



Harnessing Artificial Intelligence for Climate-Aligned Corporate Sustainability: Integrating ESG Frameworks, CSR Mandates, and SDGs toward a Resilient Low-Carbon Economy

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Abstract

The mounting urgency of climate change has compelled businesses, policymakers, and researchers to look beyond conventional financial metrics when evaluating corporate performance. This chapter investigates how artificial intelligence (AI) can serve as a meaningful enabler of climate-oriented corporate sustainability by facilitating the convergence of Environmental, Social, and Governance (ESG) reporting frameworks, Corporate Social Responsibility (CSR) mandates, and the United Nations Sustainable Development Goals (SDGs). Drawing on the policy landscape of emerging economies—with particular attention to India's evolving regulatory architecture—the chapter examines how AI-powered tools can strengthen sustainability measurement, sharpen ESG disclosures, enhance supply chain transparency, and support evidence-based climate governance. The analysis identifies persistent barriers including fragmented data standards, algorithmic bias, and uneven institutional capacity, while outlining practical pathways for responsible AI deployment aligned with the objectives of the Paris Agreement and the 2030 Agenda for Sustainable Development. The chapter contributes to the growing discourse on AI's role in translating climate commitments into verifiable, accountable, and inclusive corporate action.

Keywords: Artificial Intelligence; ESG; Climate Sustainability; CSR; SDGs; Supply Chain Transparency; Climate Governance



1. Introduction

The relationship between economic activity and environmental stability has never been more fraught or more consequential. Decades of carbon-intensive industrialisation have pushed global average temperatures toward thresholds that climate science widely regards as dangerous, and the window for corrective action grows narrower with each passing year. Against this backdrop, a growing consensus holds that the private sector cannot remain a passive bystander. Corporations control enormous flows of capital, labour, and innovation, and the manner in which they deploy those resources will either accelerate or constrain humanity's collective response to climate change.

Yet translating corporate climate commitments into verifiable outcomes has proven elusive. The landscape of sustainability reporting remains fragmented, with multiple competing standards, inconsistent methodologies, and a persistent gap between what organisations disclose and what they actually do. This credibility deficit undermines investor confidence, misleads consumers, and—most critically—impedes the kind of systemic change that climate stabilisation demands.

It is precisely here that artificial intelligence enters the conversation, not as a panacea, but as a genuinely promising set of tools. Machine learning models can process vast and heterogeneous datasets—satellite imagery, supply chain records, energy consumption logs, financial filings—and surface patterns that human analysts would struggle to detect. Natural language processing can interrogate sustainability reports for internal inconsistencies or outright greenwashing. Predictive analytics can model climate risk exposures across business units, geographies, and time horizons. When these capabilities are deliberately oriented toward ESG objectives and aligned with the SDGs, AI has the potential to bridge the chasm between ambition and accountability in corporate climate action.

This chapter approaches that potential critically. It situates AI-enabled corporate sustainability within the broader governance architecture of the Paris Agreement and the 2030 Agenda, paying close attention to the institutional and regulatory context of India—a country whose scale, development trajectory, and policy innovations make it a particularly instructive case. It examines four interconnected domains: the current state of ESG frameworks and their climate relevance; the specific roles AI can play in strengthening sustainability measurement and disclosure; the application of AI to climate-sensitive supply chain governance; and the ethical and institutional conditions required for responsible deployment. The chapter concludes by identifying research and policy priorities that could help maximise AI's contribution to a resilient, low-carbon economy.

2. ESG Frameworks, CSR Mandates, and Their Climate Significance

2.1 The Architecture of Corporate Climate Accountability

The term 'ESG' entered mainstream discourse in the mid-2000s, but its conceptual roots reach back further—to the socially responsible investment movement of the 1970s, the Brundtland Commission's articulation of sustainable development in 1987, and the UN Global Compact of 2000. What distinguishes contemporary ESG frameworks is their explicit linkage to financial materiality: the recognition that environmental and social risks are not peripheral concerns but potential drivers of asset value, systemic risk, and long-term corporate viability.

Climate change occupies a central position within the 'E' dimension of ESG for reasons that are simultaneously physical, transitional, and liability-based. Physical risks—rising sea levels, extreme weather events, shifting agricultural zones—directly threaten assets and operations. Transition risks arise from the policy, technology, and market shifts associated with decarbonisation. Liability risks emerge as litigation against carbon majors and misrepresenting corporations intensifies globally. Together, these risk categories make climate-related ESG disclosure not merely a normative aspiration but an analytically urgent imperative.



