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Advisory Note:

Potential for the application of the Proton Technologies Clear H2 process in the UK

At JS Global we have 40 years of experience in the geological evaluation and development of onshore oil and gas assets in the UK and internationally. Throughout this period, we have worked to ensure that such developments take place in a manner that protects the local and wider environment and have a social licence to operate.

With the pressing but potentially conflicting need to reduce global carbon emissions whilst ensuring there are adequate energy resources available to meet sustainable development needs, the energy transition needs to be pushed forward rapidly. For the UK, recent events have demonstrated that there is also a need to maintain a diversity of indigenous energy sources in the mix.

It is recognised and acknowledged that the existing energy infrastructure needs to adapt to meet the low carbon future and that Hydrogen (H_2) will form part of the mix. This is where innovation and the aggregation of existing processes to provide low carbon fuels can really be beneficial.

The process identified here presents one such opportunity that has potential application in selected locations in the UK and could help the UK meet the planned H_2 production targets.

The Clear H_2 Process

The Clear H_2 Process, under development by Proton Technologies, is a development of existing processes and procedures that enables the in-situ generation of hydrogen from end-of-life oil fields.

By combining two proven technologies, in-situ gasification and hydrogen selectivity techniques, the process separates $H2$ and sends it to the surface while leaving hydrocarbons and the associated contaminants underground.

In simplistic terms, this two-step process allows for the heating and in-situ oxidation of the residual oil in existing mature, depleted or abandoned oil fields to create a hydrogen rich gas. This gas is then collected through Hygeneration wells and separated out via palladium alloy membranes, with residual Carbon Monoxide and other elements reinjected back into the reservoir.

