



India’s Green Energy Transition: Opportunities & Challenges

What it is

Our Asia Pacific (APAC) based Sustainable Investing and Stewardship analysts discuss the current state of energy transition and the critical roles policy and investment in renewable energy are playing in India.

Why it matters

As India’s economy grows and energy sector modernizes, risks and opportunities must be navigated by investors.

Where it’s going

The next decade will be critical to the development of a robust renewable energy and grid infrastructure if India intends to meet a stated goal of net zero by 2070.

India is undergoing one of the world’s largest and most consequential energy transitions.¹ As the country balances rapid economic growth with its commitment to Net Zero by 2070, India’s government is developing a policy framework to drive a transition to renewable sources — intended to benefit from clean power’s cost efficiencies. Solar and wind energy are currently cheaper than fossil fuel power generation;² and the levelized costs of energy from renewable sources are expected to fall another 2–11% globally.³

This paper aims to provide institutional investors with a comprehensive overview of India’s green energy transition. We analyze the evolving policy landscape, investment opportunities, and the challenges companies face as India pursues its Net Zero target by 2070 and key insights from our stewardship engagements across Indian companies.

While the shift towards renewable is an opportunity for Indian companies to capitalize on these cost efficiencies, it also comes with risks. We recently visited a handful of these companies and have the following important takeaways:

- Indian companies are subject to average- to high climate transition risks. This poses risks due to future demand destruction in fossil fuel based energy as well as opportunities for leading companies to invest in new technology and infrastructure in this evolving space.

¹ Source: Reuters, India hits 50% non-fossil power milestone ahead of 2030 clean energy target.

² India cost per megawatt (MWh) in US\$ (nominal) by source: Natural Gas \$61; Coal \$102; Solar \$28; Onshore wind \$46; Battery Storage \$179. Source: Vasdev, A. (2025). Levelized Cost of Electricity Update 2025. BloombergNEF. As of February 6, 2025.

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³ Source: BloombergNEF. “Global Cost of Renewables to Continue Falling in 2025 as China Extends Manufacturing Lead,” *BloombergNEF Blog*, February 6, 2025.

- We expect a significant uplift in domestic renewable energy development and generation in India over the next decade, leading to potential opportunities for investors.
- A pragmatic and tailored approach to integrate climate considerations (managing risks and capturing opportunities) in portfolios is essential for institutional investors seeking to balance resilience with growth.
- Stewardship plays a key role in improving transparency as well as holistically understanding the set of challenges Indian companies are navigating to develop and bring renewables on line.

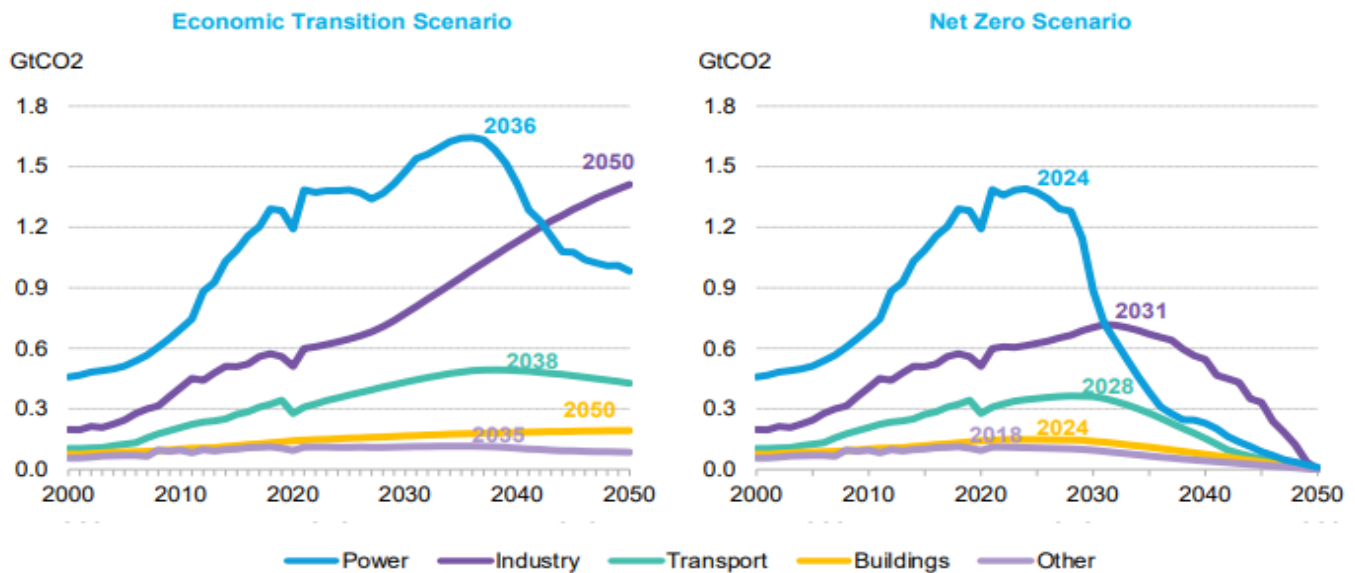
India's Energy Landscape: Drivers and Barriers to Green Transformation

