Master’s Thesis

## Techno-Economic Assessment of Biological Biogas Upgrading Based on German Biogas Plants

## Background

Biomethane production has attracted lots of attention as a sustainable approach to overcoming energy scarcity. In this context, Germany is the leading country by holding the highest number of biogas upgrading plants among other European countries. Currently, physicochemical technologies are broadly implemented in which CO2 is removed or separated from methane-rich biogas. On the contrary, a newly introduced upgrading method, so-called, ‘Biological biogas Upgrading’, captures and converts the CO2 present in the biogas into CH4. Although this process could be done either in ex-situ or in-situ forms, in-situ method has intrinsic problems with pH stability. Therefore, ex-situ upgrading appears to have higher market potential. Nevertheless, to increases the technological readiness level (TRL) of this technology, it is necessary to evaluate its economic feasibility by calculating the economic criteria such as Levelized cost of energy (LCOE), Net Present Value (NPV), and Payback Period. Among the important criteria when developing the cost sheet, price of electricity to provide the hydrogen demand of the process constitutes a high share of operational costs. Thereby, the impact of electricity price should be evaluated on the projected selling cost of biomethane.

## Goals

The current master thesis aims to evaluate the economic and technical performance of both anaerobic digestion (AD) and biomethanation processes within a full-scale biogas plant. The primary goal is to uncover the specific circumstances under which biomethanation can be financially viable. The study involves creating and simulating process models for AD and biomethanation by estimating the equipment sizing and costs. Also, economic performance will be investigated by taking into account the prices of hydrogen (H2) and biomethane, as well as considering a supporting scheme for biogas production and upgrading.

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