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Geological subsurface will contribute significantly to the implementation of the energy policy towards renewables in Germany

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The demands to exploit the geological subsurface are increasing. In addition to the traditional production of raw materials such as natural gas and petroleum, or potable groundwater extraction the underground will most likely also be used to implement the climate and energy policy objectives in the context of the energy transition to renewables. These include the storage of energy from renewable sources (e.g. hydrogen and methane), the use of geothermal energy and possibly the long-term storage of carbon dioxide to reduce the release of greenhouse gases into the atmosphere.

The presentation addresses the question which realistic contribution can be expected from the geo-resource subsurface for the energy revolution, the detachment of fossil and nuclear fuels as well as the reduction of CO_2 emissions. The study of Henning and Palzer [1] that models the energy balance of the electricity and heat sector including all renewable energy converters, storage components and loads for a future German energy system shows that provision with 100% renewables is economically feasible by 2050. Based on their work, our estimates underline that already in 2015 more than 100% of the required methane storage capacities therein are available and more than 100% of the heat pump demands might be covered by shallow and deep geothermal energy production in the future. In addition we show that a newly developed energy storage system [2-3] could be applied to store 20-60% of the surplus energy from renewables expected for 2050 with integrated gas storage of methane and CO_2.

[1] Henning H-M, Palzer A (2014) A comprehensive model for the German electricity and heat sector in a future energy system with a dominant contribution from renewable energy technologies—Part I: Methodology. Renewable and Sustainable Energy Reviews 30, 1003-1018. doi: 10.1016/j.rser.2013.09.012

[2] Kühn M, Nakaten N, Streibel M, Kempka T (2014) CO_2 geological storage and utilization for a carbon neutral “power-to-gas-to-power” cycle to even out fluctuations of renewable energy provision. Energy Procedia 63, 8044-8049. doi: 10.1016/j.egypro.2014.11.841

[3] Kühn M, Streibel M, Nakaten N, Kempka T (2014) Integrated underground gas storage of CO_2 and CH4 to decarbonise the “power-to-gas-to-gas-to-power” technology. Energy Procedia 59, 9-15. doi: 10.1016/j.egypro.2014.10.342