Simultaneous CCS and NG Storage in Salt Caverns

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Since the start of the industrial revolution, the world has seen unprecedented technological progress coupled to an accelerated energy demand, which is currently more than 90% carbon-intensive combustion. Necessarily, an equally proportional increase in CO_2 emissions has followed, together with an increment in the global average temperatures of more than 1°C. Clearly, in the forthcoming future, a significant reduction of CO_2 emission is not realistic. Even if clean energies are delivered to consumers, the primary energy source will continue to be carbon-based. This leaves the innovation in efficient Carbon Capture and Storage (CCS) as the only sustainable option for our modern society and the only way to meet the Paris climate accord targets.

Natural gas (NG) currently represents 24% of Germany's primary energy use. Although NG results in fewer emissions of nearly all air pollutants, the unit mass ratio of CO_2 generation to NG is around 3. Additionally, NG's energy demand is heavily seasonal-dependent; the winter peak demand almost doubles that of the summer, requiring buffering the supply with reserves, 24% of which are stored in deep salt caverns operating up to 200 bar. However, to balance the lithostatic pressure, a minimum operating pressure of about 70 bar is required, resulting in around 30% mass of the NG in salt caverns to be permanently stored.

The current German salt caverns storage capacity is above 15 billion m^3, while the estimated total annual German CO_2emissions are equivalent to just 1 billion m^3 of CO_2 at 30 ºC and 100 bar. When mixed with some fluids, CO_2 develops very peculiar behaviour, such as phase barotropicity. This behaviour may allow the simultaneous storage of NG and CO_2 in salt caverns, resulting in innovative scenarios for CCS, providing an excellent contribution to Germany's carbon neutrality commitments, as well as those of many other countries.