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The cost of production and storage of renewable hydrogen in South Africa and transport to Japan and EU up to 2050 under different scenarios

Thomas H. Roos

Energy Centre, CSIR, P O Box 395, Pretoria, 0001, South Africa

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Abstract

The decarbonisation of hard-to-abate sectors globally will require significant volumes of carbon-free hydrogen. An investigation has been performed to determine the cost at which hydrogen can be generated by electrolysis using renewable electricity in South Africa between 2020 and 2050; stored in suitable carriers: liquid organic hydrogen carrier (LOHC), cryogenic liquid hydrogen, and ammonia; then shipped to Japan and EU. Renewable electrolysis hydrogen is produced at lowest cost in South Africa using electricity generated by a hybrid fleet of wind and single-axis tracking PV power plants, using large-scale alkaline electrolyser plants. Hydrogen is converted and stored at lowest cost as LOHC, but delivered to Japan at lowest cost as ammonia. It may be delivered to Japan at or below the Japanese target cost of US $3/kg or €2.50/kg by 2030 (when bulk imports are planned to begin) in one of two ways: firstly by reconverting the ammonia carrier to gaseous hydrogen, provided that concessionary finance allows a maximum weighted average cost of capital (WACC) of 3% the for renewable power and electrolyser infrastructure, or secondly as ammonia for direct use (without reconversion to gaseous hydrogen), provided concessionary finance allows a maximum WACC of 6%. In any event, the landed target price may be met for gaseous hydrogen by 2040 (when hydrogen imports must be carbon-free) at a WACC of up to 6%.