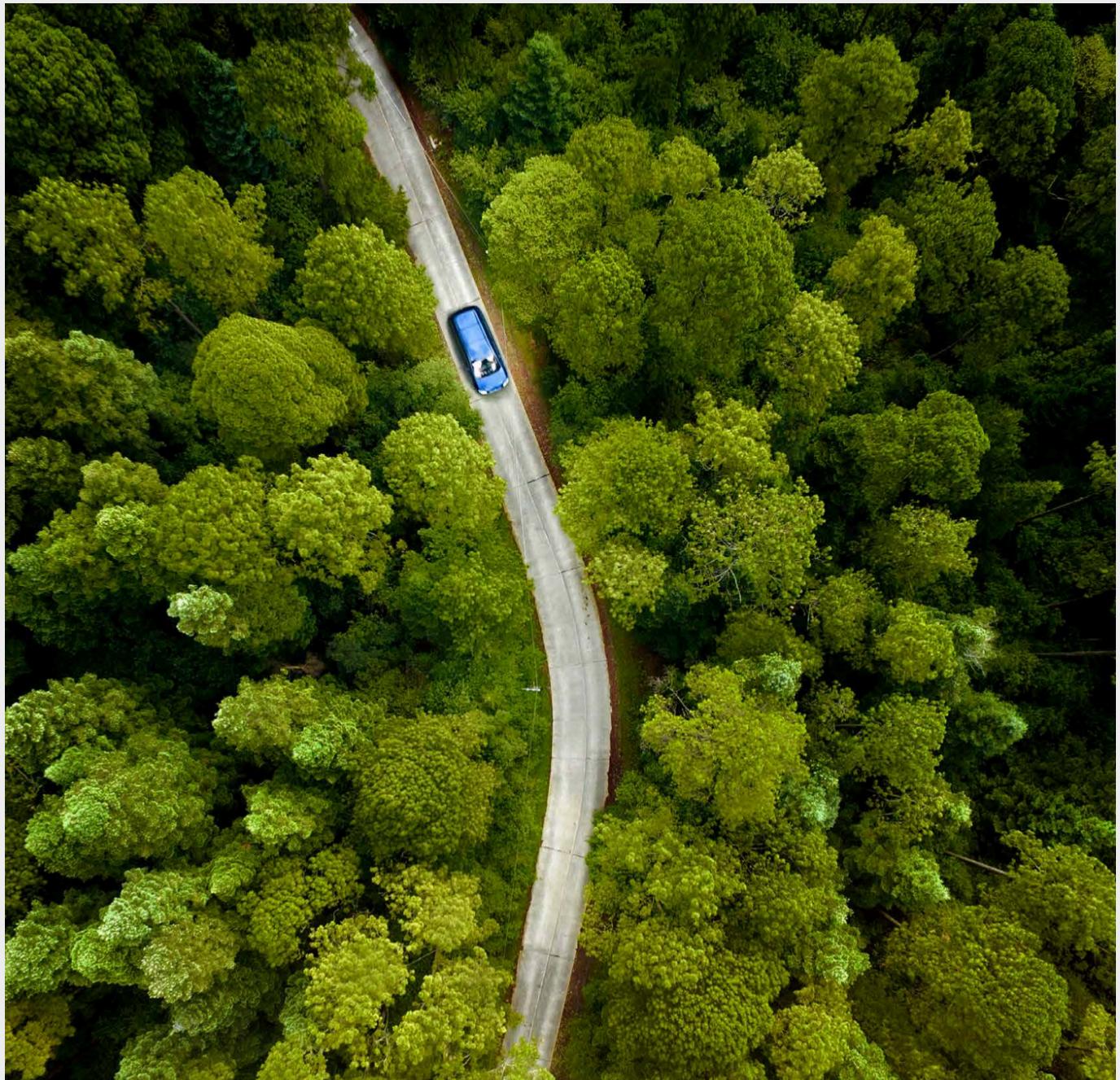
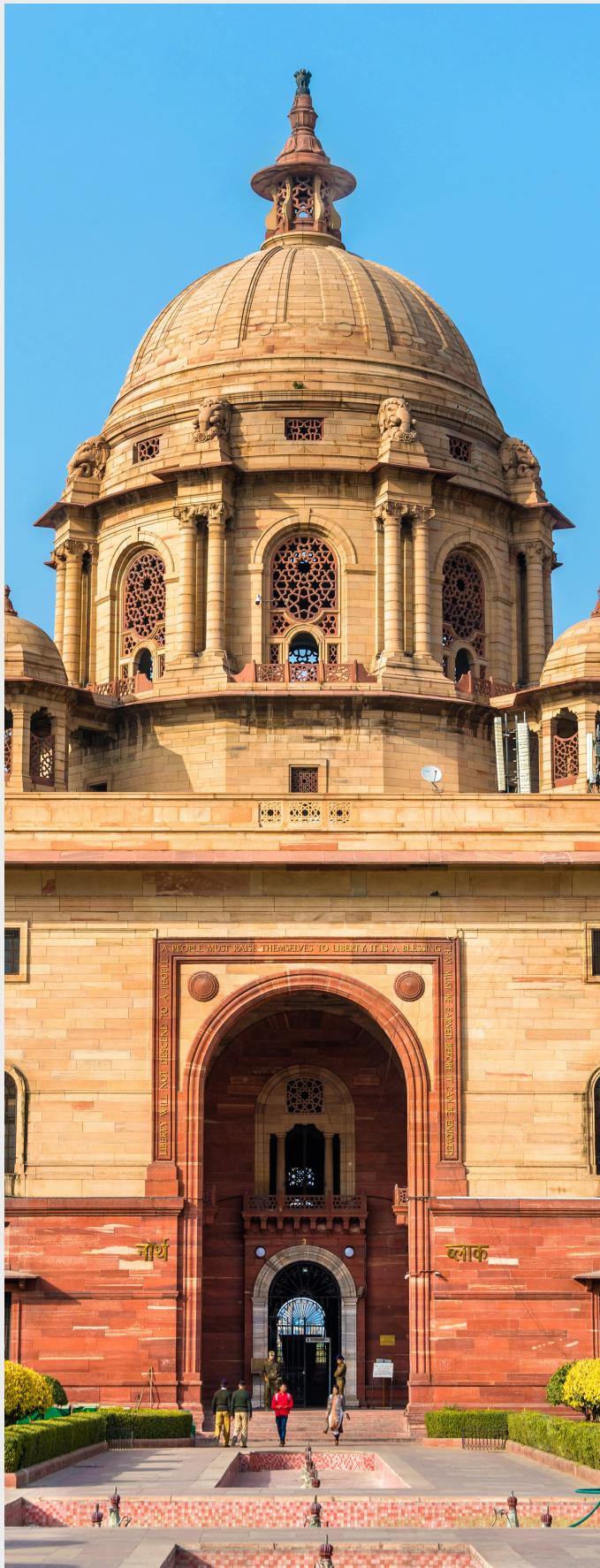


AARTHIK SAMVAAD

DIALOGUE | DISCOURSE | DELIBERATION



**GREEN FINANCE: THE KEY TO
UNLOCKING A NET-ZERO FUTURE**



ACKNOWLEDGEMENT

We convey our deepest gratitude to all those whose unwavering support has rendered the second edition of our newsletter a resounding triumph.

We express our profound gratitude to Shri Hardeep Singh Puri, Hon'ble Minister of Petroleum and Natural Gas, for his gracious and illuminating remarks, which have aptly set the tone for this edition.

Our sincere appreciation is extended to Shri Devesh Tripathi, President, NEF, for his steadfast commitment and invaluable guidance, which have been the cornerstone of this endeavour.

A special note of gratitude is due to Dr. Sunchu Glory Swarupa, Director General of the National Institute for Micro, Small, and Medium Enterprises (Ni-MSME), for her generous contributions of insight and wisdom. Her intellectual engagement has enriched our publication and elevated its discourse on economics to new heights.

We also acknowledge with great reverence the exceptional leadership of Shri Amitabh Banerjee, Director, NEF, whose vision and strategic acumen have been pivotal in steering this initiative toward success.

Our heartfelt thanks are due to the indefatigable NEF team, whose dedication across domains such as design, content creation, social media, editing, and logistical coordination has been instrumental in actualising this newsletter.

Finally, but by no means least, we express our profound gratitude to you, our esteemed readers, for your continued engagement and support in advancing NEF's mission to catalyse transformative change in India's economic landscape.

Warm regards,
National Economic Forum



Message

I am glad to note that the National Economic Forum is releasing the second volume of its newsletter Arthik Samvaad on the important subject of green finance. The recent discussions at COP-29 in Baku have brought the topic of green finance to mainstream prominence. While the final decisions at the conference were not as encouraging as developing countries, including India, might have hoped for, it is heartening to see that there is deeper discourse on mobilising capital to achieve a clean energy transition.

Achieving net zero requires massive investments in renewable energy, energy efficiency, sustainable transport, and climate-resilient infrastructure. 2023 was the first year where funding for clean technologies surpassed fossil fuel investment. By the end of this year, investments in clean technologies are expected to reach \$2 trillion – almost double than the slightly over \$1 trillion going toward coal, gas and oil.

Enhancing the channels to access green finance through mechanisms such as green bonds, climate funds, and carbon credits not only accelerates the adoption of renewable energy technologies, but also encourages innovations in energy storage and grid modernisation. At the same time, investments in green sectors have the potential to stimulate economic activity and create millions of green jobs, contributing to just transitions that benefit society at large.

I hope that the National Economic Forum is able to generate thought-provoking dialogue on the subject, and look forward to reading this newsletter.



(Hardeep S Puri)

New Delhi
29 November 2024



PRESIDENT'S ADDRESS

Dear Readers,



It is with immense pride and purpose that I present to you the second edition of Aarthik Samvaad, a newsletter that embodies the ethos of the National Economic Forum: rigorous inquiry, forward-looking discourse, and actionable insights. The theme of this edition, Green Finance: The Key to Unlocking a Net-Zero Future, could not have been more timely as the global community recently converged at COP29 in Baku to address the monumental challenge of climate change.

India stands at pivotal crossroads in its developmental trajectory - a moment where sustainability must be the fulcrum of progress. As one of the world's most dynamic economies, our aspirations for growth must be tempered with a commitment to our planet's well-being. Green finance, in this context, emerges as the indispensable catalyst, bridging the chasm between ambition and action.

This edition delves deep into how innovative financial mechanisms can underpin India's journey to carbon neutrality, exploring a range of sectors from renewable energy and climate-smart agriculture to MSMEs and sustainable urban development. It also examines how instruments like carbon markets and circular economy models can pave the way for a holistic approach to sustainability - an approach that aligns economic imperatives with environmental stewardship.

I invite you to immerse yourself in these pages, not merely as a reader but as a co-traveler in the quest for a greener, more equitable future. Together, let us envision and enact a tomorrow where prosperity and sustainability are not adversaries but allies.

Warm Regards,

Devesh Tripathi

Devesh Tripathi
President, National Economic Forum



DIRECTOR'S ADDRESS



Dear Readers,

As we unveil the second edition of Aarthik Samvaad, I am struck by the enormity of the challenge before us - and the boundless potential we possess to rise to it. The theme, Green Finance: The Key to Unlocking a Net-Zero Future, encapsulates both the urgency of our era and the optimism with which we must approach it.

India's journey toward net-zero emissions is not merely a policy imperative; it is a moral obligation, a national aspiration, and, indeed, a global expectation. Yet, this journey is fraught with complexities - economic, technological, and infrastructural. It is here that green finance assumes a transformative role, serving as the lifeblood of innovation, infrastructure, and inclusive growth.

In this edition, we explore the multifaceted dimensions of climate finance - its role in scaling renewable energy, revolutionising urban transport, and much more. We also highlight the significance of equitable financing mechanisms that empower small businesses, vulnerable communities, and emerging sectors, ensuring that no one is left behind in the transition to a low-carbon economy.

As stewards of public discourse and policy innovation, it is incumbent upon us to catalyse conversations that inspire action. Through the thoughtful analyses and visionary ideas encapsulated in this edition, we hope to provide stakeholders with the insights they need to shape India's green finance ecosystem.

Let us harness the collective power of ideas, investments, and innovations to create a future that is not only economically robust but also environmentally resilient.

Warm Regards,


Amitabh Banerjee
Director, National Economic Forum

Mission

The National Economic Forum (NEF) is an independent, non-partisan policy research organization dedicated to envisioning and facilitating transformative policy changes through collective action. Anchored in the triadic pillars of People, Places, and Programs, NEF strives to conceptualise solutions (Programs) aimed at fostering equitable outcomes (People) while meticulously tailoring implementation plans to each state's (Places) distinctive strengths and challenges.

Our overarching aim is to equip government stakeholders with incisive, data-driven insights into India's most pressing and emergent economic challenges.

Vision

Our vision is of an India that draws wisdom from the world while serving as a source of inspiration for it. Rooted in our identity yet ever-reaching, we envision a future where economic growth seamlessly aligns with national interests, propelling India toward self-reliance, sustainability, and resilience.

We champion an approach that emphasises pragmatic, implementable solutions designed to address India's evolving legal and policy challenges. By crafting robust, coherent, and collaborative frameworks, we seek to contribute meaningfully to the nation's journey toward an inclusive and prosperous future.

ABOUT US

The National Economic Forum (NEF) is among India's preeminent not-for-profit, independent, and non-partisan think tanks and policy research institutions. Driven by a commitment to analytical rigor and evidence-based inquiry, NEF employs data-driven research, comprehensive analysis, and policy outreach initiatives to deliver actionable solutions to the economic issues that shape India's present and future.



Focus Areas

Techonomics

Governance for Growth

Knowledge Economy

Sustainable Horizons

Law & Economy

Geostrategic Frontiers



editorial

The world convened in Baku for COP29, indicating that the urgency to address climate change has never been more palpable. At the crux of these deliberations lies an indispensable catalyst for action - **green finance**. It is both the enabler and the accelerant for achieving a net-zero future, a shared aspiration that unites nations, economies, and individuals in an unparalleled global endeavour.

In this second edition of **Aarthik Samvaad**, we delve into the pivotal role of green finance in India's metamorphosis into a low-carbon economy. The stakes are monumental. India, with its burgeoning energy demands, expanding urban landscapes, and ambitious targets for carbon neutrality, stands at the confluence of challenge and opportunity. How we marshal financial resources to decarbonise our energy systems, revolutionise our transportation networks, and create climate-resilient agriculture will define not just our economic trajectory but also our legacy as stewards of the planet.

This edition seeks to illuminate the pathways through which innovative funding mechanisms can bridge the chasm between ambition and implementation. We explore the potential of green bonds, blended finance, and carbon markets, which promise not only to fund projects but to transform them into sustainable benchmarks. From the thriving micro, small, and medium

enterprises (MSMEs) that form the backbone of our economy to the ever-expanding e-Mobility sector, green finance emerges as the cornerstone upon which sustainable growth pivots.

Moreover, we spotlight the intersection of circular economy initiatives and sustainable land use, two arenas where the convergence of finance, policy, and technology can yield transformative outcomes. The ethos of this newsletter is to highlight how environmental stewardship need not be at odds with economic development. On the contrary, the two can - and must - be harmonised to ensure prosperity for generations to come.

As we navigate the corridors of climate action, let Arthik Samvaad serve as a repository of insights, a catalyst for dialogue, and a clarion call for collective action. For it is through robust and collaborative frameworks that we can aspire to unlock the immense potential of green finance and transform aspirations of a net-zero future into an attainable reality.

Let us embark on this journey together, galvanised by the belief that a sustainable India is not just possible - it is imperative.

Warm regards,

Editorial Team
National Economic Forum



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CROSSWORD

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GREEN BUCKS & GLOBAL GOALS:

DECODING CLIMATE FINANCE

YASH KAPUR



The pivotal role of climate finance in combating the escalating global climate crisis cannot be overstated. At its essence, climate finance serves as the financial backbone of international climate action, funnelling resources into both mitigation and adaptation strategies. The latest discussions at COP29 [1] in Baku, Azerbaijan, reiterate the urgency of strengthening climate finance mechanisms to meet the ambitious targets of the Paris Agreement [2]. With countries across the world striving for a net-zero future, climate finance remains an indispensable tool to bridge the gap between global aspirations and practical realities. In this context, it is crucial to examine the complexities of climate finance, its operational mechanisms, and its indispensable role in achieving the United Nations' Sustainable Development Goals (SDGs) [3], particularly in the fight against climate change. COP29's emphasis on increasing financial flows into green projects and adaptation measures illustrates the necessity of fostering financial partnerships and commitments to catalyse sustainable progress.

At its core, climate finance encompasses the allocation of financial resources for climate action, targeting projects designed to mitigate the effects of climate change and enhance the adaptive capacity of vulnerable communities. These resources, sourced from public, private, and multilateral entities, are intended to facilitate a transition to low-carbon, climate-resilient economies. Central to the philosophy of climate finance is the notion of dual objectives: immediate intervention to alleviate vulnerabilities, coupled with long-term, systemic solutions to safeguard against future climate impacts. For e.g., the Green Climate Fund (GCF) [4] is central in this dual approach, channelling billions into projects designed to reduce greenhouse gas emissions while fostering adaptation in regions most susceptible to climate risks. Despite its critical role, the financial

commitments set out in the 2009 Copenhagen Accord [5], namely the goal of mobilising \$100 billion annually by 2020, remain unmet, highlighting the urgent need for new and innovative financing frameworks. Recent data emerging from COP29 indicates that, while substantial progress has been made, the full realisation of this target continues to elude the international community, necessitating an increase in both private sector engagement and multilateral cooperation post-2025.

Accelerating the Energy Transition: The burgeoning investment in renewable energy is one of the most visible outcomes of climate finance. In particular, wind & solar energy have seen exponential growth due to strategic investments, with nations such as India & South Africa leading the charge in the Global South. COP29 placed particular emphasis on accelerating these efforts, with Azerbaijan's announcement of the Climate Finance Action Fund (CFAF) [6], a \$1 billion initial fundraising initiative designed to boost green energy projects in the developing world - illustrating the central role of such investments in energy transition strategies. Furthermore, global new renewable energy investment reached an estimated record high of \$623 billion [7] in 2023, marking an 8.1% [8] increase from 2022. This surge in funding is indicative of the crucial link between climate finance and the transition to a low-carbon future.

Supporting Vulnerable Nations: While climate change is a global challenge, its impacts are disproportionately felt by developing and least-developed countries (LDCs). These nations, despite contributing minimally to global emissions, are often the hardest hit by rising sea levels, extreme weather events, and changing agricultural



patterns. Adaptation finance, therefore, becomes crucial in empowering these nations to build resilience against such threats. COP29's discussions surely stressed upon the urgent need to increase funding for adaptation efforts, particularly in regions such as sub-Saharan Africa and small island developing states (SIDS), where the vulnerabilities to climate impacts are extreme. The African Development Bank (AfDB) estimates that the continent alone will need \$400 billion [9] annually till 2030 for adaptation projects, a stark reminder of the financial gap that must be closed if the global community is to achieve meaningful climate resilience.

Fostering Innovation: Climate finance also plays a crucial role in driving innovation in sustainable technologies, particularly in emerging sectors like carbon capture and storage (CCS), electric vehicles (EVs), and nature-based solutions such as reforestation. The growing focus on these technologies has attracted considerable private sector interest, with venture and private equity investment in green technologies skyrocketing to \$638 billion [10] in 2023. The proliferation of green bonds, which now exceed \$1 trillion [11] globally, reflects a burgeoning market dedicated to funding environmentally sustainable innovations. This shift towards greener technologies is vital in driving forward the transition to a sustainable future, addressing both the economic and environmental dimensions of climate change.

Bridging Public and Private Finance: Achieving the scale of financing required to meet the global climate targets necessitates greater collaboration between public and private sectors. The leveraging of private investments through blended finance - where public funding is used to mitigate risks and attract private capital - has proven to be a vital mechanism. For example, blended finance has been instrumental in

financing large-scale renewable energy projects in emerging markets, where risks are perceived to be higher. The success of such projects can be seen in India's solar industry, which has secured around \$10 billion [12] in private investments to scale up solar energy capacity. Such collaborations are crucial for scaling climate solutions and ensuring that finance flows seamlessly into the most critical projects.

Mechanisms of Climate Finance: Climate finance is channelled through a variety of mechanisms, each designed to ensure that financial resources are directed toward projects with measurable climate benefits. These mechanisms include:

Multilateral Climate Funds: The Green Climate Fund (GCF), established under the United Nations Framework Convention on Climate Change (UNFCCC), remains one of the most significant players in global climate finance. As of 2024, the GCF has received over \$13 billion [13] in pledges and has disbursed funds to 130+ countries, supporting projects that span both mitigation and adaptation efforts. Its role in advancing climate justice - particularly in least-developed countries - cannot be overstated.

Carbon Markets: Emissions trading systems (ETS) and carbon pricing mechanisms represent another key instrument for financing climate action. By putting a price on carbon emissions, these markets incentivise the reduction of greenhouse gases. COP29's discussions highlighted the need for greater transparency and accountability in these markets to ensure they are functioning as effective tools for emission reduction. Enhanced market



integration, particularly with a global carbon pricing framework, could unlock significant additional finance for climate goals.

Blended Finance: Blended finance remains a powerful tool for de-risking investments and mobilising private sector capital for climate projects. This approach has been particularly effective in financing large infrastructure projects, such as the development of renewable energy grids in regions with emerging market risks.

Green Bonds: The issuance of green bonds is another major instrument in climate finance. In 2023, global issuance surpassed \$1 trillion, driven by both governmental and corporate issuers keen to finance climate-friendly projects. This market is set to expand as more investors seek sustainable investment opportunities, further institutionalising green finance.

Innovative Financing Mechanisms: New financing mechanisms, such as resilience bonds and debt-for-climate swaps, represent innovative approaches to aligning financial incentives with climate goals. These mechanisms are particularly valuable in highly indebted developing countries, where traditional climate finance models may not be sufficient to meet both developmental and environmental needs ([Vaijhala S. & Rhodes J., 2018](#)) [14].

Challenges in Climate Finance

With COP29 coming to a close, the global climate finance landscape remained fraught with complexities, yet again revealing a stark reality: mobilising funds to address climate change is as formidable as tackling the crisis itself. Despite significant pledges and diplomatic overtures, the disparities between the developed and

developing nations in terms of access, equity, and adequacy of climate finance remain unresolved.

The Elusive \$100 Billion Commitment: A persistent point of contention throughout COP29 was the unmet promise of mobilising US \$100 billion annually from developed nations to support climate mitigation and adaptation efforts in developing countries. Originally pledged at COP15 in 2009, this target was meant to be achieved by 2020 but remains unrealised to this day. According to the OECD's book series [Climate Finance and the USD 100 Billion Goal](#) [15], the \$100 billion target may finally be met by 2025, but with some caveats - much of the finance counted towards this total includes loans rather than grants, which increases the debt burden on developing nations, counteracting their climate resilience efforts.

The UNFCCC's Standing Committee on Finance (SCF) [report](#) [16] also highlighted that the current flow of funds continues to fall short of the actual needs. Estimates suggest that developing nations require nearly US\$6 trillion in total by 2030 to meet their Nationally Determined Contributions (NDCs) under the Paris Agreement - a sum vastly exceeding the \$100 billion target.

A Growing Adaptation Deficit: While mitigation finance has seen modest progress, adaptation finance remains significantly underfunded. Adaptation is critical for vulnerable nations, particularly those in the Global South, as they face disproportionate impacts from climate-induced disasters such as floods, droughts, and sea-level rise. However, according to the [2023 Global Adaptation Gap Report](#) [17] published by UNEP, the adaptation finance gap could reach well over



\$ 300 billion annually by 2030 unless corrective action is taken. COP29 witnessed heated negotiations on scaling up adaptation finance, but the reluctance of developed nations to meet these demands in a timely manner was a major stumbling block.

The GCF, which serves as a vital channel for adaptation finance, is also facing challenges in replenishment, exacerbating the crisis. As GCF's Executive Director, Mafalda Duarte, warned during COP29, unless substantial new pledges are made, the fund's capacity to support transformative adaptation projects will be severely compromised. Only the passage of time will reveal the outcomes of the ambitious new pledge [18] - to triple climate finance for developing nations, raising the target from the previous goal of \$100 billion annually to an extraordinary \$300 billion per annum by 2035.

Loss and Damage - A Historic Yet Underfunded Facility:

Facility: A notable breakthrough at COP27 was the creation of a Loss and Damage Fund [19] aimed at compensating countries most affected by climate disasters. COP29 saw the operationalisation of this fund as a landmark achievement. However, the question of where the money will come from remains unresolved. Developing countries, led by climate-vulnerable nations like the Maldives and Bangladesh, repeatedly expressed frustration over the lack of concrete financial commitments.

The Loss and Damage Fund's estimated financing needs are projected to be upwards of \$200 billion annually by 2030, according to a recent analysis [20] by Climate Analytics. Yet, by the end of COP29, the pledges towards this fund remained a fraction of the required amount. Additionally, the reluctance of major

emitting countries to increase their contributions has slowed the operationalisation of the facility.

Private Sector Finance: The Missing Puzzle Piece:

Piece: Despite various efforts to catalyse private sector involvement in climate finance, COP29 reiterated that private investment remains underwhelming. While private sector climate finance has increased, it still represents only around 43% [21] of the total. Furthermore, the geographical distribution of these funds is highly uneven, with a majority flowing into mitigation projects in middle-income countries, while low-income countries remain neglected.

