A Review Study on the Impact of Green Technology Adoption on Corporate Performance

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Abstract:

This study explores the impact of green technology adoption on corporate performance, focusing on both financial and non-financial dimensions. As businesses increasingly face pressure to reduce environmental footprints, integrating sustainable technologies has become a strategic imperative. This paper investigates how such adoption influences profitability, efficiency, brand image, and stakeholder value, with data from leading corporations and recent empirical studies. Also focus on challenges related to green technology adoption by corporate and ways to face these challenges. The findings suggest a strong correlation between sustainable technology practices and improved long-term performance.

Keywords: Green Technology, Corporate Sustainability, Environmental Performance, Business Growth, ESG, Renewable Energy, Sustainability Strategy

Introduction

In the era of rapid industrialization and climate urgency, corporations are increasingly expected to align business strategies with environmental sustainability goals. Green technology adoption—ranging from eco-innovations in product design and manufacturing to green banking, IT, and infrastructure—has become a cornerstone of corporate responsibility and strategic growth. In India, where environmental concerns are compounded by economic development pressures, this transition holds even greater significance.

A growing body of empirical research affirms that integrating green technologies into core operations yields substantial performance benefits for companies. Studies by Jain (2023) and Dua (2024) reveal that green product innovations and environmental management practices significantly enhance investor confidence and market valuation, while Bapat et al. (2023) and Singh, Kumar & Agrawal (2021) highlight operational efficiency and competitiveness gains in SMEs adopting green manufacturing. Similarly, Thapliyal et al. (2024) demonstrate that green banking improves environmental performance and lending capabilities. Mondal & Sahu (2023) and Nandini et al. (2022) establish a strong link between environmental expenditure and financial returns like ROA, ROE, and profit margins, underlining the profitability of responsible environmental behavior.

At the same time, the literature acknowledges that green technology adoption is often constrained by sector-specific barriers. Vidyashree & Sheriff (2024) report that Indian manufacturers struggle with high implementation costs, lack of skilled manpower, and resistance to change. Malik & Garg (2024) find that banks face challenges related to perceived risk and technological complexity, while Verma & Mourya (2024) cite trust and greenwashing concerns in green marketing. The real estate and IT sectors also face hurdles, such as inadequate incentives, awareness gaps, and lack of regulatory support, as noted by Saha et al. (2021) and Bagla et al. (2022).

Nonetheless, these challenges are not insurmountable. Several studies propose actionable solutions: government subsidies, green financing mechanisms, employee training programs, leadership engagement, and

public-private partnerships. For example, Yadav et al. (2024) and Adhana & Rashmi (2024) suggest that digital transformation and ESG-driven entrepreneurship significantly strengthen the environmental impact of corporate strategies, while Esfahani et al. (2015) underscore the global trend of ecological responsiveness and CSR as primary drivers of green IT/IS adoption.

This research paper aims to synthesize these insights, analyzing the dual dimensions of impact and barriers associated with green technology adoption in Indian corporate sectors. It investigates how green practices influence corporate performance across financial, operational, and reputational parameters, while also evaluating the systemic, organizational, and policy-level obstacles hindering widespread adoption. The ultimate objective is to provide a comprehensive framework that not only captures the potential of green technologies for sustainable growth but also offers strategic pathways to overcome adoption challenges in the Indian business ecosystem.

Review of Literature

Jain, M. (2023) found that "Green product innovation (not green process innovation) significantly improves investor perceptions and financial performance. Green process innovation boosts investor confidence when coupled with strong quality management".

Srivastava & Gupta (2024) conducted a survey of 103 Indian firms, organizational traits, public policy, and technology characteristics significantly drive green tech adoption, which in turn positively influences economic, social, and environmental performance.

According to Bapat et al. (2023), "Indian SMEs implementing green manufacturing techniques (resource efficiency, waste reduction, renewable energy) saw measurable gains in operational efficiency, cost savings, and market competitiveness."

Singh, Kumar & Agrawal (2021) conducted the case studies of Indian SMEs show green manufacturing correlates with higher productivity, lower energy use, and stronger organizational performance metrics.

Systematic literature review of Mishra, Datta & Behera (2024) confirms a positive link between environmental responsibility (e.g., green accounting, tech investments) and improved financial outcomes, such as ROA and ROE.

Thapliyal, Gupta & Jindal (2024) found that Indian banks implementing green banking practices (digital processes, energy-efficient branches) improved both internal environmental performance and their capacity to lend to green sectors.

According to Kour, Kaur, Bhullar & Chaudhary (2020), "In auto firms, integrated environmental management, eco-design, tech integration, and green marketing positively impacted financial performance; pollution prevention and customer orientation had no significant effect."

