CHAPTER 1

Conversion pathways for biomass-derived aviation fuels

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1. Introduction

The utilization of fossil fuels such as transportation fuels has resulted in an increase of atmospheric greenhouse gases particularly carbon dioxide (CO_2) [1]. Numerous initiatives, including the expansion of biomass-based renewable energy resources have been introduced to lower the CO_2 emissions [2]. Several countries and automobile industries have a vision to partially or completely replace gasoline fueled jets by sole-electric or hybrid alternatives [3]. However, the fossil fuel resources are still being used as main source in the aviation industry. Notably, the current energy source for jet fuel is a mixture of hydrocarbon paraffins, isoparaffins, aromatics, and cycloalkanes, with defined carbon chain lengths and properties [4,5].

The demand for jet fuel is continuously increasing day by day. An annual increase of about 5% is projected by 2050 according to the prediction of International Air Transport Association (IATA) [2,6]. Furthermore, the fleet number and size will become triple in the next two decades [7,8]. In the last 20 years, the total consumption of jet fuel by airlines amplified from 260 million to 340 million per year [2]. It is projected that the fleet size will increase from 340 million to more than 500 million per year by 2026 [9]. In this context, the renewable aviation fuel could be a potential replacement to decrease CO_2 emissions and achieve the goals of decarbonization in 2050 [10,11]. The literature showed that biojet fuel (or renewable jet fuel (RJF)) produced from renewable feedstocks could drastically reduce (~80%) emission of greenhouse gases [12,13]. Therefore, the demand for RJF has stimulated for the aviation transportation [14].

Generally, the aviation-fuel is a mixture of different hydrocarbons, such as branched chain isoalkanes, n-paraffins, aromatics, and cyclic alkanes [15]. However, the carbon numbers and molecular weights of the fuel substantially depend on the refinery process and distribution of molecular size ranging from C_8 to C_{16} [16]. In general, the renewable

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