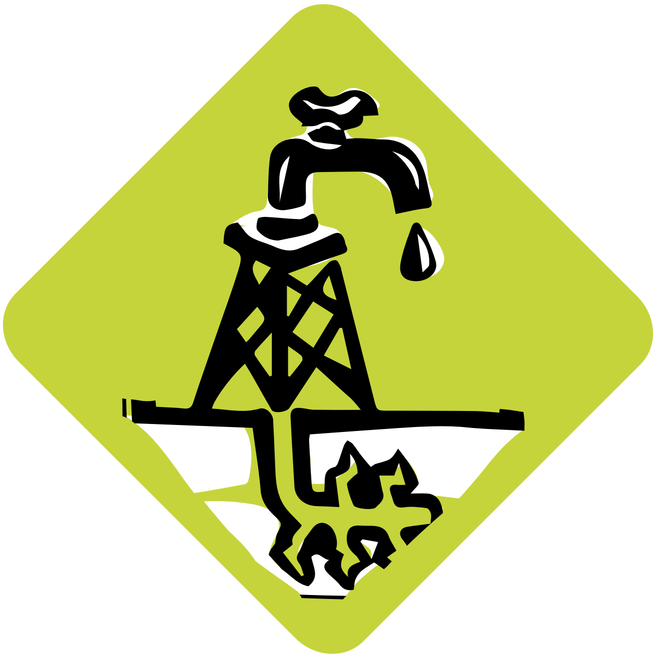


SHALE OIL
(TIGHT OIL)

CRUDE OIL FOUND IN **SHALE** OR OTHER ROCK WHERE IT IS TIGHTLY HELD IN PLACE AND DOES NOT FLOW EASILY.

REQUIRES USE OF **FRACKING** WITH RISK OF **WATER POLLUTION** AND WORSENS CLIMATE CHANGE.

WHAT IS IT?

Shale oil, or tight oil, is a type of crude oil that is found in low permeability rock formations such as shale or tight sandstone. The 'tight' refers to the fact that the oil is tightly trapped in the rock, unlike conventional oil formations where the oil flows relatively easily. Recent technologies used for shale gas extraction, such as fracking and horizontal drilling, have made it economical to extract shale and tight oil.

HOW IS IT EXTRACTED?

Shale oil has been known about for a long time, but has only been exploited on a large-scale in the last ten years or so. This has partly been driven by the development of two technologies: horizontal drilling, which opens up deposits inaccessible by conventional vertical drilling, and advanced hydraulic fracturing, or fracking.

Fracking is used to free oil or gas trapped in rock by drilling into it and injecting pressurised fluid, creating cracks and releasing the oil or gas. The fracking fluid consists of water, sand and a variety of chemicals which are added to aid the extraction process e.g. by dissolving minerals, killing bacteria that might plug up the well, or reducing friction. The fracking process produces a large volume of waste water, containing a variety of contaminants both from the fracking fluid, and toxic and radioactive materials which are leached out of the rocks. In addition to fracking, acidisation is also sometimes used. This is where the well is pumped with acid to dissolve the rock that is obstructing the flow of oil.

Production from shale oil wells declines very quickly and so new wells must be drilled constantly. This process of continual drilling and fracking means that huge areas of land are covered with well pads where thousands of wells are drilled, with each well requiring millions of litres of water.

Shale and tight oil deposits are also highly heterogenous, meaning there is substantial variation within the formation in the qualities of the rock and the oil it contains. Even adjacent wells can have very different production rates. The oil that is extracted from shale is very similar to crude oil from conventional sources and does not require further processing before it can be refined.

"US HOUSE OF REPRESENTATIVES COMMITTEE ON ENERGY AND COMMERCE REPORT FOUND 750 DIFFERENT CHEMICALS HAD BEEN USED IN FRACKING FLUIDS, INCLUDING MANY KNOWN HUMAN CARCINOGENS AND OTHER TOXIC COMPOUNDS "

Oil shale or shale oil?

