EASA
European Union Aviation Safety Agency

EUROPEAN UNION

Welcome to the 6th webinar of the series on

Sustainability - EU/SEA CCCA CORSIA Project

The webinar will start @ 15h Bangkok/Jakarta/Hanoi Time
16h Singapore/Manila Time
10h Brussels/Cologne Time

1977-2022
EU-ASEAN
45 YEARS OF PARTNERSHIP

Your safety is our mission.

An Agency of the European Union

EASA
European Union Aviation Safety Agency

Webinar 06:

Initiatives at State Level on SAF: the Indian Coalition

… What is the value of SAF for a State? Who should lead the development of SAF at State level? How to successfully set a collaborative platform to engage all relevant stakeholders in a country? What are the existing tools to support SAF policies?

An Agency of the European Union

EU-CCCA CORSIA project

Objective: to Support to ASEAN MS in CO2 reduction initiatives international aviation

- ✓ CORSIA Implementation
- ✓ Support to State Action Plan for CO2 Reduction
- ✓ Emission data management systems
- ✓ Climate Change Policies (e.g. SAF)

EU-SEA CCCA CORSIA – Areas of action

CORSIA Implementation

State Action Plan for CO2 Reduction (SAP)

EU-SEA CCCA CORSIA

Aviation Emission Data Management Systems (AeDMS)

Climate Change Policies

(e.g. SAF)

Some practicalities & moderators

Santiago Haya Leiva
santiago.haya-leiva@easa.europa.eu
EU-SEA CCCA CORSIA Project Manager

Ralph Kossmann
ralph.kossmann@easa.europa.eu
EU-SEA CCCA CORSIA Operations Manager

Rebekka Freienstein
rebekka.freienstein@easa.europa.eu
EU-SEA CCCA CORSIA Project Assistant

→ **Q&A** after the speaker

→ Use Q&A section (Slido)

→ Vote up/down questions

→ **Free chat**, please express yourself live

Join at

slido.com

#SAF6

Passcode: **x1dvxb**

EASA
European Union Aviation Safety Agency

Webinar 06:

Initiatives at State Level on SAF: the Indian Coalition

… What is the value of SAF for a State? Who should lead the development of SAF at State level? How to successfully set a collaborative platform to engage all relevant stakeholders in a country? What are the existing tools to support SAF policies?

An Agency of the European Union

Our key speakers for today!

Adrienne Gibbs

adrienne.gibbs@weforum.org

World Economic Forum

Clean Skies for Tomorrow Policy Lead

Leads Clean Skies for Tomorrow(CST) policy and government engagement work at the World Economic Forum, bringing member organizations and governments together to align on policy measures to create regulatory framework to accelerate the production and use of SAF worldwide. Prior to CST, Adrienne held roles with the International Air Transport Association, the Australian Government and Sydney Airport.

Dr Anjan Ray

anjan.ray@iip.res.in

CSIR - Indian Institute of Petroleum

Director

An energy and sustainability expert with wide ranging interests of relevance to climate science, Anjan heads CSIR-IIP, a publicly funded research Institute in India that developed India's first indigenous flight-proven sustainable aviation fuel. Prior to this role, he worked with Honeywell UOP as Regional Commercial Director (Asia-Pacific), Renewable Fuels and Chemicals. He holds a Ph.D. from the University of Pennsylvania and has extensive experience in R&D, Technical Service and Strategic Management in the Chemical and Energy sectors.

Sonum Gayatri Malhotra

sonumgayatri.malhotra@weforum.org

World Economic Forum

Clean Skies for Tomorrow – Indian Coalition

India Lead for Clean Skies for Tomorrow (CST). The India coalition launched in 2020 has brought together multi-sector partnership that convenes to discuss opportunities for collaboration on critical solutions and plansto accelerate the decarbonisation of the aviation sector with the objective of reaching net-zero emissions. Prior to CST, Sonum Gayatri held roles with the Ministry of Finance, Government of India, The World Bank and The Centre for Policy Research in India.

World Economic Forum: Clean Skies for Tomorrow

- Adrienne Gibbs

The Clean Skies for Tomorrow initiative

Clean Skies for Tomorrow

Led by the

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

In collaboration with

Energy Transitions Commission

RMI

ENERGY. TRANSFORMED.

