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**Abstract**

**Title: Short and Medium Term Potential of Power-to-X-Options in Germany**

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**Abstract**

The energy transition in Germany aims at a significant greenhouse gas emissions' reduction of at least 80% in 2050 compared to 1990. Fossil energy sources have to be saved or replaced by renewable energies to reach the decarbonization target. One important element for this is the increasing electricity usage in the demand sectors to substitute fossil energy sources by electricity or to improve the efficiency. Power-to-x describes these new capabilities to link the electricity sector with the field of applications in the residential, commercial, transport and industrial sector. Furthermore, these new power consumers can offer flexibility, which supports the integration of fluctuating renewable energies into the energy system, e.g. additional flexibility can reduce the curtailment of renewable energy feeding in times of surplus electricity.

A scenario based investigation is conducted to assess the short and medium term potential of offering flexibility and decarbonating the future energy system. At the beginning the term "power-to-x" is introduced and we have a general discussion related to energy policy. Afterwards, we present a general overview of the power-to-x-options' potential in Germany and identify the main options in the transportation, heat and industry sector. Selected power-to-x-options are investigated with regard to their realization potential and to their possible contribution to energy and climate change policy targets in 2020/2030. The focus of the analysis is on the greenhouse gas saving potential, the fossil energy source saving potential and the change in electricity consumption.

Perceptively, the analysis shows that all investigated power-to-x-options support the fulfillment of the energy and climate change targets by substituting fossil energy sources by renewable electricity. However, the greenhouse gas savings of some power-to-x-options are not only based on the substitution of fossil energy but also on improved energy efficiency. A high saving in greenhouse gas emissions can be found especially by electric vehicles, heat pumps and electric steel production. Hydrogen usage in the industry has a high potential, but it is not economic in the actual regulatory framework. Moreover, typical market growth rates conclude that an early penetration of a market is required for a short or medium term market-development. In addition, the analysis demonstrates that the flexibility in the energy system can be increased and can make a major contribution to the balancing in the field of hours or days.