Chapter-21
Eco-friendly Industrial Practices: Policy, Innovation, and CSR in India

Dr. B Kalaiyarasan[1], Dr. A Kamalakannan[2]

[1]Assistant Professor, Department of MBA, School of Management Studies, Vels Institute of Science Technology & Advanced Studies (VISTAS), Pallavaram, Chennai

[2]Assistant Professor, Master of Social Work, Mar Gregorios College of Arts and Science Chennai

Email - drbkarasan@gmail.com

Abstract

This study intentions to explore the change of the Indian industrial sector to generate environmentally friendly profits, technological innovations, and community development (CSR) policies. This chapter emphases on manufacturing, energy, textiles, and chemicals, and it defines the body of research, goals, and conclusions about the ways in which sustainable industrial processes, green manufacturing, and the combination of renewable energy are shifting industrial performs in India. As a balancing driver, Corporate Social Responsibility (CSR) has arose, with leading corporations such as Tata, Infosys, and Wipro investing in renewable energy, sustainable supply chains, and community-based environmental projects. The addition of corporate social responsibility (CSR) creativities into corporate strategy has connected environmental stewardship to stakeholder trust and brand repute.

Keywords: Eco-friendly industry, green manufacturing, renewable energy, sustainable development and Industrial automation.

Introduction

India's industrial growth has historically be contingent expressively on resources, leading to environmental harm. However, with commitments such as Net Zero by 2070 and an importance on sustainable development, industries are increasingly implementing eco-friendly applies. These observes include the amalgamation of renewable energy, waste reduction, water recycling, and computerisation to enhancement efficacy. Industrialization has been essential to India's economic progress, subsidising considerably to GDP growth, job creation, and participation in global trade. Yet, this expansion has commonly been resource-intensive, resulting in environmental contests like air and water pollution, greenhouse gas emissions, and unjustifiable resource withdrawal. With India's ambition to achieve Net Zero emissions by 2070, the industrial sector is under cumulative pressure to adopt eco-friendly attitudes that bring into line economic growth with environmental responsibility. The transition towards sustainability is shaped by policy initiatives such as the National Action Plan on Climate Change (NAPCC), the Perform, Achieve, and Trade (PAT) scheme, and renewable energy incentives. These initiatives encourage industries to reduce carbon intensity, improve energy efficiency, and implement cleaner technologies. At the same time, technological innovations like automation, artificial intelligence (AI), and the Internet of Things (IoT)

are enabling industries to optimize production, minimize waste, and enhance resource efficiency.

Corporate Social Responsibility (CSR) has appeared as a vital part, with leading companies implanting sustainability into their main strategies. Organizations like Tata Steel, Infosys, and Hindustan Unilever have pioneered the adoption of environmentally friendly practices, ranging from the use of renewable energy to the creation of sustainable supply chains. These efforts not only reduce environmental harm but also enhance competitiveness in global markets where sustainability criteria are becoming increasingly important. Thus, acceptance eco-friendly industrial practices in India is not just a strategic imperative but also a moral duty. It goes past simple compliance; it involves reimagining industrial growth to guarantee long-term flexibility, competitiveness, and environmental stewardship.

General Objectives

- To analyse how regulatory frameworks supporting eco-friendly industrial practices.
- To evaluate technological innovations in manufacturing and energy sectors.
- To study review of related literature on sustainable industrial practices in India
- To identify challenges and opportunities in implementing eco-friendly processes.

Review of Literature

EY Report (2025) explores Green Manufacturing and Net Zero Goals, highlighting India's ambition to become a developed nation by 2047 while achieving Net Zero by 2070. It emphasizes the need for decarbonisation in hard-to-abate sectors. The report positions India's industrial transformation in the context of these dual objectives: becoming a developed nation by 2047 and reaching Net Zero by 2070. It underscores the importance of decarbonising challenging sectors such as steel, cement, and chemicals. Furthermore, the report identifies the integration of renewable energy as a crucial factor for industrial sustainability. It also points out how automation and digitalization contribute to emission reductions. Policy frameworks like the PAT scheme are mentioned as catalysts for adoption. Additionally, the report addresses the global competitiveness associated with environmentally friendly processes. In summary, EY presents green manufacturing as a vital economic and environmental necessity.

Industrial Automation India (2025) examines how automation and renewable energy might be combined in manufacturing to promote sustainability and operational excellence. This essay explores how India's industrial sustainability is changing as a result of government incentives. It examines programs that promote waste reduction, water recycling, and the usage of renewable energy. The authors stress how important public-private collaborations are to the development of environmentally friendly technologies. They argue that improving India's industrial competitiveness requires resource efficiency. Real-world applications are illustrated through case studies from the chemical and textile industries. Inconsistent adoption across various businesses and geographical areas is one of the difficulties encountered. The study comes to the conclusion that bringing eco-friendly practices into the mainstream requires policy-driven incentives.

India CSR (2024) Examination ESG and Corporate Innovations Policy Reports: Stress the importance of government incentives, innovation, and corporate social responsibility in promoting environmentally sustainable activities. Corporate R&D facilities that support environmentally friendly product and process developments are the focus of this report. It links industrial sustainability with environmental, social, and governance (ESG) frameworks. The study highlights CSR efforts in sustainable sourcing, waste management, and renewable energy. It emphasizes the importance of innovation in boosting environmental responsibility and competitiveness. Infosys' carbon-neutral operations and Tata Steel's waste heat recovery are two notable examples. According to the report, CSR-driven innovation enhances stakeholder trust and brand reputation. To sum up, it establishes corporate innovation as a key component of environmentally responsible industrial operations.