Supported by

MISSION POSSIBLE PARTNERSHIP

CST Workstreams

	1 Building the Technology Fact Base	2 Democratizing Global SAF Supply and Demand	3 Fostering an Enabling Policy Environment	4 Scaling Demand Signals	5 Financing the Transition
Aim	Bring certainty to governments, industry, and investors over the true potential and sustainability of decarbonization pathways.	Ensure that SAF production and market development are fostered globally.	Accelerate the implementation of policies and regulations that will create the conditions for SAF market development across regions.	Drive voluntary SAF demand through aggregation mechanisms and support development of harmonized reporting, and accounting standards.	Increase investment in SAF production by bridging the knowledge gap between industry and financiers and designing innovative financing mechanisms.

CST India

CTS India Coalition Members:

Government and associated agencies*:

1. Ministry of Civil Aviation and Director General of Civil Aviation (DGCA)
2. Ministry of Petroleum and Natural Gas.
3. Indian Air Force, Defense
4. RSB
5. Oil and Natural Gas Corporation
6. Bharat Petroleum
7. Hindustan Petroleum LTD.

* those we are in contact with on a regular basis

Initiatives at State Level on SAF: the Indian Coalition

- Dr Anjan Ray
- Somun Gayatri Malhotra

Clean Skies for Tomorrow

India coalition

Initiatives at State Level on SAF, the Indian Coalition

26 October 2022

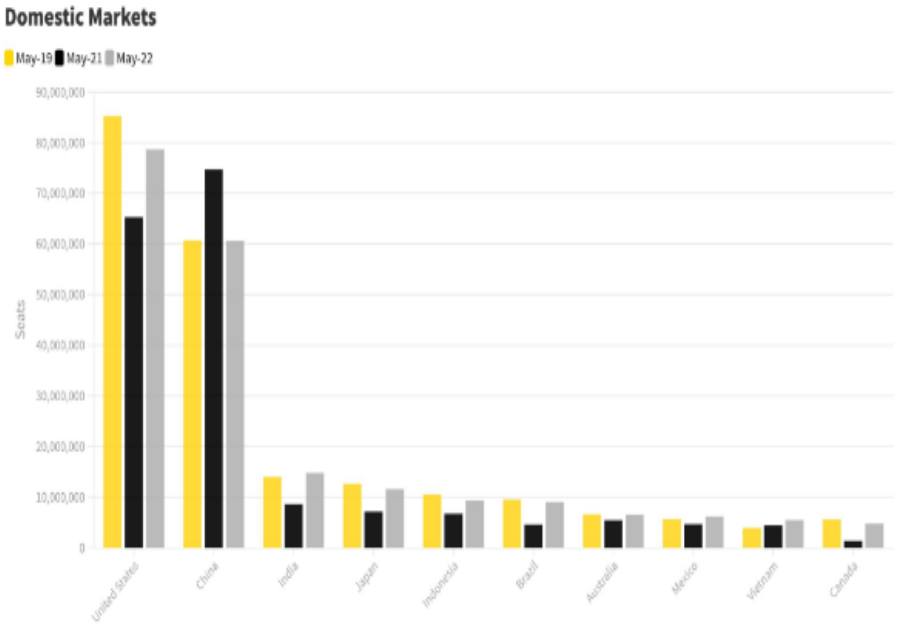
Anjan Ray
CSIR-Indian Institute of Petroleum, Dehradun, India

VISION 2040- THE NEXT BILLION

- As other industries reduce fossil fuels, aviation may account for a growing share of global emissions
- India is already the 3rd largest domestic civil aviation market, behind US and China
- Passenger traffic is expected to grow 6x by 2040, to over 1 billion