Barriers to private sector involvement, such as perceived risk, lack of clear policy frameworks, and limited access to concessional finance, continue to persist. The need for innovative financing mechanisms such as blended finance, i.e., combining concessional public finance with private capital was reiterated, but actual progress in structuring these deals remains slow.

The Political Economy of Climate Finance:

Underlying these financial hurdles is the broader issue of geopolitics. COP29 revealed that the political will to address climate finance inequities is still fragmented. Developed nations remain wary of overcommitting, especially in the face of domestic economic challenges and inflationary pressures. On the other hand, emerging economies like China and India, while increasing their domestic climate spending, argue that the onus of climate finance should predominantly fall on historically high emitters, a position that remains hotly contested.



The Global Climate Risk Index [22], which places many developing countries at the highest risk of climate impacts, has made clear that the most affected nations are the least equipped financially to mitigate and adapt to climate change. This disparity in climate vulnerability and financial capability was a recurring theme in COP29 deliberations.

A reform of the global climate finance mechanism, with a stronger emphasis on transparency, accountability, and equitable access to funds, is essential. The coming years will test whether the promises made at COP29 can be transformed into meaningful actions or whether climate finance will continue to lag behind the rapidly escalating demands of the climate crisis.

The Path Forward: Recommendations from COP29

COP29 has called for greater multilateral cooperation to harmonise global financing frameworks and enhance resource mobilisation. This cooperation will be critical in scaling up the resources needed to meet the ambitious targets of the Paris Agreement. Expanding instruments like green bonds, carbon markets, and blended finance will be crucial in unlocking new sources of capital. Technological advancements, such as blockchain, could further enhance the transparency and efficiency of these mechanisms. Ensuring that adaptation and resilience funding is prioritised for vulnerable regions is essential to leaving no one behind in the global transition to sustainability. Climate finance must be inclusive and accessible to all nations, particularly those in the Global South.

Governments must create an enabling environment for private sector participation in climate finance by providing tax incentives, clear regulatory guidelines, and risk mitigation mechanisms. The post-2025 climate finance goals must reflect the urgency of the climate crisis, setting ambitious but achievable targets that can drive real action at a global scale.

Climate finance is not just a necessary condition for mitigating climate change; it is the bedrock upon which a sustainable, equitable future can be built. The discussions and commitments emerging from COP29 provide a roadmap for aligning financial flows with climate goals, offering a tangible pathway to a greener, more resilient world. By continuing to foster innovation, strengthening global cooperation, and ensuring equitable access to resources, climate finance can play an integral role in realising the global ambition of a net-zero future. The time to act is now, and climate finance is the key to unlocking the solutions we urgently need.



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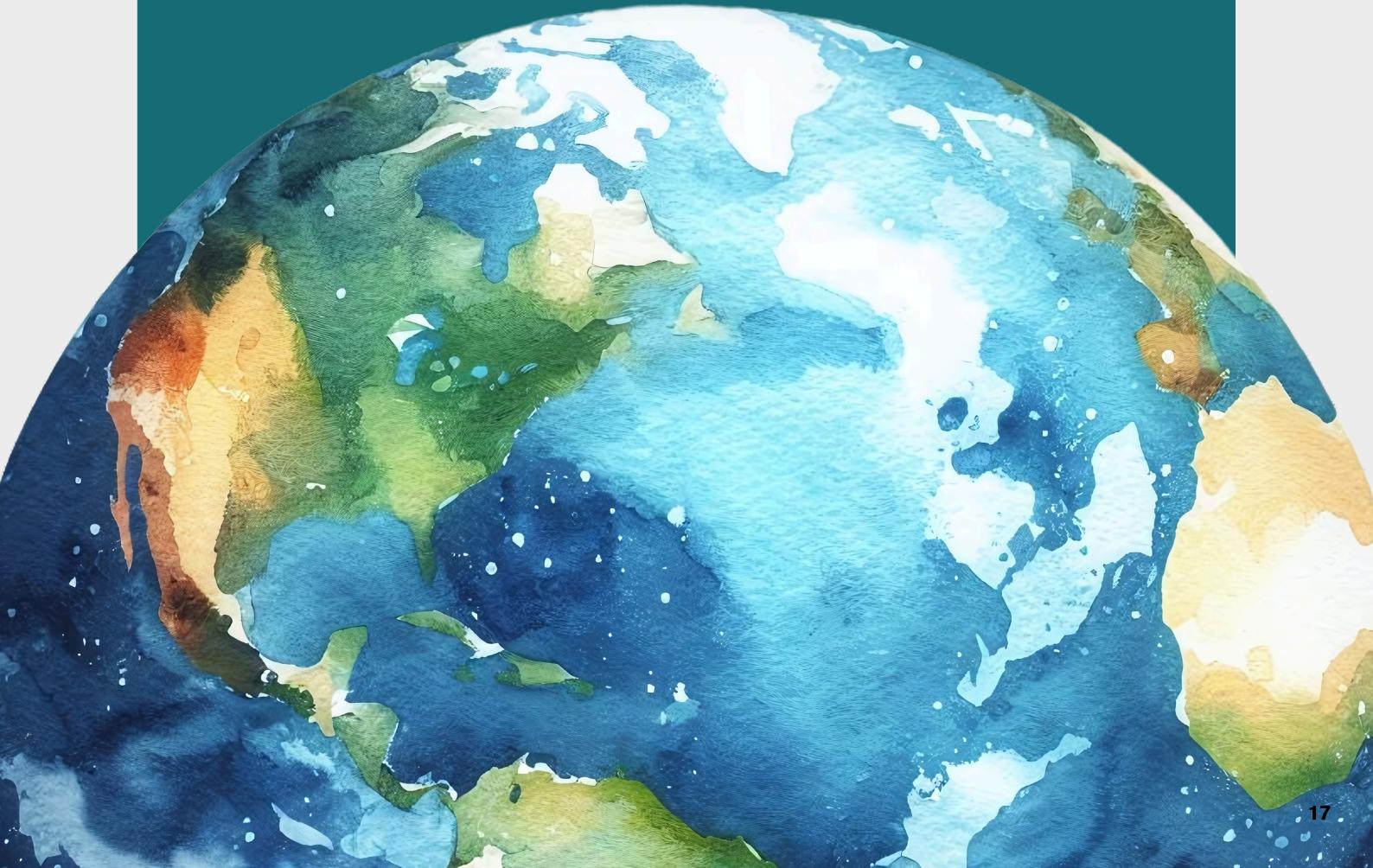
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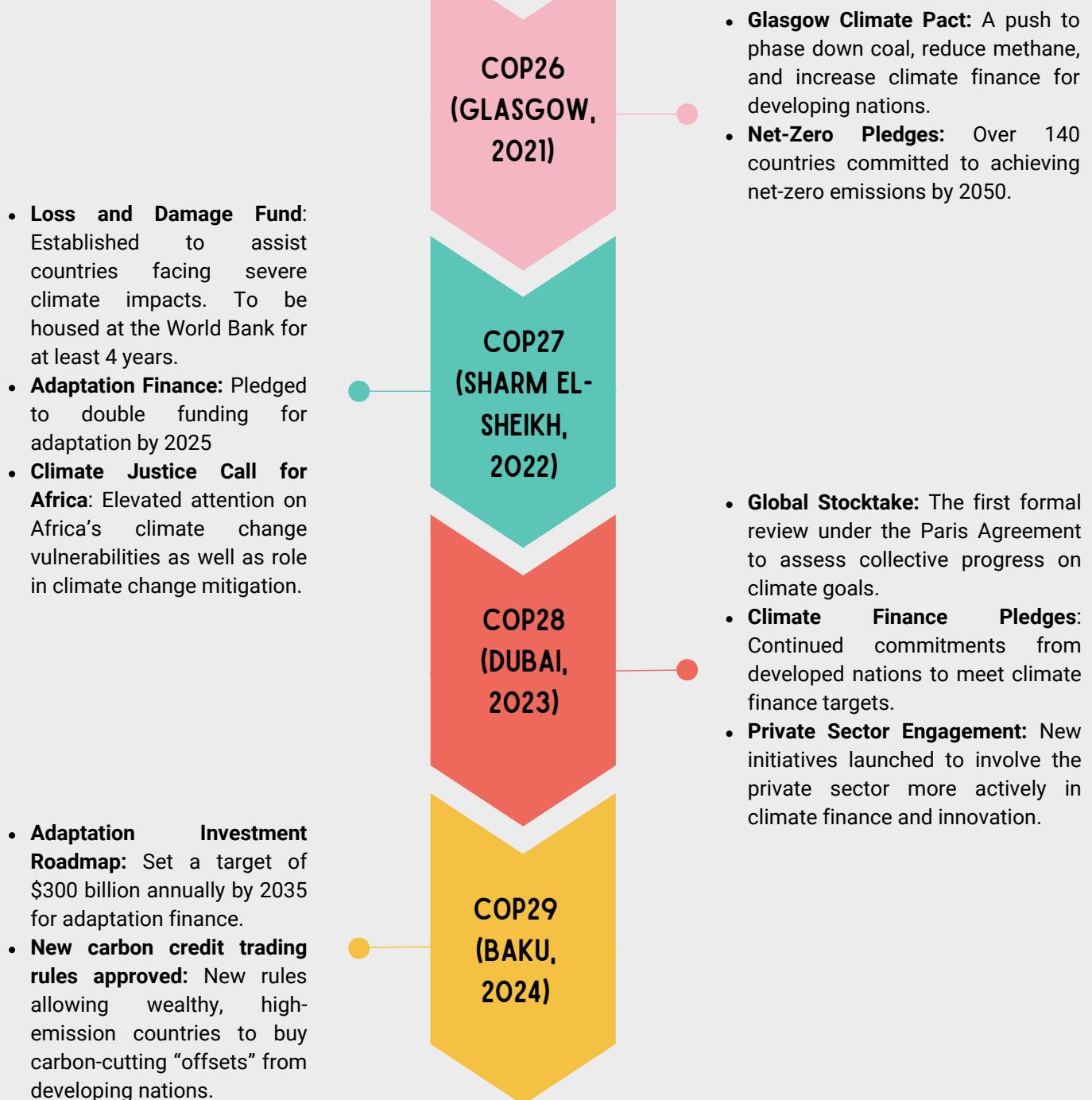
COP29
Baku
Azerbaijan

Decisive Milestones:

Key Outcomes from COP21 Paris to COP29 Baku







The Economics of Survival: Climate Finance for MSMEs and Beyond



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INTRODUCTION

Climate change has emerged as a critical economic and environmental challenge, demanding urgent attention across all sectors of society. One way to combat climate change and its effects is to regulate emissions and promote renewable energy and sustainable development towards ESG (Environmental, Social, and Governance). The Father of the Green Revolution, M.S. Swaminathan proposed the idea of an “Evergreen Revolution” in India, and the United Nations Environment Programme (UNEP) has played a significant role in defining and supporting the “Green Economy” to lessen the environmental dangers. India’s economy is among the world’s fastest-growing and rising markets in terms of growth. Global Climate Risk Index 2021 ranks India as the seventh most susceptible country to climate change, with a loss of USD 69 billion, as evidenced by the country’s vulnerability.

For developing economies like India, the Micro, Small, and Medium Enterprises (MSME) sector plays a crucial role in driving economic growth and providing employment. The MSME sector is a cornerstone of India's economy, contributing significantly to GDP, Exports and Employment. With over 63 million MSMEs across the country, these businesses account for approximately 30% of India's GDP and employ more than 110 million people. The sector's importance is evident in its ability to foster entrepreneurship, stimulate regional development and support low-income communities. Yet, due to their size and limited resources, MSMEs often struggle with the financial burdens and risks associated with climate-related disruptions.

A study conducted by the Centre for Study of Science, Technology & Policy (CSTEP) on the Scope for Deep Decarbonisation in the MSME Manufacturing Sector tells that across seven clusters of MSMEs manufacturing sector like Pharmaceutical, bakery, textiles and rest, annually abated carbon dioxide is 1,36,581 tonnes [1].



A report by The Energy and Resources Institute (TERI) mentions that MSMEs account for nearly 25% [2] of the total energy consumption within India's industrial sector. Of this, 85% [2] constitutes thermal energy usage, with the remaining 15% being electricity consumption. The sector's projected energy consumption is expected to result in emissions equivalent to over 72 million metric tonnes [2] of CO₂ by 2030.

It is necessary to provide financial support for projects that reduce carbon emissions and pollution and improve energy and resource efficiency in fields such as clean technology.

CLIMATE CHANGE

Climate Finance refers to local, national or international funds that support climate mitigation and adaptation activities. Mitigation efforts aim to reduce greenhouse gas emissions, while adaptation focuses on adjusting to the effects of climate change. For MSMEs, Climate Finance can facilitate the adoption of sustainable practices, development of green technologies and implementation of risk management strategies to cope with the impacts of climate change. The sources of climate finance include government funds, international organisations, private sector investments and innovative financing mechanisms such as green bonds.



Fig. 1: Green Economy Indicators

Challenges in Climate Finance for MSMEs

1. Limited Access to Finance

One of the primary barriers for MSMEs is limited access to affordable finance. Many small businesses find it difficult to secure loans due to their lack of credit history, inadequate collateral and high-risk perception by financial institutions. Accessing finance has been a significant barrier for MSMEs across India. A study by the International Finance Corporation (IFC) found that only 16% [3] of MSMEs in India are funded through the formal banking system, leaving a credit gap of approximately USD 240 billion [3] (INR 16.66 trillion) as of 2018. The Reserve Bank of India highlights that 93% [3] of MSMEs lack access to formal or informal financial systems. This financial exclusion makes it difficult for MSMEs to access climate finance, which often operates through formal financial channels with stringent requirements. The cost of implementing climate adaptation or mitigation strategies, such as adopting renewable energy or energy-efficient technologies can be prohibitive without sufficient financial support.

The Ministry of Finance (MoF), in collaboration with the Department of Economic Affairs (DEA) and the Ministry of MSMEs (MoMSME), is responsible for managing the

distribution of financial support to MSMEs, including climate finance. The DEA's Climate Change Finance Unit (CCFU) serves as the central body for climate-related financial matters. However, despite the establishment of the CCFU, India lacks a comprehensive coordination mechanism to streamline climate finance, making it difficult for MSMEs to secure the resources necessary for transitioning to low-carbon technologies.

2. Knowledge and Awareness Gaps

There is often a lack of awareness among MSMEs regarding the risks posed by climate change and the benefits of sustainable practices. Many enterprises lack the knowledge or resources to identify suitable climate finance mechanisms, hindering their ability to adopt green technologies or climate resilient business models. This information gap extends to understand the potential return on investment for climate-related initiatives, which can deter MSMEs from pursuing sustainable practices. Financial products can be poorly suited to MSME investments, possibly because funding is difficult for intermediaries and MSMEs to access, or there are high costs and high risks associated with MSME lending.

3. Regulatory and Policy Barriers

While India has made strides in developing policies to address climate change, the regulatory landscape can be complex and challenging for MSMEs to navigate. Compliance with environmental regulations, coupled with the costs of meeting standards, can be a significant burden. Inconsistent policies, lack of targeted incentives for MSMEs and bureaucratic hurdles further exacerbate the difficulties in accessing climate finance.

It is observed that 16 percent of MSMEs in India receive financing through the formal banking system, as many are unable to meet the strict regulatory requirements. Climate finance in India also flows primarily through formal, regulated channels, including Union and State Budgets, national climate funds, the National Adaptation Fund, private sector, and international sources. However, the stringent



eligibility criteria of these mechanisms often exclude MSMEs. For example, international climate finance bodies, like the Green Climate Fund (GCF), require proposals to come from accredited entities or qualified financial institutions partnered with GCF-accredited entities, making it difficult for MSMEs to access these resources directly.

4. Vulnerability to Climate Risks

According to the 2021 Biennial Update Report (BUR) [4] of India released by the Ministry of Environment, Forest and Climate Change (MoEFCC), the MSME sector in India is widely using outdated technologies and processes, resulting in higher energy intensity. The needs of the sector require innovation in financing models, such as incentive and blended-based financing in order to achieve low carbon pathways. MSMEs are highly susceptible to climate risks, such as extreme weather events, resource scarcity, and disruptions in supply chains. These risks can lead to business interruptions, higher operational costs and damage to infrastructure. The limited resilience of MSMEs to absorb such shocks makes it critical for them to access climate finance for adaptation measures. However, financial products tailored to the needs of MSMEs are often scarce.

Opportunities for MSMEs in Climate Finance

1. Green Bonds and Blended Finance

The growing market for Green Bonds and blended finance provides MSMEs with an opportunity to access capital for sustainable projects. Green

bonds, which are specifically designed to fund climate friendly initiatives, can be used by MSMEs to invest in energy efficiency, waste management, and renewable energy projects. Blended finance, which combines public and private funding, can help to reduce investment risks and encourage private sector participation in climate-related projects. Private sector climate finance investment will need to grow significantly to reach the USD 1 trillion needed globally each year.

2. Government Incentives and Subsidies

The Indian Government has introduced various schemes to promote sustainable practices, such as subsidies for solar installations, tax incentives for energy-efficient machinery and grants for waste management initiatives. MSMEs can leverage these incentives to reduce the cost of implementing green solutions. Programs like the Credit Guarantee Scheme for Micro and Small Enterprises (CGTMSE) can also facilitate access to credit by providing loan guarantees.

3. Technology and Innovation

The adoption of green technologies can help MSMEs to reduce their carbon footprint and improve operational efficiency. Technological innovations such as energy-efficient equipment, eco-friendly packaging and sustainable raw materials can lower costs and enhance competitiveness. Digital finance platforms and fintech solutions are also emerging as viable channels for providing MSMEs with climate finance, through alternative lending models and peer-to-peer financing.

4. Integration into Global Value Chains

With the increasing focus on sustainability in global



trade, MSMEs that adopt climate-friendly practices can gain a competitive advantage by integrating into global value chains. Large corporations and international buyers are increasingly seeking suppliers with sustainable business practices. By meeting these requirements, MSMEs can access new markets and expand their business opportunities.

Strategies for Enhancing Climate Finance for MSMEs

Strengthening the Financial Inclusion

Enhancing the financial inclusion for MSMEs through targeted credit facilities and financial products can improve their access to climate finance. Developing credit assessment tools that factor in climate risk and sustainability metrics can help financial institutions better evaluate the creditworthiness of MSMEs engaging in green initiatives. Additionally, microfinance institutions and cooperatives can play a crucial role in extending climate finance to small businesses. Scaling up and tailoring the supply of existing products to meet the demand, or designing new structures that can help to overcome barriers. Investors provide intermediaries with financing (debt, equity, grants and risk products including guarantees and insurance), and information on financing opportunities and requirements. Intermediaries provide investors with returns, and information on the performance of investments (financial and climate impact) and their financing needs.

Initiatives to improve climate awareness and provide training on sustainable business practices can empower MSMEs to make informed decisions. Capacity-building programs can focus on educating MSMEs about the economic benefits of climate-resilient practices, available finance mechanisms, and best practices for implementing green projects. Collaboration between government, financial institutions and industry associations can drive these efforts. Identifying marketing, communications and knowledge products which are required to build the credibility of the sector. The 10-year, Ministry of Agriculture-funded Sustainable Modernization of Traditional Agricultural (MasAgro) program in Mexico aims to achieve a sustainable increase in production and maize and wheat yields, mainly among low-income farmers in rain-fed areas. The program combines research on seed enhancement, climate smart agronomic practices and provides capacity building for farmers and extension agents, inputs and crop input financing. A central aspect of the program is the building of a network of networks (e.g. 41 innovation platforms) that facilitates peer to-peer learning.

Policy Reforms and Incentives

Policymakers need to simplify regulatory frameworks and create targeted incentives for MSMEs to adopt climate-friendly practices. Introducing tax rebates, grants or low-interest loans specifically for green projects can encourage more MSMEs to invest in sustainability. Streamlining bureaucratic processes and ensuring that climate policies are inclusive of MSME needs can also enhance access to climate finance.

Capacity Building and Awareness Programs



Green Funds Scheme (GFS), Netherlands

The GFS is a tax credit scheme that encourages stakeholders to make green investments. The GFS allows investors to invest in specific funds that finance environmental projects. Investors receive a below-market interest rate on their investment, enabling the banks to offer cheaper loans to green projects. The lower interest rate is offset by a tax credit and a waiver on dividend and interest payments. As a result of the scheme, 250,000 investors have invested EUR 7 billion in green funds, funding 6,000 green projects.

Public-Private Partnership (PPPs)

Leveraging the public-private partnerships can mobilize the resources for Climate Finance and support MSMEs in adopting sustainable practices. PPPs can facilitate the sharing of technology, expertise and funding to create scalable climate solutions. For instance, collaborations between banks, insurance companies and government agencies can lead to the development of innovative financial products that cater specifically to MSMEs' climate adaptation needs.

Conclusion



While MSMEs are a key focus, Climate Finance has broader implications for the economy and society. It supports the transition to a low-carbon economy by encouraging investment in renewable energy, sustainable agriculture and green infrastructure. Effective Climate Finance can reduce poverty, promote inclusive growth and foster resilient communities. In the long term, aligning financial flows with climate goals will be crucial for ensuring sustainable development.

The economics of survival for India's MSMEs hinges on their ability to access and utilise Climate Finance effectively. While there are significant challenges,

ranging from limited access to finance, awareness gaps to regulatory hurdles, there are also numerous opportunities for MSMEs to harness Climate Finance for growth and resilience. By addressing these challenges through tailored financial products, public-private partnerships and supportive policies, MSMEs can not only survive but thrive in a climate-resilient economy. For India to achieve its climate and economic goals, integrating MSMEs into the broader Climate Finance agenda is essential. A targeted approach to Climate Finance can empower MSMEs to adopt sustainable practices, drive economic growth and contribute to the global fight against climate change.

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*Ready to trade in traffic jams for a cleaner, greener ride?
Sustainable transportation isn't just about getting from point A
to point B - it's about cruising toward a net-zero future with a
little help from climate finance!*

Charging Up the Future: Financing India's E-Mobility Revolution with Climate Funds

SAGARIKA CHAUDHARY



India's electric vehicle (EV) journey is revving up, and it's not just about swapping gas for green. This shift could reshape how we move, breathe, and even do business. But let's be real-going electric is no small feat. We need a lot more than just a handful of EV chargers and government pep talks. Enter climate finance: the behind-the-scenes force that could drive this transition from dreamy to doable. And with the [UNFCCC COP29 summit](#) [1] just convened, India's taking the stage, asking developed nations to put their (green) money where their mouth is.

India's big ask? Fair financing and accountability. Think of it as India saying, "Hey, you guys built your economies on fossil fuels, so how about a little help as we try to clean up the mess?" With over a billion people, a growing economy, and a commitment to net-zero by 2070, India's EV goals are ambitious, yet absolutely essential. Right now, we've got some big programs, from the FAME II scheme to state-level EV policies and a few international funds in the mix, but it's only scratching the surface of what's needed.

"Think of climate finance as the green fuel in the tank of sustainable transportation—revving up for a net-zero ride."



In short, India's racing toward an electric future, but without the funds to supercharge the journey, it risks stalling out. COP29 could change the game, helping India build a roadmap that's not only green but equitable - so buckle up, because this could be one wild (and sustainable) ride!

As the country aspires to meet its ambitious target of achieving [30% electric vehicle \(EV\) adoption by 2030](#) [2], significant funding is essential to build the necessary infrastructure, ensure widespread adoption, and support related policy measures. The article aims to assess the current landscape of climate finance in India, particularly in the context of e-mobility, identifying key gaps in policy, financial mechanisms, and infrastructure. This will help in understanding the barriers faced by both public and private sectors in securing financing for EV projects and laying out scenario-based pathways for financing the EV transition.

Global climate finance is on the move, and for 2022, it's roaring in with a record [USD 100 billion](#) [3] from multilateral development banks (MDBs). Out of this hefty sum, USD 61 billion made its way to low- and middle-income countries, India included, helping fuel projects that tackle everything from renewable energy to sustainable transport. Investment loans led the charge, making up 60% of the total financing, with policy-based and results-based financing following at 18%. It seems the world is opening its wallets wider than ever-but where exactly is the money going?

GLOBAL CLIMATE FINANCE AND TRANSPORTATION IN INDIA



For India, this global funding has been especially helpful in powering up key sectors. Based on India's recent submission to the UNFCCC [4], during 2015-2020, 36% [4] of international climate financing coming into the country was directed toward electricity and renewables - essential for a clean-energy future. The transportation sector took a decent slice of the pie too, with 22% of funds going toward road and highway projects. However, there's a catch: the climate-related impact of these projects sometimes feels like a drizzle rather than a downpour. In most cases, climate outcomes make up less than 30% of total project budgets, leaving a lot to be desired in terms of "green" bang for the buck.

One of the big issues here is transparency. Right now, climate-related benefits are often "self-reported" by donor agencies, with no standardised system in place to verify actual environmental gains. This creates a bit of a guessing game - how much of this funding is truly moving the needle on decarbonisation? With COP29 highlighting the need for accountability, India is joining other nations in calling for a better system. More transparent Monitoring, Reporting, and Verification (MRV) could ensure that climate finance actually drives transformative outcomes, especially in EV adoption and clean transport.

In other words, while global climate finance is putting some serious torque behind India's low - carbon ambitions, the path to a green mobility future might need a tune-up-one that involves clearer reporting, more targeted funding, and less skidding off the climate impact track.

India's EV Adoption Rollercoaster - Full Charge or Just a Spark?

