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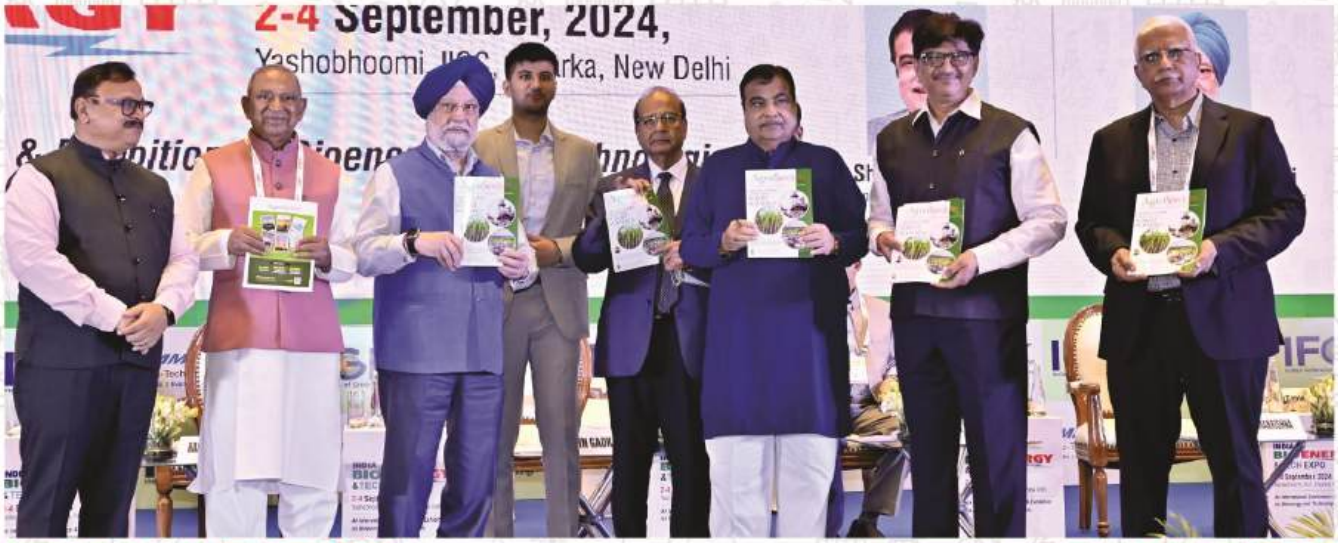
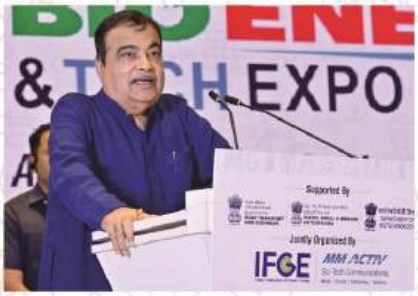
INDIA BIOENERGY & TECH EXPO

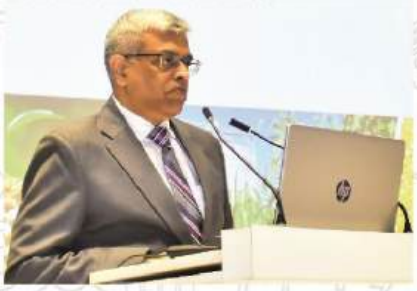
2-4 September, 2024
Yashobhoomi, IICC, Dwarka, New Delhi

An International Conference & Exhibition on Bioenergy and Technologies

POST EVENT REPORT







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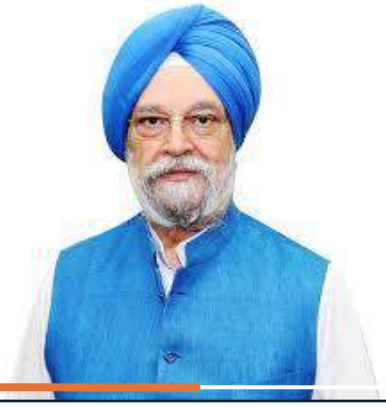
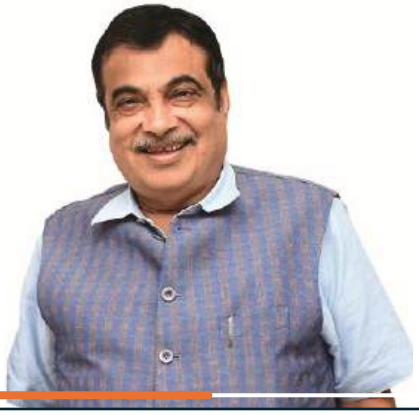
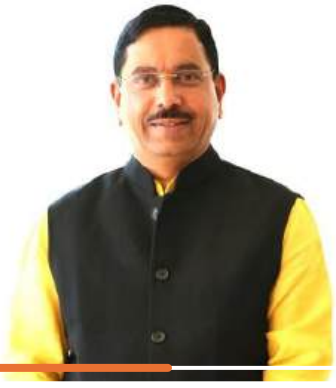


Shri Hardeep Singh Puri
Hon'ble Minister of Petroleum and Natural Gas
Government of India



Shri Nitin Gadkari
Hon'ble Minister of Road Transport & Highways
Government of India

VALEDICTORY SESSION BY



Shri Pralhad Joshi
Hon'ble Minster of New and Renewable Energy,
Consumer Affairs, Food and Public Distribution
Government of India

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Day 1: Inaugural Session

Address by Shri Nitin Gadkari, Hon'ble Minister for Road Transport and Highways, Government of India

- Bioenergy or biofuel is set to reach 50 per cent of fossil fuel in the country over the next five years.
- Factors such as economic viability, proven technology, the availability of raw materials, and marketability of the finished product are in favour of the development of these engines.
- The Government remains committed to developing flex-fuel engines as we have the proven technology to make it possible and Flex fuel engines are important. The companies like Tata Motors, Suzuki and Toyota have already decided to start flex engine cars in the country. There is huge potential for flex engines in India. The cost of biofuel is less and there is no pollution.

  Many generator manufacturers are working to change the diesel generators into ethanol. One of the companies is taking an interest in converting 5 lakhs of telecommunication towers with 250 crore litre consumption of diesel and now planning to opt for ethanol-based generators.
- The 400 Ethanol Pumps in Karnataka, Tamil Nadu, Uttar Pradesh, & Maharashtra started by Indian Oil is a one of the major steps for promoting biofuel in India.
- Presently, India is importing Rs. 22 Lakh Crores of fossil fuel which is a major concern for air pollution and for our economy. Biofuels will not only benefit the environment but also uplift the agriculture sector.
- Despite comprising 65% of the population, the agriculture sector contributes only 12% to the total GDP growth. In contrast, the manufacturing sector contributes 22-24%, while the service sector contributes 52-54%.
- The aim of the Prime Minister of India is to make India Atma Nirbhar Bharat, $ 5 trillion economy and to make India as 3rd largest Economy in World, with an aim to reduce imports and increase exports.
- The transportation sector of India is contributing 330 million tons of CO_2 annually, this environmental impact could be reduced by embracing bio-energy solutions.
- India is the 3rd largest vehicle market in the World after the USA and China. Earlier, India was the 7th largest market for Vehicles.
- India's automobile industry employs 4.5 crore people and pays the maximum GST to the central and state governments. Two-wheeler manufacturers like TVS, Hero and Bajaj export 50% of their production from India.
- Flex engines will play an important role in boosting biofuel market.
- Presently, 85 percent of the transport sector still relies on fossil fuels and there is a large potential for growth of biofuels sector. In October 2023, the Ministry of Road Transport and Highways advised states to consider reducing road tax on flex-fuel vehicles, similar to the tax reductions for electric vehicles, as part of efforts to decarbonise the transport sector.
- In Year 2023, the rate of corn was Rs.1,200 per quintal. However, due to ethanol production from corn, the rate in Bihar and Uttar Pradesh is ₹2,800 per quintal. Farmers are now giving priority to growing corn. Due to technological advancements, the acreage of corn has been increased and now production of corn is 30 quintals per acre.

Continuation of Address by Shri Nitin Gadkari, Hon'ble Minister for Road Transport and Highways, Government of India

- Ethanol is also being produced from Sugarcane, Molasses, Sweet Sorghum.
- The Central Government needs the support of the states to promote flex engine vehicles by reducing the applicable Goods and Services Tax (GST) by up to 12 per cent. Presently, these vehicles fall under the umbrella of the 'other vehicle' category, which attracts a GST of 28 per cent plus a cess of 15 per cent.
- CNG and LNG are also the good fuels to run the vehicles, bio-CNG can be developed from Sugarcane spent wash and other sugarcane waste.

Address by Shri Hardeep Singh Puri, Hon'ble Minister of Petroleum and Natural Gas, Government of India

- Bioenergy has gained much prominence in recent years. It is one of the alternate sources of energy to reduce the dependence on Fossil fuels and an avenue for income for the rural community.
- Indian government's strategic efforts to advance the bioenergy sector which will facilitate in reducing import dependence, saving foreign exchange, and promoting a circular economy.
- The government's initiative towards ethanol and biodiesel blending, Compressed Biogas (CBG), Sustainable Aviation Fuels, biomass utilization (such as pellets and briquettes), Biohydrogen, and waste-to-energy solutions will promote the bioenergy sector.
- The ethanol blending percentage has surged from 1.53% in 2014 to 15% in 2024 and the target of reaching 20% blending by 2025 is one of the progressing goals. This initiative has delivered benefits in saving Rs. 99,014 crores in foreign exchange, reducing CO_2 emissions by 519 lakh metric tons, and substituting 173 lakh metric tons of crude oil. The initiative has provided the considerable economic impact, with Oil Marketing Companies disbursing Rs. 1,45,930 crores to distillers and Rs. 87,558 crores to farmers.
- The availability of E20 fuel available at 15,600 retail outlets across India is one the important step taken by Indian government.
- The Pradhan Mantri JI-VAN Yojana is providing the financial support to advanced biofuel projects, which is crucial for developing a sustainable ethanol production ecosystem.
- To enhance ethanol production and mitigate environmental impact; two second-generation (2G) refineries have been established in Panipat and Numaligarh to convert agricultural residues like Parali and bamboo into ethanol. These refineries are instrumental in reducing pollution and bolstering energy security while transforming farmers into "URJADATA".
- The importance of diversifying feedstocks for ethanol production to ensure security and avoid over-reliance on any single source. The government's policy of providing stable and remunerative prices for ethanol has effectively reduced pending arrears for sugarcane farmers, lessened crude oil import dependence, and contributed to foreign exchange savings while benefiting the environment.
- A major milestone in ethanol fuel expansion is the successful launch of E100 fuel at over 400 retail outlets across the country. E100 fuel not only improves engine performance by increasing the octane number but also enhances engine efficiency. Ethanol's presence in fuel helps prevent pre-ignition knock and improves overall engine operation

Continuation of Address by Shri Hardeep Singh Puri, Hon'ble Minister of Petroleum and Natural Gas, Government of India

- The government has introduced various incentives for ethanol production which includes Rs. 9.72 per litre for ethanol derived from maize, Rs. 8.46 per litre for ethanol from damaged rice, and Rs. 6.87 per litre for ethanol from C-heavy molasses. This initiative has boosted maize's contribution to ethanol production, which has risen to 36% in the 2023-24 Ethanol Supply Year (ESY) from a mere 0% in 2021-22. Government has resumed the supply of FCI rice to ethanol distilleries, allowing for the purchase of up to 23 lakh tonnes through e-auctions from August to October 2024. Starting from November 2024, the supply of sugarcane juice and syrup to distilleries will also commence, marking the start of the 2024-25 Ethanol Supply Year.
- Brazil's successful use of high ethanol blends—up to 60-70% in vehicles—demonstrating the viability of high ethanol content. He reassured that India is committed to scaling up E20 production and supporting the transition with measures to facilitate the use of transition fuels in older vehicles.
- The automobile manufacturers are not only producing new E20-compliant vehicles but are also developing retrofit kits for older models. These kits, which can be installed during regular servicing, represent a significant advancement in accommodating older vehicles and promoting biofuel adoption.
- The vital role of biofuels in reducing fossil fuel dependence and emissions, paving the way for a cleaner and more sustainable future. The Global Biofuels Alliance (GBA), established during India's G20 presidency, serves as a collaborative platform for sharing knowledge, advancing technology, and developing policies to harness the $500 billion opportunity in biofuels and accelerate global adoption through technology transfer.

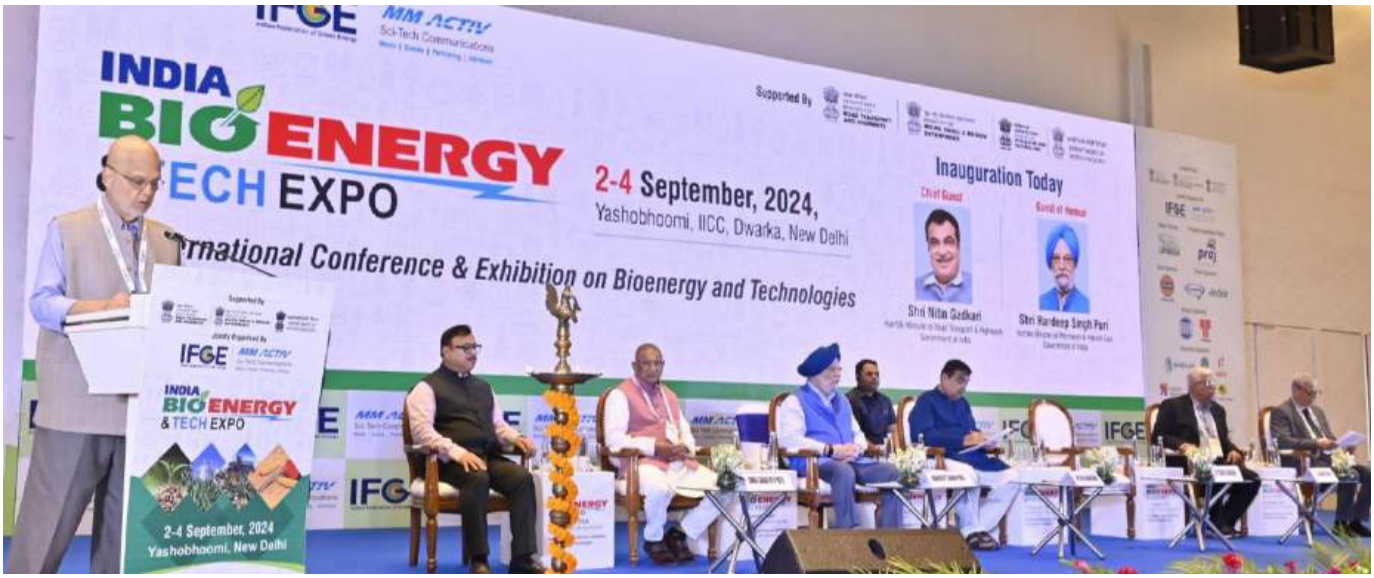
Address by Dr. Pramod Chaudhari, President, Indian Federation of Green Energy (IFGE) and Executive Chairman, Praj Industries

- The Government of India has lifted the ban and permitted sugar mills to use cane juice or syrup along with B heavy and C heavy molasses to produce ethanol for ESY 2024-25.
- Government has additionally permitted distilleries to buy up to 2.3 million metric tons of rice from the Food Corporation of India, exclusively for ethanol production, this will boost the renewable energy use and decreasing reliance on fossil fuels.
- Bioeconomy is playing a major role in overall GDP growth. Bioeconomy will boost farm to fuel concept while ensuring economic growth of farmers. Its global potential is estimated to around $ 4 trillion and projected to grow to $ 30 trillion by 2050. India will be the reference to the globe by showcasing the Bioeconomy development and its major contribution to overall GDP. Presently, India's projected growth is around $ 300 billion by 2030 in this Sector.
- To decarbonize the transportation sector, it is very crucial to use the energy efficient technologies for production of 1G ethanol, advanced biofuels (e.g. 2G ethanol, SAF, CBG) and next gen biofuels (e.g. marine, green hydrogen, etc.). Four R's ie. Reduce, Reuse, Recycle, and Repurpose should be applied in all value chains of carbon utilization.
- The application of biofuels in the transportation sector will boost the circular economy, by doubling the farmers' income, creating rural employment, reducing GHG emissions, and forex saving of Rs. 24,300 Crore in 2022-23.

- Energy Transition is playing major role in building Circular Bioeconomy and addressing climate change. Discussion on forums like COP28, G20, World Bioeconomy Forum, etc. on increased capacity and efficiency building on different pathways of Energy Transition will also include financial and environmental benefits to global society. India's leadership by launching Global Biofuels Alliance (GBA) to promote Biofuels applications in air, road and marine sectors will be the major milestone in energy transition. Bioenergy would be playing a major role in Energy Transition by addressing the challenges of climate change and employment.
- The major steps taken by Government of India are:
  - Launching National Biofuel Policy 2018
  - Ethanol Blending Program - E20 by 2025
  - SATAT to promote CBG - 15 MMT of CNG to be replaced by setting 5000 CBG plants
  - Ethanol blending from around 2%; (in Year 2014) to around 15% (in Year 2024)
  - PM-JIVAN Yojna – to support advanced biofuels and recently amended with Bolt-on and Brown field projects
  - Inclusion of Alternate feedstock development e.g. sweet sorghum.
  - Govt of India has indicated 1% SAF blend in jet fuel by 2027.
  - National Hydrogen Mission.
  - The first commercial passenger flight with 1% SAF blending in Jet fuel was successfully flown from Pune to Delhi in Year 2023.
- Renewable Chemicals and Material will also add value proposition to the overall umbrella of Bioeconomy going forward. Indigenous technology is ready to replace all fossil-based refinery products with the bio-refinery processes.
- India has also developed the ecosystem to launch new technologies e.g. 2nd Generation Biomass to bioethanol projects, CBG production from industry and agri-residue, hybrid flex-fuel passenger car (ethanol blends > 20%), building a network of E20 & E100 gasoline stations across India, CNG Gbike and ethanol bikes, etc.
- To reduce pollution, application of biomaterials in different sectors from agri to FMCG, Industry to end-user, is crucial. For the same, the Govt of India has come out with a Bio Manufacturing and Bio-Foundry supportive mechanism
- Government of India has launched BioE3 policy for a wide spectrum of applications, Vigyandhara scheme ~ INR 10,500 Cr for R&D, innovation, technology development and deployment. Renewable chemicals and materials like bioplastics through Biomanufacturing & bio-foundries are the future bio-refinery products.
- GBA will play a crucial role in advancing the biofuel revolution in member countries, especially the global south. There is scope for alternate ethanol applications like Flex-fuel hybrids, ethanol bikes, diesel blending, DG set fuel, and cooking fuel in some countries.
- India has to set its own standards and guidelines for advanced biofuels to meet the global standards. E.g. SAF standards matching with CORSIA guidelines, Life Cycle Assessment (LCA) mechanism and certification for low carbon ethanol, etc.
- To meet the requirements of Industry, raw materials development is one of the important need. Utilizing surplus crop residue of around 228 million MT per annum and alternate feedstock development will meet biofuel blending mandates of India. Thus, needless to mention that India is poised to become biofuel hub for global requirements.

Day 1: Inaugural Session

Recommendations and Key Takeaways from the session:



*L to R**: Dr. Pramod Chaudhari,** President IFGE & Executive Chairman, Praj Industries, **Shri Ravindra Boratkar,** Founder Member, IFGE & Managing Director, MM Activ Sci-Tech Communications, **Shri Anna Saheb M K Patil:** Chairman, IFGE & Former Minister of State for Rural Development, Government of India, **Shri Hardeep Singh Puri:** Hon'ble Minister for Petroleum & Natural Gas, Government of India, **Shri Nitin Gadkari,** Hon'ble Minister for Road Transport and Highways, Government of India, **Shri Y. B. Ramakrishna:** Sr Vice President, IFGE & Former Chairman- Working Group on Biofuel MoPNG , **Shri Sanjay Ganjoo,** Director General, IFGE*

- **Feedstock Flexibility:** Continue allowing the use of sugarcane juice, B-heavy, C-heavy molasses, and surplus food grains (such as rice from FCI) for ethanol production. This will ensure flexibility in the supply chain and strengthen renewable energy initiatives.
- **Advanced Biofuels Focus:** Strengthen policy frameworks to boost the production and application of advanced biofuels, such as 2G ethanol, SAF, CBG, and next-generation biofuels like green hydrogen. These are crucial for decarbonizing the transportation sector and reducing reliance on fossil fuels.
- **Infrastructure Development:** Scale up the infrastructure for E20 and E100 fuel stations, alongside policies supporting hybrid flex-fuel vehicles, ethanol bikes, and CNG bikes. This will enhance the adoption of biofuels and support energy transition efforts.
- **Global Standards Alignment:** Establish clear standards and certifications, such as SAF standards under CORSIA guidelines and Life Cycle Assessment (LCA) mechanisms for low-carbon fuels. This alignment with global benchmarks is vital for India's leadership in biofuel technology.
- **Sustainable Feedstock Development:** Promote the use of surplus agricultural residues, estimated at around 228 million MT annually, and the development of alternative feedstocks like sweet sorghum to meet biofuel blending mandates. This will ensure a sustainable supply chain for biofuels.
- **Financial and Regulatory Support:** Expand financial and regulatory mechanisms to support bio-manufacturing and bio-foundries, driving innovation in bio-refinery products, bioplastics, and renewable chemicals. This will add value to the bioeconomy.
- **Global Leadership in Biofuels:** Strengthen India's role in the Global Biofuels Alliance (GBA) to promote biofuels globally, particularly in the Global South. Collaboration and knowledge-sharing will foster biofuel technology and market development.
- **Circular Bioeconomy:** Encourage circular bioeconomy practices by promoting the reuse, recycling, and repurposing of carbon and biomaterials across sectors. This will reduce emissions, enhance rural employment, and support economic growth.
- **Innovation and R&D:** Prioritize research and development (R&D) for renewable chemicals and materials under initiatives like the BioE3 Policy and Vigyandhara scheme. This will spur innovation and advance the bioeconomy sector, positioning India as a global leader in biofuel technology and production.

Day 1 Plenary Session 1: Evolving Policy Ecosystem in India: Global Biofuel Alliance Towards Globalization

Key Topics Discussed: The session emphasized India's progress in ethanol blending and sustainable feedstock development, the role of the Global Biofuels Alliance, the need for a dedicated bioenergy ministry, and opportunities in Sustainable Aviation Fuel (SAF) aligned with future government mandates.

Address by Mr. Y.B. Ramakrishna, Sr. Vice President, IFGE & Former Chairman - Working Group on Biofuel, MoPNG

- Ethanol blending was started in the era of second world war around the year 1943-44, at that time there was 20% of blending in petrol in the city of Mumbai. This blended petrol was known as Power Petrol and was used in Buses as there were challenges in importing crude oil due world war.
- The ethanol blending was formally started in Year 2003, in year 2009 Government of India has come with the policy. However, there was a lack in clarity for achieving the targets. In year 2018 the National Biofuel Policy was launched with new targets. To reduce the regulatory hurdles lot of emphasis was given to augmenting the ethanol supplies to the program.
- Earlier the prices of ethanol was fixed by OMCs and ethanol suppliers were not able to supply due to pricing constraint.
- There was an interest subvention scheme on setting up 1G Ethanol plant and PM JI-VAN viability gap funding program was announced with a fund of Rs. 1950 crore for setting up 2 G Ethanol Plants.
- A big investment was made by OMCs to store ethanol and process the ethanol blending. There is a requirement of 11 billion liters of ethanol for 10% blending and we have infrastructure of 15 billion liters.
- All the ethanol programs mention the surplus feedstock or about the wasted resource in the country. The requirement of ethanol will also be for E20, E100, Sustainable Aviation Fuel (SAF) and 5% of ethanol blending in diesel by 2030. We should also focus on feedstock availability for ethanol and bio-methane program.
- The first biogas plant was set up in 1890's in Mumbai, with the improvement in technology MNRE has started establishing biogas plants in 1980's and there are now around 4.5 million biogas plants in India.
- Under SATAT, the focus is on commercial plants and to upgrade biogas into bio-methane to use for transport sector. The SATAT Program provides:
  - 100% offtake guarantee
  - Availability of floor price
  - Pricing linked with CNG Prices
  - Separate pricing on injecting with grid
  - Central Financial Assistance (CFA) available for CBG plants by MNRE.
  - Subsidies for pipeline connectivity by MoPNG
  - Green Credits

- There are huge opportunities in Sustainable Aviation Fuel (SAF), in year 2002-03 there was consortium was formed between IIT, IISc, OMCs and some Canadian companies to identify the opportunities and groundwork required. Reports of SAF have been submitted in Year 2008-09. The Government of India has come with a mandate to start the international flights by 2026-27 with 1% SAF blending and 5% SAF blending by 2030.
- The policy ecosystem of SAF is yet to be involved, there is no certain price mechanism and price on which OMCs will buy the SAF.
- The Government of India has recently released the Bio E3 Policy focusing the Fostering High-Performance Biomanufacturing which is covering sustainable and efficient utilization of biological resources through scientific knowledge for innovation, scaling-up and biomanufacturing of specialty chemicals, enzymes, biopolymers, functional foods, smart proteins, veterinary products, precision biotherapeutics and services.
- Beyond the energy we are also creating Bioeconomy but considering globalization, policies are restrictive for import and export of fuels. India was clear not to open up the global markets until they start investments and production. Now India has created the Global Biofuel Alliance which will create global markets for biomaterials and biochemicals.
- Some of the previous global initiatives taken by Government of India:
- Biofuture Platform which was created in year 2016 which was led by Brazil for first 3 Years and currently being led by USA. 22 countries are the member of Biofuture Platform. India has taken the lead in creation of the biofuture platform.
- In 2017, there was a cooperation between India and European Union for the advanced biofuels. Three workshops were also held in Delhi and there is a Indo-European Union low carbon biofuel forum which is active now at industry level.
- In Year 2014-15 Indo-US cooperation was also looking for feedstock and technology for second generation ethanol.
- There are few challenges in collecting feedstock and creating the sustainable feedstock supply chain, energy crops are one of the solution. However, challenges are also being faced on the technological side.
- There is a need of the Government's Financial Institution dedicated for Bioenergy & Biofuels.
- Carbon market is an evolving sector and there is a need for carbon accounting system and marketing infrastructure for India and on Global levels also. This could be achieved only by Government cooperation.
- There should be a dedicated Ministry for Bioenergy which could deal with all the policy gaps related to bioenergy and biofuels.