India is now the world's most populous country and the third-largest emitter of CO₂ and contributing 10% to global gross domestic product (GDP),⁴ while maintaining per-capita emissions significantly below the global average.⁵ However, India's rapid development is quickly turning the subcontinent into one of the world's largest emitters, driven by rapid increases in fossil fuel consumption. As seen in **Exhibit 1 (left)**, the majority of this consumption is driven by growing demand for power generation.

India's current emissions trajectories present material economic risk. Without decisive action, India stands to lose nearly a quarter of its GDP by 2070 under current climate pathways.⁶ In order to meet the national net zero goal, fossil fuel emissions must peak in the next decade, and rapidly taper off, also seen in **Exhibit 1 (right)**.

Exhibit 1: India's Growing Power Demand

Emissions by sector and peak year in Energy Transition (left) and Net Zero (right) Scenarios



Source: BloombergNEF. As of August 2023. Note: Labels show year of peak emissions. 'Other' includes agriculture, forestry, fishing, energy industry own energy consumption, and other final energy consumption no further specified.

To mitigate this, India is exploring a host of policies, ranging from carbon markets (both voluntary and compliance based) to renewable subsidies to a National Green Hydrogen Mission. These policies are fostering capital deployment into key markets to support technology upgrades as well as basic infrastructure to deliver new energy to the grid via the Green Grids Initiative (also known as: One Sun, One World, One Grid). India is also investing in onshoring critical industrial processes, such as photovoltaic (read: solar) panel and long duration storage (read: battery) production, that will cut down import dependencies. We believe these policies are even more important as geopolitical tensions and

⁴ Source: World Economic Research, London. As of November 2024.

⁵ Source: Friedlingstein, P. et al. (2024). Global Carbon Budget 2024. *Earth System Science Data*. March 14, 2025.

⁶ Source: Asia-Pacific Climate Report 2024: Catalyzing Finance and Policy Solutions. Asian Development Bank: Manila. October 2024.