Study of Mondal & Sahu (2023) on Panel data (224 NSE-500 firms, 2014–22) shows green initiatives and improved GHG/energy productivity significantly raised financial performance.

According to Nandini, Sudharani & Suresh (2022), "Spending on environmental protection among BSE-listed companies had a significant positive effect on ROCE, ROA, ROE, net margin, and DPS."

Sobha (2022) found that Model simulations suggest large-scale renewable energy adoption (wind/solar/hydro + storage) could fully decarbonize India's grid by 2030—critical for power sector corporate ESG performance.

Jawa, Zamani & Kumar (2021) found that Analyzed panel data from 44 renewable vs. 100 traditional power firms (2009–2018). Found no significant difference in financial performance, indicating renewable energy firms perform on par with traditional counterparts.

Nandini, Sudharani & Suresh (2022) studied 18 BSE-listed firms over 10 years; environmental protection expenditures were significantly positively correlated with return metrics (ROCE, ROA, ROE, profit margin, DPS), affirming the financial value of environmental accounting.

According to Gouda, Ghosh & Awasthy (2018), "Identified organizational culture, supply chain drivers, regulatory pressure, and competitive strategy as key determinants of green initiatives in Indian firms."

Systematic review of Mishra, Datta & Behera (2024) of Indian firms' ESG reporting shows a consistent positive link between corporate environmental responsibility and financial outcomes.

Dua (2024) conducted a study on 89 listed IT firms, adoption of environmental management practices led to higher market valuation (Tobin's Q, M/B ratios), with effects emerging two years post-adoption—implying long-term investor value.

Based on survey conducted by Shankar Yadav et al. (2024), data from Indian manufacturing and service firms, the study finds that ESG-oriented entrepreneurship improves environmental performance, with digital transformation and technological innovation significantly strengthening (moderating) this relationship.

Adhana & Rashmi (2024) conduct a survey 320 Indian SMEs, results demonstrate a strong positive correlation between adoption of green innovations and both environmental awareness and further technology uptake.

Devi & Indoria (2024) conducted a quantitative survey of 85 Indian automotive firms shows that green innovation strategies mediate the relationship between green supply chain practices and improved environmental & financial performance.

Yadav & Pathak (2015) studies that reveals that leading Indian IT firms adopting Green IT practices—such as energy-efficient data centers and e-waste recycling—improved their internal operational efficiency and enhanced brand reputation.

Esfahani, Abdul Rahman & Zakaria (2015) conducted a comprehensive review of 137 studies, Indian and global organizational adoption of Green IT/IS was found motivated by ecological responsiveness and CSR, and effectively enhances corporate environmental performance and strategic value.

Vidyashree & Sheriff (2024) found Barriers in Adopting Lean and Green Practices in Indian Manufacturing Companies. And suggest ways to deal with these barriers –

- Develop skilled workforce through targeted training programs.
- Mitigate high costs via government grants, subsidies, and public–private partnerships.
- Overcome organizational resistance with leadership buy-in and change management.
- Create supply-chain awareness campaigns to educate suppliers and customers on green benefits.

Malik & Garg (2024) found barriers in Green Banking Adoption and suggest –

- Reduce perceived risk with pilot projects and risk-sharing mechanisms.
- Lower complexity using standard frameworks and financial training for bank employees.
- Emphasize usefulness and compatibility via case studies and benchmarking.

Verma & Mourya (2024) conduct study on challenges related to green marketing and find solutions –

- Implement standard eco-labeling and certification bodies.
- Launch consumer awareness campaigns to boost credibility.
- Adopt third-party verification to counter greenwashing.

Saha, Hiremath, Prasad & Kumar (2021) identified barriers to Adoption of Commercial Green Buildings and solutions recommended –

- Provide financial incentives—subsidies, tax breaks, green bonds.
- Enforce policy standards and certification (e.g., mandatory energy codes).
- Build supply-chain integration through accredited green materials suppliers.
- Increase public awareness on long-term ROI in green buildings.

Bagla, Trivedi & Bagga (2022) found barriers to Adoption of Green Computing and solutions presented -

- Launch IT professional training on energy-efficient computing.
- Develop legal frameworks and industry green computing guidelines.
- Establish public–private partnerships to promote eco-friendly IT infrastructure.

Objectives of the Study

- To assess impact of Green Technology on Corporate Performance
- To know barriers related to adoption of green technology by corporations
- To find the solutions to barriers related to adoption of green technology by corporations

Research Methodology

Research Design: Descriptive and exploratory research design

Data type: Secondary Data is used

Sources of Data: Analyze existing research, case studies, and industry reports, reports of various institutions.

Findings

Why Corporates Are Adopting Green Technology

Regulatory Compliance
- Governments across the globe enforce environmental laws (e.g., carbon taxes, emission caps).
- Corporates adopt green tech to avoid penalties and meet legal standards.

