E-ISSN: 2664-603X
P-ISSN: 2664-6021
Impact Factor (RJIF): 5.92
IJPSG 2026; 8(1): 40-48
www.journalofpoliticalscience.com
Received: 12-09-2025
Accepted: 14-10-2025

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Recalibrating the Global 1.5 °C Pathway: India's Leadership and Opportunity Toward 2035

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DOI: https://doi.org/10.33545/26646021.2026.v8.i1a.831

Abstract
The 1.5 °C temperature threshold represents a critical limit for global climate stability, yet current trajectories remain misaligned with this goal. This study reassesses India's role in recalibrating the global 1.5 °C pathway, with a specific focus on the underexplored 2035 mid-term horizon. Using a mixed-method approach combining secondary data analysis, comparative policy review, and climate-finance assessment, the paper evaluates India's progress in renewable-energy expansion, emission-intensity reduction, and sectoral decarbonisation. The findings show that while global climate governance remains off-track due to rising emissions and delayed commitments, India demonstrates emerging alignment through rapid renewable growth, indigenous mitigation initiatives, and equity-driven climate diplomacy. However, structural inertia, continued fossil-fuel dependence, and governance fragmentation constrain full 1.5 °C compatibility. The study identifies 2035 as a decisive window for accelerated coal phase-out, grid and storage integration, and strengthened climate-finance mechanisms. It concludes that with enhanced policy coherence, institutional coordination, and South-South cooperation, India can transition from an emerging climate actor to a global climate leader.

Keywords: India 2035, Paris Agreement, Net Zero, Renewable Energy, Asia-Pacific, Climate Finance, Equity

Introduction
Nearly a decade after the landmark Paris Agreement (2015), the global community finds itself at a critical juncture in climate governance. Despite the establishment of robust multilateral frameworks, global greenhouse-gas (GHG) emissions continue to rise at an alarming rate. The Intergovernmental Panel on Climate Change (IPCC, 2023) cautions that the remaining global carbon budget consistent with a 1.5 °C temperature threshold may be exhausted before 2030 unless emissions decline by at least 45 % below 2010 levels (Jiang *et al*., 2025) [11]. The United Nations Environment Programme (UNEP, 2025) reports that current policy pledges place the world on a warming trajectory of approximately 2.6-2.8 °C by the end of the century (UNEP, 2025; Bhardwaj, 2025) [2]. This widening emissions gap underscores a profound mismatch between scientific urgency and political action. The persistence of fossil-fuel subsidies, slow renewable transitions, and fragmented carbon-markets reflect entrenched structural inertia (Yadav, 2023) [29]. Consequently, the 2030s will represent a decisive decade in which the success or failure of climate stabilization will hinge on emerging economies—particularly India, China and Indonesia—whose development trajectories will largely determine global emission outcomes. Developing economies, however, face the dual imperative of sustaining economic growth and alleviating poverty while simultaneously undertaking deep decarbonisation. India embodies this paradox with unique complexity. Home to 1.4 billion people, India's developmental aspirations remain intertwined with energy demand growth, industrialisation, and infrastructure expansion. Yet it also illustrates the possibility that development and decarbonisation are not mutually exclusive but can proceed concurrently when guided by coherent policy, technological innovation, and equitable finance (Kaur, 2025) [15]. India's progress offers a compelling case of climate-leadership rooted in both pragmatism and principle. As of 2025, India's installed renewable-energy capacity exceeded approximately 210 GW, positioning it among the largest renewable-energy producers globally (Prajapati, 2025) [19]. Still, fossil-fuels continue to supply roughly 68 % of India's primary energy (Singh, 2025) [21]. This duality

highlights the country's unique development-climate nexus. The 2035 timeline thus assumes strategic significance: it becomes a juncture for India that aligns its high-growth development agenda with deep decarbonisation and enables it to transition from follower to potential global climate leader. Moreover, the Asia-Pacific region accounts for over 60 % of global GHG emissions (UN ESCAP, 2024), meaning India's actions have regional spill-over effects across trade, technology-transfer and energy diplomacy. India's active engagement in initiatives such as the International Solar Alliance (ISA) and the Coalition for Disaster Resilient Infrastructure (CDRI) underscores its commitment to both multilateralism and moral leadership (Kaur, 2025) [15]. In this context, the 2035 milestone emerges as both an immense challenge and an unparalleled opportunity for India. Its policy coherence, financial architecture, and technological innovation during this period will determine not only the country's trajectory but also its capacity to contribute meaningfully to the global 1.5 °C objective. Accordingly, this paper seeks to reassess India's trajectory toward 2035 through a comparative and data-driven analysis of national and regional trends. It examines how India's evolving policy frameworks, institutional structures and renewable-expansion strategies can help recalibrate the global 1.5 °C pathway—so that climate action becomes a developmental opportunity rather than simply a compliance obligation.

