Renewable hydrogen cost for industrial purposes in Spain and Austria

Sector Coupling/Renewable Hydrogen
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Motivation and research Questions

In the industrial sector, hydrogen (H_2) is a main component of many production processes and products, which traditionally has mainly been produced from fossil resources such as natural gas, coal or oil. With the global climate change mitigation goals, this fossil gas shall be replaced by renewable hydrogen. Current research, however, mainly analyses its production cost [1]. Considering distributed production for industrial purposes from nearby intermittent wind power or onsite solar PV, however, the cost of H_2 storage options become relevant. This work analyses the cost of two potential strategies—either electricity price optimized production with storage or just in time production.

Methodology

Initially, the industry's hourly H_2 demand in Austria and Spain needs to be defined. Then the cost of production based on the LCOE and storage in a decentralized system is analysed. The LCOE of renewable H_2 is based on the electricity price and specific tax exemptions for renewables, the investment cost considering the learning rate, electrolyser lifetime, efficiency, the interest rate and the expected amount of full load hours.

Apart from the centralized production of the renewable gas from the distribution grid, the industrial sector has two options:

- Optimized according to electricity price: Production at times of low electricity prices/ and storage until use
- Just in time – production according to demand regardless of the current electricity price avoiding storage

The first option, therefore, also includes storage cost depending on the technical requirements, volume and time of storage.

Depending on the mismatch between industry demand and renewable H_2 supply, the associated production and storage cost and the ability of demand side management, one of the two options will be economically favourable. These aspects also differ with country specifics of renewable energy supply, the industrial demand and relevant policies and tax exemptions for electrolysis, which is why we compare Spain and Austria.

Results and Conclusions

Figure 1 describes the two H_2 use strategies. This first analysis is based on exemplary industry demand to show the purpose of the two strategies. After this ad hoc data analysis, the price optimized strategy achieves a 20% cost reduction for H_2 production compared to the just in time approach. To complete the analysis as indicated, the timing and amount of demand for industry needs to be defined exactly, as well as the storage options and associated cost. The storage cost must not consume the cost saving by optimized production to be the favourable strategy. Towards 2030 H_2 storage technologies are expected to reduce their LCOE significantly [2] and could be economical for the arbitrage of the electricity market for direct use in e.g. industry [3].
With the just in time approach, the risk of a lack of renewable electricity supply is high. A certain amount of buffer storage will be required nevertheless to guarantee renewable gas supply whenever there is demand while efficiently using renewable electricity supply [4]. This is shown in the blank space between demand and JIT production in Figure 1.

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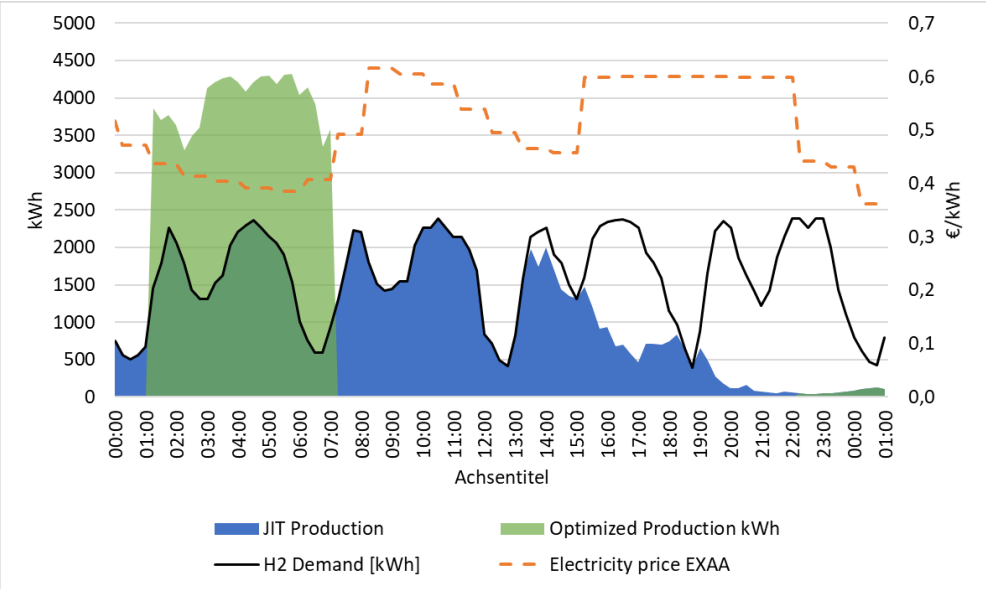

Figure 1: Renewable H_2 production for industry using two different approaches: Optimized according to the electricity price with storage or just in time according to demand

References

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