Examining Climate Transition Risk for Power Companies: Evidence from India

Executive Summary

Authors: Abhinav Jindal, Gireesh Shrimali, Bertrand Gallice, Antonio Buller, Marcin Borsuk, Jakub Cervenka, Arnab Sarkar

Full paper available on SSRN: https://papers.ssrn.com/abstract=5125213

February 2025

Abstract

This study investigates the financial impact of climate transition risks for Indian power companies, using a forward-looking, microeconomic climate transition risk model. The analysis utilizes firm-level financial and environmental data, supported by widely used modelling scenarios such as GCAM and REMIND, across different NGFS pathways (B2DS and NZ2050) and shock years (2025 and 2030). Our analysis includes a comprehensive data set with 1,703 power companies across diverse technologies, including coal, gas, renewables, nuclear, hydro, and oil. Key findings include the following: First, substantial NPV losses for coal (85%-90%) and gas companies across all scenarios, particularly under delayed shock years, with GCAM models indicating higher losses than REMIND. Second, for renewable companies, consistent positive NPV gains (14%-30%), with GCAM reflecting higher variability and returns than REMIND. Third, the later the shock, the more intense the shock, in terms of gains for renewables or losses for coal and gas companies. Next, in-depth firm-Level Cash flow-at-Risk (CfaR) analysis for six leading and diverse Indian power firms reveals similar outcomes: Renewable-focused firms like Adani Green Energy and ReNew Power experience NPV gains under transition scenarios, while fossil heavy firms such as NTPC and Adani Power as well as mixed portfolio firms such as JSW Energy and Tata Power witness substantial decline in value. These findings emphasize the urgent need for proactive climate strategies, resilience building, and investment realignment in the Indian power sector to mitigate financial risks and leverage emerging opportunities. Finally, the study draws out significant implications for policy makers, investors, and companies seeking to mitigate climate financial risks and transition India to a low-carbon economy.

Acknowledgement

We would like to express our gratitude to Reserve Bank of India (RBI), Securities and Exchange Board of India (SEBI), Coalition for Disaster Resilient Infrastructure (CDRI) and NITI Aayog for their valuable feedback. This paper was developed as part of the 1in1000 Initiative, a joint research partnership between Theia Finance Labs and the University of Oxford Sustainable Finance Group.

The views expressed in this paper are solely the responsibility of the authors and do not necessarily reflect the opinions of the acknowledged individuals.

Executive summary

India, as one of the world's largest and fastest-growing economies, faces significant climate transition risks due to its heavy reliance on coal for power generation, which accounts for around 70% of its energy mix. As the country strives for Net Zero, coal-based power firms are increasingly vulnerable to rising carbon prices, potential regulatory changes, and stranded assets, which could lead to financial losses and higher operational costs. These risks extend to workers and communities dependent on the coal sector. Given India's unique exposure to transition risks and its critical role in global emissions reduction, this study aims to examine the financial impact of these risks on India's power companies, highlighting the potential challenges and opportunities.