A review of recent literature and global assessments (IPCC, 2023; UNEP, 2025; IEA, 2025) reveals several unresolved gaps in the understanding of decarbonisation pathways, particularly concerning India's leadership potential toward 2035. While the global discourse on emission reduction, renewable energy, and carbon markets has expanded substantially, critical deficiencies remain at both conceptual and empirical levels. At the global scale, the first major gap concerns the inadequate focus on the 2035 mid-term horizon. Most modelling frameworks, including those used in integrated assessment models, emphasize 2030 or 2050 milestones, leaving the intervening decade underexplored (Höhne *et al*., 2024; Jiang *et al*., 2025) [11]. Consequently, there is limited understanding of whether the current momentum from existing Nationally Determined Contributions (NDCs) can be sustained through 2035. Secondly, despite the International Energy Agency's (2025) documentation of more than USD 1.2 trillion in fossil-fuel subsidies, few empirical analyses incorporate such subsidies as a feedback factor influencing emission intensity and renewable energy competitiveness. This omission underrepresents the policy-induced inertia embedded in energy systems. A third global research gap lies in the insufficient integration of ethical and equity dimensions into mitigation frameworks. As noted by Kaur (2025) [15], the overwhelming emphasis on technological interventions often neglects distributive justice and responsibility-sharing—factors essential for developing economies that face disproportionate climate impacts.

At the regional level, particularly within the Asia-Pacific (APAC) context, three key gaps are discernible. First, comparative climate studies lack standardized sectoral benchmarks that could facilitate cross-national assessments of decarbonisation progress among major emitters like India, China, and Indonesia, and smaller economies such as Vietnam and Thailand (UN ESCAP, 2024). Second, while just-transition principles have been introduced in recent NDC frameworks (ADB, 2025), empirical research evaluating their operationalization in labor-intensive sectors such as coal mining, transport, and manufacturing remains scarce. This leaves the socioeconomic consequences of energy transitions underexplored. Third, there is limited examination of intra-regional cooperation mechanisms, such as South-South technology transfers, finance flows, and harmonized regulatory regimes (Bhardwaj, 2025) [2]. Such collaboration is vital for scaling up renewable deployment and building adaptive capacity, yet it remains poorly represented in existing analyses. At the national level, India's literature displays distinct data and policy gaps. One of the most significant is the absence of granular, sub-national emission data. Although national inventories are periodically updated, the lack of state- and district-level datasets constrains dynamic modelling and spatially disaggregated policy design (Singh & Ghosh, 2025) [21]. Moreover, flagship initiatives—including the National Green Hydrogen Mission (2023), the FAME II mobility policy, and the Carbon Credit Trading Scheme (2024)—have not been comprehensively evaluated for their actual performance, cost-effectiveness, or governance efficiency. Existing studies tend to be descriptive rather than empirical or impact-oriented. Additionally, there is a disconnect between mitigation and adaptation policies; most Indian studies focus on emissions reduction, while overlooking the co-benefits and synergies between adaptation, health, agriculture, and water security (TERI, 2024). Another critical gap concerns climate finance and governance architecture. Although India has introduced sovereign green bonds and a domestic carbon market (MoEFCC, 2024), there is limited research on institutional capacity, fiscal accountability, and the role of sub-national finance mechanisms in accelerating the green transition (Yadav, 2023) [29].

Overall, these gaps underscore the urgent need for integrated, interdisciplinary, and India-centric analyses that connect global carbon-budget trajectories with national development imperatives. Future research must focus on the underexplored 2035 mid-term horizon, integrate sectoral and financial analyses with ethical and equity-based dimensions, and examine India's dual role as both a domestic reformer and a regional catalyst for the Asia-Pacific transition. By addressing these research voids, the present study aims to bridge empirical data with policy evaluation, thereby contributing a more coherent understanding of how India can recalibrate the global 1.5 °C pathway through innovation, cooperation, and ethical leadership.

Methodology

The present study employs a mixed-method comparative policy-analysis approach, integrating both quantitative and qualitative dimensions to capture the complex and multidimensional nature of climate policy and energy transition in India. The rationale for adopting this approach lies in the inherently interdisciplinary character of climate governance, which intertwines economic, technological, environmental, and ethical dimensions. A singular methodological lens would therefore be insufficient to evaluate India's evolving role in the global 1.5 °C pathway. The quantitative component of the research focuses on empirical data analysis derived from internationally recognized datasets and institutional reports, including the

Intergovernmental Panel on Climate Change (IPCC, 2023), the United Nations Environment Programme (UNEP, 2025), the International Renewable Energy Agency (IRENA, 2025), the International Energy Agency (IEA, 2025), and the World Bank (2025). These sources provide validated and comparable data on key performance indicators such as the share of renewable energy in the total power mix, greenhouse-gas (GHG) emission intensity, carbon sink capacity, and climate-finance inflows. By analyzing these indicators over time, the study evaluates the extent to which India's policy trajectory aligns with global mitigation benchmarks and how this trajectory compares to those of other Asia-Pacific economies. Quantitative data are analyzed using trend comparison and proportional change methods to assess the progress toward India's 2030 and projected 2035 climate goals.