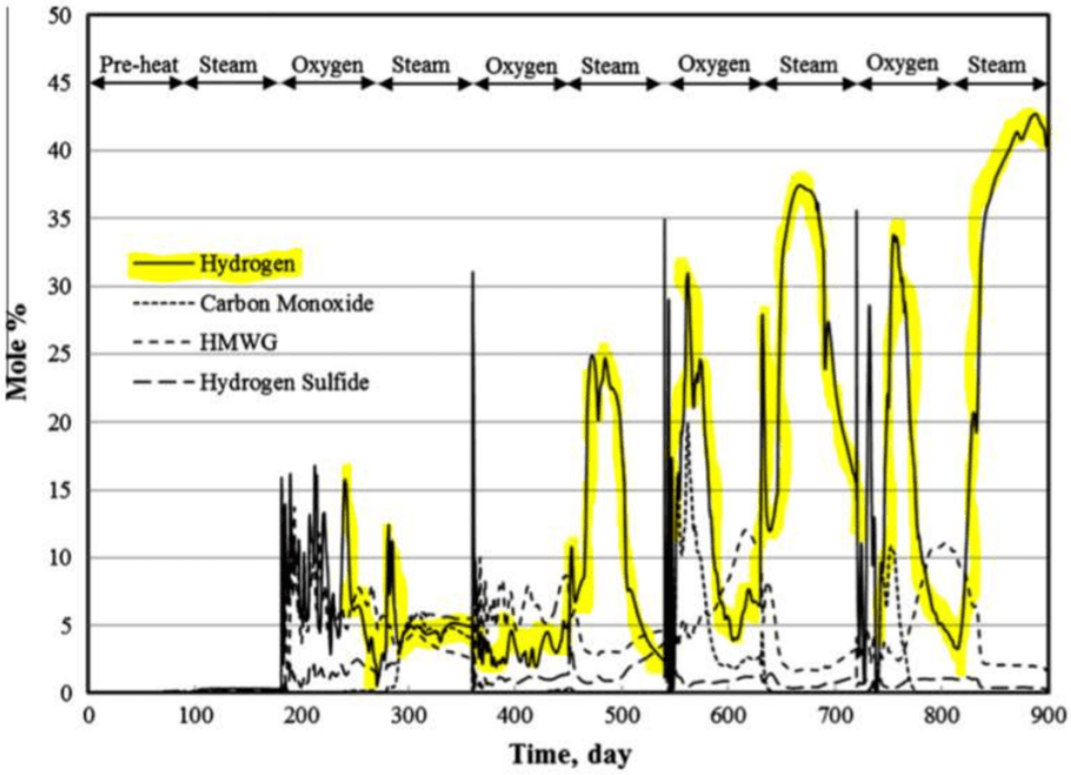


Diagram: Trial process in Canada: Hydrogen, carbon monoxide, heavy molecular weight gas (HMWG), and hydrogen sulfide composition in produced gas from heavy oil production well during cyclic injection of steam and oxygen.

The processes are potentially able to utilise existing surface and well infrastructure, though some additional systems would be required for both the injection and hydrogen separation. This means that the technical process could be easily and rapidly applied, using modular systems to fields where the necessary consents exist.

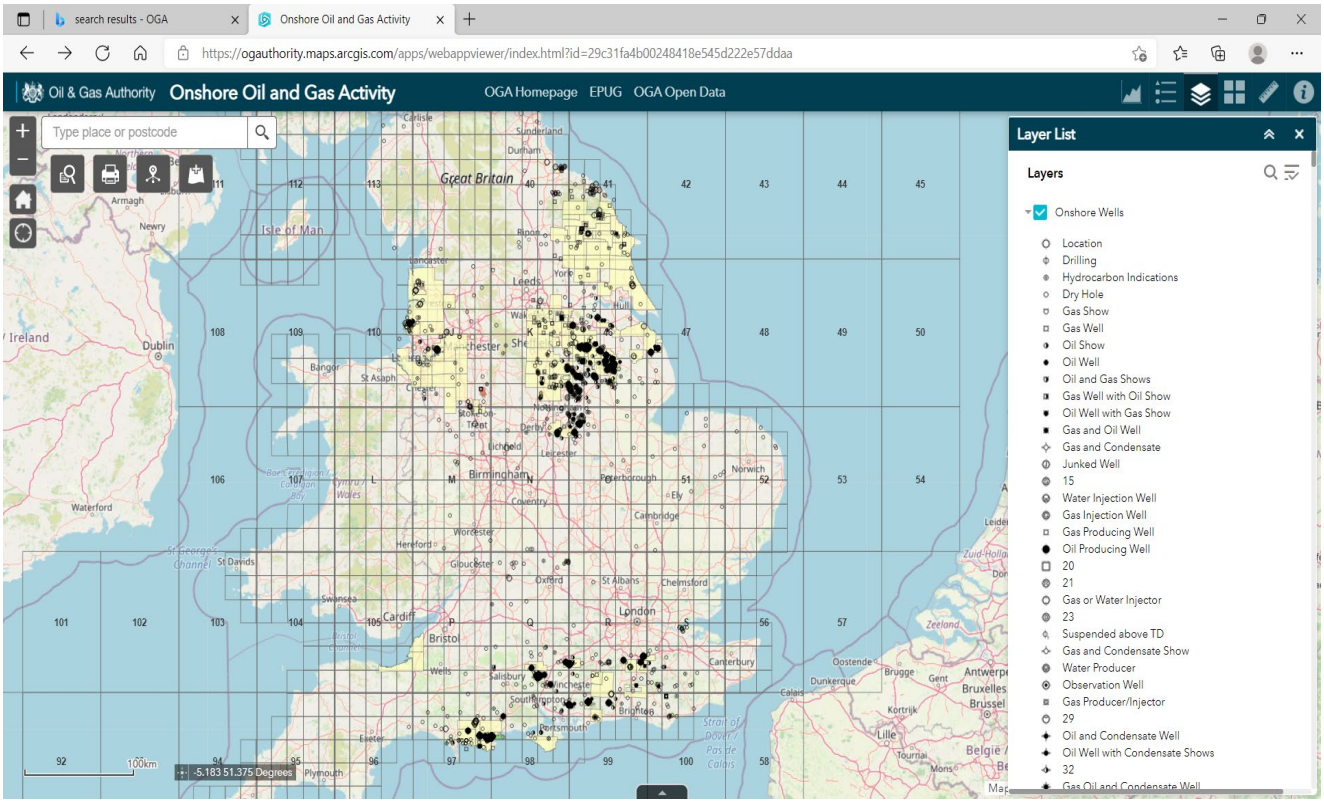
It should be noted that the majority of oil production processes only ever extract about 40% of the oil in situ, leaving the remainder within the reservoir rock. The Proton process enables a portion of this residue to be converted into beneficial H_2. This is where innovation and the aggregation of existing processes to provide low carbon fuels can really be beneficial.