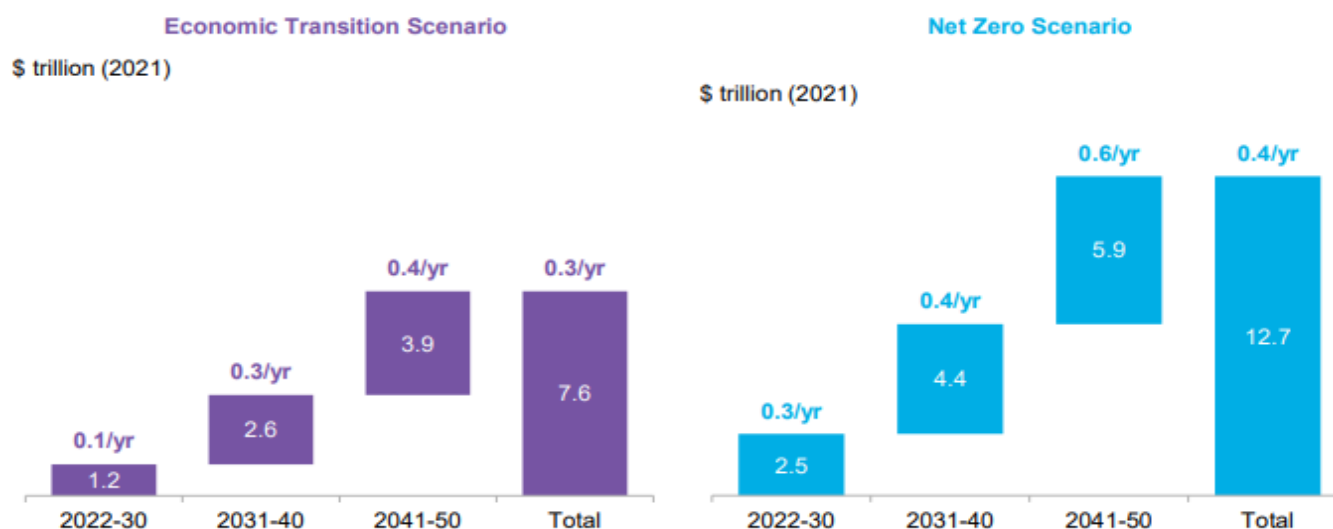
tariffs continue to threaten the global supply chain.

Driving these innovations will require vast amounts of capital, with estimates ranging from US\$7.6 trillion to US\$12.7 trillion, as seen in **Exhibit 2**. To hit targets, India must increase renewable energy capacity by 20X, while also doubling the size of the country's transmission grid to deliver new energy to the market.⁷ These two critical areas combined require nearly \$US6 trillion of the required capital.⁸

Despite record setting investments the last few years in Indian renewables, and energy generation and delivery in general, a significant investment gap still exists between the amount required to achieve net zero and what is available from traditional investment sources. In 2021, the Indian government estimated the investment gap over the next five decades to be around US\$3.5 trillion — requiring around US\$8 billion additional investment over the next decade, and peaking at over US\$40 billion in the decade leading up to 2070.⁹ Bridging the gap will require capital investment in both equity and fixed income markets. We also believe there will be ample opportunities for institutional investors in the private equity and private infrastructure space to invest in India's renewable energy development due to the potential of producing income while hitting decarbonization targets in a large market with high liquidity and low risk due to renewable's sector maturity.

Exhibit 2: Significant Transition Capital Required

Investment Required in India's Energy Supply and Demand based on Energy Transition and Net Zero Scenarios (US\$ trillions)



Source: BloombergNEF. As of August 2023. Note: The numbers inside the bars show the annual investment in each decade and the ones above indicate average annual investment.

⁷ Source: Hostert, D. et. al. (2024). New Energy Outlook India. *BloombergNEF*. As of September 2024.

⁸ *ibid.*

⁹ Source: Singh, V., and G. Sidhu. (2021). *Investment Sizing India's 2070 Net-Zero Target*. New Delhi: Council on Energy, Environment and Water—Center For Energy Finance. November 2021.

