4

Green Transition After COP29

Opportunities, and the Way Forward[1]

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4.1. Introduction

Climate risks pose significant challenges to financial institutions, the economy, and businesses. Banks, as key financial intermediaries, play a crucial role in combating these risks by directing funds toward environmentally sustainable projects and integrating climate risk management into their operations. Regulators and policymakers are giving top priority to climate change risk to ensure the sustainability of operations. Regulatory bodies like the Reserve Bank of India (RBI) and global frameworks such as the Task Force on Climate-Related Financial Disclosures (TCFD) emphasise the need for climate risk inclusion in decision-making. Measures like carbon emission reduction, Scope 1, 2, and 3 cuts, Green Bonds, and CSR initiatives help banks not only meet regulatory requirements but also enhance market performance and financial stability.

The eleven-day-long summit of COP29 held in Baku, Azerbaijan brought nearly 65,000 world leaders from around 200 countries. The United Nations Climate Change Conference was attended by decision-makers, private sector organisations, and civil society with a central focus on climate finance. As per the World Meteorological Organisation, 2024 is on track to be the hottest year, as global warming hit 1.5 degrees Celsius, resulting in ocean warming, increased sea level, glacier loss, and multi-hazard early warning reports by 108 countries. The key focus of COP29 was climate finance, and discussions were held on strategies to allocate funds for initiatives related to climate change, set a new target for climate finance, strengthen Nationally Determined Contribution (NDC), and progress on the pledges of COP28.

A new global climate finance target was set up. Parties negotiated to reach the decision for developed nations to give USD 300 billion to developing countries. The establishment of an international architecture for carbon markets was agreed upon. The supervisory body would oversee the mechanism to develop a comprehensive action plan for 2025. Nations were encouraged to update their NDCs to make them more ambitious and investable. However, the outcome of COP29 missed the momentum of the transition away from fossil fuels. The mechanisms for disbursement and scalability of the funds were unclear. Unlike COP28 in Dubai, nature was not a prominent point of discussion, although it strongly focused on creating effective carbon market mechanisms. Parties also agreed to mobilise USD 300 billion of climate finance even if it is short of the three trillion-dollar figure demanded by developing countries.

The first COP summit was held in Berlin, Germany in 1995. COPs examine the countries' preparation towards climate change goals and they result in various agreements and treaties like the Kyoto Protocol and the Paris Agreement. Table 4.1 provides a summary of details

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TABLE 4.1

A Summary Comparison of the Conference of the Parties (COP) Annual Meetings

COP Version	*Year & Location*	*Key Highlights*	*Mandate (Objectives & Agreement)*	*Focus Areas*
COP15	2009, Copenhagen, Denmark	• Adoption of the Copenhagen Accord (non-binding) • Developed nations pledged to mobilise USD 100 billion per year by 2020 for climate finance • Acknowledged the need to limit global warming to below 2°C • No legally binding emissions reduction targets	• Attempt to establish a legally binding treaty (failed due to lack of consensus) • Strengthen climate finance commitments for developing nations	• Climate finance for developing nations • Setting emission reduction goals • Adaptation & mitigation strategies
COP25	2019, Madrid, Spain (originally Chile)	• Focused on Article 6 (carbon markets) of the Paris Agreement (negotiations unresolved) • The Madrid Climate Action Plan emphasised stronger NDCs (Nationally Determined Contributions) • Introduction of Climate Ambition Alliance to boost long-term commitments	• Finalise rules for carbon markets (Article 6) • Strengthen financial & adaptation commitments • Accelerate climate action before 2025	• Carbon pricing & trading mechanisms • Climate adaptation & resilience • Strengthening NDCs
COP26	2021, Glasgow, UK	• Glasgow Climate Pact (urged stronger emission reductions by 2030) • First explicit mention of fossil fuels in COP agreements (commitment to 'phase down' coal) • Global Methane Pledge to reduce methane emissions by 30% by 2030 • Countries agreed to update NDCs by the end of 2022 • Climate finance commitment extended beyond USD 100B per year	• Keep the 1.5°C target alive under the Paris Agreement • Enhance climate finance for developing nations • Accelerate net zero commitments	• Phasing down coal & fossil fuels • Net zero targets & updated NDCs • Climate finance & loss and damage
COP27	2022, Sharm El-Sheikh, Egypt	• Established a Loss and Damage Fund to compensate vulnerable nations • Focused on climate justice & implementation gaps • Work Programme on Just Transition adopted for sustainable economic shifts • Discussion on climate adaptation (Sharm El-Sheikh Adaptation Agenda)	• Operationalise Loss and Damage Fund • Ensure full implementation of previous COP pledges • Enhance support for climate-vulnerable nations	• Climate justice & equity • Loss and damage compensation • Adaptation finance & resilience
COP28	2023, Dubai, UAE	• First Global Stocktake (GST) under the Paris Agreement • Commitment to triple renewable energy capacity & double energy efficiency by 2030 • Landmark agreement to transition away from fossil fuels • Loss & Damage Fund operationalised with initial contributions • Focus on health and climate change (first-ever Health Day at COP)	• Assess global climate progress & set a stronger roadmap • Strengthen climate finance & adaptation support • Push for global renewable energy expansion	• Fossil fuel transition & clean energy • Climate finance expansion • Adaptation & resilience building
COP29	2024, Baku, Azerbaijan	• Discussions on new global climate finance goals beyond USD 100 Billion • Focus on adaptation finance & support for developing nations • Push for increased private sector investments in climate projects • Revisiting unresolved issues from Article 6 (carbon markets)	• Establish new climate finance commitments for post 2025 • Strengthen adaptation finance mechanisms • Build consensus on carbon market regulations	• Climate finance reform • Implementation of adaptation measures • Strengthening carbon markets

Source: Authors' Compilation.

about various COP summits and key focus areas and mandates.

It is expected that the next COP30 will focus more on climate risk mitigation and sustainability, and link biodiversity pathways with climate action. It may be noted that COP 30 will take place in Belem city, Brazil on November 10–21, 2025.

