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Future Mobility Demonstrator

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Motivation

As part of the energy strategy 2050 of the Swiss Federal Office of Energy (BFE) the share of electricity produced by new renewable energy sources is to be increased to more than 25% of the total production. This way nuclear power plants can be replaced and more energy is harvested within national borders.

However, in contrast to conventional power plants the electricity stemming from wind turbines and photovoltaic plants is subject to strong fluctuations. Meaning that high and rapidly changing discrepancies between electricity production and demand will result.

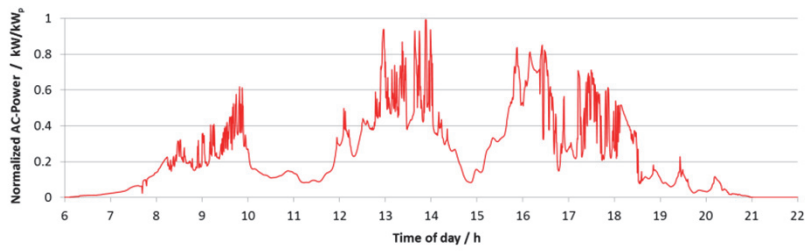

Fig. 1: Normalized power output of an exemplary photovoltaic plant showing strong fluctuations during one day

To reduce peak loads and level out the production rates from new renewable energy sources the introduction of storage systems becomes inevitable. The project at hand demonstrates how temporary excess electricity can be converted into gaseous energy carriers and stored for later use. This process is called Power-to-Gas.

Strategy

To efficiently use excess electricity, it makes sense to link electricity generation with power storage systems such as the Future Mobility Demonstrator. During times of high production and low demand electricity is converted into energy carriers for the mobility sector.

- **e^+: Battery storage**
  Electricity is stored in grid batteries to recharge electric vehicles at a later point in time
- **H_2: Electrolysis** *(research topic PSI)*
  Hydrogen is generated and stored in high pressure vessels to refuel H_2-vehicles
- **HCNG: Blending station**
  Employing a newly developed blending station hydrogen will be mixed with natural gas yielding the fuel HCNG which shows promising effects on emissions
- **CH_4: Methanation** *(research topic PSI)*
  Generation of synthetic natural gas that is used as fuel or fed into the natural gas grid (enables seasonal energy storage)

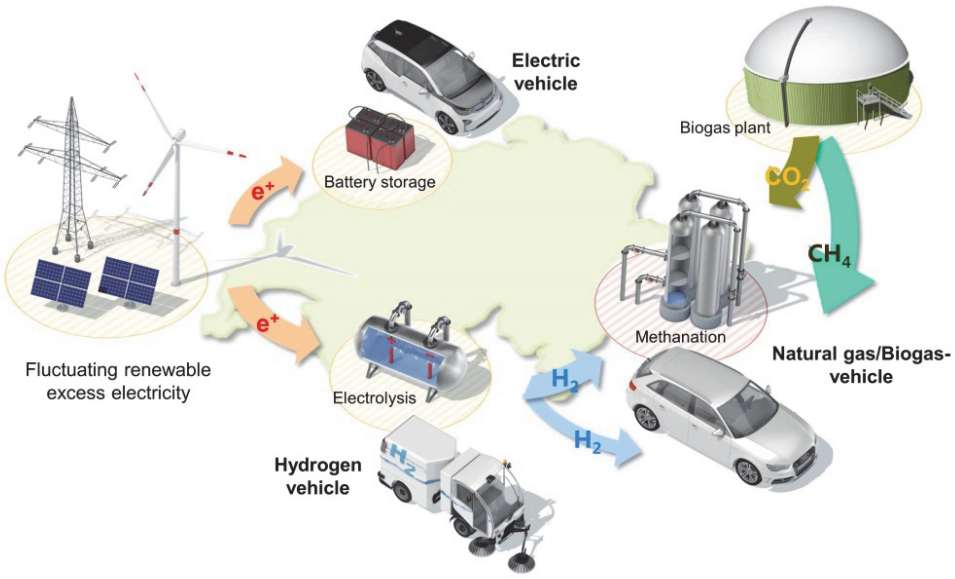

Fig. 2: Ways of efficiently using excess electricity by linking power generation with the mobility sector

Demonstrator setup

With the aid of the Power-to-Gas plant Future Mobility Demonstrator excess electricity can be converted into hydrogen via electrolysis. The following schematic shows the main components of the plant.

