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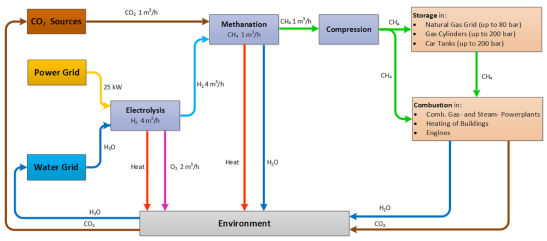
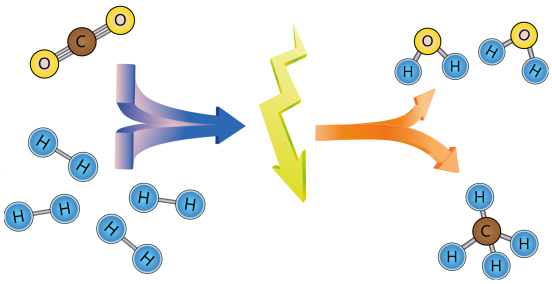
Project Partners	Norður Power Grid Association

Material and Energy Flow Analysis for the Feasibility of a Power-to-Gas Plant in Iceland

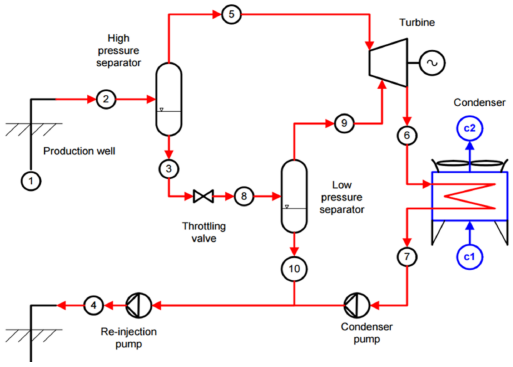
Project work in the Master's degree Master of Science in Engineering



Process flowsheet of a power-to-methane demo plant, calculated and normalised to an output of CH_4 of 1 m3/h, IET Institute



Methane – Synthesis, IET Institute for Energy Technology



Double flash cycle of a geothermal power plant, Dr. Páll Valdimarsson, University of Iceland

Introduction: Today the energy demand is mainly covered by fossil energy carriers. Fossil energy carriers also play an important role in mobility. The energy transition requires a rethinking in dealing with energy. In the mobility sector, fossil fuels can be replaced by renewable, CO_2-neutral fuels. Power-to-gas and power-to-liquid are two promising technologies to produce renewable and CO_2-neutral fuels. This project work is about the implementation of a power-to-gas plant in Iceland for producing SNG synthetic natural gas."Power-to-gas" is a process in which electrical energy is converted into chemical energy and is therefore easily storable. Power-to-gas covers the following two methods: power-to-hydrogen, in which hydrogen is produced and power-to-methane, which is a two-step process: in a first step hydrogen is produced, which is then converted together with CO_2 into methane. Methane has an energy density of 9.9 or 11.0 kWh/m^3 (LHV or HHV), which is comparable to the energy content of one liter of gasoline. The methane synthesis is based on the Sabatier process, which was developed in 1902 by the chemists Paul Sabatier and Jean Baptiste Senderens.

Objective: The main targets of this project work are:

- Qualitative and quantitative analysis of all input variables (educts gases, heat, water, steam, electricity, etc.) in cooperation with the Reykjavik University. This includes in particular the determination of the chemical composition of different educts gases.
- Verification of the plant size of the feasibility study by the determination and analysis of material and energy flows on site.
- Compilation, techno-economic analysis and evaluation of various treatment paths and technologies for delivering educts gases in the quality required for methanation.

Result: After the material and energy flows analysis an overall draft of concept was elaborated. Six feasible concept variants were derived from the overall concept. In the concept comparison economic aspects and ecological aspects were investigated. One specific variant could be identified with the best economic performance, mainly based on the highest production capacity. A slightly different concept variant turned out to be better regarding ecological aspects, because of the lowest environmental impact points. This variant could be extended if a higher methane production is required.