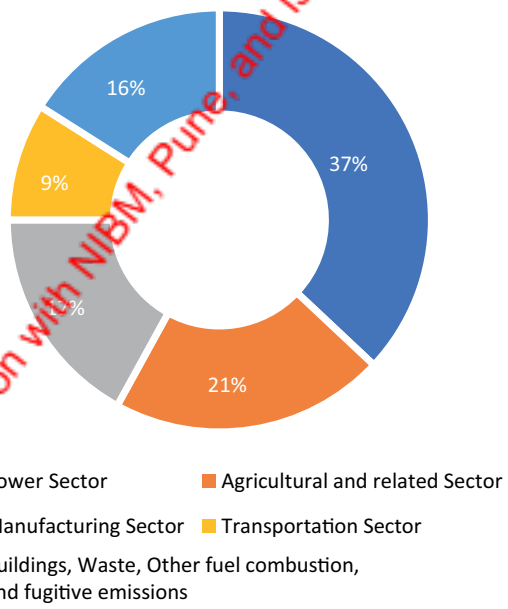
The chapter proceeds as follows. Section 4.2 describes India's stance and recent action on green transition. Section 4.3 provides a snapshot of Climate Finance initiatives in India. Section 4.4 discusses future strategies. Section 4.5 presents the journey of Indian banks and explores whether ESG metrics influence bank performance and asset quality. Section 4.6 concludes, with a few thoughts on the challenges, policy imperatives and future scope of research.

4.2. India's Position

India emerged as the leader of the global south when its representative, Chandni Raina, mentioned, in response to the USD 300 billion pledge by the developed countries, that India and other developing nations believe that at least USD 1.3 trillion is required to cope with the climate crisis. Declaring the agreement an 'Optical Illusion', India argued that the pledged amount was not enough to address the enormity of the challenges developing nations face because of climate change. In 2009, the commitment to provide USD 100 billion annually was viewed as insignificant, and it was also fulfilled only in 2022, two years after the deadline. Unlike this year, last year India commended the COP28 Presidency for steering the summit as the 'COP for Action', the action evident on the very first day with the successful operationalisation of the Loss and Damage Fund by the Union Minister of Environment, Forest, and Climate Change. India took the Green Credit Initiative at COP28 for the creation of a participatory global platform to exchange innovative environmental programmes and instruments.

India is the third largest greenhouse gas (GHG) emitter in the world, with the power sector being the largest contributor with 37 per cent of total GHG emissions in the country, followed by the agricultural sector with 21 per cent. In the power sector, electricity generation is dominated by the use of coal which accounts for over 70 per cent of electricity output. Manufacturing which includes sectors like iron and steel, cement, fertiliser, and petroleum refining constitutes 17 per cent of the emissions. The transportation sector accounts for 9 per cent, and the rest 16 per cent of GHG is emitted from buildings, waste, other fuel combustion, and fugitive emissions.

FIGURE 4.1
Sector-wise Contribution of GHG Emission in India



Source: International Monetary Fund, 2023.

The Government of India has focused on reducing emission intensity for existing as well as new coal-fired generation plants. At the same time, the Government of India is implementing many innovative mechanisms to boost renewable energy deployment. India could successfully reduce the emission intensity vis-à-vis its GDP by 33% between 2005 and 2019, thus achieving the initial NDC target for 2030, 11 years ahead of the scheduled time. The Global Biofuel Alliance (GBA) was launched at the G20 summit in New Delhi and seeks to foster global collaboration for the advancement and widespread adoption of biofuels. UJALA initiative aims at energy-efficient lighting and reduction in carbon emission through reduced price of LED bulbs. India was among the first few G20

TABLE 4.2

State-wise Estimated Potential of Renewable Energy

State	*Estimated Potential of Renewable Energy*
Rajasthan	20.30%
Maharashtra	11.79%
Gujarat	10.45%
Karnataka	9.75%
Andhra Pradesh	7.92%
Jammu & Kashmir	5.96%
Madhya Pradesh	5.84%
Tamil Nadu	5.56%
Telangana	3.71%
Himachal Pradesh	2.65%
Odisha	1.96%
Uttarakhand	1.53%
Uttar Pradesh	1.52%
Chhattisgarh	1.13%
Jharkhand	0.89%
Bihar	0.81%
Rest of India	8.23%

Source: Energy Statistics India, 2024, Ministry of Statistics and Programme Implementation (MOSPI).

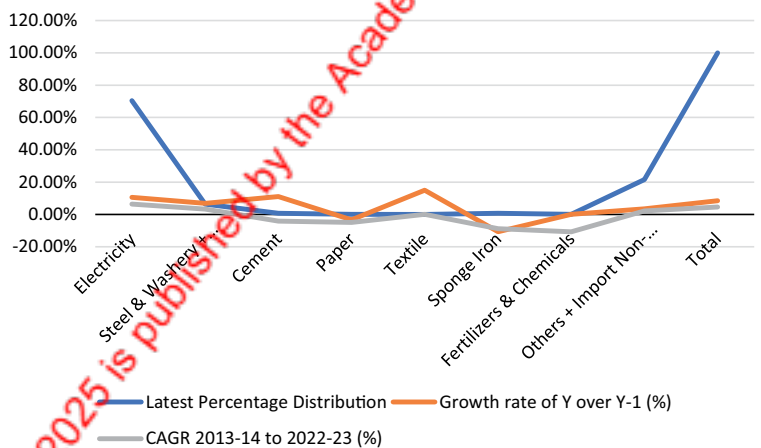
nations to fulfil its commitment to Paris Agreement on green energy. The commitment was fulfilled nine years before the target of 2030. In the last decade, India's capacity in non-fossil fuel and solar energy increased nearly 300% and 3000% respectively. As per the IMF (2023) report, more than 40 per cent of installed capacity in India is coming from renewable energy and it is rising. India's focus on green hydrogen may help in decarbonisation of industries such as refineries, fertilisers, steel, and transportation which are difficult to electrify. Green hydrogen may also be used to store the surplus renewable energy.

The geographic distribution of the estimated potential of renewable energy (Table 4.2) indicates that Rajasthan stands at the top with 20.3% (428322 MW), followed by Maharashtra with 11.79% (share 248665MW). Gujarat and Karnataka come third and fourth respectively with a 10.45% and 9.75% share (220505 MW and 205648 MW respectively). These four states have more than 52% of the total potential of renewable power in India.

