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Power-to-Gas-to-Power is a competitive excess energy subsurface storage technology

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The underlying study addresses the ambitious German Federal Government's objectives for the transition to a new energy era by proposing the implementation of a low-carbon energy system, improving the electricity grid as well as solar and wind power initiatives. Hereby, the "Power-to-Gas-to-Power" (PGP) approach combines the storage of excess energy from renewable power sources in the form of synthetic hydrocarbons, and their subsequent utilisation in a closed cycle to produce low-carbon electricity [1]. Based on the availability of two adjacent subsurface storage formations for CO_2 and CH_4 [2], hydrogen gained from excess solar and/or wind power is transformed into methane by means of CO_2 captured on-site. When required, electricity is regained in a combined cycle plant by burning the CH4, with CO_2 cycled in a closed loop.

In a show case study for the two German cities of Potsdam and Brandenburg, the PGP process chain was quantified to a total process efficiency of about 26%, exhibiting costs of 20 eurocent/kWh [2]. These previous assessments referring to energy production and storage technologies economics of the year 2012, have shown that PGP is generally economically competitive compared to conventional storage technologies [2]. Further results show that PGP can compete with global cost bandwidths of hydropower and compressed air storage as well as with upper limit COEs for solar thermal power and photovoltaic. However, PGP is not competitive compared to fossil fuel-based as well as onshore/offshore wind-based energy production [3]. However, cost trends related to energy production and storage technologies significantly correlate with fuel and commodity prices, CO_2 emission charges as well as technology improvements that have been rapidly changing in the past few years. Thus, the purpose of the present study is to update the previously published PGP costs and elaborate a general overview on the current status of PGP on the global energy market.

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