Cost Savings
- Renewable energy (solar, wind) and energy-efficient systems reduce operating costs.
- Waste reduction, recycling, and water-saving techniques also cut expenses.

Brand Image and Market Demand
- Eco-conscious consumers prefer sustainable brands.
- Green practices enhance reputation and customer loyalty.

Investor Pressure
- ESG (Environmental, Social, Governance) criteria are now crucial for attracting investments.
- Sustainability reporting is expected by many investors.

Innovation and Competitive Advantage
- Green innovation can differentiate a company and open new market opportunities.

Common Green Technologies Adopted

Technology	Description	Corporate Use
Renewable Energy	Solar, wind, hydro	Power plants, office buildings, manufacturing
Energy-efficient Appliances	LED lights, smart HVAC	Offices, retail stores, warehouses
Green Building Design	LEED-certified buildings, natural ventilation	Headquarters, campuses
Waste Management Systems	Recycling, composting, waste-to-energy	Manufacturing, hospitality
Water Conservation Tech	Rainwater harvesting, waterless urinals	Construction, hospitality
Carbon Capture & Offsets	CO_2 absorption or purchase of carbon credits	Industrial firms, oil & gas
Electric Vehicles (EVs)	EV fleets, charging stations	Logistics, employee transport
Digitalization & IoT	Smart grids, energy monitoring	IT and manufacturing sectors

Challenges in Green Technology Adoption

High Initial Costs

- **Problem:** Green technologies often require significant capital investment (e.g., solar panels, energy-efficient machinery, green IT infrastructure).
- **Impact:** Small and medium enterprises (SMEs) struggle to finance these costs without subsidies or external funding.
- **Example:** Renewable energy, green buildings, and electric vehicle infrastructure have high upfront costs despite long-term savings.

Lack of Awareness and Expertise

- **Problem:** Many companies, especially in traditional sectors, are unaware of available green technologies or lack technical knowledge to implement them.
- **Impact:** Limits adoption and leads to poor implementation, making benefits hard to quantify.
- **Example:** Low awareness among SMEs about government green finance schemes or industry benchmarks.

Organizational Resistance to Change

- **Problem:** Employees and top management may resist adopting new eco-friendly processes due to perceived disruptions or fear of failure.
- **Impact:** Innovation is stalled; existing business models are rigid.
- **Example:** Manufacturing units hesitant to replace polluting machinery with cleaner alternatives.

Inadequate Policy and Regulatory Support

- **Problem:** Lack of clear, consistent green policies, incentives, and enforcement mechanisms.
- **Impact:** Businesses lack confidence and motivation to transition to greener alternatives.
- **Example:** Delays in environmental clearance, weak implementation of energy codes, and fragmented green building norms.

Difficulty in Measuring ROI

- **Problem:** The benefits of green technologies (e.g., energy savings, brand value, carbon reduction) are long-term and not immediately reflected in financial statements.
- **Impact:** Boards and investors may deprioritize green investments.
- **Example:** Difficulty in quantifying environmental KPIs in ROI calculations.

Technological Complexity and Compatibility

- **Problem:** Some green technologies are complex or incompatible with existing infrastructure.
- **Impact:** Requires retraining staff, altering operations, and overhauling legacy systems.
- **Example:** Integration of green computing in legacy IT systems.

Limited Green Supply Chain and Vendor Support

- **Problem:** Suppliers may not offer sustainable options or may not comply with green standards.
- **Impact:** Creates a bottleneck in implementing green practices holistically.
- **Example:** Green-certified raw materials and packaging may be unavailable or costlier.

Perceived Risk and Uncertainty

- **Problem:** Businesses perceive adopting green technology as risky due to lack of precedents or fear of poor returns.
- **Impact:** Leads to delayed decision-making or avoidance of investment.
- **Example:** Risk-averse banks may hesitate to fund green infrastructure projects.

Insufficient Consumer Demand

- **Problem:** In many cases, consumers are not yet fully aligned with green products or are unwilling to pay a premium.
- **Impact:** Reduces incentives for businesses to innovate in sustainable products.
- **Example:** Low demand for eco-labeled products due to limited awareness or affordability.

Lack of Skilled Workforce

- **Problem:** Skilled personnel in green engineering, renewable energy systems, sustainability management, etc., are in short supply.
- **Impact:** Slows down the pace of adoption and innovation.
- **Example:** Shortage of LEED/IGBC-certified architects or energy auditors in India.

Solutions to Challenges in Green Technology Adoption

High Initial Costs

Solution:

- **Government Incentives:** Offer subsidies, tax breaks, and low-interest green loans.
- **Green Bonds:** Encourage corporates to raise funds through green bonds or sustainability-linked bonds.
- **Public–Private Partnerships (PPPs):** Promote co-investment in large-scale projects like renewable energy parks or eco-industrial zones.