Vision 2040 at a glance

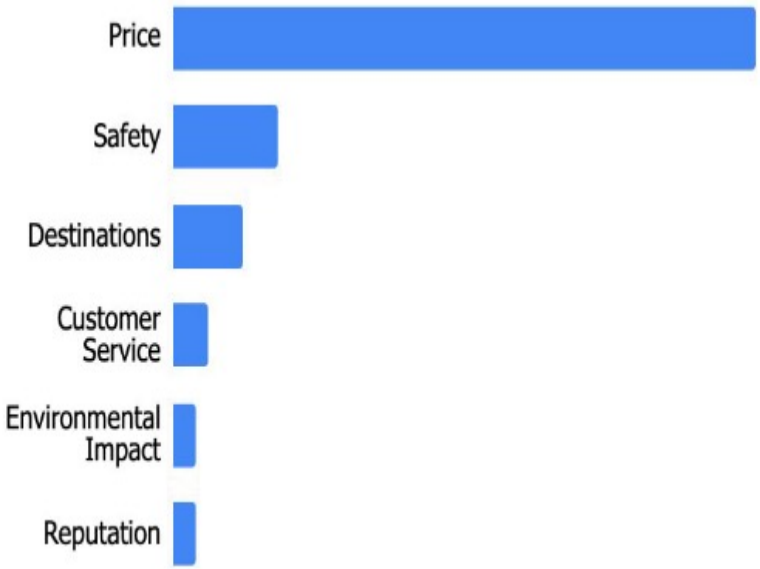
Parameter	Year ended Mar 2018	Year ended Mar 2040	CAGR (%)
Total passengers (million)	187	1124	8.5%
Global ranking	7	3	
Scheduled airline fleet	622	2,360	6.2%
General aviation fleet	750	6,100	10%
Industry revenue (USD billion at FY 2018 prices)	11.4	28.6	4.3%
Number of operational airports	99	160-180	3%
Number of cities with two or more airports (does not include general aviation or military airports)	0	33	
Number of airports with over 10 million passenger throughput	7	47	9%
Cargo throughput (million tons)	3.4	17	7.7%
Revenue of Indian MRO industry (USD million)[3]	50	540	11%

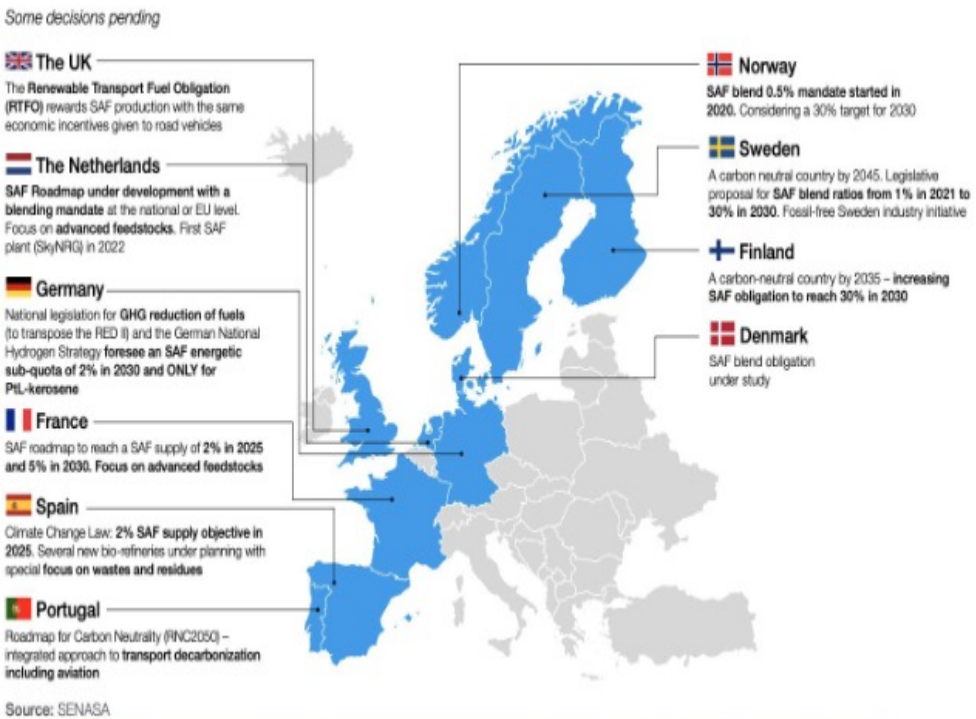


Source: FICCI-KPMG Vision 2040 for the Civil Aviation Industry in India, 2019; OAG Frequency & Capacity Statistics, May 2022

Who pays for Climate Action?

- The primary factor of airline choice for 3 out of 4 flyers is price. Environmental impact has a relatively low importance.
- SAF adoption globally has been driven by policy, not by consumers - Sweden, Norway, lead the way.
- Pro-environmental attitudes are high in Europe, but costly climate action is low. The median willingness-to-pay to curb emissions in actual studies with European airlines is 'zero', mean willingness-to-pay is only ~€1.