Complementing the quantitative analysis, a qualitative content analysis was conducted to provide interpretive insights into the policy, institutional, and governance dimensions of India's climate strategy. This analysis involved a systematic review of primary and secondary documents, including official proceedings from COP28 and COP29, ministerial statements from the Ministry of Environment, Forest and Climate Change (MoEFCC), and a curated body of recent academic and policy literature. Using a thematic coding framework, the study identified recurring challenges and drivers within India's climate discourse—particularly in the domains of financial mechanisms, technology access, and institutional governance. Thematic clusters were constructed to capture patterns of policy evolution and the interplay between national objectives and global expectations. To ensure comprehensive evaluation, the study applies a comparative framework that situates India's progress within the broader Asia-Pacific context. This framework is structured around three analytical criteria: first, the degree of alignment of national policies with 1.5 °C-compatible pathways as outlined in IPCC scenario models; second, the temporal ambition reflected in the 2035 climate and energy targets, which serve as an intermediate milestone between the 2030 NDC commitments and the 2070 Net-Zero vision; and third, the sectoral inclusiveness of these commitments, covering energy, industry, agriculture, and transport. Comparative data for regional economies—such as China, Japan, Indonesia, Vietnam, and Thailand—were sourced primarily from Energy Tracker Asia (2025) and the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP, 2024).

Throughout the analytical process, triangulation was employed to enhance data reliability and validity. This involved cross-verification of quantitative indicators with qualitative findings and consistency checks across data sources. For example, renewable capacity data from IRENA were validated against national reports, while emission-intensity trends were compared with those cited in IPCC and IEA publications. The integration of multiple data streams mitigates biases inherent in any single dataset and ensures a holistic understanding of India's policy performance. This methodological design facilitates both macro-level comparison and micro-level policy interpretation. It allows the study to move beyond descriptive statistics and engage with structural, institutional, and ethical factors shaping India's climate transition. By blending numerical analysis with interpretive inquiry, the approach strengthens the empirical foundation of the findings while situating them within a broader narrative of global climate equity and sustainable development.

Results and Discussion

The Emissions Gap Report (2024) forecasts that, even if all current commitments are fulfilled, global temperatures are projected to rise by 2.6-2.8 °C by the year 2100. In 2024, global fossil-fuel subsidies reached an unprecedented USD 1 trillion (IEA, 2025),

Table 1: Global Climate and Energy Transition Indicators (2020-2025): Trends and Policy Implications

Indicator (2025)	Value	Trend vs 2020	Source
Global GHG Emissions	58.2 Gt CO_2e	↑ +7 %	UNEP (2025)
Fossil Fuel Subsidies	USD 1.2 trillion	↑ +20 %	IEA (2025)
Global Renewable Share in Power	31%	↑ +8 pp	IRENA (2025)
NDC Submission Rate (2035)	5 % on-time	↓ -90 %	UNFCCC Registry (2025)

The data indicate that global greenhouse-gas (GHG) emissions reached 58.2 Gt CO_2e in 2025, representing a 7 % increase relative to 2020 (UNEP, 2025). This reversal of prior reductions highlights that even as many nations profess deep decarbonisation ambitions, absolute emissions continue to climb—a phenomenon consistent with findings that global emissions from major sectors persist in rising despite policy efforts (Joint Research Centre, 2025). The implication is clear: incremental annual declines are insufficient, and the global mitigation architecture remains off-track. Simultaneously, fossil-fuel subsidies amounting to USD 1.2 trillion and rising by 20 % indicate that structural legacy incentives for high-carbon energy remain deeply embedded (IEA, 2025). The literature suggests that such policy-induced economic distortions significantly hamper transitions by reducing the relative competitiveness of low-carbon alternatives (Jiang *et al*., 2025) [11]. In effect, subsidy regimes continue to act as a countervailing force to climate goals.

On a more positive note, the global share of renewables in power supply has reached 31 %—an increase of 8 percentage points since 2020 (IRENA, 2025). This reflects substantial progress in deployment of wind, solar and other non-fossil sources. Yet the pace of change remains modest relative to the scale and urgency required. Research by Jiang *et al*. (2025) [11] notes that while carbon intensity globally has improved at about 3.1 % annually in the post-Paris era, much faster rates are required to remain within the 1.5 °C carbon budget. Finally, only 5 % of the 2035 Nationally Determined Contributions (NDCs) were submitted on-time, reflecting a drop of 90 % compared to prior cycles (UNFCCC Registry, 2025). This low submission rate underscores a wider governance and ambition gap: commitments and institutional follow-through are lagging, even as technical capabilities for largescale renewable deployment accumulate. Together, these indicators paint a sobering picture. While technical progress in renewables is evident, the simultaneous increases in absolute emissions

and fossil-fuel subsidies illustrate that systemic change remains elusive. The pace of intensity reduction (≈3 % annually) may imply significant improvements, but that rate still falls short of the roughly 4 %-5 % annual intensity decline scholars deem necessary for a pathway consistent with 1.5 °C (Jiang *et al*., 2025) [11]. Therefore, it becomes evident that without radical policy shifts in subsidy reform, accelerated renewable integration, and enhanced institutional commitment to NDCs, the trajectory remains misaligned with global climate targets.