India's Renewable Targets

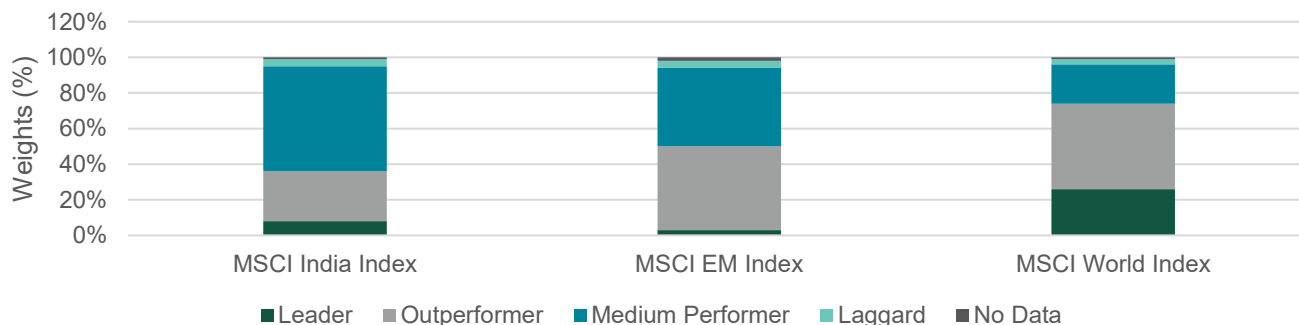
India has set a near-term target of 500 GW of non-fossil fuel capacity by 2030. In early 2025, the country reached a major milestone: **50% of installed electricity capacity now comes from non-fossil sources**, achieving a Paris Agreement target five years ahead of schedule. Government renewable energy subsidies are playing a key role in meeting targets, including ₹14,843 crore¹⁰ (US\$1.8 billion) in 2023.¹¹ By the end of 2024, India had issued US\$55.9 billion in green, social, sustainability, and sustainability-linked (GSS+) debt — a 186% rise since 2021. Green debt leads the way, making up 83% of the total, with most funds going into clean energy and transport.¹² We expect this market to grow and play an important role in fueling India's renewable energy growth. We believe this is all positive momentum and needs to continue to meet India's Net Zero 2070 target. It is important to note that clean energy subsidies account for less than 10% of India's total energy subsidies in 2023, with the lion's share (over 40%) going to fossil fuels. These numbers must switch for India to fulfill the Net Zero 2070 target, potentially providing more opportunities in the renewable space for investors in coming years. Additionally, to complement intermittent renewable sources such as solar and wind, the Indian government plans to expand nuclear capacity from 8 GW to 22 GW by 2031–32, with a longer-term target of 100 GW by 2047. In late 2025, the government enacted the Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India (SHANTI) Act—an important reform that opens the nuclear power sector to private players and foreign investors.

Corporate Readiness: Navigating Climate Risks and Opportunities in India's Transition

Climate transition poses risks but also provides opportunities for Indian companies to remain competitive in the global market. Indian companies are highly exposed to climate-related transition risks compared to developed market (DM) companies. To illustrate this point, we analyzed MSCI India Index, MSCI Emerging Market (EM) Index and MSCI World Index companies using the ISS Carbon Risk Rating (CRR) as a reference, the results are shown in **Exhibit 3**. More than 60% of the companies in the MSCI India Index are rated as “laggard” or “medium performer” compared to 48% of MSCI EM Index and only 25% of MSCI World Index universe, indicating Indian companies' lack of preparedness and exposure to higher transition risks in future. These could impact companies due to increased operational and/or capital cost from carbon pricing, stranded assets risk due to shifting regulations, and reduced demand for carbon intensive products and services.

Exhibit 3: Risk Scoring India's Companies Versus Other Markets

Comparing ISS CRR Ratings Distribution Across MSCI India Index vs. MSCI EM Index vs. MSCI World Index



Source: NTAM, ISS. All index holdings and data as of September 30, 2025. Note: ISS CRR ratings is a quantitative forward-looking assessment of the climate-related risk of companies' and measure to what extent a company is able to mitigate transition risks based on its specific baseline carbon risk exposure. Companies are scored on a 0–100 scale where higher the score the better and classified into four groups: Laggard, Medium Performer, Outperformer and Leader.

