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Techno-economic analysis of biodiesel and hydrogen production via Fusion-Biomass Hybrid Model

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This paper aims to investigate techno-economic analysis of fusion-biomass hybrid model based on previously proposed technical and chemical concept. Fusion-biomass hybrid model, which takes no value of waste biomass from municipal, agricultural, and forestry areas as feedstock, produces synthetic gas generated by endothermic pyrolytic gasification using high temperature of fusion heat. Several blanket designs based on LiPb and SiC technology such as Dual Coolant Lithium Lead (DCLL) would be available for the heat over 700oC. Its technical extension is possible to perform biomass gasification of (C6H10O5 + H2O ⟶ 6H2+ 6CO -814 kJ) to produce chemical energy, synthetic gas. Produced synthetic gas can be converted into two different products; diesel and hydrogen. First, synthetic gas that contains hydrogen (H2) and carbon monoxide (CO) can be converted into diesel which is regarded as "carbon-neutral biofuel"by Fischer-Tropsch process (2H2+ CO ⟶ -CH2-+ H2O + 160kJ). The other is to produce hydrogen by water-gas shift reaction process (CO + H2O ↔ H2+ CO2 + 32 kJ). Carbon dioxide from water-gas shift reaction can be managed by carbon capture and sequestration technology.
Underlying the technical and chemical process of fusion-biomass hybrid model, levelized cost of fuel for diesel and hydrogen is calculated as USD0.41/kg and USD1.21/kg, respectively. Breakeven price is USD0.73/kg for diesel and USD2.65/kg for hydrogen under the assumption of 1,000ton/day of fusion-biomass hybrid plant with 30-year lifetime. Sensitivity analysis is performed applying total capital investment, operation & maintenance cost, fuel production amount, operating time and fusion heat cost to understand the correlations between variables and fuel price. In addition to that, net present value after 30-year operation is calculated according to the change in fusion heat cost and fuel price, because technical structure and advancement highly affect fusion heat cost.
Fusion-biomass hybrid model benefits in terms of environmental aspect by decreasing both waste biomass and CO2 emission. This study can provide guideline in targeting which fuel could be economically justified in the circumstances of variable environmental policy under different market demand and economical situations that would have a significant impacts on the designing of the fusion commercial reactors.

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