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INDIA'S PERSPECTIVE ON SUSTAINABLE AVIATION FUEL

(Presented by India)

INFORMATION PAPER

SUMMARY

India is committed to be a leader in climate action, by making responsible development choices that move the economy along low GHG emissions pathways towards net zero by 2070. In aviation sector SAF has been proven as a solution to achieve the major share of carbon reductions. However, SAF production and deployment remains a challenge in emerging economies which requires upfront investment, capacity building, robust infrastructure and support from the developed economies.

INDIA'S PERSPECTIVE ON SUSTAINABLE AVIATION FUEL

1. INTRODUCTION

1.1 India is currently one of the fastest growing economies in the world, home to almost one-sixth of humanity. Its growth momentum is an integral part of global development and is essential to global advance in meeting the sustainable development goals. While a number of challenges confront India's development agenda, climate change is an unwelcome constraint thrust on India and the entire world. India's contribution to historical cumulative emissions till 2019, is only about 4.5% of the global total, while its current annual per capita emissions are well below the world average. Thus, its contribution to the making of the challenge of global warming is minimal.

1.2 Nevertheless, India is committed to be a leader in climate action, by making responsible development choices that move the economy along low GHG emissions pathways towards net zero by 2070. Recognizing that global warming is a global collective action problem, it is committed to addressing the challenge with firm adherence to multilateralism, and, on the basis of equity and the principle of common but differentiated responsibilities and respective capabilities, as embodied in the United Nations Framework Convention on Climate Change (UNFCCC).

1.3 India has consistently made ambitious commitments at the UNFCCC and its Paris Agreement, the key multilateral forum for climate change, and has a strong track record of meeting these commitments, despite its minimal responsibility. Building upon Prime Minister Narendra Modi's Panchamrit pledges (five nectar elements) at the 26th Conference of Parties (COP 26) of the UNFCCC in Glasgow, including the target of net-zero emissions by 2070, India updated its NDCs in August 2022 as follows:

i. Meet 50% of India's cumulative electric power installed capacity from non-fossil sources by 2030.

ii. Reduce the emission intensity of GDP by 45% below 2005 levels by 2030.

iii. To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation, including through a mass movement for L.I.F.E. – Lifestyle for Environment as a key to combating climate change.

1.4 Aviation industry plays a key role in the economic prosperity of a country, besides providing a worldwide rapid transportation network. It also contributes significantly to world trade. However, its expansion is also impacting the environment; the emissions from aircraft and aero-engines occur at high altitude and therefore their influence on the atmosphere is highly localized and potentially more impactful than ground vehicle emissions. Sustainable aviation fuels are the cornerstone of this carbon reduction, which cannot be achieved in totality by non-biofuel measures like efficient air traffic management and new aircraft having better fuel economy.

1.5 In continuation to CORSIA, the 41ST ICAO Assembly resolved that "ICAO and States are encouraged to work together to strive to achieve a collective long-term global aspirational goal for international aviation (LTAG) of net-zero carbon emissions by 2050, in support of the Paris Agreement's temperature goal, recognizing that each State's special circumstances and respective capabilities (e.g. the level of development, maturity of aviation markets, sustainable growth of its international aviation, just transition, and national priorities of air transport development) will inform the ability of each State to contribute to the LTAG within its own national timeframe".

1.6 Achieving the LTAG requires a comprehensive approach consisting of a basket of measures, including technology, sustainable fuels, operational improvements, and market-based measures. Sustainable Aviation Fuels (SAF), Lower Carbon Aviation Fuels (LCAF) and other aviation cleaner energies are expected to have the largest contribution to aviation CO2 emissions reduction by 2050 and, whilst there are increasing initiatives to develop and deploy these fuels, current production levels of these fuels is only 0.2 per cent of all aviation fuel use.

1.7 ICAO Assembly Resolution A41-21, 17th preamble “recalls the UNFCCC and the Paris Agreement and acknowledges its principle of common but differentiated responsibilities and respective capabilities, in light of different national circumstances”.

