Methane clathrate

the last desperate hope of the fossil fuels industry

Extreme Energy is a term which encompasses many different forms of ‘unconventional’ energy resources. From fracking, to tar sands, to some types of renewable energy which take more energy and carbon to produce than they save (mostly plant biomass) – these ‘extreme’ energy sources represent the last hope of the global energy corporations.

Why this is so tells a much greater truth about the global commitment to address climate change.

The transition from ‘conventional’ oil and gas – produced from free-flowing reservoirs of hydrocarbons underground – to ‘unconventional’ sources is tied implicitly to the depletion of fossil fuels. As conventional sources are harder to find, and more difficult to produce, previously uneconomic unconventional sources of fossil fuel become profitable.

Despite recently low oil prices – the result of global economic stagnation rather than over-supply – the writing’s on the wall in terms of where the global energy industry is heading. If depletion doesn’t force a change in their business model soon, then the need to drastically cut carbon emissions must do so.

The new extreme – *methane clathrate*

The world’s river systems deposit large quantities of sediment, containing organic matter, onto the ocean floor surrounding the continental land masses. As this material slowly decomposes, with little oxygen available, it produces methane gas.

Some of this methane dissolves into the sea water, or bubbles up from the sea floor to the surface, but under the right conditions it can become trapped within the saturated sediments.

'Burning' clathrate ice

Methane clathrate – also know as methane hydrate, methane ice or natural gas hydrate – is a mixture of methane gas and water. Though it is often called methane ‘ice’, it doesn’t have to be frozen to allow methane to become trapped between the water molecules.

Clathrate is formed when methane becomes wedged between a stable lattice of water molecules. What controls the formation of the clathrate is the combination of temperature and pressure. It can form at low pressure in shallow water at freezing temperatures, but it can also form at higher temperatures under high pressure in deep water.

Clathrate is highly sensitive to this temperature/pressure balance. Even a small can cause the whole clathrate formation to break down, destabilizing the sediments, and causing the methane to erupt as gas into the water column.

Clathrate was identified in the 1960s, but it wasn’t until the end of the 1990s that interest began in clathrate as a source of energy. That was for one key reason – *the potential size of the available resource*.

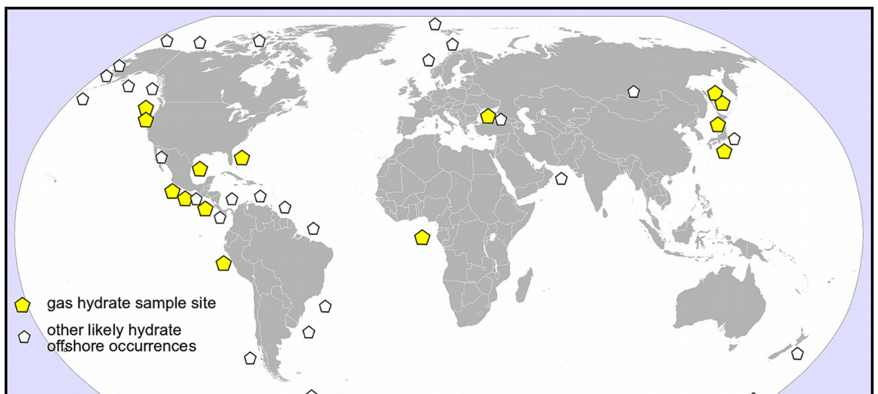
The current global natural gas ‘reserve’ – the amount which we are 90% sure might be produced – is about 186 trillion cubic metres of methane. Current estimates of how much gas might be produced from clathrate vary from 10 to 100 times that figure.

The engineering challenge

Nearly all clathrate is found offshore – which increases the costs of exploring for it. That cost is as nothing compared to the technical challenge of actually recovering the gas, because of its volatile nature.

Thus far there are three proposed methods to get the gas out of the sediment:

- The first is to drill into deep sediments and then release the pressure holding the methane in place – by pumping the water and gas mixture back up the well bore. This is the method currently under test in the Far East.
- The second involves heating the sediment, using high temperature steam, causing the gas to bubble off. That’s not considered as practical because of the extra energy input required compared to de-pressurization.
- The final method would involve pumping carbon dioxide into the sediment to try and dislodge the methane without causing the sediments to destabilize – but this hasn’t been tested yet. This would require even more investment because of the need to set-up the gas injection system.



US Geological Survey (USGS) Gas Hydrates Project map of clathrate deposits

Around 30 countries have expressed interest in clathrate research – though few have active programmes today. Given that fossil fuel depletion is a “known, known”, many states are desperate to find any new source of natural gas to keep the industrialized economy ticking over.