2.2 India's Regulatory Landscape: BRSR, CSR, and the SDG Nexus

India presents an unusually rich case study in the institutionalisation of corporate sustainability. Section 135 of the Companies Act (2013) established a statutory CSR obligation—requiring companies above specified thresholds to spend at least two per cent of their average net profits on prescribed social and environmental activities. While the original mandate was criticised for its spend-based rather than outcomes-based orientation, amendments in 2021 introduced greater accountability measures and impact reporting requirements.

The Securities and Exchange Board of India (SEBI) has progressively tightened sustainability disclosure norms. The Business Responsibility and Sustainability Report (BRSR) framework, made mandatory for the top thousand listed companies from 2022-23, replaced the earlier Business Responsibility Report with a more granular and internationally aligned disclosure structure. The subsequent BRSR Core introduced a set of 'Key Performance Indicators' subject to third-party assurance—a significant step toward credible, auditable sustainability data. Crucially, several BRSR Core indicators directly address climate dimensions: greenhouse gas emissions intensity, energy consumption, water usage, and supply chain sustainability. These disclosures create the data infrastructure that AI systems can interrogate, aggregate, and analyse at scale.

The National Guidelines on Responsible Business Conduct (NGRBC, 2019) complemented these disclosure requirements by articulating nine principles of responsible business, including commitments to environmental stewardship, inclusive employment, and ethical governance. India's Nationally Determined Contribution under the Paris Agreement—targeting net zero by 2070 and a substantial expansion of non-fossil energy capacity—provides the macro-level frame within which these corporate-level mechanisms must ultimately be evaluated. The convergence between CSR obligations, ESG disclosures, and SDG commitments thus defines a multi-layered governance architecture that is ambitious but still fragmented in practice.

3. Artificial Intelligence as a Climate Sustainability Enabler

3.1 Enhancing Sustainability Measurement and Disclosure Quality

One of the most immediate contributions AI can make to corporate climate governance lies in improving the quality and comparability of sustainability data. Current ESG reporting suffers from profound heterogeneity: companies use different scopes, methodologies, and reference years when calculating carbon emissions; social metrics lack standardised definitions; governance disclosures range from substantive to purely cosmetic. This variability makes it difficult for investors, regulators, and policymakers to make meaningful comparisons or to identify genuine leaders and laggards.

Natural language processing models can systematically analyse sustainability reports to identify inconsistencies, flag boilerplate language that may obscure substantive disclosure, and cross-reference stated commitments against historical performance data. Computer vision algorithms applied to satellite imagery can independently verify claims about deforestation, land use, and biodiversity impact—providing an external check on corporate self-reporting that has historically been almost entirely absent. Machine learning models trained on large pools of ESG data can also generate company-specific benchmarks, flagging anomalies that warrant closer regulatory scrutiny.

Importantly, these capabilities are increasingly accessible to regulators as well as market actors. SEBI and other emerging-market securities regulators could deploy AI-powered disclosure analysis tools to strengthen supervision without proportionally expanding enforcement headcount. The European Securities and Markets Authority has begun exploring similar approaches, suggesting a convergent trajectory in regulatory technology that Indian institutions would be well-positioned to emulate and adapt.



3.2 Climate Risk Modelling and Scenario Analysis

The Task Force on Climate-related Financial Disclosures (TCFD) has made scenario analysis a centrepiece of its recommendations, asking companies to assess their resilience against different climate trajectories—including a 1.5°C pathway, a 2°C pathway, and a business-as-usual scenario involving significantly higher warming. Conducting such analysis meaningfully requires integrating climatic, economic, and operational data across long and uncertain time horizons—an inherently complex modelling challenge.

AI-driven analytics platforms are beginning to make such analysis more tractable for firms that lack dedicated climate science teams. By coupling physical climate models with asset-level exposure data and macroeconomic projections, these platforms can generate probabilistic assessments of climate risk across a company's operations, assets, and supply base. For Indian firms with significant exposure to monsoon variability, coastal flooding, and temperature extremes, such tools have obvious operational relevance beyond mere disclosure compliance.

Predictive models can also support internal carbon accounting, helping companies optimise across Scope 1, 2, and 3 emissions by identifying abatement levers with the highest marginal impact relative to cost. This kind of granular, real-time visibility over emissions profiles is particularly valuable as more jurisdictions introduce carbon pricing mechanisms that penalise inefficiency directly. Embedding AI into carbon management systems thus serves both the regulatory compliance and the commercial competitiveness agendas simultaneously.

