

Biomass Co-Firing – A Bridge Pathway for Clean Energy and Rural Growth

Biomass Co-Firing

India faces three interconnected challenges – rural distress, severe air pollution, and the urgent need for cleaner energy pathways. One promising solution is the co-firing of biomass pellets in coal-fired power plants. Biomass co-firing involves blending a proportion of agricultural residues, processed into pellets, with coal in existing thermal power plants. This approach offers a low-cost transitional strategy – it reduces dependence on coal, cuts emissions, curbs stubble burning, and creates rural income – all without dismantling the country's vast coal-based infrastructure. The SAMARTH Mission (Sustainable Agrarian Mission on Use of Agri-Residue in Thermal Power Plants), launched by the Ministry of Power, mandates 5% biomass blending in coal plants, rising to 7%. While modest, this step has transformative potential if scaled effectively.

Nature of Biomass Pellets

Biomass pellets are compact, energy-dense fuel units created from surplus agricultural residues such as –

1. Rice straw, paddy husk, and sugarcane bagasse
2. Cotton stalks, mustard husk, and other crop wastes

These pellets are –

1. **Uniform in size and quality** → allowing efficient co-firing with coal
 2. **Low in moisture** → ensuring higher calorific value compared to raw residue
 3. **Easier to transport and store** → enabling supply chains between villages and power plants
- By converting agricultural waste into usable pellets, India addresses two problems at once – pollution from stubble burning and shortage of clean energy alternatives.

Significance of Biomass Co-Firing and Global Experience

The significance of biomass co-firing lies in its triple-win model –

1. **Environmental** – Reduces CO₂ emissions by 15–20% per unit of electricity generated, depending on blend ratio.
2. **Energy Transition** – Extends the life of coal assets while reducing their carbon footprint.
3. **Rural Development** – Generates demand for agri-waste, benefiting farmers and small industries.

Global Lessons –

1. **United Kingdom** – Drax power station shifted from coal to 80% biomass, cutting emissions sharply.
2. **Japan & South Korea** – Integrated biomass in energy mix with national plans targeting 10–20% co-firing.
3. **Indonesia** – Committed to biomass blending in 52 coal plants (10% target).
4. **Sweden** – Uses biomass co-firing as part of a low-carbon pathway.

These examples show that biomass is not a silver bullet but a bridge technology, supporting cleaner energy transitions without massive immediate capital expenditure.

Impact on Rural Economy

1. Additional Farmer Income

1. Farmers can earn ₹3,000–6,000 per acre by selling residues.
2. For smallholders, this supplemental income (₹6,000–12,000 for 2 acres) offsets rising input costs.

2. Employment Generation

1. Pellet manufacturing units, often run by local entrepreneurs, create direct jobs.
2. Ancillary work in collection, transport, and equipment servicing boosts rural livelihoods.
3. The National Bio-Energy Mission estimates 50,000+ direct jobs through full-scale adoption.

3. Curbing Pollution

1. Reduces stubble burning in Punjab, Haryana, and Uttar Pradesh.
2. Helps lower particulate pollution in the Indo-Gangetic Plain, especially in winter.

Problems and Challenges

1. Supply Chain Issues

1. Uneven pellet availability and lack of reliable collection networks.
2. Transport from rural areas to plants remains costly.

2. Cost Concerns

1. Co-firing is slightly costlier than coal on a per-unit energy basis.
2. Private power producers hesitate without assured subsidies or incentives.

3. Technical Barriers

1. Compatibility varies across plants.
2. Ash content and handling issues require modifications in boilers.

4. Limited Awareness

1. Farmers often unaware of commercial potential of residues.
2. Many lack access to pelletization infrastructure.

5. Enforcement Gap

While blending is mandated, compliance is inconsistent across utilities.

Government Measures – SAMARTH Mission

The SAMARTH Mission is India's flagship program for biomass use in thermal plants.

Key features

1. Mandatory blending of 5% biomass in coal-fired plants (rising to 7%).
2. Support for supply chains to aggregate and deliver biomass.
3. Promotion of pellet manufacturing units, especially in northern India.
4. Awareness campaigns for farmers to monetize residues.

