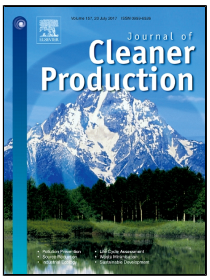
# Accepted Manuscript

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Grazia Leonzio

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# Design and feasibility analysis of a Power-to-Gas plant in Germany

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## Abstract

The Power-to-Gas process chain could play a significant role in the future energy system. Renewable electric energy (wind or solar) can be transformed into storable methane via electrolysis and subsequent methanation through Sabatier reaction. The aim of this research is a design and techno-economic analysis of a Power-to-Gas process. The plant is integrated with an anaerobic digester to have the carbon dioxide, by the upgrading of the biogas, for the Sabatier reaction. Electrical and thermal power are produced by a cogeneration system. A business to business analysis, not present in other literature works, is carried out for the process: it is then the main innovation of this research. Results show that to produce 1000 $kW_{el}$, 10 kmol/h of methane are needed: in the Sabatier reaction, the flow rate of carbon dioxide and hydrogen are respectively equal to 4.6 kmol/h and 22 kmol/h. The power of the eolic park is 1980 $kW_{el}$. In the business to business analysis, a swot analysis (strengths, weaknesses, opportunities and threats) is developed. Success critical factors and risks are found in addition to several strategies that must to be involved to be successful in the project. The success of the process is the use of 100% of renewable energy to produce a need for the society, enhancing a waste material as the carbon dioxide to produce methane. The techno-economic feasibility shows that the plant is economic feasible with VAN, PBP and LCOE equal to 8 million €,4 years and 260 €/MWh respectively. Economic incentives are also obtained.

The future construction of the plant in Germany will verify the obtained results and future researches should realize the most sustainable process with lower environmental impact.

**key words:** Power-to-Gas, Process design, Renewable energy, Business to business analysis, Process simulation