Indo-German Energy Forum

PtX Hub

Sustainable Aviation Fuel (SAF) & Sustainable Maritime Fuel (SMF) Stakeholder Mapping and Survey Report

Report by:

DORNIER Group

On behalf of:

GOVERNMENT OF INDIA
MINISTRY OF NEW AND RENEWABLE ENERGY
सत्यमेव जयते

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Acronyms and Abbreviations

Abbreviation	Explanation
ASTM	American Society for Testing and Materials
ATF	Aviation Turbine Fuel
CHT	Centre for High Technology
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CSIR	Centre for Scientific and Industrial Research
DGCA	Director General of Civil Aviation
DGI	Dornier Group (India) Private Limited
DPR	Detailed Project Report
FDI	Foreign Direct Investment
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GHG	Greenhouse Gases
GoI	Government of India
GST	Goods and Services Tax
HMEL	HPCL-Mittal Energy Limited
HPCL	Hindustan Petroleum Corporation Limited
ICAO	International Civil Aviation Organization
IGEF-SO	Indo-German Energy Forum Support Office
IIP	Indian Institute of Petroleum
IOCL	Indian Oil Corporation Limited
MoCA	Ministry of Civil Aviation
MoPNG	Ministry of Petroleum and Natural Gas
MRPL	Mangalore Refineries Private Limited
NGO	Non-Governmental Organisation (Social Activist)
PEM	Proton Exchange Membrane
PPP	Public Private Partnership
PtL	Power-to-Liquid
PtX	Power-to-X
R&D	Research and Development
RE	Renewable Energy
SAF	Sustainable Aviation Fuel
SCG	Stakeholder Consultation Groups
SMF	Sustainable Marine Fuel
SOEC	Solid Oxide Electrolyser Cell
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollars

Executive Summary

To adopt Sustainable Aviation Fuels (SAF) and Sustainable Maritime Fuels (SMF) in the aviation and maritime sector of India, collaborations and partnerships between the various stakeholders are vital for knowledge sharing, technology transfer, capacity building and implementation of policy frameworks for the production, distribution, and use of these fuels.

This report aims to identify and categorise the relevant stakeholders along the SAF and SMF value chain. Therefore a stakeholder mapping and survey has been carried out for India.

Oil companies have started their internal capacity building through R&D for manufacturing SAF and SMF by collaborating with global technology suppliers and/or private industry partners. Among the oil marketing companies, Indian Oil Corporation Limited (IOCL), is the forerunner and the major stakeholder for providing SAF for the users.

Research organizations are entering collaborations with technology suppliers for developing country specific technology setups of manufacturing facilities.

Awareness among NGOs, journalists, and general public is found to be still at low level. However, enlightened corporate executives are found to be ready to pay a premium for the freight using SAF and SMF.

Though Government of India is yet to notify any SAF and/or SMF policy, similar actions towards promoting biofuels from agro-industry waste are a great facilitator towards ground building for SAF and SMF production.

Key Findings of SAF mapping and survey

All findings mentioned below are based on the **survey data**, **web-research** and **interviews** conducted on SAF in India.

1) **Government of India, Industry bodies, Researchers and Airlines are aware of the ongoing developments on SAF**. Few sectoral developments:
   - NITI Aayog has proposed multiple steps to increase the local production of sustainable aviation fuel (SAF), such as:
     - Goods and Sales Tax (GST) on SAF could be as low as 5%
     - Passenger fee could be waived off and
     - User development charges could be waived off.
   - Ministry of Civil Aviation (MoCA) has advised all states to consider the carbon emission offsetting in the design and operation for all future proposals and Detailed Project Reports (DPRs)
   - Ministry of Petroleum and Natural Gas has established a Bio-ATF development committee
   - SpiceJet has tested a flight with biofuel blend with Aviation Turbine Fuel (ATF) (25:75) on a test aircraft Bombardier Q400
   - AirAsia India hit the headlines for operating a domestic flight using Indian-made SAF.

2) **All stakeholders are aware of the possible reduction in the carbon footprint on adoption of SAF.**
   Survey responses and interviews with various stakeholders indicate the presence of general awareness on the benefits of SAF as:
   - SAF can have significant contribution in decarbonisation.
   - Adoption of SAF will lead to industrial development and thereby job opportunities.

3) **Government of India started encouraging / promoting the use of SAF and allows Public-Private Partnerships to promote manufacturing of SAF in India.**
   - Production of SAF using sugarcane molasses under "Aatmanirbhar Bharat," is a major step towards self-reliance and decarbonisation of the aviation sector
   - IOCL-LanzaJet, CSIR-IIP-Praj Industries are already visible players
   - Reliance Petroleum, Mangalore Refineries Private Limited (MRPL) are in queue
   - IOCL has the largest market share for ATF refuelling.

4) **Government of India is yet to notify a definite policy or any roadmap on SAF.**
   - Indian authorities are working on a plan to mandate a 1% blending of SAF with regular fuel for all Indian carriers by 2025
   - India would need 140 million litres of biofuel annually, if 1% blending of SAF is mandated

- In case of a more ambitious 5% target, the amount of SAF required per annum will be around 700 million litres.

5) **Users seem to be ready to pay some incremental price if SAF are made mandatory by the Government.**
   - Survey responses and interviews with frequent fliers in a corporate environment indicate that they are ready to bear some (may be up to 10%) increment in air freight.

Key Findings of SMF mapping and survey

All findings mentioned below are based on the **survey data**, **web-research** and **interviews** conducted on SMF in India.

1) **Government of India, Industry bodies, Researchers and Marine lines are aware of the on-going developments on SMF.** Few sectoral developments:

   - The Government of India has permitted the use of sustainable biofuels for the Indian Shipping Industry to promote the use of alternative fuels to reduce carbon emissions
   - The Ministry of Ports, Shipping and Waterways has formulated a policy regarding the use of biofuel and its blends as fuel for the Indian Maritime Industry
   - The Great Eastern Shipping Company, India's largest private sector shipping firm, has completed a trial run on a tanker by using biofuel blending
   - The Indian Register of Shipping has undertaken successful sea trials for two vessels towards use of biofuels.

2) **All stakeholders are aware of the possible reduction in carbon footprint on adoption of SMF.**
   Survey responses and interviews with various stakeholders indicate the presence of general awareness on the benefits of SMF, as:
   - SMF has significant contribution in decarbonisation
   - Adoption of SMF will lead to industrial development and thereby job opportunities.

3) **Government of India has a roadmap to use up to 5% SMF by 2030 in the shipping industry.**
   - Production of SMF will be mainly based on biofuels
   - IOCL, BPCL, HPCL and MRPL are the major public sector oil refining and marketing companies. However, IOCL has the largest market share for Marine Fuel Bunkering
   - Reliance Petroleum and HMEL are two major private sector players in this field.

4) **Users seem to be ready to pay some incremental price if SMF are made mandatory by Government.**
   However survey responses from users/affected persons of SMF are limited hence no trend or opinion could be established.

In general, there are four SAF/SMF production pathways, that can be explored for the purpose of feasibility study in India, viz;

- Hydro-processed esters and fatty acids (HEFA) - mostly from used cooking oil (UCO)
- Alcohol-to-jet (AtJ) - using agricultural residues and surplus sugar streams such as cane molasses and syrup
- Gasification/Fischer-Tropsch (GAS-FT) - using municipal solid waste (MSW) and/or agricultural residues
- Power-to-liquid (PtL) - using access to point sources of carbon in the chemical, steel, and cement industries.

Introduction

As part of the commitment of Government of India in various international forums, India seeks to transition to a low-carbon economy and addresses the environmental impact of the aviation and maritime sector. Adoption of SAF and SMF plays an important role. These fuels not only reduce greenhouse gas emissions, but also promote sustainable development in the transportation sector along with enhancing the energy security of the country. As for the Indian aviation sector, adopting SAF presents a viable solution to mitigate the carbon footprint in the air transportation sector.

Government of India estimates a feedstock for a potential production of 19 - 24 million tons of SAF per year in the country. The estimated maximum requirement of SAF in India, by 2030, considering 50% blend, would be around 8 to 10 million tons per year.

Fuels synthesised from the Power to Liquid (PtL) method, a combination of hydrogen from electrolysis process and captured carbon dioxide, offer a carbon-neutral alternative to ATF. India also seeks to increase its global leadership in the renewable energy market along with its aspirations for implementation and manufacturing of green hydrogen production technologies – favourable conditions for PtL based SAF production.

In the maritime sector too, India can play a vital role in decarbonising the shipping sector, by adopting SMF like green ammonia and methanol. With a vast coastline and strategic location, India can become a hub for refuelling stations. The availability of sustainable maritime fuels at Indian ports would not only contribute to reducing emissions from the shipping sector but also enhance India's position as a sustainable maritime hub. India's commitment to clean energy and its robust manufacturing capabilities can support the development of infrastructure for the production, storage, and distribution of green ammonia and methanol, creating a sustainable ecosystem for maritime fuels in the country.

To promote the adoption of SAF and SMF, collaborations and partnerships between the various stakeholders are vital for knowledge sharing, technology transfer and inputs to potential policy frameworks. The Indo-German Energy Forum (IGEF) aims at strengthening such collaborations between India and Germany. Therefore, IGEF and its affiliated programme, the International PtX Hub, requested the company Dornier to carry out a stakeholder mapping and survey along the SAF and SMF value chain. One objective is to accelerate the development of India as a global hub for sustainable Power-to-X (PtX) applications.

Scope of Work

The scope of work included the following tasks:

Task 1: Stakeholder Mapping

- to compile a database of stakeholders with a presence in India active along the SAF/SMF value chain. The database shall include the basic information on the companies/organisations, such as name, product and service offering, projects, turnover, number of employees and general contact information, including country of origin. The stakeholders should be categorised and mapped visually.

Task 2: Stakeholder Survey

- to select and perform a survey of at least 30 of the most relevant stakeholders identified in the stakeholder mapping and provide a report on the survey.

Methodology

The methodology adopted to map the stakeholders, included the following steps:

- **Identification** – where all relevant organisations, institutions and individuals were identified through both desk study as well as consultations with a selected stakeholder group.

- **Analysis** – information obtained through survey questionnaire is analysed in respect of awareness, willingness, and affordability of the products of new technology. This will cover the readiness to pay for future environmental sustainability.

- **Mapping** – drawing relationships between the different stakeholder groups in order to identify the sensitivity of key stakeholders. As a process, a detailed questionnaire was circulated among some identified entities and in some cases physical or telephonic or online interviews were conducted. The responses received through the above actions were analysed.

All the above three steps were carried out simultaneously through the following processes:

- Selection of the relevant stakeholders: More than 30 relevant stakeholders from different categories have been targeted in the SAF/SMF value chain for the purpose of conducting the survey.

- Data collection of the relevant stakeholders (via questionnaire): Through the above survey, a set of relevant data was targeted to be collected. While collecting the data, it was kept in mind that an equal level of awareness about the process, technology, and subsequent impact on environmental sustainability could be expected from all levels of respondents. Accordingly,

scope for discussion and dissemination of relevant information were also considered.

- Removal of data: Collected responses against the questionnaires has been structured and normalised to suitably club similar/dissimilar responses and non-prioritising the less relevant data.

- Data classification into categories: The actions elaborated in the above point resulted into the classification and categorisation.

- Coding of data categorised: The categorised and classified data has been grouped by numbers to indicate the level of confidence and inter-relationships among the various stakeholders to create the potential mapping.

- Data visualisation: After analysing the classified, categorised, codified and its representation into numbered confidence level, a general impression/visualisation was created which has been represented in graphical formats for easy understanding.

Identification of stakeholders began with a desk study and mapping of broad categories of stakeholders relevant for climate mitigation and adaptation in India, who have strong relevance and can positively impact the deployment of climate friendly technologies in aviation fuel in the form of SAF and SMF. The following groups have been identified:

- Ministries, regulators, departments, and individuals that are responsible for development of policies and regulations in the subject area/sectors.
- Industry associations and businesses operating in the subject area/sector that have a significant interest on climate friendly SAF/SMF value chain.
- Industrial establishments and/or research organisation who are taking interest in technology development and providing supplies to the users.
- Renewable Energy Providers including electricity utilities.
- Banks and other lenders who could be involved in providing co-financing for the climate mitigation and adaptation projects.
- Transport Fleet Operators who could be the potential users of the new environment friendly fuel and be the cause for reducing the effects of climate change (e.g., aviation and shipping companies)
- Academia, research institutions, think tanks that generate knowledge and provide technical support to government and industry.

It may please be noted that while conceiving the mapping concept, NGOs involved in promoting sustainable development and climate change mitigation, media houses and international organisations, cooperation agencies and donors have not been included.

In addition to identifying the key groups of stakeholders, the project team has worked on identifying the possible correlations among the various stakeholders. The following roles were identified:

- Providing data and technical assistance (on technologies, adaptability, costs, etc.)
- Providing financing for project implementation
- Supporting policy making
- Social and institutional support, including dissemination of results
- Project beneficiary

The exercise of mapping of stakeholders continued with consultations with a key group of relevant members of the key ministries, academic, private sector actors/companies, and non-profit institutions in India.

The feedback on stakeholders obtained through the survey questionnaire is analysed to generate the market understanding on various issues related to popularising SAF/SMF.

Utilising the above and consolidating all the responses, a summary of most relevant issues has been created and presented as "key findings" above.

Overview of Survey

Stakeholder identification is a critical undertaking focused on recognising all organisations, entities, and individuals directly or indirectly impacted by specific activities or those with a specific interest in the said activities. Stakeholder surveys, in general, are a quantitative method based on a questionnaire to gather information from various stakeholders selected using sampling techniques, about their preferences, constraints, views, knowledge, experience, and interests pertaining to a given program, project or services of an organisation. Stakeholder mapping is a visual process that involves charting out the stakeholders associated with a product, process, project, or idea on a comprehensive map. The primary advantage of stakeholder mapping lies in providing a visual representation of all individuals capable of influencing a project or product, showcasing their connections or correlations.

To facilitate this process, two questionnaires were crafted - one focusing on SAF and the other on SMF. A contact list was prepared to include at least one representation from each identified stakeholder group, and the questionnaires were distributed.

Stakeholder Groups

As per the initial assessment of the stakeholders, identification of the possible respondents under the following groups were done as follows:

- Group A – Government Authorities
- Group B – Fuel Producers/Suppliers
- Group C – Research Institutions
- Group D – Airlines/Marine lines
- Group E – Aero-Engine/Marine Engine Manufacturers
- Group F – Airport/Seaport Operators/Users
- Group G – Industry Bodies/Environmentalists
- Group H – Biofuel/SAF/SMF Manufacturers
- Group I – Electrolyser Manufacturers/Providers
- Group J – Carbon Capture Technology Providers
- Group K – Bankers/Lenders
- Group L – Renewable Energy Developers
- Group M – Hydrogen Production Technology Providers

Under Group A following agencies/entities were considered:

Table 1: Government Authorities Considered

S.No.	Entity	Contact Designation
1	Directorate General of Civil Aviation	Director (Aircraft Engineering)
2	Centre for Military Airworthiness and Certification	Chief Executive
3	Airport Economic Regulation Authority	Director (Tariff, Policy & Stat.)
4	Ministry of Environment, Forest, and Climate Change	Scientist
5	Ministry of Science and Technology - Department of Biotechnology	Scientist
6	Ministry of Petroleum & Natural Gas	SO (Bio-Refinery)
7	Centre for High Technology	Additional Director
8	Airport Authority of India	GM (Engineering)
9	Ministry of New and Renewable Energy	Director
10	Industrial Promotion & Investment Corporation of Odisha	CGM
11	Directorate General of Shipping	Chief Surveyor
12	Ministry of Ports, Shipping and Waterways	Director (Engineering)

Under Group B following agencies/entities were considered:

Table 2: Fuel Producers Considered

S.No.	Entity	Contact Designation
1	Indian Oil Corp. Ltd.	Executive Director (Alternate Energy and Sustainable Development)
2	Bharat Petroleum Corp. Ltd.	Dy General Manager
3	Shell MRPL Aviation Fuels & Services Ltd	Chief Technical Officer
4	Hindustan Petroleum Corp. Ltd.	Operations Officer
5	Reliance BP Mobility Ltd.	Head of Business Development
6	Bharat Oman Refinery Ltd.	DGM (Tech Services)
7	Mangalore Refinery and Petrochemicals Ltd.	General Manager (Operations)
8	HPCL Mittal Energy Limited	Head Regional Manager
9	Nayara Energy Limited	General Manager Operations
10	Chennai Petroleum Corporation Limited	CGM - Technical
11	Numaligarh Refineries Ltd.	Senior Manager
12	Reliance Industries Ltd.	Product Manager - Technology & Solutions - Hydrogen
13	Adani Bunkering Private Limited	Associate Project Manager

Under Group C following agencies/entities were considered:

Table 3: Research Institutions Considered

S.No.	Entity	Contact Designation
1	Council Of Scientific and Industrial Research – Indian Institute of Petroleum	Senior Principal Scientist
2	The Energy and Resources Institute	Senior Fellow (Scientist) and Area Convenor – Biofuels and Green Shipping

Under Group D following agencies/entities were considered:

Table 4: Airline/Marine Line Considered

S.No.	Entity	Contact Designation
1	AIX Connect	Chief Pilot Technical
2	Indigo	Sr. Manager - HR (Talent Engagement)
3	Air India	Director – Commercial
4	Vistara	VP & Head of Corporate Communications
5	SpiceJet	Chief Customer Officer
6	Air India Express	VP & Head of Corporate Communications
7	Akasa Air	Senior Manager Commercial
8	Go First	Business Development Manager
9	Alliance Air	Dy Engineer
10	SpiceXpress	Chief Officer
11	Blue Dart Aviation	Technical Manager
12	DHL	Head - Corporate Communications & CSR
13	Jeena & Company	Business Development Manager
14	FedEx	Business Development Manager
15	VRL Logistics Limited	Business Development Manager
16	The Shipping Corporation of India Ltd	DGM (Stores, Bunkers & Services)
17	Essar Shipping	Head - Chartering & Operations
18	The Great Eastern Shipping Company	DGM
19	Trans Asia Shipping Services Pvt Ltd	Regional Head (Indian Subcontinent – South-East)
20	San Marine	Business Development Manage
21	Global Marine Services	Managing Partner
22	Mazagon Dock Shipbuilders Limited	General Manager (CP)
23	Bharathi Defence and Infra Limited	Assistant Manager
24	Cochin Shipyard Ltd	Head - Business Development
25	Global Offshore Services Ltd.	President - Technical
26	Merchant Navy	Merchant Navy Officer

Under Group E following agencies/entities were considered:

Table 5: Aero-Engine/Marine Engine Manufacturers Considered

S.No.	Entity	Contact Designation
1	GE Aerospace	Director & CFO
2	Rolls Royce India Private Limited	Engineering Manager
3	Pratt and Whitney	President and Country Head
4	CFM International	Lead Field Services Engineer
5	Hindustan Aeronautics Limited	Dy. General Manager at Engine Division
6	International Aero Engines	Senior Vice President

Under Group F following agencies/entities were considered:

Table 6: Airport/Seaport Operators/Users Considered

S.No.	Entity	Contact Designation
1	Cochin International Airport Limited	Managing Director
2	Bangalore International Airport Limited	General Manager - Aviation Safety
3	Delhi International Airport Ltd.	Media Relations Specialist
4	GMR Hyderabad International Airport Limited	Media Relations Specialist
5	GMR Airports Infrastructure Limited	Media Relations Specialist
6	Kannur International Airport Limited	Head - Commercial
7	Adani Airport Holdings Ltd.	Head of Business Development
8	Fluor Daniel India Private Limited	Director (Supply Chain Management)
9	Phillips	Director Sales
10	Bank (Private Equity Investment)	General Manager- Investment
11	Insurance Provider	Vice President – Analytics Centre of Excellence
12	Deendayal Port Trust	Dy. Conservator
13	Paradip Port Trust	Dy. Conservator
14	Jawaharlal Nehru Port Trust	Dy. Conservator
15	Visakhapatnam Port Trust	Dy. Conservator
16	Mumbai Port Trust	Dy. Conservator
17	Syama Prasad Mookerjee Port Trust	Chief Engineer
18	Chennai Port Trust	Dy. Conservator
19	New Mangaluru Port Trust	Dy. Conservator
20	V. O. Chidambaranar Port Trust	Dy. Conservator
21	Cochin Port Trust	Dy. Conservator
22	Kamarajar Port Limited	Captain GM
23	Mormugao Port Trust	Dy. Conservator

24	Gujarat Pipavav Port Ltd	Manager Marine

Under Group G following agencies/entities were considered:

Table 7: Industry/Environmental Bodies/Associations Considered

S.No.	Entity	Contact Designation
1	Confederation of Indian Industry	Chief Executive Officer, Food Safety and Standards Authority of India
2	Federation of Indian Chambers of Commerce & Industry	Vice President
3	The Aeronautical Society of India	President
4	Business Aircraft Operators Association	Managing Director
5	Federation of Indian Pilots	Vice President
6	Federation of Indian Petroleum Industry	Director - Oil, Refining and Marketing
7	Environmental Industry	Energy Journalist
8	Indian Ports Association	Senior Consultant

