Comparative analysis of tools applied to hydrogen power plants

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ABSTRACT

The development of off-grid green hydrogen power plants is advancing in the current decade and it is important to study its techno economic viability. It is known that there is currently few information on running hydrogen power plants, so it is important to characterize the functioning and better predict the costs of running the hydrogen production.
The methods and parameters chosen to characterize a hydrogen power plant (HPP) and that are behind a techno-economic analysis (TEA) might vary according to the vision, conception or objectives of the user.
The levelized cost of hydrogen (LCOH) is the general indicator used to evaluate the economic viability of the project and to compare it with other projects. The indicator allows the generation of a reference price of the hydrogen for the whole lifetime of the project.
As can be noted, by some of the literature produced in the last years on TEA on HPPs, the LCOH is a very volatile indicator and it is very sensitive to some of the factors that influence its final value. Factors like the CAPEX, OPEX, the efficiency of the electrolyser, energy capacity factor or financial factors like the inflation, might be very influential in the LCOH final value [1-3].
The main objective of this study is to develop an analysis of the current and existent tools that perform TEA on off-grid green hydrogen HPPs. Seven different tools were selected and among them are:

- Levelized Cost of Hydrogen Calculator
- H2A-Lite
- HySupply Cost Tool
- EH2 Analytics Suite
- HyJack
- Galway University Tool
- Hydra H2

A thoroughly analysis was performed on the different tools methods of techno-economic characterization, parameters used, detail and number of inputs, assumptions made and limitations. To complement the study the simulation of a TEA was performed in all the tools selected. The objective was to, starting from a common guide of values and inputs of a HPP example, calculate the different LCOH values using the different tools. This would allow the assessment of the dispersion of results. Since the tools have all different conceptions of TEA, this procedure would be important to understand if different approaches or the consideration of different parameters might influence significantly the final LCOH value.

A HPP with a standard 100 MW PEM electrolyser and a 300 MW PV solar farm was simulated for the different tools, with other significant parameters also defined for all the tools analyzed. The results obtained can be summarized as it is possible to see in the boxplot of the figure 1. As it is possible to see, the dispersion of values was considerable (3,7€/kg between the highest and the lowest LCOH obtained) and these differences were target of analysis.

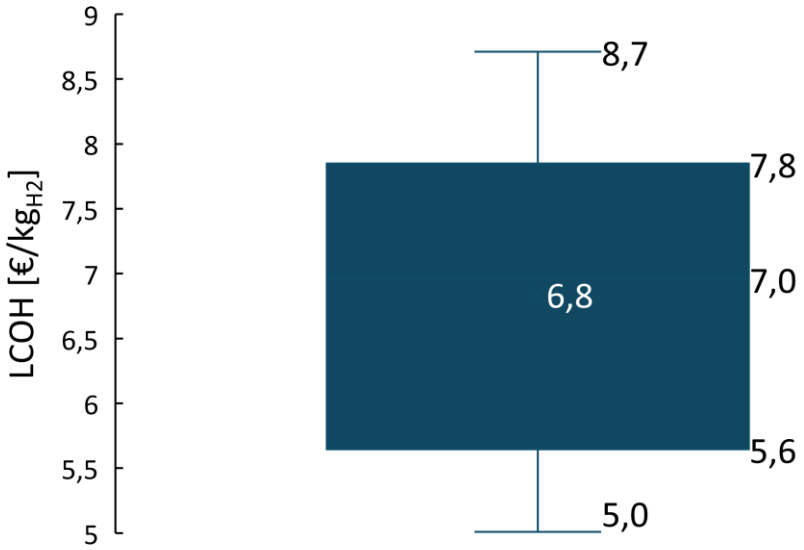

Figure 1 - Boxplot of LCOH values results.

The dispersion of results, even though, there was a tentative to homogenize the main parameters of the HPP for all the tools, was considerable. The main conclusion is conducive with the initial thesis, backed by the scientific literature, that TEA of HPPs might be very dependent of several parameters, the different methods used and of the assumptions of the user.

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