Coal is the major source of energy across the sectors. Transitioning from coal to renewable energy sources would require sector-specific strategies; however, government strategies are playing a significant role in bringing down the dependence on coal. Cement, Paper, Sponge Iron and Fertilisers & Chemicals recorded a negative CAGR (2013-14 to 2022-23) in consumption of coal (Figure 4.2).

FIGURE 4.2

Industry-wise Consumption of Coal



Source: Ministry of Statistics and Programme Implementation.

4.3. Climate Finance and Trade Situation in India

Climate change has gained the attention of the government, regulatory bodies, and the industry players, who are now taking several steps towards decarbonisation and reducing carbon emissions.

In the last fiscal year, total climate equity funding in India reached USD 4.82 billion. Funding for energy transition accounted for a share of 60%, followed by funding in mobility sector with 23.4%, climate finance funding with 5.8%, sustainable agriculture funding with 5.1%, funding to increase efficiency at 3.4%, funding for waste circularity at 1.4% and funding for emerging sectors with 0.9%. Energy Transition includes transitioning from traditional sources to biomass, solar, and wind energy (Figure 4.3). The clean Mobility sector comprises electric public transport, EV ecosystem, and batteries used in EVs. Climate finance includes EV financ-

ing, green energy financing, and agri-financing. Sustainable agriculture includes agri-supply chain, digital agronomy, and food systems.

Debt financing is also very crucial in India's efforts towards climate action, and will become widely available once the sector becomes mainstream and profitability gets recorded. Debt financers offer loans at affordable interest rates for renewable energy and EVs. International Development Financial Institutions (DFI) and domestic lenders such as Power Finance Corporation and commercial banks handle large ticket loans, while the small loans are mainly provided by retail plyers such as local banks, SIDBI, NBFCs, and climate fintech such as Tata Capital Cleantech, Mufin Green Finance, Aerem Fintech, Ecofy and Revfin Finance. Figure 4.4 illustrates the debt and equity financing in the last three years.

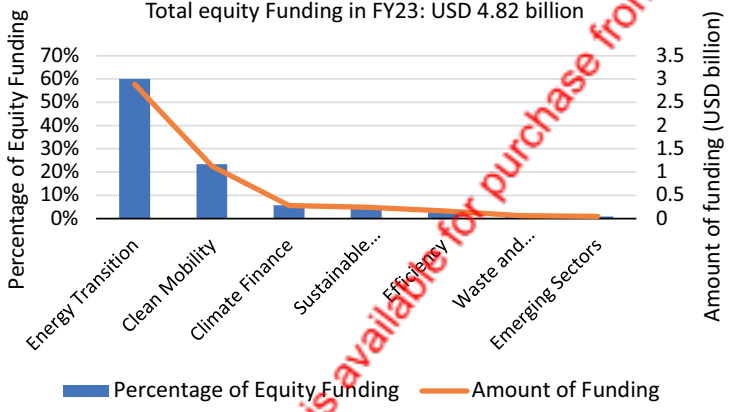
Carbon credit trading is a market-based approach to reduce GHG emissions. Carbon credits are generated by projects that reduce the carbon released in the atmosphere or take back carbon from the atmosphere. One carbon credit allows the emission of one ton of carbon dioxide and equivalent (CO2e). In July 2024, the government adopted regulations for the Carbon Credit Trading Scheme (CCTS). An advancement in the country's carbon pricing framework, CCTS would initially cover carbon dioxide and perfluorocarbons, and at a later phase, other GHG emissions. Bureau of Energy Efficiency (BEE) has the target to develop a sectoral GHG emission intensity trajectory up to 2030. The industry-level emissions trajectory has been presented in Figure 4.5.

4.3. Challenges

Climate change has gained the attention of the government, regulatory bodies, and industry players, who are now taking several steps towards decarbonisation and reducing carbon emissions. Net-zero transition of the hard-to-abate sectors is a challenging task due to lack of commercially viable alternatives, high carbon intensity and process emissions, involvement of high capital cost and long asset lifespan, high energy demand and infrastructure constraints, and supply chain and market risks.

FIGURE 4.3

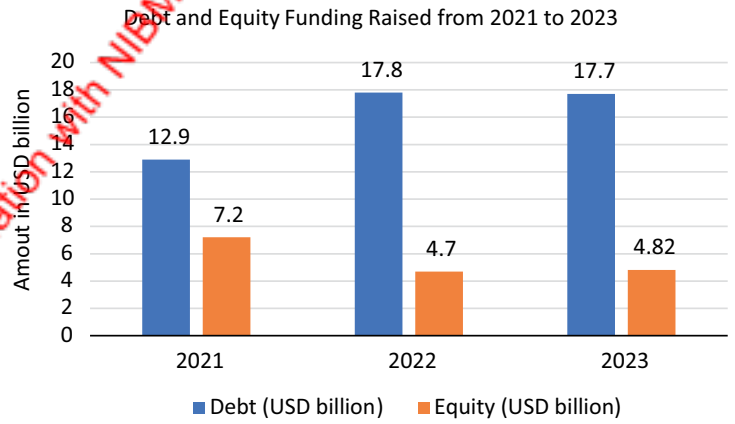
Sector-wise Equity Funding in FY23



Source: Unitus Capital.

FIGURE 4.4

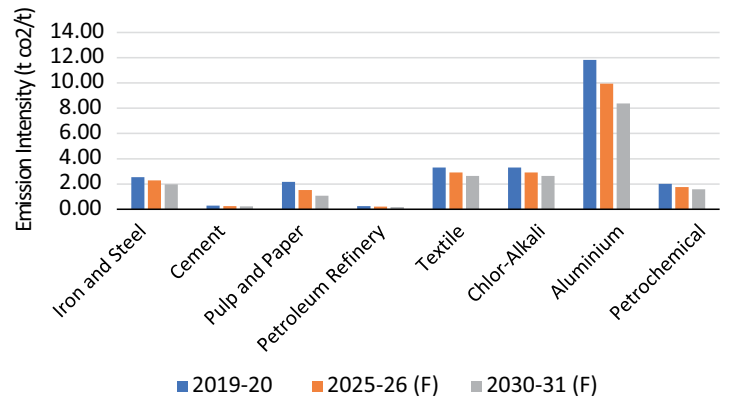
Year-wise Debt and Equity Funding



Source: Unitus Capital (2023).