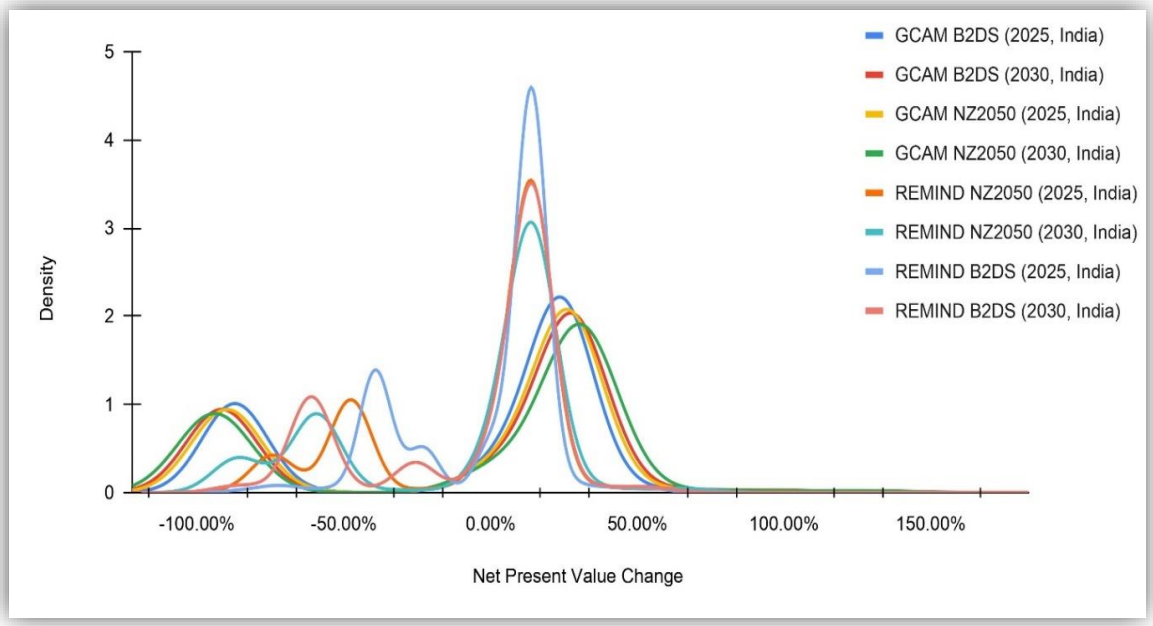
We examine the financial implications of climate transition risks on Indian power companies using a forward-looking, microeconomic climate transition risk model. We integrate firm-level financial and environmental data and employs modelling scenarios such as GCAM and REMIND across multiple NGFS pathways (B2DS and NZ2050) for shock years 2025 and 2030. We utilize an extensive dataset comprising 1,703 power companies across coal, gas, renewables, nuclear, hydro, and oil, to assess financial vulnerabilities and opportunities associated with India's energy transition.

The study reveals that coal and gas companies in India face substantial NPV losses (85%-90%) across all scenarios, particularly under delayed transition shocks, with GCAM models indicating greater losses than REMIND. In contrast, renewable companies show consistent NPV gains (14%-30%), with GCAM reflecting higher variability and returns. Firm-level analysis of six major power firms confirms these trends, with renewable-focused firms like Adani Green Energy and ReNew Power experiencing gains, while fossil-heavy firms such as NTPC and Adani Power, along with mixed portfolio firms like JSW Energy and Tata Power, facing significant value declines.

Key Findings

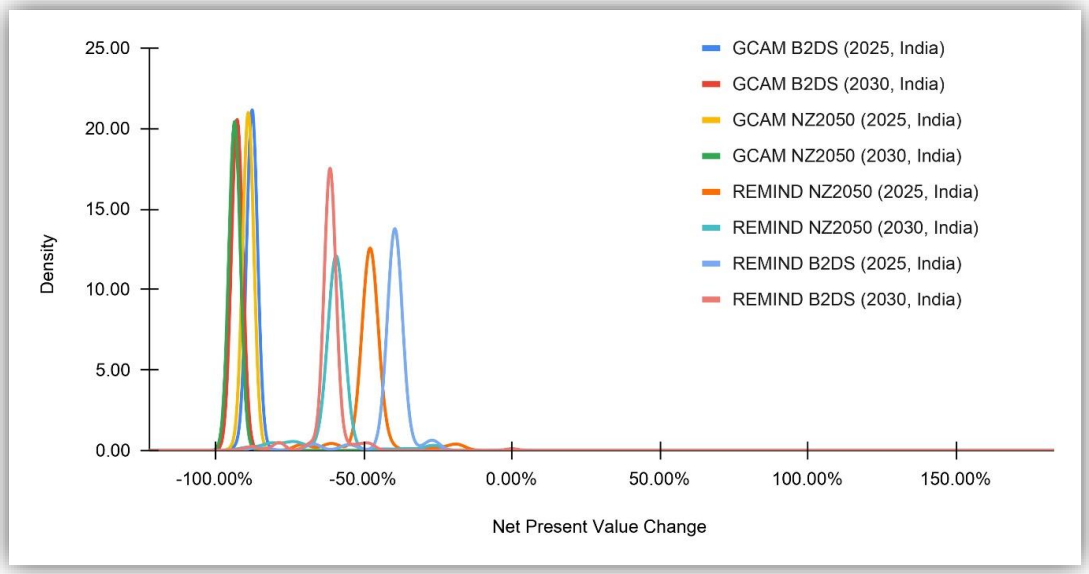
First, scenario model choice matters (Figure 1)**.** We find that the selection of the model choice significantly affects the results wherein GCAM impacts are more extreme than REMIND. We also find that the choice of shock year (2025 or 2030) and target year (NZ2050 versus B2DS) appears minimal at overall level.