India's transition toward electric mobility reflects the global push for decarbonization and aligns with its climate goals, including achieving net-zero by 2070. India's EV adoption rates are cruising along, but it's a mixed bag across different vehicle types. Leading the charge (quite literally) are electric 3-wheelers, which hold the top spot with a solid 12% [5] market share. Think rickshaws and last-mile delivery vehicles buzzing around the city, saving on fuel costs while cutting emissions. Close behind, the 2-wheelers are zooming forward at 5% [5] - these electric scooters and bikes have become a hit among urban commuters. A dash of subsidies, growing awareness, and a wide variety of models have made them the perfect green alternative for the eco-conscious rider.

Then we've got the commercial 4-wheelers taxis and fleet vehicles holding steady at around 4% [5] market share. With companies and governments finally onboard the green train, these vehicles are rolling into action. For buses, however, it's a slow start at 2% [5]. These EV giants are crucial for green public transport, but high upfront costs and scarce charging infrastructure have kept them on the slow lane.

On the flip side, private electric cars are just getting started with a humble 0.4% [5] market share. Affordability, or the lack thereof, keeps them out of reach for most, and the lack of a robust charging network doesn't help the cause. Finally, light

commercial vehicles (LCVs) are barely inching forward, holding a tiny share of less than 0.1%. Long distances and heavy loads mean that current EV tech doesn't quite cut it yet for these workhorses.

But why aren't we all zipping around in EVs by now? Well, the road to mass adoption is full of potholes. High initial costs-especially for private and commercial EVs-make many think twice. Even with lower running costs, the upfront expense, driven largely by battery costs, keeps most EVs out of reach for the average buyer. Then, there's charging infrastructure-or the lack thereof. Most EV buyers, especially those in rural or semi-urban areas, wonder if they'll be able "juice up"

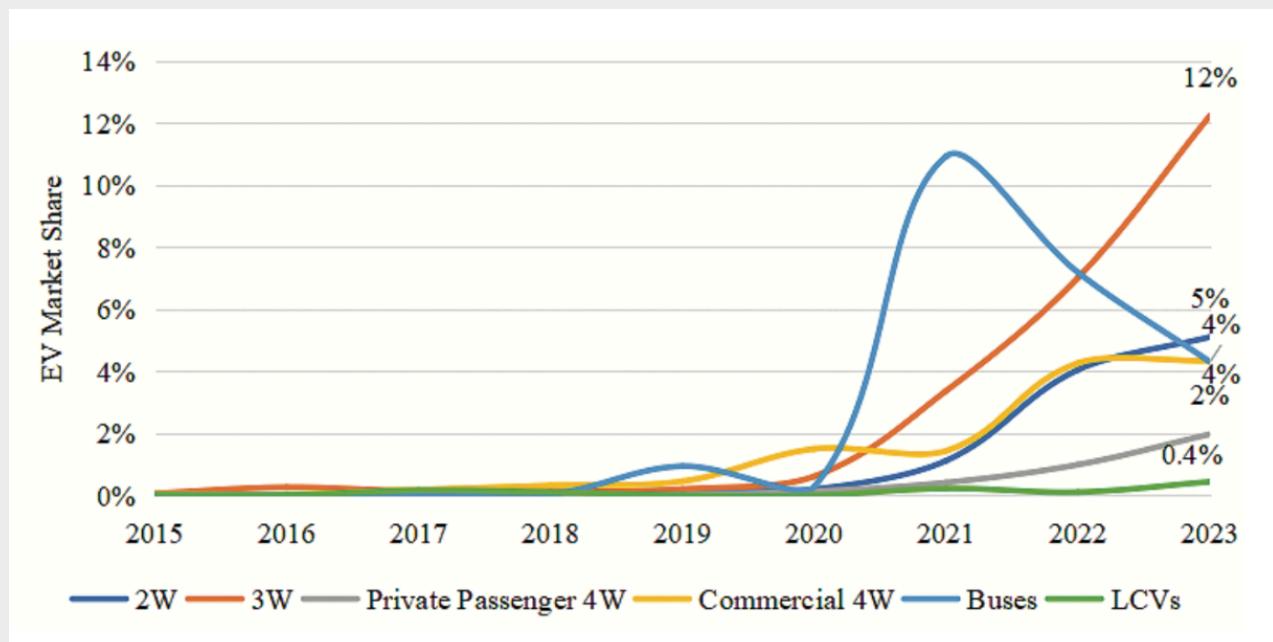


Figure1 : EV market shares by segment from 2015 – 2023 (Jan – Nov)
Source: VAHAN Dashboard, Ministry of Road Transport and Highways, Government of India

when they need to. No one wants to be stranded with a dead battery miles away from the nearest charger!

Battery limitations also mean that range is still a big deal, especially for commercial and light commercial EVs that need to travel far and fast. financing options remain scarce, too. Even with incentives, without proper EV-specific loans or lease options, buying an EV can feel like buying a spaceship. And don't forget, India depends heavily on imported components like lithium-ion batteries, driving up production costs and making us reliant on global supply chains.

India's adoption goal, set by the EV 30@30 campaign [6], is ambitious, aiming for 30% of new vehicle sales to be electric by 2030. However, projections indicate that achieving this target will require an annual compounded growth rate of 38% from 2023 onward. This rapid expansion hinges on a robust ecosystem of policy, infrastructure, and financing support. State policies across India reinforce this goal, with states like Delhi aiming for 25% of new vehicle registrations to be EVs by 2024, while Tamil Nadu targets 30% electrification of its public transportation fleet by 2030. These policies vary in approach, from direct consumer

subsidies and tax waivers to incentives for EV manufacturers to establish local production.

Despite these bumps, there's no shortage of enthusiasm or opportunity. With the right mix of policy support, infrastructure upgrades, financing solutions, and a bit of public EV charm, India could be well on its way to transforming how we get around. But for now, we're accelerating, even if it's still at a cautious pace!



Funding the EV Dream: Current financing landscape

India's EV financing landscape is evolving, with various programs, policies, and incentives aiming to bridge the financing gap, but much remains to be done. At the national level, the Faster Adoption and Manufacturing of Electric Vehicles (FAME) II [7] scheme stands out with a budget of ₹10,000 crore. Launched in 2019 and extended to 2024, FAME II focuses on providing demand incentives for electric two-wheelers, three-wheelers, buses, and passenger vehicles used in public transport. For instance, in the two-wheeler segment, FAME II offers ₹15,000 per kWh of battery capacity subsidy, which has significantly driven up sales in this category. By October 2023, FAME II had allocated ₹7,500 crore to support the deployment of around 7,000 electric buses across various states, and has led to the sale of over 500,000 electric two-wheelers.

The Production-Linked Incentive (PLI) [8] scheme is another key initiative, allocating ₹18,100 crore to boost the local manufacturing of EV batteries and components. This aims to reduce dependency on imports, as battery costs account for 30-40% of an

EV's total price. Under the PLI scheme, manufacturers are incentivised to produce advanced chemistry cells domestically, with the government targeting 50 GWh of domestic battery manufacturing capacity by 2030. This is crucial as India currently imports the majority of its lithium-ion batteries, primarily from China.

At the state level, several governments have introduced additional incentives to attract EV manufacturing and adoption. For instance, Delhi offers a purchase subsidy of ₹5,000 per kWh of battery capacity for electric two-wheelers, with a cap of ₹30,000. Maharashtra provides up to ₹1 lakh in subsidies for electric four-wheelers, along with waivers on road tax and registration fees. Tamil Nadu and Andhra Pradesh have set up dedicated EV policies offering capital subsidies for manufacturers, low-interest loans, and tax incentives, aiming to make these states hubs for EV production and investment. These state-level incentives complement FAME II and drive regional EV adoption in a way that is customised to local needs and manufacturing capabilities.

Banks and non-banking financial companies (NBFCs) are increasingly stepping in to address the need for affordable financing for EV buyers. Leading banks like SBI and HDFC Bank have introduced EV-specific loan products with lower interest rates and extended tenures, while NBFCs like Magma Fincorp and RevFin specialise in financing for electric three-wheelers and two-wheelers. However, challenges remain as traditional financiers remain cautious, particularly about battery degradation, resale value, and the still-nascent resale market for EVs. The risk perception around EVs, especially for commercial vehicles, limits the accessibility of capital and makes it harder for small and medium-sized businesses to adopt EV fleets.

On the global stage, India has tapped into international funding sources to support its EV ambitions. The Green Climate Fund (GCF) approved \$150 million [9] for India's Electric Mobility Program, targeting electric buses and charging infrastructure, with a focus on

reducing air pollution in urban areas. The Asian Development Bank (ADB) [10] has also provided funding support for India's EV push, including concessional loans aimed at public transport electrification. At the ongoing COP29 summit, India is advocating for more equitable climate finance, pushing for structured financing and accountability mechanisms. These international funds, however, are often tied to stringent conditions and require matching funds from Indian agencies, which can slow the disbursement and implementation process.

Despite these initiatives, there remains a sizable gap

between India's financing needs for EVs and the resources currently available. Studies estimate that India needs \$266 billion by 2030 [11] to achieve its electric mobility goals. Given that domestic policies and international climate finance have so far mobilised only a fraction of this amount, innovative financing solutions are urgently needed. Blended finance models, green bonds, and climate-linked financial products could provide the necessary boost. But until these financial tools are fully realised, India's journey toward a fully electrified transportation sector may remain only partially charged.



Figure 2 : Summary of EV policies across states in India

Table 1: Existing and proposed projects financing ZEV transition in India (Sourced from UC Davis Report)

Table 1 enlists initiatives by key players such as the World Bank, International Finance Corporation (IFC), Asian Development Bank (ADB), UN Environment Program (UNEP), Global Environment Facility (GEF), Asian Infrastructure Investment Bank (AIIB), Green Climate Fund (GCF), and various private sector organisations. These institutions are actively contributing to the EV ecosystem through investments, policy engagement, and technical support for developing policy frameworks. They are also backing private companies to expand EV manufacturing and infrastructure, aiming to create a supportive environment for faster EV adoption.

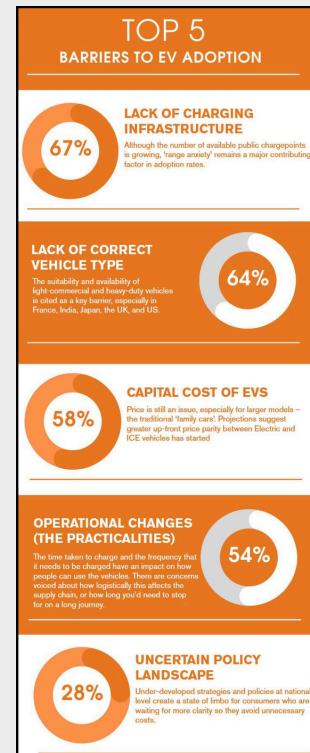
Bridging the EV Finance Gap: A Scenario Analysis for India's EV Transition

Alright, let's talk about money, because India's EV future isn't going to fund itself. We've crunched the numbers, and there's a serious gap between what we've got in the bank and what we need to electrify our roads. Imagine it like this: India's EV dream is a cross-country journey, and right now, we're only a few miles in, with miles of charging stations, battery factories, and e-buses ahead. Here's how we can make it to the finish line under three funding scenarios: low, moderate, and high.

Picture three scenarios, each with its own funding level, impact, and possibilities. Think of it as a "choose your own adventure" book, but instead of pirates and wizards, we have green bonds, EV subsidies, and carbon emissions cuts. Let's see what the future looks like under Low, Moderate, and High Financing scenarios!

Scenario 1: Low Financing (\$5-10 Billion) – The Bare Bones Ride

In this low-budget world, we're looking at the bare necessities. Imagine India's EV dream as a cross-country road trip but in an old car with just enough fuel to get you to the next gas station. With \$5-10 billion, the focus will be on budget-friendly essentials, nothing flashy, but enough to get things moving.



The priority? Affordable EV adoption in segments like two- and three-wheelers, which are the bread and butter of India's roads. This funding level will aim at big cities, installing charging stations in urban hotspots while rural areas will, sadly, be left waiting for their turn.

Now, how do we squeeze the most out of a limited budget? Enter green bonds and public-private partnerships (PPPs). Think of green bonds as the EV version of a public stock offering—targeting eco-conscious investors who want their money to fight climate change. These bonds can attract capital for infrastructure projects by offering tax perks to investors.

Meanwhile, PPPs invite private companies to co-invest in critical areas, like setting up charging stations in high-traffic zones.

But even in this thrifty scenario, there's a catch: progress is limited. With just 10% of vehicles going electric and only 20% of the necessary charging infrastructure in place, we'll only see a modest 15% drop in transport emissions by 2030. It's better than nothing, but this low-gear journey won't win us any green medals.

Table 1: Existing and proposed projects financing ZEV transition in India (Sourced from UC Davis Report)

Projects	Objective	Funding (USD million)	Timelines	Project Leading Agencies
India E-mobility Financing Program Leading Agency ¹	Support faster adoption of EVs and development of EV ecosystem	1,497	2023-2032	Green Climate Fund (GCF)
Green Growth Equity Fund (GGEF) ²	Provision of clean and affordable transportation to the masses	217 ⁴	2021-2030	Green Climate Fund (GCF)
Electrifying Mobility in Cities: Investing in the Transformation to Electric Mobility in India ³	Catalyze access to finance for a large-scale adoption of EV across vehicle segments	168	2021-2025	Global Environment Facility (GEF) (UNEP and ADB led)
Program for Transformative Mobility and Battery Storage: Environmental and Social Systems Assessment ⁴	Accelerate green transition in transport and energy sector	500 ⁵	To be implemented in 2024	World Bank (WB)
Global Facility to Decarbonize Transport (GFDT): Accelerating E-Mobility in India ⁵	Accelerate deployment and adoption of EVs	0.4	NA	World Bank (WB)
GreenCell Electric Bus Financing Project ⁶	Finance procurement of E-buses and development of allied infrastructure	79	2022-2025	Asian Development Bank (ADB), Asian Infrastructure Investment Bank (AIIB), and Clean Technology Fund (CTF)
India: Sustainable Transport Financing ⁷	Finance acquisition of new energy efficient vehicles	100 ⁶	Approved in 2023	AIIB
Napino Auto and Electronics Limited ⁸	Scaling up EV manufacturing facilities	40	Approved in 2023	International Finance Corporation (IFC)
Last-Mile Mobility (LMM) Company ⁹	Scaling up of last mile connectivity in passenger and cargo segments	73	Approved in 2023	IFC
Ather Energy Private Limited ¹⁰	Scaling up production and distribution network of electric 2W	25	To be approved	IFC
British International Investment (BII) and Mahindra & Mahindra Ltd ¹¹	Accelerate availability and adoption of electric four-wheelers in India and other markets served by M&M	244.6	Approved in 2022	British International Investment (BII)
SIDBI and Shell Foundation RSF ¹²	Improve access to finance and scale up the adoption of e2Ws and e3Ws across India	6	Approved in 2023	Small Industries Development Bank of India (SIDBI) and Shell Foundation
Climate-friendly Modernisation of Urban Public Transport in Tamil Nadu ¹³	Support public transport expansion	107 ⁷		German Development Bank (KfW)



Scenario 2: Moderate Financing (\$10-25 Billion) – The Middle Lane Approach

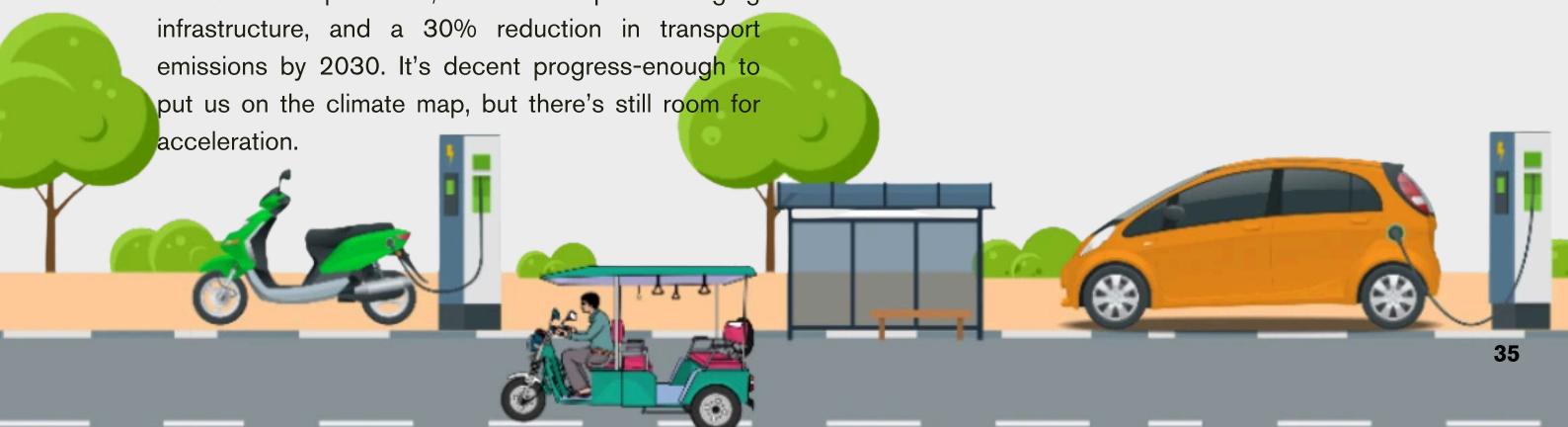
Step it up to \$10-25 billion, and now we're talking! This is the "we're getting somewhere" level, enough to fund a serious transformation without breaking the bank. In this scenario, we're moving out of the city and into semi-rural areas with charging networks and adding incentives for local battery manufacturing. Plus, we might even have enough left over for subsidies on four-wheelers, making EVs accessible for families and businesses alike.

How do we get creative with this mid-range budget? By mixing up financing models. First up, blended finance. Think of it as the financial world's version of a smoothie, where concessional loans (low-interest loans with favourable terms) blend with commercial capital. This mix makes it less risky for private investors, unlocking a larger pool of funds for the EV sector. Banks, which currently prioritise loans for agriculture, could expand priority sector lending to include EVs, offering lower interest rates and making EVs more affordable, especially in rural regions.

To keep up the momentum, we can level up our green bonds by joining hands with development banks like the Asian Development Bank (ADB) or the Green Climate Fund (GCF) to create an "Indian Green Mobility Bond." This extra support could lower EV prices by boosting local production, creating a more competitive market.

Then there's the cool tech stuff, like Battery Swapping and Leasing Models. Here's how it works: battery leasing reduces the upfront cost of EVs, and battery swapping lets you pay only for battery "fuel" as needed. Imagine never needing to wait hours at a charging station—just swap the battery like you would an empty gas cylinder. This pay-as-you-go approach could be a game-changer for India's EV landscape.

So, what do we get with this middle-lane approach? A 20% EV adoption rate, half of the required charging infrastructure, and a 30% reduction in transport emissions by 2030. It's decent progress—enough to put us on the climate map, but there's still room for acceleration.



Scenario 3: High Financing (\$25-50 Billion) – The Full Throttle Vision

Now we're talking. At the \$25-50 billion level, it's full speed ahead! We're looking at a nationwide charging network, massive battery manufacturing plants, and subsidies that make EVs affordable across the board. This is the "go big or go home" scenario that could put India on the fast track to a 100% EV adoption dream by 2030.

Where does this high-octane financing come from? Time to go global! We'd tap into every major international climate fund from the Global Environment Facility (GEF) to the Green Climate Fund (GCF) to back our electric ambitions. And we'd get creative with climate-linked domestic bonds and foreign direct investment (FDI), offering incentives to attract international investors who are ready to fund green infrastructure in one of the world's biggest markets.

To top it all off, priority sector lending could be scaled up, allowing banks to offer low-interest loans for EV purchases and infrastructure projects. And here's a wild idea: crowdfunding climate finance. Imagine smaller-scale investments from regular folks who believe in India's green future, chipping in to support local EV businesses or charging startups. Every rupee counts, and retail investors could bring micro-capital to help cover the last few miles.

Under this scenario, India could see a stunning 40% EV adoption rate, a fully developed charging network, and a whopping 50% reduction in transport emissions by 2030. This isn't just a path to an EV future – it's a superhighway!

SCENARIO ANALYSIS FOR INDIA'S EV TRANSITION

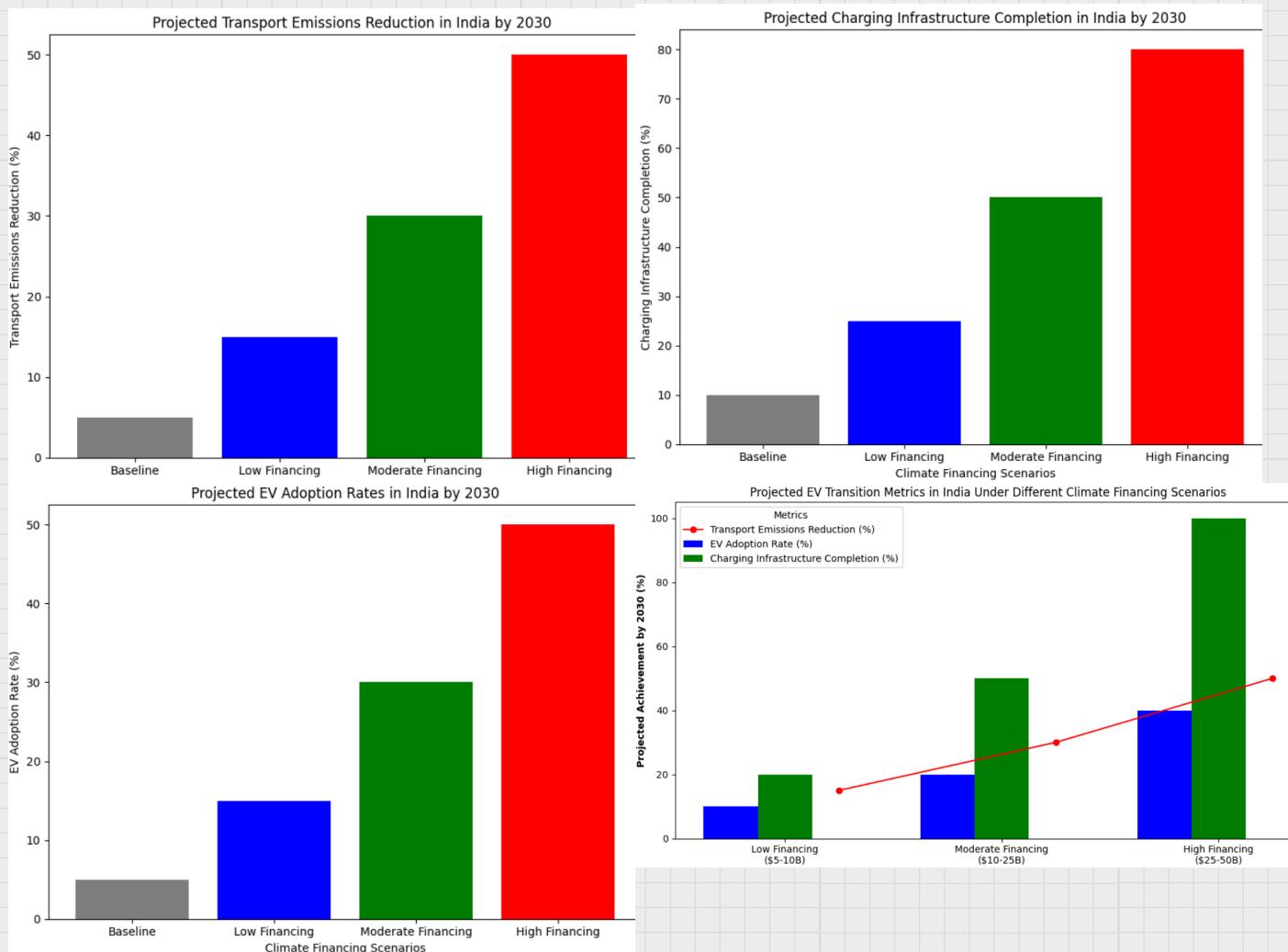
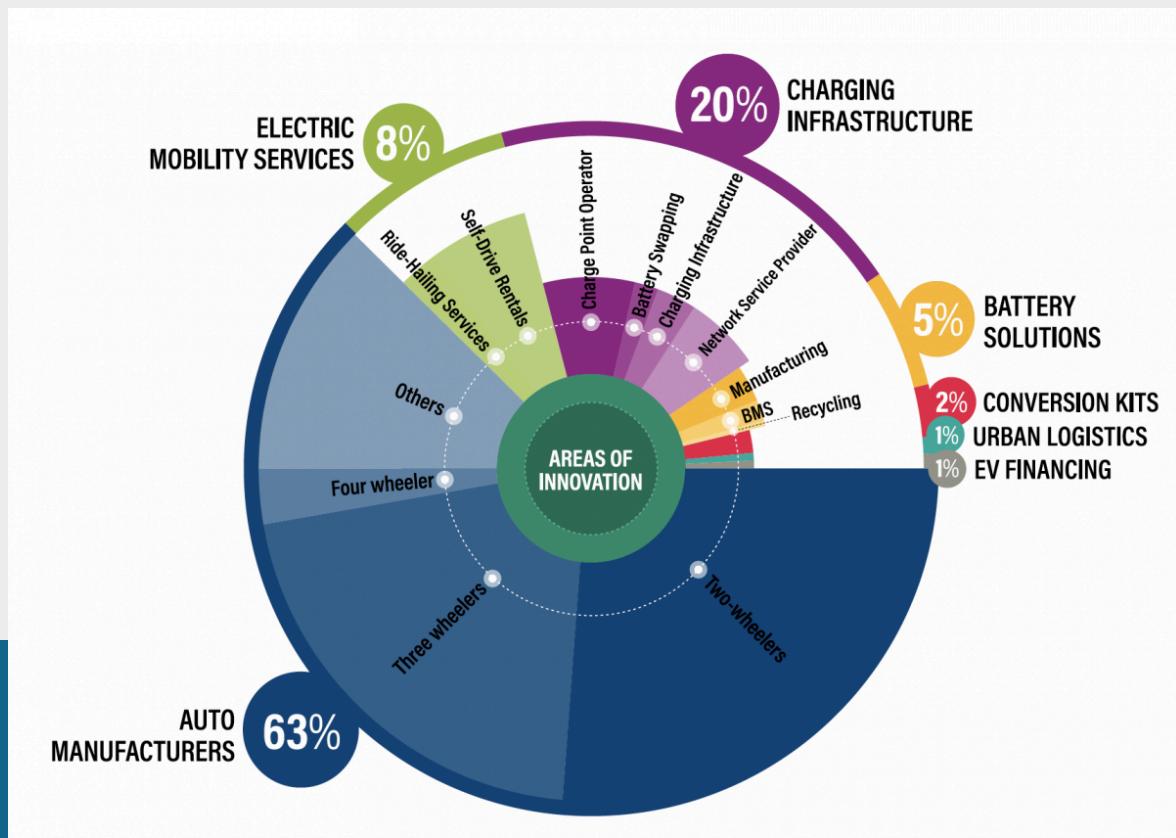


Figure 3: Self analysis on EV trajectory for India in domains of charging infrastructure, transport emissions and EV adoption rates across three scenarios of low financing, moderate financing and high financing





The Road Ahead for India's EV Journey

So, where do we go from here? Each scenario presents a different path, with the Low Financing option as a modest start, the Moderate Financing approach as steady progress, and the High Financing dream as a transformative leap.

