Photovoltaic and Electrolysis hybridization:
Sizing and performance for a LCOH minimization

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Introduction

Green hydrogen plays a significant role in the decarbonization global goals using renewable energy and electrolyzers (ELYs). However, the current levelized cost of hydrogen (LCOH) produced by electrolysis is about four times more expensive than its fossil counterpart. Furthermore, due to the current regulations of the European Commission, it must be considered the hourly correlation of photovoltaic (PV) and hydrogen generation.

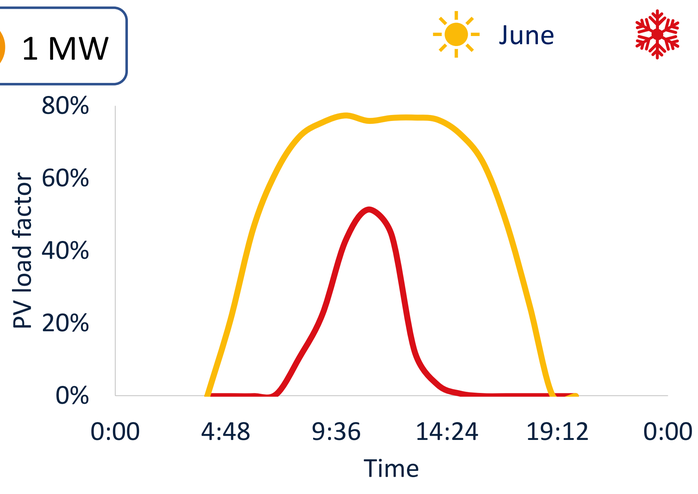
It is proposed a mathematical model of a PV and ELY hybridization system using commercial efficiencies, costs and real data obtained from PV plants in Spain. The LCOH was calculated for different PV/ELY dimension ratios, varying the economic incentives that are granted in Europe. These values are compared with those that could be implemented in the United States, considering the current proposal to apply a subsidy to the LCOH.

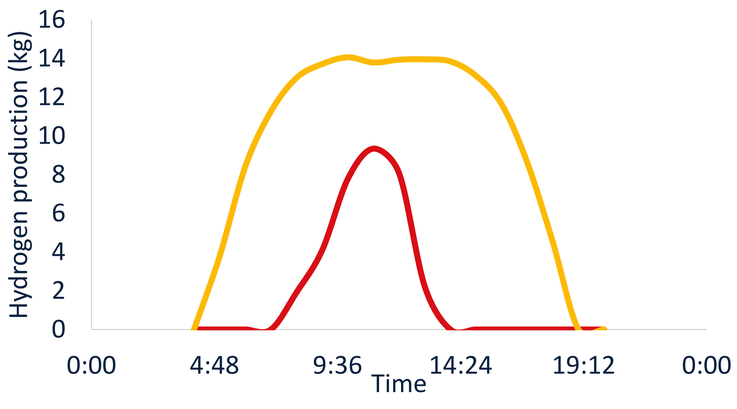
Mathematical modelling

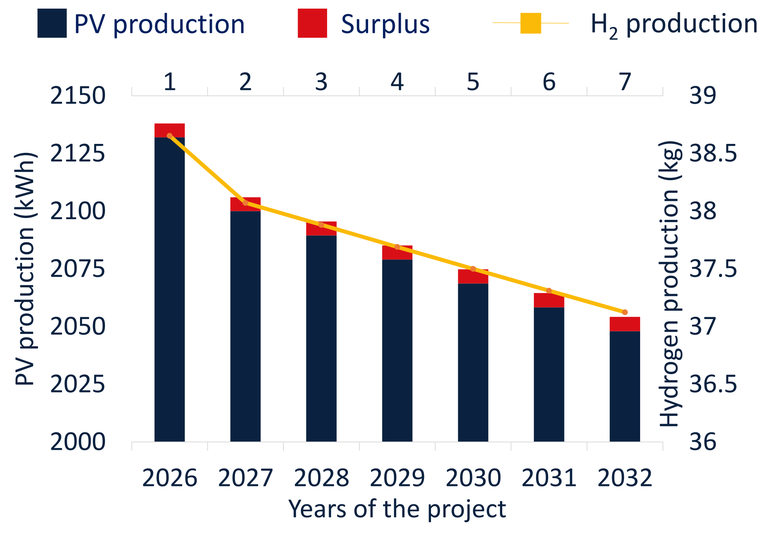
- Off-grid
- Energy requirement (efficiency): 55 kWh/kg
- 1 MW electrolizer
- ELY CAPEX and services grant: 30%
- CAPEX: 1500 €/kW
- Location: Equivalent to 2.131,98 kWh/m^2

