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The hidden energy of the oceans

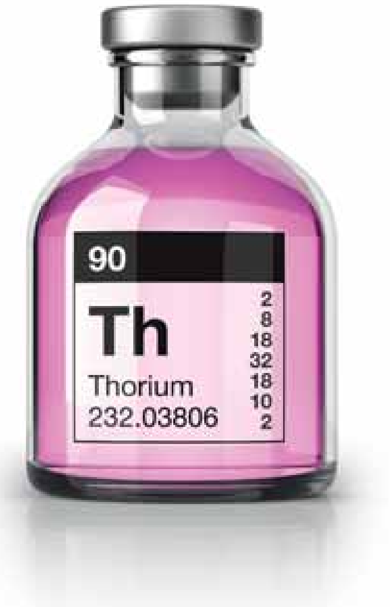
Could a new energy source as large as the oil industry be waiting in the deeps? *Jon Herbert* looks at the potential of "fire-ice".

Methane clathrate could change your life. Not a term perhaps to trip lightly off the tongue, but nevertheless a possible gigantic source of energy that could overturn the established global geography, politics and oil economics that have shaped the world for nearly 100 years.

Methane hydrate, hydromethane, fire-ice, natural gas hydrate, gas hydrate, methane ice or, as it is now termed, "explosive-ice", lies some 2000 metres deep within the ocean floor and has not been seriously explored as a viable source of energy for mankind. Until now.

Japan is devoid of any energy reserves of its own. Since the Fukushima nuclear disaster, it has been taking clathrates very seriously. Its target is deep waters to the southwest of Tokyo and under the Philippine Sea. Here, the research vessel Chikyu is drilling to record depths. Japan believes it will have a technical solution within 10 years, and potentially change the world.

A clathrate is an icy molecular cage that traps, in this case, a fossil-fuel molecule. Clathrates have been known to geologists and the oil industry for many years. They occur naturally in the Arctic. However, the discovery of extensive layers of loosely held layers of fire-ice, in a huge arc drawn across the bottom of the world's oceans, is more recent.



Ever since the western powers carved up the Middle East in the post-Ottoman end to the First World War, the world has been heavily influenced by the politics of oil. Fire-ice could usher in a new era. The question is whether it offers a solution to the gathering energy crisis, or simply perpetuates the age of carbon-based energy.

In search of energy

The world is on an urgent hunt for radically new forms of energy to overcome the triple-hurdle that is holding much of the world to ransom — cost, supply security, and environmental impact. There are many candidates.

In August 2013, Norway sank a structure the size of a football pitch 125 miles off its coast to the floor of the North Sea. It houses an extremely cost-effective compressor that could replace conventional surface rigs and platforms in the ever-deeper search for new oil and gas resources.

Norwegian environmentalists challenge the wisdom of trying to retrieve more fossil fuels when the world cannot burn more than a third of what it already has, if carbon targets are to be met.

The US fracking revolution is now so profound that it is mutating world natural gas markets, reducing imports, increasing exports, replacing oil use and starting to change the world's energy map. Low carbon though it is, natural gas from any source is still a fossil fuel. Workable UK shale gas reserves may also be extensive. In the north of England alone there could be 1500 trillion cubic feet, 10% of which is exploitable.

Meanwhile, thorium could be the much safer fuel of a nuclear renaissance. UN weapons inspector Hans Blix thinks so. He is keen that it should be the radioactive element that replaces uranium in future nuclear reactors. Thorium is three times more abundant and, importantly, cannot be used in nuclear arsenals. India is researching the feasibility of a thorium-based reactor, and trials are also being carried out in Norway by the private firm Thor Energy; thorium itself was discovered in Norway in 1828 and is named after the Norse god of thunder. The company hopes to have thorium licensed in parallel with uranium for existing water-cooled reactors. Long-lived waste is not a problem.

Nuclear fusion is another grail. It powers the stars by joining atoms rather than splitting them in fission. In 1989, the dream of "cold fusion" was reportedly solved by Stanley Pons and Martin Fleishman, with the prospect of a tame nuclear reaction at room temperature — fusion in a jam jar. Other scientists were unable to reproduce their work.

