World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:16, No:09, 2022

Assessment of Hydrogen Demand for Different Technological Pathways to Decarbonise the Aviation Sector in Germany

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Abstract : The decarbonization of hard-to-abate sectors is currently high on the agenda in the EU and its member states, as these sectors have substantial shares in overall GHG emissions while it is facing serious challenges to decarbonize. In particular, the aviation sector accounts for 2.8% of global anthropogenic CO_2 emissions. These emissions are anticipated to grow dramatically unless immediate mitigating efforts are implemented. Hydrogen and its derivatives based on renewable electricity can have a key role in the transition towards CO_2-neutral flights. The substantial shares of energy carriers in the form of drop-in fuel, direct combustion and Hydrogen-to-Electric are promising in most scenarios towards 2050. For creating appropriate policies to ramp up the production and utilisation of hydrogen commodities in the German aviation sector, a detailed analysis of the spatial distribution of supply-demand sites is essential. The objective of this research work is to assess the demand for hydrogen-based alternative fuels in the German aviation sector to achieve the perceived goal of the 'Net Zero' scenario by 2050. Here, the analysis of the technological pathways for the production and utilisation of these fuels in various aircraft options is conducted for reaching mitigation targets. Our method is based on data-driven bottom-up assessment, considering production and demand sites and their spatial distribution. The resulting energy demand and its spatial distribution with consideration of technology diffusion lead to a possible transition pathway of the aviation sector to meet short-term and long-term mitigation targets. Additionally, to achieve mitigation targets in this sector, costs and policy aspects are discussed, which would support decision-makers from airline industries, policymakers and the producers of energy commodities.

Keywords : the aviation sector, hard-to-abate sectors, hydrogen demand, alternative fuels, technological pathways, data-driven approach
Conference Title : ICHES 2022 : International Conference on Hydrogen Energy Systems
Conference Location : Amsterdam, Netherlands
Conference Dates : September 15-16, 2022

Open Science Index, Energy and Power Engineering Vol:16, No:09, 2022 publications.waset.org/abstracts/147902.pdf