Results

1 MW

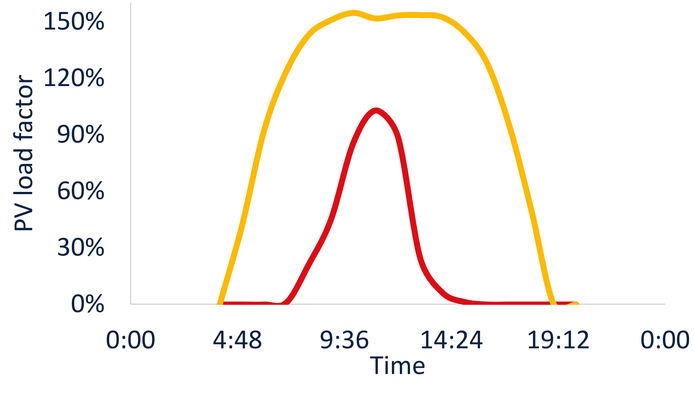


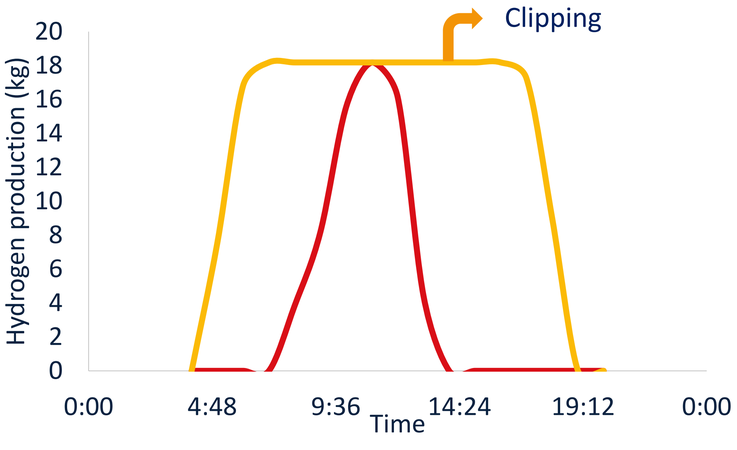


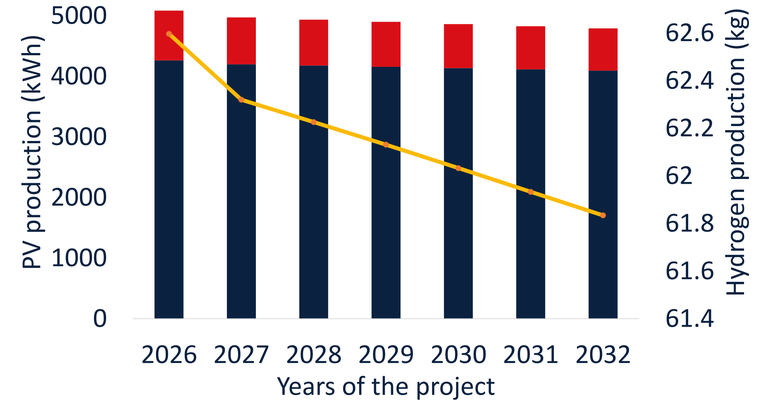


2 MW

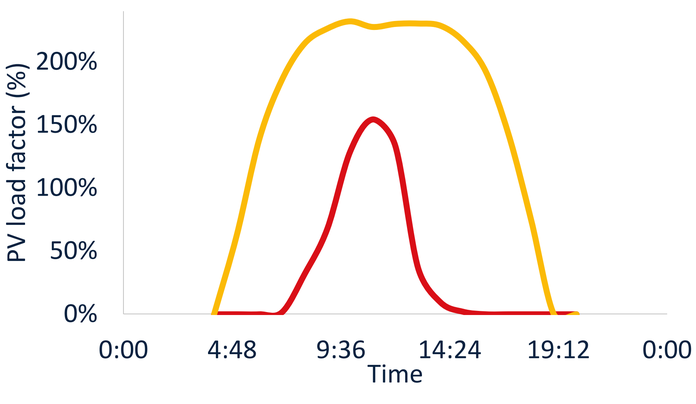
Optimal ratio

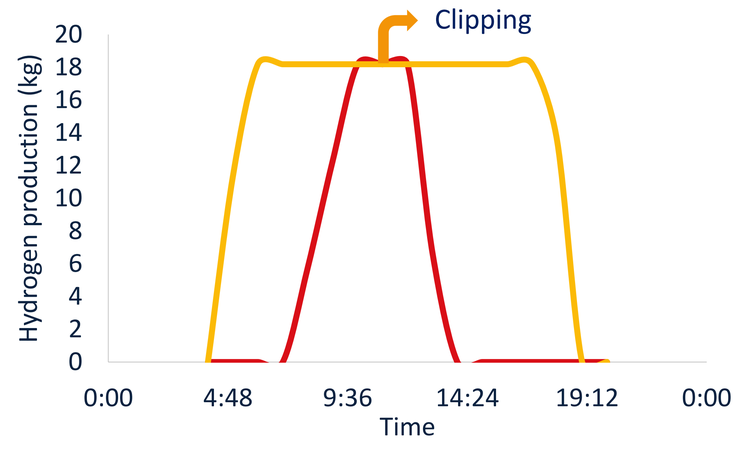


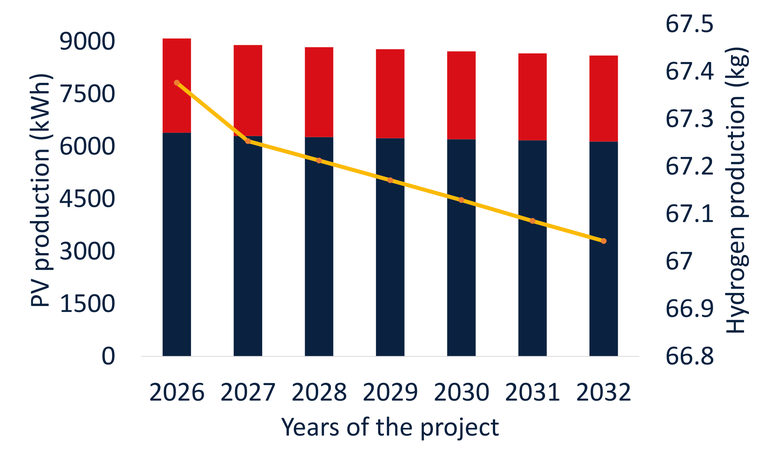


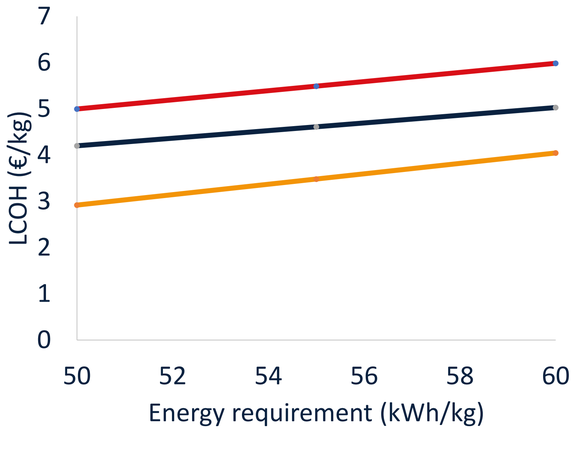


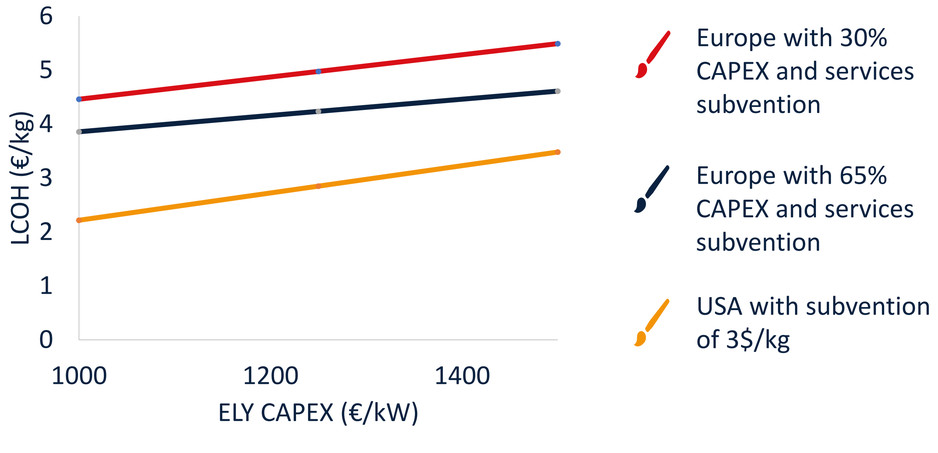
3 MW











Conclusions

From the studied model it can be concluded that for the selected location the best PV/ELY power ratio is 2.1. In this way, hydrogen production is optimized, leading to less a clipping in the electrolyzer.

Due to the current geopolitical situation hydrogen subsidies in Europe could reach up to 65% of CAPEX and services. However, the price of hydrogen is still disadvantaged in relation to what could be achieved in the USA if a grant directly to the LCOH is applied.