Design of pilot plants for hydrogen production via solar water splitting employing hybrid photoelectrochemical-photovoltaic tandem devices

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Photoelectrochemical water splitting is a promising route for renewable hydrogen production. Abundant but intermittent solar energy is captured and finally stored in a chemical energy carrier which may be consumed according to the demand. The development and demonstration of hybrid photoelectrochemical-photovoltaic tandem devices made from earth-abundant materials and providing a solar-to-hydrogen efficiency of at least 8% are objectives of the European project PECDEMO. An important part of the project is an extensive techno-economic analysis which shall evaluate the potential for large-scale commercialization of the technology. It comprises three different scenarios concerning the utilization of produced hydrogen: a refuelling station for transportation purposes and an industrial process based on [1] as well as a single home application covering a wide range of plant sizes with an average capacity of 400 kg/day, 4000 kg/day, and 1 kg/day, respectively. A high level of global solar radiation promotes an economic plant operation. Seville (Spain) and the Negev (Israel) have been chosen for the analysis as promising sites. The two locations are considered involving the specific local infrastructure. The sizes of the collector fields were calculated based on the average global solar radiation provided at the different locations. Preliminary plant designs including the main components required by the process were elaborated and simulated employing *Aspen Plus* for thermodynamic analysis. An initial flow sheet of the hydrogen refuelling station is shown in Fig.1. The next steps will comprehend an inventory analysis and component sizing finally aimed at competitive hydrogen production in the context of benchmarking processes.

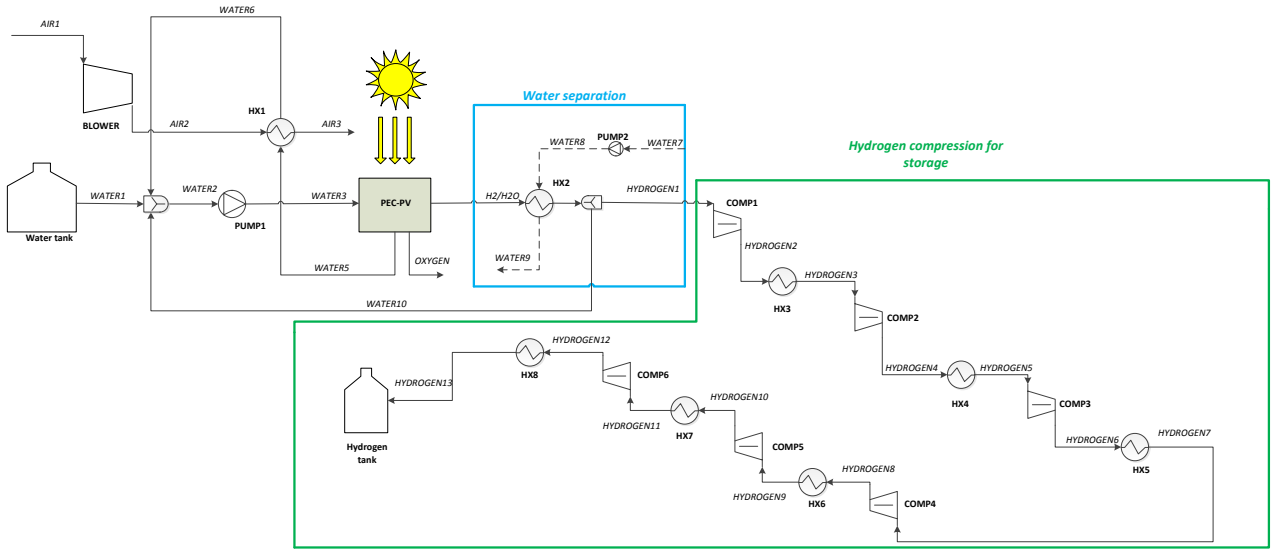

Fig.1 – Initial flow sheet of a hydrogen refuelling station for transportation purposes involving hybrid photoelectrochemical-photovoltaic tandem devices

References

[1] L. Bertuccioli, A. Chan, D. Hart, F. Lehner, B. Madden, E. Standen, “Development of Water Electrolysis in the European Union” (Final Report), Lausanne (CH), Cambridge (GB): E4tech Sàrl with Element Energy Ltd for the Fuel Cells and Hydrogen Joint Undertaking; 2014.

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