In the Low Financing world, we're getting a mere taste of what EVs could offer, with limited progress in urban areas and a small dent in emissions. Moderate Financing gives us momentum, expanding EV reach to semi-rural regions and slashing emissions by a more substantial 30%. But it's the High Financing scenario that really electrifies things, positioning India as a global leader in green transport and cutting emissions by half.

To hit that High Financing sweet spot, India needs a mix of international support, innovative finance models, and crowd-sourced investment. The goal? Create an EV ecosystem so attractive it draws in private investors like bees to a blooming flower. Policies and incentives will be key, but we'll also need public enthusiasm, especially if we go down the crowdfunding route. As India accelerates its journey towards a cleaner transportation future, the need for streamlined financing and coordinated policy frameworks has never been greater. A robust approach will require aligning national and state-level policies to create a cohesive pathway for EV adoption.



This means adopting flexible national targets that allow each state to customise implementation based on unique local needs. For instance, while Maharashtra and Gujarat could lead manufacturing initiatives, states in the Northeast could collaborate on EV policy standards, creating regional zones of cooperation that leverage both demand and supply benefits.

Attracting international financing is another critical piece of the puzzle. India could establish "Green Mobility Bonds" with development banks to draw in both foreign and domestic investors, while blended finance models-combining concessional loans with private capital-can help reduce risks for commercial

investors. Crowdfunding could even allow everyday Indians to contribute small investments toward local EV projects, making the transition a grassroots effort with broad public support.

Beyond subsidies, EV policies should prioritise inclusivity and innovation. For example, introducing incentives for used EVs and rural mobility solutions would ensure the transition is equitable and far-reaching. Policymakers can also drive innovation by supporting models like battery leasing, which reduces upfront costs for consumers, and setting enforceable targets by vehicle type, especially for challenging segments like freight.

Recommendations for India's National and State Governments	Recommendations for International Financial Institutions
<p>1. Consider setting enforceable EV targets by vehicle type, including hard-to-abate segments.</p>	<p>Look to create a platform for greater engagement with states while designing financing initiatives – the ZEV Country Partnership with India could provide this.</p>
<p>2. Explore options for creating program-based EV transition roadmaps that are aligned to targets including infrastructure.</p>	<p>Consider coordinating with the global international financial ecosystem on activities and programs. This could be facilitated through the ZEVTC International Assistance Taskforce and the delivery framework of the Global ZEV Transition Roadmap.</p>
<p>3. Look to integrate equity within EV policy frameworks.</p>	<p>Leveraging the India ZEV Country Partnership Framework to support a dialogue on creating a Results-based or a Policy-Based Financing approach to EV transitions.</p>
<p>4. Coordinate with other States for regional cooperation and policy best practice sharing.</p>	<p>Explore opportunities to promote market innovation and technology development.</p>

A National Monitoring, Review, and Verification (MRV) mechanism [12], led by the Ministry of Heavy Industries in collaboration with other key agencies, could provide a dynamic framework for tracking progress, enabling real-time adjustments, and fostering collaboration among national, state, and international stakeholders. International financial institutions (IFIs) also have a vital role to play; by establishing a common engagement platform, IFIs can better coordinate their support, avoid duplication, and maximise impact.

India's EV transition is a multifaceted endeavour that demands bold policy moves, strategic financing, and strong partnerships. By embracing this comprehensive approach, India can not only accelerate its clean transportation goals but also serve as a model for sustainable mobility transitions globally.



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Carbon Chronicles: How Emission Trading is Financing Our Planet's Future

GRACE GILL & VAASU AGGARWAL

As the climate crisis intensifies, global negotiations have taken centre stage, making each Conference of Parties (COP) under the United Nations Framework Convention on Climate Change (UNFCCC) a critical moment for shaping climate policy and fostering collaborative action. COP29 holds particular importance as developing economies like India work to balance ambitious climate goals with economic growth. A major focus area in these efforts is the role of carbon pricing.

Carbon pricing provides a way to embed the cost of greenhouse gas (GHG) emissions into the prices of goods and services, influencing both producers and consumers. The most widely used carbon pricing mechanisms in compliance markets are carbon taxes and emissions trading systems (ETS), also known as cap-and-trade systems. Carbon taxes set a fixed price on GHG emissions, typically applied through existing tax structures, without directly capping emissions.

Carbon Markets Mechanism

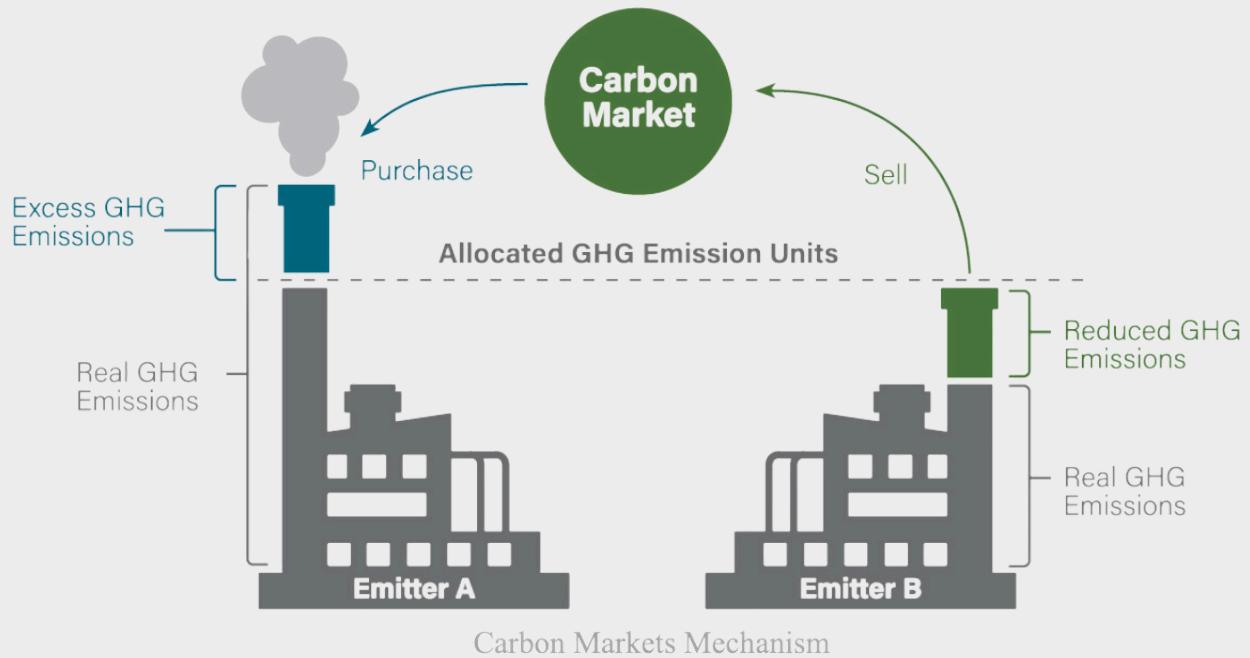
In contrast, an ETS allows emitters to buy and sell emission permits, with the market itself setting the carbon price based on supply and demand. Both approaches are crucial for driving down emissions, spurring investment in low-carbon technologies, generating government revenue, and fostering sustainable economic growth—all of which support the shift to a low-carbon future.

Carbon markets have emerged as a vital component of climate finance, facilitating the reduction of greenhouse gas emissions while promoting economic sustainability. These markets operate on the principle of putting a price on carbon emissions, thereby internalising externalities - social costs related to environmental damage that are not typically accounted for in traditional market transactions which leads to production over and above the socially optimal level of output.

By assigning a financial value to carbon emissions, carbon markets create a powerful incentive for businesses and governments to adopt cleaner technologies and practices, effectively integrating environmental considerations into economic decision-making. The rationale behind this is based on the "polluter pays" concept, wherein the emitter is charged for the emissions that are released into the ecosystem. There are two broad types of markets, namely; compliance and voluntary carbon markets.

Compliance markets are structured by regulatory bodies that enforce emissions limits on specific industries. These industries must meet set emissions standards by either reducing their own emissions or purchasing carbon credits to offset any excess emissions. Compliance markets blend command-and-control policies with market-based flexibility: where regulatory bodies set the emissions cap, and companies choose to comply either through direct reductions or by buying credits. This approach aims to ensure that industries meet climate goals while providing autonomy in how they achieve them, achieving economic efficiency in the process where the desired goals are met with minimum social costs.

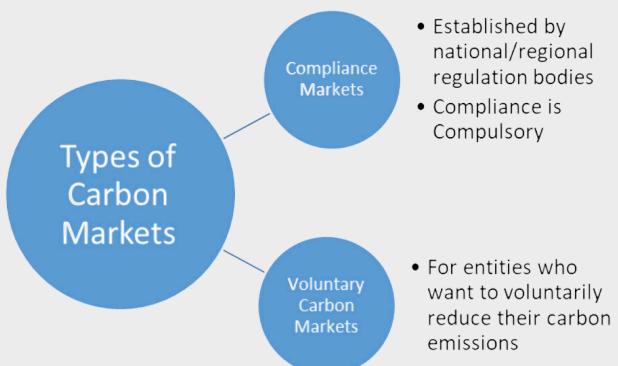
Voluntary carbon markets enable participants to offset their GHG emissions by purchasing carbon credits on a non-mandatory basis. Unlike compliance markets, which are regulated and enforced, voluntary markets operate independently of legal obligations, driven by environmental goals, corporate social responsibility, or consumer demand. Participants often seek to meet self-imposed sustainability targets of reducing their carbon footprint, or enhancing their reputation for environmental stewardship. By purchasing credits from projects that reduce or remove emissions, such as reforestation or renewable energy initiatives, entities contribute to reduction in global emissions while demonstrating their commitment to climate action.



Carbon markets have evolved significantly since their inception in the Kyoto Protocol. The Clean Development Mechanism (CDM), one of the three market-based mechanisms under the Kyoto Protocol, allows industrialised countries to invest in carbon-reduction projects in developing countries, thus earning certified emission reductions (CERs) which can then be used to meet their own national targets. Since then, carbon markets have continued to grow, notably with the introduction of the Paris Agreement's Article 6, which establishes frameworks for international carbon trading [1]. The demand for carbon credits is also on the rise due to increasing corporate pledges for net-zero targets and national commitments to reduce emissions under the Paris Agreement.

India is a significant player in the global fight against climate change. As the 5th largest economy in the world and one of the fastest-growing markets, the nation faces a unique set of challenges in balancing economic development with environmental sustainability. At COP26, India announced its ambitious goal of achieving net-zero emissions by 2070. As part of its Nationally Determined Contributions (NDCs), India also committed to reducing its emissions intensity (emissions per unit of GDP) by 45% by 2030 compared to 2005 levels [2],

and increasing its share of non-fossil fuel energy capacity to 50% by the same year.



In 2007, Delhi Metro Railway Corporation (DMRC) became the first metro or railway project in the world to be registered by the United Nations under the Clean Development Mechanism (CDM), which is a project-based greenhouse gas (GHG) offset mechanism under the Kyoto Protocol that enables both public and private sectors in high-income countries to buy carbon credits from emissions-reducing projects in low- and middle-income countries. CDM allows DMRC to claim carbon credits for its clean energy projects. Delhi metro raised almost INR 20 crores [3] from the sale of 3.55 million carbon credits earned over a period of six years.

Currently, there are two incumbent market mechanisms in India which incentivises regulated

entities to reduce/offset their carbon emissions, which are the PAT and the REC scheme. Under the PAT (Perform, Achieve and Trade) scheme, the Bureau of Energy Efficiency (BEE) sets specific energy consumption targets for various industries to encourage greater efficiency and lower emissions. Under this, regulated entities that surpass their designated energy-saving targets are awarded Energy Saving Certificates (ES Certs). These ES Certs can then be traded on the market to industries that fall short of meeting their targets, allowing them to purchase certificates as a way to comply with PAT requirements. This trading mechanism incentivizes energy-efficient practices by financially rewarding companies that excel in reducing their energy use, while providing a flexible compliance option for companies facing challenges in meeting targets. However, the PAT scheme has been criticised for establishing overly modest targets leading to an oversupply of targets, bringing down the prices of ES Certs. Industry experts emphasise that the CCTS must learn from these shortcomings by setting more challenging targets for both individual companies and sectors, considering best practices and going beyond existing policies to ensure the market drives genuine progress rather than mere compliance.

Similarly, the Renewable Energy Certificate (REC) scheme mandates that industries source a specific percentage of their energy consumption from renewable sources, such as wind, solar, or biomass. Industries that exceed this renewable energy requirement earn RECs as recognition of their efforts, where one REC (Renewable Energy Certificate) represents 1 MWh of energy generated from renewable sources. These RECs can then be traded only once with other industries that are unable to meet their renewable energy targets, allowing companies to fulfil their obligations by purchasing certificates from more energy-efficient counterparts. The scheme creates a compliance marketplace that promotes the use of renewable energy by encouraging industries to adopt cleaner energy sources. It offers incentives for those working to meet

them, facilitating a sector-wide shift towards renewable energy and helping build a more sustainable energy future. Indian Energy Exchange's (IEX), India's Premier Power Exchange providing a nationwide automated trading platform for the physical delivery of electricity, renewable energy, and certificates, total trade volume rose 4 per cent year-on-year to 9,642 million units (MU) with over 4.44 lakh renewable energy certificates (RECs) being traded, recording a staggering 105% year-on-year increase. [4]

The implementation of the Energy Conservation (Amendment) Act 2022, paves the way for the establishment of a Carbon Credit Trading Scheme (CCTS), marking a significant milestone in India's climate policy landscape. The market regulated by BEE, builds on these two established frameworks and broadens their scope by creating a single unified carbon market. The market is set to be rolled out in a phased manner, the timelines of which are aligned with the implementation of Carbon Border Adjustment Mechanism (CBAM) in the European Union (EU), which is set to be rolled out in 2026.

The CBAM is a proposed policy by the EU aimed at reducing carbon leakage and ensuring fair competition in global markets, imposing a carbon tax on certain imported goods based on their carbon footprint, aligning their carbon costs with those faced by EU producers under strict emissions regulations. The primary goal of CBAM is to encourage non-EU countries to adopt similar climate policies, preventing companies from relocating production to regions with looser environmental regulations, a practice known as carbon leakage. CBAM initially targets high-emission sectors like steel, cement, and aluminium, with plans to expand in the future. By equalising carbon costs, CBAM supports the EU's climate ambitions while fostering a global shift toward lower emissions.

India being the second-largest producer of steel in the world [5] and with approximately 30% of the nation's iron and steel exports being to the EU,

additional tariffs of 13% and 6% on steel and aluminium respectively would amount to an estimated loss of revenue worth \$1–1.7 billion [6] which would be paid to the EU as compliance costs. However, with the introduction of CCTS this loss of revenue could be internalised and kept within the nation as the CBAM states that nations be “allowed to claim a reduction in the number of CBAM certificates to be surrendered corresponding to the carbon price already effectively paid in the country of origin for the declared embedded emissions.” [7]

This implies that industries already subjected to a carbon price in their home country may be partially or fully exempted from CBAM, depending on how their

domestic carbon price compares to that under the EU Emissions Trading System (EU ETS). Thus, implementing carbon pricing mechanisms in India could serve a dual purpose of preventing revenue losses from CBAM while advancing India's NDCs by reducing greenhouse gas emissions.

However, the scheme has a lot to overcome before the final rollout. The challenges originate from the fact that the sectors targeted are wide and involve organisational complexities. Below mentioned are some of the challenges that can be overcome by leveraging resources properly and with a structured approach.



Challenges

- Notably, India's carbon credit trading system (CCTS) excludes major polluting sectors like electricity and agriculture. Albeit the reason can be difficulty in ascertaining the complete sub-components of these sectors at the initial stages. Example, methane emissions from livestock or waste decomposition are less consistent and harder to track than industrial emissions. There is another trade off when it comes to exclusion of agriculture initially. That is, inclusion will lead to rise in costs for farmers that will eventually lead to harm in food security and further marginalisation of small farmers.
- Secondly, experts involved in the scheme's rollout predict minimal improvements in air quality until 2031, as the system only covers about 30% of the country's emissions [8], leaving a large portion unregulated. India's total GHG emissions are approximately 2.6 billion metric tons [9] of CO₂ equivalent annually. So, with only 30% covered, that leaves around 1.8 billion metric tons outside the immediate scope of the carbon trading scheme, which is a big number.
- There is a delay in rollout, because of which some issues might arise. The EU's ETS was launched in 2005 and has gone through several reforms over

its four phases till date. California's Cap and Trade (CaT) has also seen several reforms since its launch in 2013. China's ETS was launched in 2021 after almost nine years of sub-national pilots. So, India is bound to take many years till all the sectors are included. Considering, we have global deadlines for adoption of renewable energy and net-zero, the expedite in the process seems essential.

- The right pricing is another challenge that needs pertinent attention. The experience with the perform, achieve and trade scheme so far suggests that it seems to have had lax targets, resulting in an over-supply and under-pricing of energy saving certificates (ESCert). A survey conducted by CEEW and Shakti Sustainable Energy Foundation [10] showed that nearly 60% of participants (mostly industrial units) considered the PAT targets easy to achieve with minimal additional effort, leading to excess ESCerts in the market.
- Another major challenge is overlapping functions. In India, there are overlapping responsibilities between ministries. For instance, while the Ministry of Power is primarily responsible for energy efficiency, the Ministry of Environment, Forest and Climate Change (MoEFCC) oversees broader climate policies. India's CCTS system has been critiqued for ambiguous enforcement and weak compliance penalties, which are handled by different agencies. In the EU ETS,

technical recommendations and policy decisions are generally handled by expert groups directly under the European Commission, like the Climate Change Committee. This committee provides technical inputs, but the EC has final say on most operational matters, reducing the potential for disagreements or delays.

- Then comes the strictness in following the penal provisions if companies are found flouting the rules. There is no publicly available data on any penal provisions being invoked against defaulting entities under the perform, achieve and trade scheme. In contrast to India's PAT scheme, the EU ETS has a centralised and well-enforced penalty structure. Non-compliance with emissions caps results in a standardised fine, which as of recent years, is set at €100 per ton of excess CO₂ emitted beyond allocated allowances.





Here is an example of a company penalised under the EU ETS:

Airlines faced penalties for failing to submit a sufficient number of emissions allowances on time. The airline was subject to fines per ton of emissions that exceeded its allowances.

Therefore, before there is a thrust on CCTS, the procedure for a strict action against the defaulting entities has to be clearly stated.

- Currently, the scheme does not have a clause for revenue generation. California's cap-and-trade system includes quarterly auctions of allowances, which have become a significant revenue source for the state. New Zealand's ETS uses its revenue through auctions for indigenous and forestry initiatives. Therefore, the method of revenue generation has to be clearly defined in the CCTS.
- The informal sector of India throws a challenge in a way that MSMEs contributing 30 per cent to total GDP rely on thermal energy substantially. CCTS aims to include large industrial sectors, but many rely on MSMEs. Obtaining accurate emissions data from MSMEs, often lacking due to informal fuel sources, is a problem that needs to be addressed.

CCTS can enhance export competitiveness while encouraging industries to invest in carbon-reducing technologies. By emitting less, companies can generate tradable credits, creating an additional source of revenue. CCTS in addition to domestic investments, also opens up opportunities for foreign investments through cross-border carbon credit trading. By aligning economic interests with environmental goals, frameworks like CCTS could help industries transition to greener practices while enhancing their resilience and competitive edge on the global stage. In this way, CCTS not only supports a low-carbon economy but also positions national industries as leaders in sustainable innovation.

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India's Transition to Circular Economy

K. Shruti Prakash



Introduction

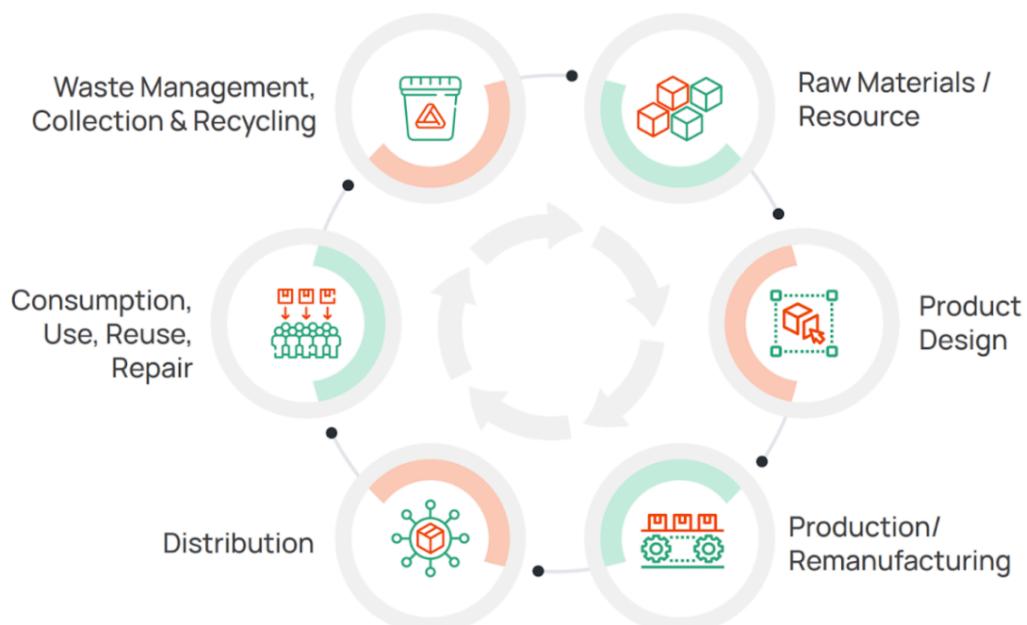
Every day, we are confronted with alarming news reports highlighting resource shortages and pollution across India. We are not only grappling with a severe shortage of basic resources like water and food, but we also rank among the largest polluters in the world, facing widespread waste disposal issues and environmental degradation. This is not just an Indian problem; it is a global reality. But why is this the case?

One of the primary drivers of this situation is the linear extraction model on which we currently rely. In today's economy, resources are extracted, transformed, and discarded at an astonishing rate, creating vast amounts of waste and contributing to environmental degradation. Every stage—from extraction and production to disposal—generates by-products and waste, leading to resource depletion and escalating pollution. As a result, the exploitation of resources and generation of waste continue to rise, with no end in sight.

But what if there were an alternative model that could reverse this cycle? Enter the circular economy—a system designed to minimise waste, maximise resource efficiency, and keep materials in use for as long as possible. By rethinking how we approach production and consumption, the circular economy offers a path to reduce waste, lessen environmental impact, and build a more sustainable and resilient future. This is the focus of the article that follows.

What is Circular economy?

The circular economy (CE) represents a transformative shift from traditional linear practice toward a closed-loop model that keeps resources in use for as long as possible. Rather than discarding products after a single use, the circular economy reimagines every stage of a product's lifecycle—from design to disposal—to minimise waste, conserve resources, and reduce environmental impact.



Source: Kalaari [1]

A circular economy can be best achieved by a 9R framework [2], which offers a roadmap for maximising the value of materials while reducing waste. The framework begins with Refuse (avoiding unnecessary consumption) and Rethink (reimagining ways to use products), moving through Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, and Recover. Each step emphasises the responsible use and repurposing of materials, with each step forming part of a broader strategy that addresses the entire lifecycle.

The circular economy, thus, goes far beyond recycling. While recycling primarily addresses the end-of-life stage of a product's lifecycle by recovering value from materials that would otherwise become waste, the circular economy takes a more comprehensive approach. It considers the entire lifecycle of products and materials—from design and production through consumption and end-of-life management – aiming to create a system where resources are continuously reused and waste is minimised at all stages.

