FINANCING CLIMATE ACTION

INDIA IN A GLOBAL CONTEXT

EDITED BY
Mritiunjoy Mohanty and Runa Sarkar

Financing Climate Action

The urgency of mitigating climate change is mounting globally, and developing countries have a key role to play in ensuring a sustainable future. This book provides a comprehensive overview of all aspects of climate finance from the perspective of developing economies, with a focus on India.

Catalysing climate action requires economic and societal adjustments, beginning with additional resource mobilisation, capital reallocation and financing structures supported by appropriate regulations, reasonably functioning markets and effective institutions. Through an integrated assessment of macro-financial policies and market microstructures, this book provides a thorough understanding of how countries in the Global South can effectively mobilise and deploy financial resources to address climate change challenges. It brings together the views of academics, bureaucrats, policy analysts and civil society organisations that are actively engaged in climate finance to discuss challenges and options for India as it seeks to finance effective climate action. It offers a plurality of often-opposing ideas and observations, rooted in the reality of India's political economy. The volume presents novel solutions as well as lessons from international experiences to initiate and accelerate the flow of finance into climate-related activities.

This book will be an essential resource for scholars in environmental studies, development economics and public policy, while offering crucial insights for policymakers and practitioners engaged in sustainable finance.

Runa Sarkar is a professor with the Economics Group at the Indian Institute of Management Calcutta. Her interests lie in sustainable development, where business interests are in consonance with environmental and social interests. She serves as an independent director on the boards of Bandhan Financial Holdings Limited, Climate Policy Initiative and BASIX Consulting and Technology Services.

Mritiunjoy Mohanty retired in September 2024 as a professor of economics at the Indian Institute of Management Calcutta, Kolkata. Outside of climate change, he is currently also researching the comparative growth trajectories of China and India and the nature and pattern of their integration into the global economy.

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Mritiunjoy Mohanty retired in September 2024 as a professor of economics at the Indian Institute of Management Calcutta, Kolkata. Outside of climate change, he is currently also researching the comparative growth trajectories of China and India and the nature and pattern of their integration into the global economy.

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Preface and Acknowledgements

Financing Climate Action: India in a Global Context is the outcome of a project titled 'Building Roadmaps for Industrial Decarbonisation and Green Economy-2' (BRIDGE-2), undertaken by us at IIM Calcutta from October 2023. The volume seeks to contribute to the discussion around climate finance, and it does so by clearly focusing on the plurality of viewpoints (with 71 contributors and 37 affiliations) that have emerged so that in taking the debate forward, all these may be considered. The process commenced with a brainstorming workshop on 17 and 18 April 2024 (40 delegates from 30 institutions), followed by a writers' workshop on 6 and 7 August 2024 (51 delegates from 37 institutions) to build-in detailed peer review into the development of the volume as well as a mechanism to ensure coherence and connections between chapters. Further, an editorial committee comprising Dhruba Purkayastha (then Director for Growth, Council for Energy, Environment and Water (CEEW)), Mritiunjoy Mohanty (Retd Professor, IIM Calcutta), Runa Sarkar (Professor, IIM Calcutta) and Vibhuti Garg (Director, South Asia, Institute for Energy Economics and Financial Analysis (IEEFA)) oversaw the process and made the final selection of chapters for the volume. Mritiunjoy Mohanty and Runa Sarkar then took over for the more hands-on editorial tasks, including connecting with Routledge for publication of the volume.

Since the time we commenced our work, the world has changed in myriad ways, so much so that the current geopolitical scenario has dwarfed the disappointment about the COP29 outcomes. Yet the problem of global warming continues to stare us in the face, and therefore, the need for climate finance and finding ways to structure it are as important if not more than before. Although the context for the upcoming COP30 in Belem could not be more different than the prior one in Baku, the need to find collective solutions is even more pressing. This volume speaks to that and provides a wide-angle view of the financing aspects in dealing with the challenges posed by climate change – mitigation, adaptation and loss and damage – addressing these issues at both micro and macro levels as well as integrating them in terms of an appropriate governance structure. Climate finance is squarely located within a discussion of the overall macroeconomy and how this might shape resource flows towards the real economy as well as market functioning.

This volume would not have seen the light of day without institutional support, in particular that of our former director, Professor Uttam Sarkar, and our then director-in-charge, Professor Saibal Chattopadhyay. Rapporteuring support from our doctoral students Manhar Manchanda, Shubham Ojha, Satpute Ravi Ashok, as well as research associates Debarup Bhattacharya and Saptorshee Chakraborty for the two workshops is acknowledged as is the support from Aryan Panwar, academic associate, particularly when we faced a serious time crunch. Ananya Mondal's unstinting efforts at backstopping both workshops ensured that these were successfully concluded. She also held fort with all the groundwork to put together this volume, considerably lightening our workload. Finally, a big thank you to Ajit Mondal for the endless cups of coffee served with an encouraging smile to keep us going.

Shoma Choudhury has always been encouraging, and her team at Routledge has gone out of the way to support us in this endeavour. We would also like to acknowledge and thank our anonymous reviewers, whose comments have enriched and sharpened our work.

Of course, this book is the outcome of the discussions of the two workshops on 17 and 18 April, 2024, and 6 and 7 August, 2024, and we cannot thank every workshop and writeshop attendee enough for their engaged participation. Every contributor to this volume has been patient, cooperative and responsive, making our lives as editors much easier. Today, the research web we established with the coal volume is even more vibrant and has widened and deepened. This network has played a very important role in shaping this volume. That today, there is a network of academics and policy practitioners working together and sharing ideas on financing, at the frontiers of climate change, is perhaps the biggest gift of this volume, for which we will always remain grateful.

Mritiunjoy Mohanty and Runa Sarkar

Abbreviations

A&R	Adaptation and resilience
ABS	Asset-backed securities
ACM	Automation capabilities management
ADB	Asian Development Bank
AFOLU	Agriculture, forestry and other land use
AIF	Alternative investment fund
AIM	Asia-Pacific integrated model
AIM-CGE	Asia-Pacific integrated model/computable general equilibrium
AITUC	All India Trade Union Congress
AMSER	Aggregated microcredits from Sequestration or Emission Reduction
ANEEL	Agência Nacional de Energia Elétrica
APGENCO	Andhra Pradesh Power Generation Corporation Limited
ARC	African risk capacity
ASEAN	Association of Southeast Asian Nations
AUM	Assets under management
BAU	Business as usual
BCBS	Basel Committee on Banking Supervision
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BEE	Bureau of Energy Efficiency
BESS	Battery energy storage systems
BIMSTEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
BLY	Bachat Lamp Yojana
BMS	Bharatiya Mazdoor Sangh
BNDES	Brazilian National Bank for Economic and Social Development
BOB	Bay of Bengal
BOT	Build-operate-transfer
BRAC	Bangladesh Rural Advancement Committee
BRSR	Business Responsibility and Sustainability Reporting
CAGR	Compound annual growth rate
CB	Central bank
CS	Centrally Sponsored Schemes
CBAM	Carbon border adjustment mechanism
CBDRRC	Common but differentiated responsibilities and respective capabilities
CBI	Climate Bonds Initiative

CBOs	Community-based organisations
CBS	Climate Bond Standard
CCA	Climate change adaptation
CCfD	Carbon contract for difference
CCQI	Carbon Credit Quality Initiative
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CCS	Carbon capture and storage
CCTS	Carbon Credit Trading Scheme
CCUS	Carbon capture, utilisation and storage
CDM	Clean development mechanism
CEA	Central Electricity Authority
CEA	Chief economic advisor
CEE	Centre for Environment Education
CEEW	Council on Energy, Environment and Water
CERC	Central Electricity Regulatory Commission
CES	Constant elasticity of substitution
CFL	Compact fluorescent lamps
CFPP	Coal-fired power plant
CFPP	Cold filter plugging point
CGE	Computable general equilibrium
CGST	Central goods and services tax
CGTMSE	Credit Guarantee Fund Trust for Micro and Small Enterprises
CIF-ACT	Climate Investment Funds Accelerating Coal Transition
CIL	Coal India Limited
CITU	Centre of Indian Trade Unions
CLOs	Collateralised loan obligations
CNG	Compressed natural gas
CO_2	Carbon dioxide
COD	Commercial operations
COP	Conference of the parties
CPI	Consumer price index
CRD	Climate resilient development
CREB	Clean renewable energy bonds
CRFR	Climate-related financial risk
CSIs	Civil society institutions
CSO	Civil society organisations
CSRD	Corporate Sustainability Reporting Directive
CSRS	Civil Service Retirement System
CSS	Centre-State Sponsired Schmes
CTF	Clean Technology Fund
DART	Dialogue, access, risk assessment, and transparency
DC	Designated consumers
DEA	Detailed energy audits
DFI	Development financial institution
DISCOMs	Distribution companies
DMRE	Deployment of renewable projects
DPR	Detailed project report

DRC	Democratic Republic of the Congo
DRE	Distributed renewable energy
DREAM	Demand Resources Energy Analysis Model
DRIP	Dam Rehabilitation and Improvement Project
DRR	Disaster risk reduction
EBRD	European Bank for Reconstruction and Development
EC	Energy conservation
ECLG	Emergency Credit Line Guarantee Scheme
EE	Energy efficient
EEFP	Energy Efficiency Financing Platform
EIA	Environmental impact assessment
EIB	European Investment Bank
EMDE	Emerging Market and Developing Economy
EME	Emerging Market Economy
EFSL	Energy Efficiency Services Limited
EPPA	Emissions Prediction and Policy Analysis
ESCerts	Energy saving certificates
ESCO	Energy service company
ETM	Energy transition mechanism
ETS	Emissions trading system
EU	European Union
EU-ETS	European Union Emissions Trading System
EV	Electric vehicles
FACTS	Flexible Alternating Current Transmission System
FAME	Faster Adoption and Manufacturing of Electric Vehicles
FC	Finance Commission
FCRA	Foreign Contribution Regulation Act
FDI	Foreign direct investment
FEEED	Framework for Energy Efficient Economic Development
FI	Financial institutions
FICCI	Federation of Indian Chambers of Commerce & Industry
FPIs	Foreign portfolio investors
FPO	Farmers' producer organisations
FY	Financial year
G20	The group of 20
GAT	Governance assessment tool
GB	Great Britain
GCAM	Global Change Assessment Model
GCF	Greatest common factor
GDP	Gross domestic product
GEC	Green energy corridor
GEF	Global environment facility
GEM-E3	General Equilibrium Model for Economy-Energy-Environment
GENCOs	Government-owned electricity generation companies
GENeSYSMOD	Global Energy System Model
GFANZ	Glasgow Financial Alliance for Net Zero
GFCF	Gross fixed capital formation

GGRF	Greenhouse Gas Reduction Fund
GHG	Greenhouse gas
GIM	Green India Mission
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GLP	Green Loan Principles
GOI	Government of India
GOI	Government of Indonesia
GOI-ASUSE	Government of India Annual Survey of Unincorporated Sector Enterprises
GOI-MJS	Government of India Ministry of Jal Shakti
GP	Gram panchayats
GPDP	Gram Panchayat Development Plan
GRIHA	Green Rating for Integrated Habitat Assessment
GSDP	Gross state domestic product
GSECL	Gujarat State Electricity Corporation Limited
GST	Goods and services tax
GTAP	Global Trade Analysis Project
GW	Gigawatt
HCF	Household carbon footprint
HMS	Hind Mazdoor Sabha
IAMs	Integrated assessment models
IC Engines	Internal combustion engines
ICBC	Industrial and Commercial Bank of China Limited
ICM	Indian Carbon Market
ICMA	International Capital Market Association
IEA	International Energy Agency
IEG	Institute of Economic Growth
IEGC	Indian Electricity Grid Code
IEX	India Energy Exchange Limited
IFAWG	International Financial Architecture Working Group
IFC	International Finance Corporation
IFRS	International Financial Reporting Standards
IIGF	Indonesia Infrastructure Guarantee Fund
IMACLIM	Impact Assessment of CLIMate Policies
INDC	India's Nationally Determined Contribution
INR	Indian Rupee
INTUC	Indian National Trade Union Congress
InvITs	Infrastructure investment trusts
IPCC	Intergovernmental Panel on Climate Change
IPG	International Partners Group
IPPs	Independent power producers
IRADe-Neg	Integrated Research and Action for Development
IRDAI	Insurance Regulatory and Development Authority of India
IREDA	Indian Renewable Energy Development Agency
IRENA	International Renewable Energy Agency
IRRs	Internal rates of return
ISA	International Solar Alliance

ISSB	International Sustainability Standards Board
ISTS	Interstate transmission system
ISTSL	India SME Technology Services Limited
ITMO	Internationally transferred mitigation outcomes
JET-IP	Just Energy Transition Investment Plan
JETP	Just Energy Transition Partnership
JETPI	Just Energy Transition Partnership Indonesia
JFM	Joint Forest Management
JNNSM	Jawaharlal Nehru National Solar Mission (JNNSM)
JSW	Jindal South West
JT	Just Transition
KPCL	Karnataka Power Corporation Limited
KPI	Key performance indicators
KWh	Kilowatt-hour
L&D	Loss and damage
LBNL	Lawrence Berkeley National Laboratory
LCOE	Levelized cost of electricity
LDCs	Least developed countries
LEAP	Leadership execution and action planning
LEED	Leadership in Energy and Environmental Design
LiFE	Lifestyle for the Environment
LNG	Liquefied natural gas
LoCAL	Local Climate Adaptive Living Facility
LoS	Line of sight
LPG	Liquefied petroleum gas
LT-LEDs	Low emission development strategies
LULUCF	Land Use, Land-Use Change and Forestry
MARKAL	MARKet ALlocation
MBM	Market-based mechanisms
MCD	Municipal Corporation of Delhi
MCF	Multilateral climate funds
MDB	Multilateral development banks
MESSAGE	Model for Energy Supply Strategy Alternatives and Their General Environmental Impacts
MFI	Microfinance institutions
MFI	Multilateral financial institutions
MFs	Mutual funds
MHI	Mitsubishi Heavy Industries
MIGA	Multilateral Investment Guarantee Agency
MME	Ministry of Mines and Energy
MNRE	Ministry of New and Renewable Energy
MoEFCC	Ministry of Environment, Forest and Climate Change
MOU	Memorandum of understanding
MRV	Monitoring, reporting, verification
MSAAPC	Maharashtra State Adaptation Action Plan on Climate Change
MSPGCL	Maharashtra State Power Generation Corporation Limited
Mtoe	Million tonnes of oil equivalent

MU	Million unit
MuDSM	Municipal demand side management
MVA	Motor vehicle agreement
MVAR	Mega volt-amperes reactive
MW	Megawatt
NABARD	National Bank for Agriculture and Rural Development
NAP	National adaptation plans
NAPCC	National Action Plan on Climate Change
NASA	National Aeronautics and Space Administration
NASDAQ	National Association of Securities Dealers Automatic Quotation System
NBFCs	Non-banking Financial Company
NBSAP	National Biodiversity Strategies and Action Plans
NCC	National clean credits
NCEF	National Clean Energy Fund
NCQG	New collective quantitative goal
NDC	Nationally determined contribution
NELD	Non-economic losses and damages
NGO	Non-governmental organisation
NHPC	National Hydroelectric Power Corporation
NITI Aayog	National Institution for Transforming India
NLC	Neyveli Lignite Corporation
NMA	Non-market approaches
NMEEE	National Mission for Enhanced Energy Efficiency
NOAA	National Oceanic and Atmospheric Administration
NTPC	National Thermal Power Corporation
NUM	National Union of Mineworkers
NUMSA	National Union of Metalworkers of South Africa
NZE	Net-zero emissions
NZEBs	Net-zero energy buildings
ODA	Official development assistance
OECD	Organisation for Economic Co-operation and Development
OEM	Original component manufacturer
ONGC	Oil and Natural Gas Corporation
ONS	Operador Nacional do Sistema Eléctrico
PACE	Prepare, analyse, communicate, execute
PAT	Perform, achieve and trade
PE	Private equity
PFRDA	Pension Fund Regulatory Development Authority
PHC	Primary health centres
PLN	Perusahaan Listrik Negara
PMCCC	Prime Minister's Council on Climate Change
PMUY	Pradhan Mantri Ujjwala Scheme
PPA	Power purchase agreements
PPP	Public private partnership
PQ	Power quality
PRS	Poverty reduction strategies

PRSF	Partial risk sharing facility
PRSF	Partial risk sharing facility for energy efficiency
PSPP	Pumped storage power plants
PSP	Pumped storage projects
PSU	Public sector undertakings
PTCs	Pass-through certificates
PTI	Press Trust of India
PV system	Photovoltaic system
PXIL	Power Exchange of India Limited
QE	Quantitative easing
QECB	Qualified Energy Conservation Bonds
R&D	Research and development
RBI	Reserve Bank of India
REC	Renewable energy certificates
REDD+	Reducing Emissions from Deforestation and Forest Degradation
REE	Rational expectations equilibrium
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
RoW	Rest of the world
RPO	Renewable purchase obligation
RTC	Round the clock
RWA	Regional water authorities
RWAs	Resident welfare associations
SAF	Sustainable aviation fuel
SAM	social accounting matrix
SAPCC	State Action Plans for Climate Change
SBM	Swachh Bharat Mission
SBTi	Science Based Targets Initiative
SDG	Sustainable development goal
SDL	State development loan
SDR	Social discount rate
SEB	State electricity boards
SEBI	Securities and Exchange Board of India
SECI	Solar Energy Corporation of India
SERC	State Electricity Regulatory Commissions
SGC	State Government Contibuted Schemes
SGHs	Self-help group
SGST	State goods and services tax
SIDBI	Small Industries Development Bank of India
SIDS	Small island developing states
SLB	Sustainability-linked bonds
SLGBs	Sustainability-linked green bonds
SLR	Sea level rise
SME	Small and medium enterprises
SMI	Sarana Multi Infrastruktur
SNM	Strategic niche management
SOC	Social opportunity cost
SOEs	State-owned enterprises
SoG	State-owned generation companies

SPC	Shadow price of capital
SPT	Sustainability performance targets
SPV	Solar photovoltaic
SPV	Special purpose vehicle
SRTP	Social rate of time preference
SST	Sea surface temperature
STACOM	Satellite communications
SLR	Statutory liquidity ratio
STRIPS	Separate Trading of Registered Interest and Principal Securities
SVC	Static VAr Compensator
SYNCONS	Synchronous condensers
tCO_2	Total carbon dioxide
TERI	The Energy and Resources Institute
TIAM-UCL	TIMES Integrated Assessment Model at University College London
TNERC	Tamil Nadu Electricity Regulatory Commission
TPT	Transition Plan Task Force
TRL	Technology readiness level
TU	Trade union
TW	Terawatts
UJALA	Unnat Jyoti by Affordable LED for All
UK	United Kingdom
ULB	Urban local bodies
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UoP	Use of proceeds
UPI	Unified payments interface
US	United States
USD	United States dollar
USEPA	United States Environmental Protection Agency
UT	Union territories
VAT	Value added tax
VC	Venture capital
VCM	Voluntary carbon market
VGF	Viability gap funding
VRE	Variable renewable electricity
WBG	World Bank Group
WHO	World Health Organization
WMO	World Meteorological Organization
WRI	World Resources Institute
WSPF	Water and Sanitation Pooled Fund

Introduction

Mritiunjoy Mohanty and Runa Sarkar

The challenge of addressing climate change is that we have to transition away, over a period of 30–50 years, from a carbon-intensive to low-carbon economic growth model – in terms of power generation, industrialisation, mobility and, in general, mechanisation of human activity – that has evolved and recomposed over the last two centuries. This urgency to take action in the present is to reduce the accumulation of carbon in the atmosphere or face irreversible tipping points. Further, that such investment and cost (in humanity's collective future) are to be incurred by a set of nations (and disparate populations within the nations) who may or may not benefit directly and therefore may view this as an expense is an added challenge. Furthermore, this challenge is exacerbated by the fact that there is another set of nations (primarily in the Global South) that is directly affected but not in a position to finance climate action on the scale required.

Catalysing such action would require economic and societal adjustments, beginning with additional resource mobilisation, capital reallocation and financing structures supported by state intervention, given that climate change is probably the biggest market failure the world has seen in a century, which would need appropriate regulations, reasonably functioning markets and effective institutions. In light of this, the United Nations Framework Convention on Climate Change (UNFCCC) Standing Committee on Finance states, "*Climate finance aims at reducing emissions and enhancing sinks of greenhouse gases and aims at reducing vulnerability of, and maintaining and increasing the resilience of, human and ecological systems to negative climate change impacts.*"[1] *In other words, climate finance is the flow of funds to all activities which address and respond to climate change (mitigation, adaptation and loss and damage) across economic sectors nationally and globally.*

Keeping in mind the UNFCCC's definition, this volume approaches climate finance in its broadest definition and attempts to address these multiple facets of financing climate-positive action in India while drawing some lessons from global experience in this regard. After painting the present climate finance landscape, the volume addresses the climate finance regulatory and governance infrastructure both in the context of extant institutional arrangements and alternate structures to enhance and facilitate the flow of finance. We then delve into financial instruments and mechanisms specifically for climate finance, which looks at market-making and creation of financial products. Climate finance is the amount of investment and expenditure by the public and private sector towards mitigation and adaptation. We explore next the financing of specific climate-positive projects followed by an extensive discussion of the need for public resources underscoring its

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need. The volume concludes with a section on international experiences in the realm of climate finance that may be relevant to India's transition pathway.

The volume was conceived and operationalised weeks before COP29. As a result, some of the chapters do not address issues that emerged from that COP and often present a wish list for COP29, which may now be addressed by COP30. The major outcomes from COP29 include operationalising Article 6 and the loss and damage (L&D) fund and the disappointing allocation of public funds for new collective quantifiable goals (NCQG) while leaving the doors open for negotiation through the Baku to Belem discussions. Of course, as we know, these have been completely overshadowed by the re-election of President Donald Trump for a second term that is currently underway. Not only has the United States withdrawn, again, from the Paris Agreement, it has also sought to change its financing commitments to international financial institutions, including those to the Global South. The world order is changing, and political and economic power is shifting, albeit incrementally, to the Global South, and we think climate action continues irrespective of US commitments which, in any case, has not been substantial. COP30, therefore, takes on a completely different task under a very different geopolitical context to try and ensure that climate action is not derailed. Since the reality of climate change and related global warming will not go away irrespective of whether or not the United States and some other members of the Global North recast their financial and nonfinancial obligations, new strategies of South-South cooperation have to be found to improve financial and technology flows to address the pressing needs and demands of those nations that are most vulnerable to climate change. Despite this tectonic shift in geopolitics, the issues that the volume deals with remain relevant, perhaps even more so.

As we read through this volume, some overarching themes become evident. Since each section has a short editorial introduction, we use a slightly unconventional approach of discussing these themes and using them to thread the different contributions together. The themes, that cut across the six parts of the volume, discussed are as follows: *the need to view top-down and bottom-up approaches holistically; institutional structures to enable markets and states to work together; role of carbon markets in supporting climate finance; mitigation and adaptation as complements; regional cooperation and platforms*. Each is discussed in turn.

When approaching an effective and efficient financial architecture to fund climate action, we often use a top-down approach, as these large organisations have demonstrated the capability and capacity to engage with big problems, often, however, ignoring smaller players and a bottom-up view. Clearly, these need not be binaries; the top-down and bottom-up have to speak to each other if climate finance is to be effective. This becomes particularly important when we include adaptation and L&D in the ambit of the discussions. While discussing the potential of bottom-up approaches, Vijay Mahajan (Chapter 4) introduces the possibility of carbon sequestration, underpinned by community action for adaptation, which in turn could leverage carbon markets for its funding – an approach that is not normally considered when we talk of climate finance. Bajpai, Garimella and Solanki as well as Upendra Bhatt (Chapters 9 and 13, respectively) discuss the case of the state of Maharashtra in the context of funding climate actions using and leveraging state finances. Through an assessment of programmatic expenditure at the district level, across thematic areas of the State Action Plan for Climate Change (SAPCC), Chapter 9 highlights areas, themes, schemes and programmes where additional allocations will result in better outcomes for climate adaptation and resilience: for example, in the water resources and in industry. While proposing many innovative financing and de-risking mechanisms for climate action, Chapter 13 recommends following sectoral or cluster-level convergence to allow climate action to be integrated with the socio-economic conditions of the state and help sharpen specific interventions. The role of the lowest tier of decentralised governance in rural areas for climate action, namely gram panchayats, is explored by Solanki, Dutt and Gupta (Chapter 10). They discuss a successful intervention in Uttar Pradesh of financing climate smart gram panchayat action plans, underlining the need for actions at the ground level to align public and private finance towards the delivery of adaptation goals as outlined on the SAPCC. Pal, Sarkar and Sikka (Chapter 21) advocate the seamless integration of local grassroots wisdom into a scalable, knowledgeable, accountability and efficiency-driven multilateral agency system for effective governance of L&D funds.

MSMEs form the backbone of India's industrial economy, and energy transition will remain incomplete unless these, often financially and technologically constrained, units are brought into the fold. Jena and Trivedi as well as Shrivastava and Garg (Chapters 15 and 16, respectively) discuss two different aspects of climate finance for MSMEs. Chapter 15 discusses structured products, whereas Chapter 16 specifically explores enhancing energy efficiency in MSMEs. Kumar, Nida and Pasha (Chapter 20) focus on the role of trade unions in ensuring a just transition by engaging with elements of corporate governance in the coal mining sector. They establish that bringing trade unions into the fold of governance related to financial allocations and expenditures offers the potentiality of aligning transition goals with a more inclusive outcome for all stakeholders. Finally, Nandan Nawn (Chapter 7) stresses the importance of developing a well-defined climate finance taxonomy for central bank regulation which goes beyond traditional measures of risk, incorporating therefore the nature of risks borne by MSME financing.

The discussion around climate finance often implicitly and sometimes explicitly puts markets and states as being alternative approaches. The truth is that for effective financing, more often than not, markets and the state can complement each other in the provision of climate finance. These can happen in terms of domestic public investments, guarantees and underwriting, each of which can be leveraged to attract finance at scale regardless of the nature of international flows. Therefore, even though international climate finance clearly has a role to play, it is equally important to mobilise domestic financial resources and create an enabling domestic financial environment.

Chapters 2, 3 and 25 are examples of policy in action, where public finance worked in tandem with private sector players to deliver favourable results for economic growth and renewable energy expansion. Mathur and George (Chapter 2) discuss how the International Solar Alliance has been able to expand the adoption of solar energy technology in Africa, leveraging public guarantees to unlock private lending. Ajay Shankar (Chapter 3) discusses policy measures that have underpinned the successful rollout of wind and solar energy by private sector players. In a discussion on the efficacy of carbon taxes and green bond issuances by the European Union, Mandal, Brahma and Vardhini (Chapter 25) demonstrate that, while they work through different routes, neither resulted in increased inflation while significantly increasing renewable energy investments.

Grover, Goel, Mahto and Goyal (Chapter 24) take us on a journey through Brazil, South Africa and the UK to demonstrate that sole reliance on the private sector to deliver utilities has almost always resulted in failure and ultimately a bailout by the public sector. Hence, they recommend a balance of public and private sector investments in India's energy transition. Kumar and Sarkar (Chapter 23) discuss the potentiality of using green quantitative easing by central banks as a mechanism to encourage private investment in energy transition. Nandan Nawn (Chapter 7) echoes a similar position coming from the standpoint of a well-defined climate taxonomy. Finally, Raizada and Sharma (Chapter 6) recommend a calibrated 'reform, target and shift' approach to unlock public finance for energy transition.

The importance of appropriate institutional structures that can catalyse and support both public and private investment has also been addressed. Mritiunjoy Mohanty (Chapter 22) makes the distinction between uncertainty and risk and argues that public investment banks are capable of taking care of the former, thereby unlocking private finance for the latter where mitigation efforts are concerned. Shailesh Vickram Singh (Chapter 14) discusses the possibility of attracting risk capital for financing energy transition through the mechanism of venture capital. Energy transmission is an understudied area which is critical to successful energy transition, integrating variable renewable energy into the grid. Sarkar, Habib and Sen (Chapter 19) specifically consider infrastructure investment trusts (InviTs) as a financing vehicle for greening India's transmission grid and the underlying institutional mechanisms required. Chapters 11, 12 and 14 look at the institutional structure of financial markets as mechanisms of resource mobilisation. Gada and Khanna (Chapter 11) explore recycling, refinancing and securitisation to release additional private sector financing for energy transition. Shantanu Shrivastava (Chapter 17) discusses how validating the transition plans of corporate entities might help attract external investor finance on favourable terms. Dey and Sharma (Chapter 12) assess the role of carbon markets in supporting transition finance through price discovery and recommend the introduction of carbon taxes in a phased manner.

Over the last decade, carbon markets have grown and matured in many economies. They have also been 'in principle' operationalised as one of the outcomes of COP29, specifically Article 6.4. We see carbon markets as playing a complementary role of price discovery and reduction of information asymmetry, which will help in the way other financial markets and instruments function. That is to say, they are an important part of the global financial architecture for climate action and a prerequisite for the design of various financial mechanisms while clearly not a solution in and of themselves. Mandal, Brahma and Vardhini (Chapter 25) demonstrate the effectiveness of the EU Emissions Trading System (EU-ETS) as an integral part of the EU financial architecture for climate finance. Mehra, Ahmad, Sawhney and Aggarwal (Chapter 18) explore the EU-ETS and California carbon markets as institutional mechanisms of price discovery and carbon finance. They underline that the markets must be in operation for a reasonable period and with sufficient trading taking place for adequate price discovery, concluding with recommendations for the Indian carbon market. Finally, Jena and Trivedi (Chapter 15) look specifically at the market for sustainability-linked green bonds as a mechanism for financing energy transition. Chand, Dasgupta and Pitigala (Chapter 8) introduce a new element into the functioning of markets, suggesting linkages between successful sequestration projects and access to carbon credit markets globally will be key to international partnerships.

Climate financing, thus far, has focused almost solely on mitigation possibilities. However, what has emerged is that progress has been slow, and as a result, the ability to keep within the two-degree Paris target is increasingly compromised. This has led to an intensification of climate events, bringing to the fore the need for adaptation as a central pillar of climate finance. Therefore, the importance of seeing mitigation and adaptation work together is clear as the way ahead. We need to revisit projections, question the underlying assumptions of IAMs and other economic models and the cost at which financing is available, particularly the use of social discount rates (as opposed to the more usual metric of financial rates of return) in financing climate action. At a different level, the possibilities afforded by a truly bottom-up people-driven decarbonisation strategy gains salience.

For the volume, an important focus has been the way mitigation and adaptation goals can work together in financing climate action. Ray, Bandyopadhyay and Majumder (Chapter 1) explore different estimates of resources required in the Indian context for financing mitigation and adaptation, seen both from the macro perspective and from summing up different initiatives from the ground up. Agarwal and Upadhyay (Chapter 5) focus on the underexplored issue of trade-offs involved in increasing the supply of variable renewable energy in the power mix. They argue that an unfettered focus on mitigation, not taking into account these trade-offs, implies adapting to higher costs of power in the future. Therefore, they advocate a systems approach that addresses both mitigation and adaptation implications. Vijay Mahajan (Chapter 4) demonstrates how in, rural India, adaptation initiatives could lead to carbon sequestration, an important but understudied element of climate action, thus contributing to mitigation as well (which could be monetised) though community-led initiatives. Pal, Sarkar and Sikka (Chapter 21) suggest the need for an inclusive and full-spectrum approach towards funding arrangements. L&D compensation activities require complementarity on the ground, with different funding streams of adaptation, development, humanitarian aid and loss and damage support. Central to all this is the cost at which finance is made available. Mritiunjoy Mohanty (Chapter 22) argues that public investment banks have the institutional capability of using social discount rates to finance adaptation, something private capital will not do. He therefore argues that publicly funded green investment banks are a key institutional requirement of successful climate action. Swasti Raizada (Chapter 22) explores the social discount rate and its institutional underpinning as a key price at which public financing can be triggered.

Finally, in the discussions around climate finance, often the region dimension and inter-country cooperation are completely missed. As the reality of climate change affects our present, and metaphorically, our backs are to the wall, it is possible that regional cooperation may be leveraged to address similar types of challenges faced by communities in the context of adaptation and building resilience in the face of climate change events. A different aspect of inter-country cooperation is addressed through country platforms and nationally determined contributions (NDCs). The possibility of learning from each other's' experience in designing NDCs has great potential.

Towards this end, Iyer and Yustika (Chapter 27) discuss Indonesia's experience of financing a just energy transition using its Energy Transition Mechanism (ETM) country platform using a blend of concessional and commercial capital (blended finance) supported by the ADB. Joshi, Sabogal Reyes and Singhal (Chapter 26) take the country platform discussion forward as they explore how these may be integrated into NDCs of individual countries, making them attractive to international private and multilateral investors by reducing information asymmetries. Pal, Sarkar and Sikka (Chapter 21) also advocate for a regional approach for the governance of L&D financing, as climate events do not respect political boundaries. Chand, Dasgupta and Pitigala (Chapter 8) discuss BIMSTEC as a potential platform for regional cooperation in the context of climate adaptation and finance.

As this brief overview of themes that are covered in the volume indicates, climate finance is multifaceted in terms of instruments, players, geographies and competing resource needs, and unless we understand the interconnectedness of these elements, it is difficult to appreciate how we might move forward. One of the enduring lessons of this set of essays is that markets and states working together are the best institutional mechanisms of dealing with both uncertainty and risk by allocating risk between public and private sectors. It is possible to harness the scale and nimbleness of venture capital as it assesses risk when public investment clarifies the nature of risks involved by absorbing some of the uncertainty. Neither on their own will be particularly effective, either in technological or in cost terms.

Perhaps the one theme that we have not explored is that markets themselves and the relationship between public and private players are not constants. As President Trump's second term unfolds, policy reversals and changing geopolitical realities have shaped the responses of markets as well as influenced the expectations of players. Therefore, many private players have reassessed their commitment to climate goals and recalibrated their responses in line with President Trump's focus on fossil fuels as an important and continuing energy resource. Whether the policy reversals that have resulted have a long-term impact remains to be seen, but for the present, they complicate the path to a carbon-neutral future. Be that as it may, the reality of climate change and global warming cannot be wished away, and it is well accepted that the costs of climate change far outweigh the expenditure required to mitigate it. Therefore, these underlying realities enjoin upon all players, particularly those of the Global South, to fashion new collaborations so as to be able to cope with and mitigate the worst effects of climate change. We hope this volume contributes to that discussion.

Note

1 https://unfccc.int/files/cooperation_and_support/financial_mechanism/standing_committee/application/pdf/2014_biennial_assessment_and_overview_of_climate_finance_flows_report_web.pdf. Page 5

Part 1

Climate Finance Landscape

An Introduction

Mritiunjoy Mohanty and Runa Sarkar

Like all action, climate action also needs a context. This section attempts to provide the context for financing climate action by discussing both successes as well as challenges in the climate finance landscape. By assessing a multiplicity of India's transition pathways, it provides the reader with an estimate of the scale of financing required and places investments in adaptation and resilience at the centre-stage of India's climate policy and programmes.

This section contains six chapters that offer different views of the role and institutional context of climate financing in India. It opens with an overview chapter by Saon Ray, Kuntala Bandyopadhyay and Piyali Majumder, detailing estimates of climate finance from most extant sources using multiple methodologies that they classify into top-down (macro-level) and bottom-up (granular, sector-specific) approaches. The authors discuss the distinction between carbon neutrality and net zero, favouring the latter for its comprehensiveness, and effectively integrate economic, technological and policy considerations in their discussions. They identify five key sectors, energy, transportation, industry, urban and agriculture, which must coevolve to successfully achieve net-zero emissions. Challenges include land availability, flexible generation capacity, financial health of distribution companies and reliance on imported energy materials.

Ajay Mathur and Anita Marangoly George, in Chapter 2, discuss how public finance can catalyse private investment by lowering the latter's risk profile. In this context, they discuss the International Solar Alliance and its success in financing solar power capacity installation and generation in Africa. They demonstrate that the alliance plays a pivotal role, given the paucity of private finance, in renewable energy markets. In addition, the chapter's framework for analysing the different financing needs and challenges faced by country groupings based on their levels of development as well as their exposure to climate risk (Organisation for Economic Cooperation and Development (OECD), Emerging Markets and Developing Economies (EMDE), Small Island Developing States (SIDS) and Less Developed Countries (LDCs)) is a useful tool.

Continuing on the theme of private finance, the third chapter by Ajay Shankar argues how targeted and agile public policy with minimal public finance outlays underpinned the success of wind and solar energy capacity in India by assuring stable returns which crowded in private investment. The specific instrument used was allowing for the accelerated depreciation of physical capital for wind and a tariff-based bidding system and bundling mechanism for solar energy. In addition, Shankar points out that value addition continues to remain a challenge and puts forward a mechanism to enhance investments

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in value addition of renewable energy supply chains while asserting that finance has not been a constraint for renewable energy growth in India.

Vijay Mahajan provides a community-driven view of how public investments in adaptation and climate resilience can generate resources for ground-up mitigation as well through a farmer-driven carbon sequestration process. To give this a more concrete shape, he provides elaborate back-of-the-envelope estimates on the basis of extant data and introduces the novel concept of aggregated microcredits from sequestration or emission reduction (AMSERs) to mobilise climate finance by aggregating small-scale adaptation efforts. Mahajan's contribution is noteworthy particularly in the context that sequestration is among the most technologically challenging aspects of climate change policy.

The fifth chapter by Manish Agarwal and Yogesh Upadhyaya is grounded in the complexities of transitioning to variable renewable energy (VRE) in the context of a just energy transition. They contend that the reason for the lack of enthusiasm on the part of private finance are risks associated with the increasing share of VRE in the energy mix and the resulting impact on grid stability and the cost of power. Policymakers need to carefully consider the energy trilemma – that is, trade-offs between cheap, firm and clean energy, and perhaps a more comprehensive assessment of the economic costs of VRE is necessary before designing appropriate financial instruments for climate action.

The section ends with a contribution by Swasti Raizada and Deepak Sharma who discuss the importance of domestic public finance in India's climate action, emphasising the need for a strategic approach to utilise these funds effectively. After highlighting the complexities of India's fiscal federalism, particularly the division of tax resources between the central and state governments, which can hinder the mobilisation of domestic public finance for climate action, they delve into real-world examples from mitigation efforts, specifically in the energy sector, to highlight how a calibrated approach of 'reform, target and shift' can further unlock domestic public finance for climate action. They caution that any attempt to reform domestic public finance for carbon-intensive sectors needs to be implemented extremely carefully, as changing any support mechanism, purely on efficiency grounds, is neither desirable nor practical.

1 Financing Net Zero

An Assessment of the Top-Down and Bottom-Up Approaches in India

Saon Ray, Kuntala Bandyopadhyay and Piyali Majumder

1.1 Introduction

In 2021, India contributed 6.8% of the global CO_2 emissions, and the per capita emission was 1.6 tCO_2/capita (IEA, 2021). It has committed to a reduction in the emissions intensity of its GDP by 45% from its 2005 level and 50% of its installed power capacity from non-fossil-fuel-based energy resources by 2030 (PIB, 2022). Given the multiplicity of estimates of the quantum of finance required to meet these commitments, this chapter explores these and the associated pathways, using top-down and bottom-up[1] approaches. In the next section, we discuss the concepts of net zero and carbon neutrality and why they cannot be used interchangeably. Section 1.3 discusses the top-down approach, while Section 1.4 discusses the bottom-up approach. Section 1.5 concludes.

1.2 Net Zero versus Carbon Neutrality

While corporates worldwide are exploring new investment opportunities to finance their climate action plans (in tandem with the nationally determined contributions) to achieve 'carbon neutrality' and net-zero emissions (NZE), it is imperative to dissect these two buzz words, which are often used interchangeably. Both the terms are related but have different implications in terms of their scope and scale and, accordingly, have different financial implications.

Carbon neutrality is the process of ensuring balance between the level of carbon emission vis-à-vis removing or offsetting equivalent amounts of carbon from the atmosphere. If removal becomes infeasible, then investments can be made in projects aimed at reducing, avoiding or capturing carbon to store into natural carbon sinks such as forests, soil and oceans. Only a few studies have undertaken holistic assessments of carbon neutrality and its associated implications, challenges or barriers at the global, national or regional levels. Country-level or regional assessments have been conducted for Bhutan (Kamei et al., 2021), Finland (Pilpola et al., 2019), Nepal (Pradhan et al., 2018), Korea (Kim et al., 2022), China (Fuhrman et al., 2020; Zhao et al., 2022), the UK (Shahbaz et al., 2020), France, Sweden (Millot et al., 2020), Switzerland (Li et al., 2020), four industrialised economies (the EU, the United States, Japan, and Australia) (Schreyer et al., 2020) and the EU (Salvia et al., 2021).

Carbon neutrality reinforces the importance of carbon markets, especially voluntary carbon markets, where businesses trade carbon offsets, as opposed to compliance markets defined under the Kyoto Protocol of 1997. If a company can remove one unit of

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carbon from the atmosphere, it creates one carbon offset, which can then be purchased by another business to reduce its carbon footprint.

In contrast, the NZE target is a more comprehensive approach using either balancing or removing all greenhouse gas (GHG) emissions originating from any anthropogenic activity, not just CO_2 emissions (Fankhauser et al., 2022). The signatories of the Paris Agreement are committed to developing national climate action plans to achieve the NZE target. The pathways and time scales of achieving NZE vary across countries. While formulating plans to achieve NZE targets, ensuring carbon neutrality across economies is essential.

According to the IEA (2021), by the end of the first quarter of 2021, 44 countries and the European Union had pledged to achieve NZE. At the same time, carbon neutrality assessments have gained significant traction in recent years, primarily from a subsectoral or industry perspective. Notable examples include the global construction industry (Zuo et al., 2012), the global aluminium industry (Das, 2012), the Australian red meat sector (Mayberry et al., 2019), China's passenger transport system (Bu et al., 2021), the Swedish industry sector (Sandberg, 2020), the Indian transport sector (Gupta and Garg, 2020) and the global and national building sectors (Ürge-Vorsatz et al., 2020; Jain et al., 2017; Liang et al., 2019).

This study primarily focuses on the financial implications of achieving the net-zero targets proposed by the government of India (GoI).

The Government of India has committed to achieving NZE targets by 2070 and has laid out a 'Panchamrit action plan' to achieve the same. It envisages expanding the non-fossil-fuel-energy capacity by 2030, reducing CO_2 emissions by a billion tonnes. This is supposed to be accompanied by reducing the carbon emission intensity of the GDP below 45% by 2030. The expansion of non-fossil-fuel-based energy generation capacity, the integration of clean-energy-based technologies into the production process and building resilience against climate change entail a large sum of funding.

In the Indian context, many researchers (IFC, 2023; Khanna et al., 2022; Deloitte and FICCI, 2023) have estimated that the funding required to finance the NZE targets may reach US$10.1 trillion (see Table 1.1). Some researchers (Bloomberg, 2023; Das et al., 2023) have also analysed the financial implications of NZE targets for the power sector.

These estimates are indicative and depend on the underlying assumption of the rise in global versus local temperatures. This, in turn, determines the margin of loss associated with the rise in economic activities across the globe. Bilal and Känzig (2024) showed, empirically, that 'global temperature' (including sea surface temperature) change results in five to six times more economic loss than the loss associated with using 'local temperature' (country-level panel estimates of temperature) estimates.

In what follows, we discuss estimates for NZE for India, arrived at using both top-down and bottom-up approaches. We discuss each in turn.

1.3 Financing Climate through the Top-Down Approach

India is one of the fastest-growing economies, with a large and growing population, increasing urbanisation and changing consumption patterns. Although its per capita CO_2 emissions of two tonnes per person in 2019 is relatively low, it was the world's third-largest CO_2 emitter, following China and the United States (Levin and Lebling,

Table 1.1 Financial Estimates to Achieve Net-Zero Targets

Authors	*Monetary Estimates for Reaching Net-Zero Emissions*	*Monetary Estimates for Reaching Net-Zero Emissions in Any Specific Sector*
Srinivasan et al. (2023)	USD 10 trillion (cumulative) by 2070	
IFC (2023)	\$200–\$350 billion per year only for its climate mitigation action alone	
Khanna et al. (2022)	USD 170 billion per year (from 2015 to 2030)	
Comptroller and Auditor General of India (2024)	USD 10 trillion annually by 2050	
Bloomberg NEF, New Energy Outlook India (2023)		Power Sector: annual spending of USD 438 billion between 2022 and 2050
Das et al. (2023)		Power Sector: annual investment of USD160 billion (net zero by 2050)
Deloitte and FICCI (2023)	USD 300 billion annually between 2022 and 2070	

Source: Authors' compilation from various papers.

2019). The energy sector accounted for about 83% of the country's GHG emissions, including land use, land-use change and forestry (LULUCF) in 2016, highlighting its decarbonisation potential (MOEFCC, 2022). It has committed to a reduction in the emissions intensity of its GDP by 45% from its 2005 level and 50% installed power capacity from non-fossil-fuel-based energy resources by 2030 (PIB, 2022).

Several studies have explored low-carbon energy transition pathways for India's growing economy, based on current trends and scenarios, guided by different levels of national carbon budgets and technological progress (e.g. Mathur and Shekhar, 2020; Anandarajah and Gambhir, 2014; Lawrenz et al., 2018; Van Soest et al., 2017; Vishwanathan and Garg, 2020; Thambi et al., 2018; Vishwanathan et al., 2018; Parikh et al., 2018). Some studies also present scenarios driven by carbon prices to encourage the adoption of low-carbon technologies (Shukla and Chaturvedi, 2012). Gupta (2018) discusses the low-carbon pathways open to India and finds that, in the low-carbon scenario, emissions rise from 1.7 tonne/capita to 3.6 tonnes/capita by 2047, while India's energy demand rises by a factor of three.

A few studies also investigate energy transitions from a socio-economic perspective. Shukla et al. (2010) explored the implications of energy transition scenarios on developmental indicators. Byravan et al. (2017) evaluated the energy system implications of a scenario focused on improving aspects of quality of life such as equity and access. Gupta et al. (2019) and Namazu et al. (2013) examined the macroeconomic implications of energy transitions.

1.3.1 A Methodological Survey

There are two approaches to assess the net-zero pathways of a country: a top-down or bottom-up approach. Some models integrate both methods. Top-down analyses typically use multiregional computable general equilibrium (CGE) models, such as DART, EPPA, PACE or AIM/CGE. Bottom-up approaches, on the other hand,[2] (like Kumar and Madlener (2016)) use the LEAP model to address the challenge of reducing coal intensity in the Indian power sector by deploying renewable alternatives amid rising demand. Vishwanathan et al. (2018) examine the opportunities and challenges in meeting the 2°C and well-below 2°C global temperature increase goals using the AIM/Enduse model. Within the top-down approach, there are two primary approaches: quantitative and qualitative. We discuss each in turn.

Quantitative analysis models various scenarios to understand the implications of India's net-zero goals across sectors such as electricity, transport, buildings and industry. Das et al. (2023) use the MESSAGE (Model for Energy Supply Strategy Alternatives and Their General Environmental Impacts) model to explore pathways to achieve NZE in India's power sector. Similarly, Chaturvedi and Malyan (2022) investigate the implications of NZE targets across different time frames and technology availability scenarios.

Qualitative Analysis delves into the institutional and infrastructural aspects necessary for realising an NZE energy system in India. These studies examine public sector involvement, labour unions, distribution companies, power market design, pricing mechanisms, fossil fuel–dependent regions and citizen engagement. They advocate for strategies like engaging with citizens and the energy sector workforce, implementing carbon pricing, deploying affordable finance options and emphasising additional benefits beyond emissions reduction to society.

Analysts typically adopt a case study research design, gathering data through in-depth interviews with key stakeholders or leveraging qualitative data analysis software like ATLAS.ti to analyse the collected data effectively. For instance, Jain et al. (2016) employ tools like the governance assessment tool (GAT) and strategic niche management (SNM) to evaluate the governance context for the adoption and integration of Net-Zero Energy Buildings (NZEBs) in New Delhi.

Several studies have explored India's mitigation pathways, focusing on the transition of energy systems and their associated costs (Fragkos and Kouvaritakis, 2018; Dubash et al., 2015; Lucas et al., 2013; Chaturvedi and Shukla, 2014; Shukla et al., 2010, 2015; van Ruijven et al., 2012). Some research assesses the implications for specific sectors like transport (Dhar et al., 2018, 2017) or renewable energy supply (Shukla and Chaturvedi, 2012; Mittal et al., 2016). Sector-specific low-carbon scenarios, particularly for high-emitting sectors, such as power (Shukla and Chaturvedi, 2012; Gadre and Anandarajah, 2019; Chaturvedi et al., 2021) and transport (Dhar and Shukla, 2015), are the focus of many studies, which examine various outcomes related to energy transition, including emission levels, energy demand, and the emission intensity of GDP.

Most studies utilised a variety of energy and integrated assessment models (IAMs). These models varied in their design approaches (top-down, bottom-up, hybrid), regional coverage (regional, global), solution methodologies (cost optimisation, general equilibrium, simulation, accounting) and sectoral coverage. The most used models were optimisation models (AIM/ENDUSE, ANSWER-MARKAL, GENeSYSMOD, IMRIT, TIAM-UCL). Additionally, general and partial equilibrium models (AIM-CGE, GCAM, GCAM-IIM) and hybrid models (AIM/ENDUSE + IMACLIM, AIM/ENDUSE + GEM-E3) were frequently utilised.

Other modelling frameworks included top-down optimisation (IRADe-Neg), bottom-up simulation/stock accounting (LBNL India Dream), energy systems simulation (EnergyPLAN) and statistical forecasting (bass diffusion model, simple logistic model).

Van Ruijven et al. (2012) conducted a comprehensive survey of pre-2012 studies using these models. Mittal et al. (2016) employed the India-specific AIM/CGE model to assess the GDP costs of mitigation efforts. The Indian Planning Commission (2014) analysed the costs of adopting a low-carbon, inclusive growth strategy using a model that integrates some bottom-up technology information within a top-down framework. Parikh (2012) proposed a sustainable development strategy for India utilising a top-down econometric model and an integrated energy systems model.

These models aim to improve the interface between economic and technical systems by refining descriptions of energy supply with explicit mixes of discrete technologies (Hourcade et al., 2006). However, they are entrenched in the CGE paradigm, which struggles to model the inert, complex dynamics of energy demands and the constraints development requirements impose on energy transition dynamics (Edenhofer et al., 2014). They also adhere to a uniform pricing rule, which prevents the proper treatment of heterogeneous pricing for homogeneous goods like electricity or natural gas (Le Treut et al., 2021). Additionally, using the GTAP database for calibration introduces discrepancies from national sources due to the statistical adjustments needed to balance international trade, neglecting the second-best features of developing economies such as administered prices, wages and exchange rate controls.

The Institute of Economic Growth (IEG) CGE model by Pradhan and Ghosh (2012), built on an original social accounting matrix (SAM), considers the macroeconomic dimension of mitigation pathways in India by using alternative closure rules. This model integrates with the DART model to connect national and international scales of analysis (Weitzel, 2017), although it lacks explicit physical energy statistics in its SAM or modelling specifications. Johansson et al. (2015) encountered similar calibration issues when assessing the economic and energy implications of limiting global temperature increases to 2°C above pre-industrial levels, employing top-down IEG-CGE and bottom-up MARKAL-India models alongside global models.

Vats and Mathur (2022) analyse pathways for India to achieve net-zero emissions in its energy sector by 2050. The study assesses the feasibility of complete decarbonisation, focusing on the integration of renewable energy sources, advancements in energy efficiency and the adoption of emerging technologies, such as green hydrogen. It highlights that achieving net-zero emissions in India's energy sector will require dependence on technologies still in the pilot stage. Real-world constraints – such as resource availability, infrastructure, safety, cost, behavioural factors and policy or regulatory hurdles – can limit the adoption of these technologies, affecting their scalability and effectiveness in driving the transition to a low-carbon energy system. It also discusses policy frameworks and infrastructural changes necessary to support this transition. The authors highlight challenges such as technological innovation, financial investment and policy implementation while underscoring the importance of sustainable development in India's energy transformation.

Top-down models often lack technological detail, while bottom-up models fail to incorporate macroeconomic feedback and microeconomic behaviours (Grubb, 1993). Bridging these two approaches is essential for comprehensive assessments of the impacts of mitigation on economic growth and development goals. Despite their international expertise on mitigation pathways, multiregional modelling tools lack the flexibility to represent the increasingly country-specific nature of national mitigation strategies accurately. Shukla et al. (2010) used a soft-coupling strategy combining bottom-up (AIM/CGE) and top-down (MARKAL) approaches to explore low-carbon futures for India. However, this linkage was limited to one-way feeding AIM demand drivers into MARKAL, without feedback on updated energy costs and investment requirements. Gupta et al. (2019) investigated the macroeconomic impacts of pursuing low-carbon development paths using a hybrid modelling framework that integrates the strengths of the AIM/Enduse bottom-up model of Indian energy systems with the IMACLIM top-down economy-wide model of India.

Net-zero assessments from a subsectoral or industry perspective have gained significant traction recently. Notable examples include the global construction industry (Zuo et al., 2012), the global aluminium industry (Das, 2012), the Australian red meat sector (Mayberry et al., 2019), China's passenger transport system (Bu et al., 2021), the Swedish industry sector (Sandberg, 2020), the Indian transport sector (Gupta and Garg, 2020) and the global and national building sectors (Ürge-Vorsatz et al., 2020; Jain et al., 2017). Additionally, Faubert et al. (2020) conducted a carbon neutrality assessment at the level of a fossil fuel production facility.

Only a few studies have undertaken holistic assessments of NZE and its associated implications, challenges or barriers at the global, national or regional levels. Country-level or regional assessments have been conducted for Bhutan (Kamei et al., 2021), Finland (Pilpola et al., 2019), Nepal (Pradhan et al., 2018), Korea (Kim et al., 2022), China (Fuhrman et al., 2020; Zhao et al., 2022), the UK (Shahbaz et al., 2020), France, Sweden (Millot et al., 2020), Switzerland (Li et al., 2020), four industrialised economies (the EU, the United States, Japan, and Australia) (Schreyer et al., 2020) and the EU (Salvia et al., 2021).

1.3.2 Important Sectors for Net-Zero Analysis

This section summarises academic contributions of top-down analyses of decarbonisation pathways across different sectors for India (see Table 1.2).

1.3.2.1 Power and Energy

The Shell-TERI (2021) report presents ambitious decarbonisation scenarios for India, emphasising the need to increase overall electrification in end-use sectors and replace fossil fuel–based power generation with solar and wind. Between 2019 and 2030, the electricity system is projected to grow by 2–2.5 times across all scenarios. Coal demand significantly drops under more ambitious decarbonisation scenarios aiming for net-zero emissions. In less ambitious scenarios, such as Towards Net Zero, coal demand grows by about 36%, which is lower than the overall increase in power demand.

Solar PV, onshore wind, offshore wind and battery storage are identified as key technologies for achieving net-zero emissions. By 2050, solar and wind are projected to account for 85% of total generation capacity, increasing to 90% by 2060. Technologies like coal plants with carbon capture and storage (CCS) and nuclear power are also important. Even in the less ambitious scenarios, solar and wind power generation is expected to increase at least eightfold from current levels and anywhere between 17 and 25 times in more ambitious scenarios. Natural gas demand for power generation is also expected

Table 1.2 Transition Pathways for Sector and Finance Needed to Attain Net Zero

Sector	*Year in Which Net Zero to Be Achieved*	*Alternative Transition Pathways*	*Finance Needed to Attain Net Zero*
Urban	2070	**Efficient urban planning** (MOEFCC, 2022) a) Transit-oriented city development to reduce city sprawl. b) A decentralised approach to sourcing, treating and managing water supply to improve energy efficiency in water management processes. c) Effective management of waste (including optimisation of waste generation/collection/disposal facilities and incineration/gasification of waste to generate energy). d) Additionally, the creation of large, open, green spaces can serve as localised sinks that contribute to carbon sequestration. **Smart cities** a) Electrification of transportation: Transitioning public and private transportation to electric vehicles, enhancing public transit infrastructure and promoting nonmotorised transport options. b) Energy-efficient buildings: Implementing strict energy efficiency standards for new buildings and retrofitting existing buildings to improve their energy performance. c) Renewable energy adoption: Expanding the use of renewable energy sources, such as solar and wind, within city limits and integrating them into the urban grid. d) Smart city technologies: Deploying smart grids, energy management systems and IoT solutions to optimise energy use and reduce emissions. **Low-carbon buildings and infrastructure** a) Design of carbon-efficient new buildings (retrofitting existing structures, modular building design, optimal cross ventilation and thermal insulation). b) Adoption of low-carbon construction processes (using low-emissions materials like wood, fly ash, hemp and bioplastics) and the modification and enforcement of building energy codes such as GRIHA, LEED and ICBC to track energy performance of new and existing buildings can help reduce urban CO_2 emissions.	$7.2 trillion under the BAU scenario and an additional $4.9 trillion under the accelerated scenario by 2050.

(*Continued*)

Table 1.2 (Continued)

Sector	*Year in Which Net Zero to Be Achieved*	*Alternative Transition Pathways*	*Finance Needed to Attain Net Zero*
		c) Adopting modular and prefabricated construction techniques to reduce waste and improve efficiency. d) A nationally coordinated approach from the currently fragmented national and local policies and regulations. **On-site renewable energy generation** Installing renewable energy systems, such as solar panels, on construction sites to reduce reliance on fossil fuels.	
Energy supply	2070	REPLACE legacy fossil fuel energy infrastructure with renewables (Shankar et al., 2024). REDUCE emissions from legacy fossil fuel infrastructure through the following: a) Enhanced efficiencies, both coal-firing power plants and oil refineries. b) Running assets at best-in-class heat rates/yield via reliability-centred maintenance and operating parameter optimisation, driven by artificial intelligence/machine learning. c) Reducing energy wastage in the distribution network through digital means of aggregate technical and commercial loss reduction. d) Adoption of smart grids to predict power flows and enable two-way communication with the consumer can help reduce emissions. **Expected energy capacity mix** (Deloitte and FICCI, 2023) 2030 a) Solar: 230–300 GW b) Onshore wind: 150–160 GW c) Nuclear: 15–20 GW 2050 a) Solar: 700–800 GW b) Onshore wind: 450–550 GW c) Nuclear: 50–60 GW	~US$15 trillion to achieve net zero between 2022 and 2070, equating to an average annual spend of ~US$300 billion, warranting significantly higher outlay in the initial years (Shankar et al., 2024).

(*Continued*)

Table 1.2 (Continued)

Sector	*Year in Which Net Zero to Be Achieved*	*Alternative Transition Pathways*	*Finance Needed to Attain Net Zero*
		2070 a) Solar: 1,300–1,500 GW b) Onshore wind: 450–550 GW c) Offshore wind: 120–150 GW d) Nuclear: 80–90 GW	
Industry[3]	Coal use in the industrial sector must peak by 2040 and reduce by 97% between 2040 and 2065. Hydrogen share in total industrial energy use (heat and feedstock) must increase to 15% by 2050 and 19% by 2070. The industrial energy intensity of total GDP must decline by 54% between 2015 and 2050 and by a further 32% between 2050 and 2070.	a) Green hydrogen production: Investing in green hydrogen as a fuel alternative for industrial processes. This involves setting up electrolyser manufacturing, pipelines and storage infrastructure to facilitate widespread use of hydrogen. b) Material circularity: Enhancing the circular economy by promoting recycling and the use of recycled materials to reduce the demand for virgin resources and lower overall emissions. c) Carbon capture, utilisation and storage (CCUS): Implementing technologies to capture carbon dioxide emissions from industrial processes and either reuse it in other processes or store it underground to prevent it from entering the atmosphere. d) Energy efficiency improvements: Upgrading equipment and processes to be more energy efficient, thereby reducing the overall energy demand and associated emissions. e) Renewable energy integration: Shifting to renewable energy sources for electricity and heating needs within the manufacturing sector to reduce reliance on fossil fuels. f) 6) Advanced manufacturing technologies: Adopting advanced manufacturing technologies such as 3D printing and artificial intelligence–driven process optimisations to reduce waste and increase efficiency.	

(*Continued*)

Table 1.2 (Continued)

Sector	*Year in Which Net Zero to Be Achieved*	*Alternative Transition Pathways*	*Finance Needed to Attain Net Zero*
Iron and steel	2030: Reduction of 20% 2047: Reduction of 50% 2070: Net zero.	a) Using biomass, primarily charcoal, as a primary energy source in blast furnaces. This method is limited in application due to constraints on sustainable biomass supply and technical challenges. b) Utilising natural gas in direct reduction processes to produce iron. While effective in reducing emissions compared to coal, it does not achieve near-zero emissions without CCS. c) Enhanced use of energy flows, advanced process controls, and artificial intelligence for predictive maintenance and operational efficiency.	INR 16–22 lakh crore investment will be required.
Transport (IRENA, I. (2023). World energy transitions outlook 2023: 1.5°C pathway)	2030: Railways 2060–2065: Light commercial vehicles (LCVs) to be fully electrified 2070: Complete phase-out of fossil fuels.	a) Completion of electrification of railways for all passengers and freight movement. b) Electricity consumed by railways would use captive solar generation. c) Green energy open access would be necessary. d) Large-scale adoption of electric vehicles (EVs) for passenger and commercial applications. e) Exploring green hydrogen as an alternative fuel, especially for long-haul and heavy-duty transportation. f) Development of supporting infrastructure like EV-charging stations and hydrogen refuelling stations.	Automotive: Line of sight (LoS) scenario: $1.9 trillion until 2050. Accelerated scenario: An additional $1.3 trillion, totalling $3.2 trillion until 2050. Aviation: Accelerated scenario: $347 billion until 2050 for sustainable aviation fuel (SAF) production to maximum potential.

Source: Authors' compilation.

to rise, ranging from 60 to 200%, depending on the scenario. Although current energy storage solutions are not yet cost competitive, they are anticipated to become more economically viable post-2030, crucial for supporting a fully decarbonised electricity grid.

The Shell-TERI report suggests a finance policy that includes direct public funding and incentivising private investment to achieve several objectives: expanding the power grid, enhancing grid interconnection and optimising grid operations. An enabling financial environment to stimulate investment in generation, storage and infrastructure, including lowering surcharges and cross-subsidies that can distort investment incentives, is vital.

Fifteen sectoral scenarios (from nine power sector papers) analysed coal transitions (Shearer et al., 2017; Malik et al., 2020), short-term power sector developments (Laha et al., 2020; Mukhopadhyay et al., 2020) and long-term renewable development pathways (Gulagi et al., 2017; Gadre and Anandarajah, 2019). Das et al. (2023) use the MESSAGE model to examine a range of technologies, including CO_2 capture and storage, nuclear, solar PV, thermal, battery storage, pumped storage and hydro, alongside energy efficiency measures.

Many sectoral scenarios (see Shukla et al., 2015, for example) indicate that India is likely to achieve its power sector's nationally determined contribution (NDC) target. Other scenarios suggest India may exceed this target, achieving 45–59% non-fossil-fuel capacity by 2030 (Chattopadhyay and Sharma, 2017; Chaturvedi et al., 2021; IEA, 2021).

1.3.2.2 Transport

The transport sector is a significant and growing source of India's greenhouse gas emissions, primarily driven by road transport. As of 2023, electric vehicles (EVs) are projected to represent approximately 3% of new car sales, a trend expected to persist throughout the decade. The Ministry of Finance (2023) anticipates India's domestic EV market to grow at a compound annual rate of 49% from 2022 to 2030, expanding from current annual sales of around one million vehicles to ten million by 2030. However, many low-carbon alternatives for sectors that are challenging to electrify, such as hydrogen and advanced biofuels, are not expected to reach commercial scale until after 2030.

Fossil fuels are projected to remain dominant in the transport sector throughout this decade, even under the most ambitious decarbonisation scenarios. As transportation demand rises alongside economic growth and improved living standards, fossil fuel demand will increase by 30–80% between 2019 and 2030 across all scenarios.

1.3.2.3 Industry

Steel, cement and chemical production are the three primary industries that contribute significantly to GHG emissions. Energy efficiency and optimal resource utilisation are needed for decarbonising the industrial sector (Ray and Kumar, 2018). This process necessitates establishing a circular economy for industrial materials; electrifying lighter industries such as paper and textiles; and transitioning heavy industries like steel, chemicals and cement to low-carbon fuels like hydrogen and bioenergy. The adoption of low-carbon technologies such as carbon capture and storage (CCS) will also play a crucial role in industrial decarbonisation.

Across all scenarios, industrial energy consumption is projected to increase 1.6–3.5 times by 2030 and 3.1–6.2 times by 2050, relative to 2019 levels (Ministry of Finance, 2023). Economic development and government initiatives like 'Make in India' are expected to drive this growth.

1.3.2.4 Agriculture

A World Bank report (Sutton et al., 2024) indicates that the world's agrifood system emits almost 16 gigatonnes of greenhouse gases annually, about one-third of all global emissions. Direct energy consumption and GHG emissions in agriculture result from land preparation, irrigation, harvesting and threshing, with land preparation and irrigation being the most energy intensive. In India, 60% of agrifood system emissions come from on-farm activities, with enteric fermentation from livestock being the largest contributor. Adopting renewable energy in India's agrifood system can significantly reduce emissions, with 80% of the mitigation potential achievable through cost-saving measures alone. By December 2020, India had deployed over 272,000 solar-powered irrigation systems.

Shell-TERI's 2021 scenario sketch analysis suggests that India should focus on encouraging the adoption of solar-powered and electric irrigation equipment and electrifying low-horsepower agricultural vehicles. Along with this, devising a strategy to decarbonise higher horsepower tractors and tillers through a mix of electrification, bio-CNG and biofuel-based or blended diesel would also help to reduce uncertainty and encourage greater use.

1.4 Bottom-Up Approach

The bottom-up approach uses micro-level data based on individual technologies and household behaviour, allowing a detailed assessment of technology investments. In contrast, in the top-down approach, aggregate macro data at the country or subnational/state level is used to estimate the income elasticity of consumption by econometric analysis over a relatively long time. Bottom-up models examine the ownership and use of energy-consuming products and consider end-use technology scenarios from an engineering point of view. Kumar et al. (2009) advocate for a bottom-up approach over a top-down mandate like the Kyoto Protocol for combating climate change in India. The bottom-up approach focuses on incentivising concrete actions tailored to a country's specific conditions and priorities. This allows a country such as India to integrate climate goals into developmental objectives such as poverty alleviation and economic growth. The paper lists the mitigation options for various sectors depending on the cost. Three cost options are discussed: (1) Negative or zero cost; (2) Low cost (less than USD 10/tCO_2); (3) High cost (more than USD 10/tCO_2).

1.4.1 Transition Pathways according to the Bottom-Up Approach

Du Can et al. (2019) use a bottom-up model to assess energy sector emissions, representing 80.1% of all GHG in India over the next 35 years. The paper is based on the Lawrence Berkeley National Laboratory (LBNL) India Demand Resources Energy Analysis Model (DREAM). LBNL DREAM is a stock accounting model with a physical accounting of material production that is interlinked to the demand for material based on increased technology penetration where the lifetime of equipment is taken into account to determine technology change. India's emissions are projected to almost quadruple by 2050 without new policies. However, with the implementation of current policies, India can meet its NDC target. Much of the emission growth will come from the industry sector, with four subsectors expected to account for 78% of total direct emissions by 2050. Energy use in agriculture is expected to rise but with potential for efficiency improvements. The transport sector's emissions are also projected to grow significantly, acting as a call for action to switch to more efficient technologies. Residential and commercial buildings will see increased energy use with urbanisation and economic growth, but efficiency gains can mitigate some of this increase.

Kumar and Madlener (2016) utilised the LEAP model to tackle the challenge of reducing coal intensity in India's power sector by incorporating renewable energy sources amid growing demand. Similarly, Vishwanathan et al. (2018) explored the feasibility of meeting the 2°C and well-below 2°C global temperature targets using the AIM/Enduse model. However, bottom-up models like AIM/Enduse and LEAP do not consider the feedback effects of energy costs on demand or the broader economy, either through consumption or investment markets.

1.4.2 Sectoral Pathways

Table 1.2 summarises the sectoral costs associated with transition pathways and presents information on the year in which net zero is to be achieved, alternative transition pathways and the finance needed. It shows several alternative pathways to net zero, with different sectors achieving NZE at different times.

The study 'Modeling India's Energy Future Using a Bottom-Up Approach' (du Can et al. (2019) explores potential pathways for India's energy future through a detailed modelling approach, showing that India can achieve substantial economic growth while meeting NDC targets with current policies emphasising emission reductions and energy efficiency, particularly in the industrial sector. The 'Financing Industry Transitions' (CII, 2024) report analyses the financial strategies required for India to achieve net-zero carbon emissions by 2070, presenting two scenarios: line of sight (LoS) and accelerated. The LoS scenario predicts outcomes based on existing policies, while the accelerated scenario involves aggressive policy measures and rapid technology adoption. It underscores the necessity for robust financial mechanisms, innovative banking practices and supportive policies to facilitate this green transition.

Key points include the need for substantial renewable energy capacity additions and improving energy efficiency across sectors. The LoS scenario requires a \$2.5 trillion investment by 2050, with annual investments of \$40–\$45 billion until 2030, increasing to \$7,080 billion thereafter. The accelerated scenario demands an additional \$750 billion in investments.

1.5 Conclusion

We have discussed the top-down and bottom-up approaches to achieving net-zero emissions based on the financial estimates from the extant literature. Our literature review has identified five key sectors: energy, transportation, industry, urban and agriculture – as crucial to India's net-zero journey. These sectors must evolve collectively to achieve net-zero emissions. For each sector and under various scenarios, the pathways involve a combination of targeted interventions. India must transition from fossil fuels to renewable energy, enhance energy efficiency and invest significantly to meet its NDC and climate targets for 2°C and well below 2°C. Challenges include land availability, flexible generation capacity, the financial health of distribution companies and reliance on imported energy materials. As this chapter indicates, there are a variety of methodologies and, consequently, estimates of financing required, and these do not always speak to each other. What does appear necessary, however, is that some combination of a top-down and bottom-up approach be used to for a more robust and comprehensive estimate. Top-down will give us an important macro view, be it for the economy as a whole or individual sectors. On the other hand, this macro view has to be undergirded by a bottom-up approach to give it both context as well as a more straightforward path for implementation.

Notes

1 A top-down approach, in this instance, refers to macro estimates of requirements at the country level, leading to micro-level targets, which may or may not be realistic. A bottom-up approach, on the other hand, refers to identifying reductions at the sectoral level and aggregating them to arrive at an estimate for the country, which might miss out on macro constraints.
2 The bottom-up models are discussed in greater detail in the next section.
3 Financing needs for specific subsectors within the industrial sector is available, for example, in iron and steel in Elango et al. (2023).

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2 Public Finance Catalysing Private Capital for Scaling Renewable Energy Projects

Ajay Mathur and Anita Marangoly George

2.1 Introduction

The world is in the grip of a climate crisis. The Intergovernmental Panel on Climate Change (IPCC) has unequivocally stated that human-induced climate change is causing widespread, rapid and intensifying impacts on nature and people. The average global temperature has already risen by approximately 1.0°C above pre-industrial levels, and the trajectory we are currently on signals a stark misalignment with the Paris Agreement's goal of limiting global warming to 1.5°Celsius.

As we navigate the critical decade ahead, the imperative for swift and substantial action to curb global emissions becomes abundantly clear. The ramifications of such a trajectory are felt across all corners of the globe, with climate change leaving an indelible mark on regions worldwide. The toll on economies is staggering, as the world incurred losses exceeding $2.5 trillion in the 2011–2020 period due to extreme weather events, underscoring the urgent need for a paradigm shift in our approach to climate action.

To avert the worst impacts, global greenhouse gas (GHG) emissions must be reduced by 45% by 2030 and reach net zero by 2050. Addressing this crisis requires a massive and urgent global response, including a rapid transition to clean energy sources, the protection of ecosystems and the development of resilient communities. Central to this effort is climate finance, which refers to the local, national or transnational financing of projects aimed at mitigating or adapting to climate change. The scale of the challenge is immense. According to the Climate Policy Initiative (CPI), average annual climate finance flows reached almost USD 1.4 trillion in 2022 (see Figure 2.1). However, these flows continue to fall short of the estimated needs, particularly in emerging economies and least developed countries (LDCs).

Figure 2.1 also demonstrates that, as per CPI analysis, USD 30 billion, or just over 2% of global climate finance in 2021/2022, flowed to or within LDCs, while USD 179 billion, or 14% of the total, went to emerging markets and developing economies (EMDEs), excluding China. While not responsible for high emissions historically, EMDEs and LDCs are disproportionately vulnerable to the impacts of climate change and face substantial related funding challenges. The urgency of addressing climate change is intertwined with the multifaceted development challenges that these countries face, while high existing debt levels further constrain their ability to finance a clean and just transition.

Average project investments are lower than USD 100,000 in LDCs and USD 2.2 million in EMDEs, which is substantially lower than the USD 6.3 million average in developed countries. This reflects the difficulties faced by LDCs and EMDEs in securing finance for large-scale projects. Such challenges arise from these projects' relatively high-risk

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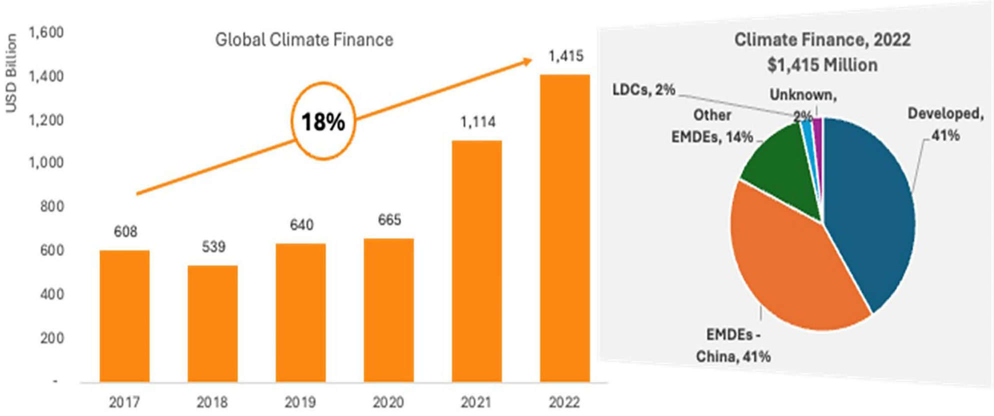


Figure 2.1 Global Climate Finance Flows

Source: Redrawn by authors from CPI: Global Landscape of Climate Finance (2023).

profiles, both perceived and actual, as well as the complex funding application processes of major multilateral climate funds (MCFs) and development finance institutions (DFIs) (WRI, 2021).

2.1.1 Definition and Scope of Climate Finance

Climate finance refers to the financial resources allocated for activities and projects aimed at addressing climate change either by reducing GHG emissions or by enhancing resilience to the adverse effects of climate change. The concept encompasses a range of financial instruments and mechanisms, including grants, loans, equity investments, and guarantees. The scope of climate finance is broad and multidimensional. It spans various sectors such as renewable energy, energy efficiency, sustainable agriculture and climate adaptation projects.

Specifically, the renewable energy sector, which includes technologies like solar, wind and hydropower, has been a focal point for climate finance. Solar energy, in particular, has seen accelerated investment due to its potential for both mitigating climate change and providing sustainable energy access. Data from the International Renewable Energy Agency (IRENA) shows that global investment in renewable energy technologies reached approximately USD 500 billion in 2022.

This chapter addresses the following question: In what ways can public resources catalyse private investment into climate solutions? Thus, it narrows the definition of climate finance to focus on the renewable energy sector, especially solar. The chapter provides analytical frameworks within which this may be discussed – in terms of global macroeconomic trends and the variations in the evolution of the finance for solar energy and the renewable energy ecosystem in different countries while accounting for variations in country needs and hence of the type of finance needed.

2.2 Evolution of Climate Finance

The evolution of climate finance has been marked by significant milestones and varied approaches across the globe. Historically, climate finance emerged as a critical component of international environmental agreements, as depicted in Figure 2.2.

Different countries have adopted various frameworks and mechanisms to address their unique climate finance needs. In the European Union, climate finance has been integrated into broader sustainable finance frameworks, such as the EU Taxonomy Regulation and the European Green Deal, which set ambitious targets for reducing greenhouse gas emissions and increasing investment in green projects. The United States has leveraged both federal- and state-level initiatives, including the Green New Deal proposals and the Inflation Reduction Act, which focus on a mix of direct funding, tax incentives and regulatory reforms to promote clean energy and sustainable infrastructure.

In contrast, many developing countries have relied heavily on international financial institutions, such as the Green Climate Fund (GCF) and the World Bank Group (WBG), to support their climate initiatives. These mechanisms provide grants, concessional loans and other forms of financial assistance to help build resilience and reduce emissions. Additionally, some countries have developed domestic frameworks tailored to their specific contexts, such as India's National Action Plan on Climate Change, which outlines strategic missions and financing mechanisms to drive sustainable development.

2.2.1 *Macroeconomic Conditions and Climate Finance*

Macroeconomic conditions impact climate finance by shaping the availability and effectiveness of financial resources dedicated to environmental sustainability. The complex interplay between economic growth, inflation, interest rates and exchange rates affects climate finance, influencing both policy and investment strategies. Historically, increased global energy consumption has been correlated with improved social development indicators, such as reduced mortality rates and enhanced economic wellbeing, as reflected in rising GDP per capita. However, this relationship has also led to higher emissions. The current global energy transition demands a thorough decoupling of energy consumption from emissions, while maintaining a focus on people-centric growth.

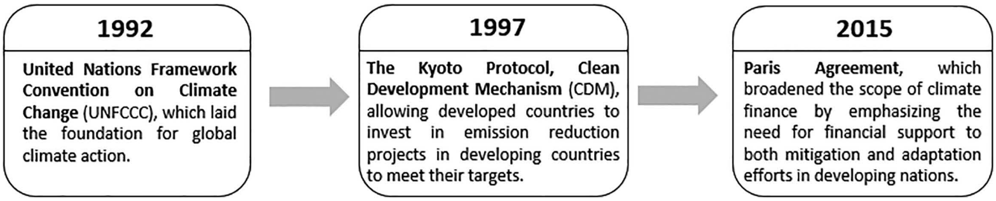


Figure 2.2 Evolution of Climate Finance

Source: Authors.

2.2.2 Types of Climate Finance Instruments

In the context of solar energy, the applicability of various climate finance instruments – grants, equity, debt and guarantees – depends heavily on the macroeconomic environment of different countries.

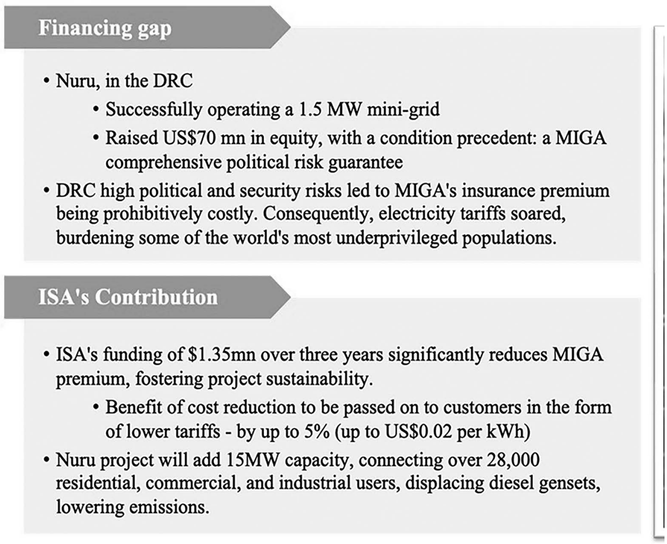
a) **Grants** are especially relevant in developing economies and low-income countries, where they provide essential non-repayable funding to support the initial phases of solar projects, such as feasibility studies, pilot installations and capacity building. In these regions, grants can help overcome barriers to entry and facilitate the deployment of solar technologies in areas with underdeveloped financial markets or high economic instability.
b) **Equity financing** is most applicable in emerging and growth economies with relatively stable macroeconomic conditions. For these markets, equity investments play a crucial role in scaling up solar energy projects and fostering innovation. Venture capital and private equity can fund solar startups and growth-stage companies, enabling them to expand their operations and commercialise new solar technologies. However, equity financing is less suitable for countries experiencing significant economic volatility, where the risks might outweigh potential returns.
c) **Debt financing**, including green bonds and project finance loans, is particularly effective in developed and stable economies or stable emerging markets with reliable financial systems. For solar energy projects, debt instruments can provide the necessary capital for large-scale installations and infrastructure development. Green bonds, specifically issued to fund solar projects, are ideal for economies with strong credit markets and predictable revenue streams. In contrast, debt financing is less practical in countries facing severe economic challenges, where high inflation or unstable credit conditions could impede borrowing.
d) **Guarantees** serve as a crucial tool in high-risk or transition economies, where they help mitigate financial risks for investors. By providing safety nets and risk-sharing mechanisms, guarantees can attract private capital to solar projects in countries with economic uncertainties or undergoing transitions. These instruments can bridge the gap between public and private funding and support innovations, making solar energy projects more feasible in less financially stable environments.

Box 2.1 DRC as a Case of How Additional Support Can Amplify the Effectiveness of Solar Project Guarantees

In low-income countries, such as the Democratic Republic of the Congo (DRC), renewable energy projects often require political risk insurance, which is provided by global development finance institutions like the Multilateral Investment Guarantee Agency (MIGA), a member of the World Bank Group. MIGA offers political risk insurance and credit enhancement for cross-border private sector investments in developing countries, protecting against noncommercial risks. However, given the high-risk nature of these markets, the cost of such insurance can become prohibitively expensive, making projects economically unfeasible. In such contexts, a global entity like the International Solar Alliance (ISA) can play a pivotal role by offering a first-loss layer of protection. This first-loss layer complements the guarantees provided by development finance institutions, thereby reducing the overall risk exposure. By doing so, the ISA helps lower the cost of financing for solar projects, which, in turn, reduces the cost of electricity delivered to local communities and enhances the feasibility of solar energy solutions in these high-risk environments.

One such example is the ISA's intervention in unlocking solar mini-grid project in DRC by making critical political insurance/guarantee affordable.

Solar *Mini-grid* P*roject*



Source: Authors.

e) **Blended finance approaches and leveraging complementarities**, which combine grants, equity, debt and guarantees, offer a versatile solution for countries with diverse macroeconomic conditions. In the solar energy sector, blended finance can effectively address multiple layers of risk and financing needs by leveraging the strengths of different instruments. This approach is particularly beneficial in regions where economic conditions vary significantly, providing a tailored solution to support solar energy projects and drive global climate goals. For instance, combining technical assistance with guarantees improves both the technical and financial readiness of solar projects. Similarly, interest rate subsidies on loans make solar project financing more affordable, while guarantees address risk concerns.

Figure 2.3 summarises the share of each instrument discussed earlier in global climate finance flows for 2022. As is evident, debt was the most common financial instrument (USD 766 billion, or 60%) followed by equity (USD 422 billion or 35%) and then grants (USD 69 billion or 6%). Most (USD 561 billion or 54%) of the debt finance was provided

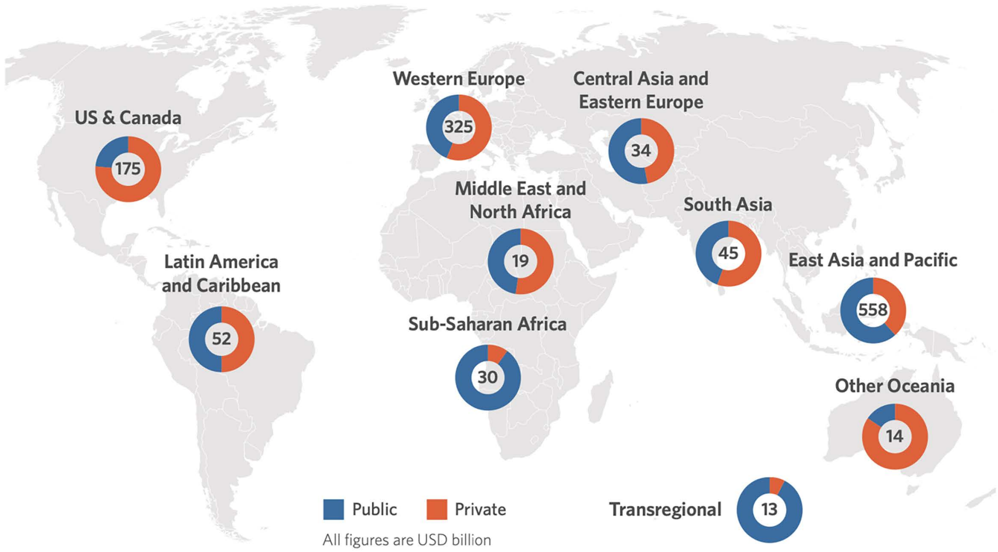


Figure 2.3 Global Climate Finance by Instrument in 2022

Source: Adapted and redrawn from CPI: Global Landscape of Climate Finance (2023).

at market rate. Balance sheet financing[1] constituted 11% of global climate finance flows in 2022. Concessional finance in the form of low-cost debts (5%) and grants (6%) constituted another 11%.

2.2.3 Private Finance

While private finance is growing, the rate and scale required are not commensurate with present needs of investment, even in solar energy. As per CPI estimates (CPI, 2023), private actors contributed 49% of the total climate finance, amounting to USD 625 billion. As is evident from Figure 2.4, developed economies are significantly more successful at mobilising private finance compared to emerging economies and low-income countries, particularly in Africa. This disparity highlights the challenges faced by less developed regions in attracting and utilising private sector investment for climate initiatives.

The most notable growth in private sector finance has been driven by household spending, which now constitutes 31% of all private finance. This increase is largely due to a surge in demand for electric vehicles (EVs), with sales doubling from 2020 to 2021, bolstered by robust domestic fiscal policies designed to support the adoption of these technologies.

DFIs remain the primary source of public climate finance, providing 57% of the total public funds. However, over 17% of public finance directed towards LDCs is in the form of market-rate debt (which is normally higher than the interest rate charged by DFIs), exacerbating their already significant debt burdens. Given this context, there is an urgent need to strategically utilise public funds and concessional finance to catalyse significantly more private capital. This approach is crucial for scaling up climate finance and achieving global climate goals.

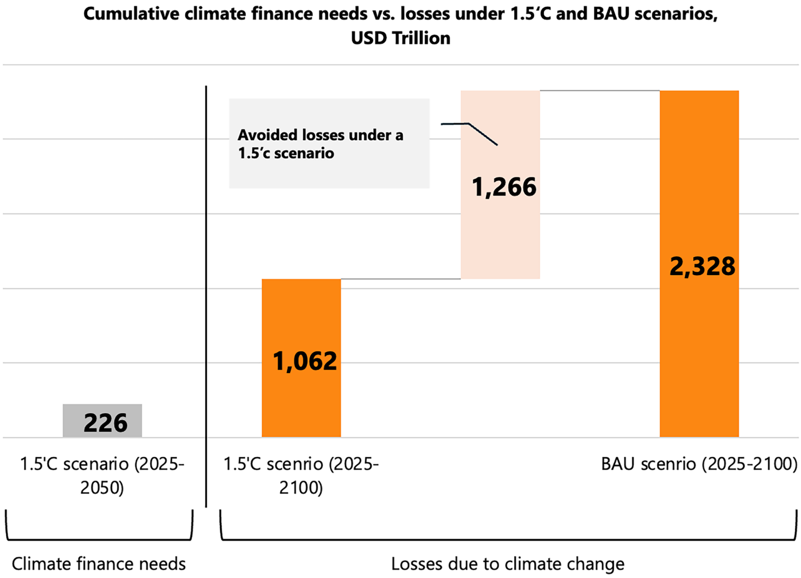


Figure 2.4 Public versus Private Climate Finance by Region, 2021–2022

Source: CPI: Global Landscape of Climate Finance (2023).

2.2.4 The Climate Finance Gap and the Consequences of Inaction

The climate finance gap is substantial, driven by two primary factors: insufficient public funding and inadequate private sector investment. Governments often face budget constraints and competing priorities, which limit their ability to allocate sufficient resources for climate action. At the same time, private sector investment in climate-related projects is frequently deterred by uncertainties and perceived and actual risks. Regulatory ambiguity, unclear investment frameworks and high-risk perceptions can discourage private investors from committing to climate initiatives. This has led to a significant gap between actual climate finance flows of USD 1.4 trillion as compared to the annual requirement of USD 8.1 trillion (rising to $9 trillion in 2030) to meet the target of 1.5°C global temperatures scenarios.

After 2030, this need will surge to over $10 trillion per year, continuing through 2050. To avert the most catastrophic impacts of climate change, we must increase climate finance by at least five times annually and do so urgently. Delaying investment in climate solutions only exacerbates the costs, both in mitigating global temperature rise and addressing its inevitable impacts and therefore adaptation costs. While the annual climate investment needs are substantial, they are dwarfed by the potential losses we face if we persist with business-as-usual (BAU) approaches, which would lead to global temperatures rising well above 1.5°C.

Estimates based on CPI analysis of BAU and 1.5°C damage scenarios reveal that the financial losses could be staggering. These figures, illustrated in Figure 2.5, account for direct economic impacts such as increased weather-related damages, higher production costs, reduced productivity and health costs. However, these estimates likely underrepresent the true costs by not including capital losses from stranded assets, ecological and

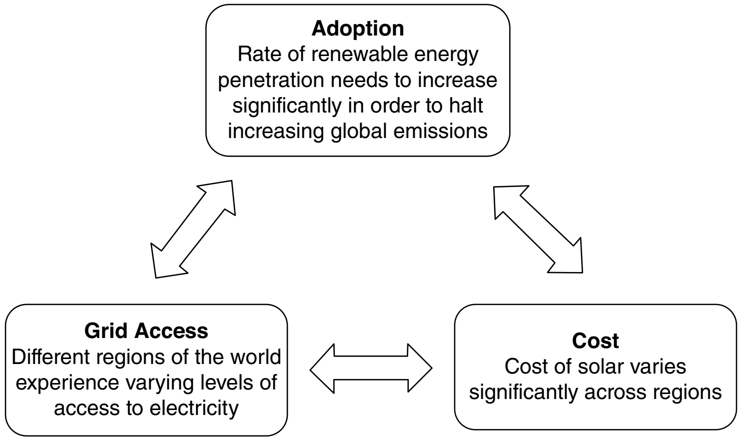


Figure 2.5 Cumulative Climate Finance Needs versus Losses under 1.5°C and BAU Scenarios (Trillion USD)

Source: Redrawn from CPI: Global Landscape of Climate Finance (2023).

biodiversity losses or the ramifications of increased conflict and migration, which remain challenging to quantify.

Despite the limitations of current data and methodologies, they underscore the urgent need for immediate investment and the significant opportunities for businesses to transition to low-carbon and climate-resilient pathways. The economic rationale for action is clear: investing now is not only a necessity but also a strategic advantage in navigating and mitigating the future impacts of climate change.

2.3 Transition to Solar Energy Is Key to Climate Action Plans

Solar energy has swiftly risen as the most promising clean energy technology, boasting a remarkable growth rate with a 21% CAGR from 2015 to 2022, surpassing wind, bioenergy and hydro energy. It the most economical renewable energy source, with a low levelized cost of electricity (LCOE)[2] of \$0.049/kWh and lower than other renewable energy sources like wind (\$0.081/kWh), bio (\$0.061/kWh) and hydro (\$0.061/kWh). Solar also offers the highest energy potential, capable of producing 1,600–49,800 EJ per year, higher than other renewable energy sources: namely, bio (56 EJ), wind (443 EJ) and hydro (461 EJ). Additionally, solar emits a mere five tonnes of carbon dioxide equivalent (tCO_2), significantly lower than hydropower (34 tCO_2) and bioenergy (350 tCO_2). Furthermore, solar energy is the most used off-grid solution, particularly in developing and low-income nations. As a result, solar energy is projected to contribute 27% to the total energy mix by 2030, necessitating 3,500 GW of capacity addition. In our view, solar energy would form the bulwark of the global energy transition journey, with the world requiring \$1.6–\$2 trillion in solar investments by 2030.

However, increased solar adoption faces several challenges, with countries at varying development levels encountering unique obstacles, as summarised in Figure 2.6.

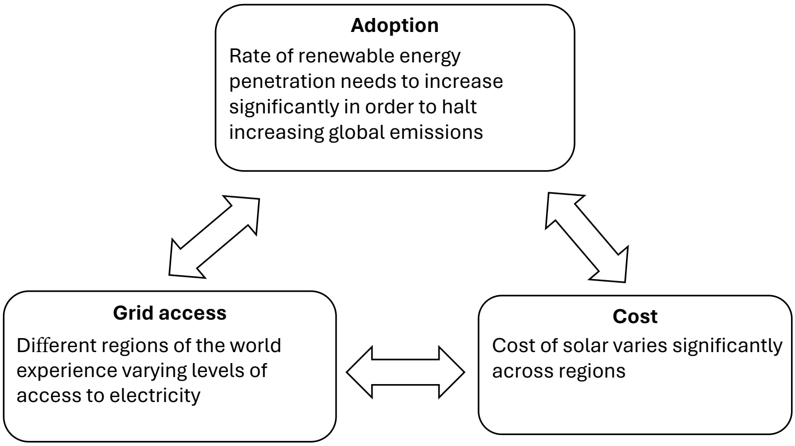


Figure 2.6 Feedback Loops in Adopting Solar Energy

Source: Authors.

2.3.1 Factors Influencing the Speed of Evolution in the Solar Sector

a) **Regulatory Frameworks:** The transition from feed-in tariffs to competitive bidding mechanisms, including reverse auctions, is crucial. Government support through subsidies, tax breaks and support pricing is essential in the early stages as the sector scales.

b) **Supply Chain:** The availability of solar PV panels, inverters and balance-of-plant components, along with the infrastructure for grid power evacuation and storage solutions for off-grid systems, is vital. Solar module prices fell by up to 93% between 2010 and 2020. During the same period, the global weighted-average LCOE for utility-scale solar PV projects fell by 85%. However, the benefits of this price decline are disproportionately weighted towards markets where solar has scaled enough to attract supply. The overlay of macro trends and geopolitics also affect the supply chain for solar, which adds another dimension of complexity in the deployment of solar worldwide.

c) **Solar Developers:** Experienced developers who understand the technology and critical factors for successful deployment are necessary.

d) **Financing:** Delivered cost of solar is significantly impacted by financing cost. Therefore, reducing the cost of financing is as critical as the cost of the technology itself in terms of delivered price of solar to the end consumer.

e) **Consumers:** Both grid-connected and distributed renewable energy (DRE) customers who are willing and able to pay for electricity play a significant role. DRE projects have benefited especially in places where grid connectivity is lacking or unreliable. Figure 2.7 demonstrates how commercial viability is a function of distance from the grid. At distances under 10–15 km from the existing grid, grid extension can prove more cost effective than mini-grids, more so if the number of households increase. Grid extension costs increase sharply after 30 km due to the need for use of higher voltage lines.

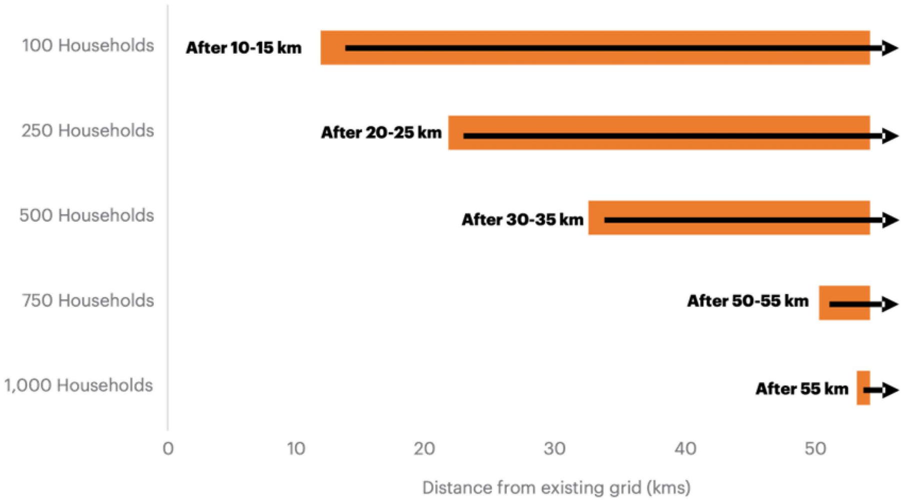


Figure 2.7 Mini-grid Viability in Comparison to Grid Extension Based on Distance from the Grid
Source: ISA – International Solar Alliance (2023, p. 71).

2.4 Analytical Framework to Identify Four Archetypes of Countries

The journey toward a 1.5-degree pathway varies significantly, as economies are at different stages of development and face unique challenges. Disparities in energy access, electricity consumption, climate risks, carbon emissions, financial flows, resource availability and capabilities create a broad spectrum of issues. Addressing these complexities requires tailored, people-centric strategies rather than a one-size-fits-all solution. Analysing global solar development, we identify four archetypes of country groupings: OECD countries, EMDEs, small island developing states (SIDS) and LDCs. Each archetype follows a distinct energy transition agenda, necessitating customised solutions to meet their specific needs.

2.4.1 OECD Countries

OECD countries, due to their substantial economic activity and high energy consumption, have historically been major contributors to climate change. Recognising their role in the global emission landscape, these high-income nations have committed to ambitious climate targets, aiming to reduce emissions significantly and transition to renewable energy. Table 2.1 summarises the distinct energy transition agenda for OECD countries.

2.4.2 Emerging Economies

Emerging economies, characterised by rapid growth and developing infrastructure, face a dual challenge of expanding their energy systems while managing climate risks. Despite their increasing solar capacity, these nations face significant barriers in transitioning to renewable energy, including high funding requirements and private sector engagement hurdles.

2.4.3 Small Island Developing States

SIDS are particularly vulnerable to climate change due to their geographic isolation, limited land area and high dependence on imported fossil fuels. This vulnerability

Table 2.1 Energy Transition Agenda for OECD Countries

Need for Energy Transition	*Current Status and Outlook*
• **Significant share of emissions:** OECD countries are significant emitters and recognised as significant contributors to climate change. • **Ambitious targets:** Set out ambitious NDC commitments, committing to up to a 50% reduction in emissions by 2030, achieving net-zero status by 2050. This is coupled with a regulatory and legal risk framework carrying a significant cost of noncompliance.	• **Emissions and targets:** OECD countries collectively account for more than 60% of global greenhouse gas emissions. Despite this significant contribution, there has been a notable reduction in emissions per capita from 2015 to 2021. Many of these countries have set ambitious nationally determined contributions (NDCs) under the Paris Agreement, committing to a 50% reduction in emissions by 2030 and achieving net-zero emissions by 2050. • **Regulatory frameworks and enforcement:** The commitment of OECD countries to their climate targets is supported by robust legal and regulatory frameworks. These frameworks include stringent emission reduction mandates and penalties for noncompliance, which incentivise adherence to climate goals.
Challenges to the Transition	**Strategic Solutions**
• **Energy transition requirements:** The transition to renewable energy involves both the addition of new renewable energy capacity and the transformation of existing assets. OECD countries need to scale up their renewable energy capacity by approximately 2.3× to meet their targets. Additionally, there are legacy assets, such as fossil fuel power plants, amounting to around two terawatts (TW) that need green energy transition. • **Decarbonisation beyond borders:** High-income countries, with their extensive involvement in global value chains, have opportunities to contribute to decarbonisation beyond their borders. The global nature of supply chains means that these countries can influence emissions reductions in developing regions through trade policies, investment and technology transfer.	• **Rapid deployment of transition finance:** To support the global transition, OECD countries should lead in rapid deployment of transition finance for domestic markets, along with directing financial flows towards developing regions, where access to capital for clean energy projects can be limited. • **Increased investment in research and development:** Investing in research and development (R&D) of novel energy technologies is crucial for driving down costs and improving the efficiency of renewable energy systems. OECD countries can enhance their support for R&D initiatives, focusing on advancements in energy storage technologies, which are essential for managing the intermittency of renewable energy sources. • **Driving results-based carbon financing:** Facilitating results-based carbon financing opportunities in new growth economies can stimulate additional investments in clean energy projects. By linking financial incentives to verified emission reductions, OECD countries can encourage sustainable development and accelerate the deployment of renewable energy technologies in developing regions.

Source: Authors.

Table 2.2 Energy Transition Agenda for EMDEs

Need for Energy Transition	*Current Status and Outlook*
• **Economic and emission growth:** Emerging economies are expected to experience high GDP growth rates, accompanied by an increased growth rate of emissions. As these nations develop economically, their energy demand is expected to rise significantly, which can strain their ability to manage emissions effectively. • **Human development and climate risks:** Notably, 91% of climate-related fatalities occur in these regions, highlighting the urgency of addressing climate vulnerabilities and integrating climate resilience into development strategies.	• **Growth and impact:** Emerging economies have made strides in increasing solar energy capacity. However, this growth has resulted in only minimal changes in emissions per capita due to the scale of expansion required. Current solar capacity represents only 3% of what is needed over the next two decades, necessitating a substantial increase in investment. • **Funding requirements:** Achieving the required solar capacity expansion will necessitate investments exceeding $3 trillion over the next 20 years. The challenge lies in mobilising these funds, particularly given the higher risk perceptions associated with renewable energy projects in emerging economies.
Challenges to the Transition	**Strategic Solutions**
• **Limited private sector participation:** Private sector participation in renewable energy projects is currently limited. The ratio of private sector involvement is approximately 1.3 times the existing capacity, compared to the 2–3 times increase required. The higher return on equity (ROE) expectations in emerging economies (8%–17%) compared to developed nations (4%–5%) exacerbate the difficulty in attracting investment. • **Risk perception and financing:** The higher perceived risks associated with renewable energy projects in emerging economies pose a significant barrier. These risks include greater economic volatility as well as regulatory uncertainties, both of which deter private investors and increase the cost of capital.	• **Institutional capacity building:** Strengthening institutional capacity and building awareness of green growth practices are crucial. Incorporating global best practices in governance, policy frameworks and project management can support the development of effective and sustainable energy transition strategies. • **Innovative financial instruments:** The deployment of innovative financial instruments is essential to catalyse the transition. This includes the following: • Blended finance: Combining public and private financing to mitigate risks and attract investment. • Credit guarantees: Providing assurances to reduce the risk for private investors. • Asset refinancing: Allowing for the restructuring of existing investments to free up capital for further renewable energy projects. • **De-risking renewable energy projects:** To address the high-risk perception, strategies for de-risking renewable energy projects are vital. This can involve the following: • Development of risk mitigation mechanisms: Implementing mechanisms to share and mitigate risks among stakeholders. • Government support: Providing subsidies, tax incentives and policy stability to encourage private sector investment. • International collaboration: Engaging in international partnerships and agreements to secure funding and technical assistance.

Source: Authors.

Table 2.3 Energy Transition Agenda for SIDS

Need for Energy Transition	*Current Status and Outlook*
• **Exposure to climate risk:** SIDS are among the most climate-vulnerable regions in the world, experiencing extreme weather events such as hurricanes and rising sea levels. Their heavy reliance on fossil fuels for electricity generation exacerbates their exposure to climate risks and contributes to high emissions per unit of electricity. • **Dependence on fossil fuels:** The reliance on imported fossil fuels leads to elevated greenhouse gas emissions and energy insecurity. Reducing this dependence is crucial for improving both environmental and economic resilience.	• **Emissions and solar capacity:** While per capita emissions are decreasing in some SIDS, there is a substantial gap in the current and required solar capacity. By 2050, SIDS need to significantly increase their solar capacity to meet their climate goals and reduce emissions. • **Climate finance gap:** There is a significant shortfall in climate finance available to SIDS, with current flows estimated at $5 billion compared to the $100 billion required by 2050. This gap underscores the need for increased financial support to achieve renewable energy targets.
Challenges to the Transition	**Strategic Solutions**
• **High costs:** The cost of solar energy development in SIDS is three times the global average per gigawatt, driven by factors such as high transportation costs, limited economies of scale and expensive technology. • **Geographic constraints:** Limited land mass restricts opportunities for large-scale solar installations and remote areas with grid inaccessibility poses additional challenges for integrating solar power into existing infrastructure. • **Financing barriers:** Access to low-cost finance is critical for enabling solar energy projects, yet SIDS struggle with high financing costs and limited availability of appropriate financial instruments.	• **Innovation in technology:** To overcome geographic and cost barriers, the adoption of innovative technologies is essential: • Floating solar: Utilising water bodies for solar installations can mitigate land constraints and provide a scalable solution for SIDS. • Energy storage systems: Implementing advanced battery and storage technologies can address intermittency issues and enhance the reliability of solar power. • High-efficiency models: Investing in high-efficiency solar panels and systems can reduce overall costs and improve energy output. • **Access to low-cost finance:** Increasing access to low-cost mitigation finance is crucial. This includes the following: • Blended finance: Combining public and private funding to reduce risks and attract investment. • Credit guarantees: Providing assurances to investors to lower the cost of capital. • Asset refinancing: Restructuring existing investments to free up capital for new projects. • **Institutional and financial support:** Building institutional capacity and incorporating global best practices can enhance the effectiveness of energy transition efforts. Support mechanisms include the following: • Policy frameworks: Developing supportive policies and regulatory frameworks to facilitate renewable energy investments. • International collaboration: Engaging in partnerships and agreements to secure additional funding and technical assistance. • Capacity building: Training local stakeholders and institutions to manage and implement renewable energy projects effectively.

Source: Authors.

necessitates urgent action to reduce greenhouse gas emissions from electricity consumption. Solar energy presents a promising solution, but its adoption is hindered by high costs and geographic constraints.

2.4.4 Less Developed Countries

LDCs are characterised by limited energy access, with less than 50% of their populations having reliable electricity. Despite possessing substantial solar generation potential, these countries face numerous obstacles in transitioning to clean energy.

Table 2.4 Energy Transition Agenda for LDCs

Need for Energy Transition	*Current Status and Outlook*
• **Low electrification rates:** LDCs struggle with some of the lowest electrification rates globally, affecting millions of people who lack reliable access to electricity. Enhancing energy access is critical for economic development and improving the quality of life. • **High energy costs:** Energy prices in LDCs are often unaffordable for a significant portion of the population. The high cost of energy exacerbates economic challenges and hinders progress towards sustainable development. • **Solar generation potential:** Despite having substantial solar generation potential (exceeding 6 kWh/m²), LDCs are unable to fully capitalise on this resource due to financial and infrastructural constraints.	• **Financing requirements:** To meet clean energy targets by 2050, LDCs require approximately $400 billion in financing. However, the current financing flow stands at a mere $5 billion, representing only 1% of the needed amount. This significant gap underscores the urgent need for increased financial support. • **High costs of capital:** LDCs face exorbitant costs of capital, ranging from 20% to 30%, compared to 5%–20% globally. This high cost of debt is a major barrier to investment in renewable energy projects. • **Lack of domestic supply chains:** The absence of domestic renewable energy supply chains further complicates solar asset development. Without local manufacturing capabilities, the cost of solar technology remains high.
Challenges to the Transition	**Strategic Solutions**
• **Need for distributed renewable energy solutions:** Distributed renewable energy solutions are essential for LDCs, where centralised grid infrastructure may be lacking. However, less than 1% of financing in 2022 focused on off-grid solar solutions, highlighting a critical gap in support for decentralised projects. • **High costs of solar energy:** The cost of solar energy projects in LDCs is higher than the global average, driven by factors such as high import costs, lack of local manufacturing and expensive technology.	• **Pilot projects for novel technologies:** Implementing pilot projects can serve as proof of concept for novel technologies and innovative approaches. These projects can demonstrate the viability of new solutions and attract further investment. • **Increasing access to climate finance:** To address the financing gap, LDCs need enhanced access to climate finance through the following: • Blended financial products: Combining public and private funding to lower the cost of capital and mitigate risks. • Credit guarantees: Providing assurances to reduce investor risk and make financing more accessible.

(*Continued*)

Table 2.4 (Continued)

Need for Energy Transition	*Current Status and Outlook*
• **Access to affordable financing:** The high cost of capital and limited access to affordable financing inhibit the development and scaling of clean energy projects. Effective financial mechanisms are needed to lower costs and attract investment.	• Asset refinancing: Restructuring existing investments to free up capital for new projects. • **Prioritising local renewable energy ecosystems:** Building and supporting local renewable energy ecosystems can significantly impact the energy transition: • Creating manufacturing hubs: Establishing global and local manufacturing hubs for solar technology to reduce costs and build local capacity. • Institutional enablement: Strengthening local institutions and regulatory frameworks to support the development and deployment of renewable energy projects.

Source: Authors.

2.5 Key Levers to Promote an Equitable Energy Transition

The three key levers to promote an equitable energy transition to solar energy are finance, technology and policy. Table 2.5 summarises specific enablers and their impact under each of these categories.

2.6 Conclusion and Recommendations

Climate finance is experiencing growth, yet it remains insufficient and unevenly distributed across regions. Although private finance is increasing, it is not expanding at the scale or pace needed to meet global climate goals. The landscape of climate finance is evolving rapidly, influenced by multiple concurrent crises that demand political and financial attention and raise the cost of capital. Despite these challenges, there is mounting pressure to translate climate commitments into tangible, deployed finance from both public and private sectors.

To meet the 1.5°C target set by the Paris Agreement, there is an urgent need to accelerate equitable and people-centric development, underpinned by low-carbon energy growth. The trajectory of renewable energy expansion will vary significantly across different economies based on their unique socio-economic contexts. EMDEs, LDCs, and SIDS are expected to drive new renewable energy capacity, while high-income economies will focus on advancing their energy transitions. Among renewable resources, solar energy stands out as the most cost effective and versatile, emerging as a key driver in the renewable energy agenda.

Differences in GDP growth, energy consumption, energy access, financing requirements, current penetration of renewables and other socio-economic indicators across various archetypes necessitate tailored, differentiated solutions to effectively advance the adoption of solar and renewable energy. Addressing the diverse needs and opportunities across various economies requires a data-centric and archetype-specific approach.

Table 2.5 Key Levers to Promote an Equitable Energy Transition

Finance

1 **Access to Affordable, Long-Term Climate Finance:**
- Action: Secure commitments from financial institutions to clean investment mandates.
- Impact: Provides financial visibility to renewable projects and supports sustainable, long-term investment strategies.

2 **Mitigating High Capital Costs:**
- Action: (a) Expand the use of blended financial products, credit guarantees and asset refinancing; (b) Enhance financial institutions' expertise in risk assessment methodologies specifically tailored for solar projects.
- Impact: Lowers the cost of capital, making renewable investments more attractive and feasible.

3 **Large-Scale Demand Aggregation:**
- Action: Aggregate demand at national or regional levels to achieve economies of scale.
- Impact: Drives down costs through bulk procurement and streamlined supply chains.

Technology

4 **Advanced Technological Solutions and Access Models:**
- Action: Invest in engineering, R&D and establish centres of excellence to accelerate advancements in storage solutions, distributed renewable energy systems and innovative panel designs (e.g. floating panels).
- Impact: Enhances the efficiency, accessibility and affordability of renewable technologies.

5 **Enhanced Off-grid Distribution Models:**
- Action: Develop domestic ecosystems for component manufacturing and assembly.
- Impact: Improves local access to renewable technologies and supports sustainable development.

6 **Data Utilisation for Financial Institutions:**
- Action: Emphasise the importance of data on solar projects for risk assessment.
- Impact: Enables better-informed investment decisions and risk management.

Policy

7 **Institutional Capacity Building:**
- Action: Conduct large-scale training and awareness programmes for financial institutions and policymakers.
- Impact: Strengthens institutional knowledge and capability, fostering more effective policy implementation and investment in renewables.

8 **Supportive Green Policy Environment:**
- Action: Understand and implement best practices in green policy to facilitate the adoption of renewable technologies.
- Impact: Creates a favourable regulatory framework that supports green growth and renewable energy integration.

9 **Carbon Financing Mechanisms:**
- Action: Explore and implement results-based carbon financing mechanisms.
- Impact: Provides financial incentives for emissions reduction and supports the growth of renewable energy projects.

Source: Authors.

The four primary archetypes identified in this research highlight the distinct challenges and solutions pertinent to different regions, as illustrated in Figure 2.8, particularly with respect to policies required. Tailoring strategies to these specific contexts is crucial for enhancing the adoption of renewable energy and ensuring that climate finance effectively supports global climate goals.

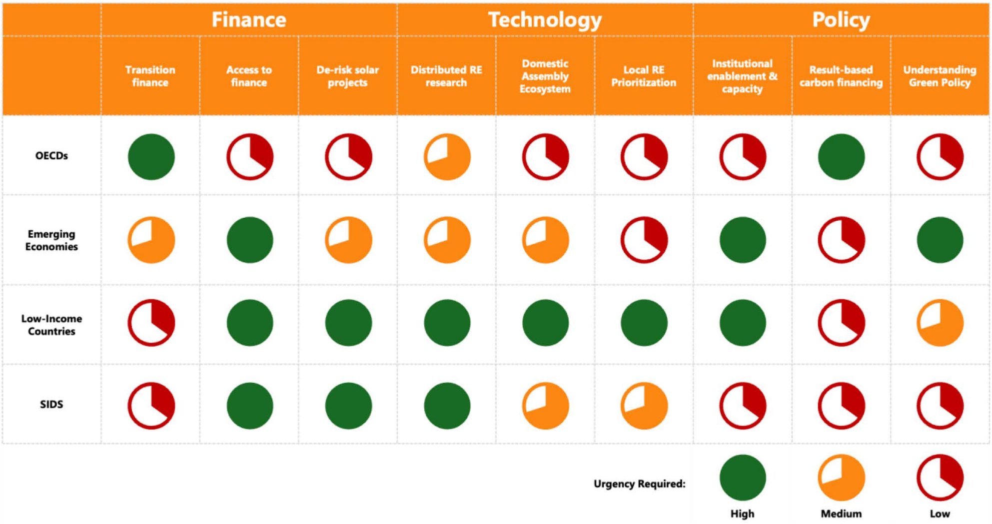


Figure 2.8 Different Solutions Are Variably Suited to Be Deployed across Economies

Source: Authors.

Notes

1 Financing decisions, usually based on the entire corporate balance sheet of a company rather than on the cash flow generating capacity of a specific project or dedicated special purpose vehicle.

2 LCOE is a measurement used to assess and compare alternative methods of energy production which incorporates both direct and indirect costs.

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3 Financing India's Decarbonisation Journey – the Role of Private Investment for Mitigation

Ajay Shankar

3.1 Introduction

Carbon finance has been moving to the centre of global discussions on climate change. The reality of the impending disaster from global warming is generating a sense of urgency in global elites. At the Conference of Parties in Paris, countries agreed that the rise in global temperatures had to be restricted to 1.5 degrees (UNFCCC, n.d). However, actions to reduce carbon emissions have been inadequate. As a result, this may no longer be feasible. Unless there is an immediate and massive increase in effective mitigation measures to control emissions by reducing the use of fossil fuels across the world, the future will keep getting bleaker. This is a global problem. Action is needed everywhere. The need for adaptation grows as temperatures rise. The costs of adaptation rise sharply with increasing temperatures. Mitigation is clearly the cheaper option for all.

The modern industrial economy has evolved using commercial energy based on fossil fuels. A basic restructuring to move to a trajectory of decreasing carbon intensity and going on to net zero at the earliest is required. This is a gigantic effort for which the investment needs are massive. The Climate Policy Institute has estimated that the world needs to invest USD 6.2 trillion annually in energy transition till 2030 and USD 7.3 trillion by 2050 to achieve net zero (Climate Policy Initiative, 2023).

The availability of adequate climate finance is a prerequisite for structural transformation. It is a necessary though not sufficient condition for achieving the breakthrough on climate action that is urgently needed. Action for mitigation – that is, the lowering of carbon emissions, which is already delayed – needs money. Many of the advanced economies of the world, the OECD countries, despite having abundant capital, have not yet done enough on this account. Their problem is their inability to get the internal consensus and political will for decisive action. Further, their governments feel constrained as they grapple with the perennial challenge of living within their means and keeping the fiscal deficit within prudential norms. This is why they have difficulty in providing public money for climate action in their own countries, let alone keeping their promises and doing what needs to be done to provide climate finance to developing countries.

The bigger problem is in developing countries. They need finance to act on mitigation, to move to a development pathway which is less carbon intensive. Further, adaptation needs are emerging with extreme weather events. Many developing countries tend to be highly indebted. They are often unable to raise large sums of money from the financial markets of the advanced economies. Their needs for climate finance are far higher than what the multilateral development financial institutions such as the World Bank provide.

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Efforts of the international community to arrange climate finance and the modalities for sanction and disbursement are, therefore, critical. As of now, this is still a case of too little, too late. It is hoped that these efforts gather momentum and that the actual flow of funds to developing countries begins to rise exponentially. Further, it is imperative that some solutions are found to remedy the phenomenon of the risk premium for a particular country which makes the interest rate of loans for it too high (Persaud, 2023). Inaction in developing countries while their economies continue to grow in the traditional fossil fuel–intensive mode is a recipe for global disaster. It could undo the positive impact of mitigation action in developed countries.

India has successfully embarked on a climate journey which has been increasing in both scale and momentum. The outcomes so far have been better than expected. We have the third-largest solar capacity, over 90 GW, and the fourth largest wind power capacity, 47GW, in the world. These have been created largely by private investment. This is one of the rare examples where the government has been able to achieve far more than it had initially hoped for and that too by attracting private investment. We are now succeeding in the promotion of EVs (electric vehicles). The journey to net zero requires electrification of as much of economic activity as is technically feasible and in parallel reducing carbon emissions per unit of electricity to move to net zero. 'Hard to abate' sectors are the ones where the transition to zero emissions appears difficult. Green hydrogen offers promise for these sectors, and India has been forward-looking in launching its Green Hydrogen Mission.

Within this broader global context, this chapter looks at our experience in India in some detail and tries to explain how our journey has evolved. It then puts together the key learnings from our experience for our own future journey as well as for other parts of the world to the extent that these may be relevant and applicable. Progress and the prognosis for the future are examined through the prism of financing. Section 3.2 looks at India's journey in generating renewable energy from wind power. Section 3.3 considers solar power. Section 3.4 addresses issues of the storage of renewable power. Section 3.5 is a brief discussion on electric mobility. Section 3.6 draws together lessons from India's renewable journey thus far, and finally, Section 3.7 concludes with a discussion of the way forward.

3.2 Wind Journey

India first achieved success in the development of the renewable energy source, wind power, with private investment. This began in the early 1990s. Growth has since been remarkable. This growth was triggered by an effective and agile policy framework. With rapid growth, India was then able to develop a globally competitive wind power manufacturing industry. The industry emerged to meet the growing demand in the domestic market. Table 3.1 provides the growth of wind power capacity in the country and the private investment that went into creating this from 1992 till date (NITI Aayog, n.d.a). Also see Figure 3.1.

The fiscal incentive of accelerated depreciation provided by the central government and the provision of the 'banking' mechanism by the state governments made private investment in captive wind farms attractive. Investments and capacities grew in the states where there was good wind power potential. The per-unit costs of wind power declined with increasing volumes of production as investments grew, which is not unusual.

Table 3.1 Year-Wise Growth in Wind Power Capacity since 1990[1]

Years	*Capacity Addition per Year (MW)*	*Cumulative Capacity (MW)*	*Annual Investment (Crore INR)*	*Cumulative Investment (Crore INR)*
1992–1993	15	16	90	96
1993–1994	59	75	356	452
1994–1995	266	266	1,594	1,594
1995–1996	359	700	2,157	4,203
1996–1997	155	855	929	5,132
1997–1998	62	917	371	5,504
1998–1999	45	962	267	5,771
1999–2000	132	1,094	794	6,565
2000–2001	182	1,276	1,091	7,656
2001–2002	251	1,527	1,505	9,161
2002–2003	237	1,764	1,422	10,583
2003–2004	669	2,433	4,013	14,596
2004–2005	1,120	3,553	6,722	21,318
2005–2006	1,751	5,304	10,507	31,825
2006–2007	1,812	7,116	10,869	42,695
2007–2008	1,595	8,711	9,571	52,266
2008–2009	1,473	10,183	8,835	61,101
2009–2010	1,607	11,791	9,644	70,745
2010–2011	2,341	14,132	14,045	84,790
2011–2012	3,081	17,212	18,483	103,274
2012–2013	1,803	19,015	10,817	114,090
2013–2014	2,027	21,042	12,159	126,249
2014–2015	2,326	23,368	13,956	140,206
2015–2016	3,410	26,777	20,459	160,664
2016–2017	5,502	32,280	33,014	193,679
2017–2018	1,865	34,145	11,191	204,870
2018–2019	1,481	35,626	8,886	213,756
2019–2020	2,068	37,694	12,407	226,163
2020–2021	1,553	39,247	9,320	235,482
2021–2022	1,111	40,358	6,663	242,146
2022–2023	2,276	42,633	13,653	255,799
2023–2024	3,253	45,887	19,520	275,319
2024–2025 (as on Sep 2024)	1,476	47,363	8,858	284,178

Source: Author.

3.2.1 Accelerated Depreciation

Accelerated depreciation of 100% was introduced in 1994 for wind energy projects. This gave huge tax benefits to the investors in wind power. Private sector investment in captive wind farms began to surge. These investors harnessed wind energy to meet their demand for electricity and at the same time reduced their tax liability substantially. Private investments created the domestic market for wind turbines, which in turn led to the growth of the manufacturing industry and other allied services. During the initial years, wind capacity was developed primarily for captive consumption. From 2004 to 2014, the wind sector grew at a phenomenal compound growth rate of 24%.

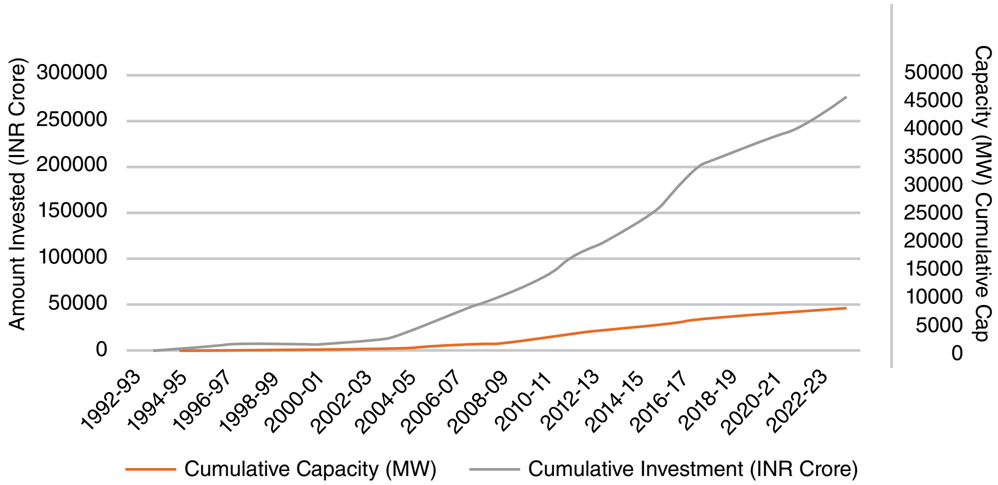

Figure 3.1 Capacity and Investment Trends in Wind Energy in India

Source: Adapted by author from NITI Aayog (n.d.a).

