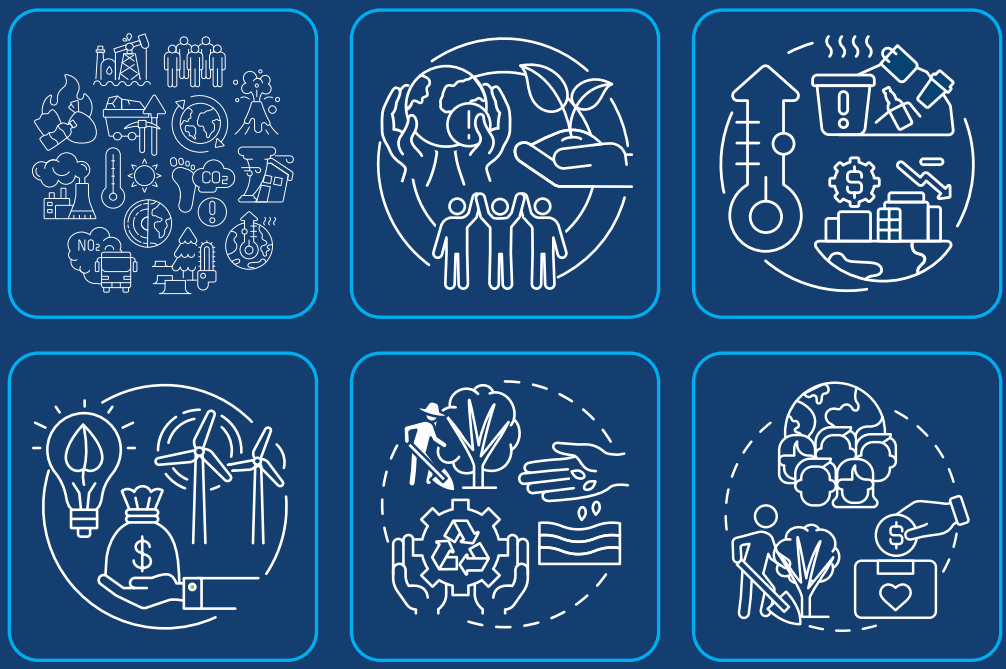
COP26 CHARTER OF ACTIONS

RALLYING THE GLOBAL COMMUNITY FOR AN EQUITABLE CLIMATE AGENDA



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Creating Innovative Solutions for a Sustainable Future

WSDS

COP26 CHARTER

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THE ENERGY AND RESOURCES INSTITUTE
Creating Innovative Solutions for a Sustainable Future

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Message

I am happy to see The Energy and Resources Institute (TERI)'s work in preparing the 'COP26 Charter of Actions'. The document has taken a holistic approach, touching upon issues closely aligned with India's priority areas, including issues related to equity, energy, green finance, adaptation and resilience, nature-based solutions, energy, business and industry, and clean transport, all of which are important areas to drive climate action as far as India is concerned. I am confident that this initiative will provide directions for charting a course for equitable and sustainable climate actions in India and for the world.

Climate change is the defining issue confronting humanity right now. The impacts of climate change in the form of extreme weather events are being felt in different parts of the world. The need of the hour is a comprehensive set of actions, within socio-economic and developmental contexts, to deal with the catastrophes related to climate change. Concerted actions are needed in terms of cooperation between all countries, with developed countries taking the lead on climate actions through mitigation, adaptation, and provision of support to developing countries in terms of climate finance, capacity building and technology transfer.

The recently released report by IPCC (Intergovernmental Panel on Climate Change) has sounded alarm bells louder than ever; it is a clarion call for the developed countries to undertake immediate deep emission cuts. India is a committed constituent of the United Nations Framework Convention on Climate Change (UNFCCC) and Paris Agreement, and I am hopeful for a successful and balanced outcome at COP26.