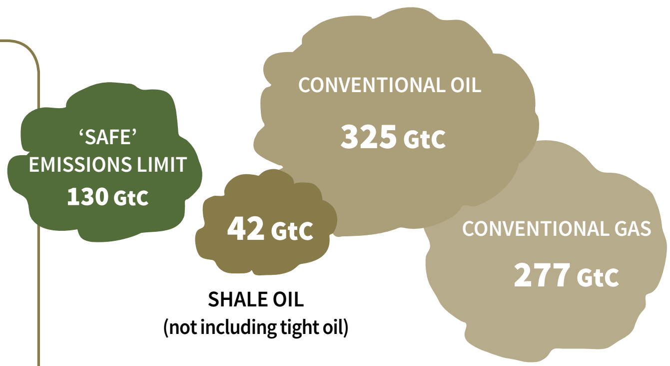
Confusingly, 'shale oil' can refer oil extracted from shale rock using techniques such as fracking, or to the liquid fuel extracted from 'oil shale' by heating it (see separate Oil Shale factsheet). The first definition began being used when the US boom in shale gas resulted in shale formations also being exploited for oil. A great deal of confusion and disagreement persists, but many have started to use the term 'tight oil' to refer to oil extracted from shale formations using horizontal drilling and fracking. Even more confusingly, the term 'oil shale', which usually means the oily rock rich in kerogen (discussed in a separate factsheet), is also sometimes used to refer to shale formations which contain oil. Baffled? Well, you're not alone!

CLIMATE CHANGE

Oil, whether from shale or conventional sources, is a fossil fuel and releases significant greenhouse gas emissions when burned. As long as energy demand increases additional sources of fossil fuels such as shale oil are likely to supplement rather than replace other existing ones such as coal.

If we are to reduce carbon emissions to anything like the levels required to maintain a reasonably habitable planet we must move away from all forms of fossil fuel as fast as possible. Measuring from the start of the industrial revolution (around 1750), a maximum of 500 Gigatonnes of carbon (GtC) can be emitted to the atmosphere while still avoiding most serious impacts and the risk of irreversible and uncontrollable changes to the climate.[1] Between 1750 and now (2014), we have already emitted about 370 GtC leaving a limit of 130 GtC that could be further added.[2]

In order to stay within this limit we have to leave the vast majority of the remaining conventional oil, coal and gas in the ground. Estimates vary significantly, but remaining conventional coal reserves alone are well over 500GtC.[3]



Exploiting the world's shale oil resources would add around 42 GtC to the atmosphere.[4] This is certainly an underestimate as it excludes Russia, which is estimated to have the largest shale oil reserves, much of the Middle East, and tight oil formations other than shale. The carbon locked up in shale and tight oil represents a huge source of emissions which, given the limits outlined above, we clearly cannot afford to add to the atmosphere.

Carbon Capture and Storage (CCS)

Proponents of unconventional fossil fuels often argue that with CCS technologies, these new energy sources could be exploited at the same time as reducing GHG emissions. However, even if the huge problems with CCS technology are overcome (and this currently looking extremely unlikely), it would not change the fact that we need to move away from all forms of fossil fuel, conventional and unconventional, as soon as possible.

In the most optimistic (and highly implausible) scenario, CCS could be used to reduce a small proportion of emissions from fossil fuels. In reality, the promise of CCS being implemented in the future is being used to allow the continued expansion of fossil fuel production, to prevent alternatives from being developed, and to deflect attention away from approaches which tackle the underlying systemic causes of climate change and other ecological crises. Ultimately CCS is a smokescreen, allowing the fossil fuel industry to continue profiting from the destruction of the environment. (see 'Carbon Capture Storage' factsheet for more information).

