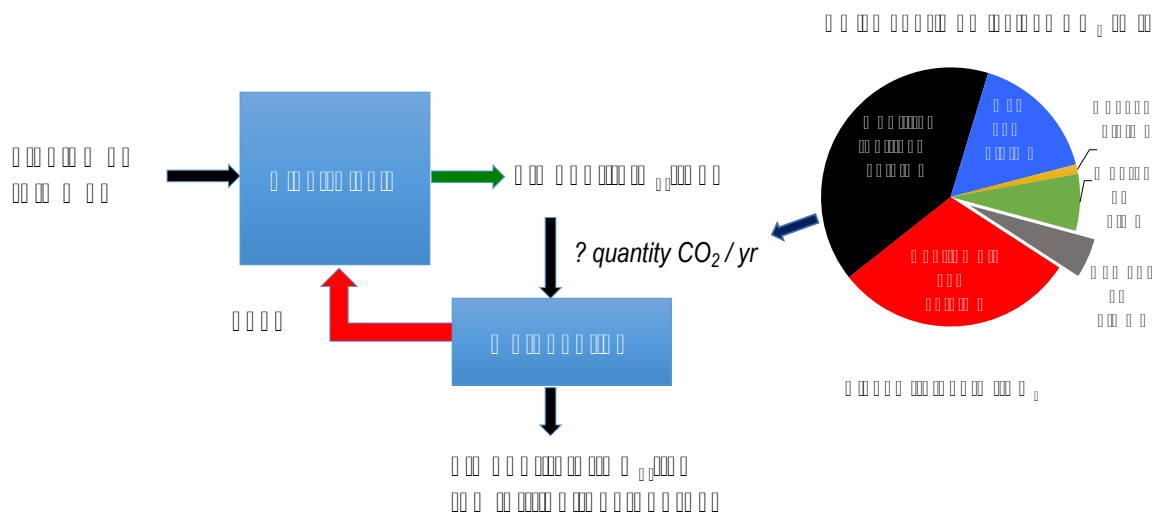


1. H₂ filling station

How big an electrolyser is needed to produce the daily amount of H₂ for a filling station (HRS: hydrogen refuelling station)), under the following assumptions?:

- 1000 cars/day, equivalent of 50 L gasoline/car (LHV_gasoline: 33 MJ/L)
- car average consumption : 7 L gasoline/100km
- a FCEV (fuel cell electric vehicle) consumes 1 kg H₂/100 km (LHV_H₂ : 120 MJ/kg)
- water electrolyser efficiency (electricity → H₂): 68% HHV
- compression energy needed to 400 bar (estimate as 9 % of LHV)
- the electrolyser operates 50% of the time
- Extrapolate the electrolysis power needed for 150 HRS, which is ~the quantity of existing natural gas filling stations in Switzerland, enough to cover most of the national territory. Please comment.

2. Power-to-gas



Switzerland stores yearly about 4 TWhe of electricity via hydro-pumping. Assume instead that this amount of electricity were used to generate H₂ via electrolysis, which would then be combined with CO₂ in a methanation reaction to produce synthetic methane CH₄ for injection into the natural gas grid.

- Assume ~continuous operation: what is the installed electrolysis power? (MWe)
- Use 100% efficiency for steam electrolysis, how much H₂ is generated per day? (m³/day)
- How much CO₂ is needed for methanation? ($4 \text{ H}_2 + \text{CO}_2 \leftrightarrow \text{CH}_4 + 2 \text{ H}_2\text{O}$)
- How does this compare with Switzerland's CO₂ emissions?
- How much CH₄ would be generated per year?
- How does this compare to the yearly Swiss natural gas consumption of 35 TWh (126 PJ)?