Table 2: Asia-Pacific 2035 Targets and Alignment (ETA 2025)

Country	2035 Target Status	1.5 °C Alignment	Highlights
China	Emissions peak ~2025; -30 % by 2035	Partial	1,500 GW renewables; coal approvals continue
Japan	-60 % vs 2013	Below 1.5 °C	Ammonia co-firing; LNG dependence
Indonesia	Coal phase-out by 2040	Low	JETP finance underway
Philippines	-75 % conditional by 2030	Conditional alignment	Strong policy needs finance
India	Updated NDC pending	Emerging alignment	Fastest renewable growth in G-20

The data presented in Table 2 illustrate a differentiated yet interlinked picture of the Asia-Pacific region's decarbonisation trajectory toward 2035. China, which aims to peak its emissions by 2025 and reduce them by approximately 30 % by 2035, demonstrates a "partial" alignment with the 1.5 °C goal. Although China's renewable-energy capacity has surpassed 1,500 GW, continued coal approvals reflect a policy contradiction that undermines its long-term climate commitments. As Watanabe and Yadav (2025) [29] note, this persistent reliance on coal threatens to offset renewable gains, particularly as heavy-industry demand rebounds post-pandemic. Similarly, BloombergNEF (2024) emphasizes that China's strategy of balancing energy security with rapid decarbonisation represents both an opportunity and a challenge for maintaining regional leadership. Japan exhibits relatively stronger ambition, targeting a 60 % reduction from 2013 levels by 2035; however, its dependence on liquefied natural gas (LNG) and ammonia co-firing restricts full 1.5 °C alignment. Studies such as the Asia-Pacific Energy Outlook (2024) report that Japan's energy diversification policies remain constrained by slow electrification of transport and heavy industrial sectors. Energy Transition Readiness Assessment (2025) further argues that Japan's techno-centric transition model neglects deeper institutional reforms necessary for large-scale decarbonisation.

In Indonesia, the commitment to phase out coal by 2040 marks an important policy shift but still places the country in the "low alignment" category relative to 1.5 °C pathways. According to the Asian Development Bank (2025), coal dependency and limited institutional readiness continue to impede progress despite the ongoing Just Energy Transition Partnership (JETP). The ADB study further indicates that Indonesia's JETP finance arrangements have yet to catalyze a decisive reduction in coal reliance. The Philippines, with its -75 % conditional target by 2030, represents one of the region's most ambitious frameworks, yet its success hinges on international finance and technology transfer. The UN ESCAP (2024) assessment concludes that although policy ambition is high, the implementation capacity remains fragile, with adaptation financing gaps threatening to derail mitigation targets. India, whose updated NDC remains pending, is characterized by "emerging alignment." The country demonstrates the fastest renewable-energy growth among G20 nations, but to reach a 1.5 °C-consistent pathway, early emission peaking and accelerated fossil-fuel phase-out are essential (Bloomberg NEF, 2024; Jiang *et al*., 2025) [11]. India's pathway underscores the importance of combining indigenous innovation, fiscal decentralisation, and global finance in order to sustain its leadership role within South-South cooperation frameworks.

Collectively, these findings affirm that none of the major Asia-Pacific economies are yet fully aligned with 1.5 °C trajectories. As noted in the State of Climate Action (2025) report, the region's aggregate emissions trajectory remains inconsistent with global targets, despite renewable expansion. The comparative evidence suggests that ambition alone is insufficient; the implementation gap—driven by fossil-fuel inertia, limited carbon-market integration, and uneven access to climate finance—continues to define the region's challenge. To achieve genuine 1.5 °C compatibility, Asia-Pacific countries must integrate technological deployment with policy coherence, social inclusion, and ethical leadership (Energy Transition Readiness Assessment, 2025).

Table 3: India's Key Climate and Energy Transition Indicators: 2025 Estimates and 2035 Aspirational Targets

Parameter	2025 Estimate	2035 Target	Remarks
Renewable Capacity	210 GW	850 GW	Strong growth; needs storage integration
Non-Fossil Share in Power	44%	75%	Requires coal retirement strategy
Emission Intensity Reduction (vs 2005)	38%	65%	On track
Green Hydrogen Production	0.2 MMT	10 MMT	Rapid scale-up expected
Electric Mobility (Urban)	12%	60%	Expanding policy support
Forest Carbon Sink	+2.8 billion t CO_2	+4 billion t CO_2	Afforestation and farm forestry

The 2025 estimate showing India's renewable-capacity installed base at 210 GW—on a trajectory toward a 2035 target of 850 GW—reflects strong momentum in the energy transition. Recent empirical data indicate that India added approx. 21.9 GW of solar and wind capacity in just the first half of 2025, a year-on-year increase of over 56 % (JMK Research, 2025). However, as some scholars emphasise, the shift toward renewables now must emphasise integration, particularly energy-storage deployment and grid upgrades, to ensure reliability and avoid bottlenecks (Ministry of New and Renewable Energy, 2025; Rystad Energy, 2025). This gap between capacity addition and system readiness underscores a key implementation risk. Regarding the non-fossil share of power, the 2025 figure of 44 % moving

toward a 2035 target of 75 % signifies a substantial structural shift. While India recently reportedly hit a non-fossil installed power milestone ahead of schedule (Reuters, 2025), the literature warns that achieving a high non-fossil share will require not just expanding renewables but also retiring coal assets, upgrading transmission and distribution infrastructure, and addressing dispatchability and grid stability issues (Ding, Mallapragada, & Stoner, 2024) [4]. Without a comprehensive coal retirement strategy, the non-fossil share alone may not translate into proportionate emissions reductions.