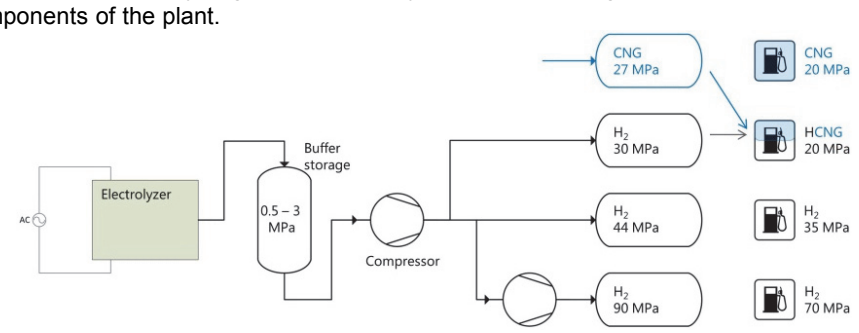

Fig. 3: Schematic of the Power-to-Gas plant "Future Mobility Demonstrator" including fuel dispensers

The hydrogen generated exits the electrolyzer at 3 MPa and is sent to a buffer storage. From there it is compressed and stored in various vessels at different pressure levels. The Demonstrator also includes fuel dispensers for both natural gas (CNG) and hydrogen (H_2) as well as its mixture (HCNG).

Within the scope of follow-up projects the Demonstrator is planned to be extended by an installation for methanation as well as a possibility to recharge electric vehicles.

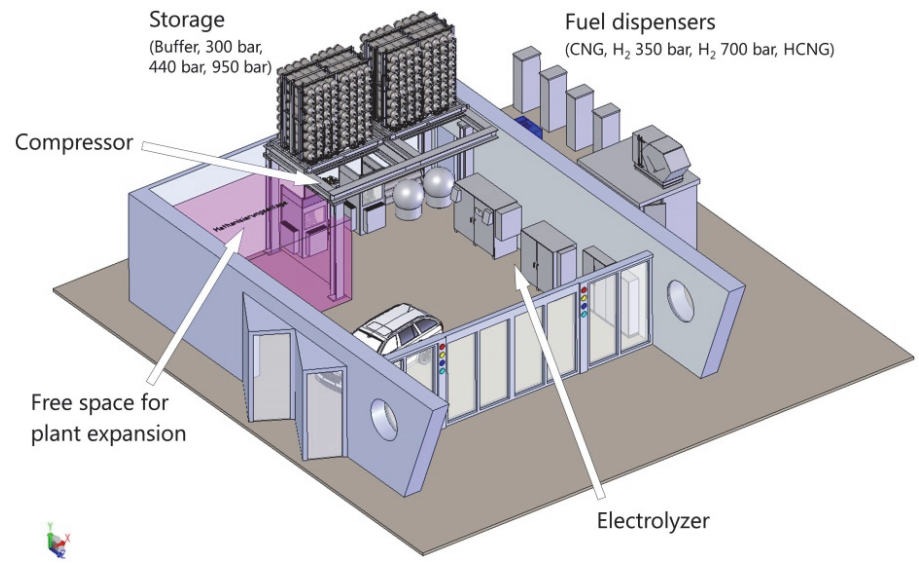

Fig. 4: Arrangement of the plant's main components within the building

Key figures of the plant

Electrolyzer: rated power	[kW]	180
Electrolyzer: operating range	[%]	0 – 100
Maximum hydrogen production rate	[kg/d]	60
Storage capacity	[kg]	> 130
Hydrogen fueling pressures	[bar]	350 & 700
Amount for refueling H_2-vehicle	[kg]	5 - 6
Amount for refueling HCNG-vehicle (10 vol-% H_2)	[kg]	0.25
Amount for refueling HCNG-vehicle (25 vol-% H_2)	[kg]	0.75

Tab. 1: Key figures of the Future Mobility Demonstrator

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