The provisions of accelerated depreciation were withdrawn in 2012, as it was felt that this gave excessive benefits. The withdrawal of 100% accelerated depreciation had an adverse impact on investors, as they saw a substantial decline in the returns on putting up wind farms. New capacity creation fell. The Ministry of New and Renewable Energy was able to persuade the Ministry of Finance to restore the higher rate of depreciation. After a two-year gap, accelerated depreciation was reinstated in 2014. In April 2017, the rate was lowered to 40%.

In 2017, competitive tariff-based bidding was adopted for the development of wind power. Accelerated depreciation thereafter ceased to be the primary driver of new capacity creation. In theory, a tax concession involves a loss of revenue and is equivalent to an equivalent amount going as subsidy. But finance ministries find it easier to agree to tax concessions than provide actual funds for subsidies from the budget.

3.2.2 Banking of Wind Power

The concept of banking was first introduced in the state of Tamil Nadu, and since then, it has been used by several other states (TNERC, 2021) Under 'banking', the electricity distribution company (DISCOM) took the electricity generated by a captive wind farm of an industrial enterprise and banked it. This banking was notional. The industrial enterprise which was supplied (thermal) electricity from the DISCOM was billed on a net basis after deducting the quantum of wind power it had banked. The banking mechanism proved to be an attractive option for industrial consumers. The DISCOM tariff for industrial consumers ranged between INR 7–9/kWh. The banking provisions allowed them to avail electricity at a cost of INR 4–5/kWh, the actual cost of electricity from their captive wind farm, resulting in large savings.

3.3 Solar Journey

3.3.1 National Solar Mission

The Jawaharlal Nehru National Solar Mission (JNNSM) was launched in 2010. The target was to achieve solar power capacity of 20 GW by 2022. The solar mission adopted the innovative process of inviting tariff-based bids for grid-connected solar power projects. A series of bids were invited, and projects were awarded to a few bidders in each round to create a new competitive industry structure of solar power developers.

The growth of solar power in India has been very rapid. And so has been the decline in costs. When the solar mission commenced in 2010–2011, the solar tariff approved by the Central Electricity Regulatory Commission was INR 17.91/kWh. The mission was successful in getting tariffs to go down substantially through competition and a decline in costs. Solar tariffs declined rapidly from around INR 12 when the mission began to less than INR 2.50 in response to the competitive bid process. Figure 3.2 depicts the decreasing trend of tariffs in India. When the solar mission was started, the solar power capacity was only 11 MW. From being more expensive than thermal power, solar power is now decisively cheaper.

3.3.2 Bundling Mechanism

Bundling was an innovative mechanism used to launch the National Solar Mission without any budgetary support from the government. Bundling enabled the sale of solar power even though its cost was much higher than new thermal power. Under this mechanism, costly solar power was bundled with relatively cheaper power from old, depreciated coal-based thermal power plants of the NTPC, a central government public sector undertaking, where 15% of the capacity was available to the central government for

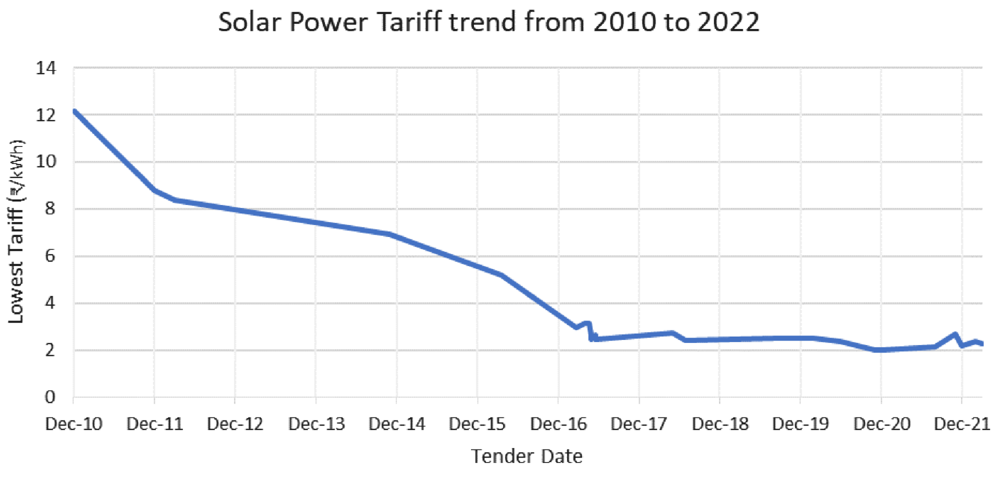

Figure 3.2 Trend of Solar Tariffs in India from 2010 to 2022

Source: Compiled by the author from MNRE (2021).

discretionary allocation. The cost of the bundled power was made comparable to the conventional grid power from new projects. DISCOMs were therefore willing to buy this power through normal power purchase agreements (PPAs). Solar power projects were selected through competitive tariff-based bidding. This power was sold to DISCOMs after bundling with cheap power from old, depreciated thermal power stations of the NTPC at a price comparable to that from a new thermal plant.

3.3.3 Viability Gap Funding

After the success in getting attractive bids from private solar power developers during the initial phase of bundling, the programme needed to be scaled up. The availability of unallocated power from the NTPC was limited. SECI (Solar Energy Corporation of India) was created to drive the solar mission. Viability gap funding (VGF) was then introduced to take the programme to the next level. VGF is a capital subsidy to bridge the gap between the project cost and the cost needed to provide electricity at the prevailing rate. So whoever asked for the lowest VGF would get the project. The tariff to be paid to the developer was pre-fixed by SECI. Under this scheme, over 5,000 MW of grid-connected solar photovoltaic power projects were developed. The tariffs continued to fall rapidly and became less than the cost of new thermal power. Financial support was no longer needed for solar power to be able to get buyers. The scheme was therefore discontinued in 2017. Since then, solar projects have been coming up through competition in the reverse auction process. Table 3.2 captures the year-wise growth of grid-connected solar capacity in India in the last decade. This is also captured graphically in Figure 3.3.

Table 3.2 Year-Wise Growth of Solar Power Capacity[2]

Year	*Capacity Added (MW)*	*Cumulative Capacity (MW)*	*Annual Investment (Crore INR)*	*Cumulative Investment (Crore INR)*
2009–2010	8	8	48	40
2010–2011	25	33	149	165
2011–2012	906	939	5,437	4,695
2012–2013	745	1,684	4,471	8,421
2013–2014	946	2,630	5,673	13,149
2014–2015	2,247	4,877	13,482	24,383
2015–2016	1,884	6,761	11,304	33,803
2016–2017	5,526	12,287	33,156	61,433
2017–2018	9,363	21,649	56,176	108,246
2018–2019	6,529	28,179	39,175	140,893
2019–2020	6,447	34,626	38,683	173,128
2020–2021	5,458	40,083	32,745	200,416
2021–2022	13,911	53,994	83,467	269,972
2022–2023	12,784	66,778	76,703	333,891
2023–2024	15,033	81,811	90,200	409,057
2024–2025 (as on Oct 24)	10,306	92,117	61,833	460,585

Source: NITI Aayog (n.d.b).

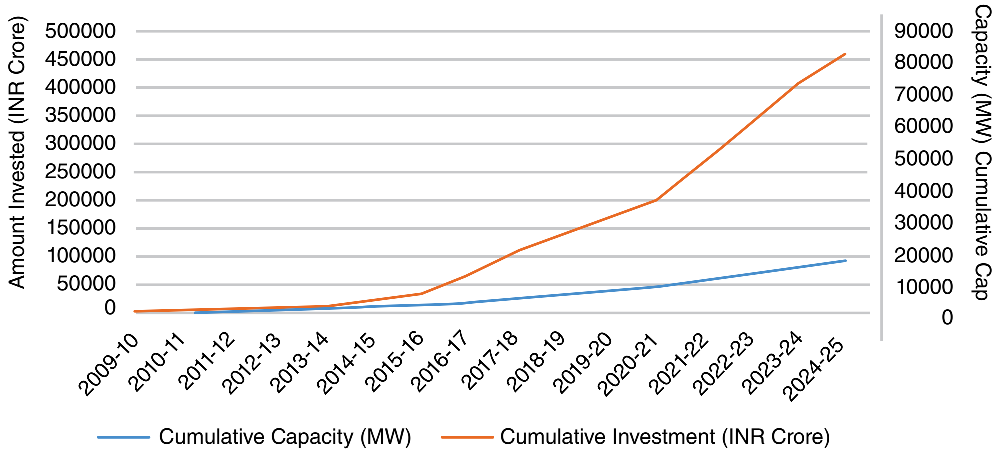

Figure 3.3 Capacity and Investment Trends in India's Solar Energy[3]

Source: Redrawn by the author from NITI Aayog (n.d.b).

Table 3.3 SECI's Capacity-Wise RTC Tenders

Tender	*Capacity (in MWh)*	*Source of Data*
RTC 1 (2019)	400	*www.seci.co.in/Upload/Archives/RFS%20for%20400%20MW%20RTC%20supply_final%20upload.pdf*
RTC 2 (2020)	5,000	*www.seci.co.in/view/publish/tender/details?tenderid=53454349303030303232*
RTC 3 (2024)	1,200	*www.seci.co.in/whats-new-detail/2818*

Source: Author.

India was able to get the full benefit from the global decline in production costs of solar panels through its policy of competitive bidding. A strong competitive private industry structure also emerged in India. Many players have been able to access lower-cost, concessional international finance. There has been innovation and cost reduction in the installation of solar panels and their maintenance. Indian companies have begun to explore foreign stock exchanges as a source of funds. For example, ReNew Power is now NASDAQ listed. India has become an attractive destination for investment in renewables.

3.4 Storage

Recognising the imperative need for creating storage of renewable solar power to provide carbon-free electricity at night, as well as maintain grid stability and reliability, as the share of renewables rise, SECI initiated the process of inviting bids for round-the-clock (RTC) supply. Bidders had flexibility in choosing the mode of storage. This has been gathering momentum, as demonstrated in Table 3.3.

Battery storage: To induct battery energy storage systems (BESS), SECI has, through a bidding process, contracted 1,200 MWh solar-plus-BESS capacity (SECI, 2024).

Table 3.4 Status of Pumped Storage Development in India

Status of Pumped Storage Development in India						
Status	*On River*		*Off River*		*Total*	
	No. of Projects	*Installed Capacity (MW)*	*No. of Projects*	*Installed Capacity (MW)*	*No. of Projects*	*Installed Capacity (MW)*
In operation	8	4,745.60			8	4,745.60
Under construction	3	1,580	1	1,200	4	2,780
DPR concurred by CEA	2	2,350			2	2,350
Under examination	–	–	–	–	–	–
Under S&I	5	6,940	37	48,910	42	55,850
Grand total	18	15,615.60	38	50,110	56	65,725.60

Source: Adapted by the author from CEA (2024).

PSP (Pumped storage projects): PSPs are a mature, proven storage technology. PSPs are now being promoted. The potential of 'on-river pumped storage' in India is estimated at 103 GW (Ministry of Power, 2024). Table 3.4 summarises the status of PSP in India.

3.5 Electric Mobility

India became an early mover in promoting electric mobility as a pillar for decarbonisation of transport in the future. The carbon emissions per unit of electricity would begin to decline with the rising share of renewables in electricity generation. In parallel, the share of EVs would rise. Here again, smart policies have led to a surge in private investments, and competition has been intense.

The FAME (Faster Adoption and Manufacturing of Electric Vehicles) scheme was started in 2015 for the promotion of electric and hybrid vehicles. The share of EVs has now begun to rise substantially. New startups have emerged to produce two wheelers. Figure 3.4 summarises the growth of EVs across two wheelers, cars, buses and trucks.

3.6 Lessons

Looking at an investor's perspective in taking decisions on potential investment opportunities is a good starting point in trying to understand our experience. First, the investor must see reasonable returns on his investment. Investments are made only when there is an expectation of profits. Then the investor makes their assessment of risk in the potential investment. The expected return and risk calculus determine the decision of a particular investor. Some will take greater risk provided the expected returns are higher, whereas others would only invest if the risks were low and are comfortable with lower returns.

In a competitive bid process, all the bidders expect to get returns that they are comfortable with through their bid price. In the competitive bid process followed for solar energy capacity additions, the purchase of the entire power being produced was assured for a 25-year-long period at the bid price of the successful bidder through a long-term PPA. Therefore, the successful bidder received their expected returns. The PPAs were with the

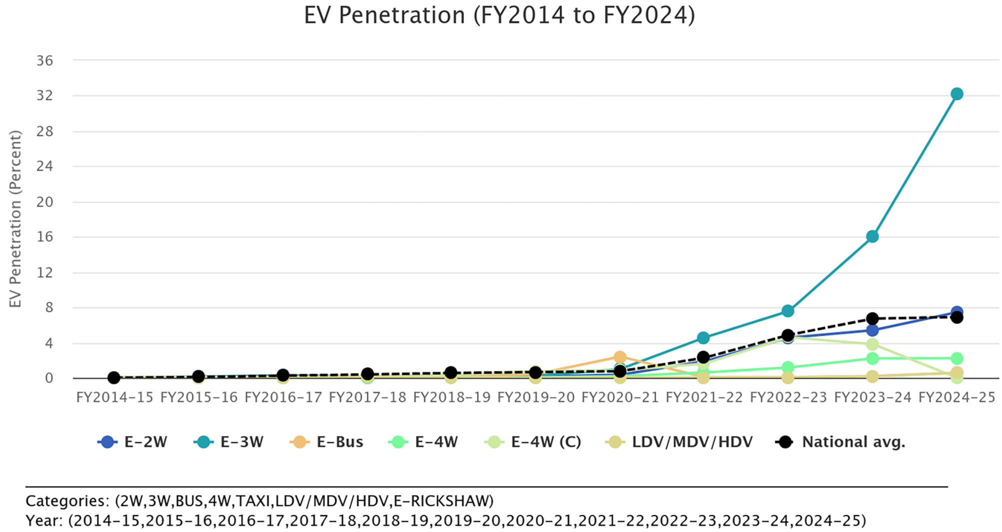

Figure 3.4 EV Penetration Trend from 2014 to 2024

Source: Adapted by the author from CEEW (2024).

state power DISCOMs. *Being state-owned utilities providing such an essential service, there was an implicit state guarantee underpinning these PPAs*. These state DISCOMs may have losses and financial difficulties, but at the end of the day, they are bailed out and kept afloat, as they cannot be allowed to go under. Hence, investor response to these bids has been good, and competition has nudged prices downwards. Such 'risk-free' investment made it easy for successful bidders to raise finance, both for equity and debt, from domestic as well as international markets. Debt was readily available and at competitive rates of interest. As a result, INR 7,44,763 crores of investment were financed by domestic and international financial markets.

Recently, bids are being invited for RTC supply from renewables. Competitive price bids have been forthcoming, and bidders are creating electricity storage capacities to meet their contractual obligations. The first off-river PSP is likely to be commissioned soon. Battery energy storage systems are being put up by other successful bidders for RTC contracts. Competition has driven prices down to such an extent that the price of electricity in these RTC contracts is lower than from a new thermal plant. In my view, therefore, the commercial case for building new thermal plants has ceased to exist. The de-risking of investment continues in the RTC bids with similar positive market response.

India's financial markets and international financial markets are interconnected, and funds are readily available for what are assessed as profitable projects. Finance has not been a constraint for these massive investments in renewable power.

In the EV sector, the FAME programme has been successful in reducing the cost of EVs and has therefore elicited a robust demand response from the market. Market forces have thereafter driven progress. Startups have appeared and taken greater market share in the two-wheeler segment, as the successful incumbents with IC engine products have been slower in trying to seize opportunities in the emerging EV market space. In the four-wheeler segment, the incumbents are introducing vehicles at competitive prices which are gradually gaining consumer acceptance (CEEW, 2023).

3.7 Way Forward: A Policy Framework

India must move to net zero and act to reduce and eliminate emissions in the 'hard-to-abate' sectors. For this, expensive green hydrogen would have to replace fossil fuels. In some cases, carbon capture and use or storage would also have to be undertaken. As the new, green carbon-free product is bound to be more expensive, the state would need to assume responsibility for creating demand. Extending and adapting the successful and proven approach of de-risking investment would be the right way to proceed.

The best de-risking occurs when there is an assured market for long-term supply at a remunerative price – a modified version of the PPA for renewable energy. The government through an SPV (special purpose vehicle), created on the lines of SECI, could undertake procurement through repeated bids for the supply of solar panels, green carbon-free steel and carbon-free fertiliser with preconditions. The condition would be full value addition in India by ten years from the date of going into production for a new plant built by the successful bidder. The successful bidder would then have no difficulty in raising finance on competitive terms. A government agency would be buying the full output for ten years. Debt repayment is assured as well as return on equity. Repeated bids would generate competitive pressures on the industry and would nudge downward movement of the cost curve. The government has the task of then using this more expensive product.

This is easily done for solar panels. All the campuses of government agencies and institutions funded by the government may be given these panels at the purchase price with payment in instalments. The SPV can be used to raise money from financial institutions for this purpose. They can all start becoming carbon neutral and then carbon positive. Defence establishments, public sector undertakings, university and school campuses, residential complexes of staff, all have enormous potential for installing solar panels. These campuses should be able to pay the instalments for the solar panels from their savings on electricity bills. In my view, no special budgetary expenditure would be needed.

With carbon-free steel, the government can use such steel for its own projects as well as those of the agencies funded by it. All new public buildings such as offices, housing complexes, educational buildings and hospitals can use green steel. In my view, the impact on per-unit cost would be marginal and could be easily absorbed in the individual project costs.

In the case of green fertiliser, the government would have to fully bear the higher cost with an enhanced expenditure on fertiliser subsidy. The government, at present, ensures the delivery of fertilisers at a fixed subsidised price and pays for the difference between the production costs and the sale price for farmers. For green fertiliser, the subsidy would be higher. The government would have to take a view about the pace of scaling up green fertiliser production after assessing the extent to which it can make higher provisions for fertiliser subsidy.

Where de-risking through long-term procurement contracts is not feasible, there the government needs to create the market for the more expensive carbon-free green product. EVs and government support through FAME is an ongoing successful example where finance has not been a constraint for the producers and the buyers. For the buyers, the auto finance market has been an efficient one. For the incumbent producers, financing for adding EVs to their product range has not been a problem. India now has a startup ecosystem where good ideas get backed by angel investors, PE Funds etc. This is the positive outcome of integration with international financial markets that has taken place.

A market for green products with lower embedded carbon at a higher price is emerging and can be expected to rise rapidly. Europe is already doing so by creating the carbon border adjustment mechanism (CBAM), which entails the levy of higher duties on goods with a higher embedded carbon content. The government can, through some pilot projects, help create price-competitive, green, carbon-free production capacities which could serve the European market and grow. Firms in India would create a market for lower carbon footprint in their supply chains. Early signs of this are being seen in the announcements of becoming net zero by a growing number of firms.

In the domestic market, there are a range of policy options. A rational decision would be feasible only after market discovery of the higher cost of the green product. A political decision would then need to be taken to determine the way forward. The options are as follows:

1 No cost to government and no compulsion. This would require putting in place a voluntary credible system of traceability of all embedded carbon emissions: Scope 1, 2 and 3 for goods and services. This is in any case essential for the European market under CBAM. In the domestic market, purchasers in the supply chain may be willing to pay more to be able to sell their final product with a price premium for having low or zero embedded carbon. It would be difficult to speculate how this market would grow till it has been in place for a couple of years. If this market grows, private investment will also grow to cater to the rising demand. This investment would get financed as all other demand-based investments get financed.
2 The government could make good the cost difference by having different GST rates. For EVs, the rate is 5%, whereas the rate is 28% (ClearTax, n.d.) for normal internal combustion engines. Further, subsidies were made available under FAME. The market is, however, free and open, and consumers have a choice between traditional internal combustion engine vehicles and newer EVs. The benefits of competition in the market are being seen. Many new firms have emerged and are doing well. Finance has not been a constraint for new manufacturers of EVs.
3 The government could move further and mandate that for a particular product all new production should be green and carbon-free from a prospective date. It can levy a carbon tax/cess on the production from older plants so that the price in the market for carbon-free and older technology–based carbon-embedded products become similar. In this case, all consumers would have to pay the higher price for the lowering of carbon emissions. Competition and scale would then drive the industry to innovate, cut costs and charge lower prices. Older plants would gradually get phased out on their own. In case the government would like faster decarbonisation, it could prescribe a prospective road map for the closure of all such plants.

What has emerged from the preceding analysis is that with the right policy instruments private investment has come and will come. Climate finance has not been a constraint for India, nor is it likely to be.

The above analysis has looked at private investment for mitigation, getting carbon emissions to move towards zero. There will, however, be a growing need for money for investment in adaptation. These are intrinsically non-revenue generating. The government would have no option but to find the money for it. Ideally, this money should come from advanced countries and go to developing countries as grants or long-term loans at very low interest rates. Notwithstanding all the well-meaning rhetoric, the prospects of substantial climate finance flows of this kind do not appear bright yet.

Notes

1 The calculation is made assuming that an investment of INR 6 crore is required per MW of wind power. The actual investments would have been higher, as the cost per MW has declined. The intention is to get an approximate computation of the magnitude of investment in the sector rather than an accurate figure for actual investment.
2 Investment is calculated assuming a cost of INR 5 crore per MW of solar energy. The actual investments would have been higher, as the cost per MW has declined. The intention is to get an approximate computation of the magnitude of investment in the sector rather than an accurate figure for actual investment.
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4 How to Make Climate Change Action a Nationwide Movement in India, and How to Finance It?

Vijay Mahajan

4.1 Efforts for Climate Change Adaptation and Resilience in India

We must act to stop, indeed, reverse climate change. Extreme climate events such as hurricanes, cloudbursts and heat waves lead to loss and damage. At present, most of the loss is borne by the victims, with sporadic compensation from governments. The United Nations Framework Convention for Climate Change (UNFCCC) has established a loss and damage fund for dealing with climate-related loss and damage only as recently as in 2023 (UNFCCC, 2023).

Mitigation is a response to reduce the causes of climate change, which are usually industrial and agricultural greenhouse gas (GHG) emissions. Due to penalties, mitigation mechanisms usually have positive internal rates of return (IRRs) and therefore get widely adopted.

The efforts to enable humans and other species to survive adverse changes are called adaptation, and the ability to survive the shocks, and to the extent possible, recover from those, is called resilience. In this chapter, we focus on adaptation and resilience (A&R). In contrast to mitigation, A&R efforts require significant behavioural change at the individual and household level as well as at the level of small farms and micro-enterprises. Moreover, A&R strategies from the bottom-up require much more public involvement and collective action.

Financing of A&R through the market mechanism is difficult, as returns are neither assured nor can be captured solely by the entity investing in A&R. As a result, "while mitigation finance has accelerated dramatically in the last two years to USD 1.2 trillion annually" (CPI, 2023), adaptation finance flows declined as a proportion of total climate finance from 7% in 2019–20 to 5% in 2021–22 (CPI, 2023). At the same time, estimated needs of A&R financing are continuously rising as the need and scope for A&R increases and technical understanding of A&R mechanisms and their costs improves.

In 2009, at the 15th Conference of Parties (COP15) of the UNFCCC in Copenhagen, developed countries agreed to mobilise USD 100 billion per year by 2020 to help developing countries adapt to and mitigate climate change. The goal was extended to 2025 at COP21 in Paris. According to the OECD, developed countries met the goal only in 2022, providing $115.9 billion in climate finance to developing countries (OECD, 2023). Even this has been questioned by several experts on the grounds that some of it is existing aid, renamed or double-counted, or that much of it was mere commitments rather than flows. The COP29 at Baku in November 2024 came up with a New Collective Quantitative Goal (NCQG) of USD 300 billion per annum (UNFCCC, 2024), which was nowhere close to the USD 1.3 trillion per annum that the "group of like-minded" developing

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countries were demanding – a significant percentage of that on grant basis. They also wanted 50% of the outlay for mitigation and 50% for adaptation (UNFCCC, 2021), thereby significantly increasing funding for A&R.

4.2 Begin by Strengthening the Social and Institutional Capacity for A&R

India's share in whatever flows in as climate finance will remain well below the investment requirements. And the share of financing for A&R will remain a single digit percentage. Yet we cannot wait. Thus, we need to bootstrap – use our own meagre resources for – A&R in India. For this, we need to build a nationwide movement for A&R. We maintain that strengthening society's resolve to combat climate change is the starting point. This is not a task that corporations or governments can perform. It will have to be carried out by civil society institutions (CSIs).

To activate the people, CSIs will have to emphasise the adverse effects of environmental degradation on people's health and livelihoods. They would have to highlight the World Health Organization (WHO)'s concept of 'One Health', which "recognizes that the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent". It then advocates "an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems" (WHO, 2017). Once societal consciousness is aroused, it will trigger collective action. Then it will become possible to mobilise A&R efforts widely. There are four components to this:

- Public education on the adverse effects of climate change on health and livelihoods and the need for A&R efforts by individuals and households.
- Strengthening local social institutions – such as self-help groups (SHGs), resident welfare associations (RWAs) and Farmers' producer organisations (FPOs) – for A&R efforts.
- Strengthening the capacity of local self-governance institutions, starting with the smallest units, wards, of gram panchayats (village bodies), zilla parishads (district bodies) and nagar palikas (municipal councils) for A&R efforts.
- Strengthening the capacity of local scientific, technical and CSIs for A&R efforts.

4.2.1 Public Education in Climate Change A&R

Every citizen needs to be made aware of the adverse effects of climate change on their health and livelihoods. The relationship between individual-, household-, community- and enterprise-level actions and climate change and the need to take responsible action has to be inculcated at all levels. This education needs to begin with schoolchildren. Towards this, for example, UNICEF in India is "has engaged with members of a national focus group on environmental education to integrate climate change elements into the new National Curriculum Framework" (UNICEF, 2024). Among NGOs, the Centre for Environment Education is a national institution in India that works to promote environmental awareness and education for sustainable development among children and youth (CEE, 2024). The Indian Youth Climate Network (2024) was founded in 2008 as a coalition of young people and youth-oriented organisations to take action on climate change. Many more such programmes need to be built, in every neighbourhood, school and college.

4.2.2 *Strengthening Local Social Institutions*

There are many local social institutions in India, a large number of them informal. These include over 1.2 crore women's self-help groups (SHGs), with over 15 crore members, engaged in savings and credit work as well as women's empowerment and general rural development. Many of them have started taking action for A&R. See, for example, a case study of an SHG in the Puri district in Odisha which used nature-based solutions against climate risks (CEEW, 2024). As the SHG movement is ubiquitous, it needs to be harnessed for the work on A&R efforts. The link of climate change with health and livelihoods, for the women members and family members, will particularly appeal to them.

In addition to SHGs, there are other local social institutions such as resident welfare associations (RWAs) in urban areas which can be mobilised for A&R efforts. There are crores of such bodies all over the country, which will create the mass base for turning A&R into a nationwide movement as well provide the organising capability for the human resources required and the capability to aggregate the carbon credits generated from these efforts.

4.2.3 *Strengthening the Capacity of Local Self-Governance Institutions*

Gram panchayats (elected village councils), zilla parishads (elected district councils) and nagar palikas (elected municipal bodies) need to be made much more proactive in the issue of dealing with climate change. Towards this, exemplary efforts have been made in Kerala (Nirupama, 2024) but also in some other states such as Karnataka, Telangana and Andhra Pradesh. During the COVID pandemic, these local bodies were at the forefront of handling the health challenge.

Another time when such bodies become active is when there are severe weather-related events such as cyclones or in case of catastrophes like earthquakes. Under normal times, these local bodies are engaged with a number of livelihood promotion programmes such as the National Rural Employment Guarantee and the National Rural/Urban Livelihood Missions. These bodies need to be provided the necessary funds, functions (powers) and functionaries (staff) to enable them to play a leading role in addressing the adverse effects of climate change which require locally led citizen action. The United Nations Capital Development Fund (UNCDF) has established a programme called the Local Climate Adaptive Living Facility (LoCAL) that helps local governments in developing and least developed countries (LDCs) adapt to climate change (UNCDF, 2024)

4.2.4 *Strengthening the Capacity of Scientific Research and CSIs*

To ensure that the efforts at the individual level, household level, social groups and local governance institutions are based on tested knowledge, and are informed with best practices, it would be necessary to have a dense presence of local scientific research and CSIs all over India. Research will be needed in identifying new ways for adaptation to the effects of climate change as well as new ways to cope with shocks and build resilience. CSIs will contribute to organising individuals, households and social groups effectively for A&R efforts for addressing the adverse effects of climate change on health and livelihoods.

4.2.5 *Key Assumptions*

This chapter attempts to provide estimates of investments needed for an A&R focused strategy and how some of it may be financed in tables[1] in the paper. From Table 4.1 to

Table 4.1 A&R Efforts – Societal and Institutional Level

Interventions Proposed for Strengthening the Capacity for Adaptation and Resilience (A&R)	*Total Investment (Crore INR in 2024 Prices)*	*AMSERs in INR Crore per Annum*	*AMSERs in Tonnes per Unit per Annum*	*Assumed AMSER% towards A&R*	*Per unit AMSERs in Tonnes*	*Reference*
Public education on the adverse effects of environmental degradation on health and livelihoods and on A&R efforts to counter these	14,400	35,562	0.147	10%	1.47	Nautiyal et al. (2023)
Strengthening local social institutions – SHGs, RWAs, trade associations and NGOs for undertaking A&R efforts and participating in loss and damage control	20,000	16,380	4.875	5%	6.5	Nautiyal et al. (2023); WRI (2024)
Strengthening capacity of wards – building blocks of local self-governance institutions – of gram and block panchayats, zilla parishads and nagar palikas for undertaking A&R efforts and participating in loss and damage control	5,000	54,600	650.0	10%	6.5	Nautiyal et al. (2023); Nirupama (2024)
Strengthening capacity of specialised scientific, technical and civil society institutions for A&R	10,000					
Strengthening the societal and institutional capacity for A&R efforts	**49,400**	**106,542**				

Source: Author.

Table 4.5, we explain the A&R intervention in the first column of each row, followed by the extent to which it is required in the corresponding units, the investment needed per unit of intervention and, finally, the total investment needed in crore INR,[2] in 2024 prices.

We have also tried to estimate the benefits in terms of carbon dioxide (CO_2) sequestration or CO_2 equivalent GHG emission reductions in tonnes. These will originate from a large number of microsites such as households, farms and micro-enterprises; these will need to be aggregated for trading. In this model, aggregated microcredits for carbon sequestration and emission reductions or AMSERs will be able to help mobilise the finance needed for the A&R efforts. For better estimates, a mechanism is needed by which the CO_2 sequestered or GHG emissions reduced by individuals can be measured reliably and aggregated into AMSERs. AMSERs have been assumed to sell at USD 20 per ton, and USD 1 has been assumed to be INR 84.

The references for the data used in the various estimates are shown in the last column of each intervention row.

4.3 Individuals', Households' and Livelihood Enterprises' Efforts for A&R

We all want global warming to be reversed or at least slowed down, but there is little we want to change in our own lifestyle or consumption patterns. In this context, the concept of 'Lifestyle for the Environment (LiFE)' was introduced by India's prime minister at COP26 in Glasgow on 1 November 2021. He called upon the global community of individuals and institutions to drive LiFE as an international mass movement towards mindful and deliberate utilisation, instead of mindless and destructive consumption, to protect and preserve the environment. LiFE puts individual and collective duty on everyone to live a life that is in tune with Earth and does not harm it. Those who practise such a lifestyle are recognised as Pro Planet People under LiFE (GoI-MyGov, 2024).

4.3.1 Individual-Level Efforts for A&R

Here are some examples of lifestyle changes that can significantly reduce an individual's carbon footprint (Lund University, 2021). It is evident that all these can be easily adopted by a large number of Indians, with some supportive public policy and behavioural nudges.

- Eating a plant-based diet: Can reduce carbon emissions by about 0.8 tonnes of CO_2 p.a.
- Living car-free: Can reduce carbon emissions by up to two tonnes per year. Switching one trip per day from car driving to cycling can reduce CO_2emissions by about 0.5 tonne a year.
- Avoiding air travel: Can save 1.6 tonnes of CO_2 per round-trip flight.

A mechanism is needed by which the carbon emissions saved by an individual can be measured reliably and aggregated into AMSERs which the individuals can encash.

4.3.2 Household-Level Efforts for A&R

A study by Nautiyal et al. (2023) showed that "[t]he average household carbon footprint (HCF) of Indian households is estimated at around 6.5 tons CO_2 equivalent per year with a corresponding per capita carbon footprint of 1.47 tons CO_2 equivalent per year".

As in the case of individuals, it is evident that all household efforts to reduce A&R can be easily adopted by a large number of Indian households, with some supportive public programmes. Some of these are already in place, such as establishing household biogas digesters, replacing coal- and wood-burning stoves with LPG or piped municipal sewage gas, enhancing non-fossil-fuel-burning public transportation, encouraging private automobiles to shift from petrol and diesel to CNG and electric and promoting energy efficiency in home temperature control. A mechanism is needed by which the carbon emissions saved by a household can be measured reliably and aggregated into AMSERs which the household can encash.

A fairly large-scale effort in this respect exists in India at Bagepalle, a taluka in the Chikballapur district of Karnataka, about 100 km north of Bengaluru. Here, an NGO called ADATS and the community organisation it formed called Coolie Sangha have educated over 30,000 rural households on how to reduce carbon emissions by using biogas in place of kerosene or LPG and using improved wood-burning cookstoves. See the video for more details (RGF, 2020).

4.3.3 Farmers' Efforts for A&R

Agriculture in India contributes around 16% of the country's total GHG emissions, which is equivalent to 417.22 million tonnes of CO_2 equivalent per year (NAAS, 2014). This is due to the use of energy-intensive practices, such as nitrogenous fertilisers and increasing use of farm machinery, particularly tractors, which burn diesel fuel. Methane is produced when organic materials decompose in oxygen-deprived conditions, notably from paddy grown under flooded conditions and through fermentative digestion by ruminant livestock and stored manures. Thus, irrigated paddy cultivation and livestock production are major emitters of methane, a potent GHG that has more than 80 times the warming power of CO_2 over the first 20 years after it reaches the atmosphere.

> Agriculture is the one sector that has the ability to transform from a net emitter of CO_2 to a net sequesterer of CO_2 – there is no other human managed realm with this potential. There are numerous land management practices that can be adopted to increase soil carbon storage in agro-ecosystems, such as changes in crop rotations, tillage, fertiliser management, and organic amendments. The most effective means for increasing soil carbon sequestration is through changing land cover, such as converting annual cropland to forest or perennial grasses.
>
> Jansson et al. (2021, p. 2)

The number of operational farm holdings as per the Agriculture Census of India 2015–2016 was 14.65 crore. Of these, 10.03 crore (68.45%) were marginal holdings, less than 1 hectare (ha) in area. Another 2.58 crore (17.62%) were small, having between 1 and 2 ha of cropped area. Programmes for increasing productivity and reducing costs and risks for small farmers exist to help them earn more. These also serve to sequester CO_2. Likewise, setting up biogas plants for livestock enterprises can lead to reduction in GHG, particularly methane emissions. As each intervention leads to a combination of mitigation as well as A&R benefits, we have assumed only 10–20% of the total carbon reduction towards A&R.

4.3.4 Non-Farm Micro-Entrepreneurs' Efforts for A&R

India's non-farm sector accounts for nearly 85% of the GDP and about 55% of the workforce. Moreover, it has registered a higher growth than the farm sector, so it is the growth engine of the economy. As per the Annual Survey of Unincorporated Sector Enterprises, 2022–2023 (G0I-ASUSE 2023), there were as many as 6.50 crore micro-enterprises. In addition, there were 0.22 crore small, medium and large enterprises. Together, these produced 11 crore tonnes of GHG emissions, as per a study (Mohapatra et al., 2023). That

Table 4.2 A&R Efforts – Individuals, Households and Livelihood Enterprises

Interventions Proposed for Strengthening the Capacity for Adaptation and Resilience (A&R)	*Investment (Crore INR in 2024 Prices)*	*AMSERs in INR Crore per Annum*	*AMSERs in Tonnes per Unit per Annum*	*Assumed AMSER% towards A&R*	*Per Unit AMSERs in Tonnes*
Strengthening the individual capacity for A&R through better nutrition, healthcare, physicality, education and skilling	14,400	35,562	0.147	10%	1.47
Strengthening the household capacity for A&R through physical improvements in water, sanitation, ventilation, shelter, roads etc.	16,500	36,036	0.650	10%	6.5
Farms can reduce GHG emissions through soil and water conservation, irrigation, polyhouses and diversification. These are mitigation efforts, but with community participation, they can partially help with A&R	219,750	12,328	0.501	20%	2.505
Livestock enterprises A&R efforts can reduce GHG emissions through stall feeding, biogas digesters etc. These are mitigation efforts, but with community participation, they can partially help with A&R	40,000	1,683	0.501	20%	2.505
Non-farm micro-enterprise A&R efforts through better equipment, weather proofing, renewable energy and diversification. These are mitigation efforts, but with community participation, they can partially help with A&R	225,000	4,125	0.327	20%	1.637
Strengthening individuals', households' and livelihood enterprises' capacity for A&R	**515,650**	**89,734**			

References for data: Individual and household carbon footprint – Nautiyal et al (2023).
Agricultural and livestock enterprise carbon emissions – National Academy of Agricultural Sciences (2014).
Non-farm micro-enterprise carbon emissions – Mohapatra et al. (2023).

Source: Author.

amounts to an average of 1.637 tonnes per non-farm enterprise, with the average being much closer to the average of micro-enterprises, given their very large share of total enterprises.

As micro-enterprises shift from fossil fuels to renewables, some reduction in GHG emissions is expected. This will lead to mitigation. However, this can also help the A&R efforts by providing renewable energy for protective irrigation, street lighting, drinking water pumping etc. As each intervention leads to a combination of mitigation as well as A&R benefits, we have assumed only 20% of the total carbon reduction towards A&R.

4.4 Regeneration of Nature Commons for A&R

The phrase 'jal, jangal, jameen' (water, forest, land) was first used by Gond tribal leader Komram Bheem in the 1930s to assert the rights and custodianship of the tribal people over these gifts of nature (Shoba, 2018). Over the last two decades, thanks to the work of people like Shri P. V. Rajagopal, leader of the Ekta Parishad, this has become a people's movement. These movements teach us that we need to stop looking at nature as a set of resources we can exploit at will. Instead, we must return to the early human view of nature as the mother, the very source of our existence and sustenance. We need to invest in regenerating nature – water, forests and land. This needs to be done urgently and largely with public funds.

The rise of CO_2 concentration in the atmosphere by 47% since the start of the industrial period (USEPA, 2024) has led to the rise in global temperatures. Therefore, the sequestration of carbon from the atmosphere to the earth is needed in addition to reducing the amount of CO_2 released. Though this is part of mitigation efforts when done by governments and corporations, when it is done through local community participation, it also helps with A&R.

4.4.1 Regeneration of Water Commons above and below the Ground

Water is the essence of carbon sequestration, as plant growth does not happen without water (Smith, 2022). In this section, we focus on water conservation efforts. In India, 13 rivers and their 202 tributaries have been identified by the Ministry of Jal Shakti (GoI-MJS, Aug 2022) for rejuvenation. Together, these add up to a length of 42,830 km of rivers and their tributaries and streams. Assuming rejuvenating each km of river length requires water conservation treatment and reforestation of 12 square kms of proximate land, the total work will be spread over roughly five lakh square kms or five crore hectares.

There were 24 lakh water bodies in the country (Govt of India, 2023b). About one in six water bodies were not in use due to reasons such as blockage of inlet streams, siltation, construction in the pond bed, irreparable damage to earthen walls, salinity and inflow of untreated sewage and industrial effluents. Thus, on the one hand, surface water storage and use gets reduced, and on the other hand, recharge of groundwater, necessary to prevent long-term groundwater depletion, suffers. Four lakh water bodies need full rejuvenation. The remaining 20 lakh water bodies also need repairs.

These rejuvenated tanks will also help recharge groundwater aquifers. This recharge will be over and above the specific water structures built primarily for groundwater recharge, such as contour trenches on hill slopes and small check dams and percolation tanks in streams and rivulets. They slow down the rainwater run-off, which facilitates water percolation downwards into the soil.

Based on expert estimates (GoI-MJS, Aug 2022, 2023a, 2023b) of what is required to be done for conserving surface and groundwater, and what it costs, we have tried to estimate the total investment required. This is shown in Table 4.3. The investment needed for regeneration of surface water is INR 7.74 lakh crore and for groundwater recharge is INR 1.32 lakh crore, both over five years. Thus, the total investment needed for water source regeneration is 9.06 lakh crore.

Water conservation efforts will lead to sequestration of CO_2, which will generate AMSERs worth INR 43,381 crore per annum on an ongoing basis from the sixth year onwards. Direct carbon sequestration by water bodies is modest and, in some cases, can even be negative, if they are not adequately oxygenated and as a result emit methane. Likewise, groundwater has mixed effects on carbon sequestration.

4.4.2 Regeneration of Forest Commons

Forest regeneration efforts have been tried for several decades. The first major effort involving communities was the Joint Forest Management (JFM) programme. The area covered by JFM till 2010 was 24.6 mha, which was about 30% of the forest cover of the country. In 2014, the Green India Mission (GIM) was launched for ten years. The mission had a goal to increase the forest/tree cover in 5 mha land and improve the density of tree cover in another 5 mha (total 1 crore hectares). Unfortunately, achievement under the GIM from FY 2015–2016 to 2020–2021 was a meagre 1.17 lakh hectares (GoI-GIM, Aug 2022). India has committed to capture 2.5–3 billion tonnes of CO_2 by enhancing forest and tree cover through 2030. To achieve this, India has adopted the Reducing Emissions from Deforestation and Forest Degradation (REDD+) strategy, which aims to mitigate climate change by enhancing carbon sequestration through forest conservation (Verma and Ghosh, 2022). There have been recent studies which indicate that "about 94% of the credits from the [REDD+] projects don't represent real reductions in carbon emissions" (Thales et al., 2023).

Based on various expert estimates (GoI-GIM, 2022; Dhyani et al., 2020) of what is required to be done for regenerating degraded forests, we have tried to estimate the total investment required, which comes to INR 4.77 lakh crore. Due to additional tree cover that will come up, these efforts will lead to sequestration of CO_2. The estimate for this is shown in Table 4.4.

4.4.3 Regeneration of Commons Lands including Soil Cover

Land has always been discussed from the redistribution of ownership point of view. While that is still a valid concern and needs to be addressed over time, in the meanwhile, we need to worry about land and soil health. Desertification is another major challenge that India's landmass is facing. This land needs soil regeneration.

India's cultivable land area of about 160 million hectares (mha) is the second largest in the world, after the United States. Between the 1950s and 2020, the cultivable land area has gone up about 8–10 mha. India's net sown area is 141 mha, which is 42.4% of the country's total geographical area (GoI-LU, 2021). The gross cropped area is 195 mha. Of this, India's gross irrigated crop area of 82.6 mha is suffering from the effects of intensive irrigation and excessive use of chemical fertilisers. This had made land less and

Table 4.3 Estimates for Regeneration of Water Commons with Community Participation

Interventions Proposed for Strengthening the Capacity for Adaptation and Resilience (A&R)	*Investment (Crore INR in 2024 Prices)*	*AMSERs in INR Crore per Annum*	*AMSERs in Tonnes per Unit per Annum*	*Assumed AMSER% towards A&R*	*Per Unit AMSERs in Tonnes*	*Reference*
Surface water conservation						
River rejuvenation – treatment of river basin	472,528					GoI-MJS, Aug 2022
Restoration of defunct water bodies	98,625					GoI-MJS (2023a)
Restoration of damaged water bodies	203,004					Ghosh et al. (2017)
Subtotal surface water conservation	**774,157**	**28,921**	**0.888**	**80%**	**1.11**	
Groundwater recharge						GoI, MJS (2023b) for all
Recharge shafts	9,977		-			
Injection wells	1,218		-			
Subsurface dykes	155		-			
New check dams	25,426		-			
New percolation tanks	25,010		-			
New gabion structures	1,517		-			
Rooftop rainwater harvesting	36,794		-			
Springshed/watershed development	1,401		-			
Others	30,982		-			
Subtotal surface water conservation	132,480	**14,460**	0.888	80%	**1.11**	
Regeneration of water commons	**906,637**	**43,381**				

Source: Author.

Table 4.4 Estimates for Regeneration of Forest Commons with Community Participation

Interventions Proposed for Strengthening the Capacity for Adaptation and Resilience (A&R)	*Investment (Crore INR in 2024 Prices)*	*AMSERs in INR Crore per Annum*	*AMSERs in Tonnes per Unit per Annum*	*Assumed AMSER% towards A&R*	*Per Unit AMSERs in Tonnes*	*Reference*
Regreening of open/scrub forestland through agroforestry and planted forests	324,605	8,685	1.50	75%	2.0	GoI-GIM, Aug 2022; Dhyani et al. (2020) estimate a range from 0.29 to 15.21 Tonnes/ha per year
Restoring moderately dense forests – mainly through assisted natural regeneration	153,239	7,524	1.50	50%	3.0	Trillion Trees (2022)
Regeneration of forest commons leading to A&R benefits	**477,844**	**16,209**				

Source: Author.

less fertile, thus needing more chemical fertilisers. The only way to reverse this vicious cycle is to regenerate the soil. Thus, soil treatment to increase soil organic carbon, cation exchange capacity and water-holding capacity is essential.

Soil is the biggest land-based sink of CO_2, although in terms of annual incremental sequestration, forests are much higher. Based on various expert estimates of what is required to be done for regenerating degraded soils (TERI, 2019), we have tried to estimate the total investment required. This is shown in Table 4.5.

We must remember that the AMSERs will be low because most of the regenerated land resources will be used for crop cultivation, and most field crops are not great at carbon sequestration. In fact, crops like paddy are net emitters of GHGs like methane. We have assumed a modest 1 ton per hectare of carbon sequestration of the treated lands.

4.4.4 Environmental Benefits

The value of the environmental benefits in terms of carbon sequestration and GHG emission reductions are mentioned in Table 4.6 and are valued at INR 2.72 lakh crore per year. This is based on nearly 162.28 crore (1.62 billion) tonnes of AMSERs per annum. This should be compared to the estimated figure of four billion tonnes of GHG emissions per year by India.

India had pledged to reduce GHG emissions by 2030 by one billion tonnes and also sequester CO_2 to the extent of 2.5–3 billion tonnes under the Paris Agreement (Verma and Ghosh, 2022). Thus, the suggested efforts will reduce the current GHG emissions by a little over 40% and contribute to the Paris commitments, basing those on a nationwide movement for A&R.

Table 4.5 Estimates for Regeneration of Common Land/Soil with Community Participation

Interventions Proposed for Strengthening the Capacity for Adaptation and Resilience (A&R)	*Investment (Crore INR in 2024 Prices)*	*AMSERs in INR Crore per Annum*	*AMSERs in Tonnes per Unit per Annum*	*Assumed AMSER% towards A&R*	*Assumed per Unit AMSERs in Tonnes*	*Reference*
Restoration of land affected by salinity	39,312	153	0.25	25%	1.0	TERI (2019)
Of land affected by wind erosion	67,206	603	0.20	25%	1.0	Note: We have indexed it by a factor of 1.8 to bring the 2016 estimates to 2024 prices
Of land affected by water erosion	97,740	1,216	0.20	25%	1.0	0.20
Of land affected by waterlogging	7,290	14	0.10	25%	1.0	0.10
Of soil nutrients in single-cropped land	140,000	4,704	0.20	100%	1.0	0.20
Of soil nutrients in multiple-cropped land	150,000	10,080	1.00	100%	1.0	1.00
Regeneration of land commons leading to A&R benefits	**501,548**	**16,770**				

Source: Author.

Table 4.6 Summary of Estimates for Investments and Environmental Benefits from Various Interventions

Interventions Proposed for Strengthening the Capacity for Adaptation and Resilience (A&R)	*Total Investment (Crore INR in 2024 Prices)*	*AMSERs in INR Crore per Annum*	*AMSERs in Crore Tonnes per Annum*
Strengthening the societal and institutional capacity for A&R efforts	49,400	106,542	63.42
Strengthening individuals', households' and livelihood enterprises' capacity for A&R	515,650	89,734	53.413
Regeneration of water commons	906,637	43,381	25.822
Regeneration of forest commons	477,844	16,209	9.648
Regeneration of land commons	501,548	16,770	9.982
Total	**2,451,079**	**272,636**	**162.28**

Source: Author.

4.5 Financing Aspects

4.5.1 Investment Requirements

The total investment needed for A&R efforts is shown in Table 4.7 and is INR 24.51 lakh crore or USD 292 billion, which is about 9% of the projected GDP of India in 2024–2025. This investment is proposed to be made over five years, so the investment level required is only about 2.2% of the GDP in 2024–2025 or about 6.6% of the capital investment in the economy every year.

How the investments will be used, by sector, by purpose, is summarised in Table 4.8. About one-fourth of the total investment is in strengthening societal and institutional capacity for A&R coupled with individual, household, local institutional and livelihood enterprises' A&R efforts. Once this capacity is built at every building block of society (individuals, households, local social groups and local governance institutions) and the micro-economy (farms and micro-enterprises), the investment thereafter in regeneration of nature commons – water, forests and land – will fructify. In the absence of one-fourth of the investment in capacity building first, the three-fourths investment in nature commons will also have doubtful prospects.

It should be noted that the above efforts for A&R will together generate INR 2.72 lakh crores (USD 32.3 billion) of AMSERs. We have indicated that if the appropriate steps are taken to aggregate and sell the carbon sequestration microcredits and GHG emission reduction microcredits, then a significant part of the financing required can be mobilised from the upcoming climate finance market. This large-scale aggregation of dispersed microcredits is possible only if society is committed to and organised for this effort. This methodology was evolved by CTRAN Consulting Pvt Ltd, a company of the BASIX Social Enterprise Group, and many such microcredit aggregations were done by it (Business Standard, 2013).

4.5.2 Sources of Funds

A possible means of how the investments will be mobilised from different sources is shown in the Table 4.8. Broadly, our approach is that of blended finance. The good

Table 4.7 Summary of Estimates for Investment and Carbon Reduction Benefits as % of Total

Interventions Proposed for Strengthening the Capacity for Adaptation and Resilience (A&R)	*Investment (Crore INR in 2024 Prices)*	*Investment in This Intervention as % of Total*	*AMSERs in INR Crore per Annum*	*AMSERs in INR Crore per Annum as % of Total*
Strengthening the societal and institutional capacity for A&R	49,400	2.0%	106,542	39.1%
Strengthening individuals', households' and livelihood enterprises' capacity for A&R	515,650	21.0%	89,734	32.9%
Regeneration of water commons	906,637	37.0%	43,381	15.9%
Regeneration of forest commons	477,844	19.5%	16,209	5.9%
Regeneration of land commons	501,548	20.5%	16,770	6.2%
Total	**2,451,079**	100.0%	**272,636**	100.0%

Source: Author.

news with this formulation is that a little over a third of the total investment required has to come from the government budget. This amounts to about INR 7.08 lakh crore or USD 84.4 billion over five years or an average of INR 1.41 lakh crore or USD 17 billion per year. In 2024–2025, the government had budgeted for a capital expenditure of INR 11.11 lakh crore. Thus, we are seeking less than 11% of the capital expenditure that the government already makes to be directed towards the urgent task of A&R. The better news is that about two-thirds of the investment for various purposes will come from private sources – household savings leveraged with bank loans, as well as philanthropy, CSR and carbon/climate finance. We discuss the different possible sources one by one.

4.5.2.1 Private Funding by Individuals and Communities

Due to the nationwide public education campaign on the adverse effects of climate changes on the health of individuals, their family members and on their livelihood, there will be far greater awareness and thus willingness to do something about it. Thus individuals, households and local communities will bear some share of the investment.

4.5.2.2 Financial Institution (FI)/Bank Finance

Of the total investment, bank credit expected is INR 2.91 lakh crore or USD 31.7 billion. The current level of net bank credit is about INR 290 lakh crore in Sep 2024, so we are asking about 1% of this to be directed towards environmental sustainability transition over five years. Once again, this is a reasonable demand, given the enormous payoff. The RBI has already announced some guidelines for voluntary initiatives in climate finance (RBI, 2022) and some MFIs, such as Pahal Financial Services, have started offering products for climate change adaptation.

4.5.2.3 Philanthropic Funding, CSR and Individual Giving

These are relatively modest sources of funds in terms of percentages, but they are very important in terms of involving a wide range of people and communities. Philanthropic funds usually also give access to a large number of other innovative approaches, while

Table 4.8 Sources of Funds for the Proposed Interventions

Sources of Funds (Crore INR in 2024 Prices, in Billion USD and as % of Total)

Interventions Proposed for Strengthening the Capacity for Adaptation and Resilience (A&R)	*Total Investment Cost (Crore INR in 2024 Prices)*	*Own Private Funding by Individual or Community*	*Bank/ FI Loans Taken by Private Individuals/ Entities*	*Philanthropic Foundations and CSR Funds*	*Individual Giving, Resource Sharing and Volunteering*	*Carbon/ Climate Finance*	*Climate Finance against AMSERs Annuities with Sovereign Guarantee*	*Balance from the Government Budget*	*This Intervention as % of Total Investment*	*Billion USD*
Strengthening the societal and institutional capacity for A&R efforts	49,400	2,470	-	4,940	9,880	494	-	31,616	**2.0%**	5.9
Strengthening individuals', households' and livelihood enterprises' capacity for A&R	515,650	103,130	103,130	25,783	51,565	25,783	10,313	195,947	**21.0%**	61.4
Regeneration of water commons	906,637	226,659	90,664	45,332	45,332	90,664	90,664	317,323	**37.0%**	107.9
Regeneration of forest commons	477,844	23,892	47,784	23,892	23,892	95,569	95,569	167,245	**19.5%**	56.9
Regeneration of land commons	501,548	100,310	50,155	25,077	25,077	50,155	50,155	200,619	**20.5%**	59.7
Total	2,451,079	**456,461**	**291,733**	**125,024**	**155,746**	**262,664**	**246,700**	**912,751**	**100.0%**	291.8
Billion USD	291.8	54.3	34.7	14.9	18.5	31.3	29.4	108.7		
Sources of Fund as % of Total										

(*Continued*)

Table 4.8 (Continued)

Sources of Funds (Crore INR in 2024 Prices, in Billion USD and as % of Total)

Interventions Proposed for Strengthening the Capacity for Adaptation and Resilience (A&R)	*Total Investment Cost (Crore INR in 2024 Prices)*	*Own Private Funding by Individual or Community*	*Bank/ FI Loans Taken by Private Individuals/ Entities*	*Philanthropic Foundations and CSR Funds*	*Individual Giving, Resource Sharing and Volunteering*	*Carbon/ Climate Finance*	*Climate Finance against AMSERs Annuities with Sovereign Guarantee*	*Balance from the Government Budget*	*This Intervention as % of Total Investment*	*Billion USD*
Strengthening the societal and institutional capacity for A&R efforts	49,400	5.0%	0.0%	10.0%	20.0%	1.0%	0.0%	64.0%	100.0%	
Strengthening individuals', households' and livelihood enterprises' capacity for A&R	515,650	20.0%	20.0%	5.0%	10.0%	5.0%	2.0%	38.0%	100.0%	
Regeneration of water commons	906,637	25.0%	10.0%	5.0%	5.0%	10.0%	10.0%	35.0%	100.0%	
Regeneration of forest commons	477,844	5.0%	10.0%	5.0%	5.0%	20.0%	20.0%	35.0%	100.0%	
Regeneration of land commons	501,548	20.0%	10.0%	5.0%	5.0%	10.0%	10.0%	40.0%	100.0%	
Total	**2,451,079**	**18.6%**	**11.9%**	**5.1%**	**6.4%**	**10.7%**	**10.1%**	**37.2%**	**100.0%**	

Source: Author.

CSR funds tend to establish systems for planning, budgeting and monitoring. Individual giving is at present largely directed towards religious purposes or medical relief or education of disadvantaged groups. The first of these can be moved partially from religious purposes to nature regeneration, with some creative communication, such as handing over saplings instead of *laddus* as *prasadam* in Hindu temples and asking devotees to plant and care for these as a religious duty.

4.5.2.4 Using AMSERs to Mobilise Climate Finance Upfront

As most of the A&R measures we have indicated are very micro – at the individual and household levels or at the level of small farms and micro-enterprises, each generating a ton or less of carbon sequestration/emission reduction credits a year – these will require to be aggregated, verified and then offered in the voluntary carbon markets. These aggregated microcredits from carbon sequestration or from GHG reductions or AMSERs could potentially generate INR 2.46 lakh crore or USD 29.4 billion a year after all the investments are made. This is about 10% of the total investment.

This can be used to finance the efforts towards A&R. One way is to sell these AMSERs annually, but a smarter way is to offer these as assured annuity payments and borrow funds against those. With a sovereign guarantee, it should be possible to raise ten times this amount upfront, which could be up to INR 24.6 lakh crore, or about USD 320 billion, thus fully financing the proposed interventions. As this is still at the level of an idea, in our sources of funds projections in Table 4.8, we have assumed a much more modest share of climate finance through this route.

4.6 Conclusion

This chapter began by drawing attention to the urgency of the need to respond to the adverse effects of climate change through mitigation, adaptation and by building resilience despite the shocks causing loss and damage. We noted that while efforts are being made globally to increase the funds for overall climate change action, the COP29 held in Baku in November 2024 led to an NCQG of USD 300 billion, much lower than the USD 1.3 trillion per annum demanded by the developing world.

We estimate the total investment needed for A&R efforts in India at INR 24.51 lakh crore or USD 292 billion over five years. It is very unlikely that this magnitude of funds will come from grant sources, whether international or domestic, and therefore would have to come from the government budget. Yet the task is urgent and essential. In pursuit of this, we recommend that financing for A&R should be based largely on raising funds from the global capital markets using AMSERs that can be earned by aggregating the micro A&R efforts of crores of individuals, households, small farms and micro-enterprises.

In order to raise funding in advance, credible projects can be drawn up, and the AMSERs should be pledged as annuity payments for the project financing. This would become even more feasible with sovereign guarantees from the government of India. This may have to be supplemented by grants from philanthropies, CSR and public funding. We have also suggested the use of insurance where possible to compensate for some of the loss and damage of adverse climate events.

Funding, however, has to be spent first on building a nationwide movement for A&R. Unless people are mobilised, the rest of the investment will largely revert to standard mitigation investments. In order to involve people widely in the efforts for A&R, we argued that people will get mobilised more easily when they perceive the threat to their health and livelihoods. For this, a large-scale public education campaign is called for on the adverse effects of climate change on people's health and livelihoods and what can be done to counter those. This campaign should be led by CSIs, working with local social groups and local self-governments. It must have wide community participation. Governments and corporations should provide all support but cannot lead this type of work.

The government can, however, provide incentives to individuals, households, farmers and micro-entrepreneurs to engage in behaviour that builds A&R. For example, fitness incentives can be given every quarter to secondary school youth who participate in five or ten Km runs or equivalent physical tests, which cannot be passed without regular practice. If youngsters below 18 years engage in physical exercise, chances are they will maintain the practice as they grow older. Adults and senior citizens who maintain an optimum body-mass ratio (BMR) may be given a discount on their health insurance premiums. BMR cannot be maintained without diet control and regular exercise, which builds resilience among individuals. In addition to monetary incentives, recognition by public figures and mainstream and social media mentions can be another incentive.

Households need to be incentivised to adapt to hotter weather by growing trees in their periphery, redoing their ventilation and white-painting their roofs. To adapt to water shortages, they need to do rooftop rainwater harvesting and create underground storage. RWA presidents and municipal councillors in whose areas a significant proportion of households adopt such practices should be publicly recognised by the state governments.

Farmers need to be encouraged to diversify beyond the water-guzzling crops like paddy and sugarcane to alternative crops such as 'coarse' but healthier cereals like jowar, bajra and ragi and pulses, oilseeds and even tree crops. So the government can offer remunerative minimum support prices for those. They should also be encouraged and financed to adopt soil and water conservation, dig farm ponds, do composting rather than burning crop residue and build greenhouses to manage weather irregularities.

Micro-entrepreneurs need to be incentivised and financed to switch to using renewable energy sources and to recycle as much of their waste material as possible so that they move from linear to circular production. For this, the approach of "waste of one enterprise is a useful input of another" must be encouraged to be adopted. For this, the government may give temporary price subsidies on the use of recycled rather than first-time-use raw materials.

Recently, the Kerala State Biodiversity Board, in collaboration with Kudumbasree, the world's largest women-led community network with over 4.5 million members in Kerala, is initiating a project to recognise and build capacity for women-led efforts in [nature] restoration, climate resilience and sustainable livelihoods.

Panchayats where a significant proportion of farmers adopt A&R practices should be publicly recognised and given additional developmental funds by state governments.

We are running out of time, and the consequences of inaction will be disastrous for the health and livelihoods of crores of people. We end with a call to action, with citizens taking the initiative. Governments, corporations and capital markets will respond sooner or later, but till then we, the people, must pull ourselves up by our bootstraps.

Notes

1 The spreadsheet is available on Google Drive at https://docs.google.com/spreadsheets/d/1-a3WFTCPG9QqqLlc2W6Gg9xSgZfUXRxA/edit?gid=386529408#gid=386529408
2 As this chapter is written for participation in the wider Indian public discourse, for numbers, we have used lakhs (hundred thousand) and crores (ten million). One million is ten lakhs, and one billion is one hundred crores. Miraculously, East meets West at a trillion, which is the same as one lakh crore.

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5 Alarm Calls Are Ringing Out

Yogesh Upadhyaya and Manish Agarwal

5.1 Risks from an Increasing Share of VRE in India's Energy Mix

Have you ever sat in a jungle in India just listening? One part of this great experience is following the alarm calls of animals – cries they raise when they have sensed a predator. The first call that you hear may be that of a barking deer, but then it is a particularly skittish animal, so this could be a false alarm. *Langurs* (monkeys) from high up in the trees can spot tigers from far, and theirs may be the next set of calls. Finally, there is the high-pitched call of spotted deer (*chital*), possibly the most reliable indicator of a tiger.

Something similar seems to be happening in the world of electricity. Alarm calls are coming in from all over the world about the risks of adding variable renewable electricity (VRE) plants to the grid. Can these be false alarms? After all, in a jungle, there are many false alarms much to the disappointment of safari tourists. However, the deer never ignore these alarm calls, as their lives depend on it. When it comes to the importance of reliability and low cost of electricity, we are deer rather than interested tourists. It would behove us to take these alarm calls seriously. We should not take a stand that solutions will emerge. The consequences of a high cost of electricity and unreliable grid are too disastrous to contemplate.

The loudest of alarms – the alarm from the spotted deer if you will – comes from the world of finance.

5.2 Financial Market Concerns about VRE Risk

There have been many voices in the financial world talking about the emerging risks from the addition of VRE plants to the grid. We have chosen three.

Recently, Standard & Poor's, the rating agency, came up with a report on the impact of VRE on the grid. The report is provocatively titled 'The Piper at the Gates of Dawn'. The report does not leave much room for ambiguity, with statements such as, "A Good Idea Taken [t]oo Far Becomes Indistinguishable [f]rom [a] Bad One" and "At the heart of the issue is that the generation that renewables are displacing is dispatchable, meaning it can be reliably called on to meet power demand when needed by the grid" (Prabhu et al., 2024, p. 5). They go on to state, "[O]ne could say that renewables have temporarily become destructively disruptive – they have displaced dispatchable baseload generation without the ability at the present time to supplant them" (p. 6). Standard & Poor's warns clearly that policymakers can choose only two of the three objectives of a grid: cheap, firm and clean (including low carbon).

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Joining Standard & Poor's is JPMorgan. In its energy policy paper, titled 'Electravision', JPMorgan says that "Looking ahead, the fiscal costs of the US energy bill could reach $900 bn by 2030 and $1.1 trillion by 2035" (Cembalest, 2024, p. 2).

Closer home, in India, the chief economic advisor (CEA) has called green bonds disappointing, commenting on only 1–2 bps (basis points) "Greenium" for green bonds. He admitted that "We need to accept that there are economic trade-offs in terms of doing energy transition versus securing energy availability for our country" (Sahu, 2024).

5.3 Sources of VRE Risk

We now explore why there is a trade-off when using VRE and why financial institutions are talking about large investments to support a high VRE grid. When VRE power plants are added to the grid, the overall cost of electricity goes up. This is because the nature of VRE generation necessitates a (thermal) capacity backup, and the resulting excess capacity poses a cost. Also, VRE requires a much higher investment in transmission and distribution as compared to thermal capacity. Finally, addition of VRE increases grid instability, necessitating another round of investments to make the grid stable.

These costs are not apparent when you look only at the levelized cost of electricity (LCOE) of VRE plants, which has fallen. LCOE is not the right metric anymore. In the words of Paul Joskow:

> Unfortunately, conventional "levelized cost" is a flawed metric for comparing the economic attractiveness of technologies such as wind and solar with conventional dispatchable generating technologies such as nuclear, coal, and gas-combined-cycle. It is flawed because it effectively treats all electricity generated as a homogeneous product governed by the law of one price.
>
> Joskow (2011, p. 239)

We have taken a system-wide approach to highlight the three contributors to cost increases that will accompany the increase in share of VRE capacity. We worry that these cost increases fall in our collective blind spot because they get socialised in pooled costs. We argue that as these costs translate to higher tariffs for industrial and commercial consumers, and in higher subsidy requirements, they further impede the job creation potential in the country. Finally, we surmise that financial investors know that higher system costs adversely impact the financial strength of distribution companies, making investments in power generation risky and green finance costlier.

We are not monists. That is, we don't believe that there is only one reason for an outcome in a complex system. For example, we do not believe that high VRE levels are the only reason for the high electricity costs in Germany and California. However, given the importance of cheap, reliable energy in development, we believe that it is not up to us to prove to the satisfaction of everyone that VRE makes electricity more expensive and the grid unstable. It is for the proponents of VRE to show that it does not. This is because cheap and reliable electricity is fundamental to development. If our electricity becomes even more expensive and unreliable than it is, it could kill the 'Make in India' programme and have a disastrous impact on job creation that India desperately needs. Expensive and unreliable electricity will also have serious fiscal and political consequences.

5.3.1 Excess Capacity to Ensure Reliable Electricity Supply

Perhaps no country has done as much to add renewable energy capacity as Germany. The share of renewables in electricity generation in Germany had gone up to nearly 40% in 2023 (Appuun et al., 2024). However, the thermal capacity in Germany, in absolute terms, has not gone down (see Figure 5.1), and the country still needs to build and maintain its thermal power plants.

In the meanwhile, electricity prices in Germany continue to be the highest among major EU countries (see Figures 5.2a and 5.2b).

Similarly, California, which is known to be at the forefront of combating climate change, has one of the highest electricity tariffs in the United States (Eurostat: Electric Power Monthly, 2024). As an aside, in many states in the United States, the industrial tariff is of the order of 0.06–0.08 \$/kwh, which is about 25–50% lower than what Indian industries pay.

5.3.1.1 Alternatives to Thermal Energy Backup

There is a belief that excess thermal capacity would not be needed once inexpensive storage is available. However, one has to note that most of the storage being talked about is to smooth over daily variations in generation arising from intermittency such as that coming from clouds. At best, this storage is to allow for the quick daily ramp-up needed because of the duck curve.[1]

Dealing with seasonal variation will require very different quantities of storage, with significantly higher implication for area requirement and costs. Solar generation varies by day and by seasons (due to tilt in the earth's axis). In India, it also has a severe

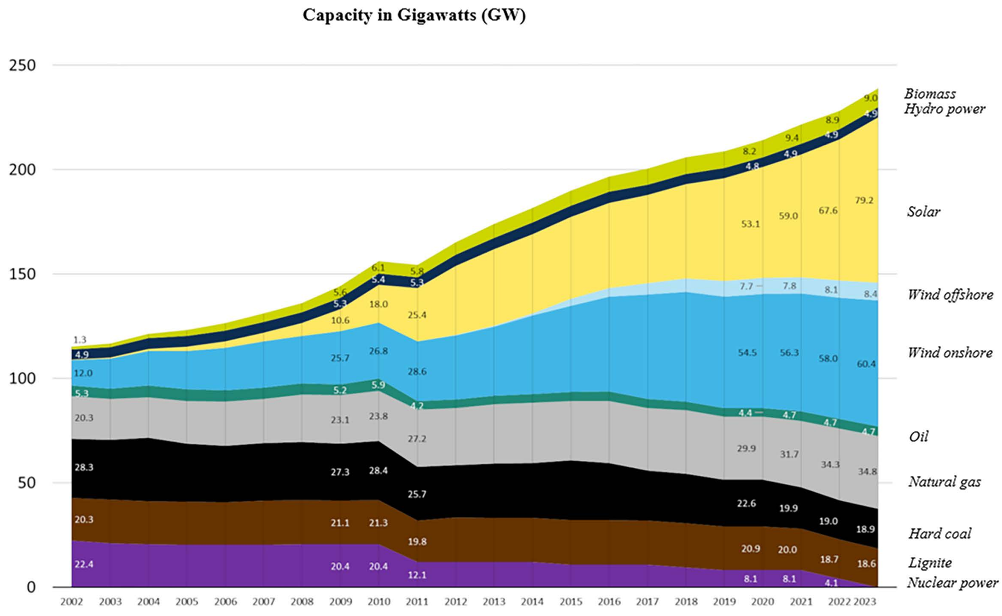

Figure 5.1 Germany's Power Generation Capacity over the Years

Source: Extracted by authors from Appuun et al. (2024).

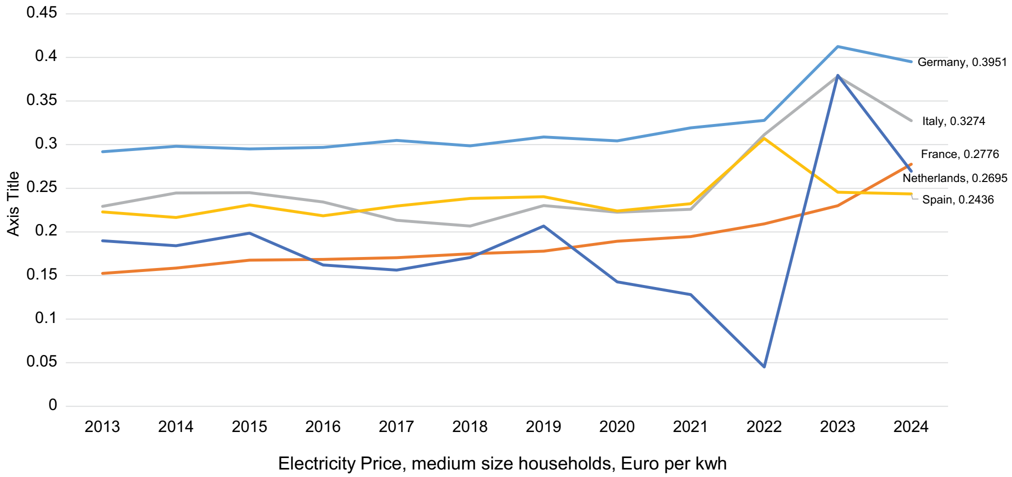

Figure 5.2a Household Electricity Prices in Major EU Countries

Source: Chart prepared by authors from Eurostat data; electricity prices by type of user.

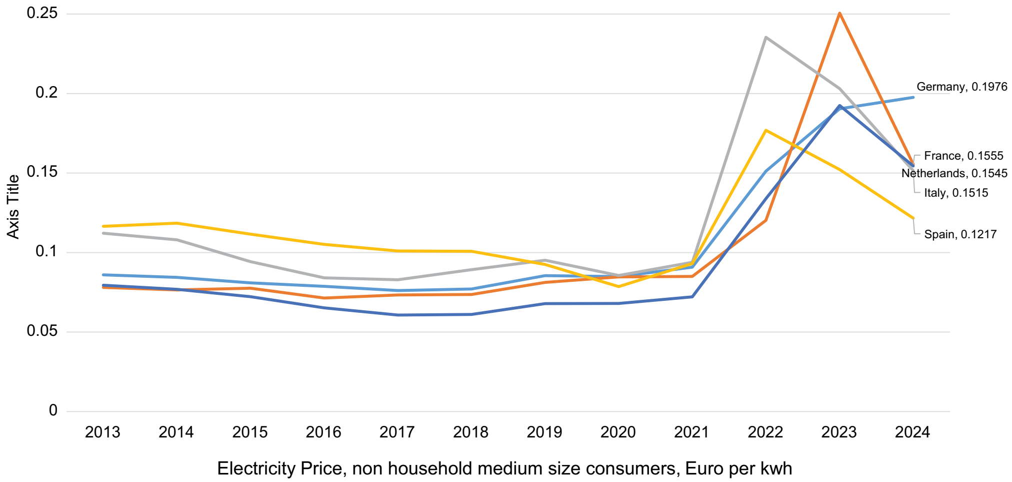

Figure 5.2b Non-household Electricity Prices in Major EU Countries

Source: Chart prepared by authors from Eurostat data; electricity prices by type of user.

drop due to the monsoons. The Central Electricity Authority (CEA) publishes the daily solar and wind generation for each month, and a look at the reports for May 2023 and July 2023 shows that the maximum solar generation in July was just slightly more than the minimum of May (see Table 5.1).

More importantly, over a two-month period, the generation nearly halved from 350 MU on 10 May 2023 to 182 MU on 27 July 2023. As is the case with such data, if we look at hourly variance and regional figures, we will find that the variance is even greater. This imposes reliability costs on the grid.

Table 5.1 Seasonal Variation in Solar Generation

Month	*Maximum Generation Date*	*Maximum Generation*	*Minimum Generation Date*	*Minimum Generation*
May 2023	10 May 10 2023	350 MU	2 May 2 2023	286 MU
July 2023	2 July 2 2023	297 MU	27 July 2023	182 MU

Source: CEA Daily Renewable Generation Report, May and July 2023.

Table 5.2 Seasonal Variation in Wind Generation

Month	*Maximum Generation Date*	*Maximum Generation*	*Minimum Generation Date*	*Minimum Generation*
May 2024	28 May 2024	619 MU	12 May 2024	105 MU

Source: CEA Daily Renewable Generation Report, May 2023.

The cost imposed by wind generation is higher. Table 5.2 presents generation data for wind for May 2024, and as is evident, within a period of two weeks, the generation increased sixfold. It is very difficult, therefore, for a grid to rely on wind power plants.

The variation in wind generation is so much that a recent discussion paper by CEA states (CEA, 2024a, p. 21): “The generation of VRE sources in India, particularly wind, is subject to significant fluctuations and cannot be accurately forecasted. (sic)”

The international experience corroborates the unreliability of wind.

> In March 2021, Great Britain (GB) experienced one of the longest cold calm spells in over a decade; the national wind farm fleet operated at 11% of its rated capacity for eleven consecutive days during a period where low temperatures drove up heating and electricity demand.
>
> Potisomporn et al. (2024, p. 1)

Given the current technological configuration, the challenges with building long-term storage are related to the capital intensity and ratcheting costs with increasing duration for storage, as illustrated in Figure 5.3.

5.3.2 Higher Transmission Investments

Transmission investments in VRE are higher than for conventional power plants primarily because the plant load factors (a measure of the plant’s capacity utilisation) of VRE plants are lower. Most of the time, they are less than 20%, which is less than a fourth of the availability of a thermal plant’s capacity. This means that the transmission investments dedicated to a VRE plant are spread over a fourth of the number of units as compared to that of a conventional power plant. This makes the per-unit cost of transmission much higher.

The Central Electricity Authority (CEA), under the Ministry of Power, estimated that the amount of investment needed to support the renewable energy capacity being created in the country would be INR 2,44,200 crores (CEA, December 2022). This is, of course,

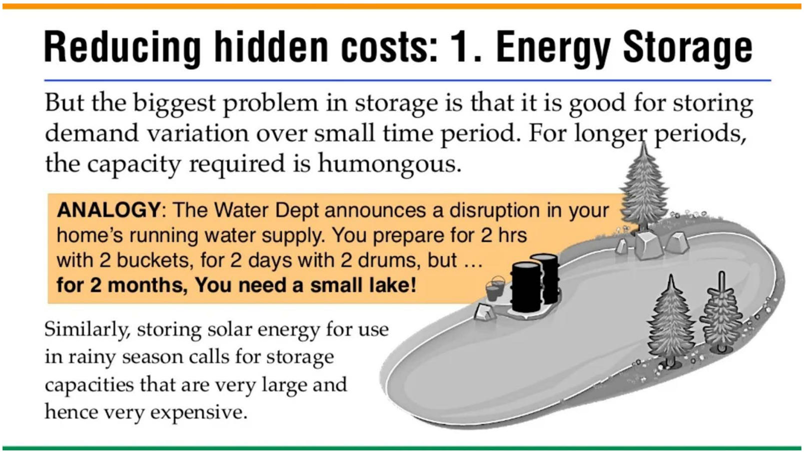

Figure 5.3 An Analogy to Appreciate the Challenge of Long-Duration Electricity Storage

Source: "Is RE ready for prime time?", AskHow India.

tentative, and in our estimate, it is likely to increase, perhaps significantly, when the projects are actually executed.

In the United States, the Department of Energy released a report which looks at various studies which estimate the additional investment needed in transmission. The sums needed are huge. For example, in California alone, some authors contend that more than $30 billion of investment would be needed (US DOE: National Transmissions Need Study, 2023, p. 7).

5.3.3 Investments to Address Grid Instability

It is becoming increasingly indisputable that the addition of VRE generators causes the grid to become more unstable. In February 2024, MISO, an 'independent, not-for-profit, member-based organisation responsible for keeping the power flowing' across 15fifteen US states and the Manitoba province in Canada, came out with a report which began with "We have to face some hard realities. There are immediate and serious challenges to the reliability of our region's electric grid" (MISO regional reliability imperative, 2024, p. 1). Further, the cause of this instability is described: "the transition that is underway to get to a decarbonised end state is posing material, adverse challenges to electric reliability" (p. 1) and

> [a] key risk is that many existing "dispatchable" resources that can be turned on and off and adjusted as needed are being replaced with weather-dependent resources such as wind and solar that have materially different characteristics and capabilities. While wind and solar produce needed clean energy, they lack certain key reliability attributes that are needed to keep the grid reliable every hour of the year. Although several emerging technologies may someday change that calculus, they are not yet proven at grid scale. Meanwhile, efforts to build new dispatchable resources face headwinds from government regulations and policies, as well as prevailing investment criteria for financing new energy projects.
>
> (p. 1)

The CEA states:

> In a grid connected SPV system there are two challenges related to power quality (PQ) – one is at source end like power factor, reactive power compensation, harmonics and voltage regulations and the other is handling the PQ issues arising out of the nonlinear loads on this PV system which can generate sag swells and switching transients in the network. In general, these power quality issues decrease the efficiency and longevity of the Distribution Transformers, Voltage regulators, capacitors and machines etc, hence becomes more pertinent to address.
>
> (CEA, 2018, p. 1)

CEA (2024b), in its discussion paper on capacity credit of generation resources, states:

> While the cost of solar and wind energy has decreased significantly over the years, there are still economic challenges associated with VRE deployment. These include upfront capital costs for infrastructure, intermittency-related costs (e.g., backup generation or energy storage), and the need for supportive policies and incentives to drive investment in renewable energy projects.
>
> (CEA, 2024b, p. 4)

And

> . . . the determination of capacity credit for VRE sources is a challenge for system planners. This becomes a major issue as more and more VRE capacity is added to the portfolio and a reliable supply of power becomes a challenge during RE Disturbances Demand variation etc.
>
> (p. 18)

There are numerous reports in the media suggesting that these power quality issues have led to our grid becoming more unstable (Shetty, 2023, for example). In any case, any solution that is implemented would further increase the system costs. Given the "popularity" of VRE at present, it is likely that the power quality concerns being raised are understated rather than overstated.

5.4 India's VRE Risk in a Comparative Context

It is important to recognise in this context that India is different from the rest of the world in a way that makes the risks arising from VRE worse for India. The reasons for these could be classified into three categories: namely, buffer capacities, relative unavailability of natural gas and extant high cost of power. We discuss each of them separately.

5.4.1 Buffer Capacities

Germany and the United States started adding significant quantities of VRE to the grid, when not only was their electricity demand stable – i.e. growing much slower than in India – but they also had surplus electricity supply. Years of focus on grid reliability meant that there was significant conventional capacity in excess of peak demand.

In contrast, the demand in India is increasing sharply. The country finished electrifying all its villages just a few years ago. Additionally, India is electrifying more and more parts of its economy. For example, the Indian railways has been 94% electrified (ref "About 94% of Total Broad Gauge Network of the Indian Railways Electrified", Ministry of Railways press release). Increasingly, citizens of the country expect 24/7 reliable and affordable electricity. Perhaps most importantly, there is a significant increase in electricity demand from industries. In addition, India has suffered perennially from a supply shortfall with 'load shedding' a common phenomenon leading to private provision for power, which in turn leads to higher power costs.

An increasing demand with limited or no buffer capacity scenario is fundamentally different from what is prevailing in the West with its surplus capacity. This scenario implies that the possibility of grid instability, even at a lower proportion of VRE generation capacity is high. This is evident in the MISO report: "Incremental load growth: While electricity demand has been flat for many years, it is expected to increase due to the electrification of other sectors of the economy" (MISO, 2024, p. 1) and

> Load additions: Some parts of the MISO region are enjoying a resurgence in manufacturing and/or other types of economic growth, with companies planning and building new factories, data centers and other energy-intensive facilities. While such development is welcome from an economic perspective, it can also pose significant reliability risks if the load additions it spurs cannot be reliably served with existing or planned resources.
>
> (p. 2)

Another important implication of the absence of buffer capacity in India is that the country would need to put up new thermal capacity to back up VRE, which necessarily will not be fully utilised, making it costlier and, thereby, increase electricity costs sharply.

5.4.2 *Natural Gas Availability*

Another reason for lower grid stability risk in the United States is that a very large generation capacity in that country is natural gas based. Natural gas plants can ramp up and down very fast, which is required to match the variability of sun and wind power plants. The so-called Shale Revolution in the United States has helped it greatly in this respect, as it enjoyed very low gas prices. The generation from natural gas–based plants increased from 382 billion kwh in 1991 to 1,579 billion kwh. The generation from coal-based plants fell from 1,591 billion kwh to 898 billion kwh in the same period. Incidentally, the increase in renewables has only been from 358 billion kwh to 815 billion kwh (EIA, n.d.)

This is not so in India, where gas is expensive, as it is mostly imported. The imported LNG prices are much higher than gas prices in the United States.

This very high difference in the price of gas means that India prefers to keep natural gas–based power plants working way below capacity rather than run them on imported LNG.

5.4.3 *High Electricity Prices for Industry*

The third big difference between India and the West is its focus on manufacturing, especially for employment generation. Most employment in the country comes from agriculture and low-value-added services (Economic Survey 2023–2024, p. 274). The Directorate General of Employment lists many schemes that would help in employment, including the ‘Make in India’ and productions-linked incentives, which are manufacturing intensive. Since margins in manufacturing are low, the cost of electricity is an important factor for firms engaged in such activities.

It is important to remember in this context that the virtuous reinforcing loop of ‘energy use – productivity increase – income growth’, fuelled by cheap energy, has been key to the economic development of rich countries. In India, the effectiveness of this loop has been dampened by high electricity prices for industrial and commercial users and high subsidy burden on the government trying to keep domestic and agriculture tariffs low.

Figure 5.4 shows the cause-effect chains that help to understand the system of subsidies and cross-subsidies inherent in the electricity supply in India. India’s demand for electricity is growing (for various factors that have not been shown in the figure). The demand growth has caused capacity increase, which (along with other factors) has led to cost increase. This cost increase is allocated differentially to industrial and commercial consumers on one hand and agricultural and residential consumers on the other. The industrial and commercial consumers are charged a higher tariff than cost so as to keep the tariff for agricultural and residential consumers below cost (cross-subsidy). Further, the state government often requires agricultural or residential tariff to be reduced further and promises to pay the difference to the distribution company (subsidy). The higher-than-possible tariff for industrial and commercial consumers is one of the factors (among others) that causes businesses to be less competitive, leading to the creation of fewer jobs than would have been possible if tariffs reflected costs. Electricity sector

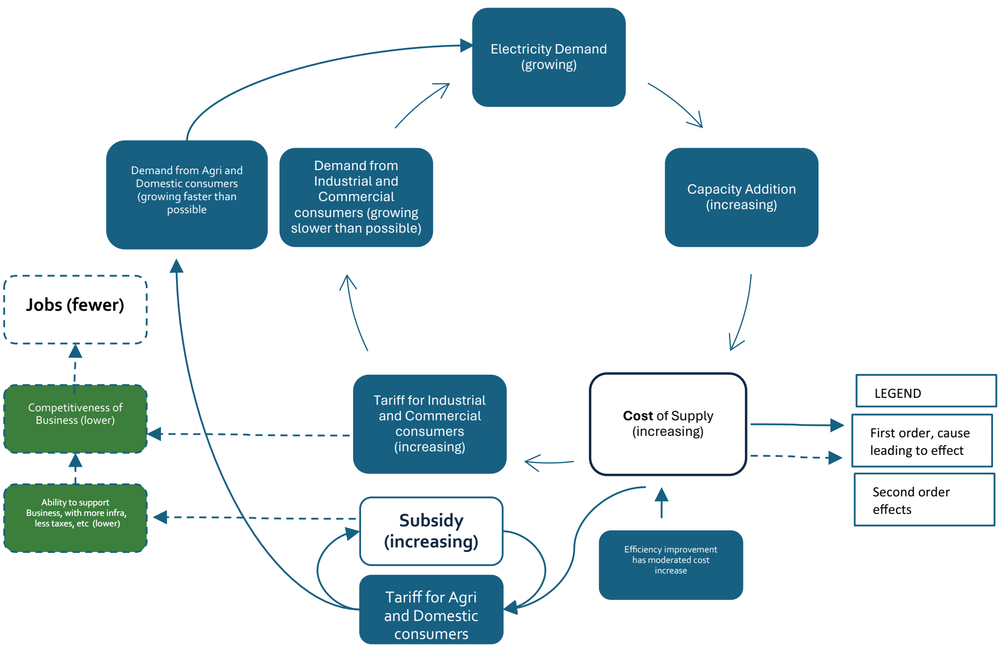

Figure 5.4 Cause-Effect Chains for the System of Subsidies and Cross-Subsidies in Electricity Supply in India

Source: Authors.

subsidies also leave less funds with the state government for being able to support the business environment. The diagram also shows that the cost increase has been moderated due to the significant efficiency improvements in the system (particularly in distribution) over the last two decades; however, the scope of further improvement is limited. The system of cross-subsidies and subsidies is so firmly ingrained in the system that even legislation has not been able to make a significant change.

5.5 Summary and Discussion

In this chapter, we have discussed that the financial world is now engaging with the risks arising from addition of VRE capacity to the grid. The risks arise because VRE cannot be relied upon, and it requires backup of additional thermal capacity that is not fully utilised. This makes the system costs high, which is not captured in measures such as LCOE. The system costs also go up because the transmission costs associated with VRE are more than four times the costs associated with conventional plants. Finally, the technical characteristics of VRE electricity mean that more investments need to be made for grid stability. We also showed that the storage today does not address reliability needs, especially for seasonal variability. The financial world is recognising the risks.

Policymakers should be concerned beyond the issue that VRE plants may not get the targeted levels of financing. Financing has dried up for thermal generation because of climate change–related concerns. This would further reduce reliability and increase outages. Combined with high electricity tariffs, this would then impact the competitiveness of businesses and job creation. India cannot afford this.

Figure 5.5 shows the cause-effect chains that are playing out at present in India as it adds VRE capacity. As investors have preferred VRE investments and shunned thermal

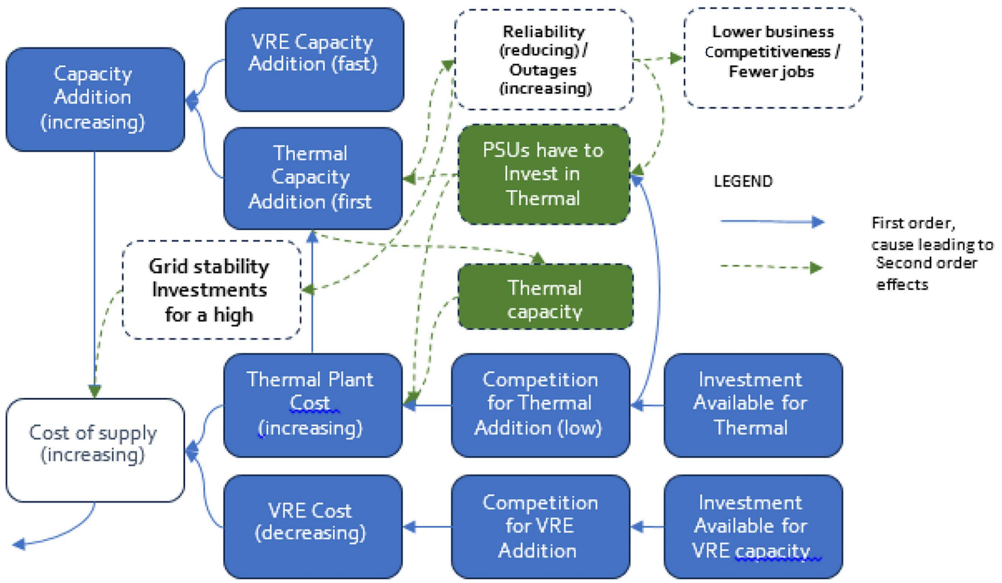

Figure 5.5 The System Costs of VRE Will Aggravate Cost-Tariff-Subsidy Balance Further

Source: Authors.

investments, it has caused more competition for VRE projects. This has increased demand and innovation, driving VRE costs down, leading to more demand. Thus, while VRE capacity addition has been growing fast, thermal capacity addition has significantly slowed down. However, as the share of VRE capacity in the grid has increased rapidly, it has led to concerns about reliability and outages. (VRE plants do not supply on demand, and storage capacity is still low and expensive, particularly for longer durations.) The government has hence asked its PSUs to rapidly add thermal capacity and privatised coalmines to scale up domestic coal production. Hence, thermal power capacity addition, which initially slowed down, will accelerate again.

Considering the intermittent nature of VRE and its must-run status, thermal plants will need to be on standby, to pick up load whenever VRE (and VRE + storage) generation reduces. This will lead to lower utilisation of thermal plants, leading to higher per-unit cost. Also, coal plants are not well suited for such a role and will incur cost (for building in such flexibility and for operating outside their optimal loading range). High share of VRE will also lead to higher transmission cost. One, due to lower utilisation of transmission lines that primarily transmit power from VRE projects. Two, due to investments to be made in the grid to ensure resilience, which VRE and storage are not able to provide.

The above three factors will lead to increase in the cost of supply. In other countries, this has reflected in higher electricity tariffs for businesses and households. We are not aware of any study which shows that reduction in the cost of VRE will override this increase in system costs. The effects of higher cost of supply are shown in Figure 5.4.

Unless one accounts for these concerns, the response to added VRE capacity will further add to the costs of power through two channels. First, PSUs may have to add thermal generation capacity, but the capacity utilisation would be lower, as some of them would be required to operate as standby to VRE. Second, significant investments in managing a high VRE grid (which will also crowd out other transmission investments, given the limited financial leverage of transmission cash flows) are required.

5.6 Implications

We believe that investors can see this system behaviour – i.e. more VRE will translate to high electricity costs (as has happened in other parts of the world). This will further impact the weak financial strength of distribution companies (discoms), thereby increasing risks for all private investments, including in VRE. We believe this is one of the key reasons why the greenium on RE investments is immaterially small.

Furthermore, this is an intergenerational issue – i.e. whether the current generation should slow down its economic growth (with high electricity costs), for a possibly better future. The academic answer to this trade-off may be easy, but in a democracy, this is decided by the people through the politicians they select. While we live in the hope that large-scale storage becomes affordable and reduces the intensity of the trade-off, Indian policy is riding in two boats (encouraging VRE and thermal capacity addition). In the process, adaptation is getting neither the policy attention it deserves nor investments.

The alarm calls can be heard from all around. If it is a false alarm, an assessment of the system costs for the target level of VRE and reliability could show it to be so. Various reports on the reliability requirements for high VRE do not estimate the corresponding impact on the cost of supply or tariffs. The religious fervour of energy transition is perhaps preventing an honest assessment of the economic cost of the current policy path.

The financiers will price in the risk. The consumers and citizens will face the trade-off of lesser funding for competing development requirements, including adaptation.

Note

1 The duck curve shows the difference between electricity demand and solar energy generation over the course of a day. The curve is named after its resemblance to a duck, with a flat belly during the day and a long neck representing the steep upward slope in the evening. It represents the potential for power system instability, as the grid attempts to cope with extreme changes in demand across different parts of the day.

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6 How to ‘Reform, Target and Shift’ Domestic Public Finance Effectively

Lessons from Energy Financing in India

Swasti Raizada and Deepak Sharma

6.1 Background

Climate finance directed at mitigation and adaptation efforts come from both international and domestic sources and can be public or private. Broadly, international sources of climate finance include multilateral and bilateral aid, foreign direct investment, multinational corporations and philanthropy, while domestic sources are a mix of government budgets, extra-budgetary resources[1] and private actors in the country. In India, public finance contributes to around half (48%) of all known[2] climate finance, of which nearly 84% comes from domestic sources (government budgets at the national and subnational level and extra-budgetary resources), and the remaining 16% comes from international public climate finance (Khanna et al., 2022). Adaptation efforts are almost completely funded by public finance.

Domestic public finance is thus one of the most critical sources of mobilising climate finance in India and can have an important multiplier effect on real economy actors. For state governments and local governments in India, its importance is expected to be even higher, especially when it comes to financing adaptation efforts.

This chapter will delve into real-world examples from mitigation efforts, specifically in the energy sector, to highlight how a calibrated approach of ‘reform, target and shift’ (see Box 6.1) can further unlock domestic public finance for climate action (Zinecker et al., 2018). Through this, we aim to provide a theoretical framework for designing financial reforms towards climate-positive policy interventions. The framework can be especially relevant for state governments and local governments in India looking for economic diversification pathways away from carbon-intensive sectors. However, division of tax resources between the centre and the state remain in a state of flux, with unresolved issues, particularly after the rollout of the goods and services tax (GST) and the COVID-19 pandemic. This may constrain states more than the centre.

To foreground our analysis, we explore the evolving nature of fiscal federalism in the era of climate change by using specific examples of policy experiments undertaken at the national level, their impact on select states and similar interventions designed by states of India. The lessons and challenges drawn from these examples can provide critical insights to policymakers and the XVI Finance Commission (FC) to design fiscal shifts away from carbon-intensive sectors towards local climate action. These learnings are also useful for informing the climate finance architecture in India, which is often spread across ministries and departments at the union, state and local levels.

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6.2 The Importance of Domestic Public Finance for Climate Action

In common parlance, domestic public finance is often understood as tax and nontax revenues and their budgetary allocations. Budgetary allocations are made by governments through budgets in the form of direct subsidies such as cash transfers and capital grants that are visible and easier to track. However, governments across the world, especially in emerging economies such as India, also channelise domestic public finance indirectly through extra-budgetary resources to state actors such as public sector undertakings (state-owned enterprises) and public financial institutions. For this, governments make use of instruments such as concessional loans, guarantees, credit enhancements and policy directives, to name a few. Therefore, the investment decisions of these state actors are also influenced by domestic public finance and consequently determine the scale of climate action.

Further, governments also provide support through less researched mechanisms such as tax exemptions and underpricing of government-owned goods and services that are often harder to quantify and track (Garg et al., 2017). These may, in turn, have an adverse impact on the ability of countries to mobilise domestic resources for climate action. For example, countries that provide tax exemptions to carbon-intensive sectors such as fossil fuels may find it difficult to raise and mobilise domestic public finance for climate action due to historical lock-ins (Corkal & Gass, 2019; Damania et al., 2023).

Box 6.1 The 'Reform, Target and Shift' Approach

The 'reform, target and shift' approach is a pragmatic solution to direct domestic public finance towards climate-positive solutions in an equitable and socially responsible manner. It addresses the fundamental question of 'how to pay for transitions' for governments and 'what to (not) fund' in the context of climate change. It involves carefully calibrating the act of gradually withdrawing domestic public finance from carbon-intensive sectors, designing targeted welfare measures for those negatively affected and reallocating resources to climate-positive solutions. The 'reform, target and shift' approach can be designed and implemented both at a sectoral level such as the energy transition or can be used at an economy-wide level.

Policy Intervention	*Description*
Reform	Identify and phase out government support for carbon-intensive sectors (such as fossil fuel subsidies) through detailed reviews.
Target	Target necessary support aimed towards increasing access and reducing living cost effectively to those who really need them.
Shift	Earmark support to climate-positive solutions (such as clean energy) to fund transitions in an equitable and socially responsible manner.

6.3 Lessons from Energy Sector Reforms in India

India's energy sector, which includes the consumption of fossil fuels in the country and their associated fugitive emissions (from transport to power sector), contributed nearly 76% of the total greenhouse gas (GHG) emissions (excluding LULUCF) in 2019 and is the main GHG emitting sector in the country (Ministry of Environment, Forest and Climate Change, 2023). An important policy lever available to governments to reduce GHG emissions from the sector is to reform domestic public financial flows to fossil fuels in a socially responsible manner.

This section presents lessons from the application of the 'reform, target and shift' approach in India's energy sector over the last decade. These sectoral learnings can help inform the future of climate finance in India.

6.3.1 Fossil Fuel Subsidy and Taxation Reform

Fossil fuel subsidy and taxation reform carried out by the union government from 2010 to 2017 indirectly helped mobilise domestic public finance needed to support clean energy. Between 2010 and 2014, the union government brought in reforms to gradually 'reform' the fiscal subsidy ('under recoveries') on petrol and diesel and carried out incremental tax increases (between 2010 and 2017) while carefully evaluating its impact on retail fuel prices. Through this, India was able to create the fiscal space to provide government support to renewable energy, electric vehicles and schemes to strengthen the electricity infrastructure in subsequent years (see Figure 6.1). The additional tax revenues from gradual excise duty increases on petrol and diesel between 2014 and 2017 – a period of

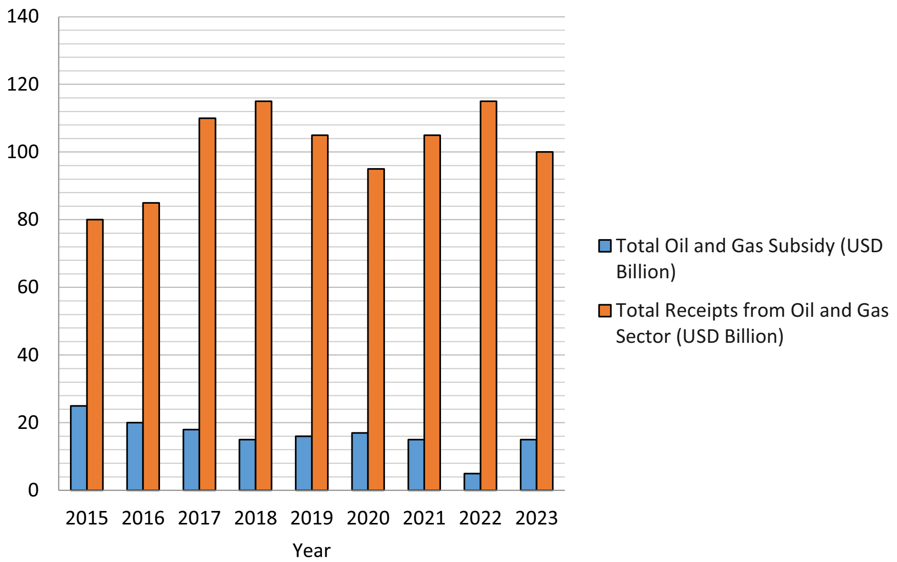


Figure 6.1 Impact of Petroleum Subsidy and Tax Reforms on Public Budget for the Government of India (Billion USD)

Source: Raizada et al. (2024); redrawn by the authors.

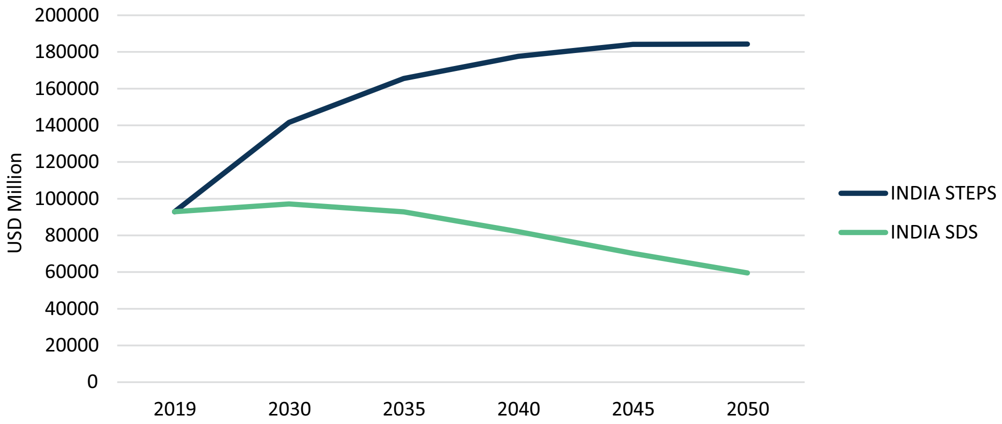


Figure 6.2 Scenarios for Government Revenue from Fossil Fuel Products, 2019–2050

Source: Aggarwal et al. (2022); redrawn by the authors.

low international crude oil prices – also helped create the fiscal space to improve energy access and 'target' subsidies for cleaner cooking alternatives. Through this, the government also been able to expand LPG coverage for the rural poor under the Pradhan Mantri Ujjwala Scheme (PMUY), although the targeting measures were not bereft of errors (Laan et al., 2018). These reforms when implemented, provide important policy signals for the choice of energy technology that governments support.

Over the last decade, these measures have helped mobilise domestic public finance necessary for supporting the energy transition. Oil and gas now contribute a large share of government revenue, at nearly 20% for the centre and 10% for states and UTs (Aggarwal et al., 2022). Studies suggest that oil and gas revenues will grow in the short term, largely due to anticipated growth in oil product prices and consumption. Even in scenarios (see Figure 6.2) with accelerated clean energy transition, an additional INR 30,000 340,000 crore (USD 4–48 billion) could be mobilised by 2030, compared to 2019, depending upon whether the world and India continue under current policy settings (the IEA's stated policy scenario: STEPS) or adopt more ambitious climate policies (sustainable development scenario: SDS) (Aggarwal et al., 2022).

6.3.2 Earmarking of Fossil Fuel Revenues to Enable Effective Fiscal 'Shifts'

Earmarking of fossil fuel revenues will be critical over the next decade to enable effective fiscal 'shifts' towards climate-positive solutions for both the centre and states in India. Besides the 'reform' and 'target' approach in the oil and gas sector, the government also introduced an important 'shift' instrument between 2010 and 2017 in the form of a cess (tax) on coal production and imports. Around 30% of the cess collections were channelled to a National Clean Energy and Environment Fund that supported clean energy and environment projects. At about USD 4.8 per tonne of coal produced or imported, the cess bolstered the budget of the Ministry of New and Renewable Energy by more than 50% between 2013 and 2017 and provided the initial funds for India's Green Energy Corridor scheme and the National Solar Mission, which helped bring down the cost of utility-scale solar energy and fund many off-grid renewable energy solutions. Besides this, the cess collections also supported the Ministry of Environment, Forests and Climate Change through increased budgetary allocation (Srinivasan et al., 2023). However, after 2017, with the introduction of the goods and services tax (GST) in India, the coal cess was fully subsumed within the GST compensation cess, on account of governance issues and the need to compensate states for revenue losses associated with the new tax regime (Garg et al., 2020).

Therefore, while there had been gains from the 'shift', the reform process remained incomplete. Between 2017 and 2022, the GST compensation cess (which subsumed the coal cess) was used to fill state budgetary deficits and fund regional development needs rather than clean energy initiatives. The introduction of GST followed by the pandemic thus redirected proceeds from one of the most significant albeit implicit carbon taxes in India back to the category of general expenditure.

The compensation cess regime expired in June 2022, but the cess has been allowed to continue till March 2026 to repay the interest and principal of the INR 2.7 lakh crore back-to-back loan secured by the centre during COVID-19 to meet a part of the shortfall in cess collection (Press Trust of India, 2023). It is important to highlight here that the coal cess alone contributed around INR 46,909 crore (USD 5.8 billion) in FY 2023, which is equivalent to nearly 77% of the finance raised through sovereign green bond issuances in the year (Raizada et al., 2024).

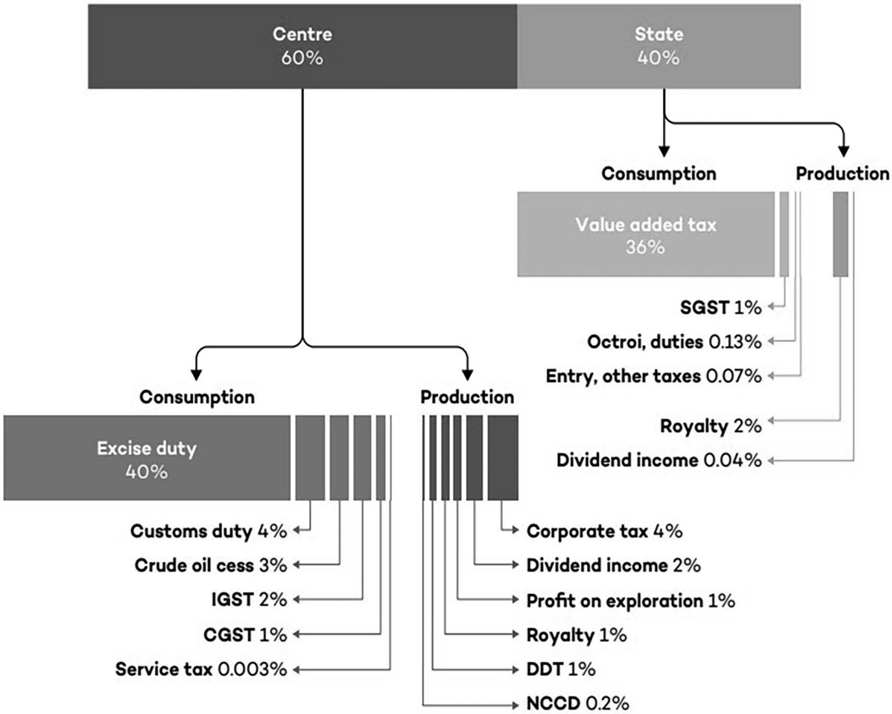
Designing 'shifts', while important, can thus be hard to implement since they are often diverted for general expenditure by governments during fiscal stress. As an emerging economy with a narrow tax base, India is no exception to this. But this example (see Box 6.2) shows that when designed, earmarked and implemented properly, 'shifts' can lead to responsibly shifting domestic public finance towards climate-positive solutions. For scaling climate finance, hypothecation or ring fencing – the earmarking of specific tax revenues for designated expenditures – is thus critical for policy continuity and to prevent policy reversals in the future. It is noteworthy that, overall, between 2014 and 2023, fossil fuel subsidy reforms alongside taxation measures have helped India create the fiscal space to increase electrification and transition to clean energy, subsidies for which grew by around two and a half times and four times, respectively (Raizada et al., 2024).

Box 6.2 Lessons for State Governments

State governments in India can make use of several tax measures under their direct control such as VAT on diesel and petrol for designing similar 'shifts' through earmarking. State-level VAT made up nearly 36% of all oil and gas revenues in 2020 (Aggarwal et al., 2022).

One key strategy could be to leverage the increased VAT collections from diesel and petrol sales, especially during periods of softening crude oil prices to fund state-level incentives for electric vehicles (EVs). By providing capital subsidies for electric vehicles on top of national incentives, states can significantly boost EV adoption and expedite the decarbonisation of the transportation sector.

Central and State Oil and Gas Revenues, FY 2020 (as a % of Total Oil and Gas Revenues)



Source: Authors.

6.3.3 Potential for Increased Centre-State Fiscal Disputes

Rising climate finance needs and limited jurisdiction to tax carbon-intensive sectors at the state level could potentially lead to increased centre-state fiscal disputes. Designing fiscal 'shifts' away from carbon-intensive sectors also requires a careful assessment of India's fiscal architecture and needs to be embedded within the evolving centre-state relationships in India. Rising climate finance needs at the state level are leading to new complexities in environmental taxation due to India's narrow tax base, at times leading to centre-state disputes.

One such example is the Green Cess Act of Gujarat, enacted in 2011, that imposed a green cess of INR 0.02 per unit on electricity generated from conventional sources, including both public and private enterprises, as well as industries with captive power generation. The primary purpose of this cess was to fund renewable energy projects and environmental protection initiatives within the state. However, the Gujarat High Court ruled the act unconstitutional in March 2023, arguing that electricity generation is a subject under the union's jurisdiction, thus beyond the state's legislative competence. Major industrial players challenged the act, contending that the state government lacked authority to levy such a tax. In response to the legal challenge, the Supreme Court stayed the high court's judgement and admitted the state's plea to levy the cess but directed that the collection of dues be suspended until the appeal is resolved.

Given the fiscal constraints, state governments are also increasingly introducing tax exemptions rather than direct subsidies to support climate mitigation efforts, particularly in the realm of clean energy. For instance, to facilitate the development of renewable energy projects, some states have exempted stamp duty on the purchase or lease of land, along with land conversion and registration charges (Sharma & Shahi, 2024). Moreover, several states provided exemptions on electricity duty for open access and captive renewable energy (RE) and energy storage projects early on. Select states also exempted cross-subsidy surcharge for green open access consumers to further incentivise commercial and industrial consumers to switch to greener energy sources. Some states also waived wheeling charges for renewable energy, enhancing the economic viability of transporting clean energy across regions. However, studies show that since the centre notified the electricity (Promoting Renewable Energy through Green Energy Open Access) rules, 2022, states have been reluctant to draft implementation policies (Konda, 2023).

6.3.4 Principles of Fiscal Federalism

India's prospective planning and 'shifts' for climate finance should be based on principles of fiscal federalism. The FC has played a critical role in determining the flow of India's intergovernmental fiscal transfers. Over the last decade, India's FCs have adopted innovative fiscal mechanisms to embed the lens of sustainability in intergovernmental fiscal transfers. Recent FCs have been including forestry, disaster management, water sector management and clean energy variables in their decision framework for state grants and are important developments in India's nascent climate federalism.

From 1 April 2010 to 31 March 2014, for the first time, the XIII FC recommended an incentive grant of INR 5,000 crore for grid-connected renewable energy based on the states' achievement in renewable energy capacity addition (Thirteenth Finance Commission, 2009). Out of this, INR 4,992 crore was finally disbursed to the states (Datt et al., 2019), the distribution of which is illustrated in Figure 6.3.

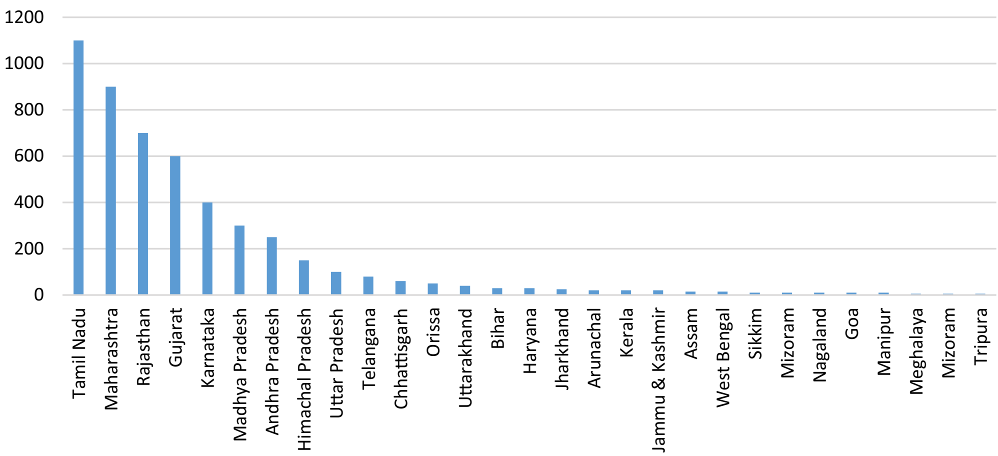


Figure 6.3 XIII FC Grant for Renewable Energy: Actual Release (Crore INR)

Source: Datt et al. (2019); redrawn by the authors.

The grant allocated for the renewable energy was performance based; therefore, no state-wise allocation was done upfront by the XIII FC. There were two subcomponents to the incentive:

- Achievement in installed capacity addition relative to unachieved potential, with a weightage of 25% to account for the uneven distribution of renewable energy potential.
- Achievement in installed capacity addition relative to aggregate installed capacity addition across all states, with a weightage of 75% (Thirteenth Finance Commission, 2009).

Further, the commission also recommended a cap in the incentive as follows:

- A cap of INR 1.25 crore/MW of installed capacity addition during 2010–2014 for general states
- A cap of INR 1.50 crore/MW of installed capacity addition for special states to account for factors related to access and consequent cost disability (Thirteenth Finance Commission, 2009).

While promotion of renewable energy did not feature as a criterion in the incentive formula in subsequent years, FCs have continued to monitor and provide incentives linked to sustainable development goals to states (see Box 6.3). The XV FC (2021–2026) evaluated this on a case basis and recommended an amount of INR 700 crore to the Jharkhand government for four major renewable energy programmes: rooftop programme for government building and residential consumers, solar pumps, solar street lights and small hydro projects, based on a request from the state government (XV Finance Commission, 2020). The XV FC, interestingly, also uses India's international commitment to increasing forest cover to make recommendations – establishing a minor link between international processes and India's fiscal structure (Pillai & Dubash, 2023). The XVI FC (2026–2031) recently set up has an opportunity to continue to further expand on the work of previous commissions by revisiting and updating the weightages assigned to climate goals.

Box 6.3 Innovative State-Level Models for Designing Shifts

Finance Commissions over the past decade has been incentivising states to protect and increase forest cover. Coal mining in protected forest areas poses a significant challenge for states like Chhattisgarh, as the state government risks losing out on devolution revenues if compensatory afforestation is not adequately pursued. In response, the Chhattisgarh government has progressively increased the forest cess on coal mining (a form of state-level carbon tax) over the last three years, raising it from INR 15 per tonne to INR 57 per tonne (South Eastern Coalfields Limited, 2022). Additionally, the state has revised the infrastructure development and environment cess on coal mining to better address the environmental impacts associated with these activities.

States like Chhattisgarh that are currently dependent on coal mining and are witnessing increasing revenue from similar carbon-intensive activities can design such 'shifts' to create a just transition fund and 'target' disbursement from it to affected communities using increased revenues from the auction of coalmines to help prepare better for the energy transition. This fund would address the socio-economic needs of regions with inefficient and aging coalmines slated for closure, ensuring a fair transition for affected communities. These fiscal measures collectively enhance, improve transparency and accountability of domestic public financial flows directed towards climate action while addressing the environmental and social impacts of traditional energy sources.

6.4 Conclusion

Any attempt to reform domestic public finance for carbon-intensive sectors needs to be implemented extremely carefully, as changing any support mechanism, purely on efficiency grounds, is neither desirable nor practical. For example, in countries where fossil fuel subsidies exist, their removal without the introduction of well-targeted compensation mechanisms can lead to an increase in poverty levels in the short term (Zinecker et al., 2018). Such examples from the energy sector globally and in India, where the 'reform, target and shift' approach has been often used, hold valuable lessons for reforming domestic public financial flows to carbon-intensive sectors. We fully acknowledge that reforming public financial flows to carbon-intensive sectors are often marred by issues of political contestation due to embedded subsidies and legacy tax incentives – issues that were beyond the scope of this study. Further, the political economy effects of such reforms can be varied and need to be located within a particular political system for deeper analysis (Leon et al., 2024). The aim of this framework was to provide a starting point for policymakers who are looking to design reforms towards climate-positive policy interventions.

Therefore, for a 'reform, target and shift' approach to effectively work, we recommend the following broad steps for governments at all levels:

- Conduct a detailed policy review of domestic public finance made available to carbon-intensive sectors.
- Delineate public financial flows under direct (e.g. own revenues at the state level) and indirect (e.g. intergovernmental transfers) control to identify potential resource mobilisation strategies from taxation reforms.
- Articulate desired outcomes and identify and list policy options for reform of domestic public finance.
- Evaluate possible negative and positive impacts on households, businesses, the economy and the environment prior to the reform.
- Legitimise shifts through legislative action to ensure policy continuity and avoid policy reversal when exposed to price volatility.
- Introduce or strengthen response measures to the proposed reform, such as investments in social programmes or cash transfers, that can attenuate potential negative impacts.

The 'reform, target and shift' approach is, thus, a useful framework in India due to its narrow tax base and disproportionate reliance on indirect taxes. The approach, when used to design public financial shifts can be particularly useful, given the complicated political economy structure of fiscal federalism and centre-state relationships in India.

Notes

1 Extra-budgetary resources include external resources of state actors, such as investments made by public sector undertakings (state-owned enterprises) and public financial institutions.
2 In the absence of a global or national consensus, climate finance can be hard to track owing to multiple interpretations of the UNFCCC definition that are often contested.

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Part 2

Governance

An Introduction

Mritiunjoy Mohanty and Runa Sarkar

This section will examine the institutional arrangements and governance logics that shape climate finance. The expansion of climate finance into market-inflected forms of blended finance, as well as debt-based financing, without a concomitant emphasis on mechanisms to increase public finance is evidence of a neoliberal logic that shifts power to market actors. This in turn may affect the efficacy of climate finance, especially when it comes to adaptation or other high-risk mitigation projects. Hence, a greater focus on developing a financial architecture that has public finance at its centre may be emphasised. Also, financial sector regulation, as it interfaces with other regulations, so as to facilitate the flow of funds into projects that address climate change will be examined.

In Chapter 7, Nandan Nawn addresses the changing perception of the Reserve Bank of India (RBI) as it comes to grips with administering and overseeing financial institutions and markets in the context of climate risks. Specifically, this chapter explores the complexities of climate-related financial risks (CRFR) within India's economic and regulatory framework, focusing on the RBI's efforts to mitigate these risks. It begins by acknowledging the limitations of traditional risk assessment models in predicting and managing CRFR due to their unique and unpredictable nature. The study further examines the global regulatory standards set by the Basel Committee on Banking Supervision (BCBS) and their adaptation by the RBI, highlighting the challenges in data granularity, computational complexity and the overall preparedness of Indian banks. The paper also offers a comparative analysis of the disclosure frameworks proposed by the International Financial Reporting Standards (IFRS) and the RBI, particularly focusing on balancing the need for comprehensive disclosure and the practical challenges it poses for regulated entities. The necessity of a well-defined climate finance taxonomy is emphasised, underscoring its role in providing clarity and standardisation in climate-related financial disclosures.

Vikram K. Chand, Dipak Dasgupta and Nihal Pitigala use a regional approach to thinking about climate policy that can leverage littoral nation cooperation to deliver effective climate solutions, building on the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) as an institution in Chapter 8. They summarise the climate challenges in the Bay of Bengal region, link them to sustainable development goals (SDGs) and propose regional cooperation as a key solution. They highlight how climate impacts disproportionately affect vulnerable coastal populations, reinforcing the urgency of action and advocate for BIMSTEC-driven initiatives in trade, energy, disaster management and infrastructure. Multi-sectoral policy approaches, such as blue economy strategies, mangrove afforestation and decentralised renewable energy solutions, are introduced. The salience of regional cooperation as a response to climate

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events increases with the likelihood of going beyond the threshold of a 1.5°C increase in global temperature. From where we are today, this seems a distinct possibility.

From the regional, we move to the subnational approaches. In Chapter 9, Saransh Bajpai, Pranav Prakhyat Garimella and Faiza Solanki dive into finances at the state level, unpacking the state budget (2023–2024) for the state of Maharashtra to demonstrate how revenues and grants can be used to finance climate action. They first set a baseline for climate action in the state and then map the budgetary allocations for specific climate change mitigation and adaptation strategies, such as climate-proof water management and low-carbon transition of industrial sectors. The study provides quantitative evidence of Maharashtra's climate-relevant spending, which is quite low at 9%, both in relative and absolute terms. The sectoral breakdown offers a nuanced view of financing deficits. They identify the lack of national public expenditure tracking (PET) guidelines as a key barrier to effective climate finance tracking, highlighting how PET could enhance transparency as well as mobilise private and international climate finance. They also compare Maharashtra's climate budgeting approach with that of Odisha and Bihar, demonstrating alternative PET approaches, and discuss some global case studies.

From the state level, we move to the local and panchayat level. Chapter 10 assesses how climate action can be financed at the local panchayat level, bringing in examples from experiences in the villages of Uttar Pradesh. Shivika Solanki, Rini Dutt and Swati Gupta outline the challenges and opportunities in financing climate action at the local level in India and cite examples from multiple states, including Kerala, Gujarat, West Bengal, Tamil Nadu, Sikkim and Rajasthan to demonstrate successful fund mobilisation efforts. With this discussion as the backdrop, they dive deep into financing specific, measurable, achievable, relevant and time-bound (SMART) gram panchayats action plans in Uttar Pradesh through government schemes and programmes and other innovative approaches, most unique of them being the panchayat-private partnerships. The panchayat-private partnership is formalised in the form of an MoU between the Department of Environment, Forest and Climate Change of the government of Uttar Pradesh, the respective GP and CSR organisations or private companies. They demonstrate that the appropriately designed gram panchayat development plan can yield substantial benefits in terms of adaptation and resilience.

7 Addressing Climate-Related Financial Risks

Interrogating Efficacy of Actions by the RBI

Nandan Nawn

7.1 Introduction

The Reserve Bank of India (RBI) is tasked with ensuring 'monetary stability' in India.[1] Ostensibly, various risks can impact such stability. Historically, they have originated from inside the financial system, be it fraud, capital inadequacy and other such. In recent times, the RBI has recognised a new source of risk originating from outside the financial system and termed it as 'climate-related risk' in its chapter on 'Macroprudential Risks' in one of its financial stability reports (RBI 2021c, p. 16) and as 'climate-related financial risk' (CRFR henceforth) in a discussion paper (RBI 2022b, p. 3). A deputy governor of the RBI recognised that CRFR can "affect the stability of the financial system and safety and soundness of the financial entities" (Rao 2022), and the RBI being the 'custodian of financial stability', needs to use "instruments or strategies to meet sustainability goals without compromising on their existing policy mandates" (Rao 2023). Further, the RBI acknowledged that it "may [even] pose risks to global financial stability" (RBI 2022b, p. 3). In short, addressing CRFR falls within the statutory mandate of the RBI.