Address by Mr. Shishir Joshipura, CEO & MD, Praj Industries

- Mr. Joshipura highlighted the growth of the Bioenergy sector. Over the past five years, biofuels have shifted from a push-based sector to a pull-based industry, thanks to favorable policies in India and globally.
- Critical Role in Climate Change: Biofuels are key to combating climate change by reducing carbon emissions, ensuring a better future for the next generation.
- Expansion of Biofuels in India: India, once reliant on a single feedstock, has now expanded biofuel production nationwide, with significant growth since 2019.
- Leveraging India's Resources: India must utilize its abundant sunlight, land, and agricultural workforce to drive bioenergy production, enhancing energy security and creating rural employment.
- Benefits of Biofuels:
  - Energy independence
  - Wealth creation for local communities
  - Employment in rural areas
  - Reduced carbon emissions, benefiting both India and the world.
- Global Biofuels Alliance (GBA): The launch of GBA enables countries to share knowledge and resources. India, Brazil, and the U.S. are leading examples, while countries like Mauritius and African nations show interest in local biofuel production.
- Policy Alignment: Mr. Shishir stressed the importance of aligning biofuel policies, ensuring India's E-20 program success is reflected across policies like the CAFE norms.
- Conclusion: He encouraged stakeholders to expand the global biofuel horizon, with India playing a leadership role for a sustainable future.

Address by Dr. Jennifer Holmgren, CEO, LanzaTech

- Dr. Jennifer highlighted the importance of rethinking carbon usage, stating that carbon is not the enemy but rather where we source it from is crucial for our carbon future.
- She emphasized the necessity of giving carbon a "second chance" by reusing it in a circular economy model.
- Ethanol is seen as an intermediate product for making other chemicals and fuels. Dr. Jennifer stressed that ethanol can be made from a variety of waste resources, including municipal solid waste, and is a versatile feedstock for sustainable aviation fuel (SAF) production.
- Ethanol can aggregate waste and convert it into useful products, including fleece, surfactants, and other commercial products.
- Her company is working on converting ethanol into SAF, with their first commercial SAF plant set to produce 40 million liters annually.
- Dr. Jennifer emphasized the need to use local feedstocks for biofuel production, promoting a distributed economy that fosters energy independence. This model can help countries like India grow by utilizing agricultural residues, industrial waste, and municipal solid waste.
- India is well-positioned to benefit from this new carbon economy due to its growing steel, refining, and biomass sectors.

Address by Mr. Poul V. Jensen, Managing Director, EBTC

- Mr. Jensen mentioned the involvement of EBTC in collaboration between India and Europe in biofuels, sustainability, and clean technologies
- He stated biofuel development requires supportive policies and close collaboration between industry, policymakers, and technology experts.
- The Global Biofuel Alliance (GBA) facilitates global cooperation on biofuel development, backed by strong leadership.
- He explained how farmers are key to the biofuel supply chain and need assistance in meeting global sustainability standards without being overburdened.
- Expanded biofuel supply chains are needed for industries like aviation and maritime to meet increasing demand for sustainable fuels.
- Encourage circular economy practices by utilizing industrial waste as energy inputs for biofuel production.
- The EU-India Clean Energy Partnership is working on a biofuel roadmap to promote knowledge sharing and sector growth

Day 1 Plenary Session 1: Evolving Policy Ecosystem in India: Global Biofuel Alliance Towards Globalization

Recommendations and Key Takeaways from the session:

*L to R**: Mr. Atul Kharate, Chief Operating Officer, Indian Oil Adani Ventures Limited, Mr. Poul V. Jensen,** Managing Director, EBTC**, Ms. Jennifer Holmgren,** CEO, LanzaTech, **Mr. Shishir Joshipura,** CEO & MD, Praj Industries and **Mr. Y. B. Ramakrishna,** Sr. Vice President, IFGE & Former Chairman- Working Group on Biofuel MoPNG.*

- **Strengthening Feedstock Availability:** Focus on ensuring the availability of diverse feedstocks like agricultural residues, municipal solid waste, and energy crops to meet the increasing ethanol demand for E20, E100, SAF, and bio-methane production by 2030. Develop sustainable supply chains for these materials.
- **Policy and Pricing Clarity:** Establish clear price mechanisms for ethanol and Sustainable Aviation Fuel (SAF) to ensure stable market growth. Address price uncertainty by setting specific purchasing rates for OMCs to stimulate investment in SAF production.
- **Infrastructure Development:** Invest in storage and blending infrastructure for ethanol, ensuring capacity for 15 billion liters by 2030. Expand the network of ethanol blending stations and support the adoption of biofuel-based technologies like CNG and ethanol-based vehicles.
- **Enhance Biogas and Bio-Methane Programs:** Expand the SATAT initiative to accelerate the development of biogas and bio-methane plants, especially for the transport sector. Provide additional financial assistance, ensure pipeline connectivity, and maintain pricing linked with CNG rates.
- **Creation of a Dedicated Bioenergy Ministry:** Establish a dedicated ministry to streamline bioenergy and biofuels policies, focusing on closing existing gaps, coordinating across sectors, and driving innovation in biofuel technologies.
- **Global Leadership in Biofuels:** Strengthen India's leadership role through initiatives like the Global Biofuels Alliance (GBA), collaborating with international partners to create global markets for biofuels, biomaterials, and biochemicals.
- **Support for SAF Ecosystem:** Develop a robust policy framework for SAF production, ensuring targets of 1% SAF blending by 2027 and 5% by 2030. Support research, pricing, and infrastructure to make India a global hub for SAF production.
- **Financial Institution for Biofuels:** Establish a government-backed financial institution to fund bioenergy projects, ensuring long-term financial stability for the industry and supporting both national and international biofuel initiatives.
- **Carbon Market and Accounting Systems:** Develop a comprehensive carbon accounting system and marketing infrastructure to facilitate the growth of carbon markets both in India and globally, ensuring biofuels contribute effectively to climate goals.
- **Promote Circular Economy:** Encourage policies that prioritize the reuse of industrial and agricultural waste for biofuel production, aligning with the principles of the circular economy to reduce waste and increase energy independence.

Day 1 Plenary Session on Government Support, Incentives, and State Policies in the Bioenergy Sector

Key Topics Discussed: The session covered topics including the National Bioenergy Programme, Uttar Pradesh's CBG production targets, biofuels' role in energy security, growth in ethanol production, the need for policy and financial support, building a robust supply chain, technological innovations, and promoting public-private partnerships in bioenergy development.

Address by Dr. Sangita M. Kasture, Scientist G, Ministry of New and Renewable Energy, Government of India

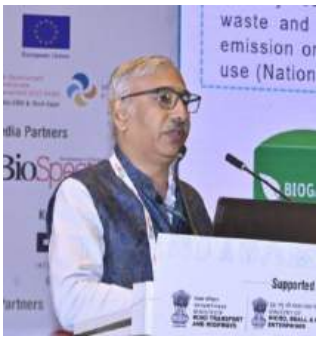
- Dr. Sangeeta Kasturi emphasized the National Bioenergy Programme under the Ministry of New and Renewable Energy, highlighting the need to increase bioenergy's share in the energy sector, currently at 11%
- She outlined the programme's three main components: the Waste to Energy Programme, the Biomass Power Programme, and the Biogas Programme.
- Waste-to-energy projects supported by the Ministry include biogas generation at ₹0.25 crore per 12,000 m^3/day, bio-CNG production at ₹4 crore for new plants and ₹3 crore for existing ones, and biogas power at ₹0.75 crore per MW for new plants.
- Biomass gasifiers are priced at ₹2,500 per kWe for dual fuel engines, ₹15,000 for 100% gas engines, and ₹2 lakh per 300 kWh. Power generation from agro-industrial waste is at ₹0.4 crore per MW.
- The Biogas Programme provides subsidies for small-scale businesses ranging from ₹9,800 to ₹70,400 per plant, with further support for power generation at ₹35,000 to ₹45,000 per kW, and thermal applications at ₹17,000 to ₹25,000 per kW for medium plants.
- In Phase I of the National Biogas Programme, 95 Bio-CNG projects (625 TPD), 7 power projects (12 MW), and 5 biogas projects (72,100 m^3/day) were approved. The Biomass Programme sanctioned 3 non-biogas cogeneration projects (31 MW) and 50 briquette/pellet projects (631 TPH). The Biogas Programme includes 68,500 small and medium plants generating 3.45 MW.
- Dr. Kasturi stressed the importance of feedstock availability and advancing technology for future growth in the bioenergy sector.

Address by Mr. Narendra Bhooshan, Principal Secretary, Energy & Additional Sources of Energy, Uttar Pradesh

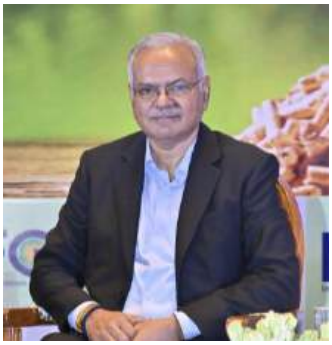
- Mr. Narendra Bhooshan highlighted India's leadership in compressed biogas (CBG) production, with Uttar Pradesh being a major player. With around 117 plants which have been sanctioned in the state, 24 are fully operational, producing 200 tons per day.
- Mr Bhooshan emphasized the role of UPNEDA as the nodal agency implementing various bioenergy schemes, covering bio-CNG, bio-coal, and biodiesel, along with significant capital subsidies and incentives. He also mentioned UP's goal to reach 1,000 tons per day of CBG, 4,000 tons per day of bio-coal, and 2,000 kiloliters per day of bioethanol and biodiesel by 2026-27, inviting investors to take advantage of the state's fertile land and policy support.
- Mr Bhooshan further stressed the importance of building a robust supply chain for CBG production, particularly focusing on farmers benefiting from organic manure produced from crops like sugarcane.
- He outlined several key drivers of success for UP’s bioenergy sector, including land allotment, online application systems, crop residue, and pressmud availability.
- He also highlighted the well-organized sugarcane cooperatives, making the state an ideal hub for bioenergy investments. Among the policy recommendations, he was proposed the introduction of CNG-powered tractors, aligning with the recent GST reduction on green vehicles under the leadership of Chief Minister Yogi Adityanath.

Address by Mr. Shekhar Kulkarni Director (Act. I/c), CHT, MoPNG

- Mr. Kulkarni emphasized biofuels' role in achieving a clean environment, enhancing energy security, and boosting rural income
- India's biofuels can help reduce dependency on crude oil and natural gas imports, which cost $121.6 billion in FY 2023-24.
- Biofuels support India's target of net-zero carbon emissions by 2070 and a 50% renewable energy share by 2030.
- Ethanol production in India is growing rapidly, making it the third-largest global producer, saving ₹85,000 crore in foreign exchange and reducing CO2 emissions equivalent to planting 1.75 crore trees.
- Surplus biomass and initiatives like the compressed biomass obligation and SAF blending targets are driving bioenergy, but challenges remain in feedstock supply and market development.
- Three key policy areas identified: financial support (subsidies and grants), policy support (mandatory biofuel blending), and tax benefits
- The PM JI-VAN Scheme has set up ethanol plants with ₹1,950 crore in financial assistance.
- Ambitious goals for SAF include a 70% blending rate by 2050, with 72 CBG plants commissioned and 21,000 MT sold in FY 2023-24.
- Public-private investment is increasing, but further efforts are needed to create a favorable business environment for biofuels.



Address by Mr. P.S. Ravi, Director (Downstream), FIPI



- Mr. P.S. Ravi highlighted the significant growth in India's ethanol production, which increased from 60 to 700 crore liters by 2024.
- He emphasized that while policies related to the ethanol blending program are important, their effective implementation is crucial.
- He recalled challenges faced in 2013, particularly market pricing issues, which were resolved with a policy change allowing price fixation by the Indian government.
- A key breakthrough was the decision to allow the free movement of ethanol across the country, which initially concentrated production in Uttar Pradesh, Karnataka, and Maharashtra due to limited sugarcane availability.
- To tackle distribution challenges, the Hub and Spoke Mechanism was introduced, establishing regional hubs like Kanpur for ethanol-blended petrol distribution.
- The government expanded ethanol production beyond sugarcane by incorporating alternative feedstocks such as damaged food grains and maize.
- To cut costs, the oil industry explored setting up ethanol production facilities in various states, attracting private investment, with 131 firms joining the effort in 2021.
- India is projected to reach an ethanol production capacity of 1500-1700 crore liters by October 2026.
- Mr. Ravi stressed that the industry requires trust due to its dynamic nature and highlighted focus areas, including demand creation, ethanol conversion to isobutanol for diesel blending, bioplastics, and ensuring a steady feedstock supply.

Address by Mr. Atul Mulay, Chairman, Bioenergy Committee of IFGE, President - Bioenergy, Praj Industries

- Mr. Mulay stressed the importance of ensuring feedstock availability across India for the biofuel sector.
- He emphasized the need for a uniform supply of feedstock, especially during the off-season when sugar production declines.
- Consistent lifting and supply of feedstock would enhance the efficiency of biofuel industry operations.
- He highlighted growing interest in emerging biofuels like sustainable aviation fuel and marine biofuel.
- While investments in these areas are increasing, there is still a need to establish fair and sustainable pricing models, particularly for second-generation ethanol.
- He discussed the challenges in utilizing compressed biogas (CBG) products due to the lack of standardized criteria, causing market confusion.
- Mr. Mulay pointed out inconsistencies in standards for Distilled Dried Grain Solubles (DDGS), an important byproduct, and emphasized the need for uniform standards to guide the market effectively.

Address by Mr. K. S. Ngangbam, Director (SBM-V), DDWS, Ministry of Jal Shakti, Government of India

- Mr. Ngangbam emphasized the government's focus on compressed biogas (CBG) through the SATAT initiative, led by the Ministry of Petroleum and Natural Gas (MoPNG).
- He highlighted coordinated efforts among various ministries, including MNRE and the Department of Agriculture, to facilitate CBG projects, with committees formed in 12 states and mission directors from Swachh Bharat Mission overseeing implementation.
- Regular interactions with key stakeholders, including CBG proponent and plant operators, were noted, with the government addressing challenges through cross-ministry collaboration since 2020.
- Key initiatives include CBG plants being included under priority sector lending by RBI, and issues related to fermented organic manure (FOM) and liquid fermented organic manure (LFOM) being resolved with their inclusion in the fertilizer control order (FCO).
- CBG is also now part of the Agri-Infrastructure Fund, and regulatory burdens have been reduced by placing CBG plants in more favorable environmental categories.
- The Waste to Energy Program has been extended, and budget allocations for Phase II are being sought. CBG is included in carbon credit trading, with tax exemptions under GST, and ongoing work on pricing mechanisms and FCO amendments.
- Financial support is provided for marketing FOM and LFOM under the MDA scheme.
- A pipeline connectivity scheme is being implemented, with a portal launched for applications, and mandatory CBG blending is set to begin with 1% by 2025-26, increasing to 5% by 2029.
- Mr. Ngangbam mentioned the development of a portal for CBG plant registration to access benefits across ministries and emphasized ongoing efforts to improve policy effectiveness through stakeholder feedback.
- He encouraged states to introduce bioenergy policies, highlighting proactive efforts in Uttar Pradesh and Bihar, and called for single-window clearance for CBG projects.
- Concluding, he stressed the importance of collaboration to support the CBG sector in areas like financing, feedstock, marketing, and technology.

Address by Dr. Virinder Sharma, Member- Technical, CAQM

- Dr. Virinder Sharma discussed the role of the Commission for Air Quality Management (CAQM), established in 2022, and its relevance to bioenergy, particularly in managing air quality issues related to biomass burning.
- He emphasized the need to integrate paddy stubble into the bioenergy value chain to address both air quality and energy production, particularly through its use in thermal power plants.
- CAQM has taken a multisectoral approach to air quality management in the Indo-Gangetic Plain, focusing on agricultural stubble burning and open biomass burning.
- To date, CAQM has issued 81 directives and 41 advisories, collaborating with central and state governments, NITI Aayog, NGOs, and other organizations to curb air pollution.
- He highlighted the promotion of biomass co-firing in coal-fired boilers and CAQM's directive to use paddy straw biomass in NCR region power plants to mitigate air quality issues.
- By 2024-25, the target is to co-fire 2-3% biomass in power plants, increasing to 5% by 2025-26, with innovations needed to address challenges in biomass co-firing.
- He stressed the importance of a sustainable biomass supply chain, involving both state governments and private entities, to ensure biomass availability for thermal plants.
- Dr. Sharma addressed challenges such as the high silica content in paddy stubble and the need for an efficient supply chain for biomass pellets.
- He highlighted state biomass policies and incentives as progress in reducing stubble burning and improving air quality in the Indo-Gangetic Plain.
- He concluded by stressing ongoing enforcement, monitoring, and policy formulation to address both air pollution and fossil fuel reliance through coordinated efforts involving multiple stakeholders.

Day 1 Plenary Session on Government Support, Incentives, and State Policies in the Bioenergy Sector

Recommendations and Key Takeaways from the session:

L to R : ***Dr. Sangita M. Kasture,*** *Scientist G, MNRE****, Mr. Subodh Kumar,*** *Advisor to the National Team, IFGE, ED, ValPro & Former ED, IOCL,* ***Mr. P.S. Ravi,*** *Director (Downstream), FIPI,* ***Mr. Virinder Sharma,*** *Member- Technical, CAQM,* ***Mr. Narendra Bhooshan,*** *Principal Secretary- Energy & Additional Sources of Energy,UP,* ***Mr. Shekhar Kulkarni Director*** *(Act. I/c), CHT, MoPNG,* ***Mr. K. S. Ngangbam,*** *Director (SBM-V), DDWS, Ministry of Jal Shakti,* ***Mr. Atul Mulay,*** *Chairman, Bioenergy Committee of IFGE, President - Bioenergy, Praj Industries.*

- **Scaling Compressed Biogas (CBG) Production:** Uttar Pradesh is already leading in CBG production with 24 fully operational plants producing 200 tons per day. The state aims to produce 1,000 tons per day by 2026-27. Policies should continue to incentivize this growth, focusing on capital subsidies, incentives, and streamlined land allotment for new plants, Building a robust supply chain for CBG production is critical, especially by engaging farmers in supplying feedstock such as crop residue and organic manure.
- **Increased Investment in Bio-CNG, Bio-Coal, and Biodiesel:** By 2026-27, Uttar Pradesh targets 4,000 tons per day of bio-coal and 2,000 kiloliters per day of bioethanol and biodiesel. To attract investment, a comprehensive policy should offer capital subsidies, feedstock supply guarantees, and streamlined approval processes via online application systems, The establishment of CNG-powered tractors aligns with recent GST reductions on green vehicles. This can serve as a pioneering move for green agricultural practices, reducing emissions and providing farmers with cleaner energy options.
- **Supporting Farmers through Organic Manure:** Uttar Pradesh's bioenergy growth strategy should focus on increasing farmer participation by promoting the use of organic manure produced from sugarcane and other crops. Establishing direct linkages between bioenergy plants and farmer cooperatives can ensure a steady supply of feedstock and offer additional revenue streams to farmers.
- **Encouraging Public-Private Partnerships (PPP):** UPNEDA should actively promote PPP models to attract private sector investment in the bioenergy sector. Collaboration between private players, government agencies, and farmer cooperatives will be critical to the state's success in achieving its bioenergy targets.

Recommendations and Key Takeaways from the session:

- **Policy Harmonization and Simplification:** To streamline bioenergy investments, Uttar Pradesh should focus on simplifying regulatory frameworks. A single-window clearance system would help investors navigate bureaucratic hurdles, ensuring faster project implementation, A harmonized policy for the production and distribution of bio-CNG, bio-coal, and biodiesel will create a more conducive environment for bioenergy growth.
- **Innovations in Technology:** Introducing CNG-powered tractors and encouraging the use of mechanized harvesting systems that reduce crop residue burning will further promote sustainable agriculture practices, aligned with both the state and national goals for green energy production.
- **Fostering a Bioenergy Ecosystem through Cooperative Sugarcane Mills:** Given the state's well-organized sugarcane cooperatives, UPNEDA should build a strong linkage between sugarcane mills and bioenergy projects. Pressmud (a sugarcane byproduct) can be a vital feedstock, ensuring cost-effective and large-scale production of bio-CNG, bioethanol, and bio-coal.

Day 1 Session on Carbon Credits in Bioenergy Sector

Key Topics Discussed: Carbon Credit, Bioenergy, Biofuels, CCTS, Carbon Credit Policies and Methods, Global scenario, Case Studies

The session commenced with a welcome address from the Moderator, followed by Mr. Nisal engaging all the panellists in a discussion focused on enhancing the carbon credit framework within the Bioenergy sector.

Address by Mr. Srikant Nagulapalli, Additional Secretary, Ministry of Power, Government of India

- Mr. Nagulapalli, chair of the session, highlighted India's updated Nationally Determined Contributions (NDC) targeting:
  - A 40% reduction in emission intensity by 2030 compared to 2005 levels.
  - A Net Zero goal by 2070.
  - India has established a carbon trading market under the Carbon Credit Trading Scheme (CCTS), with bioenergy projects included in the offset mechanism.
- He emphasized bioenergy's potential in key sectors such as transport, electricity, and building.
- Globally, around 2 billion tons of municipal solid waste (MSW) are produced annually, with expectations to double by 2050.
- Proper MSW management can reduce greenhouse gas emissions and create economic opportunities:
- Landfills currently generate 19 million tons of CO2, projected to reach 40 million tons by 2030.
- In India, compressed biogas (CBG) holds substantial potential, with:
- 62 million tons of resources.
- A 370 million-ton bio manure production capacity.
- CBG is listed for carbon credit trading under the Article 6 mechanism, offering revenue opportunities for project developers.
- The government's carbon credit incentivization aims to double farmers' income.
- India accounted for 17% of global carbon credit exports in 2022.

Address by Mr. Satyendra Kumar, Director, Hazardous Substances Management (HSM), Ministry of Environment, Forest and Climate Change, Government of India

- Mr. Kumar discussed how carbon credits attract attention due to their potential for revenue generation, especially in the bioenergy sector and compressed biogas (CBG) plants.
- There are two distinct carbon markets:Voluntary Carbon Market: Operates under voluntary standards; credits can be sold without adjustment. Paris Agreement Mechanisms: Article 6.2 and 6.4; credits sold are adjusted and count towards other countries' NDCs.
- The Paris Agreement's mechanisms are still being finalized, which could lead to higher carbon credit prices compared to the voluntary market.
- The Indian government has identified 14 activities eligible for carbon credit trading under the Paris Agreement, including CBG, to stimulate revenue generation.
- CBG was included due to:
  - Lack of existing low-carbon technologies.
  - Need for investment in financially viable decarbonization activities.
  - As economies of scale are achieved and investments mobilized, reliance on carbon credit trading may diminish, allowing for new activities to emerge.
  - Business developers are encouraged to explore potential partnerships in other countries to capitalize on these opportunities for revenue and investment in the bioenergy sector.

Address by Mr. Rajesh K Mediratta, MD & CEO, Indian Gas Exchange Limited

- Mr. Mediratta emphasized the significance of RGCs and CBG Blending Obligations (CBO), initially set for 10 years, focusing on CNG (Transport) and PNG (Domestic).
- CBO is expected to increase from 1% to 5% between FY 2026 and FY 2029.
- Biomethane, a combination of methane and green attributes, is crucial for carbon capture and demonstrates the potential of Compressed Biogas (CBG).
- Renewable Gas Certificates serve as proof of CBG purchase, facilitating long- and short-term trades between parties.
- **Certification Benefits:**
  - RGCs provide an additional revenue stream for CBG producers.
  - Allow selling of CBG without extra costs.
  - Offer buyers freedom and flexibility in purchasing.
- Involves an obligation for redemption, easing gas exchange for producers through the issuance of certificates by the Certification and Registration Body (CRB).
- RGC Framework: Involves multiple agencies, including:
  - PNGRB (Petroleum and Natural Gas Regulatory Board)
  - CRB (PPAC)
  - CGD entities
- The CRB acts as a link between CBG producers and buyers, confirming certificates and trade notifications.
- Include platforms like Grexel, EEX, NORD POOL, HenE, among others.
- Governed under PNGRB with six regional gas hubs facilitating the framework.

Address by Mr. Rohit Kumar, Secretary General, Carbon Market Association of India

- Mr. Rohit Kumar, Secretary General of CMAI, emphasized that biofuel is a critical area for development.
- He introduced various carbon credit standards, including the Gold Standard and VCS (Verified Carbon Standard).
- Carbon Credit Generation:
  - Biomass: 0.9 credits generated per ton of biomass.
  - Pallets: 250-300 credits generated per ton of pellets.
  - Bio-CNG Production: 7210 carbon credits from 3000 TPD daily.
  - Total Biofuel Production: 9523 carbon credits from 3000 tons annually.
  - Biodiesel Production: Can earn 10,000 - 11,000 carbon credits annually from 10 TPD plants.
  - Ethanol Production: Similarly, can earn 10,000 - 11,000 carbon credits annually from 10 TPD plants.
- CBG production from cow dung/organic waste can earn 8500 - 9000 carbon credits annually from 10 TPD plantsPNGRB (Petroleum and Natural Gas Regulatory Board)
  - Vegetable oil can also be registered for carbon credit projects.
  - Sustainable Aviation Fuel (SAF) has significant potential for generating carbon credits.

Address by Mr. Vipan Chand Waila, Vice President, Kosher Climate India Pvt. Ltd.

- Mr. Waila stressed the conversation that to achieve the 1.5°C temperature goal, we need to cut 23 billion tons of GHG emissions from current levels by 2030.
- Biogas projects address 14 out of 17 Sustainable Development Goals (SDGs), benefiting both greenhouse gas (GHG) reduction and community development.
- Annual demand for carbon credits could reach 1.5 to 2.0 gigatons by 2030.
- Demand may increase to 7 to 13 billion tons CO2 by 2050.
- He elaborate the sources of Carbon Credits:
  - Nature-Based Sequestration: Such as reforestation.
  - Avoided Nature Loss: Including deforestation.
- Innovative methods to extract carbon from the environment.
- The carbon cycle typically takes a minimum of 2 years before the first monetization, involving two main steps:
  - Registration of the Project.
  - Verification and Issuance of Carbon Credits.

