Selection of Sustainable Aviation Fuel Technology Pathway

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Climate change represents one of the most pressing global challenges, necessitating collective action through a shared vision and collaboration among governments, industries, and societies. The signing of the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement in 2016 marked a pivotal moment, reflecting global consensus and commitment to addressing the threat of climate change. In charting strategies to meet the goals of the agreement, namely limiting climate change to within 2℃ and setting a target of 1.5℃, governments of various countries outlined their plans to contribute to achieving the common goal.

Aviation is one of six hard-to-abate sectors, accounting for approximately 2% to 3% of global annual carbon emissions. The economic and social benefits of air travel are undeniable, as the aviation industry facilitates access to goods and services, fosters cultural exchange, and plays a critical role in advancing globalization. However, according to the European Commission, by the mid-21st century, the demand for flight could increase greenhouse gas emissions in the aviation industry by over 300% compared to 2005 levels. Against this backdrop, the aviation industry and its entire value chain face the challenge of continuing to deliver these benefits in an environmentally sustainable way.

The characteristics of civil aviation aircraft and current technological constraints indicate that hybrid-electric and hydrogen-powered aircraft cannot be widely adopted in the short term. Liquid fuels will remain essential for the foreseeable future. Sustainable aviation fuel (SAF), which has the potential to reduce carbon emissions by over 80%, offers a promising solution. SAF does not require modifications to existing aircraft fuel systems or related infrastructure, ensuring full compatibility with current aviation and refueling networks. It represents the most viable option for reducing carbon emissions in the aviation sector in the near term.

SAF is synthesized from sustainable and renewable feedstocks, such as municipal waste, agricultural residues, and used cooking oil (UCO). From a feedstock perspective, sufficient resources will be available to support SAF production by 2040. However, future advancements will require technologies with fewer restrictions on feedstock sources, such as those utilizing carbon dioxide. Power-to-liquid fuels or e-fuels, produced solely from carbon dioxide and green electricity, will require both technological maturity and increased availability of renewable energy.

By 2030, UCO and other lipid-based fuels are expected to dominate production capacity, though alternative pathways will continue to be explored and industrially tested. Scaling up these technologies will take time, necessitating immediate investment decisions for larger demonstration facilities to ensure their contribution to future production. Currently, the cost of SAF is at least twice that of conventional fuels; however, with increased production, further innovation, and improved economies of scale, costs are expected to decrease. Nevertheless, no single feedstock or production pathway is universally feasible across all regions, nor can any one pathway produce sufficient SAF to meet global demand.

This report evaluates the actual conditions in China, identifies SAF production technologies with research and development potential based on available feedstocks, outlines the technologies requiring significant advancement in various periods according to future trends, and suggests advantageous regions for each technology based on the distribution of feedstock resources.