The US Department of Energy has been giving research grants for clathrate production for a number of years. The focus of the EU has mainly been around the impacts of clathrate production. Canada has also carried out experiments on-shore in the Arctic, though that project was terminated in 2013. And India has had a clathrate research project since the late 1990s.

However, the real movers in this area though are Japan and China:

- In 2013 a Japanese project managed to extract 120,000 cubic metres of methane from clathrates in the Nankai Trough, using the depressurization method. That project was cut short when the destabilized sediments collapsed and blocked the well.
- Though it started well after other states, in the late 2000s, China developed an ambitious clathrate project. This produced its first gas in May 2017, generating between 10,000 and 35,000 cubic metres per day from the South China Sea.

How can this be economic?

Recent estimates put the cost of clathrate production at around $1,000 to $1,750 per thousand cubic metres. Current US gas prices are around $200 per thousand cubic metres. At five to eight times the current price, how can clathrates be economic?

Both the nations backing research around clathrates, and industry figures projecting the future of fossil fuels, are looking at clathrate production taking off in one or two decades – when fossil fuels become harder to produce.

Gas flares from the Japanese test in 2013

That’s when there’s money to be made.

‘Extreme’ energy isn’t just about difficult to produce energy sources. What supports these ventures is also the ‘extreme’ frontier of finance and economics.

Speculation, hedging, futures, debt instruments – energy companies raise and spend money through a variety of means, often divorced from the ‘real’ economy. The energy sector is one of the most ‘liberalized’ industries, and as a result it is intimately involved with the ‘extreme’ end of modern-day Machiavellian microeconomics.

Fracking is a good example. Fracking in the US has survived the low oil prices since 2014 because of its convoluted system of credit and production hedging. Effectively the industry has been kept alive by the gullible banks and Wall Street financiers who have swallowed the industry’s lobbying about their success – when the available economic data suggests the complete opposite.

The same is likely to be the case of any nascent clathrate industry.

Let’s assume the global clathrate resource is 5,000 trillion cubic metres. The wholesale value of 1,000 cubic metres of gas might vary from $100 to $400. That puts the value of the clathrate resource at $500,000 trillion to $2,000,000 trillion.

If you’re a financier, and you get perhaps a tenth of one percent return on that income, you’d stand to make a half to two trillion dollars. That being the case, wouldn’t you throw them fifty or a hundred million dollars in order to perfect their technology?

As in the case of fracking, it’s the race to be first to create the intellectual property for a ‘successful’ technology that yields huge profits. Those that follow later tend to lose huge sums instead.

Clathrates are climatic ‘ecocide’

Of course there has to be a big “but” here, and that’s obviously climate change.

Methane clathrate is quite possibly one of the most hazardous uncontrolled feedback mechanisms in the climate system. Climate scientists are concerned because clathrate under ice sheets in the Arctic circle, or submerged off the coast of Siberia and Canada, might suddenly destabilize and release large volumes of methane into the atmosphere – driving global temperatures far higher.

As methane clathrate becomes the new target for gas exploration, it might actually be humans who trigger the release – either through controlled production, or accidentally through production accidents. And perhaps over a much shorter time-frame compared to this natural process.

As recent research reveals, it’s only necessary for between 2% and 4% of the methane produced to leak in order for natural gas to have a climate footprint worse than coal.

While there might be 10 to 100 times the current gas resource available, the amount of carbon that these deposits contain are far greater.

That disparity occurs because such a small amount of the potential gas ‘resource’ is available to produce because of the technical limitation – so fugitive emissions could far drastically higher than conventional gas, or even fracking.

In the final analysis, we’ve already released half-a-trillion tonnes of carbon from fossil fuels since the beginning of the Industrial Revolution, raising temperatures by around 1ºC. Another half-a-trillion will warm the planet to the IPCC’s “safe” limit of 2ºC.

Depending on which estimates are used, there might be two-and-a-half to three trillion tonnes of carbon locked up in clathrate deposits.

Put more simply, the amount of carbon locked up in clathrates is about the same as the other fossil fuels combined. There can be no solution to the climate change if large-scale clathrate production begins.

The methane clathrate issue highlights the duplicitous nature of the debate over energy and climate. Climate science make it clear that emissions need to be brought near to zero by 2050, or we face a significant global shift in climate.

However, the efforts to develop large-scale natural gas production from clathrate in one or two decades demonstrates that states, and the fossil fuel industry, have no serious intent to curtail the future production of fossil fuels.

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Created for the Free Range Activism Network – http://www.fraw.org.uk/