2. DISCUSSION

SAF Key Technologies & Pathways in India

2.1 Out of 11 approved pathways by ASTM, following three pathways have high technology readiness level and shows enormous potential for commercialization, particularly in India:

- Hydro processed Esters and Fatty Acids (HEFA): This pathway is technologically mature and is already commercialized in USA and Europe. This pathway was approved by ASTM in 2011 and most of the demonstration flights using SAF blend are based on SAF produced from HEFA pathway. HEFA refines lipids such as vegetable oils, waste oils, or fats into SAF and other valuable co-product such as Renewable Diesel. This process consists of hydro treatment and isomerization to convert triglycerides into hydrocarbons in the ATF range.

- Alcohol-to-Jet (ATJ): This pathway utilizes alcohol as a source (either Iso-butanol or Ethanol) for production of SAF. The Alcohol can be produced from Sugary, Starchy and Biomass feedstock. ATJ converts Alcohols into SAF by removing the oxygen (Dehydration) and linking the molecules together to get the desired carbon chain length (i.e., Oligomerization). Further processing includes Hydrogenation and Fractionation to get the SAF and co-products such as Renewable Gasoline (Isooctane), Green Diesel etc. The technology of this pathway is rapidly maturing and many commercial scale plants based on ATJ pathway are already announced across the globe.

- Fischer Tropsch (FT): In this process, the Syngas, produced from biomass gasification, is synthesized and catalytically cracked to produce SAF. Two different FT processes have been certified by ASTM to date, one that produces a straight paraffinic jet fuel (SPK) and one that also produces additional aromatic compounds (SAK).

2.2 Apart from above technologies, ‘Power to Liquid’ technology for SAF production is rapidly emerging as the more sustainable alternative to other technology pathways. Although, this technology pathway has high environmental sustainability, it may take at-least couple of decades for this pathway to become commercially viable.

Efforts of SAF technology development in India

2.3 While SAF technology development in initial phase is primarily conducted in USA and Europe, some Indian organizations and research labs are also leading the efforts in developing technological solutions for production of SAF based on feedstock available in India:

- CSIR-IIP: The Indian Institute of Petroleum (IIP), one of the constituent laboratories under the umbrella of Council of Scientific & Industrial Research (CSIR), has developed an indigenous single step catalytic technology based on hydro-processing of waste lipids, such as Used Cooking Oil & Tree borne oils to produce SAF. CSIR-IIP has also established pilot scale testing facility with the capacity to process feed up to 50 kg per day.

- Praj Industries Ltd.: The technology is based on ASTM approved ATJ pathway, in which the commonly available feedstock in India such as Cane Molasses, Cane Syrup, Agricultural Residues etc. are first converted into Isobutanol, which is further processed into SAF.

- Lanzajet: The technology is based on ASTM approved ATJ pathway, in which the commonly available feedstock in India are produced from a low-carbon, sustainable ethanol sourced from a diverse and flexible set of feedstocks including off-gasses, ag-waste, and MSW.

Feedstock Availability

2.4 The successful commercialization of SAF largely depend on availability of low-cost sustainable feedstock. Currently, most of the SAF produced in the world is based on lipid feedstock such as Used Cooking Oil, Animal Tallow etc. However, SAF plant facilities based on Corn, Sugarcane & Second Generation (2G) Lignocellulosic Biomass (such as Agricultural or Forest Residues) are either in planningstage or under construction in various parts of the world.

2.5 Here is the overview of various prominent feedstock available in India for SAF production:

Agricultural Residues / Second Generation (2G) Feedstock (for SAF production based on ATJ pathway)

2.6 Every year, around 500 million tons of Agricultural Residues are produced in India and around 100 million tons of these residues are burnt on the field causing widespread pollution. In order to mitigate the pollution caused by burning of residues, Govt. of India launched an ambitious program of setting up 12 number ethanol plants operating on Agricultural Residues as feedstock.

2.7 India's first Second Generation (2G) Ethanol plant was inaugurated by Hon. Prime Minister in August 2022 in Haryana and the same plant is now producing 100,000 litres of Bioethanol per day from Rice Straw.