Some of the activities financed by banks and non-banking financial companies (regulated entities under the purview of the RBI, RE henceforth) contribute to CRFR by either augmenting or reducing it. Dilip and Kundu (2020) write that "[i]ncentivis[ing] banks towards green projects by redesigning capital and collateral rules" are among the "measures that can be examined by central banks for adoption to mitigate risks from climate change" (p. 121). RBI (2023a) announced a 'Framework for Acceptance of Green Deposit Scheme' in 2023 to address this matter.[2] The purpose was "[t]o encourage . . . (REs) to offer green deposits to customers, protect interest of the depositors, aid customers to achieve their sustainability agenda, address greenwashing concerns and help augment the flow of credit to green activities/projects" (RBI 2023a). The State Bank of India accordingly offered a 'Green Rupee Term Deposit' scheme in early 2024 "to mobilise deposits to support Bank in financing green initiatives" (SBI 2023), but it did not receive an adequate response (ET 2024).[3] Such green activities, projects, initiatives etc. envisaged within 'green deposit schemes' are expected to reduce CRFR. SEBI has launched a 'Green Debt Securities' (SEBI 2023b) with similar objectives as the RBI's 'Green Deposit Scheme'. Addressing CRFR through these means is vital for ensuring 'monetary stability' in macroprudential terms beyond ensuring the stability of just the financial system. The latter can be handled through 'disclosures' on various aspects of CRFR. A reduction in CRFR warrants clarity on what 'green' projects and activities are and therefore an appropriate taxonomy.[4]

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Views expressed in this chapter are strictly those of the author and not attributable to Reserve Bank of India (RBI).

It is obvious that CRFR can turn some of the existing loans and (mortgaged) assets into nonperforming assets. Given the networked nature of the financial system, a domino effect at the global level cannot be ruled out. To gauge the extent of vulnerability of the financial ecosystem and management of the associated risks, the RBI released a 'Draft Disclosure Framework on Climate-Related Financial Risks, 2024' (RBI 2024).[5] Its purpose is to facilitate the disclosure of information by REs "about their [CRFR] . . . and opportunities for the users of financial statements" (RBI 2024). This is expected to result in "an early assessment" of CRFR "and [climate related financial] opportunities and also facilitate market discipline" (RBI 2024). Keeping in mind the potentially significant effect of CRFR on the REs, the RBI advocated the implementation of "a robust . . . [CRFR] management policies and processes" by the REs (RBI 2024). The proposed disclosures are expected to provide adequate information to avoid "mispricing of assets and misallocation of capital" (RBI 2024).

Ostensibly, the CRFR 'management policies and processes' aided by disclosures can reduce the impact of climate change on the financial ecosystem, if not improve its resilience. These are microprudential matters at the level of REs. But "maintain[ing] price stability while keeping in mind the objective of growth"[6] – one of the mandates of the RBI – requires taking care of macroprudential matters. As per the present RBI governor, slow-moving changes in the climatic variables and sudden and intense extreme weather events can "affect the productivity of sectors that are heavily dependent on nature" (Das 2023, p. 9). These "can disrupt production and supply chains and create shortages of essential goods and services at anytime, anywhere", besides causing "damage [to] infrastructure and property" (Das 2023, p. 9). To him, "[a]ll these factors can contribute to higher inflation and lower growth" (Das 2023, p. 9).

The statutory mandate of the RBI warrants acting on these matters – just like addressing CRFR, as noted earlier. Its flagship Annual Report on Currency and Finance for 2022–2023 (RBI 2023c) focused on a greener, cleaner India. Box II.1.2, titled 'Role of Central Banks in Climate Change', in its Annual Report 2021–2022 (RBI 2022a) catalogues statements made by central banks in Europe, England and the United States on the onus of taking 'climate action'. The common thread is that even while the primary responsibility in this matter rests with the legislature, central banks have a role because climate change can affect price stability. This boils down to a question of choice: Should the RBI take the lead towards taking the required 'climate action' followed by the line ministries or vice versa, or should it be left exclusively to line ministries? This is similar to the decision on the sequence of monetary and fiscal instruments to reach the 'optimal' combination of rates of inflation and economic growth.

The RBI's draft disclosure framework (RBI 2024) followed the developments at:

(a) the International Sustainability Standards Board (ISSB) towards developing International Financial Reporting Standards (IFRS) on Disclosure of Sustainability-Related Financial Information (ISSB 2023a) and Climate-Related Ones (ISSB 2023b);
(b) the Basel Committee on Banking Supervision (BCBS) to modify the 'Core Principles for Effective Banking Supervision' governing the banks in the light of CRFR (and other 'new' risks) (BCBS 2024); and
(c) the Network for Greening the Financial System (NGFS) towards various advisories issued to central banks connected with CRFR, including climate disclosure for central banks.[7]

Section 7.2 will discuss some of the developments at BCBS around CRFR, given 'enhancing financial stability' as its central purpose and the importance that its advisories enjoy worldwide. Section 7.3 offers a contrast between the disclosure framework recommended by the ISSB (2023a, 2023b) and the RBI's draft disclosure framework (2024) that followed the ISSB (2023a, 2023b). The basic contention here is that such disclosures are likely to address the potential instability of the financial system against CRFR (as mentioned earlier) but is unlikely to address the macroprudential matters under the mandate of the RBI.

Section 7.4 concludes with a brief review of developments vis-à-vis 'taxonomy' in this domain in India. Given the centrality of the financial system in economic systems, and the need for consistency between 'climate actions' spanning different sectors, subsectors and activities, it is argued that the RBI is suitably placed to prepare the broad contours of 'climate finance taxonomy'.

7.2 Developments at BCBS on Supervisor's 'New' Tasks to Take Care of CRFR

On the question of methods to measure CRFR, BCBS (2021a) has made a number of observations.

It was acknowledged that CRFR "have unique properties that challenge traditional risk measurement" (BCBS 2021a, p. 6). The challenge owes to the fact that the traditional 'risk to damage functions' may not be useful for CRFR. It owes to the demands that it makes on the availability of "empirical functions . . . for all sectors, exposures and hazards" (BCBS 2021a, p. 6). The resulting difficulties in "mapping of exposure to climate risk and the measurement of climate-related financial risks" (BCBS 2021a, p. 6) call for modifications in the usual risk management methods and processes.

It was acknowledged that mapping expected damages from physical risks and then fitting them to the traditional risk assessment models is possible in theory. In practice, however, it requires accessing, understanding and analysing voluminous data before recommending action, if any. Further, due to the nonlinear relationship between climatic changes and their impacts, historical data cannot be extrapolated for assessment of future risks (see, for example, De Bandt et al. 2023). 'Tipping points' or breaching of 'thresholds' in nature add to the challenges. In contrast to the requirement of herculean (but not impossible) efforts to address the physical risks, it is impossible to predict the future direction of relevant policies (i.e. transition risks). Adoption of policies and enactment of laws at multiple tiers of governance (such as in India) increases the uncertainty in the future direction of policies that has a bearing on the transition risks.[8]

Assessing the impact of different risks on transactions between banks and its clients requires varying "level(s) of exposure granularity" – "increase in granularity" results in "increasing computational complexity" (BCBS 2021a, p. 7).

> Methodologies reliant on a higher degree of granularity may be more useful for underwriting, valuation, or pricing, but may suffer from high computational intensity and a paucity of clean, standardised input data. Conversely, methodologies that are less complex and more tolerant of sparse data may be more useful for strategic planning or portfolio allocation. Banks, and to a lesser extent supervisors, face a trade-off on these methodological decisions.
>
> BCBS (2021a, p. 7)

In any case, it is expected that the personnel at the bank or the model/software used by them will be able to handle these, including gathering data at the required level of granularity. It may be noted that responses by banks to a survey conducted by the RBI in 2022 revealed that on the question of preparedness and 'action', Indian public sector banks are behind their private sector counterparts, and foreign banks are much ahead of private banks, in general (RBI 2022c). Presumably, since then, most, if not all, the public and private sector banks have improved their capacity and capabilities in addressing and managing CRFR. Nevertheless, the challenges to integrate CRFR by the REs in risk assessment models are real, not just in India, but elsewhere too.

BCBS (2023) in its consultative document, 'Core Principles for Effective Banking Supervision'[9] proposed inclusion of 'new risks' towards a 'revision' of the core principles.[10] One such was CRFR. It was acknowledged that these risks "can affect the safety and soundness of banks and have broader financial stability implications for the banking system" (BCBS 2023, p. 4). Accordingly, it proposed amendments to several core principles. In April 2024, BCBS published the revised 'Core Principles for Effective Banking Supervision' (BCBS 2024). Four core principles (CP) took cognisance of CRFR, as reflected in the draft and final versions.

1. CP 8 Supervisory Approach: This CP deals with "forward-looking assessment of the risk profile of individual banks" to "identify, assess and address risks emanating from banks and the banking system as a whole", among others (BCBS 2023, p. 31). The term 'forward-looking' deals with "business model sustainability" of the banks (BCBS 2024, p. 28) with a time horizon concomitant with CRFR. Towards assessment of banks, besides the usual 'macroeconomic environment', it was proposed to include "climate-related financial risks and other emerging risks" (BCBS 2023, p. 32). It follows that CRFR is no longer considered 9an emerging risk.
2. CP 10 Supervisory Reporting: This deals with reviewing and analysing various kinds of reports from banks. Like CP 8, it proposed to include information on "assessment of the materiality of climate-related financial risks and emerging risks" while reporting various matters, such as "risk concentrations (including by economic sector, geography and currency)" (BCBS 2023, p. 35) among others.
3. CP 15 Risk Management: Here, the supervisor needs to be assured about a "comprehensive risk management process . . . to identify, measure, evaluate, monitor, report and control or mitigate all material risks (including, but not limited to, climate-related financial risks and emerging risks assessed over relevant time horizons) on a timely basis" (BCBS 2023, p. 42). This principle asks the bank board, subject to the satisfaction of the supervisor, to ensure that "all material risks (including climate-related financial risks and emerging risks)" are monitored and controlled in sync with 'strategies' and 'risk appetite' (BCBS 2023, p. 45). It also acknowledged that CRFR "could materialise over varying time horizons that go beyond their traditional capital planning horizon" (BCBS 2023, p. 4). Stress testing and use of scenarios were suggested for the evaluation of risks over the relevant time horizon.
4. CP 26 Internal Control and Audit: The banks were asked to consider CRFR within their 'internal control framework'. A "properly controlled operating environment" was to be established "with a forward looking view" that "appropriately reflect(s)" CRFR "and emerging risks as needed" (BCBS 2023, p. 66).

In short, BCBS, "the primary global standard setter for the prudential regulation of banks" that "provides a forum for cooperation on banking supervisory matters" with a "mandate . . . to strengthen the regulation, supervision and practices of banks worldwide with the purpose of enhancing financial stability" has considered modification of its 'core principle' to accommodate the 'new' risk: namely, CRFR.[11] It may be noted that "[t]he Core Principles are considered universally applicable and should be applied by national authorities in the supervision of banks within their jurisdictions" (BCBS 2024, p. 3) and also that the "revised Core Principles standard is . . . effective immediately" (BCBS 2024, p. 2). These developments, in all likelihood will be able to make financial systems resilient enough to withstand even the changing but uncertain dimensions of CRFR.[12] In parallel to these developments over (somewhat abstract) 'principles', there has been progress on new disclosure requirements vis-à-vis CRFR, to which we turn next.

7.3 Disclosure Frameworks Proposed by the RBI and IFRS towards Management of CRFR by Banks

The ISSB was set up by the trustees of the IFRS Foundation in 2021. One of the objectives of the ISSB is "to develop standards for a global baseline of sustainability disclosures" (ISSB n.d.). In 2023, it published two standards towards this end. One is for general requirements for sustainability-related information, and the other was specifically on climate-related ones, as mentioned earlier. The draft disclosure framework published by the RBI (RBI 2024) closely follows the ISSB (and BCBS 2021a) in terms of structure, with four groups of disclosures: namely, governance, strategy, risk management and metrics and targets. In terms of content, the similarities and differences between the two are captured below.

Objectives: The disclosure recommended by ISSB "is to require an entity to disclose information about its sustainability-related risks and opportunities that is useful to primary users of general purpose financial reports in making decisions relating to providing resources to the entity" (ISSB 2023a, p. 6). In ISSB (2023b), the objective is to disclose information about 'climate-related risks and opportunities'. The RBI is concerned only with CRFR and therefore puts the purpose of disclosure of information about "climate-related risks and opportunities for the users of financial statements" (RBI 2024). These disclosures are expected to "facilitate market discipline" (RBI 2024). In addition, it asks if the disclosures on "targets are aligned with India's Nationally Determined Contribution" (INDC) (RBI 2024). As it is well known, INDCs include specific targets, and they are dynamic in nature. This additional specificity makes the disclosures mandated by the RBI more useful.

Competence of human capital at the banks to handle CRFR and remuneration: Both the ISSB (2023a, 2023b) and RBI (2024) express concerns on the competence of human resources at the banks to recognise and manage all aspects of CRFR. To address this, additional remuneration for those handling CRFR has been mentioned by both (though within non-mandatory 'enhanced' disclosures in the RBI draft framework), although such incentives are not mentioned for those handling other risks. This demonstrates the importance given to CRFR. One can hope that such prioritisation will not result in the neglect of other risks. Further, the RBI draft framework asks for 'compulsory disclosure' on methodologies "to understand the impact of climate-related risk drivers on the"

(a) 'market risk positions', (b) 'liquidity risk profiles' and (c) 'operational risk', against 'risk management'. This requires sophisticated analysis, which can be carried out only by competent personnel, and an assessment of extant capabilities is recommended.[13]

Elements of the strategy: This aspect involves disclosure on all matters that affects the 'prospects' of a regulated entity. It includes "current and anticipated effects of those climate-related risks and opportunities on the entity's business model and value chain" (ISSB 2023b, p. 7) besides 'climate-related transition plan', 'strategy and decision-making', 'financial position, financial performance and cash flows' (ISSB 2023b, p. 7) and 'revenue, costs, assets, etc.' (RBI 2024). This is quite a tall order – one can hope that Indian banks are in a position to disclose all the pertinent information.

Costs of information: Both the ISSB and RBI ask for disclosure of an enormous amount of information. For example, vis-à-vis 'climate scenario analysis' (to gauge the extent of impact of CRFR on an entity) the following information is to be disclosed:

> (i) climate scenarios used for the analysis and source of the scenarios, (ii) whether it included a diverse range of climate scenarios, (iii) whether it was associated with climate-related transition risks or physical risks, (iv) whether it included a scenario aligned to the Nationally Determined Contribution, (v) the reasons for choosing the climate scenarios (i.e., why they are relevant to assessing the RE's resilience to climate-related changes, developments or uncertainties), (vi) the time horizons used in the analysis, (vii) the scope of climate scenario analysis; (vii) the assumptions used like the climate-related policies at the national/state levels, macroeconomic trends, national/state-level variables.
>
> RBI (2024)[14]

The RBI framework does not mention any aspect of costs of information collection, collation or analysis. The ISSB on the other hand recommends using information made available only "without undue cost or effort" (ISSB 2023b, p. 16). It is obvious that given the size and scope of operations of REs, this cost can be significant for some of them (say, small cooperative banks).[15]

Type of information to assess risks: The ISSB asks for disclosure on "description of where in the entity's business model and value chain climate-related risks and opportunities are concentrated (for example, geographical areas, facilities and types of assets)" (ISSB 2023a, p. 11). It is a necessary requirement for 'stress testing'. Dilip and Kundu (2020) mention 'scenario analysis and stress testing', as does the financial stability report (RBI 2021c). Rao (2023) also mentioned that

> [a]t a firm-level, the scenario analysis and stress testing would help frame the strategies to manage the risks for individual entities. Central banks across the globe are encouraging banks and other lenders to identify such vulnerabilities. In India, we plan on issuing guidance to banks on the stress testing for climate vulnerability of their credit portfolio soon.

Yet, the RBI draft framework (RBI 2024) does not ask for disclosure on ways to capture concentration of risks. One wonders if this is a wilful omission on the part of the RBI due to nonavailability of data at the required level of granularity.

Validation and verification of disclosed information: Both the ISSB and RBI framework ask for engagement of and validation by a 'third party' for "target and the methodology for setting the target" and "metrics" (RBI 2024). SEBI has shown a way, vis-à-vis

BRSR-Core.[16] However, the nature and type of information that the disclosure framework of RBI (and ISSB) asks for is far more complex. Transparency, assumptions and related value judgements are key. One can hope that the analysts at the 'third party' and management at the banks will be able to understand each other on this matter.

The volume of disclosed information as per the draft framework of RBI may be too large for the majority of depositors and lenders in India, although this may not be difficult for international finance corporations or multinational banks, given their capabilities and capacities. In this context, an appropriate taxonomy will be useful, to which we turn next.[17]

7.4 A Way Forward: 'Climate Finance Taxonomy' Framework Initiated by RBI

The Government of India (GoI) calls for a 'climate finance taxonomy' (as stated earlier) rather than a green or a sustainable taxonomy.[18] In climate finance taxonomy, the set of criteria – as per the requirements of any taxonomy – will be against indicators that can gauge the contribution of the activity or project in question to meet objectives such as climate change adaptation and mitigation.

Incidentally, the term 'taxonomy' has appeared in official documents of at least two statutory bodies in India (RBI and SEBI) other than the Ministry of Finance. The notification from the RBI on the Framework for Acceptance of Green Deposits (RBI 2023a) includes the following text:

> The allocation of proceeds raised from green deposits shall be based on the official Indian green taxonomy. Pending finalization of the taxonomy, as an interim measure, REs [regulated entities] shall be required to allocate the proceeds raised through green deposits towards the following list of green activities/projects which encourage energy efficiency in resource utilisation, reduce carbon emissions and greenhouse gases, promote climate resilience and/or adaptation and value and improve natural ecosystems and biodiversity.
>
> RBI (2023a, emphasis added)

The 'list' mentioned in the quote was adopted from the 'list of eligible green projects' falling under 'eligible categories' defined in table 1 of the GoI's 'Framework for Sovereign Green Bonds' (DEA 2022), published on 9 November 2022. The phrase 'official' presumably means complete.

The RBI has specified the key characteristics of taxonomy in the 2023 issue of its report on currency and finance:

> III.43 Reliable and standardised information dissemination and disclosure is the backbone of efficient financial intermediation. A uniformly accepted 'green taxonomy', therefore, plays a major role in the identification, standardisation, disclosure and awareness regarding climate change.
>
> III.44 As a principle, any financial instrument whose proceeds are used for environmentally sustainable projects, initiatives, and policies under the single goal of promoting a green economic transformation could be referred to as green finance. A good taxonomy provides a strong signal to investors and other stakeholders and assists in their decision-making by identifying the nonfinancial benefits of a given asset. Taxonomies can be classified depending on four key characteristics:

> a) objective: which sustainability goals are supported? b) scope: which activities/industries/entities are included? c) target: how is the purpose translated into a measurable target? d) output: what type of information is provided?
>
> (RBI 2023b, 91–92; emphasis added)

SEBI's revised circular on green bond securities mentioned several "initial disclosure requirements for issue and listing of green debt securities" (SEBI 2023b). One of them reads "Details of taxonomies, green standards or certifications both Indian and global, if any referenced and the alignment of projects with said taxonomies, related eligibility criteria, and exclusion criteria, if applicable" (SEBI 2023b, p. 2).

These already-existing 'taxonomies' in India (Sovereign Green Bonds and Green Debt Securities) – albeit partial – have some differences, related to the institutional requirements of 'bonds' and 'securities' as financial instruments. Both SEBI and the GoI follow 'green bond principles' of the International Capital Market Association. While the objective of Green Debt Securities of SEBI is generic in nature,[19] Sovereign Green Bonds of the GoI includes five principles against different categories of projects[20] besides a generic objective.[21] Similarly, while the process to check the eligibility of a 'project' in SEBI is generic, the GoI lists different criteria under each of the categories. Most of the remaining responsibilities (say, identification of 'eligible' projects/assets) in case of SEBI lie with the issuer of the green security, while in case of the GoI, it is with the 'green finance working committee'. In any case, the differences are not much, and it is possible to subsume both of them within the 'official Indian taxonomy' with minor adjustments.

SEBI's Green Debt Securities Framework (SEBI 2023b) mentions that funds raised through it are to be "utilised for project(s) and/or asset(s)" under certain categories: "renewable and sustainable energy including wind, bioenergy, other sources of energy which use clean technology", "climate change adaptation including efforts to make infrastructure more resilient to impacts of climate change" etc.[22] There exists some lack of clarity here. For example, it is not clear if shifting the transmission and distribution network below the ground from above the ground to carry electricity from thermal power plants can be considered under "climate change adaptation including efforts to make infrastructure more resilient to impacts of climate change" (SEBI 2021 [2023]).

Also included in the list of permitted assets/projects in the SEBI framework is 'yellow bonds', consisting of "solar energy generation and the upstream industries and downstream industries associated with it" (SEBI 2021 [2023]). In contrast to the list of projects in the previous paragraph, delineation of the 'system boundary' is clear in case of 'yellow bonds'. It appears that the transmission and distribution network for electricity from solar as well as all the equipment and structures to make harvesting of solar energy will be included within its scope. This lack of 'system boundary' is true for all projects mentioned in the previous paragraph. There are two ways to address this, besides defining the 'system boundary': first is to use a 'taxonomy' structure like China's 'Green Bond Endorsed Projects Catalogue', where the activities included within each 'project' is defined (PBOC, NDRC and CSRS 2021), delineating the scope of 'project'; second is to identify just the activities (and not projects) as in the taxonomy of EU (European Commission 2023) or ASEAN (ATB 2023) that are eligible to receive the funds. Taxonomy using alternative approaches can offer clarity in both cases.

The scope of projects in the GoI framework is generic in nature, and the descriptions do not provide clarity. For example, does investment in hydropower include design, installation and maintenance? Are grids carrying electricity from thermal power plants eligible? Again, taxonomy can improve the clarity here too by either specifying the activities or the system boundary of projects under its scope.

To reiterate, the frameworks of both SEBI and the GoI can be improved by meeting the requirements of a 'complete' taxonomy. It is expected that the 'sustainable taxonomy system' or 'climate finance taxonomy' of the Ministry of Finance will not substantially diverge from the existing classification of green projects/assets being followed by SEBI and the GoI (notwithstanding the slight differences). A significant departure may disrupt the need for "maintain[ing] regulatory continuity and investor confidence" (Bhattacharya 2024). On the other hand, synchronising the Indian taxonomy with taxonomies used in other countries or regions (to attract finance from such places) can result in such disruptions.[23]

The challenges to address CRFR are somewhat known: from granularity of data to identifying the appropriate method for analysis of data to actual analysis, interpretation of results and taking action by competent personnel. This knowledge is mostly theoretical – and so are the solutions. Given the changing dimensions and uncertain nature of CRFR, it will be of interest to see how the RBI handles both the matters covered in this chapter: to improve the resilience of the financial system governed by it from CRFR and to reduce the CRFR by taking 'climate action' along with line ministries. One can hope that 'climate finance taxonomy' will not remain just a part of the budget speech by the honourable Minister of Finance.

Notes

1 Chapeau of the Reserve Bank of India Act, 1934. www.indiacode.nic.in/bitstream/123456789/2398/1/a1934-2.pdf

2 To be technically correct, the RBI only executed the government of India's 'Framework for Sovereign Green Bonds' (DEA 2022). In any case, the framework of the Green Deposit Scheme is distinctly similar to the objective of 'Green Bond Endorsed Projects Catalogue' of China and Green Bond Securities of SEBI (see below). A follow-up FAQ on the Green Deposit Scheme was published by the RBI in December 2023 (RBI 2023b).

3 It was reported in early June 2024 that the RBI had cancelled "10-year green bond auction for the first time" "as traders refused to pay greenium, said dealers" (Business Standard 2024).

4 Examples are 'Taxonomy for Sustainable Finance' (ASEAN), 'Sustainable Finance Policy for Banks and Financial Institutions' (Bangladesh), 'Green Bond Endorsed Projects Catalogue' (China), 'Taxonomy for Sustainable Activities' (European Union), 'Basic Guidelines on Climate Transition Finance' (Japan), 'Climate Change and Principle-Based Taxonomy' (Malaysia), 'Taxonomy for Sustainable Finance' (Singapore), 'Green Finance Taxonomy' (South Africa) etc.

5 SEBI has implemented its own disclosure framework, BRSR-Core (SEBI 2023a).

6 Chapeau of the Reserve Bank of India Act, 1934. www.indiacode.nic.in/bitstream/123456789/2398/1/a1934-2.pdf

7 The RBI joined the NGFS in 2021 (RBI 2021a) and expressed its commitment to support the NGFS (RBI 2021b).

8 In India, laws can be enacted by the state governments, the central government or both as per the state list (fisheries, for example), union list (banking, for example) and concurrent list (bankruptcy and insolvency) in the Constitution of India.

9 This followed the publication of 'Principles for the Effective Management and Supervision of Climate-Related Financial Risks' (BCBS 2021b) that sought comments on the manner on which different dimensions of CRFR were proposed to be included within 18 principles against 10 aspects: corporate governance; internal control framework; capital and liquidity adequacy; risk management process; management monitoring and reporting; comprehensive management of credit risk; comprehensive management of market, liquidity, operational and other risks; and scenario analysis (BCBS 2021b, iii). The RBI provided comments in turn (RBI 2022d). On

principle 17 (capacity at the supervisor's end) it emphasised a "need for supervisors to acquire greater sustainability and climate risk knowledge which coupled with hands-on work experience would help them to effectively assess supervised banks' management of climate-related financial risks" (RBI 2022d, p. 3). The final version was published in June 2022 (BCBS 2022).

10 "The Core Principles for effective banking supervision . . . are the de facto minimum standard for sound prudential regulation and supervision of banks and banking systems" (BCBS 2024, p. 3).

11 "Basel Committee Charter" (BCBS 2018).

12 Basel III was "developed by the Basel Committee on Banking Supervision in response to the financial crisis of 2007–09" as "an internationally agreed set of measures". www.bis.org/bcbs/basel3.htm?m=76

13 The RBI has set up the RBI Academy, "a training institution . . . for imparting trainings on topics of relevance to Central Bankers, Regulators and Supervisors around the globe". *Source:* https://rbiacademy.rbi.org.in/Home

14 This is almost verbatim from ISSB (2023b, p. 12).

15 The RBI draft framework will be applicable for "a) All Scheduled Commercial Banks (excluding Local Area Banks, Payments Banks and Regional Rural Banks); (b) All Tier-IV Primary (Urban) Co-operative Banks (UCBs); (c) All All-India Financial Institutions (viz., EXIM Bank, NABARD, NaBFID, NHB and SIDBI); (d) All Top and Upper Layer Non-Banking Financial Companies (NBFCs)" (RBI 2024).

16 BRSR (Business Responsibility and Sustainability Report) Core: Framework for assurance and ESG disclosures for value chain was announced by SEBI in 2023. It asks for disclosure of information by listed entities as per a standardised reporting format (SEBI 2023).

17 Taxonomy is used to classify and categorise objects into groups based on shared characteristics. Its use originated in the field of biology. There, it is used to classify living beings ('populations') into different groups ('taxon' or 'taxa') according to specified biological criteria.

18 Arguably, climate finance is a subset of green finance, which is a subset of sustainable finance (The UNEP Inquiry 2016, p. 3).

19 Disclosure of "a statement on environmental sustainability objectives of the issue of green debt securities" (SEBI 2023b).

20 Some principles are common across categories, but some are not.

21 "[T]o tap . . . the requisite finance from potential investors for deployment in public sector projects aimed at reducing the carbon intensity of the economy" (DEA 2022).

22 Updated section 2 (q) of SEBI 2021 [2023].

23 There are international efforts to identify the 'common ground' across taxonomies.

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8 Achieving Sustainable Development Goals and Climate Resilience in Low-Income Contexts

The Bay of Bengal Region

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8.1 Significance of the Bay of Bengal Region as a Natural Economic Geography

The Bay of Bengal (BoB), the largest and among the most productive deltas in the world, is a natural-economic-geographical feature comprising parts of seven countries (Bangladesh, Bhutan, India, Nepal, Myanmar, Sri Lanka and Thailand) that comprise BIMSTEC[1] (founded in 1997) (see Figure 8.1). Nepal and Bhutan are landlocked Himalayan countries, as are Assam and seven smaller Northeastern states in India, whose proximity to the BoB is their primary natural access to global trade. Four Eastern states in India (West Bengal, Odisha, Andhra Pradesh and Tamil Nadu) have long coastlines. In addition, three other landlocked Eastern states in India (Bihar, Jharkhand and Chhattisgarh) share close borders and economic relations within the BIMSTEC.

Their combined population is about one billion people, about one-eighth of the global total. Extreme poverty rates (less than $2/day) are high, about 20% of the combined population. Average incomes are mostly very low, about USD 2,100 per capita, just above the low-income threshold on a global basis, and the grouping's combined GDP is about $2.4 billion. Trade accounts for some 60% of the combined BIMSTEC GDP. However, intra-regional trade remains low, with trade barriers impeding trade flows including high tariffs and non-tariff barriers (De, 2017). The BoB provides natural access to shipping routes for access to global trade, and there are multiple ports, including several deep-water ones.

The common features of this natural geography are (a) very high population density and agriculture as the primary occupation, of which fisheries is a major activity; (b) transboundary issues of fisheries overexploitation and loss, marine habitats degradation of mangroves, coral reefs and seagrass, tropical storms and cyclones, very high monsoon precipitation and floods; (c) labour migration (within and between countries); and (d) rising occurrence of conflicts.

This partnership to foster regional economic development can also be leveraged as an important voice in the global climate action negotiations. It can play a potentially key role to align local action with the global climate agenda, and this chapter attempts to demonstrate how this partnership can be leveraged.

8.2 Climate Change as a Risk to SDGs in the BoB

The BoB is among the world's 17 *climate change hotspots*. Sea surface temperatures (SST) have risen by 0.2–0.3°C over the past decades (twice as fast as global average) and

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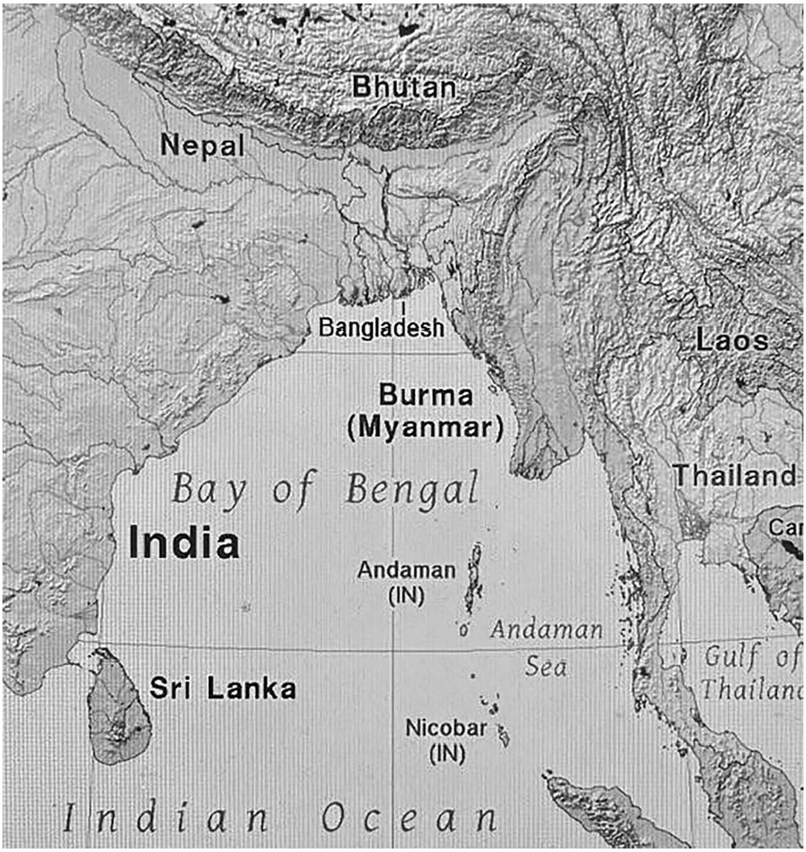

Figure 8.1 Map: Bay of Bengal Region

Source: ian.macky.net. Pat (n.d.).

are expected to rise by 2–3.5°C by the end of the century (Rajalakshmi and Achyuthan, 2021). The sea-level rise (SLR) is expected to be 35–45 cm in the medium-term (2050).

The Sundarbans, the *world's largest contiguous mangrove forest* (10,000 sq km, 6,000 sq km in Bangladesh, rest in West Bengal), is one of its most productive ecosystems but at greatest risk; extensive mangroves are also found elsewhere (Myanmar, Andhra Pradesh, Tamil Nadu, Sri Lanka). This ecologically sensitive area is expected to be inundated by as much as 40–60% by 2050 (Al Jabir et al., 2021) and may lose 42–80% of their area under a business as usual scenario by 2100 (Samanta et al., 2023). This would displace large coastal populations and reduce protection inland from storm surges.

As one of the world's largest marine ecosystems with a coastal population of 450 million, fisheries are a major source of income and exports, and they are under pressure due to declining or stagnant fish catch. The stress on fisheries is expected to accelerate by rising SSTs, ocean acidification, deoxygenation and escalating marine heat waves moving to a near-permanent state (because they reduce phytoplankton as food for fish, coral reef bleaching, and fish migration) (Kumar et al., 2023; Roxy et al., 2024). One estimate of future cumulative losses on the east coast of India is as much as USD 17 billion over the next two decades (Mohanty et al., 2017).

The BoB accounts for just 7% of *tropical cyclones* in the world, but accounts for over 80% of global human losses as a result. With global warming, the frequency of more intense cyclones is expected to rise (Vivekandan et al., 2016). The coastal inundation and flooding effects will likely intensify, with the highest effects in Bangladesh, West Bengal, Odisha and Andhra Pradesh in coastal India (Rao et al., 2020).

Extreme precipitation is expected to increase in the Northeastern and Eastern parts of the BoB during the monsoons, causing risks of extreme flooding. Owing to local high topography and monsoonal winds that converge, extreme rainfall events have quadrupled over southeast and northeast Bangladesh and India between 1950 and 2021, which will extend further over the same region in the future (2050–2079) with increased future extreme events (Fahad et al., 2023; Saha et al., 2023).

The highest *exposure to humid heat stress* among the five global hotspots is also likely to be the coastal populations of BoB (Yang et al., 2023). Productivity losses from exposure to high humid heat were estimated to be about $51 billion in Bangladesh and Thailand between 2001 and 2020, or about $2.5 billion annually (Parsons et al., 2022), and about four times higher (population-weighted) for the entire BoB region. Since 1950, average temperatures in Kolkata, the biggest city in the region, have risen by more than any other global megacity studied, and the number of extreme heat days (11 in 2000) would more than double to 25 days by 2030 and double again by 2050 (Gowen et al., 2023; *Carbon Plan*, 2023). Lethal heatwaves are weakening SDG progress across South Asia, affecting food grain yields, vector-borne diseases and urban sustainability.

Smallholder crop agriculture and plantations, the mainstay of rural occupations, are increasingly threatened by global warming. Tea cultivation is expected to decline by 14% in Sri Lanka by 2050 (Jayasinghe and Kumar, 2020). In the mountainous states, extreme precipitation and fragile geomorphology are causing soil erosion risks, greater rainfall variability and droughts (Das et al., 2011). Coastal crop agriculture will be affected by salinity intrusion and land losses.

Among *cities exposed to coastal flooding risks*, six of the world's top 20 cities are in the BoB: Kolkata, Dhaka, Bangkok, Yangon, Khulna and Chittagong (Nicholls et al., 2007). The Bangladesh-Myanmar-Northeastern India corridor is especially exposed to climate-magnified conflict and insecurity, but climate vulnerability stresses also affect other sub-regions.

The BoB region, because of its vulnerability to climate change, could face compound risk factors of *political instability and strife* in the coming decades (Balsari et al., 2020). Livelihoods in border communities are fragile, vulnerable to spillover effects of conflict (e.g., from the flow of refugees into Bangladesh from Myanmar's embattled Rohingya community) and prone to smuggling of drugs and timber.

Rising energy needs are an increasing challenge in the BoB, and in the absence of sufficient development of alternatives, it could turn to fossil fuels. Thus far, the region has contributed little, historically, to global warming because of its low per capita carbon consumption (less than 2 tCO_2). It is already a major source of coal for power generation and steel (Chhattisgarh and Jharkhand) and has underexploited offshore oil and gas resources (Myanmar, Bangladesh, Krishna-Godavari basin and elsewhere).

The combined effect of these major climate change effects and sharply slowing growth (Section 8.3) is likely to affect all 17 SDGs negatively for this region's one billion low-income population, with the worst effects on the bottom quartiles of the income distribution.

8.3 Near-Term Aggregate Impacts of Climate Change

By 'near-term' we mean the impacts in the next two and half decades (by about 2050).

The Stern Review (2006) reported the mean cost of climate change in India and South-East Asia at about 6% lower baseline GDP *by 2100*. Given that this was projected to happen over a very long period, with actual GDP expected to grow much larger (e.g., about 17 times larger over 90 years till 2100 with an average 3% compounded annual growth rate), the loss of 6% by 2100 would be relatively small and far away (within the realm of errors in forecasting) and insufficient to ring alarm bells.

Newer classes of models now focus more on the near term, with a finer disaggregation of regions, and examine the relatively high certainty of near-term impacts of ongoing climate change (versus 'risks in the long term'). One recent update suggested a 12% risk of GDP losses to baseline GDP (equivalent to a reduction in annual growth rate by 0.5% annually in South Asia) by 2050 (Munday et al., 2023).

The most recent empirical estimates further double the size of expected climate change damages when looking at the BoB (Kotz et al., 2024). They suggest a loss in GDP from climate change to baseline estimates (without climate change) of 20–30% by 2050 (annual GDP losses of 0.9%). These estimates of committed losses are equal to as much as one-quarter to one-half of recent decadal rates of per capita GDP growth in the region (2–4% annually).

Climate change damages are often abrupt changes with persistent effects (which have been partially considered using lagged effects in the model). Moreover, the likely GDP losses estimated above do not consider the effects of regional 'spillovers' that may further amplify these effects, with migration, resource conflict, trade disruptions and supply-chain impacts. Nor do they include other channels, such as the effects of extreme humid heat days, SLR and tropical cyclones; and major non-market impacts such as health (rapid spread of vectors and diseases such as malaria and dengue) (Wang et al., 2023) and ecosystems (e.g., mangroves and fisheries losses). The economic impacts of heat-related labour productivity losses are especially worrisome (Debnath et al., 2024).

While a comprehensive assessment of aggregate climate change impacts in the BoB is not possible here, the authors assess the significance of the omitted variables and their impact to be very high from other studies. In their assessment, the size of the additional adverse climate effects for the BoB region could easily be double the current expected negative impacts of temperature and precipitation in the near-term and may even slow per capita growth to close to zero by 2050 if sufficient actions are not taken.

8.4 Framing Climate Change and Climate Resilient Development Partnerships

Climate resilient development (CRD) is about implementing climate adaptation and mitigation options to support sustainable development (IPCC, 2023). It combines climate actions with underlying development choices and everyday actions carried out by multiple actors within a region's political, economic, ecological, socio-ethical and knowledge-technology boundaries.

The BoB region has many borders and political divides that have limited their ability to find effective solutions to common problems. The region involves seven countries of varying size, diversity and development challenges. Despite these differences, our focus is on the regional picture because, first, the single biggest common challenge for this region is climate change and its impact on development. Second, the payoffs and opportunities for joint partnership solutions are much larger than those feasible in relative isolation.

Third, the region is a very large low-income global 'climate hotspot' that will require global partnership attention, especially in climate finance. This is both for equity reasons, because the region has thus far contributed little to ongoing global climate change, and to avoid future risks of larger spillovers.

Enhanced partnerships are important because the BoB region exemplifies how climate change acts as a public 'bad' due to geographic interconnectivity, necessitating collective action. Shared river systems like the Ganges, Brahmaputra and Meghna, affected by altered rainfall patterns and glacial melt, along with increased cyclone and monsoon intensity, pose shared risks and impacts across borders, including transportation affecting connectivity to regional and global markets. The threat of SLR, particularly acute in low-lying areas like Bangladesh, and the need to protect vital ecosystems such as the Sundarban mangroves further underline the interconnected environmental challenges.

Higher levels of partnerships with each other and the rest of the world (RoW) would be especially important in seven critical areas: (a) protection of shared resources in agriculture and adaptation strategies, including for blue carbon assets and fisheries; (b) disaster planning and management; (c) sustainable low-carbon energy access and development (hydropower and regional grids); (d) managing urban development; (e) trade, infrastructure and supply chains, together with accompanying upgrading of low-carbon labour-intensive manufacturing (garments, footwear, light engineering); and (f) governance and capacity building. Accelerated partnerships would encourage and require expanded climate financing partnerships within the region and with the RoW, especially to attract private investment.

To illustrate the choices, Figure 8.2, showing the global choices from the IPCC's recent report (Dasgupta et al., 2023), applies even more at the regional BoB level, where the

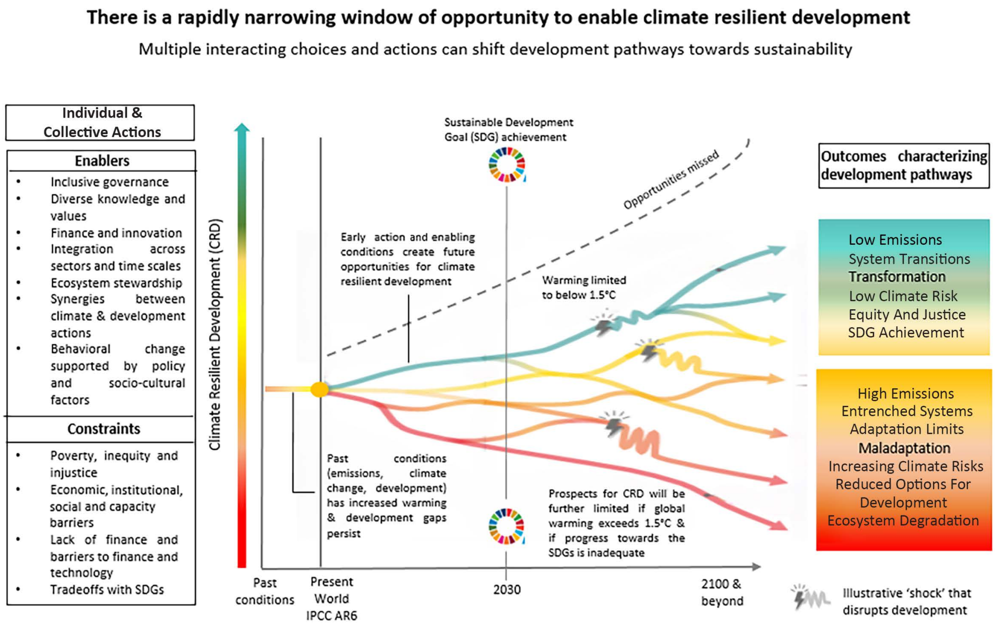

Figure 8.2 CRD Choices in BoB: Enhanced Regional and RoW Partnerships

Source: Adapted from IPCC Climate Change 2023 Synthesis Report (*Dasgupta et al., 2023*) upper line pathways can be seen as representing the regional and broader RoW partnership possibilities for CRD for all countries in the region, versus the bottom (darker) line pathways which represent the (avoidable) outcomes of relative isolation and fragmented inability to handle rising climate challenges. We focus on some key elements of the essential common 'frameworks'.

Partnerships will be key in sustainable livelihoods, water, energy and urban management. While partnerships can also help promote trade and improve governance, these are best treated as solutions in their own right, not just as examples of partnerships at work.

8.4.1 Sustainable Livelihoods, Mangrove Afforestation and Sustainable Fisheries

Stepped-up protection of mangroves and associated coastal population protection is critical, as are measures to manage common fisheries. Research suggests that mangroves and coastal wetlands sequester carbon at a rate ten times greater than mature tropical forests (NOAA, n.d.). Finding the linkages between successful sequestration projects and access to carbon credit markets globally will be key to international partnerships. Coastal mangrove afforestation, mixed with structural coastal protection measures, could also play an effective role in protecting coastal areas from storm surges (Gupta et al., 2022). Managing crop agriculture, with increased adaptation to climate stressors and water, will require more local approaches, changes in cropping patterns, improved varieties and farming practices, as well as improved access to irrigation and water management. Common resources management would include expanded capacity building, agricultural research and partnerships.

8.4.2 Managing Water and Natural Disasters

Given the rising risks of extreme precipitation and extensive flooding, managing the storage and drainage of water requires stepped-up long-term hydrology planning and investments. However, long-term structural measures have often proved costly and ineffective. Flood forecasting and warning systems and disaster planning and management have played a key role in recent years in mitigating disaster. The focus of the models has shifted to a 'mixed' approach incorporating structural measures and better flood forecasting, planning and management (Haque et al., 2019). Early warning systems for planning and managing the effects of storm surges and tropical cyclones, led by the Indian Meteorological Department as a Regional Specialized Meteorological Centre provide tracking in real-time. Nonetheless, a recent analysis and comparison of location and intensity forecast errors suggests that uncertainty in real time persists in many of these model forecasts of cyclones in the BoB region (Kotal et al., 2024). Regional cooperation could enhance forecasting capabilities of climate models.

8.4.3 Sustainable Energy Investments

The Bob region has one of the highest population densities and significant cloud cover, which precludes large-scale renewable solar energy projects. Instead, community-based smaller-scale distributed renewable energy projects (solar, including rooftop and hydro) are likely to be more sustainable. This includes solar water pumps for safe, fresh water supply in coastal areas. At scale, nevertheless, the region is likely to continue investment in large-scale coal and offshore fossil fuels (Myanmar offshore gas and oil) unless alternatives are found through international partnerships to fund and develop more capital-intensive offshore wind energy. Bangladesh has already launched four offshore wind energy projects, one of them funded by the Swedish H&M group and Danish partners (in a corporate pooling),[2] to reduce the emissions related to the country's garments sector. Similar plans are possible for scaled-up offshore wind projects in the BoB region.[3]

The untapped hydro-power potential of the Indian Northeast, Nepal and Bhutan is immense but underutilised because of the difficulties in reaching the grids and trading power across borders into Bangladesh and elsewhere. BIMSTEC has agreed to set up an Energy Centre and establish a secretariat for coordinating grid inter-connection.

Cooperation across borders involving multiple stakeholders is the key to building inter-connected power systems (IEA, 2023). Integrating grids at a regional scale would bring considerable benefits by enhancing energy security, facilitating clean and affordable energy, scaling and balancing the fuel and peak power demands. Renewable energy could more than double in the electricity fuel mix by 2030 to over 40% in BIMSTEC (Panda and Karthik, 2020). Although cross-border electricity trade is rapidly increasing, it is essentially bilateral (with some trilateral), between Bhutan and India, India and Bangladesh, India and Nepal, and India and Myanmar. The size is small compared to a potential of 328 GW of hydropower and will require a robust grid and market.

Intergovernmental agreements among countries are the first step, followed by agreements by operators, public and private, on trading rules, system operation and monitoring, dispute resolution and data reporting. The first step in signing a Memorandum of Understanding (MOU) to establish a BIMSTEC Grid Inter-Connection was undertaken in 2017. The CERC in India issued a cross-border trade in electricity regulations in 2019, which could serve as a platform to develop a comprehensive electricity grid inter-connection and power trade system in BIMSTEC.

8.4.4 Managing Urban Heat Stress and City Risks

Large-scale investment in improving city-level management of risks of urban heat and flooding is essential. These will include cooling spaces, changing the green density of cities, managing drainage and flooding risks and changing the work environment, especially in labour-intensive manufacturing. Global partnership among cities will be crucial to transferring knowledge on how to deal with climate-related challenges.

8.5 Finding the Solutions: Trade, Supply Chains and Low-Carbon Sustainable Activity

Despite the South Asian Free Trade Agreement, BIMSTEC and various bilateral treaties, formal trade within the BoB remains relatively low despite abundant natural resource endowments, a favourable demographic dividend and geographic proximity due to high trade costs, including tariffs, non-tariff barriers and inadequate infrastructure.

The plan for a regional BIMSTEC connectivity includes (a) coastal shipping and maritime agreements in the region's 25 ports; (b) abolition of *cabotage* (restriction of operation of sea, air and road transport to a particular country's own transport services); (c) overland trilateral highways; seamless border connectivity; (d) enhanced regional air transport agreements; (e) energy connectivity; and (f) services agreements (e.g., tourism, health and education) (De, 2017).

To unleash the full potential between BIMSTEC countries requires, at one level improving border governance and infrastructure; and at macro and regional level, significantly improving port capacities and implementing existing bilateral and BIMSTEC trade liberalisation agenda. Simulations on the implementation of the BIMSTEC Free Trade Area and Trade Facilitation shows economic gains for member countries to the tune of USD 1.1, 5, 2.8, 1 and 2.2 billion for Bangladesh, India, Nepal, Sri Lanka and Thailand respectively (Selim and Pitigala, 2024), with significant spillovers to border communities in coastal regions.

Implementation of the Motor Vehicle Agreement (MVA) among Bangladesh, Bhutan, India and Nepal is a step towards facilitating smoother cross-border cargo and passenger vehicle passage and achieving transport efficiency. Under a scenario of full integration of the MVA between India and Bangladesh, for example, national income would increase by 7.6% in India and 16.6% in Bangladesh (World Bank, 2021).

Strengthening supply chain resilience and links to global sustainable supply chains is especially crucial in vulnerable sectors like agriculture and fisheries to support SDGs such as Zero Hunger (SDG 2) and Decent Work and Economic Growth (SDG 8). Resilient supply chains ensure the continuity of food supplies and economic stability, help mitigate socioeconomic disparities (SDG 10, SDG 1) and sustain critical infrastructure essential for health, education and sanitation (SDGs 3, 4, 6). Additionally, they facilitate climate action (SDG 13), conserve aquatic life (SDG 14) and promote gender equality (SDG 5) by enabling equitable access to resources and supporting adaptive capacities, thereby integrating and enhancing community resilience and sustainability in the face of climate challenges.

To effectively address the complex challenges impacting trade, a multidimensional, well-coordinated bottom-up approach is essential across district, local and regional levels. A significant gap exists in macroeconomic modelling, which requires further refinement through finer disaggregation of regions and sub-regions, coupled with the ongoing impacts of climate change in the near term. We suggest a trading model that would examine two pivotal scenarios: one that underscores the benefits of coordinated governance and sustainable trade practices for climate-resilient development and another that illustrates the adverse effects of isolation and fragmented responses.

8.6 Finding the Solutions: Governance and Capacity Building

Three major shifts, in leadership, administration and engagement at the grassroots, are needed to grapple with climate change issues and achieve SDGs more effectively in the BoB region.

8.6.1 Leadership

First, political and societal leaders in the region need to value the importance of climate change as an issue that affects development across the board and act accordingly. Several countries/states in the region face societal conflicts, polarisation and/or gridlock, which make it difficult to focus on the more long-term issue of climate change. Leadership action in climate change is a function that is poorly understood but essential (Schwerhoff, 2015; Schwerkoff et al., 2018). Because coordinated effort in the regional context involves complicated and time-consuming negotiations, some leaders' unilateral and bolder leadership steps to kick-start such regional cooperation may have large payoffs in incentives for others to follow faster. As the largest partner, India has an especially important role as the 'driver behind the wheel' (De Silva, 2024).

Leadership initiatives are heavily dependent on the understanding of how critical climate change action is likely to be in the coming years in the BoB. Placing the BoB climate change challenge in the front ranks of national and state policy-setting is thus a critical step. However, there is no evidence that regional or sub-regional climate change priorities have made their way into international discussions. For example, the link of global climate change and regional BoB priorities finds a weak or non-existent connection in international climate negotiations and processes, in contrast to the discussion of other regional groupings, such as for small island states or even larger low-income regions such as Sub-Saharan Africa. Although within BIMSTEC climate change is a major concern, as a regional grouping it needs to find its way into the global climate dialogue. The early placement of the sub-region's priorities into the national plans of the countries in the region, and in turn, into the global climate financing, needs are urgent.

8.6.2 Institutions and Bureaucracy

Second, institutions and the bureaucracy must function differently to address climate change more effectively. Bureaucracies tend to function in silos: what is required is an overall strategy to restructure service delivery, growth strategy and development programmes to address climate change that cuts across departments and is embraced by the highest levels of state and national governments. Increased resourcing for climate change can supplement national, state and urban local body budgets as they typically run large deficits, have limited borrowing capacity and are torn between current expenditures on salaries, pensions and interest instead of investing in infrastructure and better service delivery. While a small budget space for climate change initiatives exists at the national and state level, it is virtually non-existent at the local level. The financing gap between resources need for climate change versus what is available is huge, especially for smaller countries like Nepal and Bangladesh, and cannot be met by concessional finance alone. International funding from MDBs and bilateral organisations will remain important to financing the response to climate change at the local, state and national levels in the BoB region.

The government of Nepal estimates that it will need about USD 47.4 billion to address the challenges of climate change (World Bank, 2022a). The resource gap for Bangladesh is even greater, with the Bangladesh Delta Plan 2100 alone identifying projects worth USD 38 billion. Expanding fiscal space, reducing fuel subsidies, introducing carbon taxes, raising government revenue through faster growth and enhancing expenditure efficiency will all be necessary to address the funding gap, along with substantial private sector support. The power of governments will also have to be deployed to promote green procurement across sectors, but may require moving away from a least-cost approach to procuring goods and services. Viewing the entire government budget through a climate change lens will also nudge spending in the right direction. Both Nepal and Bangladesh have developed Climate Change Fiscal Frameworks, and Nepal has introduced a climate-related budget code to track expenditures effectively (World Bank, 2022, 2022a).

In addition to finances, improving the transparency and quality of governance and service delivery is crucial to developing and implementing climate change initiatives effectively. Corruption remains a major issue in the BoB region.[4] Tackling corruption to improve expenditure efficiency is essential through better legal enforcement and stronger anti-corruption institutions; the adoption of transparency measures; reforms in human resource management; and the greater use of technology to facilitate accountability. Weak service delivery in health and education, particularly in the states adjoining the BoB in India, undermines building resilience. In infrastructure, poor road design and implementation makes it more difficult to build roads to higher standards so that they can withstand flooding or intense rains.

Central and state/provincial governments lack specialised staff relating to climate change (Pillai and Dubash, 2021). Most expertise is developed in-house by officials who happen to hold or have held a climate-related positions in the bureaucracy or by hiring consultants whose use can undermine the government's own capabilities. Therefore, developing a cadre of officers trained specifically on climate change is an important priority.

An integrated perspective is crucial to making climate change a central part of the government's overall development strategy. In states, the Chief Minister's offices/leaders of provincial governments working in conjunction with national governments can lead the response assisted by technical teams. Maximising coordination across different layers of government, particularly in federal systems like Nepal, India and Sri Lanka, is crucial for better climate governance. Indian federalism gives the central government considerable fiscal power and allows it to intervene in many arenas involving state governments through the concurrent list, which enumerates areas where both the centre and states may legislate (in the event of a clash, central legislation prevails). Yet, state governments are responsible for most implementation and expenditure responsibilities. Improving the efficiency of centrally sponsored schemes relating to sectors with vulnerabilities to climate change through better coordination between states and the centre is crucial. Reconciling the more centralised nature of Indian federalism with the widely varying impacts of climate change across different states is a major institutional challenge to be overcome (Pillai and Dubash, 2023).

A significant problem with bottom up strategies is the relative weakness of local governments in India, Bangladesh and Nepal. Strapped for funds, limited by the intrusion of central and state/provincial governments, and lacking administrative capacity, local governments represent a weak link in the chain of responsibility for dealing with climate change. Weak local government also stifles an important arena for local civic action in the fight against climate change. A recent study reveals that local governments in Nepal have failed to achieve their goals in adapting to climate change, despite considerable decentralisation in recent years. Local politicians exaggerated their knowledge of climate change issues, doubted that their constituents would prioritise adaptation over development and failed to allocate proper funding for climate resilience and disaster management (Pande et al., 2024).

8.6.2.1 Climate Institutions

Climate Institutions in the BoB region need to be strengthened and integrated with each other. In India, between 2007 and 2009, a Prime Minister's Council on Climate Change (PMCCC) was constituted along with the appointment of a Special Envoy for Climate Change to oversee India's response to global pressures to address climate change and coordinate government's response across Ministries. Over time, an increasingly active Ministry of Environment and Forest became the leading institution facilitating the adjustment to climate change,[5] but lacked the overall cross-cutting authority of the PMCCC. The Office of the Special Envoy was discontinued in 2010 and PMCCC fell into disuse after 2011 (Pillai and Dubash, 2021). India at this time thus lacks a strong institutional framework cutting across ministries to drive the process of responding to climate change. The recognition of the special needs of the BoB region and BIMSTEC priorities into its national plans is especially critical.

In Nepal, the Prime Minister chairs an Environmental Protection and Climate Change Management Council, while the Secretary of the Ministry of Forests and Environment oversees an Inter-Ministerial Coordination Committee to iron out differences on how to address mitigation and adaptation questions. Both these bodies, however, are relatively new and lack a strong institutional basis. Similar Councils chaired by the Chief Ministers of Nepal's provinces are meant to drive climate reforms at lower levels of government (World Bank, 2022a). Like India, Nepal has formulated national and provincial level plans to address the problem of climate change, but capacity constraints hinder their implementation on the ground.

Bangladesh, a country that has wrestled with natural disasters since its creation in 1971, may be better placed to deal with the problem of climate change. As early as 2005, the country developed a national adaptation plan and created a climate change unit in the Ministry of Environment and Forests.[6] In 2009, it promulgated a Bangladesh Climate Change Strategy and Action Plan (BCCSAP), which sought to embed climate change issues across all major sectors, such as food, social protection, health and infrastructure; strengthen local research and knowledge; and bolster institutional capacity. Climate change has figured prominently in the country's 8th Five-Year Plan, the Bangladesh Delta Plan 2100 and other high-level documents. The World Bank has, in a recent report, urged the country to establish a high-level national coordination committee for national development and climate change, enact a climate change law and strengthen local governments to address mitigation and adaptation challenges (World Bank, 2023).

8.6.3 Civil Society Actors

Civil society actors are crucial to educating and equipping citizens to deal with the challenges of adapting to climate change/pushing governments to act. Both societal and official actors are increasingly aware of the dangers stemming from climate change. Stepped-up research by local universities, research centres and other institutions is essential. Electronic and print media are beginning to scale-up their focus on the issues of climate change at the country, state and local levels in the BoB region; they are also beginning to cover the common regional issues, such as fisheries, heat stress, cyclones and disaster management (as also evident from rising interest in such topics in Google search trends, for example). Capacity-building needs to focus on the lower levels of bureaucracy, which are most likely to face the brunt of dealing with a climate change event. Civil society organisations (CSOs) and the media play a significant role in channelling societal pressures to address climate change that can, in turn, push political parties and government actors to respond. As the ill effects of climate change become more apparent, climate change is likely to become an electoral issue as well, bringing more pressure on political elites to show they are serious in tackling it.

Odisha presents an example of what a mobilised community-based strategy to deal with climate-related disasters would look like. In the wake of a super-cyclone in 1999, which caused enormous death and destruction, the state and community organisations worked hand in hand to develop a disaster management strategy. Local governments (Gram Panchayats), community groups and 100,000 plus volunteers were brought together to put in place a disaster-preparedness and coping strategy involving early warning systems, a network of 800 shelters across the state and building evacuation roads from villages along the coast. The process was led by the Orissa State Management Disaster Authority, the first such organisation at the state level in India (Jena and Kouame, 2023).

Bangladesh is lucky to be home to a rich layer of civil society organisations, like BRAC, with major service delivery functions (Smillie, 2009). BRAC, the country's largest NGO touching the lives of some 130 million Bangladeshis, adopted a strategy to make the organisation climate-smart by bringing a climate-related perspective to all its activities (BRAC, 2017). This in turn is bound to have major impacts on other civil society actors and the government itself.

Institutional change in its broadest sense, involving greater transparency and effectiveness in state actions and a greater role for non-state actors (business and civil society), is thus likely to be important in the BoB region. Encouraging CSOs to monitor government commitments, identify shortcomings in programme implementation and disseminate precise data on climate change (in collaboration with the government) to inform and empower citizens would go a long way in ensuring accountability.

8.7 Addressing the Regional Climate Financing Gap

Galvanising partnerships, bolstering trade and strengthening governance will help draw in climate financing for the BoB region. The larger countries in the region (India, Bangladesh, Thailand) and several of their states already have well-developed or large financial systems, reasonably capable private sectors and access to country-specific financing from the RoW. The smaller countries and states in the region have much more constrained fiscal capacity and relatively underdeveloped financial systems. They will need to attract continued concessional financing within their larger country settings or from the RoW. BIMSTEC could enable a hub-and-spoke' architecture where individual larger partners could attract and administer funds from their ends for necessary investments in larger regional projects. This would circumvent concerns where, when individual larger partners are responsible for their ends of the necessary investments in larger regional projects, financing is insufficient. Because of competing national priorities, simple bilateral agreements may prove inadequate. Smaller countries and states with limited capacity may hesitate to use their voice in regional consultations.

The BoB region may focus on larger common regional priorities than has been possible to date, that may not be adequately financed, both in the settings of larger countries and especially where these involve smaller countries and states. Relying primarily on country-level priorities may also miss major regional potential and possibilities, especially those that affect the equity of smaller communities.

Specific regional 'financing windows' may, therefore, need to be created for all six of the identified priority areas to attract both sufficient public finances and sustainable private investments. One of the common frameworks that the BoB region may need to establish urgently includes mechanisms for such 'windows' and mutual agreements that facilitate investments flowing towards these regional priorities. The BIMSTEC Secretariat can play a more proactive role in this regard. Without such frameworks, there is a risk that these investments may not be financed adequately and may miss the larger regional priorities and 'spillover' potentials.

Private investments will only flow where the governance and policy frameworks are sufficiently attractive and transparent. For the same reason, a common framework of agreed priorities and improvements in policy frameworks specific to such regional priorities will be essential, together with consideration of novel or newer instruments (such as carbon financing) and for risk reduction, such as public guarantees to crowd-in such investment, and with public 'gap' financing in other cases. Large pools of private investments, as well as those made by sovereign wealth funds and global philanthropies, could be encouraged by the BIMSTEC to address this gap.

Regional frameworks for financing as proposed above are often very difficult to establish. Few such successful examples of working arrangements exist.[7] However, the risks of climate for future SDGs in the BoB region are so large that such an experiment should be encouraged and with our backs to wall may even be contemplated. The 'spillover' gains justify a departure from traditional (national) financing architectures and instruments.

8.8 Conclusions

At the end of the day, opportunities for sustainable development in the BoB region will depend on enhanced intra-regional trade partnerships that BIMSTEC is aiming to achieve. The elevation of BIMSTEC[8] needs and priorities into clear climate action national plans of its constituent nations, and into the global climate finance priorities and agenda, is also now urgent. The BIMSTEC regional partnership can play a potentially key role to align local action with the global climate agenda, as envisaged under the Paris Agreement and the UNFCCC (UNFCCC, 2016). One immediate element might be to add the BoB/BIMSTEC region to the six Regional Collaboration Centres (RCCs) currently in place. The BoB region is big enough (over 1 billion people in the immediate regional neighbourhood) and at very high global climate risk, with some unique features, to warrant such an RCC partnership with the UN Climate Change Secretariat (UN Climate Change, 2023).[9]

However, the practicalities of such actions will depend on (a) whether the national and state-level agencies can work together in an enhanced partnership; (b) whether the region can attract sufficiently large international public investments by MDBs and other agencies, especially in areas where the private markets may be unwilling or unable to find initially profitable opportunities; (c) making sure that the policies of trade and governance arrangements locally established in every place are consistent with the needs of global public and private climate finance investment flows and local societies; and (d) whether the required special regional financing 'windows' and initiatives, starting at the project level, can be smoothly accomplished and success demonstrated.

None of this may work in a 'top-down' fashion as effectively as they might instead with strongly shared local 'buy-ins'. Extensive and early groundwork done by academic institutions, management and finance institutes, climate-oriented business institutions and large-scale consultations with civil society will be essential (please also see Chapters 4 and 22 in this volume). Without enhanced civil society engagement at scale locally, CRD is difficult, if not impossible. Encouraging engagement and partnerships between local institutions and consultations with others can play as important a role as the formal government-to-government institutions and initiatives currently in place under the BIMSTEC initiative.

Notes

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1 BIMSTEC is the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation, a regional organization established in 1997.

2 https://hmgroup.com/wp-content/uploads/2024/03/HM-Group-Annual-and-Sustainability-Report-2023.pdf

3 Amid escalating energy costs and heightened environmental concerns, Sri Lanka is increasingly turning to solar power. The challenges identified, such as high population density, land, etc., apply here, too. But by 2050, SL's installed electricity generation capacity needs under plans will increase from the current 3,700 megawatts (MW) to about 34,000 MW. Of this, 15,000 MW will be wind energy, and about 16,000 MW will be solar energy. There are clean energy collaborations between India (investing). While both countries are working together to strengthen Sri Lanka's fuel supplies and tap offshore upstream hydrocarbons, India's strategic engagement in Sri Lanka's renewable energy landscape is a testament to its commitment to fostering a sustainable future, aligning with Sri Lanka's ambitious goal of achieving net zero goals.

4 Bangladesh ranked 147 out of 180 countries on Transparency International's 2022 Corruption Perceptions index compared to Nepal 110, Sri Lanka 101, India 85, and Bhutan 25. Capture of the policy-making process remains a major threat, resulting in the despoliation of forests, water, and the environment.

5 In 2014, the new government of Prime Minister Modi renamed it as the Ministry of Environment, Forest, and Climate Change.

6 Renamed in Bangladesh as the Ministry of Environment, Forest, and Climate Change in 2018.

7 Such as the Aral Sea Region Multi-Partner Trust Fund, which involves five former Soviet republics in the Aral Sea basin.

8 The Leaders at the Fifth BIMSTEC Summit held in March 2022 approved the rationalization and reconstitution of the Sectors and Sub-sectors. Environment and Climate Change has become one of the seven priority sectors of BIMSTEC cooperation.

9 UN Climate Change. (2023). *Boosting Regional Preparedness, Regional Collaboration Centres, Annual Report 2023*. https://unfccc.int/sites/default/files/resource/RCC_AR2023.pdf

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9 Financing Climate Action at the Subnational Level

Public Expenditure Tracking in Maharashtra

Pranav Prakhyat Garimella, Faiza Solanki and Saransh Bajpai

9.1 Introduction

The Intergovernmental Panel on Climate Change (IPCC) in its working group III report highlighted the slow progress on climate finance and a significant climate finance gap indicative of a misallocation of global capital, with about 90%, on average, of climate financial flows between 2017–2020 going towards climate change mitigation interventions (Kreibiehl et al., 2022). Despite that, to meet even global mitigation needs, investments need to increase by a factor of 3 to 6 times (Kreibiehl et al., 2022). On the adaptation front, modelling estimates show adaptation costs for developing countries are around USD 215 billion every year until 2030, while estimates from country nationally determined contributions (NDCs) and adaptation plans indicate a need of USD 387 billion each year (UNEP, 2023).

In the Indian context, the estimates of climate finance needed at the national level range from USD 6 to 8 trillion for 2015–2030 to USD 12.4 trillion (Live Mint, 2022) for 2070 net-zero goal. The range of different estimates (also see Chapter 1), even though not directly comparable, clearly indicates that climate finance flows needed for mitigation are substantial and in the order of tens of trillions by 2050. Climate finance needed for adaptation is even higher, of the order of INR 85.6 trillion (at 2011–12 prices) (MoEFCC, 2022).

At the subnational level in India, states have introduced two rounds of Climate Action Plans. In the first round, 25 states introduced State Action Plans for Climate Change (SAPCC). The climate finance needs to implement the first round of SAPCCs found that, for 13 SAPCCs alone, the estimated requirement was around ~USD 71.4 billion (Mandal and Rangarajan, 2015). States have started revising their SAPCCs and so far, 6 states have made revisions. The climate finance needs of the adaptation interventions in the SAPCCs of these 6 states alone is around USD 5.5 billion for the period between 2021–2030 (Chakravarty et al., 2024). *SAPCC implementation is the responsibility of the state governments and do not receive Union Government assistance*. States currently rely on domestic state budgets and international finance to meet the implementation needs of their SAPCCs (MoEFCC, 2022). At the state level particularly, state budgets are the main drivers of climate action, especially adaptation – funded through core development budgets (Resch et al., 2017).

In this context, it is important to analyse public expenditure and its importance in provision of climate finance for mitigation and adaptation-related interventions at the subnational level in India. Public expenditure tracking has several benefits for governments because they (i) help policymakers to plan, prioritise and allocate resources to

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better tackle climate change; (ii) promote transparency and accountability towards climate goals and targets; (iii) set the baseline for existing levels of climate action to be tracked over time; (iv) use it is a precursor for introduction of green financing frameworks (Resch et al., 2017). In this chapter, we carry out a budgetary analysis of the state government budget 2023–24 for Maharashtra, to set a baseline for climate action in the state and map the budgetary allocations for specific climate change mitigation and adaptation strategies such as climate-proof water management and low-carbon transition of industrial sectors. The analysis seeks to inform the budgetary planning and mainstreaming of climate action into Maharashtra's budget.

In the second section of this chapter, approaches, methodologies and case studies of public expenditure tracking are explored with the aim of highlighting the comparative advantages and disadvantages of these methodologies. The third section explores how states in India have adopted different methodologies with the aim of identifying the issues, challenges and benefits of using public expenditure tracking methodologies. In the fourth section, the budgetary analysis done for the State of Maharashtra is discussed to demonstrate how this can help in tracking and mainstreaming climate change mitigation and adaptation priorities into the planning and budgetary processes. The last section concludes with the need for uniform and routine climate budget tagging exercises at the national and subnational level.

9.2 Public Expenditure Tracking and Approaches

Public expenditure tracking for climate change as a governance tool is a relatively recent practice and borrows from public finance methodologies and budget tagging practices in the development sector (Resch et al., 2017; World Bank, 2021a). The commonality between issues such as climate change, poverty, gender and international development is the cross-sectoral and whole-of-government nature of the policies needed to address them (World Bank, 2021a). This means that any policy intervention relating to development and climate change will necessarily involve interventions and expenditures from multiple government agencies. In the normal course of budget planning and allocations, resources are focused on individual departments. Public expenditure tracking tools were therefore, developed with intent of mapping or tracking activities of multiple government departments with shared policy objectives (World Bank, 2021a).

Public expenditure tracking for development priorities started with pro-poor budget tagging as part of 'Poverty Reduction Strategies' (PRS) introduced by World Bank and IMF in the late 1990s (Wilhelm and Krause, 2007). The PRS was an approach which enabled low-income countries to articulate development priorities and design policies, programmes and resources aimed at poverty reduction (Wilhelm and Krause, 2007). Further, the PRS was aimed at greater accountability by clearly framing development goals and target setting so that they are results oriented. However, studies show a major flaw in the implementation, in terms of weak linkages between the strategies under the PRS and budgets in the low-income countries which defeated one of the objectives of the PRS meant to promote accountability of the government to its people (Wilhelm and Krause, 2007). Similarly, gender-responsive budgeting has been a widely followed practice since the 1990s – over 80 countries have adopted some form of gender budgets using budget tagging methodologies to track gender-relevant expenditure (World Bank, 2021a). The challenges and lessons from pro-poor budgeting and gender-responsive budgeting need to be kept in mind while designing climate-change-related public expenditure tracking.

9.2.1 Approaches and Methodologies

Two broad approaches have emerged for tracking public expenditures for climate-related activities. Namely, objectives-based and benefits-based approach to assess climate relevance of interventions. Objectives-based approach to assessing climate relevance of public expenditure involves assessing the objectives of schemes and programmes to analyse how they incorporate climate change whether explicitly or implicitly (Allan et al., 2019). Benefit-based approaches on the other hand, involve assessing the benefits accrued from the scheme or programme in terms of climate change, separate from economic, social and environmental benefits. The advantage of an objective-based approach is the simple and routine manner in which the assessment of climate relevance of schemes and programmes can be done (Resch et al., 2017). Anyone with access to budget documentation and knowledge of climate change (with additional resources such as scoring methodology), will be able to undertake the exercise. This means that with relatively less effort and resources such exercises can be done across government departments and agencies. The methodology of the benefits-based approach is more rigorous. However, its limitations are the new expertise, capacities and resources to undertake assessment (which might not be accessible to subnational governments). The disadvantage with objectives-based approach is the high level of subjectivity and scope for interpretation which could lead to issues like green washing (Nicholson et al., 2016). Therefore, a balance must be found between the two approaches so that the climate budget tagging exercise can be done routinely and regularly while avoiding manipulation.

In terms of methodologies for public expenditure tracking, there are three main methodologies, namely, 'Budgetary Analyses', 'Climate Public Expenditure and Institutional Reviews' and 'Climate Budget Tagging' (Resch et al., 2017). Budgetary analysis is the most common type of methodology used for climate public expenditure tracking. The three methodologies differ in terms of what sources of funding are covered – where budgetary analysis and budget tagging cover government on-budgets expenditures, public expenditure reviews also cover external off-budget sources (Resch et al., 2017). Budgetary analysis, the simpler of the three processes, can be done with little resources in terms of time, costs and frequency. Public expenditure reviews on the other end of the spectrum are more time and resource intensive and may be done infrequently.

9.3 Climate Budget Tagging and Approaches in India

In India, currently there is no framework or guidance at the national level on public expenditure tracking (Agarwala, 2022). In 2023, as part of the 2nd G20 Sustainable Finance Working Group meeting in Udaipur, India, subnational governments in India shared their experiences with climate budget tagging in states like Bihar and Odisha (G20, 2023). The discussions recommended more climate budget at the state and national levels. Several states in India have been undertaking diverse approaches and methodologies for assessing climate relevance of subnational budgets (Agarwala, 2022). State governments such as Kerala, Bihar, Odisha, Assam and Meghalaya have been undertaking different forms of public expenditure tracking tools such as green budgets and climate budgets since 2020–2021.

There is no uniform approach or methodology that has been followed. States in India have been mandated to prepare State Action Plans for Climate Change (SAPCCs). The SAPCCs have, however, proven to be difficult to implement for many state governments (Agarwala, 2022). Funding of the SAPCCs has been one of the big challenges for states as there is no separate budget allocation or support from the Government of India for implementing them – therefore, putting the onus of financing the strategies through state budgets and meagre international public and private sources of finance (Allan et al., 2019). The onus of SAPCC implementation and climate action put on the state governments in India is a major challenge as poorer states might not have resources to implement climate action, as it is an extra burden on state budgets, which also have to prioritise developmental priorities.

For this chapter, public expenditure tracking in Odisha and Bihar will be highlighted. Odisha was among the first states to draft a SAPCC and subsequently identifying the financing needs for SAPCC interventions within existing state budgets (Allan et al., 2019). The SAPCC identified 12 schemes explicitly linked to SAPCC-related activities. Thereafter Odisha undertook a more extensive, cross-sectoral climate budget tagging exercise for 11 departments in the state starting in FY 2020–2021 (Government of Odisha, 2023). The Odisha climate budget first assesses the climate relevance of the departmental budgets in the state (Agarwala, 2022). Next, it assesses the vulnerability of public expenditure to future climate impacts. The Odisha climate budget is annually reported alongside the state budget for all the schemes and programmes for 11 departments. The climate budget in Odisha has enhanced the state's commitment to financing climate action and strengthened planning and allocations in the budget for climate action (Allan et al., 2019).

Bihar followed a different approach. Even the objectives of the Bihar green budget were different from that of Odisha. In Bihar, the green budget or Harit budget was also first undertaken in 2020–21 to identify and map fiscal and economic policy from the perspective of environment (Agarwala, 2022). Bihar's green budget sought to focus on inter-departmental cooperation to better respond to the threat of environmental sustainability. Further, policies in the state were sought to be aligned with national commitments on environmental sustainability (Government of Bihar, 2023). The green budget of Bihar is focused on issues such as climate change, biodiversity, restoration, and ecosystem but does not follow any globally standardised methodology as there is still no standardised approach for green budgeting globally (Agarwala, 2022).

9.4 Budgetary Analysis of State Budget FY 2021–2024 for Maharashtra, India

9.4.1 Approach

Step 1: Review of Department-Wise Budgets

Climate relevance of charged and voted expenditures, and revenue and capital allocation was undertaken for Maharashtra State Budget. The budget estimates and actuals from FY 2021–2022 until FY 2024–2025 were extracted for 14 departmental budgets in Maharashtra, and coded for climate relevance (Figure 9.1).

Step 2: Developing a Template for Budgetary Analysis

A template was developed for conducting the tagging exercise, in which the allocated expenditures for departments' major and minor codes along with grant codes (contributions, subsidies codes), and expenditure codes. Further, the departmental budget data was disaggregated to understand the source of the budget flows, budget allocations from

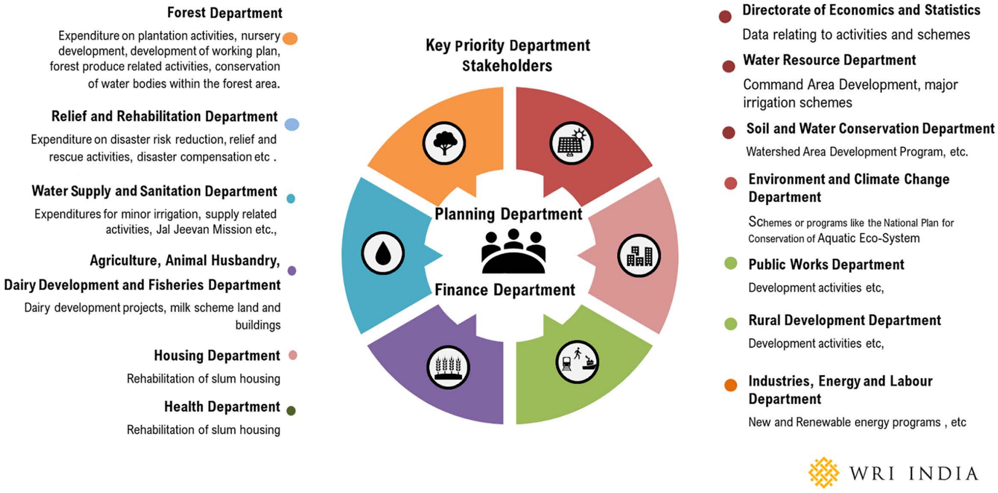

Figure 9.1 Fourteen Departments for Budget Coding Exercise

Source: Author's compilation

central sector schemes, centrally sponsored schemes, and state-sponsored schemes. It is worth noting that, for this analysis, only the non-salary/grant components have been considered for the budget tagging, excluding the salary and administrative budget lines.

Step 3: Review of Objectives and Goals of the Scheme/Programme

Upon populating the budget codes and relevant expenditure codes in the template, a mapping exercise was done with the aim of doing a robust literature review of schemes/programmes and mapping scheme and programme objectives and goals. National schematic programme manuals, programme performance budgets, annual status reports, and DPRs were the main sources of literature reviewed for the mapping.

Step 4: Weighted-Averages Matrix for tagging climate relevance

After the in-depth literature review, the Climate Public Expenditure and Institutional Review (developed by UNDP and World Bank) scoring methodology (Dendura and Le, 2015) was used for conducting the tagging exercise, in which weighted averages were assigned for the budget lines identified in step 1 and 2. Figure 9.2 shows the tagging using CPEIR weighted scores as an illustration.

Schemes/programmes with a clear primary objective of delivering specific outcomes that improve climate resilience or contribute to mitigation were assigned <75% and marked as high relevance. Schemes and programmes whose secondary objectives are related to building climate resilience or contributing to mitigation, or mixed programmes with a range of activities that are not easily separable but include at least some activities promote climate resilience or mitigation were tagged between 50–74% or medium

Soil and Water Conservation Department						
Major Head	*Minor Head*	*Expenditure Code*	*Budget Item Descriptions*	*Objective of the scheme*	*Budget Estimates 2023–2024 (INR Thous)*	*Assessment of Climate Change Relevant Expenditure*
4402	102	53	Pradhan Mantri Krishi Sinchan Yojana – Integrated Watershed Area Development Management Programme (C.S.S.) (Central Share 60%)(Scheme)	A vision of extending the coverage of irrigation 'Har Khet ko pani' and improving water use efficiency 'More crop per drop' for source creation, distribution, management, field application and extension activities,	2552192	High
4402	102	53	Project for Efficient Water Management and Agriculture Technology Adoption For Climate Adaptive and Resilient Farming System in 51 Villages of Nandurbar and Buldhana Districts of Maharashtra 100%CSS) (Scheme)	Aims at developing climate adaptive and resilient farming system through efficient water management and technology adoption for adaptive agriculture by rural households in agriculture and allied sector	114700	High
4402	102	53	Jalyukata Shivar – Jalyukta Shlvar Abhiyan (Scheme)	To make Maharashtra a drought-free state. The project involves deepening and widening of streams, construction of cement and earthen stop dams, work on *nullahs* (small streams) and digging of farm ponds.	5450000	High

Figure 9.2 Tagged Weighted Averages Along Soil, Water Conservation Department

Sources: Authors' compilation

Soil and Water Conservation Department

Major Head	*Minor Head*	*Expenditure Code*	*Budget Item Descriptions*	*Objective of the scheme*	*Budget Estimates 2023–2024 (INR Thous)*	*Assessment of Climate Change Relevant Expenditure*
4402	101	53	Capital Outlay on Minor Irrigation – Surface Water – Minor Irrigation Works 0 To 100 Hectares Capacity (Scheme)	Infrastructure and procurement for canal development – Project objective documentation not available	1500000	Marginal
2402	196	31	Establishment of District Water Conservation Officer Zilla Parishad Minor Irrigation (Committed)	For water conservation projects -Project objective documentation not available	37224	Low
2402	80	31	Grant in Aid to WALMI under Command Area Development Authority (CADA) (Scheme)	For ongoing Command Area Development and Water Management Programme covered under the PMKSY Har Khet Ko Pani (HKKP) component given to Water and Land Management Institute	300000	Medium

>75% High Relevance – Clear primary objective as climate change 50%–7.4% Medium Relevance – Secondary objective/mixed programmes 25%–49% Low Relevance-Indirect adaptation and mitigation <25% Marginal Relevance – Only very indirect to climate resilience

Figure 9.2 (Continued)

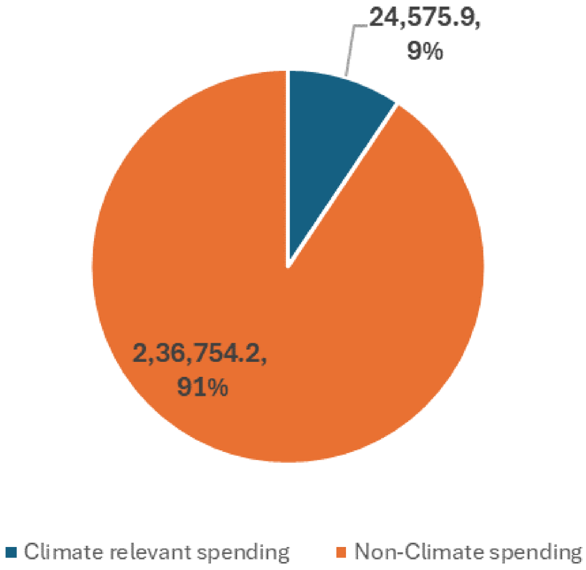

Figure 9.3 Total Climate-Relevant Spending for FY 2023–2024

Source: Authors' compilation

relevance. For schemes and programmes whose objectives had indirect impact on mitigation or adaptation were assigned 25% – 49% or low relevance. Lastly, budget lines with very indirect impact on resilience were assigned marginal relevance. With this analysis, the overall climate relevance of the department-wise budget was tagged and assigned climate relevance using a weighted score. Figure 9.3 shows the total climate-relevant spending for 14 departments tagged.

Step 5: Tracking Climate Relevance by Use

Further analysis was done to tag the allocations to assign which type of climate action the budget lines impact, namely, relevance to adaptation, resilience, and mitigation. From Figure 9.4, we can see that out of the high climate relevant expenditures in Maharashtra (9% of coded budget), 5% of the schemes and programmes contribute to adaptation, 2% towards resilience building, and 2% towards mitigation. As seen in the Figure 9.4, 91% of the total coded budget is medium, low or marginally climate relevant.

9.4.2 Budgetary Analysis for Adaptation-Related Interventions – Water Resources

Maharashtra will face the twin challenges of both water scarcity and flooding according to the Intergovernmental Panel on Climate Change's (IPCC) in its sixth assessment (Singh, 2022). According to the Maharashtra State Adaptation Action Plan on Climate Change (MSAAPC), a quarter of drought-prone districts in the country are in Maharashtra. In the state, 40% of the total geographical area is drought-prone and another 7% is flood-prone. The drought-affected districts of Maharashtra account for 60% of the

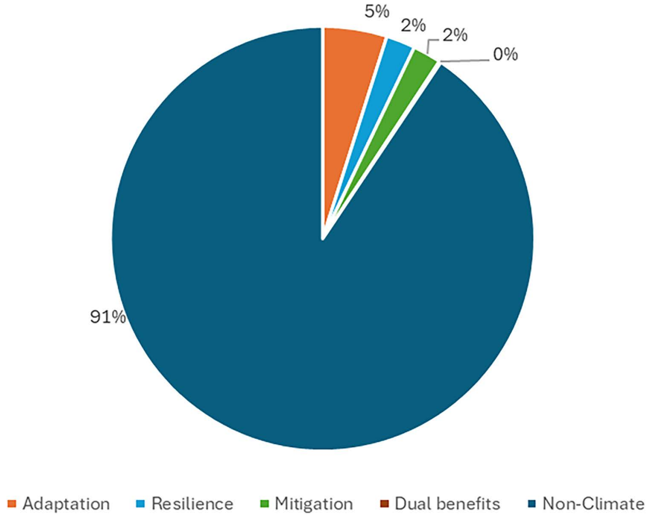

Figure 9.4 Tracking the Climate Relevance Allocation by Use

Source: Authors' compilation

net sown area and lie in the rain shadow region east of the Sahayadri mountain ranges in Maharashtra and the adjacent Marathwada region (TERI, 2014). The Marathwada regions are the most drought-prone areas of the State, with an annual average rainfall of less than 600 millimetres. These regions are generally characterised by extreme aridity, hot climate, and acute deficiency in water availability (TERI, 2014). To meet the water demand, the Marathwada region has 953 government and private tankers distributing drinking water across five of its eight districts. The most number of water tankers are supplying Chhatrapati Sambhajinagar (formerly Aurangabad) district at 443, followed by Jalna at 321, and 117 water tankers in Beed (Nitnaware, 2024).

In this context, this section will analyse the budget of the water resources department in the state to understand how the Government of Maharashtra is allocating budgets for issues relating to drought and flooding. Out of the total Maharashtra State Budget for FY 2023–2024, INR 2,031 crore was allocated for the water resources department which was 0.3% of the total budget of the state. The budgetary analysis assessed the climate relevance of the department. From Figure 9.5, it can be seen that out of the total climate-relevant allocations for the department budget, only 12% is high climate relevant. Figure 9.5 also shows that 88% of the water resources department budget is medium, low or marginally climate relevant.

Of the 12% of the departmental budget which is highly relevant to climate, 83% has been allocated for adaptation-related (Figure 9.6) schemes such as the Maharashtra Krishna Valley Development Corporation (DRIP-World Bank Share) (World Bank, 1998), Godavari Marathwada Irrigation Development Corporation (DRIP-World Bank Share) (World Bank, 2021b), Vidarbha Irrigation Development Corporation (DRIP-World Bank Share) (MPCB, n.d.), Tapi Irrigation Development Corporation (DRIP-State Share) (Testbook, n.d.), Konkan Irrigation Development Corporation, Kharland Schemes for Soil conservation, Punyashlok Ahilyadevi Holkar Water Users Association Awards (Raj

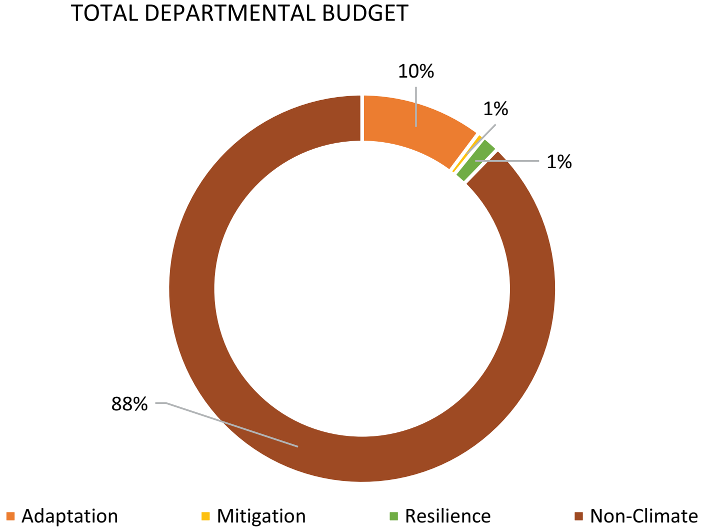

Figure 9.5 Climate Relevance in the Budget Allocated for the Water Resources Department
Source: Authors' compilation

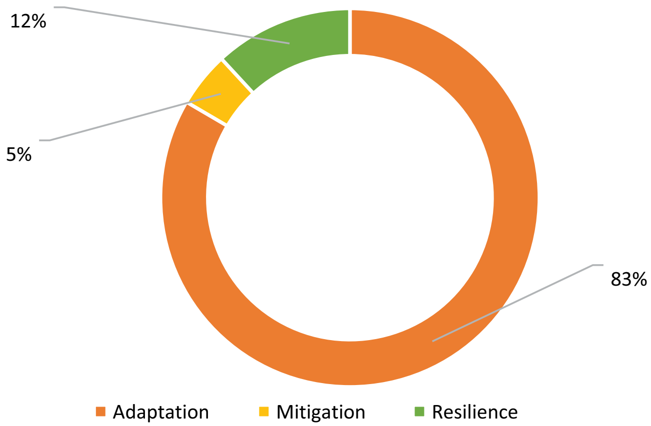

Figure 9.6 High Climate Relevance for Water Resources Department (FY 2023–2024)
Source: Author's compilation from, *Government of Maharashtra (2023–2024)*

Bhavan Maharashtra, 2022) and contributions to Pradhan Mantri Krishi Sinchai Yojana. As can be seen a majority of the high climate relevant budget allocation is towards the issue of droughts in the state. However, research has shown that Maharashtra's expenditure on the issue of drought-proofing has not resulted in positive outcomes for people of Maharashtra, especially for farmers and rural population (Nitnaware, 2024). The budgetary analysis along with research in this fashion shows that the baseline public expenditure on drought-related adaptation is inadequate and there is a need to increase allocations and mainstream adaptation-related interventions in the Water Resources Department budget.

Further, of the 12% high climate relevant budget allocations of the water resources department in Maharashtra, only 1% is allocated for schemes and programmes which build resilience (Figure 9.6) – schemes like the Jalsaksharta and Jaljagruti Programme under the Jalyukt Shivar Abhiya[1] and Command Area Development schemes. With respect to resilience to drought and flooding, there is a need to increase and mainstream resilience-related interventions in the department budget. Department budget allocations for hydro-electric projects was 1% (contributing to mitigation) out of the high climate relevant allocations for the water resources department, which includes projects like the Bhatsa Hydro Electric Project (WRD Maharashtra, n.d), Bhira Tail Race Hydro Electric Project (Global Energy Monitor, n.d.), Kumbhe Hydro Electric Project (Government of Maharashtra, 2011), Majalgaon Hydro Electric Project (Government of Maharashtra, 2024), Pench Hydro Electric Project (Power Technology, 2021) and the Koyna Hydro Electric (Project Power Technology, 2024).

Nearly 94% of the expenditure allocation is towards state sector schemes like the Jalsaksharta and Jaljagruti Programme and 5% are centrally sponsored schemes. 1% contribution is from supporting development finance instructions like the World Bank DRIP share schemes and financial aid from the National Bank for Agriculture and Rural Development (NABARD) (Figure 9.7).

In other states in India such as Tamil Nadu and Odisha, the estimated annual adaptation investment needed is around INR 17,600 crores and INR 19,800 crore respectively (Chakravarty et al., 2024). The total financial gap for adaptation reforms in water resources in states like Tamil Nadu itself stood at INR 2314 Cr. State public expenditure enhancement for adaptation-related interventions relating to water resources is important for bridging the adaptation gap. This could be done by allocating more budget

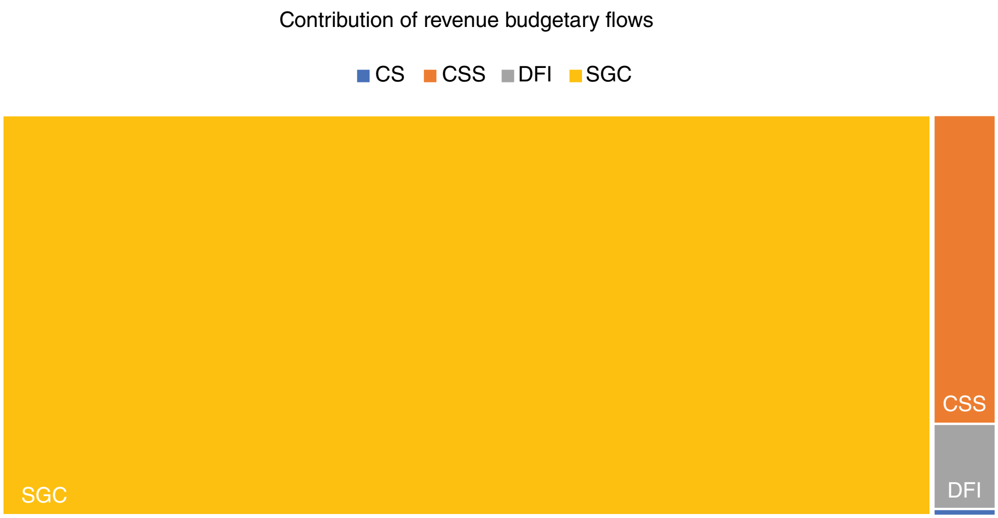

Figure 9.7 Contribution of Different Sources of Budgetary Flows

Source: Authors' compilation from *Government of Maharashtra (2023–2024)* towards conservation and re-naturalisation of rivers and water bodies, enhancement of water storage, and groundwater recharge, and improvement of water use efficiency at the grassroots levels. At the national level, the total tracked green finance for adaptation in 2020 was INR 37,000 crores per annum, which falls short of the needs of the country (Srinivasan et al., 2023). Further, many states in India are in the process of updating their SAPCCs and estimates show that only for six states, the investment needs for adaptation amount to INR 44,400 crores for the period 2021–30 (Chakravarty et al., 2024). These numbers highlight the large gap between the adaptation needs and finance flows for adaptation, which at the subnational level are primarily coming from public expenditures. Therefore, it is important to do more such budgetary analysis to track and mainstream adaptation priorities into subnational budgets.

Examples from other geographies show the benefit of climate budgeting exercises in enhancing funding for adaptation and resilience to climate change. In the Philippines, the government has established a cross-sectoral budget programme specifically focused on adaptation and risk resilience for coordinating with different implementing agencies and their budgets to deliver a harmonised programme of investment (Allan et al., 2019). The Government of the Philippines also ensures that budget hearings routinely consider climate change, and it operates a climate budget tagging system, which results in a series of climate budget reports being issued throughout the fiscal year. In terms of the impact on the Government's spending on adaptation, these reforms have contributed to the increased levels of national budget allocations for adaptation seen in recent years, which has seen a compound annual growth rate of 22% over the last four years (Allan et al., 2019). Further, budget allocations in the Philippines for water-related adaptation and resilience interventions has significantly increased (Allan et al., 2019). Budgetary analysis and climate budget tagging can inform and lead to enhancement of sectoral allocations for specific schemes and programmes which will have a greater impact on mainstreaming climate adaptation, and resilience. In Maharashtra the findings of the budgetary analysis combined with best practices from other states and geographies will inform budgetary planning for climate action.

9.4.3 Budgetary Analysis for Low-Carbon Transition and Resilience of Workers

Maharashtra has, in terms of number, the third largest industrial and the largest of auto sector and has an opportunity to undertake an economy-wide approach to decarbonisation which would lead to green jobs and green growth (iForest, 2024). Currently, one of its challenges is the high level of unorganised employment. At the same time, there are multiple policies which are enabling a low-carbon transition in Maharashtra. For example, the state's EV policy was first introduced in 2021 with the target of increasing the share of EVs to increase to 10% of all vehicle registration in the state by 2025 (Government of Maharashtra, 2021). Several large car manufacturers have started or are planning on starting EV manufacturing in the state. Maharashtra has 16,602 automobile manufacturing and engineering enterprises (OEMs and ACMs), of which 79.5% are micro-scale enterprises and 17.8% are SMEs – employing around 3.4 lakh people (Clean Mobility Shift, 2024). In Maharashtra districts such as Pune, Kolhapur, Shambaji Nagar, Thane, and Mumbai suburban, alone account for 60% of the vehicle industry (Clean Mobility Shift, 2024). The EV transition will, therefore, impact big car manufacturers as well as their supply chain. Maharashtra also has about 17,000 brick manufacturing units producing an estimated 28 billion bricks annually (Sameeeksha, n.d.). In districts in

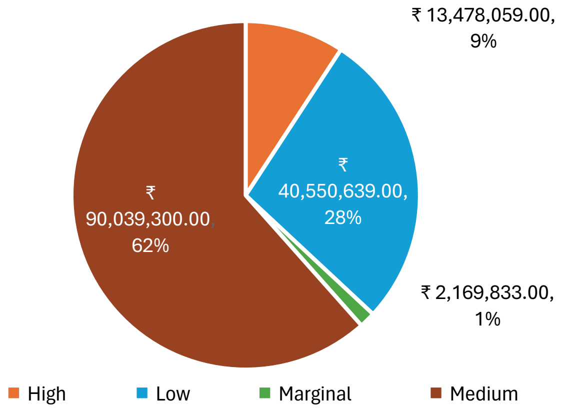

Figure 9.8 Industry, Energy and Labour Department FY 2023–2024
Source: Authors' compilation from *Government of Maharashtra (2023*–2024)

Maharashtra such as Pune, Mumbai, Thane, Sangli, and Nagpur, the brick industry is a major source of employment – which has high level of informality. These manufacturing units and its workers will become vulnerable due to more energy efficient technologies and low-carbon transition in the state. The low-carbon transition will involve skilling new workers and re-skilling the existing workforce where possible.

The Industry, Energy, and Labour department budget in Maharashtra does not specifically have allocation aimed at workers affected by the transition in different economic sectors or building resilience of workers in the state through different social protection schemes and programmes. The departments allocations towards workers have largely been towards the strengthening of the Maharashtra Institute of Labour Studies, social security for workers under the Fund for Pradhikaran aimed at unorganised workers, and development of schemes for common facilities and infrastructure in the approved MSME Industrial Cluster (IIUS scheme). However, as shown in the Figure 9.8, this is less than 1% of the overall high climate relevant allocations of the departmental budget.

Out of the total allocated budget for the urban development department (INR 4694 cr), the budgetary analysis has coded INR 4569 Cr. Out of which about INR 224 Cr is allocated for labour and skill development. Analysis shows that there has been a decrease of 5.96% in the allocations for FY 2023–2024 for labour and skill development compared to the previous FY 2022–2023. If we look at the financial flows from the centre, there has been a decrease of 16.67% in overall financial outlays in terms of grants or CSS compared to the previous FY. The major allocations are for the Dindayal Antyoday Yojana National Urban Livelihood Mission, and the state livelihood mission, whose objective is to provide self-employment and skilled-wage employment opportunities to empower the middle-lower income. Figure 9.8 provides the total allocation for adaptation, resilience, and mitigation-related schemes. As the analysis shows, though the allocation for adaptation and mitigation-related activities is high, resilience-related allocations are very low (Figure 9.9). The analysis highlights the need for Maharashtra to have greater focus on building resilience of organised and unorganised workers in the state for the low-carbon transition in different economic sectors.

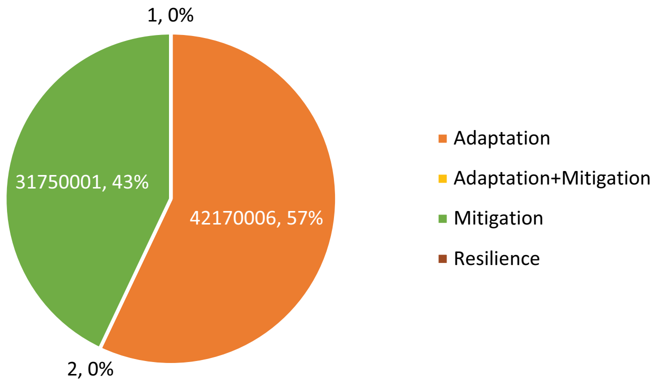

Figure 9.9 Adaptation and Mitigation Expenditures by Urban Development Dept FY 2023–2024
Source: Authors' compilation from *Government of Maharashtra (2023*–2024)

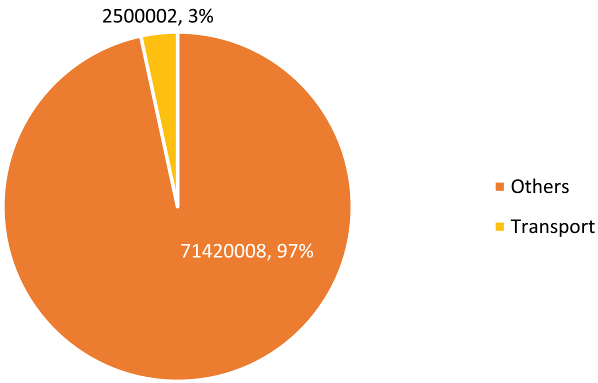

Figure 9.10 Transport Expenditure by Urban Development Dept FY 2023–2024
Source: Authors' compilation from *Government of Maharashtra (2023*–2024)

9.4.4 Building Resilience from the Gender Perspective

Transport which is a key function of the urban development department's priorities, has been allocated only 3% out of the total allocation for urban development department (Figure 9.10). Out of the 3% of the department budget which focuses public transport inclusive transport priorities are not a focus – with less than 0.5% allocated towards gender-related schemes like the Tejaswini Ladies Bus Service (Scheme).

In the rural development department (Figure 9.11), out of the total allocated budget, 42% is allocated towards schemes addressing building climate resilience. But only a few schemes, for instance the Sumatibai Sukalikar Udyogini Mahila Sakshamikaran Yojana provide loans at zero percent rate to the women self-help groups who repay their loans regularly. This was established under the National Rural Development Mission. Similarly, another programme, the Startup Village Entrepreneurship Programme (SVEP) aims

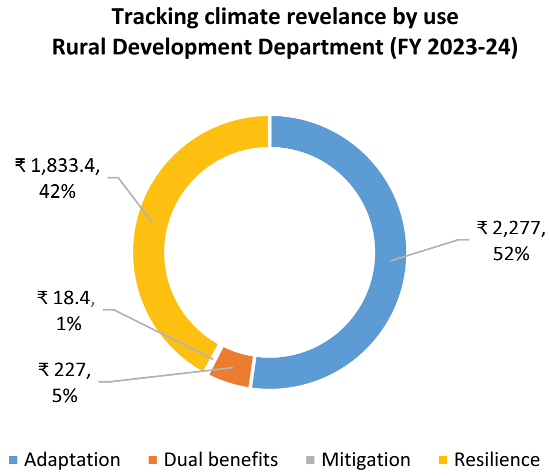

Figure 9.11 Adaptation and Mitigation Expenditure by Rural Development Department FY 2023–2024

Source: Authors' compilation from *Government of Maharashtra (2023*–2024)

at supporting the rural poor by creating a local community cadre for the promotion of enterprises, supporting early-stage rural enterprises by providing them with a range of critical services, business development support, mentoring, finance, access to the banking system along with guidance for convergence, and integration with other government schemes. However, this only accounts for 1% of the overall budget which is dedicated to a building resilience from a gender perspective. The budgetary analysis of the urban development department and rural development departments in Maharashtra shows there is further scope to mainstream resilience from a gender perspective by allocating more towards schemes and programmes aimed at inclusive transport, and livelihood support for women.

9.5 Conclusion

The budgetary analysis undertaken in Maharashtra has demonstrated how public expenditure tracking methodologies can be an effective way of tracking budgetary allocations and expenditures towards important issues relating to climate change. The analysis is complemented by literature, and best practices can inform governments on where to enhance budgets to mainstream climate action. The examples of water-resources-related adaptation and resilience are important because the main driver of climate adaptation, especially at the subnational level, is state budgets in India. The analysis of the water resources department highlights areas, themes, schemes and programmes where additional allocations will result in better outcomes for climate adaptation and resilience. Similarly, the analysis of the industries, energy and labour department shows how public finances can build resilience for industries and workers in the state in the context of the low-carbon transitions being undertaken by states.

Public expenditure tracking is a useful tool for governments at different levels in promoting accountability and transparency in terms of climate action. The case study of

Maharashtra also showcases how such budgetary analysis can be leveraged to mainstream climate action into planning processes and budgets. Wider adoption and standardised methodologies of public expenditure tracking tools will become more relevant as the impacts of climate change worsen in the future. Analysis and exercises such as the one done in Maharashtra can help the subnational government in accessing and mobilising climate finance at the state level based on the departmental needs identified. Public expenditure tracking exercises are often precursors for mobilising additional climate finance, for example, green bonds, as they identify areas and gaps where private sector and public international sources of climate finance are needed. For Maharashtra, public expenditure tracking can serve as a signal for attracting other sources of climate finance in the state – along with increasing transparency and mainstreaming of climate priorities in domestic public expenditure.

Note

1 Major objective is aimed at making Maharashtra a drought-free state by 2019. The project involves deepening and widening of streams, construction of cement and earthen stop dams, work on nullahs and digging of farm ponds.

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10 Financing Climate Action at Local Level

Scope, Opportunities and Challenges

Shivika Solanki, Rini Dutt and Swati Gupta

10.1 Rationale for Enhancing Access to Climate Finance at a Local Level in India

Climate change is an unprecedented global challenge affecting ecosystems, economies, and societies. Rising temperatures are already having severe consequences globally, including more frequent and intense droughts since 2000 and an increase of the order of billions in the number of people will live in areas that are water-scarce for at least one month each year (UNCCD, 2022). Climate-related health issues have also been on the rise, with the World Health Organization estimating that between 2030 and 2050, climate change will cause approximately 250,000 additional deaths per year from malnutrition, malaria, diarrhoea, and heat stress (WHO, 2023). We are experiencing the fastest ever biodiversity loss in recorded history with extinction rates estimated to be 1,000 times higher than natural background rates (Pappas, 2014). The scale of the challenge is matched only by the financial resources required to address it.

India's updated Nationally Determined Contributions (NDCs) under the Paris Agreement, outline ambitious climate goals, including reducing emissions intensity, increasing renewable energy capacity, and enhancing resilience that necessitates substantial investments. Its population projected to increase by about 1.6 billion to reach 9.7 billion by 2050 (World Population Review, 2024) and it will encounter escalating climate risks of extreme weather events, water scarcity, heatwaves, and other climate related disasters. Rapid urbanisation and increasing climate impacts make it imperative to enhance access to climate finance, at all levels, especially at the local level. Further, local governments play a crucial role in implementing climate action on ground, highlighting the need for robust financial support.

India's efforts in climate action are largely self-financed, with domestic mobilisation playing a crucial role in supporting various mitigation and adaptation projects. While global as well as domestic funds exist, channelling them effectively to local levels remains a challenge. At the end of the day, climate action is inherently local and enhancing local access to climate finance is the key to combat climate change. Investments in renewable energy, green infrastructure, and community resilience yield tangible benefits. When aggregated, these local efforts contribute significantly to global climate goals.

Enhancing access to climate finance at the local level in India is not only a necessity but also an opportunity. By empowering local governments and communities, we can build resilient, sustainable and equitable societies and accelerate progress towards a climate-resilient future.

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10.2 Context: Climate Finance at a Sub-National Level in India

According to India's initial Nationally Determined Contribution (NDC), climate action requires USD 2.5 trillion from 2015 to 2030, approximately USD 170 billion per year. Estimates by NITI Aayog indicate that the mitigation activities for moderate low-carbon development would cost around USD 834 billion till 2030 at 2011 prices (UNFCCC, n.d.). Understanding the flow of climate finance within India is essential to grasp how resources are allocated for climate mitigation and adaptation at various governance levels. This section attempts to describe the current flow of finance within the country across three main streams, namely, international finance, national finance, and state-level finance. Private finance has been excluded from this discussion.

International Finance comes in in the form of funds from multilateral agencies and institutions like the World Bank, Asian Development Bank (ADB), and Green Climate Fund (GCF). These institutions provide significant aid which is often routed through national entities such as the Ministry of Environment, Forest and Climate Change (MoE-FCC) and the National Implementing Agency (NIE) as well as various state governments. Several developed countries like Germany, Japan, and the UK also provide bilateral aid for climate projects in India.

National Finance for climate action is routed through the various schemes of the Government of India which are dedicated to climate action such as National Clean Energy Fund (NCEF), Swachh Bharat Mission (SBM), and missions under the National Action Plan on Climate Change (NAPCC) among others. Further, the Union Budget reveals several other schemes and programmes which may not have an explicit climate mitigation or adaptation agenda but have substantial direct or indirect benefits for climate action as well as other co-benefits, such as Mahatma Gandhi National Rural Employment Guarantee Scheme, Jal Jeevan Mission, Pradhan Mantri Krishi Sinchai Yojana, amongst others. National finance for climate action is also routed through Public Sector Undertakings (PSUs) like National Thermal Power Corporation (NTPC) and Oil and Natural Gas Corporation (ONGC), which invest heavily in renewable energy and other climate projects.

State-level Finance includes funds allocated by state governments for climate projects through their annual budgets. Many states like Bihar, Tamil Nadu, Gujarat and Maharashtra have climate action plans with dedicated budgetary provisions while a few states also have a dedicated climate budget/green budget like Odisha. State level agencies such as the Gujarat Climate Change Department and Directorate of Environment and Climate Change, Government of Kerala manage state level climate finance.

The flow of climate finance from national and state levels to local bodies has been visualised in Figure 10.1.

National level funds are allocated by the central government through budgetary provisions and specific schemes and funds of various ministries such as MoEFCC, MNRE etc. These ministries disburse funds either to state governments, or directly to implementing agencies or directly to beneficiaries or through Urban Local Bodies (ULBs) and Gram Panchayats (GPs). At the state level, funds received from the central government as well as additional allocations are disbursed to ULBs, GPs or directly to beneficiaries through various state department schemes and programmes as well as through various state level agencies. The ULBs and GPs implement projects using the allocated funds, often with technical support from state and central agencies.

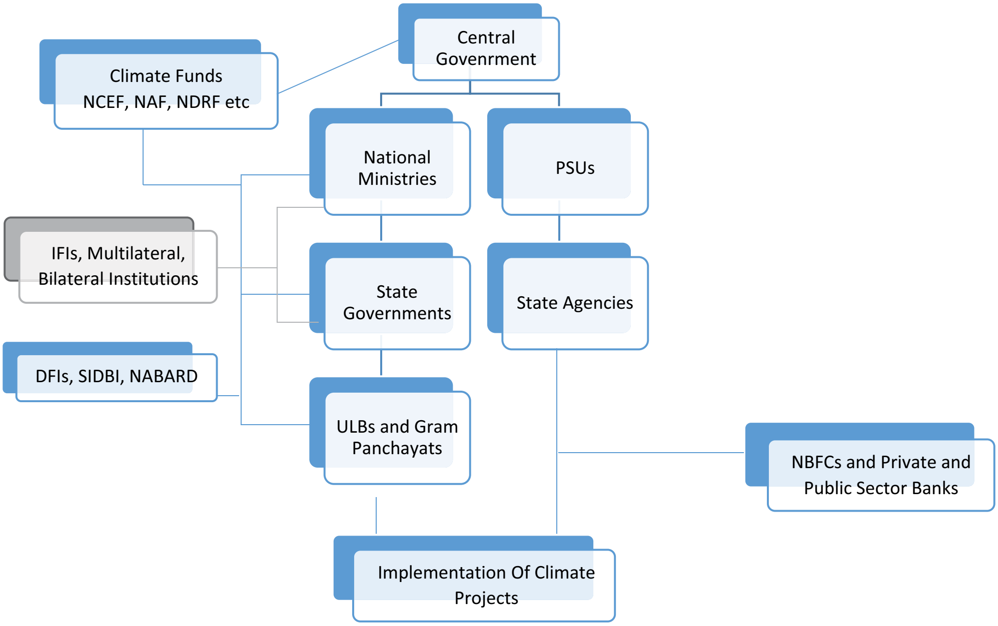

Figure 10.1 Flow of Climate Finance in India

Source: Authors

10.2.1 Climate Finance Allocations

10.2.1.1 Adaptation versus Mitigation Finance

Historically, mitigation projects such as expanding renewable energy capacity, low-carbon transportation, improving energy efficiency and enhancing emissions reduction have received a significantly larger share of the total climate finance in the country.

Fund flows into adaptation actions are harder to track. However, finance for adaptation is increasingly being recognised for its importance, especially in rural and vulnerable areas, particularly in the disaster management and preparedness segment. Adaptation actions also include investments in water conservation, climate resilient agriculture and livelihood generation/security, especially green livelihoods. Figure 10.2 tracks climate finance flows from various international finance funds in adaption and mitigation actions in India.

10.2.1.2 Urban versus Rural Allocation

Climate finance allocation between urban and rural areas reflects their differing needs and challenges. It is reported that nearly 44% of India's rapidly growing carbon emissions have urban origins, despite urban areas occupying a significantly smaller portion of land. These emissions emanate from transport, industry, buildings, and waste (NIUA, n.d.). The majority of urban climate finance is focused on sustainable infrastructure,

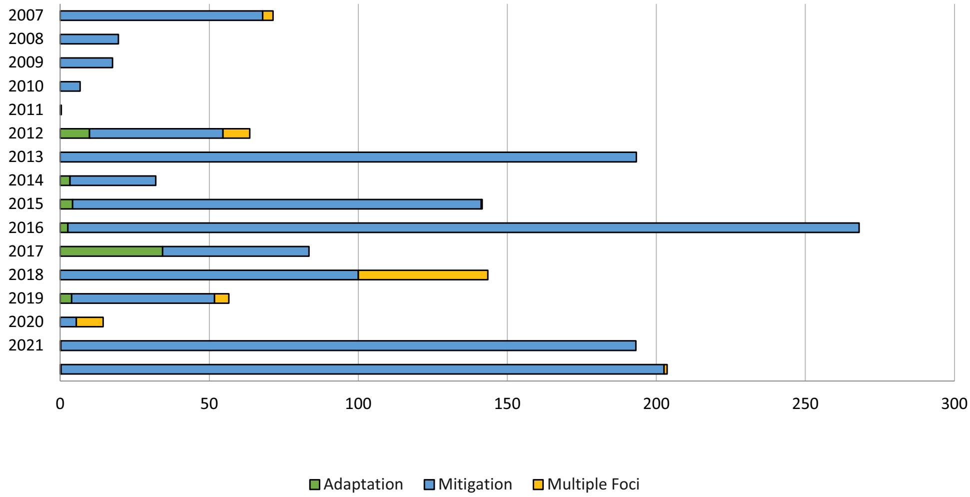

Figure 10.2 Trends of Multilateral Climate Change Funding in India (2007–2022)

Source: Climate Funds Update: Data dashboard (n.d.); redrawn by the authors

public transport, electric mobility, renewable energy and pollution control. But climate finance has also been received for urban resilience projects for cities like Mumbai, Bangalore and Delhi (Thakre, 2024). Climate finance in rural India largely focuses on water management, climate resilient agriculture and improving livelihoods.

10.2.1.3 Sectoral Distribution of Climate Finance

Different sectors in India receive varying amounts of climate finance. A breakdown of the sectoral climate finance in India for FY 2019–2020 is given in Figure 10.3. The key sectors include energy, transport, water and waste management, agriculture and forestry and disaster preparedness.

The latest Union Budget 2024–2025 marks an increase in allocation to renewable energy and sustainable transport solutions through initiatives such as rooftop solar, electric mobility and public transport. Energy transition, nuclear power and critical minerals are the emerging sectors to receive increasing climate finance allocations. Agriculture and allied sector initiatives such as irrigation, climate resilient seeds and digital farming etc. have also received increased allocations. Further, the outlay for water resource development and conservation as well as disaster management has also been increased, highlighting the growing focus on climate adaptation and building resilience (TERI, 2024).

10.3 Challenges and Opportunities in Local Level Climate Finance

Strong local climate action requires strong intermediary organisations and regular engagement with vulnerable groups (Deutsche Gesellschaft für, 2021). This section explores the current challenges and opportunities for financing climate action at local levels.

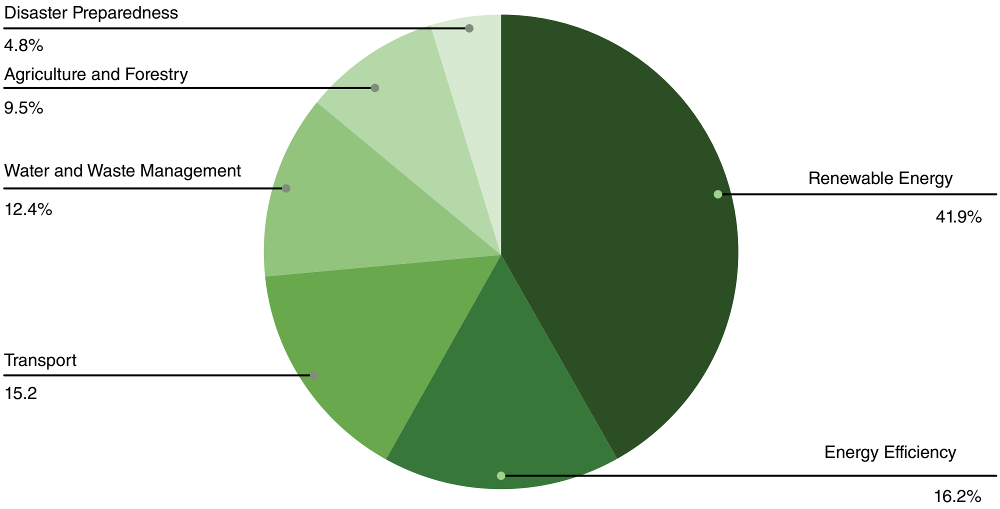

Figure 10.3 Sector-wise Climate Finance in India in FY 2019–2020

Source: Redrawn by authors from CPI, 2022

10.3.1 Challenges and Shortfalls

Fiscal Constraints – One of the primary challenges is the insufficient allocation of funds at the local level. Despite the large financial needs for climate adaptation and mitigation, top down government processes mean local governments often struggle to secure adequate resources and capital. This hampers the implementation of critical projects, such as building locally focused climate-resilient infrastructure or promoting sustainable practices.

Limited Financial and Administrative Autonomy – While Gram Panchayats in India have a significant role in implementing climate-related initiatives, but their decision-making powers are limited by several factors such as the dependence on higher levels of government for approvals and constraints in financial management and allocation, which can lead to possible delays. This can hinder their ability to independently allocate funds for climate projects. Ensuring alignment of climate projects with local development priorities, for instance, project alignment with the 29 subjects under the 11th schedule of the Constitution (that also forms the basis of Gram Panchayat Development Plans) can ensure effective adoption and implementation of climate initiatives in Gram Panchayats. Further, there is a need for enhancing capacity as well as collaboration within levels of government to ensure effective project planning, smoother and quicker approval process, and better financial management of projects.

Capacity Constraints – Local institutions face capacity limitations in securing and managing climate finance effectively. Lack of technical expertise, administrative capacity, and financial literacy can hinder the absorption and utilisation of available funds and accessing additional funds.

Limited Partnerships – There is a lack of information and procedures in terms of guidelines, benefits and understanding of best practices in building partnerships for implementing climate initiatives. Evidence based information dissemination, development of guidelines for collaboration and creating a network of local governments can help overcome this challenge. Further, Gram Panchayats can form partnerships with private sector, CSRs, for securing funding and with CSOs for technical partnership.

Fragmented Approaches and Systemic Constraints – Climate finance often operates in silos, across different government departments and agencies handling various aspects. This fragmentation leads to inefficiencies, duplication of efforts, and difficulties in coordinating across sectors. Further, navigating processes for accessing climate finance may lead to delays. Local officials face administrative hurdles, complex paperwork, and lengthy approval procedures. Streamlining these processes is crucial to expedite climate funding.

Lack of Incentives – Ensuring better policy outcomes does not necessarily always have incentives for Panchayat leaders, further, securing recognition can also be difficult. Direct benefits or recognition for successful projects can help generate motivation among the local leadership to increase policy adoption as well as increase a sense of ownership within the leadership as well as the communities.

10.3.2 Opportunities

Leveraging Multilateral Funds – Local bodies in India can tap into multilateral funds such as the Green Climate Fund (GCF) and the Adaptation Fund. These global mechanisms provide financial support for climate projects at the local level. By aligning local priorities with these funds, cities and rural areas can access much-needed resources.

Innovative Financing Models – Exploring innovative financing models can unlock additional resources. Public-private partnerships (PPPs), green bonds, community based funds and impact investing offer avenues for mobilising capital. Local governments can collaborate with private entities to fund sustainable infrastructure and resilience-building projects.

Community Participation – Engaging local communities is vital. Participatory budgeting, citizen-led initiatives, and community-driven projects enhance ownership and ensure that climate finance aligns with local needs. Empowering community-based organisations fosters resilience, strengthens the impact of climate investments and builds a sense of ownership among the community and the local leadership.

10.3.3 Long-Term Benefits

Tapping into the available opportunities to enhance climate finance and overcoming the current challenges can help avail the following benefits in the long term.

Community Empowerment – Local climate finance provides an opportunity to engage communities directly. When residents participate in decision-making, project design and project implementation, it fosters ownership and ensures that interventions align with local needs. Further, the implemented projected is far better maintained if the ownership in the community is instilled, which in turn will attract more funding and investments.

Job Creation and Economic Growth – Climate projects generate employment opportunities, especially in sectors like renewable energy, waste management, and ecosystem restoration. Investing in local climate action can address livelihood issues along with environmental challenges. Moreover, opportunities for inclusion of women in the workforce also increases as several women, especially in rural areas are developing green job skills.

Ecosystem Services – Investing in natural ecosystems (forests, wetlands, etc.) not only sequesters carbon but also provides essential services like water purification, soil fertility, and biodiversity conservation. These benefits extend far into the future.

Resilient Infrastructure – By investing in climate-resilient infrastructure (such as flood-resistant roads, water supply systems, and green spaces), localities can enhance their adaptive capacity. These investments pay off over the long term by reducing disaster risks and ensuring sustainable development.

Health and Livelihood Benefits – Climate action directly impacts public health and livelihoods. Improved air quality, reduced vulnerability to extreme weather events, and sustainable livelihood options contribute to long-term well-being.

10.4 Bridging the Gap between Climate Action and Finance

Bridging the gap between local climate action and finance in India requires concerted efforts from multiple stakeholders. By leveraging various funding sources, adopting innovative financing mechanisms, scaling up or incentivising private sector engagements, and fostering conducive regulatory environment and collaborative partnerships, both urban and rural local bodies can effectively address their climate challenges. Strengthening advocacy efforts and engaging with relevant stakeholders are critical steps in this process. Furthermore, establishing a climate finance taxonomy can help channel investments towards impactful climate action in a timely manner.

10.4.1 Perspectives of Urban and Rural Local Bodies and Sources of Funds

ULBs and rural local bodies (RLBs) in India operate in different contexts and thus have varying needs, sectoral vulnerabilities and resources for climate action.