Under Group H following agencies/entities were considered:

Table 8: Biofuel/SAF/SMF Manufacturers Considered

S.No.	Entity	Contact Designation
1	Praj Industries	Assistant Vice President - Corporate Strategy, Bioenergy
2	Kotyark Industries Limited	Director
3	Emami Agrotech Ltd.	Manager - Business Development
4	PAN Oleo Energy Limited	Plant Manager
5	Verbio India Private Limited	Project Manager
6	HIF Global	Group CFO and Head of Asia Pacific
7	Infinium	Vice President, Business Development

Under Group I following agencies/entities were considered:

Table 9: Electrolyser Manufacturers Considered

S.No.	Entity	Contact Designation
1	Ohmium India Private Ltd.	Senior Manufacturing Operations Manager
2	H2e Power Systems Private Ltd.	Assistant Manager Project Coordinator - Electrical Engineer

3	Brise Chemicals Private Ltd.	Technical Consultant - Electrical Engineer
4	John Cockerill India Ltd.	GM-Projects

Under Group J following agencies/entities were considered:

Table 10: Carbon Capture Technology Provider Considered

S.No.	Entity	Contact Designation
1	LanzaTech	-
2	Axens India	-
3	Carbon Clean	Business Development Manager
4	Linde Engineering India Pvt. Ltd.	Business Development Head

Under Group K following agencies/entities were considered:

Table 11: Bankers/Lenders Considered

S.No.	Entity	Contact Designation
1	SBI Capital Markets	(VP - SBI Capital Markets) Climate & Renewables Finance Practitioner
2	Small Industries Development Bank of India	Green Climate & Sustainable Finance Practitioner
3	Indian Renewable Energy Development Agency	Senior Manager - New and Emerging Technologies

Under Group L following agencies/entities were considered:

Table 12: Renewable Energy Developers Considered

S.No.	Entity	Contact Designation
1	ReNew	Project Development Manger
2	Adani Green Energy Ltd.	Associate Project Manager
3	Greenko Group	Renewable Energy Manager
4	SembCorp Industries Limited	Manager - Business development
5	Avaada Energy Private Limited	Senior Manager - Strategy
6	ACME	Dy. General Manager - Oil & Gas, Green Hydrogen & Green Ammonia

Under Group M following agencies/entities were considered:

Table 13: Hydrogen Production Companies Considered

S.No.	Entity	Contact Designation
1	L&T	Manager - Green Hydrogen - Strategy & Business Development
2	Adani New Industries Limited	General Manager and Head Strategy & BD - Petrochemicals
3	IOCL	Executive Director (Alternate Energy and Sustainable Development)
4	Reliance Industries Ltd.	Product Manager - Technology & Solutions – Hydrogen

Stakeholder Description

Brief description about each group of SAF stakeholders is tabulated below:

Table 14: Brief Description of SAF Stakeholder

S.No.	Entity	Type of Organisation/Role in SAF
1	Directorate General of Civil Aviation	Government Authority (Policy)
2	Centre for Military Airworthiness and Certification	Government Authority (Certification)
3	Airport Economic Regulation Authority	Government Authority (Regulator)
4	Ministry of Environment, Forest, and Climate Change	Government Authority (R&D and Policies)
5	Ministry of Science and Technology - Department of Biotechnology	Government Authority (R&D and Policies)
6	Ministry of Petroleum & Natural Gas	Government Authority (R&D and Policies)
7	Centre for High Technology	Government Authority (R&D and Policies)
8	Airport Authority of India	Government Authority (Airport Operator)
9	Ministry of New and Renewable Energy	Government Authority (Policies and R&D)
10	Industrial Promotion & Investment Corporation of Odisha	Government Authority (Investor)
11	Indian Oil Corp. Ltd.	Fuel Producer (Biofuel, Marine fuel)

12	Bharat Petroleum Corp. Ltd.	Fuel Producers (ATF)
13	Shell MRPL Aviation Fuels & Services Ltd.	Fuel Producers (ATF)
14	Hindustan Petroleum Corp. Ltd.	Fuel Producers (ATF and Biodiesel)
15	Reliance BP Mobility Ltd.	Fuel Producers (ATF)
16	Bharat Oman Refinery Ltd.	Fuel Producers (ATF and Marine Fuel)
17	Mangalore Refinery and Petrochemicals Ltd.	Fuel Producers (ATF and Marine Fuel)
18	HPCL Mittal Energy Limited	Fuel Producers (ATF and Marine Fuel)
19	Nayara Energy Limited	Fuel Producers (Marine Fuel)
20	Chennai Petroleum Corporation Limited	Fuel Producers (ATF and Marine Fuel)
21	Numaligarh Refineries Ltd.	Fuel Producers (ATF and Marine Fuel)
22	Reliance Industries Ltd.	Fuel Producers (ATF and Marine Fuel)
23	Council of Scientific and Industrial Research – Indian Institute of Petroleum	Research Institutions (R&D)
24	The Energy and Resources Institute (TERI)	Research Institutions (R&D)
25	AIX Connect	Airline (Operator)
26	Indigo	Airline (Operator)
27	Air India	Airline (Operator)
28	Vistara	Airline (Operator)
29	SpiceJet	Airline (Operator)
30	Air India Express	Airline (Operator)
31	Akasa Air	Airline (Operator)
32	Go First	Airline (Operator)
33	Alliance Air	Airline (Operator)
34	SpiceXpress	Airline (Operator)
35	Blue Dart Aviation	Airline (Operator)
36	DHL	Airline (Operator)
37	Jeena & Company	Airline (Operator)
38	FedEx	Airline (Operator)
39	VRL Logistics Limited	Airline (Operator)
40	GE Aerospace	Aero-Engine Manufacturer
41	Rolls Royce India Private Limited	Aero-Engine Manufacturer
42	Pratt and Whitney	Aero-Engine Manufacturer
43	CFM International	Aero-Engine Manufacturer
44	Hindustan Aeronautics Limited	Aero-Engine Manufacturer
45	International Aero Engines	Aero-Engine Manufacturer
46	Cochin International Airport Limited	Airport Operator
47	Bangalore International Airport Limited	Airport Operator

48	Delhi International Airport Ltd.	Airport Operator
49	GMR Hyderabad International Airport Limited	Airport Operator
50	GMR Airports Infrastructure Limited	Airport Operator
51	Kannur International Airport Limited	Airport Operator
52	Adani Airport Holdings Ltd.	Airport Operator
53	Fluor Daniel India Private Limited	Airline User
54	Phillips	Airline User
55	Bank (Private Equity Investment)	Airline User
56	Insurance Provider	Airline User
57	Confederation of Indian Industry	Industry Association (Policy – collaborate between industry and Govt.)
58	Federation of Indian Chambers of Commerce & Industry	Industry Association (Connecting stakeholders)
59	The Aeronautical Society of India	Industry Association (Decisions for Airport Operators)
60	Business Aircraft Operators Association	Industry Association (Policy – collaborate between industry and Govt.)
61	Federation of Indian Pilots	Industry Association (Decisions for Pilots)
62	Federation of Indian Petroleum Industry	Industry Association (Policy – collaborate between industry and Govt.)
63	Energy Journalism	Airline User
64	Praj Industries	Biofuel Manufacturer (SAF and Biodiesel)
65	Kotyark Industries Limited	Biofuel Manufacturer (Biodiesel)
66	Emami Agrotech Ltd.	Biofuel Manufacturer (Biodiesel)
67	PAN Oleo Energy Limited	Biofuel Manufacturer (SAF and Biodiesel)
68	Verbio India Private Limited	Biofuel Manufacturer (Bioethanol and Biodiesel)
69	HIF Global	Biofuel Manufacturer (SAF and Biodiesel)
70	Infinium	Biofuel Manufacturer (SAF, SMF and Biodiesel)
71	Ohmium India Private Ltd.	Electrolyser Manufacturers (PEM)
72	H2e Power Systems Private Ltd.	Electrolyser Manufacturers (SOEC, Biofuels and Hydrogen)
73	Brise Chemicals Private Ltd.	Electrolyser Manufacturers (Alkaline Water Electrolysers and Hydrogen)
74	John Cockerill India Ltd.	Electrolyser Manufacturers (Hydrogen)
75	LanzaTech	Carbon Capture Technology Providers
76	Axens India	Carbon Capture Technology Providers

77	Carbon Clean	Carbon Capture Technology Providers
78	Linde Engineering India Pvt. Ltd.	Carbon Capture Technology Providers
79	SBI Capital Markets	Bankers/Lenders (Bonds and Loans for Renewable Energy projects)
80	Small Industries Development Bank of India	Bankers/Lenders (Green Finance for Clean Fuel)
81	Indian Renewable Energy Development Agency	Bankers/Lenders (Finance for a Clean Fuel)
82	ReNew	Renewable Energy Developers
83	Adani Green Energy Ltd.	Renewable Energy Developers
84	Greenko Group	Renewable Energy Developers
85	SembCorp Industries Limited	Renewable Energy Developers
86	Avaada Energy Private Limited	Renewable Energy Developers
87	ACME	Renewable Energy Developers
88	L&T	Hydrogen Production Companies
89	Adani New Industries Limited	Hydrogen Production Companies
90	IOCL	Hydrogen Production Companies
91	Reliance Industries Ltd.	Hydrogen Production Companies

Brief description about each group of SMF stakeholders is tabulated below:

Table 15: Brief Description of SMF Stakeholder

S.No.	Entity	Type of Organisation/Role in SMF promotion
1	Ministry of Environment, Forest, and Climate Change	Government Authority (R&D and Policies)
2	Ministry of Science and Technology - Department of Biotechnology	Government Authority (R&D and Policies)
3	Ministry of Petroleum & Natural Gas	Government Authority (R&D and Policies)
4	Centre for High Technology	Government Authority (R&D and Policies)
5	Ministry of New and Renewable Energy	Government Authority (Policies and R&D)
6	Directorate General of Shipping	Government Authority (Policies)
7	Ministry of Ports, Shipping and Waterways	Government Authority (Policies)
8	Indian Oil Corp. Ltd.	Fuel Producers (Biofuel, Marine fuel)
9	Hindustan Petroleum Corp. Ltd.	Fuel Producers (ATF and Biodiesel)
10	Bharat Oman Refinery Ltd.	Fuel Producers (ATF and Marine Fuel)
11	Mangalore Refinery and Petrochemicals Ltd.	Fuel Producers (ATF and Marine Fuel)
12	HPCL Mittal Energy Limited	Fuel Producers (ATF and Marine Fuel)

13	Nayara Energy Limited	Fuel Producers (Marine Fuel)
14	Chennai Petroleum Corporation Limited	Fuel Producers (ATF and Marine Fuel)
15	Numaligarh Refineries Ltd.	Fuel Producers (ATF and Marine Fuel)
16	Reliance Industries Ltd.	Fuel Producers (ATF and Marine Fuel)
17	Adani Bunkering Private Limited	Fuel Producers (Marine Fuel)
18	Council of Scientific and Industrial Research – Indian Institute of Petroleum	Research Institutions (R&D)
19	The Energy and Resources Institute	Research Institutions (R&D)
20	The Shipping Corporation of India Ltd.	Marine line (Ship & marine assets owner and Ship Building)
21	Essar Shipping	Marine line (Ship & marine assets owner)
22	The Great Eastern Shipping Company	Marine line (Shipping logistics & marine assets owner)
23	Trans Asia Shipping Services Pvt Ltd	Marine line (Shipping logistics and ship & marine assets owner)
24	San Marine	Marine line (Naval logistics and ship building)
25	Global Marine Services	Marine line (Ship Repairer and Fuel supplier)
26	Mazagon Dock Shipbuilders Limited	Ship Builders (Warship and Submarine)
27	Bharathi Defence and Infra Limited	Ship Builders (Defence Vessels)
28	Cochin Shipyard Ltd	Ship Builders (Ship Builder and Repairer)
29	Global Offshore Services Ltd.	Ship Builders (Ship Builder and Repairer)
30	Merchant Navy	Merchant Navy
31	Deendayal Port Trust	Seaport Operator
32	Paradip Port Trust	Seaport Operator
33	Jawaharlal Nehru Port Trust	Seaport Operator
34	Visakhapatnam Port Trust	Seaport Operator
35	Mumbai Port Trust	Seaport Operator
36	Syama Prasad Mookerjee Port Trust	Seaport Operator
37	Chennai Port Trust	Seaport Operator
38	New Mangaluru Port Trust	Seaport Operator
39	V. O. Chidambaranar Port Trust	Seaport Operator
40	Cochin Port Trust	Seaport Operator
41	Kamarajar Port Limited	Seaport Operator
42	Mormugao Port Trust	Seaport Operator
43	Gujarat Pipavav Port Ltd	Seaport Operator

44	Confederation of Indian Industry	Industry Association (Policy – collaborate between industry and Govt.)
45	Federation of Indian Chambers of Commerce & Industry	Industry Association (Connecting stakeholders)
46	Federation of Indian Petroleum Industry	Industry Association (Policy – collaborate between industry and Govt.)
47	Indian Ports Association	Industry Association (Decisions for Major Seaport Operators)
48	Praj Industries	Biofuel Manufacturer (SAF and Biodiesel)
49	Kotyark Industries Limited	Biofuel Manufacturer (Biodiesel)
50	Emami Agrotech Ltd.	Biofuel Manufacturer (Biodiesel)
51	PAN Oleo Energy Limited	Biofuel Manufacturer (SAF and Biodiesel)
52	Verbio India Private Limited	Biofuel Manufacturer (Bioethanol and Biodiesel)
53	Infinium	Biofuel Manufacturer (SAF, SMF and Biodiesel)
54	Ohmium India Private Ltd.	Electrolyzer Manufacturers (PEM)
55	H2e Power Systems Private Ltd.	Electrolyzer Manufacturers (SOEC, Biofuels and Hydrogen)
56	Brise Chemicals Private Ltd.	Electrolyzer Manufacturers (Alkaline Water Electrolysers and Hydrogen)
57	John Cockerill India Ltd.	Electrolyzer Manufacturers (Hydrogen)
58	LanzaTech	Carbon Capture Technology Providers
59	Axens India	Carbon Capture Technology Providers
60	Carbon Clean	Carbon Capture Technology Providers
61	Linde Engineering India Pvt. Ltd.	Carbon Capture Technology Providers
62	SBI Capital Markets	Bankers/Lenders (Bonds and Loans for Renewable Energy projects)
63	Small Industries Development Bank of India	Bankers/Lenders (Green Finance for Clean Fuel)
64	Indian Renewable Energy Development Agency	Bankers/Lenders (Finance for a Clean Fuel)
65	ReNew	Renewable Energy Developers
66	Adani Green Energy Ltd.	Renewable Energy Developers
67	Greenko Group	Renewable Energy Developers
68	SembCorp Industries Limited	Renewable Energy Developers
69	Avaada Energy Private Limited	Renewable Energy Developers
70	ACME	Renewable Energy Developers
71	L&T	Hydrogen Production Companies
72	Adani New Industries Limited	Hydrogen Production Companies
73	IOCL	Hydrogen Production Companies
74	Reliance Industries Ltd.	Hydrogen Production Companies

Interrelationship of Stakeholders

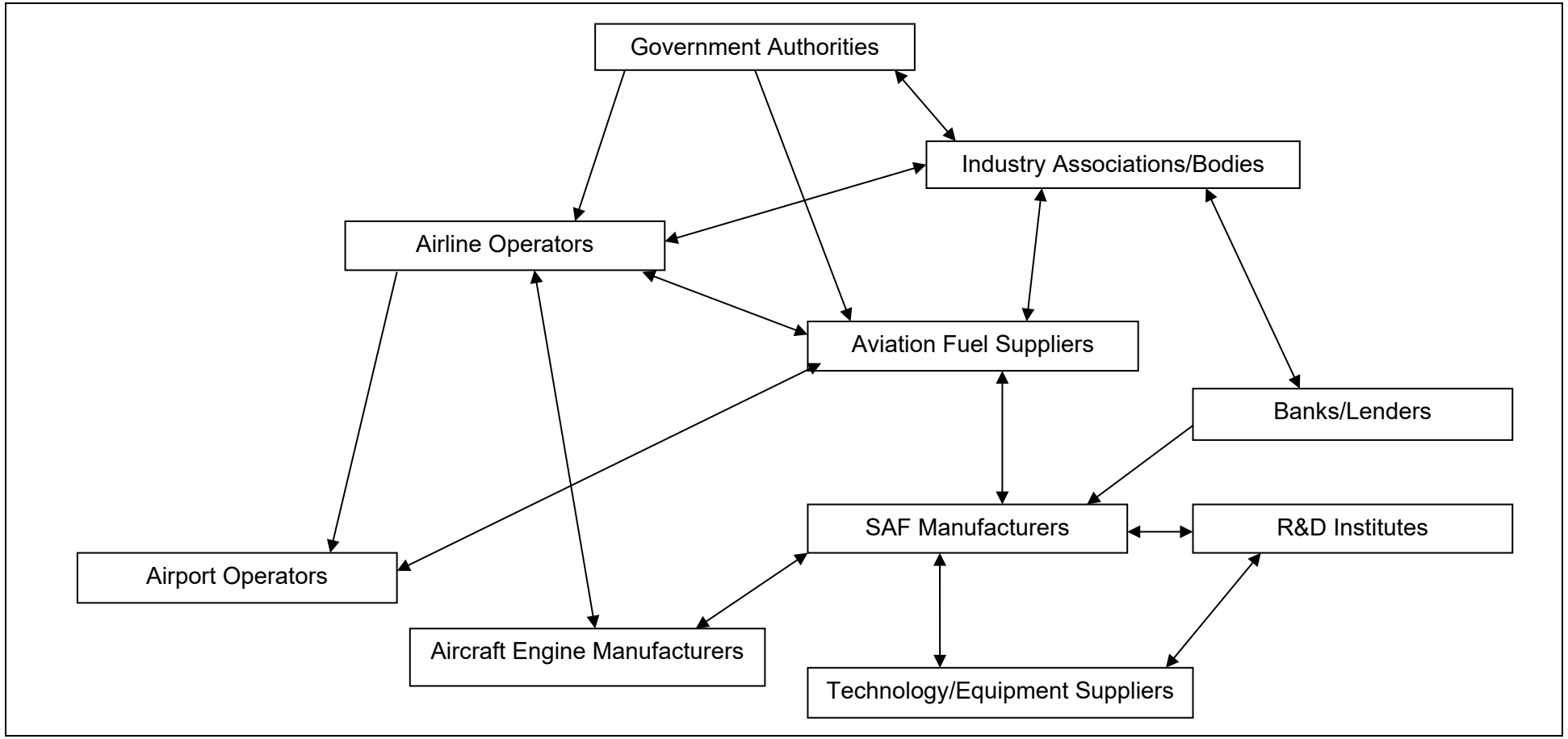

Figure 1: Interrelationship of different stakeholders in SAF

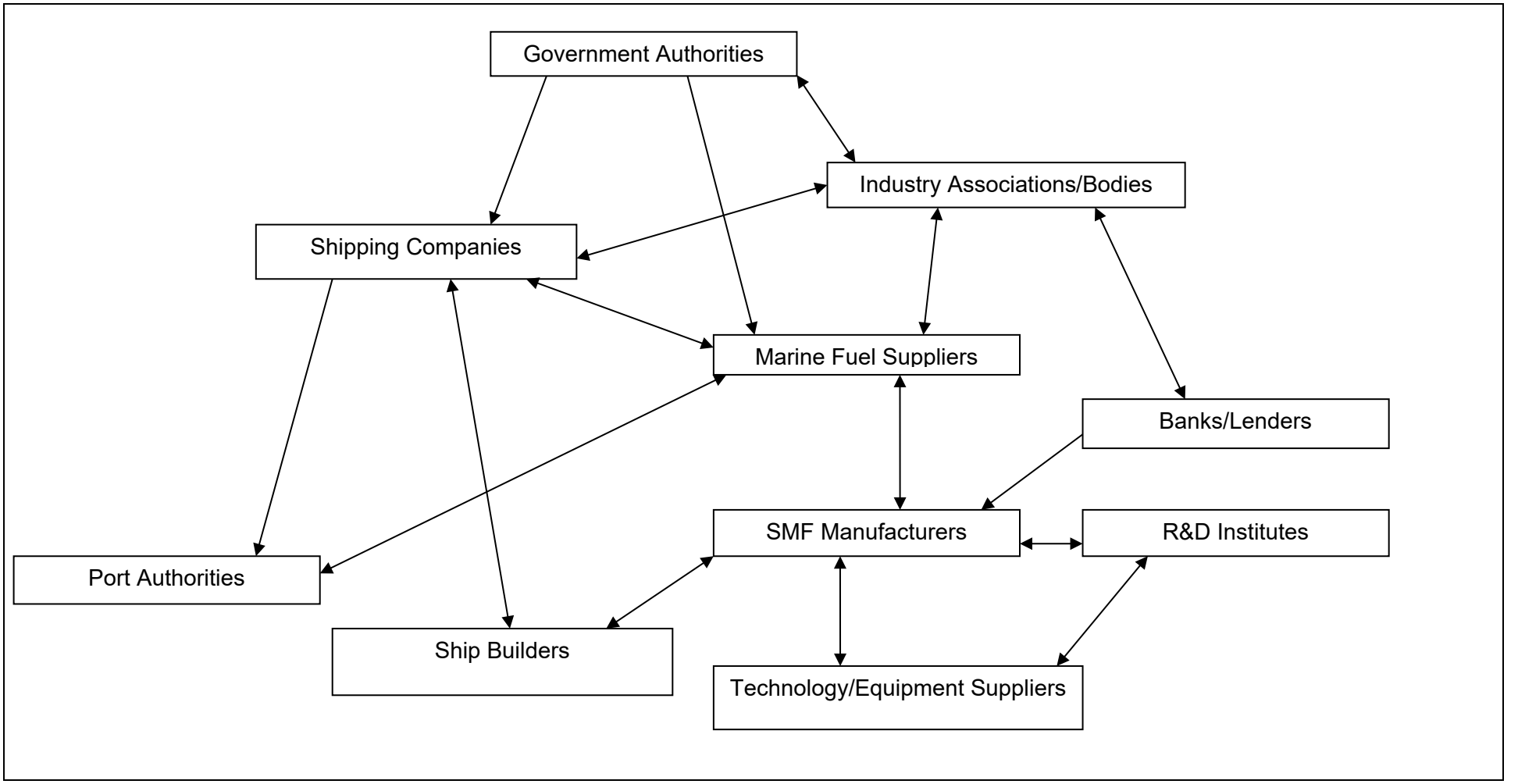

Figure 2: Interrelationship of different stakeholders in SMF

Response Status

In the case of SAF, a commendable number of responses were received from the questionnaires distributed, reflecting valuable stakeholder insights. One interview result has been considered in other sections resulting the total response as twenty one. The following table indicates the status of responses for SAF from various stakeholders.