2.8 Ethanol produced using Agricultural Residues can be converted into SAF using ASTM approved ATJ pathway. Even converting 50 million tons of Agricultural Residues, which is just 10% of total agricultural residues available in India, would yield around 4 to 5 million tons of SAF per year, and thereby saving around 10 to 15 million tons of GHG emissions per year. Further carbon emission savings could also be derived from high-value low carbon renewable fuels produced as co-products during the refining process.

First Generation (1G) Feedstock for Alcohol production (for SAF production based on ATJ pathway).

2.9 Despite 20% blending of Ethanol in the gasoline pool in India, there is likely to be availability of either surplus Ethanol or feedstock for production of Alcohols (Isobutanol or Ethanol) such as Sugary Streams (Cane Syrup, Cane Molasses etc.) and grains unfit for human consumption. The supply chain for production of Alcohols based on 1G feedstock is already established and surplus Ethanol or Isobutanol produced from 1G feedstock can be converted into SAF through setting up plants based on ATJ pathway.

2.10 Currently, Cane Molasses, which is widely available in India and is in surplus quantity, is classified as 'Byproduct' of sugar manufacturing process, whereas Cane Molasses is the 'waste' product of the sugar manufacturing process.

Lipids (Used Cooking Oil or Tree Borne Oil) for SAF production based on HEFA pathway.

2.11 Considering that India consumes almost 22 to 27 million tons of vegetable oil every year, there is significant quantity of Used Cooking Oil (UCO) produced in India.

2.12 Tree Borne Oil (TBO) from plants such as Jatropha and Pongamia cultivated on degraded land is another potential feedstock in India for production of SAF.

Policy Support

2.13 While there is the policy of CORSIA catering for use of SAF for international aviation, the commercial use of SAF in India will also require policy interventions by the government, with regulations and incentives throughout the value chain.

2.14 Various policies to promote Biofuels have already been established by the Government of India which include the National Policy on Biofuels 2018, Ethanol Blending Mandate, PM-JiVan Yojana, the Sustainable Alternative towards Affordable Transportation (SATAT) and national solar and hydrogen missions.

SAF Flights

- Biofuel produced from Jatropha seeds by Indian Institute of Petroleum, CSIR lab – 25% SAF with ATF was blended and used in one engine of Bombardier Q 400 aircraft for 01 hour flight from Dehradun to Delhi in August, 2018. The fuel is still under process of ASTM approval.

- M/s Indigo carried out its first international ferry flight with 10% blended fuel from Toulouse to Delhi on 17th Feb 2022.

- M/s Vistara conducted its ferry flight of B-787 from USA to India using 28% of SAF blended fuel on 29th March 2023.

- M/s Air Asia to carry out its first commercial domestic flight (Pune to Delhi) with 0.75% SAF blended fuel on 19th May 2023.

- Airlines will carry out all their ferry flights with 5% SAF blended fuel provided by M/s Airbus originating from Toulouse and Hamburg.

Challenges in SAF commercialization in India

- With rapidly maturing technologies, cost of SAF production is declining. However, currently the cost of SAF is almost 3 to 5 times the cost of fossil ATF, depending on the feedstock and pathway used for production of SAF. Lack of infrastructure and ecosystem is also adding to the cost of SAF.

- Establishing SAF production facilities requires substantial upfront investment. Access to financing, especially in the early stages of development, can be a barrier.

- SAF is a relatively new concept, and public awareness and acceptance are crucial. Adoption of SAF is lower than expected.

- Limited potential for HEFA based SAF (lowest cost pathway currently) in India compared to world, keeping India's cost competitiveness at risk.

- Establishing rigorous certification and sustainability standards for SAF production is important to ensure that the fuel meets environmental and social criteria. This can involve complex challenges related to traceability and lifecycle assessment.

- Fragmented supply chains and limited feedstock access. While there are plentiful in India, the infrastructure needed to collect, sort, transport and store these materials in a cost-effective way remains underdeveloped.

3. ACTION BY THE CONFERENCE

3.1 The Conference is invited to note the information contained in this Paper.

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