MDPI Study (2023) examines how SMEs are becoming important participants in a new green revolution by adopting sustainable green manufacturing techniques. The importance of small and medium-sized businesses (SMEs) in advancing environmentally friendly industrial practices is highlighted by this study. It focuses on tactics including increasing resource efficiency, reducing waste, and using renewable energy. Despite their limited resources, the authors argue that SMEs are quick to adopt creative solutions. They portray SMEs as crucial drivers of a "green revolution" in the industrial industry. The need for government incentives to promote these behaviors is emphasized throughout the article. It also tackles problems including a lack of competent workers and financing. In conclusion, SMEs are portrayed as essential players in India's shift to sustainability.

Findings

- Manufacturing and energy sectors show the highest adoption of eco-friendly practices.
- SMEs are crucial in scaling sustainable innovations.
- Automation and renewable energy integration are strategic necessities for competitiveness.
- Policy support and CSR initiatives accelerate adoption.

Table 1: Adoption of Eco-friendly Processes by Sector

S/No	Sector	Adoption Rate (%)	Key Practices
1	Manufacturing	65	Waste minimization, automation, recycling
2	Energy	55	Renewable integration, smart grids
3	Textiles	45	Water recycling, eco-friendly dyes
4	Chemicals	35	Cleaner production, emission control

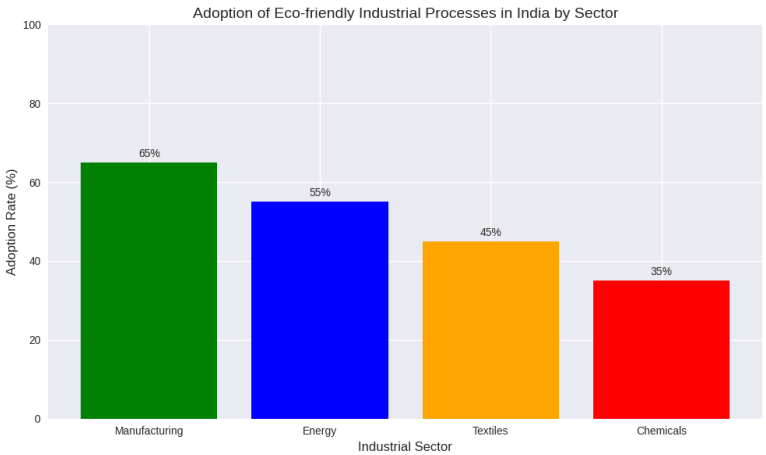

Fig 1: Adoption Trends

Discussion

Government programs such as the Perform, Achieve, and Trade (PAT) scheme have an impact on eco-friendly industrial practices in India. Automation, AI, and IoT are examples of technological developments that are intended to improve energy efficiency. Sectoral uptake: Energy, textiles, and chemicals follow manufacturing, which has the highest adoption rate at 65%. Significant initial investments, a lack of skilled workers, and limited international cooperation are some of the challenges.

Government policies such as the Perform, Achieve, and Trade (PAT) scheme

A market-driven strategy that encourages enterprises to improve their energy efficiency is the PAT program, which is a component of the National Mission on Enhanced Energy Efficiency (NMEEE). It promotes cost-effective compliance by setting clear goals for various industries and facilitating the exchange of energy efficiency credits. Apart from PAT, initiatives like the National Electric Mobility Mission, the Renewable Energy Development Fund, and Zero Effect, Zero Defect (ZED) certification have created a legal environment that pushes businesses to use greener production techniques. In addition to reducing emissions, these regulations increase competitiveness in international markets where sustainability norms are becoming more and more crucial.

Technological drivers like automation, AI, and IoT for energy efficiency

Innovative technologies enable industry to reduce waste and maximize resource use. Automation improves production processes, while analytics driven by AI help identify inefficiencies and estimate energy requirements. IoT devices monitor pollution, water use, and energy use in real time, allowing for prompt remedial action. For example, predictive maintenance in manufacturing and smart grids in the energy industry reduce resource loss and downtime. When taken as a whole, these technologies form the basis of "Industry 4.0 for sustainability," which combines environmental stewardship with digital innovations.

Sectorial adoption: Manufacturing takes the lead with a 65% adoption rate, followed closely by the energy, textiles, and chemicals sectors

Manufacturing has taken the lead in adopting environmentally friendly techniques, mostly due to pressure from the global supply chain and government incentives. Waste heat recovery and the integration of renewable energy sources are advances being made by energy-intensive industries like steel and cement. While the chemical industry is investigating cleaner manufacturing methods and technology for emission management, the textile industry is placing a higher priority on water recycling and the use of eco-friendly dyes. Despite variations in adoption rates, the general pattern indicates a steady shift towards sustainability in a number of industries.

Challenges: High initial costs, a shortage of skilled workforce, and limited international collaboration

Despite these developments, industries face significant challenges, adopting small and medium-sized businesses (SMEs), in particular, the initial capital required adopting green technologies can be a major obstacle. Furthermore, advancement is hampered by a shortage of qualified personnel in industries like green engineering, AI-driven sustainability, and renewable energy integration. Additionally, access to the newest breakthroughs is hampered by India's low participation in international research collaborations. To overcome these obstacles and accelerate the shift to environmentally friendly industrial practices, more financial incentives, skill-building programs, and international collaborations are required.

Conclusion

In India, environmentally friendly industrial operations are crucial for both the environment and strategic reasons. India is poised to lead the way in sustainable industrialization because to strong governmental frameworks, technical breakthroughs, and corporate social responsibility-driven initiatives. However, problems such as financial obstacles and inadequate international cooperation must be addressed.

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