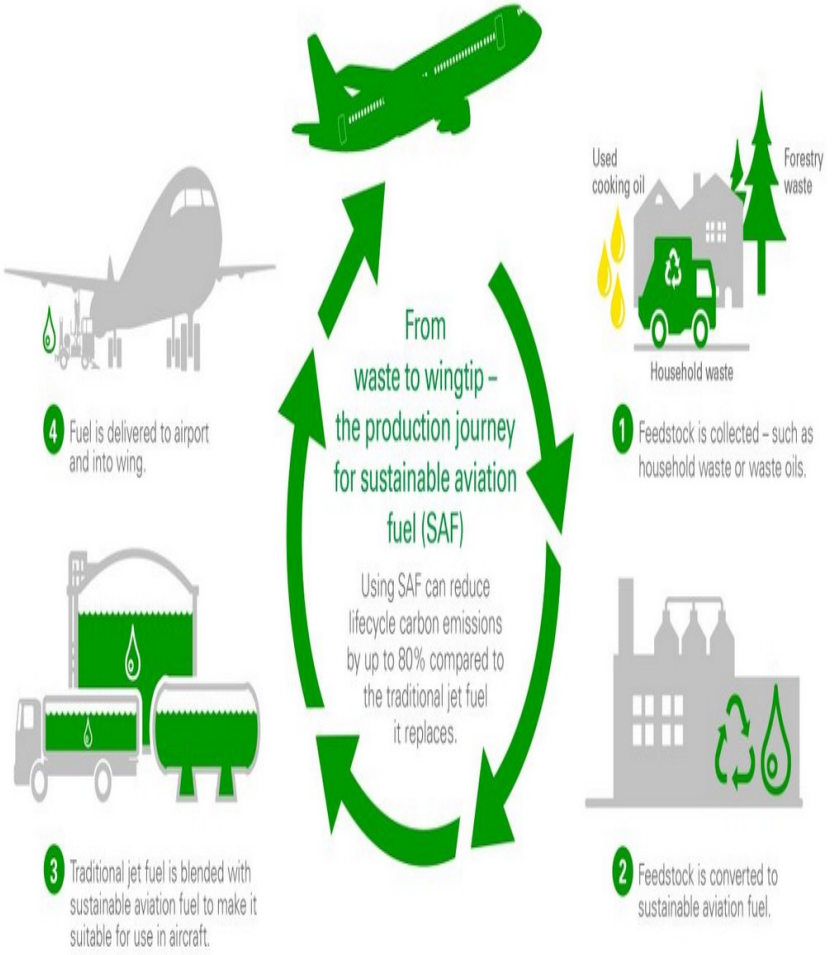




Source: Oliver Wyman Travel Sentiment Survey; Assessing whether environmental impact is a criterion of consumers when actually selecting an airline, International Journal of Advanced Research; WEF CST - SAF as a Pathway to Net-Zero Aviation; Willingness-to-pay for carbon dioxide offsets: Field evidence on revealed preferences in the aviation industry, Global Environmental Change, Volume 73, 2022, 102470.

SAF: The here and now option

- **Climate change cannot wait for electric planes.**
- **“Drop in fuels”: fuels that are fully compatible with existing aircraft and fuel supply systems.**
- **No need for additional infrastructure investment or aircraft replacement.**
- **SAF likely the only option for long haul flights until 2050.**



The case for SAF in India

- "Sustainable Aviation Fuel, or SAF, made from waste and agricultural by-products or power-to-liquid based on hydrogen technology can be 100% less carbon-intensive than traditional jet fuel over its lifecycle.
- Early adoption of SAF can provide environmental and economic benefits at 10 times higher than initial costs as India's aviation sector grows, while progressing on global climate goals.
- India is well placed to become a leader in a rapidly growing global SAF industry, given access to feedstock and low-cost solar energy."