¹⁰ Core denotes 10 million. Therefore, ₹1 crore is equivalent to ₹10 million.

¹¹ Source: Raizada, S., Sharma, D., Laan, T., and S. Jain. (2024). Mapping India's Energy Policy 2023: A decade in action. The International Institute for Sustainable Development.

¹² Source: Climate Bonds Initiative. India Sustainable Debt State of the Market Report 2024. June 26, 2025.

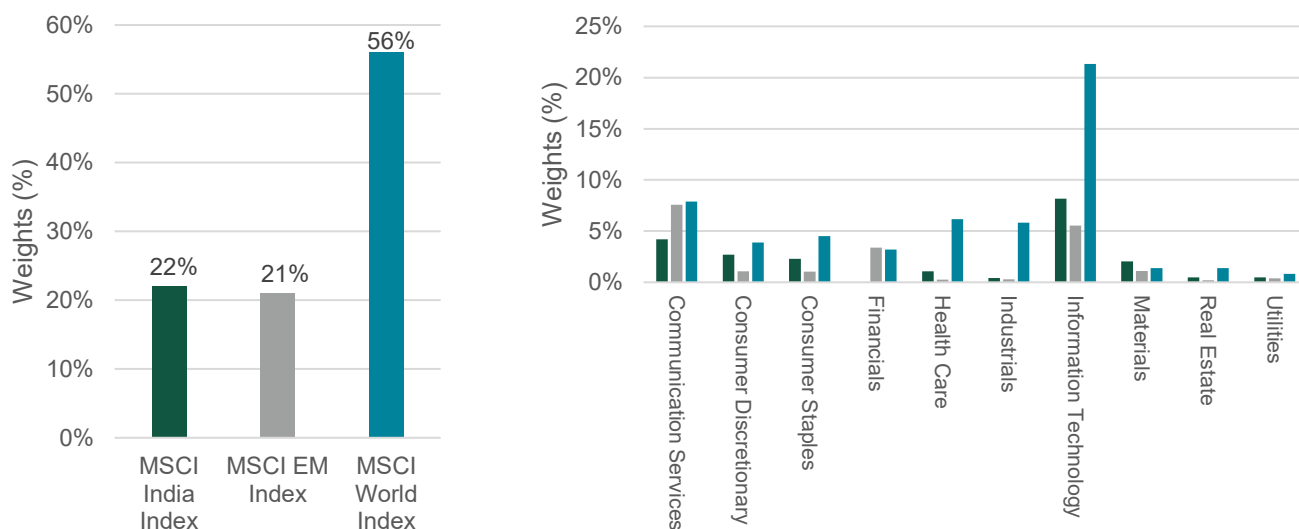
For India to achieve its Net Zero goal, companies would need to take action and set carbon emissions reduction goals covering **Scope 1 (direct), Scope 2 (purchased energy), and material Scope 3 (value chain)** emissions to keep global temperature rise well below 2°C. We observed limited early adoption for this call to action as MSCI India Index companies are currently behind DMs, as measured by the MSCI World Index, but slightly ahead of MSCI EM Index companies on commitments to Science Based Targets (SBTi) as shown in **Exhibit 4 (left)**.

Looking at the SBTi targets by sector (**Exhibit 4 (right)**) provides interesting insights:

- High-carbon intensive sectors (e.g., materials, industrials, utilities, etc.) SBTi commitments of Indian companies are not far off in comparison to EMs and DMs with Indian companies leading marginally in the materials sector.
- Information Technology sector companies in the MSCI World Index have much higher SBTi commitments (more than 20% by market value) compared to MSCI EM Index and MSCI India Index.

