbon energy sources.[61]

20. Provided we adhere to this framework, as we should, we can be confident that investment in gas in the UK would primarily mean replacing imported gas with domestic gas, while reducing overall unabated gas consumption, promoting low-carbon energy, and retiring unabated coal. EU regulation requires the retirement of old coal plants, and the UK's new emissions performance standard will prevent any new coal plants being built without technology to capture and store emissions.[62] Meanwhile, there are supportive policies in place to promote low-carbon investment, such as Contracts for Difference and the Carbon Price Floor.[63] Private investment in shale gas does nothing to undermine these mechanisms, and may actually help encourage investment in intermittent renewables, such as wind, by providing more flexible backup than coal.[64]

IT IS NOT TOO LATE TO INVEST IN UK SHALE GAS

21. It is sometimes argued that investing in new gas 'infrastructure' will 'lock us in' to fossil fuels at a time when we should be moving to low-carbon energy sources.[65] This is not the case. The UK already has the necessary gas generation and distribution infrastructure in place; we only need to invest in wells to extract shale gas. A well pad is small and relatively quick to set up, with most gas being produced early on in its lifetime.[66] And the number of wells is scalable, meaning production can quickly be scaled up or down. In any case, private companies would be making the investment and taking the financial risk, not the taxpayer or energy user.[67] The situation is not comparable, then, to investing in capital-intensive, long-term, low-carbon infrastructure, which is a large undertaking and paid for in part by the public,[68] and these two processes can exist side-by-side.

22. If we move forward with exploration and an evidence-based approach, the UK could be producing shale gas by the 2020s,[69] when we will still need gas for a few decades as transition fuel. In the longer term, we will also continue to need gas as a chemical feedstock, and it could play an important role in our energy mix if abated with Carbon Capture and Storage technology, delivering vital industrial heat, and providing flexible backup to intermittent renewables and inflexible nuclear.[70] Gas, combined with Carbon Capture and Storage also has the potential to underpin a move to using hydrogen in the energy system.[71 72]

WE MUST MINIMISE METHANE LEAKAGE TO DELIVER THE FULL CLIMATE BENEFITS OF GAS

23. Methane is a significantly more potent greenhouse gas than CO_2,[73] so we must take steps to prevent methane leakage when extracting gas. If not, we will undermine the climate benefits of using gas over coal and cause unnecessary damage to the climate. The weight of evidence suggests, however, that factoring in typical methane leakage, natural gas is still half as damaging to the climate as coal, and methane leakage can be effectively controlled.[74]

24. A study from Cornell University, published in 2011, suggested that extracting shale gas might involve higher levels of methane leakage than conventional extraction, making it worse for the climate than coal.[75] This, however, is out of step with the rest of the scientific literature and has been criticised for overestimating leakage; for underestimating the effect of 'green completions' (now mandatory measures in the USA to minimise methane leakage); for comparing coal to gas in terms of heat rather than electricity generation (when coal is almost exclusively used for electricity); and for only using a twenty-year timeframe that exaggerated the impact of methane with respect to CO_2.[76 77 78]

25. Studies that take account of more recent data and the industry's use of green completions have consistently found that shale gas has a comparable carbon footprint to conventional gas and a slightly better footprint than liquefied natural gas (LNG).[79 80] A recent study has found that with use of green completion technology, emissions from UK shale gas would be lower than Qatari LNG (which has to be compressed and shipped to us) and Russian gas (often produced using antiquated and poorly maintained infrastructure and transported in leaky pipelines over a great distance to Europe).[81]

26. The industry is committed to minimising methane emissions through comprehensive monitoring, robustly engineering wells and using green completions as recommended in a report produced for the UK government by David MacKay and Timothy Stone.[82] INEOS welcomes further research in this area, such as that being conducted by the ReFINE group,[83] which may identify further ways to maximise the benefit of switching from coal to gas.

WE SHOULD WORK TO PROMOTE GAS AND DECARBONISATION INTERNATIONALLY

27. If countries switch to gas but do not retire coal production there is the danger that coal is still produced and exported to markets where gas is relatively more expensive, resulting in more coal being used there in place of gas: this reduces the extent to which the world as a whole moves from coal to gas.

28. This was seen to a certain extent in the USA, where domestic emissions fell by 12% between 2007-2012, in part due to shale gas displacing coal (as well as the recession reducing energy use).[84] Displaced US coal was

then exported to Europe at low prices, which encouraged some countries, like Germany, to shift a portion of their electricity generation back from gas to coal.[85] This is unlikely to happen if we develop shale gas in the UK, given the planned retirement of coal production in the 2020s, but it is, nevertheless, an issue that the UK may be concerned to address internationally.

29. To maximise the net global move from coal to gas we need to ensure competitively priced gas is available in different regions, while working to phase out coal and agree a binding global climate deal. Promoting shale gas is part of the solution that will allow more countries to choose gas over coal, and should go hand in hand with efforts to secure international decarbonisation commitments though the UNFCCC. We should also call for more to be done to phase out coal internationally, building on the EU Large Combustion Plant Directive and Industrial Emissions Directive, as well as domestic policies in countries such as the UK, Denmark, Finland, and the Netherlands.[86] If this approach is adopted internationally it is a credible and practical path to decarbonisation, and the UK can set an example

SHALE GAS IS AN OPPORTUNITY FOR THE UK THAT WE MUST CONSIDER FULLY

30. With appropriate regulation and best practice, shale gas is not only compatible with tackling climate change, but can be a key enabler of the transition to a low-carbon society.[87] Similarly, with appropriate regulation and best practice, extraction can be managed safely.[88] Given that shale gas could help the UK reduce its dependence on imported gas, while delivering significant economic benefits, we have a responsibility to consider the opportunity fully in a dispassionate and evidence-based way.

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19. Decarbonising electricity is relatively straightforward because it primarily involves incentivising a small number of energy companies to invest in new generation infrastructure, which can be done with government policy. Decarbonising transport and heat, however, is much more challenging, because tens of millions of individuals homes and businesses, as well as industrial sites, across the country have to make significant investments in new technology.

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