ULBs often have more access to financial resources and technical expertise, relative to RLBs. However, they face significant challenges due to high population density, rapid urbanisation, and consequent higher demand of resources and infrastructure. Climate action in ULBs generally focus on renewable energy, electric mobility, sustainable urban planning, green infrastructure, and pollution control measures.

RLBs and Panchayati Raj Institutions (PRIs), generally have limited financial and technical capacities. Climate finance for PRIs needs to prioritise sustainable agricultural practices, water conservation, and rural energy solutions.

In addition to sources of public finance discussed earlier, private finance and market mechanisms can play a critical role in supplementing public funds for local climate action. Encouraging private sector participation through public-private partnerships (PPPs) can bring in additional resources and expertise. ULBs, in particular, can attract investment for infrastructure projects such as green buildings, public transportation, and renewable energy. Similarly, microfinance Institutions can support small-scale climate projects, particularly in rural areas. These institutions can provide loans for sustainable agricultural practices, solar home systems, and other climate-resilient and climate-smart technologies. Market mechanisms such as carbon credits and emission trading have the potential to be tapped to generate additional revenue for climate projects. Local bodies can engage in these markets to finance low-carbon initiatives. However, they require capacity building and training to effectively tap into carbon markets and enhance monitoring and evaluation of projects. Finally, offering tax breaks and incentives for businesses and individuals investing in climate-friendly practices can stimulate local climate action. This includes incentives for installing solar panels, adopting energy-efficient technologies, and supporting green businesses.

There is a need for comprehensive planning by developing local area climate action plans which prioritise local needs and align with local development budgets as well as with national and state climate targets. Mobilisation of resources and effective implementation of climate action requires coordination across all levels and collaboration among a wide range of stakeholder at the local level, including government, local NGOs, community based organisations (CBOs), private sector initiatives such as CSR as well as local communities. Regular engagement and collaboration can help foster a sense of ownership and increase chances of successful implementation and continuation of climate action.

Additionally, effective advocacy and capacity building is essential to raise awareness, build knowledge base about the importance of climate finance and garner support from various stakeholders. This can be achieved through targeted awareness campaigns for communities, local leaders, and policy makers. It is important to highlight success stories and tangible short- and long-term benefits. Media campaigns can help reach a wider audience and help ensure accountability while giving momentum to local level climate action.

Finally, implementation of robust monitoring and evaluation will help ensure accountability and effective utilisation of climate finance. Continuous assessment, impact analysis and adaptive management can enhance the impact of climate finance.

10.5 Optimising and Mobilising Finance for Local Governments

This section delves into various strategies and mechanisms to optimise and mobilise financial resources for cities, towns, and gram panchayats (villages). We discuss four key mechanisms/strategies, namely convergence of climate action plans with existing schemes and budgets, tapping creative and non-traditional financing approaches, building public-private partnerships, and exploring revenue-generating and self-sustaining projects.

10.5.1 Convergence

Integrating and mainstreaming climate action into existing plans and budgets is an effective way to optimise resource allocation is inherently critical to ensure the sustainability of climate initiatives. Convergence involves aligning climate action plans with the Gram Panchayat Development Plan (GPDP), where they exist, or with ULB annual budgets in order to tap on existing budgetary allocation under various schemes.

By embedding climate action into existing development plans, local bodies can ensure that climate resilience and sustainability are considered in all development activities. This approach maximises the use of available resources and avoids duplication of efforts. Some successful examples of convergence are given below:

Kerala's Climate-Resilient GPDP: Kerala has integrated water budgeting into its GPDP, focusing on sustainable agriculture, water conservation, and disaster management. This integration has led to improved resource efficiency and building water resilience as well as overall adaptive capacity at the village level (Abraham, 2023).

Ahmedabad's Heat Action Plan: Ahmedabad's Heat Action Plan, integrated into the city's health and urban planning initiatives, has been successful in reducing heat-related mortality and morbidity by leveraging existing health infrastructure and resources (C40knowledgehub, 2019).

10.5.2 Tapping Creative and Non-Traditional Financing Approaches/Mechanisms

Exploring unconventional funding sources can unlock additional resources for local climate action and eases financial resource mobilisation constraints. Creative and non-traditional financing approaches include green bonds, impact investments, crowd-funding, and community-based financing.

Green Bonds: Municipal green bonds can finance urban climate projects like renewable energy installations and sustainable transportation. For example, the Pune Municipal Corporation issued green bonds to fund a waste-to-energy project, attracting both domestic and international investors. (My Pune Pulse, 2023).

Impact Investments: These investments target social and environmental outcomes alongside financial returns. In India, impact investors have funded projects in renewable energy, sustainable agriculture, and water management.

Crowdfunding: Platforms like Ketto and Milaap enable communities to raise small contributions from individuals for local climate projects. An example is the 'Solar for All' campaign, which crowdfunded solar panel installations and innovation in rural schools (Fraunhofer ISE, 2016).

Community-Based Financing: CBOs such as cooperative societies and Self-Help Groups (SHGs) can pool resources for climate initiatives. In Karnataka, SHGs have financed biogas plants and rainwater harvesting systems through community contributions (Reddy, 2004).

10.5.3 Building on Public-Private Partnerships for Climate Action

Public-private partnerships can leverage private sector expertise and resources for local climate action while de-risking investments to a certain extent. These partnerships can take various forms, including joint ventures, co-financing arrangements, and corporate sponsorships.

Local bodies can enter joint ventures with private companies to implement large-scale climate projects. For example, a joint venture between the Chennai Municipal Corporation and a private company which facilitated the installation of solar streetlights across the city (C40, 2021). Co-Financing Arrangements, with shared project costs between public and private entities are another possibility. For example, in Rajasthan, the Rajasthan Renewable Energy Corporation Limited (RRECL) co-financed solar irrigation projects with private investors, benefiting local farmers (Goel et al., 2015). Companies can also allocate CSR funds to local climate projects. Tata Power's CSR initiative in Sunderbans, West Bengal (Tata Power Solar, n.d.) and Mahindra's CSR initiative in Kushinagar, Uttar Pradesh (CSR Live, 2015) supports solar microgrids in rural areas, enhancing energy access and sustainability.

10.5.4 Revenue Generating and Self-Sustaining Projects

Local bodies can significantly benefit from investing in renewable energy installations like solar, wind, and biogas projects to generate revenue and reduce reliance on fossil fuels. A prime example is the Cochin International Airport in Kerala, which operates entirely on solar power, setting a precedent for other large facilities such as public hospitals, bus depots, and railway stations. Similarly, the Pavagada Solar Park in Karnataka, one of the largest solar parks globally, underscores the potential for large-scale renewable energy projects to contribute to local economies and energy independence. Local renewable energy projects can not only generate income but also reduce energy costs for households.

Eco-tourism also presents a viable revenue stream while promoting environmental conservation. Sikkim's eco-tourism initiatives, focused on sustainable practices and community involvement, have successfully boosted local economies and raised environmental awareness. In Andhra Pradesh, partnerships with the private sector have further enhanced eco-tourism, demonstrating significant economic and environmental benefits.

Sustainable agriculture is another key area which can generate long-term economic benefits, with practices like organic farming, agroforestry, and water-efficient irrigation increasing agricultural resilience, enhancing food security, reduce vulnerabilities and increase profitability. The Andhra Pradesh Community-Managed Natural Farming initiative exemplifies how sustainable agriculture can benefit thousands of farmers by enhancing food security and reducing the carbon footprint of agricultural practices. Additionally, implementing insurance schemes such as the Pradhan Mantri Fasal Bima Yojana (PMFBY) provides essential safety nets for crops, livestock, and infrastructure, mitigating risks associated with climate change and reducing financial losses due to climate variability. Expanding such schemes to cover more aspects of rural livelihoods and to support local MSMEs could further bolster resilience.

By generating revenue, these projects empower local communities economically, reduce dependency on external funds in the long term. Further, as self-sustaining projects create a stable financial environment, it can help attract both public and private investments for other use cases in other regions, as investors are more likely to support projects that have demonstrated economic viability and sustainability.

10.6 Uttar Pradesh: Financing Climate-Smart Gram Panchayat Action Plans

The state of Uttar Pradesh has embarked on first of its kind initiative to strengthen climate resilience in rural regions by developing Climate Smart Gram Panchayats Action Plans (Shukla, 2023). Under this initiative an attempt has been made to understand the GP-specific climate-related risks, vulnerabilities and adaptation needs. The plans are being developed following a bottom-up approach with community and relevant stakeholders participating in all the stages of the plan development.

The Climate Smart Gram Panchayat Action Plans are in alignment with the GP budgets or the GPDP and also identify potential sources of financing, the proposed actions through government schemes, and programmes and other innovative approaches, most unique of them being the Panchayat-Private-Partnerships. The Panchayat-Private-Partnership is formalised in the form of an MoU between the Department of Environment, Forest and Climate Change, Government of Uttar Pradesh, the respective GP and CSR organisations or private companies. The primary goal of the partnership is to support rural level climate action through CSR contributions through providing finance and technical know-how where possible. It therefore addresses two issues critical to rural areas, access to finance and building capabilities. Scaling up such an initiative opens up opportunities for further exploring other financing avenues.

40 Gram Panchayat Action Plans are being developed by the Department of Environment, Forest and Climate Change, Government of Uttar Pradesh in association with Vasudha Foundation. These are 11-years action plans for enhancing climate resilience at the GP level while also reducing emissions through action in sustainable agriculture; access to clean, affordable and reliable energy; management and rejuvenation of water bodies; sustainable waste management; sustainable and enhanced mobility and enhancing livelihoods and green entrepreneurship.

The climate-smart actions have been identified through a mix of primary surveys, secondary data from various departments and Participatory Rural Appraisal exercises. The prioritisation of these actions has been obtained through engagement with local leaders and communities.

The key findings show that in these 40 GPs, majority of the population is engaged in agriculture and allied sectors while a significant number is reliant on wage labour for their means of livelihood. These sectors are particularly vulnerable to climate risk, and their building resilience will strengthen economic activities for the rural communities.

The identified climate smart initiatives in these action plans can benefit over 2 lakh individuals. The overall estimated cost of implementation of mitigation and adaptation actions in the selected 40 GPs is over INR 1,500 crores over a period of 11 years, that is, nearly INR 135 crores per annum or over INR 78,000 per capita for the 11-year period or INR 7,156 per capita per annum. The total identified greenhouse gas mitigation potential is over 112,000 tCO_2e per annum which can be achieved through clean energy interventions, other adaptation measures in the agriculture and livestock sectors will lead to additional GHG mitigation. The identified sequestration potential through various suggested plantation activities is over 2 million tonnes CO_2, which can generate further economic opportunities for tapping into carbon markets. What this demonstrates is that appropriately designed GPDPs can yield substantial benefits in terms of adaptation and resilience.

10.7 Conclusion

There is a growing recognition of the importance of adaptation finance, especially adaptation finance, particularly in rural and vulnerable areas, which is beginning to receive increased attention. Local bodies are pivotal in implementing effective climate action on the ground, and their success hinges on robust support systems. This can be achieved by combining capacity building, fostering a conducive regulatory environment, addressing coordination at all levels, introducing a green taxonomy to streamline investments and empowering and recognising local leaders. Additionally, strategies to facilitate partnerships and increase ownership among local leaders, communities and officials are necessary to tap into the available streams of finance. Schemes such as PM Surya Ghar Yojana are aimed at enhancing building local level climate resilience. Furthermore, aligning local climate actions with existing budgets and best practices is essential for enhancing local economies and ensuring community ownership of sustainable initiatives. By empowering local governments and communities with the necessary tools and resources, India can unlock the full potential of climate finance at local level and accelerate its progress towards a climate-resilient future, balancing the dual imperatives of economic growth and environmental stewardship.

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Part 3

Instruments and Mechanisms

An Introduction

Mritiunjoy Mohanty and Runa Sarkar

Having laid out the financial landscape and provided an overview on appropriate governance frameworks at different levels of the economy, this part goes into the structure of specific financial market instruments that may be used to mobilise climate finance and their analysis. Different types of finance, or instruments used to provide it, for example, development aid, equity, debt or blended instruments, are discussed. Mechanisms of risk sharing specific to each are highlighted, as well as the cost (interest) at which these are made available. Carbon markets as a necessary element for price discovery to support financing are also covered.

The first chapter (Chapter 11) identifies avenues beyond plain vanilla loans from banks that entities could access, such as recycling capital through bond markets, securitisation and other innovative mechanisms. This has the additional advantage that banks themselves free up space on their balance sheets and can go in for additional lending. Kalpesh Gada and Neha Khanna propose alternative capital recycling mechanisms, such as refinancing, securitisation and pooled bonds to mobilise additional private capital, emphasising the need for innovative financial instruments to connect smaller borrowers to the capital market. Pooled bonds and securitisation, in particular, can aggregate fragmented loan portfolios, improve creditworthiness and facilitate capital recycling, but careful structuring is required to ensure transparency and mitigate risks. Further, these mechanisms, while playing a vital role in expanding green and transition finance, are not a singular solution and must be complemented by broader efforts to develop a green taxonomy and deepen India's market for corporate debt. Box 11.1, authored by Harsimran Sandhu and Abhinav Jindal explores the green bond market in India. Lavanya Prakash Jena Saarthak Khurana and Parag Puri discuss long-duration deep-discount bonds and the possibility of using these to finance industrial decarbonisation in Box 11.2.

Shubhashis Dey and Kartikey Sharma explore carbon pricing in India, examining policy options, impacts and pathways to a sustainable economy to complement climate finance markets in Chapter 12. They explore both carbon taxes and emissions trading systems (ETS), discussing the advantages and disadvantages of each approach and drawing on international experiences, particularly from Europe. They also analyse the potential impacts of carbon pricing on growth, jobs and industrial competitiveness in India, considering the country's unique economic and social context. A hybrid approach that combines carbon taxes and ETS, leveraging the strengths of both mechanisms, is proposed. They recommend a phased implementation of carbon taxes, starting with a low rate and gradually increasing it over time, using the GST framework to integrate carbon taxes into the existing tax system. For ETS, they recommend setting ambitious but

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achievable targets, creating a market management entity and linking the domestic carbon market with global ETS. In Box 12.1 Yash Kashyap and Saarthak Khurana discuss using instruments such as a carbon contract for difference for industrial decarbonisation. Lavanya Prakash Jena Saarthak Khurana and Parag Puri explore long-term carbon STRIPS bonds as a possible instrument in Box 12.2

Upendra Bhatt explores synergies between private and public financial institutions and the opportunity for blended finance as a key tool of transition finance using the state of Maharashtra as a case in point in Chapter 13. He emphasises the critical role of sub-national governments in achieving India's climate goals, highlighting Maharashtra's role, as it is one of India's most industrialised states with a significant agricultural sector and extensive coastline and contributes over 14% to the national GDP and receives 30% of India's FDI inflow. He further emphasises that the scale-up of climate financing is dependent on the availability of bankable projects, restructuring public sector debt, fostering partnerships between public and private financial institutions, and innovating financial instruments for adaptation and loss and damage interventions. The chapter suggests green state development loans, infrastructure investment trusts and debt-for-climate swaps, along with public-private partnerships and blended finance, to attract investors and compensate for the lack of depth in financial markets. It also recommends innovative revenue sources like land value capture taxes.

Finally, in Chapter 14 Shailesh Vickram Singh challenges conventional climate finance narratives, critiquing exaggerated investment estimates and highlighting the inefficiency of solely focusing on large-scale funding as he views climate finance with an entrepreneurial lens to offer venture capital as the solution to finance climate technology developments. He contends that current estimates of climate finance needs are often based on past patterns and existing technologies, which fail to account for future innovations and industry disruptions that could significantly alter the landscape by drawing on historical examples, such as the failure to predict the impact of the internet and mobile telephony. The focus on large sums of money can overshadow the importance of risk capital, which is essential for funding innovative ideas and helping entrepreneurs take bold moonshots in solving complex problems. He proposes an 'Industrial 5.0 Framework' for India, emphasising the need for innovation and research into affordable, reliable and climate-friendly technologies. He argues that risk capital is more effective than grants or bonds in driving innovation and calls for a policy environment that enables grant funding for start-ups working in the climate tech area, as well as a blended finance model that combines grants, equity and debt.

11 Increasing Flows for Green and Transition Finance – Thinking Beyond Bank Debt

Kalpesh Gada and Neha Khanna

11.1 Introduction

India would need cumulative investments of USD 10.1 trillion by 2070 to achieve its net-zero ambitions (Singh and Sidhu, 2021). Given that the tracked finance flows to climate mitigation account for approximately 25% of the total climate investments required (Khanna and Purkayastha, 2022) in India, it can be inferred that the transition to net-zero will require a significant increase in climate investments not only towards cleaner energy and transport, but also to hard-to-abate sectors like industries and buildings, with a focus on reduction in carbon emissions. This means that flows to both green and transition activities will need to increase. The definitions of both are given in Table 11.1.

Public capital alone is not sufficient to meet the demand for financing transition and thus this paper focuses on augmenting private capital flows. For increasing the mobilisation of private capital, multiple factors need to align. While there is a plethora of literature in the market on how to mobilise private capital, we haven't found one which adequately explores the use of capital recycling mechanisms which can help lower the over-dependence on the banking sector while utilising the debt capital market better.

In this chapter we aim to explore the possible alternative instruments and mechanisms that could help augment green and transition finance. The chapter is structured in three parts – first, problem definition, that is, the various factors which impact flow of capital when looked at from the lens of capital stack, sector, and type of institution, second, challenges which exist currently, and third, the way forward. Section 11.5 concludes.

11.2 Defining the Problem

Debt funding in India is highly bank-dominated. For instance, the outstanding bank credit is INR 170 lakh crore as opposed to outstanding corporate bonds which is INR 45 lakh crore (IndiaBondInfo). The country's green finance need/demand is massive. Thus, there is a need to explore alternative capital pools, possibly using alternative instruments and mechanisms. In this section we look at the various factors which impact flow of capital when looked at from the lens of capital stack, sector, and type of institution. To do this, we will first ring fence each of these factors for the purpose of this chapter.

11.2.1 Capital Stack

Capital stack is a spectrum of modes of investment instruments, ranging from equity at one end to debt on the other, with intermediate instruments in between, along a scale of

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Table 11.1 Difference between Green and Transition Finance

	Green Finance	*Transition Finance*
Definition	Financing zero/near-zero-emissions technologies that are aligned with the Paris Agreement	Financing activities that reduce emissions for hard-to-abate sectors or sectors that are important for emissions reductions in other sectors (as enablers). In most cases, these activities are not Paris Aligned but are important due to the lack of suitable 'green' alternatives.
Examples	Solar PV, Wind	Steel, Cement, Shipping, Aviation, Heavy-duty transport, etc.

Source: Authors

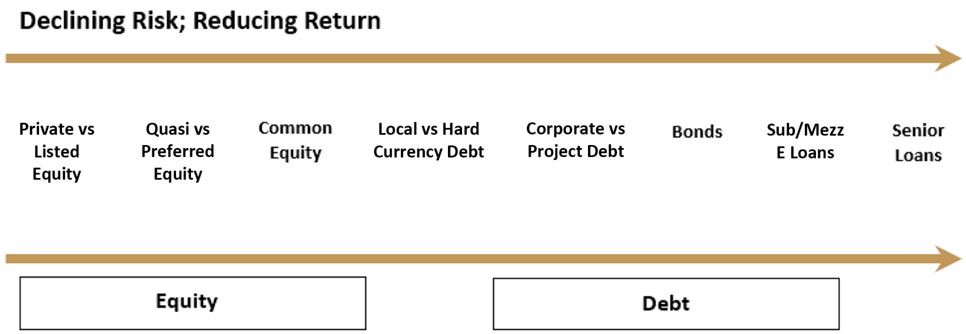

Figure 11.1 Types of Financing Instruments

Source: (Kashyap and Purkayastha, 2024), Redrawn by the authors

returns in line with investor risk in descending order (see Figure 11.1). Some hybrid instruments are also possible, such as those that combine fixed income and variable returns.

The capital stack is deployed through different mechanisms. Typically, financial mechanisms are institutional approaches defined by financial regulators in India, namely the Reserve Bank of India (RBI), Insurance Regulatory and Development Authority of India (IRDA) and Securities and Exchange Board of India (SEBI). Examples of mechanisms include securitisation, blended finance and guarantees.

To increase the flow of green and transition finance, understanding the workings of financial mechanisms is key. For example, blended finance is a mechanism which can be implemented in multiple ways. Understanding the basic concepts and then designing the mechanisms to best suit the situation and context is important.

11.2.2 Sector

Another aspect which we will be touching upon is how vast the spectrum of entities, technologies and requirements are. A report by IIC and CPI titled Green Investment Opportunities (CPI, 2023; Kashyap and Pal, 2023), analyses a variety of sectors and sub-sectors which have activities that can be classified as green. Figure 11.2 illustrates

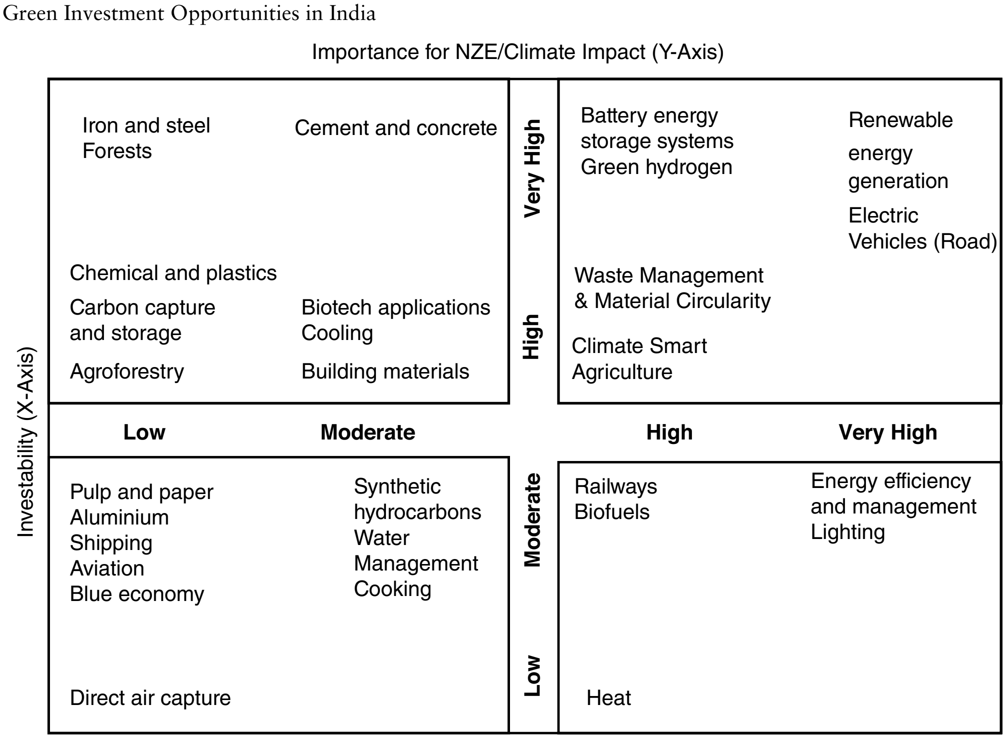

Figure 11.2 Sector and Sub-sector Mapping of Green Investment Opportunities in India
Source: CPI (2023), Redrawn by the authors

the mapping of these sub-sectors on the basis of two metrics: their importance for India's net-zero emissions target or climate impact, and their 'investability'. As is evident, green activities, and consequently green finance needs and opportunities, are strewn across a wide set of heterogeneous sectors.

While 'green' is well accepted, 'transition' is still not as clearly defined in either the Indian or international context. The activities under transition are more subjective, but they can usually be classified under hard-to-abate sectors and activities that will never be classified as fully green but which reduce emissions (also see Table 11.1). An example of the latter is certain aspects of the agriculture sector. Since green and transition activities are at varying levels of technological and commercial readiness, assessing the appropriate type of funding required for them can be a challenge.

11.2.3 Entity Type

As discussed above, to attain the net-zero target, transition efforts will cut across multiple sectors, including energy, manufacturing, agriculture and mobility. Adding another layer to this equation is the fact that each sector has a value chain of its own, involving a set of players, often with varying size, scale and financial heft. Thus, the types of entities that contribute to the overall transition goal of the country are varied, as is the quantum and type of funding support. For the larger players with a stronger credit rating, fund raising may not be a challenge, while typically, at some point in the value chain (read, for the

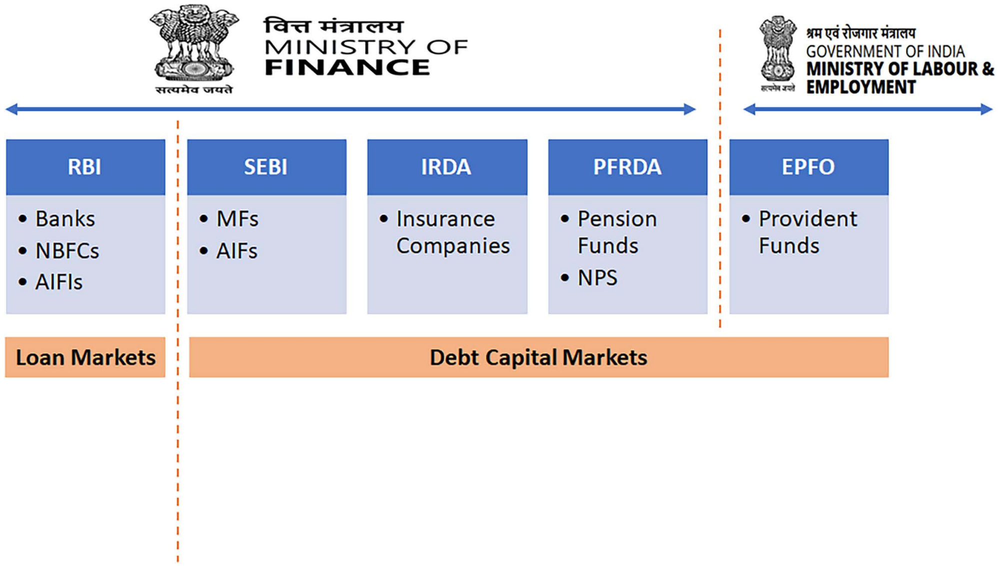

Figure 11.3 Capital Providers Across Debt Capital Stack

Source: Authors' analysis

MSME sector), cost as well as adequate availability of credit is, more often than not, a constraint.

What ties all of the above together is the type of institutions that provide capital. For the purpose of this chapter, we will focus only on debt. There is a continuum of debt providers that includes Microfinance Institutions (MFIs), Non-Banking Financial Company (NBFCs), Alternative Investment Fund (AIFs), Banks, Mutual Funds (MFs), Insurance companies and pension funds, with each serving a different need. It is important to understand which pool of capital is ideally suited to serve which segment. Figure 11.3 depicts the mapping of players and the spectrum of capital that they provide, along with the corresponding policy makers and regulators that provide oversight.

Most institutions will have access to the loan markets, with only the larger players having access to debt capital markets. We look at the challenges which limit the access to debt capital markets and identify potential solutions to address those challenges.

11.3 Challenges

For any country to decarbonise, the efforts have to be such that they encompass the whole value chain. This means looking at not only the large corporations, but also the micro, small, and medium enterprises, whether they are stand-alone or parts of larger value chains. If the smaller businesses were to be able to access the capital markets, indirectly, if not directly, it could be a win-win situation for all. We explore the key challenges that currently exist in this context.

11.3.1 Banking Sector Saturation

One of the primary challenges is the ability of the banking sector to support the investment needs as identified by various entities. Finance flows in India are predominantly supported by the banking sector which includes scheduled commercial banks, Non-Banking Financial Company (NBFCs), All India Financial Institutions (AIFI), and other RBI regulated entities. Even though it has grown, the depth and breadth of capital markets is limited in comparison. For example, while more bond issuance by large corporates are needed, so are issuances by the smaller entities – not only the MSME sector but also mid-size and emerging corporates.

The concern is at two levels:

1) The total investment required can't be met with the current combined levels of capital markets and the banking sector. This suggests the need for both banking and capital markets to grow.
2) The banking sector can't grow beyond a certain point. The current credit to deposit ratio at 80% (Careedge Ratings, 2024) is already at a decadal high and to ensure compliance with Basel III norms, the scope for credit to grow within the banking sector is limited.

Therefore, the requirement is for capital markets to increase and become accessible to players across the board.

11.3.2 Access to Markets

Analysis of the bond market highlights the fact that the bond issuance is dominated by larger conglomerates. Currently, around 65% of the debt issuances are by companies rated in the AA category or AAA category (Dezerv). Further, the issuances have been pronounced in limited sectors with growth not at par at what is potentially required.

When one looks at the green, transition, sustainability-linked bond space, the total size is even more muted. A 2021 CBI report (Climate Bonds Initiative, 2021) showed that transition bonds had yet not been issued in India and the green bond issuance was only at USD 18.3 billion. Fast forward 2 years, the issuance of transition bonds were still absent and growth in the green, sustainability and social sectors was also not substantial, as per the Global state of the market report (2021) (see Figure 11.4).

Total size of the Indian GSS market as of 31/12/2021

	Green	Sustainability	Social	Total
Total size of market	USD18.3bn	USD600m	USD500m	USD19.5bn
Number of issuers	72	1	2	75
Number of currencies	3	1	2	3

Figure 11.4 Total Size of the Indian GSS Market

Source: Climate Bonds Initiative (2021), Redrawn by the authors

GSS+ scorecard

	Green	Social	Sustainability	Transition	SLB
Total size of market (cumulative)	USD 2.2 tn	USD 653.6 bn	USD 682.0 bn	USD 12.5 bn	USD 204.2 bn
Number of issuers	2,457	772	507	39	336
Number of countries	85	49	57	12	50
Number of currencies	49	42	41	7	21

Figure 11.5 Total Size of the Global Market for Green Debt

Source: Climate Bonds Initiative (2022), Redrawn by the authors

While instruments for green finance are more common, instruments for transition finance are coming up. An analysis by CBI shows how the global market for green debt is over USD 2.2 trillion while that for transition is just USD 12.5 billion (see Figure 11.5).

In the Indian context, another factor is that the majority of the bond issuances of green, transition, sustainability linked bonds have been international placements and not domestic placements. This may be attributable to limited dedicated capital pools, for example green funds, available in India.

Thus, in the present scheme of things, the medium and smaller sized companies are largely unable to directly access capital markets for meeting their debt funding needs, the reasons for which can be crystallised for the following: First, the largest investor segments in debt capital market (MFs, insurance companies, pension funds) prefer highly rated securities (AA and above), while the smaller companies are usually rated much lower. Second, notwithstanding their Assets Under Management (AUM) size, most debt capital participants prefer doing a few large investments rather than a large number of smaller transactions. The individual issuance value (ticket size) of the medium and smaller companies is much smaller than the issuance size preferred by most debt investors. Apart from the size and credit quality mismatch, the third limitation is the massive variety of sectors and sub-sectors involved, each with their own nuances and complexities. Most debt investors simply don't have the bandwidth to do a deep dive into the multitude of sectors unless it has massive volumes.

11.4 Way Forward

In this section we look at three approaches and mechanisms, as well as their benefits and challenges.

11.4.1 Proposed Approaches and Mechanisms

11.4.1.1 Refinancing

Players in the debt capital market, DFIs and MDBs have larger pools of capital to be deployed, however these entities are not suited for direct funding at the initial stage, as explained below. Rather, they are better placed to access financial markets via refinancing. For example, it is quite common for infrastructure projects to get funded by banks initially. Later, once the project is commissioned, the bank debt gets refinanced (typically with a top up)[1] through a bond (in which insurance companies or pension funds invest).

Take the example of a typical road project, being implemented under the public-private partnership (PPP) route. In India, the popular models of PPP that have been used for development of National Highways are the Build Operate and Transfer (BOT) Toll basis model and Build Operate and Transfer (BOT) Annuity basis model. In either case, the tenure of the concession (loan) agreement is typically 20 to 30 years, with the Concessionaire's (investor) return on investment being regulated by the relevant government authority. The long tenure of the project (and the associated long tenure of the debt) along with regulated returns, make fixed-income investors like insurance companies and pension funds the ideal providers of debt capital to such infrastructure projects. However, it is important to note that funding such projects at the initial stage (project finance) is associated with high project risk and a complex appraisal process. While financiers like insurance companies have long-term capital to be invested, the due diligence required at the project start stage and the sheer credit risk is too high for them. Thus, it is common for banks to appraise and fund such projects initially. Later, once the project is commissioned and some track record is built, it is common for the project company to refinance its bank loans through a longer tenure bond issuance.

While this is common in the road and power sector, the broad principle could be extended to some green and transition sectors as well. In this model, the replacement is not directly with the initial funding institutions but rather via the borrower. If the exposures are taken out from the bank books and funded by capital market interventions, it creates space for fresh rounds of funding, thus enabling an efficient recycling of capital.

11.4.1.2 Securitisation

Securitisation is a process through which a set of loans is pooled and repackaged into tradeable securities called Pass-Through Certificates (PTCs). A typical securitisation transaction (also see Figure 11.6) involves two key parts:

1. A company (typically a bank or a non-banking financial institution), termed as the 'Originator' identifies the loan assets it wants to remove from its balance sheet and creates a 'securitisation pool'. The Originator sells this pool of receivables to the 'Issuer', often a Special Purpose Vehicle (SPV) created solely for the transaction in question and receives immediate payment against the same.
2. The Issuer finances the acquisition of the securitisation pool by issuing PTCs that are then sold to capital market investors. The PTCs carry a pre-defined schedule of principal and interest, making them akin to a fixed income instrument.

There can be multiple tiers of PTCs, called 'tranches'. For instance, in a typical 3-tranche structure, the 'senior' tranche is paid out first followed by the 'mezzanine' tranche, with

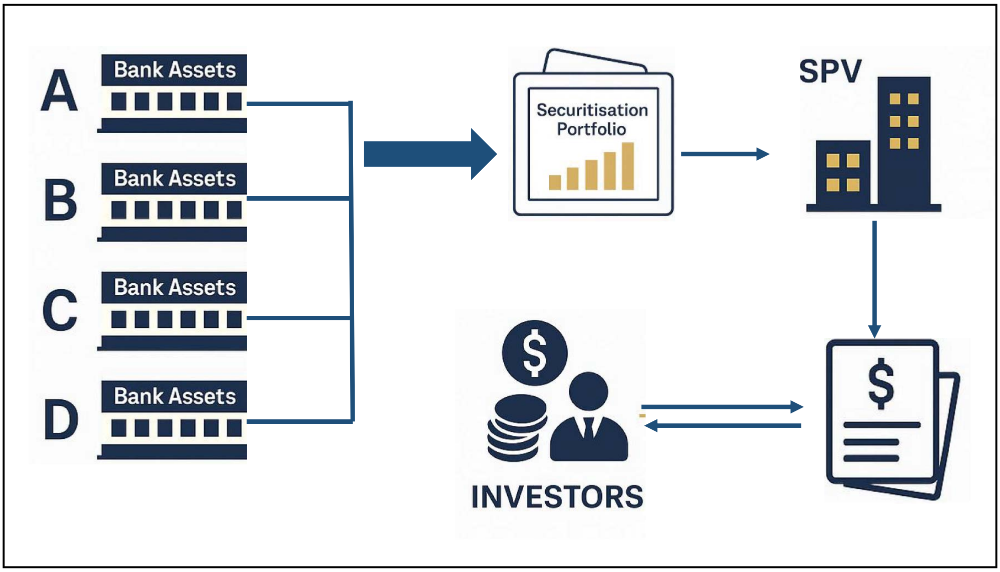

Figure 11.6 Securitisation Explained

Source: Policy Note: Securitisation for Sustainable Development – Accelerating Capital Velocity, MOBILIST (2023, p. 2), Redrawn by the authors

the 'subordinate or equity' tranche having a claim on the residual cash flow, after the scheduled payout on the higher tranches has been made. After the execution of the transaction, on an on-going basis, the underlying borrowers continue to pay their loan instalments as earlier, also called as 'pool collections', which are transferred to an account of the Issuer/SPV. These 'pool collections' are used to service the PTCs.

We evaluate securitisation from a green sector perspective and a transition sector perspective, respectively. This is because green and transition are at different stages of development.

Green securitisations may take different forms, including green collateral transactions and green Use of Proceeds (UoP) securitisation. In green collateral transactions, some or all of the underlying portfolio comprises green assets (e.g. renewable energy projects, energy-efficient mortgages or electric vehicles). In green Use of Proceeds (UoP) securitisation proceeds of the securitisation are deployed towards projects or initiatives with green characteristics, often in accordance with a sustainable finance framework.

In the case of green collateral transactions, the 'green' condition is met at the pool origination stage itself, and therefore, there is no subsequent requirement for the Originator to ringfence the use of proceeds for specific purposes. Such a structure, therefore, does not necessarily result in creation of any new green assets, as the creation of green assets precedes the securitisation itself. Green UoP securitisation, on the other hand, is the type of securitisation arrangement where the 'proceeds' of the securitisation transaction are utilised towards 'green'. In such a structure, the collateral is created on 'brown' assets, and the use of 'proceeds' are, in turn, earmarked for 'green' financing. In other words, such structures could be used to support the transition from brown to 'less brown' or 'green'.

Transition loans, at least so far, are characterised by large corporate entities borrowing a large sum for projects that support emission reduction. For instance, in 2022, DBS Bank provided a transition loan of INR 1,750 million to Shree Renuka Sugars Limited, a subsidiary of Wilmar International Limited (Wilmar), one of India's largest sugar and green energy producers (DBS Bank India, 2022). The loan was deployed to expand the company's sustainable bioethanol business as a part of Wilmar's overall decarbonisation strategy. Around the same time, in September 2022, Mitsubishi Heavy Industries (MHI) Group issued its inaugural JPY 10 billion (63 million USD) five-year transition bond (Mitsubishi Heavy Industries, 2022). The end use of the bonds was towards making new investments and refinancing of existing investments into projects meant to decarbonise existing infrastructure, build hydrogen solutions ecosystem, and build a CO_2 solutions ecosystem.

Large corporate entities typically borrow from capital markets directly at beneficial rates.[2] Even if they do borrow from banks and FIs, as noted earlier, the securitisation of such large corporate loans, called Collateralised Loan Obligations (CLOs), in securitisation parlance, is a product largely absent in India. Smaller ticket size transition loans availed of by MSMEs, especially micro-enterprises, could be more amenable to securitisation. Although transition loans to MSMEs are few and far between today, it is probably only a question of time when the asset class could develop meaningfully, given the growing pressure on MSMEs to measure and minimise their emissions as parts of the value chains of large corporations.

11.4.1.3 Pooled Bonds

As stated above, one of the challenges for MSMEs, and mid-sized corporates is their firm size and perceived credit worthiness. Pooled bonds have the ability to address both these issues. The basic construct of a pooled bond is that there is a pooling of issuers, and a single instrument is issued, lowering transaction costs. Further the issuance is backed by a credit enhancement, thereby resulting in lower interest rates. This has been applied in public finance space by municipalities for over 20 years.

An example of a pooled bond issuance is the 2002 Water and Sanitation Pooled Fund (WSPF) (TNUIFSL, n.d.). It facilitated access to domestic capital markets for 13 small and medium urban local bodies (ULBs). The pooled bond took the form of a structured debt obligation and was rated AA. *It is important to note is that the 13 ULBs were not of equal financial strength, but the structuring of the bond enabled them to raise USD 6.2 million.* The bond had a maturity of 15 years and coupon of 9.2%. The structure for the bond is depicted in Figure 11.7.

In more recent times, the concept of pooled bonds has been employed by several MFIs and NBFCs. For instance, in March 2021, CDC Group, a UK-based DFI, invested in pooled bonds aggregating to INR 320 crores issued by six leading Indian MFIs. The factor binding these bonds issued by the individual companies was the common partial guarantee, provided by Northern Arc, an Indian debt platform (British International Investment, n.d.). The pooling resulting in aggregation (and thus a bigger transaction size), and the guarantee provided credit enhancement.

A similar approach could be applied for the MSME sector. This would enable them to raise capital at more favourable terms.

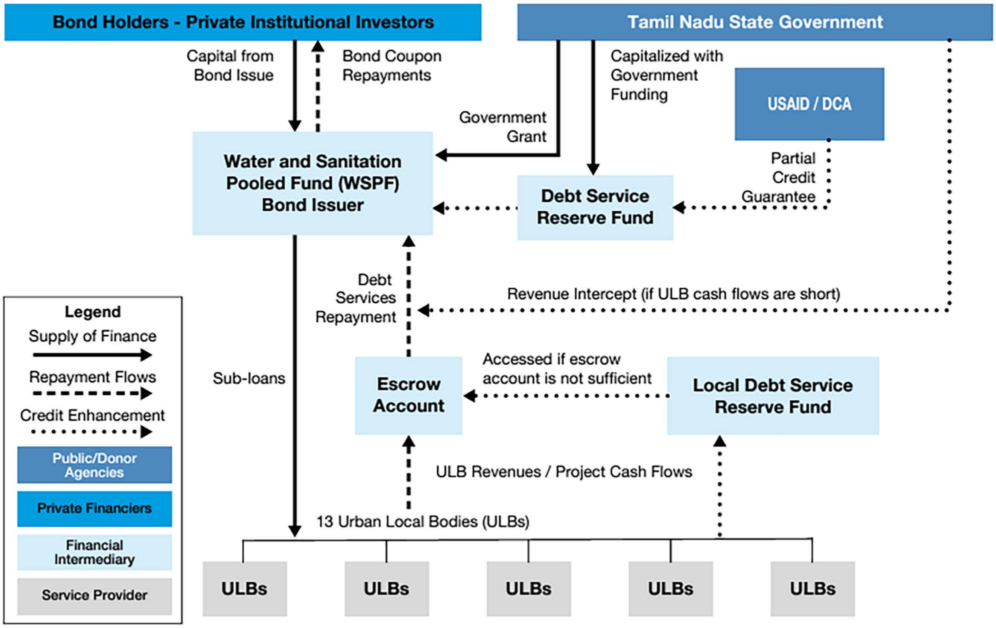

Figure 11.7 Pooled Municipal Bond Issuance in Tamil Nadu

Source: Case Studies in Blended Finance for Water and Sanitation, World Bank (2016)

11.4.2 Benefits

These approaches, especially pooled bonds and securitisation work on aggregation as the base driver. Given the fragmented nature, this is important because individual MSME loan sizes are too small to be amenable to capital market issuances. Further, they make cost of issuance affordable thanks to aggregation, provide diversification and loss reduction.

All three approached open up the potential of providing of credit enhancement/credit risk mitigation. This addresses one of the bigger challenges in access to credit to mid corporates and MSMEs. Systemic benefits are also reaped due to capital recycling and specialisation. Banks/NBFCs which are good at originating loans, but they may not be best suited to hold these for long periods. With the three approaches recommended above, they can focus on originating and collecting, while capital market investors such as pension funds can hold the financial asset for long tenures. This plays on the strength of both the banking sector and the capital markets.

In the global stage where markets are more developed, we have seen all the three approaches play a greater role. Given India's growth trajectory as well as the increased need for capital, these approaches offer potential solutions which are innovative yet tested.

11.4.3 Challenges with These Approaches

While the above approaches solve a problem, they are not a panacea in themselves.

Securitisation is often accused of encouraging originate-to-sell behaviour among Originators, and therefore Indian regulations have been framed to discourage such tendencies. RBI Guidelines on securitisation stipulate a minimum period for which a loan needs to be held on books before it can be transferred (Minimum Holding Period or MHP which is 3 or 6 months depending on the loan tenure). Also, RBI has stipulated a minimum economic interest in the securitised assets to be retained by the Originator through the tenure of the transaction (Minimum Retention Requirement or MRR, which is 5% or 10% of the loans being securitised, depending on the loan tenure). These twin stipulations of MHP and MRR are designed to discourage originate-to-sell tendencies. The strict regulatory regime, which otherwise could be viewed as an impediment, has been and continues to be an important safeguard and will shape the growth of a robust market.

While refinancing does not require homogenous asset classes to exist, both securitisation and pooled bonds are best suited for a homogenous set of assets. This is currently missing, as green activities are in the nascent stages and transition activities don't have a singular globally accepted definition.

Another potential hurdle, especially to securitisation, is the absence of adequate past data on loan performance. For securitisation to be an economically viable alternative, investors need a past track record to get a reasonable level of confidence about the likely performance of the underlying loans. Given the nascent nature of many of the categories of green/transition loans, their track record will take time to be established. In the meanwhile, green/transition loans will likely carry the tag of being 'high-risk', as is the case with any new asset class, and therefore require greater credit enhancement, resulting in higher costs.

Securitisation, as a key funding source, is often seen as an important ingredient in the success and growth of MFIs in India. No wonder, an idea worth exploring is whether securitisation can play a similar role in the growth of green finance going forward. In that regard, the authors acknowledge some vital differences between the two sectors, that could act as hurdles to the relevance of green securitisation. Firstly, micro loan interest rates have always been upwards of 20%, leaving enough room for borrowing cost, operating cost and credit cost. Secondly, the RBI guidelines pursuant to the Malegam Committee Report (1995), especially the interest spread related provisions, significantly contributed to investors gaining confidence about the regulatory stability in the sector. Both these factors were instrumental to the prosperity of MFIs in the country, in turn also helping the securitisation of MFI loans. Unfortunately, green loans are not comparable with MFI loans, either on interest rate parameter or on regulatory support.

Another accusation is that risk bearing at systemic level becomes obscured. However, on this count again, Indian regulations prohibit complex and opaque instruments like synthetic securitisations and CDO-squared.[3] What is permitted, and therefore prevalent, in India, is traditional securitisation, involving homogenous loans bundled into a pool, and tradable securities issued against them. The distribution of the pool cashflows is as per a clearly laid out cashflow sequence transparently documented in the transaction documents, and thus the risk-bearing is clear and traceable. For instance, in most cases, the cash reserve (provided by the Originator) bears the first loss in the transaction, (and is thus, the riskiest), while the Seniormost tranche (the highest rated tranche) is the last to be exposed to any loss.

Box 11.1 Exploring the Green Bond Market in India: Efficacy and Future Prospects

Harsimran Sandhu and Abhinav Jindal

1. Introduction

Green bonds are designed to fund projects with environmental benefits. Since its inception in 2014, India's green bond market has experienced impressive growth, with both public and private sector players raising funds through these bonds to finance solar, wind, geothermal, bioenergy, energy efficiency, water efficiency, and other projects with positive environmental impacts.

We examine the growing green bond market in India and assess whether green bonds could complement existing assets for companies seeking to refinance expensive loans into fixed-rate, lower-cost bond financing. Additionally, given the challenges in the secondary bond market and the long-term nature of many green transition projects, they may primarily serve as a secondary mechanism to enhance resource mobilisation rather than supporting the primary issuance of new projects.

Issuance of Green Bonds

The issuance of green bonds typically involves several phases. Before issuance, objectives are set, eligible projects are defined, a Green Bond Working Group is formed, and a framework is created in line with global standards. The structuring phase includes legal and financial structuring, obtaining third-party verification, and marketing the bond to environmentally minded investors. During issuance, regulatory approvals are obtained, the bond is priced and distributed, and funds are settled. Post-issuance, proceeds are allocated to green projects, which are regularly monitored, reported on, and assessed for impact. Investors receive regular updates to ensure transparency regarding the progress of funded projects.

Green bonds come in various types based on proceeds and debt recourse:

1. **'Use of Proceeds' Bond:** Funds earmarked for green projects, with recourse to the issuer's credit rating. Example: EIB 'Climate Awareness Bond'.
2. **'Use of Proceeds' Revenue Bond or ABS:** Funds earmarked for green projects, with revenue streams as collateral. Example: Hawaii State Green Bond.
3. **Project Bond:** Funds ring-fenced for specific green projects, with recourse only to the project's assets. Example: Invenergy Wind Farm Bond.
4. **Securitisation (ABS) Bond:** Funds refinance green project portfolios, with recourse to grouped projects. Example: Tesla Energy Bond.
5. **Covered Bond:** Funds earmarked for projects in the covered pool, with recourse to the issuer and covered pool. Example: Berlin Hyp Green Pfandbrief.
6. **Loan:** Funds earmarked for green projects, with full recourse to borrower(s). Example: MEP Werke Loan.
7. **Other Debt Instruments:** Funds earmarked for green projects. Examples include Convertible Bonds, Schuldschein, and Sukuk.

(Source: Climatebond.net)

2. *The Green Bond Market in India*

The green bond market in India has evolved exponentially over the past decade. The first green bond, issued by the Indian multinational private sector lender Yes Bank in February 2015, was valued at INR 1,000 crore for renewable energy project financing. Subsequent issuances followed, including Axis Bank's USD 500 million green bond in January 2017, the Indian Renewable Energy Development Agency (IREDA) in August 2018, a second issuance by Yes Bank in November 2018, a third issuance by Yes Bank in December 2018, and Western Coalfields Limited's first green bond in March 2020. By February 2023, Indian green bond issuances had reached USD 21 billion, with 84% coming from the private sector.

Tax incentives make green bonds more attractive for domestic and foreign investors. Tax-free infrastructure bonds were introduced in 2015 and provide an exemption from all taxation on interest income for investors. A similar reduction in withholding tax on interest income on rupee-denominated bonds (including green bonds) for foreign portfolio investors from 20% to 5% makes foreign investment in rupee bonds attractive. Long-term capital gains on listed green bonds held for three years and above are exempt from tax; investing in certain infrastructure bonds that provide funding to green projects can also enjoy tax deductions under Section 80CCF. Priority sector lending status for renewable energy projects makes it easier for those projects to raise finances at cheaper rates. SEBI guidelines have made green bond issuance and the proper use of proceeds more transparent. Broader incentives for green energy projects include accelerated depreciation and tax holidays for 10 years, in addition to a reduction of duties on certain equipment.

In February 2022, India announced its intention to issue sovereign green bonds to mobilise resources for green infrastructure. The first tranche of sovereign green bonds, worth INR 8,000 crore (about USD 1 billion), was released in January 2023, with another tranche of the same size auctioned in February 2023. This initiative is part of India's effort to achieve its Nationally Determined Contributions and build a reputation in the global green finance ecosystem (KPMG, 2022). These bonds are designed to meet the International Capital Market Association's (ICMA, 2015) Green Bond Principles, which focus on enhancing transparency, disclosure, and clear project-selection criteria. So far, the proceeds have been invested in projects related to renewable energy, energy efficiency, and pollution abatement, among other environmental benefits.

In effect, sovereign green bonds with their investment grade aim to be the 'anchor' bonds that seed a large green finance market and drive further growth in the bond market by enticing private sector issuance of green bonds. Another advantage of sovereign green bonds is the 'greenium' – a situation where investors accept lower returns for bonds with environmental benefits, thus helping project developers achieve a cheaper cost of capital and making project funding more viable.

According to the Hussain and Dill (2023), 'The sovereign green bonds showcase India's commitment to expanding renewable energy production and reducing its carbon intensity by supporting expenditures for renewable energy and electrification of transport systems.'

Green bonds have the potential to attract a larger segment of socially responsible investors and offer longer maturities. At present, however, green bonds have mainly attracted niche 'green' investors willing to forgo some yield for enhanced environmental impact. India's bond market suffers from limited liquidity and a relatively thin secondary market, which can hinder the green bonds' potential as a primary investment source. Currently, green bonds primarily serve as a repository for excess or contingent cash rather than as the main source of funding for green projects. To meet the investment needs of large-scale environmentally beneficial projects, the market will need to expand significantly on both the supply and demand sides.

3. *Strategies to Enhance the Role of Green Bonds in India*

Tax and Policy Support

Indian policymakers can boost green bond issuance through tax incentives for investors and issuers:

- Tax Credit Bonds: Investors receive tax credits instead of interest, reducing issuers' interest costs. Examples include the U.S. CREBs and QECBs programmes.
- Direct Subsidy Bonds: Issuers receive government cash rebates to lower their net interest payments, as seen in the CREBs and QECBs programmes.
- Tax-Exempt Bonds: Investors do not pay tax on interest from green bonds, allowing issuers to offer lower rates. This is common in U.S. municipal bonds and used in Brazil for wind projects.

Regulatory Support

To further enhance the role of green bonds in India, there needs to be strong and comprehensive regulatory frameworks to address concerns around transparency, accountability, and credibility. SEBI's own guidelines are steps in this regard, but more needs to be done to comply with best international practices. Additional tax incentives and subsidies, such as tax-free infrastructure bonds, lower withholding taxes, and even exemptions on long-term capital gains, could make these bonds more attractive to issuers and investors.

Promoting Investor Confidence

Promoting investor confidence is essential for the development of the green bond market. This can be achieved through credible disclosure norms, specific screening criteria for green projects, project reporting, and external verification and certification of green bonds to avoid the risk of greenwashing.

Leveraging Global Best Practices

India can leverage global best practices in the process of green bond issuance. It can align with internationally accepted taxonomies, like the taxonomy developed by the European Union or the Climate Bond Standard (CBS), to capture greater attention from foreign investors and showcase its ability to attract their capital in the long term. Additionally, taking cues from countries that have issued sovereign green bonds in the past will be beneficial.

As the above suggests, India's green bond market remains circumscribed both in scope and diversity despite regulatory attention to develop the market. It is therefore important to look at the specific challenges this market faces along the lines suggested in this article.

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Box 11.2 Long-Duration Deep-Discount Bonds for Industrial Decarbonization

Labanya Prakash Jena, Saarthak Khurana and Parag Puri

The industrial sector, a key component for economic growth, contributed to 25% of India's greenhouse gas emissions in 2021 (IEA, 2022). Certain technologies offer significant potential for reducing emissions in hard-to-decarbonize industries, both on the supply and demand sides. On the supply side, solutions include improvements in energy efficiency, carbon capture and storage (CCS), electrification, and the use of green hydrogen. On the demand side, strategies like material-efficient design, waste reduction, and circular economy initiatives are critical for decarbonization. This also involves investing in (proven) technologies and research, whose viability and scalability are not established. Considering the long asset lives (typically 40–50 years) of production units in the hard-to-decarbonize sector, it is also critical to understand and factor in the costs of carbon for commodities produced through conventional technologies vis-à-vis low-carbon technologies. Carbon prices are expected to rise sharply with the global and national push for carbon markets and the introduction of cross-border adjustment mechanisms (CBAM). Companies that adopt decarbonizing technologies must raise capital with a long-term horizon to gain financial benefits.

Long-duration deep discount bonds for industrial decarbonisation is a suitable financing solution for the hard to decarbonise sector. These bonds could offer debt capital for over 20 years aimed at low-carbon solutions against the current 10- to 20-year debt duration that is typically available for companies in this sector. This extended duration is particularly beneficial for industries focused on low-carbon solutions, which often require substantial upfront investment and longer time horizons to realise returns. A key advantage of these long-term bonds lies in their ability to limit the annual repayment outgo on the low-carbon industrial production units. By spreading repayments over a longer period, these bonds can significantly limit the annual financial burden on these units. This, in turn, can improve their cost competitiveness, making them more attractive to investors and more viable as an investment solution.

The rebate on the bond can be structured to offer a yield similar to other comparable fixed-income securities for the initial 15- to 20-year period, after which coupons[4] can be paid for the balance duration of the security. The deferred coupon payment structure, also known as a deep discount, can significantly reduce the financial burdens on companies, which would allow companies to adopt low-carbon technologies now in lieu of future financial benefits, such as reduced energy costs and increased efficiency. This is important to ensure the near-term cost competitiveness and investability of the low-carbon industrial production in the absence of a strong demand pull or effective carbon price presently.

It is expected that after this initial period, the pressures of limited carbon budget availability and, consequently, a higher global cost of carbon would make low-carbon commodities more cost-competitive than ones produced through conventional industrial processes. The coupon offered after the initial deep discount period can partly factor in the then fair value of carbon abated through low-carbon industrial production. This would mean that the coupon's value would be partly linked to the amount of carbon saved, effectively turning carbon savings into a form of financial return. Given the likely high cost of carbon in the future, this innovative approach of linking the coupon to carbon savings could provide a compelling incentive structure for investors.

This financial instrument can win the trust of shareholders and debt financers as this will safeguard against risks associated with climate transition, thereby resulting in a mutually beneficial situation. The future favourable environment combined with attractive features can make these deep discount bonds instrument stable.

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11.5 Conclusion

The analysis leads the authors to conclude that India is at a juncture where there is a massive need for green/transition funding. Banks (and other lending institutions) that have traditionally borne the load of most of the country's debt needs, are experiencing a worsening credit-deposit ratio, and hence their incremental lending ability is constrained. On the other hand, debt capital market investors are not ideally suited for investing in most of the green/transition actions directly, given that these activities are spread across a large number of sub-sectors and many of the businesses have unproven technologies, unstable businesses models and hence are perceived to be of weaker credit quality.

Mechanisms like securitisation, pooled bond offerings and refinancing offer the prospect of creating a bridge between the green/transition borrowers and the capital markets, thereby recycling the capital in the system better and eventually helping the financial system look beyond bank debt. The one thing we have not explored in this paper is how the above would differ for green sectors versus transition sectors. The authors acknowledge that some of the above is easier for certain sub-sectors under green but would be much harder under transition. Another study – A Roadmap for Green and Transition Finance in India (Khanna et al., 2024) – done by the authors looks at the role of securitisation specifically in transition finance.

We have aimed to showcase some of the options that can be explored to increase the depth of debt capital markets in India. It is not an easy feat given the sheer size and complexity of the market, but in the next few years, we can see some of these suggestions come to life. Undoubtedly, if green and transition sectors had been allowed to evolve in a traditional time frame, some of these would have happened on their own without external intervention.

Notes

1 A top up refers to financing over and above an existing loan offered to customers who have an existing relationship with the lender, a good credit score and have repayment ability.

2 As mentioned in Section 2 of this essay, there is a continuum of debt providers in India, with the capital market institutions – which mainly include Mutual Funds, insurance companies, and pension funds – generally being the lowest-cost debt providers. With interest rates being directly correlated with borrower credit quality, it follows that this low cost debt – provided by the capital market players – is largely accessible mainly to large corporate entities with relatively stronger credit profiles.

3 CDO-squared is a collateralized debt obligation backed primarily by the tranches issued by other CDOs.

4 A coupon refers to the interest payment (at a flat rate, usually a fixed percentage of the face value) that a bond issuer promises to pay a bondholder regularly until the bond reaches maturity.

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12 Navigating Carbon Pricing in India

Assessing Policy Options, Impacts, and Pathways to a Sustainable Economy

Shubhashis Dey and Kartikey Sharma

12.1 Introduction

Carbon pricing is an established policy instrument that can reduce the cost of emissions reductions, promote low-carbon investments, and help shift sectors away from fossil-intensive technology lock-in. It can drive green capital markets by providing a strong price signal to investors. It also delivers a potential mechanism for the government to raise revenues through taxes (in the case of a carbon tax) or via auction of allocations and/or through taxing the proceeds (in the case of an Emissions Trading System). This could become a vital fiscal source for governments that depend on fossil fuel tax revenues as they progressively advance towards net-zero emissions. Carbon pricing can be implemented through a carbon tax, which prices the emissions, or by implementing a carbon market that sets a limit on the emissions and allows regulated entities to trade, thus creating a price for carbon (Ma, 2023; Boyce et al., 2023; Wu et al., 2022).

This chapter looks at whether India needs carbon pricing, which carbon pricing instrument – carbon tax, emission trading scheme (ETS), or a combination – is more appropriate given India's climate and development objectives; what design considerations should be kept in mind while developing and implementing such instruments; and finally the potential impact of those instruments on growth, jobs, and industrial competitiveness (Popova, 2022; Xiayimulati, 2023).

12.2 Carbon Pricing: Markets or Taxes – The European Experience

Research suggests that carbon taxes and carbon markets should be viewed as part of a broader set of mitigation strategies rather than as exclusive 'first best' options. Practically every region that implements a carbon tax also operates an ETS, and regions with either mechanism employ additional policies to curb emissions from sources covered by these mechanisms.

12.2.1 Carbon Tax

Instituting a carbon tax is relatively straightforward from an institutional standpoint, as it can be integrated into existing fuel taxes, generating revenues that finance ministries can use. However, the implications of a carbon tax are significant. Although an optimal tax rate would apply equally across all sectors, existing carbon taxes often exempt

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politically influential sectors or those vulnerable to international competition, even in the most environmentally ambitious countries (Prasad, 2022). Finland and the Netherlands have had a carbon price since 1990, Sweden and Norway since 1991, and Denmark since 1992 (Lin and Li, 2011). Sweden's higher tax rates in transport have reduced transport emissions, but lower rates on oil and natural gas have not achieved similar results (Bohlin, 1998). In Norway, only about 60% of emissions are taxed, with exemptions for the most energy-intensive industries (Bruvol and Larsen, 2004).

The potential for revenue generation is a significant advantage of a carbon tax system, as the proceeds can fund climate action programmes while reducing carbon emissions. This, however, has to acknowledge assumptions about what happens to changes in the overall tax revenue for the government given the tradeoffs involved. A carbon tax's flat rate, applicable to all sectors, makes it an ideal policy instrument from both political and economic standpoints due to its simplicity and revenue generation capability.

12.2.2 Carbon Markets

In recent years, many countries have adopted carbon markets, such as an emission trading system (ETS) to reduce carbon emissions. As of 2022, 23.17% of global emissions were covered by carbon pricing, of which, 17.55% are in the form of carbon markets (World Bank, 2022).

An ETS is complex and requires a separate institutional setup to govern its operation. It needs a regulatory body to oversee operations and various setups for market aspects such as monitoring and verification, project registration, data collection, energy audits, and price oversight. If not operated correctly, these structures are prone to coordination failures and can be very capital-intensive.

The European Union Emissions Trading System (EU-ETS), established in 2005, was the first international cap-and-trade system and plays a crucial role in the EU's goal of reducing greenhouse gas (GHG) emissions by at least 55% below 1990 levels by 2030. OECD analysis indicates that between 2005 and 2012, the EU-ETS reduced carbon emissions by around 10% without negatively impacting the labour market (Dechezleprêtre et al., 2018). The system has cut CO_2 emissions by 40–80 million tonnes annually, accounting for 2–4% of the total capped emissions (Laing et al., 2014). While the European Union Emissions Trading System (EU-ETS) is widely regarded as a benchmark for cap-and-trade mechanisms, one of the persistent challenges it has faced is carbon price volatility. In its early years, the EU-ETS experienced significant price fluctuations due to over-allocation of allowances, economic downturns, and shifting policy signals. Price volatility in emissions trading systems (ETS) can undermine market confidence, discourage long-term investment in low-carbon technologies, and create uncertainty for businesses relying on carbon price signals for decision-making.

12.2.3 Impact of Carbon Pricing on Price, Jobs and Competitiveness

A comprehensive review of empirical assessments found no statistically significant effects of carbon pricing on competitiveness in OECD and G20 countries, including dimensions such as net imports, foreign direct investments, turnover, value added, employment, profits, productivity, and innovation (Venmans et al., 2020). Additionally, a study on British Columbia's carbon tax reform noted limited impacts on industrial competitiveness,

Box 12.1 Carbon Contract for Difference Mechanism for Industry Decarbonisation

Yash Kashyap and Saarthak Khurana

Context

Breakthrough low-carbon technologies for decarbonising hard-to-abate sectors such as steel, cement, chemicals, shipping and aviation, can have substantial incremental production costs compared to conventional carbon-intensive technologies. Consequently, the cost of carbon abatement for these technologies is high, ranging between 30 and 150 USD/tCO_2eq. (CPI, 2024), depending on the sector and technology.

Carbon prices in a market-based system are susceptible to volatility which leads to revenue uncertainty and adds to the financial risk-premium, directly impacting a project's access to finance (particularly debt), financing structure (debt-to-equity ratio), financing costs, cost of carbon abatement; and ultimately, financial viability (Richstein and Neuhoff, 2022). Carbon price risk in functioning carbon markets, especially in early stages of market operations, need to be managed to support projects that would rely on carbon revenues to reach final investment decisions.

Given the above, many innovative technologies face a valley of death during early deployment and commercialisation phase, where policy support is needed to improve the risk-return profile projects. Carbon Contract for Difference (CCfD) is one such policy and financial mechanism to hedge against the uncertainty in carbon prices, mitigate market (price) risk and balance out the potential carbon price volatility of carbon markets.

Mechanism

A CCfD is a bilateral contract between the government/government-owned entity/multilateral institution and a low-carbon project intended to cover the initial incremental cost of production compared to the conventional fossil-intensive technology. The contract is structured around an agreed carbon price required to make the project viable, the 'strike price' (equal to project-specific cost of carbon abatement), and the price of carbon in the market. As per the contract, the low-carbon project would receive (or give) payments if strike price is higher (or lower) than the price of carbon in the market. The payment is calculated as the difference in strike price and market price, multiplied by the tons of reduced carbon emissions compared to the baseline emissions (reference) in the sector from a conventional technology.

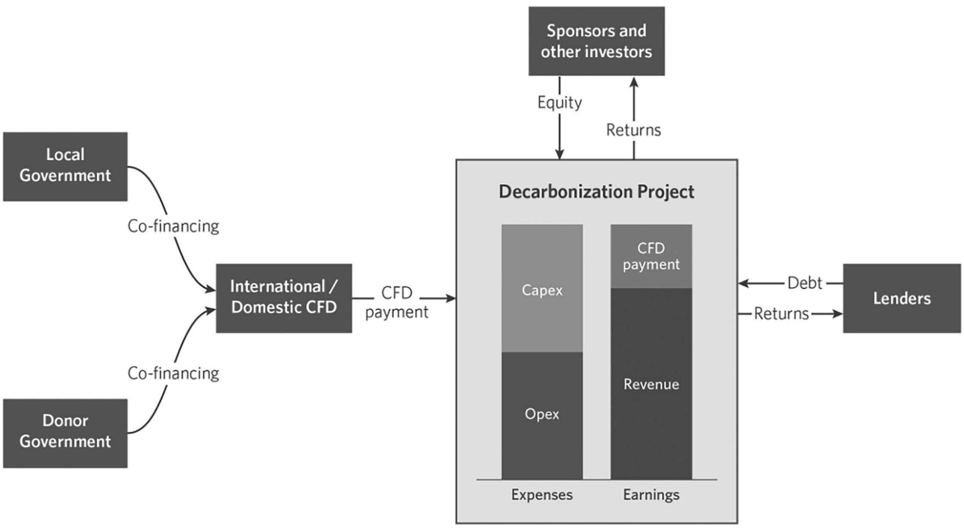
By guaranteeing a fixed price on carbon, a CCfD acts as a hedging mechanism against the volatility of carbon price in the market. It is both a policy de-risking and a financial (direct compensation) instrument that promotes investments in climate friendly technologies by addressing market uncertainties. A key benefit of a CCfD is the stabilisation of carbon revenues, which improves bankability and leverage – the share of debt capital available to projects. Improved financing conditions could lower overall financing and carbon mitigation costs by up to 27% (for the latter) (Richstein and Neuhoff, 2022).

Germany's industrial sector CCfD programme: In 2023, Germany announced a plan to launch a CCfD programme to support the transition of industries that are currently covered by the EU-ETS (such as steel, cement, lime, glass, and ceramics), in a move towards achieving its target of carbon neutrality by 2045. The German Government will provide CCfD to companies for a period of 15 years, compensating them for the additional capital expenditure and operating costs as compared with traditional plants, hedging them against price risk. The objective is to support industry in the initial stages. Over time, declining cost of technologies and an increasing price on carbon would remove the need for state support.

An alternative to CCfD is a Contract for Difference (CfD) based on the price of material (e.g., low-carbon emission steel) rather than the carbon price. In such a programme, the low-carbon project would receive payments equal to the difference in the levelised cost of production using a low-carbon technology (the strike price) versus the market price of steel produced using conventional technologies (see Figure). CfDs have been adopted by several countries including the UK, Germany, Australia, France, Italy, and Portugal to promote renewable energy deployment.

The outcomes of a CCfD programme and the contingent liabilities of the government (public funding requirement) will depend on the design specifications of the programme (discussed below), as well as other factors such as the scale of implementation (e.g., the industrial sectors included and the amount of industrial output covered), the movement of the carbon price in the market, and the rate of cost reduction of low-carbon technologies. While increasing scale will increase demand for funding support, increasing carbon price in the market will play a counter-balancing role, limiting public funding requirements to run the programme.

Contract for Difference Mechanism



Source: CPI (2024), adapted from Richstein and Neuhoff (2022).

Design Considerations

There are numerous design parameters that need to be considered which will impact the programme's effectiveness, efficiency and fairness. For instance, the reference (baseline) against which to compare projects to be contracted, the eligibility criteria and selection process, calculation of the strike price, duration of contract, etc.

Acknowledging that there are trade-offs involved in designing a CCfD programme, policymakers must strive to ensure that the programme in credible, stringent, and stable, yet flexible. The associated table discusses some of the key design parameters and suggestions for design calibrations.

Table Design Parameters for a Carbon Contract for Difference Programme

Design Parameter	*Description*
Contract type	*Bi-directional contract* where the project receives payments if the market price of carbon is lower than the strike price and pays back when the market price is higher. The alternative is a have a put-option in the contract which guarantees a floor price to the project (no payback from the project in this case). Floor prices will have the same effect as a strike price if it is close to the actual cost of abatement of low-carbon projects. However, cost of abatement of breakthrough technologies is quite high, and implementing economy-wide high floor prices which are effective may be politically infeasible.
Programme coverage (scope)	The economic efficiency of CCfD schemes can be maximised through *project-based CCfDs* that limit exposure of the government to specific projects that meet the eligibility criteria, while also allowing recuperation of part of the public capital support when market prices exceed the strike price. Project-based CCfDs may also be more politically feasible to implement than an economy-wide carbon price floor in the carbon market. Low-carbon technologies are at different stages of maturity and can have drastically different abatement costs. To support a wide range of technologies, the programme can have a sector-specific multi-tiered design with funding quotas linked to: (a) levels of emissions reduction achieved against the baseline; and/or (b) the stage of maturity of technologies.
Eligibility criteria	*Low-carbon technologies identified in the government's/government-recognised sectoral net-zero pathways*. Pathways would need to be updated periodically to include new innovations and the movement of technologies along different stages of maturity.
Technology specificity	*Technology-neutral* design promotes adoption of lowest-cost options (on a carbon abatement basis) available to the industry and allows market competition to drive green growth. Technology neutrality also takes care of the distributional effects since the relative costs of technologies may differ across different regions based on availability and cost of inputs and the supporting infrastructure.

(*Continued*)

Table (Continued)

Design Parameter	*Description*
Project selection	Selection of projects through a *competitive bidding process of reverse auctions* promotes efficient use of public capital. Reverse auctions allow for price discovery (of cost of abatement) of various low-carbon alternatives in the market and competition incentivises developers to reduce their costs over time. The minimum bid selection can be based on a self-adjusting formula (so as to remove political interference) that estimates lifetime liabilities of the government based on the reduction in emission intensity of production (against a baseline), the carbon price required to achieve the same (strike price), and the projected price of carbon in the market.
Strike price and contractual payments	The calculation of strike price could *account for the total cost of production and all potential revenue streams* (including green premiums if available) to reflect the actual total cost of abatement and avoid overfunding. Alternatively, CCfDs could cover just the incremental operating costs, while support for the capital costs is provided through other instruments such as viability gap funding (capital subsidies). Since the input prices (of electricity, raw materials, fuels and feedstock, etc.) required to calculate the incremental costs of the low-carbon technology and the baseline costs for the conventional technology are volatile, the strike price would need to be revised dynamically (suggested every one year) to address price risks and improve efficiency of the programme (prevent over- or under-funding). Only those cost factors which have a significant impact on the incremental cost of low-carbon production may be considered to reduce regulatory and administrative burden.
Baseline (reference conventional technology)	*Defined by best available conventional technology benchmark*. For sectors with multiple conventional technologies (like steel), the technology with the lowest cost of production can be chosen as the benchmark. Sectoral decarbonisation pathways, technological roadmaps and reference benchmarks need to be defined and updated regularly to account for technological improvements, innovations and improvements in the baseline emission intensity.
Contract period	Structuring *long-term contracts for 10 years or more* to sufficiently hedge against long-term carbon and energy price risk.
Emissions system boundary	For ease of monitoring and reporting, the system boundary for emissions from production of materials covered by the CCfD could be *mapped to the boundaries defined under the regulated carbon market*.
Scheme duration	The CCfD scheme can be *phased-out as the baseline emission intensity declines and low-carbon technologies become price-setting* in the market, i.e., competitive against conventional technologies.

(*Continued*)

Table (Continued)

Design Parameter	*Description*
Market stability mechanism	A *regulatory mechanism to stabilise carbon price movement* and steer it predictably towards higher price levels (ratcheting up over time), such as the Market Stabilisation Fund proposed under the Indian Carbon Markets. Such a mechanism will improve the carbon market's credibility and predictability, while lowering long-term government liabilities (public expenditure) towards CCfD contracts.
Funding for the programme	The funding for the CCfD programme could come *either entirely from the budget expenditure of the national government or with support from foreign governments*.

Source: Compiled by authors from Lösch et al., 2022; Rilling et al., 2022.

Expected Outcomes

Key outcomes of a well-designed CCfD programme include:

Direct innovation towards low-carbon and deep decarbonisation technologies for bringing about a structural change in key economic sectors.
Improve credibility and effectiveness of regulated carbon pricing schemes.
Improved financing conditions for supported projects – availability and share of debt, loan tenor and cost of financing.
Improved overall economic efficiency of carbon abatement and public cost savings.

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alongside a small but statistically significant annual increase in jobs over the period of 2007–2013 (Arlinghaus, 2015).

Another study demonstrated that a global uniform carbon price could shift the burden of solving climate change to developing countries, potentially impacting the prices of products like metal, fuel, and textiles manufactured in newly industrialised Asian economies such as China, India, and Indonesia (Känzig, 2021). For example, the price of Indian metal, fuel, and textiles would increase by 15%, 8%, and 7% respectively due to the implementation of a global carbon price of USD 50. This increase could negatively affect competitiveness and put jobs under pressure. In India and China, 3% and 2% of jobs respectively might be at risk due to such a policy, particularly impacting the low and medium-skilled workforce (Frankovic, 2022; Xue and Sun, 2022).

12.3 Why India Needs a Carbon Pricing Mechanism

Achieving India's net-zero target will require a structural shift in the economy, necessitating large-scale reallocation of resources from carbon-intensive to clean technologies and production processes, besides sizeable additional investments during the next few decades. One critical component of this strategy is the implementation of a carbon pricing mechanism.

Carbon pricing can be an effective tool to generate the necessary funds for low-carbon investments. By putting a price on carbon emissions, it creates a financial incentive for businesses to reduce their carbon footprint and invest in cleaner technologies. The revenue generated from carbon pricing can be reinvested into renewable energy projects, energy efficiency improvements, green hydrogen, small modular reactors, carbon capture and utilisation and other green initiatives, thus driving the energy transition forward.

Secondly, carbon pricing is crucial in the context of global trade and competitiveness. The European Union's Carbon Border Adjustment Mechanism (CBAM), the United Kingdom's similar initiatives, and the potential foreign pollution fee under discussion in the USA signify a global shift towards penalising carbon-intensive imports to level the playing field (Boute, 2024). For India, not having a carbon pricing mechanism could result in its exports being subject to these additional costs, thereby reducing their competitiveness.

Moreover, carbon pricing serves as a powerful signal to the market, incentivising low-carbon activities and penalising carbon-intensive ones. Creating a secondary market for carbon credits could generate fiscal benefits that can be channelled into low-carbon infrastructure projects.

12.4 Carbon Pricing Experiences from India

For India, the level of ambition of government policy significantly impacts carbon pricing. In the most ambitious policy scenario, where emissions peak in 2030 and achieve net zero by 2050, the carbon price in 2070 is 2.1 to 4.6 times higher compared to the least ambitious scenario, where emissions peak in 2050 and reach net zero by 2080, depending on the availability of breakthrough technologies. In the long run, if Carbon Capture and Storage (CCS) technology is unavailable, the carbon price in a net-zero world would need to exceed 900 USD/tCO_2. Conversely, if CCS is available, the required carbon price would be approximately half that amount (Chaturvedi and Malyan, 2022).

12.4.1 Carbon Taxes

India does not have an explicit carbon tax, but petroleum products are subject to substantial duties and taxes, which, according to India's Long-Term Low-Carbon Development Strategy document launched during COP27, amounts to an effective carbon tax, higher than that prevailing in many parts of the developed world (MoEFCC, 2022).

In 2010, India introduced a clean energy cess on coal at the rate of INR 50 per tonne. The proceeds were earmarked for the newly created National Clean Energy Fund (NCEF) with the objective of financing research and development in clean energy technology projects (Guttikunda and Jawahar, 2014). Since its inception the coal cess was increased on two separate occasions, in 2015 when it was revised to INR 200 per tonne and again in 2016 when it was doubled to INR 400 per tonne (IISD, 2018). In 2017, the clean energy cess was replaced by the Goods and Services Tax (GST) compensation cess of INR 400 per tonne on coal production, which was meant to bridge the revenue shortfall of states owing to the implementation of GST (Parry et al., 2017).

In an effort to curb pollution and improve air quality, the Municipal Corporation of Delhi (MCD) levied an environmental fee on commercial vehicles entering Delhi. This fee is intended to deter heavy-duty vehicles from entering the city, thus reducing vehicular emissions which are a significant source of air pollution in Delhi. By imposing this environmental fee, the MCD aims to encourage the use of cleaner fuels and reduce the volume of polluting vehicles on the roads, contributing to a decrease in overall emissions and improvement in air quality (Goyal et al., 2013).

It is estimated that 54.7% of greenhouse gas (GHG) emissions in India are subject to a positive net effective carbon rate[1] (NECR). The NECR in India is highest in the road transport sector and zero or negative in other sectors such as agriculture, industry, and buildings (OECD, 2021).

12.4.2 Market-Based Mechanisms

There are two market based mechanisms currently working in India to promote adoption of clean energy and energy efficiency. These are the perform achieve and trade (PAT) scheme and renewable energy certificates (REC) mechanism. The PAT scheme was designed to tap into the energy efficiency potential in energy intensive industry units. Till 2019, PAT covered 13 sectors covering 956 designated consumers (DC). In 2023, additional sectors were included under PAT scheme. Energy savings accrued by the DCs were converted into energy saving certificates (ESCerts) and traded through the national electricity trading platforms – India Energy Exchange Limited (IEX) and Power Exchange of India Limited (PXIL). During the first cycle of PAT (2012–2013 to 2014–2015), the market fluctuated over the trading period with price of ESCerts varying between INR 200 per ESCert to INR 1200 per ESCert. Experts identified two major challenges with the PAT scheme; first, it could not provide a consistent price signal to attract additional investments, since the certificates were issued ex-post and second, the targets were not sufficiently stringent and could be easily achieved (Sarangi and Taghizadeh-Hesary, 2020).

Renewable purchase obligation (RPO) is a mechanism by which obligated entities are mandated to buy a firm ratio of the total consumption of power from renewable energy sources such as solar, wind, etc. RPO has been notified by more than 30 states and union territories which allows obligated entities to purchase renewable energy certificates

(REC) for RPO compliance. Electricity generated by a renewable energy generator has two components – electricity and environmental attribute. The environmental attributes can be exchanged in the form of RECs. The REC mechanism successfully registered, issued, and traded RECs on the designated power exchanges. However, lack of compliance by the obligated entities created a huge inventory of RECs. Since the last decade or so, the floor price has become the market clearing price for both solar and non-solar RECs.

Recognising the importance of carbon pricing, the Government of India notified the Carbon Credit Trading Scheme (CCTS), 2023, on 28th June 2023. Obligated entities under the Indian CCTS will receive carbon intensity targets as opposed to, for example, the European Union's Emission Trading Scheme (EU ETS) that functions on absolute allocations. CCTS 2023 will be a compliance-based scheme in which the Ministry of Power (MoP) will decide the sectors and the obligated entities to be covered under the compliance mechanism based on the recommendation of the Bureau of Energy Efficiency (BEE). Additionally, BEE has also assumed control of the voluntary carbon market to ensure better vigilance on its operational functionality. The bureau will look to identify the sectoral scope in which non-obligated entities may register for generating carbon credits and the methodologies to be used under the offset mechanism. Potentially it is also looking at its overall alignment with the global Voluntary Carbon Market (VCM) as well (MoEFCC, 2022).

12.5 Carbon Tax or Carbon Market: Which One Is More Suitable for India?

The two pricing systems come with their own set of operational principles, making them viable choices for policy adoption. While both policy options have demonstrated their ability to reduce emissions from a business-as-usual scenario, the choice of instrument and its design are largely influenced by jurisdiction-specific circumstances, including the emissions profile, constitutional provisions, and political considerations. Many countries in Europe that have a carbon tax also have a corresponding ETS policy in place to complement it. In fact, globally, 53 national level initiatives of carbon pricing mechanism have been implemented (including EU) of which Canada, Mexico, UK, and Switzerland have both carbon taxes and ETS (World Bank, 2024).

One fundamental difference in approach is that a carbon market regulates the maximum quantity of emissions, while a carbon tax fixes the price of emissions. In an ideal world, a carbon tax provides a more balanced signal to investors and often brings the added benefit of raising significant fiscal revenue. Unlike carbon markets, taxes are not exposed to market uncertainties, and the carbon price remains stable regardless of other climate and energy policies (Black and Zhunussova, 2022). A well-structured market with a sufficient number of players, can provide economic efficiency gains by promoting investment in emission reductions in companies or infrastructure at the lowest cost.

Carbon taxes have the advantage of not requiring a trading infrastructure, making them relatively easy to administer (Partnership for Market Readiness, 2017). However, the path to implementing a carbon tax is fraught with challenges. The political landscape is replete with concerns about the potential short-term impacts on prices, employment, and competitiveness.

In the backdrop of this narrative, the International Monetary Fund (IMF) estimates that a USD 25 per tonne carbon tax in India could reduce emissions by approximately 25% by 2030. Yet, as the nation aspires to achieve net-zero emissions by 2070, the tax would need to increase progressively to USD 117 per tonne by 2050 (Agarwal et al., 2021). The

Reserve Bank of India (2023) scenario analysis in its report aligns with the IMF's projections: a carbon tax of USD 25 per tonne could reduce emissions by 25%, and if raised to USD 50 per tonne, the reduction could reach 36% by 2030. It suggests that integrating this tax with other policies, such as ETS, feebates, and regulatory measures, could significantly amplify the impact, achieving an additional 93% reduction in emissions.

Global experience with carbon pricing instruments suggests that carbon taxes are more effective, but comparatively less used, and non-tax risk mitigation measures such as the ETS, feebates, and regulations can complement carbon taxes (Dabla-Norris et al., 2021). There are sound theoretical and practical reasons for using multiple price and non-price instruments to reduce GHG emissions (Haites, 2018). This account underscores the importance of a balanced approach, leveraging both carbon taxes and complementary measures to pave the way for a sustainable and resilient future.

12.6 Recommendations

India's current measures for climate mitigation include a mix of efficiency standards, renewable energy targets, carbon credit trading scheme, taxes, subsidies, and regulations. Given India's multi-pronged policy approach to achieving the updated NDCs and the net zero by 2070 target, the following carbon pricing measures are recommended:

- Given that use of fossil fuels is already taxed in India, carbon taxes should be included in GST, Central Excise and State VAT, without altering the rate of taxation in the near term.
- Receipts from carbon taxes should be credited to a separate ring-fenced fund and a part of the receipts should be invested in clean energy projects supporting India's net-zero transition.
- A carbon market should be used as a complementary policy without significantly altering the existing carbon taxes or subsidies. The primary goal of carbon market should be to accelerate decarbonisation in industries.
- Taxes and trading price do not necessarily have to be the same as they will be two separate mechanisms, implying that policy makers could maintain some sense of control over equity and distributional impacts.

12.6.1 Design of Carbon Taxes

The basis for recommending a carbon charge or cess stems from global and domestic experiences where carbon pricing has been successfully integrated into the tax system. Furthermore, integrating these with the GST framework can ensure transparent and efficient allocation of revenues for green initiatives. The following recommendations are proposed:

1. **Phase-Wise Implementation:** Introduce a carbon tax gradually over several years, starting with a lower rate and increasing it incrementally. This allows businesses and individuals time to adjust and adopt clean technologies.
    - Various announcements by government officials suggest that India's reliance on coal for energy will persist in the short to medium term. Therefore, it is recommended to maintain coal under GST and introduce an additional carbon tax linked to coal's carbon emissions. During this process, the government can decide how to

repurpose non-tax revenues from coal, such as railway freight charges. With the completion of the five-year statutory period under the GST Compensation Act of 2017, there is a need to repurpose and rename the compensation cess on tobacco, coal, and fossil-fuel transportation as a carbon tax.

- The government is encouraged to pass on the real cost of electricity to consumers. Lessons from diesel subsidy reforms show that market-linked diesel pricing policies provided more economic growth than the heavily subsidised earlier policy (Ghosh, 2022).
- Carbon tax rates, once established, should not be frequently altered and should only be increased gradually.
- The impact of the carbon tax on the economy and emission reductions should be monitored and reported for policy adjustments and ensuring the tax's effectiveness.

2. **Revenue:** Revenue generated from a carbon tax must be reinvested into the economy to foster green growth and address any distributional impacts resulting from the tax.

   - The receipts should be ringfenced.
   - A portion of the revenue should be allocated to mitigate the distributional impacts on vulnerable households, farmers, and businesses. Additionally, the funds should be used to implement climate adaptation measures to minimise the effects of climate change on vulnerable communities.
   - Another portion of the revenue should be invested in research and development of clean technologies and renewable energy sources. By fostering innovation, the economy can become more resilient, sustainable, and competitive.

3. **Bringing Uniformity:** A carbon tax should be applied to all fuels currently taxed (both under GST and outside of GST). To achieve uniformity, the impact of non-tax charges on fossil fuels must also be considered. For instance, Indian Railways disproportionately charges coal freight to subsidise passenger transport (The Energy and Resources Institute, 2019).

   - The carbon tax should be implemented within the existing GST legislative framework, in addition to GST, with rates determined based on carbon emissions and calibrated to protect government revenues.
   - Both the social cost of carbon and the abatement approach indicate that the current tax burden on petroleum products is already high. It is therefore recommended that the carbon tax on petroleum products should be included under GST subject to a uniform GST rate with an additional non-creditable carbon tax (EY and Shakti, 2018) while carbon tax on coal should be gradually increased over time.
   - If states do not support the levy of a carbon tax under GST, the differences between the centre and state on these matters may be reconciled using consultative mechanisms.

4. **Upstream versus Downstream:** The carbon tax can be levied upstream for administrative ease, utilising existing tax laws. To encourage consumer behaviour change, a downstream levy can be applied, such as higher taxes on vehicles with lower fuel efficiency, polluting fuel and higher carbon emissions.
5. **Sectoral Strategies:** The carbon tax rate for different sectors should be based on their emissions intensity and ability to adapt. Exemptions or lower tax rates can be proposed for sectors that are critical to the economy but harder to abate.

6. **Balanced Approach:** In the short and medium term, a balance between climate objectives and economic considerations is crucial to ensure that the policy achieves its intended goals with minimal unintended consequences for businesses and individuals. The design of carbon pricing mechanisms needs to consider local economic conditions, particularly in cost-sensitive industries like steel, where shifting to greener alternatives, can notably raise production expenses. Pricing should be thoughtfully structured to prevent placing undue burden on industries and consumers, using strategies like targeted subsidies or phased implementation. New carbon taxes should be informed by data and designed through a consultative process.

12.6.2 Design of Carbon Market

Based on recent developments in this sector, the following recommendations are made:

1. **Maintaining Liquidity, Trading, Price, and Stability:** Market management principles must be enforced to maintain liquidity, trading, stability, and price management. This can be achieved by:
   - Setting ambitious but appropriate targets.
   - Conceptualising a 'market management' function during the early phases of the Indian carbon market. The market management entity should purchase, bank, and trade surplus credits in subsequent cycles to ensure price stability.
   - Permitting credits from the international/voluntary market during market deficits (for limited windows). Similarly, restricting the outward flow of credits (for limited windows) from sectors allowed to export (eligible and non-NDC sectors) to ensure market stability. These measures are necessary in the early phases of the Indian carbon market.
   - Exploring the feasibility of limited and selective futures contracts, as well as monthly/quarterly settlements, to generate liquidity for financing innovative measures and ambitious projects.
   - Ensuring that all credits are easily transferable across all market participants when energy and non-energy sectors become part of the crediting scheme.
   - Encouraging public NetZero pledges and commitments from high emitters, and allowing these entities to meet a certain percentage (e.g., 10–15%) of their voluntary obligations from CCTS.
2. **Price volatility:** Recognising the potential risks of price volatility, India's Carbon Credit Trading Scheme (CCTS) could benefit from incorporating key stabilisation mechanisms. Implementing a price floor for carbon credits, ensuring a robust allowance adjustment mechanism, and facilitating banking and borrowing of credits could enhance market resilience. Additionally, considering a future linkage between India's carbon market and international ETS would provide further price stabilisation benefits while integrating Indian industries into global carbon pricing regimes.
3. **Creation of a secondary carbon market:** Secondary carbon markets can be distinguished from the primary carbon market through its ability to facilitate trading of emission allowances (or units) among a diverse set of market participants. India may allow the creation of a secondary market only after the market attains maturity. Classifying carbon credits as financial instruments brings them under the preview of financial market rules to stabilise the carbon market by ensuring robustness and transparency.

4. **Linking Domestic Carbon Crediting Mechanisms with Global ETS:** Linking a domestic carbon crediting mechanism with a global Emissions Trading System (ETS) can streamline efforts to address climate change and promote international cooperation. Here are some steps to establish such a linkage:

   - **Maintain High Quality of Credits:** Establish a robust monitoring, reporting, and verification (MRV) mechanism.
   - **Identify ETS Opportunities**: Identify existing global or regional ETS that India can join or create new global or regional ETS with like-minded countries.
   - **Coordinate with International Partners:** Harmonise emission reduction or removal methodologies with international partners. Establish common standards and protocols to ensure transparency, accuracy, and consistency in calculating carbon credits across different jurisdictions.
   - **Develop Equivalency Criteria:** Develop equivalency criteria for carbon credits generated through domestic mechanisms and those traded in the global ETS. This may involve setting benchmarks or conversion factors to ensure the comparability of credits.

5. **Supply of High-Quality Emissions Reduction:** Although the demand for carbon credits is expected to rise in the future, ensuring a supply of high-quality carbon credits is often challenging in practice. Here are some steps to address this issue:

   - **Establish Additionality and Crediting Baseline**: Utilise mechanisms such as the Carbon Credit Quality Initiative (CCQI) to assess the quality of additionality and crediting baselines.
   - **Blockchain-based platforms and AI-driven digital MRV**: To enhance transparency and efficiency in India's Carbon Credit Trading Scheme (CCTS), integrating blockchain-based platforms and AI-driven digital Monitoring, Reporting, and Verification (MRV) tools is essential. Blockchain can provide a tamper-proof, decentralised ledger for carbon credit tracking, ensuring real-time, fraud-resistant transactions and preventing double counting. Technologies like NASA's OCO-3 (Orbiting Carbon Observatory-3) and ESA's Copernicus Sentinel-5P can support independent CO_2 emissions verification, while IoT-enabled smart meters in industrial facilities enable real-time emissions tracking and automated compliance. By leveraging these digital innovations, India can build a robust, transparent, and globally aligned carbon market, fostering investor confidence and accelerating decarbonisation efforts.

6. **Create Safeguards:** Implement safeguards to avoid carbon leakage, carbon-intensive technology lock-in, negative impacts on other environmental indicators such as biodiversity, and perverse incentives.
7. **Qualifying criteria for Obligated or Voluntary buyers:** While ensuring the quality of supply, there must be qualifying criteria for entities purchasing these credits to offset their own emissions. Carbon credits should not become a tool for delaying emission reductions within the buyer's own operations or across its value chain.

12.7 Conclusion

We conclude that the option of levying a carbon tax should be explored along with the development of a domestic carbon market for India. The biggest advantage of a carbon tax is its ability to raise fiscal revenues, which can be used not only to build future low-carbon infrastructure but also to mitigate some of the welfare impacts of carbon pricing. For India, it is recommended to reduce income tax to mitigate any potential adverse impact of carbon pricing.

Note

1 This is an approximation of the total price of carbon emissions resulting from taxes (carbon and fuel taxes) and compliance with emissions trading markets.

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Box 12.2 Pioneering Financial Instruments for Industrial Decarbonisation: The Long-Term Carbon STRIPS Bond

Labanya Prakash Jena, Saarthak Khurana and Parag Puri

Hard-to-abate industries need to invest significant capital in low-carbon technologies, including ones that are not as yet technologically mature and commercially viable, to decarbonise. Current policy and financial conditions often do not support such long-haul interventions. Yet, not investing enough in low-carbon technologies exposes companies in hard-to-abate industries to transition risk.

We propose a new financial instrument called the 'Long-term Carbon STRIPS Bond' that can address the financial challenges for the hard-to abate sector while mitigating transition risks. This instrument is similar to 'Separate Trading of Registered Interest and Principal Securities' (STRIPS), where the principal and interest are traded separately. In a carbon-stripped bond, the debt obligation (including principal and coupon payments) and carbon security are separated and sold as separate securities to investors. The carbon security is derived from carbon credits achieved through the usage of decarbonisation technologies compared to business-as-usual scenarios. Our hypothesis is that future increases in carbon prices will benefit companies investing significantly in low-carbon technologies by allowing them to avoid carbon-based penalties or import duties based on carbon intensity in international markets. Adding carbon security can effectively reduce the yield of the deep discount bond price that incentivises companies to issue these bonds. Corporations can issue bonds at a deep discount but with a lower yield as the investors will also receive carbon securities. The low interest rate and a deep discount feature will allow the company to invest in low-carbon technologies as its impact on financial metrics (ROEs, debt coverage, etc.) will be significantly lower compared to high-interest-bearing and medium-term conventional bonds.

Bond investors can then sell their carbon securities to those buying carbon credits. However, investors can also hold these carbon securities to hedge against climate transition risk. This carbon stripping enhances market liquidity and price discovery as investors can participate in the carbon market and create new investment opportunities. This mechanism helps corporations meet decarbonisation targets while fostering a robust carbon market, aligning economic incentives with climate action. The balance of benefits from these financial instruments will support the industrial sector investing in deep-decarbonising technologies to create a low-carbon green economy while providing sufficient financial incentives for investors to subscribe.

This represents a useful step towards creating financial structures that are diversified in terms of instruments that help in aligning long-term economic incentives with the urgent need to address climate change.

13 Sub-National Climate Finance Needs and Innovations to Mobilise Requisite Resources – Case for Maharashtra

Upendra Bhatt

13.1 Setting the Context

Economy-wide decarbonisation is essential for achieving the climate goals set by the country, both for the mid-term, that is, Nationally Determined Contributions (NDC) goals, and long-term 2070 net-zero targets. Sub-national governments are key to implementing NDCs and ensuring ground actions are undertaken at a pace in line with a country's net-zero transition trajectory.

Maharashtra is the third-most vulnerable (CEEW, 2021) state in India from a climate standpoint. The state is faced with a complex set of climate transition challenges given that it is not only one of the most industrialised states in India but also has a very large agricultural sector and a very extensive coastline. Major industries in Maharashtra include automobiles, engineering, textiles, pharmaceuticals, chemicals, petrochemicals, food processing and IT/ITeS. Agriculture's share in the GDP is only at 12–13% but is crucial given that it employs 50% of Maharashtra's working population (Maharashtra Economic Advisory Council, 2023).

Local climate vulnerabilities are increasingly leading to higher infrastructure development and rehabilitation expenditure for the local government. The State's climate strategy and resilience is critical for ensuring the continued national growth, since it contributes over 14% to the national GDP and receives 30% of India's FDI inflow. As part of the overall climate strategy, the state has been enhancing its state action plan on climate change. This effort is also being expanded upon by key cities and urban areas in the state, which have and are identifying concrete climate adaptation and resilience measures to be undertaken in the near to mid-term.

There is a growing interest in green infrastructure deployment and green technology development within the state's industries. Green financing requires finding the right capital and, in many cases, entails bundling technology choices together with financing. Given the scale as well as the complexity associated with the sub-national public investment ecosystem, a blend of solutions needs to be looked into to structure financing pathways for climate change projects.

13.2 Baselining Current Climate Investments in the State

The annual climate-specific spend has been identified based on retrospective green attribution aligned to the thematic taxonomy outlined as part of India's sovereign green bond framework.

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A retrospective analysis of state schemes, centrally sponsored schemes, central sector schemes and externally aided projects indicates that the *average annual public climate investment since FY 2017 in the state to be around INR 68 billion and INR 126 billion by the private sector however the public spend more than doubled in FY 2023.*

Estimated public climate expenditure at INR 139 billion in FY 2023 was more than 2× that of the annual actual climate expenditure of previous years.

The majority of spending has been in Renewable Energy (~53%), followed by Clean Transportation (14%), Pollution Prevention and Control including Industrial Efficiency (9%) and Sustainable Water and Waste Management.

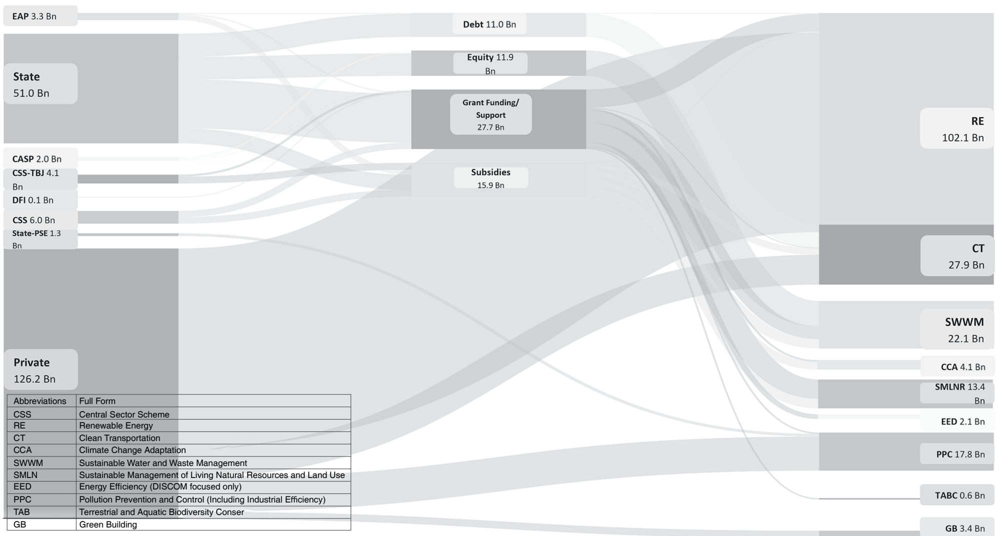
Overall, grants and subsidies make up a little over two-thirds of the public spending, with balance being in returnable form (nearly equal split between debt and equity contribution to state enterprises and related projects). Sector-wise mapping is indicated in Figure 13.1.

As is evident from the figure, and not surprisingly, the majority of capital flows have been directed towards Renewable Energy (~53%) followed by Clean Transportation (14%), Pollution Prevention and Control (including Industrial Efficiency) (9%) and Sustainable Water and Waste Management.

Grants and subsidies make up a little over two-thirds of the public spending with balance being in returnable form (nearly equal split between debt and equity contribution to state enterprises and related projects).

13.3 Outlining the Climate Finance Demand in Maharashtra

The Climate Finance need for Maharashtra has been based on the additional investments needed from 2024 to 2030 to achieve the State contribution to India's NDC targets.



Abbreviations	Full Form
CSS	Central Sector Scheme
RE	Renewable Energy
CT	Clean Transportation
CCA	Climate Change Adaptation
SWWM	Sustainable Water and Waste Management
SMLN	Sustainable Management of Living Natural Resources and Land Use
EED	Energy Efficiency (DISCOM focused only)
PPC	Pollution Prevention and Control (Including Industrial Efficiency)
TAB	Terrestrial and Aquatic Biodiversity Conser
GB	Green Building

Figure 13.1 Mapping the Climate Finance Flow by Source, Instrument and Demand Sectors (billion INR)

Source: Author's estimates and calculations

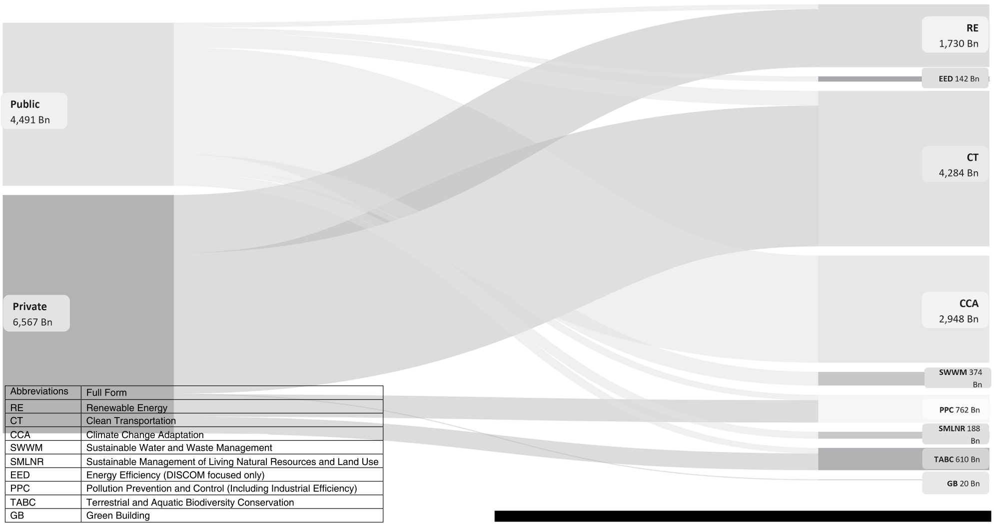


Figure 13.2 Estimated Sectoral Demand Flow for 2030 Climate Finance Needs in Maharashtra (billion INR)

Source: Ckinetics analysis

The assessment has been aligned to Maharashtra's stated goal of becoming a USD 1 trillion economy by the end of this decade and leveraging that ambition to scale up the transition efforts of the State aligned to the focus sectors driving the growth – manufacturing, power, agriculture and infrastructure. This entails projected nominal GSDP growth of 13–14%.

The broader climate transition in the state aligned to 2030 NDC goals requires a total investment of nearly USD 135 billion (INR 11 tn+) with the majority of investment towards industry, green buildings, renewables and transport sectors besides adaptation (Figure 13.2).

Clean Transportation, Renewable Energy, Pollution Prevention and Control (including Green Hydrogen, Industries Efficiency), Terrestrial and Aquatic Biodiversity Conservation are sectors where major focus in the mid-term would be on attracting private sector investments.

Some sectors may have adequate climate finance momentum however, the sectors with funding gap would need to have targeted financing solutions. Out of the foreseen investment requirements discussed above, public finances[1] are expected to contribute upto 25% while the remaining investment is expected to be from private sources.

Overall, there is a *need to attract private finance at scale with public sector funding prioritised for bankable portfolio development, co-financing or derisking capital.*

13.3.1 Gauging the Gap

INR 5 to nearly 6 trillion gap is foreseen for meeting 2030 climate goals depending on the budgetary allocations and end-uses; range is computed based on continuity of the average public climate spending trend of last 7 years (FY 2017 to FY 2023, inclusive of both) versus being aligned to the estimated annual public budgetary climate expenditure in FY 2023 to reflect ongoing government priorities.

The scale-up of climate financing is dependent on:

- Adequate scale of bankable projects and monetisability of the assets, i.e. ability to generate cashflow for the asset owners
- Restructuring and managing of state public sector's debt to make headroom for climate investments
- Approaches for crafting partnerships between private and public financial institutions and framing blended finance mechanisms as a key tool of transition finance
- Innovation on the Instruments front for galvanising resources including adaptation/loss and damage interventions.

In order to expedite the scale of bankable projects, the State Government can commission design-level carbon audit for ongoing conventional public infrastructure projects so that these can be added to the Climate sector programme portfolio and undertaken in the favourable terms of concessional green financing. Examples of such projects could be public housing projects, public works (buildings) projects, irrigation projects, transport and logistics projects, water supply projects, utilities projects, agriculture projects, dairy and livestock projects etc.

13.3.2 Expanding Funding for Climate Action

In order to expedite the scale of bankable projects, the State Government can commission design-level carbon audit for ongoing conventional public infrastructure projects so that these can be added to the Climate sector programme portfolio and undertaken in the favourable terms of concessional green financing. Examples of such projects could be public housing projects, public works (buildings) projects, irrigation projects, transport and logistics projects, water supply projects, utilities projects, agriculture projects, dairy and livestock projects etc.

Some strategic pathways are indicated below. These include tax schemes tied to land-use and emissions that can be used to promote green practices and overall energy/resource efficiency; thus generating a corpus for Climate Projects.

Mechanisms	*Transportation*	*Power*	*Industries*	*Buildings*	*Water/Waste*
Taxes, fees and charges	• Parking fees (perhaps even benchmarked to Congestion) • High Occupancy Toll lanes	• Electricity user fees	• Waste management fees	• Property tax Building permits	• Tariffs and fees
Grants	Grants indexed to environmental indicators or specific outcome focused grants				
Results based contracts	PPP concessions		Energy performance contracts		Water as a service
Land-based income	Development charges/ impact fees		• Tax increment financing	• Higher density building rights	Development charges/ impact fees
Loans and bonds	• Loans and green bonds • State incentives for companies registered in Maharashtra and seeking to deploy proceeds of Green Bonds in Maharashtra				
Carbon Finance	• Carbon finance • Initiate sector-specific schemes in Industries to help catalyse capital for supporting MSME transition				

The *concept of Land Value Capture* can be applied to evolve a new index for determining the tax applied on the property.

Land Value Capture can enable recovery of a portion of the increase in land and property values that result from public investments. This can take form of land value taxes, impact fees and charges on building rights, among others.

Focus also needs to be on effectively integrating local taxation strategies and financing insurance to *cover areas where local measures fall short*, thus ensuring that strategy is appropriately oriented towards the most vulnerable in a scalable, sustainable, and equitable way.

13.4 Innovative Financing Instruments and Mechanisms for Climate Projects

The most obvious pools like to be directed to states such as Maharashtra are concessional funding lines. These could be from conventional multi-lateral/bi-lateral sovereign intermediated process or even crafted based on innovative partnerships from blending commercial capital with Climate Investment Funds.

However given the need to optimise the use of available fiscal window and the range of climate contexts in the state, it is prudent for the state to consider a range of interventions – cutting from innovative credit guarantee mechanisms to instruments such as Green SDLs, INVITs, Debt Climate Swaps etc.

The focus needs to be on enhancing domestic and international funding integrated with empowering local entities. This provides a great opportunity for state agencies to foster innovative partnerships and tap into the opportunities and steer capital flows towards climate aligned projects/interventions.

In case of Climate Change Adaptation, *funding gap requires PPP innovations to stimulate private capital, going beyond public finance deployments*. Maharashtra has reasonable fiscal space (of around USD 6 billion) to help trigger the process.

Key innovations that seem relevant for Maharashtra include:

1. **Green State Development Loans** (SDLs) – As a state with significant access to Capital Markets and with considerable interest from Foreign Portfolio Investors (FPIs), it would be prudent for the State to frame a Green SDL to help place new assets. A basic analysis indicates that nearly 30 to 60% of the state's future borrowings could benefit from this approach.
2. **INVITs/Green Bond issuances by State Agencies** – State institutions such as MAHAPREIT could tap into the markets with Green Bonds issuances and in time, or purse INVITs. The latter would allow such agencies to use the sovereign/sub-sovereign window to borrow and invest in green infrastructure and thereafter bundle these assets into INVITs and sell down to release pools for further asset development.

   This circularity will create headroom without creating fiscal instability for the state. These INVITs can also be structured as Revolving Funds – Revolving funds are a flexible and self-sustaining financing mechanism to support climate action plans and projects, while also generating economic and environmental benefits for the state.
3. Debt-for-climate (DFC) swaps – An innovative instrument that helps reallocate a portion of ongoing debt obligations towards investments in climate action.

   An illustrative view of the mechanism is indicated in Figure 13.3, which illustrates a tripartite swap among a State entity, commercial creditors, and the State mandated NGO(s).

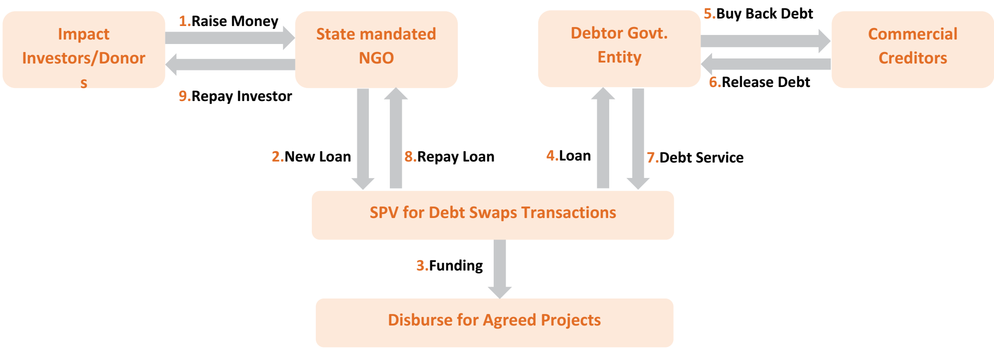


Figure 13.3 Illustrative Structure of a Tripartite Debt Swap

Source: IMF Working Paper 'Debt-for-Climate Swaps: Analysis, Design, and Implementation' – Chamon et al., 2022

A good case could be to frame certain coastal resilience/biodiversity projects and commission a few ground NGOs under the aegis of Majhi Vasundhara initiative of the state.

Nearly 15% of the State's climate funding could emerge from such application. The success of DFC swaps depends on two factors: (a) definition of use of funds and; (b) quantum of debt relief offered.

The scale-up of the instrument requires careful packaging of climate projects and linking debt to the budgetary use of funds as also crafting climate performance indicators.

4. **Risk mitigation mechanisms to reduce the cost of capital and attract private investments**

e.g. SIDBI's risk sharing facility for pursuing energy efficiency, credit guarantee and payment security mechanisms for scaling up distributed renewables and promoting meter-as-a-service (Smart Meter rollout underway)

Such credit guarantees can leverage state funding coupled with philanthropic funding to develop portfolio level fist loss pools to catalyse private capital flow for enterprises as also end-users, particularly for the industrial and SME transition in the State.

The mechanism (see Figure 13.4) is primarily necessitated since many of the SME focused interventions or sponsored by early stage start-up e projects do not meet standard debt covenants and there remain gaps regarding benchmarks as also limited understanding of technical and operational aspects, etc. Thus perception of high risks prevails in the lending institutions resulting in need for collaterals whereas most of these prospective borrowers have limited collaterals and hence can't avail loans.

The proposed Credit Guarantee construct comprises of: (a) First Loss/Liquidity backstop pool at a portfolio level; (b) Partial Credit Guarantee on defaulting loans.

5. **Financing facilities comprising of parametric insurance, resilience bonds and risk pooling to insure against climate risks**

A key facet of reflection is the innovation to ensure adaptation and loss and damage intervention funding. Given the lack of prior expertise in assessing adaptation as also loss and damage needs, bundled mechanisms comprising of parametric insurance, resilience bonds and risk poling is seen as an appropriate strategy.

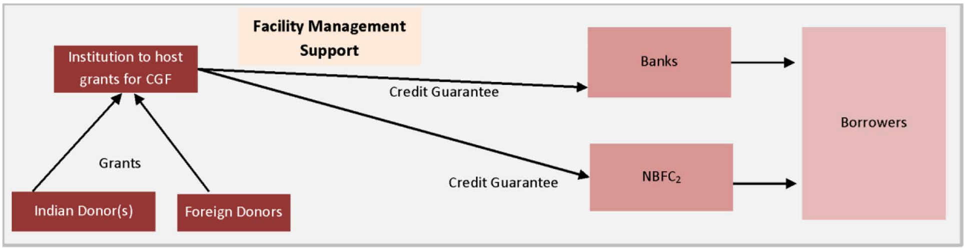


Figure 13.4 A Proposed Risk Mitigation Mechanism

Source: Author's Own

This can be particularly relevant in Maharashtra for Climate Adaptation related financing and Insurance mechanisms.

Pooled – Debt approach enables access to the debt market, particularly international markets, which otherwise are not feasible due to costs (bond issuance, legal) and lack of credit rating.

A natural capital insurance for coastal resilience can be crafted as a combination of Trust Fund and Insurance component.

Coastal resilience is a public good and the instrument advocated above can help incentivise private entities and help craft investments in large-scale restoration and sustainable management of natural assets for coastal protection

6. **Biodiversity credits** can be a variant to the Nature based capital solutions under discussion. These are economic assets crafted from allowing private companies to finance activities like forest conservation that deliver positive biodiversity outcomes.

   NGOs, governments, landowners or companies aiming to conserve or restore land generate a supply of 'certificates', or credits – for example, one credit may represent X amount of land restored over a certain period.

   Private firms can then buy these credits to meet their own nature-based commitments, like carbon credits. *Importantly, biodiversity credits are intended to have a net-positive effect on nature, rather than simply offsetting unavoidable damage.* Facets to consider are:

   - Ensuring just/equitable distribution of rewards particularly to local community
   - Governance and appropriate measurement mechanisms for baselining as also ongoing maintenance of biodiversity
   - Sustaining supply and demand for high-integrity credits

The instruments discussed above are relevant not just for Maharashtra but other States as well. Continued access to funding would need to be evolved at on a state-specific basis to ensure the approaches are resilient and aligned to the local context.

The complexity of the financing methods foreseen as needed to met the entire spectrum of requirement underlines the need to catalyse dedicated 'local' green institutions in the state with requisite capacity and knowledge to access green and climate finance sources.

Adopting a bottom-up approach and following sectoral or cluster level convergence will allow climate action to be integrated with the socio-economic conditions of the State and help sharpen specific interventions.

Note

1 *Analysis of the state's budget undertaken by cKinetics indicates that just around 10% of the state's revenue and capital expenditure budget can be deemed as climate relevant.*

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14 Beyond the Trillions

Solving Climate Through Innovation and Risk Capital Than Big Money

Shailesh Vickram Singh

14.1 Introduction

$6,000,000,000,000. Six trillion USD. Yes, you read that correctly. This is the estimated amount needed to tackle climate change. According to the first Needs Determination Report from a recent UN meeting, $6 trillion is required for climate action (UNFCCC, 2024). It is not that this astonishing amount required to tackle climate change is appearing for the first time. Estimates of the staggering amount of investments required – ranging from $100 billion to $1.3 trillion to $6 trillion per year – depending on the calculation methodology abound (see Chapter 1). For instance, after the conference in 2009, the developed countries agreed to mobilise USD 100 billion annually till 2020. Then, in 2015, under the Paris Agreement, the agenda was extended with the intention to set up a new finance goal by 2025. Finally, in 2024, after accounting for the needs and challenges of the developed countries, experts have arrived at the large figure of $6 trillion. It's imperative to mention that many of the estimates do not take the cost of climate adaptation into consideration. There are many challenges with these whopping financial numbers.

14.1.1 Perils of the Mega Estimates

The first challenge relates to the vast range of these estimates, which spans from USD 500 billion to USD 6 trillion – nearly 12 times the lower end of the spectrum. This disparity fosters doubt among governments, policymakers, and the general public, inviting confusion about the actual required budget.

The second and more significant challenge is the sheer size of these estimates. To put the numbers in context, USD 6 trillion for climate action is almost nine times Japan's and six times Germany's annual budget revenue estimates for 2022.[1] These amounts are so far off from the financial metrics that we use normally that we do not even register them, making them seem like impractical moonshots that are too high to even aim for. It's almost impossible for governments to justify significant spending on climate action when they are facing record deficits and struggling to address pressing issues in areas like healthcare, education, housing, and infrastructure.

While these large numbers make a perfect screaming headline and are good talking points, the estimates do very little to advance action towards climate change. In fact, they do more harm than good. These enormous estimates often make climate finance discussions seem infeasible, which in turn stifles investment in emerging climate technologies,

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eliminating the possibility of allocations to technological innovations and alternative solutions that could effectively address climate change.

14.2 Need for Capital

14.2.1 The Rearview Mirror

One of the key reasons experts project such a large number for required investments is that they make their predictions solely based on past patterns of existing technology. These assumptions seem to be made more by looking at the rearview mirror rather than the road ahead. In other words, they do not account for the innovations, inventions, and industry disruptions that will occur in the future and eventually reshape human history. Thus, often, their predictions prove to be incorrect and the inability to correctly assess future developments result in the projection of exaggerated figures and statements which look embarrassing in retrospect.

History is full of stories of great intellectuals and institutions who failed to predict the future. Often, their estimate of innovation and technology in day-to-day human life was widely off the mark. For instance, Paul Krugman, an American economist and Nobel laureate, predicted in 1998 that 'By 2005 or so, it will become clear that the internet's impact on the economy has been no greater than the fax machine's' (Krugman, 2023, n.d.)

It is not only that Krugman was wrong; even renowned institutions fell short in understanding the shape innovations will take. For example, in the early 1980s, AT&T asked McKinsey to estimate how many cellular phones would be in use by 2000. McKinsey highlighted several issues with the devices, heavy handsets, short battery life, patchy coverage, and high costs and projected a global market of about 900,000 users. This led AT&T to initially exit the market, though it later reversed its decision. By the 1990s, 900,000 new subscribers were joining global mobile services every three days, and today, there are an astounding 8.9 billion mobile phone users worldwide, showing how terribly incorrect the initial analysis was and how difficult it is to assess the evolution of new technologies (The Economist, 1999; Statista, 2024)

14.2.2 Innovation Paradigm

Roy Amara (Amara, 2016) famously said that we tend to overestimate the short-term effects of technology and underestimate its long-term impact. This applies equally to innovation, which often disrupts entire sectors in ways that defy predictions, triggering paradigm shifts. History is full of stories where innovation, investment, and disruption intersect unpredictably, often tipping the balance in favour of humanity and transforming our lifestyle for the better.

Furthermore, these innovations not only reshape our lifestyles but also generate significant revenue for governments, proving to be a net positive venture. In some cases, governments that took the risk to allocate large budgets based on expert advice saw unexpected tax or revenue windfalls from technological advances. The most notable examples where such innovations drove substantial returns are: Banking and Telecom.

In the 1980s, India made significant efforts to expand telephony across the nation despite various socio-economic challenges. At that time, the country had only about 2.5 million telephones for a population of around 700 million, meaning just 3% of its

600,000 villages had telephone services. By the 1990s, telephone adoption remained slow, and the government allocated a budget of INR 40,555 crore for the expansion and modernisation of telecom services (Ministry of Communications, 1992). As is evident from Figure 14.1, in 1992, India's ministry of communication had, among its many ambitious goals, to reduce the waiting period for telephone connections to just two years. Imagine spending INR 44,555 crore in 1992 (in today's terms) and only achieving a two-year waiting period! While the plan was sound and ambitious, it had a critical flaw – it failed to account for the rise of mobile telephony, which was already gaining traction in the western world. The entire strategy focused on landlines, the need for exchange systems, and the nationwide rollout of copper wire cables.

Fast forward to 2024, and the Department of Telecom expects to generate a license fee of INR 1.2 lakh crore (USD 14 billion) in revenue despite a weak auction, with the Government of India having earned over USD 100 billion in today's prices from the telecom sector. The rise of mobile technology not only reduced the overall cost of the original project but also generated net positive revenue for all stakeholders. This demonstrates how innovation can trigger paradigm shifts that exceed even the most ambitious predictions, transforming industries and creating unforeseen value streams (Rathee, 2024).

A similar chapter unfolded in the history of the banking sector as well. Since the early 1970s, the Government of India (GoI), along with the Reserve Bank of India (RBI), has focused on financial inclusion, aiming to provide banking services to rural areas, including remote populations. Multiple rural banking regulations and committees were established to achieve this. As recently as 2012, the RBI was urging banks to develop cost-effective village branch models (Economic Times, 2012). However, expanding banking access required a significant infrastructural commitment – not only in opening branches and hiring staff, but also in maintaining ATMs, which involved high operational costs, such as 24/7 electricity, air conditioning, security, and other infrastructure to dispense and collect cash properly.

6. In their action taken notes dated 20 August 1992, the Ministry of Communications (Department of Telecommunications) stated:

> The revised draft 8th plan proposals (92–97) as also the Perspective Plan 2000 AD were drawn up keeping in mind the role played by the telecommunications services for the development of the socio-economic activities of the nation. The outlay proposed was INR. 40555 crores covering expansion and modernisation of the telecom services. A major thrust proposed was to achieve nation-wide connectivity of all subscribers. The plan inter-alia envisaged the following:

- Provide telephones practically on demand in rural and tribal areas.
- Waiting period for telephone connections not to exceed two years.
- Provide phone facility in all Gram Panchayats by 1.4.1995.
- Additional 1.5 lakh villages to have Long Distance Public Telephones by 1.4.1997.

Figure 14.1 Excerpt of Note from Action Taken Report of Ministry of Communications

Source: (Ministry of communications, 1992).

However, everything changed with the introduction of the UPI, which enabled digital banking and cashless transactions from mobile phones, obviating the need to visit banks or use ATMs physically. The fact that the demonetisation drive of the GoI facilitated the roll-out of UPI-based services and products proves that unpredictable elements play a crucial role in deploying innovative technology at the public level. Furthermore, the start-ups engaged in this sector raised about USD 10 billion in total, paid huge taxes, created jobs, and ended up being net revenue generators with limited cost to the government.

In both cases, we see how innovation, combined with favourable government policies, can leapfrog the innovation chasm and drive economic growth and development. These advancements are often achieved not by incumbents but by new entrants with a greater risk appetite and innovative approaches. In fact, large organisations, think tanks and elite consulting firms often fail to accurately estimate the investment needed to achieve specific goals, as they overlook the importance of scientific development and innovation. Their reports rely on past patterns, leading to excessively large investment models that deter potential investors from committing.

In a situation like climate change, where the problem (and commitments) is global, scientific development, innovation, and industry disruptions play a pivotal role in tipping the scale towards net positive outcomes. Moreover, when technology and innovation are in question, the challenge is more about the nature and type of capital needed rather than its size.

14.2.3 Industrial 5.0 Framework for India

In a developing country like India where poverty plagues all sectors be it agriculture, sanitation, education, or healthcare, the allocation of such a high budget just for climate action is clearly impossible. Climate action is a sustainable development goal (SDG) indeed, but so are goals like 'No Poverty' 'Quality Education', 'Sanitation', and others. The allocation of large budget on climate will put a clear strain on developmental goals and bring negative impact as the need of the hour is to provide aid to more pressing problems like farmer suicide, crumbling infrastructure, eradicating poverty, healthcare and education.

The developed world's per capita GHG emissions like US (14 ton per capita), Australia (15 ton per capita), Canada (15 tpc), Germany (8 tpc), UK (6tpc)) are far higher compared to India (under 2 tons per capita), and other emerging economies (Wikipedia, n.d.). Even a 50% per capita increase in consumption in India, given its large population, compared to the Western standards will push things beyond the point of no return as far as climate change is concerned. So, India cannot rely on the same technology as the traditional models of power generation, distribution, air conditioning, housing, and building infrastructure for economic development.