FIGURE 4.5

Industry-wise Emission Trajectory



Source: Ministry of Power.

This transition may be achieved by scaling up green hydrogen and alternative fuels, developing infrastructure for carbon capture, utilisation, and storage (CCUS), and collaborative industry efforts. It is estimated by the Council on Energy, Environment and Water (CEEW) that India would require an investment of USD 10.1 trillion by 2070 to achieve the net-zero goals. As of now, it has received only a quarter of the required investments inflow for climate change risk mitigation.

Climate finance for net-zero transition would require a fine blend of green finance and transition finance. Green finance accounts for financing technologies that have zero or near-zero emissions, and are aligned with the Paris Agreement, while transition finance constitutes financing towards reducing emissions in hard-to-abate sectors. In India, green finance is more common than transition finance. As of 2021, green bonds issued in India by 72 issuers is of USD 18.3 billion, while transition bonds have yet not been issued.

India's financial sector is driven by banks, which play a significant role in driving economic growth and development of the country. However, there are several challenges that limit their ability to promote climate finance for net zero transition. Banks and other financial institutions often face difficulties in identifying and classifying green projects due to the absence of well-defined taxonomy. This also increases the risk of greenwashing. Green projects such as renewable energy and sustainable agriculture have a long gestation period, making it difficult for the banking institutions to lend in such projects.

Traditional credit risk models do not assess the borrower-level climate risk. Though some institutions have started considering physical risks such as floods and droughts in their credit decisions, transition risks are yet not tracked by the financial institutions. As per Basel III norms, banks must maintain a fixed capital adequacy ratio, which makes it difficult for them to have their exposure in green sectors that are perceived as risky. There is no regulatory guideline which can ask banks to have a minimum net-zero or green finance portfolio. Banks have to rely mainly on green bonds and sustainable finance instruments for financing green projects because the short-term deposits on which they heavily rely do not align with green projects having a long payback period. There are measures that may be taken by the regulators and financial institutions to endorse climate finance and green lending. To avoid greenwashing risks and track climate finance flows efficiently, a standardised Indian green taxonomy must be developed. This can be done by collaborating with RBI and the Securities and Exchange Board of India (SEBI), and aligning with TCFD, EU Green Taxonomy and IFRS Sustainability Standards.

To measure the financial risk induced by climate risk, banks may conduct scenario analysis. Climate risk may be included in the internal credit rating model, so that the credit analysts may have climate-related inputs in their credit decisions. Firms, irrespective of their size, may be encouraged to disclose climate-related financial impacts as per the Carbon Disclosure Project (CDP) or TCFD. Sustainability-sensitive loans may be introduced with a lower interest rate for borrowers working on green projects. Study by Bandyopadhyay and Kashyap (2024) on Indian firms found that borrowers had more distance to default (DD), a lower probability of default, and better credit-worthiness if they had better ESG rating, less carbon emission, and better climate risk disclosure. Hence, banks may consider financing companies having better ESG ratings and lesser climate-related financial risk to improve their portfolio's credit quality and reduce their overall NPA.

Climate-related database of the borrowers may be developed by the regulatory agencies so that the banks, NBFCs and fintechs may use them to develop AI and blockchain-based models to verify green projects, carry out ESG risk analysis, and make sustainable investment decisions. Furthermore, banks' risk management officers may be given mandatory training on ESG and climate risk, so that the experts may take a climate risk-sensitive credit decision.

4.4. Road Ahead

With proper formulation and execution of a standard climate policy framework across all

the sectors, along with sector-specific policies, domestic as well as foreign investment in renewable energy and sustainable industries are expected to accelerate. Green bond markets may be expanded to finance climate-resilient projects. To promote green and transition finance, Public-Private Partnership (PPP) may be encouraged and incentive-based projects may be adopted. Continuing its practice of leveraging platforms like G20 and BRICS, India may push for climate justice and equitable transitions.

The initiative of launching International Solar Alliance (ISA) has helped India to establish a climate-aware leadership position. A similar platform may be created for green hydrogen as well. Successful partnerships may help the decarbonisation of carbon-intensive industries. A sustainable water management alliance is missing in South Asia, which India may leverage to strengthen itself as a leader among South Asian countries by reducing geopolitical tension over water resources and promoting solutions for desalination, water recycling, and equitable water distribution. Bio-economy is a less explored area, and India may endorse the GBA where knowledge and technology on biofuels and bioplastics can be transferred among countries. Further, India may be seen as an ideal host for global alliance on blue economy. The maritime sector has a huge capacity to foster economy through several innovations in fuels and internal combustion engines used in Indian ships. Corporates in India need to be more proactive in Cabon Disclosure Projects (CDP). Policy-makers, financial institutions, and investors may implement an ESG framework so that even MSMEs and startups would measure their carbon footprints in order to get a loan or investment.

Greenwashing and the Need for a Standard Audit Framework

Third-party audits and assurances play a very crucial role in making climate and ESG disclosures reliable, as they ensure data accuracy and prevent the risk of possible greenwashing. Greenwashing is a situation where corporates and financial institutions exaggerate or misinterpret their environmental performance. The sustainable debt market has grown to USD 55.9 billion by December 2024, with green bonds having a share of 83 per cent; however, this surge has taken place without any sufficient third-party validation. Even though India has issued sovereign green bonds of USD 5.7 billion since 2023 (Climate Bond Initiative, 2025), the absence of a standard external audit framework and unified taxonomy leaves a gap for potential greenwashing.