3.3 AI-Enabled Sustainable Supply Chains

Supply chains are among the most climate-intensive components of corporate activity. For many companies, Scope 3 emissions—those embedded in purchased goods and services, and in the use and disposal of sold products—dwarf direct operational emissions by an order of magnitude. Achieving meaningful decarbonisation therefore requires extending climate accountability deep into supply networks, including to tier-two and tier-three suppliers who may lack the resources or the incentive to measure and disclose their own environmental footprint.

AI, combined with distributed ledger technologies, offers a technically credible pathway toward end-to-end supply chain transparency. Blockchain-based traceability platforms can create immutable records of material provenance, energy inputs, and environmental certifications at each node in a supply network. Machine learning algorithms can then process this stream of structured and unstructured data to identify high-risk suppliers, flag deforestation-linked sourcing, and optimise logistics routes for minimum carbon intensity. These capabilities are no longer purely theoretical—pilot implementations in the apparel, food, and electronics sectors have demonstrated proof of concept, though scaling challenges remain significant.

For Indian businesses, supply chain AI carries particular strategic relevance. India's manufacturing ambitions—reflected in Production Linked Incentive schemes and the broader Atmanirbhar Bharat framework—are increasingly conditioned by the sustainability expectations of international buyers and investors. European importers, for instance, face growing obligations under the Corporate Sustainability Due Diligence Directive to trace environmental and human rights risks in their supply chains. Indian exporters who can demonstrate verified, AI-enabled supply chain sustainability will enjoy a meaningful competitive advantage in these markets.

4. Connecting Corporate AI-Sustainability to the SDGs

The Sustainable Development Goals provide the most comprehensive normative framework for evaluating the societal impact of corporate sustainability action. While all seventeen goals intersect with corporate behaviour in various ways, several are particularly germane to the AI-ESG-climate nexus examined in this chapter.



SDG 13 (Climate Action) is the most direct touchpoint: AI-enhanced emissions measurement, climate risk disclosure, and decarbonisation planning all contribute to more credible and effective corporate climate action. SDG 7 (Affordable and Clean Energy) is advanced by AI applications in smart grid management, renewable energy forecasting, and industrial energy efficiency—areas where Indian corporations are increasingly active. SDG 12 (Responsible Consumption and Production) finds expression in AI-enabled circular economy applications, sustainable procurement systems, and product lifecycle analytics. SDG 15 (Life on Land) benefits from satellite-based monitoring of deforestation and land degradation, with AI substantially extending the reach and resolution of such surveillance.

The social dimensions of the SDGs are equally important. SDG 8 (Decent Work and Economic Growth) intersects with corporate AI deployment through its implications for employment quality, workplace equity, and the distribution of productivity gains. SDG 10 (Reduced Inequalities) raises questions about whether AI-enabled sustainability creates new divides—between large corporations with the data infrastructure to comply and smaller firms that cannot, or between countries with sophisticated regulatory capacity and those without.

These equity dimensions deserve serious attention. The risk that AI-driven sustainability compliance requirements become a non-tariff barrier, concentrating market access in the hands of well-resourced incumbents while excluding smaller suppliers, is not merely theoretical. Policy design—at national and international levels—must explicitly account for this asymmetry, including through capacity-building provisions, open-source tooling, and differentiated compliance timelines.

5. Ethical Dimensions and Barriers to Responsible Deployment

5.1 Algorithmic Bias and Fairness in Climate AI

Any serious discussion of AI in climate governance must grapple with the ethical risks inherent in algorithmic systems. Training data that reflects historical patterns of environmental harm, economic exclusion, or regulatory neglect will tend to reproduce those patterns in model outputs. An AI system used to score supplier sustainability, for example, might systematically penalise smaller producers in low-income countries whose paper-based record-keeping does not conform to the data structures the model expects—not because those producers are actually less sustainable, but because their documentation practices differ from the norm on which the model was trained.

Addressing this risk requires deliberate investment in representative and diverse training datasets, transparent model architectures that allow external audit, and governance structures that include affected communities in model design and evaluation. The principle of explainability—ensuring that AI-generated sustainability assessments can be understood and contested by those subject to them—is not merely a technical nicety but a justice imperative.

5.2 The Carbon Footprint of AI Infrastructure

A particularly acute tension in the deployment of AI for climate purposes concerns the energy intensity of AI systems themselves. Training large-scale machine learning models consumes substantial computational resources, much of it still powered by fossil fuels. Inference at scale—running trained models to generate ongoing predictions and recommendations—adds a further, continuous load. If AI is to serve as a genuine instrument of decarbonisation rather than simply adding to global emissions, the sector must address its own environmental footprint with the same rigour it applies to others.