Yet, the pace of innovation in core sectors, be it power generation, transportation, agriculture or cement production, has been far slower than what has been seen in the technology sector and hence the challenge of climate change is more of an engineering challenge. In the author's opinion, this gap in climate technology may be due to the lack of innovation and poor engineering models. The technology is old, and developed during a different era when resources were not constrained. The challenge is to build affordable, reliable technology that is also climate-friendly, emits less GHG, and can remove CO_2 from the atmosphere. This means that climate change demands urgent innovation and groundbreaking research that can be deployed into the market and made available to all at scale.

14.3 Can Capital Alone Solve This?

The constraints identified above in terms of technological lock-in also creates a significant opportunity for both capital and innovation. We have seen how China has built massive infrastructure comparable to the West at a relatively lower cost by leveraging technological advancements. Similarly, sectors like energy, waste, and mobility don't just need large investments; they also require innovative technology solutions that allow India and other emerging economies to achieve the same standard of living without consuming as many resources.

However, addressing these challenges requires putting capital to work in these sectors. But simply injecting large amounts of capital does not solve the problem. If we analyse impact investments[2] over the past three years, we find that more than USD 500 billion, a substantial sum, has been deployed as impact capital for climate change initiatives and poverty alleviation. Yet, while we see the influence of a smaller quantum of venture capital everywhere in our daily lives (Uber, Netflix, Urban Company, for instance), similar success stories are absent in the realm of impact investments.

So, what's missing?

14.3.1 Grants, Bonds versus Risk Capital

The challenge seems to be more about nature and type of capital than the amount of capital. As it generally happens, noble intentions may not always lead to noble outcomes. The biggest change this sector has seen is the inflow of impact capital, which, by its very definition, focuses on doing good rather than generating superior returns. This sounds great if only the real world was similar to a utopian fantasy of passionate teams working on solving large and complex problems without worrying about generating returns. Impact capital focuses on societal good and not returns, hence the majority of it is either in the form of grants or green bonds. While grants expect no repayment, bonds do expect the return of principal and interest even if at less than commercial rates.

There are a few basic challenges with grants and climate bonds. Since grants are non-repatriable capital, they create a limit on available capital and, by nature, remain of small value – grants above USD 10 million are almost unheard of. Compare this with the USD 10 million rounds that happen in the start-up world! Thus, despite their best intentions grants cannot ensure the supply of a large amount of capital and, as a result of their design, keep large problems capital-deficient. Furthermore, incentives for teams to build faster, better and cheaper solutions are lacking. Therefore, these problems not only remain capital deficient but also entrepreneur-deficient, as entrepreneurs are not drawn to these sectors due to the lack of alignment of interest.

On the other hand, climate bonds have no such challenge. A huge amount of capital is raised through green bonds and there are many examples of super-sized issuances in the past few years, thus helping fund large projects. The challenge with bonds is that they are debt instruments. They are risk-averse, dependent on supporting equity, and the strength of the balance sheet. This risk-averse capital can drive away innovation, as in a lot of cases, the best outcomes are driven by risk capital and not by debt. Imagine starting Google/Uber/Intel/Paytm by raising debt, where interest needs to be paid quarterly!

The point is that while we do need grants/climate bonds to form the basic layer of capital in order to build initial infrastructure as well as support core research, the real need of the hour is risk capital, which can fund innovative ideas and help entrepreneurs take bold moonshots in solving large problems.

Risk capital or venture capital (VC), by its very nature, is geared towards high business failures. Almost 40–60% of the investments by funds are written off and no more than 30% of the fund achieve grand supernormal returns. However, the critical point is not the success ratio but rather the failure rate. This business model of the VC world with its high failure rate makes the whole chain of investors, from angels to large funds, mentally aware of the possibility of failure. This, in turn, results in funding for a large number of start-ups focused on solving complex problems in relatively simple ways. Many a time these do succeed, resulting in paradigm shifts in the industry. Thus, the VC world has been able to create a large impact in every sector that they have dabbled in without necessarily focusing on impact. On the other hand, impact funds, despite their best efforts and focus on impact, have not been able to match up to the success of VCs.

Green bonds and grants only need a significant policy push, but innovations always precede policy, so to truly make a difference in the space, risk capital is the best way forward.

14.3.2 Triggering Risk capital

That the need of the hour is allocating risk capital towards climate action is obvious. However, allocation alone is not enough. The VC path has its own challenges and is a little more complicated.

Worldwide, the VC ecosystem operates on the principles of fail fast, fail cheap, roll out product faster, asset-light models, etc. Unfortunately, all these dictums of classical VC investing models fall flat in the climate tech world. Figure 14.2 illustrates the classical

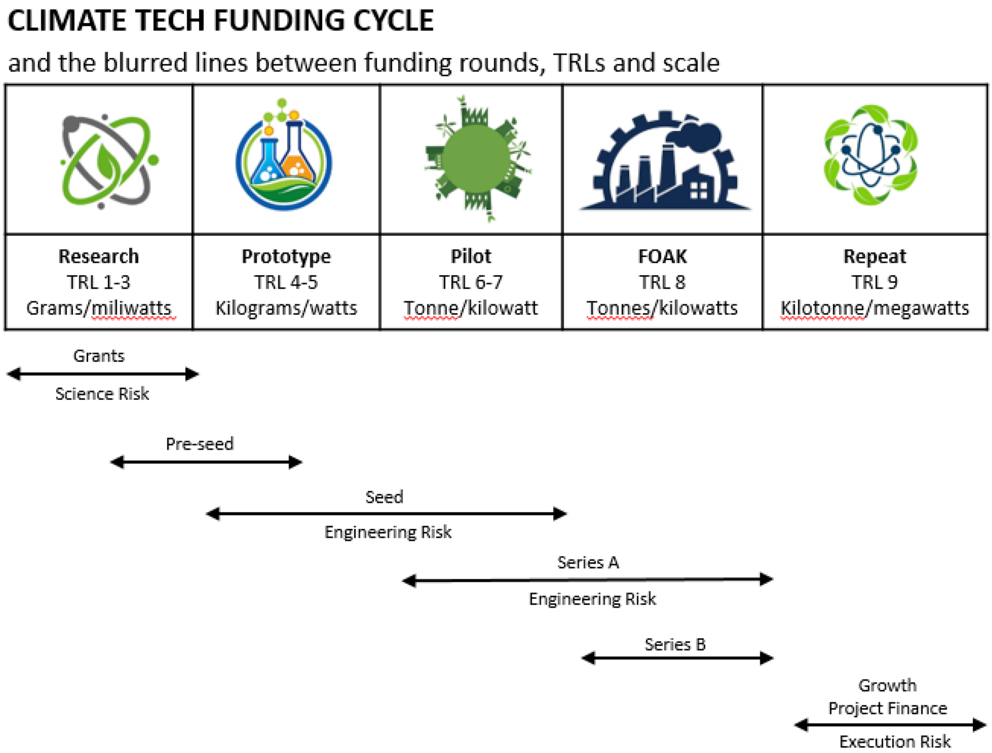

Figure 14.2 Climate Tech Funding Cycle

Source: Redrawn from (Reem, 2023)

fund cycle of IP/Research based climate tech start-ups globally, illustrating that they need to be viewed from funding from the technology readiness level (TRL) stage or product viability stage, rather than early traction or virality stage for classical VC investing models.

It is evident that the first level of money generally comes from grants/government aid to tide over science risk, and the pre-seed money/seed money kicks in during science risk and engineering risk phase, which is contrary to the existing VC ecosystem where the majority of the seed investment happens around product – market fit stage and then later on for addressing marketing risks. Early stage funding, which include engineering risks, are exceedingly rare for traditional VC investors. Hence, it is clear that the present start-up accelerator/venture eco system is not conducive for climate tech start-ups and there needs to be a lot of thinking through and model building to create a conducive environment for triggering funding in climate tech start-ups.

However, it is not that climate tech start-ups just need grants at the seed stage; there is an equally high need to access debt at a later stage as a majority of these start-ups have significant assets on their books. The chart (Figure 14.3) best illustrates the scenario of blended finance in a Climate tech start-up ecosystem where grants, debt and equity

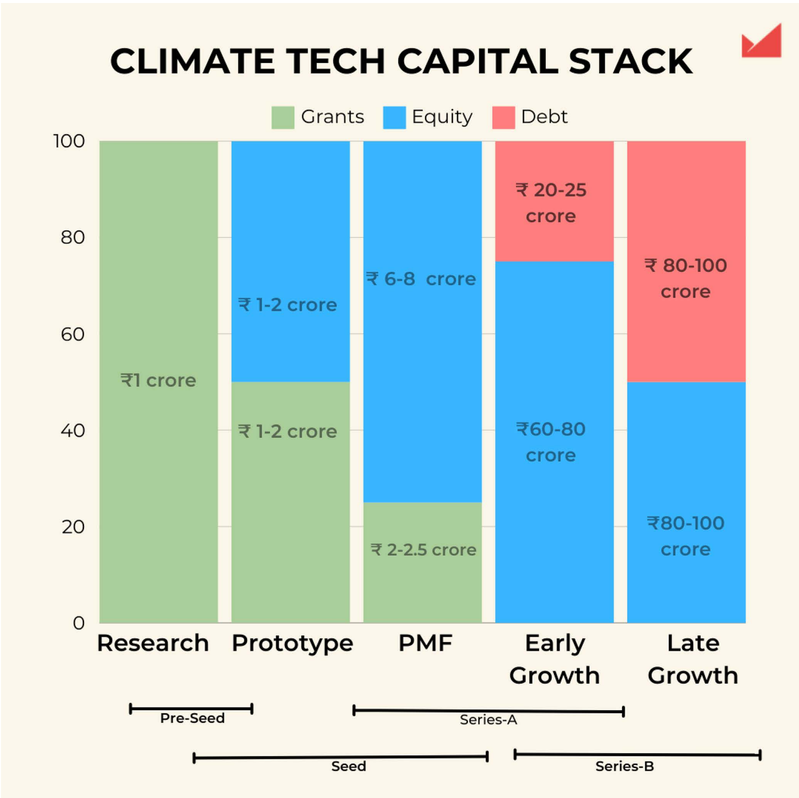

Figure 14.3 Climate Tech Capital Stack

Source: Developed by author based on observed practice capital are needed to scale the start-ups, a scenario not very common in typical consumer tech or Software-As-A-Service start-ups which have been in vogue of late in India.

Hence, it is quite evident from the above examples that to kick start the Climate-Tech ecosystem, one will need a fair amount of grants as the majority of climate tech start-ups are IP-based and have a large lab/asset component which cannot be financed by equity alone. Furthermore, to move from the lab scale to the market risk category, grants will be an essential component of overall financing. Hence, there is a need to create a policy environment to enable grant funding for start-ups working in the climate tech area.

14.3.3 Policy and Enabling Environment for Grants and Corporate Social Responsibility Funds

India is among the first countries in the world to have statutorily mandated that listed firms allocate Corporate Social Responsibility (CSR) funding. It seeks to make sure companies do good things, by mandating that 2% of their profit be spent on corporate social responsibility (CSR) activities. The combined CSR expenditure by 1,205 listed companies that were required to spend under the law stood at INR 14,801 crore for year 2021–22 (Kiran and Bhattacharya, 2023). However, overall philanthropy contributions are much bigger, with private contributions at about USD 13 billion (INR 1.05 lakh crore) in FY 2022. So while overall grants/philanthropy contribution seems quite strong, it is fully dedicated towards non-profit/non-government organisations dedicated towards social sector.

The other bigger challenge is related to grants/donations coming from foreign donors. The foreign funding is regulated through FCRA [Foreign Contribution (Regulation) Act, 2010] and there are significant regulations on fund usage (Ministry of Law and Justice, 2010).

Furthermore, the Act requires companies to be a section 8 company, in operations for 3 years. Needless to say, it is almost impossible for any start-up to get a foreign grant, which creates a significant challenge as foreign donors are not structured to invest in equities/convertible notes or similar instruments. FCRA norms prohibit Indian companies or local arms of multinationals and Indian companies with an overseas stake holding of more than 50%, to contribute to startup ecosystem beyond philanthropy. Although, a recent amendment allowed CSR contributions to incubators supporting for-profit ventures working on social objective. However, due to incubators having had limited success in obtaining CSR capital for start-ups in general, let alone climate start-ups, which are a relatively new category; we haven't been able to see any traction in this regard (see Figure 14.4). Furthermore, it is restricted to only government incubators that often do not attract the best of the start-ups for various reasons.

Even though funding to technology incubators, albeit under a narrower definition, has been allowed for a while, the sector hasn't seen significant funding – less than 0.2% of total CSR spending from 2014–2015 to 2017–2018. In 2022, out of total CSR spend of around INR 27,000 crore in India, less than INR 100 crores were allocated to incubators (The CSR Universe, 2024). Historically it has been observed that big institutions prefer setting up their own foundations for CSR as it provides them more administrative oversight over fund utilisation. All these combined have hindered the potential of CSR impact in climate tech innovations in high impact areas such as water, waste and agriculture which require grants and patient capital from ideation/R&D till product market fit.

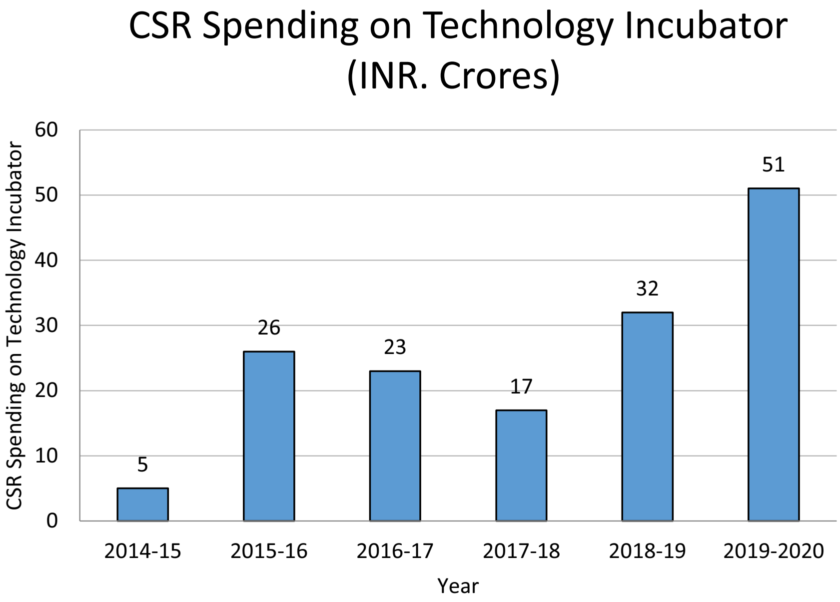

Figure 14.4 Annual CSR Spending on Technology Incubators

Source: Redrawn from (Nabar and Singhania, 2022, p. 4.)

14.4 The Policy Opportunity: Road Ahead

It is quite evident that to kick start the climate tech start-up ecosystem, apart from running capacity building programmes focused on accelerators/investors, significant policy interventions will be needed to build a blended finance model.

One good road map to follow for this could be Alternative Investment Funds (AIF) regulations or the Fund of Fund strategy implemented by Government of India through SIDBI and various ministries. In 2012, the government of India put an AIF regulation in place to channelise investments in Venture Capital/Private equity and Hedge Funds (BSE, n.d.). Since the inception of AIF's in mid-2012, category 1 funds in India have raised around INR 29400 Cr, whereas category 2 funds have raised around 270240 Cr till date (Figure 14.5). The AIF space has witnessed the sharpest growth in the investment industry in the past 10 years, with over 88% compound annual growth rate (CAGR) as of FY2 (NSE Indices, 2024).

Appropriate regulations can channelise much needed capital into climate tech startups. AIF regulation has triggered start-up investing in India, and from being a 100% foreign capital dependent, Indian VC/PE sector has come of age with increasing participation of domestic capital in building India's start-up story. Hence, suitable regulation which can channelise grant investing into start-ups from Domestic/Foreign companies/donors into R&D and provide gap funding with adequate safeguards is the need of the day.

A successful example is the Fund of Fund scheme of SIDBI where it has triggered almost 50,000 Cr investment in Indian start-ups eco system with SIDBI kick-starting the domestic fund market by being the first to commit and last to disburse (SIDBI, n.d.).

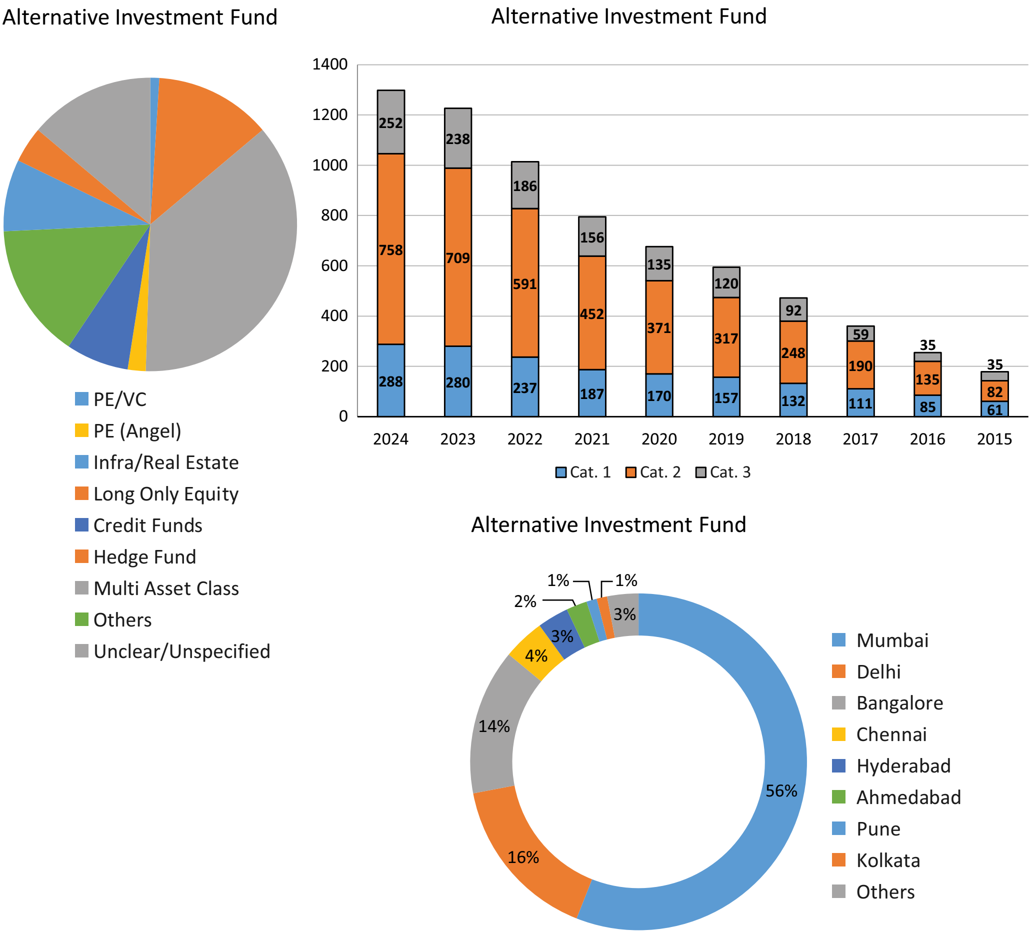

Figure 14.5 Alternative Investment Funds

Source: Redrawn from Finolutions (n.d.), as illustrated in Table 14.1.

SIDBI generally invests somewhere 20% to 30% of the fund and has already committed 13,850 Cr so in a maximum commitment scenario that will lead to raise of INR 46,000 Cr (assuming highest commitment of 30%) to INR 92000 Cr (assuming mean commitment of 15%).

Thus, we have a great opportunity to kick-start the climate tech ecosystem through proper policy interventions. The focus has to move from fixating on quantum of climate finance to providing risk capital for innovation. A judicious blend of grant, equity, and debt, depending upon the state and the stage of innovation is required. All of this can be achieved not by direct government support alone but through the right kind of policies that channelise grants and CSR funds, offset projects, and Fund of Fund model to support innovation. History has repeatedly illustrated that only technological innovation can address the multiple challenges to life and development.

Table 14.1 Data Relating to Activities of Alternative Investment Funds

Data relating to activities of Alternative Investment Funds (AIFs)			
Cumulative net figures as at the end of June 30.2023			
(All figures in INR crores)			
Category of AIF	*Commitments Raised*	*Funds Raised*	*Investments Made*
Category 1			
Infrastructure Fund	**17.569.53**	**5.803.08**	**5.000.10**
Social Venture Fund	**1.501.24**	**692 77**	**447.90**
Venture Capital Fund	**43.529.40**	**22.563.88**	**19.238.55**
SME Fund	**1,136.22**	**341.95**	**289.20**
Category I Total	**63.736.39**	**29.401.68**	**24.975.75**
Category II	**6.96.132.37**	**2.70.241.46**	**2.5Z830.87**
Category III	**85.057.72**	**74,482.64**	**72,499.55**
Grand Total	**8.44.926.48**	**3.74.125.78**	**3.50.306.17**

Source: (Mishra, 2023)

Notes

1 Compiled from www.cia.gov/the-world-factbook/field/budget/
2 Impact investing is defined as the deployment of funds into investments that generate a measurable and beneficial social or environmental impact alongside a financial return on investment.

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Part 4

Financing the Real Economy to Address Climate Change

An Introduction

Mritiunjoy Mohanty and Runa Sarkar

This part bridges the real economy, that is, the activities or productive assets that receive finance (including whether actions are directly or indirectly related to mitigation, adaptation or compensation for damages), with financial markets by discussing issues related to decarbonisation strategies in large and small enterprises, mining and energy transmission. Companies are recognising how shifting investor preferences (and technology, regulation and consumer behaviour) are changing the basis for competition and require greater global and local collaboration. Orderly transition, where the ramp-down of high-emitting assets, both physical and financial, is carefully coordinated with the ramp-up of low-emitting ones, supported by the appropriate redundancy and resiliency measures, needs a well-designed projection of demand for funds and matching financial flows over time. Issues related to designing a project proposal that can access climate finance, differences in mitigation and adaptation projects, and therefore financing mechanisms, and repurposing are explored.

In Chapter 15 Saurabh Trivedi and Labanya Prakash Jena identify tailored or bespoke mechanisms to drive investments in low-carbon sectors and de-risk potential institutional capital with a focus on MSMEs. The chapter is divided into two broad sections. The first section explores the role of sustainability-linked green bonds (SLGBs), which can help private coal power producers in repurposing existing coal power plants into renewable energy projects. Given that MSMEs often lack the creditworthiness to raise cost-effective bank financing and the capacity to access capital markets, the second section focuses on facilitating affordable financing for MSMEs to adopt low-carbon technologies. A government-backed green finance platform for MSMEs is proposed to enable them to access debt from capital markets for investing in low-carbon technologies.

Shantanu Srivastava and Vibhuti Garg continue the discussion on the challenges and possible solutions to finance energy efficiency initiatives in MSMEs in Chapter 16. The chapter starts with assessing the potential impact of energy efficiency on India's energy transition, with a particular focus on the MSME sector. After analysing the current financing landscape for energy efficiency (EE) in MSMEs, considering the roles of various stakeholders and the challenges they face, it examines successful domestic case studies, such as the BEE's cluster approach, SIDBI's MSME EE financing scheme and the UJALA Scheme. Global examples, including on-bill financing, energy-saving insurance models, the PACE scheme in the USA, and initiatives like the EU's open-source database and LAUNCH programme, are discussed. They conclude with recommendations for enhancing existing schemes and developing new mechanisms and instruments to bolster MSME

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energy efficiency financing. Box 16.1 (Saakshi Chauhan and Pradip Swarnakar) discusses how insurance could potentially play a role in incentivising distributed RE installations.

Chapter 17 discusses how balance sheet disclosures might be used as an effective instrument to mobilise investment for decarbonisation strategies of large firms. Shantanu Srivastava explores the role of transition plans in mobilising transition finance for corporates in India and the role different stakeholders and regulations play in ensuring that a robust ecosystem that supports transition planning is developed. Case studies of robust transition planning and reporting by power sector companies globally are presented. The chapter concludes by sketching broad contours of a transition planning and disclosure framework for Indian companies that could be mandated by SEBI. Srinivas Cherla supplements this discussion by emphasising the need for good governance practices to attract finance in Box 17.1.

Pawan Mehra, Tarana Ahmad, Tanay Sawhney and Malaika Aggarwal first examine the role of carbon markets in influencing economy-wide emissions and providing a source of climate finance and then explore the potential of India's planned carbon market (ICM) in Chapter 18. Globally carbon markets cover 25% of the manmade emissions and have played an important role in decoupling emissions from economic activity. However, this happens with a lag, to the extent of 5 to 8 years for older markets and 3 to 5 years for newer markets. Volatility, especially in the early years, is a common feature. The authors demonstrate, through the example of the EU ETS and California carbon markets, how carbon markets are now an important tool in the policy-makers kit for climate finance. In this context they estimate minimum carbon prices in the ICM for meaningful mitigation action and, assuming that 60% of India's emissions are covered by the ICM, forecast that a well-designed ICM could generate about INR 2,880 billion per annum. In Box 18.1 Yash Kashyap and Saarthak Khurana discuss how Article 6 of the Paris Agreement can be leveraged for industrial decarbonisation.

Chapter 19 (Arnab Sarkar, Md Tariq Habib and Vivek Sen) addresses thorny issues related to financing needs of electricity transmission and distribution as a result of an increasing share of variable renewable energy (RE) in the energy mix. The surge in new generation, mainly from renewables, underlines the urgent need to fortify the country's transmission network, addressing efficiency and RE intermittency. Integrating variable RE sources into the energy mix poses challenges for grid stability, exacerbated by grid congestion, especially in the Western region due to increased RE influx. Integrating RE via the Inter-State Transmission System by 2030 entails an estimated INR 2,44,200 crore investment. However, significant financing challenges plague the transmission sector, with banks hitting exposure limits, constraining liquidity. Regulatory hurdles, including ambiguous exposure norms for insurers and pension funds, impede innovative financing. Streamlining regulations, collaborative efforts between banks and developers for devising viable funding structures, especially during construction and developing realistic bidding mechanisms, are crucial for the sector's long-term sustainability.

This part concludes with the trade union perspective on just energy transition and how governance related to the allocation of funds might be used to achieve these ends. Randhir Kumar, Aiman Nida and S.M.F. Pasha first explore trade unions' views on what constitutes a Just Transition in the coal sector, their expectations from financing mechanisms and their role in negotiating contracts with terms that protect workers' rights and livelihoods of the affected communities. They then analyse the financing mechanisms necessary for a Just Transition, examining barriers to accessing finance, and evaluate the potential solutions to overcome these constraints. This is followed by a critical evaluation of different funding models (public finance, private investment, and blended finance models) on three parameters, the effectiveness in addressing resource scarcity, the (mis) alignment of financial instruments with affected workers and community needs and the (mis)governance in the allocation of funds for Just Transition.

15 Blended Capital Market Mechanisms for Critical Decarbonisation Projects in India

Saurabh Trivedi and Labanya Prakash Jena

15.1 Context

This chapter focuses on two critical sectors that demand urgent decarbonisation efforts – India's coal-fired power plants, which dominate the electricity generation mix, and its vast landscape of micro, small, and medium enterprises (MSMEs), which contribute substantially to the nation's Gross Domestic Product (GDP) and exports. Repurposing existing coal-fired power plants into renewable energy facilities presents substantial economic opportunities, with studies demonstrating the potential for significant financial gains compared to early retirement costs. Similarly, facilitating affordable financing for MSMEs to adopt low-carbon technologies is pivotal, given their significant contribution to the energy consumption of large industries. This chapter proposes two innovative financing mechanisms to drive investment from the rapidly growing sustainable debt capital market by leveraging public capital that can address these challenges. These mechanisms are:

1. **Sustainability-linked green bonds (SLGBs)**: This can help private coal power producers by aligning financial incentives with sustainability targets, such as coal plant decommissioning and renewable energy capacity additions. These bonds would fund repurposing projects, attracting environmentally conscious investors while ensuring the funds flow towards facilitating the transition. By tapping into the sustainable debt market and leveraging public capital, SLGBs can unlock financing for these critical projects.
2. **A government-backed green finance platform for MSMEs**: Such a platform will enable MSMEs to access debt from capital markets for investing in low-carbon technologies. It would adhere to international standards for green bonds and loans, fostering investor confidence and unlocking long-term financing at reasonable rates for MSMEs. This platform can provide much-needed funding for MSMEs' decarbonisation efforts by leveraging public capital and the growing sustainable debt market.

These tailored mechanisms aim to mitigate barriers, unlock funding for climate-friendly projects and harness diverse capital sources, including public finance, private debt and the burgeoning sustainable debt capital market. Using SLGBs to Repurpose India's Coal-fired Power Plants

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15.2 Economic Case for Repurposing Coal-fired Power Plants

Achieving emission reduction goals necessitates the early retirement of coal-fired power plants. However, the timing and pace of these retirements have become a contentious issue among policymakers, plant owners, financiers, and other stakeholders (Varadhan, 2023).

One potential solution that has gained traction globally is the repurposing existing coal-fired power plants into renewable energy facilities. This approach not only mitigates the environmental impact of coal-fired generation but also leverages existing infrastructure, reducing the capital costs and land acquisition challenges associated with greenfield renewable energy projects while offering a relatively smoother just transition. This approach ensures that a rapidly growing country like India can meet its emissions reduction targets without compromising energy security.

Repurposing coal plants can offer substantial economic benefits. According to a study by Climate Risk Horizon, converting coal-fired power plants in Maharashtra could yield financial benefits 2–4 times greater than the costs of early retirement (Shrimali, 2022). Further, it would also help the state's electricity distribution company save around USD 9.08 billion (INR 750 billion) over a decade because of cheaper renewable energy costs. The savings from repurposing could cover 30–170% of the new capital expenses required for converting the coal plants into renewable energy facilities, benefiting both coal power producers and energy off-takers while aligning with India's climate objectives.

Another study (Jindal and Shrimali, 2022) evaluates the economic rationale for repurposing a representative 1,000 megawatts (MW) coal-fired power plant in India for solar energy, battery storage and synchronous condensers. The study develops a detailed cost-benefit framework to show a strong economic case for repurposing over decommissioning. Significantly, the present value of benefits from repurposing (USD 590.82 million/INR 49.4 billion) far exceeds the total decommissioning costs (USD 103.91 million/INR 8.7 billion). Even excluding social benefits, the net economic benefits covered 10–32% of the required capital expenditure, demonstrating financial viability. The study estimates that, in India, decommissioning costs are nearly half (USD 58 million/INR 4.8 billion) that of plants in the U.S. (USD 117 million/INR 9.8 billion), which is another economic benefit. It also provides a practical methodology for identifying and prioritising plants suitable for repurposing. Factors like age, energy charges, and other qualitative criteria form the basis of the methodology. Overall, the substantial net positive economic value, coupled with relatively lower decommissioning costs, form a compelling argument for repurposing India's coal-fired power plants as the country transitions from fossil fuels.

A recent study finds that renewables can potentially profitably replace around 800 coal-fired power plants in emerging economies (Jacobson, 2024). The five coal-to-clean transition opportunities assessed in the study are economically viable within the next five years without subsidies, allowing private capital and utilities to finance these deals profitably. Some coal-fired power plants may need partial philanthropic support or risk mitigation to demonstrate feasibility. But, generally, the economics of repurposing favours proactive sourcing and financing of such projects by private investors and utilities, with positive estimated returns exceeding the weighted average cost of capital.

15.2.1 A Case for Capital Market-Based Solutions for Repurposing Indian Coal-fired Power Plants

In India, the initiative for repurposing will likely have to come from the private sector. The government hesitates to retire coal assets prematurely due to energy security concerns (Varadhan, 2023). However, private-sector coal-based power producers can pursue early retirement and repurposing. Companies like Tata Power, Adani Power, and JSW Energy have committed to decarbonisation and have strong balance sheets. They can leverage capital market-based solutions to finance repurposing projects of technically feasible coal-fired power plants.

These companies account for a significant portion of India's coal-fired power generation capacity. According to the Central Electricity Authority, as of June 2024, private companies owned approximately 35% or 73.5GW of India's coal-based capacity (CEA, 2024). Targeting these privately owned assets for repurposing could be a starting point.

Next, we propose and discuss a market-based mechanism that companies can use for repurposing projects. Companies with access to debt capital markets have more leeway to retire coal plants earlier. Even state-owned companies like NTPC can easily use the proposed structure if the government formulates a clear policy around repurposing and early retirement of coal-fired power plants.

15.2.2 SLGBs: A Financing Solution for Repurposing Coal Power Plants

One potential financing solution for Indian coal-fired power producers is issuing sustainability-linked green bonds (SLGBs). This innovative financial instrument combines the features of traditional green bonds, whose issuers can only use the proceeds to finance environmentally friendly projects, with sustainability-linked bonds (SLBs), which incentivise the achievement of predetermined sustainability targets at a corporate level.[1]

Key Performance Indicators (KPIs) related to the issuer's environmental, social and governance (ESG) targets form the pillars of the structure of a vanilla SLB. Issuers face penalties if they fail to meet these KPI targets. On the other hand, meeting the KPIs can bring down subsequent coupon payments.

The global SLB market stands at USD 297 billion as of 31 May 2024, with the first issuance as recently as 2019. However, greenwashing concerns have emerged as the proceeds of vanilla SLBs can end up funding non-green projects. We propose an SLGB structure to overcome this hurdle, which links KPIs and proceeds to specified projects.

Under this proposal, a coal-fired power generator would issue an SLGB with the following three KPIs:

1. Decommission coal-fired power plants with an ambitious target date.
2. Integrate renewable energy generation capacity or other zero-carbon assets and infrastructure projects, either before or simultaneously, with the decommissioning of coal-fired power plants.
3. Reskill, rehire and offer compensation packages to displaced manpower to ensure a just transition from coal to a renewable energy plant.

Beyond the KPIs, the issuer must also ring-fence the SLGB proceeds to specified projects that would fulfil each KPI to ensure the issuance's transparency and prevent funds' misuse.

The SLGB structure offers several benefits. It aligns the financial incentives of the issuer with India's climate goals by linking the bond's performance to measurable sustainability targets. It also ensures the funds raised flow to projects that facilitate the transition to renewable energy while supporting a just transition for affected workers and communities.

Furthermore, SLGBs can help attract a broader investor base, including environmentally conscious investors seeking sustainable investment opportunities. This increased demand for SLGBs could lower the cost of borrowing for issuers, further enhancing the economic viability of repurposing projects.

15.2.2.1 Blending SLGBs with Public Capital and Carbon Credits

A lower cost of borrowing would be crucial to motivate coal-fired power generators to repurpose their plants early. We discuss a few ways to further enhance the economic viability of SLGBs, as illustrated in Figure 15.1.

15.2.2.1.1 DUAL-TRANCHE ISSUANCE AND CONCESSIONAL FINANCING

A potential avenue could be a dual-tranche issuance, where the senior tranche targets institutional investors, while the secondary tranche presents an opportunity at a preferential rate for multilateral development banks (MDBs). This concessional funding could

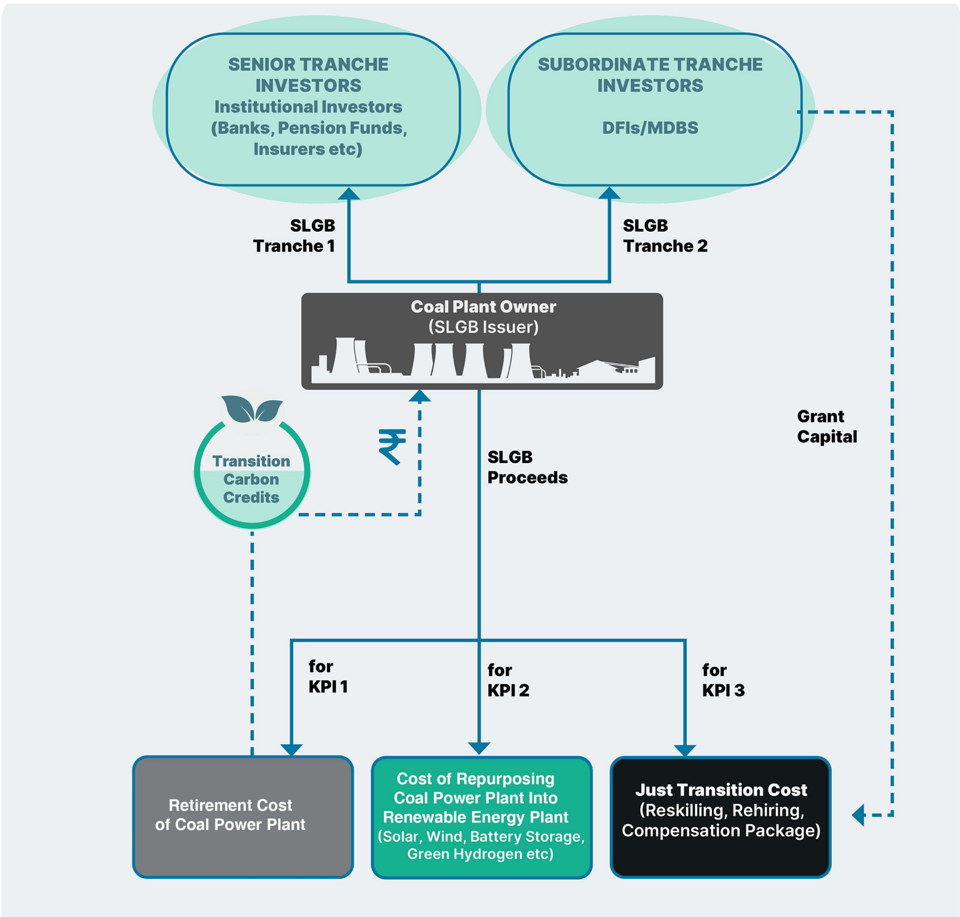

Figure 15.1 A Blended SLGB Mechanism for CFPP Repurposing

Source: Authors

lower the overall borrowing cost, making early coal plant repurposing more attractive for utility companies.

Alternatively, credit guarantees provided by MDBs and development finance institutions (DFIs) could lower the risk profile of SLGBs, thus reducing the cost of borrowing. MDBs and DFIs can also offer grants to fund workforce reskilling programmes, transaction costs and ongoing monitoring and verification expenses required for credible SLGB issuances.

MDBs like the Asian Development Bank (ADB) are already involved in early coal retirement through blended finance mechanisms like the Energy Transition Mechanism (ETM) in other countries such as Indonesia, Vietnam, Philippines, Pakistan and Kazakhstan (ADB, 2023). The proposed tranche or guarantee mechanism would allow them to expand ETM in India.

15.2.2.1.2 CARBON CREDITS FOR DEBT SERVICING

We propose creating a high-integrity 'transition credits' mechanism, as suggested in a working paper by the Monetary Authority of Singapore (MAS) and McKinsey & Company (Monetary Authority of Singapore, 2023). These credits, created from verified emissions reductions achieved by retiring coal-fired power plants early and replacing them with clean energy assets, serve as a complementary revenue stream for the overall repurposing project. Plant owners can use this revenue stream to service SLGBs.

Under this approach, a portion of SLGB proceeds would fund early repurposing projects. The issuer generates transition credits quantified by an approved methodology upon achieving decommissioning and renewable addition targets. The issuer then monetises these credits by selling to entities seeking carbon offsets.

The regulatory framework should mandate that the issuer ring-fence and explicitly earmark the proceeds from the transition carbon credit transactions towards servicing the SLGB debt obligations, providing bondholders additional cashflow assurance. Third-party verification would ensure carbon credit integrity per established standards.

Integrating transition credits allows issuers to leverage an added revenue stream, enhancing the economic viability of repurposing projects while giving bondholders extra debt service coverage from the transition credit revenue.

15.2.2.2 SLGBs: Ideal for Repurposing Coal-fired Power Plants

The proposed SLGB structure can catalyse repurposing by private companies, aligning financial incentives with sustainability targets like coal retirement and renewable addition. Blending SLGB with public finance would further enhance the economic viability of the bond.

The structure also opens up an avenue for public and private debt providers to participate in the early retirement of India's coal plants. The mechanism also addresses greenwashing concerns as it ensures issuers utilise funds for their intended purpose. As such, the transaction's credibility will grow. Moreover, coal-fired power producers will have an incentive to act early and support a just transition. Our proposed use of transition credits, formed after verifying emissions reductions from repurposing projects, adds to the issuer's revenue stream for servicing SLGBs. Most significantly, the mechanism primarily utilises market-based mechanisms, with some support from MDBs, to aid India's pursuit of emissions reduction goals.

15.3 Green Finance Platform for Mobilising Funds to Decarbonise MSMEs

India is second only to China with 63 million MSMEs, which play a pivotal role in the nation's social and economic development. In the fiscal year (FY) 2023–2024 (till September 2023), they contributed a substantial 29.15% to India's GDP and an impressive 45.56% of its overall exports (PIB, 2023). Besides, MSMEs provide direct livelihoods to 190 million people (The Economic Times, 2024). Moreover, their penetration in rural and semi-urban areas and widespread geographic distribution give much-needed regional balance in economic development. As India progresses, MSMEs will continue to be indispensable drivers of economic growth and sustainable development.

MSMEs use a substantial 25% of the energy consumption of large industries (OECD, 2022) making their decarbonisation vital for meeting India's climate objectives. Additionally, the economic and social importance of MSMEs requires special consideration from policymakers as the reshaping of industrial structures and dynamics from the green economic transition can cause social repercussions. While significant opportunities exist for MSMEs to thrive in this transition, such as the increasing demand for electric vehicle components, there are also risks of destabilisation for those unable to adapt their manufacturing facilities and processes to meet new demands.

15.3.1 Financing Challenges for MSMEs Decarbonisation

Financing per se has always been a key challenge for MSMEs, with mainstream financers usually denying them loans. Even when financiers provide loans, they add stringent terms and conditions, including high interest rates, heavy collateral demand, and personal guarantees. Small project ticket sizes, high transaction costs, limited historical record, lack of transparency, dated financial reporting, high close-down ratio, and low competitiveness compared to large companies discourage mainstream financers from lending to MSMEs (Jena, 2021). Only 14% of India's MSMEs have access to credit from mainstream financiers, translating into a USD 530 billion (INR 44.3 trillion) credit gap in the segment (Choksi, 2024).

Decarbonisation requires significant upfront costs for investment in various low-carbon technologies (e.g., rooftop solar energy systems, energy-efficient equipment, etc.). The lack of credit available at a reasonable cost will hinder MSMEs' decarbonisation plans, even if it helps them become competitive and improve financial performance. The latter is true because energy costs for the most polluting manufacturing sector MSMEs account for 10–30% of their total production costs (Power Line, 2020) As a result, there is a clear incentive to invest in energy-efficient plants and machinery and source electricity from cheaper renewable sources. In the absence of market-determined capital availability, policymakers need to intervene to support MSMEs in accessing debt at an affordable rate, enabling them to decarbonise and be competitive in the era of green economic transition. The support will help the country's effort to green the economic system and achieve its sustainable development goals.

The key technological options for renewable energy, energy efficiency and electrification (primarily heating) are capital-intensive. All these technologies need medium and long-term low-cost capital to justify the heavy investment that will allow the user to recover its principal investment and generate additional returns. Banks are reluctant to offer long-term debt to MSMEs and short liability duration limits the exposure to long-duration debt. In addition, banks have limitations to investing in energy-specific sectors as multiple technologies (e.g., renewable energy utilities, transmission, etc.) compete for the same pie of capital and with large-scale utility companies (e.g., thermal power plants, utility-scale solar, and transmission companies). Moreover, banks already have significant exposure to MSMEs in their loan books. Therefore, banks are unlikely to grow their MSME loan books quickly to meet the latter's funding needs for low-carbon technologies.

The capital market route is ideal for any borrower as it can provide long-term capital and possibly at a lower rate. Low credit rating, stringent paper requirements to raise capital, and small transaction volumes limit MSME access. Even large corporates in India rely on bank financing instead of the capital market for their debt needs. We propose a government-supported green finance platform through which MSMEs can borrow from the capital market.

15.3.2 Proposed Green Finance Platform

Our proposal starts with an institution setting up a green finance platform, which would act like a financial facility inside the institution. Figure 15.2 sketches the architecture for the proposed platform. The platform would develop eligibility criteria for green loans for MSME borrowers. The requirements would consider the green aspects of projects/technologies (e.g., GHG reduction potential) in which the borrower would deploy the capital proceeds. Alternatively, the platform would provide financial intermediaries, such as commercial banks and Non-Banking Financial Companies (NBFCs), that would lend to eligible MSMEs. Banks and NBFCs would meet similar criteria and conditions (e.g., offering loans for rooftop solar only to MSMEs) to qualify for lending. Green loans can take different forms – term loans, revolving credit facilities or even working capital.

The institution would raise debt by issuing green bonds in the capital market earmarked only for MSMEs meeting the above criteria. The issuance will follow the Securities and Exchange Board of India (SEBI)'s green bond guidelines (SEBI, 2016). The platform would ensure regular impact reporting of green bonds to investors based on the International Capital Market Association's guidelines to attract foreign investors (ICMA, 2024). It would use the proceeds to provide green loans to MSMEs. The platform would also follow the Loan Market Association's Green Loan Principles (GLP) (LMA, 2023) to boost bond investors' confidence regarding loans flowing into green businesses.

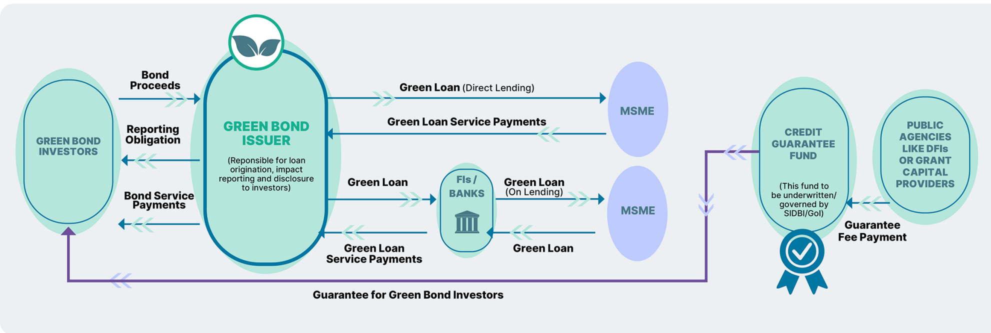

Figure 15.2 Green Finance Platform for MSMEs

Source: Authors

Finally, the platform would appoint a third-party verification agency to ensure loans fund green projects. As greenwashing concerns investors, particularly foreign investors, aligning with international standards and appointing a third-party verification agency would assuage fears. When other commercial banks or NBFCs receive green loans, they must follow the GLP principle as discussed above.

15.3.2.1 Credit Enhancement Mechanisms

Credit enhancement by public institutions and philanthropies can raise the issuer's profile. It helps improve the bond issuance term (e.g., longer tenor, lower rates, etc.). We suggest creating a credit guarantee fund that offers additional cushion to bond investors. Risk sharing between borrowers, lenders, and guarantors is the key to the success of a credit guarantee scheme. An improper credit guarantee structure can reduce moral hazard among borrowers and lenders.

We suggest governments, foundations, donors and bilateral institutions provide guarantee fees. They support MSME decarbonisation in developing countries by giving risky, concessional capital and grants to banks and financial institutions to create financial and development additionality. They can offer grants and risky capital to create a guarantee fund to enhance the credit profile of the facility. For example, grants or concessional capital can be used to offer partial credit guarantees to bond investors. A partial credit guarantee can give additional cushion to the institution issuing green bonds as a portion of credit risk can go to the credit guarantee providers.

15.3.2.2 MDBs as Cornerstone Investors

MDBs and multilateral financial institutions (MFIs) can be cornerstone investors that can attract private investors to green bond offerings. As the former institutions have a mandate to invest in green technologies and support MSMEs in developing countries, they would invest in these bonds. As climate finance increasingly gains attention from these multilateral institutions, they can demonstrate low-carbon technologies' commercial viability. They would hold securities till the private investors are confident about the credit profile of these bonds and can exit after that instead of competing with private investors. Their participation also gives confidence to private investors concerned about greenwashing, as MDBs conduct extensive due diligence before investment.

15.3.3 SIDBI: The Ideal Institution to Govern the Platform

An institution with a high credit rating and experience in raising long-term debt capital from the capital market would be ideal to set up and manage the platform. Besides, the institution must have experience in the MSME lending business, a strong balance sheet, an understanding of the risks and opportunities of climate change on the financial performance of borrowers, and a commitment to support climate action. The Small Industries Development Bank of India (SIDBI) meets all the aforementioned criteria. It has a mandate to support MSMEs by offering concessional capital and other non-funded support. SIDBI has a high AAA (ICRA) credit rating (ICRA, 2022). It is also an accredited entity of the Green Climate Fund (GCF) (Green Climate Fund, 2021) demonstrating its commitment to supporting climate actions and experience in understanding climate-related risks and opportunities. Besides, the Indian government backs SIDBI. Through the issuance of green bonds, SIDBI can follow other domestic and international development financial institutions that have successfully issued green bonds and signal their commitment to climate actions. A strong issuer like SIDBI would attract ESG investors looking to generate a significant impact on their investment.

15.3.3.1 Barriers Addressed Through this Platform

The platform can address multiple barriers to Indian MSMEs' investment in low-carbon technologies, including the availability of long-term debt, its high cost, and perceived risk. The aggregation of MSMEs through the green financing platform will allow SIDBI to issue a big-size bond, which could decrease the cost of debt that can pass through to the borrowers of the financing facility (MSMEs). The larger the size of the bond, the more liquidity in the financial market, owing to the lower inventory costs of large bond issuance. This is because more liquid bonds have a lower spread than similar bonds with lower liquidity.

Adequate policy or financial support for MSMEs from the Indian government or SIDBI can help ensure comparatively low interest rates on these loans with longer tenors. This will enable the platform to provide long-term debt to MSMEs at a reasonable interest rate. The platform can demonstrate low-carbon technologies' commercial viability, thereby decreasing the sector's risk perception.

15.3.3.2 Benefits for SIDBI

SIDBI has been increasingly paying attention to green finance in recent years as the organisation realised that MSMEs' participation is important in the country's low-carbon transition. Setting up a green finance platform can unlock long-term green capital from the capital market for SIDBI, which it hasn't yet done. By issuing green bonds, SIDBI can enhance its reputation among investors who have seriously started integrating climate change risk and opportunity in their investment decision-making process. SIDBI can subsequently issue long-term green bonds without relying on short or medium-term financing. The long-term green bonds will help SIDBI strategically deploy capital to support MSMEs investing in low-carbon technologies, including providing venture debt to them.

15.3.4 Challenges and Solutions

MSMEs' poor credit profile is a significant hurdle for any institution, including SIDBI, to issue green bonds at an attractive term as investors consider them too risky. This may negatively affect the issuer's credit profile. The institution can set up a credit guarantee fund to support the green financing platform, similar to the existing Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE), to mitigate these risks (CGTMSE, 2024). As suggested earlier, public and developmental institutions can provide concessional capital to cover guarantee fees instead of passing the cost to creditors. The guarantee fund would absorb the potential default risk of the platform, thereby improving the credit profile of the green bonds issued through the platform. Credit risk coverage of around 60–70% is the most effective for any guarantee fund. It should not be more than 80% to align with the interests of lenders (Levitsky and Prasad, 1987). There will be moral hazard if credit guarantee coverage is very high – a classical lending issue. The guarantee fund should have experienced staff who can design the scheme and loan underwriting and recovery processes.

MSMEs are not prepared and cannot follow stringent GLP guidelines. MDBs (e.g., World Bank, Asian Development Bank) and development institutions (e.g., Deutsche Gesellschaft für Internationale Zusammenarbeit, United States Agency for International Development) who have experience in conducting similar capacity-building exercises can support SIDBI. They can create a small technical assistance pool covering the technical assistance costs, including capacity building and third-party verification costs.

15.4 Conclusion

The innovative financing mechanisms proposed in this chapter blend capital market solutions with public capital. The SLGBs for repurposing coal-fired power plants and a green finance platform for enabling MSME decarbonisation offer robust pathways to accelerate India's energy transition. These solutions address sector-specific challenges and catalyse investments in low-carbon projects by leveraging diverse capital sources, aligning financial incentives with sustainability targets, and fostering investor confidence. Importantly, they pave the way for a just and inclusive transition, ensuring that no segment of the economy is left behind in India's pursuit of its climate goals while maintaining energy security and economic growth.

Note

1 The proposed mechanism by IEEFA/authors has been discussed in detail by the Reserve Bank of India (RBI) in its recent monthly bulletin titled 'Transitioning India's Power Sector: Repurposing of Coal-Fired Power Plants' (https://m.rbi.org.in//Scripts/BS_ViewBulletin.aspx?Id=22191) and by The Glasgow Financial Alliance for Net Zero (GFANZ) report (https://assets.bbhub.io/company/sites/63/2023/11/GFANZ-Financing-the-Managed-Phaseout-of-Coal-Fired-Power-Plants-APAC-December-2023.pdf (page 107, 284)) on Financing the Managed Phaseout of Coal-Fired Power Plants in Asia Pacific. The report cited our article with complete proposed structure on financing the coal power plants repurposing in India.

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16 Financing Energy Efficiency for MSMEs in India

Shantanu Srivastava and Vibhuti Garg

16.1 Introduction

India is home to 63 million micro, small and medium enterprises (MSMEs), the second-highest in the world, just behind China. Of its industrial units, 96% are small companies. These small companies comprise 40% of India's industrial production and 42% of its exports (Tambe, 2024). The share of energy consumption of MSMEs is 20–25% compared with the country's large industries. (TERI, 2022, p. 65), By embracing modern technology and best practices, MSMEs can achieve significant energy savings, and reduce emissions and costs. Therefore, MSMEs are crucial in India's journey towards net-zero emissions (Figure 16.1).

The MSME spectrum ranges from highly innovative and growth-oriented enterprises to unregistered units using outdated technologies and practices. This variation in technology and operations leads to significant differences in energy performance and emissions. MSMEs, especially small and micro units, also face several challenges while accessing financing for technology upgradation for energy savings. These range from lack of technical expertise and awareness among MSMEs to policy-related barriers. Section 16.3 identities some of the key financing barriers faced by MSMEs.

16.2 Current Landscape of Financing for MSMEs in India

A 2022 Finance Committee report reveals a credit gap of INR 20–25 trillion in India for MSMEs, indicating significant funding shortages in the sector (Mittal, 2024). Another report by the International Finance Corporation (IFC) estimates that this number could be much higher. According to the IFC, formal credit supply addresses MSME financing needs only partially, to the tune of INR 10.9 trillion. The overall finance demand by MSMEs is INR 69.3 trillion, with 70% of the credit requirement attributed to filling the working capital gap.

Formal credit penetration in the MSME sector stands at a mere 20% (Association of Chartered Certified Accountant)[1] due to the same reasons that impede financing for energy efficiency, such as lack of collateral and informal accounting practices. An Asian Development Bank survey noted that 87% of MSMEs cited funding shortages as a key barrier to upgrading their technology (Sharma, 2024).

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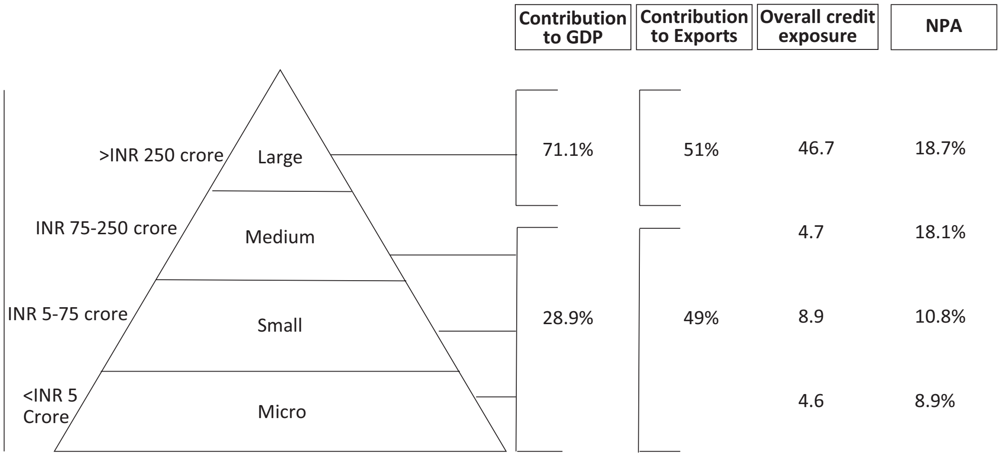

Figure 16.1 Classification of MSMEs in India

Source: Redrawn from PwC India (n.d.), *Unlocking credit for MSMEs Report.*

Box 16.1 Risk-Based Premium Optimisation for Financially Viable Distributed Renewable Energy Systems

Saakshi Chauhan and Pradip Swarnakar

Abstract

Distributed Renewable Energy (DRE) systems play a pivotal role in the global shift towards clean energy production while also enhancing energy security and providing electricity to remote areas. Yet, such projects face significant financial risks that deter investment and reduce project viability. Insurance can help reduce such risks by providing tailored coverage that mitigates potential losses from operational disruptions, natural disasters, and other project-specific risks. This study proposes a comprehensive approach for determining optimal insurance premiums for DRE projects by integrating project-specific variables and balancing the risk aversion profiles of both the producer and the insurer. Key insights reveal the importance of dynamic premium adjustment and the interdependence of risk factors. The model also assists in project planning by emphasising the importance of location, technology, and comprehensive risk management. The study equips policymakers with insights to develop targeted incentives and regulations that support DRE projects, thereby creating a conducive environment for increased financing and accelerated deployment of renewable energy technologies.

1. Introduction

Distributed Renewable Energy systems (DREs), such as small scale solar, wind, hydro and biomass projects are essential components of the global transition to clean energy. These systems not only reduce carbon emissions but also but also enhance energy security and supply electricity to remote areas. They, however, face significant financial risks and uncertainties, making it challenging to attract investment and ensure project viability. Despite the growing importance of DREs, existing literature and financial models fail to address the specific risk factors associated with these projects. Traditional insurance models typically overlook the localised nature of DRE systems and the distinct financial and operational risks associated with them (Wing and Jin, 2014). This inadequacy can result in suboptimal insurance coverage, either by overpricing policies, which can deter investment, or by underpricing them, which exposes insurers to excessive risk (Heiligtag et al., 2018). To address this gap, this theoretical assessment explores the conceptual foundation of a comprehensive approach for determining optimal insurance premiums for DRE projects. The goal is to balance the risk aversion profiles of both producers and insurers, thereby enhancing the financial viability of DRE systems.

2. *Understanding the Financial Risks in DRE Projects*

DRE projects are unique as they are often small-scaled, localised and dependent on various environmental and technological factors. These characteristics present numerous risks that can affect the financial outcomes of the projects. Key risk factors include:

- **Project Size and Scale:** Larger DRE projects typically have higher revenue potential due to greater energy production capacity. However, this also leads to higher costs and therefore greater risks, specifically in terms of operational performance and exposure to technical failures. For instance, The Cape Wind Project in Massachusetts faced major delays and cost overruns. The complexity of managing such a large project combined with other operational issues led to its cancellation in 2017 (Seelye, 2017).
- **Location-Specific Risks:** The geographic location of a DRE project plays a crucial role in its risk profile. This includes projects that are situated in an area that is prone to natural disasters like floods, earthquakes, or landslides, which increase their operational risks. Additionally, local regulatory environments can create risks through unstable laws or policies that make it difficult to predict the project's financial outcomes. Climate conditions specific to location, such as availability of sunlight for solar projects or wind patterns for wind energy projects also impact efficiency and reliability. For instance, Astonfield Solar in Gujarat, is facing significant setbacks due to disputes over damages caused by natural disasters, mainly floods (Gupta, 2024).
- **Technological Risks:** The type of renewable energy technology used in a DRE project also impacts its risk profile. Advanced technologies may offer higher efficiency and reliability which reduces the risk of operational failures, whereas, outdated or experimental technologies may present higher risks due to uncertainties in operation and maintenance requirements. For instance, Solyndra Inc., went bankrupt in 2011 due to the high costs and performance issues of its innovative solar panels (Mulkern, 2011).

- **Financial Stability and Historical Performance:** The financial health and track record of a developer or a contractor are important indicators of a project's risk. Projects backed by financially strong institutions with a track record of successful implementation are generally considered as a low risk category. In addition, robust mitigation measures such as comprehensive planning for project maintenance and having a contingency fund can further reduce overall risk. For instance, SunEdison filed for bankruptcy in 2016 due to severe financial difficulties and mismanagement which included project delays and cost overruns, resulting in significant investor losses (Hals and Groom, 2016)

3. *Key Elements of Risk Based Premium Optimisation*

To optimise insurance premiums for DRE projects, it is essential to incorporate certain elements in the calculation process that accounts for the diverse nature of risks that these projects face. It is crucial that the process considers the risk aversion levels of both the energy producer (referred to as producer from here on) and the insurer, along with project-specific risk factors, cost-benefit analysis and incorporate dynamic adjustments based changing circumstances. This approach ensures that insurance premiums are reflective of the true risk landscape, thus enhancing their financial viability.

Key Elements for Optimum Insurance Premium for DRE projects:

1. Comprehensive Risk Assessment: Optimising insurance premiums for DRE projects requires a detailed risk assessment considering factors like size, location, technology, and financial support. For example, a solar microgrid in a flood-prone region of Bangladesh initially faces high premiums due to frequent storms. To mitigate risks, developers invest in elevated solar panel structures and weather-resistant battery storage. Using real-time weather data and flood prediction models, the insurer reassesses the risk and reduces the premium by 20%. This case illustrates how dynamic adjustments and risk mitigation strategies can optimise premiums while enhancing project viability. Incorporating historical data and forecasting further refines premium calculations for better financial sustainability.
2. Producer and Insurer Risk Aversion: The risk aversion factor of the producer and the insurer is an important element for optimising insurance premiums for DRE projects. Risk aversion refers to the extent to which an individual or an organisation prefers to avoid uncertainty. Producers, or project developers generally present a high-risk aversion behaviour as they prefer a more stable and predictable returns on their investments. This level of high-risk aversion shows a tendency towards higher insurance coverage even at a higher premium to reduce the potential losses from uncertain events. Insurers, on the other hand, seek to balance their risk exposure with profitability. They are willing to accept some level of risk in exchange for the income from premiums, however, they also carefully calculate and charge premiums that adequately reflects the level of risk they are agreeing to cover. Therefore, it is important to quantify these risk aversion levels and then incorporate them into the premium calculation process.

3. Project-Specific Risk Factors: As previously stated, it is important to account for several project-specific risk factors like size, location, technology and historical performance, which influence both expected losses and overall financial viability. These elements are crucial in tailoring insurance premiums to reflect the true risk profile of each DRE project, ensuring that coverage is both adequate and cost effective.
4. Dynamic Premium Adjustments: The risk landscape of DRE projects is not static as it evolves over time due to changes in technology, regulatory environments, and other external factors. For example, if a project adopts new technologies that reduce operational risks, the insurance premium should be modified to reflect the lower risk. Similarly, if a project faces new environmental risk, the premium may need to be increased. This dynamic approach ensures that premiums remain fair and accurately reflect the current risk profile of a project.
5. Cost-Benefit Analysis: Another important aspect is to conduct a cost-benefit analysis to balance the costs of insurance against its benefits. This analysis should help determine the optimal level of insurance that provides adequate coverage without placing undue financial burden on the producer.
6. Incentives for Risk Mitigation: It is important to include mechanisms that incentivise DRE projects for implementing risk mitigation strategies, such as, advanced disaster resilient technologies. This not only reduces the premium amount but also encourages innovation in the renewable energy sector.
7. Environmental Considerations: As part of the premium optimisation process, it is important to analyse the local environmental risks. Factors such as weather and proximity to natural hazards should be factored into the calculations for premium.
8. Data-driven Insights and Advanced Techniques: Machine learning techniques enhance insurance premium optimisation by improving risk prediction accuracy through methods like decision trees, Bayesian models, and neural networks. These models analyse historical failure rates, evolving financial risks, and real-time IoT data to adjust premiums dynamically. For instance, a solar microgrid using IoT sensors to monitor efficiency can receive lower premiums if data indicates sustained performance improvements.

4. *Key Takeaways on Premium Optimisation*

The exploration of optimising insurance premiums has highlighted several crucial points:

- **Interconnected Risk Factors:** There are complex interdependencies in various risk factors, such as, a higher premium may be required for projects located in high-risk areas, however, if they adopt advanced disaster resilient technologies then the premium can be lowered. Balancing these factors is crucial for determining an optimum premium.
- **Premium Flexibility:** The approach discussed allows for premiums to be modified as project conditions evolve. This adaptability ensures that premiums accurately reflect the current risk landscape.

- **Promoting Innovation:** Projects that incorporate advanced technologies or implement strong risk mitigation strategies may require a lower premium, promoting the development of more efficient renewable energy systems.
- **Building Stakeholder Confidence:** By demonstrating that insurance premiums are based on a detailed and thoughtful risk assessment, it reassures stakeholders about the viability and security of their investments in the DRE projects.

5. Conclusion

This study offers a structured way to optimise premiums for DRE systems. By integrating various risk factors as well as the risk aversion of the producer and insurer, it aims to arrive at a premium that is fair and reflects the true risk landscape specific to a DRE project. However, it is important to validate the model and therefore future studies may conduct empirical assessments with data from diverse projects. To further refine these ideas, advanced risk assessment techniques using machine learning and real time data analytics may be employed. Performing comparative studies across different geographical regions and renewable energy technologies will help in understanding the variability and applicability of the study in various contexts. By focusing on these areas, future studies can enhance the robustness and applicability of this approach, ensuring it serves as a valuable tool for optimising insurance premiums and promoting the financial viability of Distributed Renewable Energy projects.

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16.2.1 Role of Credit Guarantees in Spurring MSMEs Credit

One instrument that has worked well in the past in mobilising credit for MSMEs is guarantees. The government has been making efforts to bridge the MSME financing gap. The allocation to the MSME Ministry has increased from INR 28 billion in financial year FY 2016 to INR 221 billion in FY 2024. The government, in its recent budget, also acknowledged the lack of term loan financing options for MSMEs. The government plans to introduce a credit guarantee scheme that will operate on pooling credit risks of MSMEs (Mishra and Walia, 2024). The Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE), set up by the Government of India and Small Industries Development Bank of India (SIDBI) in August 2000 to make collateral-free credit facilities available to micro and small enterprises, has been running successfully.

Under the scheme, credit guarantees worth INR 3 trillion were approved during FY2023 and FY 2024 against the target of INR 2 trillion in four years (India Budget, 2024). Since its inception, 9.2 million guarantees amounting to INR 6.8 trillion have been approved under the scheme (Figure 16.2).

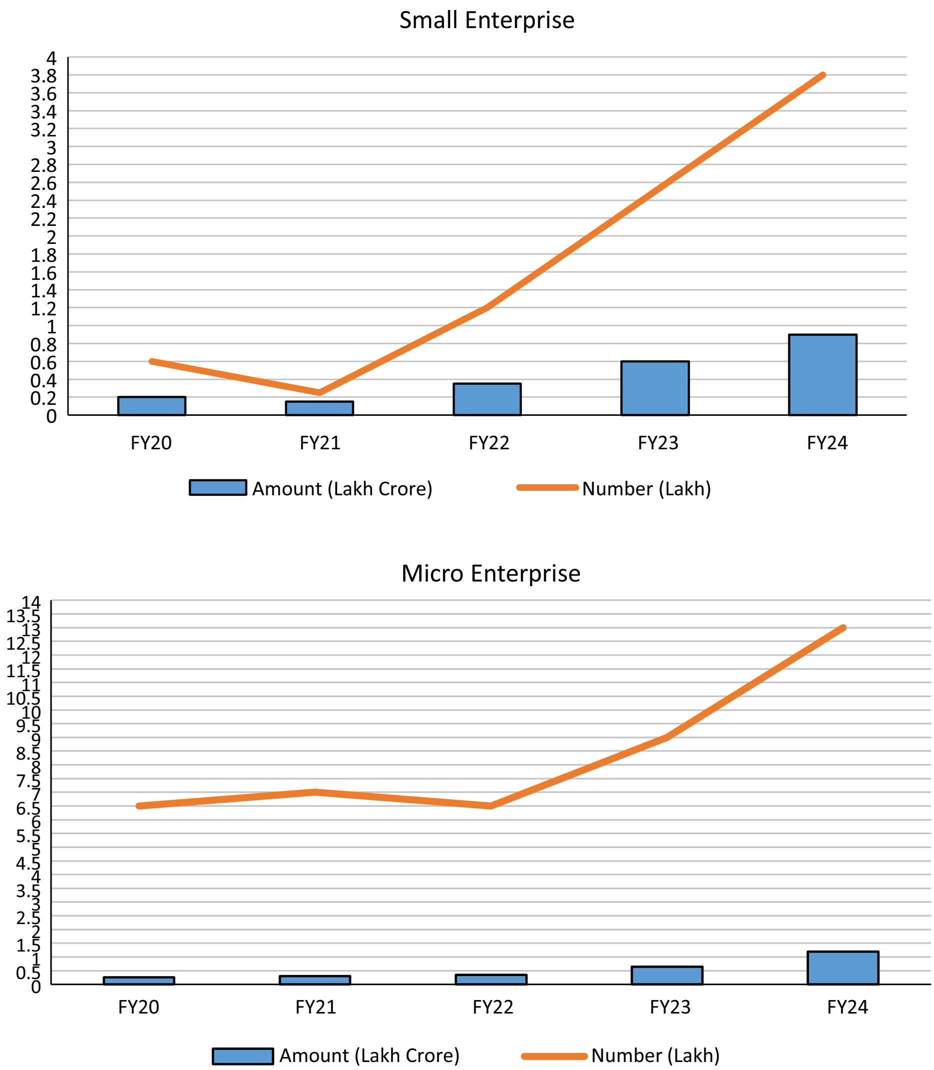

Figure 16.2 Guarantees Approved under CGTMSE

Source: Redrawn from Kumar, 2024

Another government-sponsored guarantee fund, the Emergency Credit Line Guarantee Scheme (ECLGS), launched after the COVID-19 outbreak to support businesses hit by the pandemic, has successfully mobilised commercial loans for the MSME sector. The scheme provides a 100% guarantee on the loans extended by financial institutions under ECLGS (Bajaj Finserv, n.d.). As per the India Economic Survey 2023–24, the availability of collateral-free loans with a 100% credit guarantee under ECLGS has given a boost to MSME credit disbursal (India Budget, 2024). Banks have sanctioned loans worth INR 3.1 trillion to the MSME sector under ECLGS.

16.2.2 Role of Digital Financing for MSMEs in India

While government-sponsored credit guarantees have successfully mobilised credit for the MSME sector, there is still a significant gap in credit demand. To fill the gap, the government is banking on finance technology (Fintech) companies to bring more micro and small enterprises into the formal lending system. Fintech companies use alternative lending models that leverage technology to utilise alternative data like Goods and Services Tax (GST). This gives an insight into business parameters, such as inputs, value, place of business and the amount of taxes levied, to derive information about business book size, assess financial risk appetite and gauge capacity to service further debt obligations. Utility bills and bank account statements are some other data points that Fintech companies use. GST returns offer rich data. They can be instrumental in bridging the information asymmetry for the MSME sector and lead to alternative lending models, such as cash flow-based financing, besides the conventional collateral or balance sheet-based financing model that is prevalent. Estimates suggest India's digital lending market was worth USD 270 billion in 2022. As per a report by media and information platform Inc42, the Indian Fintech market is expected to reach USD 1 trillion in Assets Under Management by 2030 (Inc42, 2022).

However, most of the digital financing for MSMEs in India has been for short-term and small-ticket loans, such as working capital. Additionally, only an estimated 12% or 7.7 million MSMEs in India are digitised. Those businesses that have partly transitioned their operations online have digital records of their financial transactions that they can use for digital lending. Nonetheless, the growing market for cash flow-based financing shows that alternative credit scoring mechanisms for MSMEs offer significant opportunities for providing financing solutions for this market segment.

The next section maps the various government schemes and efforts by government bodies to grow the market for energy efficiency in India.

16.3 India's Efforts to Grow the Market for Energy Efficiency

The Government of India enacted the Energy Conservation (EC) Act in 2001 to promote energy efficiency. The Act established a legal framework and regulatory mechanisms at the central and state levels to promote energy efficiency initiatives. The Act came into effect on 1 March 2002 and operationalised the Bureau of Energy Efficiency (BEE), a statutory body under the Ministry of Power responsible for spearheading energy efficiency improvement (India Code, n.d.).

A focus on energy efficiency from the policy side also helped garner interest from the financial sector to leverage various schemes (elaborated in Section 16.3.1) and lend to entities ranging from government bodies to industries, both large and small. While most

MSMEs are still outside the formal financing network (as elaborated earlier), the MSME sector has still benefitted from specific financial interventions and market building efforts catering to their needs for energy efficiency financing. These efforts have been led by SIDBI, but there have been some private sector entities that have tested the waters too, with varying results.

16.3.1 Schemes Creating Market-Based Mechanisms to Facilitate Growth of Energy Efficiency Market

The EC Act also established the National Mission for Enhanced Energy Efficiency (NMEEE). The mission aims to create market-based mechanisms to enhance the cost-effectiveness of energy efficiency improvements. Several provisions of the mission have been notable.

One example is the Perform, Achieve and Trade (PAT) scheme, which aims to reduce energy use for Designated Consumers (DCs) in energy-intensive sectors. The scheme allows conversion of excess energy savings into tradable Energy Savings Certificates (ESCerts). As of Cycle VII, PAT has saved approximately 28 million tonnes of oil equivalent (Mtoe) of energy (Bureau of Energy Efficiency, (n.d.). The scheme identifies threshold energy consumption limits for different industries. This helps identify DCs under PAT. However, due to the high threshold, PAT identifies only large corporates in industrial sectors as DCs. As a result, only large corporates having the balance sheet strength and access to financing options to install energy-efficiency equipment have been selected.

The Bachat Lamp Yojana (BLY) programme was another important provision of the NMEEE. It aimed to replace inefficient bulbs with Compact Fluorescent Lamps (CFLs) via a Public-Private Partnership model. The programme relied on economies of scale to reduce the cost of production and earn additional income through carbon credit trading. Despite issues from the carbon credit market crash (Financial Times, 2012) the involvement of large-scale manufacturers ensured that financing remained available.

The government phased out the BLY programme six years after its launch and replaced it with the Unnat Jyoti by Affordable LEDs for All (UJALA) scheme in 2015. UJALA focused on supplying Light-emitting diode (LED) lighting. Energy Efficiency Services Limited (EESL), a Super Energy Service Company (ESCO) under the central government, executed the UJALA scheme.[2] Like BLY, the scheme focused on economies of scale through bulk procurement and competitive bidding to select manufacturers and suppliers to cut costs. One key aspect of UJALA was innovative financing, where EESL covered upfront costs. Retail consumers paid for LEDs through instalments added to their electricity bills.

Another provision of the NMEEE was the Municipal Demand Side Management (MuDSM). This initiative focused on enhancing the energy efficiency of local urban bodies. BEE initiated the programme across 175 municipalities (CREDA, n.d.) with energy audits and preparation of detailed project reports and implementation through ESCO mode. Under this mode, ESCOs earn through sharing energy savings achieved. The municipalities have access to state and central-level budgetary resources and own revenue sources to finance energy efficiency projects. ESCOs are also keen to engage with municipalities in performance-based contracts. Here, ESCOs recover their costs and profits from the energy savings achieved over the contract period.

These three provisions involved large established entities where access to financing was not an issue to drive energy efficiency initiatives.

16.3.2 Schemes Providing Financial Support or Facilitating Financing for Energy Efficiency

The NMEEE also has initiatives to facilitate financing availability for different stakeholders. One such initiative was the Energy Efficiency Financing Platform (EEFP). Launched in May 2015, the EEFP aims to bring together financial institutions and project developers to enhance investments in energy efficiency projects. BEE has set up an online facilitation centre for the EEFP programme. Through this centre, BEE supported the financing of 14 projects with loans of more than INR 14.5 billion, roughly an average of INR 1 billion per project (BEE, n.d.). Hence, EEFP seems to have helped primarily large industries/corporations access financing.

In the context of MSMEs, NMEEE acknowledged the importance of addressing the 'knowledge gap' in the sector. This includes enhancing local capacities, developing and promoting energy efficiency technologies, training in best operating practices and implementing specialised financing mechanisms to help MSMEs adopt advanced technologies.

One key initiative for MSME energy efficiency financing within NMEEE is the Framework for Energy Efficient Economic Development (FEEED). The initiative seeks to develop instruments to promote energy efficiency. One of FEEED's key programmes is the Partial Risk Sharing Facility (PRSF), which provides partial credit guarantees to cover a share of the default risk faced by participating financial institutions, currently 15. These 15 financial institutions lend to eligible BEE-empanelled ESCOs – currently 135 (BEE, n.d.) – implementing energy efficiency projects. These projects are across large industrial players, buildings and MSMEs. PRSF aims to lower the risk perception of financial institutions for funding energy efficiency projects, especially those implemented through small ESCOs. The World Bank is the implementing agency for this programme. The Clean Technology Fund (CTF) and Global Environment Facility (GEF) fund this programme, while SIDBI is the project executing agency. The PRSF had a target to mobilise INR 10.2 billion worth of commercial financing for energy efficiency investments across various demand-side sectors, thereby triggering large-scale market transformation.

As of April 2024, the PRSF supports 79 energy efficiency projects worth INR 857.7 million with a total guarantee coverage of INR 510.4 million (BEE, n.d.). To date, it has received only two guarantee claims, which showcases the low risk of energy efficiency financing by banks (World Bank, 2024). The initial risk-sharing facility corpus amounted to INR 3 billion (SIDBI, n.d.) which means eventual utilisation was less than a fifth of the committed capital. The central government created a similar guarantee fund, the Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE), with a commitment of INR 3 billion (see Figure 16.3).

16.3.3 MSME Energy Efficiency Financing Schemes Beyond the NMEEE

Besides the NMEEE, entities like BEE, EESL and SIDBI spearheaded a few other schemes for MSME energy efficiency.

BEE implemented the programme 'Promoting Energy Efficiency and Renewable Energy in Selected MSME Clusters in India' in collaboration with the United Nations Industrial Development Organization (UNIDO), receiving a USD 7.2 million grant from the GEF. This cluster-based initiative identified MSME clusters across India, established energy management cells in states, and provided capacity-building and financial assistance to MSMEs. Active in 23 clusters, it implemented 599 small-scale energy-efficient

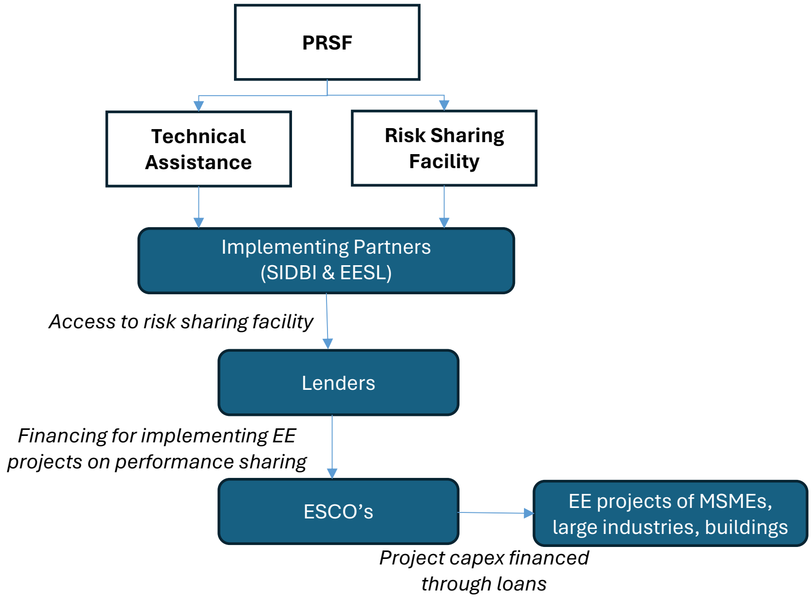

Figure 16.3 De-risking Provided by PRSF for ESCO Loans

Source: Authors, IEEFA Analysis

projects by March 2022. Additionally, the programme developed a portal, Simplified Digital Hands-on Information on Energy Efficiency (SIDHIEE), for project activities, case studies, project reports, energy audit reports and vendor information on energy efficiency across all sectors and clusters.

The programme, which ended in December 2022 after 11 years, improved financing for medium-scale enterprises, *but struggled to address collateral and liquidity issues for micro and small ones*. This is significant as a majority of Indian MSMEs are small units. The programme found that 98% of the MSMEs self-finance their energy efficiency and renewable energy investments. These investments amounted to USD 34.3 million for this programme across 1,843 projects. The grant support from UNIDO provided for an initial set of early energy efficiency adopters and helped offset 20–35% of the aforementioned investments. The programme also found that despite all the project work with financial institutions, many MSMEs borrow funds from informal lending sources. Hence, the programme could not create an ecosystem for financing energy efficiency for MSMEs, especially small and micro entities. From a lender's perspective, MSMEs do not have the required collateral (with most on leased land) to borrow funds for energy efficiency investments (UNIDO, 2023).

Another UNIDO-GEF programme, implemented with EESL, Promoting Market Transformation for Energy Efficiency in MSMEs, primarily catered to micro units (GEF, n.d.). The programme includes identifying energy-intensive MSME clusters and replicable technologies, implementing technology demonstrations, aggregating demand and developing financial models. The programme started in 2015, and will run until March 2025. To date, the programme has identified 12 clusters, 70 local service providers, 36 energy efficiency technologies for implementation across various sectors and quick estimation tools developed to facilitate energy-saving assessment and evaluation. Further, the programme has helped install 19 energy efficiency technologies in 33 MSME units as a demonstration. After the demonstration stage, EESL aims to leverage economies of scale to reduce energy efficiency equipment costs through bulk procurement and supply to ESCOs. Under the programme consultations were held to create the structure of an EESL MSME Revolving Fund (EMRF) that will provide funding for identified energy efficiency projects. However, the fund is still not operational.

The programme is running behind schedule and is yet to make an impact beyond the demonstration phase, focusing mainly on pilot accomplishments with little replication. Resources are now concentrated on the most promising clusters and technologies to establish credible pilot projects.

SIDBI has also initiated a couple of programmes for MSME energy efficiency financing. Two prominent ones were with funding lines from the Japan International Cooperation Agency (JICA) and Germany's KfW Development Bank (KfW). Both agencies provided low-cost funding lines to SIDBI to finance and refinance MSME energy efficiency loans on their own and with partner institutions. One of the requirements of the JICA scheme was that MSME units have a satisfactory track record of past performance and sound financial position, along with collateral requirements as necessary. The KfW funding line focuses on providing funding at 100 basis points lower than existing bank rates and concentrates on replacing existing equipment (JICA, n.d.). As found in the BEE-UNIDO scheme, these schemes may not be a good fit for small and micro MSME units, given their inability and unwillingness to access financing from formal banking institutions. Additionally, the lack of collateral and incentives to replace existing equipment, if still operational, acted as deterrents to the JICA and KfW schemes.

Another SIDBI scheme, Financing End-to-End Energy Efficiency Investments in MSMEs (4E), focused on implementing energy efficiency measures on an end-to-end basis so that MSMEs can concentrate on their core business (see Figure 16.4). The scheme required

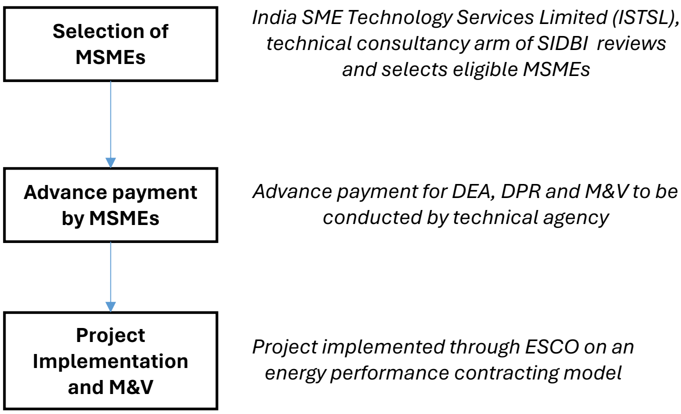

Figure 16.4 Operating Structure of the 4E Scheme

Source: Authors, IEEFA Analysis

the preparation of detailed energy audits (DEA) and detailed project reports (DPRs) by a third-party technical agency for any loan application (SIDBI, n.d.). The project implementation through an ESCO could happen only after these steps. While 4E subsidised the cost of DEA and DPR for the initial set of MSMEs, for small and medium enterprises, any expenditure that does not contribute directly to the top line will not be enough incentive. India SME Technology Services Limited (ISTSL), the technical consultancy arm of SIDBI that implemented this scheme, is in liquidation. This indicates that the 4E scheme was not successful (SIDBI, n.d.).

Table 16.1 summarises the above-discussed major schemes and programmes that public enterprises have undertaken, along with developmental partners, to grow the market

Table 16.1 Analysis of Key Schemes and Programmes for Energy Efficiency in India

Scheme/ Programme	*Implementing Organisation*	*Stakeholder Focus*	*What Worked and Drawbacks*
Perform, Achieve and Trade (PAT) scheme	BEE	Large industrial sector companies	• Companies financed energy efficiency investments without any support through their balance sheets or availing bank financing. • Focus only on large industrial units.
Bachat Lamp Yojana (BLY) Programme	BEE	Household sector	• Driving down the cost of Compact Fluorescent Lamps (CFLs) through bulk procurement using a public-private partnership model. • Relied on the Clean Development Mechanism (CDM) for covering cost differential, which crashed.
UJALA Scheme	EESL	Household sector	• Bulk procurement and competitive bidding to drive down costs, along with an option for households to pay for LEDs through instalments added to electricity bills.
Municipal demand side management (MuDSM)	BEE	Urban local bodies	• Municipalities have access to state and central-level budgetary resources and their own revenue sources to finance energy efficiency projects. • Implementation through ESCOs on a saving sharing model where ESCOs may not be bankable themselves.
Energy Efficiency Financing Platform (EEFP)	BEE	Large industries, MSMEs	• Brought together various financial institutions and project developers to enhance investments in energy efficiency projects. • Primarily helped large industries/ corporations to access financing.
Partial Risk Sharing Facility (PRSF)	BEE and SIDBI	Large industrial players, buildings, and MSMEs	• To date, it has received only two guarantee claims while it supported 79 energy efficiency projects. The scheme was able to mobilise 2.3 times the private capital on the total guaranteed loan amount. • The scheme seems to have benefitted large industries and MSMEs.

(*Continued*)

Table 16.1 (Continued)

Scheme/ Programme	*Implementing Organisation*	*Stakeholder Focus*	*What Worked and Drawbacks*
Promoting Energy Efficiency and Renewable Energy in Selected MSME Clusters in India	BEE-UNIDO-GEF	MSMEs	• Identified 23 energy-intensive MSME clusters, established energy management cells in states, and provided MSMEs capacity building and financial assistance. Implemented 599 small-scale energy efficiency projects. The Simplified Digital Hands-on Information on Energy Efficiency (SIDHEE) portal was developed to leverage successful case studies, DPRs, DEAs, vendors and ESCOs. • The financing line remained unutilised as 98% of MSMEs self-financed or relied on informal lending sources.
Promoting Market Transformation for Energy Efficiency in MSMEs	EESL-UNIDO-GEF	Focus on Micro units within MSMEs	• Identified 12 clusters, 70 local service providers and 36 energy efficiency technologies for implementation. Developed quick estimation tools for energy-saving assessment. Installed 19 energy efficiency technologies in 33 MSME units as demonstrations. • Could not scale up beyond the pilot stage. • Financing mechanism is still not developed to provide financing for identified projects.
SIDBI Energy Efficiency Financing Lines	SIDBI-JICA SIDBI-KfW	MSMEs	• Low-cost funding lines to SIDBI to finance and refinance MSME energy efficiency loans. • Past credit data of MSMEs and collateral requirements for the JICA credit line were key bottlenecks. • Replacement rather than retrofitting energy efficiency equipment is required, and there is insufficient concessionality for the KfW credit line.
Financing End-to-End Energy Efficiency Investments in MSMEs (4E)	SIDBI	MSMEs	• Provided end-to-end support to MSMEs to install energy-efficiency equipment. Subsidised cost of DPR and DEA for initial set of MSMEs. • For small and micro enterprises, expenditures not directly boosting revenue are insufficient incentives to install energy efficiency equipment. Additionally, small and micro enterprises may not be keen to pay upfront for DEA and DPR.

Source: IEEFA Analysis

for energy efficiency in India and facilitate the flow of financing to the sector. The table mentions schemes to grow the market for energy efficiency and also those that facilitate financing for the sector. We have listed what worked (or did not) from a financial perspective, and also some challenges and positives.

Analysing the 10 schemes and programmes in Table 16.1 offers insights into what has effectively created a market for energy efficiency in India and which financing interventions have worked. More importantly, it highlights what has not worked for small and micro enterprises, indicating the specific interventions needed to create a market for MSME energy efficiency investments and facilitate financing.

MSME energy financing faces several challenges. These include limited awareness and understanding of energy efficiency technologies by MSMEs, insufficient data on energy usage and asset performance with lenders, small loan sizes with high administrative costs where small and micro enterprises are completely neglected, such as for preparing DPR and DEAs, the perceived risk around MSMEs as borrowers and lack of suitable risk mitigation mechanisms for lenders and ESCOs. Despite introducing various initiatives, efforts have generally failed to promote the widespread adoption of MSME energy efficiency investments. Therefore, there is a need for a tailored approach to build on past successes and address the issues hindering widespread adoption.

16.4 Way Forward for Energy Efficiency Financing for MSMEs in India

Since the EC Act came into force in 2001, several notable developments have helped grow India's energy efficiency market. Based on the analysis of current and past schemes and programmes for energy efficiency rolled out in India, as well as the current status of MSME financing in India, we can gather several insights.

1) Energy efficiency schemes have succeeded when the counterparty was a large established player, such as large industrial units in the PAT scheme or municipalities in MuDSM.
2) Leveraging economies of scale through bulk procurement of standardised energy efficiency equipment through competitive bidding has helped reduce unit costs. EESL has experience in undertaking such processes.
3) Leveraging a marketplace model by creating physical or digital spaces for lenders and project developers for energy efficiency has been successful. However, these have primarily helped medium-sized enterprises.
4) Credit guarantees have successfully mobilised financing for energy efficiency projects implemented through ESCOs. However, these seem to have benefitted larger MSMEs.
5) There have been efforts to map MSME industrial clusters, standardise technology in those clusters, develop a local ecosystem of suppliers and developers, build capacity for MSMEs and other stakeholders, and create a database of DPR and DEAs. The Small and Medium Enterprises. Energy Efficiency and Knowledge Sharing Platform (SAMEEKSHA) portal maintains a comprehensive database of all such efforts undertaken by domestic and international entities (SAMEEKSHA, n.d.). Similarly, the SIDHEE portal is a repository of policy-focused initiatives executed by BEE for the MSME sector (SIDHEE, n.d.).
6) Most micro and small enterprises rely on self-financing for energy efficiency investments or accessing informal lending channels. This stems from their inability to meet standard lender requirements, such as collateral, tax filing, past credit history and proper accounting.

7) Micro and small enterprises do not have the financial literacy, management bandwidth, financial strength and motivation to finance energy efficiency investments where there is no immediate contribution to the top line and where they have to shell out some capital upfront (for DEA and DPR, for instance). Concessional loans may work well for medium and large enterprises, but micro and small enterprises are not keen to take debt on their books for new capex.

Hence, with large and medium enterprises, the bottleneck to energy efficiency adoption is not particularly financing. Current efforts on capacity building, financing schemes and standardisation of equipment and processes have benefitted medium enterprises (either industrial units or ESCOs). These units can borrow from formal financing channels, based on conventional collateralised funding mechanisms. However, micro and small enterprises (MSEs), primarily out of the formal financing net, will need another model to adopt energy efficiency as part of their operations.

16.4.1 Feasible Model for Financing Energy Efficiency Investment for MSEs

The feeble financing condition of MSEs and the lack of risk appetite and motivation to adopt energy efficiency investments require a more appropriate model. The installation of energy efficiency through ESCOs will be more suitable, where the ESCO assumes the operational and financial risk. In this case, micro and small enterprises can focus on their core business and let ESCOs concentrate on the energy audit, identify energy-saving levers and technologies, procure equipment, and arrange and service debt. However, given the size of MSE operations, ESCOs may be MSME players and find it challenging to arrange financing. Hence, financial interventions need to focus on the ESCO.

The EESL-UNIDO-GEF programme for Promoting Market Transformation for Energy Efficiency in MSMEs was one such programme that focused on MSEs. However, it required MSEs to pay for the DEA upfront and lacked a financing mechanism for the ESCO. Additionally, the programme fell short of meeting targets as it was overly ambitious, and lacked coordination and understanding among the various partners.

The following points need to be taken into consideration while creating the new programme:

- The proposed programme should build on the EESL-UNIDO-GEF programme further. It should shortlist 2–3 clusters and identify a few established technologies with a record of successful demonstration and understanding among local service providers/ESCOs. The extensive database maintained by the SIDHEE portal and SAMEEKSHA can help identify the low-hanging fruits to work on.
- For the business model, ESCO should follow the 'shared savings model', which assumes performance and financing risks. *The MSE industrial unit will take no financial obligation besides paying a pre-decided percentage of the actual savings to the ESCO over a specified period of time.* The portion of savings paid to the ESCO will be higher compared to the MSE unit, reflecting the higher risk that the former assumes.
- For the identified energy efficiency technologies, leveraging EESL's experience in bulk procurement will be beneficial for reducing costs. EESL can procure energy efficiency units through competitive auctions and supply them to ESCOs for installation. This approach will help standardise technology, achieve energy savings and reduce costs.
- The financing mechanism should focus on ensuring financing availability and de-risking ESCO financing for the lending institution. ESCOs may have banking relations with

local banks, non-banking financial companies (NBFCs), microfinance institutions or digital finance companies. The programme should focus on facilitating financing through any financial institution that the banking sector regulator regulates and not focus on a set of participating financial institutions. This will help leverage the ESCO's existing banking relationship with its current lenders. However, the programme can onboard a certain set of financial institutions, such as Fintech companies, to provide term loans to the ESCOs on a cash flow-based model, leveraging alternative data points such as GST returns, utility bills, invoices, etc.

- Additionally, creating a risk capital pool is necessary to guarantee lending institutions 80–100% of the loan amount. SIDBI can manage this capital pool that can be capitalised by developmental agencies such as the GEF. The model of the lending pool can be the same as the PRSF and CGTSME but focus specifically on micro and small enterprise ESCOs. The guarantee fee paid to SIDBI should come from the cash flows of the actual savings realised by the ESCO. Additionally, EESL should consider the feasibility of creating a secondary market for energy efficiency equipment mortgaged with the lender. This could be achieved through a buyback guarantee by EESL based on the fulfilment of certain preconditions such as equipment condition and useful life. The presence of a buyback guarantee (even at a haircut) will further de-risk lender exposure to ESCOs financing this equipment.
- For faster processing, DEA and DPR from the SIDHE and SAMEEKSHA portal for successful demonstration projects should be leveraged by the ESCO. Any energy audit cost should not be charged upfront to the MSEs but paid from a recoverable grant pool provided by development agencies and managed by an entity such as BEE. The audit fees should be recovered through the energy savings realised after operationalisation.
- Even within mapped clusters, many MSEs may be unaware of the benefits and de-risking mechanisms for installing energy-efficiency equipment. Therefore, a dedicated technical assistance grant, provided by development agencies such as GEF and managed by entities such as UNIDO or BEE, focused on capacity building for MSEs in these identified clusters should be introduced. Most MSEs focus only on the initial investment (purchase cost) when considering new equipment and technologies rather than the running and lifetime costs. Thus, raising awareness about the cost savings from installing energy-efficient equipment is essential. Additionally, MSEs often lack the time and technical knowledge to actively search for and finance energy efficiency technologies. MSEs tend to be risk averse and therefore there is also a mistrust of unfamiliar or unestablished equipment. Further, locally credible vendors and suppliers are often unavailable in most clusters. Therefore, capacity building should also aim to raise awareness of these aspects and explain how the programme will help address these concerns.

Table 16.2 summarises the perceived and actual risks that different counterparties within the programme may face and some possible de-risking mechanisms. The table also proposes the names of some agencies that could assume the role of de-risking/implementing partners and those that will finance the de-risking mechanisms, where required.

The actual returns the implementing ESCO will realise may vary from one project to the other. A more detailed study is necessary to understand where the returns, feasibility and risks of implementation for the ESCO are most favourable.

Table 16.2 Identified Risks and De-risking Mechanisms

Identified Risks	*De-Risking Mechanism*	*Proposed De-Risking Counterparty*	*Financing*
Project scope overly ambitious	2–3 clusters and the most viable and proven technologies identified for each cluster	UNIDO/BEE	Technical grant by GEF/other development partner
Micro and small enterprises may find energy efficiency installation a risky proposition	Awareness through cluster-level capacity-building programmes with micro and small enterprises	UNIDO/BEE	Technical grant by GEF/other development partner
Micro and small enterprises have limited expertise, bandwidth, and financial strength to invest in energy efficiency	Energy efficiency investment for industrial micro and small enterprises' units to be undertaken by ESCO through a shared savings model	EESL empanelled ESCOs	NA
Costs of identified energy-efficient technologies will be high, making ESCO returns limited	Bulk procurement of identified equipment through competitive bidding	EESL	EESL arranges financing through its balance sheet
Micro and small enterprises may not want to pay for the DEA study and M&E services	DEA and monitoring and evaluation (M&E) services are to be paid through a revolving pool of capital that gets replenished from the savings realised by micro and small enterprises	UNIDO/BEE	Recoverable grant provided by GEF/other development partner
Micro and small ESCOs may have difficulty accessing financing	ESCOs can leverage existing banking relationships or get financing through participating Fintech companies that provide finance on a cash flow-based model	NA	NA
Financial institutions may find ESCO energy efficiency financing risky	A risk capital pool provides credit guarantee to lenders	SIDBI	Guarantee provided by GEF/CTF/GoI/other development partner
Micro and small ESCOs may not be able to pay the guarantee fee upfront	Guarantee fee to be recovered from the ESCO once project-level energy savings start coming in	SIDBI	Recoverable grant provided by GEF/CTF/GoI/other development partner
Lenders may charge higher rates of interest considering their unfamiliarity with the energy-efficient technology and no history of asset recovery post-default	Buyback of the asset after a haircut based on parameters such as asset quality and useful life	EESL	EESL arranges financing through its balance sheet

Source: Authors

16.5 Conclusion

While the overall market for energy efficiency has grown drastically over the years through schemes like PAT and UJALA, there is still significant potential to tap into the market for MSME energy efficiency. India's MSMEs face several issues in adopting energy efficiency, financing being one key problem. Due to domestic lenders' perceived high risk of MSMEs and the unfamiliarity with energy efficiency technology, financing has been difficult. This problem is larger in the case of micro and small industrial enterprises.

However, the various schemes and programmes undertaken to grow the market for MSME energy efficiency provide several lessons. There is a need to create tailor-made programmes that cater to micro and small enterprises' unique needs and address the risks stakeholders face in energy efficiency investments into such units. This chapter has tried to analyse past schemes and programmes, listing the key achievements and bottlenecks in India's major energy efficiency schemes. It uses the learnings to propose a viable model to grow the micro and small enterprise energy efficiency market, a few clusters and technologies at a time.

Notes

1 Association of Chartered Certified Accountants.
2 A Super ESCO enables consumers, industries and governments to effectively manage their energy needs through energy efficient technologies.

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17 Mainstreaming Transition Plan Disclosures for Indian Companies

Shantanu Srivastava

17.1 Introduction

Transition plans involve setting specific, measurable emission reduction targets with clear timelines, and strategies that the company plans to deploy to meet these objectives (Figure 17.1). They include governance structures that integrate climate considerations into the overall business strategy, risk management and decision-making processes.

A robust climate transition plan has many advantages, such as boosting investor confidence by demonstrating the company's readiness and strategic approach to climate risks and opportunities. It aligns the company's objectives with broader regulatory and market expectations, facilitating access to sustainable finance. Increasingly, public disclosure of these plans is becoming a regulatory necessity, aiding investors in assessing the credibility and progress of a company's climate commitments.

Transition plans are meant to complement, not replace, existing disclosures. While existing disclosures typically detail companies' sustainability efforts to date, and the risks and opportunities identified, transition plans describe continuing and new efforts to address those risks and opportunities, and how those actions can contribute to a net-zero future.

17.1.1 Existing Guidelines for Transition Plan Disclosures

The UK has been at the forefront of transition plan disclosures, having created a framework in 2023 for listed companies and financial institutions (Jones, 2023). Companies are expected to use this framework to disclose their transition plans, starting 2025. The UK established the Transition Plan Task Force (TPT) in 2022 to develop a gold standard for private sector climate transition plans.

The European Union has adopted the Corporate Sustainability Due Diligence Directive, which mandates climate transition plan disclosures for applicable companies (ERM, 2024). It is also implementing the Corporate Sustainability Reporting Directive to ensure that transition plans align with climate goals.

Other regions, including the Philippines, Singapore, Switzerland, Hong Kong, the US and Australia, are also mandating or planning to mandate transition plans.

17.2 Importance of Transition Plans in Raising Finance for Energy Transition

Transition plans are pivotal for raising finance for energy transitions, especially for corporates in emerging markets like India. These plans are essential regardless of the term of

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PRINCIPLES	Ambition	Action		Accountability	
DISCLOSURE ELEMENTS	1. Foundations	2. Implementation strategy	3. Engagement Strategy	4. Metrics and Targets	5. Governance
DISCLOSURE SUB-ELEMENTS	1.1 Strategic Ambition	2.1 Business operations	3.1 Engagement with value chain	4.1 Governance, engagement, business and operational metrics and targets	5.1 Board oversight and reporting
	1.2 Business model and value chain	2.2 Products and services	3.2 Engagement with industry	4.2 Financial metrics and targets	5.2 Management roles, responsibility and accountability
	1.3 Key assumptions and external factors	2.3 Policies and conditions	3.3 Engagement with government, public sector, communities and civil society	4.3 GHG metrics and targets	5.3 Culture
		2.4 Financial planning		4.4 Carbon credits	5.4 Incentives and remuneration
					5.5 Skills, competencies and training

Figure 17.1 The Transition Plan Task Force Disclosure Framework

Source: Redrawn from Transition Plan Task Force (2023, p. 15) any transition-related financial instrument such as a green bond or sustainability linked bond. Claims that a financial instrument supports a company's transition can only be credible if the long-term transition strategy and performance targets are well-defined, showing how specific investments contribute to broader goals (see Box 17.2).

A global statement to governments, signed by 602 institutional investors representing almost USD 42 trillion in assets under management, stressed the importance of the public disclosure of 1.5°C pathway-aligned, independently verifiable transition plans as a core element of mandatory reporting (The Investor Agenda, 2022). Investors need transparency in the way climate risk assessments shape strategies, governance, capital expenditure and business opportunities.

More than one in four companies disclosed through CDP, one of the largest global sustainability disclosure systems, that they have a 1.5°C-aligned climate transition plan in place – an increase of 44% since last year (CDP, 2024a). Most of these companies are in developed markets, particularly Europe, where transition plan regulations are being tightened. Consequently, companies in emerging markets may struggle to raise capital in these jurisdictions for energy transition.

Box 17.1 Aligning Interests: How Corporations Approach Climate Financing and the Role of Good Corporate Governance

Srinivas Cherla

Corporations adopt different approaches to climate financing based on their specific circumstances, industry sector, and sustainability goals. This financing can take various forms as discussed below.

1. Bonds: Corporations increasingly issue bonds and incorporate environmental, social, and governance (ESG) criteria into their investment strategies to attract capital from socially responsible investors. Such bonds allow corporations to raise funds specifically earmarked for climate-related projects, thereby enhancing transparency and accountability in their use of proceeds.
2. Strategic Partnerships: Many corporations form strategic partnerships with financial institutions, development banks, and impact investors to access climate financing. These partnerships often involve co-investment arrangements and joint initiatives focused on renewable energy, energy efficiency, sustainable supply chains, and climate resilience.
3. Internal Funding: Some corporations allocate internal funds and resources towards climate-related initiatives, leveraging their innovation capabilities and R&D investments to develop sustainable technologies, products, and business models. These companies view climate action as a strategic imperative for driving long-term value creation and competitive advantage.

Challenges

In the context of climate finance, a firm may not want to reveal all information to outside investors, as it may be detrimental to their chances of securing funding.

Misinformation or Greenwashing: Exaggerating the project's environmental benefits or downplaying potential negative impacts is a major red flag. For example, in 2021, a major bank faced criticism for financing a hydropower project in Southeast Asia that displaced local communities and caused environmental damage. While the project might have been presented as 'green' based on energy generation, the social and environmental costs weren't adequately addressed.

Proprietary Information: While some technical details might be considered proprietary, anything directly related to the project's green credentials shouldn't be withheld. For example, consider a situation where a company develops a new technology or process that reduces the energy intensity of the product being manufactured. While they may be willing to share the efficiency improvement and market their product as green, they would not want to disclose the exact nature of invention or technology so as to retain their competitive advantage.

Confidential Business Plans: While the overall financial viability of the project is important, highly confidential details unrelated to environmental impact might not be necessary to disclose. For ex. as a part of the SDG commitments, many large corporates have already shared long-term targets for emissions and GHG. These long-term commitments need to be backed by short to medium term targets, strategy roadmaps, performance metrics and governance mechanisms. Unfortunately, most corporates seeking funding would be reluctant to provide detailed technology and internal business strategy roadmaps to a third parties fearing loss of competitive advantage.

Historical Disclosures: Corporates would find it difficult to share information about any actions/activities taken by them in the past that resulted in destruction in the past or continue to degrade the environment. For example, consider a beverage industry that has been accused of degrading aquifers in the past decides to undertake comprehensive water management (catchment area, rain water harvesting, storage, treatment etc.) and tree plantation. While the project would definitely have a positive environmental impact, admitting what led to the current situation would put the company in a tough spot.

Material Disclosures: Companies should disclose all information that's material to the project's environmental impact. Materiality refers to information that a reasonable investor would consider important when making a decision. For example,. imagine a company seeking green financing for a new 'sustainable' building. They might focus heavily on energy-efficient features, but fail to disclose the use of potentially harmful materials in construction or a weak plan for waste management during the building's operation.

Transparency Throughout the Project Lifecycle: Companies could find it difficult to maintain the same level of transparency to demonstrate ongoing commitment to environmental goals through regular reporting and updates for investors. This lack of transparency on the project's full environmental footprint could lead to financing being denied or revoked later if discovered.

Conclusion

As corporations increasingly turn to climate financing to support their sustainability ambitions, the importance of disclosures cannot be overstated. Following the recently standardised European Union (EU) Taxonomy provides a common language and a clear definition of what is considered environmentally sustainable. This would provide a structure for shaping the exchange of critical information that brings focus on transparency and takes a holistic approach to sustainability. By adopting transparent reporting practices, strengthening board oversight, and engaging stakeholders effectively, corporations can align the interests of financers and beneficiaries, thereby maximising the impact of climate financing on environmental stewardship and long-term value creation. In doing so, they can contribute to a more sustainable and resilient future for all.

17.2.1 Sustainable Finance Market Perspective

The sustainable finance market for instruments such as green bonds and sustainability linked bonds (SLBs) and loans, has faced challenges regarding the relevance, reliability and ambition of transition pathways. Targets set by issuers are often difficult to compare with peers or broader goals like the Paris Agreement target, leading to scepticism that some issuances are merely 'business-as-usual'. This issue has particularly affected the market for sustainability linked instruments. In calendar year 2023, global issuance of sustainability-linked loans and bonds plummeted by 55% and 24%, respectively (BNEF, n.d.). In India, JSW Infrastructure's issuance of an SLB in 2022 met with criticism for its lack of ambition, as it only included Scope 1 and Scope 2 emission reduction targets. This was particularly contentious given the company's ongoing construction of a coal terminal in Odisha (Webb, 2022). This showed the disconnect between the company's wider corporate strategy and sustainability strategy – an issue that is at the core of creating robust transition plans.

Box 17.2 Transition Bonds in Japan

Transition bonds have also gained traction over the last year, after Japan issued the world's first sovereign transition bond totalling USD 11 billion. Before issuance, the government ensured the bond proceeds aligned with its 2050 carbon-neutral goal. With oil constituting 80% of its energy mix, Japan needs to invest in both green and transition assets. This required clear definitions of transition assets and decarbonisation pathways across hard-to-abate sectors. Consequently, Japan released a transition taxonomy, a green transformation (GX) strategy and a detailed technological roadmap. The bond proceeds were linked to this taxonomy and the roadmap, and were based on GX investment targets for different sectors, giving investors clarity on how their investment into the bond would support Japan's decarbonisation target. Japan's successful issuance of transition bonds showcases the criticality of linking sustainable bond issuances with overall decarbonisation strategy, akin to linking corporate strategy to sustainability strategy.

Transition plans can significantly enhance the sustainable bond market by providing a strategic framework to evaluate the consistency of issuers' transition and sustainability commitments. These plans help issuers avoid controversies related to potential carbon lock-in risks in their projects and investments. Additionally, they improve the setting of sustainability-linked bond targets and key performance indicators (KPIs), offering a clear context for assessing failed targets and understanding circumstances beyond the entity's control.

17.2.2 Linking Transition Plans to Financial Impact

Corporate strategies are based on company-specific and macro-economic assumptions. These lead to forward-looking statements published by corporates, which are used by stakeholders, such as investors, financiers and insurers. From an energy transition perspective, these corporate strategies should incorporate assumptions around product demand, regulatory action such as carbon emission quotas and energy efficiency targets, low-carbon technological development, R&D costs, product prices and operational expenditure, among others. These assumptions should also guide regulatory exercises such as asset impairment tests and estimation of useful lives of high emission assets. A transition plan disclosure is an appropriate way to link decarbonisation strategies with key financial risks and opportunities, and associated financial decisions and impact.

For example, Shell's financial reporting estimates that its energy transition will require over USD 4 billion over the next couple of years in total capital expenditure for carbon abatement projects, including efficiency improvement, transformation of energy and chemical parks, and the use of renewable power. Shell's Operating Plan also projects that annual carbon emission costs will increase from about USD 0.8 billion in 2023 to around USD 1.5 billion by 2032. On asset impairment, Shell estimates that a 10% change in the commodity price outlook, averaged over the asset life cycle, would result in an impairment of approximately USD 2–5 billion in its Integrated Gas and Upstream division (Shell, 2022).

ESG-aligned investors and financiers are increasingly incorporating climate risks and opportunities in their decision-making process. If corporations deviate from or understate these climate risks compared to those factored in by investors during their decision-making process, it can result in loss of investor support. For example, in July 2023, shareholders of TotalEnergies claimed that the company had failed to adequately account for asset depreciation in line with future carbon costs and had underestimated Scope 3 emissions. The miscalculations affected asset valuation, leading to overestimated profits and potentially unlawful dividend distribution (Reuters, 2023).

17.3 Current Transition Plan Disclosure Practices in India and Global Best Practices

In India, current practices for transition plan disclosures are evolving, with companies increasingly recognising the importance of transparency in their climate strategies. However, the level of detail and ambition in these disclosures varies significantly, presumably due to the lack of regulatory requirement or guidance on transition planning and disclosures. However, numerous standards and guidance documents from global regulators and voluntary organisations can assist Indian companies in their transition journey. As part of the Security and Exchange Board of India's (SEBI's) Business Responsibility and Sustainability Reporting (BRSR) regulations, regulated entities have to describe the processes for identifying key stakeholder groups of the entity, the identified stakeholders, and frequency, mode, and purpose of engagement with them.

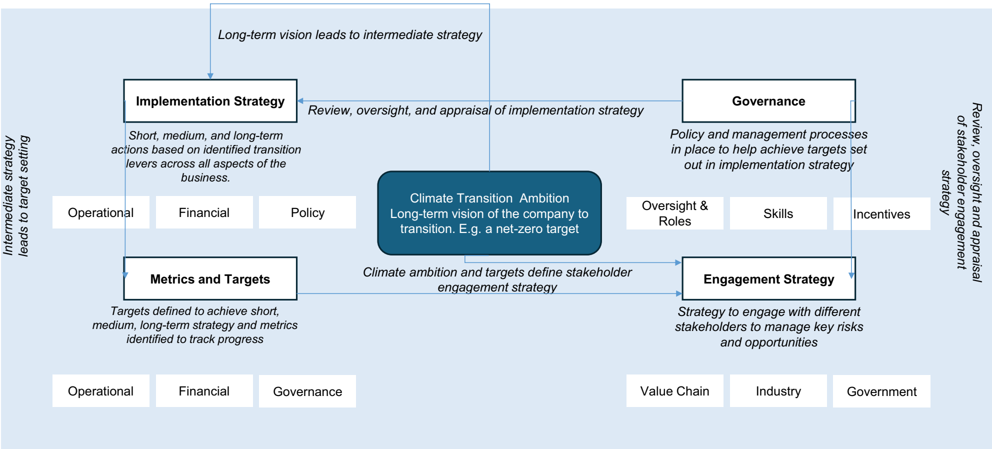

Figure 17.2 Key Considerations in Creating a Robust Transition Plan

Source: IEEFA Analysis

Figure 17.2 outlines the various aspects of creating a transition plan for a corporate entity, based on the current transition plan guidance. These interconnected aspects aim to provide stakeholders a comprehensive view of the entity's transition plan. The following sections detail each aspect, its linkage to other transition plan areas, current practices by Indian and global companies, and the alignment of BRSR with each disclosure area.

17.3.1 Defining a Climate Transition Ambition

The first step is to define long-term decarbonisation ambitions and business model transition goals, such as setting a net-zero target or other long-term ESG objectives. A sustainability materiality assessment to identify the most significant ESG risks and opportunities pertinent to the corporate, is a good starting point to define this. The assessment involves consulting stakeholders like investors, financiers, customers, employees, suppliers and communities. Based on stakeholder inputs, the identified risks and opportunities are stress-tested to ascertain their materiality to the company's operations, based on future scenarios. These scenarios could be industry-specific, geography-specific or a mix of both and provided by entities such as the International Energy Agency or based on domestic climate targets such as Nationally Determined Contributions. The ESG ambition of the corporate (including on climate) is derived from this exercise.

Under Section A of the BRSR, companies identify the material environmental and social matters that present a risk or opportunity to their business, along with a rationale to identifying that approach to adapting or mitigating the risk, and financial implications. Hence, BRSR includes disclosures on material ESG risks for the company. Section B of the BRSR requires entities to identify their specific ESG goals and commitments. However, not all companies have used this exercise to identify climate ambitions such as a net-zero target. For instance, Adani Power, one of the largest private thermal power producers in India, is exploring 'net carbon neutral possibilities' and public disclosures by 2024–25 even though the company says that its approach to climate change adaptation and mitigation is in line with the Paris Agreement (Adani Power, 2023). Among the companies that have identified a net-zero target, some do not incorporate Scope 3 emissions. For instance, ONGC, one of the largest oil and gas companies in the country, aims to achieve net zero by 2038, but omits Scope 3 emissions from its ambit, which are the most material emission source for their business (ONGC, n.d.).

Despite the disclosures mandated by SEBI, which enable setting ambitious ESG targets, as noted above, corporates often fail to establish long-term ambitions. The entity's disclosure in Section A, which pertains to identified material risks and opportunities, should be connected to the commitments and goals outlined in Section B. Furthermore, there should be a requirement for the entity to identify strategic transition ambitions that will serve as the guiding vision for the company's transition plan.

17.3.2 Creating an Implementation Strategy

Once a corporate defines its climate ambition, the next step is to identify specific transition levers available at its disposal, which will be most effective in achieving its long-term objectives. These transition levers are based on company-specific factors, such as the nature of operations, and availability and access to capital, technology and manpower, along with macro-economic factors, such as policy direction, market demand, financing scenario and the availability of low-carbon technology. The company should disclose the assumptions that it makes while identifying an implementation strategy.

Based on the scenario analysis conducted in defining the climate ambition, the key opportunities and risks can be used to identify transition levers. The corporate also assesses the impact and dependencies of various stakeholders in using specific transition levers that feed into its engagement strategy with these stakeholders (elaborated upon in a later section). For instance, if strategic ambition identified by a company is net-zero by 2050 and climate transition risk is identified as a key risk, the transition levers could be increasing the share of renewable energy in its portfolio, installing energy efficiency equipment, retrofitting thermal plants for biogas cofiring, improving supplier ESG assessments, and training the existing workforce to redeploy in low-carbon businesses.

NTPC, India's largest thermal power producer, has identified some key levers for its energy transition as part of its sustainability strategy named 'The Brighter Plan 2032' (see Figure 17.3). The levers include ultra-mega renewable energy power parks, green

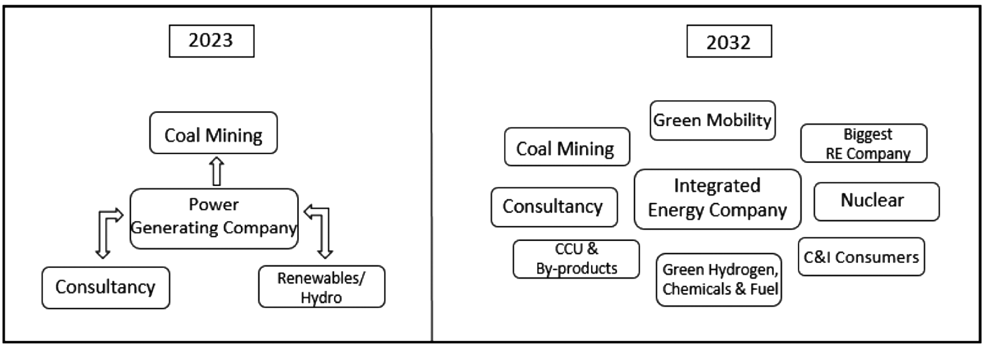

Figure 17.3 NTPC's Brighter Plan 2032

Source: Redrawn from NTPC (2024)

hydrogen, energy storage, offshore wind, upgrading older thermal fleets for efficiency and emissions reduction, and using carbon sinks and carbon utilisation. These levers offer some insight into NTPC's sustainability implementation strategy to investors. The Brighter Plan 2032, however, does not link to the company's BRSR disclosures. Additionally, the company has diversified into coal mining and power equipment manufacturing, along with expanding its thermal fleet, which shows that the implementation strategy is not in sync with its corporate strategy.

Another key aspect of the implementation strategy is financial planning, where the financial impact of the transition is identified using the transition plan. In NTPC's case, its capital expenditure is driven by investments in upgrading its coal generation fleet with pollution control technology, and in constructing new coal-fired power plants, which do not align with its implementation strategy. On the other hand, Spanish utility Iberdrola is a good example of how transition plans can be linked with financial planning (see Figure 17.4). The company links operating income generation to two different transition scenarios that help stakeholders gauge the company's vulnerability to climate risks.

According to CDP, of all the companies that completed its transition plan questionnaire, only 15% identified spending/revenue that is aligned with a climate transition plan (CDP, 2024b). Hence, linking financial planning and budgeting for transition plans is a challenging task. The UK's TPT suggests that quantitative information for short-term actions be prioritised for this metric.

Another key exercise part of the implementation strategy is identifying existing or new policies that can leverage transition levers. These could be ESG-related policies. For instance, policies on capital-raising, supplier assessments, human resource management, and appointment of board members, among others, can be introduced or updated.

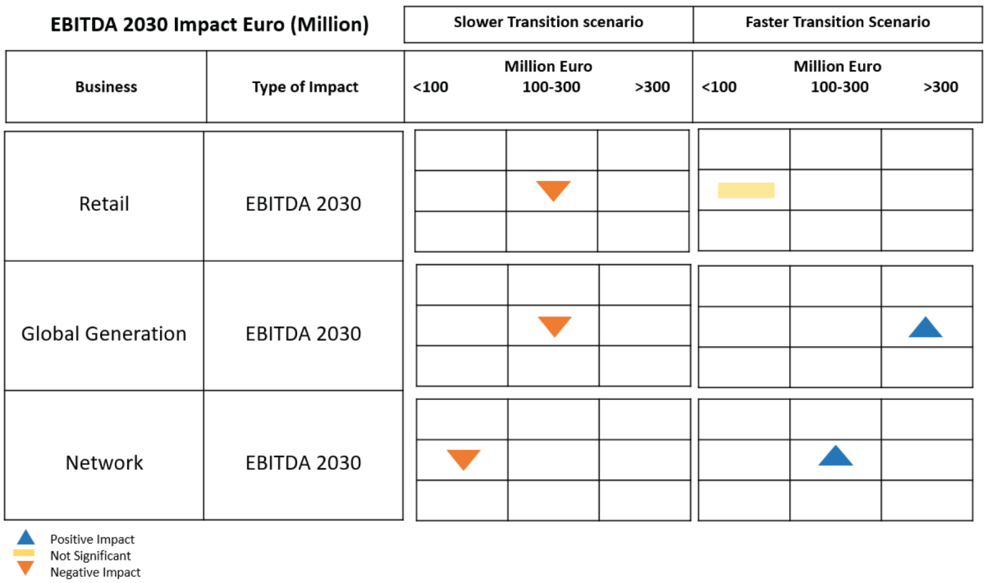

Figure 17.4 Iberdrola's Analysis of Different Transition Scenarios on Company's Future EBITDA (Euro million)

Source: Redrawn from Iberdrola

From a BRSR perspective, the key risks and opportunities identified as part of the materiality assessment, and the associated approach to adapting or mitigating the risk, and financial implications under Section A, can be used by corporates to disclose the transition levers, and associated financial impact. SEBI requires companies to respond either positively or negatively to any financial impact rather than quantifying or contextualising the implication of an identified transition activity on the operating, financing and investing aspects of the business. Section B of the BRSR requires the disclosure of policies and processes that support the nine principles of BRSR across ESG topics.

Therefore, the BRSR requires disclosures that enable a corporate to communicate its identified transition levers, associated policies, and the financial implications of implementing these policies. However, the requirement to disclose the approach to adapting or mitigating identified risks is not descriptive enough for companies to link their implementation strategy with it. Additionally, there is no requirement to identify any approach or levers to capitalise on the identified opportunities. The requirements also do not provide sufficient guidance on linking financial impact with the company's implementation strategy.

17.3.3 Defining Metrics and Targets

Based on the identified levers of transition, stakeholder dependencies and impact, financial impact, and governance policies, it is crucial to establish metrics and targets for each of these aspects. Figure 17.5 demonstrates how metrics and targets connect long-term climate ambitions to concrete actions that a company takes. For example, metrics and targets for a transition lever like growing the renewable energy portfolio will be capacity added in gigawatts during the period, under-construction capacity, pipeline capacity, and planned capacity over the short (3–5 years), and medium (5–10 years) term. An example of governance-related metrics and targets could be 30% incentive for board and key management personnel linked to achievement of short-term Scope 1 and 2 targets set by the company.