Address by Mr. Amol Nisal, AVP, Bioenergy, Praj Industries

- Mr. Nisal said that Conventional Biofuels are technologically mature and commercially viable.
- Advanced Biofuels Include 2G ethanol, sustainable aviation fuel (SAF), and biohydrogen, these are not yet commercially viable.
- Advanced biofuels significantly reduce carbon intensity, with SAF emitting 90% less than fossil fuels.
- Lifecycle emissions for conventional biofuels is 89 gm CO2 eq/MJ for SAF and 8gm CO2 eq/MJ.
- He emphasized that the Conventional jet fuel costs around ₹18 (equivalent to US price) per liter, while SAF production costs are 2 to 3 times higher. Bridging this gap is crucial for commercial viability and attracting investment.
- US Policy Incentives for SAF, price aligns with fossil fuels through incentives.
- In the US there are 2 types of Carbon Markets:
  - National Carbon Market
  - State-Level Carbon Market (lower standard emissions).
- Low Carbon Standard Features (USA):
  - Reduce carbon intensity (CI) of transportation fuels by 20% by 2030 from a 2010 baseline.
  - Annual Benchmarks Set for gasoline, diesel, and alternative fuels.
  - Fuel Pathway-Based Crediting for biofuels.
  - Project-based crediting for refineries (e.g., Green Hydrogen and CCUS).
  - CI Calculation Tools, GREET model for biofuels and oil production GHG estimator.
  - For Compliance & Reporting third-party verification for demonstrating compliance.

Day 1 Session on Carbon Credits in Bioenergy Sector

Recommendations and Key Takeaways from the session:

L to R: ***Mr. Amol Nisal,*** *AVP, Bioenergy, Praj Industries,* ***Mr. Sanjay Ganjoo****, Director General, IFGE,* ***Mr. Rajesh K Mediratta****, MD & CEO, Indian Gas Exchange Limited,* ***Mr. Srikant Nagulapalli****, Additional Secretary, Ministry of Power & Director General, Bureau of Energy Efficiency,* ***Mr. Rohit Kumar****, Secretary General, CMAI,* ***Mr. Vipan Chand Waila****, Vice President, Kosher Climate India Pvt. Ltd.*

- 40% reduction in emission intensity by 2030 (compared to 2005 levels).
- Includes bioenergy projects in the offset mechanism.
- Compressed Biogas (CBG) listed for carbon credit trading under Article 6.
- 2 billion tons of MSW globally, expected to double by 2050.
- Landfills generate 19 million tons of CO2, projected to reach 40 million tons by 2030.
- MSW management reduces GHG emissions and creates economic opportunities.
- Compressed Biogas (CBG) in India:
  - 62 million tons of resources.
  - 370-million-ton bio manure production capacity.
  - CBG can help double farmers' income through carbon credit incentives.
- Voluntary Carbon Market Operates under voluntary standards; no adjustments needed.
- Paris Agreement Mechanisms (Article 6.2 & 6.4): Credits adjusted and count towards other countries' NDCs.
- 17% of global carbon credit exports in 2022 came from India.
- CBG and other bioenergy activities eligible for carbon credit trading under the Paris Agreement.
- Bio-CNG, biodiesel, ethanol, and biogas production generate substantial carbon credits.
- Carbon Credits and Climate Goals:
  - 1.5–2.0 gigatons of carbon credit demand by 2030.
  - 7–13 billion tons of CO2 demand by 2050.
- Sustainable Aviation Fuel (SAF):
- 90% less CO2 emissions than fossil fuels but with higher production costs.
- Needs policy incentives to bridge the cost gap with conventional jet fuel.
- Low Carbon Standard targets 20% reduction in transportation fuel CI by 2030 from 2010 baseline.

Day 2 Session on Potential in CBG sector 1.0 : Economic Feasibility and Evolving Downstream Modalities

Key Topics Discussed: CBG Market assessment, CBG Pricing as per Energy Parity, MSW Management, Gas parameters Specification, Royalty modality, Feedstock Processing fees, Bio LNG market development and concern

Address by Mr. Ashish Kumar, VP, IFGE, Co- Chairperson IFGE: CBGPF, Managing Director, Verbio India.

Mr. Ashish Kumar moderated the panel discussion on raising the questions on Key topics - CBG Market assessment, CBG Pricing as per Energy Parity, MSW Management, Gas parameters Specification, Royalty modality, Feedstock Processing fees, Bio LNG market development and concern.

Address by Mr. Ketan Jadhav, Partner, EAC International Consulting

- Mr. Jadhav emphasized the agri-residue, sourced from farmers and aggregators, with an availability of 7.0-9.9 million tons per annum (MTPA) and yielding 10-14% CBG; press mud from sugar mills, contributing 350-460 thousand tons per annum (TPA) with a 3-4% yield; the organic fraction of municipal solid waste (OFMSW) from municipal corporations and urban local bodies, providing 1.8-2.5 million TPA with a 3-4% yield; and cattle dung from cow sheds, available at 60-100 thousand TPA, yielding 1-2%.
- The CBG market potential for 2024, which is projected at 9.2-12.9 million tons per annum.
- Mr. Jadhav identified several critical challenges and success factors influencing the successful implementation of Compressed Biogas (CBG) projects. Securing a consistent supply of feedstock at the right quality and cost remains the most crucial factor for success.
- Key observations of Mr. Jadhav include:
  - Assessment of feedstock availability and accessibility: A thorough evaluation of long-term supply and demand is essential to ensure a stable and adequate feedstock supply for CBG projects.
  - Assessment of feedstock quality: Factors such as form, particle size, moisture content, and impurities directly affect the yield potential, making quality assessment a vital aspect.
  - Transparency in supply chain models: Identifying cost-efficient supply chain models suitable for each region is necessary to minimize costs associated with feedstock collection.
  - Storage and maintenance of feedstock: Proper storage methods are required to preserve feedstock quality, minimize risks, and maintain the potential for high CBG yields.
- These factors underscore the need for robust strategies in feedstock management to drive the success of CBG initiatives in India.

Address by Mr. Anand Kumar Jha, Director (GP), Ministry of Petroleum and Natural Gas, Government of India

- Mr. Jha emphasized that CBG pricing can adopt various methodologies, such as linking it to energy content, competitive alternatives, or stable international benchmarks to accurately reflect usage patterns and market competition.
- A government group is currently developing a CBG pricing structure that ensures fair competition with gaseous fuels and sector-based pricing, aiming to enhance project viability by monetizing additional revenue streams.
- In the long term (5-15 years), a robust pricing framework should enable CBG to secure its market position, emphasizing gas-to-gas competitiveness while ensuring fair returns for producers and competitive consumer prices.
- CBG pricing should be based on ex-works rather than just delivered costs, with pipeline injection preferred for consistency.
- Producers must receive fair compensation for logistics and gas costs, with ongoing discussions by a government committee addressing these pricing issues.
- Additionally, pricing should account for the CO2 reduction potential of different feedstocks, akin to the structure used for ethanol pricing.
- The protection of the CBG industry under the Essential Services Management Act (ESMA) is also being considered.
- The government is in talks with the Asian Development Bank (ADB) and the World Bank regarding financing for CBG projects, with confirmation expected in the next 6-8 months.
- Detailed guidelines for CBG blending obligations are under approval, and the issuance of Renewable Gas Certificates is in progress.
- A notification regarding trunk pipeline connectivity will be issued shortly.
- Furthermore, the Ministry of Petroleum and Natural Gas (MoPNG) supports carbon sequestration from agricultural residues to restore soil health.
- By the end of the financial year, 25 CBG plants are anticipated to be operational, with measures to address disbursal concerns.

Address by Mr. Kapil Kumar Jain, Executive Director (Marketing- Retail LNG) GAIL India Ltd.

- Mr. Jain discussed that Bio LNG must maintain natural gas specifications according to the SS LNG gas conditioning skid requirements to ensure compatibility and performance.
- He mentioned that the Full utilization of Bio LNG by CGD (City Gas Distribution) entities is critical under the CBG-CGD synchronization scheme to optimize offtake and usage.
- He also discussed the Challenges in the offtake arrangements need to be addressed to ensure seamless supply chains for Bio LNG.
- Ensuring sufficient demand in the CNG (Transport) and PNG (Domestic) segments is vital, along with affordability for CGD entities, factoring in transportation and regasification costs.
- The synchronization of downstream infrastructure with the commissioning of Bio LNG units is essential. Mr. Jain recommended CGD entities must develop regasification facilities in nearby areas to facilitate smooth operations.
- He also stressed the clear guidelines on the taxation of Bio LNG are necessary to streamline operations and financial planning.

Address by Mr. Shyam Lal Poonia, Director (SBM-SPC), Ministry of Housing and Urban Affairs, Government of India

- Mr. Poonia pointed that there is a mandate to establish 75 CBG plants in urban areas under SDM 2.0, targeting a capacity of 15,000 TPD. However, many of these plants face challenges with segregation of feedstocks.
- Pricing should account for the segregation of feedstocks, and ULBs should be encouraged to provide concessional land to CBG producers based on feedstock segregation.
- Preprocessing costs could impact pricing, potentially lowering production costs. ULBs should be supported in handling waste as part of their responsibility.
- The estimated cost for a 100 TPD plant is 80 crore, and pricing should be revised to reflect actual machinery and technology costs.
- The PNGRB access code addresses pipeline pressure and gas transport beyond just gas quality, while BIS is updating standards to maintain 95-96% methane. PNGRB specifications for CNG and PNG differ slightly from BIS standards, but direct supply to commercial or industrial units doesn't require such high standards.
- OGMCs are investing in 15 MMT from 5,000 plants, with a focus on minimum offtake guarantees, especially for non-grid-connected plants. A settled ecosystem is needed, as "take and pay" is not ideal for the industry. OMCs and PSUs could offtake 75% from 50 plants, potentially up to 98% monetization, supporting bank financing.
- Challenges remain in credit extension, though MoHUA is working on a partial credit guarantee fund with NCGTC. A 1% CBG blending obligation is set for next year, but current production falls short, creating potential challenges for obligators.
- Mr. Poonia also indicated the government planning for the next 6 to 8 months which are as follows:
  - Funding Support: Provide ₹18 crore for the establishment of 100 TPD CBG plants.
  - Credit Guarantee Funds: Expedite the rollout of partial credit guarantee funds to ease financing challenges for CBG projects.
  - Land and Royalty: Ensure concessional land availability for CBG plants and remove royalty issues to facilitate smoother project execution.
  - Technology Advancement: Support the development and deployment of suitable CBG technologies to ensure long-term project success.

Day 2 Session on Potential in CBG Sector 1.0 : Economic Feasibility and Evolving Downstream Modalities

Recommendations and Key Takeaways from the session:

L to R: ***Mr. Ashish Kumar****, Vice Chairman IFGE CBG Producer Forum, Vice President IFGE & MD Verbio India,* ***Mr. Anand Kumar Jha****, Director (GP-I), MoPNG,* ***Mr. Shyam Lal Poonia****, Director (SBM-SPC), Ministry of Housing and Urban Affairs,* ***Mr. Kapil Kumar Jain****, Executive Director (Marketing-Retail LNG) GAIL (India) Limited*

- Assess and manage the availability and accessibility of relevant feedstocks across 250 districts, targeting a potential yield of 9.2 to 12.1 million tons per annum. Key feedstocks include agricultural residues (yielding 10-14% CBG, with a potential of 7-9.9 million tons), press mud (3-4% yield), organic fraction of municipal solid waste (OFMSW) (3-4% yield), and cattle dung (1-2% yield). Additional feedstocks like Napier grass should also be considered for enhancing production capacity.
- Establish clear criteria for feedstock quality assessment, focusing on particle size, moisture levels, impurities, and yield potential to ensure consistent supply and high-quality CBG production.
- Enhance transparency in the supply chain model to minimize sourcing costs, facilitating reliable collection of feedstocks while maintaining quality standards.
- Invest in effective storage and maintenance strategies to prevent losses that could affect CBG yield potential.
- Develop a robust pricing structure based on energy parity to ensure competitive positioning of CBG against other fuels. Pricing methodologies should consider energy content, competitive alternatives, and stable international benchmarks.
- Implement an ex-works pricing model that compensates producers fairly for logistics and gas costs, with a preference for pipeline injection as the standard offtake modality.
- Consider the CO_2 reduction potential of different feedstocks in pricing strategies, aligning with existing structures used for ethanol pricing to incentivize low-emission feedstocks.
- Explore government partnerships with institutions like the Asian Development Bank (ADB) and the World Bank to secure low-cost financing for CBG projects, ensuring long-term project viability.

Recommendations and Key Takeaways from the session:

- Promote municipal solid waste (MSW) management through CBG production by mandating municipalities to manage waste via CBG instead of incineration or landfilling, enhancing environmental sustainability.
- Support the establishment of urban CBG plants as part of the SDM 2.0 initiative, with a target capacity of 15,000 TPD, ensuring that ULBs are engaged in providing concessional land based on segregated feedstocks.
- Address preprocessing costs to keep CBG production economically viable, with attention to the actual costs of machinery and technology.
- Ensure alignment with PNGRB specifications for gas quality, including energy content and pipeline pressure, to maintain industry standards and facilitate market entry.
- Develop a minimum offtake guarantee structure to support bank financing, especially for plants not connected to the grid, emphasizing the need for a settled ecosystem to encourage investment.
- Prioritize the creation of a carbon sequestration strategy to restore soil health using agricultural residues, aiming to address carbon content deficiencies in soils.
- Expedite the issuance of Renewable Gas Certificates (RGCs) to incentivize green gas production and facilitate market entry for CBG.
- Monitor and enhance compliance with environmental and operational standards to promote sustainable practices within the CBG sector, ensuring long-term market stability.

Day 2 Session on Potential in CBG Sector 2.0 : Economic Feasibility and Evolving Downstream Modalities

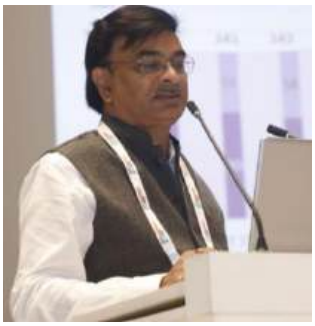
Topics Covered: The session focused on the economic viability and potential advancements within the Compressed Biogas (CBG) sector, with insights from various industry leaders.

Address by Mr. Narendra Bhooshan, Principal Secretary - Energy & Additional Sources of Energy, Government of Uttar Pradesh

- Mr. Bhooshan mentioned that the Uttar Pradesh (UP) leads with 117 CBG plants out of 526 nationwide, including 24 operational and 93 under construction, with a capacity of 210 TPD.
- The state contributes ~40,767 TPD (24%) of India's total CBG generation potential, supported by ample feedstock from agricultural and municipal solid waste.
- Government Support: UP offers a ₹20 crore subsidy for CBG producers, significantly lowering initial costs. Benefits include:
  - No Land Use Change Certificate required.
  - Aggregation of land for projects up to 12.5 acres.
  - Financial subsidy on electricity duty for 10 years.
  - Exemption from stamp duty on land procurement.
- He emphasized the need to educate farmers about the economic value of soil carbon content for profitable CBG production.
- Mr. Bhooshan discussed the need for frameworks allowing CBG producers to participate in carbon credit trading and promote CBG as a renewable energy source through green certificates.

Address by Mr. Ashish Anand Gupta, Chief General Manager (Marketing - Gas Transmission & Regulatory Affairs), GAIL (India) Limited

- Mr. Gupta highlighted a current deficit of ~7 MMSCMD, positioning CBG as a solution to bridge the gap.
- GAIL is ensuring an average offtake of ~100,000 SCMD of CBG through City Gas Distribution (CGD) networks.
- He stressed the importance of expanding the gas pipeline network for CBG integration, enhancing connectivity to demand hubs.
- Mr. Gupta noted challenges related to the quality of gas and the need for a proper evacuation system to prevent flaring of produced biogas.



Address by Dr. Tushar Patil, Assistant VP, Corporate Strategy, Praj Industries

- Dr. Patil emphasized the need for technology that maximizes gas production from feedstock through efficient conversion. He advocated for generating revenue from byproducts such as Fermented Organic Matter (FOM) to enhance economic viability. Dr Patil also Suggested designing CBG plants to utilize cellulosic biomass and emphasized the critical nature of preserving feedstock quality.

Address by Mr. Varun Karad, CEO, REnergy Dynamics (RED)

- Mr. Karad discussed the necessity of aggregating feedstock and establishing a robust supply chain for CBG.
- He raised concerns about CBG being underpriced compared to ethanol and suggested increasing MDA from ₹1,500 to ₹3,000 per ton.
- He also advocated for targeting increased prices for FOM, which can aid in improving profitability.

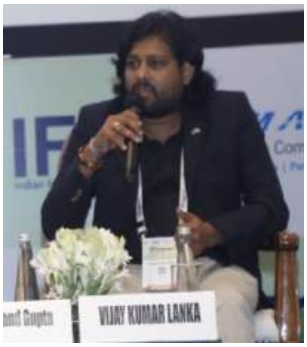
Address by Mr. Raj Mohan NC, Managing Director, Spantech Engineers Pvt. Ltd.

- Mr Mohan emphasized the need for identifying end consumers to enhance fuel value and promote industrial gas use.
- He suggested government participation in creating networks for identifying industrial zones for gas offtake.

Address by Mr. Santosh Gondhalekar, Director, Primove Engineering Pvt. Ltd.

- Mr Gondhalekar identified hydrolysis as a key bottleneck in biogas production and the need for techno-economically viable solutions.
- He also discussed, ethanol prices are not aligned internationally, affecting CBG pricing due to socio-political factors.

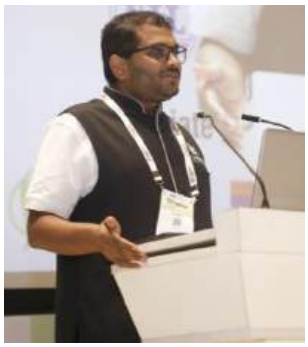
Address by Mr. Vijay Kumar Lanka, General Manager, Armatec India Pvt. Ltd.



- Mr. Lanka discussed the operational challenges in CBG plants, particularly in agitator management.

Address by Mr. Som Narayan, Director, Carbon Masters

- Mr. Narayan highlighted the importance of proper monetization of carbon credits and the need for MDA for FOM and LFOM.



Day 2 Session on Potential in CBG Sector 2.0 : Economic Feasibility and Evolving Downstream Modalities

Recommendations and Key Takeaways from the session:

L to R : ***Mr. Ashish Kumar****, Vice President, IFGE & Managing Director, VERBIO India Pvt. Ltd.,* ***Mr. Som Narayan****, Director Carbon Masters,* ***Mr. Santosh Gondhalekar****, Director, Primove Engineering Pvt. Ltd.,* ***Dr. Tushar Patil****, Assistant VP, Corporate Strategy, Praj Industries,* ***Mr. Narendra Bhoosan****, Principal Secretary- Energy & Additional Sources of Energy, Government of Uttar Pradesh,* ***Mr. Ashish Anand Gupta****, Chief General Manager (Mktg - Gas Transmission & Regulatory Affairs), GAIL (India) Limited,* ***Mr. Vijay Kumar Lanka****, General Manager, Armatec India Pvt. Ltd.,* ***Mr. Varun Karad****, CEO, REnergy Dynamics (RED),****Mr. Raj Mohan NC****, Managing Director, Spantech Engineers Pvt Ltd*

- Regularly review and adapt existing schemes to align with the evolving needs of the CBG sector, facilitating sustained investment.
- Strengthen and enforce mandatory blending obligations with penalties for non-compliance to create a stable market for CBG producers.
- Establish premium pricing mechanisms and certifications for high-quality CB
- Increase financial support for pipeline infrastructure development in remote areas and ensure timely disbursal of funds to expedite project completion. CBG production to incentivize superior output.
- Implement farmer education programs to raise awareness of the economic benefits associated with maintaining soil carbon content in relation to CBG production.
- Create frameworks for CBG producers to engage in carbon credit trading, providing additional revenue opportunities.
- Ensure ongoing financial support for infrastructure development, emphasizing timely fund disbursal for CBG projects.
- Allocate funding for research and development aimed at advancing technologies for more efficient gas production and byproduct utilization.
- Develop monitoring systems for CBG plant performance and foster collaboration among government agencies, industry stakeholders, and producers to enhance policy effectiveness.

Day 2 Session on Potential in CBG Sector - 3.0 : Taming the Feedstock Challenges and Success Factors

Key topics discussed: Financial assistance for biomass aggregation, policy recommendations for stable feedstock supply, challenges in biomass aggregation, feedstock management strategies, CBG's potential in green energy, and the need for a robust banking and policy framework.

Address by Mr. Shantanu Gupta, Executive Director, Indian Oil Corporation Limited

- Mr. Gupta opened the session with a presentation focusing on critical aspects of the CBG sector, emphasizing financial assistance schemes, policy recommendations, and feedstock supply chain management.
- Introduced the session by highlighting the crucial role of the CBG sector in India's energy landscape and its potential for growth.
- Discussed financial assistance schemes, such as the Sub-Mission on Agricultural Mechanization (SMAM), which provides a 50% subsidy for biomass collection equipment, further complemented by an additional 30% subsidy from the Uttar Pradesh government.
- Highlighted the MoP&NG scheme's allocation of ₹564.75 crore for biomass aggregation machinery, emphasizing grants for CBG producers using at least 50% biomass, making it easier for them to scale up operations.
- Emphasized the importance of policy recommendations, including the establishment of biomass clusters, long-term contracts with sugar mills for press mud, and dedicated policies for ex-situ crop residue management.
- Stressed the need for increased financial support for biomass aggregation equipment, working capital loans, and clear pricing policies to stabilize the feedstock supply chain for CBG producers.
- Concluded by addressing the various challenges faced in biomass aggregation, such as land availability, equipment shortages, and material diversion, and underscored the importance of effective feedstock management practices.

Address by Mr. V.K. Maheshwari, Executive Director, R&D, HPCL

- Mr. Maheshwari emphasized India's ambitious goal of achieving 60 MMTPA of CBG, which is equivalent to the energy output of two IOCL refineries. This ambitious target highlights the potential scale of CBG in India’s energy transition.
- He underscored the critical role of CBG as a substitute for natural gas, positioning it as a key contributor to reducing dependency on fossil fuels. Additionally, he highlighted its significance in facilitating the production of green hydrogen, further reinforcing its importance in India’s clean energy strategy.
- Mr. Maheshwari stressed the need for innovation in feedstock sourcing, particularly exploring alternatives like seaweed. This diversification is essential for maintaining a steady biomass supply chain, ensuring the sustainability of India's CBG targets in the long term.

Address by Mr. Mahesh Girdhar, MD & CEO, EverEnviro Resource Management Pvt. Ltd.

- Mr. Girdhar highlighted the circular economy potential of the CBG sector, emphasizing its contributions to renewable energy generation, carbon emission reduction, organic manure production, and effective waste management. He positioned CBG as a key element in creating sustainable and resource-efficient systems, He shared insights from the success of India's largest municipal solid waste (MSW)-based CBG plant in Indore, which benefits from a steady feedstock supply driven by increasing urbanization. However, he acknowledged the ongoing challenge of contamination from inorganic waste, which complicates the biogas production process, Mr. Girdhar also stressed the importance of educating farmers on the value proposition of CBG production, emphasizing how it can benefit both agriculture and energy sectors while providing a sustainable waste-to-energy solution

Address by Mr. Ashok Khosla, Chairman, Development Alternatives

- Mr. Khosla emphasized the critical need to balance energy production with sustainable resource use, drawing attention to the unintended consequences of over-efficiency, as exemplified by the Green Revolution. He highlighted the risks of depleting resources in the pursuit of maximum efficiency and urged a more thoughtful approach to energy development.
- He also cautioned against the potential social costs associated with rapid energy sector development, stressing the importance of careful planning to mitigate adverse outcomes. Mr. Khosla called for a holistic approach that considers not only economic gains but also the social and environmental impacts of energy policies.

Address by Mr. Govind G, VP - Business Development, TruAlt Bioenergy

- Mr. Govind discussed TruAlt Bioenergy's plans to establish four CBG plants, each with a capacity of 20 TPD. He highlighted the ongoing challenges in securing a reliable feedstock supply, which is crucial for the success of these projects.
- To address feedstock issues, he proposed integrating spent wash with the primary feedstock to meet the plants' requirements. Additionally, he emphasized the need for well-structured pricing strategies to ensure a stable and cost-effective feedstock supply. Mr. Govind also explored the potential for value-added products derived from CBG production, such as bio-sulfur and liquid-fermented organic manure, which could enhance the economic viability of the plants and contribute to sustainable waste management

Address by Mr. Tushar Lowalekar, Founding Member & CBO, Biofuel Circle Pvt. Ltd.

- Mr. Lowalekar highlighted the need for robust risk management in the CBG feedstock supply chain, calling for the creation of a supportive banking and policy framework to assist CBG producers in mitigating operational risks.
- He also emphasized the importance of establishing clear benchmark pricing for feedstock, noting that standardized pricing would help stabilize the supply chain and ensure consistent feedstock availability for CBG plants.

Address by Cdr. Subodh Rao, Head of Projects, Jwala Bioenergy

- Cdr Rao shared valuable insights from Denmark's successful biogas model, recommending a bottom-up approach that fosters collaboration between farmers and developers to ensure sustainable biogas production.
- He advocated for the adoption of co-digestion technologies and urged farmers to work together in creating centralized biogas plants. This collective approach, he emphasized, would enhance efficiency and sustainability in biogas production, benefiting both the agricultural and energy sectors.

Address by Dr. Tushar Patil, Assistant VP, Corporate Strategy, Praj Industries

- Dr. Patil highlighted the critical impact that feedstock combinations have on system efficiency, emphasizing the need for appropriate technology to optimize the digestion process and maximize biogas yields.
- He cautioned that improper mixing of different feedstocks could lead to a significant reduction in system performance, underscoring the importance of technology-driven solutions to ensure consistent and efficient biogas production.