The risk of greenwashing undermines the overall idea of ESG and leads to not only the erosion of investors' trust, but also the wrong allocation of the green funds, which are already very limited. In India, SEBI mandates that the top 1,000 listed firms increase their Business Responsibility and Sustainability Reporting (BRSR). However, only a small part of these reports is audited by a third party. This raises concern about the consistency and comparability of the Indian disclosure reports. A possible way to address the challenge of greenwashing is by strengthening disclosure norms, implementing a standard audit framework, and developing a unified green taxonomy that follows RBI, SEBI, and international standards. This will also have the potential to fix the issue that has come up after CDP became passive for Indian disclosures

4.5. Green Sustainable Banking Initiatives

India has spelled out its long-term goals and strategies for fighting against climate change: It aims to reach net zero emissions by 2070 and meet fifty per cent of its electricity requirements from renewable energy sources by 2030. The recent Union Budget 2024-25 has stressed the need for a climate finance taxonomy to encourage investments in various climate action initiatives. This will help the investors to identify activities, assets, and projects that deliver on climate, green, or sustainable objectives. Reducing global greenhouse gas (GHG) emissions has become imperative to combat climate changes. The financing of green initiatives and projects has received an immense boost through Green Bonds. Proceeds from these fixed income instruments are allocated exclusively to finance green projects.

India has pledged to reduce the carbon intensity of its economy by 2030 for which the country will require huge funding requirements. It is estimated that Rs. 162.5 trillion (USD 2.5 trillion) worth of funds will be required for taking up climate action (around Rs. 11 trillion per annum which is around USD 170 billion). The present level of investment is around USD 18 billion per annum. Green finance itself is relatively 'green' in Indian financial markets. India had less than a 3% share of the USD 155.5 billion green bond issuance in 2017 (Climate Bond Initiative 2025). The green bond issuance share in the global markets and even domestic bond markets remains insignificant. In 2021, RBI joined the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) in promoting the exchange of best practices on green finance. In the 27th United Nations Conference of Parties (COP) in Egypt in November 2023, India underlined the necessity to enhance financial flows to emerging countries to strengthen their efforts to address and adapt to climate change. The Indian government has also issued sovereign green bonds and an associated framework.

A comparison of exposure intensity to the top 10 fossil fuel-intensive sectors of two leading commercial banks in India has been presented in Table 4.3.

We have attempted to map bank credit exposures to fossil fuel-intensive sectors to gain insight into the extent of their climate change risk (mainly transition risk) exposures. This has been worked out for both the systematically largest banks in India: SBI and HDFC. One can apply climate change scenarios caused by transition risk to the entire portfolio quality.

India's two leading banks have responded positively to green sustainability requirements. The leading private sector entity, HDFC Bank, leads in CSR and ESG initiatives, with its CSR spending being highest at Rs. 945.31 crore and robust ESG integration supported by Board-level oversight and alignment with global standards. The State Bank of India (SBI) is at the forefront of renewable energy financing, with an investment of Rs. 47,418 crore supporting a capacity of 31,787 MW, making it a key contributor to India's green energy transition. SBI has also started internalising ESG factors in credit rating and loan pricing. From the disclosures, it is understood that HDFC bank is attempting to estimate financed emissions as expected in the recent RBI (2024) disclosure requirements for

TABLE 4.3

Bank Exposures to Fossil Fuel Intensive Sectors

SL#	*Industry*	*Sector Fossil Fuel Intensity*	*SBI*		*HDFC*	
			Exposure % Share	*GNPA Ratio*	*Exposure % Share*	*GNPA Ratio*
1	Beverage & Tobacco	Moderate (5% to 10%)	0.12%	0.84%	0.25%	1.89%
2	Cement	Very High (>25%)	0.33%	6.48%	0.44%	0.32%
3	Chemical	High (>10%)	3.27%	0.82%	0.89%	0.28%
4	Coal & Petroleum	Moderate (5% to 10%)	3.05%	0.46%	0.85%	0.44%
5	Electricity & Power	High (>10%)	5.93%	0.55%	2.36%	0.86%
6	IT & Telecom	Moderate (5% to 10%)	0.79%	7.62%	1.59%	0.35%
7	Metal	High (>10%)	4.26%	0.63%	1.96%	0.43%
8	Paper & Prints	High (>10%)	0.18%	3.98%	0.48%	0.96%
9	Rubber & Plastic	Moderate (5% to 10%)	0.27%	3.78%	0.46%	0.36%
10	Textiles	Moderate (5% to 10%)	0.96%	6.22%	1.80%	1.39%
Total			19.16%	1.46%	11.07%	0.73%
Bank Level Total				2.07%		1.34%

Source: Compiled from the Basel III Disclosures of Banks from the December 2024 quarter.

Note: Sectoral Fossil Fuel Intensity has been mapped from the Annual Survey of Industries, BSR Statistics, RBI Bulletin, 2022. The total exposure includes fund-based as well as non-fund-based categories. GNPA ratio is estimated from fund-based exposures.

TABLE 4.4

Green Financing Initiatives by the Two Leading SCBs in India

	SBI	*HDFC Bank*
Factors		
Climate Goal	To be carbon neutral (Scope 1 and 2) by 2030 by actively reducing energy usage through efficient facility management and switching to renewable energy	To become carbon neutral in own operations by FY32.
Sustainable Finance Framework		Yes
Renewable Energy Finance (Cumulative in Rs. Cr.)	47,418	22,026
Green Deposits		Not raised
Total GHG Emissions (tCo2e)	8,11,410	6,50,000
Emissions Intensity (Scope 1 & 2) to Operating Revenue		1.91
Energy Intensity (per rupee turnover)		9.87
ESG Score	37	57
MSCI ESG Rating		AA
CDP Score	B	B
CSR/Community Initiatives Spending (Rs. Crore)	502.32	945.31
Estimation of Financed Emission	Not Disclosed	The bank has launched an internal pilot exercise to estimate financed emissions for its lending portfolio.

Source: Authors' compilations from bank annual reports, Business Responsibility and Sustainability Reporting (BRSRs) & Sustainability Reports.

commercial banks. Both the banks have started counting and reporting emissions avoided through solar and wind energy. Their renewable energy finance includes green loans, sanctions to solar power, wind, biomass, waste to energy, and hydro projects. Both financial institutions have scaled up their renewable energy finance over time. The State Bank of India has increased it from Rs. 31,918 crores in FY 2020-21 to Rs. 47,118 crore in FY 2023-24. Following the same trend, HDFC bank has increased its renewable energy finance from Rs. 10,869 crores to Rs. 22,026 crores. Table 4.4 summarises the green financing initiatives by India's two largest commercial banks.