Exhibit 4: India's Net Zero Goals Hinge On Targets

Comparing the MSCI India Index vs. MSCI EM Index vs. MSCI World Index in setting SBTi Targets (left) and SBTi Targets by Sector (right)



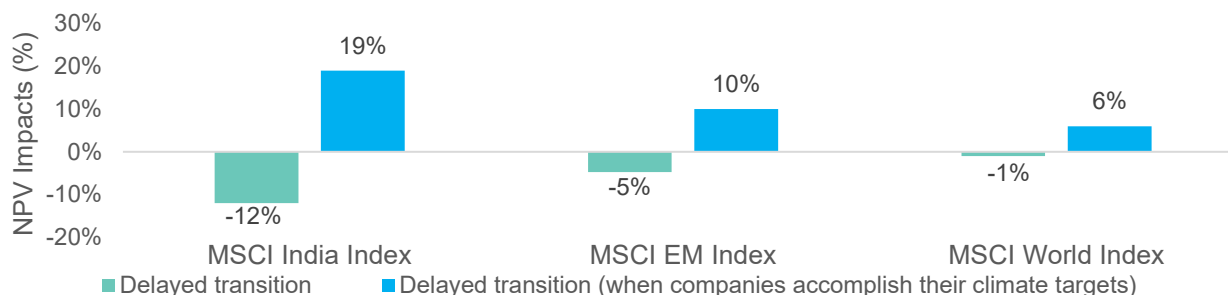
Source: NTAM, MSCI. All index holdings and data as of September 30, 2025.

If Indian companies delay or fail to transition, the impacts for investors could be devastating. Negative impacts could come in various forms, including but not limited to: increasing vulnerability to regulatory changes in form of direct carbon taxes; demand destruction and stranded asset risks due to shift in consumer preferences for clean energy; and reputational impacts. Again, comparing India based companies to other EM and DM companies, we analyzed the forward-looking impacts of climate change as measured by Net Present Value (NPV) under the Delayed Transition scenario of the Network for Greening the Financial System (NGFS) scenarios.¹³ Our analysis (see **Exhibit 5**) shows materially higher downside risk for Indian companies relative to global peers. However, companies that set and meet credible climate targets show meaningful value resilience, reinforcing the importance of transition preparedness.

¹³ The NGFS is a consortium of central banks and financial supervisors aiming to enhance climate risk management in the financial sector and support mobilization of capital for the green transition. There are seven NGFS scenarios, falling into four quadrants: Hot House World, which includes the Current Policies scenario; Disorderly, which includes Delayed Transition; Orderly, which includes Net Zero 2050; and Too Little Too Late.

Exhibit 5: Impacts to NPV

NPV Change relative to the benchmark % under Delayed Transition scenario



Source: NTAM, Planetrics. All index holdings as of September 30, 2025. Delayed Transition assumes global annual emissions do not decrease until 2030 followed by a late but accelerated policy response. Carbon emissions follow a slower trajectory, reaching net zero later than 2050 and hence, more closely aligns with the India's Net Zero 2070 target.

Hence, India meeting its Net Zero 2070 targets requires accelerated efforts and investments in green energy transition. We believe these opportunities will be primarily in solar and wind energy development, both of which require multifold increases to meet growing energy demand. Even under the Delayed Transition scenario, solar generation must increase roughly 2.5X and wind (offshore and onshore combined) must increase 2X over the next 25 years.¹⁴ This increase is backed by policy under the Renewable Purchase Obligation (RPO), which requires electricity distribution companies (DISCOMs) in every state to purchase 43.3% of their electricity from renewable sources by 2030.¹⁵ The massive push toward sustainable projects reflects India's commitment to achieving its ambitious climate goals while fostering economic growth.