Table 16: SAF Stakeholder Response Status

Sector	No. of samples	Replies	No Reply	% Response	% No-reply
Government Authorities	9	2	7	22	78
Fuel Producers/Suppliers	12	4	8	33	67
Research Institutions	2	0	2	0	100
Airlines	14	1	13	7	93
Engine Manufacturers	6	0	6	0	100
Airport Operators/Users	11	4	7	36	64
Industry Bodies/Environmentalists	8	2	6	25	75
Biofuel/SAF Manufacturers	7	2	5	29	71
Electrolyser Manufacturers/Providers	6	2	4	33	67
Carbon Capture Technology Providers	4	2	2	50	50
Bankers/Lenders	3	0	3	0	100
Renewable Energy Developers	6	0	6	0	100
Hydrogen Production Technology Providers	6	2	4	33	67
Total	94	21	73	22	78

The graphical representation of the above data is shown below:

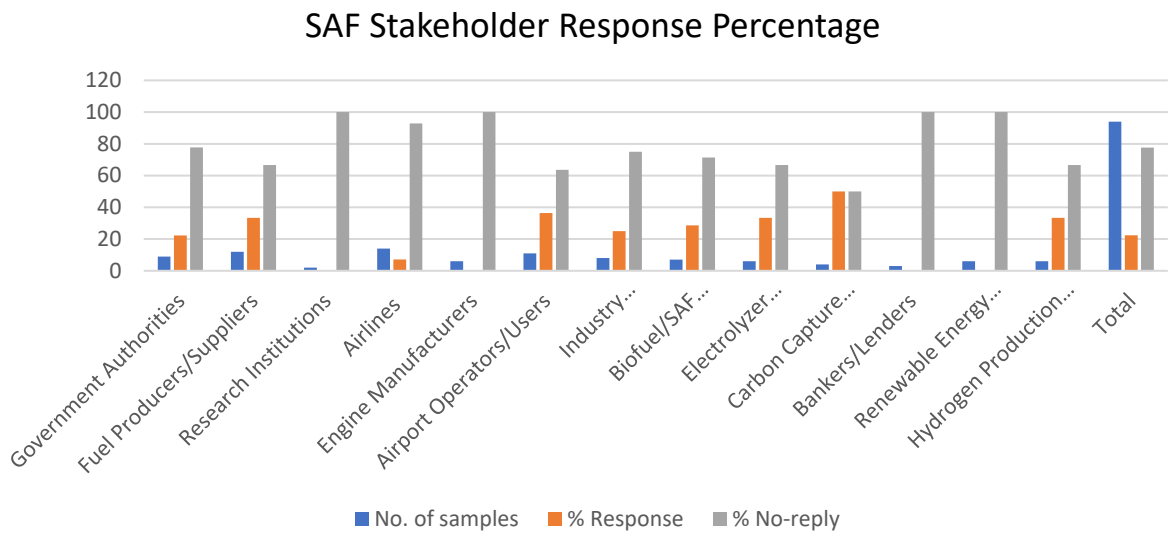

Figure 3: SAF Stakeholder Response Percentage

In the case of SMF, from the distribution of seventy-five questionnaires, we have received a notable number of responses, contributing to a valuable pool of insights. Notably, Infinium is also provider of electrolysers, carbon capture technology and hydrogen production technology, one response has been replicated in other areas, resulting total response to seven. The following table indicates the status of responses for SMF from various stakeholders.

Table 17: SMF Stakeholder Response Status

Sector	No. of samples	Replies	No Reply	% Response	% No-reply
Government Authorities	5	0	5	0	100
Fuel Producers /Suppliers	12	1	10	17	83
Research Institutions	2	0	2	0	100
Marine Lines (Shipping Companies/Officers)	12	2	10	17	83
Ship Engine Manufacturers	0	0	0	0	0
Port Authorities/Users	12	0	11	8	92
Industry Bodies/Environmentalists	4	0	4	0	100
Biofuel/SMF Manufacturers	6	1	5	17	83

Electrolyser Manufacturers/Providers	5	1	4	20	80
Carbon Capture Technology Providers	3	1	2	33	67
Bankers/Lenders	3	0	3	0	100
Renewable Energy Developers	6	0	6	0	100
Hydrogen Production Technology Providers	5	1	4	20	80
Total	75	7	68	7	93

The graphical representation of the above data is shown below:

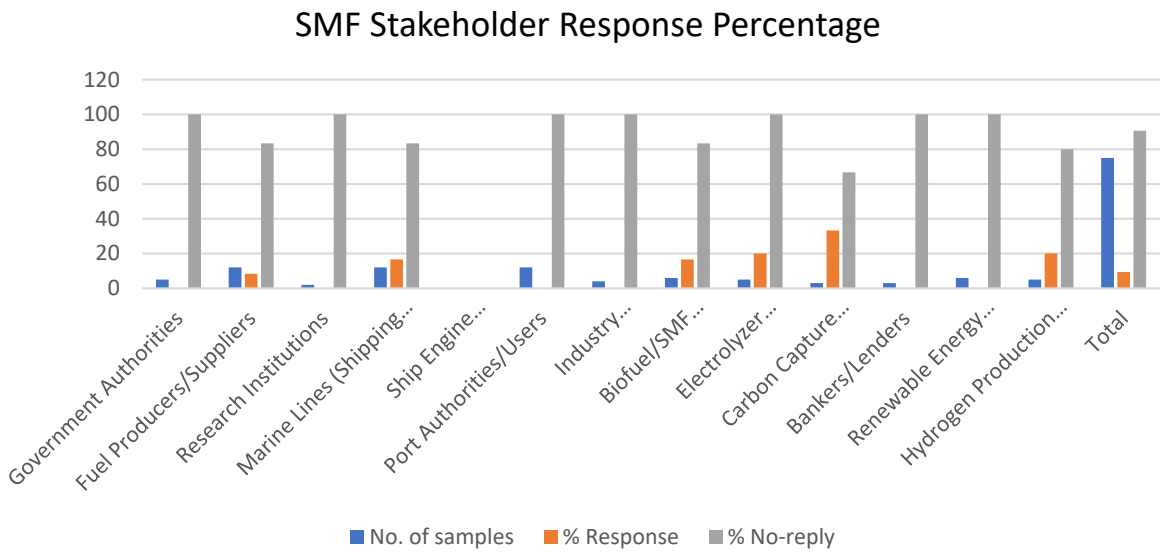

Figure 4: SMF Stakeholder Response Percentage

Formulation and Development of Public Policies in India

Apart from the role of the "Judiciary" through "The Judicial Review" which checks the constitutionality of government policy actions, the policy-making process in India consists of six steps, like agenda setting, policy formulation, adoption, implementation, evaluation, and policy maintenance[1]. It is clear from above that the "Agenda Setting" is the leading steps based on which all other steps are build-up. Usually, "Agenda Setting" for public policies are created without consulting sources external to the government but supported by various government entities, based on the domain of the subject, plays an important role at this stage, may be considered as "Leading Entities" or "Key Organisation".

Leading Entities Responsible for Policy Making

Following are the key organisations responsible for policy making in SAF.

Table 18: Key Organisations – SAF

S.No.	Entity	Role	Ministry
1	NITI Aayog	Policy making for Government of India	PMO
2	Directorate General of Civil Aviation (DGCA)	Regulatory body in aviation industry	Ministry of Civil Aviation
3	Ministry of Environment, Forest, and Climate Change	Environmental Clearance	MoEFCC
4	Ministry of New and Renewable Energy	SAF/e-SAF Policy	MNRE

Following are the key organisations responsible for policy making in SMF.

Table 19: Key Organisations – SMF

S.No.	Entity	Role	Ministry
1	NITI Aayog	Policy making for government of India	PMO
2	Directorate General of Shipping	Regulatory body in marine industry	Ministry of Ports, Shipping, Waterways
3	Ministry of Environment, Forest, and Climate Change	Environmental Clearance	MoEFCC
4	Ministry of New and Renewable Energy	SMF/e-SMF Policy	MNRE

[1] https://ispp.org.in/the-formulation-and-development-of-public-policies-in-india/30121/

Breakdown of Stakeholders by Industry, Role and Region

Table 20: Breakdown of Description of Stakeholders

S.No.	Entity	Type of Organisation	Role in SAF and/or SMF promotion	Region
1	Directorate General of Civil Aviation	Government Authority	Policy	India
2	Centre for Military Airworthiness and Certification	Government Authority	Certification	India
3	Airport Economic Regulation Authority	Government Authority	Regulator	India
4	Ministry of Environment, Forest, and Climate Change	Government Authority	R&D and Policies	India
5	Ministry of Science and Technology - Department of Biotechnology	Government Authority	R&D and Policies	India
6	Ministry of Petroleum & Natural Gas	Government Authority	R&D and Policies	India
7	Centre for High Technology	Government Authority	R&D and Policies	India
8	Airport Authority of India	Government Authority	Airport Operator	India
9	Ministry of New and Renewable Energy	Government Authority	R&D and Policies	India
10	Industrial Promotion & Investment Corporation of Odisha	Government Authority	Investor	India
11	Directorate General of Shipping	Government Authority	Policies	India
12	Ministry of Ports, Shipping and Waterways	Government Authority	Policies	India

13	Indian Oil Corp. Ltd.	Fuel Producers	Biofuel and Marine fuel	India
14	Bharat Petroleum Corp. Ltd.	Fuel Producers	ATF	India
15	Shell MRPL Aviation Fuels & Services Ltd.	Fuel Producers	ATF	India
16	Hindustan Petroleum Corp. Ltd.	Fuel Producers	ATF and Biodiesel	India
17	Reliance BP Mobility Ltd.	Fuel Producers	ATF	India
18	Bharat Oman Refinery Ltd.	Fuel Producers	ATF and Marine Fuel	India
19	Mangalore Refinery and Petrochemicals Ltd.	Fuel Producers	ATF and Marine Fuel	India
20	HPCL Mittal Energy Limited	Fuel Producers	ATF and Marine Fuel	India
21	Nayara Energy Limited	Fuel Producers	Marine Fuel	India
22	Chennai Petroleum Corporation Limited	Fuel Producers	ATF and Marine Fuel	India
23	Numaligarh Refineries Ltd.	Fuel Producers	ATF and Marine Fuel	India
24	Reliance Industries Ltd.	Fuel Producers	ATF and Marine Fuel	India
25	Adani Bunkering Private Limited	Fuel Producers	Marine Fuel	India
26	Council Of Scientific and Industrial Research – Indian Institute of Petroleum	Research Institutions	R&D	India
27	The Energy and Resources Institute	Research Institutions	R&D	India
28	AIX Connect (Air Asia)	Airline	Operator	Domestic
29	Indigo	Airline	Operator	Domestic & International
30	Air India	Airline	Operator	Domestic & International
31	Vistara	Airline	Operator	Domestic & International

32	SpiceJet	Airline	Operator	Domestic
33	Air India Express	Airline		Domestic & International
34	Akasa Air	Airline	Operator	Domestic
35	Go First	Airline	Operator	Domestic
36	Alliance Air	Airline	Operator	Domestic
37	SpiceXpress	Airline	Operator	Domestic
38	Blue Dart Aviation	Airline	Operator	Domestic & International
39	DHL	Airline	Operator	Domestic & International
40	Jeena & Company	Airline	Operator	Domestic & International
41	FedEx	Airline	Operator	Domestic & International
42	VRL Logistics Limited	Airline	Operator	Domestic
43	The Shipping Corporation of India Ltd.	Marine line	Ship & marine assets owner and Ship Building	Domestic
44	Essar Shipping	Marine line	Ship & marine assets owner	Domestic & International
45	The Great Eastern Shipping Company	Marine line	Shipping logistics & marine assets owner	Domestic & International
46	Trans Asia Shipping Services Pvt Ltd	Marine line	Shipping logistics and ship & marine assets owner	Domestic & International
47	San Marine	Marine line	Naval logistics and ship building	Domestic & International
48	Global Marine Services	Marine line	Ship Repairer and Fuel supplier	Domestic & International

49	Mazagon Dock Shipbuilders Limited	Ship Builders	Warship and Submarine	Domestic
50	Bharathi Defense and Infra Limited	Ship Builders	Defence Vessels	Domestic
51	Cochin Shipyard Ltd	Ship Builders	Ship Builder and Repairer	Domestic
52	Global Offshore Services Ltd.	Ship Builders	Ship Builder and Repairer	Domestic & International
53	Merchant Navy	Merchant Navy	Merchant Navy	Domestic & International
54	GE Aerospace	Aero-Engine Manufacturer	Aero-Engine Manufacturer	Global
55	Rolls Royce India Private Limited	Aero-Engine Manufacturer	Aero-Engine Manufacturer	Global
56	Pratt and Whitney	Aero-Engine Manufacturer	Aero-Engine Manufacturer	Global
57	CFM International	Aero-Engine Manufacturer	Aero-Engine Manufacturer	Global
58	Hindustan Aeronautics Limited	Aero-Engine Manufacturer	Aero-Engine Manufacturer	Domestic
59	International Aero Engines	Aero-Engine Manufacturer	Aero-Engine Manufacturer	Domestic & International
60	Cochin International Airport Limited	Airport Operator	Airport Operator	Domestic & International
61	Bangalore International Airport Limited	Airport Operator	Airport Operator	Domestic & International
62	Delhi International Airport Ltd.	Airport Operator	Airport Operator	Domestic & International
63	GMR Hyderabad International Airport Limited	Airport Operator	Airport Operator	Domestic & International
64	GMR Airports Infrastructure Limited	Airport Operator	Airport Operator	Domestic & International
65	Kannur International Airport Limited	Airport Operator	Airport Operator	Domestic & International

66	Adani Airport Holdings Ltd.	Airport Operator	Airport Operator	Domestic & International
67	Fluor Daniel India Private Limited	Airline User	Airline User	Domestic & International
68	Phillips	Airline User	Airline User	Domestic & International
69	Bank (Private Equity Investment)	Airline User	Airline User	Domestic & International
70	Insurance Provider	Airline User	Airline User	Domestic & International
71	Deendayal Port Trust	Seaport Operator	Seaport Operator	Domestic & International
72	Paradip Port Trust	Seaport Operator	Seaport Operator	Domestic & International
73	Jawaharlal Nehru Port Trust	Seaport Operator	Seaport Operator	Domestic & International
74	Visakhapatnam Port Trust	Seaport Operator	Seaport Operator	Domestic & International
75	Mumbai Port Trust	Seaport Operator	Seaport Operator	Domestic & International
76	Syama Prasad Mookerjee Port Trust	Seaport Operator	Seaport Operator	Domestic & International
77	Chennai Port Trust	Seaport Operator	Seaport Operator	Domestic & International
78	New Mangaluru Port Trust	Seaport Operator	Seaport Operator	Domestic & International
79	V. O. Chidambaranar Port Trust	Seaport Operator	Seaport Operator	Domestic & International
80	Cochin Port Trust	Seaport Operator	Seaport Operator	Domestic & International

81	Kamarajar Port Limited	Seaport Operator	Seaport Operator	Domestic & International
82	Mormugao Port Trust	Seaport Operator	Seaport Operator	Domestic & International
83	Gujarat Pipavav Port Ltd	Seaport Operator	Seaport Operator	Domestic & International
84	Confederation of Indian Industry	Industry Association	Policy – collaborate between industry and Govt.	India
85	Federation of Indian Chambers of Commerce & Industry	Industry Association	Connecting stakeholders	India
86	The Aeronautical Society of India	Industry Association	Decisions for Airport Operators	India
87	Business Aircraft Operators Association	Industry Association	Policy – collaborate between industry and Govt.	Domestic & International
88	Federation of Indian Pilots	Industry Association	Decisions for Pilots	India
89	Federation of Indian Petroleum Industry	Industry Association	Policy – collaborate between industry and Govt.	India
90	Energy Journalism	Airline User	Airline User	Domestic & International
91	Indian Ports Association	Industry Association	Decisions for Major Seaport Operators	India
92	Praj Industries	Biofuel Manufacturer	SAF and Biodiesel	India
93	Kotyark Industries Limited	Biofuel Manufacturer	Biodiesel	India
94	Emami Agrotech Ltd.	Biofuel Manufacturer	Biodiesel	India
95	PAN Oleo Energy Limited	Biofuel Manufacturer	SAF and Biodiesel	India
96	Verbio India Private Limited	Biofuel Manufacturer	Bioethanol and Biodiesel	Global
97	HIF Global	Biofuel Manufacturer	SAF and Biodiesel	Global

98	Infinium	Biofuel Manufacturer	SAF, SMF and Biodiesel	Global
99	Ohmium India Private Ltd.	Electrolyzer Manufacturers	PEM	India
100	H2e Power Systems Private Ltd.	Electrolyzer Manufacturers	SOEC, Biofuels and Hydrogen	India
101	Brise Chemicals Private Ltd.	Electrolyzer Manufacturers	Alkaline Water Electrolysers and Hydrogen	India
102	John Cockerill India Ltd.	Electrolyzer Manufacturers	Hydrogen	Global
103	LanzaTech	Carbon Capture Technology Providers	Carbon Capture Technology Providers	Global
104	Axens India	Carbon Capture Technology Providers	Carbon Capture Technology Providers	Global
105	Carbon Clean	Carbon Capture Technology Providers	Carbon Capture Technology Providers	Global
106	Linde Engineering India Pvt. Ltd.	Carbon Capture Technology Providers	Carbon Capture Technology Providers	Global
107	SBI Capital Markets	Bankers/Lenders	Bonds and Loans for Renewable Energy projects	India
108	Small Industries Development Bank of India	Bankers/Lenders	Green Finance for Clean Fuel	India
109	Indian Renewable Energy Development Agency	Bankers/Lenders	Finance for a Clean Fuel	India
110	ReNew	Renewable Energy Developers	Renewable Energy Developers	India
111	Adani Green Energy Ltd.	Renewable Energy Developers	Renewable Energy Developers	India
112	Greenko Group	Renewable Energy Developers	Renewable Energy Developers	India
113	SembCorp Industries Limited	Renewable Energy Developers	Renewable Energy Developers	India
114	Avaada Energy Private Limited	Renewable Energy Developers	Renewable Energy Developers	India
115	ACME	Renewable Energy Developers	Renewable Energy Developers	India
116	L&T	Hydrogen Production Companies	Hydrogen Production Companies	Global

117	Adani New Industries Limited	Hydrogen Production Companies	Hydrogen Production Companies	India
118	IOCL	Hydrogen Production Companies	Hydrogen Production Companies	India
119	Reliance Industries Ltd.	Hydrogen Production Companies	Hydrogen Production Companies	India