In a recent study, Mahadevan et al. (2025) proposed an empirical framework for Indian commercial banks to standardise the green taxonomy. This was followed by the work of Faiella and Lavecchia (2022). Their findings emphasise the importance of lending to non-carbon sectors to enhance the quality of credit portfolios. Using the bank-level exposures to different carbon-intensive as well as non-carbon critical sectors provided in their Basel 3 disclosures, their study reveals that increasing lending to non-carbon-intensive sectors plays an important role in reducing the bank's overall gross non-performing assets (NPA) ratios and improving portfolio quality. They point out that this improvement in loan quality can be due to reduced transition risks as the banks move away from carbon-intensive sectors. Similarly, Biswas et al. (2025) empirically observe that a bank's ESG practices negatively impact its risk of insolvency. Further, the governance (G) factor in ESG exhibits the strongest risk reduction impact for Indian commercial banks. Their study suggests that banks need to integrate ESG practices into their operational framework

to derive competitive advantage and ensure financial stability. Herwadkar et al. (2025) find a negative relationship between green lending share and non-performing assets ratio for banks in India. They also find a positive association between green lending and return on assets. More such studies are required to establish the linkage between green financing and firm performance to emphasise the need for climate-sustainable business performance.

Climate Risk Mitigation Journey of Banks

Climate change poses financial risks through physical and transition risks. Regulatory frameworks (Paris Agreement, Net-Zero Banking Alliance, etc.) provide direction for necessary compliance towards sustainable business growth for banks. Investors and customers expect sustainable banking practices, which in turn open up opportunities for green finance and sustainable investments. According to Velentzas, Jais and Tapia (2023), the climate mitigation journey (CMJ) provides a structured framework for banks to align with net zero commitments and sustainability. It has been developed by UNEP FI with the help of industry experts. It addresses regulatory, financial, and operational challenges. This provides a roadmap for gradual transformation towards a greener economy, and a direction to operationalise net-zero strategies. It consists of three key business capability blocks:

1. Core Climate Capabilities: Foundational competencies for climate risk management
2. Commitment & Targets Capabilities: Setting ambitious, measurable goals
3. Implementation Capabilities: Translating strategies into actionable policies and financial decisions

Banks must take a structured approach to climate mitigation by 1) Embedding climate considerations in governance and strategy; 2) Setting ambitious yet achievable targets; 3) Developing implementation pathways that align with regulations and market opportunities; and 4) Leveraging data and digital tools to enhance sustainability performance. Integrating CMJ principles into risk management will enable banks to expand green finance offerings and strengthen regulatory compliance and stakeholder engagement.

4.1. Indian Bank-Level ESG Analysis

We have utilised the MSCI ESG ratings of nineteen selected scheduled commercial banks as a measure of their climate performance over three years (2021, 2022, and 2023). Figure 4.6 presents a comparison of ESG scores given by MSCI. It is quite evident that the bank differs in terms of ESG scores. The climate performance also varies over the years. Axis Bank, HDFC Bank, and SBI are consistently performing better in terms of ESG scores.

Next, we take these bank-level ESG scores in a panel data format to examine any implications on their market performance.

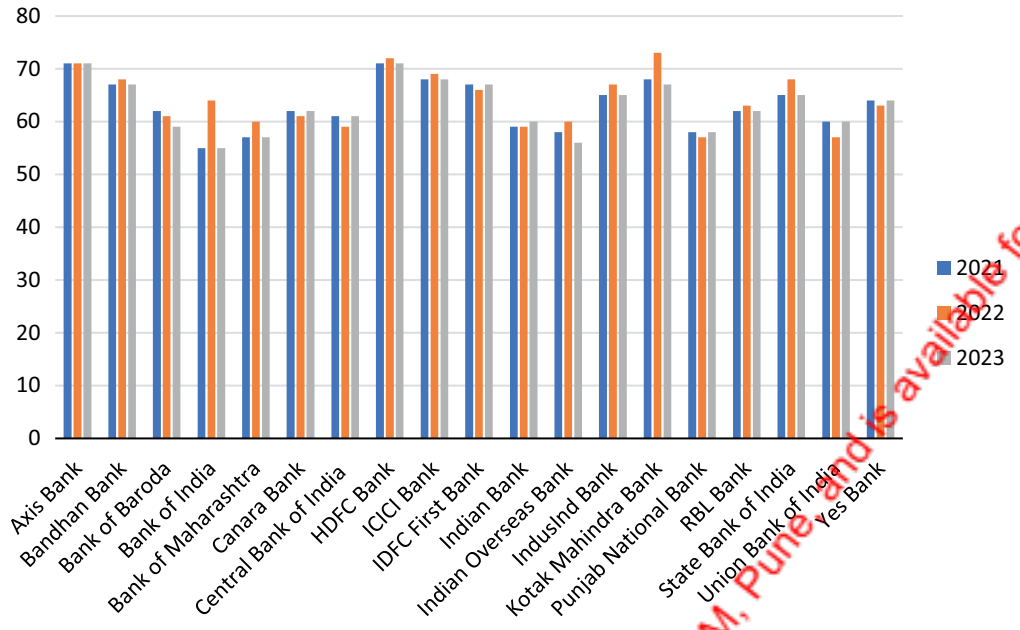
The summary statistics of bank performance data have been documented in Table 4.5. The pairwise correlation coefficients between various banking parameters and ESG scores are reported in Table 4.6.

It is interesting to observe that the bank-level ESG score is positively associated with PBR and Tier 1 Ratio, but negatively correlated with Gross NPA ratio (GNPAR). The market performance of banks (measured in terms of PBR) is negatively correlated with the GNPA ratio and positively correlated with the Tier 1 Ratio and ESG scores.

