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BIO-FUELS

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MAPPING THE EVOLUTION OF BIOFUELS IN INDIA

SYLLABUS: GS3 > Environment > Energy > Renewable Energy

India is actively pursuing biofuels as a cornerstone of its clean energy transition and long-term energy security strategy. The evolution of the country's biofuel policy illustrates a gradual but determined shift from conventional, food-based ethanol to advanced biofuels sourced from waste and non-food biomass. This transformation aligns with India's developmental needs and its international climate commitments, particularly under the Paris Agreement. The recent policy push also reflects India's ambition to become a global leader in sustainable fuels by integrating innovation, investment, and international cooperation.

WHAT ARE BIOFUELS?

Biofuels are liquid or gaseous fuels derived from organic material – typically plant or animal matter – and are classified as renewable sources of energy.

Types of Biofuels:

- **1G (First-Generation) Biofuels**: Produced from food crops such as sugarcane, corn, and wheat. *Example: Ethanol derived from sugarcane under the EBP Programme.*
- **2G (Second-Generation) Biofuels**: Derived from non-edible biomass like crop residues, lignocellulosic materials, and forest waste. *Example: Ethanol from rice straw in Indian Oil's Panipat 2G plant.*
- **3G (Third-Generation) Biofuels**: Extracted from algal biomass which offers a higher yield per acre and lower environmental impact. *Example: Algae-based fuel research at CSIR-Indian Institute of Petroleum.*

WHY BIOFUELS MATTER FOR INDIA

1. Energy Security

- India relies on imports for nearly 85% of its crude oil requirements.
- Domestic biofuel production reduces import dependency, boosts self-reliance, and saves foreign exchange.
- *Example: Achieving 12% ethanol blending in 2022 saved ₹41,500 crore in oil imports.*

2. Climate Change Mitigation

- Biofuels emit fewer greenhouse gases compared to fossil fuels.
- Supports India's NDC goals of reducing emissions intensity by 45% by 2030.
- *Example: Ethanol blending in 2022 reduced 27 lakh tonnes of CO_2 emissions.*

3. Rural Economy & Farmers' Welfare

- Creates markets for surplus agricultural produce and boosts rural incomes.
- Promotes agro-industrial linkages.
- *Example: Ethanol procurement helped clear farmer arrears in sugar mills.*

4. Waste Management

- Converts waste to wealth using stubble, cooking oil, and organic refuse.
- *Example: HPCL's biogas plant in Uttar Pradesh uses cattle dung for clean fuel.*

5. Employment Generation

- Biofuel sector generates employment in feedstock supply, logistics, and processing.
- *Example: 2G refineries in Haryana and Odisha created thousands of jobs.*

EVOLUTION OF INDIA'S BIOFUEL POLICY

1. Initial Phase (2003–2010)

- Launch of Ethanol Blended Petrol (EBP) Programme in 2003 with a 5% blending target.
- Faced implementation issues like price volatility and logistical challenges.
- *Example: Tamil Nadu and Kerala lagged due to local pricing issues.*

2. Policy Push (2010–2018)

- Launch of National Bio-Energy Mission.
- 2018 National Policy on Biofuels:
    - Categorized biofuels into 1G, 2G, 3G.
    - Set 20% ethanol blending target by 2025.
    - Enabled financial incentives and promoted non-food feedstocks.
    - *Example: Surplus FCI rice allowed for ethanol conversion since 2020.*

3. Technological Diversification (2018–Present)

- Investments in 2G ethanol refineries and promotion of SATAT.
- Testing of flex-fuel vehicles and UCO biodiesel programs.
- Inter-ministerial coordination for R&D and scale-up.
- *Example: IOCL's Panipat plant processes 200,000 tonnes of rice straw.*

GOVERNMENT PROGRAMMES AND INITIATIVES FOR BIOFUELS

- **Ethanol Blended Petrol (EBP) Programme**: Started in 2003; target advanced to 20% by 2025.
- **National Policy on Biofuels (2018)**: Comprehensive biofuel strategy; viability gap funding; feedstock diversification.

- **SATAT (2018)**: Targets 5,000 CBG plants to use urban/agro waste.
- **GOBAR-Dhan Scheme**: Supports rural biogas projects using cow dung.
- **Viability Gap Funding**: Supports 2G ethanol technology commercialization.
- **UCO Initiative**: OMCs procure biodiesel from used cooking oil.
- **Pradhan Mantri JI-VAN Yojana (2019)**: Financial aid for lignocellulosic ethanol plants.
- **Global Biofuels Alliance (2023)**: Multilateral collaboration to scale up sustainable fuels.

