Ultra-high pressure, high temperature oil and gas

What is ultra-high pressure, high temperature oil and gas?
According to the Department of Energy and Climate Change (DECC),[1] an ultra-high pressure, high temperature (uHPHT) field is an oil or gas field where the reserve is at a pressure of more than 12,500 psi and a temperature of more than 330 Fahrenheit (862 bar and 166 Celsius). These ratings come from technological standards, i.e. the capacity of components involved in the drilling and extraction process to handle the conditions of the well. uHPHT is one section of a range of degrees of high pressure and temperature. There is some variation in definition as to where the exact limits lie however the allowance announced in HM Treasury's 2014 Budget follows DECC's definition.

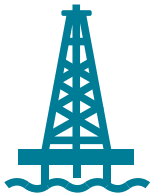
Is it something the UK has done before?
uHPHT is by no means new technology however, with 227 wells of this kind drilled in the UK Continental Shelf between 1987-2003.[8] Whilst seemingly well tested; the high pressures and temperatures make it a potentially highly dangerous venture. Technology is well practiced in either respective extreme: high temperature and low pressure (and vice versa) but the combination means that very stringent safety standards have an even higher importance than under normal conditions.

Budget 2014
On the 19 March 2014 HM Treasury announced the Budget which included details of an allowance for ultra-high pressure, high temperature (uHPHT) clusters that is planned to be introduced following a consultation. The allowance is described to "create and sustain thousands of jobs, provide a significant portion of UK gas demand, and generate billions of pounds of capital investment."[2] This announcement follows a record low for indigenous oil and gas production in 2012, with the lowest annual production volume since 1977[3], down 14% since 2011, and part of a 40% reduction over the last 3 years.[4] In 2013 the UK became a net importer of all fossil fuels for the first time[5]. Seemingly, changes to tax rates in recent years have made the UK market less competitive[5], contributing to a five-fold increase development costs per barrel over the last decade.[6]

The 2013 Wood Report highlighted a need to use technology in order to exploit available opportunities; one of which being HPHT reservoirs. The pressure in these HPHT wells makes them very productive because they can store more gas per cubic foot[7].

How does the allowance work?
In theory, the allowance will offer a tax break to producers, which will serve to ease the fiscal pressures already described. However it is yet to be decided when companies will be able to take the allowance. Or as Martin Rude Pederson, Managing Director of Maersk Oil North Sea UK describes it: "*how do you know you have a well that falls under the allowance? You don't until you've drilled it.*"[9]

This legislation is still in its infancy therefore the specifics are still vague. This factsheet is therefore intended to present a collection of perspectives that it is hoped will enlighten and engage, beginning the conversation rather than ending it.

				
The issue	**What the Government says**	**What the nuclear industry says**	**What the campaigners say**	**What the scientists say**
The situation: what does uHPHT mean for the UK?	The Government will introduce a new allowance for ultra-high pressure, high temperature (HPHT) clusters and consult on the details. The allowance is expected to support the development of big HPHT projects which would create and sustain thousands of jobs, provide a significant portion of UK gas demand, and generate billions of pounds of capital investment.[2]	"The UK is the main place where production from uHPHT is happening."[9] HPHT plays a significant role in exploration, it is described to be a key component of the future of maersk.[9] "It's not easy to find new resources globally and HPHT is an important part of that mix."[9]		
Is it dangerous?	"Individual HPHT well production rates in the North Sea area are high in comparison with field size, hence field developments comprise few wells, often less than ten. In many aspects the technical developments and optimizations go hand in hand with the development of solutions to safety issues. For HPHT wells many economic and safety improvements can only be achieved through cross industry learning and equipment/method development and this will slow down the pace at which this happens."[8]	The principles of well construction in high pressure, high-temperature (HPHT) wells are not significantly different from those used in less demanding wells, but challenges remain because of conditions that limit the range of suitable materials and affect equipment performance. The margins for error are small and the potential consequences of failure are great.[10] "When things go wrong, they go badly wrong."[9] The industry has worked at these pressures before, other industries work at far higher pressures: even 60,000-lb. Yet these industries are often far less uncertain and far more controlled.[7]		The potential risks that come from a HPHT well are: High stress environment, high operating temperatures, high temperature gradients, metallurgy susceptible to specific environments, chemical activity of well fluid components enhanced by the high temperature, massive initial flow rates of most wells, narrow margin between the boundaries presented by loading uncertainties and material property variations.[8]