We have performed a set of univariate tests to check if there is a statistically significant difference in performance between low ESG vs. Moderate & High ESG firms. For this, we have created a dummy (Desg=1 if ESG score of firms is below or equal to a 25th percentile bottom and 0 for others above it). We have performed mean as well as median comparison tests (t-test and Wilcoxon rank-sum test). Both the test results confirm that low ESG-scoring banks have significantly higher GNPA ratios and lower price-to-book ratios. Hence, they are better prepared for uncertainty. It further confirms that ESG score matters in differentiating bank risk management capabilities and market performance. The results are reported in Table 4.7.

FIGURE 4.6

ESG Scores across Selected Scheduled Commercial Banks



Source: Authors' compilation for Indian Banks using MSCI ESG scores data.

TABLE 4.5

Summary Statistics

Variable	*N*	*Mean*	*Median*	*Std. Dev.*	*Minimum*	*Maximum*
PBR	57	1.5459	1.18	1.201	0.37	5.50
GNPAR	57	6.650	5.33	4.194	1.12	16.55
LBUSS	57	13.638	13.798	1.0189	11.789	15.847
Tier 1 Ratio	57	14.515	13.78	3.055	10.08	22.48
ESG Score	57	63.386	63.00	4.825	55	73
LOPCOSTINCR	54	0.952	0.739	0.984	-0.576	5.051
CD Ratio	57	76.721	74.30	15.337	47.45	113.37
COSTINCR_OP	57	5.2019	2.024	21.535	-19.751	156.289

Note: PBR: Price to book ratio, capturing market performance (market price to book value per share); GNPAR: Gross NPA to Advances Ratio, reflecting asset quality; LBUSS: Natural log of total bank business, proxy bank size; LOPCOSTINCR: Natural log of operating cost to income ratio; CD Ratio: Credit to Deposit Ratio, reflecting business leverage positions; COSTINCR_OP: Operating Cost to Operating Income Ratio, representing cost efficiency of banks.

TABLE 4.6

Correlation Matrix

	PBR	*GNPAR*	*LBUSS*	*Tier 1 Ratio*	*ESG Score*	*OPCOSTINCR*
PBR	1.00					
GNPAR	-0.542	1.00				
LBUSS	0.018	-0.063	1.00			
Tier 1 Ratio	0.789	-0.591	-0.217	1.00		
ESG Score	0.727	-0.624	0.102	0.664	1.00	
LOPCOSTINCR	-0.031	0.135	-0.112	-0.008	0.082	1.00

TABLE 4.7

Mean and Median Comparison Performance Tests between Low ESG Banks vs. Moderate & High ESG Banks

Factors	*Mean: D_{lowESG} (ESG<=60)*	*Mean: $D_{moderate\&highESG}$ (ESG>60)*	*T-statistics for Mean Difference*	*Wicoxon Ranksum Test Statistics for Median Difference*
GNPAR (%)	9.136	5.106	4.03*** (t=3.81, df=55)	4.875*** (z=3.606)
PBR	0.845	1.896	-1.052*** (t=-3.396, df=55)	-0.915*** (z=-3.403)

Note: Z values are reported in parentheses. *** indicates significance at 1% or better level.

We have adopted the panel Feasible Generalised Least Squares (FGLS) method to study if there is any impact of ESG scores on banks' performance in terms of their price-to-book ratio. The regression results are reported in Table 4.8.

The first regression model uses the indicator price-to-book ratio, which captures the market performance of a bank. We have found a statistically significant and positive impact of ESG score on the banks' market performance. It implies that banks with higher ESG scores experience better performance in terms of price-to-book ratio. Thus, the bank's climate performance and governance have a positive influence on its performance. In a similar regression framework, we have also examined if the ESG performance of banks has any implications on their overall asset quality. Our regression result shows that a higher ESG score has a significant risk reduction effect (captured through the negative significant coefficient of factor ESG on the GNPA ratio of banks). It may be because banks with higher ESG scores follow a more prudent risk management framework, which is reflected in a lower GNPA ratio. A variance inflation factor (VIF) test further confirms the absence of multicollinearity issues in the regressions.

As a further robustness check, we have performed two-stage least squares using instrumental variable regression to address the potential endogeneity. The 2SLS instrumental variable-based regression results are presented in Table 4.9.

We have performed Wu and Hausam test to test the endogeneity. The chi2 test statistic

TABLE 4.8

Panel FGLS Regression: Impact of ESG on the Market Performance of Banks

Factors	*Dependent Variable: PBR*	*Dependent Variable: GNPAR*
LBUSS	0.127 (0.98)	-0.786 (-1.54)
Tier 1 Ratio	0.237*** (4.50)	-0.616*** (-2.62)
ESG Score	0.078*** (2.72)	-0.279*** (-2.19)
LOPCOSTINCR	-0.009 (-0.08)	-0.534 (-1.02)
Intercept	-8.345*** (-4.84)	44.42*** (5.79)
No. of Obs.	54	54
Wald Chi2 (k)	132.24 (4)	52.69 (4)
Prob>Chi2	0.00	0.00
Mean VIF	1.65	1.65

Note: Z values are reported in parentheses. *** indicates significance at 1% or better level.

is low and p value is higher than 10% in both regressions in PBR (WH Chi2=0.382 & F=0.357 with p values 0.5365 and 0.5524, respectively) as well as GNPAR (WH Chi2=2.723 & F=2.879 with p values 0.099 and 0. 096). These econometric tests are specified in Wooldridge (1995).

The two-stage regression results after taking valid instruments confirm that ESG has a significant positive impact on a bank's market performance measured in terms of price to book ratio (PBR). Since banks with strong ESG practices tend to be more attentive to stakeholder interest and social norms, it translates into better market performance. On the other

TABLE 4.9

Panel 2SLS Regression: Impact of ESG on the Market & Asset Performance of Banks

Factors	*Dependent Variable: PBR*	*Dependent Variable: GNPAR*
Tier 1 Ratio	0.2143*** (3.64)	-0.127 (-0.50)
ESG Score	0.1429*** (2.77)	-0.665*** (-2.71)
CD Ratio	-0.0192** (-2.36)	0.0047 (0.08)
Intercept	-9.152*** (-3.76)	50.09*** (4.29)
No. of Obs.	57	57
Wald Chi2 (k)	93.19 (3)	48.44 (3)
Prob>Chi2	0.00	0.00
R-square	0.712	0.377
Basmann Chi2 (df, p-value)	0.0014 (1, 0.970)	0.114 (1, 0.735)
First Stage instruments: costincr_op lbusiness		

Notes: The figures in the parentheses are the estimated z values with heteroskedasticity robust standard errors.