The reduction in emission intensity by 38 % (versus 2005) as of 2025, trending toward a 65 % reduction by 2035, signals that India is "on track" against its stated targets. Yet research warns that tracking alone is insufficient; the pace of reduction must accelerate—and deeper structural reforms are required (Sobha, 2022) [23]. For instance, the persistence of high-emitting coal plants and limited deployment of carbon capture technologies may slow further reductions in intensity unless proactively addressed (Ding *et al*., 2024). Green hydrogen production is estimated at 0.2 MMT in 2025, with a target of 10 MMT by 2035. This rapid scale-up reflects India's strategic emphasis on hydrogen, and a recent modelling effort outlines competitive cost pathways and site-specific optimisation for India's green-hydrogen ecosystem (RMI, 2025). Still, effective deployment will depend on the availability of low-cost renewable power, electrolyzer manufacturing, and export-oriented frameworks such as certification and standards (Kalra, 2025) [14]. The gap between early-stage volume and the ambitious 2035 target therefore remains substantial. For electric mobility in urban areas, the estimate of 12 % EV share in 2025 with a 60 % target by 2035 shows a strong growth path. India's expansion of EV policy support—such as the FAME II scheme—aligns with this, but scholars caution that supportive charging infrastructure, grid adequacy, battery supply chains and consumer affordability must keep pace to avoid bottlenecks (Guha Roy, 2025) [16]. The policy narrative is promising, but the scale of transformation in urban mobility required is large and operational risks remain Finally, regarding the forest carbon sink, the 2025 estimate of +2.8 billion t CO_2 moving to +4 billion t CO_2 by 2035 shows an increasing emphasis on land- and forest-based mitigation. Studies highlight that while afforestation and farm-forestry offer viable mitigation pathways, their effectiveness depends on careful species selection, land-use planning, and long-term maintenance—factors often under-explored in Indian contexts (Ortiz *et al*., 2022) [18]. The assumption of a large jump to 4 billion t CO_2 by 2035 remains ambitious unless sustained institutional and financial support is maintained. Table 3 reveals a broadly encouraging trajectory for India across multiple key parameters. Yet the meaningful inference is that achieving the 2035 targets will require not only scaled ambition but also deep systemic integration—spanning storage, grid infrastructure, coal phase-out, manufacturing ecosystems, mobility systems, and land-use governance. Without synchronised effort across these domains, the risk is that headline targets—though numerically impressive—may not translate into full alignment with a 1.5°C pathway.

Table 4: Sectoral Integration and Co-benefits

Sector	Key Interventions	Expected Outcome by 2035
Energy	Solar 850 GW, battery storage, coal retirement 50 GW	-300 Mt CO_2 reduction per year
Industry	CCUS in steel & cement; green hydrogen in fertilizer	-15 % industrial emissions
Agriculture	Bio-fertilizers; CBG plants 10,000 units	-20 % methane emissions
Transport	60 % urban EV share; 100 % green railways	-40 % sectoral emissions
Forestry	Afforestation 10 Mha	+4 billion t CO_2 sink

The energy sector's intervention of deploying 850 GW of solar capacity, integrating large-scale battery storage, and retiring 50 GW of coal by 2035 suggests a transformational shift in India's power system. This approach promises a cumulative reduction of approximately -300 Mt CO_2 per year. However, the literature underscores that simply scaling renewables is not enough—system integration and handling intermittency via storage and grid modernization are crucial for credible emissions reductions (Sobha, 2022) [23]. In fact, studies indicate that without coal retirement or retro-fitting existing coal plants, the legacy fossil-fuel infrastructure may offset gains from the renewable build-out. In industry, the adoption of carbon-capture, utilisation and storage (CCUS) in steel and cement, alongside green hydrogen in fertilizer production, is projected to reduce industrial emissions by -15 % by 2035. This aligns with research showing that heavy industries in India—particularly steel and cement—constitute a large share of industrial emissions and that CCUS will be essential to achieve meaningful abatement. The inference here is that while these technology-driven interventions promise significant gains, their effectiveness will depend on the economics, regulatory frameworks, and infrastructure support to transition hard-to-abate sectors.

