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The Bioeconomy of India: Driving Sustainable Progress alongside Inclusive Growth

India faces significant environmental and economic challenges due to its heavy reliance on fossil fuels. In 2023-24, the country imported 232.5 MMT of crude oil, costing ₹13,240 crore and contributing substantially to its 2.8 gigatonnes of GHG emissions. Reducing this dependency through biofuels, renewable energy, and efficiency measures are essential.

The bioeconomy has emerged as a crucial driver of sustainable growth. India's bioeconomy has grown from ₹1000 crore in 2014 to ₹15100 crore in 2023, with projections of ₹30,000 crore by 2030. Industrial biotechnology is gaining momentum through advancements in biofuels, biomass utilization, and biogas production.

Industrial Biotechnology: The Engine of India's Bioeconomy

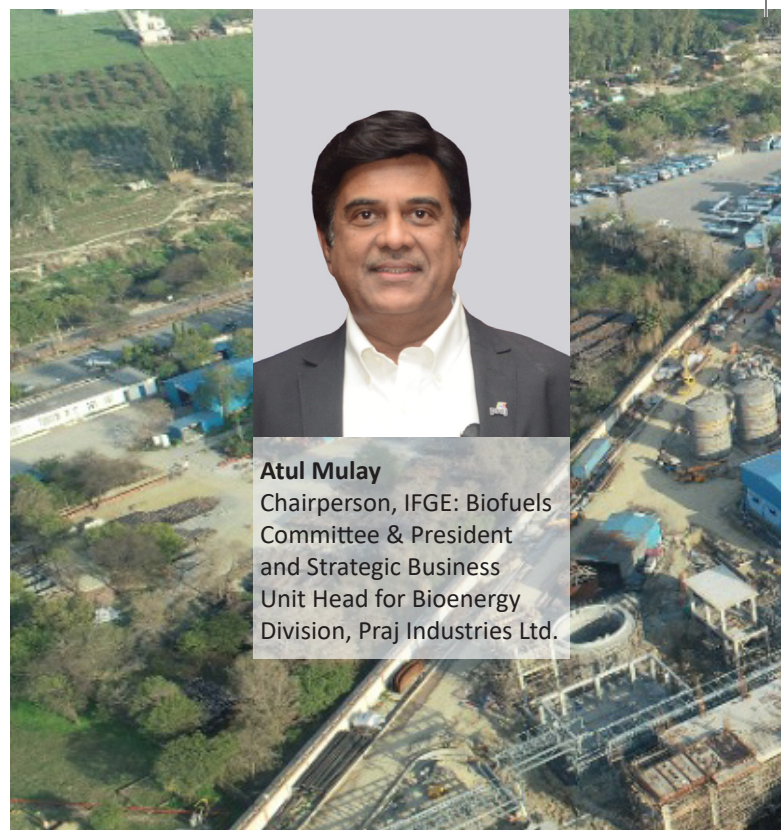
A. Biofuels: Transforming Energy Landscapes

Bioethanol

Bioethanol, derived from biomass such as corn and sugarcane, is a renewable, high-octane fuel that improves engine efficiency and blends well with petrol. It reduces pollutants and particulate matter while significantly cutting GHG emissions.

The Ethanol Blended Petrol (EBP) Program launched by Government of India aims to increase the use of domestically generated bioethanol as transportation fuel along with Gasoline (Motor Spirit or Petrol) to reduce CO₂ emissions and fossil fuel imports.

In India, ethanol blending with petrol has significantly increased from 188.6 crore liters in 2018-19 to over 700 crore liters in 2023-24, with blending percentage



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reaching approximately 14.6% in ESY 2023-24. Over the past decade, the initiative has saved ₹1,06,072 crore in foreign exchange, reduced CO₂ emissions by 544 lakh metric tonnes, and replaced 181 lakh metric tonnes of crude oil. Additionally, the program has had a significant economic impact, with Oil Marketing Companies disbursing ₹1,45,930 crore to distillers and ₹87,558 crore to farmers. Looking ahead, India aims to blend 988 crore liters of ethanol in 2024-25 and 1016 crore liters in 2025-26, as outlined by NITI Aayog.

Compressed Biogas (CBG)

Compressed Biogas (CBG), derived from agricultural waste and industrial byproducts, serves as a sustainable substitute for diesel in transportation and an alternative to natural gas in industries. Under the Sustainable Alternative Towards Affordable Transportation (SATAT) policy, launched in 2018, India aims to establish 5,000 CBG plants by 2025, to produce 15 million metric tonnes (MMT) of biogas annually. By 2023, over 50 CBG plants were operational, with the sector projected to grow at a CAGR of 10.3% until 2030. Additionally, the Indian Government's Compressed Biogas Obligation (CBO) mandates the blending of CBG with natural gas in city gas distribution networks, with a target of developing 750 CBG projects by 2028-29, supported by an estimated investment of ₹37,500 crore.

Sustainable Aviation Fuel (SAF)

With aviation contributing 2-3% of global emissions, sustainable aviation fuel (SAF) is a crucial solution.



SAF has the potential to reduce emissions by up to 65%, requiring production of 350 million tons annually to achieve the International Civil Aviation Organization's (ICAO) net-zero targets by 2050. India, leveraging its abundant agricultural feedstocks, has the capacity to produce 19-24 million tons of SAF annually. Widespread adoption of SAF would not only lower emissions but also boost India's GDP by \$2.8 billion, strengthen energy security, generate rural employment, and enhance waste management.

B. Socioeconomic and Environmental Benefits

India's bioeconomy plays a crucial role in fostering inclusive growth by generating employment, supporting rural development, and promoting sustainability. In 2023, the sector employed over 4 million people; with job creation projected to reach 35 million by 2030. Establishing biofuel facilities in rural areas strengthens local economies, curbs migration to urban centers, and enhances infrastructure development.

Additionally, biofuels align with the UN Sustainable Development Goals (SDGs), contributing to clean energy, sustainable cities, and improved public health. The use of agricultural residues in biofuel production helps to reduce air pollution while providing farmers with an additional source of income. Furthermore, biofuels bolster energy security by minimizing dependence on imported fossil fuels, reinforcing India's commitment to a sustainable and self-reliant energy future.

C. Policy and Global Leadership

India's bioeconomy is driven by robust policies such as the National Policy on Biofuels and the BioE3 (Biotechnology for Economy, Environment & Employment) initiative, which support sustainable energy development. International collaborations through the Global Biofuel Alliance further reinforce India's leadership in this sector. Strategic partnerships with countries like Brazil and the U.S. accelerate innovation and enhance India's position in the global bioeconomy.

D. Building a Resilient Ecosystem

The bioeconomy's success depends on innovation, infrastructure, and skill development. Initiatives like investments in R&D, focus on academia-industry collaboration, and establishing bio manufacturing hubs will ensure a steady pipeline of scalable solutions.

Conclusion: A Sustainable Vision for the Future

India's bioeconomy offers a transformative path to sustainable growth, blending innovation, environmental responsibility, and socio-economic benefits. Advancements in biofuels, biogas, and SAF reduce carbon footprints, enhance energy security, and empower rural communities. With strong policies, global partnerships, investments in innovation, and fostering inclusivity, India is poised to lead the global bioeconomy.

References: Statistic figures/numbers: PBI, MoPNG, BIRAC