Details of SAF Stakeholders

Table 21: SAF Stakeholders Responses

S.No.	Stakeholder Name	Industry	Job title	Company Strength	Revenue	Experience	Main Business Activity	Operational Region
1.	AIX Connect	Airline	Chief Pilot Technical	3000	1,402.31 crore	15 years	Passenger Airline	Domestic & International
2.	Business Aircraft Operators Association	Industry Association	Managing Director	-	-	17 years	Representation of General Aviation and Business Aviation	Domestic & International
3.	Bharat Oman Refinery Ltd.	Fuel Producers	DGM (Tech Services)	600	45,000 crores	12 years	Crude Oil Refining, Fuel Supplier	India
4.	Centre for High Technology (CHT)	Government Authority (MoPNG)	Additional Director	25	-	20+ years	Oil and Gas, Policy preparation	India
5.	Indian Oil Corp. Ltd.	Fuel Producers	GM (Alternative Energy)	31,254	9,34,952.66 crore	26+ years	Refinery, Production and Marketing of	India

							Petroleum Products	
6.	Reliance BP Mobility Limited	Fuel Producers	Head of Business Development	1,100	42,314 crores	8 years	ATF Fuels, EV Charging and Battery Swap, CNG	India
7.	Shell MRPL Aviation Fuels & Services Ltd.	Fuel Producers	Chief Technology Officer	0 – 50	30 – 100 crores	20 years	Technology development, research & innovation, project implementation	India
8.	Fluor Daniel India Private Limited	EPC	Director (Supply chain management)	40,000 (globally)	1,12,906.49 crores (globally)	31 years	EPFC services for Oil & Gas; Metals and Mining and Infrastructure projects	APAC
9.	IPICOL	Biofuel Manufacturer	CGM	-	-	30+ years	Investment for State Industry development	Odisha, India
10.	Infinium	Biofuel/SAF Manufacturer	-	55	101.16 crore	10+ years (SAF)	E-Naptha, SAF, E-Diesel Production	Global
11.	Infinium	Electrolyzer Technology Provider	-	55	101.16 crore	10+ years (SAF)	E-Naptha, SAF, E-Diesel Production	Global
12.	Infinium	Carbon Capture	-	55	101.16 crore	10+ years (SAF)	E-Naptha, SAF, E-Diesel Production	Global

		Technology Provider						
13.	Infinium	Hydrogen Production Technology Provider	-	55	101.16 crore	10+ years (SAF)	E-Naptha, SAF, E-Diesel Production	Global
14.	HIF Global	Biofuel/SAF Manufacture r	-	120	194.16 crore	7 years	E-fuels Production and Project Developer	Global
15.	HIF Global	Electrolyzer Technology Provider	-	120	194.16 crore	7 years	E-fuels Production and Project Developer	Global
16.	HIF Global	Carbon Capture Technology Provider	-	120	194.16 crore	7 years	E-fuels Production and Project Developer	Global
17.	HIF Global	Hydrogen Production Technology Provider	-	120	194.16 crore	7 years	E-fuels Production and Project Developer	Global
18.	Energy Journalism	Airline User	Energy Journalist	-	-	40+ years	Environmental Awareness	Domestic & International
19.	Insurance Provider	Airline User	Vice President (Analytics Centre of Excellence)	22,000 (globally)	2,27,923. 68 crore (globally)	23+ years	Sales and Service for Life Insurance	Domestic & International

20.	Phillips	Airline User	Director (Sales)	60,000 (globally)	1,71,661.6 crore (globally)	29 years	Design, manufacture, and sale healthcare device	Domestic & International
21.	Bank (Private Equity Investment)	Airline User	General Manager (Investment)	100 (globally)	820.78 crore (globally)	25 years	Investment in impact Financial Services Companies	Domestic & International

Note: *Both the companies namely, Infinium and HIF Global, being active in the areas of Biofuel/SAF Manufacturer, Electrolyser Technology Provider, Carbon Capture Technology Provider and Hydrogen Production Technology Provider results of one interview has been considered as one response in each of the four areas mentioned above.*

Details of SMF Stakeholders

Table 22: SMF Stakeholders Responses

S.No.	Stakeholder Name	Industry	Job title	Company Strength	Revenue	Experience	Main Business Activity	Operational Region
1.	Shell MRPL Aviation Fuels & Services Ltd.	Fuel Producers	Chief Technology Officer	0 - 50	30 – 100 crores	20 years	Technology development, research & innovation	India
2.	The Great Eastern Shipping Company	Marine line	Deputy General Manager	250	4,850 crores	30 years	Shipping	Domestic & International
3.	Merchant Navy	Merchant Navy	Merchant Navy	-	-	1.5 years	Cargo Transportation	Domestic & International
4.	Infinium	Biofuel/SMF Manufacturer	-	55	101.16 crore	10+ years	E-Naptha, SAF, E-Diesel Production	Global

5.	Infinium	Electrolyzer Technology	-	55	101.16 crore	10+ years	E-Naptha, SAF, E-Diesel Production	Global
6.	Infinium	Carbon Capture Technology	-	55	101.16 crore	10+ years	E-Naptha, SAF, E-Diesel Production	Global
7.	Infinium	Hydrogen Production Technology	-	55	101.16 crore	10+ years	E-Naptha, SAF, E-Diesel Production	Global

Note: *Both the companies namely, Infinium, being active in the areas of Biofuel/SAF Manufacturer, Electrolyser Technology Provider, Carbon Capture Technology Provider and Hydrogen Production Technology Provider results of one interview has been considered as one response in each of the four areas mentioned above.*

Knowledge and Awareness among Stakeholders

The responses received from the respondents against the questionnaire circulated were analysed, both quantitatively and qualitatively against the backdrop of intended investigation. To form the opinion on various issues against each of the desired aspect, the responses were classified by expert understanding. To facilitate the graphical representation of the crux of the opinions considering both quantitative and qualitative responses were captured. The rationalised understanding in graphical formats is provided under each section.

Knowledge and Awareness about SAF, SMF and PtL

The rationalised data table on the knowledge and awareness about SAF and SMF is given in graph as Figure 5 below:

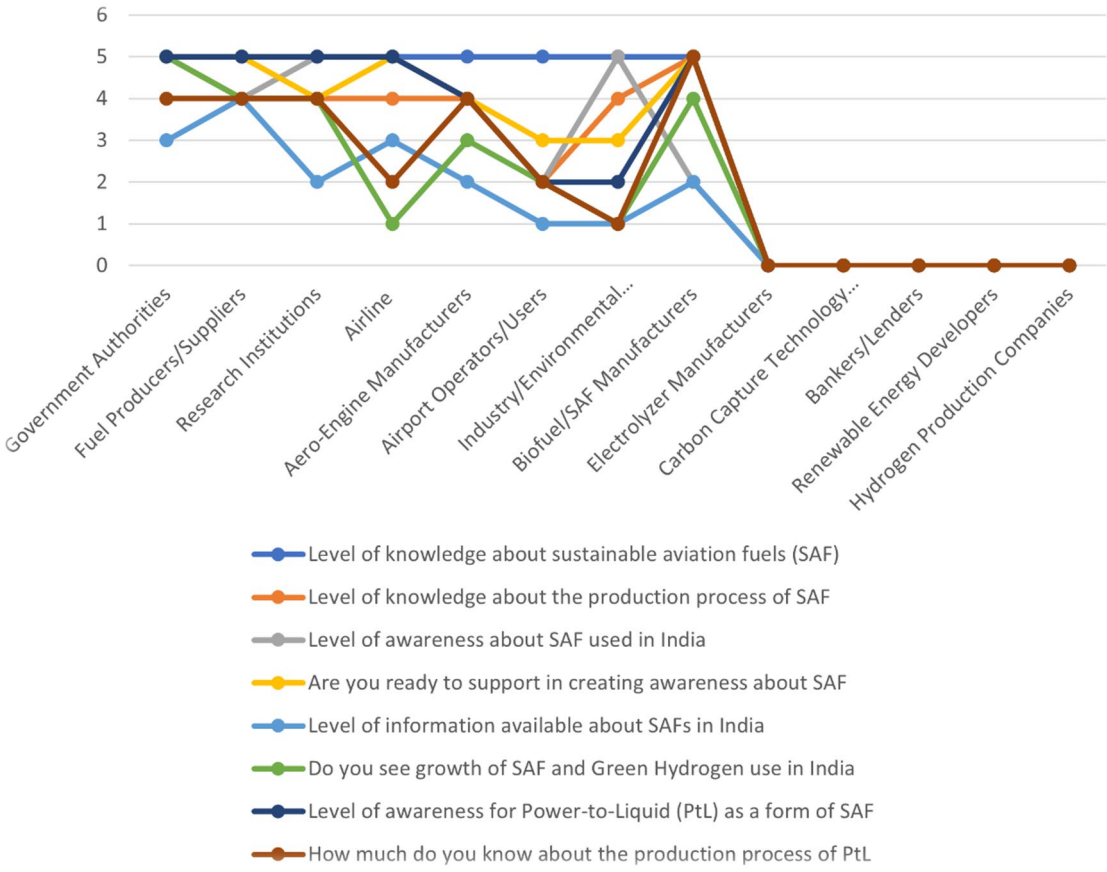

Figure 5: Knowledge and Awareness of SAF

***Note:** The scaling of 1 to 5 has been considered, with 5 being the most responsive and 1 being the least responsive. Where no reply has been received, the number zero has been assigned.*

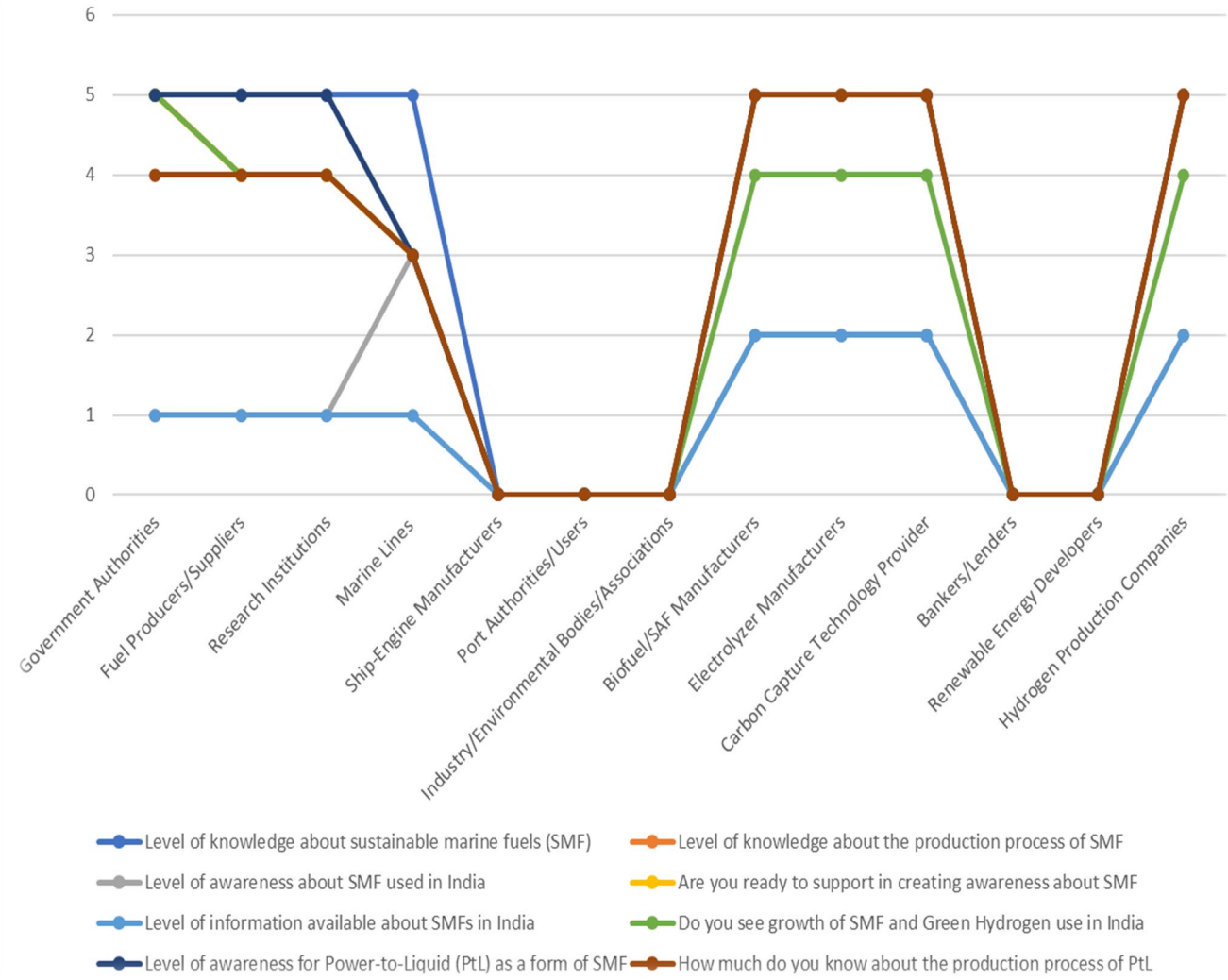

Figure 6: Knowledge and Awareness of SMF

***Note:** The scaling of 1 to 5 has been considered, with 5 being the most responsive and 1 being the least responsive. Where no reply has been received, the number zero has been assigned.*

Areas of Improvement

The above analysis shows that there is room for improvement to raise awareness among the different stakeholders. The most visible shortfall of awareness is noted among the beneficiaries/passengers. A structured campaign aid and abetted by Government and Industry bodies could be helpful.

Current Use and Future Plans of SAF/ SMF

The responses received from the respondents against the circulated questionnaires were analysed in the backdrop of intended investigation. To form the opinion on various issues against each of the desired aspect, the responses were classified by expert understanding. To facilitate the graphical representation of the crux of the opinions considering both quantitative and qualitative responses were captured. The rationalised data table and corresponding graph is provided under each area.

Figure 7: Current Use and Future Plans for SAF

Note: *The scaling of 1 to 5 has been considered, with 5 being the most responsive and 1 being the least responsive. Where no reply has been received, the number zero has been assigned.*

Key Drivers and Priorities

The responses received from the respondents against the circulated questionnaires were analysed in the backdrop of intended investigation. To form the opinion on various issues against each of the desired aspect, the responses were classified by expert understanding. To facilitate the graphical representation of the crux of the opinions considering both quantitative and qualitative responses were captured. The rationalised data table and corresponding graph is provided under each area.

Priorities of Stakeholders in terms of SAF and SMF Adoption

The rationalised responses of the respondents are represented as under.

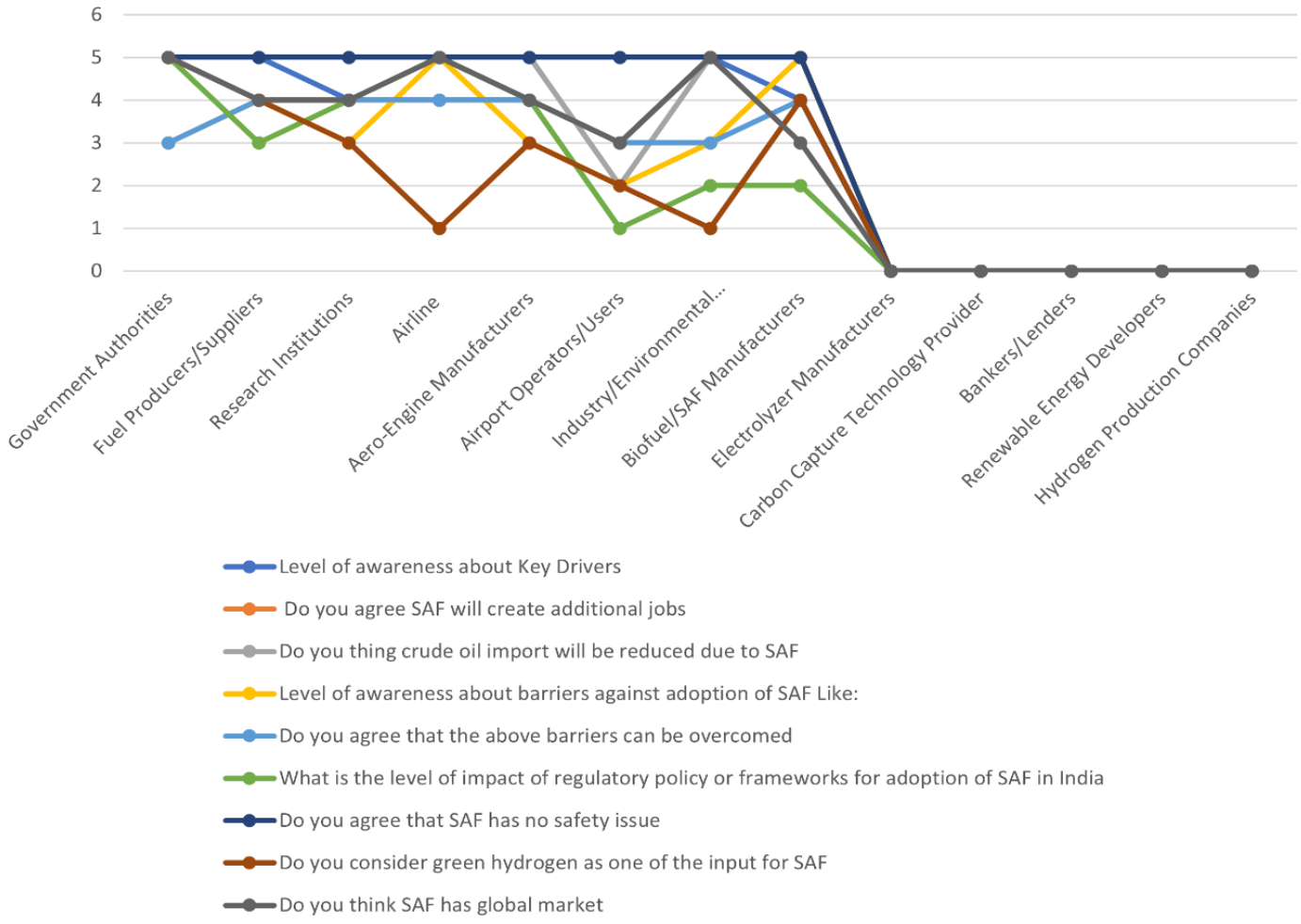

Figure 8: Key Drivers, Priorities and Challenges of SAF

Note: *The scaling of 1 to 5 has been considered, with 5 being the most responsive and 1 being the least responsive. Where no reply has been received, the number zero has been assigned.*

Factors driving adoption of SAF and SMF

The most considered factor by the respondents against the adoption of SAF and SMF are:

- Cost
- Availability
- Government mandate and subsidy
- Environmental sustainability

Regulatory and Policy Factors

A meeting of the Consultative Committee of Ministry of Civil Aviation was held in New Delhi on 28th April 2023 about SAF. The meeting was chaired by the Minister of Civil Aviation Shri Jyotiraditya M. Scindia and attended by several Hon'ble Members of Parliament.

India has committed to net zero by 2070 at COP26 to the United Nations Framework Convention on Climate Change (UNFCCC). The Ministry of Petroleum & Natural Gas (MoPNG) has notified a National Policy on Biofuels in 2018 to realise the goal of decarbonisation of aviation sector. MoPNG constituted the Bio-Aviation Turbine Fuel Programme Committee to take forward the Bio-ATF Programme in the country to promote the use of clean fuel in aviation. The Committee has submitted its report which has now been circulated to various stakeholders.

India has also taken several steps like joining International Civil Aviation Organization's (ICAO) Assistance Capacity Building & Training for Sustainable Aviation Fuels Programme. The Bureau of Indian Standards (BIS) has issued Indian Standard for Bio-Jet ATF in January 2019. Several meetings have been held with the Indian Carriers to sensitise them regarding the impact of CORSIA on airlines once the mandatory phase starts and the resultant needs to be prepared for the same.

As a part of capacity building facilitation, DGCA has also granted approval to the following:

- M/s SpiceJet operated a demonstration flight with 25% SAF (Biofuel produced from Jatropha seeds by the Indian Institute of Petroleum, CSIR lab) blended with ATF from Dehradun to Delhi in August 2018. The fuel is under process of ASTM approval
- M/s Indigo carried out its first international ferry flight with 10% blended fuel from Toulouse to Delhi on 17.02.2022.
- M/s Vistara carried out 30% blended SAF ferry flight from Seattle to Delhi in March 2023
- M/s Air Asia to carry out first commercial domestic flight with 0.57% SAF blended fuel flight is yet to commence
- Indian Oil Corporation Ltd. (IOCL) has planned an 86.8 MTPA plant at Panipat Refinery using LanzaJet ATJ (alcohol to jet) Technology. IOCL has also signed

a MoU with Pune-based Praj Industries to set up a plant for developing ATJ fuels

- Mangalore Refinery and Petrochemicals Ltd. is planning to build a bio-ATF pilot plant at Mangalore using CSIR-Indian Institute of Petroleum's technology using nonedible oils and used cooking oil as feedstock.

Regulation and Policy are two most important factors that play either as facilitator for or barrier against the adoption of any new/innovative solutions. Until now the role of Government has been very supportive but in absence of any defined policy and regulatory structure the involvement of industries is mostly into knowledge enhancement drive.

Training and Capacity Building

The responses received from the respondents against the circulated questionnaires were analysed in the backdrop of intended investigation. To form the opinion on various issues against each of the desired aspect, the responses were classified by expert understanding. To facilitate the graphical representation of the crux of the opinions considering both quantitative and qualitative responses were captured. The rationalised data table and corresponding graph is provided under each area.

