

Feasibility analysis of Power-to-Gas in future Swiss Power System

Introduction

The principal concept of Power-to-Gas (PtG) is to transform electrical energy via electrolysis into gas. The electrical energy is used to produce hydrogen (H₂) and oxygen (O₂) from water (H₂O). The concept can be expanded with an optional process step - the methanation process - which needs a source of carbon dioxide (CO₂) to produce methane (CH₄) out of H₂ and CO₂. The produced H₂ or CH₄ has various application areas such as in the mobility sector and the chemical industry. The produced H₂ or CH₄ can also be used to generate electricity fed directly into the power network or fed and stored in the gas network.

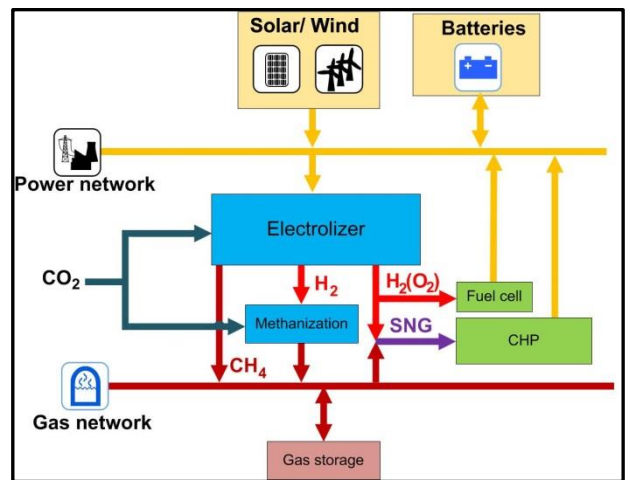


Figure 1. The concept of Power-to-Gas

Results

The study presents a qualitative and quantitative feasibility analysis of the PtG technology in the future Swiss power grid, which will be characterized by a significant share of intermittent renewable energy sources. The focus is placed on establishing a resolution to effectively integrate renewable energy sources (RES) into Swiss power grid through energy storage systems, including pumped hydro storage (PHS) and PtG. The resolution is presented through the analysis of a designed scenario that reflects the current and future energy profile of Switzerland and will utilize the strength of a model predictive controller (MPC), with respect to the optimized dispatch of storage capacity, including the existing PHS and the proposed PtG plants in addition thereto.

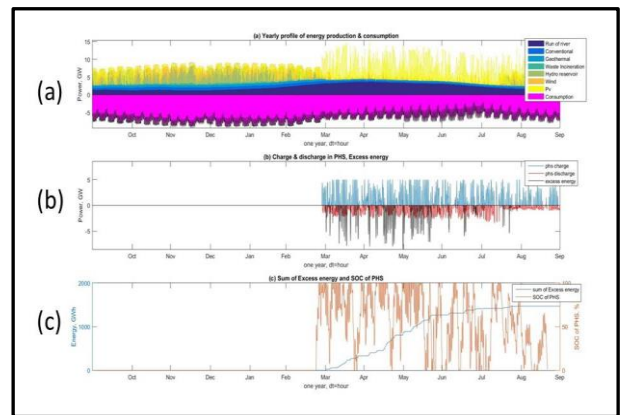


Figure 2. Results of the feasibility analysis: (a) Yearly profile of energy production and consumption; (b) Change & discharge of energy in PHS, and excess energy to be stored in PtG; (c) sum of Excess energy stored in PtG and SOC of PHS.