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Review Article

BioE3 policy: A way forward for transforming bio-manufacturing trajectories' in India

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Abstract

India is marching forward to strengthen the bioeconomy by releasing the biotechnology for economy, environment and employment (BioE3) policy to strengthen the biomanufacturing ecosystem and foster employability in the Agenda 2047. The policy includes innovation-driven support to R&D and entrepreneurship for technology development and commercialization by establishing bio-manufacturing, bio-AI hubs, and bio-foundry. The policy prioritizes regenerative bioeconomy models of green growth, facilitating the expansion of India's skilled workforce and providing a surge in job creation. The current study will determine the analysis of BioE3 policy for the roadblocks, funding ecosystems, and its decentralized innovation approach to foster changes in policy directions. The study discusses how India's paradigm shift in bio-manufacturing is driven by innovation and poised India amongst the global leaders in the next bio-based industrial revolution.

Keywords: Bio-manufacturing, Indicators, Policy, Research and Innovation.

Introduction

In an era of unprecedented changes, advancement in science and technology will become an essential determinant in India's transformation into a self-reliant global leader. The foundation of our nation's innovative thinking will be built through biotechnological innovation for economic growth, uplifting the economy, and strengthening the employability of high-performance biomanufacturing. With sweeping changes in policy directions, the nation imagines a paradigm shift in bio-manufacturing processes as they become primarily driven by innovation. In this regard, the BioE3 policy by the Department of Biotechnology, the Government of India, is a step ahead in boosting India's life science industry. The BioE3 policy by the Department of Biotechnology focuses on enabling India to advance on a sustainable development pathway to fast–track innovation to technology. There is a recent need to attune India with AI and IoT to accelerate and harness biomanufacturing solutions with diverse bioeconomic activities. This policy aims to set an "Atmanirbhar Bharat" to achieve sustainable development through economic development, social inclusion, and environmental sustainability by boosting the economy, protecting the environment, and creating employment.

Currently, two interconnected aspects need to be focused upon: exploring the mechanisms to nurture bio enablers through science technology innovation (STI) and boosting industries to accelerate transformative pathways of innovations. BioE3 policy aligns the STI ecosystem's vision with its priorities to ensure a holistic national growth trajectory. The policy aims to build a manufacturing ecosystem that nurtures and encourages bioeconomy and creates pathways for scaling up the lab to industry to meet market demand (Figure 1) for high-end technology. The policy broadly discusses the transformative pathways that lead to:

- Intensify research and innovation through bio-technology.
- Bridging the disconnect between laboratory and commercial production by boosting domestic bio-manufacturing capabilities
- Promoting integration of AI and digital technologies to accelerate the transition to bio-manufacturing
- Nurturing capacity building to develop a highly skilled workforce.
- Facilitate bio-manufacturing hubs by scaling up precommercial manufacturing.

Biotechnology exhibits the powerhouse of biology to create new services and products, which provide opportunities

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to grow the Indian economy and workforce and improve the quality of our lives and the environment. In recent years, the "Bioeconomy" derived from biotechnology has been the mandate of policies in the Global South and Global North to build a robust framework of bio-manufacturing. Countries like the USA, Japan, Australia, Finland and the European Union have revamped their innovation policies for research and development (R&D) areas of biotechnology and bio-manufacturing to reach societal goals and biological data ecosystem. The manufacturing landscape is expanding globally with emerging market players and innovative industrial solutions. The BioE3 policy of India will be focused on the six thematic sectors (Figure 2) to boost bio-based manufacturing of chemicals, functional food, precision biotherapeutics, climate resilient agriculture, carbon capture and utilization, and futuristic technologies about marine and space research, considering the following three important enablers: (i) Bioenablers, (ii) Bio AI hubs, (iii) Bio-manufacturing hubs.

The prioritization of enablers depends on engineering, improving technology spill-overs, and translating research outputs from government research institutes/ universities to manufacturing enterprises. Given that India now has many MNCs engaged in R&D work, the country's economy will benefit from these innovative activities. The government has to foster internationally accepted policy instruments that, for better and effective interaction between MNC R&D centers and local firms, must be considered and incorporated. Further, the eternal problem of links between public laboratories and manufacturing enterprises is considered in this policy to ensure better linkages between the start-up ecosystem and manufacturing sectors to push for a bio-based economy on the global stage.