UK Onshore Context

The development of onshore oil fields in the UK has been carried out successfully since the 1940's but has never reached the scale of offshore North Sea developments due to the scattered and relatively small size of the fields. A number of the older production fields have now been deemed as worked out or been 'shut in' (temporarily closed) due to low production or consent issues, but they still have significant reserves of oil in place.

Onshore UK operations are controlled by the Oil and Gas Authority (OGA) who grant potential operators the necessary Petroleum Exploration and Development Licence (PEDL).

OGA Interactive Permit Map



Key: The intensity of the black dots depicts the distribution of producing oil and gas wells onshore UK under existing and historic PEDL's.

The last OGA onshore licencing round (14th Round) led to the allocation of 93 new licence areas, of which 63 were for shale gas exploration and 19 for conventional oil and gas exploration. These are in addition to the operational sites under the current and ongoing PEDL's that have previously been issued.

The granting of a PEDL is only one step in the regulatory consent process that applies for the exploration, development and exploitation of oil and gas, as any mineral development operation also requires Planning Consent from the relevant local planning authority (usually the County Council, Unitary Authority or National Park Authority).

In addition to planning consent, any onshore oil and gas related operations also need to meet the Environment Agency (EA) regulatory requirements for pollution control. The EA published specific guidance for oil and gas companies, which sets out which environmental permits they need for onshore oil and gas operations in England in 2016. The guidance explains the permits that businesses will need and, where relevant, the best available techniques that they should use to meet regulatory requirements. The Health and Safety Executive also have specific sector rules under the COMAH regulations.

Although not specific to the Proton Technologies process or operations, it is clear that the regulatory processes identified above would also apply to in-situ hydrogen generation that utilises existing fields.

It is also anticipated that the application for the necessary permits and consents, which is through a process in the public domain, could attract the attention of a range of objectors who are opposed to any operation connected with the Oil and Gas sector.

Opportunity

Although the onshore UK fields vary in geology and environmental sensitivity, it is apparent that the existing field operators are all recognising the pressure to move into the Energy Transition process. This means that they are currently all open to the exploration of processes that could align their assets and businesses with the transition to a low carbon future. So far, this has been restricted to the appraisal of geothermal opportunities as the most applicable to their business models.

As such, the Proton Technologies process offers a real potential to move from oil (and gas) production to production of Clear Hydrogen, using existing assets and procedures that they will understand. This provides an immediate and potentially long running opportunity for the further development of the process for existing mature fields and those still in production.

Further analysis is needed to determine which Operators have the optimal fields for test development in terms of both geology and location, but initial assessment has shown that there are mature fields that appear to sit in the sweet spot for application of the Proton process.

Opinion

On the basis of 40 years of experience as a geologist and environmental advisor to the onshore oil and gas sector, it is my opinion that the Proton Technologies Clear H2 process has the potential to be a significant step forward for the Onshore UK Energy Transition process. The additional benefit of securing long term H_2 production from a reliable source could make the process a significant part of our future energy mix.

The existing onshore field operators are all seeking ways to transition into clean energy. This gives the Clear H2 process a real potential for development and adoption on existing mature fields and for wider development as oil production is reduced.

In addition to this current potential, the Sabien strategy of looking to aggregate low carbon developments offers a synergy for the co-location of other energy transition opportunities.

Henry E Lang, Director

10/11/2021