To capitalize on this opportunity, a pragmatic approach is essential for institutional investors pursuing decarbonization targets to balance resilience with growth, reassess targets and sustainability metrics regularly in their portfolios. Investors should tailor risk mitigation and opportunity capture to the specific characteristics of asset classes, sectors, and geographies. It is critical for investors to enable capital allocation toward companies demonstrating strong transition readiness while managing exposure to laggards. This nuanced methodology not only reduces exposure to transition risks but also positions portfolios to benefit from structural shifts toward low-carbon technologies and sustainable business models. By integrating flexibility and forward-looking analysis, investors can transform climate challenges into sources of long-term value creation. For a deeper discussion of the impact of backward- and forward-looking climate metrics and evolving impact of ESG Ratings on portfolio outcomes, see our recent publications Carbon Misconceptions¹⁶ and Evolving Impact of ESG Ratings on Portfolio Outcomes.¹⁷

Stewardship Insights: Four themes shaping India's Energy Transition

Our India-focused stewardship engagements over the past two years span companies across power generation, manufacturing, materials, consumer, IT, industrials, government-owned power producers and grid operators to assess how companies are integrating climate change risks and opportunities in their business strategy. In our engagements, we recommend companies be transparent in their climate change strategies, decarbonization targets and capital expenditures while also seizing market opportunities in the green economy.

¹⁴ Source: NGFS Technical documentation using NGFS V5 Remind.

¹⁵ Source: Invest India. "The Green Push: How Foreign Investors Can Contribute to India's Sustainability Goals," *Invest India Blog*, October 25, 2024. Note: This target is based on a further target of 50% of energy purchase by 2030 must derive from non-fossil fuels.

¹⁶ Source: Zymali, P., Dhall, A., Vidojevic, M., and J. Eisenhardt. Carbon Misconceptions: Clarifying the Impact of a Net Zero Commitment on Equity Portfolios. *The Journal of Impact and ESG Investing* v6(2) Winter 2025. October 15, 2025. Also available [here](#).

¹⁷ Source: Chourasia, K., Rumynin, I., Van Vliet, B., and M. Vidojevic. The Evolving Impact of ESG Ratings on Portfolio Outcomes. November 2025. Available [here](#).

Our observations indicate that coal-based thermal energy is likely to remain a dominant source due to energy security, affordability, and the need for consistent round-the-clock reliable power. Nonetheless, many companies are actively investing in manufacturing infrastructure to support renewable energy ecosystems, encompassing solar and wind power, green hydrogen, electric vehicles (EVs), and battery energy storage systems (BESS). Below are the key findings from our recent engagements:

- **Industries seek reliable and affordable renewable energy supply:** High energy usage sectors such as IT and automobiles are pursuing renewable energy through PPAs, captive solar/wind, and electrification, but progress varies. During engagements, we encourage companies to set up near-, medium-, and long-term targets to reduce their Scope 2 emission by shifting to renewable energy. Some of our portfolio companies like HCL Technologies, Vedanta Limited, Hindustan Unilever, Mahindra and Mahindra are advancing aggressively, while hard-to-abate sectors such as steel and cement lag due to infrastructure and cost challenges. For steel manufacturing, integrating green hydrogen and shifting to Electric Arc Furnace (EAF) technology is critical but requires significant investment and reliable renewable energy.¹⁸ Large-scale projects by NTPC and Reliance Industries will be key to expanding renewable capacity and enabling green hydrogen for industrial decarbonization.
- **Multifold demand for energy storage, specifically battery storage:** Our engagements show optimism around government incentives for energy storage, with power producers integrating BESS to meet peak demand and stabilize grids. Companies like Reliance Industries, Exide, and Tata Group are investing in large-scale storage, local manufacturing, and R&D, while addressing risks from raw material dependency and evolving battery technologies. In the near-term, we are engaging on strategies for securing critical minerals and managing technology shifts; in the medium-term, we will monitor progress toward self-reliance through local production, recycling, and innovation.
- **Balancing solar module supply and demand:** Policy measures are boosting solar module manufacturing, but oversupply risks could trigger price cuts and losses.¹⁹ Project delays and domestic absorption challenges may lead to market consolidation as smaller players struggle. In the near-term, we are monitoring developments and assessing portfolio companies' plans and production strategies to mitigate the risk of potential price wars driven by oversupply risks. Medium-term, we are watching for regulatory and policy actions required to expedite installation which will be critical for companies to plan operational and capital expenditures.
- **Backward integration in solar value chain:** Starting June 2026, Indian solar projects must use domestically manufactured cells, prompting companies like Reliance Industries, Tata Power, and Waaree to invest in backward integration and explore wafer and ingot production — areas still dominated by China.²⁰ Similar to battery technology, rapid advancements in solar technologies also pose a significant risk, as investments in current technologies may become obsolete if newer, more efficient solutions gain market traction. Near-term, we are maintaining active engagement with these companies to monitor their capital expenditure plans for backward integration projects and assess how they are aligning with evolving technology trends. Medium-term, we will observe how companies tackle challenges related to import dependency, availability of local machinery and components, and volatile raw material prices.