Additionally, the National Bio-Energy Mission provides support for biomass-based power projects, while Renewable Energy Certificates (REC) and carbon credit mechanisms are being considered.

Suggestions for Strengthening Implementation

1. Standardisation & Procurement Norms

Develop uniform pellet standards, transparent price benchmarks, and long-term procurement contracts.

2. Support for Pellet Manufacturers

1. Easier access to **credit and subsidies**.
2. Technical training to meet quality standards.

3. Infrastructure and Logistics

1. Develop storage hubs and transport corridors for pellet movement.
2. Encourage public-private partnerships in logistics.

4. Monitoring & Transparency

1. Publish plant-level data on co-firing and emissions saved.
2. Reward best-performing plants with incentives.

5. Integration with Carbon Markets

1. Link biomass co-firing credits with carbon trading or REC markets.
2. Offer additional financial incentives for early adopters.

6. Awareness & Farmer Outreach

1. Strengthen extension services to educate farmers on pelletization benefits.
2. Provide machinery for residue collection at subsidised rates.

Conclusion

Biomass co-firing represents a practical, inclusive, and low-cost bridge strategy for India's energy transition. It reduces emissions, addresses stubble burning, creates rural incomes, and generates jobs – all while leveraging existing coal infrastructure. India has already taken the first step with the SAMARTH Mission. To scale up, consistent enforcement, strong supply chains, and financial incentives are essential. For aspirants, biomass co-firing exemplifies how sustainability, rural development, and energy

security can converge. As India advances towards net-zero by 2070, this approach reflects a policy model where environmental goals and socio-economic inclusion move hand in hand.

Main Practice Question

1. "Biomass co-firing in coal plants under the SAMARTH Mission has been projected as a bridge solution for India's clean energy transition. Critically analyze its potential, challenges, and rural economic significance."

Answering Guidelines

Introduction (40–50 words)

1. Define biomass co-firing – blending agricultural residue pellets with coal in thermal power plants.
2. Mention India's target under SAMARTH Mission (5% rising to 7%).
3. Establish context – interlinkage with air pollution, rural incomes, and energy transition.

Body

1. Significance / Potential (80–100 words)

1. Reduces CO₂ emissions by 15–20% per unit power generated.
2. Curtails stubble burning → reduces air pollution in Indo-Gangetic Plain.
3. Enhances rural incomes (₹3,000–6,000 per acre) and generates jobs in pellet manufacturing.
4. Uses surplus residue (~140 million tonnes annually).
5. International experience – UK's Drax, Indonesia's biomass blending, Japan/South Korea's 10–20% targets.

2. Rural Economic Importance (60–80 words)

1. Farmers earn supplemental income.
2. Local entrepreneurs set up pellet plants, creating rural jobs.
3. Strengthens circular economy by converting waste to energy.

3. Challenges (80–100 words)

1. Supply chain and logistics gaps.
2. Limited availability of quality pellets.
3. Higher costs vs coal → reluctance among private generators.
4. Technical issues (boiler compatibility, ash).
5. Weak enforcement of blending mandates.

4. Government Measures (60–70 words)

1. SAMARTH Mission – mandatory 5–7% blending.
2. Support for pellet manufacturing and farmer awareness.
3. National Bio-Energy Mission → promotes biomass-based projects.
4. Exploring REC and carbon credit linkages.

5. Way Forward / Suggestions (80–100 words)

1. Standardise pellet specifications, transparent pricing, long-term contracts.
2. Provide credit and subsidies for pellet units.
3. Develop rural collection centres and logistics hubs.
4. Publish plant-level performance data to ensure accountability.
5. Link biomass co-firing with carbon markets/RECs for financial incentives.
6. Farmer outreach on pelletization benefits and supply systems.

Conclusion (40–50 words)

Biomass co-firing is a pragmatic bridge technology – reduces emissions, generates rural income, and cuts stubble burning. Success depends on scaling SAMARTH with better enforcement, supply chains, and incentives. Represents a rare policy solution aligning energy security, environment, and rural prosperity.