The need for a circular economy in India

A fundamental issue with the current linear economic model is the finiteness of resources. Given the large population and the rapid growth trajectory, this resource finiteness is a major constraint for India because we have a limited pool of resources to extract raw materials from and discharge waste into. As a result, the linear economy model creates intense pressure on the nation's resources and environment. This fallout is visible on various fronts, in the form of over-exploited groundwater reserves, depleting forest cover or soaring pollution levels. To ensure a thriving economy and good living conditions for our population, the circular economy approach must be adopted to ensure that resources are used as efficiently as possible.

In addition to countering indiscriminate resource extraction and pollution, the circular economy can also help reduce the massive inequalities that India faces.

help reduce the massive inequalities that India faces. Resource scarcity disproportionately affects lower-income communities, increasing their hardships.

Currently, around 5% of the population- 63 million people [1]-still lack access to clean drinking water, and 20%, or 240 million, remain without electricity. Similarly, over 50% of the population lacks adequate sanitation facilities. By optimising resources and promoting equitable access, the circular economy supports India's sustainable development goals (SDGs), providing economic and environmental benefits for all. Embracing a circular economy is essential for building a resilient, inclusive, and sustainable future in India.

India's reliance on conventional energy sources-67% of its production [1]-adds to environmental stress and dependency on imports, especially for oil and gas, which meet 77% of the country's energy needs. This reliance makes India vulnerable to global market shifts, as seen with recent geopolitical conflicts. A circular economy that prioritises renewable energy and resource efficiency supports the government's vision of "Atma Nirbhar Bharat" (self-reliant India) and builds resilience against economic shocks.

Key Potential Sectors in India's Circular Economy Transition

Transition to a circular economy is essential across a wide range of sectors in order to truly embrace sustainable development. The table below lists some of the key sectors which can be transformed in India. Most of these sectors have a huge socio-environmental impact associated with their production and generate large quantities of waste. Conversion to a circular economy, while generating economic benefits in terms of recycling markets and employment will also result in a significant reduction in the production of virgin materials thereby reducing the overall socio-environmental impact of these sectors.

Sector	Socio-environmental impacts resulting from production	Annual Waste Generated	Potential Economic benefit from a circular economy
Textile industry (3rd highest fast fashion waste)	<p>Increasing landfills: Current: 18.6 million tons per year 2050 (projected): 150 million tons per year</p> <p>Resources used in production: Energy: 1.24 million [3] total oil equivalents</p> <p>Water: 200 litres per 1 kg of textile</p> <p>India is also the third-highest user of textile chemicals [4].</p>	<p>Current- 92 million tons annually [5]</p> <p>2030 (projected): 134 million tons annually</p>	<p>Recycling 1,000 pieces of textile waste can create approximately 20 green jobs [6]. Less than 1% of waste is recycled. Hence, significant revenue lost from the potential use of recycled fibres</p>
Plastic waste(Highest global plastic pollution)	<p>Social Cost in India: US \$62-96 [7] billion (2023). This includes the cost of production and improper disposal.</p> <p>Plastic production contributes to fossil fuel extraction while improper disposal leads to air, soil and water pollution.</p> <p>Numerous negative impacts on human health and ecosystems</p>	<p>Plastic pollution: 9.2 million metric tons (Mt)</p> <p>[8]. Microplastics: 4 lakh tons [9]. Chemical additives: 31000 tons [9] into waterways.</p>	<p>Net present value of benefits by implementing 100% circularity by 2030: US\$170 billion[7].</p>
Agriculture and Food waste (2nd highest in the world)	<p>Soil degradation/ Loss of nutrients (due to fertilisers): ~165 kg/hect. compared to the global average of 138 [10].</p> <p>Burning crop residue: Loss of ~1.4mn tons of nutrients from the topsoil layer.</p> <p>Increasing malnutrition due to food value chain leakage.</p> <p>Land use conversion, high energy and water consumption, pollution from fertiliser and pesticide runoff etc. are other problems associated with agriculture</p>	<p>Current Waste: 350 million tonnes per year [11].</p> <p>Around 73 million tonnes of food is wasted annually in Indian households, i.e. 50 kgs of food per person [12]. Up to 40% of food is lost before it reaches the consumers [1].</p>	<p>Waste to energy potential: ~18000 MV [11]. Value of food lost: ₹92,000 crores per annum [12]. Moving to a circular economy will also reduce fertiliser usage and address malnutrition concerns</p>

Sector	Socio-environmental impacts resulting from production	Annual Waste Generated	Potential Economic benefit from a circular economy
Construction and Demolition (C&D) Waste	<p>Massive resource extraction: India extracts 1580 tonnes of resources per acre compared to the world average of 480 tonnes per acre [13]. Major source of air pollution: A major source of air pollution at all stages from mining to processing to construction (20-30% of urban air pollution) [14]. Ecosystem Impact: Stone and sand mining is one of the leading causes for deforestation and land degradation whilst also affecting riverine ecology. Human Health: Workers employed in mining, and processing are at an increased risk of diseases like silicosis [15].</p>	<p>2021: 150 million tons of waste which is 30-40% of the global waste [16].</p>	<p>Lower recycling rate of 20-25% as compared to 70% in Europe [13]. Hence, there is significant revenue potential associated with the re-use of C&D waste</p>
Lithium-ion battery recycling	<p>Lithium, nickel and cobalt mining are environmentally destructive processes associated with habitat loss and land degradation [17]. Production of lithium batteries is highly energy intensive. Further, improper disposal of lithium-ion batteries leads to soil and water pollution, and battery fires release toxic gases [18].</p>	<p>Current Waste Generation in India: 50,000 tonnes every year (from EVs and devices) [19].</p>	<p>Lost Revenue: Lithium, cobalt, and nickel are valuable but often lost in discarded batteries. ~128 GWh of batteries will be available for recycling by 2030 [20]. Recycling will also reduce dependence on imports.</p>
Solar PV recycling	<p>Solar panels use a variety of raw materials like lead (Pb), Copper (Cu), Silver (Ag), Cadmium (Cd), Silicon (Si) etc which have a significant environmental impact [21]. If not disposed of properly, solar panels are toxic to the environment.</p>	<p>India is expected to create 34,600 metric tonnes of PV waste by 2030 which can rise by 4-5 times in the next decade [22].</p>	<p>Expected to create 2,500 jobs/million tons of waste treated by 2050 [21].</p>

Financing for the Circular Economy

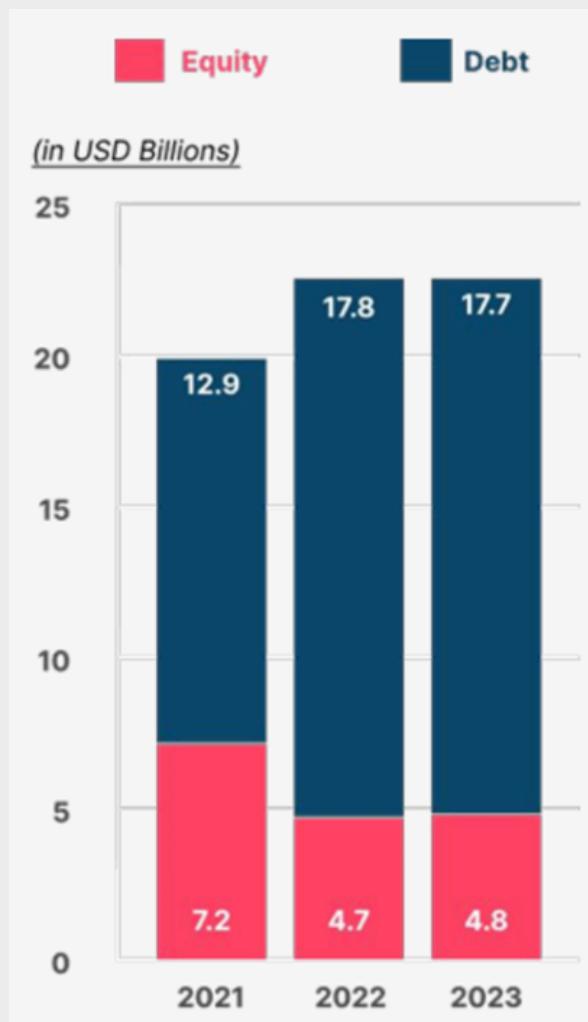
Enabling a circular economy is a capital-intensive process requiring investments in technology, recycling infrastructure and supply chains. As a result, financing is essential for both established businesses and circular economy-based startups to develop the technology and the capacity required to scale up circularity across the value chain. These funding needs can come from both public and private sources.

Government Incentives for the Circular Economy
Government incentives are crucial in accelerating circular economy practices. Public-Private Partnerships (PPP) [2] in areas like textile waste upscaling-where textile waste is transformed into valuable products without traditional recycling processes-are examples of mitigation efforts that reduce resource extraction. Government incentives, including tax breaks, grants, and subsidies, encourage private businesses to invest in sustainable technologies and resource-efficient systems, helping to scale up circularity-based practices.

In India, numerous policies such as the National Resource Efficiency Policy (NREP), Production Linked Incentive (PLI) Scheme, Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME), Swachh Bharat Mission (SBM), Pradhan Mantri Matsya Sampada Yojana (PMMSY), National Clean Energy and Environment Fund (NCEEF) and various State Green Bonds help finance or incentivise circular economy based businesses in sectors like battery recycling, waste management and recycling, fisheries etc [23]. For instance, the Government of Tamil Nadu has created a Rs 1000 crore Green Fund to invest in the circular economy, renewable energy and other projects aimed at mitigating climate change impact [24].

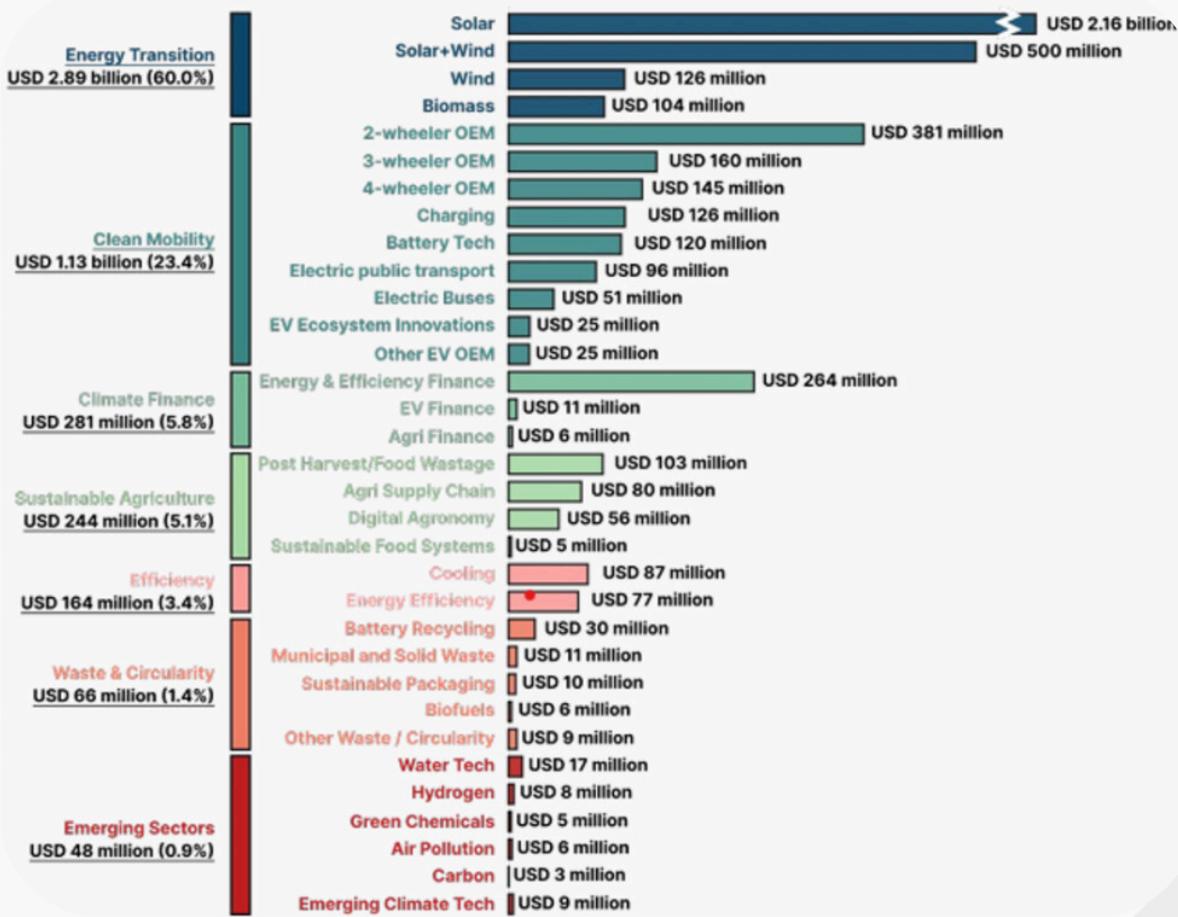
Private Funding

Total climate tech funding in India reached USD 22.5 billion in 2023, with debt financing making up USD 17.7 billion and equity contributing USD 4.82 billion. While equity funding showed a slight increase of 2.5% from 2022, it remained well below the 2021 peak of USD 7.12 billion [25].



Source: The State of Climate Finance in India 2024 [25]

Similar to global trends, climate funding in India has largely been in the Clean Energy and Mobility sectors. In 2023, India's climate tech equity funding was dominated by Energy Transition (60% of total funding), driven primarily by solar investments. Clean Mobility followed with 23.4%, focused on 2-wheeler and 4-wheeler OEMs. Smaller portions went to Climate Finance (5.8%), and Sustainable Agriculture (5.1%), with Waste Management getting just 1.4% of the total.



Source: The State of Climate Finance in India 2024 [25]

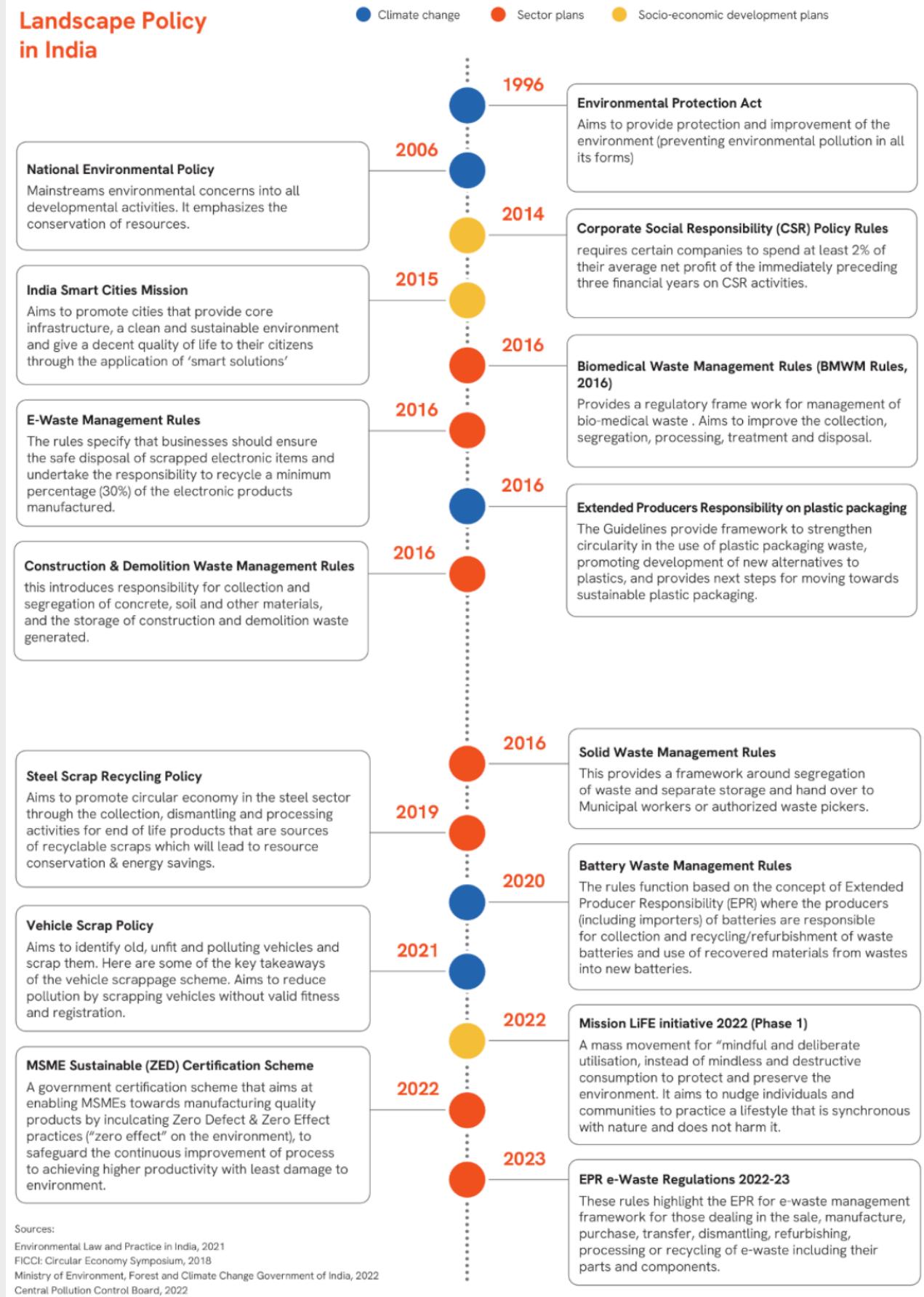
Reasons for low private funding

Solutions in agriculture, waste management and the emerging sectors are essential for enabling circularity. Yet, the amount of funds that have flown into these sectors is far from enough to tackle the scale of the problem. One of the primary reasons for this is the lack of startups in this space. Only around 400 active startups are working in this space across the country [24]. Hence, this modest number of startups limits investment opportunities despite potential investor interest. Appropriate policy measures and incentives must be brought in to encourage organisations to enter this space and develop solutions that can help India embrace circularity.

Key Circular Economy Policies in India

The government has actively formulated numerous policies to promote the adoption of the circular economy in India. The chart below provides a timeline of the policies that have been implemented.

Initially, the focus was on downstream waste management, with key developments including implementing several waste management rules and regulations. However, over time, with initiatives such as Mission LiFE, the government has now started viewing circularity at a more holistic level.



Source: Circular catalyst [26]

EPR Policies in India: Extended Producer Responsibility (EPR) places the onus of recycling and reuse on the producer/ importer/manufacturer of a particular product. The producer is thus responsible for taking the product back after its usage and recycling it. By holding producers accountable for the environmental impact of their products throughout their lifecycle, EPR aims to achieve environmental goals like recycling targets and encourage product design innovations.

Plastic: India's plastic EPR policy is limited to 3 types of packaging (flexible, rigid and multi-layered) and aims to significantly improve recovery and recycling rates by 2030, thereby ensuring that producers themselves usher in circularity [27].

E-waste: India's E-Waste (Management) Rules, 2016 (amended in 2018, 2022) cover electronic products such as computers, mobile phones, and large appliances. The EPR regulations in India aim to achieve a collection rate of 80% by 2029 [27].

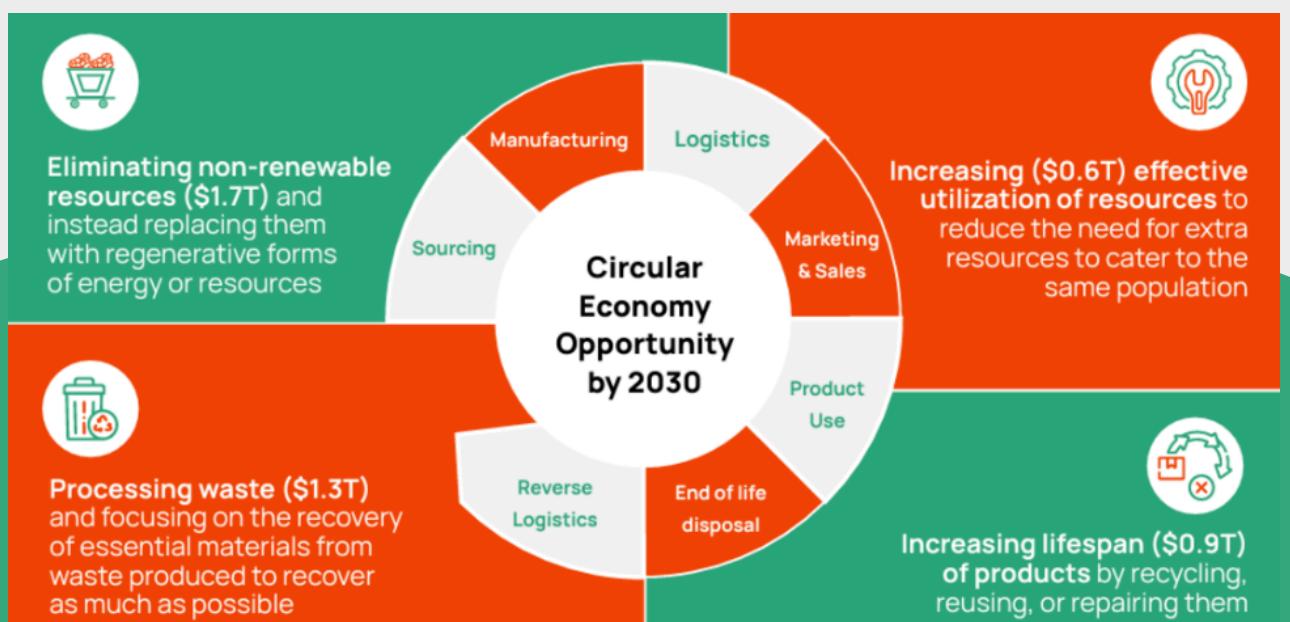
On the whole, the government has definitely covered significant ground, however, a lot still needs to be done. Many startups in this sector have highlighted the need for enhanced policy & regulatory support

[24] in order to be able to scale up their operations and make a bigger impact. In addition, bringing a larger variety of items under EPR regulations and strengthening collection and recycling rates will give a much-needed push to the circular ecosystem.

Economic Gains Enabled by a Circular Economy

As per the Ellen MacArthur Foundation, a circular economy development path in India could create an annual value of ₹14 lakh crore (US\$ 218 billion) in 2030 and ₹40 lakh crore (US\$ 624 billion) in 2050 compared with the current development scenario [28]. This analysis used just three sectors (agriculture, mobility, and construction) and estimated that the costs to provide the same level of utility would be significantly lower in the circular development scenario. In addition, the report further states that greenhouse gas (GHG) emissions could be 23% lower in 2030 and 44% lower in 2050 compared with the current development scenario.

In terms of business value, the global opportunity for the Circular Economy is expected to reach \$4.5T by 2030 as shown below.



Source: Circular-Economy-Report-2022.pdf [1]

Of this, India can capture anywhere between 1-8% of the total value taking its circular economy market size close to \$50 Billion - \$380 Billion.

When it comes to resource efficiency, moving to a circular economy is expected to reduce overall resource usage significantly. The Ellen McArthur Foundation report estimates that virgin material consumption will be 24% lower in 2030 and 38% lower in 2050 compared with the current development path. Water usage in the construction industry would be 19% lower in 2030 and 24% lower in 2050, while synthetic fertiliser and pesticide use would be 45% lower in 2030 and 71% lower in 2050 compared to the current development path [28].

Thus, the circular economy will not just enable economic value creation but will also help India to progress further on the Sustainable Development Goals (SDGs).

Recommendations and Way Forward

Climate finance has the potential to empower entrepreneurs and bridge the gap between knowledge and practice, driving the effective adoption of circular economy principles within the broader economic framework.

India can use a 5 sided circular business model to ingrain sustainability and responsible consumption from the raw material state to the final stage of the

product. Namely, circular supply chain (using renewable resources), recovery and recycling (reclaiming and processing waste), product life extension (prolonging the life of the product), sharing as a service (platforms to promote sharing and carpooling) and product as service (offering goods on a service basis rather than ownership).