As a best practice, the short- and medium-term climate targets should be aligned with the long-term target trajectory, and should be externally verified to ensure that the target is ambitious enough compared to global and domestic benchmarks. For instance, the Science-Based Targets initiative (SBTi)[1] provides validation of a company's decarbonisation targets based on its corporate net-zero standard. SBTi's guidance aims to help companies understand the level of emission reduction required to align with science but does not prescribe which emissions reduction levers should be prioritised or utilised, as this depends on each company's strategy. Disclosing information on identified transition levers along with associated metrics and targets that are linked to externally verified science-based targets, allows investors and other stakeholders to better assess the organisation's potential risk-adjusted returns, general exposure to climate issues, and progress in managing or adapting to those issues.

As an example, in India, Tata Power has committed to becoming Carbon 'Net Zero' before 2045 and its near-term decarbonisation target has been validated by SBTi (Tata Power, 2024).

Like the implementation strategy, metrics and targets should also be linked to a corporate's financial planning. For example, as part of the European Union's Corporate Sustainability Reporting Directive (CSRD) which is the EUs sustainability reporting regime, a company within the scope of the CSRD is required to report its turnover,

Metric Category	*Example Unit of Measure*	*Rationale for Inclusion*
GHG Emissions – Absolute Scope 1, Scope 2 and Scope 3; emission intensity	MT of C02e	Disclosure of GHG emissions is crucial for users to understand an organisation's exposure to climate-related risks and opportunities. Disclosure of both absolute emissions across an organisation's value chain and relevant emissions intensity provides insight into how a given organisation may be affected by policy, regulatory, market and technology responses to limit climate change.
Climate-Related Opportunities – Proportion of revenue, assets or other business activities aligned with climate-related opportunities	Amount or percentage	Disclosure of the proportion of revenue, assets or business activities aligned with climate-related opportunities provides insight into the positions of organisations relative to their peers and allows users to understand likely transition pathways and potential changes in revenue and profitability over time.
Capital Deployment – Amount of capital expenditure, financing or investment deployed towards climate-related risks and opportunities	Reporting currency	Capital investment disclosure by non-financial organisations and financing by financial organisations gives an indication of the extent to which long-term enterprise value might be affected.

Figure 17.5 Climate-Related Metric Identified by Task Force on Climate-Related Financial Disclosure (TCFD)

Source: Redrawn from TCFD (2022, p. 37)

capital expenses and operational expenses with respect to the economic activities identified in the EU taxonomy. Hence, activities identified as part of the transition levers need to be linked to the company's financial reporting.

For fundraising, a best practice is to have transition plan specified targets linked to targets identified for sustainable debt such as SLBs. For instance, as depicted in Figure 17.6, Enel, an Italian power sector utility, issues and executes financial instruments linked to predetermined Sustainability Performance Targets (SPTs). These targets give investors an idea of what impact their capital has on the company's overall decarbonisation trajectory.

BRSR's Section C comprises 140 questions – 98 on essential indicators and 42 on leadership indicators, across nine principles. These ESG indicators help corporates communicate their progress in key business areas. While Section C mandates the disclosure of metrics, the associated targets are not required to be disclosed alongside. Rather, associated targets are disclosed under Section B, which also has specific commitments, goals and targets set by the entity with defined timelines. The company's progress on these targets is also disclosed here.

While BRSR requires the disclosure of several key metrics along with associated targets and performance, it does not mandate a link between long-term targets and short- and medium-term action and associated metrics. On financial planning, BRSR requires disclosing the proportion of capital expenditure, and research and development expenditure to improve the environmental and social impact of products and processes. However,

KPI	*Actual values*	*Sustainability Performance Targets (SPT)*					
	2023	*2023*	*2024*	*2025*	*2026*	*2030*	*2040*
KPI #1 – Scope 1 GHG emissions intensity relating to power generation (gCO_{2eq}/kWh)	160	148	140	130	125	72	0
KPI #2 – Scope 1 and 3 GHG emissions intensity relating to integrated power (gCO_{2eq}/kWh)	168			135	135	73	0
KPI #3 Absolute Scope 3 GHG emissions relating to gas retail ($MtCO_{2eq}$)	16.8			20.9	20.0	11.4	0
KPI #4- Renewable installed capacity percentage (%)	68.2%	65%	69%	73%	74%	80%	100%
KPI #5 – Proportion of Capex aligned to the EU taxonomy (%)	84.8%			>80% (2023–2025)	>80% (2024–2026)		

Figure 17.6 Enel's KPIs and Sustainability Performance Targets (SPTs)

Source: Redrawn from Enel (2023)

these are not linked to transition levers, metrics and targets. Additionally, the lack of guidance on disclosing relevant metrics and targets that may not get covered in the nine principles, but have been identified by the company, leads to a lack of coherence between transition plans and sustainability disclosures.

As an illustration, Figure 17.7 illustrates the BRSR disclosure for NLC India, a state-owned thermal power producer with captive lignite mines. While the reporting on transition levers, metrics and targets, and financial implications are spread across different sections of the framework, there is a lack of coherence in NLC's identification of material risks and opportunities. While renewable energy is identified as a key transition lever and thermal assets as a key risk, the company still targets lignite mining expansion, with renewable energy projected to constitute just over a third of installed capacity by 2030. Additionally, NLC India does not disclose any strategic climate ambitions, such as a net-zero target. The absolute and intensity metrics on emissions are not linked to any company-level transition levers. Further, details of capital expenditure do not specify which business unit the funds were allocated to.

Therefore, the lack of coherence in the BRSR reporting framework across different sections related to transition plan disclosure, combined with insufficient guidance on ensuring consistency with other disclosures of the entity, raises red flags for potential investors seeking credibility in the company's transition plan.

17.3.4 Engagement Strategy

Several transition levers identified by a company depend on and impact various stakeholders. Such impact and dependencies should be mapped by the entity while identifying key transition levers and setting strategic goals. For example, a steel company aiming to reduce its Scope 3 emissions or supply chain emissions, must engage with suppliers to ensure they are also implementing decarbonisation measures, to align with the company's decarbonisation goals. Similarly, a thermal power producer planning to phase out legacy thermal assets must consider the socio-economic impact on workers and communities dependent on the thermal plant. Therefore, it is important to have a comprehensive plan outlining engagement activities and how they contribute to achieving the identified targets.

A credible engagement strategy (see Figure 17.8) disclosed as part of the transition plan that links with transition levers and has specific metrics and targets for engagement, will help communicate to investors the corporate's ability to manage social risks arising from the transition. These metrics and targets can be used as specific targets while raising sustainable debt. For instance, JSW Steel, an Indian steel major, has introduced an ESG questionnaire for supply chain vendors to identify those engaged in sustainability practices. Based on the results, they plan ESG workshops and awareness sessions to boost vendors' ESG commitment. JSW's strategy includes strategic vendor selection, and comprehensive supplier management and training. However, the company lacks targets for supply chain transition, such as the percentage of suppliers aligned with its sustainability strategy, and the number of preferred partners and training sessions. Without these metrics, investors cannot gauge the alignment of the implementation strategy with the engagement strategy.

Within BRSR, Principle 4 requires the disclosure of key stakeholder groups identified and the frequency of engagement with each group. Among leadership indicators under this principle, the corporate has an option to disclose details of engagement with and action taken to address the concerns of vulnerable/marginalised stakeholder groups.

Sl.No	*Material Issue Identified*	*Indicate whether risk or opportunity (R/O)*	*Rationale for identifying the risk/ opportunity*	*In case of risk, approach to adapt or mitigate*	*Financial implications of the risk or opportunity (indicate positive or negative implications)*
6.	Renewable energy	O	Renewable energy is one of the key focus areas of NLC as a long-term strategy.	Development of renewable energy deployments are being ventured.	Positive
10.	Climate Strategy	R	Our business activities are carbon intensive in nature. With the evolving regulatory and compliance regarding carbon markets, developing a climate strategy is critical to us.	We intend to expand our portfolio in the renewable sector. • Also, through our R&D team (CARD) we intend to develop innovations that help reduce carbon footprint.	Negative
15.	Decommissioning of Old Plants	R	Some of our plants have attained their end of life: We would be decommissioning such plants.	• Decommissioning of plants are governed by the norms of the Ministry of Power (MoP). • Ensuring safety and security of people and environmental impact during decommissioning.	Negative
5	Specific commitments, goals and targets set by the entity with defined timelines, if any.		NLCLIL has ambitiously established a growth target to emerge as a prominent energy player, aiming for a robust power generation capacity of 17,171 MW by 2030. To ensure self-sufficiency in fuel supply, the Company plans to expand its lignite mining capacity from the current 30.10 MTPA to an impressive 40.10 MTPA, as well as enhance its coal mining capacity from 20.00 MTPA to a remarkable 44.00 MTPA. Moreover, NLCLIL aims to significantly augment its renewable energy capacity to reach 6,031 MW by 2030, a substantial increase from its existing capacity of 1,421 MW.		

Figure 17.7 NLC India's BRSR Reporting on Climate-Related Risks and Opportunities

Source: Redrawn from NLC India (2023)

6. Provide details of greenhouse gas emissions (Scope 1 and Scope 2 emissions) and its intensity, in the following format:

Parameter	*Unit*	*FY 2022–2023 (Current FY)*	*FY 2021–2022 (Previous FY)*
Total Scope 1 emissions (Break-up of the GHG into CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3, if available)	Metric tonnes of CO_2 equivalent	2,55,23,638.6	2,65,76,644.4
Total Scope 2 emissions (Break-up of the GHG into CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3 if available)	Metric tonnes of CO_2 equivalent	253.2	212.6
Total Scope 1 and Scope 2 emissions per rupee of turnover (in INR)	tCO_2e/INR	0.00020	0.00027
Total Scope 1 and Scope 2 emission intensity (optional) – the relevant metric may be selected by the entity	tCO_2e	NA	NA

1. Percentage of R&D and capital expenditure (capex) investments in specific technologies to improve the environmental and social impacts of product and processes to R&D and capex investments made by the entity, respectively.

Type	*FY 2022–2023 (Current Financial Year)*	*FY 2021–2022 (Previous Financial Year)*	*Details of improvement in environmental and social aspects*
Research & Development (R&D)	37%	30%	CARD has taken up initiative for the formation of Innovation Incubation Centre (IIC). Under IIC, projects focused on environmental improvement and social impacts of products and processes are taken up. In addition, R&D works like Hi-Tech Farming, Development of Mobile Electric Vehicle based Real Time Air Quality Monitoring & Modelling for NLCIL, Lignite to Diesel, Lignite to Methanol etc. are being carried out.
Capital Expenditure (CAPEX)	95%	77%	

Figure 17.7 (Continued)

2023	*2024–2026*
30% of people leaving coal-fired plants in 2023 have been redeployed and have attended upskilling/reskilling programmes; the remaining **70%** have retired or have been involved in early retirement programmes. Redeployed coal plants people: ~ **80%** within the Enel green power and thermal generation perimeter ~ **20%** in other Enel business areas	**80%** of people leaving coal-fired plants will be redeployed and the remaining **20%** will be involved in early retirement plans Overall reskilling and upskilling dedicated to total Enel people: up to **40%** Strengthening of the 'internal training' approach

Figure 17.8 Enel's Strategy to Ensure a Just Transition for Coal Plant Workers

Source: Redrawn from Enel (2023)

However, the disclosures do not require linking engagement strategy with transition strategy and achievement of climate-related metrics and targets. BRSR also does not require the disclosure of strategy and associated metrics to reduce the impact of the company's transition efforts on stakeholders.

17.3.5 Governance

Investors and users of sustainability disclosures are interested in understanding the role of a company's board in overseeing sustainability issues as well as the management's role in managing those issues. From a transition plan perspective, the board is responsible for review and oversight of the implementation and engagement strategy. It ensures that firm incentives are aligned with the achievement of transition goals. The governance of ESG policies and control systems is also a key responsibility of the board. Auditing of sustainability reporting, policies and control systems gives investors' confidence in the robustness of transition plan governance mechanisms.

For instance, Danish power company Orsted links achievement of CDP climate score, relative Scope 1 and 2 emissions, employee satisfaction, and gender diversity and safety to executive management compensation (see Figure 17.9) (Orsted, 2023). In India, prominent cement company Shree Cement uses ESG performance as a pillar to determine the pay of directors, key management personnel and senior executives (Shree Cement, 2023). However, the company does not disclose how much the remuneration is aligned to transition goals of the company and what the metrics are.

Investors would like to be assured that the board has the requisite skillset to appraise key climate-related risks and opportunities and their impact on business operations. Hence, competencies and trainings become important. Orsted's board of directors annually reviews the overview of the required competences for its composition. In 2023, the ESG competence was further detailed to bring it in line with the EU's CSRD (Orsted, n.d.).

Under BRSR, governance disclosures are essential. Section B requires a director's statement on ESG challenges, targets and achievements, details of the highest authority overseeing the business responsibility policy, and information about the board committee responsible for sustainability decisions. It also mandates information on external assessments of policy implementation. Section C requires disclosures on ESG training programmes, the remuneration of board and key management personnel and details of

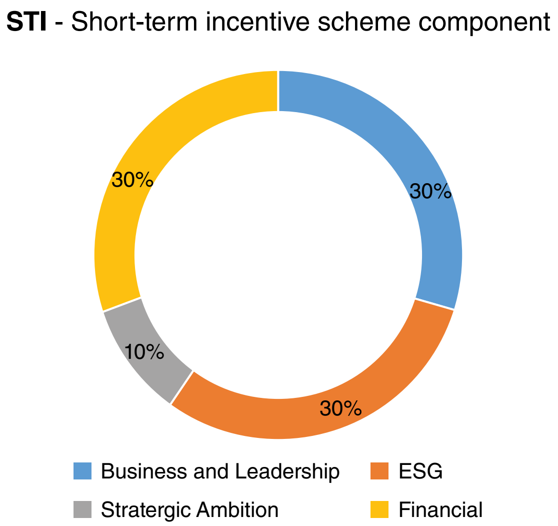

Figure 17.9 Orsted's Short-term Management Incentive Schemes

Source: Redrawn from Orsted Annual Report (2023)

corporate governance. While BRSR has comprehensive governance disclosure requirements, linking them to transition planning aspects – such as implementation strategy, engagement strategy, and metrics and targets – is crucial. Disclosing key tasks related to the transition plan, managed by the board, will help investors understand the level of governance on these matters.

17.3.6 Need for Guidance on Transition Planning from SEBI

A key aspect of transition planning and disclosure is the objective nature of the various components and their interconnectedness. Indian companies reporting under the BRSR framework lack guidance or incentives to create and disclose their detailed transition plans. However, the BRSR framework contains several elements that align well with an ideal transition plan disclosure. Therefore, as an initial step, SEBI can provide guidance on enhancing coherence and interlinkages between current disclosures, ensuring that investors and other stakeholders get a comprehensive view of the entity's transition plan. While this guidance from SEBI is necessary, the regulator also needs to keep into consideration the readiness of the regulated entities to abide by any new regulation on transition plans.

17.4 Stakeholder Roles in Ensuring Robust Transition Planning and Disclosure by Corporates in India

Various stakeholders play a crucial role in ensuring robust transition planning and disclosure by corporates in India. Table 17.1 outlines these stakeholders and their respective roles.

Table 17.1 Stakeholders Involved in Developing Transition Plan Ecosystem in India

Stakeholder	*Area of Influence*	*Why it is important*	*Current Efforts*
SEBI	Disclosure framework and guidance document	Capital market regulator SEBI is expected to standardise disclosure regulations for transition planning to prevent any greenwashing concerns, remove subjectivity in the level of ambition, and provide guidance to corporates to assist in the transition planning exercise.	SEBI does not require transition plan disclosure by regulated entities and has no guidance on transition planning for corporates.
	Linkage with other sustainability regulations	It is essential to link the BRSR disclosures on sustainability targets with the Green Debt Issuance Framework so that there are interlinkages between commitments of a corporate in issuing sustainable debt and its wider sustainability claims.	Currently, SEBI does not require sustainable debt issuance frameworks to explicitly link with the targets and claims made in Section B of the BRSR, which deals with specific commitments, goals and targets set by the entity, along with performance.
Ministry of Finance	Taxonomy regulation	A green or transition taxonomy is essential for corporates to communicate that their investments are aligned or misaligned with what is considered green/transitionary. It is particularly useful for companies in hard-to-abate sectors.	India does not have any official green taxonomy. SEBI's green debt security framework has green asset categories that act as a proxy for a taxonomy for corporate issuers.
Ministries of Different Sectors/Niti Aayog	Sectoral decarbonisation pathways	A transition plan involves creating short-, medium- or long-term (often decadal) roadmaps, that depend on macro-economic factors such as sectoral technological trajectories. Without such sectoral trajectories, it becomes difficult for corporates to create their own plans, which leads to lack of comparability.	Niti Aayog, in April 2024, had notified the formulation of inter-ministerial working groups to develop pathways for meeting national commitments on net zero. The Indian Ministry of Steel has come out with a roadmap for steel sector decarbonisation in India.[2]

(*Continued*)

Table 17.1 (Continued)

Stakeholder	*Area of Influence*	*Why it is important*	*Current Efforts*
Private Certification Agencies	Certification and assessment of transition plans	With transition plans being an emerging field in a rapidly evolving space, their quality and completeness will need to be independently assessed.	A few independent organisations, such as Assessing Corporate Transition (ACT) and the Climate Bonds Initiative (CBI), provide third-party verification of corporate transition plans globally. However, no standardised methodologies exist currently.
Financial sector regulators, including the RBI, the Insurance Regulatory Development Authority of India (IRDAI), and the Pension Fund Regulatory Development Authority (PFRDA)	Regulations directing capital provides such as banks, insurance companies and pension funds on transition planning and analysis.	A primary incentive for corporates to engage in transition planning and disclosure is to secure capital to transition. In India, this includes banking institutions and domestic institutional investors like insurers and pension funds. However, if these capital providers do not require the assessment of corporate transition plans or the creation of their own plans using corporate-provided information, the incentive is limited.	In February 2024, the RBI issued draft guidelines on 'disclosure framework on climate-related financial risks' for regulated entities, requiring them to assess and disclose these risks. This, in turn, will require corporate customers to provide relevant information to banks. However, similar measures by IRDAI or PFRDA are absent.

Source: Authors

17.5 Conclusion

Transition planning and disclosure practices are still developing globally, with several guidance and framework options emerging. As regulatory requirements for transition planning become established in some jurisdictions, best practices are expected to emerge over the next few years. Indian corporates must also integrate robust transition planning and disclosures into their corporate strategies. This integration will facilitate access to diverse capital sources, both foreign and domestic, as capital providers demand greater accountability from corporates on their decarbonisation commitments. The involvement of various stakeholders, such as regulators and policymakers, will be crucial in providing the necessary tools for corporate transition planning from an Indian perspective.

Notes

1 SBTi is an organisation that develop standards, tools and guidance which allow companies to set greenhouse gas (GHG) emissions reductions targets in line with what is needed to keep global heating below catastrophic levels and reach net-zero by 2050 at latest.
2 Ministry of Steel. Greening the Steel Sector in India Roadmap and Action Plan.

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18 Carbon Markets as a Necessary Element to Support Climate Financing in India

Pawan Mehra, Tarana Ahmad, Tanay Sawhney and Malaika Aggarwal

18.1 Carbon Markets as a Necessary Element to Support Climate Financing: Analysis of Global Markets and Relevance for India

Carbon markets are trading systems through which the reduction of carbon emissions are valued as carbon credits and these credits are bought and sold, and therefore generate a carbon price. One tradable carbon credit represents a reduction in emissions of one tonne of carbon dioxide (equivalent), or sequestered or avoided. Carbon markets can be of two types, compliance and voluntary. While compliance markets are the outcome of regulatory processes that set a limit on CO_2 emissions, voluntary markets are mechanism through which entities issue, buy and sell carbon credits on a voluntary basis, so as to offset their own emissions or benefit economically from their mitigation activity.

18.1.1 Contextualising the Size of Carbon Markets

Carbon markets today cover 25% of the manmade emissions. cKinetics (Mehra, 2022) estimates these markets to be generating over INR 984,000 Crore (USD 120 billion)[1] annually (in terms of value of carbon permits auctioned every year); and expects these markets to be bigger than the Natural gas market (INR 3,280,000 crore, USD 400 billion) by the end of the decade. They are also becoming an important source of revenue for the state, which shall be discussed later in this paper.

18.1.2 Decoupling Emissions from Economic Activity

When looking at overall CO_2 emissions throughout history, it is evident that the trajectory of increasing emissions follows that of a nation's economic growth. Of late, the growth of emissions, especially for the global north, has begun to stabilise and slow down. For the global south, however, it continues to rise with economic activity. CO_2 emissions are partly driven by carbon intensive growth strategies such as industrialisation. Therefore, a switch to (less carbon intensive) services driven growth witnessed by most of the global north over the last two decades would help decouple emissions from economic activity of these countries (Semieniuk et al., 2020). Another driver could be a switch away from fossil fuels and increased electrification. Within these two overall strategies carbon markets operate to aid the process of energy transition.

These markets are playing a role in decoupling emissions from economic activity. The EU Emissions Trading Scheme, which is the oldest carbon market (started in 2005), has enabled the EU to reduce its emission by about 21% across the economy and 30% for

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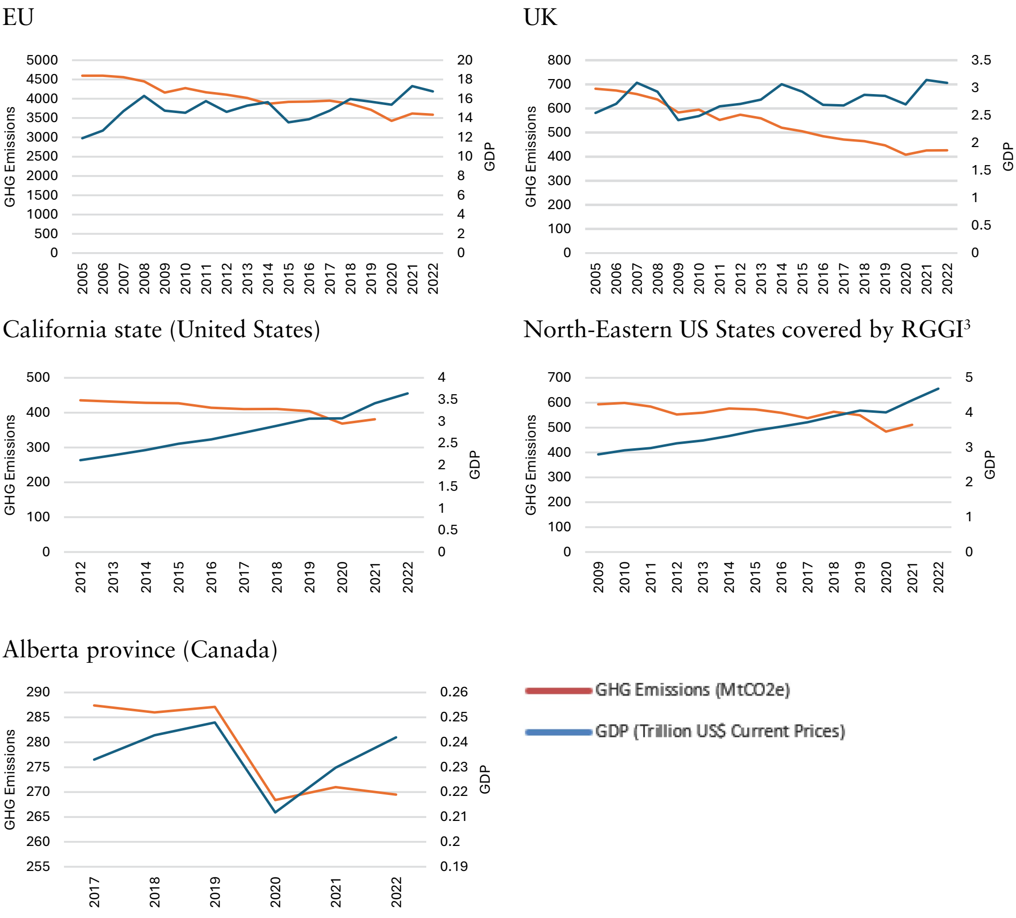
Table 18.1 Change in Emissions in Regions with an ETS from the Year the ETS Started Till the Most Recent Reporting Year

Region	*Sector*	*Emissions in the year the ETS started (Mt CO_2e)*	*Emissions in most recent reporting year (Mt CO_2e)*	*Change from programme start*	*Annualised change (rounded)*	*Emissions covered by the region's ETS*
EU						
	Electricity, heat generation	1,305	847	–35%	–3%	96%
	Oil Refineries	261	206	–21%	–1%	55%
	Industry	405	711	76%	3%	46%
	Others	2,625	1,851	–29%		
	Total	**4,597**	**3,615**	**–21%**	**–1%**	**37%**
UK						
	Power Generation	205	74	–64%	–3%	64%
	Industry	36	33	–7%	0%	95%
	Others	441	319	33%		
	Total	**681**	**426**	**–37%**	**–2%**	**25%**
California						
	Transportation	158	158	0%	0%	98%
	In state Electricity generation	82	35	–57%	–8%	85%
	Electricity imports	44	17	–61%	–9%	72%
	Refineries, Oil and Gas	39	32	–19%	–2%	100%
	Others	112	140	148%		
	Total	**436**	**381**	**–12%**	**–1%**	**74%**
North-Eastern US States with a power sector programme (RGGI)						
	Power Sector	121	81	–33%	–3%	100%
	Others	473	431	19%		
	Total	**594**	**512**	**–14%**	**–1%**	**16%**
China						
	Power Sector	5,862	5,936	1%	1%	79%
	Others	9,771	9,748	–1%		
	Total	**15,633**	**15,684**	**0.3%**	**0%**	**30%**
Alberta TIER						
	Oil and Gas	130	158	21%	1%	73%
	Agriculture	20	21	3%	0%	3%
	Manufacturing	20	22	8%	1%	92%
	Power Sector	49	19	–60%	–6%	100%
	Others	41	49	31%		
	Total	**261**	**269**	**3%**	**0%**	**59%**

Source: cKinetics' cCarbon platform; www.cCarbon.info

its target sectors[2] even as the EU GDP has grown at 1.5% per annum in the period (see Table 18.1). Similarly, the Western Climate Initiative (WCI) programme run in the US state of California, has enabled the state to reduce its emissions by over 12% (California Air Resources Board, 2022), while the state maintains its robust growth of 4.2% in that period. The same has been true of the other markets that have sufficient history. Even in the Canadian province of Alberta, emissions have started to decouple since its launch in 2018. Figure 18.1 represents a comparison of the emissions and economic activity measured as GDP for several regions of the global north. Figures 18.2 and 18.3 compare the same for India and China before and after the introduction of carbon markets in these countries.



Source: Authors

Figure 18.1 Overall Emissions ($MtCO_2e$) in the Region with Carbon Markets versus GDP (USD Trillion in Current Prices) since the Start of the Respective Programmes

(*Source:* cKinetics' cCarbon platform)[4]

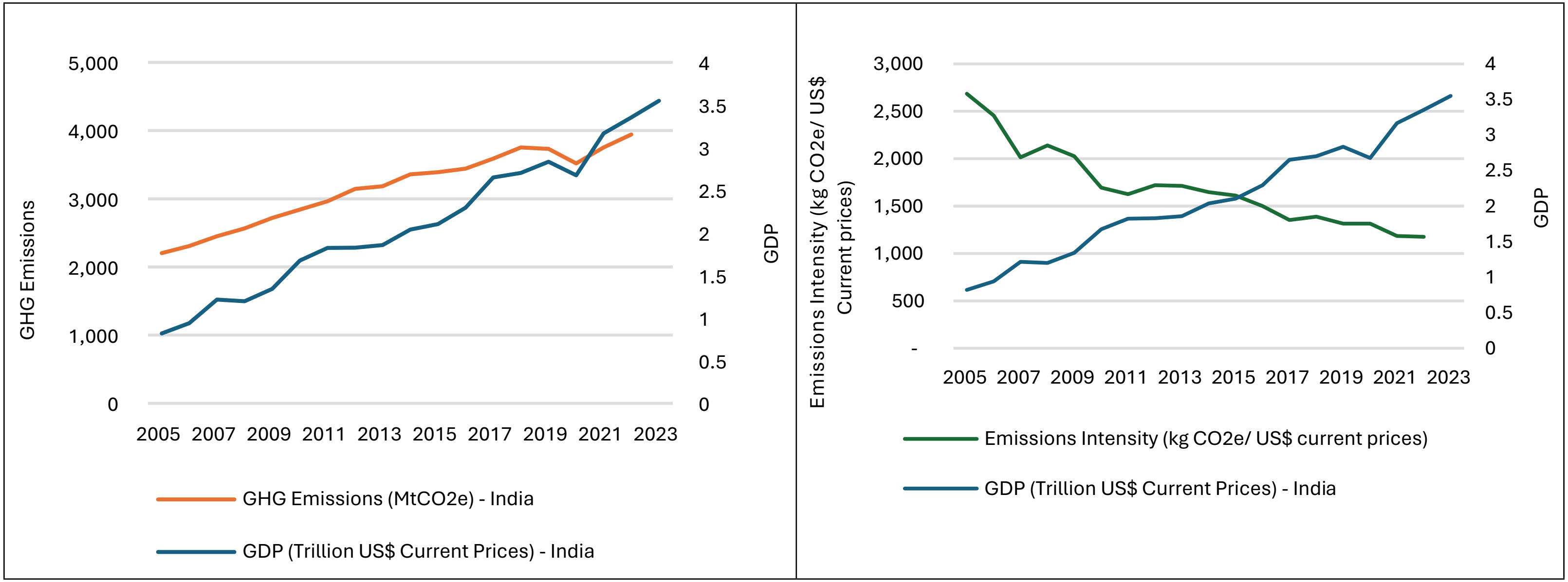


Figure 18.2 India Emissions versus GDP; and Emissions Intensity (cKinetics' ICCAD Platform)

Source: Authors. Data extracted from cKinetics' ICCAD platform; www.ICCAD.info

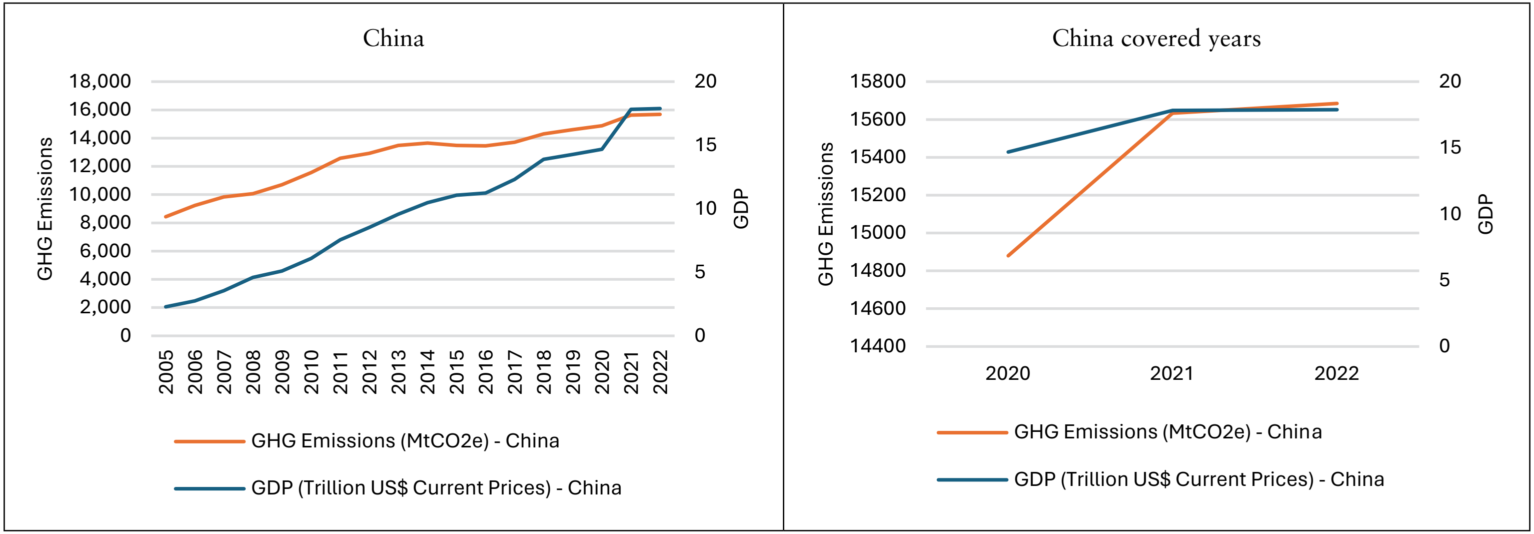


Figure 18.3 China's Emissions versus GDP since 2005 and since Programme Start in 2021

Source: cKinetics' cCarbon platform; www.cCarbon.info

India's economy which has been rapidly growing has witnessed some service driven growth, leading to a slower growth of emissions as compared to GDP growth. As GDP has grown, emissions intensity has fallen in the last 20 years.

China recently adopted a national carbon trading scheme for the power sector, which covers nearly 30% of the country's emission. While China's carbon intensity per unit GDP has also been decreasing over time from 3688 kg CO_2e/USD (current prices) in 2005 to 877 kg CO_2e/USD (current prices) in 2022, the question remains on how the new Emissions Trading Scheme (ETS) can accelerate that divergence. This is not easy, given that China has emerged as the manufacturing headquarters of the world, and manufacturing is carbon intensive.

18.1.3 Different Sectors Have Had Different Responses

Expectedly, different sectors in the economies depicted in Figures 18.1 and 18.3 have developed differently in the last few years. Table 18.1 summarises the sector-wise change in emissions between the period that the Emissions Trading Scheme (ETS) started till the most recent reporting year. It is important to note that an ETS may not cover entire sectors or the entire economy. For instance, the EU ETS covers only 37% of the EU's current emissions, whereas for California the number is 74% even as it is an economy-wide programme.

Data shows that in all regions that have had an ETS for long enough, there is a reduction in emissions. The power sector has seen the most reduction in emissions with the rise of renewable energy over the last two decades. There are also impacts on other sectors that are covered by the ETS and it is worth noting that not all the changes can be attributed to an operating ETS since these regions also have several complementary policies that are supporting emission reductions (which will get covered in Section 18.1.3.4).

18.1.3.1 Electricity Has Been Most Responsive on Emissions in Most Jurisdictions

As mentioned earlier, in all regions with an ETS, the electricity sector has seen the fastest decoupling, with an increase in renewables. *The presence of an ETS has also helped phase out fossil fuel sources of electricity, since the price of carbon is only borne by coal and natural gas electricity generators, providing an additional cost advantage for renewable energy producers.* Figure 18.4 demonstrates how the decoupling between electricity generation and electricity emissions has accelerated once an ETS has come into force for each of the economies studied.

The cost of carbon translates into roughly 3% – 10% of retail electricity price at current carbon prices and current average retail electricity prices (see Table 18.2). In other words, an electricity provider that procures electricity from fossil sources will have a margin that is lower by 3% – 10% as compared with renewable energy based electricity generators. These costs cannot be passed on to the consumer because of a competitive market with other electricity generators. Even in highly regulated power markets like California, users are given a rebate to the extent of the carbon price paid by the electricity utility. Hence carbon markets are helping accelerate the energy transition, by promoting cleaner sources of power and at the same time influencing investment decisions in fossil generation systems.

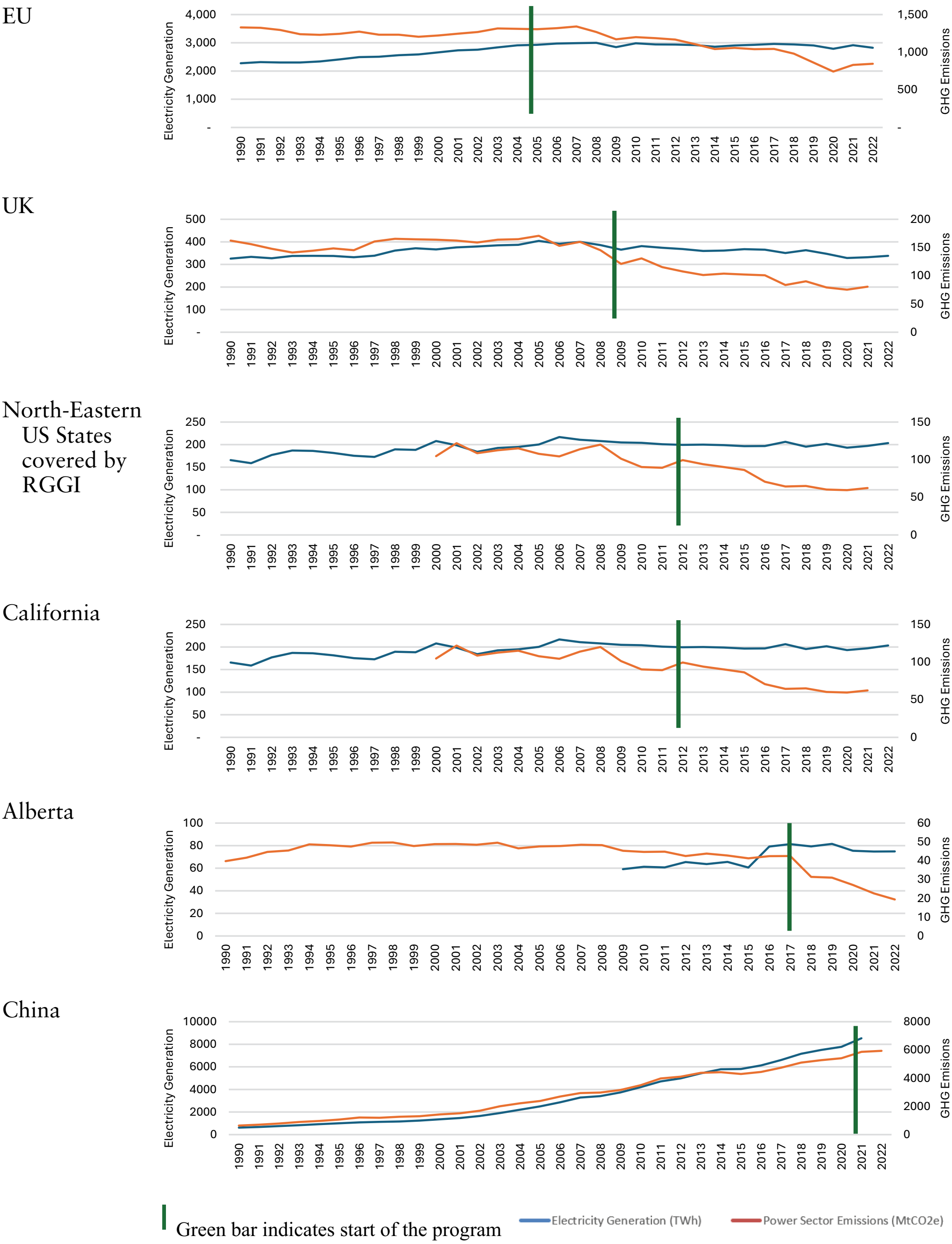


Figure 18.4 Electricity Generation versus Emissions Overlaid with the Start-year of the ETS in the Region

Source: Authors

Table 18.2 Carbon Price as a Percentage of Average Prevailing Retail Electricity Prices

Country/ programme	*Cost of carbon (USD/Ton)*	*Cost of carbon per unit of electricity*		
		Carbon equivalent in USD/kWh	*Retail Electricity Price (USD/kWh)*	*Carbon cost as %age of average retail electricity*
EU ETS	92.29	0.0276	0.28	9.9%
UK ETS	53.78	0.0111	0.28	3.9%
WCI – California	33.28	0.0069	0.22	3.1%
RGGI	24.72	0.0101	0.17	5.9%
China ETS	9.62	0.0058	0.12	4.8%

Source: cKinetics' cCarbon platform; www.cCarbon.info

Table 18.3 Price Rises in Older ETS that Will Open Up Decarbonisation Options

Market	*Carbon price (USD/ton)*		
	2015	*Current*	*2030 likely case range*
EU ETS	8.79	92.29	130–160
UK ETS	8.79	53.78	100–115
WCI (California and Quebec)	13.25	33.28	120–140
North-Eastern US States covered by RGGI	5.41	24.72	35–45

Source: cKinetics' cCarbon platform; www.cCarbon.info

18.1.3.2 Impact on Transportation Has Been Limited

Since emissions from the power sector have come down, transportation has emerged as the single largest source of emissions in most of the economies studied. Transportation emissions have not reduced so far. California is the only region that has transportation emissions covered by its ETS. The EU will begin covering transportation under the EU ETS2 that will go into effect later this decade.

Transportation emission reductions are expected in the next decade as electric vehicles become an increasing part of the stock of vehicles on the road. These regions have goals for 100% electric vehicle sales: EU, UK and California are aiming for light vehicle sales to be 100% electric by 2035. But road emissions will last through mid-century as fossil fuel vehicles phase out. The role of the ETS in accelerating this transition remains to be seen.

18.1.3.3 Carbon prices are Rising and Impact on Other Sectors Expected in the Next Decade

Carbon prices in all the ETS programmes covered in this chapter have risen over the last decade. The price signal generated by the ETS has influenced the positive reductions in emissions for other sectors as described in Table 18.1. cKinetics' cCarbon platform has modelled prices in these markets till 2045 and all these markets are expected to see an increase in price. Table 18.3 outlines price range expectations for 2030 for these economies given current legislation. These prices are expected to unlock decarbonisation in sectors like natural gas, buildings, refineries, aviation and maritime. On the energy supply side, the higher carbon prices will keep accelerating renewables (along with storage) and bring in net-generation renewable/clean fuels. And on the demand side, it will create the case for greater electrification through heat-pumps industry, process changes and faster transition to non-fossil modes of transportation.

18.1.3.4 ETS working in Conjunction with Complementary Policies

As outlined earlier, the ETS does not operate in isolation in these regions. At the time that the ETS went live in these regions, there were also fiscal measures, budgetary allocations and additional legislation targeted to reduce emissions. Table 18.4 summarises some of the key complementary policies that support the emission reduction goals in addition to the ETS. This is to say that from a policy perspective, the ETS ought to be seen as a tool that operates in alignment with one or more other interventions, depending on the sector where the effect is sought.

18.1.4 It takes 3+ years for a Carbon Market to Have an Impact

Once a carbon market goes into effect, it takes time for it to have an impact. There is a 'lag-effect': between the time that a carbon market is set-up and the time when emission reductions begin to be seen in response to that. Figures 18.5 and 18.6 demonstrate this, by normalising the emission levels to 100 units of the key emitting markets at the start of an ETS and tracking their progress.

We observe that emissions remain largely unaffected in the first 3 to 5 years after the programme starts. Indeed, in the case of the EU and UK, emissions actually rose for the sectors covered in the early years. And after that emissions reduce: both in the sectors targeted as well as economy-wide.

The lag-effect can be attributed to (a) time for the regulations to be seen as stable, (b) complementary policies to come into effect, and (c) a suitable price signal in response, that can be incorporated by the market.

It is worth noting that all these markets were designed such that the programme was lenient in the early years. This was done to allow the covered entities to incorporate the programme into their operations. At the same time, players were also allowed to accumulate a 'bank of credits' which enabled robust trading and price discovery subsequently. Even as the programme was lenient in the beginning, the targets and goals were set such that reductions expected in subsequent years were ambitious. This also contributed (and continues to contribute to) an expectation of a future higher prices: which then influences investment decisions related to emission reduction.

Figure 18.6 tracks sector-wide emissions before and after the enactment of the ETS, with a comparable baseline for all programmes. The rate of reductions in emissions in all cases accelerated after the enactment of the ETS, which is also accompanied by other complementary policies at the time. For China, where the ETS went into effect in 2021, the impact is yet to be seen and early indication is that its rise in emissions has slowed down (halted perhaps?).

Table 18.4 Complementary Policies Operating Alongside the ETS

		Fiscal measures	*Budgetary allocations and monetary measures*	*Legislation targeted at the sector*	*Other measures*	*Key complementary policies*
EU	Electricity and heat generation	Y	Y	Y	Y	European Green Deal, Fit for 55 Package, Renewable Energy Directive, Transport and Mobility Policies
	Oil Refineries		Y	Y	Y	
	Industry		Y	Y	Y	Energy Efficiency Directive, Zero Pollution Action Plan
	Others		Y	Y	Y	
UK	Power Generation			Y		Clean Air strategy, Green finance, EV strategy
	Industry			Y		
	Others	Y	Y	Y	Y	
California	Transportation		Y	Y		Low-Carbon Fuels Standard, Advanced Clean Trucks, Advanced Clean Fleets
	Natural Gas		Y			RNG in pipeline
	Electricity		Y	Y	Y	Renewable Portfolio Standard
	Refineries					
	Oil and Gas production			Y		
	Cement			Y		Cement neutrality (SB 596)
	Cogeneration			Y		
	Others			Y	Y	
RGGI						
	Power Sector	Y	Y	Y	Y	Renewable portfolio standards
China	Power Sector			Y	Y	Renewable energy development, air pollution action plan

Source: Authors

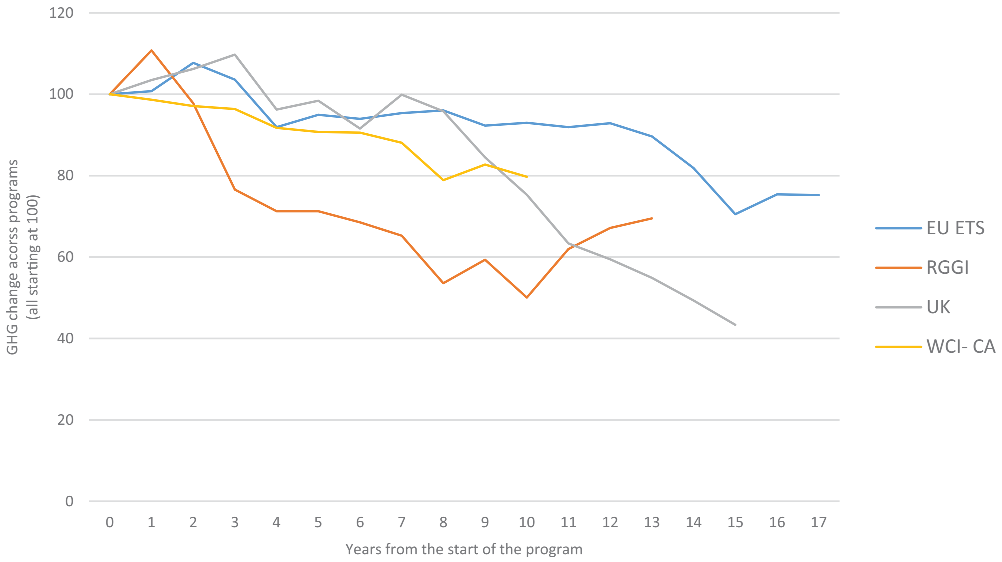


Figure 18.5 Change in Covered (Regulated) Emissions in Regions with an ETS from the Start Year of the Programme

Source: cKinetics' cCarbon platform; www.cCarbon.info

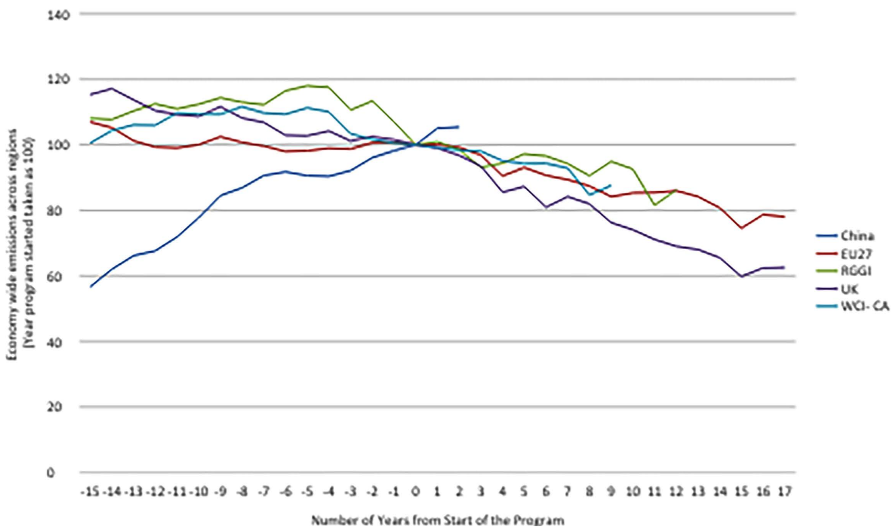


Figure 18.6 Change in Economy-Wide Emissions in Regions: Before and After Enactment of the ETS

Source: cKinetics' cCarbon platform; www.cCarbon.info

18.1.5 Using Proceeds from Carbon Markets for Climate Financing

Carbon markets are becoming an important source of finance for the regions they operate in. The EU has generated over 100 billion Euros for climate change and energy purposes (European Environment Agency, 2023). Similarly, California has generated over USD 24 billion, as of July 2023 (California Climate Investments, n.d.a). that it channels into its Greenhouse Gas Reduction Fund (GGRF). This is becoming an important tool in the policy-maker kit, since it also helps fill in the fiscal gap caused by future declines in fossil-fuel-linked revenue. These funds are subsequently allocated to specific agencies and programmes committed to particular agendas.

As they have matured, revenues from carbon markets have increased, as is evident in Table 18.5.

The funds raised from these markets have been deployed by the respective jurisdictions largely in areas related to climate and decarbonisation. For EU ETS, the largest carbon market by value, an average of 76% of revenues were spent for climate and energy purposes (European Environment Agency, 2023). About 25% of member state revenues are earmarked for specific climate and energy actions, while 27% went into dedicated environmental funds and 48% went to national budgets. EU also invests a small portion (around EUR200 million per year) of the carbon market revenues for projects at the international level – mostly benefiting developing countries via multilateral funds and institutions for climate change and energy purposes. In 2023, EU made it mandatory for the member states to spend at least 50% of auctioning revenues and 100% of aviation allowance revenues for climate- and energy-related purposes.

Climate adaptation, decarbonisation and energy-efficiency-related areas account for 50% of the fund (generated from its carbon markets) allocation for California, of which 26% is allocated to decarbonisation of the transportation sector, with a focus on mass transit, low-carbon transit, clean mobility, electric vehicles and so on. The state has also used the funds received to promote energy efficiency and renewable energy for households and businesses. It has done so through direct assistance programmes. (California Climate Investments, n.d.b).

Figure 18.7 outlines the variety of ways different jurisdictions have chosen to spend proceeds from their carbon markets.

18.2 India's Carbon Credit Trading Scheme (CCTS)

In 2023, the Government of India announced the development of the Indian Carbon Market (ICM) (PIB, 2024; BEE India, 2023), which builds on the Energy Conservation (Amendment) Bill, 2022. The Bureau of Energy Efficiency (BEE) along with the Ministry of Environment, Forest and Climate Change (MoEFCC) are building out the Carbon Credit Trading Scheme (CCTS). The programme is expected to be designed with intensity-based targets. That would mean that it will set sector or entity-level targets on emissions intensity (goals related to emissions per unit of activity).

The current design entails setting intensity goals per units of energy – grams of CO_2e/kCal or tons CO_2e/ton of oil equivalent across all fuel used by an obligated entity. The CCTS aims to build on the institutional reporting and verification capacity created by the Perform Achieve Trade (PAT) scheme.

Table 18.5 Funds Raised by the Region's Respective ETS

Start year	*Region/Programme*	*2023*	*2022*	*2021*	*2020*	*2019*	*2018*	*2017*	*2016*	*2015*	*2014*	*2013*
	North America											
2012	California (USD million)	5133	4013	4501	2624	2106	3207	2913	892	1829	1491	477
2013	Quebec (CAD million)	1419	1338	1126	690	968	831	618	456	830	112	29
2018	Alberta (CAD million)		864	504	548	476	533	94				
2009	RGGI (USD million)	1265	1194	926	416	284	239	198	266	436	367	448
	EU & UK											
2005	EU ETS (Euro Billion)		29.71	24.95	14.38	14.12	12.57	4.92	3.37	4.35	2.77	3.14
2021	UK ETS (GBP million)	4203	6134	4310	2691	NA	1621	609	424	586	402	410

Source: cKinetics' cCarbon platform; www.cCarbon.info

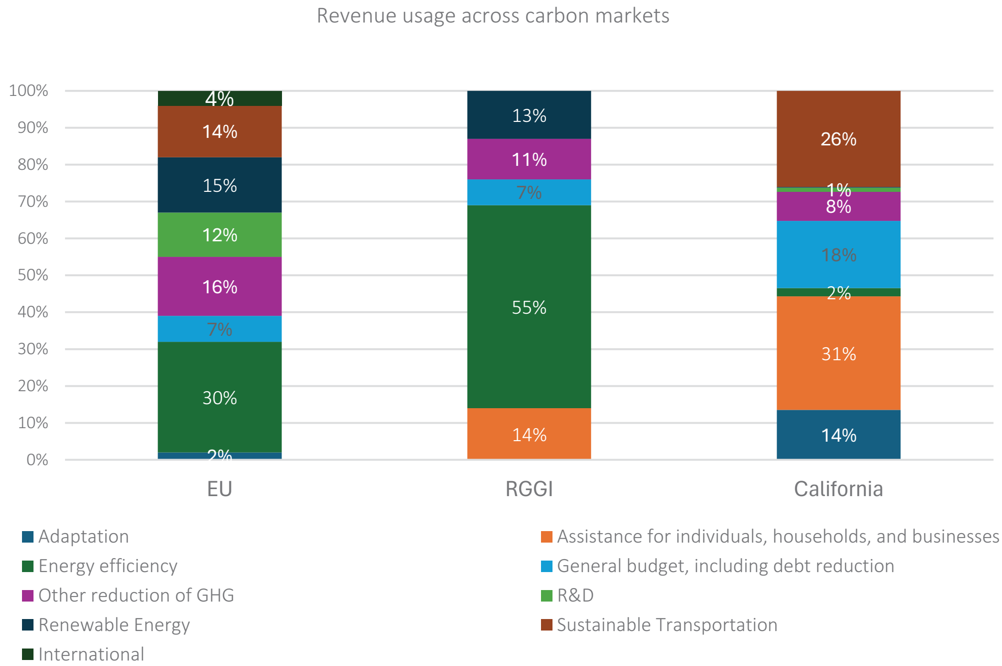


Figure 18.7 Utilisation of Funds Raised from Carbon Markets in Different Jurisdictions
Source: cKinetics' cCarbon platform; www.cCarbon.info

Based on the most recent notification (Bureau of Energy Efficiency, n.d.), the initial targeted sectors where companies are expected to be notified are:

1. Aluminium
2. Cement
3. Chlor-Alkali
4. Fertiliser
5. Iron and Steel
6. Pulp and Paper
7. Textile
8. Petrochemicals
9. Petroleum Refinery

The authors have calculated that the obligated entities in these sectors will cover approximately 30% of India's emissions.

Over the last decade, the Perform Achieve Trade (PAT) and the Renewable Energy Certificates (RECs) schemes have been run in India. They have created institutional capacity and processes for recording, reporting and verification, all of which are necessary in a carbon market.

18.2.1 Implied Carbon Prices in India at Present

Indian RECs and Indian ESCerts (instruments from the PAT scheme) have prices of INR 745 per MWh and INR 1840 per ton of oil equivalent (toe), representing a carbon price of INR 943 per ton CO_2e and INR 613 per ton CO_2e (ICCAD, 2023), respectively. These prices are comparable to prices in carbon markets in China, but may not be high enough to influence business choices. Meaningful emission mitigation reduction by businesses has been observed once prices cross a USD 25–35/ton CO_2e threshold (INR 2000–2800/ton CO_2e) (IMF, 2019). This unlocks the viability of emission reduction technologies in some sectors.

At the same time, the volume of trade in RECs and ESCerts is limited, which prevents investors to come in and bring liquidity to these instruments. This in-turn reduces the incentives for obligated entities to see these instruments as a means to finance their emission reduction projects. Imagine for instance, highly liquid ESCerts with some projections on prices and volume for the next 10–15 years. In such a case, an obligated entity may be able to get projects financed based solely on the ESCerts. As the ICM gets rolled out, efforts ought to be made to make the carbon instruments liquid that in-turn bring in carbon investors.

18.2.2 Implication on Design of the CCTS and Possible Climate Finance Revenues

As India implements its ICM, there are a few issues to keep in mind, based on past global experiences.

Lag effect: Given that the CCTS is expected to launch in 2026, its earliest impact would be seen in 3 to 5 years thence (i.e. between 2029 and 2031).

Target setting: The CCTS may start with lenient targets as has happened in other regions, allowing the regulated entities to accumulate an initial bank of credits. However, it should set aggressive targets if it is to see an impact and generate a strong price signal (as well as credibility). These targets may vary by sector but ought to be in-line or greater than the country's stated goal of net-zero by 2070. From a carbon intensity that could mean a 2.2% reduction from a baseline every year from 2026 onwards.

Moreover, the targets should be predictable and known several years into the future. At present the CCTS envisages goals to be set in 3 year windows. A long-term framework that is transparent will allow long-term planning for capital expenditure planning. Table 18.6 summarises the goal setting horizon and revision frequencies of established global carbon markets.

Table 18.6 Horizon of Goal Setting and Frequency of Compliance in Different Carbon Markets

Region/programme	*Horizon of goal setting*	*Frequency of surrendering compliance instruments*
EU ETS	Defined till 2030. Detailing underway for post 2030; 2050 goal set.	Annual verification. Annual surrender.
UK ETS	Defined till 2035.2050 goals set.	Annual verification. Annual surrender.
California WCI Quebec WCI	Currently till 2030. Being revised to 2045 at present	Annual verification. Partially surrender every year; and complete settlement every 3 years
Alberta TIER	Currently till 2030	Annual verification. Annual surrender.
RGGI	Currently till 2030. Programme review underway for longer-term goals.	Annual verification. Partially surrender every year; and complete settlement every 3 years

Source: Authors

Generate state revenue and promote investments: The CCTS can also be configured to generate revenue for the state and promote investments beyond the obligated entities. This can be done by adding two features:

a. The first is to create 'National Clean Credits' (NCC) that are issued by either BEE of MoEFCC. These credits can be used by the obligated entity to meet their compliance requirements if there aren't sufficient credits available in the market. The NCC can be made available at pre-defined prices that the state may set as the price of carbon.

   The Canadian province, Alberta, which has also been designed with intensity-based goals has a similar feature (Alberta Government, n.d.a). Obligated entities can purchase fund credits from the Technology Innovation and Emission Reduction (TIER) fund, where the prices are currently CAD 80/ton CO_2e (USD 58) and rise CAD 15/ton CO_2e (USD 11) every year (Alberta Government, n.d.b). These fund credits have generated CAD 3 billion (USD 2.1 billion) for the state over the last 5 years as outlined in Table 18.5.

   If India were to have a NCC, and priced it at a minimum of USD 25 per ton (that rises at some pre-determined rate annually), then a rough estimate would be that USD 455 million could be generated annually as revenue for climate finance. The underlying assumption here is as follows: The ICM sets a 2.5% annual reduction goal on emission intensity from the current baseline for firms. Based on past performance, companies are able to meet 3–5% emissions intensity reduction targets, and, therefore, will not need to tap into the fund for the first two years. However, from the third year onwards, firms may see the NCC as a valuable option to meet their compliance requirements. Assuming that obligated entities tap into the NCC to meet 1% of the shortfall, that would translate to USD 455 million given that obligated entities would have about 1820 million tons CO_2e of emissions (65% of India's current emissions).
b. The second is to allow obligated entities to meet their compliance needs by buying offsets from India's Voluntary Carbon Market. This can be limited to a certain extent of the compliance requirement or may be left unlimited as well (see Table 18.7 for allowances in other ETS). This would enable liquidity and support for measures that MoEFCC or BEE may want to get funded outside the covered entities. Examples that offsets can support include waste heat recovery, landfill gas capture, carbon dioxide capture, energy efficiency energy service companies, etc. that are outside the boundaries of the obligated entities.

18.2.3 The Power Sector

A key difference of the ICM with the prevalent ETS of other regions, is the exclusion of the power sector in the former. In other regions covered by ETS, the electricity sector has been the first to decarbonise. However, given that the power sector is currently outside the purview of the CCTS, the electricity consumed by entities in the covered sectors will likely decarbonise first. In other words, entities will show a preference for renewables/clean energy in their operations. Additionally, given that the power sector is not covered by the CCTS, the prices will have to cross a threshold of USD 30/ton

Table 18.7 Examples of ETS that Allow Compliance Obligations to be Met by Using Offsets: Promoting Activity beyond the Boundary of Obligated Entities

Region/programme	*Offsets allowed*	*Illustrative project types (have to be approved by the jurisdiction)*
California WCI	Upto 6% of the obligated entity's emissions with at least 50% to be sourced from within California	US forest projects, mine methane capture, livestock projects, ozone depleting substances
Quebec WCI	Upto 8% of the obligated entity's emissions	Afforestation/reforestation on private lands, methane from landfill sites, livestock projects
Alberta TIER	Upto 70% currently and rises to upto 90% by 2026. All offsets must be generated in Alberta	Wind power, Enhanced oil recovery, waste to energy, Waste heat recovery, Carbon dioxide capture
RGGI	Upto 3.3% of obligated entity's emission. Projects must be within RGGI states	Reforestation, Improved forest management, avoided methane from agriculture manure operations
UK ETS, EU ETS	Not allowed	

Source: Authors

(INR 2400 per ton CO_2e), to unlock decarbonisation projects in the rest of the sectors (Alberta Government, n.d.a).

18.3 Conclusion: CCTS can Enable Carbon Price Discovery and Support Climate Financing

India is ranked as the fifth-largest economy today and is expected to continue its growth over the next few decades. While continuing to grow, its emissions intensity has come down, primarily because growth has been service sector driven along with some successful energy efficiency interventions.

We propose that carbon markets can support an economy's emissions reduction strategy and demonstrate this for regions with relatively mature and active carbon markets such as the EU, some states in USA, Alberta province in Canada and China. We then discuss the expected outcomes of the ICM.

India's CCTS is expected to go live in 2026 and can play a key role in accelerating its emissions reduction strategy. It can do so by providing a robust carbon price signal that in-turn promotes investment (and attracts investors) in long-term decarbonisation projects. It can potentially also create a revenue stream for the Indian state, by offering an alternative of a NCC to obligated entities. Should the targets be stringent enough, the NCC could generate USD 210 million per annum by the end of this decade. These funds can be used by the state to meet a variety of its priorities ranging from adaptation, to accelerating decarbonisation, to innovation and so on.

The CCTS would work best along with complementary policies in the sectors being targeted. To that end, the fact that BEE and MoEFCC are both engaged in the roll out is advantageous from a coordination standpoint.

Box 18.1 Leveraging Article 6 (of Paris Agreement) for Industry Decarbonisation

Yash Kashyap and Saarthak Khurana

Article 6 of the Paris Agreement enables voluntary international cooperation among countries for the implementation of NDCs via both market based mechanisms (MBMs) (paragraphs 6.2–6.3 and 6.4–6.7) and non-market approaches (NMAs) (paragraphs 6.8–6.9). Through Article 6, developed countries can provide developing countries with low-cost finance and non-financial assistance for climate action, in exchange for a claim on the resulting outcomes (including potential financial returns). Relevant paragraphs under Article 6 cover the following:

Article 6.2–6.3 establishes bi-lateral cooperative approaches, which involve the use of internationally transferred mitigation outcomes (ITMOs) – GHG abatement and other mitigation co-benefits. One country (buying the ITMOs) can finance mitigation programmes and projects in another country (host), provided that the financed activities are beyond the scope of (additional to) the host country's planned activities for implementing its NDCs. The ITMOs would count towards the buying country's NDCs, and therefore, need to be correspondingly adjusted in the host country's GHG inventory to avoid double counting (i.e., the transferring country gives up the claim on the MOs). Alternatively, the transferring country could retain a share of the ITMOs to contribute towards its own NDCs, while the rest can be transferred to the buying country. These paragraphs provide a guidance framework for the transfer of ITMOs between Parties.

Article 6.4–6.7 provide the basis for *replacement of the Clean Development Mechanism (CDM),* established under the Kyoto Protocol, by a centralised UN-governed international market mechanism for trading carbon credits, under the supervision of the Conference of Parties. This multi-lateral mechanism effectively established an international carbon market for trading of emissions reductions. *Hundreds of requests are being processed for transition of existing CDM projects to Article 6.4, including 441 projects and programmes from India (UNEP, 2024).* Activities eligible for the transition could potentially generate emissions savings of up to 900 $MtCO_2eq$.

Article 6.8–6.9 provides a framework for use of NMAs to achieve NDCs through mitigation, adaptation, finance, technology development and transfer, capacity building, etc.

Art. 6.4 is being operationalised at COP29. Meanwhile, *Art. 6.2 and 6.8 present near-term opportunities for India* to engage in cooperative approaches for structuring of mechanisms to get access to, and facilitate financing for, innovative technologies and leapfrog in technological change for decarbonising hard-to-abate sectors. These are discussed next.

Article 6.2

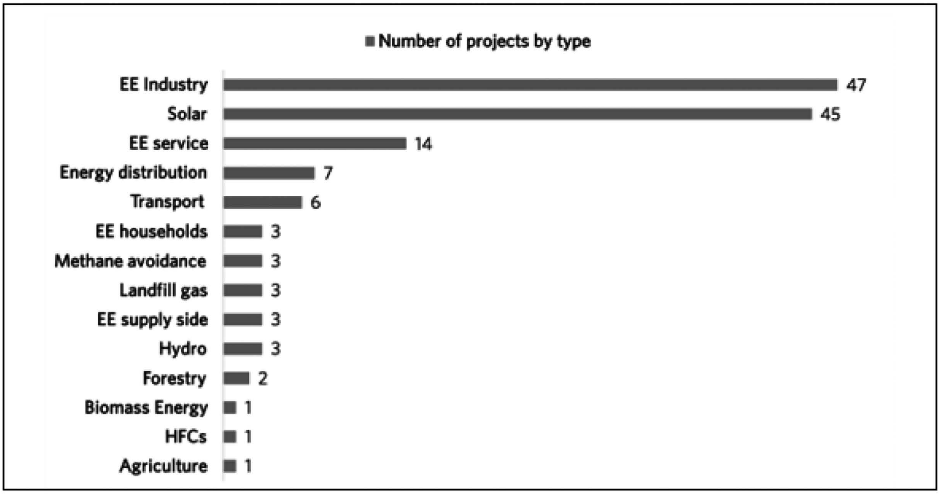
The scope of activities eligible for generation of ITMOs are broad, including programmes, projects, policy-based interventions and linking of carbon markets (guidance on Art. 6.2 activities can be accessed via. the Mitigation Action Assessment

Protocol Tool). The ITMOs generated can be measured in tCO_2eq. or any other non-GHG metric (such as renewable electricity generation), depending on the metrics used to define the partnering countries' NDCs. Both the type of activity, and the metric for measuring MOs needs to be agreed bilaterally between participating countries.

Carbon revenues obtained from sale of ITMOs can help reduce the viability gap of projects, improve the risk return profile, and catalyse private sector investments in emerging technology projects ('high-hanging fruits') in EMDEs. Governments (of host countries) could also retain a share of the revenues from transfer of ITMOs, which can be reinvested towards implementation of NDCs. However, carbon revenues may not be enough to completely cover the viability gap or to sufficiently de-risk the projects (GIZ, 2021). Therefore, other low-cost financing instruments, revenue sources (such as green premiums) and de-risking measures (such as guarantees) may be required. Moreover, developed (buying) countries may not find it desirable to simply purchase ITMOs, and developing (host) countries may not have the requisite technological solutions, digital infrastructure, institutional capabilities and regulatory framework to generate and sell the credits. Alternatives to direct purchase could be devised to overcome these issues. One study suggests a 'project investment' approach, where the financing country makes low-cost investments in projects (using a variety of financing instruments, including grants) and receive credits for a proportion of the associated emissions reductions, alongside a financial return (Sandler and Schrag, 2022).

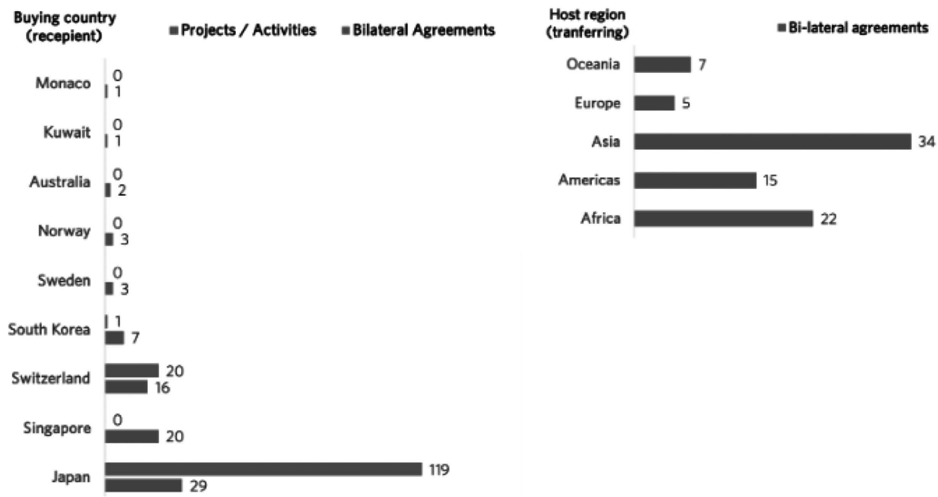
Historically, MBMs have attracted criticism in relation to the calculation of accurate baselines, additionality, double counting, and carbon leakage. Art. 6 aims to address several of these concerns. *Currently, the accounting rules, registries, and transfer and reporting mechanisms are being set-up by countries.* Given its

Number of *Bi-lateral* Projects by Target *Sector*



Source: UNEP (2024)

Number of Bi-lateral Agreements and Projects/Activities by Buying Country (Left) and Host Region (Right)



Source: UNEP (2024)

complex transnational nature, the operationalisation of this article is still at an early stage – *issues related to the scope of activities, transparency, governance, accounting methodology, monitoring, and reporting need to be addressed*. Nevertheless, progress is being made. As of July 2024, *83 bilateral agreements had been signed under Article 6.2 between 10 buying countries and 46 host countries, covering 140 mitigation projects/activities in various sectors (see Figure)*. The largest number of projects belong to industrial energy efficiency sector, followed by solar (see Figure). Japan and Switzerland have the most active participation as the 'buying' countries, together accounting for bulk of the agreements and projects. Most of these projects are hosted by countries in Asia and Africa. Figures show the number of agreements and projects by buying countries and host regions.

Way forward

While some countries have already initiated collaboration based on principles set out under Art. 6.2, India's participation in Article 6 mechanisms has been limited so far, mainly to the transition of CDM projects to the new Art. 6.4 mechanism. India needs to consider and take strategic actions to utilise the potential of Art. 6.2, especially in the context of adaptation and mitigation activities in hard-to-abate sectors. In 2023, India notified a list of activities to be considered for trading of carbon credits under bi-lateral approaches set out under Art. 6.2. These activities are listed in Table.

Going forward, the following steps would need to be taken (some of which may have already been executed) to implement activities under Art. 6.2:

List of Activities Considered under Article 6.2 by India
GHG Mitigation
RE with storage (only storage component)
Solar thermal power
Off-shore wind
Green hydrogen
Compressed bio-gas
Emerging mobility solutions like fuel cells
High end technology for energy efficiency
Sustainable aviation fuel
Best available technologies for hard-to-abate sectors
Tidal and ocean energy
High voltage direct current transmission in conjugation with RE projects
Alternate Materials
Green ammonia
Carbon removal
Carbon capture, utilisation and storage

Source: MoEFCC (2023)

- *Develop the institutional and regulatory framework* for Art. 6.2, including:
  - o Arrangements for tracking and authorising the use of ITMOs towards NDCs.
  - o National registry for accounting of ITMOs and for monitoring actions related to them (such as authorisation, transfer, acquisition and use).
  - o Appointment of an entity for long-term oversight including strategy, monitoring implementation, coordination across ministries, etc. (MoEFCC has been appointed).
  - o Integration with other national policies and regulatory frameworks.
- *Prepare a strategy for participation in Art. 6.2*, including:
  - o Identify sectors to be targeted, type of activities in these sectors and the specific programmes/projects that are additional to NDCs and requiring international support (notified, see box above).
  - o Set baseline/reference emissions level, at least for the target sectors, along with emissions reduction accounting methodologies (already available through UNFCCC and other independent carbon crediting programmes). The reference must include the existing policies and measures in place to achieve NDCs, thereby ensuring additionality of Art. 6.2 activities beyond the NDCs.
  - o Set medium- and long-term targets for the type and number of MOs the government intends to transfer.
  - o Public disclosure of the strategy to build confidence of donor countries, government agencies and the private sector.
  - o Continuous stakeholder engagement to identify the opportunities within the target sectors
- Once a strategy is in place, India and its partnering countries need to agree upon and define the requirements for an Art. 6.2 activity design, implementation and verification of data for issuance and authorisation of ITMOs.

Japan and Switzerland, countries with the highest number of Art. 6.2 agreements, would be ideal candidates as partnering countries for initiating implementation of Art. 6.2 projects in the country. India has good relations and existing bi-lateral ties with these nations, and both these countries have substantial experience in implementing Art. 6 projects (Japan's Joint Crediting Mechanism, or JCM, has been operational since 2013, even before the Paris Agreement).

Article 6.8

Under Art. 6.8, countries can adopt NMAs to implement mitigation and adaptation activities, encourage participation of a wide range of stakeholders and encourage coordination in policies and regulations. NMAs could be used to complement and increase the effectiveness of MBMs. While the scope of NMAs is still rather unclear, among other things, they may include the following (Anderson, 2022)

- Coordination in setting regulations (e.g., technological standards);
- Joint research and development programmes;
- Capacity building programmes;
- Low-cost technology transfer;
- Use of economic and fiscal instruments

While MBMs have received the most attention over the years, capacity-building and technical support programmes are being developed, with implementation support from multilateral institutions. As per UNEP data, there are *34 capacity building projects/programmes and technical support projects/programmes* linked with Art. 6, of which 27 are currently running, while others have concluded (UNEP, 2024). Most of these activities are being *funded by* developed countries (Germany, Sweden, Norway, Switzerland, Japan, Spain, UK etc.), MDBs (World Bank, EBRD, ADB, IDB, etc.), and philanthropies; and *implemented by* the UN, bi-lateral and multi-lateral organisations, and government agencies (such as the World Bank, GIZ, EBRD, GGGI, etc.). India is part of only two of these activities, both related to knowledge exchange and development of carbon markets.

Art. 6.8 gained momentum at the COP26 in Glasgow, in 2021, where broad areas for NMAs were identified. After COP 27, the Art. 6.8 went into the implementation phase. Currently, the work programmes created for implementation of the Art. 6.8 mechanism are working towards studying case study examples to replicate the *best practice, guidelines, procedures and safeguards of past NMAs*, and to create a UNFCCC administered *web-based platform* to integrate existing NMAs, develop new NMA projects and facilitate engagement between stakeholders. India can aim to leverage the web-based platform to highlight its projects and programmes, thereby garnering international interest in climate change mitigation and adaptation projects (that may also target broader sustainable development goals) sponsored by both the public and private sector. Movement on Art. 6.8 has been slow, and it is still early days, but once established, this mechanism can provide significant boost to climate action in the developing world.

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Notes

1 Conversion rate taken in this document: 1 USD= 82 INR
2 Emission trading schemes target regulated emitters over a certain threshold and these are always smaller than the overall emissions from the sector (or economy, as the case may be). Refer table 18.1 for changes in emissions.
3 Regional Greenhouse Gas Initiative.
4 Data extracted from cKinetics' cCarbon platform www.cCarbon.info

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19 Financing India's Green Grid

Overcoming Challenges and Unlocking Investment for Renewable Integration

Md Tariq Habib, Arnab Sarkar and Vivek Sen

19.1 Context

The Indian power grid is one of the largest synchronised grids in the world. Historically, the grid was designed in a way to support large thermal powers built near the coal mines to transmit electricity. Several hydropower projects, built in the Himalayas and the Deccan, also help maintain the dynamicity of the grid. The only major renewable source of energy for the grid was wind power which contributed less than 5% of the capacity mix by the early 21st century.

The landscape of the power sector has seen considerable change in recent years where renewable energy is poised to play a major role in the power system. The legacy transmission network which supported the conventional sources of power generation needs to be augmented and built at a scale to efficiently transfer electricity generated by these upcoming renewable energy (RE) projects. Central Electricity Authority (CEA) estimates the cost of the transmission system required to support the integration of additional RE to be INR 2,44,200 Cr (CEA, 2022). The financing requirement would be huge considering the relatively limited pool of capital is available with competing demands. Additionally, building new transmission lines in a short period has inherent technical and financial risks. This chapter assesses the risk associated with building new transmission lines and assesses current market levers which could be used to mitigate these risks and deploy the required capital.

19.2 Planned Capacity Addition

India's renewable capacity addition has grown fourfold from ~48 GW of capacity in 2012 to 191 GW as of March 2024 (CEA, 2024). The highlight of RE capacity addition has been *solar energy* experiencing an impressive 45% compound annual growth rate (CAGR) between 2012 and 2024. This surge is primarily due to a significant drop in solar tariffs, making it a highly competitive power source.

While *wind energy* also saw a steady rise with a 32% CAGR during the same period, its growth encountered hurdles after 2018. Land acquisition for wind farms and the high cost of dismantling older turbines have posed significant challenges. Further, the rapid expansion of the solar sector has intensified competition for wind power. Additionally, 51.9 GW of *hydropower* capacity contributes to meeting peak energy demands.

The Central Electricity Authority's (CEA) National Electricity Plan envisions an ambitious target of 580 GW of non-fossil fuel-based energy capacity by 2032 (CEA, 2023a).

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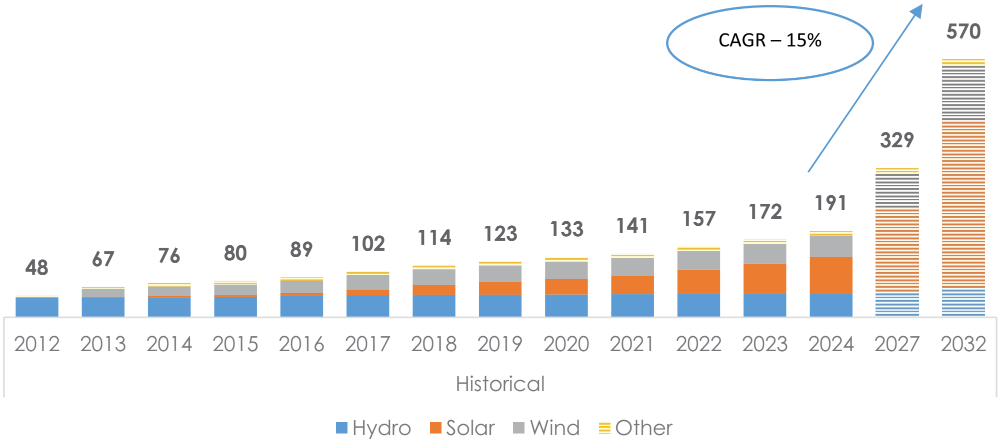

Figure 19.1 India RE Installed Capacity (GW)
Source: Adapted from CEA (2023a) and NEP (2023)

This goal includes increasing solar capacity to 365 GW, wind capacity to 122 GW, hydropower to 62 GW, and the remainder from other renewable sources such as biomass and small hydro.

Achieving this target will require an *annual addition of 35 GW of solar and 10 GW of wind capacity*. To achieve this, India will need to install 2.5 times more renewable energy capacity annually than the current record of 18 GW achieved in FY 2023–2024 (The Economic Times, 2024).

Considering 103 GW of RE projects are under construction and 72 GW under bidding, it is highly likely that the targets will be achieved. Furthermore, private sector participation, reduced project risk, favourable policies and the advent of new technologies like the offshore wind will help surge in RE deployment. However, to ensure all new capacity comes online and contributes to the grid, supporting infrastructure will play a pivotal role. The next section looks at the role of supporting infrastructure, CEA's plan for them and the need to ramp up their addition in sync with RE addition.

19.3 Supporting Infrastructure

To achieve high RE integration into India's electricity mix, a significant financial commitment is required. Estimates suggest that approximately INR 6,81,730 crore will be needed to support infrastructure alone, translating to an annual financial requirement of INR 85,216 crore between 2022 and 2030 (CEA, 2023b; National Electricity Plan, 2023). However, the fiscal years 2019 and 2020 saw only around INR 8,420 crore annually directed towards supporting infrastructure (CPI, 2022). The current financial flow covers just 10% of the necessary annual capital, revealing a stark financing gap of INR 76,796 crore per year.

Energy storage, reactive power generation and transmission lines are three elements of supporting infrastructure that are critical for RE integration into the grid at the planned scale. Each of these have been discussed next.

19.3.1 Energy Storage

Energy storage is crucial for managing the intermittent nature of RE sources. Various types of energy storage are needed, including Pumped Storage Power Plants (PSP) and battery energy storage systems (BESS). Currently, India has an installed capacity of around 4.8 GW for PSP and approximately 1.5 GW for BESS.

To meet future requirements, significant expansion is needed, with estimates suggesting up to 27 GW of PSP and 47 GW of BESS by 2030 (see Table 19.1). The capital expenditure for these storage solutions is projected to be around INR 3,49,284 crore for BESS and INR 61,727 crore for PSP.

19.3.2 Reactive Power Management

Managing reactive power is vital for maintaining grid stability. Implementing Flexible Alternating Current Transmission System (FACTS) devices like STACOM, SVC, SYNCONs, and potentially from battery storage, renewable generators and other inverter-based resources, helps in managing reactive power and maintaining voltage stability. Currently, thermal Power Plants in the country manage reactive power using price signals, incentivising or penalising for over or under-drawal under the Indian Electricity Grid Code (IEGC).

As RE becomes a larger part of the grid, traditional reactive power solutions will not be enough. Innovative approaches, such as repurposing old generators from retired coal plants into Synchronous Condensers (SYNCONs) or utilising existing hydro and battery storage systems in SYNCON mode would be required. Modern inverters in wind, solar, and battery storage systems also have the potential to contribute. However, without proper incentives, these 'non-transmission' resources will not be deployed for voltage control, reserves, or specifically targeted capacity increases, even if they're technically capable.

As per estimates, 1,08,958 Mega Volt-Amperes Reactive (MVAR) of reactive power is required to maintain grid stability and manage power flows effectively. The cost for these upgrades is estimated at around INR 26,519 crore by 2030 (National Electricity Plan, 2023). Since reactive power injection and absorption can be provided through transmission assets owned by the transmission service providers as well as generators, a clear separation among these two sources is essential in the regulatory and commercial frameworks.

Energy storage and reactive power management are critical in integrating targeted RE into the grid. The requirements and needs of these two deserve separate analysis and

Table 19.1 Estimated Capacity Addition and Funds Required for Energy Storage to Support RE Integration

Year	*BESS (GW/GWh)*	*Funds required (INR Cr.)*	*PSP (GW/GWh)*	*Funds required (INR billion)*
2022–27	8.68/34.72	56,647	7.45/47.6	54,203
2027–32	47.24/236.22	2,92,637	26.69/175.18	75,240

Source: CEA – National Electricity Plan, 2023 critical thinking. This chapter focuses only on financing the transmission aspect of supporting infrastructure.

19.3.3 Transmission Lines

Transmission infrastructure has played a pivotal role in the energy transition of India, significantly reducing transmission congestion and market splitting. Earlier challenges, such as the 16% volume of electricity that could not be cleared in Power Exchanges in 2013–14, have been addressed, bringing this figure down to only 0.06% in 2020–21. This improvement has facilitated the discovery of a single price across the power market, enhancing market efficiency (CERC, 2021).

The continuous expansion of transmission capacity has been crucial for integrating RE sources into the grid. This robust transmission infrastructure has enabled seamless power transfer from surplus to deficit regions, optimising generation resources and meeting consumer demand effectively. Consequently, peak energy deficit has reduced from over 4% in 2013–14 to just 0.4% in 2020–21, highlighting the critical role of transmission systems in India's energy landscape.

Going forward as more renewable capacity comes online, the electricity produced by these RE assets needs to be evacuated and connected to the national grid creating higher interconnection costs as similarly sized RE plants will produce less than a quarter of what conventional power plants will generate in energy terms. This translates to a higher per-unit cost of building transmission assets exclusively for RE assets. As of now, power produced by RE assets enjoys waiver on interstate transmission system (ISTS) charges, effectively cross-subsidising power. Going forward, as this waiver tapers off, the landed cost of RE will also increase.

In such a scenario, India will have to build new transmission assets with innovative financing mechanisms to cater to growing RE penetration. Specific projects, like the *Green Energy Corridor (GEC)*, aim to facilitate the smooth integration of renewable energy into the grid by improving transmission infrastructure, with an estimated capital expenditure of around INR 2,44,200 crore (Power Grid Corporation of India Limited, 2023). The GEC is a comprehensive initiative to integrate RE sources into the existing grid. The first phase involves building 3,200 kilometres of transmission lines and substations to carry 6 GW of RE between states, and an additional 9,700 kilometres of lines and substations within eight states to handle 24 GW of renewable power. The second phase will add another 20 gigawatts of RE from seven states to the grid. The entire project, costing over INR 23,000 crores, is expected to be funded by a mix of government grants, loans from German and Asian development banks, and private investments (Ministry of Power, n.d.).

As per CEA's 2022 assessment, India needs to add 50,890 circuit kilometres of transmission lines and 433,575 MVA of substation capacity by 2030 (see Figure 19.2) (CEA, 2022). These upgrades require significant investments and coordination between various stakeholders to ensure timely completion.

The trend of transmission and transformation capacity[1] addition follows the trend of RE capacity addition with a notable difference in transformation capacity. The transformation capacity required would be 50% more than what it is today compared to 20% for transmission lines by FY 2026–2027 itself. This is because of the fact stated above that infirm RE power will lead to substantial underusage of transformation capacity.[2]

Achieving targets would entail minimising risk (project and financial) for these assets. The next section explores the challenges associated with financing these new assets.

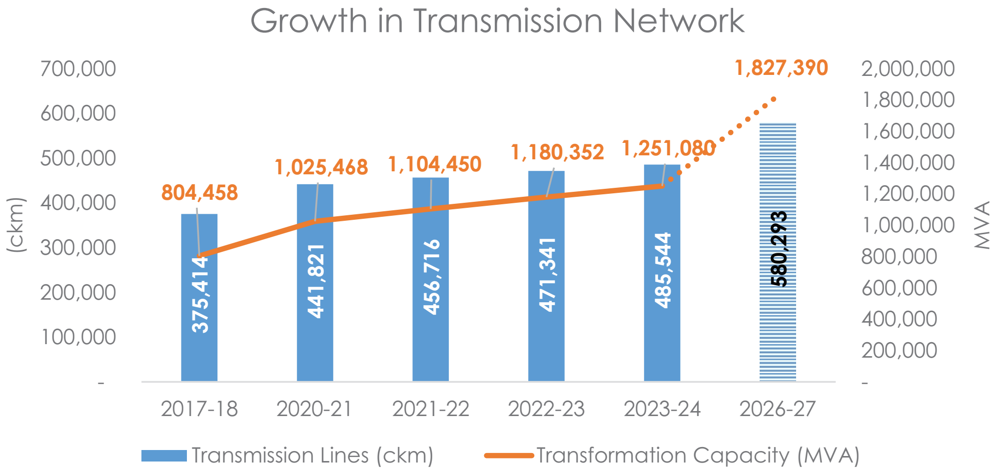

Figure 19.2 Projected Growth in India's Transmission Network

Source: Adapted from CEA (2023b) and NEP (n.d.)

19.4 Challenges in Financing Transmission Infrastructure

Currently, conventional sources account for approximately 50% of the installed capacity, providing stable power output that ensures predictable revenue for transmission infrastructure investments. However, as India aims to raise the RE share to around 70%, the variable and intermittent nature of renewable sources introduces significant financial risks. Despite requiring similar transmission capacities as conventional sources, infrastructure dedicated to RE may experience underutilisation due to the sporadic availability of renewable power. This underutilisation leads to inconsistent revenue generation, despite high initial investment in infrastructure. As a result, attracting investment for new transmission projects becomes challenging, necessitating innovative financial mechanisms and policy interventions to mitigate risks and ensure the financial viability of transmission lines designed for renewable energy. In what follows, we discuss some of the challenges and possible solutions.

Underutilisation of Assets: RE sources, such as solar and wind, are inherently intermittent. This intermittency can lead to the underutilisation of existing assets like power plants and transmission lines. When the output from RE sources fluctuates, it affects the overall capacity factor of these assets, making consistent cost recovery difficult. Since revenue generation heavily depends on consistent energy production, the unpredictability of RE output poses a significant challenge to financial planning and investment in transmission infrastructure.

Revenue Variability: Traditional power plants operate continuously, providing a steady and predictable stream of revenue. In contrast, RE generation is highly variable, influenced by weather conditions and the time of day. This variability can make revenue streams from RE projects less predictable, complicating cost recovery efforts.

Transmission Cost Burdens: To accelerate the growth of RE, the Indian government has ISTS charges for RE projects. While this policy benefits renewable energy developers by reducing their costs, it shifts the financial burden of transmission infrastructure to conventional energy sources. This imbalance necessitates a reassessment of financing mechanisms to ensure that the costs of transmission are equitably distributed, and that the financial viability of both conventional and renewable energy sources is maintained.

Limited Market Players: The market for financing transmission infrastructure is currently characterised by limited players and a lack of market depth. Strategies to attract private investment are essential. Policy reforms and incentives, such as tax breaks and guaranteed returns on investment, can encourage participation and increase market depth.

Interest During Construction: The financial impact of interest costs during the construction phase of infrastructure projects is significant. Government-backed loans with lower interest rates and longer repayment periods can alleviate the financial burden on developers.

Right of Way Issues: Securing the right of way for transmission projects often leads to delays and increased costs. Effective stakeholder engagement and streamlined regulatory processes can help overcome these challenges.

Long Payback Periods: While balancing infrastructure improves grid stability and RE integration, the payback period can be lengthy. Investors may hesitate due to the extended time required to recover their investment. Unlike conventional power plants with predictable revenue, RE projects face revenue variability.

Lack of Associated Infrastructure: Balancing infrastructure, unlike power plants, does not generate direct revenue. Its primary role is to support RE sources by storing excess energy or managing demand fluctuations. This indirect role in grid stability and RE integration makes its revenue streams less predictable. Investors may therefore assess these indirect revenue streams, which can be challenging and carry higher financial risks.

The next section discusses Infrastructure Investment Trusts (InvITs) as a possible option to unlock building new transmission assets.

19.5 InvITs for Financing India's Grid

Current financing for transmission lines relies on developers investing equity and borrowing from banks and other institutions. However, building lines just for RE would not be prudent. This is because our system follows a 'postage-stamp method', which charges everyone the same price per MW for transmission capacity, regardless of the source. As a result, it is difficult to guarantee that 'green' electricity would travel only on 'green' lines.

Without this separation, attracting financing for these dedicated lines becomes challenging. In the wake of the relatively limited pool of available capital and absence of ringfencing green transmission lines, Infrastructure Investment Trusts (InvITs) can play a major role in overcoming these challenges along with any project-related risk. InvITs function as a bridge between infrastructure projects and investors. At its core, an InvIT operates by accumulating funds from institutional and retail investors, which are then directly allocated towards infrastructure projects. These structures allow investors to partake in the ownership of infrastructure assets without involving themselves in the day-to-day management. Importantly, InvITs offer a promising avenue for ensuring steady yields over time, making them particularly attractive for long-term investments in sectors where the upfront costs are high, and the payback periods are extended.

It is useful to keep in mind that different kinds of capital have different preferences in terms of nature of returns. For instance, pension funds, family offices, sovereign wealth funds often classified as patient capital, are risk averse, have longer time horizons, expect modest and safe returns from the capital deployed. In contrast, lenders and developers, commercial capital, believe in higher risk and return, may or may not have longer time horizon.

InvITs mobilise capital by offering units, akin to shares, to investors, which represent a proportional ownership in the underlying assets. This model facilitates a greater pool of capital by lowering the entry barriers for investors who otherwise may be hesitant to engage in the heavily regulated and capital-intensive electricity transmission sector. Moreover, the structured nature of InvITs allows for efficient risk management through diversification across multiple assets, thereby enhancing its appeal to conservative investors seeking stable returns. InvITs by its definition provides an opportunity for the current set of investors/developers to exit from the operational project. This frees up capital that can be used to fund new projects. Since InvITs provide immediate access to capital that would otherwise be tied up during the project's lifetime, developers gain the flexibility to undertake more projects, potentially accelerating infrastructure development.

The regulatory landscape for InvITs, especially in the electricity transmission sector, is defined by stringent guidelines that aim to protect investors and ensure the long-term viability of projects. Governing bodies and regulatory authorities have laid down specific mandates related to asset quality, distribution norms, and operational efficiency to ensure that InvITs operate within a safe and transparent framework. Such regulations not only bolster investor confidence but also pave the way for sustainable development in the electricity transmission sector through responsible investment practices.

19.5.1 Types of InvITs

The following are different types of InvITs.

Finished infrastructure projects: InvITs that invest in finished infrastructure projects such as highways or power plants. They generate income immediately.

Under-construction infrastructure projects: They invest in under-construction infrastructure projects and take time to generate income.

Privately held: InvITs that are not listed on the stock exchange and hence cannot be bought by retail investors are privately held InvITs. They have a very limited investor base.

Public listed: InvITs that are listed on the stock exchange and can be easily traded by retail investors are publicly listed InvITs.

19.5.2 Mechanism to Leverage InvIT

Considering the limited pool of available capital and requirement of significant capital to green transmission system in the country, the objective is to free up locked capital while attributing risk to the stakeholders best suited to handle it.

Figure 19.3 shows the steps which could be followed to leverage InvIT along with other instruments of debt. The four stages, marked A, B, C and D in the figure, is described next.

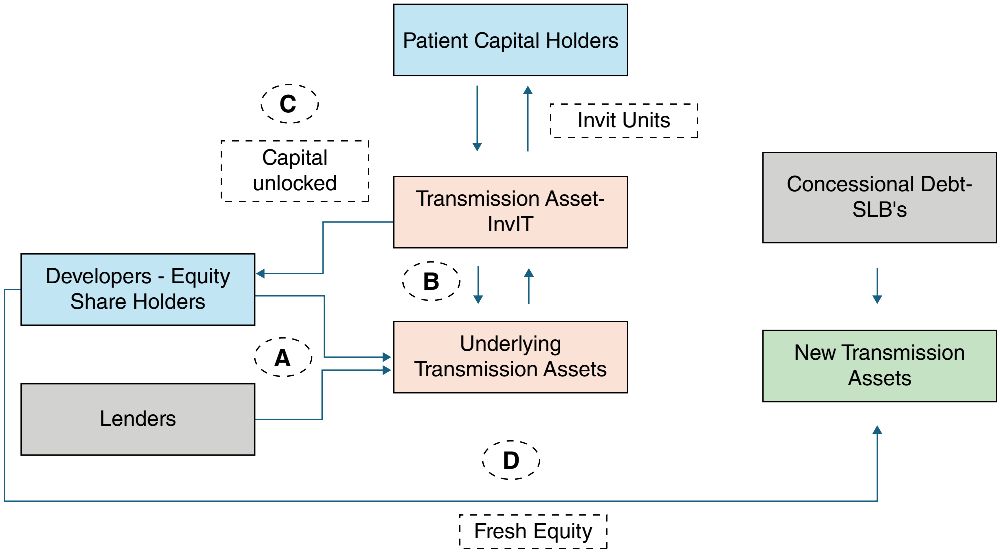

Figure 19.3 Schematic to Demonstrate How InvITs Could Unlock Capital for Investing in Grid Infrastructure

Source: Authors

A. Asset Development: The transmission planning in the country is carried out by the Central Electricity Authority (CEA). The projects are either awarded on nomination basis or through Tariff based competitive bidding (TBCB) route. Under both routes, project financing is arranged by the developer. The developers manage project-related risk to deliver the project in lieu of return generated from the asset once project achieves Commercial operations (COD).

B. Formation of InvIT: The InvITs formed could either be privately or publicly held. The publicly held InvIT will have a larger investor base and liquidity while privately held InvIT could potentially be subscribed to by marquee investors looking for long-term investment. InvIT could have either one or multiple projects as underlying assets. Multiple projects will help investors in diversifying their risk.

C. Capital Unlocking: The InvIT once subscribed to by patient capital holders looking for long-term returns will free up the equity of developers. Typically, InvITs only included fully completed projects, a mix of finished and nearly finished projects could be used to reduce the waiting period for investors.

D. New Asset Development: By freeing up capital through InvITs, developers can invest in new transmission projects. The lump sum payment from InvITs replaces the income stream they would have received over the project's lifetime. This allows them to build a larger portfolio, creating a multiplier effect. Additionally, developers can explore alternative financing options beyond traditional loans from banks and DFIs to fund new transmission projects, helping greening the power system.

An additional lever could be Sustainability linked bonds (SLB), which offer companies a way to lower their borrowing costs by achieving specific environmental goals. These predefined targets are measured over a set timeframe using key performance indicators

(KPIs). For example, an SLB's KPI could focus on improving emission intensity, which would eventually decrease as green assets are integrated into the system. By issuing SLBs, companies can access debt financing at a lower cost, making it more affordable to build critical infrastructure like transmission lines, compared to traditional financing methods.

19.6 InvITs Enabling the Electricity Transmission Sector

The integration of InvITs within the electricity transmission sector offers a paradigm shift in how infrastructure projects are financed, operated, and maintained. Unlike traditional financing models characterised by high upfront capital requirements and extended payback periods, InvITs provide a platform for pooling resources from various investors, thus distributing risk and enhancing liquidity.

Operationally, InvITs can contribute to efficiency by involving experienced and specialised operators who ensure the optimal performance of assets. This model supports better management practices, adherence to regulatory standards, and improved operational outcomes. Additionally, the steady revenue streams generated from electricity transmission assets present a lower risk profile for investors, making InvITs a suitable mechanism for long-term investment.

Box 19.1 Success of IndiGrid and Sterlite Power Grid Ventures' InvITs

The IndiGrid InvIT was launched in 2016 and has since grown to become India's first power sector InvIT to be listed on the stock exchange. IndiGrid manages several transmission assets across different states, demonstrating a practical application of InvITs in enhancing infrastructural efficiency and financial performance. The successful execution of IndiGrid's InvIT is attributed to several factors. First, robust governance frameworks ensure transparency and investor confidence, which is crucial in asset-heavy sectors like electricity transmission. Second, a diversified asset portfolio mitigates risks and stabilises returns, enhancing overall investor appeal. Lastly, strong regulatory support from SEBI (the Securities and Exchange Board of India) has established a conducive environment for InvIT operations.

Sterlite Power Grid Ventures' InvIT has successfully commissioned critical transmission projects. The initiative demonstrated superior operational efficiency through reduced construction timelines and cost optimisations, validating the operational scalability of InvITs.

Lastly, the inherent structure of InvITs allows for effective risk management by diffusing individual project risks across a broader investment base. This not only enhances investor confidence but also ensures sustainable sectoral growth.

19.6.1 Additional Financial Benefits

InvITs offer significant tax advantages in addition to other financial benefits. They are generally exempt from corporate taxes, and income distributions to investors are either tax-deferred or taxed at a reduced rate.

Moreover, InvITs facilitate liquidity compared to traditional models. Investors can buy and sell units on the stock exchange, providing a mechanism for partial or full exit without disrupting the underlying infrastructure project.

19.6.2 Operational Efficiency

The integration of InvITs into the electricity transmission sector offers a substantial boost in operational efficiency. One primary aspect is the professional management of assets. InvITs are typically managed by entities with extensive expertise in infrastructure projects, leading to optimised maintenance schedules, timely upgrades, and innovative management practices.

Another significant advantage is the improved capital allocation. InvITs are structured to attract a diverse pool of investors, which ensures a steady inflow of capital for operational needs. This continuous funding stream mitigates the common problem of financial constraints that can hinder the smooth functioning of transmission networks.

Additionally, InvITs promote economies of scale. By aggregating multiple projects under a single trust, InvITs can achieve cost reductions through bulk procurement of equipment and materials, streamlined administrative processes, and centralised decision-making. This consolidation leads to reduced operational costs and improved service delivery.

Furthermore, the implementation of advanced technological solutions is facilitated by the financial flexibility and managerial capabilities of InvITs. This can include the deployment of smart grid technologies, predictive maintenance systems, and real-time monitoring tools, all of which contribute to more efficient and reliable transmission operations.

19.6.3 Risk Management

Risk management is a critical aspect when integrating InvITs into the electricity transmission sector. Effective risk management strategies not only ensure the stability of investments but also enhance operational efficiency. First, InvITs mitigate financial risks through diversification. By pooling various transmission assets, financial instability in one asset does not heavily impact the entire portfolio. This diversification reduces exposure to individual project failures and ensures a steady revenue stream. Second, operational risks are managed by leveraging the expertise of professional managers who oversee the intricate operations of electricity transmission assets. These managers implement best practices and innovative technologies to enhance reliability and minimise downtime. Third, InvITs benefit from a structured legal and regulatory framework, ensuring compliance and reducing the potential for legal complications. Close collaboration with regulatory bodies ensures that policy changes are anticipated and swiftly adapted to. Fourth, market risks, including fluctuations in demand and competitive pressures, are managed by long-term contracts and stable tariff structures. These agreements provide predictable revenue, insulating InVITs from short-term market volatility.

19.7 Institutional Requirements for Effective InvITs

Firstly, *financial stability* is a significant benefit. InvITs provide a steady flow of income to investors due to long-term contracts and regulation-driven revenue models. This predictability bolsters investor confidence and attracts more capital into the sector.

Secondly, the importance of *operational transparency* cannot be overstated. Successful InvITs have demonstrated that comprehensive disclosure of financials, operations, and risks enhances trust among investors and regulators. This transparency leads to better risk assessment and more informed decision-making.

Moreover, *governance structures* are pivotal (see Box 19.1, for example). Effective governance frameworks ensure that the interests of unit holders are safeguarded, promoting a balance between profit motives and infrastructure development goals. Additionally, strategic asset management by professional trustees has shown to optimise asset utilisation and operational efficiency.

There are also lessons in *regulatory alignment*. Harmonising InvIT operations with regulatory expectations increases compliance and minimises legal challenges. The alignment fosters a conducive environment for sustainable growth.

Finally, the *importance of flexibility* in investment strategies has been emphasised. Adaptive strategies that consider market dynamics and evolving regulatory landscapes better position InvITs to mitigate risks and capitalise on emerging opportunities. These lessons provide a roadmap for enhancing the efficacy and appeal of InvITs in the electricity transmission sector.

Notes

1 Power generation occurs at various voltage levels, which may not be optimal for efficient transmission or consumption by end-users, transformation capacity is the ability to optimise voltage levels

2 One KW conventional power plant generating 24 Kwh of electricity in a day will require 1 KVA of transformer while one KW solar plant would require transformer of same capacity while generating only 5–6 Kwh electricity in a day.

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20 Financing Just Transition in the Coal Mining Sector – Trade Union Perspectives

*Randhir Kumar, Aiman Nida and S.M.F. Pasha**

20.1 Introduction

As nations strive towards energy transition, the concept of Just Transition (JT) has emerged as a critical element in achieving sustainable development goals, particularly in sectors heavily reliant on fossil fuels like coal (Balasubramanian et al., 2022; Filipović et al., 2022; Hägele et al., 2022; Rogers, 2021). Existing research has documented global best practices for ensuring a JT for affected stakeholders (Philip, 2019; Rugiero, 2019; UNFCCC, 2023a). In India, there have been proposals for creating a permanent 'Green Energy Transition India Fund' designed to support communities, regions, and states, as they pursue sustainable development pathways (NITI Aayog, 2021). Reports from NITI Aayog (erstwhile Planning Commission) and Ministry of Coal further advocate for fostering a JT through alternative employment, entrepreneurial ventures and livelihood opportunities for coal-dependent communities (Ministry of Coal, 2022; NITI Aayog, 2021). Together, these initiatives reflect global recognition that a successful JT demands not only financial resources but also inclusive, equitable planning to ensure that no community is left behind.

Despite rhetorical commitments to JT in India's coal mining sector, such as the development of a 'Coal Mine Closure Framework' grounded in JT principles (Ministry of Coal, 2022), the actual implementation of these visions at the grassroots level is poorly understood. This issue is particularly relevant given that India's most resource-rich states, such as Jharkhand and Odisha, paradoxically remain among the poorest and least developed (Bhushan et al., 2020; Roy et al., 2019). This suggests that these mineral-rich states face a double disadvantage: first, by historically failing to capitalise on their resources for the welfare of workers and local communities, and second, by potentially being overlooked once again during the carbon transition process, with their needs insufficiently addressed in the JT frameworks.

Besides implementation concerns, there is limited insight into how workers' organisations, such as trade unions, are integrated into these processes and how much influence they have over the planning and allocation of JT funds. While trade union (TU) participation is often framed as essential for JT (Stevis and Felli, 2015), their concerns related to workers' welfare goals are at risk of being marginalised in the decision-making process. This marginalisation is especially concerning given the 'wicked' nature of the problem, as the transition from coal to sustainable energy involves complex, multi-dimensional challenges that affect a wide range of stakeholders. TUs in the coal sector have navigated tensions between opposing and supporting green transitions, balancing job security concerns

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while protecting workers and coal-reliant communities (Azzi, 2021; Kalt, 2022). Understanding their concerns regarding the allocation and utilisation of JT funds is therefore critical. Against this backdrop, the objective of this chapter is to analyse and critically assess the financing mechanisms for a JT from the perspective of TUs. We understand JT as the equitable and inclusive process of transforming the economy towards environmental sustainability, ensuring the provision of decent work opportunities, social inclusion, and the eradication of poverty (ITUC), 2017). This understanding is in tandem with UNFCCC (2023b) conceptualisation of JT which broadly has connotation of '*transforming the economy and economic system in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind*'. This concept also encompasses well-managed efforts to safeguard the rights and livelihoods of workers and affected communities during the transition to sustainable and low-carbon economies (ITUC), 2017).

This chapter provide a critical evaluation of different funding models [public finance, private investment, and blended finance models], from the viewpoint of TUs, on three parameters – namely, *(mis)allocation* of funds affecting resource scarcity, the *(mis)alignment* of financial instruments with affected workers and community needs, and the *(mis) governance* of the allocated funds for JT. Through this examination we aim to highlight the challenges and oversights in planning and execution of JT projects in developing nations. Critics argue that the discourse on JT is dominated by the Global North, where techno-optimistic outlook is coupled with underlying premise of providing a win-win solution for all, thereby reducing this exercise to being reactive and reformist in nature (Alarcón et al., 2022). This chapter moves away from providing a win-win solution and instead focus on uncovering the complexities and concerns associated with planning and implementing a JT in developing nations of the Global South.

Climate Justice and JT are often seen as 'wicked problems' due to their inherent complexity and the involvement of diverse, often conflicting, interests (Jakimowicz, 2022; Schwab and Diaz, 2023). From the viewpoint of planning and execution of JT, solutions tend to be ambiguous, with unintended consequences that may implicitly prioritise concerns of certain stakeholders while disadvantaging others, causing further conflicts. Different stakeholders – governments, business firms, and TUs – each have their own objectives and goals, which further complicates consensus-building. Governments may prioritise economic stability and environmental sustainability, businesses, as profit-seeking entities, focus on their own sustenance, and TUs advocate for workers' rights and welfare. The relative bargaining capacity of these actors also differs due to their specific positioning within the overall hierarchical system involved in decision-making and execution. As JT issues involve diverse stakeholders with varying perspectives and interests, the planning and execution of a JT is especially challenging (Levin et al., 2012).

One approach to addressing the 'wicked problem' of JT is through collaborative frameworks that encourage discussion, negotiation, and the optimisation of proposed solutions. In the coal-mining industry, for instance, governments, unions, and companies have worked together to phase out coal while supporting workers and communities through retraining and redundancy programmes (Galgóczi, 2019; Oei et al., 2020). However, achieving a mutually negotiated solution is complex, as workers and communities, positioned at the intersection of business and climate imperatives, often bear the brunt of potential job losses during the transition. Understanding their perspectives is crucial for ensuring a fair transition. Recognising JT as a wicked problem, this chapter takes a nuanced approach, where we acknowledge that while a one-size-fits-all strategy is unfeasible, solutions come with mutual negotiation and continuous refinement of strategies.

20.2 Financing a Just Transition – Challenges and Complexities

Financing the drive towards a JT in the coal sector is crucial for upholding the socio-economic welfare of affected workers and communities. However, financing a JT poses significant challenges, including fund availability, aligning financial mechanisms with community needs, and governance of funds for equitable and sustainable economic restructuring. Given that JT occurs within a distinct geographical and temporal context, it is highly influenced by local political, social and cultural dynamics. Consequently, even when funds are available, internal conflicts and debates often arise among stakeholders regarding how best to allocate resources across competing objectives. Recognising the inherently political nature of JT pathways, researchers highlight the importance of considering the diverse economic, political, and social contexts in which low-carbon transitions take place (Baker et al., 2014). The political process of negotiation and decision-making is shaped at both global and local levels, where various stakeholders, including governments, funding agencies, industries, and civil society, together influence the direction and implementation of JT initiatives.

At the global level, the complexity of financing JT are evident in the approaches of international bodies such as the International Monetary Fund (IMF), the World Bank, and the European Bank for Reconstruction and Development (EBRD) (Black et al., 2022; Cigna et al., 2023; EBRD, 2020; World Bank, 2022). These organisations have traditionally adhered to neoliberal, market-based mechanisms, focusing on fiscal tools like carbon pricing, market incentives, and public investments to drive climate change mitigation. Climate finance initiatives backed by the Global North are often intertwined with neo-colonial practices, where nations in the Global South are coerced into adopting climate policies that prioritise the interests of more powerful nations. This frequently results in the imposition of external, top-down solutions that disregard local contexts, ultimately perpetuating unequal power dynamics and reinforcing dependency on external actors (Navarro, 2022). Furthermore, market-based solutions often fail to incorporate the distributional aspects of climate justice, which include compensating the most affected communities and ensuring equitable access to the benefits of the energy transition (Newell et al., 2023). Critics argue that the neoliberal approaches fall short of fostering a JT and emphasise the need for more proactive state involvement to guide transitions in a manner that prioritises social justice and inclusivity (Cash and Swatuk, 2022). This is especially critical in regions with weaker institutional capacities to effectively manage the socio-economic impacts of these transitions (Newell and Mulvaney, 2013; Swilling and Annecke, 2022).

Securing the necessary funding for both environmental goals and social equity presents a significant challenge, as financial mechanisms need to balance the shift towards cleaner energy solutions with the socio-economic well-being of impacted workers and communities. In South Africa, for instance, the Just Energy Transition Partnership (JETP) initiatives, which uses a blended finance model of concessional loans, grants (from international donors), and private investments to decommission coal-fired power plants and promote renewable energy, has encountered resistance from various stakeholders (Simpson and Krönke, 2024). Likewise, India's energy transition financing underscores the conflicting priorities between the nation's push for economic growth and its local environmental and socio-economic commitments (IISD, 2024). Despite efforts to provide social protection and create green jobs, there have been apprehensions about whether enough financial resources could be raised to pursue dual objectives of energy transition and JT within the envisioned time span of phasing out of coal. While the extant literature illustrates how a combination of public and private funding, along with strategic investments in social infrastructure, can facilitate a JT for workers and communities (Newell and Phillips, 2016), concerns remain about the adequacy, local political challenges and lack of clear long-term strategy for promoting social equity.

Corporate Social Responsibility (CSR) models are increasingly being recognised as viable financing mechanisms for facilitating a JT. For instance, Coal India Limited (CIL) has been involved in numerous CSR activities aimed at improving the socio-economic conditions of communities affected by coal mining operations. (Ministry of Coal, 2021). However, CSR alone cannot address the full scope of responsibilities involved in a JT, as state, market, and civil society actors all hold specific responsibilities in the JT process, based on their roles, capacities, and resources (Kortetmäki and Huttunen, 2023). CSR, as explained by Matten and Moon (2008), is often shaped by either 'explicit' voluntary policies driven by corporate discretion or 'implicit' frameworks embedded in national institutional contexts, meaning that the voluntary nature of explicit CSR can lead to significant inconsistencies in the level of support provided to communities. Thus, while CSR plays a complementary role, it cannot be seen as a substitute for more robust, state-driven policies and investments.

To sum up, financing a JT requires more than market-based mechanisms and voluntary corporate contributions. From the perspective of TUs, understanding politics of JT financing is crucial, as unions advocate for the socio-economic welfare of workers who do not wield significant power or influence in shaping the transition.

20.3 Local Context of the Study: Coal Mining Sector and Just Transition in India

Coal mining plays an indispensable role in India's energy infrastructure, contributing to nearly 70% of India's electricity generation (Ministry of Coal, 2021). India envisions a gradual transition from coal to renewable energy sources as part of its strategy to lower carbon emissions and address climate change concerns. However, this transition poses significant challenges for the workers and communities dependent on coal sector. In India, Coal India Limited (CIL), a Public Sector Undertaking under the Government of India, provides employment to 369,053 individuals, of which 128,236 are contractual workers (PIB, 2024). The state-run coal mines have high density of unionisation, which is estimated to be around 90% of the regular workforce (Roy et al., 2019).

This dense unionisation has historically empowered TUs to play a central role in the coal mining sector, advocating for workers' rights, better working conditions, and fair wages. The major TUs include the *Indian National Mines Workers Federation*, *Hind Khadan Mazdoor Federation*, *Akhil Bharatiya Khadan Mazdoor Sangh*, and the *Indian Mines Workers Federation*, and *All India Coal Workers' Federation*, which are affiliated with the Indian National Trade Union Congress (INTUC), Hind Mazdoor Sabha (HMS), Bharatiya Mazdoor Sangh (BMS), All India Trade Union Congress (AITUC), and the Centre of Indian Trade Unions (CITU) respectively (ET Bureau, 2013). These unions have historically played crucial roles in negotiating labour agreements and ensuring compliance with labour laws (Aggarwal, 2020; PIB, 2023). Within India, these unions are now increasingly focusing on the implications of the energy transition and advocating for a JT that protects livelihoods of workers and dependent communities (Bhushan et al., 2020).

20.3.1 Methodology

The outcomes of this chapter is primarily based on in-depth interviews with TU leaders involved in the coal mining sector of India. We conducted interviews with 19 resource persons, who were in various positions across different TUs in India to gain insights into their perspectives on JT, including its financing modalities and the challenges they anticipate. The data collection was conducted from June to August 2024. The questions posed to TU leaders delved into the funding models for JT, evaluating the effectiveness of public, private, and philanthropic funding sources. Another focal point of our discussion with the TU representatives was how competing priorities could influence use of resources meant for JT. We inquired about the key decision-makers in these initiatives and the inclusivity of their decision-making processes. We sought information pertaining to the governance mechanisms for fund allocation and the role of TUs in these processes. Additionally, we explored potential solutions envisioned by the TUs to address resource scarcity and innovative funding mechanisms that could bridge the gaps identified by them.

Each interview lasted between 45–90 minutes. We also conducted several follow-ups calls to seek further clarification or to confirm that our interpretations aligned with the participants' understandings. The interview data were analysed for identifying the key themes that encapsulate the TUs' perspectives on JT financing modalities. Further, we referred to reports on JT by various agencies (such as ILO and ITUC) and analysed them to complement and strengthen our findings.

20.4 Findings

We explored the financial dynamics of JT to shed light on the TUs perspectives on the scope, planning, and execution of JT in the Indian coal mining sector. We discuss – the (mis)allocation of funds affecting ability to address resource scarcity, the (mis)alignment of financial instruments with affected workers and community needs, and the (mis)governance of the allocated funds for JT. We delve into each of these themes in the subsequent sections with specific focus on three major stakeholders – permanent workers, contractual workers and the broader community – dependent on coal mining operations.

20.4.1 (Mis)allocation of Funds Affecting Resource Scarcity

The respondents from TUs concurred with the overarching objectives of JT and the necessity of gradually shifting towards cleaner forms of energy. However, they raised several concerns regarding the modalities and scope of JT. Their primary concern was related to the safeguard mechanisms and resources in place in the event of coal mine closures.

20.4.1.1 Economic Support for Retrenched Workers

An overarching concern for TUs is the scarcity of resources and the improper assessment of funds that would be required to achieve the envisioned JT. They emphasised the importance of securing adequate funding to support workers during the transition, which includes resettlement programmes and social protection measures. A TU leader pointed out the potential social security impacts of coal mine closures:

> If you look at our labour laws on retrenchment, they do not offer strong support for workers. If a worker is eligible for retrenchment compensation, the pay-outs are meagre, and there is a lack of accountability regarding finding resources for the resettlement of retrenched workers. In the absence of additional support or finding viable alternatives, the amount provided is insufficient and can act only as a stop-gap measure at best.
>
> (TU Leader – 14)

This reflects the sentiment regarding the potential closure of coal mines, highlighting the perceived inadequacy of the laws providing safeguard mechanisms to the workers. According to Section 79 (9) of the Industrial Relations Code – 2020 (Ministry of Labour and Employment, 2020), firms are required to pay 15 days' average pay, or such days as may be notified by the appropriate Government, for each year of continuous service as retrenchment compensation. Additionally, Section 79 (1a) mandates a notice period of three months, or equivalent payment for three months in lieu of such notice. However, this support is seen as minimal and for the TUs, the existing labour laws are considered to be inadequate in addressing the broader needs of workers affected by potential mine closures.

20.4.1.2 Invisibility of Contractual Workers

TUs expressed concerns that resource allocations for JT might primarily benefit permanent workers, effectively marginalising contractual workers whose numbers may be comparable to, or even exceed, those of permanent employees. When a coal mine closes due to safety issues or the exhaustion of coal reserves, management typically focuses on protecting the interests of permanent workers. In such cases, coal-mining firms often reassign these workers to other roles, claiming this approach does not impact their jobs and livelihoods. One TU leader explained the implications of such a practice on contractual workers:

> Closing coal mines involves obtaining several permissions from various authorities. These include approval from the company board, an expert review report, and the deposit of security for the activities to be carried out during the mine closure. One common way to circumvent these complexities is by declaring that the mines have stopped production, which is easier than formally closing them. Permanent workers are shifted to other mines, but the same transition for contractual workers is rarely considered.
>
> (TU Leader – 16)

This quote underscores the invisibility of contractual workers in the coal-mining sector. When mines are declared to have stopped their production, it often means that the mines are not formally closed but are left in a state of limbo. This practice inadvertently neglects the plight of contractual workers who are rarely reallocated or compensated during these transitions. Furthermore, some of these mines, once deemed unprofitable, are reallocated to private contractors for further extraction, which can exacerbate the exploitation of contractual workers. One TU leader observed:

> Now the plans are to either close down unviable or loss-making mines or tender them out to private parties. . . . How can a contractor benefit from a mine previously declared unprofitable by the government? One way is to engage contractual workers with poor pay and working conditions. This move would increase the numbers of contractual employees, potentially allowing private players to exploit them.
>
> (TU Leader – 6)

This observation highlights the systemic issues within the JT framework, where the allocated resources focus remains on safeguarding permanent workers, leaving contractual workers marginalised and vulnerable to exploitation by private contractors. This disparity suggests the need for more comprehensive resource allocation policies that ensure the welfare of all workers affected by the transition from coal-based to renewable energy sources.

20.4.1.3 Waiting for Gradual Phase-Out of Coal Mines

The TUs are cognisant of the possibility that firms may strategically wait for coal mines to be exhausted while simultaneously reducing the number of permanent workers on the payroll. This approach allows firms to minimise the need for substantial resource allocation for closing down coal fields. By gradually decreasing the permanent workforce through natural attrition, such as retirements and voluntary separations, companies can avoid the immediate financial and logistical challenges associated with mine closures, as mentioned in the Mine Closure Guidelines (Ministry of Coal, 2020). This strategy not only delays the necessary transitions but also exacerbates the casualisation of the coal mining sector, where an increasing proportion of the workforce consists of contractual workers who often lack job security and adequate compensation. Reflecting on the phenomenon, one of the TU leaders noted:

> If we see the overall statistics, on average, every year around 15,000 workers leave the coal mining sector due to retirement, superannuation or voluntary retirement. However, the number of new workers joining on permanent roles is limited to around 3,000 each year. With this rate, we will see casualisation of the coal mining sector.
>
> (TU Leader – 7)

Using this tactic of gradual and systematic decline of coal fields bypasses the need for proactive and formal JT interventions. While closing down a coal field would still attract some liability for the workers, the concerns of community dependent on the coal mining could possibly be circumvented by committing fewer resources under JT.

20.4.2 The (Mis)alignment of Financial Instruments

Another concern for TUs is the potential misalignment of financial instruments designated for JT initiatives. These concerns extend beyond workers to the broader community dependent on the coal mining sector. Often, formal JT initiatives overlook these communities, leading to the misallocation of resources that fail to meet their welfare needs. Trade unions emphasise that without addressing this issue, the allocated resources might not align with the welfare objectives for the larger community dependent on coal, thus undermining the inclusivity and effectiveness of the JT process.

20.4.2.1 Invisibility of Community Dependent on Coal

Beyond the workers, there are numerous community members whose livelihoods are directly or indirectly tied to the coal sector who often fall outside the scope of formal JT initiatives. The coal mining companies may adopt a strategy of allowing coal mines to phase out naturally, expecting that the broader community will find alternative livelihoods independently. One trade union leader articulated this concern:

> In the past, when coal mines were closed, the local economy adjusted and found alternatives in different sectors. However, the trend of hiring more contractual workers and passively waiting for closure of the coal mines is problematic as it diminishes motivation for a genuine JT. This approach also overlooks the necessity of proactively planning for alternatives for shopkeepers and informal sector workers who rely on the expenditures of workers.
>
> (TU Leader – 2)

Trade unions also fear that the strategy of natural attrition could lead to an underestimation of the resources needed to achieve a JT for all workers and the wider community reliant on coal. Without inclusive planning and appropriate resource allocation, these community members might be left to fend for themselves, undermining the fairness and effectiveness of the JT process.

20.4.2.2 Just Transition as a Part of Wage Negotiations

A primary objective of JT is to ensure that new jobs created in the economy uphold the Decent Work agenda. TUs seek to play a crucial role in this process, advocating for new positions that match or exceed the quality of those being phased out. Additionally, they aim to actively shape the design and terms of these jobs, rather than leaving their creation to chance. One TU leader highlighted this perspective:

> We want Just Transition to be integrated with the new jobs envisioned for the economy. We demand this commitment from both the government and business firms, and we have grounds for it. The original coal-mining companies have diversified into new businesses like solar energy, which has tremendous power to generate employment. If we are going for Just Transition, we need to gradually retrain our manpower and shift them to new job profiles that provide decent pay, benefits, and working conditions.
>
> (TU Leader – 17)

TUs are aware of the challenges involved in advancing this agenda and are proceeding with caution. A symbolic milestone has been the inclusion of the term 'Just Transition' in wage negotiations. This point was highlighted by a TU leader:

> We have added a commitment to 'Just Transition' in our wage settlement. While it might not seem like a big win, it opens the door for future negotiations. As we get better ideas on how to protect workers and communities, we can use these agreements to push for Just Transition initiatives.
>
> (TU Leader – 11)

TUs have collectively pushed for the inclusion of new workers in these diversified sectors under collective wage agreements, aligning their efforts with the objectives of JT. This approach supports the broader goal of ensuring that financial instruments and resources are effectively aligned to facilitate the envisioned JT, promoting equitable and sustainable employment opportunities.