Need for Training and Capacity Building for SAF and SMF Adoption

The rationalised responses of the respondents are tabulated as under.

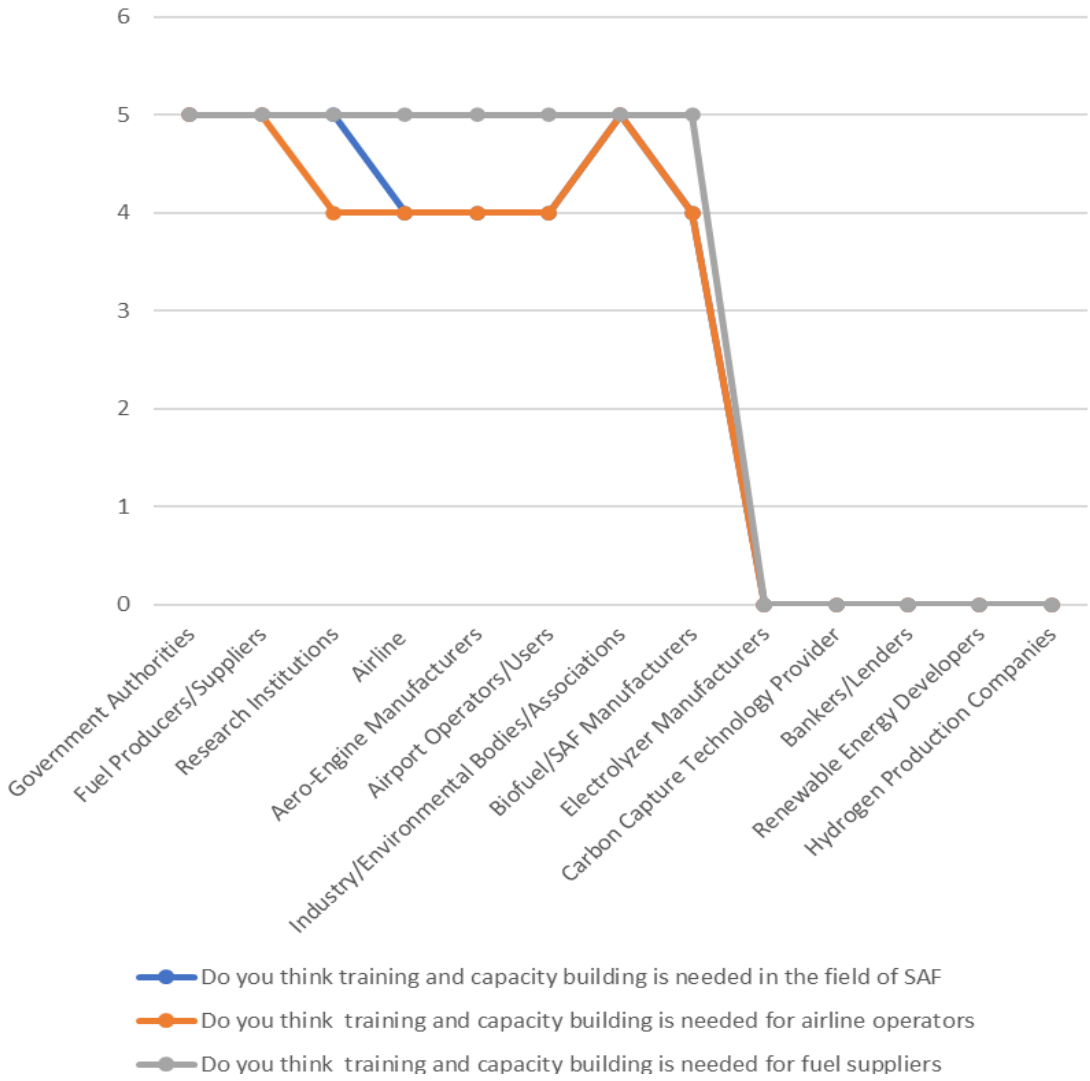

Figure 9: Training and Capacity Building Needs for SAF

Note: *The scaling of 1 to 5 has been considered, with 5 being the most responsive and 1 being the least responsive. Where no reply has been received, the number zero has been assigned.*

Suggestions for Capacity Building Programmes

During the facilitation of this study, it has transpired that more awareness at the grassroot level is expected to be beneficial for overcoming hurdles of implementation in the initial level. Following may be useful:

- A structured implementation road map
- Awareness campaign through websites, social media, and NGOs
- Notification of value-based incentives

Collaboration and Partnership Opportunities

The responses received against the circulated questionnaires were analysed for intended investigation. To form the opinion on various issues against each of the desired aspect, the responses were classified by expert understanding. To facilitate the graphical representation of the crux of the opinions considering both quantitative and qualitative responses were captured. The rationalised data table and corresponding graph is provided under each area.

Identification of Potential Stakeholders Collaboration Opportunities

The rationalised responses of the respondents on this issue are represented as under.

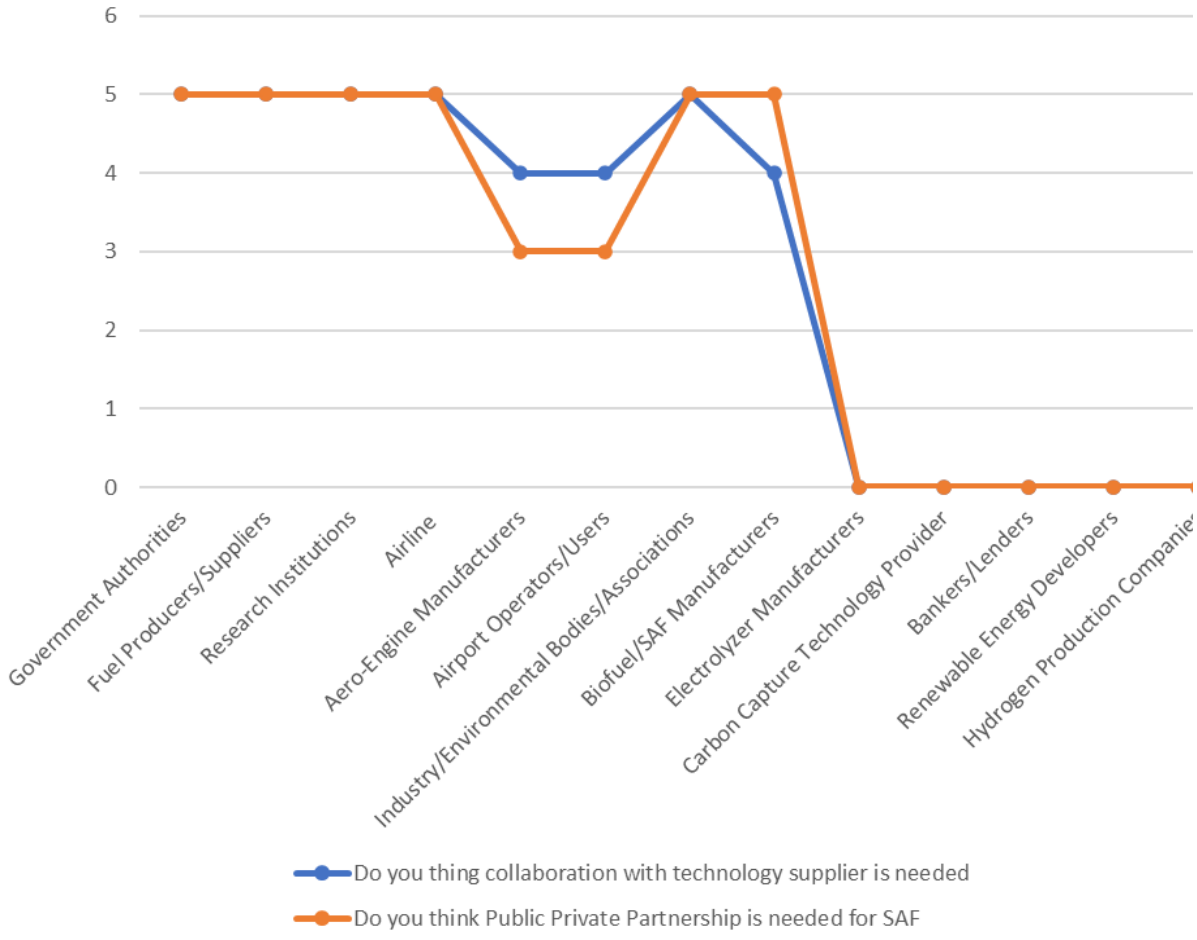

Figure 10: Collaboration and Partnership Opportunities for SAF

***Note:** The scaling of 1 to 5 has been considered, with 5 being the most responsive and 1 being the least responsive. Where no reply has been received, the number zero has been assigned.*

Opportunities for Cross-Industry Collaborations

Cross-industry collaboration usually refers to combining different industries working towards a common goal. This collaboration is driven by the need to find new and innovative solutions to complex problems that a single industry cannot efficiently handle. The development and operation become easier and cost effective by bringing together diverse perspectives, skills, and resources, cross-industry. SAF/SMF is one such issue where all the attributes required for cross industry collaboration are effective.

The stakeholder mapping will facilitate understanding on the effectiveness of the desired cross-industry collaboration. Cross industry collaboration has already started in India, like:

- Research Institutes under CSIR has already collaborated with Praj Industries
- SpiceJet collaborated with Indian Institute of Petroleum for using modified biofuel
- Indian Oil Corporation Ltd. (IOCL) has planned an 86.8 TMTPA plant at Panipat Refinery in collaboration with LanzaJet ATJ
- Mangalore Refinery and Petrochemicals Ltd. is planning to build a bio-ATF pilot plant at Mangalore in collaboration with CSIR-Indian Institute of Petroleum's and looking to collaborate with disposal contractors for non-edible oils and used cooking oil as feedstock supplier.
- IPICOL is developing a commercial grade SAF/SMF plant in the port city of Paradip, Odisha. Stakeholders will include IOCL, developers and IFIs.

Identification of Potential Partners and Stakeholders

The identification of potential partners and stakeholders and its mapping has been done and provided in the **Annexure 1** and **Annexure 2**.

Recommendations

Recommendations for Policymakers Industry Stakeholders

In order to promote and create a long-term sustainable market for SAF/SMF, Government policy is the most important driver as well as most critical barrier. Accordingly, collected responses suggest a set of recommendations for policy guidelines that would be facilitating the development of cost-effective variants as well as accelerated adoption of SAF/SMF and sustained reduction of carbon emission.

However, the outcome of the survey indicates that actions towards implementation is much more in SAF compared to SMF. Also, government authorities have spoken their mind in many forums on adoption of SAF. But, little or no statement on SMF could be accessed.

While preparing a policy on SAF, these suggestions on policy may be adopted with or without modification with the focus on decarbonisation. The suggestions are in the following areas:

Policy Recommendation for Enabling Framework for SAF

- Government funding for SAF/research & demonstration project for SAF/ Production and feedstock utilised.
- Grant, concession loans, tax credits, green bonds
- Recognise SAF/ benefits under carbon taxation - carbon tax or price, setting max emission levels etc.
- Incorporating SAF/ into existing State/National Policies
- Government commitment to SAF/ use, carbon neutral air/ travel
- Adopt sustainability standard and life cycle GHG emissions method for certification of feedstock supply and fuel production.

Additional Recommendations for SAF

- Provision for Government fund allocation to SAF research and development, (R&D) for accelerated learning and capacity building
- Provision for Production Linked Incentives (PLI) and tax holidays for SAF manufacturing infrastructure
- Provision for incentives/subsidies for SAF/ users and facilitators.
- Provision for Green Fund Financing for SAF/ manufacturers being Net-Zero facilitators
- Provision for availing carbon credit incentives as recognition of SAF/ environmental benefits
- Notifying mandates for SAF adoption with increasing incentives for increasing proportion
- Updating the existing bio-fuel policies to incorporate SAF/ and permitting to avail green finance to existing bio-fuel plants for upgradation to include SAF

- Clarity in standards and methods for certifying the sustainability of feedstock and fuel
- Encourage formation and functioning of Stakeholder Consultation Groups (SCG) as advisory body for adoption and promotion of SAF
- Relaxation of rules for Foreign Direct Investment (FDI) in SAF
- Sharing of Marketing Infrastructure.

While preparing a policy on SMF, these suggestions on policy may be adopted with or without modification with the focus on decarbonisation. The suggestions are in the following areas:

Policy Recommendation for Enabling Framework for SMF

- Government funding for SMF research & demonstration project for SMF Production and feedstock utilised
- Grant, concession loans, tax credits, green bonds
- Recognize SMF benefits under carbon taxation - carbon tax or price, setting max emission levels etc.
- Incorporating SMF into Existing State/National Policies
- Government commitment to SMF use, carbon neutral marine travel.
- Adopt sustainability standard and life cycle GHG emissions method for certification of feedstock supply and SMF production.

Additional Recommendations for SMF

- Provision for Government fund allocation to SMF research and development, (R&D) for accelerated learning and capacity building.
- Provision for Production Linked Incentives (PLI) and tax holidays for SMF manufacturing infrastructure
- Provision for incentives/subsidies for SMF users and facilitators.
- Provision for Green Fund Financing for SMF manufacturers being Net-Zero facilitators
- Provision for availing carbon credit incentives as recognition of SMF environmental benefits
- Notifying mandates for SMF adoption with increasing incentives for increasing proportion
- Updating the existing bio-fuel policies to incorporate SMF and permitting to avail green finance to existing bio-fuel plants for upgradation to include SMF
- Unambiguous standards and methods for certifying the sustainability of feedstock and fuel
- Encourage formation and functioning of Stakeholder Consultation Groups (SCG) as advisory body for adoption and promotion of /SMF
- Relaxation of rules for Foreign Direct Investment (FDI) in SMF
- Sharing of Marketing Infrastructure.

Note: *All recommendations and information are based solely on the survey data.*

Conclusion

After preparation of the stakeholder mapping and critical examination of the survey responses received, and in the backdrop of the various reports available in the public domain, following can be concluded:

- All stakeholders in the SAF/SMF value chain are reasonably aware of the benefits but are concerned about challenges
- Government of India is aware of the global trend and practices in respect of SAF, SMF and PtL
- Government of India is responding to the needs and actions against Climate Change in line with the international best practices
- Government of India has started supporting Research and Development on SAF, SMF through specific institutes under CSIR
- Government of India is open to Private Public Partnership (PPP) in the matters of collaboration with Technology Providers
- Government of India (GoI) has supported experimenting the mixing of SAF in domestic and Military aircraft, though at a very small percentage
- Government is planning to issue mandate to airline/marine lines to blend up to 1% SAF/SMF
- Going forward, there will be enormous scope for business in SAF/SMF including earning export revenue and reducing crude oil import bill.
- SAF/SMF industry has the potential to create about 100,000 job opportunities in India by 2030
- Awareness among general public needs to improve further for accelerated adoption in spite of temporary challenges
- To increase the awareness of SAF and SMF amongst government officials and policy makers, conducting seminars and roundtable interactions would be useful.

Way Forward

To provide more insight into the SAF/SMF Development in India, further market studies on the following aspects are recommended:

1) Identification of available and suitable technologies for e-SAF/SMF plants in India

2) Identification of sustainable sources of CO2 in India

3) Identification of project structures favourable for participation of International Financial Institutions (IFIs)

4) Deep dive into all available present regulatory framework conditions and concessions for e-SAF/SMF production, transport, and consumption.

Annexure 1 – SAF India Database

S. No.	Stakeholder Name	Product and service offering	Projects	Turnover	No. of Employees	Contact Person	Organisation's Website
Fuel Producers/Suppliers							
1	Indian Oil Corp. Ltd.	LPG, LNP, Naptha, Motor Spirit, Aviation Turbine Fuel, High Speed Diesel, furnace oil, Marpol FO & bitumen, Petrochemicals, Renewable Energy (solar and wind), Biogas, Biodiesel, EV charging, explosives, cryogenics and fertiliser	RLNG Pipeline, Refineries, Biodiesel production from used cooking oil, Ethanol Plant, Wind & Solar Power Plant, Crude Oil Pipeline	9,34,952.66 crore	31,254	Mr. Atul Parmar General Manager (Alternate Energy) Mr. Santanu Gupta Executive Director (Alternate Energy and Sustainable Development)	https://iocl.com/

2	Bharat Petroleum Corp. Ltd.	Petrol, Diesel, CNG, Gas, Lubricants, LPG, Naptha, Kerosene, ATF, Petcoke, Furnace Oil and Bitumen	Refinery - Naptha to Gasoline , Product Pipeline, 2G Ethanol Refinery, LPG Cryogenic Augmentation, Retail infrastructure, LPG Pipeline	4,33,406.48 crore	9,000	Mr. Abhijeet Dutta Dr. Vivek Rathore (Dy General Manager (R&D))	http://www.bharatpetroleum.in/
3	Shell MRPL Aviation Fuels & Services Ltd. (JV b/w Mangalore Refinery and Petrochemicals Limited and Shell)	ATF	ATF Fueling Stations	30 – 100 crores	0 - 50	Mr. K Tirumal Rao I/c HoD (S&D), Head- (Projects & ERP) Ms. Kirti Swain (Chief Technical Officer)	https://shellmrpl.co.in/
4	Hindustan Petroleum Corp. Ltd.	Asphalt, Diesel, Kerosene, LPG, Lube Oils, Petrols, ATF,	Ethanol Plant, Biodiesel Plant, LPG Pipeline,	4,64,683 crore	9,065	Mr. Manish Kumar Sinha	https://www.hindustanpetroleum.com/

		Power, Turbojet, Naptha, crude oil refining	Refineries, Wind and Solar Project			(Operations Officer)	
5	Reliance BP Mobility Ltd.	Diesel, Petrol, CNG, Engine oil (Vehicles), EV Charging, Aviation fuel	Fleet Charging Station - Delhi, ATF Fuel Stations	42,314 crore	1,100	Mr. Sanjay Kaushik Mr. Prasad Mr. Rajeev Barman (Head of Business Development)	https://www.jiobp.com/
6	Bharat Oman Refinery Ltd. (JV between BPCL and Oman Oil Company)	LPG, Motor Spirit, High Speed Diesel, SKO, ATF, Naptha, Sulphur, Petcoke, Fly ash	Refinery	45,000 crores	600	Mr. Ravi Mr. Hardeep Singh DGM (Tech Services)	https://www.bharatpetroleum.in/Bharat-Petroleum-For/Refineries/Bina-Refinery.aspx

7	Mangalore Refinery and Petrochemicals Ltd.	Naphtha, LPG, Motor Spirit, High-Speed Diesel, Kerosene, Aviation Turbine Fuel, Sulphur, Xylene, Bitumen, Pet Coke and Polypropylene	2G Ethanol Project, Enhancement of Grid Connectivity and Refinery System Upgradation, Petrochemical Fluidized Catalytic Cracking Flue Gas Wet Scrubber System	1,24,736 crore	2,100	Mr. Rudolph V.J. Noronha Mr. Ganesh (General Manager (Operations)	https://www.mrpl.co.in/
8	HPCL Mittal Energy Limited (JV between HPCL and Mittal Energy Investments Pte. Ltd.)	LPG, Naptha, SKO, ATF, Petcoke, Bitumen, Sulphur, HSD, MTO	Refineries, Crude Oil Pipelines	89,551.2 crore	1,928	Mr. Sudhir Soni (Head Regional Manager)	https://www.hmel.in/
9	Nayara Energy Limited	HSD, Light Disesel Oil, MTO, Low Sulphur Heavy Stock, Bitumen, Petcoke, Sulphur, Fly Ash	Polypropylene Plant, Refinery	1,19,689.4 crore	3,300	Mr. Dipesh Modi (General Manager Operations)	https://www.nayaraenergy.com/

10	Chennai Petroleum Corporation Limited	LPG, Naptha, Kerosense, ATF, HSD, High Flash Diesel, Lubes,	RLNG in Hydrogen Generation Units	90,908 crore	1,300	Mr, V. Srikanth (CGM - Technical) Mr. S. Sadagopan (CGM - Logistics and Projects)	https://cpcl.co.in/
11	Numaligarh Refineries Ltd.	LPG, Naphtha, Motor Spirit (MS), Aviation Turbine Fuel (ATF) Superior Kerosene Oil (SKO) High Speed Diesel (HSD), Raw Petroleum Coke (RPC) Calcined Petroleum Coke (CPC), Sulphur, Wax, Nitrogen, Mineral Turpentine Oil (MTO), Special Boiling Point	Refinery Expansion, Setting up Crude Oil Import Terminal, Laying pipeline for oil transportation	29,785 crore	985	Mr. Tusharjit Malakar (Senior Manager) Mrs. Madhuchanda Adhikari	https://www.nrl.co.in/