For agriculture, key interventions include bio-fertilisers and the deployment of 10,000 compressed bio-gas (CBG) plants, with an expected -20 % reduction in methane emissions by 2035. This inference reflects a growing recognition of agriculture's role in mitigation and the co-benefits of rural development and circular economy models. However, literature suggests that while such interventions hold promise, the challenge lies in scaling across diverse geographies and ensuring value chains and farmer adoption are robust. In the transport sector, the target of achieving a 60 % share of electric vehicles (EVs) in urban areas and fully green railways is projected to yield -40 % in sectoral emissions by 2035. This is substantiated by modelling work indicating that India's EV sales share could approach or exceed 60 % by 2035 in certain scenarios (IEA, 2024). The inference is persuasive: electrification offers one of the fastest mitigation levers in transport. Yet, it also implies that supporting infrastructure—such as charging networks, grid capacity, and manufacturing capability—must advance at scale to realise these co-benefits. The forestry intervention envisages afforestation on 10 million ha, delivering a forest carbon sink of +4 billion t CO_2 by 2035. This implies a strong land-use mitigation agenda intersecting with biodiversity and ecosystem services. The literature cautions, however, that success depends on species suitability, long-term maintenance, land-use governance and monitoring systems—without which afforestation targets may under-

deliver (Ortiz *et al.*, 2022) [18]. Collectively, these sectoral inferences demonstrate that India's 2035 targets are ambitious and integrated across energy, industry, agriculture, transport and forestry. The meaningful insight is that co-benefits (job creation, rural development, air quality, energy security) are embedded in these transitions. But the underlying caveat is that realising these outcomes will depend not only on technology deployment but on governance, coordination across sectors, policy stability, finance mobilisation and capacity building. Absent such systemic support, there is a risk that each sector may progress individually but fail to deliver the aggregated national emissions reduction required for alignment with the 1.5 °C trajectory.

Financing, Governance and Innovation - Achieving India's 1.5 °C-compatible transition will require substantial financial mobilisation, estimated between USD 25-30 billion annually through 2035 (IMF, 2025). This investment need reflects the dual imperative of scaling renewable energy and building climate resilience across sectors such as transport, agriculture, and industry. Traditional public expenditure alone cannot bridge this gap; a hybrid financing architecture—leveraging sovereign instruments, international partnerships, and private capital—is indispensable. Among the most promising mechanisms are sovereign green bonds, through which the Government of India has already mobilised ₹20,000 crore in 2024. If scaled to ₹1 lakh crore by 2030, as projected by the Ministry of Finance (2025), these bonds could form the backbone of India's domestic green-finance ecosystem. Concurrently, multilateral development banks (MDBs), including the World Bank, Asian Infrastructure Investment Bank (AIIB), and Asian Development Bank (ADB), are emerging as key collaborators in funding adaptation infrastructure, particularly in flood- and drought-prone regions (ADB, 2025). Private capital will also play an increasingly crucial role. Allocating even 2 % of pension and insurance portfolios to environmental, social, and governance (ESG) funds could unlock billions in long-term domestic financing for low-carbon projects. As Kaur (2025) [15] and Bhardwaj (2025) [2] note, ESG-linked investments are rapidly gaining traction in Asia, providing both reputational and financial incentives for firms to align with sustainability standards. Additionally, India's newly launched Carbon Credit Trading Scheme (MoEFCC, 2024), compliant with Article 6.2 of the Paris Agreement, offers an opportunity to integrate Indian credits into global carbon markets. Such linkages can improve liquidity, transparency, and valuation of mitigation efforts while attracting international investors.

Complementing financial instruments, institutional and governance reforms are vital to ensure that resources are allocated efficiently and that policy actions remain coherent across levels of government. Establishing a National Climate Council, chaired by the Prime Minister, could align the efforts of different ministries under a unified strategy, thereby preventing policy fragmentation—a problem noted in several existing sectoral programs (NITI Aayog, 2024). Similarly, State Climate Budgets would allow for systematic tracking of adaptation and mitigation expenditures at the sub-national level, enhancing fiscal accountability and transparency. Decentralised funding mechanisms, such as Panchayat-level Resilience Funds, could empower local bodies to address location-specific climate risks, ensuring bottom-up ownership of climate initiatives. The literature increasingly supports such decentralised frameworks as effective tools for bridging implementation gaps and integrating local knowledge into national strategies (UNDP, 2025). Developing countries account for ≈ 10 % of historical GHG emissions yet face 70 % of the damage (IPCC 2023). India's stance on Common but Differentiated Responsibilities remains central. The proposed Loss-and-Damage Fund (COP29 Baku) should channel predictable concessional finance for adaptation. India's ethical framework aligns Gandhian trusteeship with modern sustainability principles, emphasizing equity over exclusion.