In all four areas, we expect our portfolio companies to focus on projects with clear return visibility, as delays caused by existing bottlenecks can result in investment losses. While significant capital directed toward green energy

¹⁸ Note: EAFs can reduce emissions by up to 86%. Source: Global Energy Monitor. Global Iron and Steel Tracker: Electric arc furnaces and the decarbonization of steel. As of December 2025.

¹⁹ Source: Mathur, A. "Parliamentary panel recommends measures to accelerate solar project development in India," *The Times of India*, December 10, 2025.

²⁰ Note: China manufactures 97% of the global supply of silicon wafers used in PV cells. The EU has deemed it the most difficult and vulnerable stage in the PV supply chain to reshore. Source: European Solar PV Industry Alliance. Current state of the EU photovoltaic industry: An in-depth look at the ingot-wafer supply chain. Brussels, August 4, 2024.

projects, overall success remains heavily dependent on government policies and regulatory frameworks that foster a healthy ecosystem and address ongoing challenges. These include continuous infrastructure upgrades such as grid integration, development of transmission lines to connect generation assets to the grid, resolution of land acquisition issues, and ensuring the financial stability of electricity distribution companies. Furthermore, we expect our portfolio companies to maintain transparency regarding project challenges and bottlenecks, including any anticipated delays in commissioning.

Conclusion

India's green energy transition is accelerating at a scale and pace that positions the country as one of the most consequential renewable energy markets globally. This is best illustrated by Indian renewables attracting ₹315 billion (US\$3.7 billion) of foreign direct investment (FDI) in 2024, a 50% year-over-year increase.²¹ Yet, the path to Net Zero 2070 remains inherently complex. As this paper outlines, India must simultaneously meet surging energy demand, modernize its infrastructure, and strategically shift away from fossil-fuel dependence — all while navigating transition risks that are among the highest across major economies.

Two key takeaways for asset owners:

1. The opportunity set is significant. Deep structural shifts — spanning grid expansion, renewable deployment, electrification, energy storage, and new industrial processes — create avenues for both public and private market investment. However, realizing this opportunity requires a pragmatic, forward-looking approach to risk management. By integrating climate risk metrics into stock selection, investors can identify companies with credible transition readiness and allocate capital more effectively, strengthening portfolio resilience as transition risks intensify.
2. Our stewardship engagements reaffirm that companies across sectors are increasingly integrating decarbonization into long-term strategy, investing in solar and wind capacity, storage technologies, green hydrogen, and supply-chain localization. These developments underscore India's potential to become a global leader in clean-energy manufacturing and innovation. Further, this signals a long-term structural shift where companies that embrace innovation and sustainability will likely outperform peers in both financial and reputational terms.

At Northern Trust Asset Management we help investors implement sustainability strategies that remain effective, risk-aware, and adaptable as the landscape evolves.

²¹ Source: Joshi, A. "FDI in India's Renewable Sector Up 50% YOY to \$3.7 billion in FY 2024," *Mercom*, August 20, 2024.

IMPORTANT INFORMATION

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