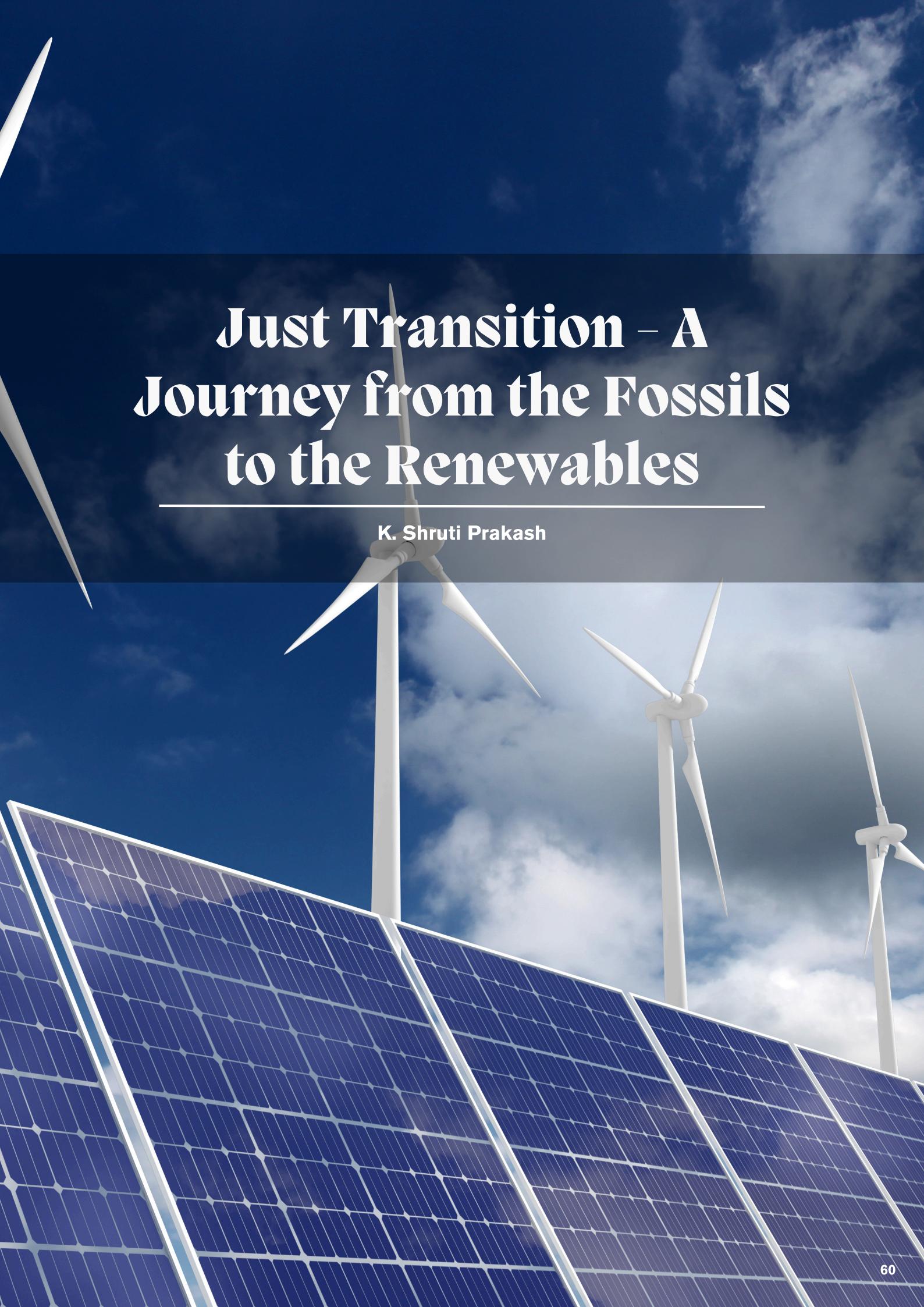
For India to successfully transition to a circular economy, it is crucial to develop holistic policies that view circularity as an interconnected system rather than isolated sector-specific initiatives. Circular economy policies should recognize the interlinkages between resources like water, minerals, energy, and raw materials, as well as the environmental and economic impacts of each. For instance, efficient water use in agriculture affects raw material needs in food processing, while responsible mineral extraction impacts manufacturing and waste management.

Policies need to promote finances, resource optimization across sectors and encourage practices that maximise reuse, recycling, and sustainability on multiple fronts. Integrated approaches can ensure that waste from one sector becomes a valuable input in another, such as converting agricultural residue into bioenergy or using treated wastewater in industrial processes. To achieve this, a coordinated policy framework - encompassing regulations, incentives, and collaborative standards-can drive cross-sector solutions and set a foundation for resilient, interconnected circular systems.



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Just Transition – A Journey from the Fossils to the Renewables

K. Shruti Prakash

SECTION 1: INTRODUCTION

“Economic growth without investment in Human development is unsustainable and unethical”. In the face of climate change, green energy is undeniably the future. Many countries are setting ambitious renewable energy targets, with India also making significant strides by investing in large-scale solar projects.

Declining renewable energy costs have further driven this transition, creating new opportunities for businesses and investors. Phasing out coal has become essential to establishing a sustainable development model.¹ While the green energy shift is promising, it brings substantial social and economic challenges in the short term. Consider the millions of workers currently employed in coal mines and thermal power plants, whose jobs are at risk. Their specialised skill sets may also limit their ability to transition into roles within the renewable energy sector.

So, what's the solution? How can we ease this economic disruption? This is where the concept of a "just transition" comes into play, and this article delves deeper into this vital approach.

SECTION 2: UNDERSTANDING JUST TRANSITION

Just transition refers to the equitable shift from a fossil fuel-based energy system to a sustainable, green energy model that benefits all sections of society. It ensures that workers and communities reliant on fossil fuels are supported with welfare gains and new opportunities in the emerging green economy. Beyond environmental goals, it addresses socioeconomic resilience, equity, and sustainable development.

As coal is phased out, industries and systems heavily dependent on it will face significant adjustments. For instance, for the Indian Railways, the largest revenue generator in the railway freight segment, accounts for approximately 50% of its earnings [1]. Similarly, industries reliant on fossil fuels must decarbonise through investments in cleaner technology and operational shifts. Coal-dependent workers will require re-skilling programs to transition into sustainable jobs in renewable energy or other growing sectors. This approach not only preserves livelihoods but also aims to create stable, high-quality employment in industries with long-term potential.

Renewable energy can generate steady employment through innovation, energy storage, and diversified power distribution, offering more sustainable livelihoods and reducing economic volatility. At the same time, coal-dependent regions must focus on building community resilience by fostering green businesses and addressing the compounded challenges of economic transition and climate change.

Energy security is another critical aspect, requiring renewable energy to scale up while maintaining accessibility and affordability. Decentralised power systems can address regional energy needs, lower costs, and reduce dependence on centralised fossil fuel systems, ensuring consistent and equitable energy supply.

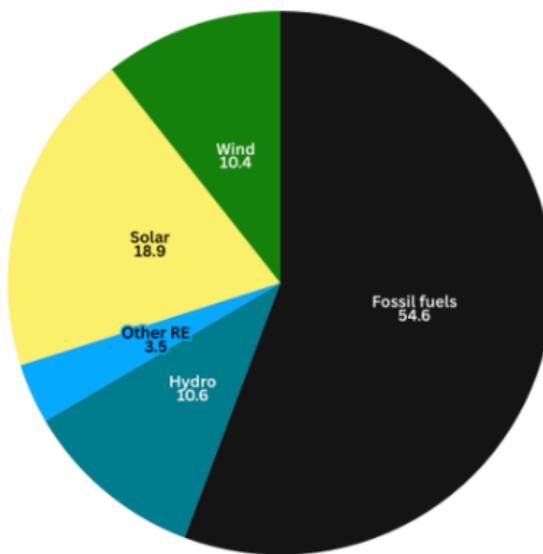
Inclusivity is central to a just transition, with decision-making involving workers, communities, and stakeholders to address inequalities and foster trust. This collaborative approach ensures that the transition is socially just and widely accepted. Ultimately, a just transition is a unique opportunity to build a sustainable economy that balances climate action with socioeconomic equity, ensuring resilience, environmental justice, and economic stability.

SECTION 3: INDIA'S CURRENT ENERGY LANDSCAPE

India's total installed power generation capacity stands at 444.757 GW, with fossil fuels contributing 54.6% and non-fossil sources making up 45.4%. Coal remains the dominant source, accounting for 47.4% of the total capacity, highlighting a continued reliance on this carbon-intensive fuel. However, renewable energy sources (RES), including solar,

wind, and hydro, contribute a significant 43.5%, showcasing India's efforts to diversify and green its energy mix. Solar power leads among renewables with 18.9%, while wind and hydro follow with 10.4% and 10.6%, respectively. The image below provides an overview of the current power generation capacity.

Share of Total Installed Capacity in May 2024



Total installed capacity is 444.57 GW;
Fossil Fuel- 242.99 GW Non-Fossil Fuel - 201.76 GW

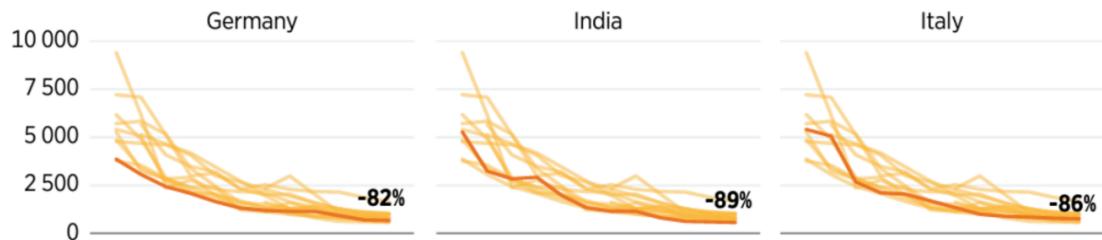
Source: Power Sector at a Glance [2]

Coal is becoming less competitive as renewable energy gains ground, with solar PV and wind tariffs ranging from 2 to 4 rupees per kWh-already lower than coal tariffs, which stand at 3 to 6 rupees per kWh [3]. Coal India Limited, responsible for 80% of

India's coal production, has closed 80 of its 350 mines due to losses. Renewable energy instalment costs, especially for solar and wind have decreased significantly since 2010, removing the barrier of entry due to price.



Cost of Solar panel PV



Source: IRENA (2023) [4]

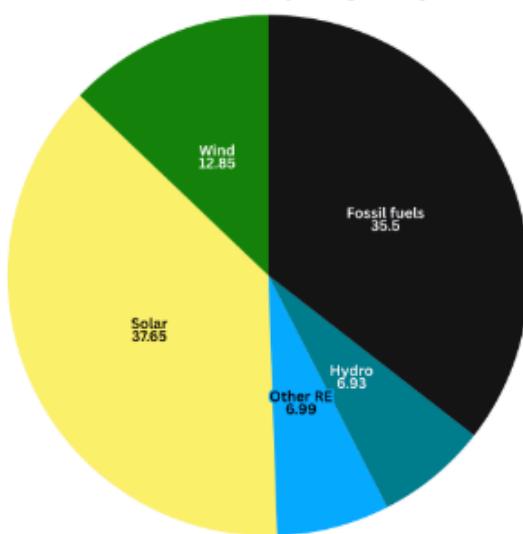
The vertical axis in the graph above shows the cost of solar panels in USD/kW. The average weighted total installed cost of utility-scale projects commissioned in India in 2021 was USD 590/kW, which is 89% lower than in 2010. This indicates a decline in costs, making the renewable market more competitive. Similarly, onshore wind installation technology costs have shown a downward trend, with a 79% decrease since 2010 [4].

As a result, India has been able to increase its renewable energy capacity over the last 10 years. Going ahead, India has ambitious plans to ramp up its green energy capacity significantly.

The Government of India has set a target to reach 500 GW of renewable power generation by 2030, with renewable energy projected to meet 50% of the country's energy needs [5].

The chart below describes India's projected installed capacity mix as of 2030. Solar and wind together are expected to account for over 50% of the total power capacity. However, given the relatively higher fluctuations in renewable energy, the installed capacity should be higher in order to achieve a generation capacity of 50%.

Share of Total Installed Capacity (Projected 2030)



Total installed capacity is 777.144 GW;
Fossil Fuel- 276.5 GW Non-Fossil Fuel - 500.644 GW

Source: CEA [6]

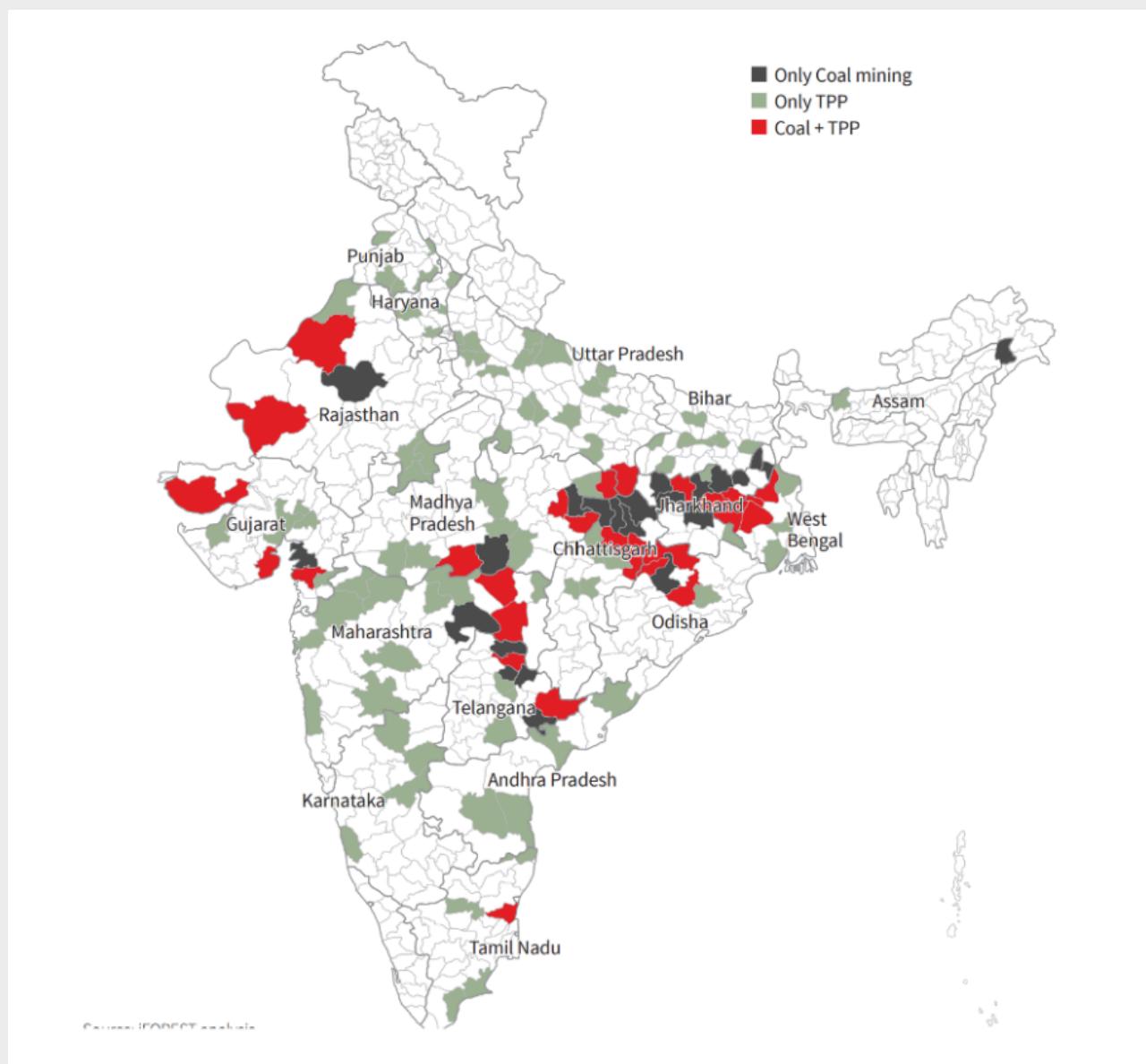
SECTION 4: HOW COAL PHASEOUT WILL AFFECT THE COUNTRY

The geographical distribution of coal mines and thermal power plants (TPP) is as follows:

- Twenty-eight districts have both coal mines and TPPs.
- Twenty-three districts have only coal mines.
- Eighty-six districts have only TPPs.

There are 417 coal and lignite mines spread across 51 districts in India. However, in terms of coal

production, 86% is concentrated in 21 districts across nine states, including districts producing over 100 million tonnes of coal per annum (MTPA). The top three coal-producing districts currently are Singrauli (Madhya Pradesh), with a production of nearly 120 MT of coal in 2022, followed by Korba (Chhattisgarh) with 113 MT, and Angul (Odisha) with 97 MT [8].



Source: iFOREST [7]

4.1. VULNERABLE STATES DUE TO TRANSITION

A vulnerability assessment serves as a stepping stone to identify states facing potential transition risks, helping to focus efforts on facilitating a just transition in these areas.

Based on fossil fuel capacity and production, CPI ranked the top five states that will be most affected by

the transition. The top five identified states for Vulnerability Assessment are Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, and West Bengal. The table ranks the states for a variety of parameters and then calculates the overall ranking. The numbers presented in the table below represent the aggregate score given for each state in each parameter.

Parameters	Formula	Aggregate ranking after considering the percentages for each parameter.				
		CG	JH	MP	OD	WB
Share of revenues from coal mining	Payment of royalty, cess, GST, and other levies	8.4	10.0	3.4	5.1	1.4
Share of revenue from power generation	Revenues from electricity duties and other charges	10.0	1.5	5.6	9.8	6.2
Value of thermal power plants at risk Vulnerability to climate extremes	Exposure*Sensitivity)/ Adaptive Capacity	2.4	1.8	4.9	10.0	7.0
Resilience to natural disasters	Function of (Early Warning System, Emergency Operation Centre, Communication, Contingency plans, etc.)	4.2	6.9	3.1	0.8	0.0
Direct and indirect employment in coal sector (mining and power generation)	(Direct + indirect employment per tonne of fossil fuel mined)) * (fossil fuel mined)) + ((direct or indirect employment per MW in fossil fuel-based power generation) * (fossil fuel-based power generation capacity))/ state population	10.0	5.9	3.2	6.7	0.7
CSR spending by NTPC and CIL & Subsidiaries	CSR spend in a state/ total CSR Spend	0.2	0.2	2.2	10.0	0.9
State's dependency on fossil fuel as power generation	Installed fossil fuel-based capacity/ total capacity in the state	10.0	9.7	7.7	8.1	9.1
Share of RE potential in comparison to fossil-fuel-based generation.	Renewable energy potential in state/ fossil fuel capacity in the state	0.9	4.1	3.8	3.5	0.6
Contribution of non-coal sectors in GSDP	Net state value added by economic activity in agriculture, banking and services/ net state value added by all economic activities	3.4	3.0	0.7	3.2	0.0
Good governance score		1.6	2.2	0.0	3.1	4.2
State finances (fiscal deficit)	Fiscal Deficit/Gross State Domestic Product	8.4	9.3	9.4	5.9	10.0
Total		59.4	54.7	44.1	66.3	40.1
Ranking		2	3	4	1	5

Source: CPI [9]

It can be seen that Odisha stands most vulnerable to transition closely followed by Chhattisgarh and Jharkhand.

4.2. HOW WILL PHASEOUT AFFECT THE EMPLOYMENT SECTOR

The largest social costs associated with coal phaseout would be from employment loss. It is estimated that ~5.9 million workers are employed in the coal sector and will need to be rehabilitated to

to ensure a just transition. The table below gives the breakup of workers across the formal, informal and induced sectors.

No. of districts: 137			
Coal mines		TPPs	
Total production capacity (MTPA)	1315	Total capacity (GW)	237.2
OC mine	1134	Existing	208.65
UG mine	89.2	Upcoming	28.55
Mixed mine	91.8		
Total lease area (ha)	343,504	Land area (ha)	124,789
OC mine	212,599	Existing	109,795
UG mine	105,232	Upcoming	14,994
Mixed mine	25,673		
Workers (million)	5.897		
Formal	1.243		
Informal	2.397		
Induced	2.257		

Source: iforest [7]

While the figures above represent the total employment in the coal sector, it is also estimated that up to 110,000 jobs are at risk across five states due to mine closures by 2030 [3].

Just Transition would entail providing essential reskilling and transition assistance to help them secure

stable employment in a low-carbon economy. The scope of support should extend beyond departmental employees in coal mining and thermal power plants (TPPs) to include contractual workers with limited social protections, informal workers without any social security, and individuals in local economies whose livelihoods depend on coal-driven economic activities.



SECTION 5: CLIMATE FINANCE - A TOOL TO SHAPE THE TRANSITION.

How are finances allocated to the clean energy sector?

Climate finance in India is largely drawn from two main sources. The first is government funds and incentives that enable larger participation in this sector. The second source of funds is private investors which include Development Finance organisations, VCs, banks etc. who enable innovation and help organisations sustain their business models. Clean energy is one of the more well-funded sectors in the green transition space and has received a fair share of investments over the years.

Government Initiatives and Funding:

Production Linked Incentive (PLI) Scheme:

With a substantial allocation of USD 2.9 billion (INR 24,000 crore), the scheme targets the establishment of large-scale manufacturing capacity for high-efficiency solar photovoltaic (PV) modules in India [10].

Lower Solar Power Tariffs and Increased Affordability for Consumers:

The government's 'National Solar Mission' has played a pivotal role in reducing solar power tariffs, making solar energy more accessible to consumers.

Private Funding:

Total climate tech funding in India reached USD 22.5 billion in 2023, with debt financing making up USD 17.7 billion and equity contributing USD 4.82 billion. 60% of the equity funding (USD 2.89 billion) went to the clean energy sector [11].

Energy transition dominates climate funding, accounting for 60% of the total equity raised since 2021. 52% of the energy deals in 2023 were over USD 100 million, driven by large-scale solar and wind. Funding for rooftop solar and biomass has also picked up as India's energy transition widens.

Finance requirements for just transition:

The finance required for just transition in India as depicted by iFOREST by taking the economic, political and social cost components is shown in the below table.

Table 4.13: Just transition investments, grants, and subsidies

Cost components	Investments		Grants and subsidies	
	₹ Crore	\$ billion, MER	₹ Crore	\$ billion, MER
Coal mine reclamation and repurposing	9,07,268	113	8,83,380	110
Thermal power decommissioning and green repowering	3,29,651	41	1,31,668	16
Economic diversification	17,98,991	225	6,92,166	87
Green energy investments (excluding green repowering of TPP)	40,29,275	504	4,02,927	50
Labour support and transition	1,73,665	22	1,73,665	22
Revenue substitution	1,78,575	22	1,78,575	22
Community resilience	6,78,887	85	6,78,887	85
Capacity building and governance	2,17,208	27	2,17,208	27
Total	83,13,520	1,039	33,58,477	420

Source: iFOREST [7]

The total cost of a just transition to phase out existing coal mines and coal-based thermal power plants (TPPs) in India is estimated to be ₹83.1 lakh crore (\$1.039 trillion) over the next three decades as shown above (until 2050). However, these cost estimates are conservative, as they exclude the investments required for new green energy plants and infrastructure to meet India's future energy demands—expected to run into trillions of dollars. Additionally, they do not account for the transition costs of coal-dependent industries like steel and cement.

Hence, while energy transition does receive a fair

share of investments from both public and private sources, the current rate of funding is not sufficient to meet our targets.

Fund Gap Estimates

A CEEW report on the Investment Gap in India estimates that the total investment gap in the power sector till 2070 will be around USD 3.1 trillion and will need external investment support of around USD 25 billion annually [12]. Bridging this gap would require investment from overseas, which may be sought on concessional terms.

	Total investment		Investment gap		Investment support	
	Aggregate from 2020 till the respective net-zero year	Average annual from 2020 till the respective net-zero year	Aggregate from 2020 till the respective net-zero year	Average annual from 2020 till the respective net-zero year	Aggregate from 2020 till the respective net-zero year	Average annual from 2020 till the respective net-zero year
Power	8,412	168	3,098	62	1,239	25
Mobility	198	4	--	--	-	--
Industrial	1,494	30	448	9	179	4

Source: CEEW [12]

SECTION 6: OPPORTUNITIES IN THE RENEWABLE ENERGY SECTOR

While the transition will lead to job and economic opportunity loss in the fossil fuel sector, there will be significant opportunities created in the renewable energy sector across various domains, including solar, wind, bioenergy, and energy storage. This sector offers a wide range of business prospects, from manufacturing and supply chains to installation, maintenance, and research and development of green technologies. By building a skilled workforce and encouraging green entrepreneurship, renewable energy can play a crucial role in offsetting the impacts of fossil fuel decline, supporting an inclusive and sustainable transition.

6.1. Green Jobs

It is estimated by the ILO that 54 million green jobs will be generated across sectors in India between 2021 and 2030. Similarly, a projection by the Skills Council for Green Jobs suggests that 30–35 million jobs will be created in India's green sectors by 2047 [13]. It is projected that the highest sectoral jobs will be created in waste management, followed by solid waste management, green construction and renewable energy.

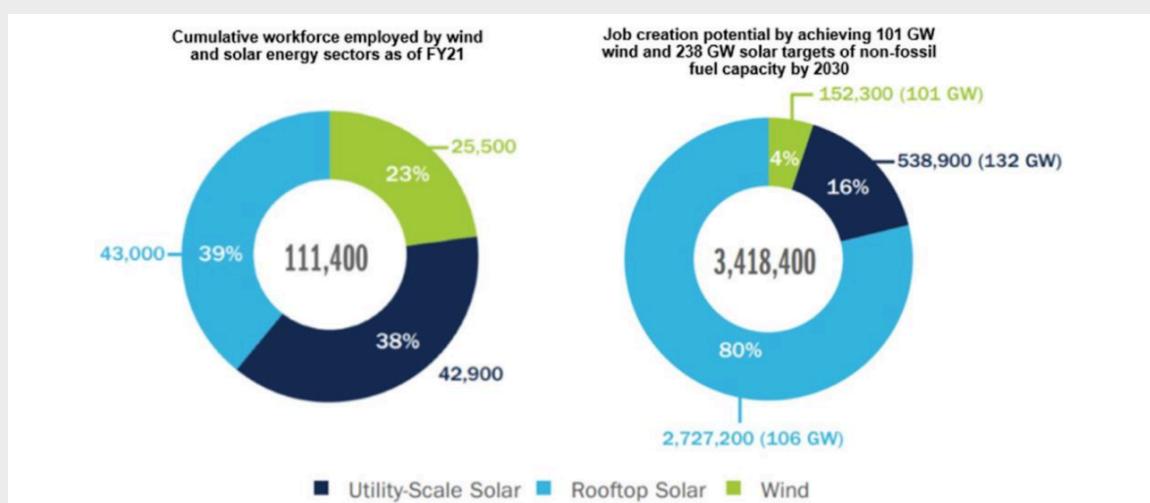
Table 3. Cumulative Jobs in Green Businesses

SI. NO.	SECTOR	SUB SECTOR	TILL 2020	TILL 2030	2021-2030
1		Solar Photovoltaics	180,00	900,00	720,000
2		Solar Thermal	14,500	35,000	20,500
3		Wind Power	60,000	180,000	120,000
4		Small Hydro Power	10,000	30,000	20,000
5	Renewable Energy	Biomass/ Cogen / CHP	25,000	100,000	75,000
6		Energy Storage	50,000	300,000	250,000
7		Biofuels, Biogas, Pellets and Briquettes	55,000	275,000	220,000
8		Clean Cook Stoves	75,000	2,968,600	2,893,600
Sub Total RE			469,500	4,788,600	4,319,100
9	Green Construction	Green Buildings / Campuses	2,200,000	11,000,000	8,800,000
10	Green Transportation				
11	Carbon Sinks		240,000	2,100,000	1,860,000
12	Water Management		3,000,000	19,000,000	16,000,000
13	Solid Waste Management		4,000,000	19,800,000	15,800,000
14	E-Waste Management		170,000	582,000	412,000
Total			10,829,500	64,770,600	53,941,100

Source: ILO, 2018 [14]

India can potentially create about 3.4 million jobs (short and long term) by installing 238 GW solar and 101 GW new wind capacity to achieve the 500 GW non-fossil electricity generation capacity by 2030 goal. These jobs represent those created in the wind

and on-grid solar energy sectors. A workforce of about one million can be employed to take up these green jobs. Jobs created are different from the workforce needed, as one worker can perform more than one job.



