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Huge subsurface storage potential for excess energy already available in Germany

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The energy supply in Germany is subject to a profound change. The present paper addresses the German potential for the innovative idea of storing excess energy from renewable power sources in the form of hydrocarbons, which can be used in a closed cycle to produce electricity in an environmentally friendly manner [1].

Excess electricity from wind and sun can be transformed into hydrogen, and with carbon dioxide subsequently into methane until large hydrogen storage capacities become available. When needed, electricity is regained in a combined cycle plant combusting the methane. To close the carbon cycle, carbon dioxide is captured on site. Two subsurface storage formations for both gases are required for the technology [2]. We studied a regional show case for the city of Potsdam and worked out the overall energy and cost efficiency [3]. Our results demonstrate that this extended way of power-to-gas is not only technically, but also economically feasible compared to other state-of-the-art excess energy storage technologies [4].

Here, we are taking into account the actual German storage capacity for natural gas. The most recent development is characterised by stagnation of the available total working gas volume and an increase in the significance of cavern storage at the expense of porous reservoirs. This resulted in the decommissioning of a couple of storage sites within the last years. In view of the fact that natural gas is still second most important for Germany's primary energy provision, those sites should better be used to store excess energy from renewables instead of their abandonment. We show that the technology to store excess energy in form of methane via power-to-gas is available and ready for operation and that the potential within the German subsurface is enormous. This provides an intermediate option to reduce greenhouse gas emissions while hydrogen storage is still under research and development.

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