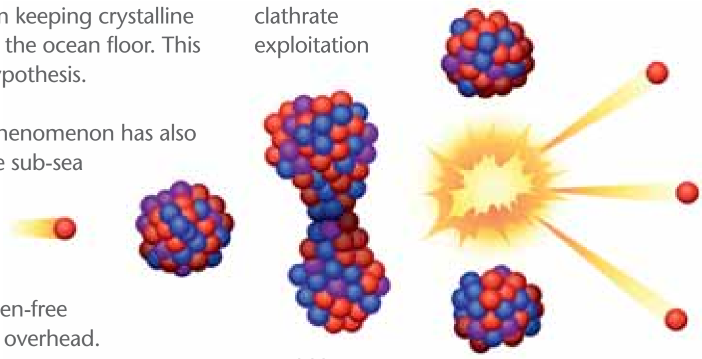
However, the world's largest attempt to harness fusion power is now at a critical stage in the European "Iter" project being developed in France. Iter is based on the use of a tokamak that holds extremely hot plasma away from its containing vessel walls with powerful magnetic forces. The project, which involves millions of precise components, is two years behind schedule and proving very expensive. The problem dogging fusion is that, although it offers the prospect of endless energy fuelled by joining two different types of hydrogen, it is constantly described as being "30 years away".

Fusion would operate at 200 million °C, hot enough to force deuterium and tritium atoms to fuse together and release spare energy. The current goal is to achieve the breakthrough of producing more energy than is consumed. However, researchers at the National Ignition Facility (NIF) in California, which uses 192 beams from the world's most powerful laser to heat and compress a small pellet of hydrogen until molecular fusion takes place, report that they have now achieved this elusive target.

Sea-bottom revolution

Deep ocean methane clathrates come with a health warning. The great terrestrial extinction of the late Permian period — known as the Great Dying, when 70% of all land species died out — was followed by an equally devastating extinction of 96% of marine species. One theory is that this followed global atmospheric temperature rises from large lava releases by the Siberian Traps. This then disturbed the equilibrium keeping crystalline natural gas stable within the ocean floor. This is the "clathrate gun" hypothesis.

The Bermuda Triangle phenomenon has also been ascribed to massive sub-sea landslides releasing hydrates that foam and reduce the density of water above, before breaking free as an oxygen-free bubble into the air lanes overhead.



Scientists only discovered methane hydrates in the middle ocean depths in the 1970s. The continents continuously shed organic molecules into the sea from wastewater treatment plants, farm run-off and general biological debris. This joined plankton and other dead microscopic creatures and then, together, they drifted down to the depths, as they have done for millions of years. Microorganisms then fed on this feast and produced methane. Before this can reach the surface, it meets very cold water in pores in the sub-sea sediment.

Under enormous pressure, cold water molecules form a crystalline lattice that traps the methane such that 1 cubic metre of lattice may hold as many as 180 cubic metres of methane. By one estimate, world methane hydrate reserves could be between 100 and 3 million times greater than US annual energy consumption. Although only a fraction will be exploitable, it is estimated that this could double the size of all other known fossil-fuel reserves combined.

Japan's methane deep-water exploration programme began 18 years ago and has swiftly identified the Nankai Trough, southwest of Tokyo, where two moving tectonic plates meet. Enter the good ship Chikyu (which means "earth" in Japanese), a research vessel with a 30-storey-high drilling derrick and a 6-mile-long drill string. The research project has retrieved and converted small test quantities of methane hydrates as deliverable natural gas. However, it has not yet identified the best and safest future way to extract clathrate gas commercially, and crucially, ship it ashore.

Positives and negatives

There are two serious implications if this potential technology is commercialised. Natural gas, from whatever form, is a carbon-based fuel. Environmentalists fear that the lure of successful clathrate exploitation would be too great to resist, despite the need to cut greenhouse gas emissions. At best, they argue, it should only be a stopgap on the road to renewables.

The other concerns the distribution of methane hydrates beneath the world's oceans. They lie largely in a southwest to northeast arc from Venezuela, under Africa and the Gulf, to Siberia. That could spell trouble in areas of global instability, with disputes over who owns what beneath the waves.

However, for nations with the technical expertise to exploit fire-ice with impunity, out of reach of armies and dictators, it might represent a fundamental redrawing of the planetary energy map. This scenario may lead to the creation of a new, politically imbalanced world, whereby successful states may no longer find it necessary to foster friendly international relationships with other nations in the name of enlightened self-interest. The familiar world created at the opening of the 20th century, when European nations needed stable oil supplies instead of coal for their imperial navies, could be replaced by a new order of winners and losers, bullies and victims. ■

John Herbert has been a Director of ISYS International. He is a former communications manager and investment advisor. He has written on environmental issues for many years.