Day 2 Session on Potential in CBG Sector - 3.0 : Taming the Feedstock Challenges and Success Factors

Recommendations and Key Takeaways from the session:

*L to R : **Dr. Tushar Patil**, Assistant VP, Corporate Strategy, Praj Industries, **Mr. Tushar Lowalekar**, Founding Member & Chief Business Officer, Biofuel Circle Pvt. Ltd. , **Mr. Atul Kharate**, Chief Operating Officer, IndianOil Adani Ventures Limited., **Mr. Shantanu Gupta**, ED, IOCL , **Mr. Ashok Khosla**, Chairman, Development Alternatives, **Mr. Mahesh Girdhar**, MD & CEO EverEnviro Resource Management Pvt. Ltd, **Mr. V.K. Maheshwari**, Executive Director (R&D) HPCL, **Mr. Govind G**, Vice President - Business Development, TruAlt Bioenergy, **Cdr Subodh Rao (Retd.)**, Head of Projects, Jwala Bioenergy*

- Continuously review and adapt financial schemes to meet the evolving needs of the CBG sector, ensuring accessibility and support for producers.
- Create biomass clusters to streamline the collection and aggregation of biomass feedstock, improving supply chain efficiency.
- Enforce 25-year agreements with sugar mills for press mud supply, ensuring price stability and reliable feedstock availability.
- Implement policies for the ex-situ use of crop residues to facilitate their effective utilization in biogas production.
- Enhance financial support by providing additional subsidies for biomass aggregation equipment, aiding producers in scaling their operations.
- Introduce financial assistance, including working capital loans and insurance schemes, to support biomass aggregators and depot operators.
- Offer land at nominal lease rates for decentralized biomass depots to facilitate aggregation and management of feedstock.
- Establish stable pricing policies for biomass feedstock to ensure fair compensation for farmers and maintain profitability for CBG producers.
- Municipal bodies should provide organic municipal solid waste to CBG plants under long-term agreements at no cost.
- Encourage research and cultivation of alternative feedstocks, such as Napier grass and seaweed, to diversify sources and enhance supply chain resilience.

Day 2 Session on Potential in CBG Sector 4.0 : FOM as Source of Organic Carbon Sequestration

Key topics discussed: This session focused on the challenges and opportunities associated with Fermented Organic Manure (FOM) as a by-product of Compressed Biogas (CBG) plants. The primary discussions revolved around positioning FOM as a soil conditioner rather than a nutrient source, addressing concerns related to quality standards, farmer adoption, and the policy framework under which FOM is governed.

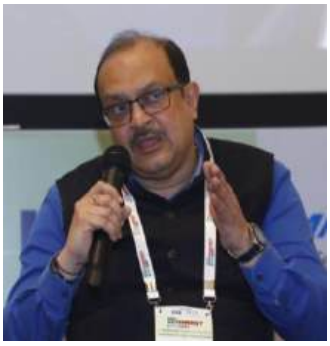
Address by Mr. Ashish Kumar, VP IFGE, Co- Chairperson IFGE: CBGPF, Managing Director, Verbio India.

- Mr. Ashish Kumar raised the need to define FOM either as a nutrient or carbon source for clearer marketing.
- Mr. Kumar also highlighted difficulties CBG plant owners face in meeting FCO norms to obtain MDA, questioning whether FOM should remain under FCO.
- He also concerned about logistical challenges in bagging large-scale FOM production, proposing bulk distribution for efficiency.

Address by Mr. Mahesh Girdhar, MD & CEO Ever Enviro Resource Management Pvt Ltd

- Mr. Girdhar advocated for recognizing FOM primarily as a soil conditioner rather than a direct nutrient source like NPK fertilizers. He emphasized its role in enhancing soil health and structure.
- He highlighted the need for relaxed yet consistent quality standards for FOM to avoid confusion in the market, ensuring that the product remains viable without overly stringent regulations.
- Additionally, he proposed a progressive subsidy model, where subsidies would be linked to the level of enrichment in FOM, encouraging producers to improve the quality of their output over time.

Address by Mr. Sabyasachi Kumar, Vice President Head-Revenue & Channel Bio Energy, Reliance Industries Limited



- Mr. Kumar acknowledged that FOM has minimal NPK value and called for enhanced collaboration between ministries to explore effective monetization strategies for FOM.
- He highlighted FOM's significant potential to restore depleted soil carbon levels in Indian agricultural lands, emphasizing its role in promoting sustainable farming practices.
- Additionally, Mr. Kumar stressed the importance of educating farmers about the long-term benefits of using FOM, encouraging them to adopt this sustainable practice for improved soil health.

Address by Dr. Tushar Patil, Assistant VP, Corporate Strategy, Praj Industries

- Dr. Patil explained that FOM acts as a microbial enhancer, significantly boosting microbial activity in the soil and leading to long-term improvements in soil health.
- He shared insights on optimizing the FOM processing time to increase efficiency; however, he noted that adhering to FCO standards can elevate production costs.
- Dr. Patil urged the need for a farmer-centric design, advocating for the development of FOM in smaller, user-friendly forms to facilitate easier application for farmers.

Address by Prof. V. K. Vijay, IREDA Chair Professor, CRDT, IIT Delhi

- Prof. Vijay emphasized the importance of customizing FOM to meet local soil requirements, advocating for tailored marketing strategies that align with specific regional needs.
- He argued that effective monetization of FOM is essential for ensuring the financial viability of CBG plants, highlighting the need for sustainable economic models within the sector.

Address by Mr. Kevin Houston, Director, Carbon Masters

- Mr. Houston shared positive outcomes from utilizing liquid digestate, highlighting its effectiveness; however, he expressed concerns regarding the nutrient delivery capabilities of solid FOM.
- He pointed out that the existing FCO framework is restrictive for organic fertilizers, arguing that traditional distribution channels are not suitable for promoting FOM.
- To enhance the adoption of FOM, Mr. Houston suggested exploring alternative distribution outlets, such as agri-tech platforms, to scale up its market presence and accessibility.

Address by Mr. Sanjeev Nagpal, MD, Sampurn Agri Ventures Pvt. Ltd.

- Mr. Nagpal asserted that FOM should not fall under the purview of the FCO due to its diverse raw materials and varying nutrient content, which makes standardization challenging.
- He expressed support for implementing safety standards for FOM; however, he opposed the establishment of nutrient-based standards, emphasizing the importance of flexibility in quality control.
- Mr. Nagpal highlighted the necessity for FOM to be tailored according to local soil conditions, advocating for customized approaches that enhance its effectiveness in different agricultural contexts.

Day 2 Session on Potential in CBG sector 4.0 : FOM as Source of Organic Carbon Sequestration

Recommendations and Key Takeaways from the session:

L to R : ***Mr. Ashish Kumar****, Vice President, IFGE & Managing Director, VERBIO India Pvt. Ltd.* ***Mr. Sanjeev Nagpal****, Director, Sampurna Agri Venture Pvt. Ltd.,* ***Dr. Tushar Patil****, Assistant VP, Corporate Strategy, Praj Industries,* ***Prof. V. K. Vijay****, IREDA Chair Professor, CRDT, IIT Delhi,* ***Mr. Sabyasachi Kumar****, Vice President Head-Revenue & Channel Bio Energy, Reliance Industries Limited,* ***Mr. Mahesh Girdhar****, MD & CEO Ever Enviro Resource Management Pvt Ltd,* ***Mr. Kevin Houston****, Director, Carbon Masters*

- FOM should be excluded from the FCO standards designed for chemical fertilizers, with a separate set of progressive quality standards developed that account for its role as a soil conditioner and carbon enhancer.
- The process for claiming MDA needs to be streamlined, with timelines for disbursal set and enforced. A digital platform could be introduced to track MDA claims, ensuring transparency and accountability.
- The government should facilitate the creation of a separate market for organic fertilizers like FOM by incentivizing distributors, building awareness campaigns for farmers, and introducing programs that recognize FOM's role in sustainable agriculture.
- A policy should be introduced to allow farmers using FOM to participate in carbon credit schemes, providing an additional revenue stream while contributing to India’s net-zero targets through carbon sequestration in soil.
- Policies should encourage the development of bulk distribution systems for FOM, particularly for large-scale CBG plants producing high volumes of FOM daily. The government could incentivize public sector units (PSUs) and private companies to engage in large-scale FOM distribution.
- The Ministry of Petroleum and Natural Gas (MoPNG) and the Ministry of Agriculture and Farmers Welfare should collaborate to promote FOM as part of broader sustainable farming initiatives, ensuring alignment in objectives through joint policies.

Day 2 Session on Potential in Biomass Sector- 1.0 : Policies & Mandate – Technology

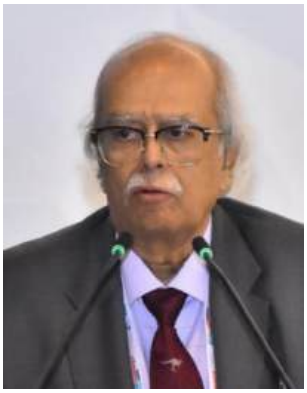
Key topics discussed: Financial implications and economic potential of biomass, Biomass Utilization in Thermal Power Plants, Collaboration and Stakeholder Engagement, Funding and Insurance Support, Sustainable Tendering Practices, Research and Development Needs, Capacity Building for Skilled Labor, Pelletization Process and Machinery, Transportation Costs, Indigenous Technology Development, New Opportunities in Renewable Energy. These topics reflect the session's focus on enhancing the viability and efficiency of the biomass industry while addressing environmental and economic challenges.

The session started with a welcome address from the Moderator and to set the tone Mr. Kwatra engaged all the panelists in discussing how to strengthen the biomass sector in every aspect.

Address by Mr. Satish Upadhyay, Mission Director, SAMARTH Mission

- Mr. Upadhyay chair of the session commenced his address by outlining the operational framework of the SAMARTH Mission, subsequently delving into the financial implications and economic potential of the biomass industry. He articulated how the adoption of briquettes and pellets for co-firing in thermal power plants can yield substantial benefits, including enhanced farmers' incomes, support for pellet manufacturers, and a reduction in CO2 emissions.
- Mission director mentioned about the recent rules mandate a minimum of 5% pellet blending in thermal power plants to avoid environmental penalties for in Delhi NCR region.
- Emphasized ongoing collaboration with farmers, GENCOs, state and central governments to address sector challenges.
- Mr. Upadhyay stressed need for effective fund allocation and encouraged insurance companies to support biomass industry for development.
- Suggested GENCOs to issue multiple smaller tenders to encourage competition and prevent defaults caused by unrealistic tender amounts, benefiting both suppliers and consumers.
- Called for increased R&D to identify proven technologies and machinery for torrefied and non-torrefied pellets in India.
- He also stressed the need to address the skilled labor shortage through capacity-building efforts.
- The SAMARTH Mission aims to create a market for biomass briquettes and pellets by promoting their use in thermal power plants and raising awareness across industries that require heat, opening up new opportunities in multiple sectors.

Address by Mr. T. S. Venkataraman, Chairman & Managing Director, Esvin Advanced Technologies Ltd.



- India has the potential to utilize 200 million metric tons of excess biomass annually due to its fertile land and favorable climate.
- High-yield energy crops can be grown on wastelands to increase biomass availability. Bagasse, currently used for electricity generation, can be more valuable if utilized for biofuel production. Discussed the possibility of converting high-lignin biomass into heating sources when unsuitable for gasification.
- Thermal gasification technology is developing as a flexible, cost-effective method to produce biofuels like bio-syngas, biomethanol, and bio-hydrogen.Advancing biomass gasification requires institutional and government support from bodies like NITI Aayog and the Government of India. Exploring various biomass types, such as bagasse and bamboo, can help in energy production, including the extraction of hydrogen and ammonia as cost-effective alternatives

Address by Mr. Subodh Kumar, Advisor to the National Team, IFGE, ED, ValPro & Former ED, IOCL

- Mr. Subodh Kumar commenced his speech by reminding the audience that biomass should not be treated as waste; it needs to be priced properly to incentivize farmers and users.The entire value chain of bioenergy, from biomass collection to conversion, needs to be made profitable, like the ethanol production model.A "pass-through" mechanism should be established where costs are covered by end consumers, ensuring a win-win situation for all stakeholders.
- Paddy straw was previously burned to clear fields for the next crop, but now it needs to be purchased for bioenergy production, adding to raw material costs.
- The costs of converting biomass into usable fuel (e.g., pellets or briquettes) need to be factored in, similar to ethanol production, where oil companies cover the cost.

Address by Mr. Kalpesh Mehta, MD, Chairman Gattuwala Energy Solutions Pvt. Ltd.

- Mr. Mehta discussed the biomass pelletizing process and its adaptability.
- Mr. Mehta highlighted that over-dependence on manual labor can negatively impact productivity, making automation crucial for modern operations.
- He discussed the key challenges facing briquette and pellet manufacturers including labourer dependency and significant downtime for maintenance.
- Mr. Mehta also discussed his company's innovative solutions, such as sensor-based machines that alert operators to issues via mobile apps, enabling remote monitoring and control. This reduces reliance on labour and minimizes downtime.

Address by Dr. Mukesh Jain, Director, Northern Region Farm Machinery Training and Testing Institute, Hisar, Ministry of Agriculture and Farmers Welfare

- Dr. Jain discussed various programs and policies that support the biomass pelletization process.
- Highlighted the use of biomass bundlers and accumulators to significantly improve efficiency in the pelletization process.
- Emphasized the importance of adding value to the machinery segment for better performance.
- Stressed the need for comprehensive testing of machines to ensure effectiveness and suitability for different biomass processing tasks.
- The government has invested over ₹10,000 crore in mechanizing crop residue management, providing machines like shredders, balers, and custom hiring centers to farmers. The active fire locations (resulting from stubble burning) have been reduced by 66% in five years due to these interventions.
- A new scheme promotes supply chain management, allowing entrepreneurs to purchase high-horsepower tractors and large balers with a subsidy of 65% on project costs up to ₹1.5 crore.
- New machines like biomass bundlers and accumulators have been introduced to improve the aggregation of biomass.

Address by Mr. Shivam Mungiya, Director, Enliven Nature (LLP)

- Mr. Mungiya highlighted the necessity of updating policies surrounding pellet manufacturing to encourage ongoing technological advancements.
- He stressed the critical role of minimizing transportation costs to improve overall efficiency and sustainability in biomass pelletization.
- Mr. Mungiya recognized recent policy changes that have positively impacted pellet manufacturers, particularly in relation to procurement by power stations.
- However, he urged for additional policy reforms aimed at reducing transportation expenses and promoting local procurement by power plants, which would not only lower the carbon footprint but also decrease logistical costs for manufacturers.
- Technology partners must persist in enhancing their machinery to meet the increasing demand for pellets and facilitate biomass aggregation.
- The panel also talked about developing indigenous machines, as most current machinery is imported, expensive, and often not suitable for specific tasks, like processing paddy straw. Improving the quality and utility of Indian-made machines through rigorous testing was emphasized.

Day 2 Session on Potential in Biomass Sector - 1.0 : Policies & Mandate – Technology

Recommendations and Key Takeaways from the session:

L to R : ***Mr. Shivam Mungiya****, Enliven Nature (LLP),* ***Mr. Amam Kwatra****, Member, IFGE: BGAF,* ***Mr. Subodh Kumar****, Advisor to the National Team, IFGE, ED, ValPro & Former ED, IOCL,* ***Mr. Satish Upadhyay****, Mission Director, SAMARTH Mission,* ***Mr. T. S. Venkataraman****, Chairman & Managing Director, Esvin Advanced Technologies Ltd.,* ***Dr. Mukesh Jain, Director****, Northern Region Farm Machinery Training and Testing Institute, Hisar (Ministry of Agriculture and Farmers Welfare,* ***Mr. Kalpesh Mehta****, MD, Chairman Gattuwala Energy Solutions Pvt. Ltd.*

- There is a strong emphasis on the need for concerted efforts among stakeholders to enhance the viability of various biomass technologies.
- The importance of indigenizing biomass technology, particularly in pelletizing and gasification, was highlighted as essential for local development and sustainability.
- Molasses, bamboo, and bagasse were identified as promising materials for biomass energy, particularly through agroforestry practices.
- The potential for producing hydrogen and green ammonia from biomass presents exciting new avenues for renewable energy.
- The necessity for sustainable machinery, along with mandatory testing standards for manufacturers, was emphasized to ensure quality and reliability in biomass processing.
- The need for automation in briquetting and pelleting processes was recognized as a way to improve efficiency and reduce dependency on manual labour.
- Addressing transportation costs is crucial for enhancing the overall efficiency and sustainability of biomass pelletization.
- There is a pressing need for efficient harvesting machinery for bamboo to reduce manual labor and increase productivity in biomass sourcing.

Overall, the session underscored the importance of innovation, sustainability, and collaboration in advancing the biomass industry.

Day 2 Session on Potential in Biomass Sector- 2.0 : Policies & Mandate – Technology

Key topics discussed: Biomass Sector Potential, Green Hydrogen Opportunities, Sustainable Supply Chains, Stubble Burning Impact, Biomass Policies, Standardization of Biomass Pellets, Biomass Integration in Energy Production, Biogas and Biofuel Conversion, AI and Data Analytics in Supply Chain, Waste Utilization Strategies, Feedstock Availability Challenges, Value Chain and Supply Chain Integration, Sustainable Practices in Biomass Production, Innovation and Marketability, Environmental Impact Mitigation, Technological Innovations, Policy Advocacy for Biomass, Collaboration Among Stakeholders

Address by Col. Rohit Dev, Co-Chairperson, IFGE: Biomass Global Associates Forum

Moderator Col. Rohit Dev commenced the session by discussing the potential of the biomass sector, highlighting opportunities in green hydrogen, entrepreneurship, and the development of sustainable biomass supply chains.

Address by Mr. Virinder Sharma, Member-Technical, Commission for Air Quality Management (CAQM)

Mr. Virinder Sharma discussed the environmental impact of stubble burning on air quality and emphasized various biomass policies and disincentives to encourage biomass utilization.

Address by Dr. Firoz Hossain, Principal Scientist, Division of Genetics, ICAR-IARI

Dr. Hossain introduced Bhima Bamboo, which can yield 40 tons of biomass per acre and is ready for harvest in 1.5 years. Discussed the cultivation of Napier grasses and husk as alternative biomass sources.

Address by Mr. Sanjay Jain, Business Head, Livgreen Cleantech Pvt. Ltd

Mr. Jain stressed on standardization of biomass pellets, by highlighting the necessity for standardizing biomass pellets to ensure quality and efficiency in energy production.

Address by Mr. Gurpreet Singh Gawra, Additional General Manager (Biomass), NTPC

Mr. Gawra discussed NTPC's approach to integrating biomass into energy production. Emphasized the importance of strategic planning in biomass sourcing and pellet utilization.

Address by Dr. Sachin Kumar, Scientist C, SSS-NIBE, Kapurthala

Dr. Sachin, explained conversion processes for biomass into biogas, ethanol, and hydrogen. Stressed the need for standardizing biogas operations and promoting indigenous biofuel technologies.

Address by Col. Sandeep Singh, Head Biofuels Operations, DCM Shriram Ltd.

Col. Sandeep discussed the use of AI and data analytics to predict biomass availability and improve supply chain efficiency. Emphasized consultation and automation in operational and maintenance aspects.

Address be Col. Neeraj Marwah, Senior Vice President (Feedstock & Supply Chain Management), GPS Renewables

Mr. Marwah, discussed waste utilization, discussed the design of plants for municipal solid waste (MSW) and agricultural waste. Highlighted the challenges of sourcing paddy straw, which requires a collection of 45,000 metric tons annually.

Address by Mr. Amrit Khater, Managing Director, Hi Tech Agro Energy Pvt. Ltd.

Mr. Khater addressed the non-uniform availability of feedstock and the strategic planning required to ensure a consistent supply.

Address by Mr. Viral Gamit, Corporate Sustainability, Arvind Mills

Mr Gamit discussed the challenges and intricacies of various business models in the biomass sector.

Day 2 Session on Potential in Biomass Sector- 2.0 : Policies & Mandate – Technology

Recommendations and Key Takeaways from the session:

L to R : Mr. Viral Gamit*, Corporate Sustainability, Arvind Mills,* ***Mr. Gurpreet Singh Gawra****, Addl. General Manager, General Manager (Biomass), NTPC,* ***Dr. Sachin Kumar****, NIBE, Kapurthala,* ***Col. Sandeep Singh****, DCM Shriram ,* ***Col. Neeraj Marwah****, Senior Vice President (Feedstock & Supply Chain Management), GPS Renewables,* ***Mr. Sanjay Jain****, Business Head, Livgreen Cleantech Pvt. Ltd,* ***Col. Rohit Dev****, Co-Chairperson, IFGE: Biomass Global Associates Forum,* ***Mr. Virinder Sharma****, Member- Technical, CAQM,* ***Dr. Firoz Hossain****, Principal Scientist, Division of Genetics, ICAR-IARI,* ***Mr. Amrit Khater****, Managing Director, Hi Tech Agro Energy Pvt. Ltd.*

Biomass Sector Potential

- Invest in Research: Promote research initiatives to unlock the full potential of biomass resources.
- Market Development: Create platforms to connect biomass producers with energy producers to enhance market access.

Green Hydrogen Opportunities

- R&D Funding: Allocate funds for research on biomass-derived green hydrogen technologies.
- Pilot Projects: Initiate pilot projects to demonstrate the feasibility and efficiency of biomass-based hydrogen production.

Sustainable Supply Chains

- Supply Chain Optimization: Implement best practices for optimizing the biomass supply chain, focusing on efficiency and cost reduction.
- Stakeholder Engagement: Foster collaboration among stakeholders to identify and address supply chain bottlenecks.

Stubble Burning Impact

- Awareness Campaigns: Launch educational campaigns to inform farmers about the environmental impact of stubble burning and the benefits of biomass utilization.
- Incentive Programs: Establish incentive programs for farmers to promote the collection and use of agricultural residues.

Biomass Policies

- Supportive Policies: Advocate for policies that incentivize biomass utilization and penalize practices like stubble burning.
- Policy Frameworks: Develop comprehensive policy frameworks that address all aspects of biomass value chain.

Recommendations and Key Takeaways from the session:

Standardization of Biomass Pellets

- Quality Standards: Establish national standards for biomass pellets to ensure consistency and reliability in energy production.
- Certification Programs: Create certification programs for producers that meet quality and sustainability criteria.

Biomass Integration in Energy Production

- Strategic Planning: Encourage power producers to integrate biomass strategically into their energy portfolios.
- Incentives for Co-firing: Provide financial incentives for thermal power plants that incorporate biomass co-firing.

Biogas and Biofuel Conversion

- Biogas Technology Promotion: Support the development and adoption of efficient biogas conversion technologies.
- Standard Operating Procedures: Create standardized protocols for biogas production and utilization.

AI and Data Analytics in Supply Chain

- Leverage AI and data analytics to enhance decision-making and optimize biomass procurement and distribution.
- Implement predictive analytics to forecast biomass availability and demand trends.

Waste Utilization Strategies

- Develop initiatives to convert municipal and agricultural waste into energy.
- Encourage innovative designs for biomass plants that effectively utilize waste materials.

Feedstock Availability Challenges

- Encourage long-term supply contracts to ensure consistent feedstock availability.
- Promote diversification of feedstock sources to reduce dependency on specific materials.

Value Chain and Supply Chain Integration

- Adopt a holistic approach to integrate value chain management with supply chain logistics for biomass.
- Facilitate collaboration between agriculture, energy, and waste management sectors.

Sustainable Practices in Biomass Production

- Share best practices for sustainable biomass production through workshops and training.
- Encourage the adoption of sustainability certifications for biomass producers.

Innovation and Marketability

- Provide funding and mentorship for startups focused on biomass innovations.
- Enhance market awareness of biomass products through promotional campaigns.

Environmental Impact Mitigation

- Conduct environmental impact assessments for biomass projects to identify and mitigate potential issues.
- Ensure compliance with environmental regulations in all biomass production and utilization activities.

Technological Innovations

- Invest in technological innovations for biomass processing and conversion.
- Partner with academic institutions to foster innovation in biomass technologies.

Policy Advocacy for Biomass

- Actively engage with policymakers to advocate for favorable biomass policies.
- Build coalitions of stakeholders to strengthen advocacy efforts for biomass sector support.

Collaboration Among Stakeholders

- Establish platforms for stakeholders to share knowledge and best practices in the biomass sector.
- Encourage joint ventures between private and public sectors to drive biomass initiatives forward.

Day 2 Session on Potential Carbon Capture, Storage and Utilization (CCUS)

Key topics discussed: Carbon Capture, Carbon Utilization, Carbon Storage, Technologies, Solvents, Industries' emissions, Policy requirement, Challenges, Solution

Address by Mr. Keshav Goela, Director, SS Gas Lab Asia

- Mr. Goela, moderator, commenced the session by providing the context, followed by introducing and welcoming the panellists.
- CCUS is critical for India's climate goals of reducing CO2 emissions by 50% by 2050 and achieving net-zero by 2070, especially in hard-to-abate sectors like steel, cement, oil, and gas.

Address by Dr. S. Dasappa, Professor, Centre for Sustainable Technologies/ ABETS, CGPL, Indian Institute of Science

- Dr. Dasappa stretched the attention of the audience that Technology and policy must work together to drive bioenergy advancements.
- A large amount of fossil fuel is still used to meet industrial needs, but technological interventions can make bioenergy solutions cost-effective.
- Decarbonizing sectors like steel is a major challenge, especially without cost-effective solutions like low-cost hydrogen and carbon pricing.
- Carbon capture is relatively easier, but utilization needs further exploration.
- He stressed the importance of Collaboration among technology providers, policymakers, and industries is essential to develop sustainable, carbon-negative solutions.

  He said that a comprehensive policy is needed to enable large-scale demonstrations of these technologies.
- A variety of solutions should evolve based on the specific end-use case (e.g., food-grade CO2 capture).
- Financial incentives per ton of CO2 may or may not work, but showcasing technological solutions is key to industry acceptance.
- CBAM (Carbon Border Adjustment Mechanism) is pushing some industries toward carbon capture and decarbonization.
- Leadership from PSUs and strong support for demonstration projects are essential to drive progress in CCUS and decarbonization initiatives.