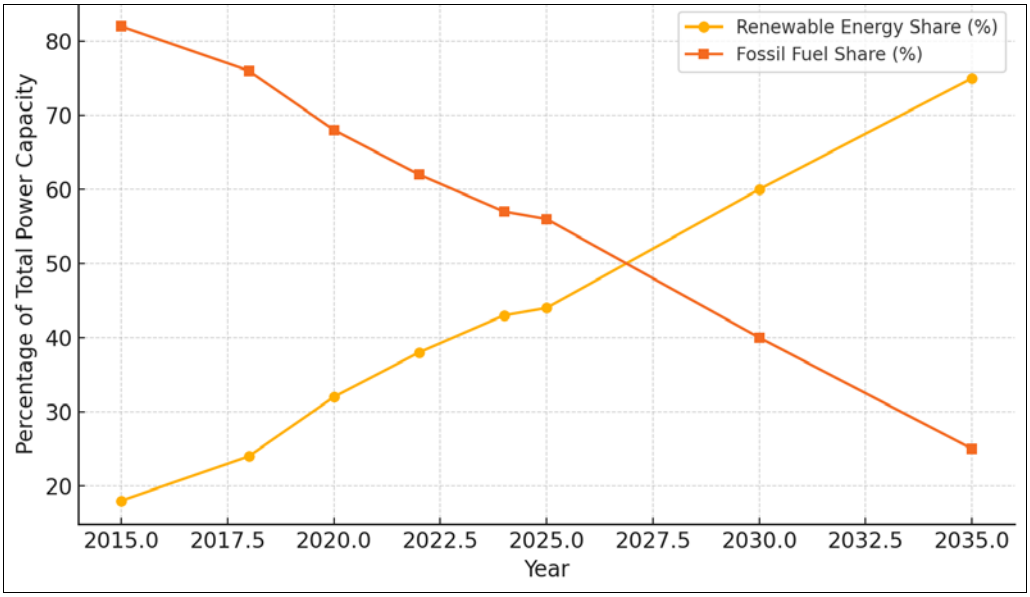

Fig 1: India's energy mist transition from 2015 -2035

The figure titled "India's Energy Mix Transition (2015-2035)" illustrates a significant structural transformation in India's power-generation portfolio over two decades. The data reveal a clear and accelerating shift from fossil fuel dependency toward renewable energy dominance. In 2015, fossil fuels accounted for over 80 % of total installed

capacity, while renewables contributed merely 18 %. By 2025, renewable energy's share rises steadily to approximately 44 %, coinciding with a corresponding decline in fossil fuel dependence to around 56 %. This inflection point represents a pivotal transition moment in India's energy landscape, reflecting the impact of national policy interventions such as the National Solar Mission, Ujjwal DISCOM Assurance Yojana (UDAY), and more recently, the Green Hydrogen Mission (2023). The trajectory projected toward 2035 suggests that renewable energy will constitute roughly 75-80 % of India's power capacity, overtaking fossil fuels entirely. This trend signals a paradigm shift toward low-carbon energy security, aligning with India's commitments under the Paris Agreement and its updated Nationally Determined Contribution (NDC, 2022). The crossover point—projected to occur around 2027-2028—marks when renewables will surpass fossil sources as the dominant share of India's electricity mix. This convergence reflects technological advancements, cost reductions in solar and wind generation, and progressive government incentives for clean energy investment.

However, while the figure demonstrates impressive renewable growth, it also underscores key systemic challenges. The declining fossil-fuel trend, though promising, assumes effective coal retirement policies, which remain politically and economically complex. As Ding, Mallapragada, and Stoner (2024) [4] argue, India's reliance on coal for baseload generation and employment makes rapid phase-out difficult without large-scale just-transition measures. Furthermore, achieving a renewable share above 70 % will require substantial expansion of energy storage systems and smart grid integration, ensuring reliability and stability during variable solar and wind output periods. Another inference from the figure is the acceleration of renewable growth post-2025, which correlates with increased private-sector participation and declining Levelized Cost of Energy (LCOE) for renewables (IRENA, 2025). This trend aligns with projections by the International Energy Agency (IEA, 2024), which estimates that India will add over 40 GW per year of new renewable capacity between 2025 and 2030, outpacing all other G20 economies. Yet, the parallel decline in fossil fuels must be managed carefully to prevent stranded assets and regional economic dislocation in coal-producing states such as Jharkhand and Chhattisgarh.

Overall, the figure provides a compelling visual narrative of India's energy transition in motion an evolution from carbon intensity to cleaner and more diversified generation. If India sustains this momentum and complements renewable growth with energy storage, grid reform, and just-transition policies, it can feasibly achieve a 75 % renewable share by 2035, contributing substantially to global efforts to remain within the 1.5 °C temperature threshold (UNEP, 2025; IMF, 2025). This transformation demonstrates India's potential to lead by example among emerging economies, showcasing how rapid economic growth and deep decarbonisation can proceed concurrently.

India's Engagement at COP30: Aligning Climate Rhetoric with Implementation Challenges: The outcomes of COP30 accentuate the ongoing tension that persists between climate ambition and tangible implementation within the UNFCCC process. Framed as an "implementation COP," the conference succeeded in making measurable strides in reinforcing the architecture of climate finance. A significant development was the advancement of the New Collective Quantified Goal (NCQG), which aims to mobilise USD 1.3 trillion annually by 2035 for developing countries. This goal reflects a growing consensus on the necessity for systemic financial transformation rather than mere ad hoc pledging, signalling a pivotal moment in acknowledging that climate action cannot proceed effectively without substantial financial backing. India, as a key player in these discussions, championed the cause of developing nations, pressing for a climate finance framework that would empower vulnerable countries to combat the adverse effects of climate change proactively. However, the absence of binding commitments, explicit delivery timelines, and predictable concessional finance raises serious questions about whether these frameworks can transcend aspirational rhetoric. Without these elements, their capacity to make meaningful impacts on developmental and adaptive challenges remains limited. It becomes clear that while the architecture appears robust on paper, the real work ahead hinges on turning these frameworks into actionable solutions.