Figure 1: Distribution of NPV change-all companies



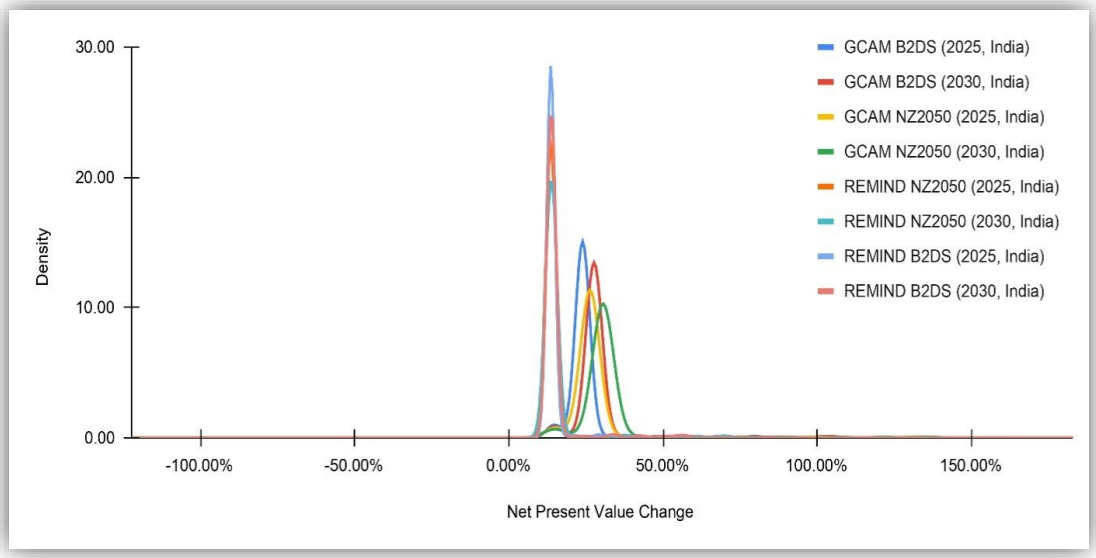
Second, fossil fuel companies face considerable financial risks (Figure 2). We find that coal firms experience NPV declines of 85%-90%, while gas firms see losses of 29%-75% across scenarios. We also find that delayed policy shocks worsen financial risks, with NPV losses increasing by 10%-15% when the shock year shifts from 2025 to 2030.

Figure 2: Distribution of NPV change-Coal Companies.



Third, renewable companies exhibit positive financial outcomes (Figure 3). We find that renewable firms realize NPV gains ranging from 14%-30%. The GCAM model predicts higher returns for renewables, with some firms experiencing up to a 35% increase in valuation. We also find that delayed shock years intensify financial gains, with renewable NPV increasing by 7%-12% in later scenarios.

Figure 3: Distribution of NPV change – Renewable Companies.



Fourth, firm-Level analysis validates sectoral trends (Table 1). We find that renewable-focused firms (Adani Green Energy, ReNew Power) show NPV growth between 30%-40%. Fossil-heavy firms (NTPC, Adani Power) and mixed-portfolio firms (JSW Energy, Tata Power) face NPV declines of 25%-40%. We also find that diversified firms mitigate risk but still face an average 15%-20% loss in valuation, emphasizing the need for adaptation strategies.

Table 1: Firm level analysis for leading Indian power firms: Cash flow at risk (CfaR).

Firm	Nature	Present capacity	Characteristics	CfaR (%)	Outlook
NTPC	Dominant coal capacity	74.64 GW (67.38 GW Thermal, 7.26 GW RE), generates 422 BUs annually	Largest power producer in India with the highest share of installed capacity and electricity generation.	33.9%	Long-term vulnerability due to coal reliance; needs aggressive renewable capacity growth.
Adani Power	Fossil fuel-based, primarily thermal power plants	15.25 GW (Thermal), generates 79 BUs annually	Largest private thermal power producer in India, with a substantial market share in coal-based generation.	39.0%	High-risk exposure under ambition scenarios due to limited diversification into renewables.

