

Techno-Economic Analysis of Renewable Hydrogen and Ammonia Supply Chains

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Australia has unique global advantage of very large solar and wind based renewable energy sources. Australia can export its vast solar and wind resources via hydrogen (H₂) transported as liquid ammonia (NH₃). Both ammonia and hydrogen can be used as feedstock for industrial processes as well as fuel sources for thermal heat, vehicles and electricity. Ammonia is liquid under mild pressure, and contains hydrogen energy 20% higher than methanol and 67% higher than liquid hydrogen. Mostly ammonia is produced in centralised plants by Haber–Bosch process natural gas as the major feedstock. Ammonia if produced by renewable energy sources can be considered an emission-less energy vector and termed as so called ‘Green Ammonia’. We are proposing a new concept of exporting Australia’s vast renewable energy based on offshore production of ammonia utilising onshore wind and solar resources. The concept is based on supplying renewable electricity from the wind and solar farms along the Australian coastline via high voltage DC (HVDC) cables to the offshore liquid ammonia production and storage plant, and offloading of liquid ammonia into transport tankers which regularly berth alongside for transporting to country like Japan. Once received in importing countries, ammonia can be used as fuel potentially for stationery electricity generation via engines, turbines or fuel cells. Importing countries can also crack ammonia back to pure H₂ using world leading CSIRO metal membrane technology. An integrated techno-economic model has been developed and used to generate first pass preliminary results. A preliminary assessment of various technologies in the chain (electricity transmission by HVDC to offshore platform, seawater desalination, PEM electrolyser, air separation, gas compression and ammonia production by H-B) have been made. The methodology and initial results for hydrogen cost from ammonia synthesised by this route will be presented. HVDC cable, electrolyser and ammonia reactor are the key expensive capital items and hydrogen production is the main energy consuming step of the ammonia production process. Future work will require a detailed analysis of this route of RE export and end-uses for ammonia. This will require multidisciplinary skills from within and outside CSIRO, and the project team would be keen to engage with others.