There has been some discussion about the possibility of using exhausted shale oil formations as a place for storing carbon dioxide. Injecting CO_2 into fracked shale formations is also being considered as a way of both storing carbon and extracting more oil at the same time (so called Enhanced Oil Recovery – see 'Other Unconventional Fossil Fuels' factsheet). However, their viability as CO_2 storage sites is questionable, and there are currently no shale oil sites being used to store CO_2. In addition there are concerns that fracking may be compromising other potential CO_2 storage sites, as the fracked shale formations are no longer impermeable and would therefore not keep CO_2 trapped in the deep saline aquifers below them.[5]

In addition fracking, the underground injection of fracking waste water (see below), and even the injection of CO_2 itself have been shown to cause earthquakes, which reveal a major flaw in CCS technology.[6] [7]

Fracking equipment

OTHER SOCIAL AND ENVIRONMENTAL ISSUES

Water use

The fracking process uses huge volumes of water, which becomes contaminated and cannot be returned to the water table. Depending on the characteristics of the well, the amount of water needed will be somewhere between about 3 million and 40 million litres.[8]

Sourcing water for fracking is a major problem. Because of transportation costs of bringing water from great distances, drillers in the US usually extract on-site water from nearby streams or underground water supplies. This puts pressure on local water resources which can lead to the worsening of droughts.[9] In 2011, the U.S. Environmental Protection Agency estimated that 70 to 140 billion gallons (265 – 531 billion litres) of water are used to fracture 35,000 wells in the United States each year.[10]

Water pollution

There has been a great deal of controversy over the chemicals contained in fracking fluids. In the US many companies have resisted revealing the recipes for their fracking mixes, claiming commercial confidentiality, or have adopted voluntary reporting measures in order to avoid stricter mandatory reporting requirements. Although the specific mix of chemicals used varies significantly, a US House of Representatives Committee on Energy and Commerce report found 750 different chemicals had been used in fracking fluids, including many known human carcinogens and other toxic compounds such as benzene and lead.[11] Chemicals found to be most commonly used in fracking fluids such as methanol and isopropyl alcohol are also known air pollutants.

A variety of chemicals are also added to the 'muds' used to drill well boreholes in order to reduce friction and increase the density of the fluid. Analysis of drilling mud has also found that they contain a number of toxic chemicals.[12] [13]

Waste water

Shale oil extraction results in large volumes of waste water contaminated by fracking fluids and naturally occurring chemicals leached out of the rock. These can include dissolved solids (e.g., salts, barium, strontium), organic pollutants (e.g., benzene, toluene) and normally occurring radioactive material (NORM) such as the highly toxic Radium 226.[14]

The volumes of waster water generated and the kinds of contaminants it contains makes treating and disposing of it safely extremely challenging. Treatment of waste water is expensive and energy intensive, and still leaves substantial amounts of residual waste that then has to be disposed of. In addition the waste water from most sites would have to transported large distances to specialised treatment plants.

In many cases, the waste water is re-injected back into the well, a process that has been shown to trigger earthquakes (see earthquake section below). In the US, there have been numerous cases of dumping of drilling cuttings and storage of waste water in open evaporation pits. In some cases waste water has even been disposed of by spreading it on roads under the guise of dust control or de-icing.

Any accidental spillages could have serious environmental and human health consequences.

Human and animal health

It is difficult to assess the health effects of fracking sites, as many impacts will take time to become apparent and there is a lack of background data and official studies. Despite this there is mounting evidence linking fracking activities to local health impacts on humans and animals. [15] [16] [17]

Air Pollution

Air pollution at shale oil sites includes emissions from vehicle traffic, flaring and venting during drilling and completion (where gas is burned off or released to the atmosphere) and on-site machinery. Local air pollution from these sources is likely to be similar to that of shale gas extraction, including BTEX (benzene, toluene, ethylene and xylene), NOx (mono oxides of nitrogen), VOCs (volatile organic compounds), methane, ethane, sulphur dioxide, ozone and particulate matter.[18]

Industrialisation of countryside

As shale is impermeable the oil cannot easily flow through it and wells are needed wherever there is oil. This means that, unlike conventional oil, exploiting tight oil requires large numbers of wells to be be drilled. In the US tens of thousands of shale wells have been drilled leading to widespread industrialisation of the landscape in some states.

