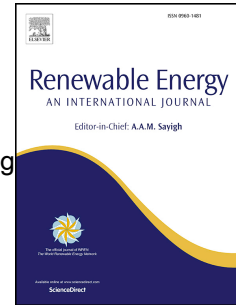


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A. Pääkkönen, H. Tolvanen, J. Rintala



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Techno-economic analysis of a power to biogas system operated based on fluctuating electricity price

A. Pääkkönen^{a,*}, H. Tolvanen^a, J. Rintala^a

^a*Laboratory of Chemistry and Bioengineering, Tampere University of Technology, Korkeakoulunkatu 8, 33720 Tampere, Finland*

Abstract

This article presents a feasibility analysis of a novel operating principle based on fluctuating electricity prices for an existing biogas plant. By investing in an electrolyzer, excess electricity from renewable production can be stored as CH₄ by biological methanation of H₂ with CO₂ originating from the biogas plant. The main components of the system are an electrolyzer that is connected to an electric grid and an anaerobic digester where the methanation takes place as well as a biogas upgrading unit. First the energy flow of the system was studied, and secondly the operation costs of the system as well as the electrolyzer investment payback time were evaluated.

The study showed that up to 40% of the electricity fed into the system can be stored as biomethane, and the system energy flow is most sensitive to the electrolyzer efficiency. The economics of the studied system depend mostly on the electrolyzer investment cost and desired target price for the CH₄. The system can be run economically with current electricity prices if the electrolyzer investment costs decrease 60-72% or the price of CH₄ increases 20-76% depending on the investment interest and price fluctuation scheme.

Keywords: flexibility, power to biogas, renewable power production, integrated system, biomethane,

1. Introduction

2 There is a global interest to increase the renewable energy production in
3 order e.g. to decrease environmental emissions and dependence on fossil fuels.
4 Currently most of the renewable electricity production is hydro-power, while
5 the amount of solar and wind power is increasing rapidly [1]. As these power
6 production methods are dependent on weather conditions the power production

*Corresponding author

Email address: anna.paakkonen@tut.fi (A. Pääkkönen)

URL: <http://www.tut.fi> (A. Pääkkönen)

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