Christoph Wolff, Lauren Uppink and Sonum Gayatri Malhotra, World Economic Forum – Clean Skies Initiative, 2021

SAF Success Factors: Indian Perspective

KEY SUCCESS FACTOR	STATUS
ENABLING NATIONAL POLICY	• India's National Biofuel Policy 2018 in place
DEMAND DRIVERS	• Climate Change Concerns: IPCC, CORSIA, ESG
OEM and REGULATORY ACCEPTANCE	• 7 pathways approved under ASTM D7566 • DILSAAF undergoing D4054 qualification
USER ACCEPTANCE	• Increasing awareness of flyers
ALTERNATE FUEL SUPPLY CHAIN	• Blend with Fossil-based Jet Fuel up to 50% *
FEEDSTOCK SUPPLY CHAIN	• Clean feedstocks (lipids, sugars) relatively constrained • Complex feedstocks (lignocellulosic, MSW) abundant but more challenging to process
PRICE	• Feedstock is a major component of cost • Demand far in excess of supply • Real prices anticipated 2.5-4x of Fossil Jet Fuel • Plant size for economy of scale conflicts with supply aggregation cost and freight GHG impact

INDIA: SAF Milestones

- Biofuel produced from Jatropha seeds by Indian Institute of Petroleum, CSIR lab – 25% blended SAF with ATF was used in one engine of Bombardier Q 400 aircraft for 01 hour flight from Dehradun to Delhi on 27th August, 2018 under special approval from DGCA
- Engine performance was satisfactory and parameters were within limits
- Bureau of Indian Standard (BSI) – issued Indian Standard for Bio-jet ATF IS:17081 in January 2019
- DGCA granted approval to a commercial airline for India's first international ferry flight with 10% blended fuel from Toulouse to Delhi on 17th Feb 2022. The flight was successful.
- Government and industry is actively working to scale up the production and availability of biofuels in India.

CSIR-IIP - SAF Flight events till date

Creating Future Fuels

Civilian Flight
Bombardier Q400
Operated by SpiceJet
Dehradun-Delhi
27 August 2018

Printed from
THE TIMES OF INDIA

In a first, IAF uses blended bio-jet fuel to fly aircraft

TNN | Dec 17, 2018, 08:15 PM IST

NEW DELHI: The IAF flew a military aircraft with blended bio-jet fuel for the very first time in India on Monday morning. A Russian-origin AN-32 transport plane was flight-tested, with the 10 per cent bio-jet blended ATF (aviation turbine fuel) made from Jatropha oil, in a sortie flown from the Chandigarh airbase.

"The project to flight-test the bio-jet fuel, with experimental test pilots and engineers from IAF's premier testing establishment ASTE, is a combined effort of IAF, DRDO, directorate general aeronautical quality assurance (DGAQA) and CSIR-Indian institute of petroleum," said IAF spokesperson Wing Commander Anupam Banerjee.

Military Flights

- Antonov-32, Indian Air Force
- > 60 hours flown since 2018
- Certified for use at 10%
- Provisional clearance for all IAF platforms subject to OEM approvals

Indigenously Developed Fuel has supported India's SAF Thrust

CSIR-IIP Drop-in Liquid Sustainable Aviation and Automotive Fuel (DILSAAF™) Process

Creating Future Fuels

- **Production at pilot scale**
  - Running since January 2018; variant of conventional HEFA process
  - Semi-continuous plant at Dehradun, India; capacity ~150L per week
  - Feed flexible – can use a wide variety of lipids including Used Cooking Oil
  - Ongoing supplies to Indian Air Force; over 9000L supplied
  - True drop-in fuel – aimed to match ASTM D1655 specs without blending – could make supply chains significantly less complex and more sustainable

- **Certification and Qualification**
  - IS: 17081 Bio-ATF standard notified, no regulatory barrier to flights within India where OEMs accord appropriate permissions
  - Lower capital and operating cost compared to established HEFA technology
  - OEM majors require ASTM D7566 approval through D4054 process; currently in advanced stage of Tier-1 evaluation
  - ASTM Task group formed under D06.J02 – inviting interested members

- **Demonstration Plant, 15000 L per day SAF output**
  - Agreements signed with a refinery and an engineering company
  - Commissioning expected by 2025

CSIR-IIP's DILSAAF™ journey

WHEN	WHAT
2009	• CSIR-IIP Concept of a 100% drop-in biofuel
2013	• Lab-made fuel successfully tested in a Pratt & Whitney engine test-bed in Canada
1/2018	• Pilot plant of up to 100L per day commissioned at CSIR-IIP
8/2018	• First Demonstration Flight (SpiceJet)
12/2019 (till date)	• Multiple Demonstration Flights by Indian Air Force (IAF)
8/2019	• Ministry of Petroleum & Natural Gas, India, set up two committees to recommend ways to expedite SAF adoption
10/2021	• Provisional Clearance Received for use of DILSAAF in all IAF flights up to 10 percent blend (subject to OEM approvals)
2021/22	• Agreements signed for 15 KL per day SAF project • Two additional sites within India under discussion • Significant interest from international agencies / licensors • Supply chain efforts ramped up • Trademark granted

