Patagonia Wind –Using Methanogenesis to Store Hydrogen on Large Scales

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Subject Topic: Energy storage using hydrogen produced from excess renewable electricity: Power to hydrogen.

Due to its perpetual windy climate, Argentine Patagonia is a unique place and for this reason HYCHICO has foreseen an opportunity to develop there green energy production and exportation by means of hydrogen. While numerous technologies were developed to store hydrogen on small scales, there are few options for large scales such as saline cavities, depleted gas reservoirs and aquifers.

As HYCHICO's facilities are located in an oil and gas field, the well "F-160" was selected for a pilot project where BRGM and HYCHICO have started to develop four years ago a new technology based on the transformation of hydrogen into methane through methanogenesis (a).

$$4H_2 + CO_2 = CH_4 + 2H_2O \quad (a)$$

The process takes place directly in a dedicated depleted gas reservoir where H_2 and CO_2 are injected together. This technology is called UCM for Underground Controlled Methanogenesis and could bring benefits on different levels:

-methane is far easier to handle and to store than hydrogen, it has a poor reactivity within geological environments and does not diffuse as easily as hydrogen

-it is possible to benefit from the long acquired experience regarding natural gas exploitation during decades to control and monitor the methane production

-if we want to transport and use directly the produced methane, there will be no need for further adaptation of the existing natural gas infrastructures

-contrarily to methanation, methanogenesis is a microbial natural process that can be harnessed and used in the reservoir without any additional cost, the small heat requirement being provided by the geothermal gradient of the gas reservoir

In order to be effective in terms of environmental value, this transformation requires taking care of the fate of the newly created methane. Therefore, the UCM technology also includes the use of integrated oxy-combustion cycle that would lead to the production of electricity and heat without emitting any additional gas. To validate the overall process, tests have been launched since 2014 both at laboratory and industrial scales, to harness the methanogenic process. Namely, water content and composition, temperature shifts during injection, pH regulation and the repartition of the different gas into the reservoir, could induce variations or heterogeneities regarding the transformation kinetic that have to be addressed. The results of these tests demonstrate the validity and feasibility of the UCM approach but also display a high sensitivity of the microbial populations regarding those parameters, namely pH and phases distribution. Together with the UCM concept, these results will be exposed and discussed during the presentation.