Address by Mr. Yash Aggrawal, Co-Founder - Carbonetics Carbon Capture

- Mr. Aggarwal mentioned that India emitted 2.4 billion tons of CO2 in 2022, with emissions set to increase as the country develops.
- India has ambitious targets: a 50% reduction in emissions by 2050 and net zero by 2070.
- Top three CO2 emitters in India: power, iron & steel, and cement industries.
- He elaborate the emission factors:
  - Power: 0.5–1 ton CO2 per megawatt-hour.
  - Iron and steel: 1.6–3.2 tons CO2 per ton of steel.
  - Cement: 0.5–0.7 tons CO2 per ton of cement.
- Focus on the cost of carbon capture: Higher CO2 partial pressure in the kiln gas (13–22%) reduces capture costs.
- India needs to optimize carbon capture technologies to reduce costs and facilitate rapid adoption maintaining industrial growth and self-reliance.
- 95% of global CCUS projects use Chemical Solvents technology
- He said that 1.52 MW energy required initially per ton of CO2.
- Achieved a 43% reduction to 0.86 MW per ton through specialized media and contactors.
- Further 16% reduction via waste heat recovery.
- Seeking government backing for demonstration units.
- The world has moved beyond MEA (Monoethanolamine) to novel solvents and specialized capture media.
- Intervention needed to demonstrate Indian-developed technologies instead of relying on foreign solutions.
- Advocating for an environment where PhDs and startups can collaborate to showcase Indian innovations.
- Suggests establishing a joint demonstration center for capital-intensive projects.

Address by Mr. Sangeet Jain, Vice President ESG, Strategy & Alliances, LanzaTech Private Limited,

- Mr. Jain discussed about the taxes journey and informed the audience and said that in the 1980s, import duties on chemicals were above 200%, supporting a thriving ethanol-based chemical industry in India.
- Post-1991 liberalization reduced import duties, increasing competition and forcing companies to adapt.
- Companies that survived liberalization scaled up their capacities with low-cost methods.
- Shifted towards specialty chemicals with higher margins and focused on premium-paying customers.
- As early as the 2000s, companies started paying a premium for products with a lower carbon footprint.
- He emphasized the policies needed to support the large-scale expansion of carbon utilization.
- New technologies face high capital costs and market uncertainty (whether products will gain premium pricing).
- In sectors where CO2 needs to be captured, there are two paths: sequestration or utilization.
- Sequestration requires significant capital investment.
- There needs to be an environment where we need to have some incentives for people to invest into these industries and create products which have lower carbon intensity.

Address by Mr. V P Bhandarkar, DGM & Head Innovation, Thermax Limited

- Mr. Bhandarkar mentioned the key polluting sectors include cement, steel, power, and refineries.
- While much focus is on decarbonizing transportation (EVs, fuel cells, ethanol), hard-to-abate sectors require more attention.
- Current technologies face challenges, particularly in terms of CAPEX and OPEX costs.
- CO2 capture technologies include absorption, adsorption, membranes, cryogenics, chemical looping, and biological (e.g., algae-based) methods.
- He discussed the cost and expressed that absorption-based technologies, especially amines (e.g., MEA), are most common but not commercially viable at scale due to high costs.
- Currently, there are around 40 operational CCUS plants, with approximately 500 in various stages of development.
- Even with these, CO2 capture capacity is expected to reach only 400 million tons per year, less than 1% of global emissions.
- MEA shows poor thermal, chemical, and oxidative stability, leading to degradation and higher OPEX.
- CO2 forms stable carbamate with MEA, requiring significant energy to regenerate amines.
- Amine degradation adds to operational costs.

Address by Dr. R N Maiti, CGM (R&D), Engineers India Limited (EIL)

- Dr. Maiti said that expertise in CO2 capture, emissions estimation, and storage (though storage tech hasn't been deployed yet).
- CO2 Chitra: an indigenous web-based software developed for CO2 emissions estimation (Scope 1 & Scope 2) and reporting.
- Patented solvent-based technologies for efficient CO2 absorption, especially for flue gases with contaminants.
- Specialized solvent formulations developed for low-pressure CO2 capture.
- Initiatives in green hydrogen and biochemicals using CO2.
- He emphasized on the development of technologies like energy heaters and software tools (Utility Optimizer) to improve energy efficiency in process industries

Address by Dr. Sasisanker Padmanabhan, Senior Principal Scientist, Praj Industries

- Mr. Padmanabhan said that the advanced absorption and cryogenic technologies are used for capture, benefiting from high-purity CO2 (99%).
- No immediate decision on a winning technology; screening innovations like electro-catalytic and bio-based catalysis.
- Assessing technologies at TRL (Technology Readiness Level) 3 or 4, aiming for demonstration and pilot plants.
- investigating renewable materials like mineral aggregates for roads and pavements.
- Emphasizing the need for a comprehensive roadmap and supportive policies similar to biofuels and energy sectors.

Day 2 Session on Potential Carbon Capture Storage and Utilization (CCUS)

Recommendations and Key Takeaways from the session:

L to R: ***Mr. Keshav Goela****, Director, SS Gas Lab Asia,* ***Mr. Yash Aggrawal****, Co-Founder - Carbonetics Carbon Capture,* ***Dr. R N Maiti****, CGM (R&D), Engineers India Limited (EIL),* ***Mr. V P Bhandarkar****, DGM & Head Innovation, Thermax Limited,* ***Dr. S. Dasappa****, Professor, Centre for Sustainable Technologies/ ABETS, CGPL, Indian Institute of Science,* ***Dr. Sasisanker Padmanabhan****, Senior Principal Scientist, Praj Industries,* ***Mr. Sangeet Jain****, Vice President ESG, Strategy & Alliances, LanzaTech Private Limited,*

- CCUS is critical for India's climate goals of reducing CO2 emissions by 50% by 2050 and achieving net-zero by 2070, especially in hard-to-abate sectors like steel, cement, oil, and gas.
- The EU's Carbon Border Adjustment Mechanism will impact heavy industry exporters, emphasizing the need for CCUS adoption for competitiveness.
- Cost-effective CCUS solutions remain elusive, with a focus on balancing innovation with industry needs.
- India emitted 2.4 billion tons of CO2 in 2022, major emitters being power, iron, steel, and cement industries.
- Cement industry contributes significantly to emissions, especially from calcination, which accounts for 60% of CO2 emissions. Transition technologies like CCUS are essential to mitigate this.
- Emission factors vary by industry—power (0.5 to 1 ton CO2/MWh), steel (1.6 to 3.2 tons CO2/ton steel), and cement (0.5 to 0.7 tons CO2/ton cement)
- Sequestering carbon helps store CO2, but utilization can create revenue streams.
- Establishing a capacity leads to building supply chains, attracting investment, and creating jobs.

Recommendations and Key Takeaways from the session:

- It promotes the production of materials with lower carbon intensity, benefiting industries that use such materials.
- Startups face challenges with bureaucracy in securing funding and grants.
- Government support for demonstration units is needed to build industry confidence.
- Indian-developed technologies should be prioritized, with joint demonstration centers for capital-intensive projects being a potential solution.
- A clear policy roadmap is needed, similar to those for biofuels and other energy sectors.
- Government initiatives to build this roadmap could provide the necessary momentum for CCUS development.
- A data-driven approach is needed for developing specialized solutions tailored to specific needs of industries.
- Significant financial investment is required for demonstration projects, accurate cost assessments are necessary.
- CCU requires geological mapping to identify suitable sites for CO2 storage, which may take significant time.
- Government policies should support de-risking of CCUS technologies to encourage innovation and investment.
- Public sector undertakings should encourage to procure green products for CCUS innovations.
- Integrating research and development efforts can lead to innovative solutions in CCUS.
- Learning from international best practices can inform the development of effective CCUS technologies.
- Engaging all stakeholders in the CCUS conversation is vital for ensuring diverse perspectives are considered.
- Establishing robust monitoring and evaluation frameworks will help track the effectiveness of CCUS initiatives.
- Implementing public awareness campaigns about the benefits of CCUS can help garner support.
- Need to develop clear regulatory frameworks which provide clarity and encourage investment in CCUS technologies.
- Innovative funding mechanisms should be explored to support CCUS projects, especially for startups.
- Encouraging collaborative innovation among different sectors can accelerate technological advancements.
- Clear policy roadmaps will help guide the development of CCUS technologies in a structured manner.
- Fostering partnerships between government and industry will drive CCUS initiatives forward.
- Emphasizing the development of localized technologies will reduce dependence on imported solutions.
- Encouraging research collaborations among academic institutions and industries can drive innovation.
- Need of technological advancements in carbon capture and utilization.

Day 2 Session on the Potential of Bio-Mobility in India

Key topics discussed: Biofuels, Fuel for Railways, Research for the sustainable Fuels, Case Studies, Availability of feedstock for fuels, Accessibility for different fuels.

Address by Mr. Sandeep Theng, Director, IFGE

The session commenced with the moderator, Mr. Theng, who warmly welcomed the panellists and introduced the chair of the session, Mr. Ram, setting an engaging tone for the discussions ahead by providing the context of the session.

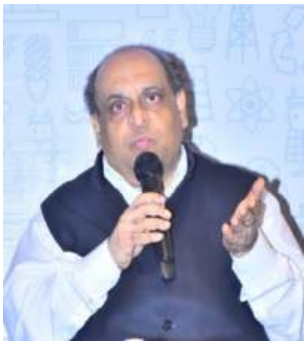
Address by Mr. Rajnath Ram, Advisor (Energy) NITI Aayog

Mr. Ram talked about the transportation contribution of GHG around 12-13% in overall GHG emission. There a lot of challenges are being faced in supply chain, Technology etc. In Primary Energy Mix, 84% compositions come from fossil basis energy resources like coal 49%, Oil 30% and 7% Gas. Oil goes to the transportation sector 70-80% are petroleum products.

Address by Mr. Joonas Sukka, Chief Technical Officer – eFlexFuel (StepOne Tech)

Mr. Sukka mentioned that Methanol consumption is much higher than Ethanol.
A conversion kit developed for ethanol and gasoline blend works for various gasoline engines (e.g., street washers, and motorcycles). Successful BS6 emission test done in collaboration with ARAI on Maruti Suzuki Swift. Efforts are underway to get approval for conversion kits on Indian roads. Maintaining optimal oxygenated fuel ratio and lambda values with ethanol blends is possible, adjusting automatically based on ethanol content.

Address by Mr. Vikram Gulati, Country Head & Executive Vice President (Corporate Affairs & Governance), Toyota Kirloskar Motor Pvt. Limited (TKM)



- Mr. Gulati said that last year especially, car segment vehicles, 24 million vehicle registered sales. Transport sector is the largest consumer of the fossil fuels.
- In 2023, only 2.2% of cars sold were electric, and 2.1% were hybrid; 95% of vehicles remain petrol/diesel-powered.
- By 2030, even with 15% electric vehicles, 85% will still be petrol/diesel due to their long lifespan (15 years).
- In 10 years of our journey, from 2014 to 2024, India has saved around 1 trillion rupees of forex on oil imports, that also led to around 55 million tons of carbon being mitigated
- Just by reaching E20 next year, we are going to be looking at a (0:59) scenario where probably 50,000 crore rupees of forex is saved because of fossil fuel.
- 1.45 trillion rupees paid to the oil marketing companies, out of which 87.5 thousand crore rupees going to the farmers.
- Flex fuel electrified vehicle which combines the best of both worlds. Substitution up to 100% by ethanol. And higher efficiencies because of the electric power that's there.
- CAFE regime is about reducing fossil fuel consumption.

Address by Mr. K. C. Sharma, Chief Engineer (MVL), Ministry of Road Transport and Highways, Government of India

- Mr. Sharma informed that better highways coming, high-speed mobility is becoming a requirement.
- We have an auto industry which is catering to nearly 7.1% of the GDP.
- Now, we have E20 compatible vehicles. We shall be moving on to E20 compatible engines also with the effect from 1st April 2025.

Address by Mr. Atul Mulay, Chairman, Bioenergy Committee of IFGE, President - Bioenergy, Praj Industries.

- Mr. Mulay informed about sugar industry track pre-lunch the industry is quite confident that they will give roughly around 1000 crores, 1500 crores litres of ethanol.
- Rice straw available for 2G ethanol has moisture higher than 15-20% and it can be store only for one season because it available for only 40-45 days and in fresh rice straw has over 50% moisture.

Address by Dr. Anirudh Gautam, Principal Executive Director (Special), Research Design & Standards Organizations, Indian Railways. GOI

- Dr. Gautam said that by next year December 2025 all the lines of Indian Railways will be electrified.
- We have a sizable population of diesel locomotives, almost 4000 in number. We are consuming about 1.7 billion liters of diesel per year for traction,100 billion liters of diesel and about 70-80 billion liters of petrol or gas oil.
- Oil marketing companies are supplying diesel blended with 7% biodiesel so this is a 7% saving of diesel.
- we are also going to turn out a first hydrogen train by end of 2024.
- China is producing 95% of methanol from its coal and municipal solid waste with very low CO2e.
- Successful BS6 emission test done in collaboration with ARAI on Maruti Suzuki Swift.
- Research and Testing work is ongoing on Ice-Hydrogen.

Day 2 Session on the Potential of Bio-Mobility in India

Recommendations and Key Takeaways from the session:

L to R: ***Mr. Sandeep Theng****, Director, IFGE,* ***Dr. Anirudh Gautam****, Principal Executive Director (Special), Research Design & Standards Organization,* ***Mr. Atul Mulay****, Chairman, Bioenergy Committee of IFGE, President - Bioenergy, Praj Industries,* ***Mr. Rajnath Ram****, Advisor (Energy), NITI Aayog, Government of India,* ***Mr. K.C. Sharma****, Chief Engineer (MVL), Ministry of Road Transport & Highways, Government of India,* ***Mr. Vikram Gulati****, Country Head & Executive Vice President (Corporate Affairs & Governance), Toyota Kirloskar Motor Pvt. Limited (TKM),* ***Mr. Joonas Sukka****, Chief Technical Officer – eFlexFuel(StepOne Tech)*

- Transport is the largest fossil fuel consumer, contributing 13% of global carbon emissions.
- In 2023, only 2.2% of cars sold were electric, and 2.1% were hybrid; 95% of vehicles remain petrol/diesel-powered.
- By 2030, even with 15% electric vehicles, 85% will still be petrol/diesel due to their long lifespan (15 years).
- Ethanol blending increased from 2-3% in 2014 to 15% in 2024.
- India saved ₹1 trillion in oil import costs and mitigated 55 million tons of CO2.
- Achieving E20 (20% ethanol blending) by 2025 could save an additional ₹50,000 crore.
- Ethanol blending has benefited rural economies, with ₹87,500 crore going to farmers.
- Toyota introduced a flex-fuel electrified vehicle running on 100% ethanol and electric power, with a carbon footprint of 19g CO_2/km (compared to 120g CO_2/km for electric vehicles powered by India's current grid).
- Flex-fuel vehicles allow consumers to adjust ethanol-gasoline blends.
- E20-compatible vehicles will be available in India by April 2025.
- India uses diesel blended with 7% biodiesel, saving 7% diesel consumption in traction.
- Bioethanol has succeeded with a clear mandate and policy support, whereas biodiesel struggled due to raw material shortages.

Recommendations and Key Takeaways from the session:

- Indian Railways is exploring bio-ethanol, bio-methanol, and bio-CNG for fuel.
- 40 trains run on CNG, and bio-CNG could replace this.
- India is set to introduce its first hydrogen train by the end of 2023.
- Ongoing efforts to convert engines to run on methanol (with 15% tested successfully).
- Methanol is more corrosive and has higher consumption rates than ethanol.
- China produces 95% of its methanol from coal and municipal solid waste with low CO_2 emissions.
- Rice straw for 2G ethanol has a high moisture content (over 50% when fresh) and is available for only 40-45 days, complicating storage and usage.
- Conversion kits for ethanol and gasoline blends are developed, with successful BS6 emission tests on Maruti Suzuki Swift.
- Green technologies like flex-fuel vehicles face higher costs due to current tax structures.
- Government and industry need to revise tax policies to make greener options affordable and meet CAFE (Corporate Average Fuel Efficiency) standards.
- Research and testing are ongoing for ICE-hydrogen technology as part of decarbonizing transport.

Day 2 Session on Potential in Sustainable Aviation Fuel

Key topics discussed: Aviation fuels, Biodiesel, feedstock, technologies/methods to generate the Biofuels, Types of Sustainable Aviation Fuel, Requirement, Availability of feedstock, Global scenario, Case Studies.

Address by Mr. Gaurav Goyal, Asst. Vice President, Business Head Sustainable Aviation Fuel, Praj Industries Ltd.

The session was started by Mr. Goyal, the moderator of the session who provided the context of the session and stretched the attention of the audience by sharing that the aviation sector contributes 2% of CO2 global emissions which is roughly 1.2 billion tons of CO2 annually and it will reach 3 billion tons CO2 by 2050.
As of 2024, the overall capacity of SAF is roughly 1 million tons per annum, and roughly 350 million tons of SAF will be needed by 2050.

Address by Mr. Ravikant Gupta, Sr. GM (R&D), Engineers India Limited (EIL)

- Mr. Gupta mentioned that India is the 3rd largest aviation market; IPCC calls for complete CO2 elimination by 2050 to keep global temperature under 1.5°C
- CO2 levels rising by 20 ppm per decade.
- National Bio-Fuel Policy 2018 emphasizes use of drop-in fuels, and SAF
- India needs to join the second phase of CORSIA, requiring SAF to lower GHG emissions.
- Govt. of India set a target of 1% SAF blending by 2027, 2% by 2028, and 5% by 2030.
- Reduce aviation CO2 emissions to 50% of 2005 levels by 2050.
- **CORSIA Compliance Options:**
  - Buy CORSIA credits for carbon offsetting.
  - Buy international bio-jet fuel (higher cost).
  - Buy Indian-produced bio-jet fuel, using indigenous technology.
- SAF is currently much more expensive than conventional jet fuels.
- Projected demand of 8-9 MMT/year, rising to 10 MMT/year by 2025, and 23 MMT/year by 2040.
- For 10% blending, 0.86 MMT SAF is needed, increasing to 1.1 MMT by 2025.
- HEFA Process converts TBO and UCO into bio-jet SAF and biodiesel.
- There are different fuels and technologies including OTJ (Oil to Jet), GTJ (Gas to Jet), ATJ (Alcohol to Jet), STJ (Sugar to Jet), WTJ (Waste to Jet), and E-jet (Power to Jet).
- Concept started in 2008-2009, progressing steadily.
- Indian Air Force allows SAF in defense jets.
- SAF can reduce CO2 emissions by up to 80%.
- Indigenous Bio-ATF technology developed by EIL and CSIR-IIP, converts lipids into hydrocarbons.
- Diverse, non-standardized feedstocks are being explored due to limited single-feed availability.
- Reported CO2 reduction of 70-80% through these technologies.

Address by Dr. SSV Ramakumar - Chairperson, IFGE: Sustainable Aviation Fuel Forum (SAFF) & Executive Vice President in the role of CTO, Greenko/ AM Green

- Mr Ramakumar discussed the Greenko plans to produce 4 million metric tons of green ammonia, with the first 1 million metric ton plant recently concluding FIDs at the eastern site.
- He mentioned that Greenko produces the world's lowest-priced green hydrogen at $3/kg.
- CORSIA has 3 phases. The pilot phase is completed; the first voluntary phase (2024-2026) is underway. By 2027, countries must use blended fuels for international flights, or face restrictions.
- ICAO Blending Targets is 2% blending by 2025, 5% by 2030, 17.5% by 2035, 40% by 2040, and 65% by 2050.
- Indian Oil is setting up a plant to produce Alcohol to Jet Fuel using LanzaJet technology.
- MoPNG launched the RUCO scheme in 2019 to produce biodiesel from used cooking oil.
- To meet E20 blending targets, 1000 crore litters of ethanol will be required by 2025.
- 50% of gasoline consumption is by 2-wheelers, and shifting this segment to electricity could significantly reduce gasoline use.

Address by Mr. Patrick Krehan, Senior Expert Biofuel, Clean Energy and Climate Partnership

- Mr. Patrick highlighted several issues hindering the rapid growth of fuel blending, particularly in relation to the 2030 targets and the gap between the current progress and future goals
- He emphasized the importance of training not only for farmers but also for administrators. This is essential for ensuring that administrators can effectively guide and educate farmers about the processes and benefits of sustainable practices.

Address by Mr. Eric van den Heuvel, Founder, Studio Gear Up / Member, EU-India Stakeholder Group Advanced Biofuels

- Mr. Heuvel discussed the CO2 from alcohol production can be used in the power-to-jet pathway, enhancing carbon efficiency, Biogenic or direct air-captured CO2 is ideal, but surplus CO2 from alcohol or biogas facilities is valuable too.
- Syngas and power-to-jet pathways share technologies, enabling better carbon efficiency and economic feasibility.
- A strong innovation agenda is needed to optimize these synergies and attract renewable energy investments.
- Europe aims 65 million tons of renewable energy by 2030 but is only one-third there.
- The maritime sector will need 60 million tons of renewable fuels by 2050.
- Collaboration is needed between road and maritime sectors is crucial to optimize fuel production and avoid competition.
- Cooperation between regions like Europe and India is essential due to different decarbonization strategies.
- The goal is to decarbonize and leave a cleaner planet for future generations through shared climate goals

Address by Mr. Sachin Lokhande, Director Business Development, Lanzajet Inc.

- Mr. Lokhande emphasized the SAF as Ideal fuel for replacing petroleum-based ATF due to lower carbon emissions, energy efficiency, and abundant feedstock.
- SAF must be compatible with existing aircraft engines for seamless fuel transitions.
- Four key categories for decarbonizing aviation:
  - Engine efficiency improvements.
  - Carbon offsets and trading.
  - Future technologies (battery/hydrogen-powered aircraft).
  - SAF (immediate solution, can cut 65% of aviation emissions).
- Pre-COVID global consumption was 96 billion gallons/year vs. 120 million gallons/year of SAF in 2022.
- HEFA SAF is limited by feedstock availability.
- Collaboration is needed among technology providers, policymakers, airlines, manufacturers, and funders.
- Waste-to-SAF is align Swachh Bharat with SAF production by converting municipal solid waste into ethanol.
- Decarbonization success relies on consumer backing, including future generations.
- World's first A2J plant producing 30 kilotons of SAF annually; commissioning and startup stages underway.

Day 2 Session on Potential in Sustainable Aviation Fuel

Recommendations and Key takeaways from the session

L to R: ***Mr. Rohit Jain, Deputy Director****, IFGE,* ***Mr. Gaurav Goyal****, Asst. Vice President, Business HeadSustainable Aviation Fuel, Praj Industries Ltd,* ***Mr. Ravikant Gupta****, Sr. GM (R&D), Engineers India Limited (EIL,* ***Mr. Patrick****,* ***Dr. SSV Ramakumar*** *- Chairperson, IFGE: Sustainable Aviation Fuel Forum (SAFF) & Executive Vice President in the role of CTO Greenko/AM Green,* ***Mr. Eric van den Heuvel****, Founder, Studio Gear Up / Member, EU-India Stakeholder Group Advanced Biofuels,* ***Mr. Atul Mulay****, Chairman, Biofuel Committee IFGE, President Praj Industries,* ***Mr. Sachin Lokhande****, Director Business Development, Lanzajet Inc*

- Contributes 2% of global CO2 emissions (~1.2 billion tons annually, projected to reach 3 billion tons by 2050).
- SAF capacity in 2024: 1 million tons/year; 350 million tons needed by 2050.
- IPCC calls for complete CO2 elimination by 2050 to maintain global temperatures below 1.5°C.
- Blending target : 1% SAF blending by 2027, 2% by 2028, 5% by 2030.
- 50% reduction in aviation CO2 emissions by 2050 (relative to 2005 levels).
- Buy CORSIA credits, international bio-jet fuel, or Indian-produced bio-jet fuel using indigenous technology.
- Pilot phase completed; voluntary phase (2024-2026) underway. Mandatory blending starts by 2027 for international flights.
- HEFA Process converts TBO and UCO into bio-jet fuel.
- Various pathways include OTJ (Oil to Jet), ATJ (Alcohol to Jet), WTJ (Waste to Jet), and E-jet (Power to Jet).
- Indigenous Bio-ATF technology (EIL and CSIR-IIP) developed to convert lipids into hydrocarbons.
- CO2 emissions reduced by up to 80% using SAF.
- Greenko produces green hydrogen at $3/kg and aims for 4 million metric tons of green ammonia production.
- Challenges in meeting 2030 blending targets due to feedstock and cost constraints.
- Importance of training for both farmers and administrators.
- Collaboration across sectors (aviation, maritime) and regions (e.g., Europe and India).
- Focus on engine efficiency, carbon offsets, future tech (battery/hydrogen-powered aircraft), and SAF.
- Pre-COVID consumption: 96 billion gallons/year vs. 120 million gallons of SAF in 2022.
- First A2J plant producing 30 kilotons of SAF annually, startup phase underway.
- SAF remains a key immediate solution, cutting up to 65% of aviation emissions.
- Long-term success relies on consumer support, investment in technology, and cross-sector collaboration.

Day 2 Session on Potential in 1 G Ethanol Industry: Current Status and Future Perspectives

Key topics discussed: The session emphasized India's progress toward ethanol blending, promoting maize-based ethanol, dynamic pricing, year-round production through bio-syrup technology, mechanization in farming, and the need for government support in supply chains and financial assistance for sugar mills.

Address by Mr. Ashwani Srivastava, Joint Secretary (Sugar), Department of Food and Public Distribution,, Ministry of Consumer Affairs, Food, and Public Distribution, Government of India

- Mr. Srivastava highlighted the government's priority in ensuring a stable supply of sugar at affordable prices in the domestic market. He shared that ethanol diversion from sugarcane is expected to increase from 24 LMT this year to 40 LMT next year, contributing significantly to ethanol production. Although India is not currently exporting sugar, future exports could be considered based on the availability of ethanol.
- India's ethanol production capacity stands at 800 crore liters from sugarcane and 600 crore liters from grain. In line with this, NITI Aayog is developing a roadmap for ethanol beyond 2025-26 to address long-term goals for the sector. The Ethanol Blending Program (EBP) will continue with policy measures designed to manage excess sugar production while supporting industry growth.
- On ethanol pricing, Mr. Srivastava noted that decisions are still under review and will be finalized soon. He also mentioned that financial support for expanding ethanol capacity has been temporarily paused, given the current sufficient capacity, and will resume after the future roadmap is outlined.
- Discussions on the adoption of flex-fuel vehicles are ongoing, involving the Ministry of Heavy Industries, ISMA, and industry stakeholders. A detailed report on flex-fuel and hybrid vehicles has already been submitted to the minister, and policy decisions are expected shortly.