		Spirit (SBPS) and Liquid Sulphur					
12	RIL	LPG, Motor Spirit, High Speed Diesel, SKO, ATF, Sulphur, Coke, Propane, Naptha, Kerosene	Refinery, Renewable Energy Projects, Exploration and Production of oil and gas	4,66,425 crore	22,642	Mrs. Nidhi Singh (Product Manager - Technology & Solutions -Hydrogen)	https://www.ril.com/
13	Council Of Scientific And Industrial Research–Indian Institute Of Petroleum (CSIR - IIP)	R & D in Petroleum Refining, Catalytic Refining and Catalysis, Evaluation and characterization of Lubrication Oil	Development and Testing of Bio-Jet Fuel for IAF, Biofuel production from Palm stearin	451.12 crore	341	Mr. Jayati Trivedi (Senior Scientist) Mr. Anil Kumar Sinha (Senior Principal Scientist)	https://www.iip.res.in/
14	The Energy and Resources Institute	Research, Policy, Consultancy and Implementation in Energy, Agriculture,	Advanced Biofuel Program, Study on biofuels for	128.59 crore	1,250	Dr. Piyali (Senior Fellow (Scientist) and Area	https://www.teriin.org/

		Climate and Environment Sectors including Biofuels	transportation, Pyrolysis Method for Biofuel Production			Convenor – Bio-fuels and Green Shipping)	
Domestic Airlines							
15	Air India	Commercial Flight Operators	Collaboration with CSIR-IIP for SAF Usage	17,105.2 crore	11,000	Mrs. Meenakshi Malik (Director – Commercial) Mr. Rajeev Bajpai	https://www.airindia.com/
16	Vistara	Commercial Flight Operators	Collaboration with CSIR-IIP for SAF Usage	4,738.45 crore	5,100	Mrs. Rashmi Soni (VP & Head of Corporate Communications)	https://www.airvistara.com/in/en
17	Indigo (passengers and cargo)	Passenger and Cargo Flight Operators	Collaboration with CSIR-IIP for SAF Usage	25,930.9 crore	26,164	Mrs. Madhulika (Sr. Manager - HR (Talent	https://www.goindigo.in/

						Engagement))	
18	Spicejet	Commercial Flight Operators	Collaboration with CSIR-IIP and Airbus for SAF Usage	7,544.5 crore	12,000	Mr. Kamal Hingorani (Chief Customer Officer)	https://www.spicejet.com/
19	Air India Express (passengers and Cargo)	Passenger and Cargo Flight Operators	Collaboration with CSIR-IIP for SAF Usage, Taxing service via robotic means saves fuel and emissions, Optimiser software to reduce fuel consumption	3,522 crore	1,900	Mrs. Meenakshi Malik (Director – Commercial) Mr. Rajeev Bajpai	https://www.airindiaexpress.com/home https://airexpresscargocarriers.com/
20	AIX Connect	Commercial Flight Operators	Collaboration with CSIR-IIP for SAF Usage, First Flight with SAF	1,402.31 crore	3,000	Mr. Pranav Sood (Chief Pilot Technical)	https://www.airindiaexpress.com/home
21	Akasa Air	Commercial Flight Operators	Flight Operations	122.22 crore	2,000	Mr. Arvind Akula (Senior Manager	https://www.akasaair.com/

						Commercial)	
22	Go First	Commercial Flight Operators	Flight Operations	4,183 crore	10,000	Mr. Abhishek Yadav (Business Developmen t Manager)	https://www.flygofirst.co m/
23	Alliance Air	Commercial Flight Operators	Flight Operations	3,012 crore	800	Mr. Yash Vardhan Singh (Dy Engineer)	https://www.allianceair.i n/book
24	SpiceXpress (Spicejet)	Cargo Carrier	Collaboration with CSIR-IIP for SAF Usage	1,943.6 crore	1000	Mr. Kamal Hingorani (Chief Officer)	https://www.spicexpress. com/
25	Blue Dart Aviation	Cargo Carrier	Signed Climate Neutral Pledge by UN for Carbon CO2 reduction	4,409 crore	6,000	Radhakrishn an Gopal (Sr. Station Manager) Carti Krish (Technical Manager)	https://www.bluedartavia tion.com/

26	DHL	Cargo Carrier	Collaboration with Neste and BP for SAF usage	8,48,184.28 crore	6,00,278	Ms. Bhumi Ms. Akansha (Head - Corporate Communications & CSR)	https://www.dhl.com/in-en/home.html?locale=true
27	Jeena & Company	Cargo Carrier	Delivery of cargo for biofuel manufacturer, Delivery of cargo for EV infrastructure	41 crore +	941	Mr. Anil Hoon Mr. Pawan Choudhary (Business Development Manager)	https://jeena.com/
28	FedEx	Cargo Carrier	Alternative fuel vehicles, including hybrid, electric, liquefied or compressed natural gas, liquefied petroleum gas, and hydrogen	76,668.88 crore	5,30,000	Mr. Ajit David Kshirsagar (Business Development Manager)	https://www.fedex.com/en-in/home.html

			fuel cell vehicles				
29	VRL Logistics Limited	Cargo Carrier	Bio-diesel and other biofuels for vehicles	2,393.65 crore	20,788	Mr. Mahendra Sagar (Business Developmen t Manager) Ramanand Bhat (CTO)	http://www.vrlgroup.in/
Aero-Engine Manufacturers							
30	GE Aerospace	Engines, components, avionics and systems for commercial, military and business & general aviation aircraft	GE Engine powered Vistara on SAF on international flight	2,13,570.4 crore	45,000	Mr. Yogesh Gupta (Director & CFO)	https://www.ge.com/in/
31	Rolls Royce India Private Limited	Engines for military, general aviation aircraft,	SAF Compatible by end of year	46,728.54 crore	17,700	Mr. Ajit Deshpande (Engineerin	https://www.rolls-royce.com/country-sites/india.aspx#/

		R&D for jet engines				g Manager, Core Turbomachiner)	
32	Pratt and Whitney	Engines and auxiliary power systems for military, business & general aviation aircraft	All engines compatible to run on 50% blended SAF with ATF, Project on Hybrid Electric Engine for Indian Airlines	1,68,054.28 crore	41,000	Mrs. Ashmita Sethi (President and Country Head)	https://www.prattwhitney.com/
33	CFM International (JV between GE and Safran Aircraft Engines)	Engines for military and general aviation aircraft	Supplying to Akasa Air LEAP Engines providing high fuel efficiency and low carbon emissions, Testing of SAF Engines	710 crore	more than 10,000	Mr. Harpreet Singh (Lead Field Services Engineer) Mr. Sreedhar G (MD)	https://www.cfmaeroengines.com/
34	Hindustan Aeronautics Limited	Repair, Overhaul,R&D,Aircraft Engines and other components	Generated Electricity via solar and wind at different airport locations,	24,620 crore	24,787	Mr. Srinivasa Murthy (Dy.General Manager at	https://hal-india.co.in/

			Biojet fuel study for aviation			Engine Division)	
35	International Aero Engines	Engines for general aviation aircraft	Engines with low CO2 emmissions and and less fuel consumption	1,283.11 crore	677	Mr. Christian Winkler (Senior Vice President)	https://links.prattwhitney.com/i-a-e/index.html
Airport Operators/Users							
36	Cochin International Airport Limited	Airport Development and Operation	Cochin	418 Crore	200	Mr.S.Suhas (MD)	https://www.cial.aero/
37	Bangalore International Airport Limited	Airport Development and Operation	Bangalore	1,648.45 crore	1,320	Mr. Satya Subramaniam (General Manager - Aviation Safety) Mrs. Gayathri Pradeep (General Manager –	https://www.bengaluruairport.com/

						Corporate Communications)	
38	Delhi International Airport Ltd.	Airport Development and Operation	Delhi	2,914 crore	1,200	Mr. Saurabh Singh (Media Relations Specialist)	https://www.newdelhiairport.in/
39	GMR Hyderabad International Airport Limited	Airport Development and Operation	Hyderabad	673 crore	717	Mr. Saurabh Singh (Media Relations Specialist)	https://www.hyderabad.aero/home.aspx
40	GMR Airports Infrastructure Limited	Airport Development and Operation	Goa (Mopa), Vishakapatnam	10,194 crores	40	Mr. Saurabh Singh (Media Relations Specialist)	https://gmrinfra.com/
41	Kannur International Airport Limited	Airport Development and Operation	Kerela	78.31 crore	100	Mr. Soni Viswanathan (Head - Commercial)	https://kannurairport.aero/

42	Adani Airport Holdings Ltd.	Airport Development and Operation	Jaipur, Mangaluru, Lucknow, Ahmedabad, Mumbai	471.98 crores	1,000	Mr. Nitin Raj Behl (Head of Business Development)	https://adaniairports.com/
43	Fluor Daniel India Private Limited (Passenger)	EPFC services for Oil & Gas; Metals and Mining and Infrastruc-ture projects	-	1,12,906.49 crores (globally)	40,000 (globally)	Mr. Subhashish Das (Director Supply Chain Management)	-
44	Phillips (Passenger)	Design, manufacture, and sale healthcare device	-	1,71,661.6 crore (glob-ally)	60,000 (globally)	Mr. Tirthankar Rakshit (Director Sales)	-
45	Bank (Private Equity Investment) (Passenger)	Investment in impact Financial Services Companies	-	820.78 crore (globally)	100 (globally)	Mr. Manas Das (General Manager Investment)	-
46	Insurance Provider (Passenger)	Sales and Service for Life Insurance	-	2,27,923.68 crore (glob-ally)	22,000 (globally)	Mr. Prashanta Mukherjee (Vice President	-

						Analytics Centre of Excellence)	
Government Authorities							
47	Airport Authority of India	Airport Operator	Chennai, Coimbatore, Tamil Nadu, Varanasi, West Bengal(Netaji), Bihar (Gaya), Surat, Vadodara, Pune (IAF), Bagdogra (IAF), Birsa, Amritsar, Bhubaneswar (Biju Patnaik), Mumbai, Jammu(IAF), Goa (Dabomin, Navy), Delhi, Bangalore	-	-	Mr. Ashok Kumar Sharma (General Manager Engineering)	https://www.aai.aero/
48	Ministry of Civil Aviation - Directorate	Regulating air transport services and for enforcement of	Implementation of CORSIA for adoption of SAF	-	-	Mr. Lalit (Director Aircraft	https://www.dgca.gov.in/digigov-portal/

	General of Civil Aviation (DGCA)	civil air regulations, air safety and airworthiness standards				Engineering)	
49	DRDO - Centre for Military Airworthiness and Certification (CEMILAC)	Airworthines certification for military aircrafts, aero-engines	Certification for airborne products light combat aircraft, avaition fuel refined by industries	-	-	Mr. APVS Prasad (Chief Executive)	https://drdo.gov.in/labs-and-establishments/centre-military-airworthiness-certification-cemilac
50	Ministry of Civil Aviation - Airport Economic Regulation Authority (AERA)	Regulates tariffs for aeronautical services, monitor performance standards at airports	Monitoring performance of all major airports in India	-	-	Mr. Ram Krishan Director (Tariff, Policy & Stat.)	https://aera.gov.in/
51	Ministry of Environment, Forest and Climate Change	Planning, promotion, co-ordination and overseeing implementation of environmental and forestry policies and programmes	Environmental Clearance for biofuel plant, Implemented National Policy on Biofuel, Promoting technology development	-	-	Dr. Rajesh Prasad Rastogi (Scientist)	https://moef.gov.in/en/

			for SAF Production				
52	Ministry of Science and Technology - Department of Biotechnology	Development and commercialisation in the field of modern biology and biotechnology	R&D on SAF, R&D on biofuels	-	-	Dr. Sanjay Kumar Mishra (Scientist)	https://dbtindia.gov.in/
53	Ministry of Petroleum & Natural Gas	Exploration and production of Oil & Natural Gas, refining, distribution and marketing, import, export and conservation of petroleum products	Blending & blending prescriptions for bio-fuels (standards for such blending), Marketing, distribution and retailing of bio-fuels and its blended products, policy/scheme for supporting manufacturing	-	-	Mr. Vivek Dhasmana (Bio-Refinery) Mr. Vinay Kumar SO (Bio-Refinery)	https://mopng.gov.in/en

			of bio-fuels, setting up of a National Bio-fuel Development Board and strengthening existing institutional mechanism and R&D and demonstration on transport application of biofuels, bio-aviation turbine fuel programme report on SAF				
54	Ministry of Petroleum & Natural Gas - Centre for High Technology (CHT)	Assess futuristic requirements, acquire, develop and adopt technologies in fields of refinery processes, petroleum products, work relating to	R&D on Synthetic Avaition Lubricants, Biofuel, hydrogen blending, Design of PEM Fuel cell	-	-	Mr Kishore Kumar (Additional Director)	https://cht.gov.in/

		modernisation of technologies	technology, R&D biofuel				
55	Ministry of New and Renewable Energy	Develop and deploy new and renewable energy, Ensuring Energy Security, Energy Affordability and Availability, R&D in Renewable Energy Technology, Policy regarding Renewable Energy and Green Hydrogen	R&D of biogas units, R&D of Solar PV, Hydel projects, tidal, wind and geothermal energy, Policies related to bioenergy and biofuels, R&D of biofuels	-	-	Mr. Aseem Kumar (Director International Relations)	https://mnre.gov.in/
56	Industrial Promotion & Investment Corporation of Odisha	Govt. of Odisha Enterprises for industrial development	SAF Pilot Project	-	-	Mr. Rajib Kumar Dhal (CGM)	https://www.ipicolorissa.com/index.php

57	Confederation of Indian Industry	Advisory and Consultative Services to partner Government and industries and working on policy issues for development of country	Study paper on biofuel policies, demand, potential, technology, regulations and financing	-	-	Mr. Pawan Kumar (Chief Executive Officer, Food Safety and Standards Authority of India)	https://www.cii.in/
58	Federation of Indian Chambers of Commerce & Industry	Policy Recommendation , Networking between stakeholders (like public sector, indian private sector and MNCs), Study Reports	Bio Energy Committee for biofuel and biogas usage, Roadmap for sustainability mobility	-	-	Mrs. Harsha Vardhan Agarwal (VP)	https://ficci.in/api/home
59	Association of Private Airport Operators	Represent interests of airport operators with objective of promoting growth and development of the privatised major airports	Represent Airports during policy affecting aviation sector, Co-operate between airport operators, fuel	-	-	Mr. Jeet Adani (Chairman) Mr. Hari Marar (MD and CEO)	https://www.apaoindia.com/

			supplier and airlines				
60	The Aeronautical Society of India	Promote advancement and diffusion of the knowledge of aeronautical sciences and aircraft engineering, R&D on aerospace science	Conducted Seminar on SAF	-	-	Dr. G. Satheesh Reddy (President) Scientific Adviser to Raksha Mantri	https://www.aerosocietyindia.co.in/
61	Business Aircraft Operators Association	Evaluate policies & regulations, Create environment for sustainable growth, Technology training, Coordination amongst industry stakeholders, regulatory authorities and the Government	Working with International Business Aviation Council on reducing carbon emissions in aviation sector	-	-	Group Captain R.K. Bali (MD)	http://baoa.in/

62	Federation of Indian Pilots	Address and handle academic, scientific, technical and issues of pilots	Journal on Sustainable Aviation by optimizing fuel efficiency	-	-	Capt. Subhashish Majumdar (VP)	https://fipindia.com/
63	Federation of Indian Petroleum Industry	Represents the industry on Government bodies, committees and task forces for policy in hydrocarbon sector	Policy recommendation on on biofuel, workshop on clean fuel for transportation	-	-	Mr. D.L.N. Sastri (Director - Oil, Refining and Marketing)	https://www.fipi.org.in/
64	Environmental Industry (Passenger)	Environmental Awareness	-	-	-	-	-
65	Praj Industries	Low Carbon Renewable Transportation Fuel, Bio-Ethanol, Renewable Natural Gas, SAF, SMF, Water Treatment	SAF Production, Marine Fuel Production, Biogas production via bio methanation technology	2,460 crore	1200	Dr.Tushar Patil (Asstt.Vice President-Corporate Strategy , Bioenergy)	https://www.praj.net/

66	Kotyark Industries Limited	Biodiesel, Crude Glycerin	Biodiesel Production plant	156.04 crore	38	Mr. Gaurang Shah (Chairman and MD) Mrs. Dhruti Shah (Director)	https://www.kotyark.com/
67	Emami Agrotech Ltd.	Bio-diesel, Edible Oil, Spices, Specialty Fats, Vanaspati	Biodiesel Production plant, Supplier of biodiesel to IOCL, BPCL, Marine Usage	18,300 crore	25,000	Mr. Ramchandra Kumar (Business Development Manager)	https://www.emamiagrotech.in/
68	PAN Oleo Energy Limited	Bio-Diesel, Ethanol, Used Cooking Oil Collector, Industrial Chemicals and Solvents	Manufacturing of SAF in near future, Low Carbon biofuel feedstock aggregation expansion project, Biodiesl production plant	100 crore	26	Mr. Thiyagu S (Plant Manager)	https://panoleoenergy.com/
69	Verbio India Private Limited (JV between IOCL and	Biodiesel, Bioethanol, BioCNG	Bio-CNG blant in india, working on biodiesel and	16,229.83 crore (Group Company)	52	Mr. Yuvraj Verma (Project Manager)	https://www.verbio.de/en/

	Verbio Vereinigte BioEnergy AG)		bioethanol plants				
70	HIF Global	E-fuels, Project Developer	E-fuels Demonstration Plant	194.16 crore	120	Mr. Ignacio Hernandez	https://hifglobal.com/
71	Infinium	E-Naptha, SAF, E-Diesel	Signed deals with ENGIE and MHI to conver CO2 to clean fuels	101.16 crore	55	Dr. James Vaughan	https://www.infiniumco.com/
Electrolyser manufacturer							
72	Ohmium India Private Ltd.	PEM Electrolysers	Electrolysers for NTPC, Amp Energy India, NovoHydrogen (USA)	Under 1 crore	250	Mr. Mahesh Hukkeri (Senior Manufacturing Operations Manager)	https://www.ohmium.com/
73	H2e Power Systems Private Ltd.	SOEC Electrolysers, E-fuels, Hybrid Systems - Fuel cell, Solar and Battery	Developing hydrogen based 3 wheeler vehicle, Green Hydrogen Production Pilot Plant,	41.03 crore (Group)	21	Mr. Aditya Shah (Assistant Manager Project Coordinator - Electrical Engineer)	https://www.h2epower.net/

74	Brise Chemicals Private Ltd.	Alkaline Water Electrolysers, Industrial Oxygen Generator, Hydrogen Generation Plants, Nitrogen Generators and other industrial equipment plants	Cryogenic Air Separation EPC plant process, Air Separation process equipment Designs, Manufacturing and Adsorption technology-based gas plants for industrial and medical applications, Projects for BPCL and Inidian Railways	Under 1 crore	26-50	Mr. Dilip Wade (Technical Consultant - Electrical Engineer)	https://www.brisechemicals.com/
75	John Cockerill India Ltd.	Solar,Thermal, Nuclear, Wind,Hydro, Hydrogen, Water treament,	Electrolysers supplied to Greenko for Ammonia Production	93,09,740.69 crore (Group)	6,500	Mr. Dilip Kumar singh (GM-Projects)	https://johncockerillindia.com/Home.aspx
76	HIF Global	E-fuels, Project Developer	Technology Provider for SAF	194.16 crore	120	Mr. Ignacio Hernandez	https://hifglobal.com/

77	Infinium	E-Naptha, SAF, E-Diesel	Technology Provider for SAF	101.16 crore	55	Dr. James Vaughan	https://www.infiniumco.com/
Carbon Capture Technology Providers							
78	LanzaTech	Carbon Recycling Technology	Bagasse to Ethanol project in India, Collaborate with IOCL for Gas to Ethanol Plant	306 crore	204	Mr. Swadhin Banerjee (Director Business Development)	https://lanzatech.com/
79	Axens India	Oil Refining, Renewable Fuels, Water Treatment, Carbon Capture, Low Carbon Hydrogen	SAF Production by collaboration with Praj industries, Hydrogen Production, Carbon Capture Projects	819.64 crore	1,193 (global)	Mr. Aravind Kumar (Technology Engineer, Diesel and Co-processing)	https://www.axens.net/our-locations/asia-oceania/axens-india
80	Carbon Clean	CO2 capture, CO2 industrial capture & utilisation and RNG upgrading / biogas	Industrial scale carbon capture in Chemical and Fertiliser Plant in Chennai,	260.64 crore	42	Mr. Niraj Singh (Business Development Manager)	https://www.carbonclean.com/

			Collaborated with Veolia for carbon capture and biofuels in India				
81	Linde Engineering India Pvt. Ltd.	Hydrogen & Syngas, Gas Processing Plants, Ethylene Plants, Polypropylene & Polyethylene Plants, Pressure Swing Adsorption Plants, CO Purification and Liquefaction Plants, NG Liquefaction and Regas	CO2 Capture in Chemical Plants, Refineries, Hydrogen Production, Fossil fuel power plants and industries like iron, steel and cement	2,73,760.42 crore (Group)	1,200	Mr. Kamlesh Desai (Business Development Head)	https://www.linde-engineering.in/en/index.html
82	HIF Global	E-fuels, Project Developer	Technology Provider for SAF	194.16 crore	120	Mr. Ignacio Hernandez	https://hifglobal.com/
83	Infinium	E-Naptha, SAF, E-Diesel	Technology Provider for SAF	101.16 crore	55	Dr. James Vaughan	https://www.infiniumco.com/