20.4.3 The (Mis)governance of the Allocated Funds

The governance of JT initiatives, particularly regarding optimum usage of allocated funds, was a critical concern for TUs. TUs emphasised the importance of ensuring transparency and accountability in handling the allocated funds for JT.

20.4.3.1 Centralised Governance Structure

One of the key concerns for TUs is the governance mechanisms for effective planning and oversight of funds allocated for JT. They emphasise the importance of a centralised governance structure to ensure that funds are distributed equitably and effectively. Furthermore, they advocate for the inclusion of TUs and civil society organisations in the governance and oversight of budgetary planning and execution. However, highlighting the need for a participatory approach, one TU leader noted:

> While having a centralized budget for JT is important, it's crucial that TUs are actively involved in the planning and execution of these projects. We shouldn't be passive recipients; we need to engage closely to ensure accountability and proper use of funds.
>
> (TU Leader –12)

Other than pushing for a better governance structure and accountability for the JT funds, TUs expressed their apprehensions towards sustainability of the JT initiatives through CSR projects.

20.4.3.2 CSR and Just Transition

Firms often resort to their CSR wings to invest in community development and address environmental concerns. While CSR initiatives by coal-mining firms are welcome, TUs believe that this is insufficient to achieve the objectives envisioned under JT. One TU leader explained:

> It is easy to provide some upskilling training to the community; however, making a livelihood out of the new skills is a different task. Once the handholding stops, such initiatives often lose their impact. For example, women who were dependent on coal-related activities find it difficult to sustain new enterprises once initial support ends.
>
> (TU leader 1)

There is scepticism about the sustainability of these initiatives and their effectiveness in addressing long-term socio-economic needs. Another TU leader expressed his anguish over the interventions:

> How the resources are used to create capacity building among the community members who would be affected by mine closures . . . I don't find imparting skills on how to make *papad* or home-made snacks as a strategy for Just Transition. What we want is a more serious engagement in both skill development and creation of decent job opportunities.
>
> (TU leader 19)

The above quote highlights the TU perspectives that JT does not mean creating just another job or livelihood opportunities that are not gainful in nature. Especially, when a majority of workers in India are already in informal sector, creating more of bad quality jobs in the name of JT does not justify the right usage of funds earmarked for skill building and creation of livelihood opportunities.

20.4.3.3 Private Investments and Just Transition

Private investments in renewable energy sectors like wind and solar are seen as potential JT alternatives. However, TUs are wary, expressing that business organisations may prioritise profits over workers' welfare. They demand that new jobs created through these investments adhere to the Decent Work agenda, ensuring fair wages, job security, and proper working conditions.

We have seen how, if left on their own, business organisations often prioritise their profits at the expense of workers' welfare. What we demand is that new jobs created through these investments also reflect our Decent Work agenda. (TU leader – 4)

The above quotes reiterate the concerns that have been long-established pertaining to social or business motives of business entity. Existing literature has identified the firms as economic entitles, which tends to priories their profitability over other (social welfare) objectives (Eberlein, 2019; Jones and Felps, 2013). Proper oversight and accountability from governmental and regulatory bodies is crucial to prevent the misallocation of funds and to ensure that the intended social benefits are realised with the understanding that government intervention may not always work (Latimer, 2018; Wu, 2024).

In summary, the findings emphasise the financial dynamics of JT through the lens of TUs. Permanent workers, while relatively protected, still encounter gaps in retrenchment packages and social security frameworks. Contractual workers, who are typically outsourced, remain largely unaccounted for in transition plans, leaving them vulnerable to exploitation. Furthermore, the broader coal-reliant community, including local businesses and informal workers, is often excluded from formal JT policies.

20.5 Discussion: Trade Union Concerns on Financing a Just Transition

The objective of this research was to understand the key concerns of TUs regarding the financing of JT initiatives, particularly in India's coal mining sector. Based on our findings, we have developed a model (Figure 20.1) to elucidate the complexities involved in the conceptualisation and financing of a JT, particularly from the perspective of TUs in the Indian coal sector.

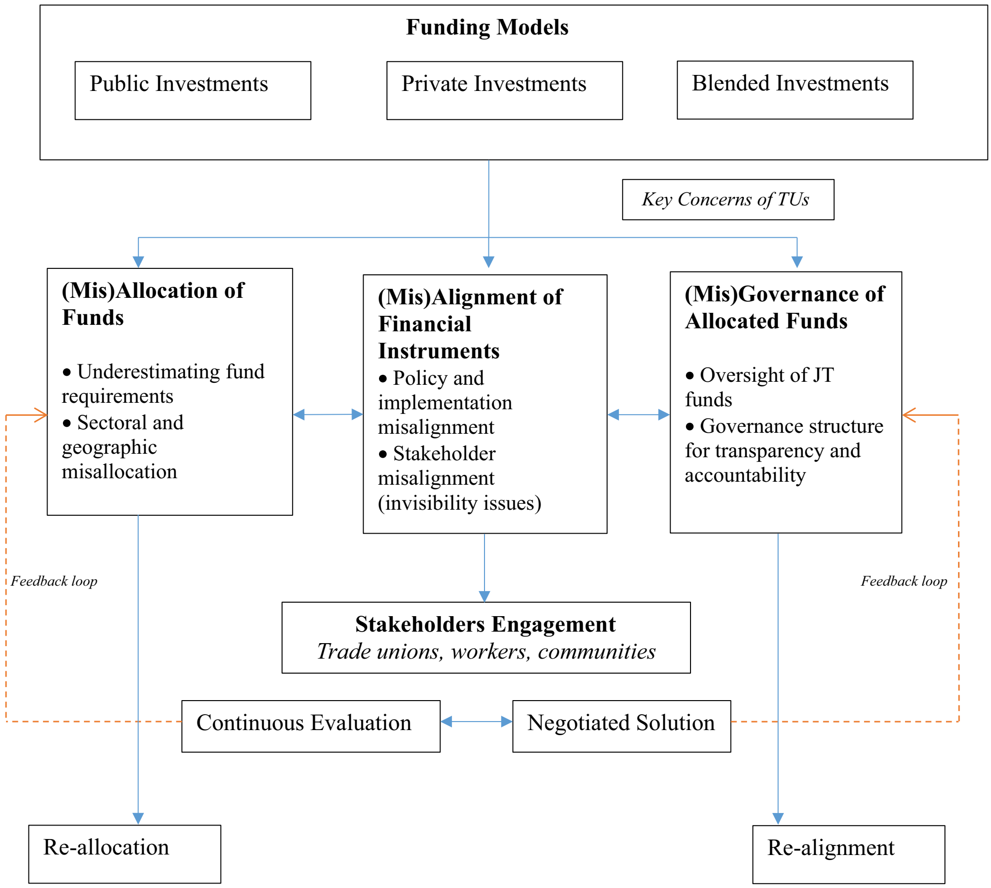

Figure 20.1 Financing a Just Transition in the Coal Sector in India

Source: Authors

20.5.1 The Financing Framework and Feedback Loops

Figure 20.1 encapsulates the funding models – public investments, private investments, and blended investments – employed to support JT. It delineates three primary concerns of trade unions (TUs): (mis)allocation of funds, (mis)alignment of financial instruments and (mis)governance of JT funds.

20.5.2 (Mis)allocation

Misallocation refers to the inefficient distribution or utilisation of financial resources designated for JT projects, leading to a failure in achieving the desired socio-economic outcomes. In the context of India's coal sector, misallocation can arise from both poor financial planning and structural inequalities within the carbon transition process.

Sectoral Misallocation happens when financial resources intended to aid workers in transitioning from coal are redirected to sectors that may not directly benefit the affected coal miners or their dependent communities. For instance, large portions of JT funds could be used to support the development of clean energy infrastructure, while neglecting the reskilling or social protection of workers whose livelihoods depend on coal mining. Nudging the market towards decarbonisation may hinder the transition's ability to be socially and economically inclusive, potentially exacerbating regional or sectoral inequalities and excluding vulnerable groups from its benefits (Moesker and Pesch, 2022; Storm, 2020).

Beneficiary Misallocation occurs when the financial benefits of JT are disproportionately distributed to certain categories of workers. Permanent workers, who often enjoy stronger protections under existing labour laws and union representation, may receive the bulk of JT funds. In contrast, contractual workers, who are typically more vulnerable due to their precarious employment status, may be and broader communities may not be sufficiently accounted for in JT planning, despite being integral to the local economy.

20.5.3 (Mis)Alignment

Misalignment refers to the disconnect between the envisioned objectives, strategies, and on-the-ground implementation. When the goals, actions, or entities involved in JT are not properly coordinated, it leads to inefficiencies, conflicting objectives, and unsatisfactory outcomes.

Policy and Implementation Misalignment arises when high-level policy frameworks and real-world execution fail to converge effectively. For instance, policies promoting renewable energy jobs may not ensure that these new opportunities are aligned with the skills and capacities of displaced coal workers. Achieving a JT requires more than merely technical solutions; it demands the political alignment of policies with the socio-economic realities of affected communities, especially to prevent exacerbating existing inequalities (Healy and Barry, 2017). Moreover, timing is critical – if support measures for coal workers and communities lag behind coal mine closures, the transition may exacerbate socio-economic instability instead of mitigating it.

Stakeholder Misalignment stems from inadequate stakeholder inclusion, which results in differing and often conflicting priorities. The exclusion of key stakeholders, such as TUs and local communities, from decision-making processes can result in their concerns about job security and community welfare being overlooked in a JT (Healy and Barry, 2017; ILO, 2022). This exclusion can lead to policies that do not fully address the needs of the very workers and communities most affected by the transition. The lack of visibility of contractual workers and informal sector participants further exacerbates this problem, resulting in imbalanced and unsustainable JT outcomes.

20.5.4 (Mis)Governance

Misgovernance refers to the lack of adequate oversight, transparency, or accountability in the management and distribution of funds allocated for JT. Misgovernance can result in funds being used improperly or failing to reach the intended beneficiaries.

Insufficient Oversight of JT Funds may lead to misgovernance. Without proper checks and balances, funds can be misused, diverted, or improperly accounted for, failing to meet their objectives especially in regions with entrenched governance issues. Critics argue that insufficient stakeholder participation risks perpetuating past justice issues, particularly related to distributive and procedural injustices, potentially undermine the fairness of JT funds allocation (Moesker and Pesch, 2022). TUs in particular emphasise the importance of transparent mechanisms that ensure JT funds are used effectively to benefit all workers, including contractual and community members.

An Effective Governance Structure for Transparency and Accountability requires the inclusion of diverse stakeholders, particularly TUs and affected local communities, in reflexive and participatory decision-making processes, ensuring that authoritarian practices are avoided and all voices are heard (Wang and Lo, 2021). Without this inclusivity, decisions may be made in a top-down manner, often failing to address the needs of those directly affected by the transition. For instance, if the governance structure lacks transparency, it could lead to a lack of accountability for the use of JT funds.

To mitigate these concerns, there is a need for continuous feedback mechanisms that reassess the allocation and utilisation of JT resources. A collaborative, inclusive approach – one that involves TUs, local communities, and other stakeholders – can help ensure a more equitable distribution of resources and avoid the negative consequences of misallocation. The feedback loops built into this model (represented as dotted lines in Figure 20.1) could facilitate continuous evaluation and recalibration of JT initiatives based on the evolving needs of the affected stakeholders. These loops allow for the reallocation of resources and realignment of JT goals in response to new information and changing socio-economic conditions. For example, if mid-term evaluations reveal that contractual workers are being disproportionately affected by mine closures, the feedback mechanism would prompt a redistribution of resources to ensure that adequate compensation and retraining opportunities are provided.

20.6 Practical Implications

The findings of this research carry practical implications for policymakers, TUs, and other stakeholders engaged in JT initiatives. First, while the model (Figure 20.1) is rooted in the Indian coal sector context, its flexible structure makes it applicable to other JT contexts, especially in the Global South. The inclusion of stakeholder feedback loops offers adaptability to various socio-economic conditions, making the framework versatile for evaluating the challenges of JT financing in different developing economies. Second, a centralised governance structure that includes TUs and other stakeholders could be effective in JT fund allocation and oversight. This structure ensures transparency, accountability, and fair distribution of resources. Moreover, exploring diverse funding sources, including public-private partnerships, international funding, and CSR initiatives, can help mobilise resources more efficiently. A participatory approach that fosters social dialogue and collaboration among all stakeholders is crucial for achieving equitable outcomes in JT.

Achieving a JT is recognised as a wicked problem due to its inherent complexity and the involvement of diverse stakeholders with competing interests. Nevertheless, continuous negotiations and a collaborative, inclusive approach can address financial, social, and governance challenges. By incorporating these elements, the transition to sustainable energy can be more equitable and beneficial for all stakeholders, particularly in developing nations reliant on coal.

Note

* The views represented in this chapter reflect the personal perspectives of the authors and do not represent the formal views or positions of the ITUC or any other affiliated organizations.

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Part 5

Public Resources

An Introduction

Mritiunjoy Mohanty and Runa Sarkar

The need for long-term patient capital which will allow financing of longer term goals related to transition and, if necessary, at less than market interest rates has been emphasised repeatedly in the preceding sections. In addition, finance for adaptation is widely recognised as an area that the private sector is dis-inclined to enter. Ideally, this is an area that national and multilateral development banks are best suited for. Their presence should help pull in private financial investors and work in tandem to deliver longer term capital requirements to meet energy transition as well as adaptation goals. This part discusses the role of public financial resources and how these might be leveraged in addressing issues related to climate change.

The first chapter in this part focuses on public financing mechanisms such as grants for the loss and damage (L&D) fund. The L&D fund is critical in financing resilience in the face of climate events. After providing an overview of the current state of the L&D fund, including its evolution and the challenges in operationalising it, Uma Pal, Runa Sarkar and Aanandita Sikka summarise the different funding mechanisms and governance structures that have been proposed till date. The L&D Fund is rooted in the principle of Common but Differentiated Responsibilities and Respective Capabilities, which recognises that the Global North bears the historical burden of greenhouse gas emissions. While vulnerable countries demand compensatory justice, wealthier nations reject liability and instead frame L&D as solidarity-based financial aid rather than legal reparations. India's position is complex: while it is the seventh most-affected country by climate change, its role as a rapidly developing economy complicates its eligibility for L&D funds. The authors conclude by making many recommendations for how to make the L&D fund more effective, including simplifying processes, building capacity and ensuring greater participation of civil society organisations (CSOs) and vulnerable community groups. Swathy Swaminathan emphasises the need for a unified approach towards L&D in Box 21.1.

Mritiunjoy Mohanty addresses the issue of climate adaptation and the need for public investment banks to finance both adaptation and mitigation initiatives in Chapter 22. He argues that the current Integrated Assessment Models (IAMs) used to inform climate policy are inadequate because they do not account for the complexities of the real world, such as institutional constraints and the role of the state in fostering technological change and have led to a neglect of adaptation in favour of mitigation. In addition, the use of neoclassical frameworks that overlook the impact of technological change on employment and therefore demand, mean that conclusions are overly optimistic. Drawing on both these, he proposes the creation of a publicly owned green investment bank, along

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the lines of Brazil's Banco Nacional de Desenvolvimento Econômico e Social (BNDES), which incorporates performance reviews into the public investment framework, thereby diminishing the possibility of rent-seeking. He argues that such a bank can play a catalytic role in promoting transformational investments in adaptation and resilience while also crowding in private investment. In Box 22.1 Swasti Raizada discusses the related issue of using the social discount rate in times of global warming. Mandar Patil and Prathamesh Mokal look at the role of municipal finance for promoting the use of EVs in cities and towns in Box 22.2.

In the last chapter in this part Ankit Kumar and Runa Sarkar adapt a New Keynesian Dynamic Stochastic General Equilibrium (DSGE) model to incorporate climate-related risks and propose modifications tailored to emerging market economies (EMEs) to explore whether green quantitative easing by the central bank is a feasible strategy to direct financial resources towards green investment. Using the Indian experience as a stylisation, specifically shallow financial markets, they explore four central bank interventions, namely directed green credit (incentivising banks to lend to green sectors via lower interest rates), differential reserve requirements (lowering reserves for green loans), differential capital requirements (adjusting risk-weighting to favour green investments) and green quantitative easing (QE). They suggest that central banks in EMEs must respond more aggressively to inflation volatility caused by climate risks. Green QE should initially focus on public sector green bonds before expanding to private assets. Banks should be incentivised to restructure their portfolios towards green investments. Credit regulation should be adjusted to include green reserve requirements but must avoid unintended distortions in private investment. Dhruba Purakayastha and Neha Khanna explore the role of Statutory Liquidity Ratio (SLR) in Box 23.1.

21 Grants and Granting Mechanisms for the Loss and Damage Fund

*Uma Pal, Runa Sarkar and Aanandita Sikka**

21.1 Introduction

When the Conference of Parties (COP) first met in 1995 in Berlin to assess progress in dealing with climate change, the climate change crisis was imminent. By 2010, when the COP was held in Bali, it was clear that the climate crisis was upon us and some countries were more affected than others, and the term loss and damage first appeared in the Bali Action Plan. Since then, the increasing frequency and intensity of extreme weather events such as cyclones and heatwaves and chronic events such as drought and sea level rise, attributed to rising average temperatures across the world over the years, continue to threaten the lives, livelihoods and habitats of people, ecosystem health and biodiversity (NASA n.d.). Moreover, the impacts of climate change are uneven, disproportionately affecting regions and communities due to a range of socio-economic, political, historical and cultural inequities, and high exposure to climate events and disasters, which limit their ability to cope with and bounce back from these devastating impacts. While collective action to reduce GHG emissions and adapt to the impacts of climate change has gained momentum, they continue to fall short of adequately tackling the intensity, frequency and scale of climate impacts, signifying the inevitability of certain losses and damages due to climate impacts (Thomas et al. 2018).

The Intergovernmental Panel on Climate Change (IPCC 2023), in its Sixth Assessment Report defines 'losses and damages'[1] as the 'harm from (observed) impacts and (projected) risks' which can be 'economic or noneconomic' (IPCC 2023). The report emphasises the irreversible impacts of the increase in the intensity and frequency of climate extremes and chronic climate events on communities, the built environment and nature. This irreversibility implies that in some cases, the impacts of the climate crisis will render human and natural systems unable to adapt. Note that loss generally refers to the irretrievable loss of land, ecosystems, or of human lives, while damage is about the costs of repair to infrastructure and property impaired as a result of climate change.

Adaptation action as a response to climate change refers to adjusting one's current practices, processes and institutional structures in response to the various manifestations of climate change so as to moderate potential damage or take advantage of potential opportunities from the change. However timely and effective it is, adaptation has its hard (associated with physiological responses to changing climates), and soft (arising from failures to implement adaptation interventions to effectively reduce vulnerability) limits, and therefore, cannot prevent all losses and damages (Mechler et al. 2020; IPCC 2023; UNEP 2023a, 2023b). Despite the contribution of some adaptation interventions to reducing vulnerability, losses and damages continue to disproportionately affect

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marginalised populations and vulnerable countries of the Global South (Thomas et al. 2018; Boyd et al. 2021).

The Paris Agreement, adopted in 2015, acknowledges the importance of averting, minimising, and addressing loss and damage associated with the adverse effects of climate change. Thus, loss and damage is now the 'third pillar' of international climate governance, situated to fill the lacuna created by the failure of mitigation and adaptation to prevent the attributable impacts of climate change (Jackson et al. 2023). Nevertheless, current governance, institutional and financial arrangements, especially in vulnerable developing countries, are not equipped to comprehensively address losses and damages (IPCC 2023).

The operationalisation of the landmark Loss and Damage (L&D) Fund during COP28 is a culmination of more than a decade of deliberations and negotiations. However, it is yet to be determined if the Fund, including funds, funding mechanism and its administration, will eventually be equipped to meet the loss and damage funding requirements of vulnerable countries (Tietjen and Gopalakrishnan 2023).

In this section, we discuss the evolution of the L&D fund, followed by a short discussion on climate justice and the challenges in operationalising a L&D fund. Section 21.2 delves deeper into the measurement challenges of L&D and offers some estimates. Section 21.3 starts with providing a snapshot of extant financial mechanisms and commitments made, highlighting the gap between the commitments and needs as assessed in Section 21.2. This is followed by some suggestions on possible financial mechanisms and some thoughts on the principles that could be used to arrive at a governance structure for the L&D fund. Section 21.4 concludes.

21.1.1 Evolution of the Loss and Damage Fund

Climate finance mechanisms have been established to support mitigation and adaptation efforts, and adequately addressing loss and damage remains a critical gap in the climate finance landscape. The concern about loss and damage was first brought up as early as 1991, even before the first conference of parties, by the Alliance of Small Island States (Boyd et al. 2021). The Paris Agreement, adopted in 2015, acknowledges the importance of averting, minimising, and addressing loss and damage associated with the adverse effects of climate change. Article 8 of the Agreement specifically addresses loss and damage, underscoring the need for international cooperation and support. Figure 21.1 provides a snapshot of the evolution of loss and damage fund from the time that it first found mention in the UNFCCC's negotiated text.

21.1.2 Climate Justice

That climate change is the outcome of the accumulation of greenhouse gases (GHGs) over centuries is well established and accepted. It is equally well known that the biggest contributors to this historical accumulation from the time of the industrial revolution are those countries who we broadly refer to as developed nations or the global north. Further, the most climatically vulnerable landmasses are found in countries commonly referred to as the global south, who have had little to contribute to the cumulative stock of GHGs historically, and are among the lowest emitters of GHGs on a per capita basis even till date. In this context, climate justice is anchored in the principle of Common but Differentiated Responsibilities and Respective Capabilities (CBDRRC), which establishes

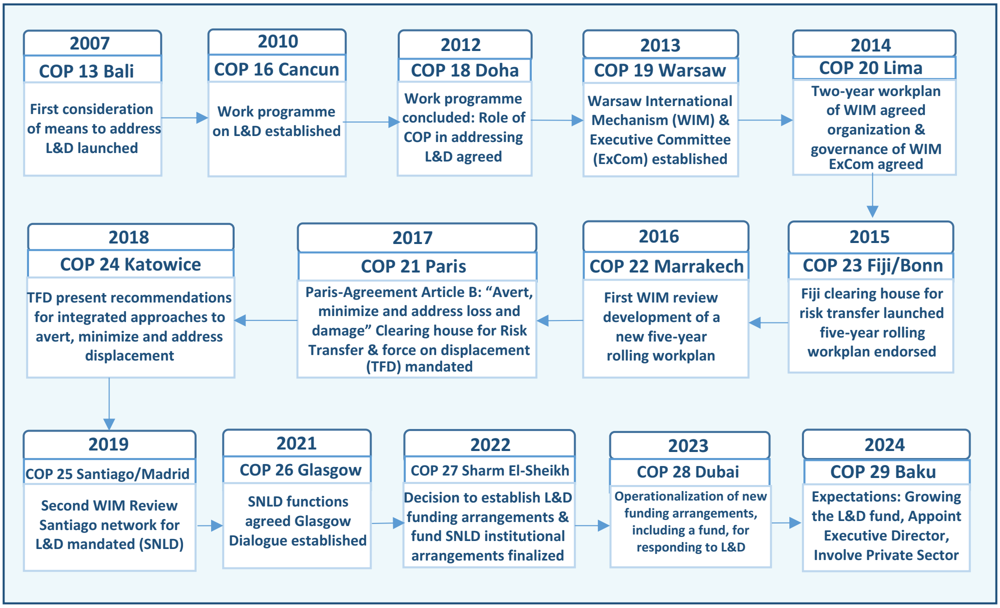

Figure 21.1 Loss and Damage Negotiations Timeline

Source: Redrawn and Extended by authors from fig 5.2 of Adaptation Gap Report (UNEP, 2023, p. 64)

the common responsibility of states for the protection of the global environment, but lays down different standards of conduct for developed and developing countries. Principle 7 of the 1992 Rio Declaration on Environment and Development cites two reasons for stricter standards of conduct for the global north. First, they contributed (and continue to contribute) more to global environmental problems, and second, they have greater technological and financial resources for climate action. However, the content of the CBDRRC principle and its application remain deeply contested.

The notion of a loss and damage fund is to compensate regions for those consequences of climate change beyond what the best adaptation and mitigation efforts can adapt to. It is being designed to assist 'developing countries that are particularly vulnerable to the adverse effects of climate change' (UNFCCC 2023). Small Island regions as well as regions between the two tropics face disproportionate losses and damages due to climate change, with projections indicating particularly high future impacts, especially as global temperature rise cannot be limited to a 1.5 C threshold. Therefore, there is an aspect of compensatory justice where claims for corrective liability, remedial responsibility and fair remedy can be made from developing nations. Unfortunately, the global north has made their stand clear on the issue of L&D that they don't view this as 'liability and compensation' for historical climate injustices, they acknowledge that vulnerable nations who are mostly situated in global south don't have the capacity to implement adaptation and mitigation measures without institutional help. Further, given the (historical) role of the global north in causing climate change and the inequitable impact of that on the global south, from the perspective of distributive justice and equity, the affected need to be compensated.

For India, the world's fifth largest economy, that is still developing, with high levels of inequality (WID 2022), the impacts of climate change could cause the country to lose 3–5% of its GDP by the end of the century (Picciariello et al. 2021). India is the 7th-most affected country by weather-related losses and climate risks according to the 2021 Germanwatch Global Climate Risk Index (Schäfer et al. 2021). In 2021 alone, storms and floods cost India USD 7.6 billion (WMO 2022). Without adequate climate action, the loss to India's GDP could be as high as 35% by 2048 (Swiss Re Institute 2022), or in a 3°C warming scenario, the cost for India could be up to USD 35 trillion by 2070 (Deloitte Economics Institute 2021). These exclude the indirect social costs associated with the impacts of climate change on social inequalities and biodiversity loss among others. Yet, developed economies led by the USA, as well as small island regions have emphasised that India and China should also pay climate reparations (Jain 2023). This is despite India's contribution to historical emissions being negligible. Though it seems that India is unlikely to benefit from the L&D Fund in the near future, various literature indicate that India can play a crucial role in negotiations and the shaping of how and where L&D finance will flow (Mishra et al. 2023).

21.1.3 Challenges

Despite the breakthrough in COP28 that laid the foundation for the operationalisation of the L&D fund, commitment has been slow, and concrete progress towards establishing the fund's governance structure, eligibility criteria and financial mechanisms is lacking. The viability of a dedicated L&D fund is faced with multiple challenges, starting with the interpretation of what exactly constitutes L&D, attribution of the damage to climate change, followed by how to maximise additionality[2] and minimise fragmentation of the fund.

21.1.3.1 Interpretation

L&D funds are expected to be earmarked for immediate relief and recovery, livelihoods protection, mental health support, ecosystem restoration and support for long-term reconstruction and rehabilitation from climate impacts (e.g., infrastructure and asset recovery, social cohesion building) both in cases of slow and rapid onset events. Boyd et al. (2021) discuss a spectrum of perspectives on L&D which can range from adaptation and mitigation to existential, which is how to address the harm done to vulnerable countries. What is evident from that discussion is that effective responses to L&D are diverse, complex and context dependent, which no list can anticipate or capture the complexity and context-specificity of. This is especially true for responses to non-economic losses and damages (NELD), which are closely tied to the economic dimensions of L&D. Thus, a standardised rules based approach predicated on a strict taxonomy may not be as effective as (recipient-led) needs assessments, following a value-based approach to losses and damages, to determine the activities to be funded in alignment with these objectives and purposes.

21.1.3.2 Attribution and Valuation

Since loss and damage may have multiple causes, it may be near impossible to attribute a certain quantum of loss and damage to climate change alone. Take for instance, the shrinking of the mangroves in the Sunderbans in India and Bangladesh. This can be attributed not only to sea-level rise (that is, climate change) but also due to a decline in sediment flows from the mainstream Ganges to its distributaries due to dams placed upstream in the river, as well as anthropogenic disruptions to the ecosystem as the size of population residing in this region increases.

The normative principles on which L&D financing has to be done to arrive at a reasonable valuation of L&D also needs more deliberation. Should damages be assessed using just an annual stock valuation of the loss, say, of a damaged embankment, or should it include the associated economic opportunity costs due to the loss of public good? Should the loss in ecosystem services be taken into account? Should one take a net present value approach for damaged infrastructure which would take years to replace and rebuild (Ghosh and Kumar 2023)?

Neither attribution nor valuation are insurmountable challenges, but they are tricky enough to warrant further attention and need detailing. Section 21.2 of this chapter addresses these issues.

21.1.3.3 Maximising Additionality

To ensure that the L&D fund is genuinely able to meet ‘the urgent and immediate need for *new,* additional, predictable and adequate financial resources’ (UNFCCC 2023), it is critical that existing development financing is not diverted to L&D. Given that there are almost no returns to L&D expenses (a recognition of climate change’s incurred costs), the source of L&D funds would be from the governments of wealthier countries, primarily as grant-in-aid. Thus there needs to be clear guidelines for donors to dedicate and quarantine ‘new and additional’ official development assistance (ODA) for this purpose, without drawing from or diverting existing aid budgets.

21.1.3.4 Minimising Fragmentation

Like health, global climate finance is now dispersed across dozens of multilateral and bilateral providers, each with their own requirements, procedures and processes. This places a significant burden on potential recipients, particularly smaller countries who are often the most vulnerable but also can find it the most difficult to access finance. This implies simplifying processes and building capacity.

21.2 Measuring Loss and Damage

Establishing a clear definition and measurability of loss and damage is a crucial first step for accelerating measures for preventing L&D. In this context, Figure 21.2 summarises the diverse perspectives on what constitutes L&D, based on different objectives and priorities.

A widely accepted definition which attempts to bring together various aspects of L&D, states that L&D aims to prevent and reduce the residual risks associated with the impacts of climate change, when adaptation and mitigation measures fall short of addressing adverse impacts (Effiong et al. 2024; Boyd et al. 2021). L&D can be categorised into three types: avoided L&D (the lowest category in Figure 21.2), unavoided L&D and unavoidable L&D or the highest category in Figure 21.2 (Schäfer and Balogun 2015). The first can be addressed through mitigation and adaptation efforts, the second arises

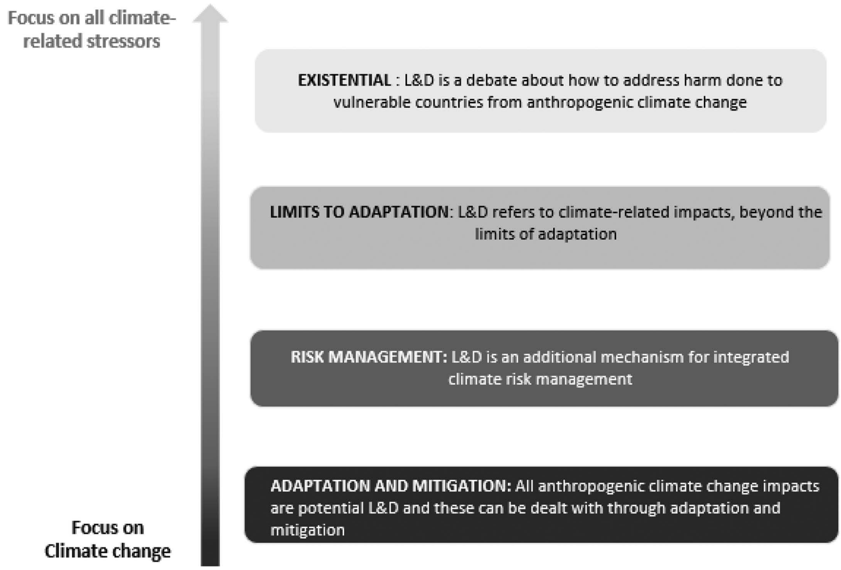

Figure 21.2 Diverse Perspectives on Climate-Change-Induced L&D

Source: Redrawn from Boyd et al. (2021)

when mitigation and adaptation efforts fall short of addressing losses and damages and the third results from the limitations of human and natural systems to adapt to climate change induced slow onset and extreme events. *We need to measure unavoided L&D and unavoidable L&D costs to arrive at an estimate of the quantum of funds to be dedicated to a L&D fund.*

L&D can be economic or non-economic, with the former caused by the impacts of climate change on goods and services that can be assessed using market prices, and the latter caused by impacts that cannot be easily quantified, especially in financial terms (Padin-Dujon 2023). Examples of economic loss and damage include damage to infrastructure, crops, loss of labour hours and revenue loss. Non-economic loss and damage (NELD), on the other hand, include harmful impacts on individuals, society, cultural heritage, indigenous knowledge, cultural identity and the biodiversity (UNFCCC 2024). Through classifying types of L&D across dimensions of materiality and economic L&D, Figure 21.3 provides a summary of the constituent of such a valuation exercise.

There have been attempts to quantify NELD from the impacts of climate change using multicriteria decision analysis, composite risk indices and qualitative or semi-quantitative methods (UNFCCC 2013). These approaches have subsequently been questioned on methodological grounds and usefulness. Alternate approaches present qualitative, descriptive and rights and power-based frameworks to unpack NELD beyond financial terms to shape strategic planning and responses (Padin-Dujon 2023).

1. Material and Non-Economic (Top-Left): Loss of culturally important landscape, Habitat destruction, Biodiversity loss, Destruction of cultural sites
2. Material and Economic (Top-Right): Loss of insured and uninsured assets, Reduced crop yield, Loss of productive land, Loss of infrastructure

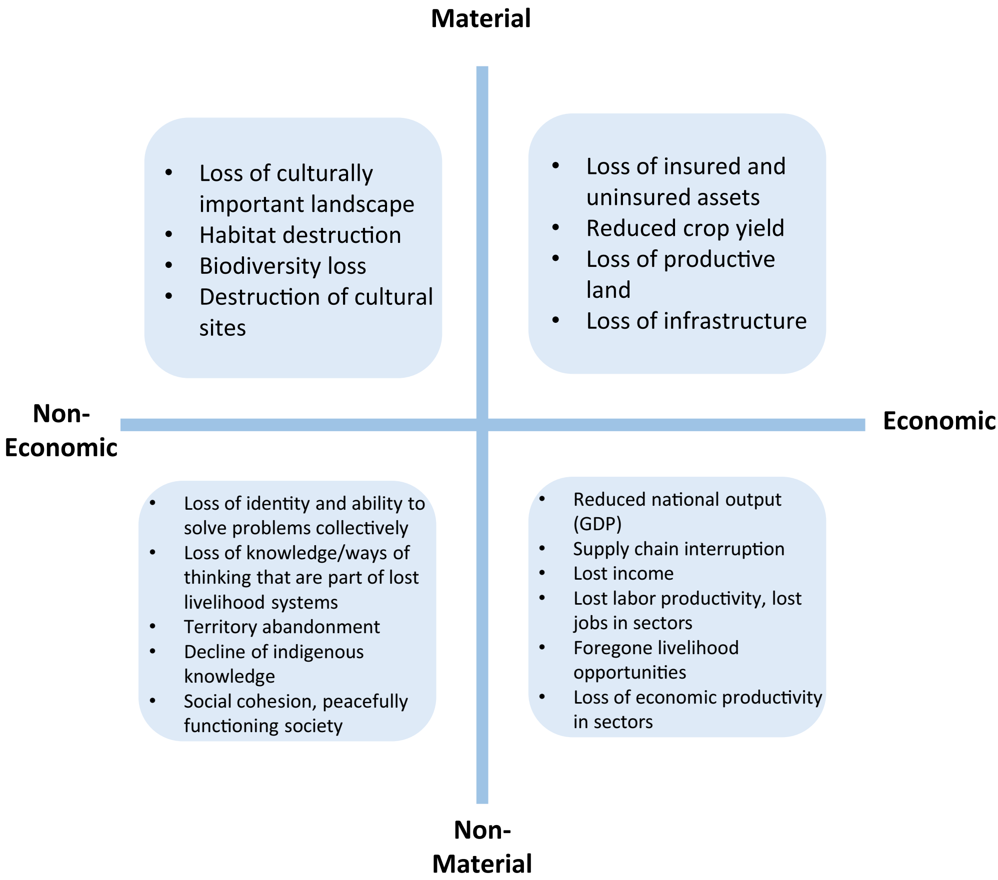

Figure 21.3 Types of L&D

Source: Redrawn from Schäfer and Balogun (2015, p. 6)

3. Non-Material and Non-Economic (Bottom-Left): Loss of identity and ability to solve problems collectively, Loss of knowledge/ways of thinking that are part of lost livelihood systems, Territory abandonment, Decline of indigenous knowledge, Social cohesion, peacefully functioning society
4. Non-Material and Economic (Bottom-Right): Reduced national output (GDP), Supply chain interruption, Lost income, Lost labour productivity, lost jobs in sectors, Foregone livelihood opportunities, Loss of economic productivity in sectors

21.2.1 *Approaches to Measure Loss and Damage*

Lessons from designing and implementing existing risk assessment approaches within disaster risk reduction (DRR) and climate change adaptation (CCA) can provide valuable insights into how these challenges can be overcome to best design L&D risk assessment frameworks (UNDRR and WMO 2020). While DRR, as its name suggests, originated as a bottom-up humanitarian emergency response to disaster events, it is seen as focusing on short-term relief rather than long-term resilience and therefore addressing mostly current and new foreseeable risks. In contrast, CCA is rooted in scientific theory and, originating from the international policy agenda, is associated with long-term perspectives and future risks. Of late, both approaches are converging towards each other. Welle and Birkmann (2015) summarises how the CCA approach to measure L&D differs from the DRR approach and lists some of the studies that have used these approaches. Table 21.1 provides a non-exhaustive list of impact and risk assessment tools, instruments and platforms that can be used to assess loss and damage (Schäfer and Balogun 2015).

21.2.2 Estimates of Loss and Damage

As the severity and frequency of climate extreme events, as well as the economic loss have been increasing with a greater impact on the developing world, the projected economic cost of loss and damage by 2030 for developing countries has been estimated to be between USD 290 and 580 billion (Mechler et al. 2018, p. 349). By 2050 the economic cost of loss and damage in developing countries is estimated to be between USD 1 to 1.8 trillion (Heinrich Böll Stiftung n.d.). Most estimates for L&D only measure economic losses for reported climate disasters (see Table 21.2 for some examples).

Estimates of economic losses are likely underestimates due to data gaps and underreporting. The UNDRR (2020) report states that from 2000 to 2019, only 13% of all disaster events in Africa and 23% of all events in South Asia reported any economic losses, underscoring the extent of underreporting.

Table 21.3 summarises the economic and humanitarian impact of major climate and weather events in developing countries in 2022, which amounts to USD 91.5 billion. Note that weather events are only one of the many components of loss and damage.

21.3 Financing Loss and Damage

As is evident from Sections 21.2.1 and 21.2.2, measurements and estimates for L&D need to be underpinned by a strong framework which recognises the multidimensionality and complexity associated with it. The building blocks for such an exercise would then lead to a framework for financing L&D. Building on the CCA and DRR approaches, we classify L&D into avoidable but unavoided L&D (failure of adaptation and mitigation) and unavoidable L&D (slow and sudden onset risks that are becoming increasing irreversible). We can use risk management finance and risk finance mechanisms to address losses because of the failure of adaptation and mitigation. To address the residual impacts of climate change that are beyond adaptation, that address the socio economic and human impact of climate change with little or no private return, we use curative finance mechanisms. Table 21.4 summarises this framework with some suggestions on the kinds of instruments that could be used under each mechanism.

21.3.1 Loss and Damage Funding Arrangements

21.3.1.1 Existing Arrangements

Existing commitments for loss and damage (see Table 21.5) leave a lot to be desired and the funding gap will keep increasing as the impact of climate change, especially on the global south becomes more intense. Not only is the quantum of commitment insufficient, many of these are contributions to Global Sheild and other insurance programs, which are

Table 21.1 Loss and Damage Risk Assessment Approaches and Tools within DRR and CCA

DISASTER RISK REDUCTION			*CLIMATE CHANGE VULNERABILITY AND ADAPTATION*	
Comprehensive impact and risk assessment	*Pre-disaster risk assessment*	*Post-disaster risk assessment*	*Vulnerability assessment*	*Climate change adaptation assessment*
Natural Disaster Hotspot - a world bank report on global risk analysis for disaster management - https://documentsl.worldbank.org/curated/en/621711468175150317/pdf/344230PAPERQNal10lofficialOuse0onlyl.pdf	**Comprehensive Approach for Probablistic Risk Assessment** (**CAPRA**) – CAPRA is a technoscientific methodology and information platform, composed of tools for the evaluation and communication of risk at various territorial levels.	**Disaster Loss Assessment Guidelines –** Provide an explanation of the process of loss assessment and guidelines for the steps required to carry out an economic assessment of disaster losses.	**Climate Vulnerability Monitor** – The Monitor comprises 34 indicators of the economic, human and ecological effects of climate change and the carbon economy. www.v-20.org/climatevulnerabilitymonitor	**Climate Change Risk Assessment –** Deployed by Dept for Environment, Food and Rural Affairs of the UK to analyse the key risks and opportunities that climate change bring to the UK.
World Risk Index – a report published jointly by IFHV and Bündnis Entwicklung Hilft, that indicates the disaster risk from extreme natural events and negative climate change impacts for 193 countries in the world. https://weltrisikobericht.de/worldrisk report/#downloads	**Catastrophe simulation Model** (**CATSIM**) – Helps policymakers, particularly in developing countries, devise public financing strategies to be implemented in both the pre- and post-disaster context.	**DesInventar** – Tool for the construction of databases of loss, damage, or effects caused by emergencies or disasters. www.desinventar.net/	**Participatory Vulnerability and Capacity Assessment** (**Part of Participatory Assessment of Disaster Risk – PADR**) – Tool for participatory assessment of vulnerability on the local level by using meetings with community leaders, focus group meetings and informant interviews. www.preventionweb.net/publication/participatory-assessment-disaster-risk-padr	**Climate Change and Environment Degradation Risk and Adaptation Assessment** (**CEDRA**) – CEDRA helps agencies working in developing countries to access and understand the science of climate change and environmental degradation and compare this with local community experience of environmental change.
	Handbook for Estimating the Socioeconomic and Environmental Effects of Disasters (**also for post-disaster**) – Describes the methods required to assess the social, economic and environmental effects of disasters	**Climate Vulnerability and Capacity Analysis** (**CVCA**) – Methodology to help understand the implications of climate change for the lives and livelihoods of the most vulnerable by combining local knowledge with scientific data. https://caredimatechange.org/cvca/		

(*Continued*)

Table 21.1 (Continued)

DISASTER RISK REDUCTION			*CLIMATE CHANGE VULNERABILITY AND ADAPTATION*	
Comprehensive impact and risk assessment	*Pre-disaster risk assessment*	*Post-disaster risk assessment*	*Vulnerability assessment*	*Climate change adaptation assessment*
Global Climate Risk Index – Determines the risk of becoming the victim of a disaster as a result of natural hazards for 173 countries throughout the world. www.germanwatch.org/en/cri	**Community based disaster risk management (also for post-disaster) –** Training manual for the inclusion of local actors in application of measures in risk analysis, disaster prevention and mitigation and disaster preparedness.	**Assessing Damage after Disasters: A participatory Framework and Toolkit –** Tool for field practitioners working in postdisaster humanitarian response, a participatory and vulnerability focused framework and appropriate effective tools to carry out the multi -sectoral damage assessment.	**The Vulnerability Sourcebook –** Standardised approach to vulnerability assessments covering a broad range of sectors and topics (e.g. water sector, agriculture, fisheries, different ecosystems) as well as different spatial levels (community, sub national, national) and time horizons (e.g. current vulnerability or vulnerability in the medium- to long-term). www.adaptationcommunity.net/download/va/vulnerability-guides-manuals-reports/vuln_source_2017_EN.pdf	**Climate Risk Assessment Guide –** Process to assess the impacts and outcomes of dimate – related events on lives and livelihoods in Central Asia.

Source: Adapted from Schäfer and Balogun (2015, pp. 24–28)

Table 21.2 Global Estimates of Loss and Damage

	Estimates	*Comments*
Climate Analytics, Research commissioned by Oxfam (2015)	USD 425 Billion in 2030, USD 1550 billion in 2050, for the developing world	Conservative projected estimates, using an AD-RICE2012 model, assuming countries meet their INDC commitments. All numbers are in 2012 dollar value https://oxfamilibrary.openrepository.com/bitstream/handle/10546/582427/rr-impacts-low-aggregate-indcs-ambition-251115-en.pdf;jsessionid=C2BF26E9CF0705630671F3821B7C7AE9?sequence=1
Gallagher Re (insurance Company)	USD 301 Billion for the world (2023)	Only climate disasters measured, there has been a slow upward trend in direct economic costs during this time (+2.2% annual rate of growth) www.ajg.com/gallagherre/-/media/files/gallagher/gallagherre/news-and-insights/2024/january/natural-catastrophe-and-climate-report-2023.pdf
UNDRR (2020)	USD 2.262 trillion, (2000 to 2019) for the world	This pertains to only climate disasters, but is an underestimation given under-reporting of losses worldwide Between 2000 and 2019, over 4 billion people worldwide were affected by disasters and over 1.2 million people lost their lives, the top ten countries affected by disaster all belonged to the global south Storms cost more than any other disaster type in terms of recorded economic damage (1.39 trillion USD), followed by floods (651 billion USD) www.undrr.org/publication/human-cost-disasters-overview-last-20-years-2000-2019

Source: Compiled by authors from various sources

Table 21.3 Economic and Humanitarian Impact of Major Climate and Weather Events in Developing Countries in 2022

Date(s)	*Event*	*Location*	*Deaths*	*Economic Loss (USD)*
Jun 14-Sep 10	Flooding	Pakistan	1,739	50.0+ billion
Jun 01– Nov 30	Flooding	China	195	15.0+ billion
Jan 01–Dec 31	Drought	China	0	7.6+ billion
May 17–Oct 31	Flooding	India	2,135	4.2+ billion
Jan 01–Dec 31	Drought	Brazil	0	4.0+ billion
Apr 08–Apr 15	Flooding	South Africa	455	3.6+ billion
Jul 01– Oct 31	Flooding	Nigeria	660	2.3+ billion
Sep 18– Sep 25	Hurricane Fiona	Caribbean, Canada	31	2.0+ billion
Jan 01–Dec 31	Drought	Somalia, Ethiopia, Kenya, Malawi	0	2.0 billion
Jan 01–Dec 31	Drought	Mexico	0	1.5+ billion
Feb 16– Feb 22	Winter Weather	China	1	795+ million
Jan 15–Feb 28	Wildfire	Argentina	0	770+ million
Oct 05– Oct 10	Hurricane Julia	Central America, Mexico	37	762+ million
Sep 01– Sep 06	Super Typhoon Hinnamnor	Japan, South Korea, Philippines	14	650+ million
Apr 28– May 09	Heatwave	India, Pakistan	90	Not quantified

Source: Authors compilation from Richards et al. (2023)

Table 21.4 Building a Financing Framework for L&D Finance

Avoidable but unavoided losses and damages		*Unavoidable losses and damages*
Risk Management Finance	*Risk Finance*	*Curative Finance*
Finance sources for supporting incremental and transformational risk assessments, risk reduction and risk financing measures	Risk financing mechanisms that transfer or retain residual risks	Financing for dealing with unavoidable risks
• National budgets • International donor assistance and aid • Resilience-themed bonds • Ecosystem Si livelihood restoration and rehabilitation funds	National and regional risk pooling and financing (incl. catastrophe risk insurance) • Catastrophe bonds • Social protection schemes • National and regional reserve/contingency funds	National, regional and global loss distribution and compensation mechanism
• National contingency finance with risk reduction provisions, e.g. in contingency trust funds (revolving funds) • National and regional risk pooling and risk transfer with built-in risk reduction incentives/requirements		

Source: Adapted from Gewirtzman et al. (2018)

Table 21.5 Commitments for a Loss and Damage Fund

Contributor	*Announced (millions)*	*Commitments in USD (millions)*
Austria	EUR 10	10.80
Canada	CAD 16	11.60
Denmark	DKK 175	25.50
Estonia	EUR 0.5	0.50
European Commission	EUR 25	27.10
Finland	EUR 3	3.26
France	EUR 100	108.90
Germany	USD 100	100.00
Iceland	EUR 0.6	0.60
Ireland	EUR 25	27.30
Italy	EUR 100	108.90
Japan	USD 10	10.00
Netherlands	EUR 15	16.30
Norway	USD 25	25.00
Portugal	EUR 5	5.45
Republic of Korea	USD 7	7
Slovenia	EUR 1.5	1.63
Spain	EUR 20	21.70
United Arab Emirates	USD 100	100.00
United Kingdom	GBP 40	50.60
United States of America	USD 17.5	17.50
Total		**679.7**

Source: UNFCCC 2024 (as communicated by the COP28 Presidency) not suited to climate events which are not probabilistic in nature any more. Estimates suggest that the USA's fair share of L&D finance would be of the order of USD 20 billion in 2022, rising to USD 117 billion annually by 2030; while France's share would be €2 billion per year, rising to €5.32 billion per year in the period 2025–2030 (Richards et al. 2023)

21.3.1.2 Effective Funding Arrangement Options

L&D funding has to be grant based or at best concessional in nature. It should be related to economic and NELD from climate change, and free from political or trade-related biases. Least Developed Countries (LDCs) and Small Island Developing States (SIDS) should be prioritised, given their vulnerability. This specialised (grant based with no conditionalities) financing can then be used to leverage a range of financial mechanisms.

Greater use of rich countries' Special Drawing Rights (SDRs), a form of reserve currency issued by the International Monetary Fund (IMF), for L&D could be a possible avenue of funding. Options to use SDRs for loss and damage have been explored by Mark Plant from the US-based Center for Global Development. To be effective, SDR based loans and low or no interest would have to be intermediated by development banks who are prescribed holders of SDRs. Plant argues that while the reserve asset strictures governing SDRs make their use challenging, 'SDRs could be useful for financing some part of L&D but within the narrowly defined set of procedures and institutions' (Plant 2023).

Debt swaps, where existing debts are forgiven, could be used to redirect funds towards climate responses. Debt forgiveness as a form of loss and damage finance, or 'debt-for-climate' swaps that involve providing debt relief to offset loss and damage costs, particularly in the wake of climate-induced disasters, could be an alternative means of L&D funds that meet the requirement of generating additionality. However, there are complexities and trade-offs, as one would have to decide how to share the (forgiven) debt burden among public and private creditors. *Further, if the global north start counting debt relief for L&D as part of their official development assistance (ODA) budgets, additionality gets diluted.*

A more direct mechanism, with the most additionality, would be the use of International tax and transfers, such as taxing windfall profits from fossil fuels (as proposed by the UN Secretary General), levies on international container shipping, financial transactions and/or airline travel. The proceeds of these levies could either be used directly to meet assessed costs via the new fund, or pooled by governments to help purchase tailored insurance products or develop investment schemes for climate-vulnerable nations. This approach has been successful under the Clean Development Mechanism, which administered a 2% levy on Certified Emissions Reduction to replenish the Adaptation Fund. However, the challenge would be to ensure that these levies don't have unintended consequences for those vulnerable countries that they are trying to assist. For example, in the context of a tax on shipping proposed by the International maritime organisation some scholars have suggested that revenues raised in developing countries could also be collected and spent domestically, e.g. through national funding entities, to ensure no net incidence on developing countries (Hirsch et al. 2019; Haque and Khan 2019).

Innovative products like L&D credit trading, L&D bonds etc. could entice private finance. Borrowing from a page from India's regulatory rulebook, governments could mandate profit-making corporations to park a specific fraction of their CSR funds in L&D-related expenditure.

Due to the perceptions of public finance likely being insufficient to meet the scale of funds required for L&D, multiple funding sources beyond just public finance, need to be integrated. The L&D fund could reach out to philanthropic organisations, foundations, the private sector, and alternative funding sources. Other ideas raised included blended finance, bilateral finance and litigation approaches.

21.3.2 Structure and Governance

A L&D fund sources its finances globally but disburses locally. Hence, a multi-tiered governance approach, that provides broad oversight and accountability while delegating decision-making power to affected groups over actual disbursements is recommended. Examples of institutions with such structures are the Global Greengrants Fund and the Global Fund to fight AIDS, Tuberculosis and Malaria.

While there are several compelling reasons to consider a dedicated, standalone agency with its own bureaucracy to administer the L&D fund, efficiency and effectiveness considerations dictate that developing a wing within existing institutions such as the Global Environment Facility or the Green Climate Fund would minimise fragmentation. This could also enable conversations between mitigation and adaptation and loss and damage efforts, which are critical.

Given its public good nature, the L&D fund must be delivered through government systems and budgets as much as possible, as the fund would basically be compensatory in nature. One could explore developing a recipient accreditation system based on existing public expenditure assessments compiled by institutions such as the World Bank for L&D flows. Since L&D funds must flow when needed irrespective of political affiliations, one would also advocate capacity building and involvement of alternative accredited local partners where there are genuine fiduciary concerns.

L&D is a local issue, and hence greater operational control must rest with the executing agency whether they are governments or accredited local partners. The governance structures must necessarily be participatory and representative of civil society organisations (CSOs) and most vulnerable community groups, while also enabling urgent decision-making. One way of structuring an arrangement that is both bottom-up and top-down is suggested in Chapter 8, which leverages the similarity of weather and social parameters in contiguous nations to maximise the effectiveness of climate interventions across boundaries.

Since the L&D fund would contribute both to longer-term slow-onset events and sudden onset events, it could have different windows for funding each. While there would be country-specific funds for anticipated slow-onset events, trigger based mechanisms could be put in place to activate immediate recovery and relief activities for sudden disasters. This could include channelling emergency funds through local CSOs with quicker (and greater) access to marginalised and vulnerable communities.

21.4 Discussion and Conclusion

This chapter has attempted to put together extant understanding of the need for and mechanism of institutionalising an effective L&D fund. Starting with a discussion on the evolution of the concept of a L&D fund, couched within social justice, the chapter has gone on to first shed light on the challenges with respect to defining and measuring L&D and then has highlighted the glaring differences between actual estimates of losses and commitments towards L&D made thus far. This is followed by a discussion on possible funding sources and mechanisms followed by some ideas on an ideal governance

Box 21.1 Bridging Climate Finance and Loss and Damage (L&D): A Unified Approach

Swathy Swaminathan

Effective integration of Loss and Damage into the broader landscape of global climate action is crucial. L&D cannot be viewed in isolation but must be embedded in a collective international effort involving both developed and developing nations. International cooperation, including North-South and South-South collaborations, is essential for mobilising resources, sharing best practices, and ensuring equitable financial flows to the most vulnerable.

Importantly, L&D initiatives must reject a top-down approach. The GCF, while pivotal in supporting climate-resilient development, is not the ideal model for Loss and Damage, given its broad focus and slower processes. Successful outcomes depend on bottom-up strategies where local actors, including communities and Civil Society Organisations (CSOs), lead the way in designing and implementing customised solutions. These local stakeholders are intimately familiar with the risks and realities faced on the ground, making their involvement crucial for the success of L&D programmes. CSOs are essential in the L&D space because of their agility and adaptability, traits that larger institutions like the Green Climate Fund (GCF) often lack. L&D efforts must prioritise agile, responsive mechanisms that can deliver immediate and appropriate support to communities affected by climate-induced disasters. CSOs engaged in activities such as disaster relief can mobilise quickly, often delivering aid more efficiently and in a more targeted manner.

The complexity and diversity of the impacts caused by climate change demand that L&D solutions be highly customised. There is no 'one-size-fits-all' approach, as different communities and regions experience unique challenges. Small island states, for instance, face existential threats that require immediate adaptation and resilience-building strategies, while other areas may need more robust systems to cope with extreme weather events or sea-level rise.

Innovative financing mechanisms, such as climate risk insurance and catastrophe bonds, offer potential pathways to mobilise additional resources for L&D. For example, climate risk insurance schemes like the African Risk Capacity (ARC) and the Caribbean Catastrophe Risk Insurance Facility (CCRIF) have shown promise in providing timely and predictable funding to countries affected by climate-related disasters. These tools can complement traditional finance mechanisms by offering rapid disbursement in the aftermath of disasters, reducing the financial burden on national governments.

By integrating L&D funding into broader climate financing structures, it is possible to create synergies that allow for more effective, targeted interventions. Adaptation projects, for instance, can reduce long-term L&D risks, and co-benefits between these areas can be leveraged to maximise the impact of financial flows.

In conclusion, Loss and Damage cannot be adequately addressed without collective global action, bottom-up governance, and tailored localised solutions. Vulnerable communities, especially in regions facing existential threats, must be at the heart of any L&D strategy, and financing mechanisms must be agile, responsive, and designed to meet the specific needs of those most affected by climate change. International cooperation and innovative financing can help close the gap, but only if they prioritise inclusivity and justice.

structure for the fund. At the end, the objective is to arrive at a fund that can attract grants at scale to administer an implementable and just L&D mechanism.

Our assessment suggests the need for an inclusive and full-spectrum approach towards funding arrangements. L&D compensation activities require complementarity on the ground with different funding streams of adaptation, development, humanitarian aid and loss and damage support. Leveraging public grants to access other forms of financial support that have synergies with other forms of climate finance could help magnify the quantum of resources needed. Equally, an important aspect to keep in mind while designing this is that mitigation and adaptation initiatives must work in tandem, that is, speak to each other. In doing this, we leverage complementarities and make best use of scarce public resources.

Such a fund must be able to integrate the local grassroots wisdom into the scalable, knowledge, accountability and efficiency driven multilateral agency system seamlessly. Having multiple boards, across regions and functions, with CSOs and representatives of the most vulnerable nations on the boards may be explored. Headquartering the L&D fund in a country belonging to the global south may be an important symbolic statement to make. To make the administration of L&D funds truly just and inclusive, it must be about vulnerability and impact, which is often at the regional level. For this, whereas being a part of the political dialogue is important, it must be decoupled from party political positions and ideological differences. The recognition that climate events do not honour political boundaries must change the way disaster relief is administered through accountable and capable CSOs in consonance with local and regional governments.

Finally, however, the future of the L&D fund remains contingent on the political buy-in from affected national governments and how seriously they are willing to pursue the cause, and equally if not more on the global north acknowledging its common but differentiated responsibility towards compensating the global south for the follies of the past.

Notes

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1 The IPCC WG II report differentiates between 'losses and damages' and 'Loss and Damage'. According to its Glossary, 'Loss and Damage' refers to "political debate under the UNFCCC following the establishment of the Warsaw Mechanism on Loss and Damage in 2013". In this chapter, we are using the two terms interchangeably.

2 Additionality refers to "additional' funding over and above what has already been planned and committed, and therefore not diverted from funds meant for mitigation, adaptation or any other development activity.

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22 Back to the Future

A Case for a Green Investment Bank

Mritiunjoy Mohanty

The chapter has as its starting point the neglect of adaptation in integrative assessment models (IAMs), a class of influential climate change models. It incorporates heterodox views of development and growth which run counter to dominant IAM views. It then goes on to argue that the shift of focus to adaptation and resilience will require institutional change in terms of developing public sector investment banks which will go where the private sector will not. The chapter is divided into 7 sections: Section 22.1 analyses the economic assumptions underlying IAM models; Section 22.2 discusses heterodox economic viewpoints on climate change and development experience; Section 22.3 is a snapshot of the current state of play of the Indian economy and how is both faces stagnation and financial fragility; Section 22.4 discusses why adaptation has to be taken seriously in climate change policy; Section 22.5 discusses the need for a public investment bank and lessons from Brazil's Banco Nacional de Desenvolvimento Econômico e Social (BNDES) on design and structure; Section 22.6 looks at some innovative grassroots adaptation projects; Section 22.7 closes.

22.1 Unpacking Integrative Assessment Models

At the heart of IPCC's assessment of plausible mitigation pathways to ensure that global warming remains within 1.5–2 degrees Celsius above pre-industrial levels are IAMs (see for example IPCC Special Report 'Global Warming of 1.5°C'). As Hare, Brecha and Schaffer (2018) explain 'IAMs couple detailed models of energy system technologies with simplified economic and climate science models to evaluate different population, economic and technological pathways, allowing an assessment of the feasibility of achieving specific climate change mitigation goals' (p. 1).

Like so much else about climate change, IAMs are controversial and their utility hotly debated. For example, Kevin Anderson (in Anderson and Jewell (2019) has argued that 'Behind a veneer of objectivity, the use of these leviathan computer models has professionalized the analysis of climate-change mitigation by substituting messy and contextual politics with non-contextual mathematical formalism'. On the other hand, Jessica Jewell (in Anderson and Jewell (2019), avers:

> By providing crucial knowledge about the driving forces of climate change and the magnitude of transformations needed to reverse these forces, IAMs play a central part in the climate debate. . . . [T]he main contribution of these scenarios was

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the warning that existing trends would lead to dangerous global warming in the twenty-first century.

However, even those who agree that IAMs may be useful, argue that they are institutionally under-specified or do not incorporate historical data about actual instances of technological change into their models.

For example, Bertram et al. (2024) argue:

> The results show *that technological constraints are not the most critical concern for mitigation,* given the latest acceleration of observed deployment in key mitigation technologies. . . . *[T]he most important dimension studied, however, is the institutional dimension.* Our results show that explicit consideration of institutional constraints allows for delineating a plausible, though fuzzy, lower limit of peak temperature increase. The nuanced results show that both the assumptions on the relationship between government effectiveness and feasible mitigation ambition and the built-in model difference have an impact on results [emphasis added]. (p. 958, p. 959)

See also Jewell and Cherp (2019) and (2023) incorporating respectively political constraints into IAMs and historical reference points into the analysis to define 'feasibility spaces'.

Therefore, in my view, in line with scholars such as Kevin Anderson, IAMs may not be fit for purpose because the plausible pathways that they point to may be misleading, as they do not account for the feasibility of these pathways. Second, the models assumptions do not allow us to consider pathways that may be feasible (Jewell and Cherp 2019, 2023; Bertram et al. (2024). It is useful to remember in this context that we are well on our way to 3 degrees. As Simon Stiel, the Executive Secretary of UNFCCC, noted in his closing remarks at the end of COP 28 in Dubai 'We are currently headed for just under 3 degrees'.

22.2 Heterodox view of Climate Change Pathways

From my standpoint, as a heterodox macroeconomist, what is equally troubling is that IAMs use panglossian assumptions of neoclassical equilibrium economics. As Hare, Brecha and Schaffer (2018) note:

> Economic system modeling . . . often starting with assumptions that world markets are in equilibrium and functioning efficiently, with perfect information available to all equally-placed actors. These models can take different assumptions on future foresight, from perfect over all time foresight to what is called myopic, or short-term foresight. (p. 5)

Or as Kevin Anderson notes (in Anderson and Jewell (2019):

> Typically, IAMs use models based on free-market axioms . . . [m]odels assume marginal changes near economic equilibrium, and are heavily reliant on small variations in demand that result from marginal changes in prices. The Paris climate agreement, by contrast, sets a mitigation challenge that is far removed from the equilibrium of today's market economy.

Finally, and from our standpoint particularly important, IAMs do not incorporate 'avoided negative externalities' (see Hare, Brecha and Schaffer (2018). Or to put it more plainly, successful adaptation strategies, where one is able to ameliorate and/or contain the negative effects of climate change events are not included in IAM modelling.

As Taylor (2008) establishes, labour productivity growth, which underpins growth in living standards and rising prosperity, has historically been associated in increases in the productive use of energy. And as Taylor et al. (2021) note, 'The International Panel on Climate change (IPCC) does not seem to have taken implications of this observation on board'. To the extent that this energy is produced by burning fossil fuels, labour productivity growth will generate greenhouse gas emissions. In addition, those of us who work in the tradition of Keynes-Kalecki-Kaldor do not assume that markets are self-regulating in search of equilibria or that market frictions will be solved by mean-reverting markets. In our world output is demand determined, and as Rezai, Taylor and Foley (2018) note:

> Income distribution has an immediate impact on output and growth. If there is insufficient demand for labour, unemployment results. For a given level of economic activity, higher labour productivity destroys jobs. High levels of unemployment weaken the bargaining position of workers and lead to lower wages. Faster productivity growth has the potential to increase living standards but also the potential for a less equal distribution of income and lower levels of employment. Climate change worsens the problem. (p. 165)

As they note, technically speaking, mitigation, by lowering energy demand could solve this problem. But as Taylor et al. (2021) note:

> A demand-driven model of economic growth is used to illustrate why front-loading of mitigation is essential. The IPCC has been prescient in advocating early mitigation, but it perhaps overestimates the possibilities for breaking away from the close relationship between use of fossil fuel energy sources and growth of output per capita. (pp. 2–3)

As Semieniuk et al. (2020):

> The simple idea of "getting the prices right", by imposing high corrective carbon prices or equivalent policies, must contend with two centuries of economic history. *Achieving sustained and fast economic growth from low levels has been far from the norm since the 1950s, and where it has been achieved it was universally by industrialisation* [emphasis added]. (p. 8)

It is in that light that one must read what the IPCC-IAM mitigation pathways imply. Again as Semieniuk et al. (2020) note,

> Stringent mitigation policy strives to break (some of) these historical trends. . . . Scenarios of the IPCC special report calculate that in order to achieve the 1.5°C goal, a structural break from historical total energy-income relationships is needed in the coming twenty years. . . . Scenario pathways in contrast combine robust growth in per capita GDP with *an unprecedented sustained reduction in final-energy/capita, particularly in the 2020s and 2030s* [emphasis added]. (p. 5)

Perhaps one of the biggest shortcomings of IAMs is the way technological change and technology development is modelled (or not). And this is entirely the result of 'free-market axioms' priors and as Kevin Anderson has already noted IAMs 'assume marginal changes near economic equilibrium, and are heavily reliant on small variations in demand that result from marginal changes in prices'. As a result, they not only miss out on technological change that is disruptive but also the role of the state in fostering both non-disruptive and disruptive technological change. As Hare, Brecha and Schaffer (2018) note:

> IAMs are designed to consider gradual changes to existing systems and are therefore not very good at capturing rapid technological advances such as recent rapid advances in deployment of solar photovoltaics and the decreasing costs of renewable energy and energy storage . . . [A]lmost by definition, IAMs model established technologies and trends much better than newer technologies. (p. 2)

As a result, and unsurprisingly, 'IAMs have been "surprised" in recent years by the dramatic cost improvements of renewable energy technologies compared to fossil fuels' (p. 7). Oddly enough, the one technology option that many IAMs do use is that of carbon capture and storage (CCS) 'despite the fact that this technology when deployed with fossil fuel power plant is now widely seen as a relatively expensive mitigation option with an uncertain future' (Hare, Brecha and Schaffer (2018, p. 2). See also Farajzadeh et al. (2020) and Robertson and Mousavian (2022).

On the other hand, what we do know of technological change and technology development is that far from being determined by the 'free market', the state has played a very important and key role in shaping and fostering both, through public investment and provision of patient finance, particularly in the early stages of the innovation process where normally the private sector hesitates to enter (see for example Chang (2002), Block and Keller (2011), Mazzucato (2013), Nayyar (2015), Reinert (2019), Mazzucato and Macfarlane (2023) and Block, Keller and Negoita (2024)). As Mazzucato and Macfarlane (2023) note: 'In these places, the state has not just sought to fix market failures but has acted boldly to create new technological and industrial landscapes by acting as investor of first resort, not simply as lender of last resort' (p. 2). This is true not only in the past but also in the creation of what we think of as new technologies such as Internet, nanotechnology, biotechnology and clean(green) technology (see Block and Keller (2011), Mazzucato (2013), Block, Keller and Negoita (2024).

Historically, after World War II, publicly owned investment banks have played a critical role in fostering and financing reconstruction, growth, technological change and development (see for example Nayyar (2015), Mazzucato (2016) and Mazzucato and Macfarlane (2023) This remains true even of renewable energy. As Mazzucato (2016) notes in financing renewable energy projects 'The four most active banks are (in order) the China Development Bank, the German KfW, the European Investment Bank (EIB) and the Brazilian BNDES'. And, as she has argued elsewhere this intervention is particularly when seen for an economy wide sustainability perspective.

> Governments play a critical role in catalysing and coordinating both public and private investment around common goals, not least transitioning to a green economy. Industrial strategies must not be about subsidizing specific sectors but about catalysing transformation across all sectors in order to meet social goals: climate action requires sectors as diverse as digital, nutrition, transport and construction to innovate and collaborate.
>
> (Mazzucato 2022, p. 93)

Finally, if IAMs chart historically unprecedented long-run pathways to reaching the Paris Agreement target of 1.5–2 degrees global warming goal, they are oblivious to structural short run macroeconomic constraints that developing economies (in today's parlance emerging economies) face. As Taylor (1994) elucidated in his celebrated 'Gap models' paper, developing economies are structurally characterised by a saving-investment gap and a current-account deficit gap and at any given point, given the context, one or the other gap might be binding and constrain economic growth. For example, in the context of global warming, if access to green technology comes through the import of capital goods, soon the current account constraint might bind. The constraint itself reflects the lack of supply side capabilities in terms of indigenous technological capabilities. In macroeconomics terms both of these gaps have to solved to unshackle the economy. In the example used above the economy either has to have learning capabilities that allow it to climb the technology ladder using imported technology and/or new export markets are to be found. Most importantly neither of this is automatic and/or can be left to market forces alone.

And despite India's growth to lower middle income status, the two gap models may still have useful lessons to offer even in a world of global capital flows.

22.3 Indian Economy: Stagnation and Financial Fragility

The Indian economy is in a very parlous state caught between stagnation and inflation. As the above graph makes clear even though post-Covid there has been some recovery in fixed-investment ratio, private corporate fixed investment has proved extremely stubborn and has stagnated. The same is true of the other autonomous demand driver, private final consumption expenditure. It has been very difficult to sustain its growth momentum. Growth therefore has been driven primarily by government investment expenditure. Without autonomous demand drivers kicking in, it will be very difficult to sustain growth purely on government expenditure. Wage deflation across the board underlies the weakness of consumption demand. India's banking system today finances consumption rather than production. In September 2023 non-food credit allocated to retail lending was 33% as opposed to industry which received only 23%., In 2013 non-food credit going to industry was 46%. Banks holds more government securities than they need to, despite declining SLRs. The gap between bank holding of securities and SLR rates has been increasing, a phenomenon dubbed as 'lazy banking'.

Chakrabarti and Mohanty (2009) in their review of financial intermediation in the 1990s had noted the following:

> The banking sector (net of RBI) is today the largest holder of government debt. Investment by scheduled commercial banks in government securities was significantly higher in the 1990s than in the 1980s.
>
> (pp. 197–204)

> The increased voluntary holding of government bonds and the accelerated lending to the government is an indicator of risk aversion on the part of banks.
>
> (p. 205)

> To conclude . . . the Indian financial system as a result of the reform process has improved in terms of efficiency and operational parameters. Stock market liquidity has improved and a reasonably deep and liquid government bond market is in place. Monetary policy is conducted through open market operations and both the

call and term money markets have improved in terms of products, intermediaries and liquidity.

(p. 249)

Improvement in bank profitability seems to have come with a marked shift away from rural lending, agriculture and SMEs. Indeed, most credit flows seem to be concentrated in metropolitan areas and there is evidence of regional concentration as well.

(p. 249)

In terms of financial intermediation, intrinsically, little has changed from that analysis. For example, Kaul (2022) establishes the commercial banks hold way more government securities than they need to, a phenomenon that is now termed "lazy banking". Indeed, things might have worsened, with the link between financial resource mobilisation and the real economy increasingly attenuated (see, for example, Kaul 2022) and Dasgupta and Raghavendra (2024)).

And the economy because of debt-financed consumption (see, e.g., Kaul (2023) has in the meantime become financially more fragile in Minskyian terms. As Minsky (1993, 1994) has argued way back, state intervention is key to stabilising the financial system and promoting private investment by reducing uncertainty. Switching to green investment-led growth strategy financed in part through green investment bank which also helps catalyse private investment is one way of solving the problem of uncertainty and demand together (Figure 22.1).

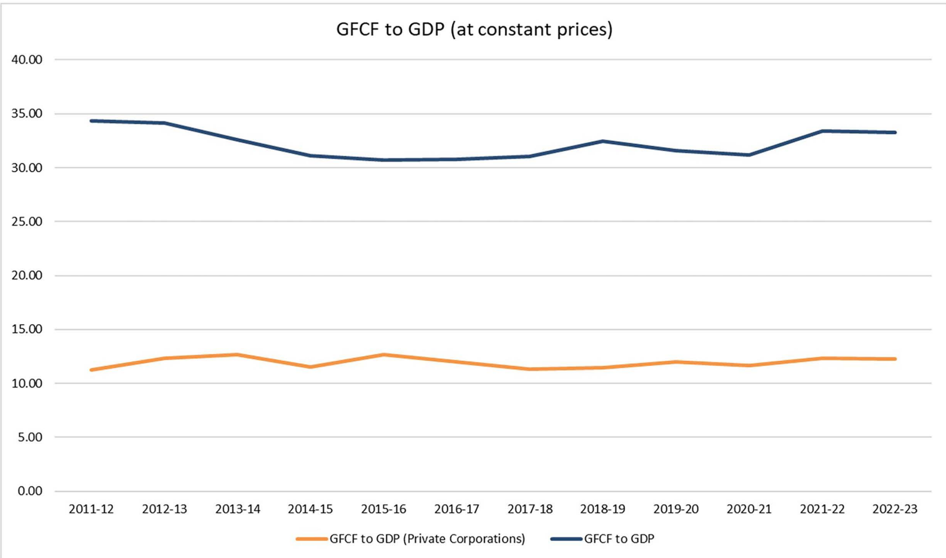

Figure 22.1 GFCF to GDP (at Constant Prices)

22.4 Beyond IAMs and the Need to Take Adaptation Seriously

Dyke, Watson and Knorr (2024) have argued that the Paris Agreement goal of 1.5–2 degree warming may well be out of reach and that the earth is in uncharted territory.

> At the start of 2023, Berkeley Earth, NASA, the UK Met Office, and Carbon Brief predicted that 2023 would be slightly warmer than the previous year but unlikely to set any records. Twelve months later and all four organisations concluded that 2023 was by some distance the warmest year ever recorded. In fact, between February 2023 and February 2024 the global average temperature warming exceeded the Paris target of 1.5°C.
>
> The extreme weather events of 2023 give us a glimpse of the suffering that further global warming will produce. A 2024 report from the World Economic Forum concluded that by 2050 climate change may have caused over 14 million deaths and USD 12.5 trillion in loss and damages.
>
> Currently we cannot fully explain why global temperatures have been so high for the past 18 months. Changes in dust, soot and other aerosols are important, and there are natural processes such as El Niño that will be having an effect.

What is equally clear from the above is that in the face of increasing frequency of climate events, adaptation should be the bedrock of climate policy rather than sticking to a failed focus on mitigation.

Little wonder then that UNEP in its Adaption Gap Report 2023, appropriately titled 'Underfinanced. Underprepared.' has this to say:

> In view of ever-increasing weather extremes such as a multi-year drought in East Africa, flooding in China and Europe, and extreme heat and wildfires in the United States of America and Canada, among others, narrowing the adaptation finance gap is of particular *importance because of the high benefits that investments in adaptation can offer in terms of reducing climate risks and improving equity and climate justice. Left unchecked however, increasing climate risks will inevitably lead to more climate-related losses and damages* . . . [c]urrent plans reflected in the nationally determined contributions (NDCs) are putting us on a path towards 2.4°C–2.6°C by the end of the century. Even if the rise in temperature eventually slows as a result of more ambitious collective climate change mitigation efforts, climate risks will accelerate with every fraction of a degree because of the compounding and cascading nature of climate-related impacts. In addition, the Intergovernmental Panel on Climate Change (IPCC) concludes that residual climate risks – that is risks remaining after ambitious adaptation efforts – will persist even if the Paris Agreement goals are reached. Residual climate risks, in turn, will inevitably lead to both economic and non-economic losses and damages. . . . [T]his demonstrates the importance of accelerating and scaling up both mitigation and adaptation action, *to respectively avert catastrophic climate change and minimize the climate impacts that remain.* In addition, more focus must be placed on anticipatory, just and effective adaptation action and support. (pXII) [emphasis added]

But as Anlar (2024) notes:

> The funding deadlock that exists to this day reflects deeper tensions in international climate negotiations, where disputes over responsibility and historical emissions continue to shape policy decisions – demonstrating that adaptation extends beyond technical challenges and is also an issue of global equity and justice.

Finally, as Rojas and Billi (2023) note the impacts of climate change are interconnected and not isolated:

> For instance, changes in land use influence the availability of water and fire dynamics; fires in turn are not only accelerated by climate change, but also contribute both to GHG emissions and to local atmospheric pollution. Air pollution, finally, affects water and soil quality, and their ability to regulate climate.

Therefore, they cannot be treated in silos. They enunciate two principles: 'Just climate action' and 'a territorial and socio-ecosystem approach'. Just climate action is defined as 'both state and society to take incremental and transformative actions to promote climate change mitigation and adaptation, moving towards a more equitable distribution of costs and benefits'. Neither just climate action nor a socio-ecosystem approach will be addressed by financial markets left to themselves. Hence at the heart of financing adaption initiatives are publicly owned investment banks.

It should have the following elements:

- Rewiring the real economy: bringing mitigation, adaptation and resilience together
- Financing green technological change: for example, investments in integrating renewable energy to the grid and on long-term renewable storage.
- Affordable climate resistant housing
- Financing agricultural R&D for example making crops more resistant to droughts and heat on the one hand and floods on the other.
- Therefore, new supply chains
- Financing resilience

Of course as we know, markets are unlikely to fund adaptation. If public investment has to finance adaptation then the rate at which finance is made available, the Social Discount Rate (see discussion in Box 22.1) becomes a key variable.

22.5 Public Investment Banks and Adaptation: Learning from BNDES

Historically, after World War II, publicly owned investment banks have played a critical role in fostering and financing reconstruction, growth, technological change and development (see for example Nayyar (2015), Mazzucato (2016) and Mazzucato and Macfarlane (2023) This remains true even of renewable energy. As Mazzucato (2016) notes in financing renewable energy projects 'The four most active banks are (in order) the China Development Bank, the German KfW, the European Investment Bank (EIB) and

Box 22.1 Social Discount Rate

Swasti Raizada

What is social discount rate (SDR)?

Discount rates are crucial, if not the most influential parameter driving investments. Discount rates can be financial or social depending on whether a project is being evaluated for its financial or economic feasibility respectively. Governments and public financial institutions across the world conduct an economic analysis, in addition to financial analysis to channelise public investments into projects that may lack commercial viability but can have wider societal benefits. Typically, a financial analysis is conducted using discounted cash flow models while an economic analysis uses cost-benefit or cost-effectiveness models.

When used to undertake an economic analysis of projects, SDR is the rate used by governments and multilateral development banks to discount costs and benefits of a public investment, reflecting society's relative valuation of today's well-being versus future wellbeing (Carlucci 2024). Broadly, it is determined either based on the 'social opportunity cost' of public funds or the 'consumption rate of interest' or a combination of both. In a perfectly competitive world without market failures, the financial discount rate is the appropriate SDR. However, in the real world where markets are distorted and/or characterised by positive and negative externalities, the market interest rates no longer fully reflect the SDR.

Broadly, there are four approaches to determine SDRs:

(i) **Social rate of time preference (SRTP) approach**, which reflects the relative value placed by society on present consumption compared to future consumption. The SRTP is based on the time preference and the wealth effect, which reflect the consumption growth per capita over time. In other words, it represents the societal preference for receiving benefits now rather than later and it reflects the rate at which society discounts the value of future benefits and costs (Addae-Dapaah 2012). For example, the British Government's Green Book uses the SRTP approach to discount costs and benefits in project appraisal. The SRTP of the Green Book is set at a fixed 3.5% in real terms, which is lower than conventional market rates (HM Treasury 2022).

(ii) **Social opportunity cost (SOC) approach**, which is assumes that available resources are scare, and private and public projects compete with one another for funds. According to this approach, the SDR reflects the marginal social opportunity cost of funds in the private sector and thus, assumes that the return of public sector investments should not be less than the return of private investments. SOC can be determined as marginal pretax rate of return on riskless private investments (Zhuang et al. 2007). In other words, the investment returns from a public project should be at least as high as those of a private investment.

(iii) **Weighted average approach,** which recognises that sources of funds available to public projects may come from displacing private investment, inducing consumers to postpone current consumption, and, in the case of an open economy, borrowing from international capital markets. This approach prescribes that the SDR should, thus, be the weighted average of SOC, SRTP, and the cost of foreign borrowing, with weights reflecting proportions of funds obtained from their respective sources.

(iv) **Shadow price of capital (SPC) approach,** which recognises that while costs of a public project can displace private investment, its benefits can also be reinvested in the private sector. In terms of generated future consumption streams, these benefits are worth more to society than if they are consumed immediately. Thus, the total cost of a public project is the sum of the current consumption that is directly displaced and those future consumption streams that are foregone due to the displacement of private investment.

An ADB survey of individual countries and multilateral development banks around the world reveal significant variations and evolving practice of estimating SDRs (Zhuang et al. 2007) (see Table 1). Generally, European nations were found to favour an SRTP approach while the SOC approach is more prevalent in Asian economies like India.

Why is the social discount rate so important for climate finance?

In the context of climate change policymaking, where questions of intergenerational and intragenerational equity are critical, the right choice of social discount rate is thus, critical to policy choices for climate action. Social discount rates can determine which climate projects get filtered for public finance and are particularly useful for governments in evaluating public investment.

Social discount rates also make a huge difference to policies where benefits occur in the distant future, such as climate positive interventions. A lower social discount rate is required to encourage sustainable projects that have long-term positive externalities (Carlucci 2024). The higher the discount rate, the greater the emphasis on short-term benefits since the benefits from a safer and better climate are a long way off in the future and heavily discounted (Thakur et al. 2021). This can work in favour of avoiding the costs of reducing emissions now (and vice versa for low discount rates).

It was a lower discount rate that drove the differences between the policy conclusions of the widely debated Stern report and the consensus view of previous cost-benefit analyses of global warming. Stern's cost-benefit analysis of global warming assumed a real discount rate of 1.4% and concluded there was a case for an immediate imposition of a high, and increasing, carbon price. Nordhaus assumed a 5.5% discount rate, and favoured a modest carbon price, increasing over time. The difference is not surprising because most of the effects of global warming take place decades in the future. At Stern's discount rate of 1.4% per year, the present value of USD 1 of damages in 100 years is 25 cents, more than 50 times greater than with Nordhaus's. The recommended polices differed because of the different discount rate assumptions (Harrison 2010).

Table 1 Summary of literature reviewed on social discount rates used by countries and multilateral development banks

Entity	*Agency*	*Social discount rate*	*Theoretical basis*
Philippines		15	SOC approach
India	Ministry of Finance	12	SOC approach
Pakistan		12	SOC approach
International Multilateral Development Banks	World Bank	10–12	SRTP approach
	Asian Development Bank	10–12	SRTP approach
	Inter-American Development Bank	12	SRTP approach
	European Bank for Reconstruction and Development	10	SRTP approach
	African Development Bank	10–12	
New Zealand	Treasury and Finance Ministry	8	SOC approach
Canada	Treasury Board	10	SOC approach
People's Republic of China		8 for short- and medium- term projects; lower than 8 for long-term projects	Weighted average approach
South Africa		8 (and test 3 and 12)	
Australia		8; reviewed annually	SOC approach
United States	Office of Management and Budget	7	SRTP approach
European Union	European Commission	5	SRTP approach
Italy	Central Guidance to Regional Authorities	5	SRTP approach
The Netherlands	Ministry of Finance	2–4.5%	Risk-adjusted SRTP approach
Japan		4%	SOC approach
France		4	SRTP approach since 2005
United Kingdom	HM Treasury	3.5 (reducing to 1% over 300 years)	SRTP approach
Norway		3.5	Government borrowing rate in real terms
Sweden		3.5	SRTP approach
Germany	Federal Finance Ministry	3	SRTP approach
United States	Environmental Protection Agency	2–3 (and test 7%)	SRTP approach

Source: Authors' compilation based on (Zhuang et al. 2007; Harrison 2010)

India's social discount rate needs to catch up with its climate reality

The Government of India had been issuing guidelines for project appraisal periodically, including processes and evaluation parameters such as discount rates. The national guidelines for project appraisal stipulate that projects must yield a minimum 12% financial and economic internal rate of return for the purpose of investment approval, a criterion that has largely remained unchanged since 1994 (Department of Economic Affairs 2013; Murty et al. 2018). India thus, firstly adopts a common discount rate for financial and economic analysis (using the SOC approach) and secondly, has continued to use the same discount rate in the last 30 years. India is no exception to this general trend in – overall, social discount rates in developing countries have largely remained unchanged in the last 20–30 years although climate science and reality has evolved significantly since then.

Given the structural changes in the Indian economy since liberalisation and the imperatives of climate change, India needs to revisit the underlying approach and assumptions of India's SDR and explore if a lower SDR could help unlock public finance for sustainability projects, especially for climate centric projects that require patient capital and can have wider intergenerational benefits. In a recent report to NITI Aayog, Murty et al. 2018 recommended that the discount rate for general government projects may be set lower at 8%; for environmental projects at 6%; and at less than 6% for long-term climate change mitigation projects. The World Bank uses SRTP approach and a lower social discount rate of 10% (combined with sensitivity analysis of even lower SDR of 6%) for conducting economic analysis of climate mitigation projects in India (International Bank of Reconstruction and Development 2017; The World Bank 2016). More recently, Dholakia et al. 2024 estimate India's STPR at 4.5% (in real terms), SOC at 2.94%, and propose an average approach of using 3.72% as the SDR for public sector projects.

It is also pertinent to note that while there is still lack of consensus among economists in the context of SDRs for climate change, there appears a general agreement that the SRTP should be used in discounting intergenerational projects (Zhuang et al. 2007). Also, some researchers suggest presenting a zero-discount rate or undiscounted economic analysis alongside discounted economic analysis to better inform policymakers of the ensuing trade-offs (Carlucci 2024).

The lack of consensus has also encouraged innovative approaches of determining SDRs such as use of sensitivity analysis and different discount rates for different goods. Many countries such as The Netherlands have prescribed the default rate as 3% and a higher rate of 4.5% for public infrastructure. It then applies a differential rate to nature at 2% (the reduced effective rate), 3% for substitutable nature, and the same rate for carbon emissions and health. Similarly, the UK Green Book iteration applies a lower discount rate to human health, at 1.5% (HM Treasury 2022).

The SDR of India thus, warrants a reassessment, particularly in the context of the recent push for higher capital spending by the public sector, revival in credit-induced household investment, and the rising need for adaptation finance.

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Box 22.2 Urban Local Bodies Can Boost Electric Mobility in Indian Cities

Mandar Patil and Prathamesh Mokal

Road transport accounts for a staggering 92% of the total emissions from the transport sector (International Energy Agency, 2024). As present, in India, electric vehicles (EVs) are considered as the cleanest alternative, and their sale has been rising gradually. The calendar year 2023 recorded sales of more than 1.5 million EV units. The total share of EV sales in India's automotive sector has increased from 1.7% in 2021 to 6.4 in 2023 (Ministry of Road Transport and Highway, n.d.). Between 2023 and 2034, the number of EVs in India are expected to grow at a

CAGR of 35% (Economic Times, 2024). Several policies from the central and state governments have been instrumental in achieving these levels of EV penetration in Indian markets. Policies like Faster Adoption and Manufacturing of Electric Vehicles Scheme (FAME) Phase I and II, the Production Linked Incentive schemes, and the Electric Mobility Promotion Scheme 2024, along with benefits and subsidies provided by state governments have given a significant boost to the EV market in past decade. While the central and state government have taken multiple initiatives to increase the uptake of EVs, city governments i.e. urban local bodies (ULBs), too, have a significant role in supporting the electrification of road transport.

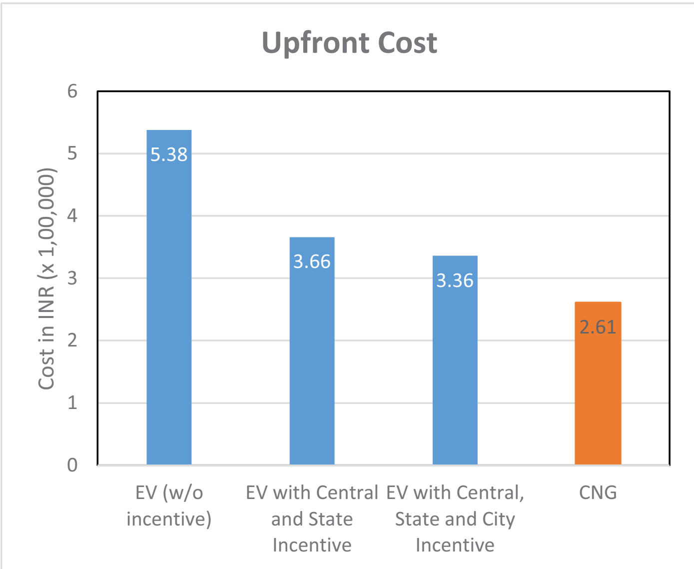
ULBs in India are well-placed to implement electric mobility solutions, primarily because they would be the facilitators for providing the supporting infrastructure like charging stations and parking spaces.

How ULBs can support electric mobility?

1. *Providing incentives for purchase of electric three-wheelers and retrofitting of older vehicles*

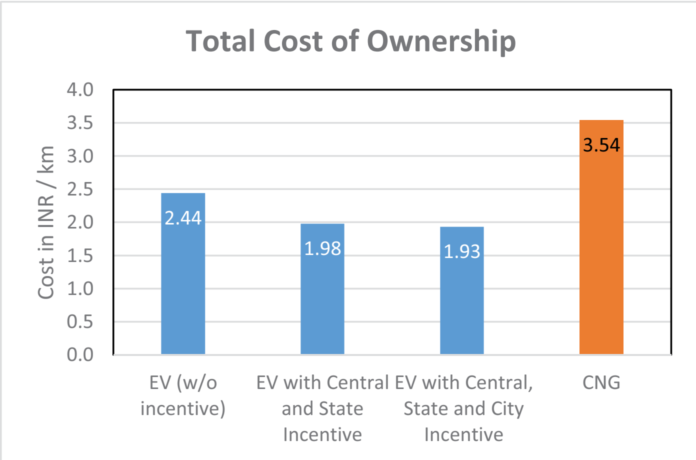
Three-wheelers are a crucial part in a city's first-and-last-mile connectivity and urban freight for better utilisation of a city's public modes of transport like buses and metro. One of the major reasons that hampers faster adoption of electric three-wheelers in India is their higher upfront cost as compared to the internal combustion engine (ICE) counterparts (almost 25% more expensive). While the economic benefits of EVs over ICE vehicles cover this price disparity easily over the life span of vehicle,

Upfront Cost of an e-3W in Pune with City-Level Incentives



Source: Authors' estimates

Total Cost of Ownership of an e-3W in Pune with city-level incentives



Source: Authors' estimates

the higher upfront cost is a deterrent, given that most buyers are financially constrained. They buying the three-wheeler using loans. In a nascent EV market like India, banks often categorise EVs as higher risk and charge for higher rates of interest. *ULBs can provide fiscal incentives in the form of subsidies to cover a part of the upfront high cost of an EV. Additionally, such a subsidy coming from the ULB can also instill confidence in the technology among the banks and financial institutions.*

The city-level incentive lowers the up-front purchase cost (Figure), and can further lower the total cost of ownership (TCO) by an additional INR 0.05/kilometre (Figure). This is significant as e-three-wheelers are driven around 6 lac kilometres over their lifetime, potentially leading to a lifetime savings of around INR 30,000 for the user.

The subsidies and incentives provided by ULBs will require dedicated funds earmarked for a specific period; 131 major cities in India have earmarked funds under the National Clean Air Program (NCAP). NCAP funds can be deployed for implementation of city-specific plan to increase the uptake of electric mobility and augmenting the charging infrastructure for EVs in a city (Central Pollution Control Board, 2022). The Pimpri Chinchwad Municipal Corporation has set up a mechanism for providing a subsidy of INR 30,000 for new EVs and/or retrofitting existing CNG autos to electric autos (EV India, 2023). Similarly, the Pune Municipal Corporation has outlined a subsidy of INR 25,000 to be provided for each transition to electric autorickshaw in the city.

2. *Providing for upstream infrastructure to set-up public charging stations in the city*

Land is the most crucial element in setting up charging infrastructure in any Indian city, where readily available land which is encroachment-free is a scarcity. Adding to that, the space needed for installing charging stations as per the guidelines issued by Ministry of Power requires at least 50 sq m of open space, good accessibility to major carriageways in the city and a round-the-clock power connection. Also, a charging station would be profitable when it is located near commercial hubs, and such land is available at premium rents.

ULBs regulate the land use in the city. In the initial phase of uptake of electric mobility in cities, private players willing to operate public charging stations can be supported by ULBs by providing land at concessional rates. The guidelines issued by Ministry of Power suggest that land owning agencies should lease out land parcels suitable for installing EV charging stations to successful bidders on a revenue sharing basis. The floor price for such a bidding process will be fixed at INR 1/kWh, and the highest bidder would be granted the lease of the land (Ministry of Power, 2022). Additionally, ULBs can also explore collaborating with local electricity distribution licensees to upgrade the necessary upstream electrical infrastructure to facilitate ease of setting up charging stations at these locations.

The overall cost of setting up one public charging station in India ranges from INR 50 to 60 lakhs. At least 10% of this cost is paid as land rent (Cars24, 2024). It has been observed that municipal corporations do not adhere to the guidelines issued by Ministry of Power. Ahmedabad Municipal Corporation, for example, in its tender for installing charging stations within the city had a fixed rental rate for the land parcels to be leased in addition to a revenue sharing mechanism (Ahmedabad Municipal Corporation, 2024). The fixed rental rate was based on the ready-reckoner rates prevailing in the city. Such stringent criteria for leasing land increases the operating cost of a public charging station.

ULBs can explore mechanisms of revenue sharing in the initial phase of EV uptake and consider providing land at concessional rates. Moreover, to ensure that benefit of concessional land is passed on to the end consumers, ULBs can ensure strict implementation of real-time data sharing by the charge point operators.

3. Providing property tax rebates for promoting charging infrastructure in residential complexes

In the initial phase of EV uptake, most of the EV charging will happen in domestic premises such as residential complexes, which may be incentivised to set up charging stations for the larger community. Residential associations can either have restricted access to these charging stations or grant access to general EV-users and earn revenue.

Property tax is a major source of revenue for ULBs in India. ULBs can explore the option of providing a rebate in property tax levied on individual owners and cooperative housing societies. The Kolhapur Municipal Corporation (Arora-Desai, 2021) and the Pimpri Chinchwad Municipal Corporation in Maharashtra have taken the lead by offering a rebate of 2 to 5% in property tax for installation of charging infrastructure within private premises.

4. Supporting e-bus operations through the Gross Cost Contract Model

In many parts of India, providing local city bus services lies within the purview of ULBs. The major barrier in public sector entities procuring electric buses is the high upfront investment. ULBs not only have to purchase the buses, but also set up high-capacity chargers in bus depots and upgrade the upstream electrical infrastructure.

Instead of outright purchase of e-buses, a cost-effective alternative is to operate them through the Gross Cost Contract (GCC) model. Under the GCC model, the successful bidder invests in the e-buses, charging infrastructure, and their operation and maintenance. The ULB pays a fixed fee per km per bus, discovered through competitive bidding for a pre-decided number of years. The ULB provides encumbrance free land to the bidder for installing charging infrastructure, whereas the operator pays for the electricity charges (Convergence Energy Services Limited, 2023). A study conducted in Pune showcased that the total cost of operating 125 e-buses by Pune Mahanagar Parivahan Mahamandal Limited though the GCC model was INR 3.37/km lesser than the diesel buses even without subsidy support. Similarly, the prices discovered through competitive bidding for operating 6,465 e-buses under the GCC model by Convergence Energy Services Ltd. were found to be 29% lower than the operating costs of diesel buses (The Economic Times, 2023).

Four options have been suggested for ULBs to support electric mobility in India. Globally, countries that are leading the EV transition are the ones where cities play a prominent role. Hence, Indian cities supporting local EV adoption can contribute significantly to achieving India's target of EV30@30.

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the Brazilian BNDES'. And, as she has argued elsewhere this intervention is particularly when seen for an economy wide sustainability perspective.

> Governments play a critical role in catalysing and coordinating both public and private investment around common goals, not least transitioning to a green economy. Industrial strategies must not be about subsidising specific sectors but about catalysing transformation across all sectors in order to meet social goals: climate action requires sectors as diverse as digital, nutrition, transport and construction to innovate and collaborate.
>
> (Mazzucato (2022, p. 93)

This brings us to the role of public investment banks and the financing of adaptation. This section is based on Mazzucato and Macfarlane (2023)

Banco Nacional de Desenvolvimento Econômico e Social (BNDES a Brazilian development bank founded in 1952

BNDES has had a catalytic role in promoting transformational investments in different phases of Brazil's development.

In 2020 BNDES held R$1,737 billion of assets ($348 billion) and employed nearly 3,000 people.

The upside gained from successful investments contribute to BNDES's profits, which translate into dividends to the Brazilian Government and returns to Brazilian workers' social security funds (FAT)

The result of this two-decade-long process was the establishment of legal, managerial and institutional capacity inside BNDES, with a set of different types of funding for innovation under four categories (variable and fixed income, variable income, fixed income and non-refundable resources), which covered an array of tools and programmes.

Besides flexibility in innovation funding, BNDES funding and investment strategy is characterised by the following five attributes:

- The use of progressive conditionalities to ensure that public money does not get wasted in rent-seeking behaviour.
- Access: ensuring equitable and affordable access to the resulting products and services (dependent on areas like pricing and intellectual property rights).

- Directionality: directing firms' activities towards socially desirable goals (e.g. net zero).
- Profit-sharing: requiring profitable firms to share returns (e.g. via royalties or equity with government).
- Reinvestment: requiring reinvestment of profits into productive activities (e.g. such as R&D or worker training).

See Mazzucato and Rodrik (2023) for a more elaborate discussion. See Mohanty, Ray and Swami (2024) on design to make rents contingent.

22.6 Institutional Innovation and Adaption Projects

Given below are two examples of institutional and financial innovations for adaptation taken from UNEP (2019). Global Commission on Adaptation report 'Driving Finance Today for the Climate Resilient Society of Tomorrow.

22.6.1 Bangladesh's Green Refinancing and Credit Allocation Policies

> The central bank of Bangladesh has also undertaken an ambitious program for "greening" its financial sector. Perhaps the most innovative and successful of its policies *are the refinancing lines at preferential terms for green loans*, which today cover more than 47 "green" products, services, and investment types. Under this program, Bangladesh Bank refunds both commercial banks and NBFIs at reduced interest rates (e.g., *"preferential rediscounting"*) for loans extended to projects and sectors considered green, including solar energy, biogas, waste treatment, water, and energy efficiency. Up until June 2016, more than US$33 million of investments have benefitted from the program. (p. 13, emphasis added)

District of Columbia's Water Environmental Impact Bond to fund a system for managing storm water runoff that mimics natural processes. Resilience bonds quantify and protect against climate risks and in the process can lower the cost of financing infrastructure potentially at risk Some bonds are already addressing adaptation needs. For example, the District of Columbia Water Environmental Impact Bond, issued in 2017, was developed not only to fund an innovative system for managing storm water runoff that mimics natural processes, but also to integrate novel performance-based terms that reduce interest paid to bondholders if storm water management attains certain thresholds of success. The issue has become more urgent with the increased frequency of heavy rainfall events due to climate change, which exacerbates storm water runoff. (p. 42)

22.7 Back to the Future

It is worthwhile quoting Nayyar (2015) about the centrality of development banks to an economy's growth strategy. 'The winding down and subsequent closure of development banks was . . . premature. It was a serious mistake'. To that I would add that the a new green development bank has become all the more urgent because of the climate catastrophe that we are faced with and therefore the need to have an effective adaptation and resilience strategy financed by a publicly owned green investment bank which will also help direct finance towards the real economy.

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23 Green Quantitative Easing

What the Lender of the Last Resort Can Do for Saving the Planet

Ankit Kumar and Runa Sarkar

23.1 Introduction

Climate change results in a slowdown of economic growth and productivity through multiple levers, which in turn impacts the macro-financial stability of an economy. The rising frequency and intensity of extreme weather events, including hurricanes, floods, and droughts, increases investment risks, interrupts economic activities, harms infrastructure, and decreases agricultural output Mechler and Schinko (2016). As an instance, severe weather comprising long periods of excess heat can devastate crops, causing food shortages and higher prices, which subsequently lowers disposable income and consumption. Driven by supply-side problems because of lower yields, increased inflation expectations can lead to a wage-price spiral. The combination of a highly inflationary environment and diminishing labour productivity due to high temperatures can lead to a reduction in production (Lai et al. 2023)).

Macro-financial stability can be threatened considerably as a result of climate-change-related events. These threats can be divided into physical risks and transition risks. Physical risks stem from the direct effects of climate-related events on assets and infrastructure, whereas transition risks arise from a transformation in demand patterns and supply value chains caused by a shift towards a low-carbon economy as a response to climate change. Financial institutions, including banks and insurance companies, are especially susceptible to climate change risks. For example, insurance companies encounter higher claims due to natural disasters (physical risks), and banks may experience an increase in non-performing loans as businesses impacted by climate change default, both as a result of transition and physical risks. Moreover, these shocks are not random, and insurance payouts need to be made to all policy holders simultaneously. Dafermos et al. (2018) highlight that these risks may lead to tighter credit conditions and reduced investment, exacerbating economic recessions. The substantial demand, supply, and macro-financial risks posed by climate change with the potential to impact global economies requires interventions from both policymakers and financial institutions.

Incorporating climate risk assessments into financial stability oversight is challenging due to the deep uncertainty of an evolving physical, social, and economic phenomenon with intricate dynamics and cascading effects. This implies that central banks have to navigate uncharted waters to ensure macro-financial stability. The key dilemma for central banks around the globe is to design the optimal intervention to manage the macroeconomic impact on stability due to climate change. If they pragmatically intervene in the market, they might be accused of straying from the principle of market neutrality, with

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their actions (potentially) resulting in the formation of financial bubbles. On the other hand, they cannot merely assess risks and wait for fiscal policy to react and the government to take action. This could lead to a situation where the central bank fails to fulfill its responsibility to maintain financial and price stability. In the most extreme instance, central banks might need to step in as the ultimate saviours for addressing the fallout as a result of climate issues or act as a collective insurance mechanism to cover climate-related damages.

The challenges of a central bank in an emerging market economy (EME) are somewhat different from those in the developed world. Emerging markets exhibit distinct macro-financial conditions compared to advanced economies. Generally, EMEs have underdeveloped political and institutional frameworks Mohan (2004). Additionally, their financial markets are less mature, resulting in smaller and shallower capital markets. The pro-cyclical nature of their fiscal policies, coupled with significant fiscal and budget deficits, present unique challenges. This often results in a non-competitive banking sector that suffers from lax institutional practices.

At the same time, numerous EMEs are grappling with extreme climate risks that rival, if not surpass, those faced by advanced economies. Since primary products like agriculture constitute a significant portion of these economies in terms of both consumption and export, these countries are at the forefront, bearing the severe consequences of climate change, which jeopardise their progress and economic stability. Moreover, for most of the EMEs, energy consumption per capita is on the rise as their population gains access to electricity, and are largely dependent on (cheap) fossil fuels for electricity generation. EMEs are responsible for approximately two-thirds of the world's greenhouse gas emissions, owing to their population size and growth prospects. Therefore, they face a monumental challenge in transitioning to net-zero emissions within limited time frame. The International Energy Agency estimates that an mind-boggling 2 trillion dollars will be required by the EMEs every single year by 2030 to meet this ambitious target.[1] This staggering financial burden underscores the massive scale and urgency of the climate crisis these nations are grappling with, highlighting the critical need for global collaboration and unparalleled investment and measures to stabilise the financial market.

Despite the centrality of the principle of market neutrality, the central bank of an EME cannot ignore the considerations of climate change in its policy interventions. In this chapter, using the context of the Indian economy as an exemplar of an EME, we attempt to explore the different avenues available to the central bank to address climate change and assess their efficacy. To start with, we briefly summarise the different weapons in the central banks arsenal to address climate change. Following this, based on the recent surge of knowledge in understanding the macro-financial implications of climate change, we focus on quantitative easing as a potent tool to address macro financial risk posed by climate change. In the process, we outline a model developed by to address macro-financial implications of climate change (ref). Section 23.4 extends this model for EMEs, using India as an exemplar. This includes recognising that (a) there is a significant fraction of economic agents in EMES who are not integrated into the banking system, (b) credit markets are shallow, and (c) the banking system is subject to more intrusive central bank regulations. The expected implications of quantitative easing (from our extended model described previously) are discussed in Section 23.5. Section 23.6 concludes with Policy implications for Central Banks of EMEs.

23.2 Tools Available to the Central Bank

Central banks, as entities in charge of overseeing monetary policy and ensuring economic financial stability, possess a range of instruments to directly impact green investment within the economy. Green investment can include investments that support environmentally sustainable activities, particularly those that address climate change, such as renewable energy, energy efficiency, and direct green technology. While we acknowledge that arriving at a standardised definition of what constitutes green investment or climate action is paramount, this goes beyond scope of this chapter, and in what follows, we will assume that there is an unambiguous understanding of what is green investment. We now summarise the key tools and policies that the central bank can use to influence green investment in the economy.

- Directed Green credit: A potential strategy for the central bank to promote financing in green investments is to channel credit directly into these areas. This can be achieved by offering subsidised interest rates for green loans, direct budgetary subsidies for green loans, or establishing a minimum credit floor for green loans. For example, including green investments in the category of allowable assets to maintain a statutory liquidity ratio for Indian banks would automatically boost the generation of green assets. By subsidising the interest rate for green credit, the central bank reduces the price of green credit in the economy, thus pushing green investment.
- Differential Reserve Requirement: Another way the central bank can influence the banking system to provide higher green credit is by reducing the reserve requirement for green credit compared to conventional investment. A lower reserve requirement will positively impact the bank's ability to provide credit, thus nudging them to give higher green credit as well. Note that here the central bank does not directly impact the price of the green credit in the economy, but rather increases the general capacity of the banks to offer loans.
- Differential Capital Requirement: The central bank can also play with capital requirement for nudging credit towards the green investment. Modifying the minimum requirements for the capital adequacy ratio, which is the ratio of a bank's capital to its risk-weighted credit exposures as mandated by the regulator, or altering the risk weightings assigned to various assets, has a direct impact on banks' capacity to generate credit. Should the central bank apply reduced risk weights to green credit, banks would likely be more inclined to provide green financing.
- Green Quantitative Easing: Finally, the central bank has the option of easing the quantity of money available for green investment by expanding its balance sheet. Quantitative easing (QE) has always been considered an unconventional monetary policy that consists of large-scale asset purchases from banks and other financial institutions via open market operations. In most economies, the asset class is restricted to government bonds, though some central banks also buy corporate bonds and equities. Through green QE, central banks can move away from market neutrality and can buy only bonds or equities related to green investment. By imposing criteria on QE that favour lending practices supporting eco-friendly development, the central bank can facilitate a plentiful supply of funds for transitioning from a high-carbon, resource-intensive economy to a low-carbon economic model. Note that here the central bank is directly changing the quantity of money in the economy available for the purpose of the green investment.

23.3 Model

Recently, there has been increased interest among both academics and policymakers in attempts to understand the macro-financial implications of climate change. Some studies try to access the macroeconomic impact of climate change such that Bilal and Känzig (2024) shows that a one-degree increase in global temperature leads to a 12% decline in global GDP. Currently, there is an effort to incorporate structural integrated assessment models (IAMs) into macro-models, thereby emphasising the fusion of advanced natural science with general equilibrium theory to study the macroeconomic effects of climate change (see Fernández-Villaverde et al. (2024)). Our work is related to the literature that explores the role of the central bank in addressing the impact of climate change and facilitating climate change action including Annicchiarico and Di Dio (2015); Ferrari and Landi (2024).

In this section, we describe the model framework of Diluiso et al. (2021) to understand how central bank policy action, specifically quantitative easing, can alleviate the adverse macro-financial impacts of climate change. The New Keynesian Dynamic Stochastic General Equilibrium framework serves as a core framework to explain and predict aggregate economic activity by central banks and to understand macroeconomic movements serves as the foundation for this model. The model incorporates the interactions between households and the goods market (the real economy) and financial markets. The households supply labour and capital and receive wage income as well as profit from monopolistically competitive firms. Financial intermediaries, such as banks, extend credit to firms in different sectors utilising funds obtained from household deposits. As a public institution, the central bank establishes the monetary policy for the economy and is involved in financial regulation.

This framework will undergo modifications to incorporate financial frictions, changes in the energy sector, and fall in pollutant emissions as a result of climate policies. Thus, in the modified model, the monopolistic-competitive firms integrate labour and capital along with energy inputs sourced from two types of energy producers: (i) those focused on low-carbon energy and (ii) fossil fuel energy producers. These monopolistic-competitive firms produce horizontally differentiated goods that are combined into a final sectoral output composite. There are capital producers that involve sector-specific repair-depreciated assets, invest in and generate new assets, and distribute them to firms producing both energy and final goods. Their actions, whether to invest in low-carbon energy or fossil fuels are driven by cost of capital and available credit. We now describe the model through some stylised facts, illustrating the above interactions:

Sectors in the Real Economy:

The model considers three sectors in the real economy. First, the Final Goods Sector Y which generates the final products by utilizing labour capital and energy from two different sectors. The second sector is the fossil fuel based energy sector $E_{F,k,t}$, and the third is the low-carbon energy sector $E_{L,k,t}$, both of which combine with a composite of labour and capital VAY to produce the final good Y. The fossil fuel sector extracts and provides fossil fuel based energy, incurring costs related to emissions and possible climate regulations and the Low-Carbon Energy Sector produces energy from renewable sources, which have lower emissions compared to fossil fuels.

Producers use a capital and labour composite $VAY_{k,t}$ and an energy bundle $E_{k,t}$, consisting of low-carbon energy $E_{L,k,t}$ and fossil fuel based energy $E_{F,k,t}$. They assume the following functional form for technology:

$$Y_{k,t} = \left(\gamma_{VAY} VAY_{k,t}^{\frac{\varepsilon_Y - 1}{\varepsilon_Y}} + \gamma_E E_{k,t}^{\frac{\varepsilon_Y - 1}{\varepsilon_Y}} \right)^{\frac{\varepsilon_Y}{\varepsilon_Y - 1}}, \quad \varepsilon_Y > 0 \tag{1}$$

where ε_Y is the elasticity of intratemporal substitution between the two composites $VAY_{k,t}$ and $E_{k,t}$, while γ_{VAY} and γ_E are the corresponding weights. These weights are also called 'distribution parameters' shows each factors share in total output. They borrow the constant elasticity of substitution (CES) nest structure of the economy and the energy system from the Integrated Assessment Models (IAMs) literature (e.g. Diluiso et al. (2021)). Consistent with this literature, they assume $\varepsilon_Y \in (0,1)$ to capture a certain degree of complementarity between the two input composites.

The capital and labour composite is of the form:

$$VAY_{k,t} = A_{Y,t} (\xi_Y K_{Y,k,t})^{\alpha_Y} N_{k,t}^{1-\alpha_Y}, \quad \alpha_Y \in (0,1) \tag{2}$$

where $A_{Y,t}$ represents the sector-specific productivity, $K_{Y,k,t}$ and $N_{k,t}$ denote the amount of capital and labour used in production, while $\xi_{Y,t}$ is an exogenous process measuring the quality of capital.

The energy composite is a CES aggregate of the energy inputs:

$$E_{k,t} = \left(\gamma_{EL} E_{L,k,t}^{\frac{\varepsilon_E - 1}{\varepsilon_E}} + \gamma_{EF} E_{F,k,t}^{\frac{\varepsilon_E - 1}{\varepsilon_E}} \right)^{\frac{\varepsilon_E}{\varepsilon_E - 1}}, \quad \varepsilon_E > 0, \tag{3}$$

where ε_E is the elasticity of substitution between low-carbon and fossil fuel based energy, while γ_{EL} and γ_{EF} are the corresponding weights. The elasticity of substitution between aggregate fossil and non-fossil energy sources is a central parameter in environmental economics. Specifically, Papageorgiou et al. (2017) identifies the elasticity of substitution between clean and dirty energy sources in the energy aggregate as a key parameter for evaluating the prerequisites for sustained green growth.

In the low-carbon sector, we assume a perfectly competitive market where firms employ capital $K_{L,t}$ to produce energy according to the linear technology:

$$E_{L,t} = A_L \xi_{L,t} K_{L,t}, \tag{4}$$

where A_L represents total factor productivity, and $\xi_{L,t}$ measures the quality of capital.

In the fossil fuel based sector, perfectly competitive firms produce energy by combining capital $K_{F,t}$ and a fossil resource X_t according to the following CES production function:

$$E_{F,t} = \left(\gamma_{VAF} VAF_t^{\frac{\varepsilon_F - 1}{\varepsilon_F}} + \gamma_X X_t^{\frac{\varepsilon_F - 1}{\varepsilon_F}} \right)^{\frac{\varepsilon_F}{\varepsilon_F - 1}}, \tag{5}$$

where $VAF_t = A_F \xi_{F,t} K_{F,t}$, $\varepsilon_F > 0$ is the elasticity of substitution between VAF_t and the fossil resource X_t, and γ_{VAF} and γ_X are the corresponding weights.

We now discuss the model related to the household sector.

23.3.1 Household Sector

The economy consists of households, which consume the final goods, supply labour, and save. Their interaction with the financial system is through their savings, which they conduct through their bank deposits and purchase of government bonds. For the sake of simplicity, we do not consider the presence of an equity market, although households have an initial endowment of shares of firms which, therefore are not tradable. In this context, all households are Ricardian, that is, they exhibit a tendency to smooth consumption over time. In simple terms, Ricardian households access the financial system to borrow in times of need and save when they have met their needs. At a point of time, t, households maximise their utility, U, from consumption C_t and leisure $1-N_t$:

$$U(C_t, L_t) = \frac{C_t^{1-\theta}}{1-\theta} + \chi \frac{(1-N_t)^{1-\nu}}{1-\nu} \tag{6}$$

where:

- θ, ν are risk aversion and labour supply elasticities, respectively,
- χ is the weight on leisure.

Subject to the budget constraint:

$$C_t + BP_t + \frac{B_t}{R_t} = W_t N_t + \Pi_t + B_{t-1} \tag{7}$$

where:

- W_t is the wage rate,
- Π_t is the profit income,
- BP_t represents bank deposits,
- B_t represents bonds.

Households benefit from consuming goods (C) and services and from time spent not working $(1-N)$, that is from leisure. Utility from consuming is moderated by θ which captures the households risk aversion, that is not saving the money for tomorrow and consuming today. Similarly, nu captures the extent of benefit from leisure, that is, not working and earning a wage to consume or save. Clearly, consumption would be bounded by a persons income from working and from shared profits, and interest income, which is captured in the budget constraint.

23.3.2 Firms

The firms in the final goods market are assumed to be monopolistically competitive and produce final goods by combining labour, capital, and energy inputs from either low-carbon or fossil fuel based producers, as reproduced in equation 1.

In addition, we consider a set of capital producers that repair and build new capital, which they then sell to all three sectors, that is, to the fossil and non fossil energy and final goods-producing firms. Firms make decisions regarding capital investments and energy consumption by considering the relative costs of acquiring such capital and climate regulations.

Capital evolves according to the standard law of motion with adjustment costs i.e. the capital in the next period is the sum of the current period's un-depreciated capital and the new investment made during this period, minus the adjustment cost required to incorporate this new investment. Mathematically, we can represent it as:

$$K_{t+1} = (1-\delta)K_t + I_t - \frac{\phi}{2}\left(\frac{I_t}{K_t} - \delta\right)^2 K_t \tag{8}$$

where:

- δ is the depreciation rate,
- I_t is the investment,
- ϕ is the adjustment cost parameter.

Financial Sector:

Banks take deposits from the household sector and extend credit to the real sector (firms) for investment. The financial sector in this model follows the setup by Gertler and Karadi (2011), incorporating financial frictions through a borrowing constraint. The bank can extend loans to the final goods sector, fossil and non fossil energy sector backed by deposits from households and its own net worth.

At the end of each period t, a typical bank's balance sheet is given by:

$$\sum_S Q_{S,t} S_{S,t} = NW_t + BP_t \tag{9}$$

where:

- $Q_{S,t} S_{S,t}$ represents the value of the claim, Q, issued by sector $S \in \{Y, L, F\}$ and intermediated by the bank.
- NW_t is the net worth (bank capital).
- BP_t represents the deposits the bank obtains from households.

In period t, the bank earns a stochastic return $R_{S,t}$ on claims issued by firms in sector S and pays a non-contingent real return R_t on deposits. The returns on loans are sector-specific and depend on the price of capital, payoffs, and capital quality shocks. The progression of net worth over time is determined by the discrepancy between income earned from assets (loans offered by the bank) and the interest paid on liabilities (deposits in the bank). The dynamic formula for bank capital is given by:

$$NW_t = \left[\sum_S \left(R_{S,t} - R_t\right) Q_{S,t-1} S_{S,t-1}\right] NW_{t-1} + R_t NW_{t\;1} \tag{10}$$

The financial frictions are introduced through a borrowing constraint that limits the amount banks can raise from households. This constraint is critical in determining the banks' ability to lend to energy and final goods producers, thereby impacting the overall investment in the economy.

A simple agency problem is assumed to limit the ability of banks to expand their assets indefinitely in each sector. At the start of each period, the banker has the option to redirect a portion of the available funds away from banking operations. If the intermediary does not fulfill its debt obligations, households (depositors) have the right to force it into bankruptcy and reclaim a portion of its assets. Depositors will agree to provide loans to bankers only if the bank's value exceeds the share of funds that can be diverted. This gives leverage constraint as:

$$V_{it} \geq \theta_t (Q_{Y,t} SY, t + \Delta Q_{F,t} S_{F,t} + \Delta_1 Q_{L,t} S_{L,t}) \tag{11}$$

Additionally, they assume different absconding rate (represented by $\Delta \,\&\, \Delta_1$) for different assets. They specifically assume that the incentive frictions which restrict arbitrage are more intense for energy-related assets (because of transition risks) compared to final goods-related assets, rendering the latter market sector less risky.

Central Bank and Monetary Policy:

> The central bank (CB) is in charge of monetary policy and financial regulation, overseeing the economy's macro-financial outcomes. The central bank follows a standard Taylor rule. As per the standard Taylor rule[2] for setting interest rate, the central bank adjusts the interest rate in the economy in response to divergences in inflation from its target level and output from its potential. Additionally, it pursues an active monetary policy, where the response coefficient to inflation exceeds unity.

In this milieu, the model first explores possible sources of macro-financial instability from climate change, particularly in the form of transition risk as well as the effectiveness of green QE in mitigating such macro-financial instability. To further illustrate, they consider a scenario in which the central bank (CB), instead of acquiring the same proportion of assets from all three sectors of the real economy, aims to balance multiple objectives – financial and macroeconomic stability alongside environmental sustainability by exclusively purchasing assets issued by the low-carbon energy sector. They show that even with a preference for green assets, QE can still deliver adequate economic stimulus. One of the most pivotal mechanisms elucidated in this model is the complete absence of any portfolio adjustment cost within the banks' balance sheets. This allows banks to significantly alleviate their credit constraints and voraciously seize arbitrage opportunities – thereby acquiring assets in various sectors that yield substantially higher returns following the infusion of liquidity.

In summary, they show that if banks do not incur extra costs for maintaining fossil fuel based assets, green QE could serve as a means to mitigate the adverse impacts of a financial shock, although it may not be effective in altering the banks' portfolio composition or transforming the economy.

23.4 Adapting the Model for Emerging Market Economies

EMEs, such as India, have a macro-financial environment that is significantly different from that of advanced nations across multiple dimensions. This observation has been corroborated by various researchers including Kumar and Dash (2020); Lahiri and Patel (2016), highlighting the different paths through which a developing economy diverges from an advanced economy. This implies that the above model, developed for an advanced economy, and its implications may not hold for an EME. In this context, some key areas of divergence, relevant to green QE, and how they could be incorporated in a revised model are encapsulated below.

Presence of a higher proportion of Non-Ricardian agents: In contrast to an advanced economy, an emerging economy like India has a large proportion of credit-restricted households who do not participate in the formal credit market and do not receive any dividends from the market (in our case, monopolistic retail companies).[3] In other words, they are hand-to-mouth economic agents with a limited ability to stabilise consumption over their lifetime. Their each period consumption relies solely on wage earnings. They do not engage with the banking system at all thus any changes that are propagated through the banking system has limited efficacy for EMEs as compared to advanced economies.

The implications of the above may be incorporated as follows. The consumption of these non-Ricardian agents can be modelled as:

$$C_{nr,t} = \frac{W_{nr,t}N_{nr,t}}{P_t} \tag{12}$$

where

- $C_{nr,t}$ is consumption of Non-Ricardian agents.
- $W_{nr,t}/P_{nr,t}$ is the real wage of Non-Ricardian agents.
- $N_{nr,t}$ is the labour supply of the Non-Ricardian agents.

Hence, the overall consumption of the economy will be a weighted sum of the consumption from both types of economic agents:

$$C_{T,t} = fC_t + (1-f)C_{nr,t} \tag{13}$$

where $C_{T,t}$ is the total consumption of the economy while f is the fraction of Ricardian agents in the economy. This implies that as f tends to unity, an economy comes closer to being more advanced.

Shallow Credit market: As noted by various studies, most of the EMEs, including India, have a shallow financial system. This is accompanied by an underdeveloped and segmented bond market, along with issues related to credit rationing by banks in the formal sector. One of the key issues that arise from a segmented bond market is that the long-term interest rate of the economy (which matters for private investment) becomes less sensitive to the CB's controlled short-term rate. The higher term premium of the long-term rate which generates from this market segmentation also impacts private investment by retail firms. In the presence of financial market imperfections, interest rates alone are insufficient to explain the distribution of credit, thus making the overall impact of a monetary action less effective. These imperfections can create disparities between the costs of internal and external financing for firms, making investment more sensitive to net worth and cash flows as compared to interest rate, resulting in interest rate as an instrument to influence private investments less potent.

Moreover, as noted by Kumar et al. (2024) firms in emerging economies like India have low capital with high loan-in-advance constraints. In this scenario, a rise in the cost of funding for lenders (with a contraction monetary policy) does not only translate to higher interest rates for borrowers, but may also result in the complete withdrawal of credit. This presents a distinct challenge for these firms to undertake risky private investments and for central banks to stimulate the economy.

In adapting our model to address this constraint, we introduce a new loan in advance constraint for the monopolistically competitive firm.

We assume that the firm purchases at least a constant fraction ψ of its new physical capital I_t using loan. This results in a 'loan in advance' constraint of the form:

$$\psi P_t^K I_t \leq Q_t S_{w,t} \tag{14}$$

where P_t^K is the price of the new physical capital. $Q_t S_{w,t}$ is the total value of the new loans that is taken by the firms.