The DILSAAF Advantage: A differentiated HEFA process

BENCHMARK HEFA	DILSAAF	Implication
Two-reactor process	Single-reactor process	• Lower capital cost
One step requires a precious metal catalyst	Base metal catalyst only	• Lower operating cost
Negligible aromatic compounds (<0.5%) while typical fossil jet fuel spec. is 8-24% aromatics	8-12% aromatics	• If qualified and approved, can potentially replace fossil jet fuel completely • Reduced supply chain costs
Requires large plants (>1000 TPD on feedstock basis) for economies of scale	Meets target at ~100 TPD feedstock basis	• Distributed production enabled • Lower carbon footprint for end-to-end supply chains • Better adapted for rural income generation in India

HEFA Pathways: Scaling up Feedstock

- Today: ONLY Food value chain by-products
  - Used Cooking Oil (UCO)
  - Palm Stearin; other edible oil refining co-products
  - Fats/oils from slaughterhouses, poultry, fisheries

- EMERGING
  - Tree borne oils (regional TBOs, not just jatropha)
  - Rotation crops (e.g. carinata: early success in Punjab)

- FUTURISTIC
  - Microbial oils
  - Dairy and sewage fats / oil / greases (FOG)
  - Repurposed plants – Tobacco, hemp, rubber

Required at 5% of diesel + 10% of jet demand ~ 6 million tons per year

Estimated available today ~ 3 million tons including UCO

ASTM D4054 Qualification and Approval Status of CSIR-IIP DILSAAF

Creating Future Fuels

Present status

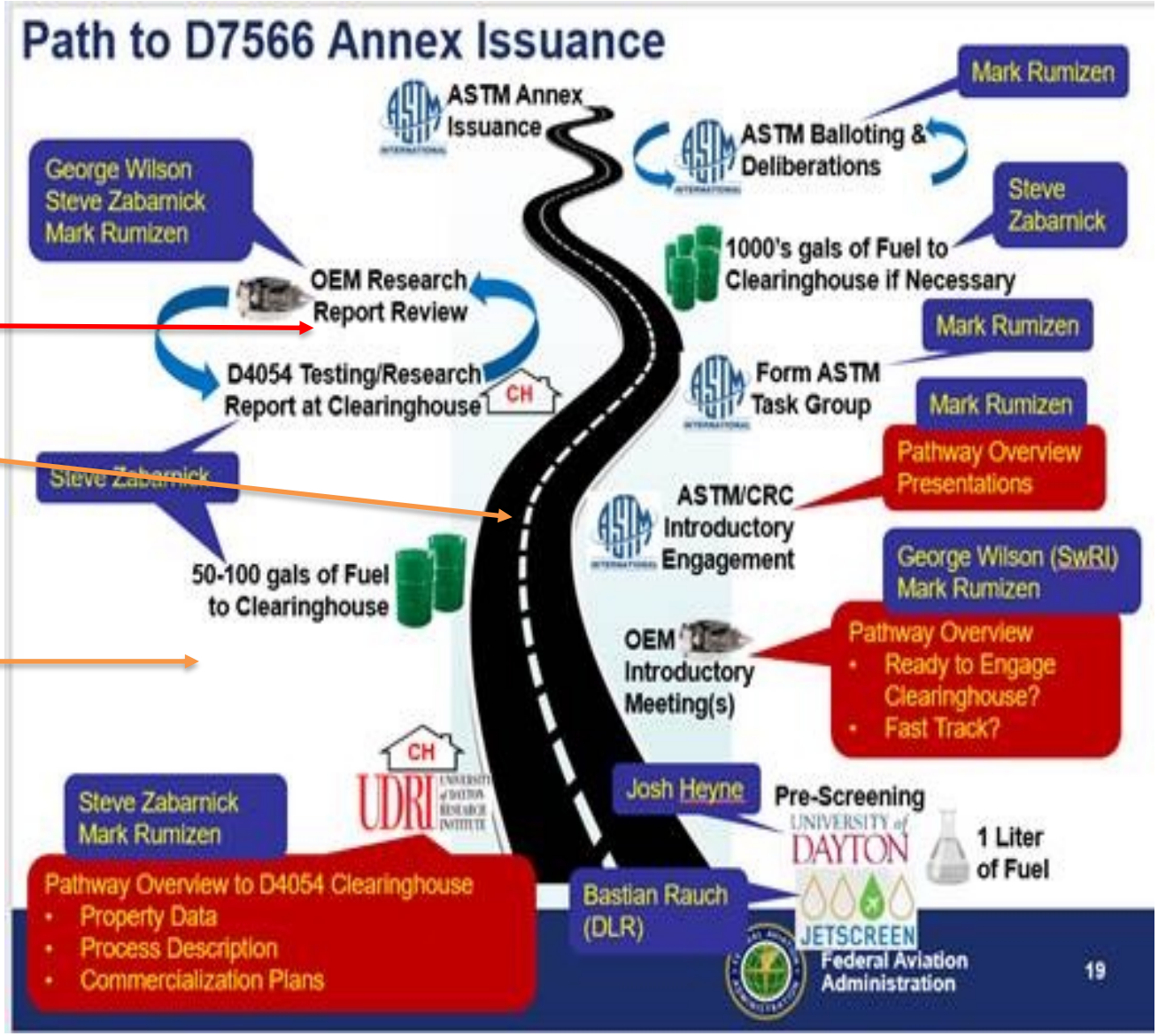
Research Report Submitted – April 2022 (under review with OEMs)