This challenge is tractable rather than fatal. Advances in model efficiency—including sparse architectures, transfer learning, and federated learning—are reducing the energy cost of state-of-the-art performance. Data



centres powered by renewable energy, already standard practice among leading technology companies, point toward a more sustainable AI infrastructure. For regulators and corporate sustainability officers alike, factoring the carbon cost of AI systems into the overall lifecycle assessment of digital sustainability initiatives is both honest and necessary.

5.3 Data Governance, Privacy, and Institutional Capacity

Effective AI-enabled sustainability governance depends on robust data infrastructure. In many emerging-economy contexts, including significant portions of India's MSME sector, this infrastructure remains underdeveloped. Inconsistent data collection, limited digital literacy, and fragmented regulatory data architectures create gaps that constrain both corporate self-assessment and external supervision. Building the institutional capacity to manage, share, and audit climate-relevant data is thus as important as developing the AI tools themselves.

Data privacy and competitive sensitivity present further complications. Supply chain transparency, while environmentally valuable, may require disclosure of commercially sensitive information. Regulatory frameworks need to strike a careful balance—mandating sufficient transparency for accountability purposes while protecting legitimate confidentiality interests. Sector-level data pooling arrangements, analogous to those used in financial stability monitoring, may offer a partial solution, allowing aggregate analysis without exposing proprietary firm-level detail.

6. Policy Recommendations and Actionable Frameworks

The analysis in the preceding sections suggests several concrete directions for policy and practice. These are organised around three themes: institutional integration, capacity and access, and standards and accountability.

6.1 Institutional Integration

India's climate governance architecture would benefit from tighter integration across the BRSR disclosure regime, the CSR spending mandate, and the National Action Plan on Climate Change. A unified national sustainability data platform—linking corporate disclosures, sectoral emissions data, and SDG progress indicators—would create the shared informational commons on which effective AI-enabled supervision depends. NITI Aayog, in coordination with SEBI, the Ministry of Corporate Affairs, and the Bureau of Energy Efficiency, appears well-positioned to lead such an initiative.

6.2 Capacity Building and Inclusive Access

Differentiating compliance requirements by firm size and sector, while providing capacity-building support to MSMEs, would help ensure that AI-enabled sustainability does not inadvertently reinforce existing inequalities. Publicly funded open-source AI tools for emissions calculation, supply chain mapping, and ESG reporting—developed in partnership with academic institutions and civil society—could substantially lower the barriers to entry for smaller enterprises. International development finance institutions have a role to play in supporting such infrastructure in emerging-economy contexts.

6.3 Standards, Accountability, and Anti-Greenwashing Measures

Harmonising India's sustainability reporting standards with the International Sustainability Standards Board (ISSB) framework—which integrates and supersedes the TCFD recommendations—would improve international comparability and investor confidence. Mandatory third-party verification of AI-generated sustainability claims, analogous to the assurance requirements already embedded in BRSR Core, would strengthen credibility. Regulatory guidance on the permissible use of AI in sustainability ratings and scoring,



including explainability and bias-audit requirements, would help ensure that AI amplifies rather than undermines accountability.

7. Conclusion

The convergence of artificial intelligence with corporate sustainability practice is neither a distant prospect nor a straightforward solution. It is an unfolding process, full of genuine promise and equally genuine peril, that is already reshaping how businesses measure, report, and act on their climate obligations. This chapter has attempted to map that process with some care—acknowledging the technical capabilities that AI brings to ESG measurement, climate risk analysis, and supply chain governance, while insisting on the ethical and institutional conditions that responsible deployment requires.

India's experience is instructive not because it offers a template but because it illustrates the complexity that any serious national response must navigate. A mandatory CSR regime, a progressively strengthening ESG disclosure architecture, ambitious climate commitments, and a large and innovative technology sector coexist with significant data deficits, institutional fragmentation, and deep inequalities in corporate capacity. These tensions are not unique to India—they are, in varying configurations, the challenges facing every emerging economy seeking to reconcile growth imperatives with climate necessity.

The central argument of this chapter can be stated simply: AI's contribution to climate-aligned corporate sustainability will be proportional to the quality of the governance frameworks within which it is deployed. Technology does not substitute for policy design, institutional capacity, or political will—it amplifies them. Where those foundations are strong, AI can genuinely accelerate the transition to a transparent, accountable, and resilient low-carbon economy. Where they are weak, AI risks becoming one more layer of complexity in an already fragmented landscape. Getting that governance right is the work of this decade.

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