Strategies

The strategies are given in the policy to uplift the bio-manufacturing research (Figure 3) by bringing application-oriented research in the front, scaling up the market, reducing cost and time, setting up the bio enablers hubs, addressing the roadblocks and capacity building. Partnership and collaboration to synergize innovation, public partnership model, international collaboration, and inter-ministerial collaboration will act as enablers for this policy.

Funding

This is the major determinant of BioE3 policy; the cabinet gave its nod to a biotechnology research innovation and entrepreneurship development (Bio-RIDE) scheme with the development of a new component titled "Biomanufacturing and Biofoundry." The actual allocation of funds in this area will determine the success of the biomanufacturing and bio-foundry initiative.

Roadblocks in implementing the BioE3 policy

Sectoral approach

A sectoral approach is needed for innovation for economic transformation to boost the bioeconomy. State innovation systems should be studied, and different challenges and drivers of innovation across states must be better understood. Good examples of institutional practice by industry boost to leverage bioeconomy, i.e., Kerala, Maharashtra, Telangana., etc., should be replicated in different states cross learnings across states must be encouraged.

Decentralise innovation

Encourage states to do more within a national framework and focus on local challenges. Every state is trying to come up with or has a biotech policy, science technology, and innovation policy, etc., which may not be easy to implement – states should play to their strengths. Bio-manufacturing innovation in states will be driven by cross-pollinating the ideas of STI policy and

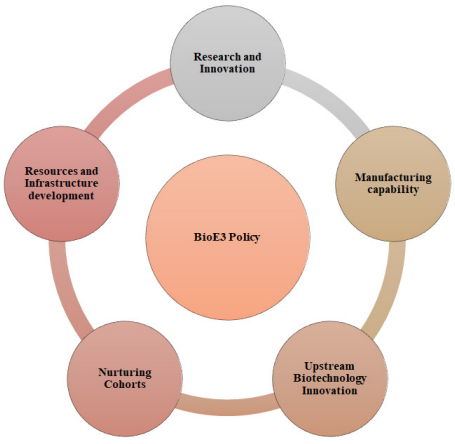

Figure 1: Interconnecting links in BioE3 policy for application oriented research and boosting bio-economy

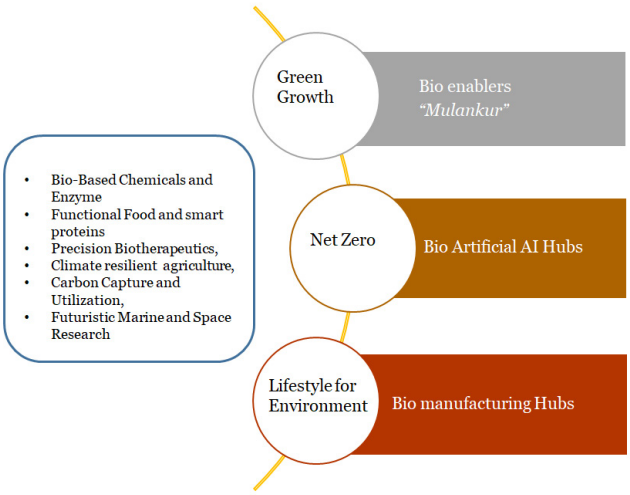

Figure 2: Focus areas of BioE3 policy

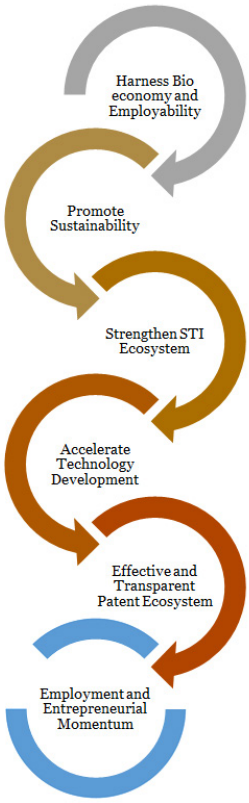

Figure 3: Strategies to uplift bio manufacturing ecosystem with BioE3 policy

biotechnology policy together with the goals of the BioE3 policy. It will boost the STI base with Bio economy-based delivery, and drivers of innovation differ across states.

Conclusion

In conclusion, the BioE3 policy is a big boost to drive innovation and foster industry-led entrepreneurship in India. Appropriate funding and regulation are needed for future prospects to facilitate the industry's growth. The policy will surely lead India into a top biotechnology destination and fulfill its ambitions of Viksit Bharat 2047.

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