JSW Energy	Mixed portfolio of fossil fuel and renewable capacity	7.24 GW (3.5 GW Thermal, 3.73 GW RE), generates 27.9 BUs annually	Balanced portfolio with ongoing diversification, among top private players transitioning to renewables.	23.2%	Moderate risk; resilience increases with accelerated renewable investments.
Tata Power	Mixed portfolio with ambitious renewable targets	14.22 GW (8.81 GW Thermal, 5.41 GW RE), generates 64.6 BUs annually	One of the largest integrated power companies with significant renewable capacity expansion goals.	35.0%	Transition-ready with ongoing renewable investments; moderate risk from legacy thermal.
ReNew Power	Fully renewable portfolio	9.5 GW (Renewables), generates 19.5 BUs annually	Second-largest renewable energy company in India, leading in solar and wind generation.	-36.8%	Strong financial positioning; benefits from a renewable-focused strategy.
Adani Green Energy	Fully renewable portfolio	10.93 GW (Renewables), generates 21 BUs annually	Largest renewable energy developer in India, with aggressive capacity expansion plans to reach 50 GW by 2030.	-30.4%	Financially resilient under the ambition scenario due to a focused renewable strategy.

Note: + CfaR implies financial loss, - CfaR implies financial gain.

Finally, financial impacts vary by sector. We find that hydropower firms maintain financial stability, with NPV shifts of less than 1%. We also find that nuclear firms experience mixed outcomes, with losses ranging from 10%-20% under aggressive decarbonization policies; whereas oil-based power firms see steep declines, with NPV reductions of 50%-65%, signalling systemic risks.

Implications

For Power Companies: Coal-dependent firms must accelerate their transition to renewables to avoid financial losses. Gas firms should invest in alternative energy sources to offset estimated decline in valuations. Renewable energy firms should expand capacity to capture new market opportunities.

For Investors: Investors should reduce exposure to coal firms, which face declining NPVs, and increase stakes in renewables with expected double-digit growth. Financial institutions should integrate climate risk models to account for potential losses across fossil fuel sectors. Renewable investments offer an average return boost of 15%-20%, making them attractive for long-term portfolios.

For Policymakers: Immediate action is required to prevent stranded assets across coal and gas. Strengthening renewable incentives can facilitate market expansion.

The Smith School of Enterprise and the Environment (SSEE)

SSEE was established with a benefaction by the Smith family in 2008 to tackle major environmental challenges by bringing public and private enterprise together with the University of Oxford's world-leading teaching and research.

Research at the Smith School shapes business practices, government policy and strategies to achieve net zero emissions and sustainable development. We offer innovative evidence-based solutions to the environmental challenges facing humanity over the coming decades. We apply expertise in economics, finance, business, and law to tackle environmental and social challenges in six areas: water, climate, energy, biodiversity, food, and the circular economy.

SSEE has several significant external research partnerships and Business Fellows, bringing experts from industry, consulting firms, and related enterprises who seek to address major environmental challenges to the University of Oxford. We offer a variety of open enrolment and custom Executive Education programmes that cater to participants from all over the world. We also provide independent research and advice on environmental strategy, corporate governance, public policy, and long-term innovation.

For more information on SSEE please visit: www.smithschool.ox.ac.uk

Oxford Sustainable Finance Group

Oxford Sustainable Finance Group are a world-leading, multi-disciplinary centre for research and teaching in sustainable finance. We are uniquely placed by virtue of our scale, scope, networks, and leadership to understand the key challenges and opportunities in different contexts, and to work with partners to ambitiously shape the future of sustainable finance.

Aligning finance with sustainability to tackle global environmental and social challenges.

Both financial institutions and the broader financial system must manage the risks and capture the opportunities of the transition to global environmental sustainability. The University of Oxford has world leading researchers and research capabilities relevant to understanding these challenges and opportunities.

Established in 2012, the Oxford Sustainable Finance Group is the focal point for these activities.

The Group is multi-disciplinary and works globally across asset classes, finance professions, and with different parts of the financial system. We are the largest such centre globally and are working to be the world's best place for research and teaching on
sustainable finance and investment. The Oxford Sustainable Finance Group is part of the Smith School of Enterprise and the Environment at the University of Oxford.

For more information please visit: sustainablefinance.ox.ac.uk/group