Address by Mr. Prakash Naiknavare, Managing Director, National Federation of Cooperative Sugar Factories Ltd.

- Mr. Naiknavare highlighted the government's initiatives for ethanol blending with petrol, biodiesel blending, compressed biogas (CBG), green hydrogen, and electric vehicles. Ethanol, as an oxygenate fuel, improves ignition efficiency, supports the rural economy, and reduces carbon dioxide emissions. India's Ethanol Blending Program (EBP) began in 2003 with a 5% target but faced challenges due to limited ethanol from molasses. The 2018 National Biofuel Policy marked a shift by promoting 1G ethanol and advancing 2G and 3G ethanol development.
- Ethanol production has grown from 421 million liters in 2013-14 to 1,589 million liters in 2023-24, achieving a 13.4% blending rate by August 2024, with a 20% target by 2025-26. Sugar-to-ethanol diversion has stabilized sugar prices, and maize-based ethanol production is rising with government support, aiming for 900 crore liters in six years.
- He urged the government to allow GM maize cultivation, convert sugar mills into multi-feed distilleries, set timely and remunerative ethanol prices, and restart regular meetings to address industry challenges.

Address by Mr. Deepak Balani, Director General, Indian Sugar & Bioenergy Manufacturers Association (ISMA)

- Mr. Balani discussed the policies needed for the ethanol industry, highlighting the sugar industry's 75-80% contribution to ethanol production, with a current capacity of around 850 crore liters and potential output of 500-550 crore liters annually.
- He noted that the 2023-24 challenges, stemming from a one-time restriction on ethanol diversion due to low sugar production, have provided valuable lessons, making future disruptions unlikely.
- He emphasized the government's ethanol blending targets of 18% in the near term and 20% by 2025-26, aligning with increased production capacity. The projected sugar production of 333 lakh tons, with consumption around 285-290 lakh tons, suggests a surplus that can be managed through ethanol diversion.
- Mr. Balani praised the government's clarity on ethanol diversion policies but stressed the need for ongoing progress and long-term policy stability. He called for revising ethanol prices to reflect increased input costs due to rising FRP, recommending a dynamic pricing mechanism based on real-time data to ensure profitability for sugar mills of varying efficiencies.
- He underscored the importance of raising sugarcane productivity from 75-76 tons per hectare to 80-90 tons, proposing initiatives like drip irrigation, trash mulching, and watershed development, which have received positive government feedback.

Address by Mr. R. L. Tamak, Executive Director & CEO (Sugar & Ethanol Business), DCM Shriram Limited

- Mr. Tamak highlighted the importance of sugarcane as a valuable crop for carbon sequestration and energy production, emphasizing its efficient use of water, contrary to the common belief that it is water-intensive. Studies have shown that sugarcane consumes less water than crops like maize and rice. He stressed the need for continued focus on improving sugarcane varieties, increasing mechanization, particularly mechanical harvesting, and expanding drip irrigation, which has seen significant progress in states like Maharashtra.
- Mr. Tamak recommended Sustain the Ethanol Blending Program and expand this initiative, as it has improved cash flow for millers and ensured timely payments to farmers.
- Mr. Tamak stressed to establish a National Mission on Sugarcane. He proposed a coordinated mission to address input-side issues like variety improvement, water conservation, and mechanization through collaboration between various ministries and stakeholders.
- Mr. Tamak encouraged sustainable sugarcane production, emphasizing the importance of supporting sustainable growth in the sector. He highlighted how millers and farmers can benefit from increased productivity through more efficient resource use, ultimately enhancing profitability and sustainability in the long term.

Address by Sameer Sinha, Chief Executive Officer Sugar Business Group, Triveni Engineering & Industries Ltd.

- Mr. Sameer Sinha emphasized the importance of dual feed distilleries, which can utilize both sugar and grains as feedstocks. This approach mitigates risks related to the depletion of one feedstock and policy changes. Initially, there were challenges in adapting fermentation cycles for grain, but successful demonstrations showed it was feasible, Mr. Sinha highlighted the previous reliance on FCI rice for ethanol production, where both input and output prices were fixed, offering reasonable returns. However, the discontinuation of FCI rice has led to difficulties.
- The rising maize prices, which were not passed on to farmers but captured by intermediaries, create supply chain issues. He recommended that the government establish a reliable supply chain for maize, possibly through cooperatives, and implement an automatic pass-through pricing mechanism for maize, similar to the tariff structure for coal. This would help stabilize pricing and alleviate concerns about input cost fluctuations.

Address by Mr. Yashodhan Mankame, EVP – Bioenergy, Praj Industries

Mr. Mankame highlighted about the bio-syrup technology developed by Praj Industries, which allows concentrated sugarcane syrup to be stored and used year-round, enabling ethanol plants attached to sugar mills to operate continuously. After a successful demonstration at Jaivan Sugar in Maharashtra, this technology has been commercially implemented at three sugar mills in Maharashtra, Karnataka, and Tamil Nadu. It provides a solution for ethanol production during the sugarcane off-season.

Address by Mr. Dilip Patil, Managing Director, Karmayogi Ankushrao Tope Samarth SSK Ltd.

- Mr. Patil highlighted the challenges faced by sugar mills, particularly the high costs of setting up ethanol plants, and emphasized the need for increased government financial support to assist sugar mills in managing these expenses.
- He noted that India has achieved a significant milestone with 15% ethanol blending in 2024, and the goal is to reach 90% flex-fuel vehicles by 2025, drawing inspiration from Brazil successful model.
- Mr. Patil explained that ethanol blending, which involves mixing ethanol with petrol, is crucial for creating cleaner-burning fuel. This helps reduce pollution, lower oil imports, and support the growth of domestic biofuel production.
- He pointed out the progress made in ethanol blending, including the target of 20% blending by 2025, doubling ethanol production capacity to 1,623 crore liters by September 2024, and increasing blending from 1.53% in 2014 to 15% in 2024. These efforts have saved ₹1.06 lakh crore in foreign exchange and reduced CO_2 emissions by 544 lakh metric tons.
- Mr. Patil stressed that ethanol blending plays a vital role in strengthening India's energy security by reducing dependence on imported oil, while also providing economic benefits to farmers and sugar mills. It helps decrease vehicle emissions and fosters technological innovation in the automotive, biotechnology, and chemical industries.

Continuation of Address by Mr. Dilip Patil, Managing Director, Karmayogi Ankushrao Tope Samarth SSK Ltd.

- He acknowledged the key challenges, including the balance between food security and fuel production, with 40% of sugarcane being diverted for ethanol; the high-water requirement for sugarcane cultivation (2,500 liters per kilogram); the need for economic competitiveness as India fixed pricing model contrasts with Brazil market-driven system; and the impact of maize diversion on poultry, animal feed, and starch industries.
- To address these challenges, Mr. Patil recommended diversifying feedstocks by promoting second-generation ethanol production from agricultural residues, building dedicated infrastructure like ethanol pipelines, investing in research and development for improved technologies and vehicle compatibility, and reforming the pricing model to be more dynamic, linking it to international crude oil prices.
- Mr. Patil concluded that a balanced and strategic approach is essential to harness the full potential of ethanol blending, ensuring a cleaner environment, stronger energy security, and a more robust economy for India.

Address by Mr. Ravi Gupta, Chairperson IFGE : Sugar Bioenergy Forum & ED, Shree Renuka Sugars

- Mr. Gupta highlighted the significant progress in ethanol blending, which increased from 0.7% in 2012-13 to 13.4% by August 2023, with the goal of reaching 15% by the end of the year and 20% by 2025-26. He noted that ethanol production grew from 38 crore liters in 2013-14 to 505 crore liters in mid-2023, with grain-based ethanol, particularly from maize, rising from 9.5 crore liters in 2018-19 to 229.15 crore liters in 2023.
- Mr. Gupta emphasized that diverting surplus sugar into ethanol has helped stabilize the sugar industry, with millions of tons converted annually. To achieve the 20% ethanol blending target, an ethanol production capacity of 2,446 crore liters will be necessary. He projected an expansion in sugarcane cultivation from 52-54 lakh hectares to 62 lakh hectares and a potential doubling of maize production in the next six years.
- Furthermore, he encouraged the government to consider allowing genetically modified maize cultivation and explore new feedstocks like sugar beet and cassava for future ethanol production. The successful implementation of bio-syrup technology in several sugar mills allows for year-round ethanol production.

Day 2 Potential in 1 G Ethanol Industry: Current Status and Future Perspectives

Recommendations and Key takeaways from the session

L to R: ***Mr. Vijay Kumar Nirani****, Vice President IFGE & MD, TruAlt Bioenergy,* ***Mr. Yashodhan Mankame****, EVP – Bioenergy, Praj Industries,* ***Mr. Sameer Sinha****, CEO, (Sugar Business Group), Triveni Engineering and Industries Limited,* ***Mr. Deepak Balani****, DG , ISMA,* ***Mr. Prakash Naiknavare****, MD, National Federation of Cooperative Sugar Factories Ltd,* ***Mr. Ravi Gupta****, ED, Shree Renuka Sugars,* ***Mr. Ashwani Srivastava,*** *Joint Secretary (Sugar), Department of Food and Public Distribution, Ministry of Consumer Affairs, Food, and Public Distribution, Government of India,* ***Mr. Atul Mulay****, Chairman, Bioenergy Committee of IFGE, President - Bioenergy, Praj Industries,* ***Mr. R. L. Tamak****, Executive Director & CEO (Sugar & Ethanol Business), DCM Shriram Limited,* ***Mr. B.B. Thombare****, Chairman, West India Sugar Mill Association,* ***Mr. Dilip Patil****, MD, Karmayogi Ankushrao Tope Samarth SSK Ltd.*

The panelists made several common recommendations that address the industry-wide challenges and suggest pathways for achieving the government's ethanol blending goals:

- Early Announcement of Ethanol Prices: The government should announce ethanol prices for the upcoming financial year earlier to avoid delays and ensure smooth planning for sugar mills and distilleries.
- Dynamic Pricing Mechanism: Implement a dynamic pricing formula for ethanol that accounts for real-time market conditions, varying efficiencies of sugar mills, and input costs such as FRP.
- Policy Stability and Long-term Roadmap: Long-term policy stability is essential for the ethanol industry to avoid disruptions. The government should ensure policy consistency and develop a clear roadmap for ethanol production beyond 2025-26.
- Multi-feed Distilleries: Promote the conversion of sugar mills into multi-feed distilleries to allow ethanol production from both grains and sugar, providing flexibility in feedstock usage and ensuring year-round production.
- Mechanization and Sustainable Farming: Expand mechanized harvesting and sustainable irrigation practices (such as drip irrigation) to increase productivity and ensure long-term sustainability in sugarcane farming.
- Supply Chain for Maize: Develop a structured supply chain for maize through cooperatives or other government mechanisms to ensure continuous availability and price stability.
- Pass-through Pricing for Maize: Implement a pass-through pricing mechanism for maize, similar to coal pricing, to stabilize costs and ensure that increases in feedstock prices do not disproportionately affect ethanol production margins.
- Year-round Ethanol Production: Encourage the adoption of bio-syrup technology to enable continuous ethanol production throughout the year, regardless of seasonal constraints.
- Infrastructure Development: Invest in and expand ethanol blending and distribution infrastructure to meet growing demand and blending targets.
- Financial Support for Smaller Mills: Provide financial support to small and medium-sized sugar mills to help them invest in ethanol production, especially for converting existing distilleries to multi-feed facilities.

Day 2 Session on Possibilities of 2G Ethanol

Key topics discussed: Critical role of 2G biofuels in India's energy future, emphasizing the need for sustainable feedstocks, innovative technologies, and collaborative efforts to overcome challenges and drive market adoption.

Address by Mr. Vijay Kumar Nirani , Vice President, IFGE & MD, TruAlt Bioenergy

- Mr. Nirani emphasized that India's long-term blending targets like E85 (85% ethanol) and E100 (100% ethanol) are unachievable without 2G biofuels, as the current 1G feedstocks like sugarcane and grains have limitations. 2G biofuels are critical to achieving the country's ambitions for flex-fuel vehicles (FFVs).
- The sugar industry in India generates 30% bagasse as a byproduct, which holds enormous potential as feedstock for 2G ethanol. He highlighted that Pradhan Mantri Gati Shakti (PMG1) policies and bolt-on technologies could help industries tap into this potential.
- While industries like Radico and TrueAlt Bioenergy are experimenting with 2G ethanol, scaling remains a challenge due to technological limitations. He called for more collaboration between industry players and technology providers to overcome barriers such as feedstock availability and production capacity.

Address by Ms. Heli Antila, CEO, Chempolis OY

- Ms. Antila expressed optimism about 2G biofuels in India, particularly as public sector units (PSUs) take the lead. She highlighted her company's ongoing project to develop a 2G ethanol plant in Assam and stressed the importance of learning from operational plants to refine technology and reduce both capital and operational costs.
- She noted that 2G biofuels use non-food biomass, which not only avoids the food vs. fuel debate but also supports food production by converting waste biomass into fuel, enhancing both energy security and environmental sustainability.
- By creating employment in rural areas and reducing environmental impact, 2G biofuels have a broader social and economic benefit. Additionally, she pointed to the potential of Sustainable Aviation Fuel (SAF), suggesting that 2G ethanol could be converted into SAF to decarbonize the aviation sector.

Address by Mr. Ravi P. Gupta, General Manager, Indian Oil Corporation Ltd.

- Mr. Gupta discussed IOC's achievement in setting up Asia's first 2G ethanol plant, utilizing paddy straw as the feedstock. However, he pointed out that the transition from a demo plant to full-scale operations (processing 400 tons/day) has posed challenges in biomass handling, pre-treatment, and enzyme supply.
- Scaling up biomass handling systems was more complex than anticipated. Pre-treatment processes that worked efficiently at demo-scale struggled at commercial scale, requiring further innovation.
- The reliance on a single enzyme supplier, which contributes 15-20% of operational costs, is a major challenge. He emphasized the need to diversify enzyme suppliers or develop local production.
- Processing paddy straw results in lignin residues, which are difficult to dispose of in large quantities. Mr. Gupta highlighted the potential to use lignin in biocomposites, bio-manure, and bitumen blends for road construction, thereby converting a waste product into a valuable resource.

Address by Mr. Vaibhav Tiwari, Sr. General Manager, Praj Industries

- Mr. Tiwari discussed the challenges associated with feedstock moisture content and other variations, which significantly impact plant performance. Plants are currently operating at around 32-40% of their full capacity, primarily due to these feedstock-related issues.
- He identified corn cob and bagasse as promising feedstocks for 2G ethanol production. Corn cob, in particular, offers higher yields and is easier to handle, making it a favorable option for the future.
- Praj Industries is developing bolt-on technologies to reduce the capital costs associated with integrating 2G ethanol production into existing sugar and grain plants.

Address by Mr. Patrick Crehan, Sr. Expert Biofuels, CECP

- Mr. Crehan provided an overview of the evolution of 2G ethanol in Europe, particularly how the food vs. fuel debate led to a shift in focus from 1G biofuels (energy crops) to 2G biofuels (non-food biomass). He stressed the importance of producing biofuels sustainably to avoid environmental harm, such as the deforestation of rainforests for energy crops.
- He emphasized that sustainability is critical to European consumers, and companies are now required to prove the sustainability of their production processes through ESG (Environmental, Social, Governance) reporting. There is a need to foster cooperation between Europe and countries in Asia, Africa, and Latin America to promote sustainable biofuel practices.
- Mr. Crehan also stressed the importance of engaging farmers, as they play a key role in the transition to biofuels. By adopting sustainable agricultural practices, farmers can increase their income while contributing to a more sustainable biofuel industry

Address by Dr. Pranab Kumar Nath, Sr. Executive, Assam Bio-Refinery Private Limited

- Dr. Nath introduced the concept of using bamboo as the primary feedstock for 2G ethanol production in the Assam Bio-Refinery. Bamboo has high cellulose content (40-50%) and is abundant in northeastern India.
- The project aims to involve around 30,000 farmers in the supply chain, enhancing their market awareness and participation through a supply chain software solution that eliminates middlemen and ensures fair pricing.

Address by Mr. Naresh Goel, Director, Pingaksh Beverages Private Limited

- Mr. Goel shared his company's experience in transitioning from brewing to ethanol production, emphasizing the adaptability required for success. Partnerships with technology providers, such as Praj, were essential in overcoming the challenges.
- He stressed the importance of thorough market research and site selection based on local feedstock availability. Additionally, establishing off-take agreements with Oil Marketing Companies (OMCs) ensures a reliable market for ethanol.
- Mr. Goel advocates for flex-fuel pumps to support ethanol distribution

Address by Mr. Subodh Kumar, Advisor to the National Team, IFGE, ED, ValPro & Former ED, IOCL

- Mr. Subodh Kumar concluded the session by acknowledging the enormous potential of 2G ethanol to transform India's biofuels sector, despite its high OPEX and CAPEX.
- He suggested a pool-pricing mechanism, similar to what the power and oil industries use, to ensure that pricing for 2G ethanol remains competitive.
- Additionally, he advocated for the cost-plus pricing model, which would ensure fair compensation for producers while protecting consumers from price fluctuations.
- The long-term outlook for 2G ethanol is promising, but continued policy support, technological advancements, and collaboration will be required to overcome challenges and scale up production.

Day 2 Track 3: Session 3 Possibilities of 2G Ethanol

Recommendations for Policy and Practice in 2G Ethanol Production

L to R : ***Ms. Heli Antila,*** *CEO-Chempolis OY,* ***Mr. Naresh Goel****, Director, Pingaksh Beverages Private Limited,* ***Mr. Vijay Kumar Nirani****, Vice President IFGE & MD, TruAlt Bioenergy,* ***Mr. Subodh Kumar****, Advisor to the National Team, IFGE, ED, ValPro & Former ED, IOCL,* ***Mr. Patrick Crehan****, Sr. Expert Biofuels, CECP (Clean Energy and Climate Partnership),* ***Mr. Ravi P. Gupta****, General Manager (Renewable Energy), IOCL, Research & Development Centre,* ***Dr. Pranab Kumar Nath****, Sr. Executive-Supply chain and Logistics, Assam Bio-Refinery Private Limited ,* ***Mr. Vaibhav Tiwari****, Sr. General Manager, Products, Praj Industries.*

- Accelerate Adoption of 2G Biofuels: Implement policies that expedite the adoption of 2G biofuels to meet long-term blending targets, such as E85 and E100.
- Leverage Sustainable Feedstocks: Encourage the utilization of non-food agricultural byproducts, such as bagasse and corn cob, as primary feedstocks for 2G ethanol production to ensure sustainability and avoid the food vs. fuel debate.
- Enhance Collaboration and Partnerships: Foster collaboration between industry stakeholders, technology providers, and government entities to address challenges in scaling up 2G biofuel production and improve efficiencies in biomass handling and processing.
- Strengthen Biomass Supply Chains: Develop robust supply chains for biomass feedstock to ensure a stable year-round supply, enhancing the reliability of 2G ethanol production.
- Invest in Research and Innovation: Allocate resources for research and development to advance fermentation technologies, enzyme production, and biomass processing techniques lower operational costs & improve efficiency.
- Promote Flex-Fuel Infrastructure: Support the establishment of infrastructure, flex-fuel pumps and off-take agreements with Oil Marketing Companies (OMCs), to facilitate the distribution and market adoption of ethanol.
- Engage and Educate Farmers: Involve local farmers in decision-making processes related to biofuel production and provide education on sustainable practices & market dynamics to enhance their participation & profitability.
- Implement Reporting and Accountability Systems: Establish comprehensive sustainability reporting systems to ensure transparency & accountability in biofuel production processes, fostering consumer and stakeholder trust.
- Encourage International Cooperation: Promote partnerships between Indian stakeholders and international organizations to exchange knowledge and best practices in sustainable biofuel production.

Key Takeaways from the Session on 2G Ethanol

- Adapt to Regulatory Changes: Stay adaptable to evolving market regulations governing biomass utilization and biofuel production to ensure compliance and sustainability.
- Critical Role of 2G Biofuels: 2G biofuels are essential for India's energy security and for achieving long-term sustainability goals.
- Potential of Agricultural Byproducts: India’s agricultural byproducts offer significant opportunities for sustainable feedstock in 2G ethanol production, reducing reliance on food crops.
- Challenges in Scaling Up: The transition from pilot projects to full-scale operations presents challenges, particularly in biomass handling, enzyme supply, and processing technologies.
- Economic and Environmental Benefits: Transitioning to 2G biofuels can enhance rural employment, improve energy security, and contribute positively to environmental sustainability.
- Importance of Collaboration: Strong partnerships among industry players, technology providers, and policymakers are crucial to overcoming barriers and promoting growth in the 2G biofuels sector.
- Need for Supportive Policies: Government policies and regulatory frameworks play a vital role in driving investment and facilitating the growth of 2G ethanol production.

Day 2 Session on Emerging Biomaterials & Biochemicals

Key topics discussed: The session highlighted key topics including the introduction of the Bio-E3 Policy, the potential of biomass for hydrogen production, the importance of collaborative efforts for achieving net-zero emissions, the role of emerging biomaterials in enhancing bioenergy, and the urgency of transitioning to biofuels and sustainable practices in energy production.

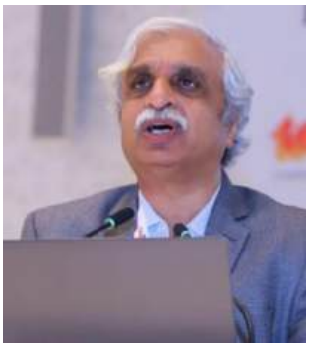
Address by Dr. Alka Sharma, Scientist `H', Advanced Biofuels, Sustainability (Scientific Decision Unit), Department of Biotechnology

- Dr. Sharma, chairing the session, introduced the Bio-E3 Policy and the concept of green growth.
- The discussion highlighted green growth as a priority in the Union Budget 2023-24.
- Emphasized the importance of collaborative efforts from government, academia and industries to achieve net-zero emissions by 2070.
- The Bio-E3 Policy, approved on August 24, aims to adopt high-performance biomanufacturing.
- Biomaterials are identified as a key component of the Bio-E3 Policy.
- The policy supports the transition to the "industrialization of biology," positioning biotechnology at the forefront of technological advancements.
- Key thematic areas of the Bio-E3 Policy were detailed:
  - Bio-based chemicals and enzymes
  - Functional foods and smart proteins
  - Precision biotherapeutics
  - Climate-resilient agriculture
  - Carbon capture and utilization
  - Futuristic marine and space research
- The implementation strategy was outlined as a three-pronged approach:
  - Integrated research and discovery
  - Bridging the gap for technology transfer
  - Developing bio-enablers like bio-foundries and manufacturing hubs.

Address by Dr. Rawel Singh, Scientist 'D', Sardar Swaran Singh National Institute of Bio-Energy, Kapurthala

- Dr. Singh highlighted the increasing volatility of fuel prices and the urgent need to address global warming, emphasizing the shift towards biofuels, biomaterials, and biochemicals in line with the Kyoto Protocol and commitments from COP 26.
- He discussed India's target to increase non-fossil energy capacity to 500 GW by 2030, underlining that biomass is a renewable, sustainable, and abundant resource with lower greenhouse gas emissions.
- Dr. Singh described the composition of lignocellulosic biomass, which includes cellulose, hemicellulose, and lignin.
- He discussed the catalytic conversion of lignocellulosic biomass into platform chemicals and bio-oil.
- He highlighted the potential of lignin and rice straw for producing sustainable aviation fuel (SAF) through direct hydrodeoxygenation, presenting it as a promising technology for the future of biofuels.

Address by Dr. S. Dasappa, Professor, Centre for Sustainable Technologies/ ABETS, CGPL, Indian Institute of Science



- Dr. Dasappa began by discussing the composition of biomass, focusing on its potential as a source for hydrogen production.
- He shared that biomass contains approximately 52.02% carbon and 6.55% hydrogen by mass, and around 65 grams of hydrogen per kilogram. He compared this with methane (250 grams of hydrogen per kilogram) and water (110 grams of hydrogen per kilogram), demonstrating that biomass is a valuable hydrogen resource.
- Given India's significant oil and carbon imports (220-240 million tons of oil and 200 million tons of carbon annually), tapping into biomass for compressed natural gas (CNG)—which contributes 60 million tons in sectors like transportation, domestic use, and power—could significantly reduce dependency on fossil fuels.
- Dr. Dasappa emphasized the decarbonization efforts across bioenergy systems, particularly in biochemical and thermochemical processes. He also highlighted the development of modular biomass gasification systems at the Indian Institute of Science (IISC), which can generate PEM quality hydrogen and syngas, making biomass a key player in the hydrogen economy. These innovations allow for high-throughput production of hydrogen, measured in tons per annum, contributing to cost-effective and sustainable energy production while capturing carbon.
- Dr. Dasappa further elaborated on the economic potential of biomass in India, emphasizing the country's 250 million tons of surplus biomass. Currently, only 10% of this biomass is being used, which limits its contribution to the energy sector. If fully harnessed, this surplus biomass could support up to 20% of India's hydrogen production, presenting a significant opportunity for the growth of the bioenergy sector.
- By converting biomass into syngas, which can then be processed into various fuels and chemicals, Dr. Dasappa argued that biomass represents an economically viable pathway for carbon capture and management.

Address by Dr. Debashish Ghosh, Principal Scientist, CSIR-Indian Institute of Petroleum

- Dr. Ghosh's presentation focused on biocatalysis and bioprocessing for chemicals, fuels, and energy alternatives using renewable carbon feedstocks such as C3, C5, C6, and C12.
- He discussed how bioprospecting and engineering renewable carbon can lead to sustainable applications, particularly through yeast-mediated fermentation using feedstocks like glycerol and sugars from waste streams.
- The SCOP process in his facility involves two schemes:Scheme 1: Focuses on biomass destruction and single-cell oil (SCO) production, Scheme 2: Handles feedstock preparation and MUFA-enriched oils for nutraceuticals.
- Dr. Ghosh emphasized the importance of utilizing techno-economic analysis (TEA), life cycle impact assessment (LCIA), and water footprint analysis (WFA) to enhance sustainability in bioprocessing.
- His facility produces various bioproducts, including lipids, xylitol, lactic acid, ethanol, and pigments such as lutein and beta carotene.
- The facility also focuses on producing fuels and chemicals, including biojet fuels and green diesel.
- Additionally, they are working on converting biomass into biochar, pyrolysis gas, and bio-oil.