It has been estimated that fracking requires 3,950 truck trips per well during early development of the well field.[19] A single well pad could generate tens of thousands of truck journeys over its lifetime[20] In addition to these increases in traffic for transportation of equipment, waste water and other materials the site itself creates significant noise, light pollution and direct impact on local wildlife and ecosystems.

Earthquakes

Underground fluid injection has been proven to cause earthquakes, and there are instances in the UK where fracking has been directly linked to small earthquakes.[21] The injection of waste water from fracking back in to wells has also been shown to cause earthquakes.[22] Although these earthquakes are usually relatively small, they can still cause minor structural damage and of particular concern is the possibility of damaging the well casings thus risking leakage. This did in fact happen after the earthquake at Cuadrilla's site in Lancashire, UK. The company failed to report the damage and were later rebuked by the then UK energy minister, Charles Hendry, for not doing so.

Occasionally larger earthquakes are triggered. A 2013 study in prestigious journal Science linked a dramatic increase in seismic activity in the midwestern United States to the injection of waste water. It also catalogues the largest quake associated with waste water injection, which occurred in Prague on November 6, 2011. This measured 5.7 on the Richter scale, and destroyed fourteen homes, buckled a highway and injured two people.[23] It should be noted that mining and conventional gas and oil extraction can also cause earthquakes.

Jobs

In practice much of the employment for oil shale developments are from outside the area in which the oil is extracted, and any boost to the local economy is relatively short lived as the industry moves on once wells are depleted. This undermines the argument, often used by those trying to promote the industry, that it will generate large-scale employment.

Economic issues

It is sometimes argued that shale oil can be used as a 'bridging fuel' in the short term while renewables are developed.[24] However, estimates of reserves containing so many years' worth of a country's oil supply ignore the fact that it will take many years and thousands of wells drilled before production rates rise sufficiently to provide significant amounts of fuel.

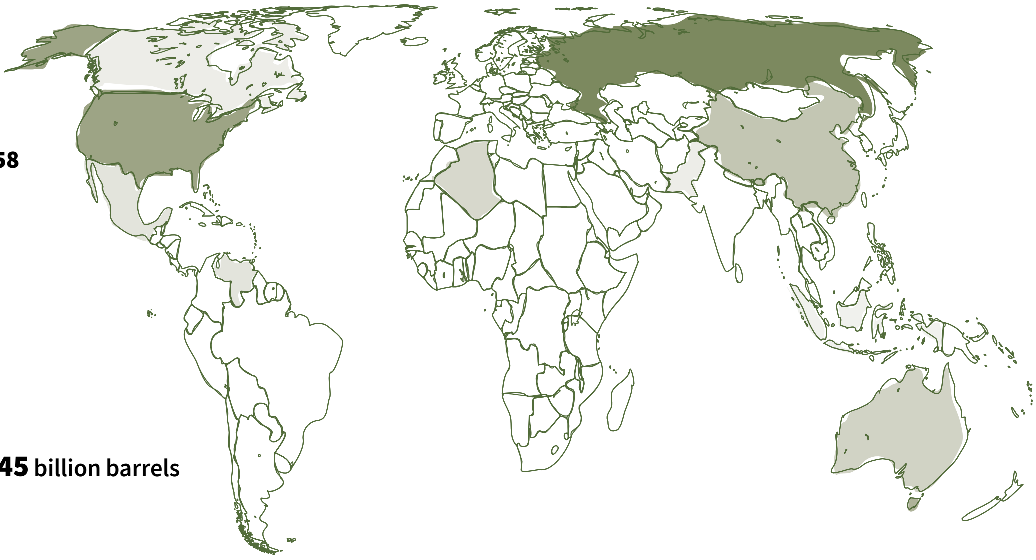
In addition, as the most productive shale plays and their 'sweet spots' are used up first, it becomes increasingly more expensive, both in terms of money and energy, to maintain production levels and there are various predictions that the shale oil boom in the US may be short lived.[25] Concerns that the same kind of financial practices that led to the US housing bubble were used to provide investment (with the prospect of profitable merger and acquisition deals attracting the financial sector) are leading some to predict that the financial bubble behind the US shale boom will burst, possibly even risking another global economic crisis.[26]