Lack of Awareness and Expertise

Solution:

- **Training Programs:** Launch national and industry-specific skill development programs on green tech.
- **Green Literacy Campaigns:** Use media and academic institutions to promote awareness.
- **Knowledge Portals:** Create centralized digital platforms sharing green technology success stories, vendors, and ROI data.

Organizational Resistance to Change

Solution:

- **Leadership Buy-In:** Engage top management through strategic sustainability workshops and ROI demonstrations.
- **Change Management Programs:** Implement structured approaches to ease the transition, including staff engagement and feedback loops.
- **Incentivize Adoption:** Provide performance bonuses or recognition for departments implementing green innovations.

Inadequate Policy and Regulatory Support

Solution:

- **Policy Reforms:** Create comprehensive, sector-specific green technology adoption policies with clear roadmaps.
- **Enforcement:** Strengthen monitoring and compliance of environmental regulations (e.g., ECBC for buildings, green procurement).
- **Unified Standards:** Harmonize standards across certifications like IGBC, GRIHA, LEED for clarity and ease of adoption.

Difficulty in Measuring ROI

Solution:

- **Sustainability Metrics:** Develop frameworks to calculate environmental ROI (e.g., carbon saved, water conserved).

- **Integrated Reporting:** Encourage ESG reporting as per global standards (e.g., GRI, SASB, BRSR in India).
- **Third-Party Verification:** Use auditors or consultants to validate environmental performance and cost-benefit analysis.

Technological Complexity and Compatibility

Solution:

- **Modular Technologies:** Promote scalable, plug-and-play green solutions adaptable to existing infrastructure.
- **Tech Transfer Platforms:** Encourage collaboration with global firms and research institutions.
- **R&D Incentives:** Offer tax relief or grants for green R&D initiatives in corporates and startups.

Limited Green Supply Chain Support

Solution:

- **Supplier Education Programs:** Train suppliers in eco-friendly practices and green compliance.
- **Green Procurement Policies:** Mandate environmentally preferable purchasing within firms.
- **Collaborative Platforms:** Build industry-wide networks to share green vendors and resources.

Perceived Risk and Uncertainty

Solution:

- **Pilot Projects:** Start with small-scale implementation to test and showcase results.
- **Risk-Sharing Mechanisms:** Engage with insurers or government-backed funds to underwrite new tech risks.
- **Case Studies and Benchmarking:** Promote successful corporate green tech stories to build confidence.

Insufficient Consumer Demand

Solution:

- **Awareness Campaigns:** Educate consumers on the long-term environmental and health benefits of green products.
- **Eco-Labeling:** Standardize trustworthy eco-certifications to build credibility.
- **Green Marketing:** Use data-driven green branding and influencer campaigns to shift preferences.

Lack of Skilled Workforce

Solution:

- **Curriculum Integration:** Include sustainability and green tech modules in university and vocational programs.
- **Certification Courses:** Promote industry-led green skill certifications (e.g., green auditors, LEED professionals).
- **Industry-Academia Partnerships:** Encourage collaborative training between corporates and academic institutions.

Conclusion

The comprehensive insights drawn from over two dozen empirical and review-based Indian studies highlight a clear and compelling relationship between green technology adoption and enhanced corporate performance. Firms across sectors—including IT, manufacturing, banking, automotive, and energy—demonstrate tangible benefits such as improved financial returns (ROA, ROE, profit margins), increased operational efficiency, better investor perception, and long-term market value through the integration of green innovations. These include green product design, energy-efficient systems, environmental accounting, and ESG-driven entrepreneurship. Moreover, green practices also contribute to non-financial gains such as improved brand image, stakeholder trust, and environmental stewardship.

However, the transition toward sustainable operations is not without its challenges. Various barriers—such as high upfront costs, technological complexity, lack of skilled manpower, regulatory uncertainty, and market skepticism—have been identified as impediments to the broader adoption of green technologies. Fortunately, the studies also offer actionable solutions to overcome these obstacles. These include government-backed subsidies and green financing mechanisms, policy standardization, capacity-building through training, third-

party certifications, digital transformation, and robust public-private collaborations. Addressing sector-specific hurdles—like green banking complexity, green marketing credibility, or IT energy inefficiencies—requires tailored approaches grounded in data, innovation, and stakeholder participation.

Ultimately, the findings suggest that green technology adoption is not merely a compliance or ethical obligation—it is a strategic catalyst for corporate growth, competitiveness, and long-term sustainability. Firms that proactively invest in green innovation and systematically dismantle adoption barriers will not only future-proof their business but also contribute meaningfully to India's sustainable development agenda.

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