Address by Prof. V. K. Vijay, IREDA Chair Professor, CRDT, IIT Delhi

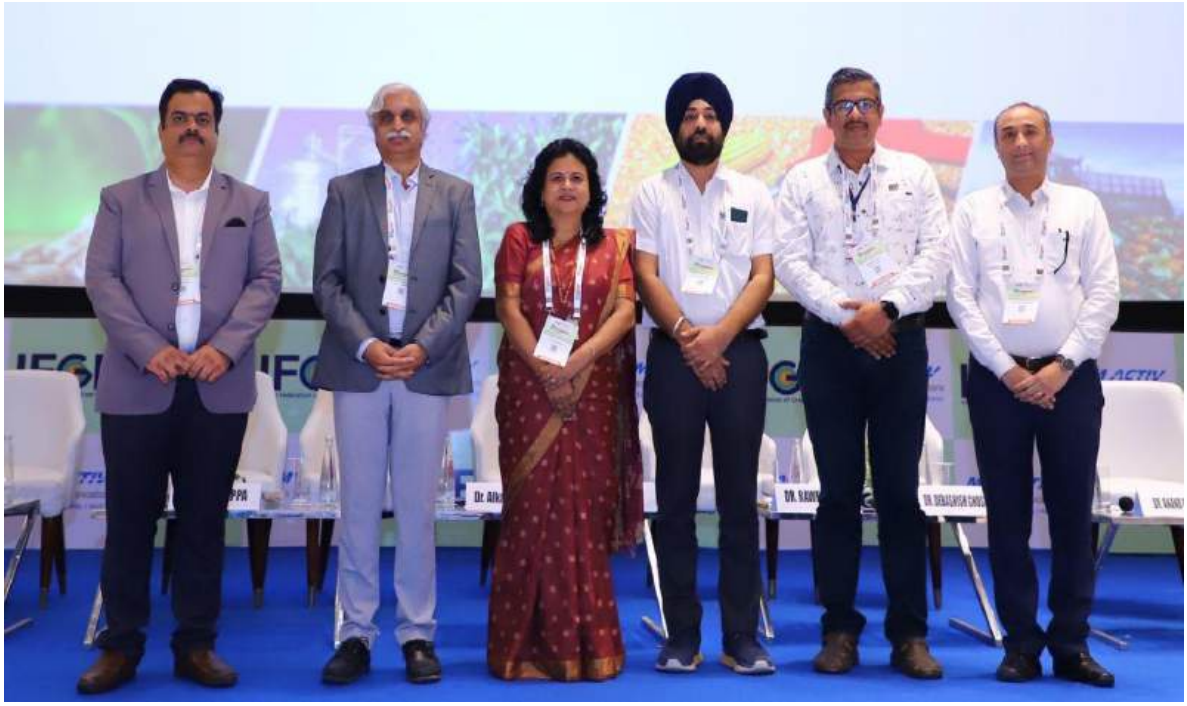
- Prof. Vijay emphasized the importance of utilizing emerging biomaterials and biochemicals to enhance bioenergy production in India, focusing on sustainable and profitable solutions.
- He highlighted the need to improve soil carbon content to boost agricultural productivity while reducing reliance on harmful chemicals, which can help lower healthcare costs.
- Prof. Vijay discussed the vast potential of agricultural waste, such as rice husk, paddy straw, and energy crops like Jatropha and switchgrass, as key biomass resources for bioenergy production.
- He also stressed the role of industrial and municipal waste, including kitchen waste, sewage sludge, and algae biomass, in generating biogas and Compressed Biogas (CBG).
- Innovations such as biological enzyme additives can significantly enhance methane production in biogas digesters, increasing methane content from 45-55% to 70-75%, making purification easier and more efficient.
- The development of advanced adsorbents was discussed, which improve gas storage capacity in LPG and CNG cylinders, increasing their efficiency and extending usage times.
- Prof. Vijay stressed the importance of sustainable, eco-friendly building materials, such as traditional mud and cow dung, which provide better thermal comfort compared to modern materials like steel and cement.
- He advocated for a circular economy, urging the development of materials that are recyclable, affordable, and job-creating, aligning with societal needs and environmental sustainability.
- Ultimately, Prof. Vijay concluded that the materials and technologies developed should facilitate the gro7th of the bioenergy sector while being environmentally friendly, cost-effective, and supportive of India's broader sustainability goals.

Address by Dr. Anand Ghoshalkar, Chief Scientist, Praj Industries

- Dr. Ghoshalkar addressed the role of bioplastics as an innovative solution to the global plastic waste problem, emphasizing their significance in mitigating environmental concerns.
- He noted that bioplastics have diverse applications across various industries, including packaging, textiles, cosmetics, automotive, and electronics.
- According to his presentation, 47.9% of bioplastics are bio-based, while 52.1% are biodegradable.
- Praj's bioplastic strategy incorporates a feedstock-agnostic, multi-product approach, leveraging expertise in design and technology demonstrations.
- Dr. Ghoshalkar highlighted the importance of Polylactic Acid (PLA) and Polyhydroxyalkanoates (PHA) in the bioplastics industry, noting that these materials are often imported.
- He emphasized Praj's commitment to developing sustainable feedstocks from agricultural and forestry residues, ensuring green processing with no waste, and promoting biodegradable materials as alternatives to single-use plastics.

Day 2 Session on Emerging Biomaterials & Biochemicals

Recommendations / Key Takeaway from the session



***Mr. Shashi Hegde**, Director, Hycons Bioenergy, **Dr. S. Dasappa**, Professor, Centre for Sustainable Technologies/ ABETS, CGPL, Indian Institute of Science, **Dr. Alka Sharma**, Scientist `H', Advanced Biofuels, Sustainability (Scientific Decision Unit), Department of Biotechnology, **Dr. Rawel Singh**, Scientist 'D', Sardar Swaran Singh National Institute of Bio-Energy, Kapurthala, **Dr. Debashish Ghosh**, Principal Scientist, CSIR-Indian Institute of Petroleum **Dr. Anand Ghoshalkar**, Chief Scientist, Praj Industries.*

- Prioritize green growth in Union Budget 2023-24 to align with sustainability goals.
- Encourage collaborative efforts among government, academia, and industries for net-zero emissions by 2070.
- Leverage Bio-E3 Policy to boost high-performance biomanufacturing & adopt biomaterials as a key component.
- Focus on six thematic areas for bioeconomic growth: bio-based chemicals, smart proteins, precision biotherapeutics, climate-resilient agriculture, carbon capture, and futuristic research (marine and space).
- Promote public-private partnerships and international collaboration to achieve policy goals.
- Maximize biomass utilization: Increase usage of India's surplus biomass to support hydrogen production and bioenergy growth.
- Promote thermochemical and biochemical processes for converting biomass into ethanol and hydrogen for sustainable energy production.
- Expand biomass gasification systems for scalable, high-throughput hydrogen production.
- Reduce dependency on carbon and oil imports through biomass-based energy solutions.
- Enhance R&D in advanced bioenergy technologies like biomass-to-syngas conversion.
- Utilize agricultural waste more efficiently for bioenergy production, particularly rice husk, paddy straw, and energy crops.
- Enhance methane production with biological enzyme additives in biogas plants to increase efficiency.

Day 2 Session on Emerging Biomaterials & Biochemicals

Recommendations / Key Takeaway from the session

- Develop advanced adsorbent materials for better gas storage in LPG and CNG cylinders.
- Encourage the use of sustainable building materials like mud and cow dung to reduce energy consumption.
- Promote a circular economy approach to ensure bioenergy materials are recyclable, affordable, & job-creating
- Support algae-based bioenergy research for scaling CBG production.
- Advance biocatalysis & bioprocessing for sustainable chemicals, fuels, energy from renewable carbon feedstocks.
- Use techno-economic analysis (TEA), life cycle impact assessment (LCIA), and water footprint analysis (WFA) to improve sustainability.
- Expand bioproducts like biojet fuels, green diesel, bio-based chemicals through fermentation & biomass conversion.
- Catalyze the shift toward biofuels and biochemicals to address climate change and rising fuel costs.
- Focus on an awareness program for farmers to use biomaterials.
- Influence lignocellulosic biomass for platform chemicals, bio-oil, and sustainable aviation fuels (SAF).
- Promote biomass as a sustainable resource to meet India's non-fossil energy targets.
- Expand bioplastics to address the global plastic waste issue; focus on PLA & PHA as sustainable alternatives.
- Develop feedstock-agnostic, biodegradable materials to replace single-use plastics.
- Promote biodegradable bioplastics across multiple industries (packaging, textiles, automotive).

Day 3 Plenary Session 4: Creating a Support Structure for Sectors of Bioenergy Business

Key topics discussed: Support Structure for Bioenergy Businesses, Global Biofuel Alliance, Proposal for a National Biofuel Alliance, Ease of Doing Business

Address by Mr. Ashish Kumar, VP, IFGE, Co- Chairperson IFGE: CBGPF, Managing Director, Verbio India.

- Mr. Ashish Kumar welcomed Mr. Pankaj Jain, Secretary of the Ministry of Petroleum and Natural Gas, and Mr. Atul Mulay, Chairman of the Biofuel Committee at IFGE and President of Praj Industries.
- He expressed gratitude for their presence at the event, emphasizing its significance as a first-of-its-kind initiative covering various sectors and sub-sectors within bioenergy.
- The event attracted nearly 3,000 visitors over two days, featuring over 1,000 participants, 20 sessions across bioenergy and biofuels, and approximately 150 speakers.
- Around 100 exhibitors participated, marking a strong beginning for the initiative, with hopes for improvement in future annual events.
- Mr. Kumar acknowledged the progressive policy framework laid out by the Ministry of Petroleum and Natural Gas under Mr. Pankaj Jain's leadership, which is continually advancing in the biofuels and bioenergy sectors.
- He highlighted the session's focus on creating a support structure for bioenergy businesses and expressed interest in the Global Biofuel Alliance initiative.
- Mr. Kumar proposed the idea of establishing a National Biofuel Alliance or similar body to integrate all sectors and sub-sectors of biofuels and bioenergy, enhancing collaboration and transparency in policy development.
- He suggested that such a structure could ease the ease of doing business and provide clarity across various aspects of the bioenergy value chain, including engagement with state governments.

Address by Mr. Atul Mulay, Chairman, Biofuel Committee, IFGE & President- Bioenergy, Praj Industries

- Mr. Mulay welcomed Mr. Pankaj Jain, acknowledging his attendance despite a busy schedule.
- He highlighted the success of the two-day workshop, featuring 20 sessions, over 1,500 delegates, and around 100 speakers.
- A key achievement was the comprehensive support across the bioenergy ecosystem, from feedstock to end-users, including the automobile industry.
- Mr. Mulay praised the success of India's ABB 20 program, which is globally recognized in biofuels initiatives.
- He noted concerns raised from various ministries, including Agriculture, DFPD, and MNRE, emphasizing the need for integrated and sustainable policy solutions.
- He acknowledged the participation of dignitaries and officials, thanking them for their guidance.
- Mr. Mulay expressed interest in establishing a national alliance to unify various ministries and discussed the role of the Indian Federation of Green Energy (IFGE) in supporting the vision of a Global Biofuel Alliance (GBA).

- Mr. Jain praised the Indian Federation of Green Energy (IFGE) for organizing the event and recognized it as an important platform to foster collaboration across the bioenergy sector. He highlighted that the event covered a broad spectrum of bioenergy topics, moving beyond biomethane and biogas to include newer technologies such as ethanol, sustainable aviation fuel (SAF), biodiesel, renewable DME, bioplastics, and green hydrogen via biomass. The event successfully created what Mr. Jain described as a “national alliance” by uniting multiple stakeholders in the bioenergy space.
- He pointed out the various Government initiatives for the upliftment of Bioenergy sector as mentioned below:

Progress in Ethanol Production:

- Ethanol Success: India has made significant progress in ethanol blending, which has had a positive impact on rural economies.
- Ethanol production has injected substantial financial resources into the rural economy, particularly benefiting farmers by improving their incomes.
- Rural Economic Impact: He explained how this progress has helped increase overall earnings for farmers, leading to value addition to their crops. Ethanol production is becoming a key driver for the viability of farming industries.
- Risks of Disruption: Mr. Jain warned that even minor disruptions in ethanol production could result in rural distress, given the close connection between farmers' incomes and biofuel production. Thus, maintaining stability in this sector is crucial.

Challenges with By-products and Viability:

- Importance of By-products: Mr. Jain emphasized that the biofuel industry’s viability heavily relies on efficiently utilizing by-products.
  - For ethanol, a critical by-product is DDGS (Distillers Dried Grains with Solubles), which is crucial in offsetting production costs. He noted challenges in monetizing DDGS, particularly from crops like maize, due to contamination concerns such as aflatoxins.
  - In compressed biogas (CBG), by-products like Liquid Fermented Organic Manure (LFOM) and Fermented Organic Manure (FOM) play a significant role. He highlighted the need to address issues around pricing, quality, and marketability of these products to enhance profitability.
- Biodiesel and SAF: Mr. Jain also mentioned that in biodiesel and SAF, the starting materials like palm stearin and used cooking oil are by-products themselves. The success of these biofuels depends on building an ecosystem to efficiently collect, process, and use these materials.

Regulatory and Ecosystem Challenges:

- Knowledge Gaps and Education: Mr. Jain stressed the need for greater awareness and education among policymakers about biofuels. He noted that there is often a lack of understanding at the state and central levels regarding emerging biofuels like SAF and CBG.
  - Collaboration with state governments is critical to ensure that policies reflect the realities of the bioenergy sector.
- Need for Efficiency: As the bioenergy industry matures, it must move beyond cost-plus models and focus on efficiency gains, process improvements, and innovation. He stressed that relying solely on government support will not be sustainable.

Scalability and Innovation: Mr. Jain called for the industry to innovate in ways that reduce costs while enhancing production efficiency, particularly in ethanol production, which must become more competitive with traditional fuels like crude oil.

Global Biofuel Alliance (GBA):

- Mr. Jain provided an update on the Global Biofuel Alliance (GBA), which has expanded to include 25 countries and 12 international organizations. This demonstrates strong global interest in biofuels.
- He acknowledged that aligning national policies and structures among such a diverse set of countries is challenging. Some nations, such as India, Brazil, and the U.S., are more advanced in biofuel production, while others, like Kenya and Sri Lanka, are still in the early stages.
- Unlike traditional organizations that focus on government-led initiatives, the GBA emphasizes the role of industry associations and private companies. However, discussions are ongoing about how best to involve industries in the alliance.

Call for Industry Participation:

- Technological Innovation: Mr. Jain urged the bioenergy industry to focus on technology and innovation, particularly in areas like cost reduction, better machinery, and the valorization of by-products.
- Policy Advocacy: He invited industry leaders to engage more actively in regulatory advocacy, ensuring that policies are conducive to growth. He emphasized that the government is open to collaboration in addressing industry challenges.
- Collaborative Working Groups: Mr. Jain noted that several working groups involving industry stakeholders have been formed to address specific challenges, particularly around regulatory issues. These groups will continue to meet and deliver tangible results in the coming months.

Infrastructure and Gas Grid Connectivity:

- CBG Connectivity: Mr. Jain addressed concerns about connecting compressed biogas (CBG) plants to the national gas grid. He explained that the gas grid was not originally designed with CBG in mind, but the government is exploring ways to incorporate it.
  - For smaller CBG plants, pipeline connectivity is more challenging, but Mr. Jain suggested that larger-scale plants could justify investments in connecting to the main gas grid.

Vote of Thanks By Mr. Subodh Kumar, Advisor to the National Team, IFGE, ED, ValPro & Former ED, IOCL

- Mr. Subodh Kumar expressed his gratitude to Mr. Pankaj Jain, Secretary, Ministry of Petroleum & Natural Gas, for his valuable time and continuous support. He acknowledged Mr. Jain's insights on Sustainable Aviation Fuel (SAF), carbon credits, and other emerging technologies, which are guiding the bioenergy sector's growth.
- Reflecting on his journey with Compressed Biogas (CBG) since 2018, Mr. Kumar noted the industry's significant progress and expressed confidence in further advancements with Mr. Jain's leadership. He also thanked Mr. Atul Mulay and Mr. Ashish Kumar for their contributions and appreciated all participants for making the event a success.

Day 3 Plenary Session 4: Creating a Support Structure for Sectors of Bioenergy Business

Recommendations and key takeaways from the session:

L to R : ***Mr. Pankaj Jain****, Secretary, MoPNG,* ***Mr. Ashish Kumar****, Vice President, IFGE & Managing Director, VERBIO India Pvt. Ltd.,* ***Mr. Atul Mulay****, Chairman, Biofuel Committee IFGE, President – Bioenergy, Praj Industries*

- Establish a National Biofuel Alliance: Create a unified body to integrate all sectors and sub-sectors of biofuels and bioenergy, facilitating collaboration and transparency in policy development.
- Enhance Support Structures: Develop comprehensive support mechanisms for bioenergy businesses that simplify regulatory processes and provide clarity on policies affecting the bioenergy value chain.
- Foster Collaboration Across Ministries: Encourage collaboration among various ministries, including Agriculture, DFPD, and MNRE, to formulate integrated and sustainable policy solutions that support the bioenergy ecosystem.
- Promote the Global Biofuel Alliance Initiative: Support the vision of the Global Biofuel Alliance (GBA) by facilitating engagement with international stakeholders and sharing best practices to strengthen India's position in the global biofuels market.
- Increase Awareness and Participation: Organize regular workshops, conferences, and seminars to engage stakeholders from all levels of the bioenergy sector, including feedstock suppliers, producers, and end-users, to foster knowledge sharing and innovation.
- Streamline Regulatory Frameworks: Review and simplify existing regulations to improve the ease of doing business in the bioenergy sector, ensuring that policies are conducive to investment and growth.
- Support Research and Development: Invest in R&D initiatives focused on biofuel technologies and sustainable practices, encouraging collaboration between academia, industry, and government to drive innovation.
- Engage State Governments: Facilitate better engagement with state governments to ensure local policies align with national bioenergy goals, promoting a coherent approach to biofuel development across the country.

Day 3 Session on Industry perspective of Financing "Wish List" and Rationale

Key topics discussed: The session addressed financing challenges, scaling biogas production, technological innovation, waste management, community opposition, and emphasized the need for farmer partnerships to ensure the success of bioenergy projects.

Address by Mr. Gaurav Kedia, Chairman, Indian Biogas Association

- Mr. Kedia presented an impassioned case for biogas as a sustainable energy solution with wide-ranging benefits beyond financial returns. His key points included:
- Personal connection to biogas: He shared his personal commitment to the biogas industry, emphasizing the role biogas can play in providing clean energy, improving waste management, and creating a positive social impact, especially in rural areas.
- Focus on impact over financial viability: He urged industry stakeholders to prioritize the broader environmental and social impacts of biogas plants rather than merely focusing on profitability, especially for small and medium-sized projects. These plants create ripple effects by addressing climate change and improving soil health through biogas-derived organic fertilizers.
- Segmenting the biogas sector: Mr. Kedia proposed breaking down the biogas industry into upstream, midstream, and downstream segments to better identify the unique challenges and opportunities each segment faces. He emphasized that policy and financial solutions need to be tailored to these stages.
- Challenges in feedstock collection: One of the major hurdles in biogas production, according to Mr. Kedia, is the difficulty in mobilizing farmers and organizing a consistent supply of agro-residues for feedstock. Without addressing this issue, biogas projects would struggle with inconsistent inputs, which increases operational costs.
- The role of policy and competition: He highlighted the need for stronger policies from the Ministry of Petroleum and Natural Gas (MoPNG) to support biogas equipment and reduce the competition from other renewable sectors, such as ethanol. A holistic view of the renewable energy landscape is crucial for the sector's growth.
- Advancing technology: There is an urgent need to improve the midstream biogas production processes to align with global energy transition goals. He noted that while technology exists, it needs to become more affordable and efficient.
- Blended finance: Mr. Kedia introduced the concept of blended finance, where investments from social and environmental stakeholders, along with traditional financiers, can help fund biogas projects. This would distribute risks and attract different pools of capital.
- Green premium and organic fertilizers: He advocated for biogas to be priced competitively against fossil fuels, factoring in its environmental benefits. In addition, the role of biogas-derived fertilizers should be better understood and priced fairly based on their nutrient content and organic carbon levels.

Address by Mr. Y. B. Ramakrishna, Sr Vice President, IFGE & Former Chairman, Working Group on Biofuel MoPNG

- Mr. Y.B. Ramakrishna highlighted that India's biogas program, initiated in 1982, resulted in the establishment of 4.5 million small biogas plants, but only 0.5 to 1 million are currently operational.
- The program was primarily target-driven, focusing on installation without adequate provisions for ongoing maintenance and management training for farmers, which has led to sustainability issues.
- Community-based biogas plants have largely failed due to insufficient management skills and technical support, resulting in their closure.
- Many plants have faced challenges due to improper feedstock management, with unsuitable materials being used in systems originally designed for cow dung.
- The SATAT program is now focusing on scaling up biogas production for transportation, industrial, and cooking applications, introducing new challenges related to feedstock supply chains and infrastructure.
- Agricultural residues are only seasonally available, and their transportation and compaction further increase energy requirements and costs.
- There is a lack of a nationwide system for effectively segregating municipal solid waste into organic and inorganic components, with only a few cities, such as Pune, Indore, and Bangalore, serving as successful examples.
- Companies are struggling to create scalable supply chains for feedstock, which increases costs and affects the viability of biogas projects.
- The existing biogas technology is often outdated, and there is a need for innovation in equipment design and improvements in gas recovery efficiency.
- Although some progress has been made in policy, significant gaps remain in ensuring the long-term sustainability of biogas projects, protecting investments, and supporting financial viability.
- In the 1980s and 1990s, developmental and infrastructural projects faced significant opposition, often based on environmental concerns.
- Two common syndromes in opposition to these projects:
- NIMBY Syndrome: People support projects but oppose them if they are proposed in their vicinity.
- Banana Syndrome: A belief in building "absolutely nothing anywhere near anything," reflecting extreme opposition.
- Recent opposition in Ludhiana against multiple projects is driven by a negative narrative and unscientific arguments, possibly fueled by background financing and political agendas.
- The complex societal and federal structure, with multiple political parties, complicates the implementation of new projects and may lead to a new norm of opposition.
- An example from Karnataka highlights resistance to a sugar mill using molasses for ethanol production, indicating that such opposition is not widely known but is prevalent.
- Challenges in bioenergy programs (upstream, downstream, midstream financing, carbon markets) may be addressed over time, but community opposition is a serious concern that requires focused advocacy.
- Farmers should be recognized as stakeholders in the bioenergy programs, moving towards a partnership model similar to that seen in the sugar industry.
- Industries must prepare for potential challenges when setting up new plants and engage with communities at the ground level to mitigate opposition.
- The idea of bringing infrastructural projects under the Indian Sugar Mills Association (ISMA) has been discussed as a potential solution, but a broader approach is necessary to address opposition proactively.

Address by Mr. Som Narayan, Director, Carbon Masters

- Mr. Narayan focused on the financial hurdles in scaling biogas production, emphasizing the importance of long-term clarity and risk mitigation
- Securing funding for infrastructure: Biogas projects face difficulties in securing long-term financing due to uncertainties in pricing. Investors need assurance on pricing stability, particularly when gas prices fluctuate. Clear pricing mechanisms with inflation adjustments would boost investor confidence.
- Need for organic fertilizers: He highlighted the agricultural need for improving soil health and reducing chemical fertilizer dependency, which could drive demand for organic fertilizers derived from biogas. There is a need to actively implement the MDA scheme to support the organic fertilizer market.
- Standardization of equipment: Mr. Narayan advocated for standardizing plant sizes and equipment to create a secondary market for biogas facilities, which would reduce risks for investors and increase project scalability.
- High capital costs and interest rates: The capital costs for biogas projects are high, with interest rates ranging from 12% to 14%. He urged the industry to push for lower interest rates similar to those offered for metro projects, which would make biogas projects more financially viable.
- Risk-sharing initiatives: He mentioned a risk-sharing facility by GIZ that offers subsidies and coverage for biogas projects, making it easier for banks to approve financing. However, despite these measures, many banks remain hesitant, fearing long-term repercussions of defaults.

Address by Col. Rohit Dev, Co-Chairperson, IFGE: Biomass Global Associates Forum

- Col. Dev presented a broad vision for the future of bioenergy financing, emphasizing farmers' roles and the need for alternative financing models:
- Farmers as partners in the bioenergy value chain: He proposed a shift toward treating farmers as partners, rather than just feedstock suppliers, in the biogas value chain. Reinvesting profits into farming communities would help secure feedstock supply and create a more sustainable system.
- Decentralization of energy security: Col. Dev suggested that energy security should be treated as a central government subject to streamline policy implementation, much like defense. This would prevent delays caused by state-level interference.
- Logistics and warehousing: He stressed the high logistics and transportation costs associated with feedstock collection and called. for customized warehousing and logistics solutions to alleviate these costs
- Alternative financing models: Col. Dev advocated for profit-sharing and other alternative financing models to reduce reliance on collateral-based lending. He also mentioned foreign financial institutions as being more open to bioenergy projects compared to domestic banks, urging Indian financial institutions to be more engaged in the sector.

- Mr. Atul Mulay discussed the multifaceted nature of the biofuel sector, highlighting the government's initiatives like the interest subvention scheme for sugar and the 595 scheme aimed at grain-to-ethanol conversion.
- He noted the initial success of these schemes, which attracted a large number of investors due to attractive pricing and guaranteed market support from OMCs, leading to significant interest from financial institutions.
- However, as financial institutions began to assess project viability, they recognized that many promoters were not likely to sustain their projects in the long run, resulting in increased demands for collateral and guarantees.
- The short-term nature of some policies has created uncertainty among bankers, necessitating long-term solutions, ideally spanning five to seven years, to provide stability for large-scale projects.
- Mr. Mulay emphasized the importance of the performance and reputation of EPC players in the financial assessment of projects, noting that negative experiences with some EPC contractors have tarnished the sector’s image and investor confidence.
- He stressed that financial institutions must broaden their evaluations to include not just the promoters but also the EPC players' credentials and financial stability.
- The need for a solid and sustainable ecosystem for the biofuel sector was highlighted, advocating for improved collaboration between financial institutions, technology providers, and project developers to ensure long-term success.
- Atul Mulay noted that long-term offtake agreements have been encouraged by Oil Marketing Companies (OMCs) for grain ethanol, while such agreements are lacking for sugar-based ethanol, despite strong balance sheets in the sugar sector attracting funding agencies.
- He pointed out that during the recent expression of interest, applicants were allocated only a percentage of the requested ethanol supply (e.g., 20%, 30%, or 50%), which has impacted project viability.
- Mulay mentioned that banks initially provided principle clearance based on the promoter's background, but later required reassessment of the project's viability due to reduced ethanol supply allocations.
- Many projects from the second expression of interest have become stalled as a result of this requirement, impacting the ability to meet blending targets of 15% to 16%.
- He emphasized the need for forums and platforms to sensitize financial institutions and relevant authorities about these challenges to facilitate smoother project progression.