Higher credit regulation: Another feature of the many emerging economies is the higher degree of credit regulation in the economy. Though India has gone through a large number of financial deregulation measures since the mid 1990s, the extent of regulatory oversight is far more pervasive than that of the advanced economies. In particular, banks in India are subject to a Statutory Liquidity Ratio (SLR), which mandates that they maintain a portion of their liabilities in the form of government securities and other low-risk assets. Although this type of financial repression regulation can improve the quality of assets held by banks, it also limits the amount of credit available to private firms for investments. We can incorporate this feature in our model in line with Kumar et al. (2024) as:

$$Q_{L,t} S_{L,t} \geq \Gamma((Q_{L,t} S_{L,t} + Q_{F,t} S_{F,t} + Q_{Y,t} S_{Y,t})) \tag{15}$$

where the left-hand side represents the amount loaned to the low-carbon energy sector, and the right-hand side corresponds to the total loans issued by the bank. The parameter Γ denotes the regulatory constraints within the model.

Figure 23.1 is a pictorial representation of our modified model.

23.5 Discussion

The distinct macro-financial structure of an EME such as India presents a significant challenge for the central bank in balancing financial stability with the macroeconomic impacts of climate change. In this section, we elaborate on our expectations of how each of the specific features discussed in the last section would affect the outcomes of the green QE model for advanced economies discussed in Section 23.2. Through this process, we come up with a reasonable understanding of the implications of green QE in an EME which is addressing climate-change-related issues.

First, the presence of a higher proportion of the Non-Ricardian or constrained agents imposes a unique challenge for the central banks. Constrained agents, as mentioned earlier, tend to consume all of their income each period (meaning their marginal propensity to consume is one), whereas unconstrained agents follow the typical Euler equation[4] aimed at smoothing consumption throughout their lifetime. The revised aggregate IS equation,[5] incorporating both constrained and unconstrained economic agents, can be

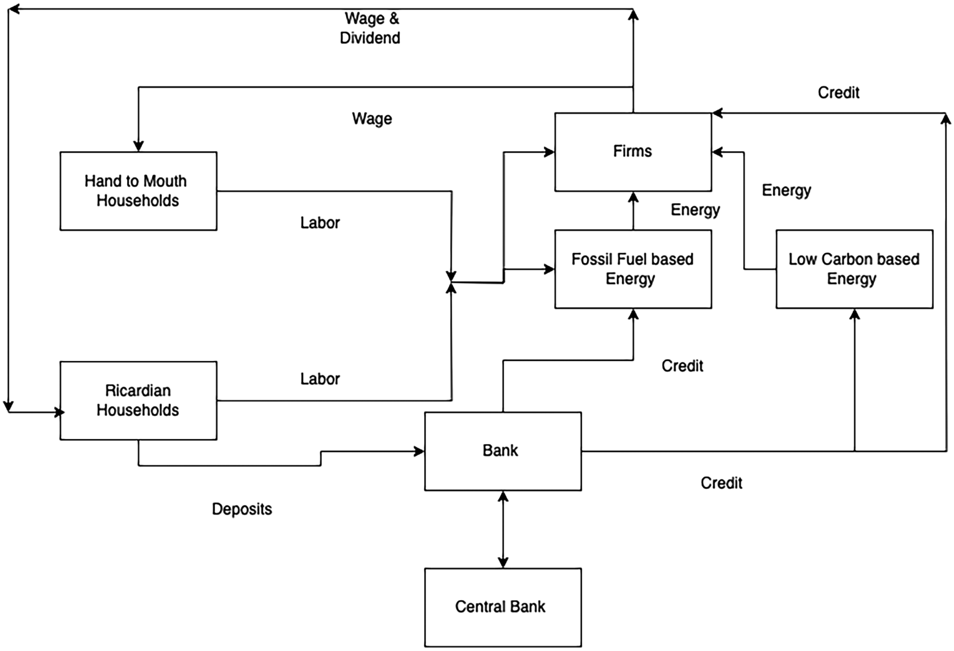


Figure 23.1 Flow Diagram of Modified Model

roughly described as a convex blend of two factors: a weight $(1-f)$ multiplied by the projected growth of disposable income, and a weight f multiplied by the real interest, where f is the fraction of Ricardian agents in the economy.

According to earlier research, the existence of financially restricted economic agents diminishes the determinacy characteristics of the central bank's interest rate rules. Gali et al. (2004) demonstrate that when significant price rigidity is present alongside a higher proportion of hand-to-mouth agents, the stability of the rational expectations equilibrium (REE), that is, individuals make decisions based on all available information, including their expectations about the future and their demand coincides with rational producer supply decisions, necessitates the central bank to implement a reinforced Taylor Principle. This principle requires that CB's response to deviation of inflation from its target and output gap have to be significantly greater than one. In simple sense, as the proportion of constrained economic agents increases, the central bank's response must be tougher to stabilise the output and inflation volatility.

The undeniable reality is that climate change significantly elevates the risk of heightened inflation volatility within the economy. This issue becomes even more pronounced in emerging economies, where the agricultural sector has a substantial presence, exacerbating economic instability. Diluiso et al. (2021) emphatically observed that inflation volatility is exacerbated under climate policies necessitating robust and decisive actions by central banks.

We expect that the modified green QE model for EMEs would yield results leading us to recommend that in economies with a higher proportion of constrained economic agents, the central bank must act more aggressively than in advanced economies.

Emerging Market Economies frequently operate a parallel informal economy not regulated by central banks. Although our adjusted model does not include this concept, from a modeling perspective, the existence of a parallel informal economy necessitates even more aggressive action from the central bank to manage inflation volatility effectively.

Next, we examine how, distinctive financial frictions arising in emerging markets due to lesser credit depth can influence the measures implemented by central banks to mitigate climate risks. As noted by previous studies Kumar et al. (2024); Lahiri and Patel (2016), firms in the emerging economies like India have higher loan-in-advance constraints. This boils down to the fact that the firms, on average, conduct a larger share of private investment through credit. If the asset base of a bank is compromised due to climate risk – such as catastrophic infrastructure damage which transforms assets into non-performing loans, this scenario may precipitate a substantial withdrawal of credit. Such a contraction in credit availability can significantly exacerbate the economic slowdown, creating a vicious cycle where reduced lending further undermines both private investment and economic stability.

One of the key channels for policymakers to mitigate climate risk is by directing available credit towards green finance. The point noted by Diluiso et al. (2021) is that QE can increase credit to the green sector. However, in absence of any portfolio cost, a higher liquidity inflow into credit markets is likely to increase flows across all sectors. This in turn implies that credit will also flow into the fossil fuel sector as well, which is contrary to promoting climate action. Therefore, despite green QE, there may be no change in the overall credit structure.

Therefore, in addition to easing liquidity in the banking sector for green credit, central banks must craft strategic interventions that compel banks to bear some form of portfolio adjustment cost on their assets. It is essential to implement this measure to encourage a shift in asset structures towards green investments over the medium term. Given that the non-competitive banking sector in the emerging economies usually suffers from lax institutional practices, it will be more difficult for the central bank to design policy in this regard so that there is a change in the asset structure of the banks without the formation of credit bubbles.

Finally, we delve into the critical issues arising from credit regulation in developing economies. These emerging markets exhibit a myriad of credit regulations, yet most converge on some form of financial repression. This financial repression mandates, or, more subtly, nudges banks to allocate a specified portion of their assets to particular instruments, notably government bonds. In essence, this system enforces a degree of controlled investment, potentially stymieing broader financial growth and flexibility, but manages the risk of larger financial instability. A recent study by Kumar et al. (2024) indicates that the existence of credit regulation can adversely affect the impact of QE on private investment. They show that when an economy is under credit regulation, QE has opposing effects on leverage and regulatory constraint. While QE increases the bank's reserve holdings, reducing the agency problem and relaxing the leverage constraint (see equation 11), it simultaneously decreases the bank's holdings of government bonds (as central banks purchase these bonds), thus tightening the regulatory constraint (see equation 15).

In addition, banks sometimes tend to hold a higher amount of government bonds than the official regulatory limit. Several factors contribute to this, such as the increased risk aversion of loan managers, the lack of creditworthy customers, or the limited loan demand across different sectors of the economy, which could aid in diversifying default risk. Nevertheless, this scenario might also arise when central banks leverage their soft power to compel banks to maintain specific loans above the mandated levels effectively tightening the regulatory constraints for the banks.[6]

In this scenario, it is possible that the overall outcome of the bond-purchasing activity could be an increased yield on private bonds, thereby reducing private investment instead of encouraging it. In the case of green QE, this mechanism will become even more complex. Intuitively, the potential for a green QE initiative to lower the term premium for both environmentally friendly and fossil fuels can be contingent upon these instruments being exempt from regulatory constraints. This delicate balancing act of financial instruments, orchestrated to favour sustainable initiatives, stands as a testament to adaptive economic strategy. The dynamic changes dramatically if green bonds or loans fall within the scope of regulation. In that case, while green QE endeavours to reduce the yields on green loans, it inadvertently causes an uptick in yields on fossil fuel loans, introducing a complex web of financial interdependencies that can sway the equilibrium of the market.

23.6 Policy Implications

Having recognised the need for central bank intervention to address potential financial instability caused by climate change and discussed the potential outcome of green QE on an EME, we now discuss the policy implications of the same.

In recent times, emerging economies have driven global growth. They must now balance sustaining growth rates with addressing climate risks and supporting global climate objectives by transitioning to a low-carbon economy. However, the distinctive characteristics of the emerging economy require a bespoke approach and unique solutions for meeting these twin objectives. This will inevitably require improving adaptive capacity by investing in robust infrastructure, early alert systems, and focused social safety nets. Based on estimates, emerging economies will need approximately 2 trillion dollars annually through 2030 to achieve the goal of net-zero emissions by 2050.[7] Further, as noted in the 2023 IMF Global Financial Stability Report, a considerable portion of funds that factor in environmental, social, and corporate governance considerations do not inherently prioritise climate-related issues.

This puts pressure on the policy makers of emerging economies to come together to put the economy on a path of sustainable growth, and the role of the central banks can be crucial in steering credit towards green investments. In this context, some of the key policy preferences for the central bank are discussed below.

The central banks of emerging economies might begin by examining the causes of inflation and output volatility more closely. Climate change can cause significant fluctuations in inflation. Given that emerging economies have a larger proportion of the hand to mouth agents, the central bank would need to react more vigorously to stabilise economic agents' inflation expectations as compared to those in advanced economies. This is crucial, because, if inflation expectations become unanchored, it could trigger a wage-price spiral, where inflation perpetuates itself, leading to larger welfare losses. These would be over and above the losses caused by climate change events that triggered the inflation in the first place.

Green QE can be beneficial in developing markets in emerging economies. At a nuanced level, in green QE, the central bank manages the assets in its balance sheet while keeping in mind the environmental impact of its asset holding. So, it can ease of the quantity of the money in the economy available for the green investment. A crucial issue that needs to be considered is whether the central bank should participate in public green QE or private green QE, meaning whether it should purchase government green loans or private green loans from banks. As noted in Cantú et al. (2021) even during the COVID-19 pandemic, central banks in emerging economies primarily engaged in public QE. Additionally, weaker institutional regulations in these economies might introduce a bias when it comes to private QE. Hence, it is crucial that central banks in EMEs initiate their efforts with public green QE first, followed by prove green QE when appropriate.

Also, as discussed above, the central bank transfers some green assets from banks to its own balance sheet, thereby creating room for banks to acquire more assets – both green and conventional. Therefore there is a need for central banks to induce some kind of adjustment cost for the bank so that banks can be nudged to change their asset structure over the medium term.

Although higher loan-in-advance constraints for firms, a unique feature in emerging economies, are a challenge for growth, there is a silver lining with respect to appropriate channelling of green QE initiatives of the central bank. A higher loan-in-advance translates into firms funding a higher proportion of investment from credit, and therefore, the firms become more sensitive to policy actions by the central bank. Therefore, with higher loan-in-advance constraints, firms can respond more effectively to the direct availability of funds for green investment.

Meanwhile, a number of emerging economies (notably not India) are burdened by substantial external debt, which restricts credit availability for firms. In such cases emerging economies should be encouraged to engage in a 'debt for climate' swap. A debt-for-climate swap is a deal where the creditor agrees to cancel part of the debtor's foreign debt or offer debt relief, in exchange for the government committing to invest in specific environmental initiatives, such as decarbonising the economy, building climate-resilient infrastructure, or safeguarding biodiversity.[8] Such swaps can be beneficial in two primary ways. Initially, they promote green public investment, which is crucial for the green transition. Subsequently, reduced external debt will decrease the sovereign risk premium, thereby lowering the overall borrowing costs for firms engaged in green transition. Central banks, which play a crucial role in managing public debt across many emerging economies, can assume a pivotal role in facilitating debt-for-climate swaps. By leveraging their position and resources, central banks can effectively orchestrate and promote these initiatives, thereby enabling a smoother transition towards a greener and more sustainable economic future. Their involvement can ensure that the mechanics of debt relief are efficiently linked with substantial environmental investments, ultimately driving both economic stability and environmental stewardship in these regions.

Historically, credit allocation or guidance policies have been crucial in developing and emerging economies, particularly during the 1950s through the 1970s. One key measure is mandatory credit requirements, the proportion of loan that commercial banks must keep in specified assets. Such practices have been entirely eliminated in numerous advanced economies today, yet they remain an element of the policy framework in emerging economies. A prevalent example is the statutory liquidity ratio (SLR) in India where a proportion of the bank assets must be in liquid cash and specified securities. Given that emerging economies already have compulsory credit regulations in place, SLR can easily be extended to a green credit regulation where a central bank mandates that banks dedicate a specific portion of their loan portfolio to the green sector or green investments.

Box 23.1 Greening Statutory Liquidity Ratio (SLR)

Dhruba Purkayastha and Neha Khanna

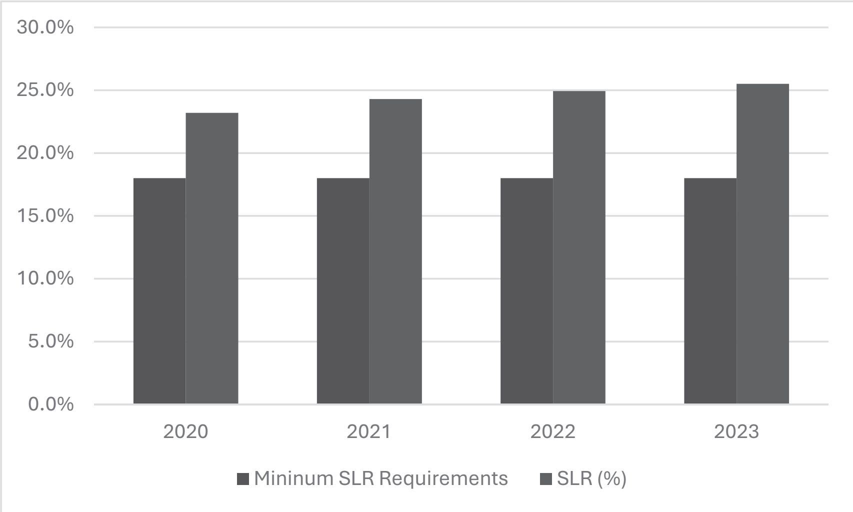
It is well known that India is falling short of required climate investments annually with respect to climate investments required for meeting India's NDC commitments, like the rest of the world and the order of magnitude for climate investments is about 30% of what is required for the world to stay below 1.5DegC or even 2DegC.

For India, tracked finance flows to mitigation account for approximately 25% of total mitigation investments required in India, and therefore, transition to net-zero will require significant increase in climate investment which would be needed for overall net-zero transition in energy, transportation, industries and finally reducing emissions from agriculture and other land use (AFOLU). Estimates done by think tanks, consultants, international commercial banks (CEEW, McKinsey, Stanchart) indicate that cumulative climate investment required for India's net-zero transition by 2070 range from $10 trillion to $15 trillion, which roughly translates to about $200 million investments per annum. RBI estimates that the required increase in investment rate for net-zero transition is about 2.5% of GDP.[9] Increasing green investments to the extent of 2.5% of GDP is itself a tall order, and the problem gets compounded because of falling financial savings rates in India (which is about 12% GDP). The role of financial intermediation and financialisation of savings is critical in transition to green to unlock private investments and also use public investments, to bridge investment gap in green investments, while considering the entire spectrum of climate-related risks.

The Reserve Bank of India (RBI) – Central Bank and Banking regulator in India, could contribute to increasing green investments in India through changes in prudential regulation and monetary policy tools, and one of them is the Statutory Liquidity Ratio (SLR). SLR and Cash Reserve Ratio (CRR) are the two 'reserve' ratios employed by RBI to manage liquidity. SLR[10] is used as a tool to manage liquidity of banks and has been revised by RBI over the years as needed. It requires banks to keep a certain amount of their money invested in specific central and state government securities.

The minimum requirement is 18%, and the maximum that an FI/bank can keep was set at 40%. Before the amendment of the Banking regulation Act in January 2017 the floor rate for SLR was 20.75%. Post the amendment the SLR requirements have been reduced and has been constant at 18%, since 2020. However, the amount of SLR kept by banks has never dipped below 20% in the last 4 years. In fact, the gap between the minimum required and the SLR kept by banks has been increasing and was 7.5% in 2023. This shows that banks are investing over and above what is required by SLR regulation in government and public sector securities. It has been argued that this amounts to incremental crowding out from what could have been commercial bank credit, and this has also contributed to stagnant credit to GDP ratios in India and as such India's credit to GDP ratio is well below world averages[11]. The figure provides the trend of increasing divergence between regulatory SLR and actual SLR invested by commercial banks in India.

Min SLR requirement versus Average SCB SLR



Source: RBI data and authors own analysis

The increase in SLR investments, as shown in Figure, by banks beyond the regulatory requirements could be called 'Extra SLR'"

a) It is available to the government and public sector.
b) It is in addition to what RBI prescribes as prudential regulatory requirements.
c) This is voluntarily done by commercial banks.

Greening of 'Excess SLRs' could a possible avenue for the Reserve Bank of India and the Ministry of Finance, GoI to consider directing excess SLR investments to Green Investments, which could then be Green SLR investment by Banks and Sovereign green borrowings by GoI, and they could add to the pool of finds raised through Sovereign Green Bonds over the last two years. Finally, RBI could also consider titling monetary policy towards enabling green investments by considering lower repo rates for Green SLR instruments. This increased public finance available for green investments could be directed to adaptation and resilience projects will be via public finance due to lack of viable business models in adaptation and resilience.

It is imperative to note that such regulations, simple as it may seem, manifests as stringent quotas. This rigid framework not only imposes direct compliance but also significantly amplifies market distortions. The inflexibility introduced by these hard quotas can exacerbate market inefficiencies, leading to a more pronounced misallocation of resources and potentially stifling innovation within the financial sector. It is a double-edged sword, promoting green investments on one hand while curbing the fluidity of market dynamics on the other.

Finally, one of the key constraints for the central bank would be that any quantitative easing can only be temporary with a definite end date. If the Central bank balance sheet is expanded to include a large volume of green assets, in the absence of robust secondary markets, it may constrain the banks capacity to respond to future macro-financial instabilities.

Through the lens of this modified model, we also examine the implication of the central bank implementing green QE along with credit policy regulation that requires a certain fraction of bank credit to be allocated towards financing green investments. In simple words, we wish to see if these policies can be established together. If green bonds (or loans) are included in credit regulations then green QE aims to lower the yields on green loans, but this could lead to higher yields on non-green loans. This could have serious implications on overall private investment of the economy. Therefore, it is imperative that the while both policies of green reserve requirement and green QE can be beneficial in emerging economies in promoting green investment, how they are applied as a combination should be given thoughtful consideration.

Notes

1 www.iea.org/reports/net-zero-by-2050
2 note that in practice, Taylor's rule may not be fully effective as a response to supply side shocks
3 Note that such agents may borrow from informal credit markets, which is outside the scope of our model
4 The Euler equation fundamentally illustrates how households decide whether to consume in the present or in the future, guided by the current real interest rate of the economy
5 The IS equation represents combinations of interest rates and levels of output such that planned spending equals income
6 Sorkin (2009) enumerates instances of governmental pressure exerted on U.S. banks. During a meeting with the CEOs of major U.S. banks, Treasury Secretary Hank Paulson reportedly emphasized the importance of acquiring Lehman Brothers by stating, "This is about our capital markets, our country. We will remember anyone who is not seen as helpful." In advanced economies, this exemplifies governmental influence. In contrast, in emerging economies, where banks are primarily state-owned, such influence manifests as encouraging banks to hold larger quantities of government bonds.
7 www.iea.org/reports/net-zero-by-2050
8 www.weforum.org/stories/2024/04/climate-finance-debt-nature-swap/
9 www.business-standard.com/finance/news/india-s-green-financing-requirement-estimated-at-2-5-of-gdp-rbi-study-123050300988_1.html
10 SLR is ratio of bank's liquid assets to its net demand and time liabilities
11 In this context see also the discussion 'lazy banking' in Chapter 22.

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Part 6

Lessons from Other Economies

An Introduction

Mritiunjoy Mohanty and Runa Sarkar

This part attempts to leverage international experiences for financing climate action and draws lessons for India. It also underlines the need for international cooperation and building platforms for regional collaborations as the way forward in coping with what is now clearly an accelerating climate crisis.

Chapter 24 foregrounds the role of public sector firms in any feasible and sustainable energy transition strategy by looking at the privatisation experience in the UK, Brazil and South Africa. Having established that State-Owned Generators (SoGs), which once dominated India's power sector now contribute just 1.7% of renewable energy (RE) capacity, due to fiscal constraints, regulatory barriers and a policy bias towards market-driven models, Simran Grover, Priyanka Goel, Manish Kumar Mahto and Anuj Goyal advocate for a balanced approach where SoGs play a key role alongside private firms. They discuss South Africa's Eskom case, illustrating that excluding public utilities from generation can lead to economic instability and job losses. Similarly, privatisation of the UK's water sector led to higher user charges and poor service, and in Brazil energy privatisation resulted in public bailouts. In situations where critical gaps remain in RE infrastructure, including energy storage and grid modernisation, alongside land disputes and social resistance that hinder investments, SoGs, with their long-term investment outlook and public accountability, are better suited to manage these risks, ensure equitable land policies and stabilise India's transition from fossil fuels.

Chapter 25 draws lessons for India from the European Union's EU ETS and carbon tax regulatory mechanisms to incentivise green investments. Sabuj Kumar Mandal, Tanurima Brahma and Vardhini V. analyse the effects of carbon taxes and green bonds on RE investment and inflation, drawing insights based on a panel dataset of 18 European countries (1996–2022). Carbon taxes stimulate RE investment but primarily impact energy prices, not overall inflation. Green bonds, on the other hand, by making possible an expansion of RE capacity and stabilising supply, mitigate energy inflation. Effective regulation enhances the impact of both carbon taxes and green bonds, minimising inflation risks. By adapting successful European strategies, India can accelerate its RE transition while maintaining economic stability. They argue that prioritising green bonds and implementing carbon taxes with caution, supported by strong regulatory oversight, will be crucial for achieving a balanced and equitable low-carbon future. Given India's reliance on fossil fuels, carbon taxes require careful, gradual implementation to avoid consumer burden. Strong regulatory frameworks and coordinated state-centre policies are essential for a just and effective transition. Importantly, their contribution also challenges the belief that RE transitions inherently lead to widespread inflation.

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Madhura Joshi, Laura Sabogal Reyes and Kavya Singhal advocate for a regional approach towards climate action for a more effective means of harnessing climate funds by creating country-level platforms in Chapter 26. Drawing on lessons from Just Energy Transition Partnerships (JETPs), the chapter promotes next-generation country platforms to align international climate finance and development support with national priorities, ensuring resources are directed towards Sustainable Development Goals (SDGs) and Paris Agreement objectives. The authors exploit the role of platforms as mechanisms of credible information sharing, thereby lowering information asymmetries and attracting potential investors. They discuss the challenges faced by Emerging Market and Developing Economies (EMDEs) in investment mobilisation and suggest political and operational principles for designing effective country platforms. Offering actionable insights for policymakers, especially in the Indian context, this chapter presents a nuanced view of both opportunities and challenges, particularly regarding financing constraints and political dynamics. Most importantly, it makes the case for a collaborative approach towards mitigating financing constraints, which is sorely needed in the current international context.

The concluding chapter provides a comprehensive analysis of Indonesia's energy transition, particularly focusing on the Energy Transition Mechanism (ETM) and Just Energy Transition Partnership (JETP). Ramnath Iyer and Mutya Yustika explain Indonesia's coal dependency, policy commitments and transition initiatives. They clearly distinguish the roles of ETM (blended financing for coal retirement) and JETP (international financing for transition). Effectively integrating policy, finance and implementation perspectives, the chapter provides a well-rounded view of Indonesia's energy transition efforts. The critique of insufficient funding (e.g., grants forming only 0.2% of transition costs) is compelling. It highlights weak legal frameworks and complex coordination issues, which are critical barriers to progress. The critique of Indonesia's taxonomy and institutional inefficiencies is particularly sharp and well-argued. In doing this, they bring together the shortcomings of international finance (very low grant element) as well as domestic institutional structures feeding off each other to stymie well-laid-out transition plans.

24 Financing Energy Transition

Private Gains or Public Risk

Simran Grover, Priyanka Goel, Manish Kumar Mahto and Anuj Goyal

24.1 Introduction

Historically, state-owned generation companies (SoGs) played a foundational role in meeting India's energy demands, establishing an infrastructure backbone and delivering energy access across the country. However, their share in the energy generation landscape is diminishing, with private players dominating the renewable energy (RE) sector due to a favourable policy environment and robust financial mechanisms designed to attract private investments (PowerLine, 2024).

India has a cumulative installed RE capacity of 154 GW till September 2024 (National Power Portal, 2024), of which, the cumulative installed capacity of RE sources for public entities was a mere 4 GW. While the RE sector has attracted major investments, it is stymied by the market and non-market risks due in an evolving markets and policy environment, the intertwining of socio-political and economic development with electricity, and the high economic cost of inadequate supply of power. These risks have resulted in slower adoption of RE, continued investment in environmentally harmful sources of power like coal, and compromised energy security.

We argue that SoGs are uniquely placed to manage these risks due to higher risk appetite, political acceptance, ability to prioritise long-term goals over short-term profits, and as a risk mitigation instrument. Therefore, the state governments should actively encourage SoGs to plan energy transitions and become active players in RE markets. Further, strengthening SoGs will also help the state governments to navigate their unique challenges of balancing energy transition with energy affordability, security and sustainability in a just and equitable manner.

The next section explores the journey of SoGs in energy transition, traversing factors that have inhibited them from playing a significant role in the process. Section 24.3 analyses the risk posed by the energy transition in the light of socio-technical and economic complexity of the power sectors. The next section demonstrates how SoGs can alleviate some of the risks posed by energy transition. The last section concludes the chapter by making a case for the public sector in a paradigm defined by the assumptions of private sector's efficiency.

24.2 State-owned Gencos Muddling through Energy Transition

Electricity is intrinsically linked with economic growth and equitable social development (Kela, 2019; Singh & Srinivasan, 2006). It is appropriately placed in the concurrent list of the Constitution as both central and State governments are responsible for promoting

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economic growth and development. Hence, both central and state governments have key roles in governing and regulating the generation, transmission and distribution of electricity. Historically, they have had a strong market presence through various public sector undertakings. However, electricity distribution is solely under the purview of the state government (Michael et al., 2024).

Central government-owned public sector enterprises, such as NTPC, NHPC, Damodar Valley Corporation, etc. and state government-owned entities incorporated under the Indian Companies Act, 1956 (now governed by the Companies Act, 2013) and State Electricity Boards (SEBs) have played a significant role in developing the sector. The state government-owned entities are particularly responsible for electricity generation, transmission, and distribution for their respective states. For this chapter, we are defining state government-owned electricity generation companies (Gencos) and generation assets under State Electricity Boards as ‘State-owned Gencos (SoGs)’. The primary objective of a State Genco is to generate electricity and supply it to the state electricity grid (Gandhi et al., 2022).

Even though SoGs have a very low share in the RE sector at present, as early movers they piloted RE generation plants, especially solar and wind-based power plants, in many states. Karnataka Power Corporation Limited (KPCL) commissioned its first wind project of 0.225MW in 1996 (Karnataka Power Corporation Limited, 2021). KPCL has commissioned six solar plants with a cumulative capacity of 35MW in the period FY 2010–2018. Similarly, Gujarat State Electricity Corporation Limited (GSECL) commissioned 8 windmills each of 1.25 MW in FY 2008 and commissioned around 18 solar plants of around 671 MW since FY 2012 (Gujarat State Electricity Corporation Limited, 2024). Maharashtra State Power Generation Corporation Limited (MSPGCL) commissioned its first 1 MW solar plant in FY 2010–2011 (Maharashtra State Electricity Distribution Co. Ltd., 2010), followed by a 4 MW plant in FY 2012 and a 125 MW additional capacity in FY 2013 (Maharashtra State Electricity Distribution Co. Ltd., 2020). Andhra Pradesh Power Generation Corporation Limited (APGENCO) installed its first solar plant of 5 MW capacity in FY 2015–2016, followed by a much larger 400 MW facility at Talaricheruvu, completed in four stages between FY 2018 and FY 2019 (APGENCO, n.d.). Despite this, SoGs have an abysmally low share of 1.7%, representing a mere 2.6 GW of the 154.2 GW of RE installed nationwide by September 2024 against a share of 35.4% representing 105.6 GW of 298 GW of non-RE generation[2] as of September 2024 (National Power Portal, 2024).

The state and central governments financed the early RE projects through budgetary support to develop the market and infrastructure for RE. However, SOGs didn’t sustain the momentum to scale up their RE portfolios, while private companies, riding the wave of global green finance, invested heavily in RE as policy and regulatory environment addressed much of their risks. The domination of the private sector in RE came concurrently with the fiscally stressed state governments, who refrained from any capital investments in the sector. While the capital expenditure rate by the state government from 2015–16 to 2023–24 has declined from 2.6% to 2.1% of GDP, subsidies on electricity have increased from 8% to 9% of revenue expenditure during the same period (PRS, 2024). The declining capital expenditure has left state governments with no choice other than preferring private players for investments in RE in keeping with the discourse of neoliberalism (Dunleavy & Hood, 1994).

SoGs face the dual challenge of balancing social obligations and managing existing legacy generation assets that are primarily coal-powered. Keeping fossil-fuel-based assets, particularly coal plants, is becoming financially unsustainable (Ministry of Power, 2023).

These assets, along with other factors, weigh heavily on the balance sheets of SoGs, forcing them to borrow from financial markets. The liquidity crisis, exacerbated by unpaid dues from state electricity distribution companies (DISCOMs), further limits their financial capacity to support the transition to cleaner energy sources (Kumar & Jairaj, 2020). Electricity has become a politically contested issue during the last few years, and most state governments provide substantial electricity subsidies. However, state governments often do not pay back the subsidies to distribution companies, and they subsequently fail to pay SoGs on time stressing the balance sheet and adversely affecting their credit rating, and hence, the capacity to borrow (Kumar & Jairaj, 2020; Prag et al., 2018).

Most state-owned enterprises must obtain multi-level and time-consuming approval for business decisions and also be accountable to multiple agencies with varying mandates, barring a few Maharatnas and Navratnas (Khanna, 2015), that reduces their managerial autonomy. Managerial autonomy gets restricted further in the case of SOGs with weak balance sheets and high dependence on budgetary support from the state governments and geographical restrictions (Bose, 2011). These restrictions create an inertia among managers to take on new projects and often do not spatially optimise their investments. Private companies and central government undertakings such as NTPC can invest in favourable regions for RE deployment such as Gujarat, Rajasthan and Tamil Nadu. However, SoGs cannot invest in these states due to geographical limitations. State-level political bureaucracy does not favour investments outside the state as politicians are concerned with transfer of jobs to other states (The Hindu, 2022).

Despite being early movers, SoGs are muddling through energy transition at present. They are facing the threat of becoming a marginal player in electricity generation soon unless they navigate the current structural barriers. In our view, the shrinking share of SoGs in electricity generation due to their inability to invest in RE deployment may have far-reaching implications for energy security, welfare, risk management, and political power of state governments.

24.3 Electricity Sector Transition Risks and Complexities

Energy transition is shaping a paradigm shift in energy generation and consumption, which has brought new challenges and risks to the sector (Debnath et al., 2022; Saraji & Streimikiene, 2023). Traditionally, electricity generation was designed to follow electricity demand. The energy transition is increasing variability and uncertainties on demand and supply side (Fodstad et al., 2022). The calls for decarbonisation of industrial production followed by massive electrification of industries and emerging shifts towards electric mobility have increased uncertainties about future demand patterns. On the other hand, increased integration of RE sources such as wind and solar has weakened the capacity of grid management in comparison to traditional fossil-fuel-based power plants. Further, the adoption of decentralised RE has made the electricity supply-demand equation more complex. In this context, energy transition has posed significant structural, socioeconomic, and political risks that need to be addressed.

24.3.1 Market and Non-Market Risks

The RE ecosystem needs new kinds of ancillary services such as energy storage, frequency control, demand side management, energy efficiency, grid modernisation and smart grids (Banshwar et al., 2017). However, these services are in the nascent stage of development and will require a long incubation period. The growth and maturation of markets of these essential services further stumbled as there is no clarity about policies and regulations in the absence of reliable pilot studies and business models (Banshwar et al., 2017). Therefore, most of the private investment is limited to the generation of RE due to public procurement, leaving out these essential ancillary services. Underinvestment in these essential services is a structural risk to energy transition and can pose a threat to energy reliability and affordability.

India has adopted an approach to energy transition that is led by the deployment of large RE-based plants (Yenneti et al., 2016). These plants are no different from the traditional developmental projects that attract significant resistance from the communities and local power structures as they create haves and have-nots. For example, scholars have highlighted that large RE projects in India have resulted in a loss of access to common pool resources and livelihoods and the dispossession of land and other natural resources by local communities (Sovacool & Stock, 2024). It has resulted in on-ground conflicts with RE companies, delaying their projects and increasing costs. Such delays result in a significant reduction in investor confidence and investment in the energy transitions.

Energy transition or shift to RE is not benevolent for all without safeguarding the livelihoods of existing workers employed in fossil-fuel-based power plants (Davidson, 2023). For example, the South African government reserved the RE sector for Independent power producers exclusively to attract global investments in 2011 (Box-I). A decade later, the Just Energy Transition Plan focused on decommissioning existing coal power plants, most of which are owned by the public utility ESKOM. It drew strong reservations from civil society and labour unions like the National Union of Mineworkers (NUM) and the National Union of Metalworkers of South Africa (NUMSA) due to potential risks to the job security of ESKOM's employees and livelihoods of nearby communities. In South Africa's case, exclusion of ESKOM from participating in RE development added a political risk to energy transition. It must be noted that the long-term progress of energy transition is subservient to the ability of state to navigate such political risks.

Box 24.1 Eskom in South Africa's Energy Transition

In 2011, the South African government launched the RE Independent Power Producer Procurement Programme (REIPPPP) to attract foreign private investment in RE through long-term power purchase agreements (PPAs) (Department of Mineral Resource and Energy, n.d.). By inviting Independent Power Producers (IPPs) into the market, the programme aimed to diversify South Africa's coal-heavy energy mix. At the same time, Eskom, the state-owned utility responsible for over 90% of the country's generation capacity was barred from investing in RE to promote investments from the private sector (Todd & McCauley, 2021).

A decade later, at COP26, the Just Energy Transition Partnership (JETP) was announced with developed countries pledging financial support to accelerate South Africa's energy transition. The partnership deal between South Africa and the governments of the United Kingdom (U.K.), United States (U.S.), France, Germany, and the European Union (EU) pledged $8.5 billion between 2023 and 2027, to facilitate South Africa's transition from coal to RE (European Union, 2011). In November 2022, the government introduced the Just Energy Transition Investment

Plan (JET-IP) for five years (2023–2027) calling for an investment requirement of over $80 billion (1.5 trillion South African rand) and outlined utilisation of the funds (The Presidency Republic of South Africa, 2022). Amongst other things, the plan focused on the decommissioning of the coal power plants.

With the JET-P pushing for the decommissioning of coal plants, Eskom's share in the country's energy mix was set to shrink substantially, raising concerns about its future viability. The dual decision of barring Eskom from RE investments and commitments to coal phase-out threatened to eliminate Eskom's role in power generation, paving the way for eventual privatisation of the energy sector. This shift drew fierce opposition from civil society groups and labour unions including the National Union of Mineworkers (NUM) and the National Union of Metalworkers of South Africa (NUMSA), particularly over the potential risks of privatisation. They argued that the state utility should continue to play a leading role in the energy transition (Global Energy Justice Workshop Collective, 2023; Lenferna, 2023; Sweeney, 2024), anticipating that allowing IPPs to dominate the renewable sector shall result in higher tariffs, deepen energy inequality, reduced job security, and profit-driven approach rather than socially driven energy policies (Geddes et al., 2020; Global Energy Justice Workshop Collective, 2023).

In response to mounting pressure from unions and ongoing challenges in implementing the JET-P, the South African government has recently indicated a shift in its position regarding Eskom's involvement in renewables (Eskom, 2024). The state administration has acknowledged the need for Eskom to have a more prominent role in the energy transition, especially in the deployment of renewable projects (DMRE et al., 2022). The state utility is planning to repurpose its decommissioned coal plants into RE hubs, thus allowing the utility to remain central to the energy sector while transitioning to cleaner sources (Eskom, 2022, 2024).

The energy transition is not just a technical transition but also deeply intersects the lives and livelihoods of impacted communities and workers. When this transition triggers systemic shifts such as ownership of the sector moving from the public sector to the private sector, it is natural that fears and apprehensions of stakeholders that are adversely impacted by the transition shall deepen further. It must be noted here that South Africa chose an implicit roadmap for privatisation wherein a gradual phase-out of the public sector was designed by barring them from investing in the RE sector.

It is not surprising that government of South Africa, in October 2024, announced that Eskom shall not be precluded from participating in RE projects and indicated the Eskom's plans to invest in 2 GW of RE projects over the next two-three years (Kemp, 2024).

24.3.2 Developmental Risks

Consumption of electricity has a positive effect on economic growth (Aneja & Mathpal, 2021) and overall development (Lipscomb et al., 2013) in India as well as in other countries. Electrification even has spread effect to those houses which do not undergo electrification (in the area which underwent electrification) (van de Walle et al., 2013). It is a strong determinant in access to healthcare services with positive causal links between reliable electricity and usage of maternal health services (Koroglu et al., 2019) and operational capacity of primary health centres (PHCs) (Chen et al., 2019). The causal nexus between electricity and education, livelihood and healthcare implies that a disruption in the supply of electricity will have a detrimental effect on them (Obolensky et al., 2019). The disruptions in electricity supply are also linked with a 'substantial drag' on manufacturing (Allcott et al., 2016), which inadvertently proves to be the 'highest hurdle' for investment and economic development in the State (Fukumi, 2022). Varigonda (2013) found that a combination of inadequate and unreliable electricity supply and tariff hikes could cause social instability.

However, the privatisation of essential utilities or withdrawal of public institutions from the provision of essential utilities can result in the deterioration of services, increase in tariffs, and developmental risks (Hall, 2022). For example, the UK privatised their water utility to improve its efficiency, reduce the fiscal burden on the public exchequer, and attract investments in 1989 (Box-II). However, private companies were driven by profits rather than ensuring water for all, which has ultimately resulted in increased tariffs for water, increasing cost of living for the poor. In our view, the complexities and uncertainties in the private sector-led energy transition can result in increased disruptions and higher prices due to its inherent incapability to prioritise long-term social and economic development over short-term profits.

Box 24.2 Privatisation of Water Utilities in the UK

The UK government undertook privatisation of several state-owned utilities in the 80s to achieve its fiscal and political objectives of reducing public sector borrowing (Bakker, 2005). The water sector underwent drastic restructuring in 1973 when virtually all the water authorities were consolidated into 10 Regional Water Authorities (RWAs) and put under the direct control of the central government (S. G. Ogden, 1995). The privatisation of the water and waste-water sector in the UK in 1989 was driven by three key objectives: reducing fiscal burden on the country's finances, attracting much-needed investment for the utilities and improving their efficiency (Lobina & Hall, 2001; S. Ogden & Anderson, 1995).

The Water Act of 1989 transferred all the assets of the 10 RWAs to 10 newly formed water utilities. The government incentivised private participation by waiving off long-term debts owed by the RWAs (Pratley, 2024) and under-pricing their assets at the time of their listing on the stock markets (Portes, 2022). To assure returns on investments, these companies were also granted exclusive rights to operate in their respective regions (Ofwat & Department for Environment Food and Rural Affairs, 2006). An independent economic regulator, the Water Services Regulation Authority (Ofwat), was established under the Act to offset the resulting lack of competition (Water Services Regulation Authority, 2006). The regulator was to be responsible for protecting consumer interests, securing long-term resilience in water supply and ensuring that the companies carry out their functions (CAG, 2015).

Over the years, the impact of privatisation on the sector and its stakeholders has been rigorously assessed. Only three of the 10 initial companies are still listed on the stock exchange as of July 2024 (Pratley, 2024) and their ownership is primarily being held by large foreign institutional investors (Almeida, 2024; Leach et al., 2022). As the long-term exclusive licenses of the companies, due for expiry in 2014, were extended by another 25 years in 2002, these companies continue to operate without any real competition (Pratley, 2024).

Investment in the sector remains underwhelming, with only 0.05% of existing pipe networks being replaced per year in the UK against an average rate of 0.5% in Europe (Horton, 2022). This poses serious health concerns for consumers as nearly three million lead pipes, which comprise a substantial share of the existing network, were yet to be replaced in 2023 (Jeraj, 2023). Reports suggest that most of the GBP 123 billion spent as capital expenditure between 1989 and 2021 has been financed by the increasing tariffs (Hall, 2021, p. 13) which have increased by nearly 360% – nearly twice the rate of inflation (Almeida, 2024). Despite the companies being debt-free at the time of privatisation, a debt of nearly GBP 52 billion has been amassed by them (Hall, 2021, p. 13; Plimmer & Hollowood, 2021) with speculations that the debts have ultimately been used for paying GBP 57 billion as dividends to the shareholders between 1991 and 2019 (Armitage, 2012; Hall, 2021, p. 14). Environment concerns such as leakages in the network resulting in nearly a trillion litres of water being wasted annually in FY 2022 (Horton, 2022) and untreated sewage being dumped into the rivers and waterbodies (Kollewe, 2024; Plimmer & Hollowood, 2021) have also been highlighted.

The more concerning aspect of the case of privatisation in England is a reversal of the role of the regulator in the sector. Hall (2021) argues that Ofwat has become a 'captured regulator' and is more concerned with the well-being of the water companies instead of serving public interests. This has been exacerbated by the regulator being outside the scope of political supervision as it is a 'non-ministerial government department' (Hall, 2021, p. 4).

For critical utility sectors, it is pertinent that companies need to balance concerns of public services, environment compliance, security (energy or water security for instance), affordability, and sustainability. Since private sector is naturally driven by profits, their observance or appetite for balancing different concerns may be lacking. This may especially be true where regulatory bodies are weak.

Further, this case serves to challenge the notion of the ability of the private sector to mobilise private capital. On the contrary, the case serves to substantiate that private sector further drains capital by rewarding dividends to shareholders despite precarious fiscal health and debt burden.

24.3.3 High Costs of Failure

Essential utilities, like electricity, have a critical role in sustaining social development and economic growth, ensuring security, and maintaining peace necessitating adequate planning and regulatory framework to mitigate potential risks (ILO, n.d.). The cardinal role of electricity in maintaining these essential services restricts the scope of 'failure', and the State does not have the option to let these utilities fail. Hence, the private provision of essential public services does not shield governments from market risks such as massive currency devaluation, increased prices in international markets, and global financial crises (Kessler & Alexander, 2004). The state must put its precious public resources into keeping these services running in case of failure (Kessler & Alexander, 2004), irrespective of whether they are private or public, making the state as the ultimate bearer of risk irrespective of ownership of any critical utility sector.

The cost of such failures is not only financial but also results in deterioration of sovereign ratings and international reputation, which are ultimately borne by the State. For instance, the Brazilian government was forced to call upon its public finance company BNDES to provide loans to the privatised distribution companies to cover their financial losses (Tankha, 2009), to ensure energy availability and reliability. Further, these loans were treated as income rather than liability, and the cost was passed to the consumers (Box 24.3).

Although the government has to bear the financial cost, it also needs technical capabilities to intervene in times of crisis in the utility sector to manage such high risks. Without this capacity, the state governments would be dependent on external agents to manage the risk at a time of crisis. Especially, in the context of energy transitions which are technically complex and intertwined with technological, socioeconomic, and environmental changes (Castrejon-Campos et al., 2020; Pearson, 2018), accounting for the non-market risks associated with these changes becomes necessary. The transition to RE therefore poses multiple challenges and uncertainties along with legitimate concerns about energy security[3] and energy equity[4] (Graylee, 2012; Saraji & Streimikiene, 2023). Hence, the diminishing share of SoGs in energy production and their near absence in the RE sector pose a serious threat of shrinking human capital and state's ability to intervene in times of crisis.

Box 24.3 Privatisation of Brazil's Power Sector in 1990s

Brazil's power sector underwent significant changes in the 1990s against a backdrop of macroeconomic instability and fiscal challenges (Balza et al., 2020; World Bank, 2002). These shifts were driven by the broader neo-liberal philosophy of the time, which advocated for the reduction of state involvement in the productive sectors of the economy. Privatisation, in this context, was seen as a remedy for fiscal deficits, underinvestment, and inefficiencies that plagued the power sector. By privatising state-owned enterprises (SOEs), the government aimed to alleviate national debt, reduce interest rates, and stimulate economic growth, with the belief that market forces would drive efficiency and modernisation in the power industry (Brown, 2002; Pinheiro & Giambiagi, 1999; Tankha, 2005).

Historically, Brazil's power sector was dominated by hydroelectric power, accounting for over 90% of the country's energy generation (Brown, 2002; World Bank, 2002). The sector was managed by federally owned companies like Furnas, Chesf, Eletrosul, and Eletronorte, under the federal utility Eletrobras (Brown, 2002). Distribution was largely managed by state-owned utilities, with each state operating its own electricity distribution company (World Bank, 2002). Wealthier states operated vertically integrated companies that combined generation, transmission, and distribution functions (Tankha, 2005).

The process began in 1995 with a focus on unbundling vertically integrated power companies and introducing competition where feasible (Muller & Rego, 2021). By 1998, most discoms had been privatised, achieving sale prices significantly above their minimum reserve values (Tankha, 2005). The second phase aimed at privatising generating and transmission companies (Tankha, 2009). However, these efforts faced major challenges following the Asian and Russian financial crises in 1999, which devalued Brazil's currency and led to substantial financial losses for privatised discoms (De Oliveira et al., 2005; Tankha, 2009). Many of these companies had large foreign-currency debts and sought tariff hikes to mitigate their losses. Although Brazil's electricity regulatory agency Agência Nacional de Energia Elétrica (ANEEL) allowed tariff hikes, they were insufficient to counteract the currency devaluation. Investor disinterest (Tankha, 2005), political opposition (World Bank, 2002), and macroeconomic instability (Arbache, 2006; Tankha, 2005; World Bank, 2002) further stalled the privatisation of Gencos, leaving the electricity system vulnerable to supply shortages and inefficiencies.

By 2001, Brazil's hydroelectric reservoirs were nearly depleted, and the Operador Nacional do Sistema Eléctrico (ONS) issued warnings about insufficient energy reserves (Tankha, 2009). In response, the government imposed a 10-month electricity rationing, cutting consumption by 20% (ESMAP, 2005; Tankha, 2009), causing $5 billion in economic losses and an estimated1.5% to 2% loss of GDP (Tankha, 2009). In 1996, the Brazilian Development Bank (BNDES) study and consultants for the Ministry of Mines and Energy (MME) warned that Brazil faced an increased risk of electricity rationing after 2000 if investment in generating capacity was delayed (Tankha, 2005). Despite warnings of rationing risks and the improved financial health of Gencos, the federal government limited their ability to invest in capacity expansion in preparation for privatisation. This left Brazil vulnerable as hydroelectric reserves dwindled without sufficient new capacity (Arbache, 2006; Mendes et al., 2017; Tankha, 2009).

Privatisation relied heavily on public financing, primarily through BNDES, which provided up to 50% of the reserve price as loans to winning bidders and extended additional financing for infrastructure, effectively ensuring that state resources underpinned the privatisation process (Brown, 2002; Tankha, 2009). While this strategy inflated asset sale prices and strengthened the government's balance sheet, it shifted significant commercial and financial risks to the public sector financial ecosystem. As the privatisation efforts faltered, particularly post 1999, BNDES was again called upon to provide loans to cover the financial losses of privatised utilities (Tankha, 2009). In return for waiving future legal claims, these companies received loans treated as income, while the costs were passed to consumers through a 10-year surcharge on electricity rates (Tankha, 2005).

Brazil's privatisation journey underlines some critical learnings, especially in the context of energy transition. Foremost, it is evident that given its social, economic and political consequences, the power sector is an essential utility sector wherein failure is not an option. It is evident that private sector drivers are not aligned to bear unforeseen risks, nor are they capable of taking a long-term position on fiscal turnaround.

Even though the failure of the energy sector may be an option for private utilities, the ultimate costs of failure lie with the political party in power and the people of the region. Hence, the role of the State is critical from the perspective of resilience and energy security. There have been cases where a bailout has not been an option, and the state can navigate such adversities only if it has a substantive public sector capacity.

Lastly, in the case of Brazil, privatisation was deemed successful only because of the financial support of public banks and later underwriting of the losses through increased tariffs. This raises significant concerns about the private sector's ability to navigate sectoral risks, their efficiencies in financing new investments or their ability to take long-term positions for building return on investments. If such burdens are to be inevitably borne by public exchequer and banks, it shall consume state's resources meant for social development and public welfare.

24.3.4 Disempowerment of the State Governments

While financial and technical risks are inevitable for the power sector, State governments have a critical stake in it as affordability and reliability of electricity have serious political consequences (Michael et al., 2024). These risks are particularly concentrated with state governments as electricity distribution is a state (provincial) subject. Consequently, the central government's decision-making may not be aligned with the needs of different states, and the state has to play a big role in the power sector is necessary to balance federal dynamics.

Navigating such risks shall become even more challenging in the backdrop of energy transition as it demands investment in grid modernisation, new infrastructure, and phasing out legacy infrastructure. The state may navigate these risks through timely investments that optimise system-level costs and mitigate the impact on electricity tariffs.

For the mitigating impact of electricity tariffs, state governments may resort to formal instruments such as consumer subsidies and building regulatory assets, or informal instruments such as foregoing return on equity for state-owned power utilities or taking losses onto their books. While these mechanisms may not be ideal, they are critical to navigating short to medium-term sectoral risks. These capabilities may as well define the political viability of energy transitions given is social-economic risks.

24.4 The Role of SoGs in Navigating Energy Transition

Energy transition demands large investments in clean energy and grid modernisation and also needs to navigate the trilemma of energy affordability, security, and sustainability (World Energy Council, 2024). It is in this context that we must evaluate the role of SoGs and their relevance in the future energy landscape.

24.4.1 Enabling New and High-Risk Investments

Formulating policies and regulations in India can be a long and complex process due to multiple agencies, inter-ministerial contestations, and federal politics (Gupta & Bhattacharya, 2024). Policy formulation for new technologies, solutions, and business models enabling energy transition is almost always playing catch-up with the rapidly changing technology and evolving needs for grid-balancing services. Delays in policy formulation and nascent markets in such dynamic environment become a substantial hurdle for new investments and clean energy transition. It delays phase-out of fossil fuel-based power generation. On one hand, private investments demand a stable policy environment to mobilise investments (Haas et al., 2023; Polzin et al., 2019), and on the other, policymakers need established standards and norms to regulate markets.

SoGs are uniquely positioned to make early-stage high-risk investments to set standards and norms of energy affordability, security, and sustainability. They can leverage Section 62 of the Electricity Act 2003 which allows State Electricity Regulatory Commissions (SERCs) to approve investments and determine tariffs through a cost-plus regime and make the electricity market more competitive.

For instance, the importance of energy storage for large-scale renewable integration was deliberated by policymakers as early as 2010 in India (Powergrid, 2012), whereas early-stage pilots were deployed only towards the end of the last decade. This included initiating stakeholder discussions on storage technologies and pilot projects such as Powergrid's 1MW/500kWh BESS in Puducherry in 2019 (Power Line, 2021) and Tata Power commissioning India's first grid-scale BESS (10MW/10MWh) in Delhi in the same year (Proctor, 2019). The Ministry of Power published the 'National Framework for Promoting Energy Storage Systems' to create 'an ecosystem for development of ESS' and encourage its adoption as early as 2023. Despite recent progress, the adoption rate is still to pick up with installed BESS capacity reaching 219.1 MWh by March 2024 (Gupta, 2024). Consequently, the momentum of the energy transition may reduce while its cost increases.

24.4.2 Navigating Non-market Risks

Conflicts around land, livelihoods, and access to commons are the root cause of non-market risks, which are known to delay the implementation of large RE projects (Gupta, 2023; Stock, 2022). RE projects in India are exempted from existing legal frameworks that address these concerns for large infrastructure projects, resulting in exposure to non-market risks for the public and private sector RE investments (Yenneti et al., 2016). The capability and public perception to manage non-market conflicts around land acquisition including displacement, compensation, access to commons, and environmental concerns, differs significantly between private and public companies. Public sector companies adhere to the legal provisions to provide compensation, provide opportunities for public consultation, and engage in comprehensive environmental assessment. On the other hand, private companies prioritise cost minimisation, speedy mitigation, and avoiding comprehensive community consultations to drive accumulation by dispossessions (Hall, 2013; Levien, 2011), despite available legal frameworks. Negotiations led by private companies are more prone to conflicts compared to public sector initiatives. If the government extends the existing safeguards to the local communities, the SoGs can play an important role in alleviating the non-market risks as a public company and can be instrumental in accelerating the adoption of RE and fostering a just energy transition.

24.4.3 Accelerating Clean Energy Transition

India has around 211 GW of coal capacity, and SoGs own 33% of the total capacity (National Power Portal, 2024). However, the unfortunate aspect of it is that SoGs are continuing to invest in coal-based thermal power plants. National Power Portal data and the Ministry of Power's Notification on the expansion of thermal power capacity, SoGs have invested close to 50,000 crore in coal-based thermal power capacity during 2019–2024. Thus, encouraging SoG participation in energy transition can shift the ongoing investment in fossils to clean energy. It will not only reduce their dependence on fossils but will also increase the pace of energy transition significantly.

Central and state governments have committed to decarbonisation of the economy to mitigate climate change. However, governments have failed to devolve these goals and plan energy transition pathways for state-owned enterprises, including SoGs. Further, current regimes of SoGs often resist investments in clean power due to deeply entrenched interests in the coal economy.

24.4.4 Empowering State Governments

Unrecovered dues, pilferage, and inefficiencies in planning are inevitable realities of the electricity sector in a developing country context. Energy transition has further complicated the power sector in different states as it presents different opportunities, challenges, and complexities due to geospatial and other factors (Doh et al., 2021). For instance, energy transition may result in loss of livelihoods in coal-bearing states such as Odisha, Jharkhand, and Chhattisgarh, and it may create additional jobs in states like Rajasthan, Gujarat, and Tamil Nadu. The increasing complexity of the sector requires an empowered state government with the financial and instrumental capacity to manage both legacy and transition challenges.

The state governments often provide subsidies to ensure energy equity and access to electricity for the socio-economically weaker sections of society for their holistic development. However, these subsidies often create an additional burden on the public exchequer, straining state finances further. The state governments manage their finances by delaying payments to SoGs, reducing their return on equity, and creating regulatory assets[5] to steer through strained finances and ensure energy availability and affordability for economic growth, social welfare, and human development. However, most of these instruments will become defunct for the state governments with their reduced direct presence in the power sector. Further, it will reduce their ability to provide subsidies and manage their state finances in the absence of these instruments, further skewing the federal power structure, which has the potential to commence a deep political crisis in the country. Therefore, it is in the interest of state governments to mandate SoGs in energy transition and ensure that they do not become irrelevant in the sector.

24.5 Conclusion

RE deployment in India continues to be dominated by large investments from private players aided by cheap global green finance. We argue for a critical rethink on the discourse favouring the private sector's role in energy transition, which, while critical, only portrays the public sector's role as an instrument to mitigate risks for the private capital. The private or public capital invested through private players does not foster capabilities to navigate certain market and most non-market risks discussed in this chapter.

In our understanding, SOGs are among the least understood agents in the transition landscape in India despite being perhaps the most critical to enabling a successful and just transition, as the international examples in the chapter demonstrate. They have capabilities that neither the private sector nor central PSUs have and unfortunately are the most hamstrung both institutionally and financially. Enabling them would create space for more competition and a better transition.

Notes

1 https://unctad.org/system/files/official-document/gdsmdpbg2420047_en.pdf
2 Includes thermal, nuclear and large hydro power generation assets
3 The concept of energy security is evolving and is becoming more dynamic in the context of clean energy transition (International Energy Agency, 2021). It includes reliability of fuel supplies and the stability of critical energy-related commodities necessary for renewable energy technologies *(ibid)*.
4 Energy equity, meanwhile, includes affordability and accessibility of energy supplies to all communities (Kamali Saraji & Streimikiene, 2023).
5 It is evident that private sector drivers are not aligned to bear unforeseen risks, nor are they capable of taking a long-term position on fiscal turnaround. Despite this World Bank's push for privatisation through conditional loans in Africa for green transition raises several concerns. While India's privatisation journey may not be dictated by the World Bank's conditionalities, it is likely to impact the resilience of the sector (Chitnis, 2024).

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25 Green Fiscal Instruments for Transition to Low-Carbon Economy

Experience from European Countries and Lessons for India

Sabuj Kumar Mandal, Tanurima Brahma and Vardhini V.

25.1 Introduction

Green transition could provide an opportunity for countries to drive growth along with meeting goals to slow down global temperature increases. Even if one assumes investments primarily come from the private sector to renewable energy sectors, public policies through taxation, expenditure and regulation are also necessary to create markets such as an Emissions Trading System (ETS), to 'crowd-in' private investments at a stage where they may not be profitable on their own (Heine and Black, 2019).

Appropriate fiscal instruments such as green fiscal instruments are required to create a market environment that discourage fossil fuel-based production and promote renewable energy capacity. We consider Carbon Tax (also known as carbon pricing) and Green bond issuance as the two major green fiscal instruments in our study.

While there are several studies that have focused on the economic impacts of phasing out fossil fuel subsidies and levying carbon taxes, a systematic statistical analysis of the inflationary impact is missing. In this chapter, we analyse the impact of carbon tax and green bonds on investment in renewable energy capacity and inflation drawing from Avgousti et al. (2023). We take European countries as a case for our analysis. As most of these countries constitute advanced economies, increasing the stringency of green fiscal policies such as higher carbon prices and lower fossil fuel subsidies would be possible. In theory, in developing countries as well, these might be feasible without significantly impacting welfare outcomes. Further, the green transition has become a recent priority owing to high natural gas and oil prices and dependence on imports of these commodities, which gives rise to energy security concerns (Schnabel, 2023).

The remainder of the paper is structured as follows: Section 25.2 sets out stylised facts around green transition fiscal instruments in Europe, Section 25.3 outlines the data and our empirical strategy. Later, in Section 25.4, results and the discussion of the results are presented. Section 25.5 concludes with policy implications and ideas for a package of economically sustainable green transition measures for India.

25.2 Stylised Facts on Green Transition Fiscal Policies

Countries can adopt fiscal, monetary and regulatory measures to exogenously influence carbon emissions and renewable energy capacity. The most important elements influencing decision making for such investments include investment costs, the availability of funding, subsidy levels, and market stability (Liu et al., 2019). As shown by Chang et al.

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(2020), policies which are effective in generating renewable energy investments include facilitating low-carbon energy technology progress and integration and implementing subsidies and tax incentives like feed-in tariffs for renewable energy producers.

Green fiscal expenditure is one component of green fiscal policy, includes tax incentives and subsidies for industries, transfers to households and public expenditure in green R&D (see figure 25.1). Most of the EU expenditure initiatives have focused on energy efficiency and energy use in buildings, followed by clean electricity generation and funding to promote research in electric mobility. In the absence of comprehensive data on renewable energy and emissions reduction, broad environmental protection data shows that EU member states spent on an average 0.15% of GDP in investments that protect the environment, while R&D expenditure on this count amounted to only 0.04% of GDP in 2019

Regulatory measures by government are non-incentive measures. They include energy efficiency for buildings and carbon dioxide emissions standards for cars.

Initially, carbon pricing through carbon taxes and ETS, appeared more sound over regulatory action (De Mooij et al., 2012). Carbon taxes are Pigouvian taxes levied on the negative externality of emissions that are unaccounted in the price of the good, but ultimately borne by society in terms of global warming. More recent studies such as by Gaspar et al. (2019) also emphasised on progressively increasing 'growth friendly' and fairly distributed carbon taxes.

Carbon taxes exhibit considerable heterogeneity, varying from around 127 USD in Sweden to about 0.2 USD in Poland. In addition to the price itself, the design of the carbon tax, in terms of recycling of revenue, emissions covered under tax and the enforcement of the tax are major characteristics of a carbon pricing tool. High emissions/sector coverage (ranging from 3% of relevant emissions in Spain to about 49% in Ireland), high tax rates, progressive redistribution/productive reinvestment of tax revenues and better

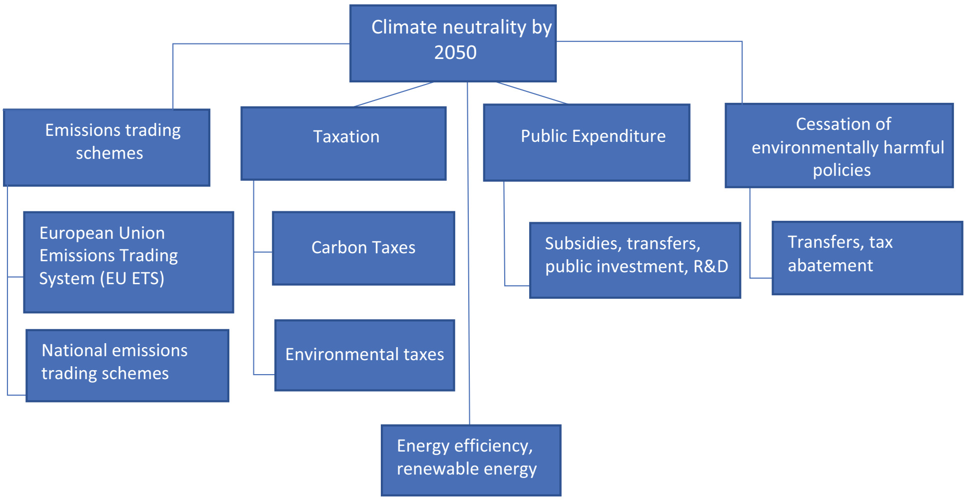

Figure 25.1 Fiscal Policies to Reach Climate Neutrality by 2050

Source: ECB, as cited in Avgousti et al. (2023)

enforcement of the policy will ensure effectiveness (Konradt and Weder di Mauro, 2023). An important observation regarding European carbon taxes is that they have been implemented at high rates in countries with lower emission intensity of GDP.

Green bonds are also important financial instrument to raise funds for renewable energy projects and other green investments, they also increase the options available to renewable energy corporations and financial institutions (indirectly) to raise funds from financial markets. Although information on green bonds has been limited given their growth after 2014, studies such as that of Caramichael and Rapp (2022) and Doronzo et al. (2021) have identified a small green premium called 'greenium', giving lower interest rates for borrowers compared to alike bonds. States issue sovereign green debt along with creation of their markets. Sovereign role in green debt markets is crucial for their expansion; as are publishing standards (the EU Green Bond Standards).

EU countries constitute the majority of global green bond issuance at 49% of total in 2021. These bonds, comprising both private, supranational and sovereign issuances amount to 1.7% of 2021 EU GDP, with over 60% coming from private issuers; nevertheless, sovereign issuance of these bonds since 2014 has raised the profile of green bond markets (Mazzacurati et al., 2021). In 2021, corporate green bonds were around 3% of total corporate bonds issued in the EU. Comparatively, the global green bond market was just over 0.4% of the total bond market size in the same year.

25.3 Data and Methodology

We construct a sample of 18 countries in Europe between 1996 and 2022, both part of and outside the Euro area that had adopted Euro. These countries are chosen based on the presence of multiple green fiscal policies, particularly, carbon taxes. We complement the data on renewable energy capacity, used to measure the benefits associated with the green transition, with other sources to consider its inflationary impacts (Sachs, 2014). The inflation data further includes two series, headline (overall consumer inflation) and energy inflation for households/consumers, based on European consumer price data. The main economic control is per capita GDP and all monetary units, unless otherwise mentioned, are in Euros. The independent variables consist of two major green fiscal instruments, carbon taxes and green bond issuance. More details on the European sample, including definitions of indicators used, correlation between variables and summary statistics, are presented in the Appendix along with the list of countries in the dataset.

The empirical analysis builds on the approaches of Konradt and Weder di Mauro (2023) and Santabarbara and Suarez – Varela (2022) who focus on carbon taxes and Azhgaliyeva et al. (2021), whose work deals with the impact of feed in tariffs and regulatory quality, to identify the response of inflation and renewable energy capacity to the fiscal policies.

Estimating a panel of multivariable, OLS regressions for each of the dependent variables:

$$\sigma(\pi)_{i,t} = \alpha + \beta\left(\textit{fiscal instrument}\right) + \delta\left(\textit{carbon tax} * \textit{regulatory quality}\right) + \gamma X_{i,t} + \epsilon_{i,t}$$

Where $\sigma(\pi)_{i,t}$ is the dependent variable (renewable energy capacity, energy inflation and headline inflation in three separate series) measured, for a country, i and for each annual period, t. $(\text{Fiscal instrument})_{i,t}$ includes the set of variables that depict the existence of (binary or dummy variable) or value in monetary or percentage terms (continuous variable) of two green fiscal measures individually and δ relates to the coefficient when an interaction is undertaken for carbon taxes alone. $X_{i,t}$ includes the relevant controls for per capita GDP. Finally, $\in_{i,t}$ represents an idiosyncratic disturbance that is expected to be independent and identically distributed. α, β, γ, are the regression constant, coefficients associated with the objective and control variables, respectively.

We seek to understand the impact of relevant policies in presence and absence of the regulatory quality taken over a longer period of time. Differentiating the above equation with respect to the green fiscal policy, we get:

$$\partial(\pi) / \partial(\text{green fiscal policy}) = \beta + \delta * \text{regulatory quality}$$

β represents the direct marginal elasticity that the policy has on renewable capacity (or inflation).

For the baseline model, we use a country fixed effects analysis. Recognising that several green fiscal policies may not immediately impact any of the dependent variables considered and may be expected to show stronger medium-term effects, we regress our benefits and costs with the lag of variables. This allows us to observe variations within the same country over time, as well as variations across countries, by holding constant the average effects of each of the countries (or years). Considering other within – country variations is expected to reduce endogeneity bias, coming from omitting some important variables or unobservable between – country differences.

25.4 Results and Discussion

25.4.1 Empirical Estimation of the Effect of Green Fiscal Policies on Renewable Energy Capacity

From Table 25.1.a and 25.1.b, it evident that both carbon tax and green bond issuance have positive and significant impact on increasing a country's renewable energy capacity.

Table 25.1.a Impact of Carbon Taxes on Renewable Capacity

	Average impact in a year on Renewable Capacity		
Per capita GDP	0.375***	0.366***	0.342***
	(0.006)	(0.005)	(0.007)
Regulatory quality	0.045***	0.068***	0.013***
	(0.001)	(0.005)	(0.004)
Carbon Tax	0.410**	0.546***	0.541**
	(0.007)	(0.001)	(0.004)
REGINDxCT	0.616***	0.532***	0.422**
	(0.002)	(0.002)	(0.001)
_cons	15.97	13.84	10.17
	(12.17)	(12.28)	(12.91)
	t = 0	1	3
Observations	217	209	194
R^2	0.237	0.240	0.242

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 25.1.b Impact of Green Bond Issuance on Renewable Capacity

	Average impact in a year on Renewable Capacity		
	t = 0	1	3
Per capita GDP	0.188***	0.0307***	0.0224***
	(0.009)	(0.00012)	(0.000191)
Green bonds	0.495***	0.718***	0.610***
	(0.006)	(0.009)	(0.008)
_cons	8.80***	3.85***	8.71***
	(4.898)	(5.787)	(8.974)
Observations	97	82	55
R^2	0.406	0.469	0.216

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Moreover, interacting carbon taxes with regulatory quality, we see that it plays a mediating role in determining the elasticity at which carbon taxes increase renewable capacity. A positive and significant interaction term indicates, as expected, that effectiveness of carbon tax depends on regulatory quality and the elasticity of renewable capacity increases with a better regulatory framework.

25.4.2 Empirical Estimation of the Effect of Green Fiscal Policies on Energy and Headline Inflation

We finally move to an estimation of the effect of green fiscal policies on overall consumer and energy prices by regressing headline and energy inflation on these policies over the immediate and short to medium term.

From Table 25.2, we see that even though carbon taxes have statistically significant impact on energy inflation, it does not have any significant impact on headline inflation. On a related note, regulatory quality independently reduces inflation and these results are statistically significant, incorporating this with the green fiscal policies greatly moderates inflation volatility.

The green bonds also do not have any significant impact on headline inflation, but have significant negative impact on energy inflation indicating that green bonds were successful to promote adequate renewable energy investment such that energy prices went down. Proceeding with green bonds, generally the literature on bond issuance and asset price inflation point to how bond investors, typically those investing in the short term, prefer low rates, low inflation and consequent high asset prices; this effect needs to be assessed for green bonds, which tend to attract investment disproportionately from asset managers who base their investments on a ‘buy and hold’ strategy and exhibit preference for instruments with a negative price premium (discount) in the expectation that future returns and bond prices increase, when compared to conventional bonds with the same characteristics (Sangiorgi and Schopohl, 2021).

25.4.3 Discussion

Consistent with existing research, we find that even though carbon taxes cause energy inflation, they do not raise headline inflation. A further observation is that the green

Table 25.2 Empirical Estimation of the Effect of Green Fiscal Policies on Energy and Headline Inflation

	Average impact in a year on headline inflation			*Average impact in a year on energy inflation*		
	t = 0	*1*	*3*	*t = 0*	*1*	*3*
Carbon tax (CT)	0.0733	0.0494	0.232	0.312***	0.349***	0.124
	(0.0491)	(0.0462)	(0.0406)	(0.002)	(0.003)	(0.166)
_cons	4.95***	2.23***	9.777**	1.11***	0.51**	3.81*
Reg. qualityxCT	0.0952	0.0041	−0.0007	−0.276**	−0.671**	−0.227**
	(0.000644)	(0.000602)	(0.000529)	(0.002)	(0.005)	(0.006)
Reg. quality	−0.143***	−0.111**	−0.0837	−0.569**	−0.453**	−0.384*
	(0.0415)	(0.0417)	(0.0435)	(0.174)	(0.175)	(0.178)
Observations	217	209	194	217	209	194
R^2	0.063	0.053	0.034	0.056	0.073	0.087
Green bonds	0.526	0.164	0.632	−0.444	−0.086***	−0.289***
	(0.145)	(0.217)	(0.55)	(0.873)	(0.002)	(0.004)
_cons	−0.889	−4.107**	−6.031***	5.79***	2.54***	1.20***
Observations	97	81	53	97	81	53
R^2	0.261	0.34	0.422	0.315	0.434	0.617

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

transition could lead to inflation volatility rather than persistent upward price pressure for energy. Our results for carbon taxes can be compared to empirical studies, such as Santabarbara and Suarez – Varela (2022), who find no significant relationship between carbon taxes and inflation. Likewise, Konradt and Weder di Mauro (2023) and Kaenzig (2021) (for ETS) also find no statistically significant relation between the two, but point to a transitory growth in headline inflation, prompted by energy and food inflation. These results contrast with simulation-based studies by McKibbin et al. (2017) and Moessner (2022), who predict higher inflation. Our findings indicate that regulatory quality also shows strong evidence of reducing inflation volatility, at least for carbon taxes, owing possibly to large European economies having a stronger need to reduce economic disruption, corresponding to the high regulatory quality required to achieve the same. On the other hand, our results for addition to renewable energy capacity suggest carbon taxes on their own increase renewable energy capacity by nearly 0.45 points over the periods considered, in line with the positive relationship between the variables shown in an Asian context by Chien et al. (2023). What would additionally be important to study is the reduction in emissions achieved beyond a threshold of just increasing carbon taxes, as Rafaty et al. (2020) suggest emissions reduction could be less elastic beyond a threshold.

Our results concerning the impact of green bonds are supported by findings in recent literature: (1) while we need to study longer term data on green bonds, Fatica (2020) uses simulations to predict that central banks would increase interest rates further to counteract inflationary pressures from the issuance of green bonds, and also that these increases in interest rates would be more volatile, (2) bond investor preference for high rates in the short term could contribute to a decline in medium term inflation (Kaminker, 2015).

25.5 Conclusion

In Europe, countries have initiated a transition to renewable energy and cleaner technologies in line with the objective of net – zero emissions by 2050. For this, a set of market – based and command and control policies ae available and the former has been preferred by developed countries, unlike preference also shown for the latter in developing countries. The question for government decision makers after the economic disruption caused by the pandemic has been whether these policies that promise climate protecting benefits essential for life on earth come at a short- or longer-term price for society in the form of inflation.

We examined the impact of Carbon tax and Green bond issuance on building of renewable energy capacity and generating inflationary pressure in the economy, both in terms of energy and overall price levels. We found that both carbon tax and green bond issuance have substantial impact on building renewable energy capacity. Moreover, neither carbon tax nor green bond was found to increase inflation. Rather, green bond was found to reduce energy inflation. This provides support for an active, promotional role to be played by countries in designing green transition policies. We see that green bonds and other such market-based instruments to finance sustainable projects need to build a base of physical infrastructure and production capabilities that will also contribute to post pandemic economic recovery, especially in countries with low economic growth rates.

Specific policy implications from our study for each of the fiscal measures include expanding the coverage for carbon taxes and issuance of green bond. Green bonds have high demand in markets, although concerns remain with assessing the green credentials of issuers. However, countries like India should take precautionary measures before implementing carbon taxes on a large scale since the Indian economy is largely dependent on fossil fuel. The Union budget for 2022–23 has also called for the issuance of sovereign green bonds in India and allowance of Foreign Institutional Investment (FII) with the major goal is to shift their focus to the renewable sources of energy and lesser dependence on the fossil fuels leading to reduced emission levels. However, being a developed nation, EU has greater fiscal space for resource and fund allocation. Carbon pricing which has an inflationary impact on the commodities, however, does not discourage the citizens to pay for it because they value the environment. India, on the other hand, despite adopting such measures might not be able to enjoy its fruits in the recent future since most of the citizens are not yet ready to value the environment. The case of European Union helps to build a roadmap towards a cleaner, eco-friendly atmosphere which can be used as a motivation for India and formulate policies accordingly. Although such steps at this stage might not yield the expected results for India given limited fiscal space, gradual policies to attract FDIs, FIIs, more integration of capital markets for investment in the renewable sectors and adoption of clean technologies, greater cooperation among the Centre-State, can generate higher renewable energies which might reduce its cost; a shift towards a low-carbon economy might be feasible in the long run, and it should be a just transition.

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Appendixes

Appendix A

Table 25.3 List of Countries in Dataset

Country	*EU membership status*
Austria	EU members using euro
Estonia	
Finland	
France	
Germany	
Ireland	
Italy	
Latvia	
The Netherlands	
Portugal	
Slovenia	
Spain	
Denmark	Members of the EU not using the euro
Poland	
Sweden	
Norway	Non EU member, not using Euro
Iceland	
Switzerland	

Appendix B

Table 25.4 Variable Definitions

Variable	*Definition*
Headline Inflation (CPI)	Annual change over time of the prices of consumer goods and services
CPI Energy	Annual change over time of the prices of energy, including fuel for transport, electricity and gas
Renewable capacity (%)	Renewable energy share of electricity capacity
Carbon Tax in Euros	Explicit tax/price per ton of carbon dioxide equivalent emissions
Green Bonds Issued (as % of GDP)	Green certified bonds issued in a given year, for a country of issue, in terms of country's GDP
Regulatory quality (percentile rank)	Regulatory quality from world governance index
Per Capita GDP in Euros	Gross domestic product divided by midyear population
GDP in Million Euros	Gross domestic product in current prices

Green Bonds Issued in Million Euros Green certified bonds issued in a given year, for a country of issue

Appendix C

Table 25.5 Summary Statistics

Variable	*Mean*	*Standard Deviation*	*Maximum*	*Minimum*
CPI (Headline inflation)	2.530426	2.794136	19.8	–1.7
CPI Energy (Energy inflation)	5.100889	9.499797	70.5	–19.8
Renewable energy capacity (%)	46.8092	27.95077	99.45	0.25
Carbon Tax (Euros)	28.26065	34.20471	157.0079	0.0336
Green Bonds Issued (as % of GDP)	0.77	0.817	4.54	0.002
Regulatory quality score (percentile)	81.25347	8.717384	93.75	58.29
Green R&D output (%)	10.00323	4.472884	25.83	0

26 Transition Planning and Country Platforms as a Way to Accelerate Development and Climate Action

Discussing Global Developments and Lessons for India

Madhura Joshi, Laura Sabogal Reyes and Kavya Singhal[*]

26.1 Introduction

The world is not on track to meet both Sustainable Development Goals (SDG) and climate targets. An assessment of 140 SDG targets[1] shows that nearly 50% are moderately or severely off-track (United Nations Department of Economic and Social Affairs, 2023). Currently, climate commitments still put the world on a beyond 2°C pathway. The impact of the polycrisis – COVID-19 pandemic impact on countries and global economy, recurring extreme weather events fuelled by climate change, worsening debt crisis for developing economies, geopolitical instability leading to increasing food and energy prices to name a few – has further constrained the ability of developing countries to spend (Strohecker and Rao, 2022; Wolf, 2023). Affordable, accessible finance, at scale, is needed for emerging and developing economies to deliver transformational changes required to meet the climate and development priorities.

Achieving net-zero goals in line with 1.5oC will require over USD 100–USD 150 trillion (Goldman Sachs, 2021) over the next three decades. Globally, over USD 4.5 trillion annually will be needed for clean energy technologies by 2050 (IRENA, 2023). Emerging and developing economies (EMDEs) are projected to need between USD 5.8 and 5.9 trillion to implement their climate targets by 2030. The IEA estimates that in 2024 global investments in clean energy technologies and infrastructure will reach USD 2 trillion – a record high (IEA, 2024). However, current levels of finance are inadequate to accelerate energy transitions in this decade. Meeting investment needs will require an increase in step change in the scale of finance. Importantly, this will also need all sources of funding, both domestic and international sources of public and private capital.

The global development finance ecosystem is coalescing around the idea of country-centred approaches, such as the Just Energy Transition Partnerships (JETP) in South Africa or Vietnam. While the success of JETP is debated, JETP experiences in-country also offer some lessons. Detailed national transition pathways based on economic and development priorities in line with raising climate ambitions coupled with country platforms offer potential solution for crowding in the scale of investments needed.

In this chapter we highlight the global momentum on transition planning (Section 26.2) and discuss lessons from JETP experiences (Section 26.3). In Section 26.4 we present why transition planning is important, how coupling it with country platforms can help in improving delivery of financial and technical assistance and catalysing investments and

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present principles learning from past experience for better next-generation country platforms. Finally, in Section 26.5 we discuss possible implications and recommendations on how India could draw from ongoing efforts on transition planning and country platforms to strengthen ongoing domestic efforts.

26.2 Global Momentum on Transition Planning and Country Platforms

Urgent action is needed to transform the delivery of climate, nature and development outcomes at the national level. Both donor and recipient governments, along with the international community, have called for comprehensive reform of the global financial architecture. This reform should focus on mobilising sufficient, timely and accessible finance as well as technical support, while ensuring coherence among all development and climate actors in relation to national priorities.

There is an opportunity to align parallel development and climate processes around a clear vision and set of actions to improve delivery. The Brazilian G20 Presidency's Taskforces on Poverty and Hunger and on Climate Finance Mobilisation are prioritising national economic transition plans to address sustainable development challenges within the context of financial system reform. A key objective under the G20 Taskforce on a global mobilisation against climate change (TF-Clima) is to strengthen the role of national transition plans and platforms in order to achieve a renewed agenda for the involvement of the financial sector in climate action; and for complementing public financing and contributing to an ambitious investment agenda for mitigation, adaptation and fair transitions, aligned with limiting temperature rise to 1.5°C. The International Financial Architecture Working Group (IFAWG) is also examining the role of Multilateral Development Banks (MDBs) in deploying these plans. This agenda could be further developed under the upcoming South African and United States G20 Presidencies.

Interest is growing in multi-actor climate and development partnerships, such as JET-Ps and nature country packages[2], which aim to mobilise finance from various sources in a country-specific context. Discussions between the International Partners Group and MDBs are ongoing to institutionalise these efforts. Additionally, the Joint MDB Group has highlighted country platforms as a means to enhance coordination and streamline finance delivery, with two initial pilots in Bangladesh and North Macedonia announced at COP28 and more expected. The broader Public Development Bank (PDB) ecosystem is also engaging in these discussions, as seen at the G20 Finance Common Summit in May 2024, where country platforms were a topic of discussion.

The upcoming NDC update in 2025 is a critical opportunity for countries and the international community to adjust their course and set the stage for effective climate action. The update of the National Biodiversity Strategies and Action Plans (NBSAP) in 2024 is similarly important for biodiversity protection. Meeting NDCs and NBSAPs, along with other international commitments, requires comprehensive national transition plans. These plans must address each country's unique political and socioeconomic challenges and provide long-term confidence through sustained political commitment.

26.3 Lessons from Experiences of Just Energy Transition Partnerships

At COP26, South Africa announced the JETP, the first ever country owned climate finance deal. JETP is a new form for a political and financial innovation designed to support and accelerate a country's clean energy transition. The key actors are the International

Partners Group (IPG) comprising donor countries and a host country for which the JETP will be domestically structured.

While the success or failure of JETPs still remains to be seen, they have helped kick-start a process of developing country-led transition plans. These help in demonstrating the scale of the transition challenge for a country, clean energy transition pathways, highlight the conditions under which meeting these pathways is feasible i.e. specific financial and technical needs including for ensuring just transitions. Since the announcement of South Africa's JETP, three other countries have signed JETP deals: Indonesia, Vietnam and Senegal.

How have the JETPs helped? First, they have helped start a country-led and country-owned transition planning mechanism. Second, JETPs helped kick-start a high-level political process to secure commitments from key national and international stakeholders. Third, it helped develop clear national transition pathways, institutional structures and mechanisms to facilitate stakeholder contributions and eventually develop a pipeline of projects that will help in accelerating transitions. The high-level political buy-in have helped in building momentum and drawing attention to the transition needs of emerging economies.

Whether new additional JETPs in their current form will be announced remains to be seen. And while there is no single blueprint that will be applicable to all, we highlight five key lessons learned from the implementation of JETPs have wider applicability for future efforts, particularly for country platforms.

1. **Factoring the political-economy landscape into the deal:** This is critical to help identify the key actors, affected communities and winner and losers of a transition. The political landscape will also help in determining whether proposed solutions will be acceptable and what would be needed to help facilitate the transition. The objective of the South African JETP is to support phase-out of coal generation in exchange for international finance for deploying clean energy infrastructure. The JETP builds on domestic momentum around just transition that started as early as 2009 (Joshi and Dsouza, 2023). The experience also highlighted the need to address existing energy access and supply challenges by rapidly building and/or connecting clean energy solutions along with efforts to phase-out to ensure reliable, sufficient power supply and avoid energy security concerns. However, a deal with the same propositions may not be replicable in other countries. Domestic realities and political economy structures shape the readiness and willingness of a country to decarbonise (ESMAP, 2023). Hence, a JETP deal cannot be a one-size-fits-all approach and needs to be structured to reflect national priorities and the context in which it will operate.
2. **Focusing on the 'just' part of the deal:** The economic, social and institutional parameters of a country while developing investment plans under a JETP or a country platform are critical. For fossil dependent countries, transitioning away from fossil fuels to clean energy would have large socio-economic impacts. However, the 'just' part of previous JETPs have not sufficiently integrated financing just transitions which need to be implemented not just in principle but also in action. This includes solutions such as compensation for impacted workers and communities who may lose out on jobs and livelihoods, skill development for current and future workforce, local economy development and social infrastructure development i.e. schools, hospitals etc. in impacted regions. Foregrounding just transitions is important both in principle and practice; and key in maintaining both social legitimacy and political support through implementation (Curtin, 2024).

3. **Providing better finance and at scale:** For most JETPs, the finance allocated is far lower than what is required. For example, South Africa's JETP provides that the IPG will mobilise an initial USD 8.5 billion between 2023 and 2027 comprising 63% of concessional loans, and less than 4% of grants and technical assistance; whereas the country's investment plan assesses that USD 98.7 billion will be needed in the next five years for the transition process (Goldman Sachs, 2021).

   A larger share of loans at commercial rates will add to the financial burden of emerging and developing economies, often, with already constrained fiscal space. The composition of funding provided under the JETP, that is, the share of grants or loans, needs to be assessed differently for each country and needs to align with country priorities and requirements (Cassel et al., 2024). Often, the grant component of a partnership may need to be frontloaded to provide for social protection, build infrastructure, or invest in solutions which private capital deems 'risky' to help mobilise greater private capital. The IPG backed by in-country political leadership can play a critical role in helping expand the donor pool, coordinate with MDBs, to make available concessional finance at scale.
4. **Building an inclusive and consultative process:** JETP countries have set up institutional mechanisms to coordinate with domestic and international experts and stakeholders to develop transition plans. However, the extent to which there is a genuine feedback mechanism and how consultative they are in practice differ. To secure buy-in from stakeholders, it is important to include affected communities, civil society, domestic and international experts, along with financiers and all arms of the local and federal government.
5. **Maintaining high-level political momentum:** Both for IPG and JETP countries, continuing to maintain and strengthen domestic and international political momentum through regular heads of states engagements, high-level public outreach and campaigns are needed to ensure that transition plans progress towards successful implementation. High-level political buy-in for a pipeline of projects developed under the transition plans, transparent communication on expected timelines of action and any deviations and commitments around regulatory solutions can help build confidence of both domestic and international stakeholders and investors.

26.4 Coupling Transition Planning with Next-Generation Country Platforms

Robust national or sectoral transition plans based on a whole-of-the-economy are key for successful country platforms. Countries that are signatories to the Paris Agreement have to submit NDCs, National Adaptation Plans (NAP) and Low Emission Development Strategies (LT-LEDs). These documents need to be necessarily linked and NDCs and LT-LEDs can, in theory, provide a country-wide integrated solution. However, studies highlight that there is insufficient coordination and lack of strategic orientation between NDCs and LT-LEDs in their current form (Climate Change, 2022; Manning et al., 2024). UNFCCC stocktakes of NDCs and LT-LEDs highlight that they do not provide details needed for useful delivery of action and support. For instance, only 66% of NDCs submitted have specific information on timelines, climate finance and technology needs and capacity building projects (UNFCCC, 2023b); and only 37% of LT-LEDs share estimates of costs of proposed climate actions and funding sources (UNFCCC, 2023a).

There is also a critical need to significantly improve the delivery of development, climate and nature outcomes at the country level. Drawing from the lessons of JETPs, Country Platforms offer a possible solution for systematically delivering climate and development aligned support (Sabogal and Ahlgren, 2024). Country Platforms are defined as 'voluntary, country-level mechanisms set out by governments to foster collaboration among development partners based on a shared strategic vision and priorities' (MOF China, 2020).

Country platforms is not a new concept even though their design and implementation can be strengthened. Next-generation country platforms should be deeply integrated with national transition plans (NTPs) and development goals as outlined in existing country-level strategies (Figure 26.1). These comprehensive, whole-of-the economy-based NTPs and development priorities encompass sectoral transition pathways, which detail specific climate and development targets, priorities and considerations for various sectors. When country platforms are anchored in well-defined national plans and translated into actionable interventions, they can effectively attract and coordinate donors and investors, promoting a structured approach to financial and technical support. However, designing new country platforms as tailor-made operational frameworks is necessary. These frameworks should align donors and investors with national climate-positive growth and transition pathways, which should then be converted into actionable plans and projects aimed at achieving SDGs.

By directly linking national climate and development priorities with financing opportunities, country platforms can help address a country's multiple objectives of growth, development, energy security, transition needs and addressing climate impacts simultaneously. This approach ensures that investments provide both financial returns and positive climate and social impacts. The integration of finance into a robust delivery model, based on plans and projects that reflect national priorities, supports their transformative potential.

Similar to JETPs, country platforms cannot have a 'one-size-fits-all' approach. A flexible, country-specific approach, based on a set of core design and implementation principles to safeguard the additional value they bring can help them be an effective model to deliver finance and ensure climate and development aligned transition. This framework

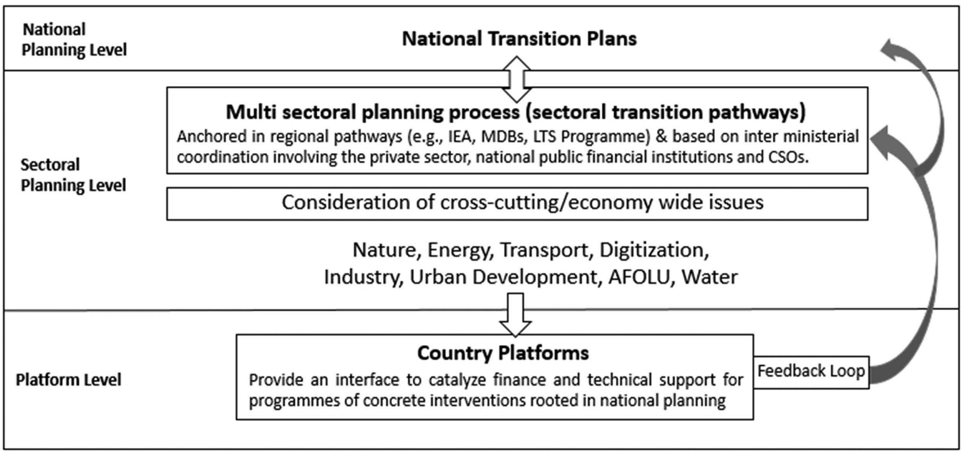

Figure 26.1 Relationship between Country Platforms and National Transition Planning Process

*Note: Sectors mentioned are not exhaustive and used for illustration can enable tailor-made international engagement with specific country priorities, using common tools adapted to the relevant context.

In the next round of NDC updates, countries need to submit revised commitments by February 2025. This presents an opportunity to align efforts on NDCs enhancement and long-term national transition planning with emerging next-generation CP principles. This can help in reducing duplication of efforts and set the stage for mobilising investments and support to meet a country's transition plan and national priorities and lay the groundwork for setting up country platforms. Figure 26.1 represents a schematic of a country platform design which interfaces with national transition plans.

Value Proposition, Constraints and Principles for Designing Country Platforms

Sabogal and Ahlgren (2024) provide a comprehensive summary of the value proposition of Country Platforms, focusing on aligning international climate and development support with national priorities, particularly SDGs and the Paris Agreement. They highlight key advantages and potential constraints, while offering recommendations on political and operational principles for effective design.

Value Proposition of Country Platforms

Aligning international climate and development support with national priorities, ensuring that resources are directed towards SDGs and the Paris Agreement goals outlined in national development plans.

Enhancing collaboration between government and international partners, improving coordination between private, public and philanthropic financiers through the establishment of inter-governmental governance structures that enable better planning, implementation and knowledge sharing.

Boosting private sector engagement by creating an investment-friendly environment through risk-sharing mechanisms, making platforms attractive to private investors.

Shifting from project-based to programmatic approaches to improve scalability, impact and administrative efficiency by coordinating financial, policy and technical support around comprehensive development and climate resilience programmes.

Connecting funders with project pipeline development initiatives, allowing country platforms to link bankable infrastructure and transition projects with potential investors. Addressing the lack of bankable projects is key to scaling up investment and increasing interest from funders.

Building capacity to design and implement national development strategies, enhancing the ability of countries to effectively plan and execute projects that support sustainable development.

Improving planning and responsiveness to international policy and regulatory developments, especially regarding more stringent Measurement, Reporting and Verification (MRV) requirements that enable better access to global markets.

Constraints

Despite the strong value proposition, several challenges arise, particularly in EMDEs:

Constrained macroeconomic environments due to high costs of capital and existing debt servicing commitments.
Investment mobilisation difficulties, stemming from underdeveloped local capital markets, limited local currency financing options and regulatory frameworks that are unfavourable to private or international finance.
Lack of granular data and sector-specific assessments, which hampers effective project development and investment mobilisation.
Economic and climate shocks that can slow progress towards achieving development goals.

Nevertheless, next-generation country platforms have the potential to address some of these challenges by offering adaptive solutions that are better suited to the specific needs of individual countries.

Suggested Political and Operational Principles for Country Platform Design

Political Principles:

Country-owned and led initiatives, with climate and development priorities aligned with long-term SDGs, Paris Agreement goals, national economic plans, sectoral transition plans, Long-Term Strategies (LTSs), National Adaptation Plans (NAPs), Integrated National Financing Frameworks (INFFs) and NDCs.
Integrating a 'just' transition component to ensure climate transitions are inclusive, equitable, accountable and, where relevant, redistributive.
High-level, long-term political commitment from international partners, including multi-year financial commitments and sustained technical support to build local institutional capacity and avoid gaps or duplication of efforts.

Operational Principles:

Matchmaking country priorities with international support, actively aligning specific country demands with the necessary financial and technical assistance needed to meet them.
Involving the full financing ecosystem, with collaboration between public development banks, national development banks and multilateral and bilateral institutions to leverage local expertise and international resources.
Strategic collaboration with the private sector, both domestic and international, to identify barriers to investment and foster an enabling environment for private sector involvement. This includes creating a feedback loop for the private sector to communicate its needs and plans to national governments.

Comprehensive monitoring and evaluation framework, with a feedback loop for iterative planning, covering macro-level indicators (e.g., total finance mobilised) and country-level success metrics (e.g., climate and development outcomes achieved).

Improving transparency and consistency of information about projects within and across CPs, making data accessible to prospective investors and ensuring best practices for engaging with investment opportunities.

Source: Adapted from (Sabogal and Ahlgren, 2024)

26.5 Implications for India

Low-carbon development of the Indian economy presents multiple benefits, such as lower cost of energy supply, reduction in fuel import expenses, increased business opportunities and job creation, improved competitiveness of industries, climate proofing financial sector, avoided costs of stranded fossil infrastructure and a cleaner environment. But the investment needs are large. According to one estimate, meeting net-zero goals for India is projected to require $7.2 trillion by 2050, and an additional $4.9 trillion in an accelerated scenario, with a large chunk of the investments being frontloaded (Gupta et al., 2022). Meeting such large needs will require all sources of financing – both domestic and international public and private capital, new financial instruments and a systematic way of crowding in and channelising investments.

The good news is that work on India's transition pathways is already under way. Several states have also announced net-zero ambitions, for instance, Tamil Nadu has set a goal of 2050 (Bureau, 2024), Bihar has released a report on its low-carbon economic transitions strategies (PTI, 2024), while Jharkhand has set up a just transition task force to assess (Just Transition Jharkhand, n.d.), estimate and recommend various steps to the state government for a planned transition process. At the national level, the central government has also set up an inter-ministerial taskforce with multi-sector committees to develop net-zero pathways for the country (Jai, 2024). These present opportunities to pilot transition planning and sectoral/subnational platforms simultaneously so as to enable climate-aligned development and catalyse investments. A few recommendations on how the Indian national and subnational governments can build on positive domestic impulses based on lessons from ongoing multilateral efforts on JETPs, transition planning and country platforms follows.

First, the government should continue to demonstrate strong political commitment both at the national, sub-national and sectoral level. The Prime Minister has led from the front on India's clean energy and net-zero ambitions. These need to be complemented by a shared vision and ambition even at the subnational level and a whole-of-the-government and economy approach. Involving MDBs and multilateral agencies and engaging high-level political actors can help in aligning efforts with emerging international frameworks and help build buy-in of investors from the beginning.

Second, introducing a national legislation that mandates transition plans based on just-transition principles at the sectoral and subnational levels based on India's development and climate priorities in line with its net-zero pathways. The legislation needs to be backed by an institutional mechanism to support coordination, provide technical assistance and help with capacity building to develop flexible transition-planning frameworks that can be tailored to local contexts. It should help align state and sectoral plans and create monitoring and evaluation frameworks to enable course correction.

Third, there is need to articulate short-, medium- and long-term priorities, actions and what is needed to achieve them. As the inter-ministerial committee looks at developing net-zero pathways, highlighting the scale of financing needs, expected budgetary expenditures, timelines of proposed actions, capacity needs and technical and financial shortfalls can help with mobilising domestic and international support and collaborations. This macro approach needs to be complemented with more granular initial project pipelines to help mobilise capital and facilitate investments. Such an exercise can also help develop tailored financial solutions to meet sector and state needs.

Fourth, create governance mechanisms and institutional arrangements to embed just transition consideration in transition planning process across levels. International experiences highlight that just transition planning needs to be well financed, backed by legislation to ensure continuity and needs to start decades before the expected transition (Joshi and Dsouza, 2023).

Fifth, create multi-stakeholder platform to encourage feedback for acceptance of the transition plans. This requires a whole-of-the-economy approach, involvement of the full financial ecosystem, as well as industries, civil societies and unions to support.

26.6 Conclusion

Planning for transitions at the pace and scale needed to limit climate impacts while ensuring meeting development goals and ensuring no one is left behind was never going to be an easy exercise. Transition planning coupled with country platforms offer a possible solution of addressing the complex challenge in a structured, systematic way. More importantly, they also have the potential to help mobilise the levels of investments needed to support accelerated transitions. Accessible, affordable finance at scale backed by political will and cooperation between domestic and international stakeholders can help in moving towards accelerated just clean energy transitions and a better future for all.

Notes

* Views expressed in this chapter are the authors' own and do not reflect institutional positions.
1 17 SDG goals, 169 targets.
2 The Seed Fund for Country Packages for Nature, Forests and Climate, for example, www.conservation.org/press-releases/2023/12/11/launch-of-the-seed-fund-for-country-packages-for-forests-nature-and-climate

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27 Indonesia's Energy Transition

The Progress and Challenge So Far

Ramnath Iyer and Mutya Yustika

27.1 Introduction

With 1.47 gigatons of CO_2e emissions in 2021 (Climate Watch, n.d.), Indonesia is one of the large emitters of carbon in Asia. In September 2022, Indonesia submitted its enhanced Nationally Determined Contribution (NDC) and committed to a higher GHG reduction target of 31.9% (relative to the business as usual baseline of 2.87 $GtCO_2$ by 2030), or 43.2% relative to that baseline conditional on international support (UNFCCC, 2022) In the longer term, it has pledged to reach net-zero emissions (NZE) in 2060 or earlier. Indonesia's commitments to energy transition are legally embodied in its ratification of the Paris Agreement in 2016 (Law No 16) (Republic of Indonesia, 2016)

The energy sector accounts for 46% of the country's carbon emissions. Within that, coal-fired power accounts for 61% of total electricity generation. The energy transition for the country will involve both a reduction of coal/fossil fuelled power and an increase in power generated from renewable sources. The Government of Indonesia (GOI) has issued several regulations with these aims to support the energy transition and achieve the NZE target (Republic of Indonesia, 2022). Regulations have been issued that ban the development on new coal-fired power plants and allow for accelerated termination of coal-fired power plants operations.

Shutting down power plants before the end of their active commercial life necessarily entails a financial loss, in the form of cash flow and profits foregone due to early plant closure. Additional funding is therefore likely to be required to offset this loss. The international community, which also stands to benefit from the positive climate impacts of such actions, has come together to support Indonesia's efforts using two separate programmes for which Indonesia will be among the pioneers in the world. The two programmes are the Energy Transition Mechanism (ETM) launched by Asian Development Bank (ADB) (Asian Development Bank, n.d.) and the Just Energy Transition Partnership for Indonesia (JETP Indonesia) launched in November 2022 in collaboration with the International Partners Group (IPG) (The White House, 2022).[1]

This chapter will analyse the early progress, and the lessons and apparent pitfalls in the implementation of such programmes in economies with a heavy dependence on coal, with a focus on the quantum and availability of finance.

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27.2 Energy Transition Schemes in Indonesia

27.2.1 Energy Transition Mechanism

The ETM was launched in November 2021 by the ADB as a platform to use a blend of concessional and commercial capital (blended finance) to accelerate the retirement of coal-fired power plants and replace them with clean energy (ADB Knowledge, 2021). The ETM began with three pilot countries, Indonesia, the Philippines, and Viet Nam, and has now extended to Pakistan and Kazakhstan (Asian Development Bank, 2023).

The ADB is supporting the ETM for Indonesia under the Climate Investment Funds Accelerating Coal Transition (CIF-ACT) programme, which received in-principal approval to access USD 500 million of concessional, risk-bearing capital in October 2022. The programme intends to accelerate up to 2 GW coal-fired power plant (CFPP) retirement by 5–10 years and thereby reduce up to 50 million tonnes of carbon dioxide equivalent ($MTCO_2e$) by 2030 and 160 $MTCO_2e$ by 2040 (it also assumes 400 MW renewable energy, 90 MW of energy storage, mine-area reclamation, reforestation and restoration) (Hamdi, 2022). Until June 2024, the ETM, via a trust fund set up by its partners to channel finance, has received contributions from the governments of Japan, Germany and New Zealand to support a variety of its activities (Asian Development Bank, n.d.).

In November 2022, ADB and other partners signed a Memorandum of Understanding with Cirebon Electric Power, an independent power producer (IPP), to explore the early retirement of the first CFPP under the ETM programme. The planned transaction will retire a 660-megawatt coal power plant in Western Java. The aim is to design this such that it becomes a model that can be replicated across other Indonesian CFPPs (Asian Development Bank, 2022) Figure 27.1 summarises how the ETM has unfolded in Indonesia since its inception.

The ETM is also expected to be one of the key delivery mechanisms to ensure successful implementation of the JETP programme.

27.2.2 Just Energy Transition Partnership – Indonesia

The Just Energy Transition Partnership – Indonesia (JETPI) was launched by GOI and a group of countries under the aegis of International Partners' Group (IPG) in

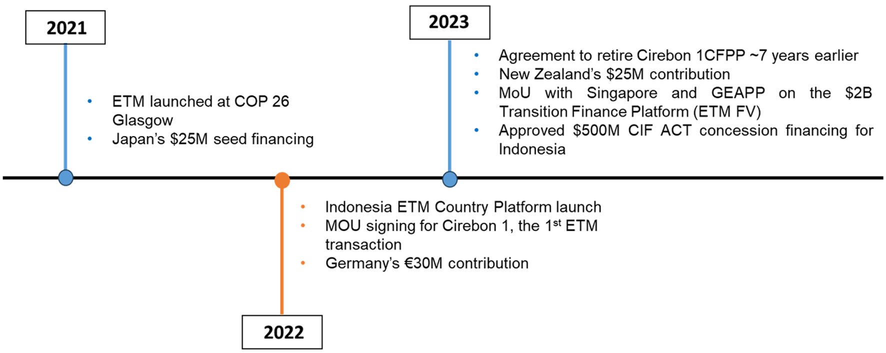


Figure 27.1 Energy Transition Mechanism Timeline

Source: (ADB, 2024)

November 2022 on the sidelines of the G20 Summit in Bali. This followed the pioneering agreement of the JETP mechanism which involved South African CFPP retirement, agreed in November 2021 (Just Energy Transition Partnership Indonesia, 2023). Under the JETPI, the IPG member countries provide public funding through bilateral development programmes, supported by MDBs, philanthropies and climate funds. Private sector funding is being coordinated through the Glasgow Financial Alliance for Net Zero (GFANZ), with a JETP working group of seven global investment banks representing 675 private sector financiers (Hauber, 2023). Figure 27.2 provides a birds-eye view of the financing relationships within JETPI.

JETPI aims to achieve peak power sector emissions of no more than 250 million tons of carbon dioxide equivalent ($MtCO_2$) by 2030, renewable energy generation share of 44% by 2030 and achievement of NZE in the power sector by 2050 (Just Energy Transition Partnership Indonesia, 2023). Under this JETP scenario, early retirements are to be carried out for 1.7 GW by 2040 enabled by support from the Energy Transition Mechanism. Figure 27.3 demonstrates how the JETPI has been structured in consonance with Indonesia's NDCs.

To achieve this, the JETPI envisages an investment plan costing USD 97.1 billion in the 2023–2030 period and up to USD 580.3 billion between 2023 and 2050. An initial commitment of USD 20 billion, half from public sources from the IPG and the other half to be catalysed from other sources, is expected to act as a further catalyst by covering approximately one-fifth of the 2023–30 needs (Just Energy Transition Partnership Indonesia, 2023).

The public financing, which includes concessional loans, grants, guarantees and market interest rate loans from public financial institutions, has been announced by the IPG

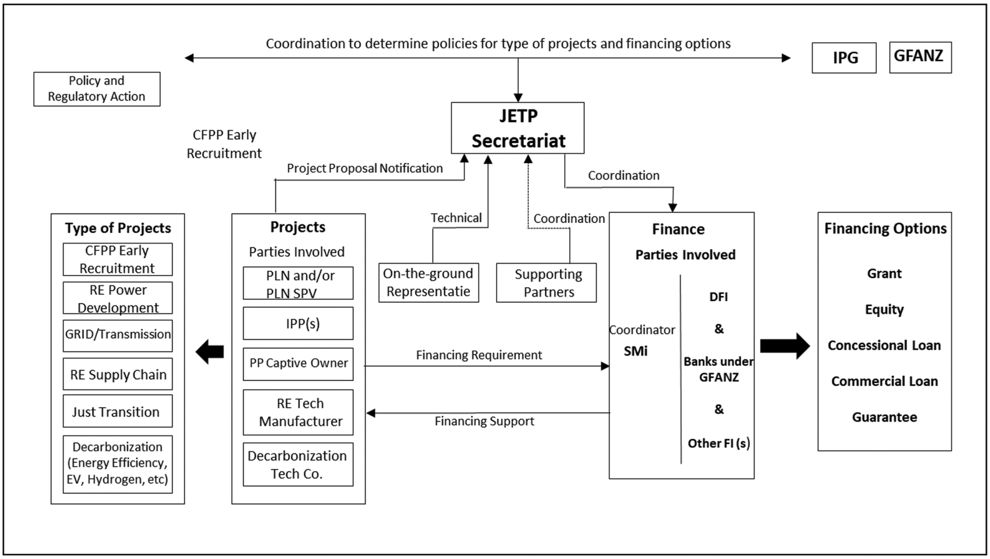


Figure 27.2 JETP Governance and Workflow

Source: MEMR. Energy Transition Financing Through JETP and ETM. March 2023.

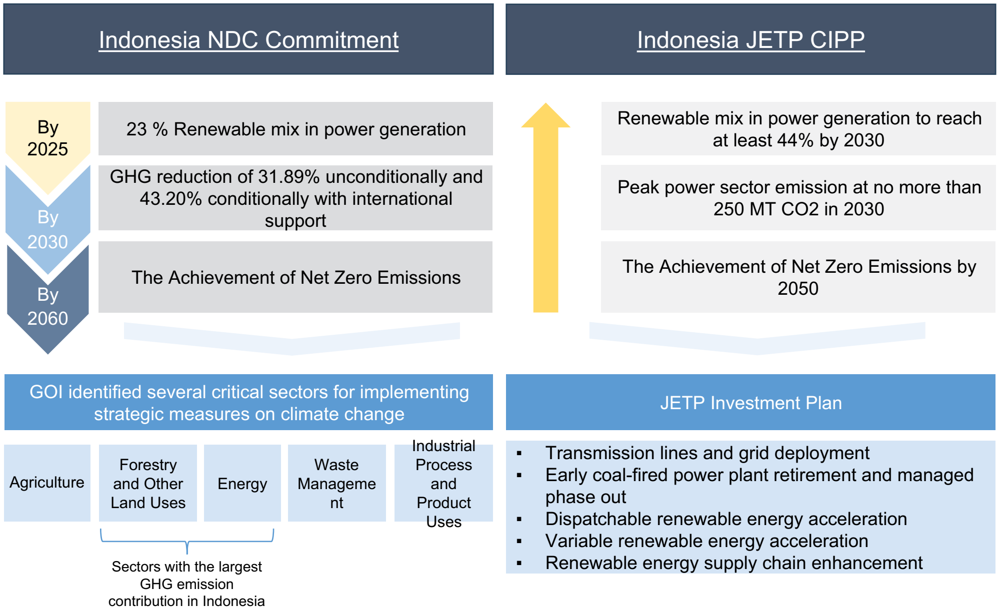


Figure 27.3 Indonesia Commitments – NDC and JETP Indonesia

Source: (Compiled by the authors from Pratama, 2023; JETP, n.d.)

participants, namely the United States, Japan, Canada, Denmark, the European Union, France, Germany, Italy, Norway and the United Kingdom. Figure 27.4 summarises the share of pledges from different member countries of the IPG. GFANZ Working Group members – Bank of America, Citi, Deutsche Bank, HSBC, Macquarie, MUFG and Standard Chartered – have likewise announced their intent to work on securing the USD 10 billion in corresponding private finance (Just Energy Transition Partnership Indonesia, 2023).

27.3 Current Progress

The progress of the JETP and ETM process has to date been somewhat slow and halting (Devex, 2023; Mafira, 2023). This is also reflected in the continuing dominance of fossil fuels in the country's electricity generation mix. As of December 2023, renewable energy only amounted to 13.1% of the total capacity, with hydroelectric, biomass and geothermal accounting for the vast majority of this (12.4GW out of 13.2GW renewables). This is well below the initial target of 17.9%. From 2018 to 2022, Indonesia only added 2.78 GW of renewable energy generating capacity and still remains heavily dependent on coal-based energy, comprising 40.5% of the energy mix, as illustrated in Figure 27.5 (Ministry of Energy and Mineral Resources of Indonesia, 2023).

In 2023, Indonesia's electricity demand rose by 17.1 Terawatt-hour (TWh) (+5.1%) compared to 2022; 67% of this rise was met with coal, and gas satisfied 31% of the increase in demand (Ember, 2023).

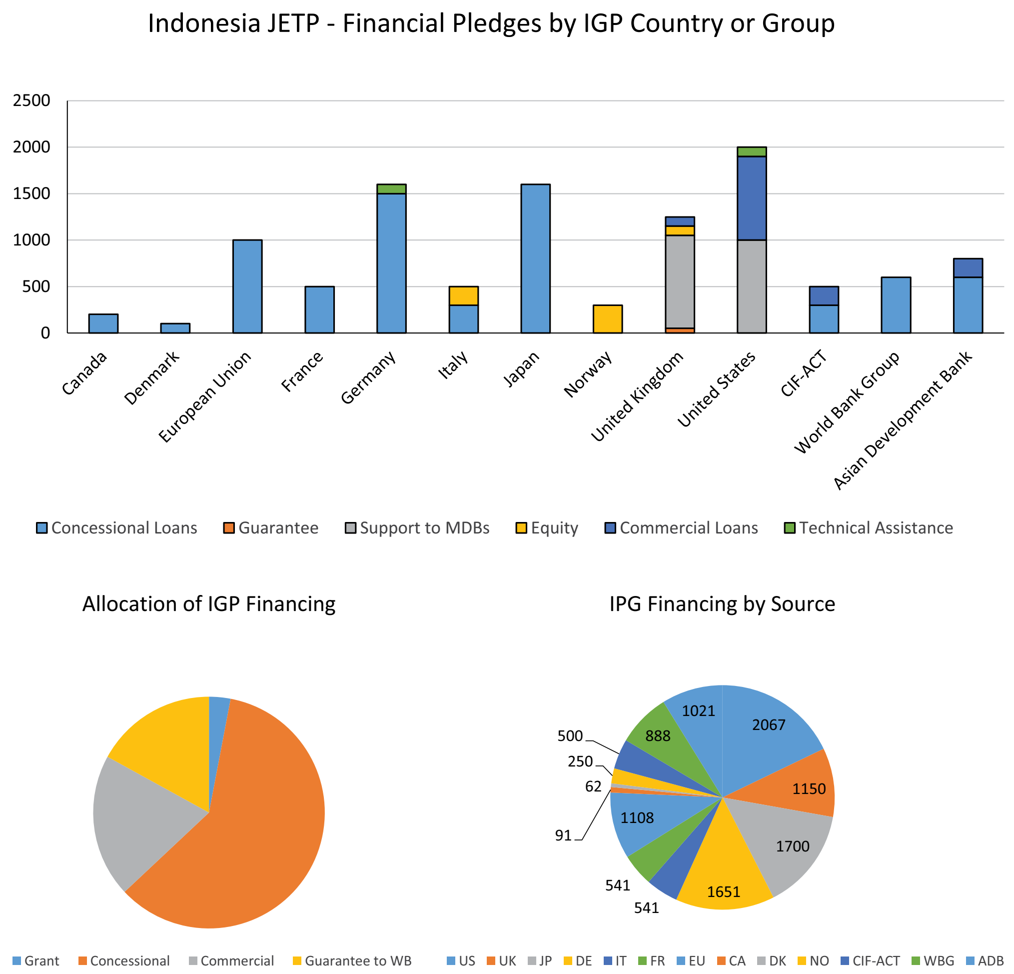
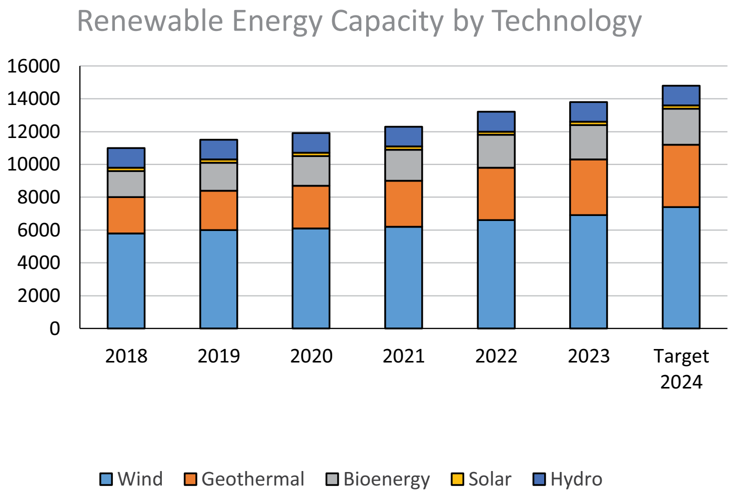


Figure 27.4 Indonesia JETP Public Finance

Source: (Hauber, 2023)

Following the November 23 launch, the JETP produced an agreement regarding the early retirement of two CFPPS, namely PLTU Cirebon-1 and PLTU Pelabuhan Ratu. The early retirements for 1.7 GW of capacity are slated to be carried out by 2040, and the plan incorporates international financial support from the ETM (Just Energy Transition Partnership Indonesia, 2023).

For the ETM specifically, the first goal is to accelerate the retirement the 660 MW Cirebon-1 CFPP, which will involve a USD 300 million refinancing consisting of concessional and non-concessional loans, as well as public and private finance. Through the proposed financing mechanism, the project aims to open the pathway for further coal-fired IPP early retirements by demonstrating the tangible willingness of the government as well as the state-owned utility PLTU Pelabuhan Ratu to operationalise the CFPP early retirement roadmap.



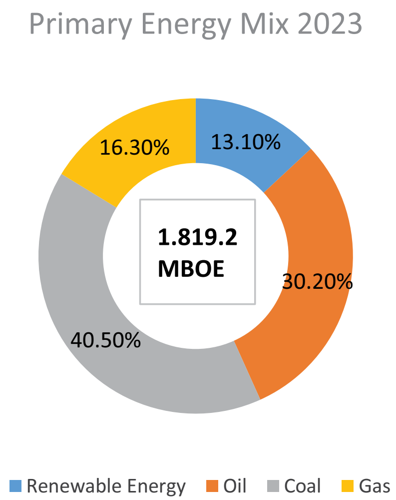


Figure 27.5 Renewable Energy Capacity by Technology (Up) and Primary Energy Mix 2023 (Down)

Source: Hamdi, E. and Adhiguna, P. (2021).

27.4 Early Observations and Recommended Course Corrections

Given that the JETP-ETM is a new attempt by global partners at trying out novel approaches to meet the challenge of retiring coal plants early, some hiccups and problems are to be expected. And early observations and news-flow suggest that this is the case. The main issues that have cropped up so far are listed below, along with some suggestions on how to handle/ameliorate them with the intention of speeding up Indonesia's energy transition.

To start with, the success or failure of ambitious and new mechanisms such as JETPI and ETMs will depend crucially on institutional backing, with a key role for the government in enabling this through transparent and consistent policy. As of date, there is a law (Presidential Regulation No. 112/2022) that is the only legal basis for JETP, ETM and CFPP retirement. However, with just one overarching presidential regulation, the legal framework cannot be considered fully developed, nor can it be deemed to be robust enough to face future legal challenges that are most likely to arise. A well-structured and complete legal framework, with laws and government regulation, are needed to provide a robust legal foundation for JETP (Tenggara, 2023).

In addition, specifically for coal plant retirements, the existing power purchase agreements (PPAs) that many of the CFPPs hold are legally binding on them to deliver power, which makes for additional difficulties to amend or change an existing PPA unless all the parties agree to the transaction. Additionally, as Indonesia's CFPP fleet is relatively young with a long-remaining useful life, often there are outstanding loans, complicating the financial aspects related to plant retirement.

The entire process of communication, coordination and policy making in a mechanism that involves different parties, as is the IPG, also requires significant thought and effort. The JETP involves several different institutions and organisations with a diverse range of stakeholders, from international governments to national ministries of finance, energy, security, industry, environment, among others, local counterparts of the same, public and private corporates in the sector and civil society organisations. These communication and coordination strategies are currently still being ironed out and need to be enhanced, with the JETPI playing the mediating role of connecting the dots between different institutions.

27.4.1 Underwhelming Finance Under the JETPI Mechanism

The committed JETP funding, initially at USD 20 billion and later increased to USD 21.7 billion, falls far short of what is needed to finance Indonesia's energy transition efforts. Even within that, the grant funding (USD 295 million), at only 2.6% of the USD 10 billion initial commitment of the IPG is too low.

On the other hand, the total cost required to finance projects under JETP as prepared by Perusahaan Listrik Negara (PLN), a state-owned company headquartered in Jakarta, is estimated at near USD 150 billion. The grant funding currently envisaged is only 0.2% of this total. Grants are crucial to help finance preparations for early development of renewable energy projects which are considered high-risk, with activities such as environmental and topographical checks, feasibility studies, reskilling for workers and vulnerable groups affected by the programme and various just energy transition risk mitigation programmes.

27.4.2 Managing Infrastructure Projects with National-Level Expertise

The national bank, PT Sarana Multi Infrastruktur (SMI) has been positioned as a key facilitator of blended finance and a partner in the JETP/ETM process (Gani, 2024) SMI is also the country platform manager of the ETM. As such, the presence of SMI, and its publicly stated ambition to enhance climate financing, should bode well for increased coordination between the international and domestic parties in the ETM and lead to higher funding being unlocked. Likewise, the Indonesia Infrastructure Guarantee Fund (IIGF) is another state-owned enterprise that benefits from higher ratings and acts to de-risk projects or bring down the borrowing costs by offering guarantees and insurance to investors and lenders.

Such financial institutions with local knowledge and expertise can play a key role in knowledge transfer from MDBs and commercial banks on transition finance. PT SMI is also one of the leaders in the region in terms of having issued a green bond, thus having experience and expertise in this area (PT SMI, n.d.). With collaborations with institutions such as European Investment Bank and KfW of Germany, SMI can also guide other domestic financial institutions in raising and channelling funds via green and sustainable debt frameworks, along with accessing blended finance and climate finance facilities as a government mandated entity.

In practice, thus far, the activities of PT SMI (and of other national infrastructure bodies in Indonesia) have remained primarily focused on general infrastructure, by and large, and less on climate finance and specifically CFPP closures. Beyond investments in a geothermal and a hydro project, current publicly available documents do not reveal whether the catalytic role envisaged for it has actually been achieved. Likewise, the IIGF remains focused on traditional infrastructure such as roads and again appears to be under-utilised in terms of its ability to contribute to the success of JTP/ETM/coal plan retirement funding, through issuing securities intended to facilitate the transition with enhanced credit guarantees, for example, and thus lower funding costs (PT PII, n.d.).

27.4.3 Importance of Enabling Environment

Finally, quasi-legal regulations and financial regulatory requirements can play a crucial role in developing a financial system that rewards the transition and penalises recalcitrant agencies. Taxonomies, which enable stakeholders to classify economic activity using environmental parameters are a crucial element in this. Led by the European Union, many countries around the world have developed 'green' taxonomies that enable financial institutions to fund such projects and make the projects attractive and eligible for funding.

Keeping in mind the stage of development in South East Asia with regard to the use of coal as the primary energy source, regional policymakers developed an advisory taxonomy named 'ASEAN Taxonomy for Sustainable Finance', which numerous regional countries have used as a template, especially for enabling finance for transitional activities such as time-based planned transition from coal-fired power (ASEAN Taxonomy Board, n.d.).

The ASEAN taxonomy, by and large, excludes coal from green classifications, but it does have room for financing of the phase out/shut down of existing coal-fired power plants. Under the ASEAN taxonomy, the Amber category has two tiers, Tier 2 and Tier 3 (Tier 1 is the 'Green' category). Specifications for Tier 2 are tighter than that for Tier 3. Tier 3 is set to reach sunset, that is, be phased out, by 2030, and Tier 2 is set to reach sunset in 2040.

The Indonesian taxonomy, though based (supposedly) on the ASEAN taxonomy, has used looser and more permissive definitions, which risk undermining the credibility of the taxonomy. The Indonesian taxonomy does not have an end date for transitional activities. Instead it merely states that activities categorised as Tier 3 need to meet certain criteria in terms of emissions by 2030 to continue.

Additionally, and more egregiously, there is a provision for new CFPPs to be financed so long as they are set up as captive generators for plants that process minerals deemed as crucial to the energy transition. Quite apart from the very wide leeway such loose definitions offer, the express allowance of CFPPs for green financing flies in the face of the trends elsewhere and likely makes further funding through joint mechanisms more fraught. So, rather than make it easier to enable transition funding by following internationally accepted norms, the taxonomy muddies the waters, potentially leading to confusion among investors and financiers. Additionally, it creates difficulties in harmonising with sustainability standards set by other countries and regions.

27.5 Conclusion

Indonesia is one of the pioneers in framing JETP strategies aimed at reducing GHG emissions. The overall strategy is well designed in theory, particularly in terms of the detail of how the transition will be financed and the engagement of both the IPG and international finance, both private and multilateral. At the outset, however, it is important to note that the grant element is abysmally low, constraining the JETP in important ways. Equally important, its practical legal underpinnings remain somewhat ambiguous and fragile. Domestic financial institutions, which are a part of the institutional architecture of the JETP, do not seem to have pulled their weight, adequately constraining their potential catalytic roles. Finally, domestic and political compulsions seem to have left loopholes in the framing, which might affect the credibility of the overall programme in the eyes of international institutional investors.

Note

The IPG comprises the governments of Indonesia, Canada, Denmark, the European Union, France, Italy, Norway and the United Kingdom, and co-chairs Japan and the United States.

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