A central and troubling contradiction emerging from COP30 lies in the evident asymmetry between financial commitments and mitigation outcomes. While adaptation and equity issues garnered political goodwill, negotiations fell short in securing a global roadmap for the phase-out of fossil fuels. This critical omission underscores the entrenched geopolitical and developmental divides that continue to hamper multilateral efforts, illustrating the challenges of consensus-based negotiations in confronting politically sensitive mitigation commitments. Without concurrent progress on reducing emissions, initiatives aimed at enhancing climate finance risk devolving into mere compensatory mechanisms, rather than serving as transformative solutions—especially for nations disproportionately affected by climate change. India's role at COP30 vividly illustrates this broader structural dilemma. On one hand, the country positioned itself as a prominent advocate for climate justice and equity, articulating the principles of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC). This advocacy served to legitimize developing nations' calls for scaled and grant-based climate finance. However, on the other hand, delays in submitting updated Nationally Determined Contributions (NDCs) and the failure to present a clearly articulated strategy for transitioning away from fossil fuels exposed a significant gap between India's diplomatic assertiveness and its domestic clarity on mitigation strategies. This duality showcases the intricate balancing act that emerging economies like India must navigate, where the pressing need for development often collides with the burgeoning global expectations for climate action.

The focus on just transition and adaptation frameworks at COP30 marks an important normative shift toward mobilizing people-centered and inclusive climate action. However, the absence of operational clarity, financing certainty, and robust accountability mechanisms constrains their transformative potential. Without effective monitoring and clear implementation pathways, even the most well-meaning just transition initiatives risk devolving into mere conceptual commitments rather than actionable policy instruments equipped to address the socio-economic

disruptions that arise from efforts to decarbonize. Overall, COP30 can be characterized as a period of incremental institutional consolidation rather than a decisive leap toward climate transformation. Although the conference succeeded in strengthening the scaffolding necessary for future action—particularly regarding finance and adaptation—it ultimately fell short of overcoming significant core mitigation challenges. The findings from this gathering suggest that the credibility of future COP outcomes will hinge less on the mere expansion of frameworks and more on the political willingness of major emitters to align their national actions with global climate goals. Bridging the gap among equity-based demands, effective financial delivery, and measurable mitigation accountability will be critical. Only by doing so can climate governance transcend procedural progress and achieve the substantive impact that the world so desperately needs.

Conclusion

This study critically re-examines India's climate trajectory within the global effort to recalibrate the 1.5 °C pathway, with particular emphasis on the strategic 2035 horizon. The findings clearly indicate that while global climate governance remains off-track—evidenced by rising absolute emissions, persistent fossil-fuel subsidies, and delayed NDC submissions—India demonstrates a comparatively stronger alignment potential through rapid renewable expansion, emission-intensity reduction, and indigenous mitigation initiatives. India's progress in renewable capacity addition, non-fossil power generation, and emission-intensity decline suggests that development and decarbonisation need not be mutually exclusive. However, the analysis also reveals that ambition alone is insufficient. Structural inertia, continued fossil-fuel dependence, fragmented governance, and uneven sectoral integration constrain the pace of transformation. India's pathway toward 2035 is characterised by emerging alignment rather than full compatibility with the 1.5 °C goal. Achieving this compatibility will require accelerated coal retirement, large-scale grid and storage integration, and coherent alignment between mitigation, adaptation, and finance frameworks. The study further highlights that India's leadership at COP30—particularly its advocacy for equity, climate finance, and just transition—strengthens its normative position globally, yet this leadership must be reinforced by timely NDC updates and clearer domestic mitigation roadmaps to enhance credibility. Overall, the evidence suggests that India possesses both the capacity and opportunity to recalibrate the global climate trajectory, provided that policy coherence, institutional coordination, and financial mobilisation are substantially strengthened. The 2035 milestone thus emerges not merely as an intermediate target, but as a decisive window in which India can transition from an emerging climate actor to a global climate leader.

Recommendation

India's climate strategy would benefit from formally institutionalising the 2035 horizon as an intermediate planning milestone between the 2030 NDCs and the 2070 net-zero target. Sector-specific interim targets across energy, industry, transport, agriculture, and forestry would enhance policy continuity, reduce implementation uncertainty, and improve alignment with 1.5 °C-compatible pathways. A clearly defined coal phase-out roadmap, embedded within region-specific just transition frameworks, is essential to balance decarbonisation with social equity. Dedicated transition funds, reskilling programmes, and alternative livelihood strategies for coal-dependent regions should be prioritised to mitigate socio-economic disruption and ensure political feasibility. Rapid renewable-energy expansion must be matched with accelerated investment in grid modernisation, energy storage, and system integration. Large-scale deployment of battery storage, green hydrogen, and smart-grid technologies is necessary to maintain reliability and maximise emissions-reduction benefits. Strengthening climate finance architecture is equally critical. Scaling sovereign green bonds, operationalising the domestic carbon market with robust MRV systems, and leveraging blended finance can mobilise capital, while sub-national climate budgeting will enhance transparency and fiscal accountability. Finally, integrating mitigation with adaptation and development co-benefits, strengthening sub-national data and governance capacity, and deepening South-South cooperation particularly in the Asia-Pacific region will enable India to translate climate ambition into measurable outcomes while reinforcing its leadership in equitable global climate governance.

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