ASTM Work Group formed with global stakeholders

Submitted summarized report on CSIR-IIP bio-jet analyzed at Dayton University and SWRI

Fuel shipped from CSIR-IIP to Clearinghouse

TIMELINE



Alcohol-to-Jet (ATJ) Processes Progress within India

- **Existing ASTM-approved pathway (D7566 Annex A5)**

➢ Unlike DILSAAF from CSIR-IIP, does not need to undergo D4054 qualification

➢ Can use ethanol (abundantly available in India) as feedstock

➢ Gevo Inc. and Praj Industries Ltd. announced partnership in 2021 to collaborate on providing renewable, low carbon, low particulate, SAF; Praj Industries has commenced pilot production at Pune, India

➢ LanzaTech recently signed a statement of intent with Indian Oil Corporation Ltd. (IOCL) to deploy LanzaJet technology in India to create SAF from 3G ethanol produced from waste carbon at IOCL's Panipat Refinery

Latest Developments

- Several more SAF flights coming up, including an ATJ-based fuel that has complete engine test bed runs with Indian Air Force
- Two major airports (DEL and BLR) committed to Net Zero by 2030
  - Delhi International Airport Limited has become Asia Pacific's first Level 4+ (Transition) accredited airport under ACI's Airport Carbon Accreditation program. The announcement was made by ACI on 17th November '20 during the ACI EUROPE Annual Assembly & Congress
- Department of Biotechnology (DBT), Government of India, has announced a funding call for SAF research and development projects
- Ministry of Petroleum and Natural Gas (MOPNG) and Ministry of Civil Aviation (MOCA), Government of India, are holding extensive stakeholder consultations towards a Sustainable Aviation Fuel mandate
- CSIR-IIP has signed cooperation agreements related to SAF with Indigo Airlines and Tata Group airlines (Air India, Air Asia India, Vistara)