Bankers/Lenders							
84	SBI Capital Markets	Retail banking, Small and Medium Enterprises (SMEs) Banking, wealth management services, corporate banking, general insurance, life insurance, merchant banking, mutual funds, securities trading, and primary dealership	Green Bonds and Green Loans for Renewable Energy Projects	60,35,342 crore (Group)	2,35,858 (Group)	Mrs. Anita Karnik (VP-SBI Capital Markets) Climate & Renewables Finance Practitioner	https://www.sbicaps.com/
85	Small Industries Development Bank of India	Principal Financial Institution for Promotion,Financing and Development of the Micro, Small and Medium	Green Finance Scheme and Energy Finance Scheme including Renewable Energy, Clean Fuel Adoption	18,484 crore	1,037	Mr. Gautam Kumar (Green Climate & Sustainable Finance)	https://www.sidbi.in/en

		Enterprise (MSME) sector					
86	IREDA	Promoting, developing and extending financial assistance for setting up projects relating to new and renewable sources of energy and energy efficiency/conservation	Bioethanol and Biodiesel financing scheme, Renewable Energy Project Financing	3,481 crore	158	Mrs. Poorva Mathur (Senior Manager - New and Emerging Technologies)	https://www.ireda.in/home#images-1
Renewable Energy Developers							
87	ReNew	Wind, Solar Power and Hydro	Wind Project in Gujarat, Solar Manufacturing Plant (Jaipur), Round the Clock Power Projects	78,22.3 crore	2,300	Mr. Suresh Deivaraja (Project Development Manager)	https://renewpower.in/

88	Adani Green Energy Ltd.	Solar, Wind and Hybrid Power	Have 54 operational renewable energy projects in 12 states	2473 crore	1,569	Mr. Mahendra Singh Dabi (Associate Project Manager)	https://www.adanigreenenergy.com/
89	Greenko Group	Develop and Engineer Solar, Wind & Hydro	Wind , Solar and Hydro Projects in Madhya Pradesh and Karnataka	5,930.78 crore	2,597	Rajesh Kumar (Renewable Energy Manager)	https://greenkogroup.com/
90	SembCorp Industries Limited	Wind and Solar Power, thermal power plants	Developed and operates thermal power plants in Andhra Pradesh, Wind and Solar Power Plants in Karanataka, Tamil Nadu, Gujarat, Rajasthan and Madhya Pradesh	7,689.1 crore	4,981	Kanwaljit Singh Rathore (Manager - Buisness developmen t)	https://www.sembcorp.com/en/

91	Avaada Energy Private Limited	Renewable Energy, Solar Module manufacturers, Electrolyser Manufacturing, Green Ammonia and Methanol Production	Solar & Wind Energy, Pumped Storage Hydro, SAF production, Green Ammonia Production	4,839.74 crore	516	Mr. Nikhil Mathew (Deputy Manager - Green hydrogen) Ms. Paridhi Khetan (Senior GM) Mr. Samank Singh (Senior Manager - Strategy)	https://avaada.com/
92	ACME	Solar Power, Solar Thermal Power, Green Hydrogen and Green Ammonia Production	Green Hydrogen and Green Ammonia Pilot Project in Rajasthan, Solar Projects in multiple states	380 crore	1,700	Mr. Ajay Singh (Dy. General Manager - Oil & Gas , Green Hydrogen & Green Ammonia) Mr. Shishir Singh	https://www.acme.in/

						(Sr Manager - Projects)	
93	L&T	Engineering, construction, manufacturing, technology, information technology and financial services in Power, Hydrocarbon, Defence Sectors	Green Hydrogen Facility in Gujarat	1,01,000 crore	50,000	Mr. Priteshkumar Patel (Manager - Green Hydrogen - Strategy & Business Development)	https://www.larsentoubro.com/
94	IOCL	LPG, LNP, Naptha, Motor Spirit, Aviation Turbine Fuel, High Speed Diesel, furnace oil, Marpol FO & bitumen, Petrochemicals, Renewable Energy (solar and wind), Biogas,	RLNG Pipeline, Refineries, Biodiesel production from used cooking oil, Ethanol Plant, Wind & Solar Power Plant, Crude Oil Pipeline	9,34,952.66 crore	31,254	Mr Atul Parmar General Manager (Alternate Energy) Mr Santanu Gupta Executive	https://iocl.com/

		Biodiesel, EV charging, explosives, cryogenics and fertiliser				Director (Alternate Energy and Sustainable Development)	
95	Adani New Industries Limited	Solar Module and Cell manufacturing	Wind nacelle facility and blade manufacturing in 2024	69,420.18 crore	1100	Mayukh Sinha General Manager and Head Strategy & BD - Petrochemicals	https://www.adanienterprises.com/
96	RIL	LPG, Motor Spirit, High Speed Diesel, SKO, ATF, Sulphur, Coke, Propane, Naptha, Kerosene	Refinery, Renewable Energy Projects, Exploration and Production of oil and gas	4,66,425 crore	22,642	Mrs. Nidhi Singh (Product Manager - Technology & Solutions -Hydrogen)	https://www.ril.com/
97	HIF Global	E-fuels, Project Developer	Technology Provider for SAF	194.16 crore	120	Mr. Ignacio Hernandez	https://hifglobal.com/

98	Infinium	E-Naptha, SAF, E-Diesel	Technology Provider for SAF	101.16 crore	55	Dr. James Vaughan	https://www.infiniumco.com/

Annexure 2 – SMF India Database

S. No.	Stakeholder Name	Product and service offering	Projects	Turnover	No. of Employees	Contact Person	Organisation's Website
Fuel Producers/Suppliers							
1.	Indian Oil Corp. Ltd.	LPG, LNP, Naptha, Motor Spirit, Aviation Turbine Fuel, High Speed Diesel, furnace oil, Marpol FO & bitumen, Petrochemicals, Renewable Energy (solar and wind), Biogas, Biodiesel, EV charging, explosives, cryogenics and fertiliser	RLNG Pipeline, Refineries, Biodiesel production from used cooking oil, Ethanol Plant, Wind & Solar Power Plant, Crude Oil Pipeline	9,34,952.66 crore	31,254	Mr Atul Parmar General Manager (Alternate Energy) Mr Santanu Gupta Executive Director (Alternate Energy and Sustainable Development)	https://iocl.com/

2.	Bharat Petroleum Corp. Ltd.	Petrol, Diesel,CNG, Gas, Lubricants, LPG, Naptha, Kerosene, ATF, Petcoke, Furnace Oil and Bitumen	Refinery - Naptha to Gasoline , Product Pipeline, 2G Ethanol Refinery, LPG Cryogenic Augmentation, Retail infrastructure, LPG Pipeline	4,33,406.48 crore	9,000	Mr. Abhijeet Dutta Dr. Vivek Rathore (Dy General Manager (R&D))	http://www.bharatpetroleum.in/
3.	Mangalore Refinery and Petrochemicals Ltd.	Naphtha, LPG, Motor Spirit, High-Speed Diesel, Kerosene, Aviation Turbine Fuel, Sulphur, Xylene, Bitumen, Pet Coke and Polypropylene	2G Ethanol Project, Enhancement of Grid Connectivity and Refinery System Upgradation, Petrochemical Fluidized Catalytic Cracking Flue Gas Wet Scrubber System	1,24,736 crore	2,100	Mr. Rudolph V.J. Noronha Mr. Ganesh (General Manager (Operations))	https://www.mrpl.co.in/

4.	Hindustan Petroleum Corp. Ltd.	Asphalt, Diesel, Kerosene, LPG, Lube Oils, Petrols, ATF, Power, Turbojet, Naptha, crude oil refining	Ethanol Plant, Biodiesel Plant, LPG Pipeline, Refineries, Wind and Solar Project	4,64,683 crore	9,065	Mr. Manish Kumar Sinha (Operations Officer)	https://www.hindustanpetroleum.com/
5.	Adani Bunkering Private Limited	Bunkering Services and Supplier, Marine Fuel supplier	Projects of Bunkering in many ports around the world	-	More than 5000	Mr. Rishi Srivastava (DGM)	https://www.adanibunkering.com/
6.	Bharat Oman Refinery Ltd. (JV between BPCL and Oman Oil Company)	LPG, Motor Spirit, High Speed Diesel, SKO, ATF, Naptha, Sulphur, Petcoke, Fly ash	Refinery	45,000 crores	600	Mr. Ravi Mr. Hardeep Singh DGM (Tech Services)	https://www.bharatpetroleum.in/Bharat-Petroleum-For/Refineries/Bina-Refinery.aspx
7.	Mangalore Refinery and Petrochemicals Ltd.	Naphtha, LPG, Motor Spirit, High-Speed Diesel, Kerosene, Aviation Turbine Fuel, Sulphur, Xylene, Bitumen,	2G Ethanol Project, Enhancement of Grid Connectivity and Refinery System	1,24,736 crore	2,100	Mr. Rudolph V.J. Noronha Mr. Ganesh (General Manager Operations)	https://www.mrpl.co.in/

		Pet Coke and Polypropylene	Upgradation, Petrochemical Fluidized Catalytic Cracking Flue Gas Wet Scrubber System				
8.	HPCL Mittal Energy Limited (JV between HPCL and Mittal Energy Investments Pte. Ltd.)	LPG, Naptha, SKO, ATF, Petcoke, Bitumen, Sulphur, HSD, MTO	Refineries, Crude Oil Pipelines	89,551.2 crore	1,928	Mr. Sudhir Soni (Head Regional Manager)	https://www.hmel.in/
9.	Nayara Energy Limited	HSD, Light Disesel Oil, MTO, Low Sulphur Heavy Stock, Bitumen, Petcoke, Sulphur, Fly Ash	Polypropylene Plant, Refinery	1,19,689.4 crore	3,300	Mr. Dipesh Modi (General Manager Operations)	https://www.nayaraenergy.com/
10.	Chennai Petroleum Corporation Limited	LPG, Naptha, Kerosense, ATF, HSD, High Flash Diesel, Lubes,	RLNG in Hydrogen Generation Units	90,908 crore	1,300	Mr, V.Srikanth (CGM - Technical) Mr. S.Sadagopan (CGM -	https://cpcl.co.in/

						Logistics and Projects)	
11.	Numaligarh Refineries Ltd.	LPG, Naphtha, Motor Spirit (MS), Aviation Turbine Fuel (ATF) Superior Kerosene Oil (SKO) High Speed Diesel (HSD), Raw Petroleum Coke (RPC) Calcined Petroleum Coke (CPC), Sulphur, Wax, Nitrogen, Mineral Turpentine Oil (MTO), Special Boiling Point Spirit (SBPS) and Liquid Sulphur	Refinery Expansion, Setting up Crude Oil Import Terminal, Laying pipeline for oil transportation	29,785 crore	985	Mr. Tusharjit Malakar (Senior Manager) Mrs. Madhuchanda Adhikari	https://www.nrl.co.in/
12.	RIL	LPG, Motor Spirit, High Speed Diesel, SKO, ATF, Sulphur, Coke, Propane, Naptha, Kerosene	Refinery, Renewable Energy Projects, Exploration and	4,66,425 crore	22,642	Mrs. Nidhi Singh (Product Manager - Technology & Solutions Hydrogen)	https://www.ril.com/

			Production of oil and gas				
13.	Council Of Scientific And Industrial Research–Indian Institute Of Petroleum (CSIR - IIP)	R & D in Petroleum Refining, Catalytic Refining and Catalysis, Evaluation and characterization of Lubrication Oil	Development and Testing of Bio-Jet Fuel for IAF, Biofuel production from Palm stearin	451.12 crore	341	Mr. Jayati Trivedi (Senior Scientist) Mr. Anil Kumar Sinha (Senior Principal Scientist)	https://www.iip.res.in/
14.	The Energy and Resources Institute (TERI)	Research, Policy, Consultancy and Implementation in Energy, Agriculture, Climate and Environment Sectors including Biofuels	Advanced Biofuel Program, Study on biofuels for transportation, Pyrolysis Method for Biofuel Production, National Centre of Excellence in Green Port and Shipping	128.59 crore	1,250	Dr. Piyali (Senior Fellow (Scientist) and Area Convenor – Biofuels and Green Shipping)	https://www.teriin.org/

Sea Port Operators/Users							
15.	Deendayal Port Trust	Operation of Port, Handling of cargo vessels and other shipping vessels	Installation of wind power projects,	1,971.92 crore	1,853	Capt. Pradeep Mohanty (Dy. Conservator)	https://www.deendayalport.gov.in/en/
16.	Paradip Port Trust	Operation of Port, Handling of cargo vessels and other shipping vessels	Various schemes under the Green Port initiative programme, Installation of 10 MW Solar Power Plant	1,732.32 crore	558	Capt. Alekha Charan sahoo (Dy. Conservator)	https://paradipport.gov.in/
17.	Jawaharlal Nehru Port Trust	Operation of Port, Handling of cargo vessels and other shipping vessels	Proposed project on electrification via solar power, Electricity	2,186.6 crore	862	Capt. Bala Saheb V.pawar (Dy. Conservator)	https://www.jnport.gov.in/

			generated via renewable energy, setting floating solar plant				
18.	Visakhapatnam Port Trust	Operation of Port, Handling of cargo vessels and other shipping vessels	Design, Engineering, Manufacture, procurement & supply, Erection, Testing, Commissioning and Comprehensive, Operation & Maintenance for 10 MW Solar PV Plant	1,525.9 crore	2,758	Capt. T. Srinivas (Dy. Conservator)	https://www.vizagport.com/
19.	Mumbai Port Trust	Operation of Port, Handling of cargo vessels and other shipping vessels	Construction of Offshore container berth and container	1,896.9 crore	4,583	Capt. Bhabatosh Chand (Dy. Conservator)	https://mumbaiport.gov.in/

			terminal, Construction of Liquid Chemical Berth				
20.	Syama Prasad Mookerjee Port Trust	Operation of Port, Handling of cargo vessels and other shipping vessels	1MW Solar Plant at Port, Grid connecetd solar plant	2624.53 crore	2,836	Mr. Gautam Mandal (Chief Engineer)	https://smportkolkata.shipping.gov.in/
21.	Chennai Port Trust	Operation of Port, Handling of cargo vessels and other shipping vessels	Setting up of Sewage Waste Water Treatment Plants, Construction of Bunker Berth, Setting up of solar plant	833.76 crore	3442	Capt. Milton Asir (Dy. Conservator)	https://www.chennaiport.gov.in/
22.	New Mangaluru Port Trust	Operation of Port, Handling of cargo vessels and other shipping vessels	Solar Power Projects, Construction of berths, Supply and installation of solar street lights	644.86 crore	417	Capt. S.R. Pattanayak (Dy. Conservator)	https://newmangaloreport.gov.in/

23.	V. O. Chidambaranar Port Trust	Operation of Port, Handling of cargo vessels and other shipping vessels	Development of Berths, Supply, installation commissioning and maintenance of 150KW direct grid connect type roof top solar power plant, Grid connected Solar power plant	596.81 crore	542	Capt. Pravin Kumar Singh (Dy. Conservator)	https://www.vocport.gov.in/Default.aspx
24.	Cochin Port Trust	Operation of Port, Handling of cargo vessels and other shipping vessels	Rooftop and ground mounted solar, Developing Additional Infrastructure for New Cochin Port Cruise Terminal, Upgradation of power	715.8 crore	568	Capt. Joseph J. Alapat (Dy. Conservator)	https://www.cochinport.gov.in/cpt

			supply distribution				
25.	Kamarajar Port Limited	Operation of Port, Handling of cargo vessels and other shipping vessels	Modification of Iron Ore Terminal, Construction of berths, Setting up of Ground Mounted Solar Power Plant	832.62 crore	94	Mr. Sanjay Kumar General Manager (CS&BD)	https://www.ennoreport.gov.in/content/
26.	Mormugao Port Trust	Operation of Port, Handling of cargo vessels and other shipping vessels	Roof Top Solar System installed at Port Hospital	433.38 crore	1283	Capt. Manoj Joshi (Dy. Conservator)	https://mptgoa.gov.in/
27.	Gujarat Pipavav Port Ltd	Handling and storage of containers, liquid and dry cargo, Harbour Tug	Green procurement to reduce greenhouse gas emissions, Rooftop Solar Plant, Green Belt Development	743.5 crore	482	Capt. Ajay Kumar (Harbour Master) Sumantakumar Biswal (General Manager, Operations – Bulk, Liquid & RoRo)	https://www.apmterminals.com/en/pipavav

Marine Line (Shipping Companies/Operators)							
28.	The Shipping Corporation Of India Ltd	Tanker Owner, Bulk Carrier, Container Services, Offshore Marine Logistics, Passenger and Cargo Transportation Services, Shipbuilding	Petronet LNG project, Green Hydrogen vessels (2027), Green Ammonia Bunkers (2035)	1,469.14 crore	554	Mr. Naveen Kumar DGM (Stores, Bunkers & Services)	https://www.shipindia.com/
29.	Essar Shipping	Owning & operating marine assets, Bulk carriers and tankers, owns fleet of land and offshore rigs, Oil & gas drilling business	Upgradation and Modernization of fleet and logistics operations, Provide renewable energy product or services and improving energy efficiency	137.87 crore	10	Capt Rahul Bhargava (Head, Chartering & Operations)	https://www.essar.com/

30.	The Great Eastern Shipping Company	Dry Bulk Carriers, Crude Oil Carriers, LPG carriers, Shipping Logistics	Biofuel blending trial, High performance pain & LED Lightning for ships, Solar panel installation	4,850 crores	250	Mr. Sanatani (DGM)	https://www.greatship.com/
31.	Trans Asia Shipping Services Pvt Ltd	Ship owners, Plantations, Container Leasing, Logistics and coastal service	Rental of Containers, Liner Shipping Services in Gulf and Asian countries, Coastal services across multiple cities in India	836.85 crore	116	Mr. Peter Fernandez Regional Head (Indian Subcontinent – South East) Mr. Raveen Mathachan- Regional Head (North & North West of India and Pakistan)	https://tassgroup.com/
32.	San Marine	Offshore Support, Naval Logistics, Ship building and fabrication, Bunker Supplies	Multiple Offshore Support Projects, Multiple Naval	128.86 crore	more than 25	Mr. Aslam San (Business Development Manager)	https://sanmarine.in/

			Logistics Projects,				
33.	Global Marine Services	Ship Chandler, Ship Repairer, Marine Fuel and Lubricant Supplier	Storing Engine spare parts, chemicals, paints, Lubricants	128 crore	40	Mr. Jatin (Managing Partner)	https://globalmarineindia.in/
34.	Mazagon Dock Shipbuilders Limited	Warships and Submarine building, repair and retrofit	Destroyers, Submarines and Corvettes for Indian Navy	5,733.28 crore	3343	Mr. Sanjay Kumar (General Manager(CP))	https://www.mazagondock.in/
35.	Bharathi Defence and Infra Limited	Shipbuilding and Fabrication Facilities	Construction of Defense Vessels, Interceptor Boats, Offshore Vessels, Anchor Handling Tug Supply vessels	2.16 crore	430	Mr. Amit Desai (Assistant Manager)	https://bdil.co.in/
36.	Cochin Shipyard Ltd	Ship Building, Ship Repairer,	Grid Connected Solar Power	3,190.00 crore	1756	Mr. Sivaram N (BD)	https://cochinshipyard.in/

		Marine Engineering	Plant, Biogas plant, Built aircraft carrier				
37.	Global Offshore Services Ltd.	Ship Building, Oil & Gas Exploration Vessels, cargo delivery, anchor handling, Towing of rigs	Building of Platform Supply Vessels, Anchor Handling Tug cum Supply Vessel in various countries	47.35 crore	29	Mr. B. P. Tripathy (President - Technical)	https://www.globaloffshore.in/index.php
38.	Merchant Navy (Passenger)	Cargo Transportation	-	-	-	Mr. Raja Bhattacharjee (Merchant Navy Officer)	-

Government Authorities							
39.	Directorate General of Shipping	Implementation of shipping policy and legislation, Development of coastal shipping, augmentation of shipping tonnage, examination and certification of Merchant Navy Officers	Seminar on Green & Sustainable Shipping, Green Shipping project with collaboration with TERI and some ports of India	-	-	Mr. Ajithkumar Sukumaran (Chief Surveyor)	https://www.dgshipping.gov.in/index.aspx
40.	Ministry of Ports, Shipping and Waterways	Shipbuilding and Ship-repair, Major Ports, National Waterways, and Inland Water Transport, Policy drafting	Implementing Green Shipping initiative by increasing renewable energy by 60% at ports, Initiation of use of alternate fuels like LNG/CNG, Storage and	-	-	Mr. Anil Pruthi (Director - Engineering)	https://shipmin.gov.in/

			bunkering facilities for environment friendly fuels like LNG, CNG, Hydrogen, Ammonia, Renewable sources of energy including Solar Power, Wind Power, Tidal power at Ports				
41.	Ministry of Environment, Forest and Climate Change	Planning, promotion, co-ordination and overseeing implementation of environmental and forestry policies and programmes	Environmental Clearance for biofuel plant, Implemented National Policy on Biofuel, Promoting technology development for SAF Production	-	-	Dr. Rajesh Prasad Rastogi (Scientist)	https://moef.gov.in/en/