Factor: costincr_op: Operating cost to operating income (cost efficiency); lbuss: natural log of total business of banks (bank size) are taken as valid instruments.

hand, ESG has a significant negative impact on asset quality measured in terms of Gross NPA ratio (GNPAR). Thus, high ESG scores reduce a bank's non-performing assets (GNPAR) by improving risk management and governance. The bank's CD ratio has a negative influence on market performance since it represents higher risk.

Thus, both univariate t & Wilcoxon rank sum test as well as multivariate regression results confirm the fact that ESG score has a significant influence of bank performance in India.

4.6. Conclusions

The main focus of COP29 was to bring together the world leaders in securing a new goal on climate finance, bringing every country to take much stronger climate action, reduce greenhouse gas emissions, and build resilient communities. It has become imperative to find a solution to improve the efficiency of electrolysers and other components used in the production of Green Hydrogen. Initiatives to explore the technology to use seawater and municipal wastewater for the production of green hydrogen has become essential to combat the climate transition risk in India. The National Institute of Solar Energy, Indian Maritime University and Ocean Engineering departments of IITs may start working on the mass production of solar-assisted electric ferries to reduce the carbon emission from the shipping sector. Researchers in risk domain may think upon developing a model to integrate ESG risk in the ongoing risk management framework applied uniformly across the banking sector. This will facilitate the top management in banks and FIs to recognise the importance of sustainable business growth. The National Centre of Excellence in Carbon Capture and Utilization at IIT Bombay may work with climate fintech to develop technology to capture, transport, and store the Co2e (Carbon dioxide and equivalent). Reputed institutions may be set up which could help the Indian companies, public authorities, cities, and states to disclose their environmental impact. In our empirical analysis, we find evidence that ESG score has a significant influence on a bank's market performance as well management of asset quality. A proper disclosure may help in mitigating the climate and environmental risk from micro to macro level. Internal Carbon Pricing (ICP) may be extended to all corporates, MSMEs, and public entities working in the carbon-intensive sectors to reduce carbon footprint, mitigate climate risk and guide climate strategy.

Key Challenges in India

There is a need to frame a detailed green taxonomy in line with the list of RBI industry codes and adopt a uniform approach prescribed by regulators for identifying green assets. This will prevent arbitrage by borrowers and encourage greater compliance towards environmental sustainability. There is very limited disclosure amongst corporates (mainly midsized companies) for their climate transition plans or sustainable strategies. A well-defined transition

pathway that is aligned to India-specific emissions will enable an accurate assessment of climate transition risk for Indian borrowers.

Need for Climate-Related Disclosures and Climate Risk Mitigation for Banks

The COP28 signalled a move away from fossil fuels. Countries like Brazil, Colombia, Japan, Egypt, and the UAE are the only few that have introduced climate disclosure requirements for banks. European Union companies including banks are mandated to report on their climate change transition plans and outline actions and policies undertaken for mitigation and adaptation (EFRAG, 2022). Investors are also actively urging banks to effectively manage climate risk in their portfolios and enhance green and transition initiatives.

Recently, on March 13, 2025, the Governor of the Reserve Bank of India stressed the need for cohesive coordination and harmonisation in approaches to managing climate change risks. In February 2024, the RBI had issued draft guidelines on the Disclosure Framework for Managing Climate-Related Financial Risks. The governor had further indicated that guidance notes for climate scenario analysis for stress testing and finalised disclosure norms will be released for regulated entities. These two documents will enable banks to prioritise their climate action plan and encourage entities to promote environmentally sustainable finance projects.

Future Scope of the Study

Natural Language Processing (NLP), Machine Learning, and Artificial Intelligence (AI) can help extend this study. NLP can be used to access large unstructured reports, news articles, and research papers, and detect the trends, risks, and opportunities in green financing.

The appropriate use of ML algorithms may enhance the ESG rating methodologies by accommodating diverse datasets under each pillar of ESG, while improving the predictive power of models, helping in the decision-making of banks and investors. Incorporating these approaches would not only enhance the ESG evaluations but also provide real-time data-driven insights to researchers, investors, regulators, and policymakers, strengthening future academic and industry research.

References

Bandyopadhyay, A., and A. Kashyap. (2024). "Understanding the Effect of Climate Risk on Banking Business—A Panel Data Analysis of Indian Firms." *The Indian Economic Journal*, 9 September. doi.org/10.1177/00194662241265555

Biswas, A., A. Das, A.K. Tiwari, and A. Patro. (2025). "Do Environmental, Social, and Governance (ESG) Practices Help Mitigate Bank Default Risk?" *Journal of Environmental Management*, vol. 380, April. doi.org/10.1016/j.jenvman.2025.124762

Faiella, I., and L. Lavecchia. (2022). "The Carbon Content of Italian Loans." *Journal of Sustainable Finance & Investment*, vol. 12, no. 3, pp. 939–957. doi.org/10.1080/20430795.2020.1814076

Herwadkar, S.S., S. Dhingra, S. Goel, and R.A. Nair. (2025). "Are Greens Healthy for Banks' Balance Sheets?" *Economic and Political Weekly*, vol. 60, no. 12, pp. 61–68.

IMF. (2023). "A Framework for Climate Change Mitigation in India." WP/23/218, October.

Mahadevan, V., V. Srivastava, and S. Subramaniam. (2025). "Green Lending: A Route to Improve Loan Quality in Indian Banks." *Finance Research Letters*, vol. 75. doi.org/10.1016/j.frl.2025.106891

MNRE. (2024). "Renewable Energy Statistics 2023–24." Government of India.

MOSPI. (2024). "Energy Statistics India 2024." Government of India.

Unitus Capital. (2023). "The State of Climate Finance in India 2023." *Climake*.