WHERE AND HOW MUCH?

According to the International Energy Agency,[27] economically recoverable shale oil reserves around the world are as follows (in billions of barrels):

1 **Russia 75**
2 **United States 48-58**
3 **China 30-35**
4 **Australia 27**
5 **Libya 26**
6 **Venezuela 13**
7 **Mexico 13**
8 **Pakistan 9**
9 **Canada 9**
10 **Indonesia 8**

World Total 335-345 billion barrels



However, these figures are only for shale rather than other tight oil formations, and do not include most of the Middle East or Russia, which is estimated to have the largest shale oil resources in the world.

In the United States, where the industry has undergone rapid development over the last ten years or so, the Bakken, Eagle Ford, Niobrara and Permian fields hold large resources of shale oil. At least 4,000 new shale oil wells were brought online in the United States in 2012.[28] Canada also has an advanced shale oil industry.

Other countries are also now beginning to consider exploiting their shale oil resources. In particular China, Mexico and Argentina are aggressively pursuing shale oil extraction. China and Mexico have been hampered by lack of expertise and difficulties with national oil and gas companies. In Argentina the industry is set to rapidly expand with a deal between the national oil and gas company YPF S.A. and Chevron to produce both shale gas and shale oil from the Vaca Muerta (Dead Cow) basin, believed to hold as much as 23 billion barrels of oil equivalent.[29]

Russia has the largest shale oil resources, but seems unlikely to exploit them in the near future, as it still has large reserves of other, easier to extract fossil fuels.[30]

COMPANIES INVOLVED

In the US multinational super-major corporations such as Exxon, Shell and Total do not dominate the shale oil industry. Mostly the work is undertaken instead by American companies, ranging in size from tiny start-ups to mid-sized companies worth tens of billions. Notable US shale companies include Chesapeake Energy, Continental Resources, Occidental Petroleum, Pioneer Natural Resources, Apache, Whiting Petroleum, Hess, EOG Resources, ConocoPhillips and Chesapeake.

Often small companies carry out the initial exploratory drilling and testing in places where the industry is in a fledgling stage. If the process is proved economically viable these companies are often bought up by larger companies. In this way, the bigger companies are protected from any loses, should the testing prove unsuccessful.

RESISTANCE

There has been widespread resistance to fracking wherever it has been conducted. The most active national movement is in the US, and many have been inspired by the film Gaslands. Protests have spurred various countries, including France, Bulgaria, Romania and the Czech Republic to adopt moratoriums or outright bans on fracking.[31]

Protesters in a number of countries have used direct action and civil disobedience to oppose fracking. The 'Lock the Gate' movement in Australia saw environmental activists and local communities linking together, using blockades in their attempts to prevent exploration.

In the village of Pungesti, in Romania, the local community have managed to remove and sabotage Chevron's equipment to test fracking, despite receiving violent police repression for doing so. Similarly, indigenous Elsipogtog First Nation and other local residents blocked a road near Rexton, New Brunswick in Canada successfully preventing South Western Energy from carrying out tests at a potential fracking site. In the UK there have been community blockades of potential fracking sites, for instance at Balcombe in Sussex and Barton Moss in Lancashire.

For more information on resistance see the Corporate Watch website (corporatewatch.org/uff/resistance)

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