Decentralized Hydrogen Production from Landfill Biogas: Lessons learned from a real case study based on LFG2H$_2$ project.

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Hydrogen production has been traditionally carried out from hydrocarbons in reformers or from natural gas reforming. The increasing need for hydrogen and the global warming has intensified the development of alternatives green hydrogen production processes. Among these alternatives, electrolysis and biogas reforming highlight. The first alternative said has been widely studied during the last decade, being technologically ready to be implemented at industrial level but economically uncompetitive versus current technologies. On the other hand, biogas reforming has still room for improvement. In particular, biogas generated in landfills is an attractive option. This biogas must be captured and treated for up to 30 years after closure to avoid methane emissions, which has a global warming potential 25 times than CO_2. This makes a great opportunity to turn an environmental problem into a cheap and green energy vector as hydrogen. This alternative also promotes the decentralization of hydrogen production to sources commonly placed outside cities. Based on these premises, the project “Landfill gas to hydrogen” (LFG2H$_2$) arises. This project, based in a real case study, has been carried out in collaboration with “Energía Sur de Europa S.L.”. The main goals of this project were to achieve the technical viability and the economic feasibility of hydrogen generation from biogas produced in landfills through reforming. To fulfil with these goals, the project was organized as follow: (1) hydrogen production from biogas process design; (2) validation of the stability of the process developed under real conditions with different catalysts; (3) analysis of technical performance, which allows obtaining recommendations for a potential compact equipment prototype for decentralized hydrogen production; (4) economic analysis, considering many alternatives, such as for example obtaining energy needs from solar resources. Overall, the results show that the project is technically viable, achieving very promising performances. Nonetheless, under the current circumstances, the process is unprofitable. An analysis of revenues and costs was carried out to identify economic bottlenecks, being the current hydrogen price one of the main factors. The results obtained envisage that greater incentives are needed to evolve towards cleaner hydrogen production pathways, revealing the great challenge that the transition towards a sustainable society faces.