Is this a signal to invest elsewhere? The UK is committed to reducing GHG emissions 80% by 2050.	"Fossil fuel generating stations play a vital role in providing reliable electricity supplies and a secure and diverse energy mix as the UK makes the transition to a low carbon economy."[11] "There is also substantial uncertainty about the outlook for fossil fuel prices, particularly gas – strengthening the case in the longer term for moving away from reliance on fossil fuels with potentially volatile prices.[12]" "We are legally committed to meeting 15% of the UK's energy demand from renewable sources by 2020. Achieving this will help to achieve energy security and carbon reduction objectives."[13]	"It is our firm belief that the current commitment to renewable sources of energy needs to be rethought. The target should focus on low carbon sources. In the first instance, this means more gas fired power plants. . . Even if they do not deliver the in emissions reductions desired in the much longer term (2040-2050), they will create the time and space in which to develop and introduce some of the new technologies required; of these, carbon capture and storage, may well be applicable to those gas fired power plants."[14]	"The world already has far more gas and oil than we can burn if we are to avoid the most catastrophic impacts of global climate change. Finding more will only make it worse."[15] "Across the world renewable projects are already out competing dirty energy, and that's before communities, and whole cities from Hamburg to Bristol, get in on the act for themselves."[16] "It's easy to see why the likes of Shell and British Gas want to stop renewable energy from becoming cheaper, and available to all . . . It's harder to understand why our politicians should agree with them."	"We are not currently on track to meet the third and fourth carbon budgets. Without a significant increase in the pace of emissions reduction, starting very soon, the costs and risks of moving to a low carbon economy in the 2020s and beyond will be increased. To meet its statutory commitments, it will be necessary for the Government to develop and implement further policy measures over the next two years."[17]
What environmental impacts could there be?	There are countless opportunities for environmental impacts throughout the processes of exploration, appraisal, development and production of oil and gas. The spectrum of problems is spread across on and offshore developments, with each having its own specific cocktail. A brief list of potential long term impacts JUST from offshore development and production are: Benthic and pelagic species disturbance, sediment and water quality disruption, water contamination from drainage, sewage, sanitary and kitchen wastes, spillage and leakage. Power and process plant emissions, noise and light disruption, solid waste disposal and potential impacts from increased marine and avionic craft movement.[19]	"The industry takes its responsibility towards the environment very seriously and works with Government and stakeholders to minimise the environmental footprint of operations. Finding and producing oil and gas is an industrial process that, inevitably, has some degree of impact on the environment and the challenge is to balance this with the benefits that society takes from having a secure energy supply."[20] In indirect response to the environmental risk highlighted by the UNEP report: "The evidence that we have for discharges to the marine environment suggests that the residual risk is not significant and that further reduction in discharges would provide no benefit to the environment."[20]	Others believe that any of these consequences are not "balanced with the benefits" and there are ample opportunities elsewhere (as above). The world already has far more gas and oil than we can burn.[15] Decades of irresponsible mining and oil and gas exploration have produced devastating effects in many developing countries, on local environments and communities, and on the climate.[21]	HPHT wells are fundamentally constructed, stimulated, produced and monitored in a manner similar to wells with less demanding conditions – the environmental problems associated are therefore very similar.[18]

The dominant concern surrounding u/HPHT wells is that production is dangerous, as described by the HSE[8]. However this concern does seem mitigated by the UK's expansive history with HPHT, the availability of experience in other industries relevant to more extreme situations and also the fact that these wells are situational extensions of procedures already actively conducted all over the world. It is a modification to the considerations but not a fundamentally different task. For some this is part of the problem, they might argue that the impacts associated with ANY exploration and production are sufficient to warrant investment elsewhere and therefore this extension can only be considered negative considering the increased potential for danger on top of the initial misguided rationality.

For others this is a key opportunity for the UK to stake a claim to energy independence, by using a technology that is far less carbon intensive than the most popular alternative: coal. They might say that natural gas provides an opportunity that we cannot ignore, it is a "lower-carbon" alternative and could serve as a critical stop-gap between carbon intensity and neutrality. For now it is a case of waiting to see what the consultation produces. There are many specifics yet to be made clear; once this happens the amount of published information on the topic will likely increase.

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