CHALLENGES IN SCALING BIOFUELS

1. Feedstock Constraints

- Over-reliance on sugarcane; underdeveloped stubble logistics.
- *Example: Punjab struggles with aggregating stubble from small farms.*

2. Technological & Financial Barriers

- 2G/3G biofuels need high investment and face commercial hurdles.
- *Example: High capital costs delayed several announced 2G projects.*

3. Environmental Trade-offs

- Sugarcane cultivation affects groundwater and biodiversity.
- *Example: Drought-prone Maharashtra is strained by water-intensive crops.*

4. Policy & Implementation Gaps

- State-level ethanol policies are uneven and infrastructure inadequate.

- *Example: Bihar faces ethanol storage and delivery bottlenecks.*

5. Awareness & Market Development

- Lack of consumer awareness and enforcement hinders uptake.
- *Example: E20 petrol blends not widely available in northern India.*
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OPPORTUNITIES & THE WAY FORWARD

1. Feedstock Diversification

- Promote non-edible oilseeds, algae, and industrial waste.
- *Example: Chhattisgarh and Odisha support jatropha cultivation.*

2. Scaling 2G/3G Technologies

- Incentivize bioenergy startups and low-cost enzyme R&D.
- *Example: DBT-ICT in Mumbai leads enzyme process innovation.*

3. Regulatory Reforms

- National ethanol pricing, real-time tracking, and procurement reforms.
- *Example: OMCs use digital dashboards to track ethanol delivery.*

4. Global Collaboration

- Leadership in Global Biofuels Alliance; MoUs with Brazil and USA.
- *Example: India-Brazil MoU on ethanol cooperation signed in 2020.*

5. Integrated Energy Vision

- Align with EV and hydrogen goals; focus on multimodal transport.
- *Example: Ethanol-run bus trials conducted in Nagpur.*

6. Institutional Strengthening

- Strengthen the Bio-Energy Board and support state-level policy innovation.
- *Example: Maharashtra's bioenergy policy offers state-level subsidies.*

India's biofuel strategy has matured into a structured, inclusive, and progressive policy ecosystem. While significant strides have been made, achieving scale and sustainability requires focused policy reforms, regional planning, robust R&D, and international partnerships. By integrating biofuels into a broader clean energy architecture, India can lead by example in achieving equitable, sustainable, and resilient energy security.

REFERENCE NEWS: https://www.orfonline.org/expert-speak/mapping-the-evolution-of-biofuels-in-india

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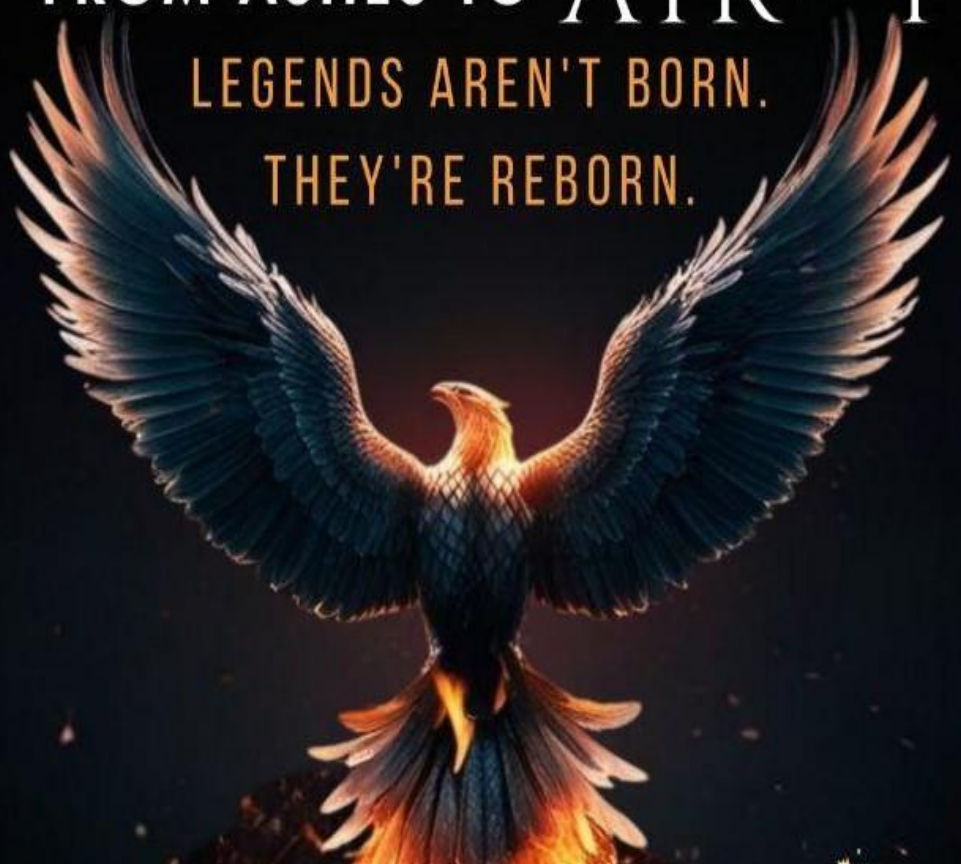

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