Airlines and Airports

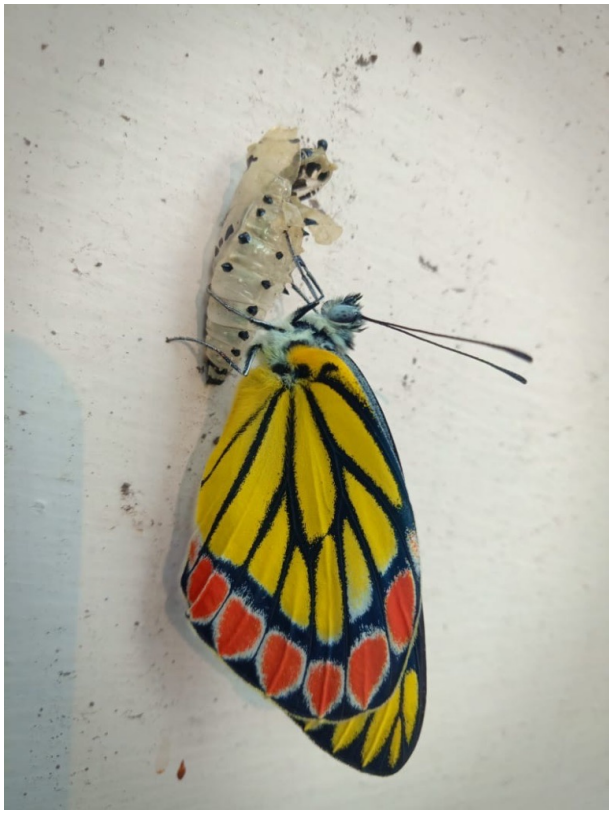
Centralized Sources of Reusable Carbon

- Waste Cooking Oil (flight kitchens / F&B outlets): Biodiesel for ground vehicles or power backup; feedstock for SAF-HEFA
- Horticultural and solid organic wastes: Gasification for heat; gas fermentation for ethanol and subsequently to SAF-ATJ
- Waste Plastic: Diesel for power backup generators; diesel and gasoline for ground vehicles
- Food Waste / Blue Ice: Bio-gas for power; Bio-PNG for flight kitchens; Bio-CNG for ground vehicles; dry ice for cooling and preservation
- Used aviation lubricants: reprocess for sale; reuse on ground vehicles
- Date-expired ground vehicles: convert to EV

Technologies emerging rapidly within India, enabling policies in progress

Sustainable Flight: Not Only for Humans

eBird database, Cornell University, 2022
205 bird species



World Environment Day, 2017
90+ butterfly and moth species

Thank You

Consumers

1. Identifying sustainability practices
2. Incorporating SAF as sustainability criteria
3. SAF priced from a market perspective - Free market or government controlled?
4. Operational challenges, if any, in utilising in SAF?
5. How do you think the proportion of SAF blend can be monitored for accounting purposes?

Technology

1. Commercial maturity of existing technologies?

2. Flexibility of feedstock in existing technologies?

3. Scale required to bring costs down?

4. Technology indigenisation

Infrastructure and Development

1. Airports play a role in facilitating the exchange and interaction between the various platforms

- Airline/ Airline operators
- Ground handling and airfield operators
- Aircraft refueling operator
- Conventional fuel supplier
- aviation fuel consortium
- Custom
- Fire and rescue teams at the airport

2. Storage condition for different SAF blends

Infrastructure and Development

1. Biomass Industry operates at a much wider scale with involvement of farmers and rural enterprises to create feedstock repositories at state-levels.
2. Plan Decentralised management supply of feedstock
3. What should be the mechanism for pricing the feedstock?
4. Should it be the market determined, should it be government controlled?

Policy and Governance

1. What is the plan for net zero emissions, and how do you plan to achieve it? How do you plan to meet those targets and what kind of government support can help decarbonize the aviation industry?
2. In order to accelerate investment and commitment to building a SAF industry, there are both existing policies on biofuels as well as emerging tools that can be adopted and extended for a green aviation policy
3. In the national Biofuel policy, states have all been directed to setup biofuel boards to invest in building biomass boards to invest in building biomass collection systems, a model that can be extended for replicated for SAF.
4. Identification of innovative financial instruments for creating an ecosystem favourable to SAF. Identification of -Market structural/Policy/regulatory risks
5. Policies and Measures de-risking investments and returns and scaling up SAF ecosystem

Questions and Answers

EASA
European Union Aviation Safety Agency

Thanks for joining!

Stay tuned for additional sessions planned for the coming weeks & months!

03.11.2022 **Environmental Reporting**
state of play, sector performance, actions, improvements

SAF hub - the **role of the Airport**
SAF **Financing** / Clean Skies for Tomorrow
SAF **Sustainability Certification** Schemes
SAF **evolutions** post 41st ICAO Assembly

EASA
European Union Aviation Safety Agency

45 years of ASEAN - EU relations

Shared ambitions

Shared challenges

Shared opportunities

Thank you for your attention

easa.europa.eu/connect

Your safety is our mission.

An Agency of the European Union