Life cycle cost analysis: A case study of hydrogen energy application on the Orkney Islands

Hydrogen can compensate for the intermittent nature of some renewable energy sources and encompass the options of supplying renewables to offset the use of fossil fuels. The integrating of hydrogen application into the energy system will change the current energy market. Therefore, this paper deploys the life cycle cost analysis of hydrogen production by polymer electrolyte membrane (PEM) electrolysis and applications for electricity and mobility purposes. The hydrogen production process includes electricity generated from wind turbines, PEM electrolyser, hydrogen compression, storage, and distribution by H2 truck and tube trailer. The hydrogen application process includes PEM fuel cell stacks generating electricity, a H2 refuelling station supplying hydrogen, and range extender fuel cell electric vehicles (RE-FCEVs). The cost analysis is conducted from a demonstration project of green hydrogen on a remote archipelago. The methodology of life cycle cost is employed to conduct the cost of hydrogen production and application. Five scenarios are developed to compare the cost of hydrogen applications with the conventional energy sources considering CO2 emission cost. The comparisons show the cost of using hydrogen for energy purposes is still higher than the cost of using fossil fuels. The largest contributor of the cost is the electricity consumption. In the sensitivity analysis, policy supports such as feed-in tariff (FITs) could bring competitive of hydrogen with fossil fuels in current energy market.