Source: CEEW [15]

6.2. Solar plants as a replacement in Coal mine areas

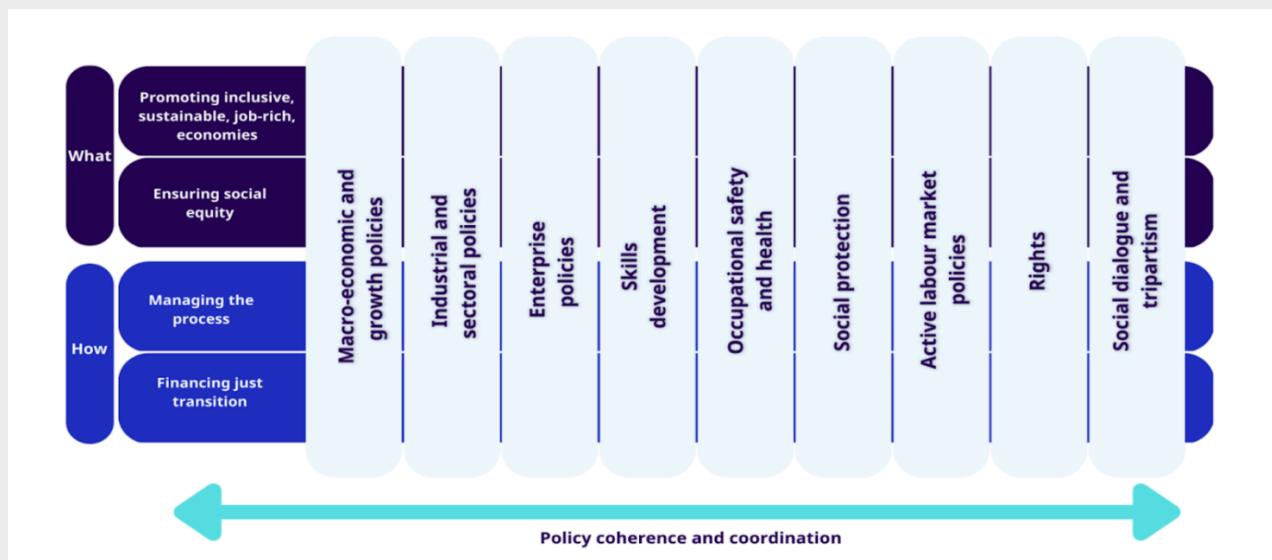
As researched, most of the coal mine areas are suitable for solar plants [16] but are not suitable for wind power. It is assessed that to set up 1MW of solar power plant 5 acres of land is needed [7].

The post-mining land can be suitably used for economic activities, such as setting up solar plants, development of industrial parks, horticulture, and

pisciculture. This has been enquired from coal companies, trade unions and the local communities from Jharkhand, Odisha and Chhattisgarh [7]. Battery Energy Storage Systems (BESS) are essential to bridge the gap between the transition issues. An efficient BESS and decentralisation can also help in a smooth transition. This will also add the workforce to the system.

SECTION 7: CURRENT POLICY FRAMEWORK

The International Labour Organization's framework for Just Transition has been attached below.



Source: ILO, 2023 [18]

All the policy areas mentioned above contribute in a distinct yet interrelated manner and are important for executing the transition. Managing the process of transition will require coherence across the policy areas, and effective institutional coordination to plan and implement the changes, aligned with evidence-based monitoring and evaluation frameworks.

In this regard, India's policies have been examined using the same framework in the table below. Policy strengths and gaps have been highlighted.

Policy	Existing policies (Highlight policies)	Policy Strength and Gaps.
Macroeconomic and growth policies (These induce investment into the renewable energy sector, and skill sector that leads to a smooth transition)	Green agenda part of national development Green hydrogen mission, NREF Ambitious Panchamitra National Targets for RE	Strong and in line with the NDC targets.
Public investment (infrastructural and R&D investments)	The public sector funded 43% of India's green investments in 2019-20. Strong International partnerships, like the UK-India Green Growth Equity Fund 195 billion rupee PLI scheme supports solar PV manufacturing. Sovereign green funds are being established.	Current green finance allocations meet only 25% of the estimated amount to achieve NDCs by 2030. Private investment is low, especially in emerging green sectors due to insufficient govt incentivesInsufficient R&D and eco-innovation investment
Industrial and Sectoral Policies (Driving business transformation towards sustainable production, efficient green energy and creating jobs)	PM-KUSUM- Installation of 30.8 GW solar plant capacity to provide renewable energy to over 3.5 million farmers by solarizing agricultural pumps. Waivers for transmission losses till 25 years. Policy Support for RE and EVs: PLI and FAME-II schemes encourage green jobs in RE and electric mobility.	Policies largely for clean transport, further emphasis is needed on overall decarbonisation. Support for the fossil fuel sector should be reduced: fossil fuel subsidies were 7.3 times clean energy subsidies in FY20.
Skilling Policies (To bridge the structural unemployment caused by transitioning economy)	Green Skills Development Programme (2017). Suryamitra Skills Development Programme (SSDP) to skill youth in the solar energy sector. Additional workforce of 9,000 to be skilled in wind energy, solar water pumping, biogas and small hydro. Ozone cells in MOEFCC have developed skill upgradation for technicians (electronics). MNRE aims to start vocational training courses to fill in the skill gap.	Better implementation is needed. Clear and up-to-date skilling requirements are also needed for professionals to support the green transition. Assessment of Suryamitra: As of 2022-23, 56087 [18] were trained but only 26967 were placed. Recruiters are sceptical as the training course is more theoretical than practical [19]. 70% of Suryamitras in FY16 earned less than INR 10,000 per month [20].

Policy	Existing policies (Highlight policies)	Policy Strength and Gaps.
Enterprise Policies (Reform regulations to boost green economy investment, support social equity, and foster diverse enterprises for innovation, productivity, and job creation)	Startup India ProgramIREDA New Scheme: Bridge loan against Generation Based Incentive (GBI) claims payable to RE developers under MNRE Scheme for grid-interactive Wind and Solar power projects	Startup India's program lacks specific policies, incentives, or support for green enterprises. Limited green funding options are available, and existing MSME greening and resilience programs could be further strengthened.
Occupational Safety and Health (OSH) (for workers affected by climate change)	No policy in the government sector Growing Focus in the Private Sector: Large enterprises are integrating OSH measures in line with global standards, especially in renewables and energy storage.	Inadequate OSH Focus in Emerging Green Sectors: Limited safety protocols and guidelines for new green value chains such as EV battery recycling and floating solar installations.
Active labour market policies	No formidable plan	Green jobs labour market information by geography/demographic not collected by the Government
Social protection (social protection for the regions affected by transition and climate change)	Social protection for climate change: Prime Minister's National Relief Fund (PMNRF), Prime Minister Khanji Kshetra Kalyan Yojana, Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). The New Labour Code for India broadens social protection (SP) coverage, while the Ministry of Labour and Employment's E-Shram portal collects data on unorganised sector workers.	Specific SP strategies for individuals and communities impacted by climate change and the green transition need strengthening, including support for reskilling and re-employment.

Source: ILO [18] , UN-Page [3]

SECTION 8: CHALLENGES

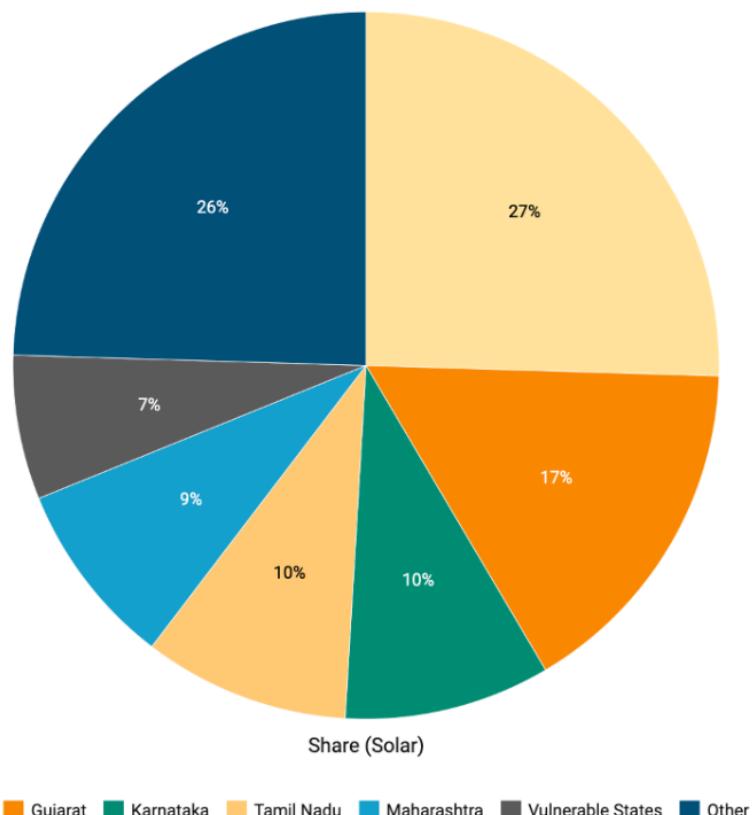
Just transition presents several challenges, ranging from the formulation and implementation of effective policies to the risk of rising unemployment. This section explores some of the key hurdles the sector poses for the broader economy.

1. Just transition framework:

Currently, India lacks a government-established framework for Just Transition planning, a critical

aspect of balancing economic, social, and environmental priorities in the shift to renewable energy. However, the renewable energy sector offers immense potential for job creation, particularly in states like Rajasthan, Gujarat, Karnataka, Andhra Pradesh, Telangana, and Tamil Nadu. Recent data highlights and the graph below shows that Rajasthan leads in solar power installations, followed closely by Gujarat and Tamil Nadu.

Share of Solar power installation in India



Source: MNRE [21]

The concept of identifying "Just Transition hotspots" becomes essential in this context. Vulnerable states such as Maharashtra, Madhya Pradesh, Chhattisgarh, Jharkhand, and West Bengal, which rely heavily on coal-dependent industries, do not significantly overlap with regions leading in renewable energy generation. While renewable energy initiatives are emerging in some of these states, there remains a pressing need to bridge this gap. A smooth transition requires proactive government planning, with a focus on reskilling and redeploying coal mine workers.

2. Inequality in the job sector:

Research indicates that job creation in the energy transition will likely surpass job losses, but gender imbalances in the workforce may persist. Although women are somewhat better represented in renewable energy than in fossil fuels, the sector overall remains male-dominated. Women are underrepresented in energy production and often face barriers in the renewable sector, including gender stereotypes, unequal access to education and training, the challenge of balancing work with family duties (which disproportionately affects women), and limited supportive workplace policies, all of which hinder entry and career progression.

3. Localising supply chains:

Renewable energy systems, unlike fossil fuels,

depend on a greater variety of minerals. Technologies like wind turbines, solar panels, and electric vehicle batteries require significantly higher quantities of minerals like copper, lithium, nickel, and cobalt. Copper demand alone is expected to reach 650 million tonnes by 2050, with lithium potentially hitting 20 million tonnes due to battery needs—much higher than requirements in fossil-based systems.

In comparison, fossil fuel infrastructure uses more iron, steel, and aluminium. However, the overall mass of materials needed for renewables by 2050 will be about 6.5 billion tonnes, less than one year of current coal usage. Renewables' reliance on scarce minerals underscores the need for secure and resilient supply chains in the energy transition. This calls for the circular economy, which assists in creating a closed loop for the minerals [22].

4. Structural Unemployment:

It is an unemployment that is caused when the workers lose their job due to mismatch in the skills of the workers in the economy. This leads to long-term unemployment in the country. The transition leads to the wide gap in the skillsets of the workers. The image below shows the skill gap in solar and wind energy.

Solar	R&D	<ul style="list-style-type: none"> ➢ Absence of exposure to advanced technologies such as the wafer technology, semiconductor technology; ➢ Design skill in installing BIPV in buildings.
	Project Management	<ul style="list-style-type: none"> ➢ Project implementation, management, planning and co-ordination especially in handling CSP.
	Manufacturing	<ul style="list-style-type: none"> ➢ Low skill in module assembly; ➢ System integration in solar PV.
	Construction / Installation	<ul style="list-style-type: none"> ➢ Erection and commissioning of large-scale and on grid solar power projects; ➢ Third party installers not skilled in erection; ➢ Grid integration of mega projects.
	Operation	<ul style="list-style-type: none"> ➢ Trouble shooting solar PV circuits; ➢ Techno-commercial marketing skills; ➢ After-sales service and customer care.
Wind	R&D	<ul style="list-style-type: none"> ➢ Offshore wind technology; ➢ Wind resource assessment; ➢ Optimization of engineering design; ➢ Battery technology; ➢ Fatigue resistant materials; ➢ Design of step-up gearbox.
	Project Management	<ul style="list-style-type: none"> ➢ Design technique to match wind resource, rating and installation.
	Manufacturing	<ul style="list-style-type: none"> ➢ Manufacturing of high-capacity turbine gearboxes; ➢ Fabrication of wind turbine blades of complex design.
	Construction / Installation	<ul style="list-style-type: none"> ➢ Installation of high-capacity wind turbines.
	Operation	<ul style="list-style-type: none"> ➢ Failure analysis of gearboxes.

Source: ILO, 2018 [14]

Way Forward

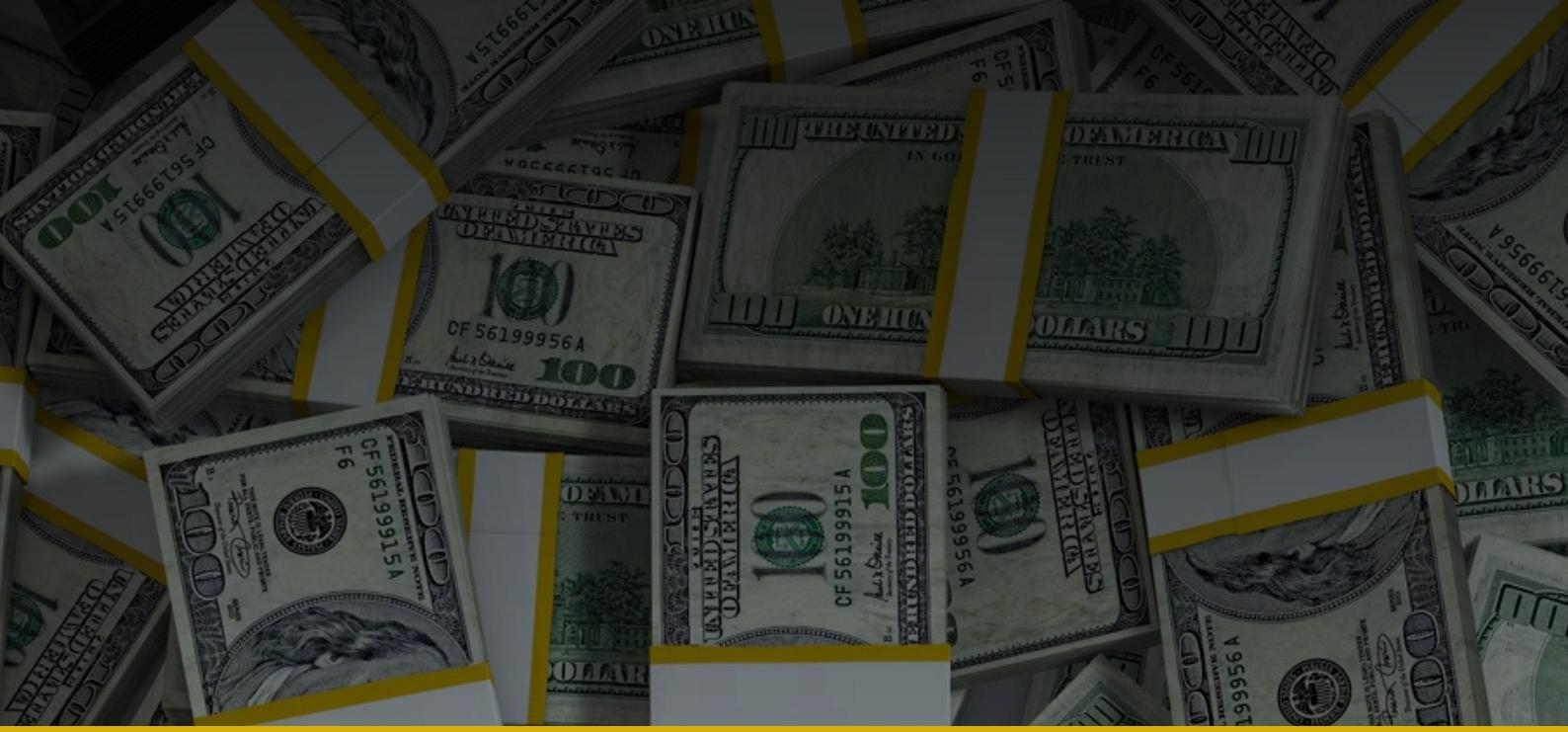
The concept of just transition may seem like a distant goal, but the magnitude of the challenge posed by it necessitates that we as a nation are ready for it. Neglecting this issue could not only delay the essential phase-out of fossil fuels but also disproportionately impact a large number of vulnerable workers who depend on the fossil fuel industry for their livelihoods. A comprehensive assessment is crucial to grasp the scale of this transition and to identify the potential obstacles that could arise along the way. This understanding will be the foundation for designing effective policy interventions and finance requirements that will ensure a fair and inclusive shift toward a greener

economy. In parallel, it is essential to focus on creating sufficient employment opportunities in renewable energy and other emerging green sectors, which are poised for significant growth. The issue of skill development is critical here, as transitioning coal and fossil fuel workers into new roles will require targeted training and reskilling programs. A well-planned strategy for skill development can equip these workers with the tools they need to succeed in the green economy, minimising disruptions to their livelihoods. Ultimately, achieving a just transition is essential in a large democracy like India, and proactive planning will be key to managing this transformation smoothly and equitably.



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Green Dreams and Dollar Schemes: Financing Climate Solutions with Green Bonds

Vaasu Aggarwal

Carbon pricing and related fiscal policies are essential for reducing greenhouse gas emissions by internalising externalities. However, the financial sector also plays a crucial complementary role. Financial institutions and markets currently provide risk mitigation through instruments such as insurance and catastrophe bonds, which help absorb some of the costs associated with disasters.

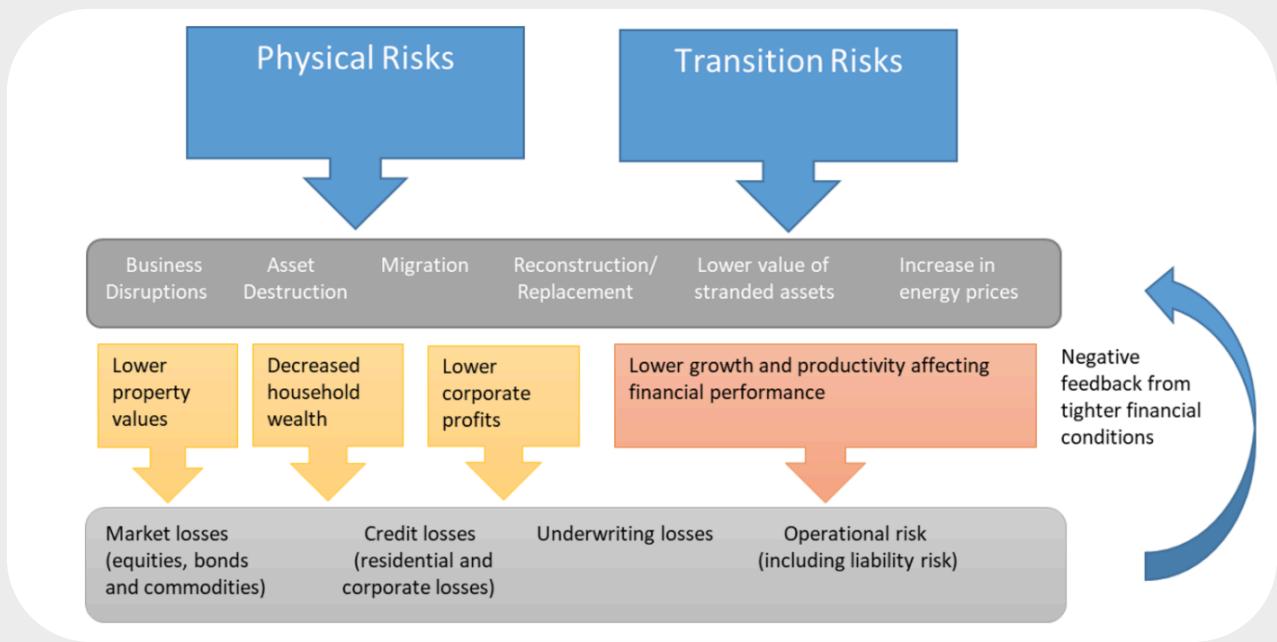
Financial institutions play a pivotal role in facilitating the transition to a low-carbon economy by mobilising capital for climate finance. As the world increasingly turns to sustainable development, banks, investment firms, and insurance companies are no longer just passive actors in managing financial risks—they are becoming active participants in driving the systemic changes needed to reduce global carbon footprints by mobilising the necessary resources for investments in climate mitigation (reducing emissions) and adaptation (enhancing resilience to climate change). When policymakers establish mechanisms to internalise externalities and create incentives for transitioning to a low-carbon economy, the financial sector can respond effectively to these market signals, facilitating the achievement of these objectives in an efficient manner.

The financial sector has the power to influence the behaviour of corporations, governments and individuals alike through strategic financing and lending practices. By integrating climate risks into financial decision-making and adopting climate risk disclosures, they can incentivise businesses to reduce their environmental impact and transition to more sustainable models. This financial stewardship can accelerate the development of low-carbon technologies, green infrastructure, and energy-efficient solutions that are crucial for meeting international climate targets.

The financial sector, like any other industry, significantly impacted by climate change, and it's crucial for the industry to recognize this at the earliest. In a [2022 survey](#) [1] of 34 banks conducted by the Reserve Bank of India (RBI), 9 banks had not yet publicly acknowledged the influence of climate change on their portfolios. Additionally, 11 banks had yet to grasp the materiality of climate-related financial risks. Given this neglect regarding climate change within the financial sector, it is essential to first explore the various channels through which these impacts manifest themselves.

Physical risks associated with climate change refer to the economic costs and financial losses resulting from the increasing severity and frequency of extreme weather events. For instance, floods in coastal regions can damage infrastructure and properties, leading to significant recovery expenses, while erratic rainfall patterns may cause crop failures, impacting food security and increasing insurance claims. Additionally, air pollution contributes to health problems, resulting in higher healthcare costs and potential environmental gentrification as communities are displaced due to pollution control measures.





On the other hand, transitional risks arise from the shift towards a low-carbon economy, impacting hard-to-abate industries such as oil, coal, cement, and steel, which may face financial losses and penalties due to stricter regulations. They include the extent to which a bank funds or has stakes in companies that emit greenhouse gases (GHGs), evolving stakeholder expectations, and associated legal or regulatory changes. This transition can also lead to investment losses, as portfolios tied to high-carbon assets may depreciate due to growing scrutiny and divestment from fossil fuels.

The financial sector has multiple avenues to enhance its contribution to a sustainable economy by directing capital toward green projects that mitigate carbon emissions. One significant financial instrument in this context is green bonds. Unlike conventional fixed deposits, which are not specifically earmarked for environmental initiatives, green bonds are designed to promote the transition to a low-carbon and climate resilient economy. The proceeds from these bonds are earmarked for environmentally friendly initiatives.

Interest earned on green bonds is generally lower than that from regular bonds. This difference in yield is often termed as "Greenium". This is because of the increasing interest shown by investors seeking sustainable investments, which creates higher

demand for green bonds. When demand rises, prices go up, leading to lower yields. Investors may view green bonds as less risky because they are often backed by projects that have strong environmental benefits and can align with regulatory trends promoting sustainability. This perception can lead to a preference for green bonds, pushing yields lower. With stakeholders becoming increasingly more climate conscious, companies and institutions choose green bonds to enhance their public image, benefits accrued to this perceived notion among the stakeholders makes them willing to invest in such bonds despite offering lower yields.