42.	Ministry of Science and Technology - Department of Biotechnology	Development and commercialisation in the field of modern biology and biotechnology	R&D on SAF, R&D on biofuels	-	-	Dr. Sanjay Kumar Mishra (Scientist)	https://dbtindia.gov.in/
43.	Ministry of Petroleum & Natural Gas	Exploration and production of Oil & Natural Gas, refining, distribution and marketing, import, export and conservation of petroleum products	Blending & blending prescriptions for bio-fuels (standards for such blending), Marketing, distribution and retailing of bio-fuels and its blended products, policy/scheme for supporting manufacturing of bio-fuels, setting up of a National	-	-	Mr. Vivek Dhasmana (Bio-Refinery) Mr. Vinay Kumar SO (Bio-Refinery)	https://mopng.gov.in/en

			Bio-fuel Development Board and strengthening existing institutional mechanism and R&D and demonstration on transport application of biofuels, bio-aviation turbine fuel programme report on SAF				
44.	Ministry of Petroleum & Natural Gas - Centre for High Technology (CHT)	Assess futuristic requirements, acquire, develop and adopt technologies in fields of refinery processes, petroleum products, work relating to	R&D on Synthetic Avaition Lubricants, Biofuel, hydrogen blending, Design of PEM Fuel cell	-	-	Mr Kishore Kumar (Additional Director)	https://cht.gov.in/

		modernisation of technologies	technology, R&D biofuel				
45.	Ministry of New and Renewable Energy	Develop and Deploy new and renewable energy , Ensuring Energy Security, Energy Affordability and Availability, R&D in Renewable Energy Technology, Policy regarding Renewable Energy	R&D of biogas units, R&D of Solar PV, Hydel projects, tidal, wind and geothermal energy, Policies related to bioenergy and biofuels, R&D of biofuels	-	-	Mr. Aseem Kumar (Director International Relations)	https://mnre.gov.in/

Industry Bodies/Associations							
46.	Confederation of Indian Industry	Advisory and Consultative Services to partner Government and industries and working on policy issues for development of country	Study paper on biofuel policies, demand, potential, technology, regulations and financing	-	-	Mr. Pawan Kumar (Chief Executive Officer, Food Safety and Standards Authority of India)	https://www.cii.in/
47.	Federation of Indian Chambers of Commerce & Industry	Policy Recommendation , Networking between stakeholders (like public sector, indian private sector and MNCs), Study Reports	Bio Energy Committee for biofuel and biogas usage, Roadmap for sustainabilit y mobility	-	-	Mrs. Harsha Vardhan Agarwal (VP)	https://ficci.in/api/home
48.	Federation of Indian Petroleum Industry	Represents the industry on Government bodies, committees and task forces for policy in	Policy recommenda tion on biofuel, workshop on clean fuel for transportati on	-	-	Mr. D.L.N. Sastri (Director - Oil, Refining and Marketing)	https://www.fipi.org.in/

		hydrocarbon sector					
49.	Indian Ports Association	Growth and development of all Major Ports, Bulk Handling, Cargo Handling and Storage	Green Port Policy Implementation (solar, wind and rain water harvesting), Webinars on Green Port Projects, Ports running on Solar or Wind	-	-	Mr. Mrinal Srikar (Senior Consultant)	https://www.ipa.nic.in/
Biofuel/SMF Manufacturers							
50.	Praj Industries	Low Carbon Renewable Transportation Fuel, Bio-Ethanol, Renewable Natural Gas, SAF,	SAF Production, Marine Fuel Production, Biogas production via bio	2,460 crore	1200	Dr.Tushar Patil (Asstt.Vice President-Corporate Strategy , Bioenergy)	https://www.praj.net/

		SMF, Water Treatment	methanation technology				
51.	Kotyark Industries Limited	Biodiesel, Crude Glycerin	Biodiesel Production plant	156.04 crore	38	Mr. Gaurang Shah (Chairman and MD) Mrs. Dhruti Shah (Director)	https://www.kotyark.com/
52.	Emami Agrotech Ltd.	Bio-diesel, Edible Oil, Spices, Specialty Fats, Vanaspati	Biodiesel Production plant, Supplier of biodiesel to IOCL, BPCL, Marine Usage	18,300 crore	25,000	Mr. Ramchandra Kumar (Business Development Manager)	https://www.emamiagrotech.in/
53.	PAN Oleo Energy Limited	Bio-Diesel, Ethanol, Used Cooking Oil Collector, Industrial Chemicals and Solvents	Manufacturing of SAF in near future, Low Carbon biofuel feedstock aggregation expansion	100 crore	26	Mr. Thiyagu S (Plant Manager)	https://panoleoenergy.com/

			project, Biodiesl production plant				
54.	Verbio India Private Limited (JV between IOCL and Verbio Vereinigte BioEnergy AG)	Biodiesel, Bioethanol, BioCNG	Bio-CNG blant in india, working on biodiesel and bioethanol plants	16,229.83 crore (Group Company)	52	Mr. Yuvraj Verma (Project Manager)	https://www.verbio.de/en/
55.	Infinium	E-Naptha, SAF, E-Diesel	Signed deals with ENGIE and MHI to conver CO2 to clean fuels	101.16 crore	55	Dr. James Vaughan	https://www.infiniumco.com/
Electrolyser Manufacturers							
56.	Ohmium India Private Ltd.	PEM Electrolysers	Electrolysers for NTPC, Amp Energy India, NovoHydrogen (USA)	Under 1 crore	250	Mr. Mahesh Hukkeri (Senior Manufacturing Operations Manager)	https://www.ohmium.com/

57.	H2e Power Systems Private Ltd.	SOEC Electrolysers, E-fuels, Hybrid Systems - Fuel cell, Solar and Battery	Developing hydrogen based 3 wheeler vehicle, Green Hydrogen Production Pilot Plant,	41.03 crore (Group)	21	Mr. Aditya Shah (Assistant Manager Project Coordinator - Electrical Engineer)	https://www.h2epower.net/
58.	Brise Chemicals Private Ltd.	Alkaline Water Electrolysers, Industrial Oxygen Generator, Hydrogen Generation Plants, Nitrogen Generators and other industrial equipment plants	Cryogenic Air Separation EPC plant process, Air Separation process equipment Designs, Manufacturing and Adsorption technology-based gas plants for industrial and medical applications, Projects for BPCL and	Under 1 crore	26-50	Mr. Dilip Wade (Technical Consultant - Electrical Engineer)	https://www.brisechemicals.com/

			Inidian Railways				
59.	John Cockerill India Ltd.	Solar,Thermal, Nuclear, Wind,Hydro, Hydrogen, Water treament,	Electrolysers supplied to Greenko for Ammonia Production	93,09,740.69 crore (Group)	6,500	Mr. Dilip Kumar singh (GM-Projects)	https://johncockerillindia.com/Home.aspx
60.	Infinium	E-Naptha, SAF, E-Diesel, Technology Provider	Technology Provider for SMF	101.16 crore	55	Dr. James Vaughan	https://www.infiniumco.com/
Carbon Capture Technology Providers							
61.	LanzaTech	Carbon Recycling Technology	Bagasse to Ethanol project in India, Collaborate with IOCL for Gas to	306 crore	204	Mr. Swadhin Banerjee (Director Business Development)	https://lanzatech.com/

			Ethanol Plant				
62.	Axens India	Oil Refining, Renewable Fuels, Water Treatment, Carbon Capture, Low Carbon Hydrogen	SAF Production by collaboration with Praj industries, Hydrogen Production, Carbon Capture Projects	819.64 crore	1,193 (global)	Mr. Aravind Kumar (Technology Engineer, Diesel and Co-processing)	https://www.axens.net/our-locations/asia-oceania/axens-india
63.	Carbon Clean	CO2 capture, CO2 industrial capture & utilisation and RNG upgrading / biogas	Industrial scale carbon capture in Chemical and Fertilizer Plant in Chennai, Collaborated with Veolia for carbon capture and biofuels in India	260.64 crore	42	Mr. Niraj Singh (Business Development Manager)	https://www.carbonclean.com/

64.	Linde Engineering India Pvt. Ltd.	Hydrogen & Syngas, Gas Processing Plants, Ethylene Plants, Polypropylene & Polyethylene Plants, Pressure Swing Adsorption Plants, CO Purification and Liquefaction Plants, NG Liquefaction and Regas	CO2 Capture in Chemical Plants, Refineries, Hydrogen Production, Fossil fuel power plants and industries like iron, steel and cement	2,73,760.42 crore (Group)	1,200	Mr. Kamlesh Desai (Business Development Head)	https://www.linde-engineering.in/en/index.html
65.	Infinium	E-Naptha, SAF, E-Diesel, Technology Provider	Technology Provider for SMF	101.16 crore	55	Dr. James Vaughan	https://www.infiniumco.com/

Bankers/Lenders							
66.	SBI Capital Markets	Retail banking, Small and Medium Enterprises (SMEs) Banking, wealth management services, corporate banking, general insurance, life insurance, merchant banking, mutual funds, securities trading, and primary dealership	Green Bonds and Green Loans for Renewable Energy Projects	60,35,342 crore (Group)	2,35,858 (Group)	Mrs. Anita Karnik (VP-SBI Capital Markets) Climate & Renewables Finance Practitioner	https://www.sbicaps.com/
67.	Small Industries Development Bank of India	Principal Financial Institution for Promotion,Financing and Development of the Micro, Small and Medium	Green Finance Scheme and Energy Finance Scheme including Renewable Energy,	18,484 crore	1,037	Mr. Gautam Kumar (Green Climate & Sustainable Finance)	https://www.sidbi.in/en

		Enterprise (MSME) secto	Clean Fuel Adoption				
68.	IREDA	Promoting, developing and extending financial assistance for setting up projects relating to new and renewable sources of energy and energy efficiency/conservation	Bioethanol and Biodiesel financing scheme, Renewable Energy Project Financing	3,481 crore	158	Mrs. Poorva Mathur (Senior Manager - New and Emerging Technologies)	https://www.ireda.in/home#images-1
Renewable Energy Developers							
69.	ReNew	Wind, Solar Power and Hydro	Wind Project in Gujarat, Solar Manufacturing Plant (Jaipur), Round the	78,22.3 crore	2,300	Mr. Suresh Deivaraja (Project Development Manger)	https://renewpower.in/

			Clock Power Projects				
70.	Adani Green Energy Ltd.	Solar, Wind and Hybrid Power	Have 54 operational renewable energy projects in 12 states	2473 crore	1,569	Mr. Mahendra Singh Dabi (Associate Project Manager)	https://www.adanigreenenergy.com/
71.	Greenko Group	Develop and Engineer Solar, Wind & Hydro	Wind , Solar and Hydro Projects in Madhya Pradesh and Karnataka	5,930.78 crore	2,597	Rajesh Kumar (Renewable Energy Manager)	https://greenkogroup.com/
72.	SembCorp Industries Limited	Wind and Solar Power, thermal power plants	Developed and operates thermal power plants in Andhra Pradesh, Wind and Solar Power Plants in Karanataka, Tamil Nadu, Gujarat,	7,689.1 crore	4,981	Kanwaljit Singh Rathore (Manager - Buisness development)	https://www.sembcorp.com/en/

			Rajasthan and Madhya Pradesh				
73.	Avaada Energy Private Limited	Renewable Energy, Solar Module manufacturers, Electrolyser Manufacturing, Green Ammonia and Methanol Production	Solar & Wind Energy, Pumped Storage Hydro, SAF production, Green Ammonia Production	4,839.74 crore	516	Mr. Nikhil Mathew (Deputy Manager - Green hydrogen) Ms. Paridhi Khetan (Senior GM) Mr. Samank Singh (Senior Manager - Strategy)	https://avaada.com/

74.	ACME	Solar Power, Solar Thermal Power, Green Hydrogen and Green Ammonia Production	Green Hydrogen and Green Ammonia Pilot Project in Rajasthan, Solar Projects in multiple states	380 crore	1,700	Mr. Ajay Singh (Dy. General Manager - Oil & Gas , Green Hydrogen & Green Ammonia) Mr. Shishir Singh (Sr Manager - Projects)	https://www.acme.in/
Hydrogen Production Companies							
75.	L&T	Engineering, construction, manufacturing, technology, information technology and financial services in Power, Hydrocarbon, Defence Sectors	Green Hydrogen Facility in Gujarat	1,01,000 crore	50,000	Mr. Priteshkumar Patel (Manager - Green Hydrogen - Strategy & Business Development)	https://www.larsentoubro.com/

76.	IOCL	LPG, LNP, Naptha, Motor Spirit, Aviation Turbine Fuel, High Speed Diesel, furnace oil, Marpol FO & bitumen, Petrochemicals, Renewable Energy (solar and wind), Biogas, Biodiesel, EV charging, explosives, cryogenics and fertiliser	RLNG Pipeline, Refineries, Biodiesel production from used cooking oil, Ethanol Plant, Wind & Solar Power Plant, Crude Oil Pipeline	9,34,952.66 crore	31,254	Mr Atul Parmar General Manager (Alternate Energy) Mr Santanu Gupta Executive Director (Alternate Energy and Sustainable Development)	https://iocl.com/
77.	Adani New Industries Limited	Solar Module and Cell manufacturing	Wind nacelle facility and blade manufacturing in 2024	69,420.18 crore	1100	Mayukh Sinha General Manager and Head Strategy & BD - Petrochemicals	https://www.adanienterprises.com/
78.	RIL	LPG, Motor Spirit, High Speed Diesel, SKO, ATF, Sulphur, Coke, Propane, Naptha, Kerosene	Refinery, Renewable Energy Projects, Exploration and	4,66,425 crore	22,642	Mrs. Nidhi Singh (Product Manager - Technology &	https://www.ril.com/

			Production of oil and gas			Solutions - Hydrogen)	
79.	Infinium	E-Naptha, SAF, E-Diesel, Technology Provider	Technology Provider for SMF	101.16 crore	55	Dr. James Vaughan	https://www.infiniumco.com/

Annexure 3 – Questionnaire for Survey of SAF

S.No.	Questions	Answers
1	**Respondent profile**	
Q.1.	What is your industry and job title?	
Q.2.	What is your organization's size and annual revenue?	
Q.3.	How many years of experience do you have in the industry?	
Q.4.	What is your organization's main business activity?	
Q.5.	What region do you operate in?	
2	**Knowledge and Awareness of Sustainable Aviation Fuels (SAFs)**	
Q.1.	What do you know about sustainable aviation fuels?	
Q.2.	How much do you know about the production process of sustainable aviation fuels?	
Q.3.	Have you seen any sustainable aviation fuels used in India?	
Q.4.	What is your/your organization's suggestions for creating awareness and expanding knowledge of SAFs?	
Q.5.	Do you think there is enough information available about SAFs in India?	
Q.6.	What are the main technologies used to produce SAF from green hydrogen, and which	
	of these do you believe have the most potential in India?	
Q.7.	Are you familiar with the concept of Power-to- Liquid (PtL) as a form of Sustainable Aviation	
	Fuel?	
Q.8.	How much do you know about the production process of PtL?	
3	**Current Use and Future Plans for Sustainable Aviation Fuels**	
Q.1.	What are the potential demand and offtake for SAF in India, and how can this be increased?	
	Could India be a refuelling station for planes?	
Q.2.	What is your expected timeline for market development for sustainable aviation fuels in	

	India?	
Q.3.	Which SAF technology options do you expect to find the most widespread adoption and why?	
Q.4.	What is your expected demand/production for sustainable aviation fuels in the next ten, twenty, thirty years?	
Q.5.	What are your expectations for the price of sustainable aviation fuels?	
Q.6.	How much would you be willing to pay for sustainable aviation fuels?	
4	**Key Drivers, Priorities and Challenges**	
Q.1.	What are the key drivers for adopting sustainable aviation fuels in India?	
Q.2.	What factors would motivate you to adopt sustainable aviation fuels?	
Q.3.	What are your priorities and needs when it comes to SAF?	
Q.4.	How will the adoption of SAFs impact the job creation market?	
Q.5.	How will the import of crude oil be affected by the blending of SAF with Aviation Turbine Fuel?	
Q.6.	Are there any specific barriers to the adoption of SAF in India that you can think of?	
Q.7.	What do you think are the solutions to the barriers to adopt SAF in India?	
Q.8.	Are there any regulatory or policy frameworks affecting the adoption of SAF in India?	
Q.9.	Are there any specific safety concerns you have with the use of SAF?	
Q.10.	What are the main challenges to producing SAF from green hydrogen in India, and how can these be addressed?	
Q.11.	Are there any specific policy or regulatory frameworks needed to support the development of SAF production and offtake in India?	
Q.12.	What are the potential market opportunities for SAF production in India, both domestically and globally?	

Q.13.	How can the industry ensure that SAF is sustainably produced and distributed in India?	
5	**Training and Capacity Building Needs**	
Q.1.	Do you think training and capacity building is needed in the field of SAF? If so, what kind of training and capacity building is needed?	
Q.2.	Where do you think training and capacity building should be offered?	
6	**Collaboration and Partnership Opportunities**	
Q.1.	What types of collaboration or partnerships would be most helpful in promoting SAFs in India?	
Q.2.	What kind of stakeholder groups do you think should be involved in collaboration efforts?	
Q.3.	What challenges do you foresee in developing partnerships for SAFs in India?	

Annexure 4 – Questionnaire for Survey of SMF

S.No.	Questions	Answers
1	**Respondent profile**	
Q.1.	What is your industry and job title?	
Q.2.	What is your organization's size and annual revenue?	
Q.3.	How many years of experience do you have in the industry?	
Q.4.	What is your organization's main business activity?	
Q.5.	What region do you operate in?	
2	**Knowledge and Awareness of Sustainable Marine/Maritime Fuels (SMFs)**	
Q.1.	What do you know about sustainable marine/maritime fuels?	
Q.2.	How much do you know about the production process of sustainable marine/maritime fuels?	
Q.3.	Have you seen any sustainable marine/maritime fuels used in India?	
Q.4.	What is your/your organization's suggestions for creating awareness and expanding knowledge of SMFs?	
Q.5.	Do you think there is enough information available about SMFs in India?	
Q.6.	What are the main technologies used to produce SMF from green hydrogen, and which of these do you believe have the most potential in India?	
Q.7.	Are you familiar with the concept of Power-to-Liquid (PtL) as a form of Sustainable Marine/Maritime Fuel?	
Q.8.	How much do you know about the production process of PtL?	
3	**Current Use and Future Plans for Sustainable Marine/Maritime Fuels**	
Q.1.	What are the potential demand and offtake for SMF in India, and how can this be increased? Could India be a refuelling station for ships?	
Q.2.	What is your expected timeline for market development for sustainable marine/maritime fuels in India?	

Q.3.	Which SMF technology options do you expect to find the most widespread adoption and why?	
Q.4.	What is your expected demand/production for sustainable marine/maritime fuels in the next ten, twenty, thirty years?	
Q.5.	What are your expectations for the price of sustainable marine/maritime fuels?	
Q.6.	How much would you be willing to pay for sustainable marine/maritime fuels?	
4	**Key Drivers, Priorities and Challenges**	
Q.1.	What are the key drivers for adopting sustainable marine/maritime fuels in India?	
Q.2.	What factors would motivate you to adopt sustainable marine/maritime fuels?	
Q.3.	What are your priorities and needs when it comes to SMF?	
Q.4.	How will the adoption of SMFs impact the job creation market?	
Q.5.	How will the import of crude oil be affected by the blending of SMF with Conventional Marine Fuel?	
Q.6.	Are there any specific barriers to the adoption of SMF in India that you can think of?	
Q.7.	What do you think are the solutions to the barriers to adopt SMF in India?	
Q.8.	Are there any regulatory or policy frameworks affecting the adoption of SMF in India?	
Q.9.	Are there any specific safety concerns you have with the use of SMF?	
Q.10.	What are the main challenges to producing SMF from green hydrogen in India, and how can these be addressed?	
Q.11.	Are there any specific policy or regulatory frameworks needed to support the development of SMF production and offtake in India?	
Q.12.	What are the potential market opportunities for SMF production in India, both domestically and globally?	
Q.13.	How can the industry ensure that SMF is sustainably produced and distributed in India?	
5	**Training and Capacity Building Needs**	

Q.1.	Do you think training and capacity building is needed in the field of SMF? If so, what kind of training and capacity building is needed?	
Q.2.	Where do you think training and capacity building should be offered?	
6	**Collaboration and Partnership Opportunities**	
Q.1.	What types of collaboration or partnerships would be most helpful in promoting SMFs in India?	
Q.2.	What kind of stakeholder groups do you think should be involved in collaboration efforts?	
Q.3.	What challenges do you foresee in developing partnerships for SMFs in India?	