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Integrated underground gas storage of CO_2 and CH4 for renewable energy storage for a test case in China

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Integration and further development of the energy supply system in China is a major challenge for the years to come. Part of the strategy is the implementation of a low carbon energy system based on carbon dioxide capture and storage (CCS). The innovative idea presented here is based on an extension of the power-to-gas-to-power (PGP) technology by establishing a closed carbon dioxide cycle [1]. Thereto, hydrogen generated from excess renewable energy is transformed into methane for combustion in a combined cycle gas power plant. To comply with the fluctuating energy demand, carbon dioxide produced during methane combustion and required for the methanation process as well as excess methane are temporarily stored in two underground reservoirs located close to each other [2]. Consequently, renewable energy generation units can be operated even if energy demand is below consumption, while stored energy can be fed into the grid as energy demand exceeds production [3].
We studied a show case for Xinjiang in China [4] to determine the energy demand of the entire process chain based on numerical computer simulations for the operation of the CO_2 and CH4 storage reservoirs, and to ascertain the pressure regimes present in the storage formations during the injection and production phases of the annual cycle.

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