In addition to facilitating bond issuance, financial institutions are instrumental in developing the secondary market for green bonds. A vibrant secondary market increases liquidity, making it easier for investors to buy and sell these instruments, which can lead to higher participation and more stable pricing. By engaging in market-making activities, banks and financial firms can help establish a more robust trading environment for green bonds, thus attracting a wider range of investors.

The rise in awareness of environmental risks among investors has significantly boosted demand for green bonds, particularly from institutional investors focused on environmental, social, and governance (ESG)

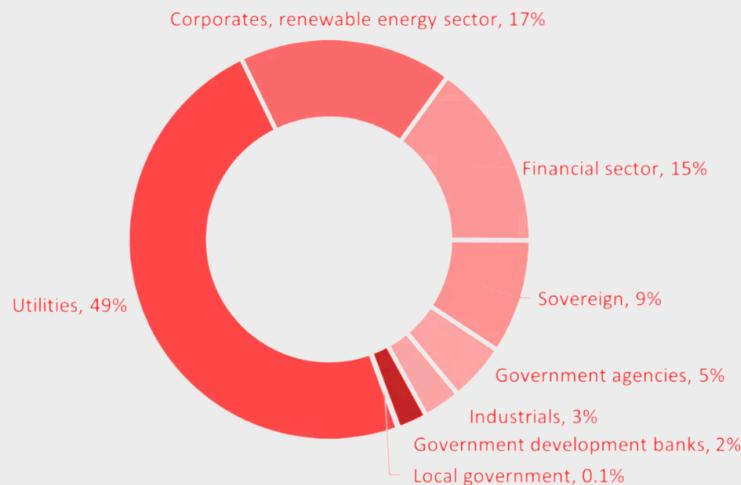
criteria. This trend not only provides essential capital for sustainable projects but also fosters a broader shift towards responsible investing within the financial market. The Indian government has played a crucial role in promoting the green bond market through supportive policies, such as the National Action Plan on Climate Change (NAPCC) and the Renewable Energy Policy, creating a favourable environment for green financing. Establishing funds like the National Clean Energy & Environment Fund (NCEEF) along with the introduction of Sovereign Green Bonds (SGrB) has further facilitated capital mobilisation for sustainable initiatives.

With the goal of promoting, fostering and developing a sustainable financial system in the country, RBI published a Framework for Acceptance of Green Deposits on 11 April 2023 [2]. The framework encourages banks and non-banking financial companies (NBFCs) to offer green deposits, thereby promoting sustainable financing options for customers. The framework also mandates establishing a comprehensive board-authorised policy, especially for green deposits along with the different avenues in which funds raised through such bonds can be channelised (see figure below).

CATEGORIES	ENVIRONMENTAL OBJECTIVE	SDG TARGETTED
RENEWABLE ENERGY	CLIMATE CHANGE MITIGATION, NET ZERO OBJECTIVES	 
ENERGY EFFICIENCY	CLIMATE CHANGE MITIGATION	 
CLEAN TRANSPORTATION	CLIMATE CHANGE MITIGATION	  
CLIMATE CHANGE ADAPTATION	CLIMATE CHANGE ADAPTION	
SUSTAINABLE WATER AND WASTE MANAGEMENT	CLIMATE CHANGE MITIGATION	
POLLUTION PREVENTION AND CONTROL	CLIMATE CHANGE MITIGATION, ENVIRONMENT PROTECTION	 
GREEN BUILDINGS	CLIMATE CHANGE MITIGATION	
SUSTAINABLE MANAGEMENT OF LIVING NATURAL RESOURCES AND LAND USE	NATURAL RESOURCE CONSERVATION	  

As of February 2023, Indian green bond issuances reached a total of USD 21 billion [3]. However, most of these funds were raised by the private sector (84%). The public sector has only recently started to gain pace when India made its debut with SGrB in FY24 with two auctions worth INR 8,000 crores totalling INR 16,000 crores which was oversubscribed owing to robust demand from various banks [4]. Indian sovereign green bonds not only contribute towards sustainable goals, but also help bolster the Indian currency.

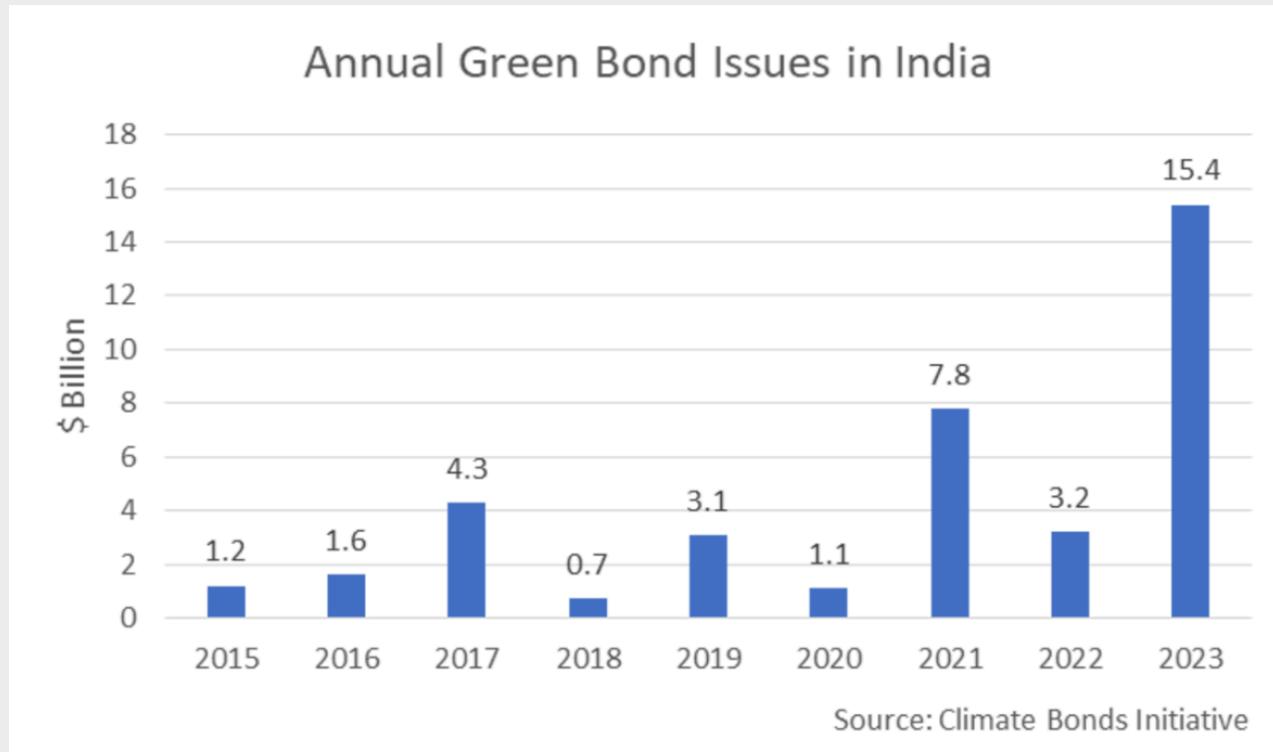
By being issued in local currency on the global market, they primarily Green Bond Issuances in India by type of issuer attract domestic investors, increasing funds available to the central bank. This influx of capital demonstrates the confidence investors have in the Indian currency, further enhancing its stability.



Green Bond Issuances in India by type of issuer
Source: World Bank, 2023

India has witnessed several notable projects funded by green bonds. For instance, the projects funded by Axis Bank issued green bonds worth USD 40 million [9] in 2019 contributed significantly to India's transition to a low-carbon economy, with estimates suggesting a reduction of approximately 1.64 million tons of CO₂ emissions [9] (tCO₂e) from renewable power generation. Funds raised by IREDA in 2017

amounting to USD 7000 million were used to finance projects in the renewable energy sector with total capacity totalling 189.53 MW [10]. NTPC issued green bonds worth INR 2000 crores were used to finance solar projects with a combined capacity of 810 MW [11] in states like Gujarat, Madhya Pradesh and Rajasthan.



REC Limited issued inaugural Yen Denominated Green Bonds aggregating to 61.1 Billion Japanese Yen.^[5]

Allocation of INR 35,000 crores in FY 24 budget towards nation's transition to net zero.^[6]

Developments in India's Renewable Energy Finance

Ministry of Finance aims to raise INR 12,000 crores in FY25 through Sovereign Green Bonds.^[7]

Sovereign Green Bonds trading at IFSC to start in second half of FY25.^[8]

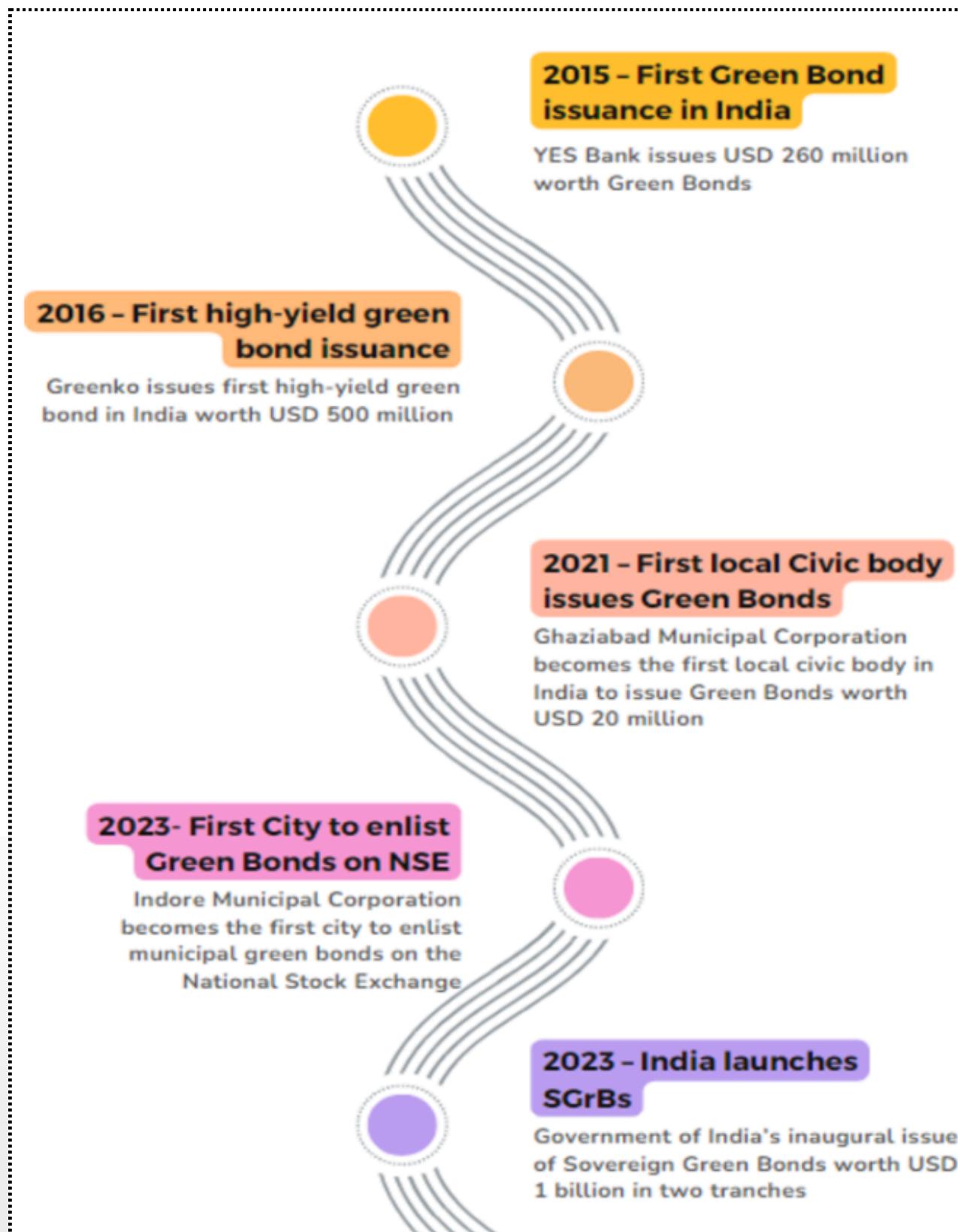
Instruments like green bonds are essential for providing funds for environmentally beneficial initiatives while also aligning with growing investor demand for sustainable investments. The increasing recognition of the materiality of climate-related financial risks among financial institutions is critical for enhancing their contributions to climate action.

To direct finance toward green projects, policymakers can implement strategic nudges. For example, incentivizing the issuance of green bonds through tax breaks or subsidies can lower the cost of capital for green projects, making them more attractive to issuers. The tax exemption for recipients under the Green SRI Sukuk Grant Scheme in Malaysia provides an example of a tax-based incentive (ADB, 2021). Corresponding evidence in India comes from a tax-free bond issued by the Indian Renewable Energy Development Agency Limited (IREDA) in 2016 which was oversubscribed by more than five times (Agliardi & Agliardi, 2018) [15].

Issuance of green bonds can also be encouraged by subsidising the issuance cost. A need for third-party verification for green bonds adds to their cost of

issuance. To ensure the interest of firms in issuing green bonds, it is important to offset this additional cost through fiscal measures. A green bond fund or a grant scheme, as implemented by other Asian nations such as Singapore and Malaysia, can be explored for the Indian market as well.





Indians' affinity for fixed deposits (FDs) is evident in the data, which shows that INR 190.93 trillion [13] is saved across millions of accounts nationwide. A straightforward policy nudge like offering slightly higher interest rates on FDs up to a certain limit for private investors or fiscal incentives such as exemptions and credits for retail investors can popularise green bonds over taxable conventional bonds. Integrating sustainability criteria into regulatory frameworks could further enhance this effort. For instance, mandating that financial institutions allocate a specific percentage of total FDs into a green fund—earmarked exclusively for financing sustainable projects—could significantly boost capital for green initiatives. Even a small percentage requirement would result in substantial funding for these projects, owing to base effects. Establishing clear standards and certification processes for green financial products can enhance transparency and build investor confidence, facilitating broader participation in the green bond market.

Despite the promising prospects, the issuance of green bonds in India has progressed slowly over the last few years. At the macro level, the Indian bond market is currently in a nascent stage. A lower sovereign credit rating has long coerced Indian corporates to pay higher coupon rates on green bonds than the international standards (Arif et al., 2022; Kumar, 2022) [16][18].

Regressive domestic regulations like India's Insurance Act restrict investments to assets with a credit rating of at least AA, limiting insurance companies' ability to fund various green infrastructure and energy initiatives (Arif et al., 2022) [16].

In July 2023, the Pension Fund Regulatory and Development Authority (PFRDA) permitted pension funds to invest in sovereign green bonds. Such regulatory adjustments are essential in India to allow institutional investors to diversify their portfolios and to attract retail investments into viable green assets (Ojha, 2023) [17].

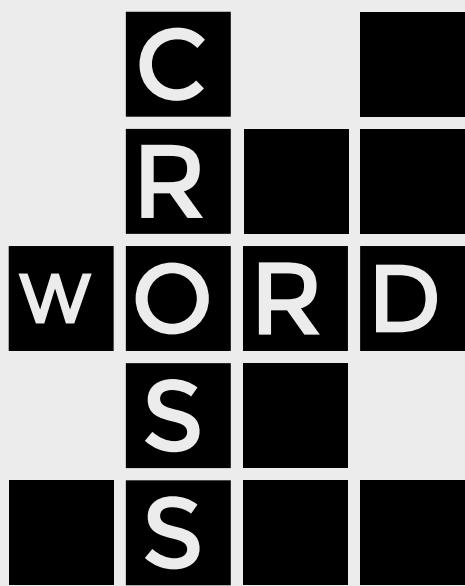
Additionally, integrating sustainability criteria into regulatory frameworks, such as requiring banks to disclose their climate-related exposures and align portfolios with net-zero goals, can drive capital toward sustainable investments. Closing data gaps is also crucial. Only with accurate and adequately standardised reporting of climate risks in financial statements can investors discern companies' actual exposures to climate-related financial risks and take appropriate remedial actions.

The undeniable challenges posed by climate change require us to rigorously assess the economic consequences it brings. Every severe storm, rising sea level, and drought diminishes global productivity, while the shift to a low-carbon economy will inevitably raise the cost of energy initially as environmental externalities are accounted for and outdated infrastructure is decommissioned. However, this transition also offers opportunities, with carbon pricing and emissions-reducing innovations, spurring technological advancements. Climate finance will be pivotal in guiding this transformation, ensuring that the shift is managed wisely for the well-being of future generations.

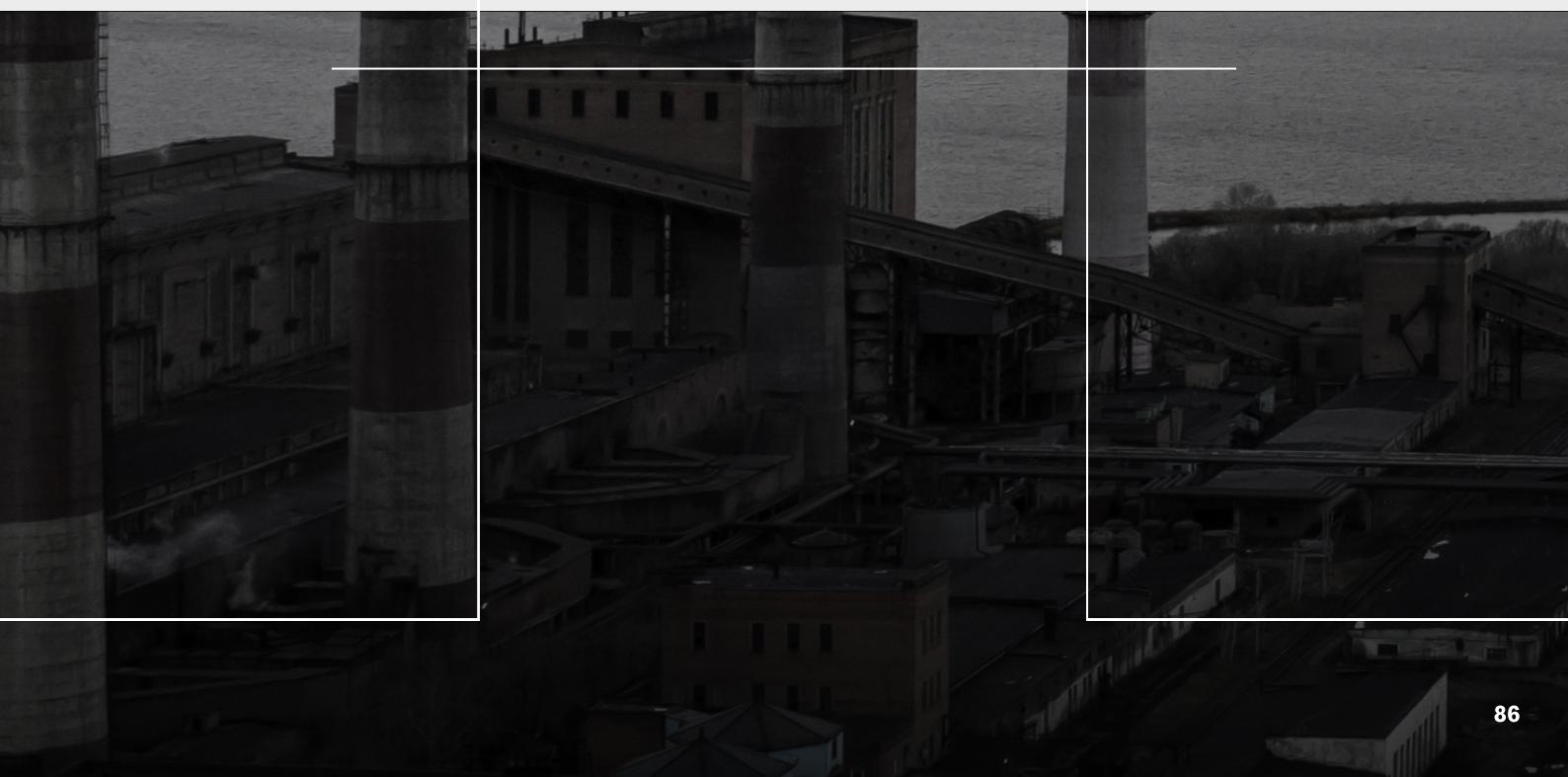


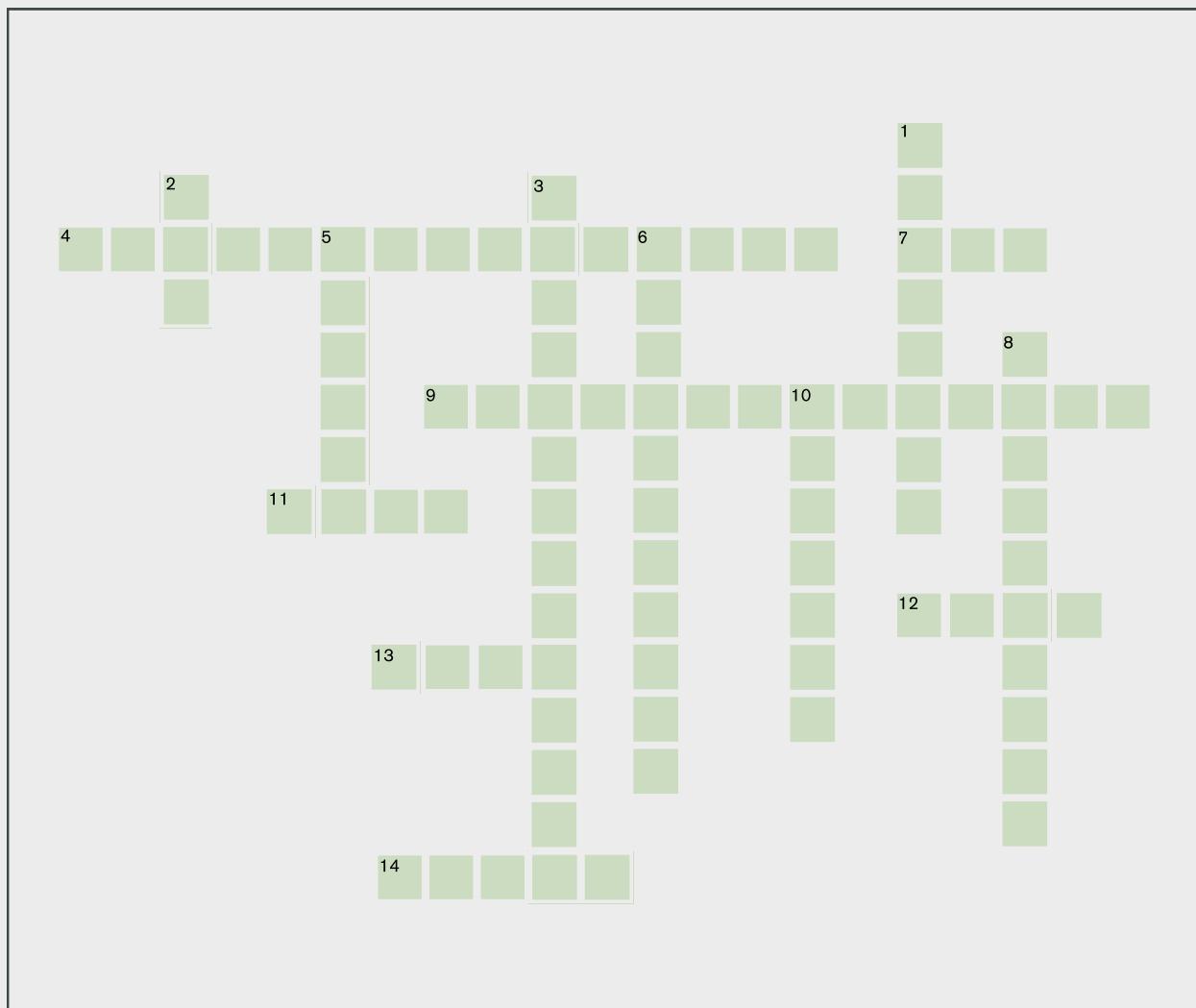
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ACROSS

- 4. Dialogue launched at COP23 to encourage transparent discussions on climate progress. (7,8)
- 7. Policy promoting reuse and buyback. (3)
- 9. Equitable movement from fossil fuel dependency. (4,10)
- 11. Scheme to increase EV adoption in India. (4)
- 12. Policy to impose carbon-related costs on imports into the EU. (4)
- 13. Contributing to 30% of India's GDP. (4)
- 14. International protocol that introduced market-based carbon mechanisms. (5)

DOWN

- 1. Term for the yield difference between green bonds and conventional bonds. (8)
- 2. Scheme to boost local manufacturing (3)
- 3. The first legally binding treaty adopted at COP21. (5,9)
- 5. A top vulnerable state in Just Transition. (6)
- 6. Estimated fund requirement for Just Transition. (3,8)
- 8. Finance required to reduce GHG emissions. (10)
- 10. The COP26 initiative where over 140 countries pledged to achieve this by 2050. (3,4)

Solutions

Across: 4. Talanoa Dialogue, 7. EPR, 9. Just Transition, 11. FAME, 12. CBAM, 13. MSME, 14. Kyoto
 Down: 1. Greenium, 2. PLI, 3. Paris Agreement, 5. Odisha, 6. One Trillion, 8. Mitigation, 10. Net Zero



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