SYMBIO: Integration of Biomass and Wind power for Biogas enhancement and upgrading Via Hydrogen Assisted Anaerobic digestion

Biogas mainly contains methane (40–75%) and Carbon dioxide (25–60%). Upgrading of biogas to methane content higher than 90% increases the heating value, and extend the biogas utilization as a renewable energy source. Biogas can substitute fossil fuels in power, heat production and transportation systems. However, raw biogas demands successive cleaning and upgrading steps before deemed fit for direct injection into the natural gas grid or used as vehicle fuel. Although, there are different commercialized biogas upgrading solutions, most of these conventional technologies suffer from high running cost due to high temperature and pressure operation or use of expensive solvent chemicals.

In contrast, microbial assisted upgrading process is a new alternative biogas upgrading method. It utilizes naturally occurring anaerobic microorganisms that can bind carbon dioxide and hydrogen into methane, producing an upgraded biogas. Moreover, the process demands an external hydrogen supply; an attractive renewable hydrogen source would be electrolysis of water powered by off grid excess electricity from fluctuating renewable sources like wind and solar power farms. However, the low solubility of H_2 in a liquid medium limits the gas-liquid mass transfer rate and subsequently it affects the microbial assisted anaerobic biogas upgrading process.

In this PhD research, an innovative microbial assisted biogas upgrading process was developed using a membrane bioreactor (MBR) system. Lab scale testing of the process revealed that biogas upgrading up to 99% methane content was possible with nearly complete utilization of the hydrogen gas supplied into the reactors. These results indicate the potential of microbial assisted biogas upgrading system as an integral part of a power to gas technology.