Day 3 Session on Industry perspective of Financing "Wish List" and Rationale

Recommendations and key takeaways from the session:

L to R : ***Mr. Ashish Kumar****, Vice President, IFGE & Managing Director, VERBIO India Limited,* ***Mr. Gaurav Kedia****, Chairman, Indian Biogas Association,* ***Mr. Som Narayan****, Director Carbon Masters,* ***Mr. Y. B. Ramakrishna****, Sr. Vice President, IFGE & Former Chairman- Working Group on Biofuel MoPNG.* ***Mr. Atul Mulay****, Chairman IFGE- Biofuel Committee and President- Bioenergy, Praj Industries,* ***Col. Rohit Dev****, Co-Chairperson, IFGE: Biomass Global Associates Forum*

- Develop a clear and stable pricing mechanism for biogas and related products, including provisions for inflation adjustments to instill investor confidence.
- Implement blended finance models, pooling resources from various stakeholders, including investors and social impact contributors, to support biogas projects.
- Foster collaboration between government agencies, financial institutions, and stakeholders within the renewable energy landscape to create a supportive ecosystem for biogas investments.
- Promote standardization of plant sizes and equipment for biogas facilities to reduce risks for investors and facilitate the development of a secondary market.
- Expand risk-sharing mechanisms, such as GIZ's facility, to provide more security for banks and financial institutions when financing bioenergy projects.
- Advocate for reduced interest rates for biogas projects, aligning them with rates available for infrastructure projects, to enhance project viability.
- Strengthen advocacy efforts to address community resistance and promote awareness of biogas among farmers and potential investors.
- Actively implement and expand the MDA scheme to support the market for biogas-derived organic fertilizers and encourage sustainable agricultural practices.
- Engage in capacity-building initiatives to educate bankers about the bioenergy sector, addressing their concerns about defaults and enhancing their understanding of bioenergy projects.

Recommendations and key takeaways from the session:

- Promote research & development in biogas technologies, applications to ensure long-term innovation & sustainability.
- Streamline subsidy disbursement processes to accelerate the availability of financial support for bioenergy projects.
- Establish long-term offtake agreements for biogas and ethanol projects to enhance their financial viability and attract investment.
- Agreements for biogas and ethanol projects to enhance their financial viability and attract investment.
- Develop clear and standardized guidelines for banks to facilitate consistent decision-making in financing bioenergy projects.
- Encourage partnerships between financial institutions, project developers, and technology providers to create a sustainable biofuel ecosystem.
- Advocate for alternative financing models, such as profit-sharing and open-book philosophies, to create an equitable value chain that benefits both farmers and entrepreneurs.
- Address the logistical challenges in the upstream feedstock supply chain, including transportation and storage costs, by encouraging government initiatives for custom warehousing solutions.
- Promote gradual project development timelines that align with the unique needs of bioenergy sectors, such as ethanol and biogas, to ensure realistic growth and project completion.
- Leverage interest from foreign financial institutions by fostering partnerships that can lead to increased investment in bioenergy projects.
- Encourage dialogue among stakeholders to align on best practices for project implementation, pricing stability, and supply chain management.
- Advocate for the recognition of farmers as key stakeholders in bioenergy programs, ensuring they receive fair compensation and are integrated into the value chain.

Address by Mr. Pralhad Joshi, Hon'ble Minster of New and Renewable Energy, Consumer Affairs, Food and Public Distribution, Government of India

- Mr. Joshi highlighted the India's energy demand which is projected to double by 2030, accelerated by urbanization and industrialization, a faster timeline than previously estimated.
- While coal has been a primary energy source, the focus is shifting towards sustainable alternatives due to climate change. Bioenergy, particularly from agricultural waste, is seen as vital in India's energy transition.
- The government has launched initiatives like the National Bioenergy Program and Samarth Mission to promote biomass in power generation and address environmental issues like stubble burning.
- A 5% biomass co-firing in coal plants has been introduced, engaging farmers and pellet manufacturers, to reduce carbon footprints and enhance clean energy efforts.
- Despite bioenergy's potential, challenges such as technology, infrastructure development, and sustainable sourcing of feedstock remain, but there are significant growth opportunities in the sector.
- Central Financial Assistance (CFTA) is being provided to support bioenergy projects, including biogas, biomass, and bio-CNG generation, with specific funding amounts based on project size and type.
- India's bio-power potential is 42 GW, but only 11 GW is currently utilized, indicating vast room for capacity expansion.
- Platforms like the India Energy and Tech Expo are essential for advancing bioenergy in India and fostering collaboration within the industry.

L to R : ***Mr. Gaurav Kedia****, Chairman, Indian Biogas Association,* ***Mr. Ravindra Boratkar****, Founder Member, IFGE & Managing Director, MM Activ Sci-Tech Communications,* ***Dr. Vidhya Murkhumbi****, Chairperson, Ravindra Energy, Past President IFGE.,* ***Mr. Y. B. Ramakrishna****, Sr. Vice President, IFGE & Former Chairman- Working Group on Biofuel MoPNG,* ***Mr. Pralhad Joshi****, Hon'ble Minster of New and Renewable Energy, Consumer Affairs, Food and Public Distribution Government of India,* ***Mr. Anna Sahab M K Patil****, Chairman, IFGE and Former MoS Rural Development.,* ***Mr. Atul Mulay****, Chairman IFGE- Biofuel Committee and President-Bioenrergy, Praj Industries,* ***Mr. Ashish Kumar****, Vice President, IFGE & Managing Director, VERBIO India Limited,* ***Col. Rohit Dev****, Co-Chairperson, IFGE: Biomass Global Associates Forum.*

Day 3 Session on Banker's Perspective on Capital Mobilization to Trigger Growth in Bioenergy Sector

Key topics discussed: The banking session covered the role of banks in green financing, risk perception and assessment, collateral concerns, cash flow analysis, capacity building for financial institutions, government support, blended finance models, partnerships, sustainable business models, and international funding sources.

Address by Mr. K S Popli, Country Director, World Biogas Association & Former CMD, IREDA

- Mr. Popli reflected on his experience since 2010, highlighting that many bioenergy projects faced significant challenges, resulting in failures within three to four years and leading to numerous Non-Performing Assets (NPAs).
- Initial assumptions about stable feedstock supply and assured offtake proved incorrect, causing issues for project viability.
- He noted the volatility in biomass feedstock pricing, with costs escalating from an estimated ₹1,500 per ton to as high as ₹3,500 per ton, jeopardizing project feasibility and exacerbated by competing uses for biomass.
- While technological advancements have been made, operational performance remains inconsistent, highlighting the need for input assurance and guaranteed offtake for successful projects.
- Mr. Popli commended recent government initiatives supporting the biomass sector, including policies guaranteeing offtake when connected to the gas grid, essential for providing a stable investment environment.
- The evolution of waste-to-energy projects was discussed, noting the importance of established tipping fees and take-or-pay agreements that support financial viability, along with improved waste segregation practices.
- He spoke about the introduction of financing policies for ethanol projects, which initially struggled to attract applicants; despite persistent challenges such as high operational and maintenance costs for biodiesel, the sector is becoming increasingly attractive.
- The session emphasized the need for continued policy and regulatory support as a critical factor for sustaining growth and attracting investment in the bioenergy sector.
- The event concluded with a call for further discussions on addressing major challenges in bioenergy financing and identifying new investment opportunities.

Address by Mr. Wolf Muth, Country Director, India, KfW

- Mr. Wolf discussed on how India is fond of Renewable energy, policy and grants related to these projects including:
- The bioenergy conference has illuminated various critical aspects of the sector.
- The selection and availability of feedstocks are essential for each form of bioenergy, similar to the considerations in wind and solar energy.
- Developing a robust business case for each factor and sector is vital.
- The extensive use of paddy straw across applications was highlighted.
- Different biogas plants require various types of feedstocks, each with distinct production costs.
- He also addressed the risks associated with various approaches and configurations of biogas projects.
- Significance of standalone processes & associated costs was discussed.

Address by Mr. Pradeep Kumar Jha, AGM, SIDBI

- Mr. Jha represents SIDBI, the Apex Institution for the promotion, development, and financing of MSMEs, with a focus on creating a green enterprise ecosystem through its green finance vertical.
- SIDBI has adopted five missions related to green finance: Mission Energy, initiated in 2005; Mission E-Mobility; Mission Renewable Energy, covering solar and wind projects; Mission Circular Economy, targeting the bioenergy sector; and Mission Adaptability, financing new technology for nature-based solutions.
- Mr. Jha discussed the challenges in financing, noting that primary security often relates to municipal or leased land, leading to concerns over collateral requirements. He pointed out that the influx of new players in the bioenergy sector introduces uncertainties regarding cash flow, affecting banks' willingness to lend.
- To ensure sustainability in the bioenergy sector, there is a crucial need for financial and technical products that help de-risk investments, along with blended finance solutions to enhance project viability. Bankers must grasp the unique life cycle of green finance projects to effectively assess their feasibility and financial health.
- SIDBI has a fund from GIZ that offers up to 50% of loans (up to ₹20 crores) to mitigate risks associated with green finance projects. Additionally, collaboration with the World Bank aims to develop further funding mechanisms.
- Recently, SIDBI contracted ₹200 million from the Global Climate Fund (GCF) for the CIDWI project, creating a total facility of ₹1,000 million, with the expectation of establishing a ₹4 billion fund for the green finance sector. The organization is focusing on a bottom-up approach to develop products for nano- and macro-entrepreneurs in the green ecosystem to foster growth from the grassroots level.
- SIDBI is actively seeking international partners, donors, and philanthropists to provide low-cost funds for MSMEs engaged in sustainable projects. New entrants in the bioenergy sector should recognize the importance of understanding the sector's challenges and incorporate additional income-generating activities related to their projects. Clear cash flow projections and partnerships for product sales and raw material procurement are essential for convincing banks of project viability.
- Entrepreneurs must possess a comprehensive understanding of both the technical and financial aspects of their projects before approaching banks for financing. Mr. Pradeep Kumar Jha’s insights underscore SIDBI’s pivotal role in facilitating green finance and supporting MSMEs in the bioenergy sector. By addressing challenges and fostering a deeper understanding of financial mechanisms, SIDBI aims to enhance the sustainability and growth potential of green enterprises in India.

- Mr. Gaurav outlined a strategic approach aiming to work at three levels, focusing on five key geographies where training is provided to waste workers of the Municipal Corporation. The initiative supports five primary objectives: Composting, Bio-Methanation plants, Material recovery facilities, Dry waste recycling facilities, and RDF (Refuse-Derived Fuel) units.
- Mr. Gaurav also highlighted efforts to unlock funds for low-carbon waste management solutions by providing partial debt guarantees on loans to waste management enterprises.
- He explained the RSF (Risk Sharing Facility) project flow, which includes steps such as credit guarantee application, screening, loan application, and guarantee approval and distribution.
- Mr. Gaurav also mentioned the involvement of various industries and companies, such as CAM industries in Goa, NEPRA Resource Management in Ahmedabad, Resqpol Pvt. Ltd. in Karnataka, Earth Care Equipment, GPS Renewables, and Cube Aditya, in the Risk Sharing Facilities initiative.
- GIZ's project, "Waste Solutions for a Circular Economy in India," promotes low-carbon waste management technologies and operates at the central, state, and city levels to implement circular economy principles in the municipal solid waste sector.
- To support the private sector, GIZ set up a pilot risk-sharing facility with SIDBI, offering credit guarantees to banks, enabling them to lend to waste management companies with up to 50% loan guarantees. This reduces risk and encourages investment in sectors like composting, biomethanation, and recycling.
- The capital guarantee program has a 6 crore INR limit per company and benefits entities like NEPRA and GPS Renewables, which use the funding for waste management and biogas projects.
- GIZ is collaborating with the Ministry of Housing and Urban Affairs to develop an advisory on biomethanation, promoting biogas as a sustainable solution for managing India's wet waste, which comprises 80,000 tons of the daily 160,000 tons of municipal solid waste.
- The project also addresses challenges in recycling multi-layer packaging and provides free online courses and business model handbooks to educate stakeholders on sustainable waste management practices.

Address by Mr. Mudit Jain, Head Research – Corporate & Cleantech Finance, Tata Capital Limited

- Mr. Jain highlighted the importance of the supply chain and additionally, he mentioned the importance of finance model which is essential for solar, wind, bioenergy and every sector
- Tata Capital, as a Non-Banking Financial Company (NBFC), offers a range of services, including corporate loans, personal loans, retail lending, and housing loans.
- The company has established a vertical dedicated to clean tech financing, initially focusing on utility-scale solar and wind projects, and expanding into open access, rooftop solar, energy efficiency, electric mobility, green hydrogen, green buildings, and water treatment.
- Tata Capital has financed approximately 50 megawatts of waste-to-energy projects, over 120 KLD of bioethanol, and more than 60 TPD of compressed biogas.
- Mr. Jain acknowledged existing challenges in the bioenergy sector and emphasized the need for solutions, particularly concerning the supply side and revenue generation.
- He compared the current state of bioenergy to the early days of solar and wind energy, noting that while challenges remain, opportunities are increasing.
- A perfected business model in bioenergy is essential, focusing on supply chain processing and the commercialization of products like compressed biogas and bioethanol.
- Scaling up bioenergy projects without subsidies or premiums is crucial for long-term sustainability.
- He asserted that once a solid business model is in place, financing should not be an issue, as significant capital is available for well-structured projects.
- He dispelled the myth that finance is a barrier, stating that with an established business model, securing substantial funding (potentially up to $100 billion) is achievable due to the high demand for limited projects.

Day 3 Session on Banker's Perspective on Capital Mobilization to Trigger Growth in Bioenergy Sector

Recommendations and key takeaways from the session:

L to R : ***Mr. Jai Kumar Gaurav****, Senior Advisor-Climate Change and Circular Economy, GIZ India,* ***Mr. Wolf Muth****, Country Director, India, KfW,* ***Mr. K S Popli****, Country Director, World Biogas Association & Former CMD, IREDA,* ***Mr. Pradeep Kumar Jha****, AGM, SIDBI* ***Mr. Mudit Jain****, Head Research – Corporate & Cleantech Finance, Tata Capital Limited*

- Develop Comprehensive Financial Products: Establish tailored financial products, including blended finance options, to address the unique challenges faced by the bioenergy sector and other green projects.
- Enhance Capacity Building: Regular training and capacity-building programs for bankers and financial institutions to improve their understanding of the bioenergy sector's life cycle and specific financing needs.
- De-risking Initiatives: Implement de-risking mechanisms, such as credit guarantees and insurance products, to lower perceived risks associated with financing new and inexperienced players in the green sector.
- Focus on Business Models: Encourage the development of sustainable business models that include diversified income streams, leveraging by-products from bioenergy projects to enhance profitability.
- Strengthen Collaboration: Foster partnerships between banks, financial institutions, government bodies, and private sector players to create a supportive ecosystem for financing green projects.
- Transparent Cash Flow Projections: Emphasize the importance of clear and accurate cash flow projections from entrepreneurs, demonstrating their financial viability and the potential for successful project outcomes.
- Engage with New Entrants: Provide guidance and support for new entrepreneurs entering the bioenergy sector to help them understand industry challenges and financial requirements.
- Promote Public-Private Partnerships: Facilitate collaboration between government initiatives and private sector financing to maximize resources and enhance the impact of green projects.
- Encourage Innovative Financing Solutions: Explore innovative financing solutions, such as low-cost funds from international partners and philanthropic sources, to support MSMEs in the green sector.
- Monitor and Evaluate Projects: Establish mechanisms for the regular monitoring and evaluation of financed projects to assess their impact and sustainability, using insights to refine future financing strategies

Day 3 Session on Bio-hydrogen, Decarbonization and Sustainability

Key topics discussed: Role of Hydrogen in Energy Goals, Green Hydrogen Potential, Net Zero Target, Challenges to Hydrogen Adoption, Biomass and Agri Residues in Hydrogen Production, Technological Advancements, Storage and Transportation Issues, Fuel Cell Costs, Renewable Energy and Bio-H2 Plants

Address by Mr. Atul Tare, Vice President - Bio-Hydrogen for Bio-mobility, Praj Industries.

Mr. Atul Tare started the session by introducing the eminent panelists and described Bio-hydrogen as a crucial clean energy source as it can be produced from renewable biomass, offering a sustainable alternative to fossil fuels. It helps reduce carbon emissions and supports decarbonization efforts, advancing the transition to a green energy future.

Address by Prof. G. D. Yadav, Former Vice-Chancellor, the Institute of Chemical Technology

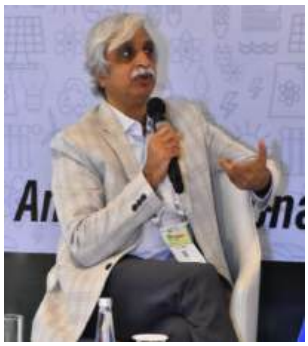
- Prof Yadav started his speech by stating that H2 by stating that it has become the Oxygen of industry
- He mentioned that India's goal for Viksit Bharat aims at reducing the CO2 emissions by 25 % by 2030 and enhance the total energy production from 450 Megaton to 850 Megaton.
- There is an urgent need to close the gap in climate action, as global temperatures are rising by 1.5°C per year, according to a report released on May 18, 2023
- He then highlighted that currently India chiefly focuses on energy through export and reduced import supply; he also mentioned that by 2050, India would need a total of 49000 terabytes/ hour of energy to suffice sustenance
- He then highlighted a few drawbacks in current H2 production system
- Deserving incentive is not given to the industry in India, unlike the system of 111 in USA which tends to provide 1 dollar for every 1 Kilo H2 produced to the industry
- According to the world record of 2023, it has been reported that 35.6 % Gigaton of CO2 was libeated in the year of 2023, where India's contribution was 2.66 billion tons. However, as India aims for 0% CO2 contribution by 2047, carbon neutrality has to be mentioned
- He also highlighted how most of the energy sources of India like LPG, Crude Oil, Coal (mostly from Indonesia) is imported into India
- He highlighted how the CSR should be increased from 2% to 3 % in order to enable researchers to develop new technologies and associate with industries by sharing their IPR.
- He also mentioned that the lack of H2 Infrastructure is yet another challenge, wherein no Type 3 or Type 4 fuel cells are available
- Additionally, there is a shortage of appropriate storage, transportation and preservation methods of H2.
- He finally ended his speech by highlighting the need to explore the byproducts generated from Ethanol include more than 30 different bioactive compounds.
- In a follow up question he mentioned that since 1 ton of H2 can give 11 tons of CO2, and so this CO2 is captured and utilized; he also mentioned how bio-based food waste can also be used to produce H2
- He concluded by stating that BioH2 is the need of the hour for a sustainable India.

Address by Prof. K K Pant, Director, IIT Roorkee

- Prof. Pant highlighted that agri residues like crop residue, algae, microalgae can serve as the biomass source for H2 production
- He highlighted that though 500 million tons of this resource is available not much production is attained
- He further mentioned that post gasification, syngas produced can be used for producing H2, besides SAF from biomass as well as edible oils.
- He also highlighted the economics of thermochemical biomass conversion involved I conversion of H2; he showed how 25 million tons of H2 can be produced from 75 million tons of crude oil
- He further mentioned that the most common challenges associated with H2 production include: Storage, Transport of H2, Cost of Fuel Cell, And Purification of H2
- He even mentioned techno-economics of using Biomass in DRI
- Green H2 production cost from biomass~ INR 260-290; Green H2 from Electrolysis is INR 350/ Kg
- Wherein the cost of 1.33 INR/ MJ (1.5 Usc) for NGat Rs. 60/ kg

Address by Prof. S Dasappa, Centre for Sustainable Technologies, Indian Institute of Science

- Prof. highlighted the different biochemical and thermos chemical conversions involved with gasification and conversion of Methane into different forms e.g. H2
- He showed the composition of biomass, which comprises of
- He highlighted how IISC, Bangalore have devised a Fuel Cell Combustion system for production of pure form of H2
- He mentioned that how H2 production is a scalable process.
- He showed the importance of syngas, which comprises of 50 % of H2 and 15 % CO2, which facilitates the pumping and transportation of H2
- He highlighted how the STEEL sector contributes as one of the chief areas where Syngas is applied in the form of the redundant
- He also highlighted on importance of the use of biomass and waste as a source for generating H2, which would also lead to reduction of CO2



Address by Mr. Vidhya Bhushan, CGM (Process), Engineers India Limited (EIL)

Mr. Bhushan mentioned the importances of switching over to green H2 and Bio H2
He identified the need for renewable energy for producing H2 and setting up of H2 plants

Day 3 Session on Bio-hydrogen, Decarbonization and Sustainability

Recommendations and key takeaways from the session:

L to R : ***Prof. S Dasappa****, Centre for Sustainable Technologies, IISc,* ***Prof. K K Pant, Director****, IIT Roorkee ,* ***Mr. Vidhya Bhushan****, CGM (Process), EIL,* ***Mr. Atul Tare****, Vice President - Bio-Hydrogen for Bio-mobility, Praj Industries.*

Promoting Hydrogen as a Key Industrial Resource

- Align India's decarbonization efforts with global standards, aiming for a 25% reduction in CO2 emissions by 2030 and achieving Net Zero by 2047 through the adoption of green hydrogen derived from solar, wind, hydro, nuclear, and biomass sources.

Incentivizing H2 Production

- Develop incentive structures to support hydrogen production, drawing inspiration from global systems like the USA's $1 per kilogram H2 incentive. This will make hydrogen production financially viable and competitive.
- Address the lack of infrastructure for hydrogen, including challenges related to fuel cells (Type 3 & 4), storage, transportation, and preservation methods.
- Increase Corporate Social Responsibility (CSR) funding from 2% to 3% to channel more resources into research and development (R&D) in the hydrogen sector.

Harnessing Bio-Hydrogen Opportunities

- Leverage bio-based H2 production from bio-waste, ethanol byproducts, and other agri residues to reduce the carbon footprint while generating cleaner energy.
- Explore the possibility of carbon capture from bio-H2 processes, where 1 ton of H2 can generate 11 tons of CO2, which can be captured and repurposed.
- Promote Bio-H2 as a critical component of India's sustainable energy future, focusing on decarbonization and reducing dependence on imported fossil fuels.

Recommendations and key takeaways from the session:

Utilizing Agri-Residue and Biomass for H2 Production

- Encourage the use of agri residues like crop waste, algae, and microalgae for H2 production via gasification processes, as highlighted by Prof. K.K. Pant.
- Support the development of techno-economic models to make biomass-based H2 production more cost-effective than current alternatives (INR 260-290/kg for biomass-based H2 compared to INR 350/kg for electrolysis).
- Address challenges in storage, transport, and purification of H2 from biomass to make production scalable and efficient in storage, transport, and purification of H2 from biomass to make production scalable and efficient.

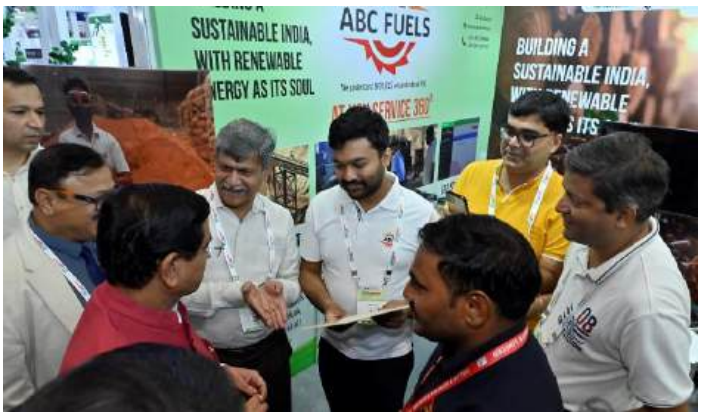
Advancing Thermochemical Conversions for Hydrogen

- Promote the use of thermochemical and biochemical conversion technologies to convert biomass and methane into hydrogen, as outlined by Prof. S. Dasappa.
- Encourage the adoption of syngas—a key byproduct of these processes—as it contains 50% H2 and 15% CO2, making it viable for steel sector applications and helping reduce emissions.
- Scale up innovations like IISC Bangalore's Fuel Cell Combustion system for producing pure hydrogen, which can boost India's green energy capabilities.

Focus on Green and Bio-Hydrogen Production

- Accelerate the transition to green hydrogen and bio-hydrogen by increasing investment in renewable energy sources such as solar and wind, as advocated by Mr. Vidhya Bhushan.
- Establish dedicated hydrogen plants across the country to bolster renewable energy production and help meet India's energy and decarbonization goals.

Glimpses of Exhibition



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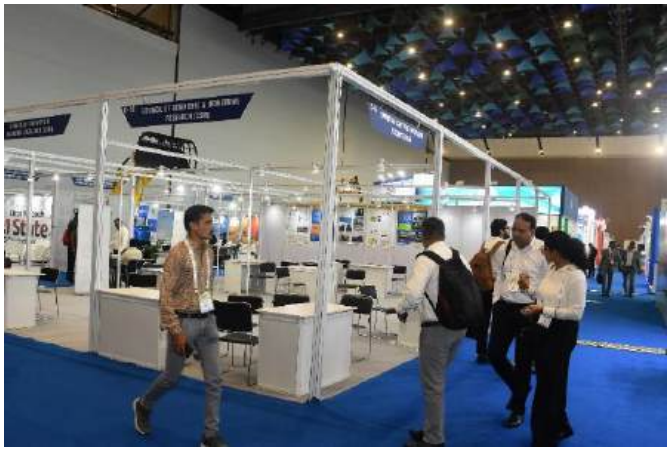

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