A tool for analyzing the sustainability of biogas production chains

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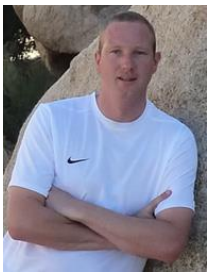

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Summary

The flexibility of biogas makes it a very capable load balancer within decentralized smart energy systems. However, within this context the sustainability of biogas production is not fully understood. What is needed is a **tool for analyzing the sustainability of biogas production pathways**. The main goal, of this research is to design a transparent flexible planning tool capable determining the sustainability of decentralized biogas production chains. This insight will help in designing a tailor-made biogas production chain for a specific geographic location, increasing the effectiveness and sustainability of biogas as a renewable resource.

Abstract

Decentralised biogas production from co-digestion can become an important player in (future) decentralised smart energy grids. Its flexibility and reasonable steady production throughout the year can make biogas very capable in balancing other more irregular decentralized renewable resources (e.g. wind and solar PV) and fluctuations in energy demand. Biogas can be transformed into electricity, heat and green gas, which includes most of the energy demand in decentralized energy grids. Green gas is upgraded biogas to natural gas grid quality, ready for injection in the national gas grid. Furthermore, biogas can potentially be stored for longer periods of time. The aforementioned qualities can give biogas a pivotal role in future decentralized renewable energy grids as load balancer.

Unfortunately, the sustainability and efficiency of biogas production, operating as load balancer within decentralized energy grids, is not fully understood. Unlike wind and solar, biogas is not very abundant, there is only a small amount of sustainable biomass available per geographic location for the production of biogas, which also differs per chosen location. Biogas production requires energy inputs partially still supplied by fossils, hidden away in for instance, cultivation, transport, processing, conversion of energy and construction of the various systems. Furthermore, there are multiple biogas production pathways possible, that either upgrade biogas to green gas, produce electricity and heat or use the biogas directly in a heat boiler. All the aforementioned variables within the introduction and more make a one size fit all biogas system very difficult to achieve. To find suitable, applications of specific biogas chain operating in decentralised energy system will require some form of optimisation tooling.

From the aforementioned one can conclude that, what is needed is an **optimization tool capable of determining the costs, sustainability and efficiency of biogas production chains operating within a decentralized smart energy system**. The Flexigas project is working towards economic and sustainable integration of biogas into the future national and decentralized energy system (Flexigas, 2013). The main goal is to design a planning tool, consisting of a dynamic LCA method integrated within a dynamic model. The resulting tool will be capable of integrating biomass availability, energy demand, biogas production and energy production from other renewable sources, such that conclusions can be drawn on the sustainability, efficiency, flexibility and economy of biogas production in the near and far future (2012 to 2050), within local decentralized smart energy grids. The tool can be programmed with average data giving a general overview or it can be programmed with more precise data to give a more specific indication of the performance of biogas pathways. Together with future research the tool can help determine; on a general level, if biogas is a suitable renewable energy source; and on a more specific level, the tool can help determine how to use the flexibility of biogas most effectively in specific decentralized energy systems. This insight will help in designing a tailor-made biogas production chain for a specific geographic location, increasing the effectiveness and sustainability of biogas as a renewable resource.

Sources

The Flexigas project 2013, www.flexigas.nl