India has taken several actions under the visionary leadership of our Hon'ble Prime Minister, Shri Narendra Modi to tackle climate change by taking several initiatives including, inter-alia, implementation of the National Action Plan on Climate Change, National Adaptation Fund on Climate Change, Pradhan Mantri Ujjwala Yojana, Faster Adoption and Manufacturing of Electric Vehicles scheme, setting up of International Solar Alliance, Coalition for Disaster Resilient Infrastructure, Leadership Group for Industry Transition; moreover, it has put in place an ambitious National Hydrogen Mission and continued efforts to decouple its emissions from economic growth. India has an aspirational target of installing 450 GW of renewable energy by 2030. Indian Railways has set an emissions target of becoming net zero by 2030. However, ambitious climate action in developing countries is dependent on ambitious support from developed countries under the Paris Agreement. India has repeatedly called upon the developed countries to fulfil their promise of the USD 100 billion per year goal. In this regard, COP26 should focus on climate finance in scope, scale and speed along with development and transfer of technologies and capacity building support.

Developing countries are highly vulnerable to climate change impacts, and India's large population is dependent on climate sensitive sectors for livelihoods. As a result, the fight against climate change cannot be undertaken by governments alone. Private sector companies should be encouraged to play a role in developing breakthrough technologies and mobilizing finance. Equity and climate justice are the touchstones of any global climate response. Mechanisms such as long-term strategies and global stock-take have to duly account for adaptation, finance, technology and equity considerations.

Bhupender Yadav

Union Minister of Environment, Forest and Climate Change, Government of India

This Message was provided for the National Conference on COP26 Charter of Actions organized on 13th October 2021. The event also saw the soft launch of the COP26 Charter of Actions.

Preface

The 26th meeting of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) is coming at a pivotal moment in these uncertain times. COP26 to be held in Glasgow will aim to mobilize action on mitigation, adaptation, and resilience, and strengthen the narrative for better alignment with sustainable development goals. The science is clear about the consequences of inaction, and unless there are immediate, rapid and large-scale reductions in greenhouse gas emissions, limiting warming to close to 1.5°C or even 2°C will be beyond reach. According to the latest report by the Intergovernmental Panel on Climate Change (IPCC), the effects of climate change is bringing multiple different changes in different regions—which will all increase with further warming. These include changes to wetness and dryness, to winds, snow and ice, coastal areas, and oceans. This has been already felt in the developing world, and now it is seen in the developed world as well.

While India's per capita emissions and historical cumulative emissions are low, it can play a crucial leadership role in mobilizing action to tackle climate change. In the wake of COVID-19 pandemic, India has tremendous opportunities to plan the recovery with greener policies. This cannot be undertaken by governments alone; all stakeholders need to come together to bring down emissions, finance the transition to low-carbon economy and adaptation, as well as contribute to knowledge creation. Businesses, civil society, research and academia need to join hands with both national and sub-national governments to take ambitious and urgent actions.

In this regard, The Energy and Resources Institute (TERI) has put together this knowledge document, titled *COP26 Charter of Actions* to assimilate questions and thematic solutions which can advance climate action and ambition in India and globally. The Charter covers various sectors such as renewable energy, sustainable mobility, and business & industry, as well as cross-cutting themes such as equity, green finance, adaptation and resilience, and nature-based solutions. This knowledge document was informed not just by TERI's experts, but also through various stakeholder discussions and national dialogues around the significance of COP26 and the various sub-themes of the Charter.

The Charter activities are a part of TERI's flagship Track-II initiative, the World Sustainable Development Summit (WSDS). We hope to upscale and continue knowledge output-based activities around the WSDS through a platform titled *Act4Earth*, the strategy document of which will be launched at the forthcoming edition of the WSDS.

I want to congratulate my colleagues for putting together this knowledge document, and thank all the partners for their support.

Vibha Dhawan
Director General, The Energy and Resources Institute

COP26 Charter of Actions

The 26th UN Climate Change Conference of the Parties (COP26), to be held on November 1–12, 2021 in Glasgow, will aim to mobilize the action on mitigation, adaptation, and resilience, and strengthen the narrative for better alignment with sustainable development goals. The Energy and Resources Institute (TERI) is preparing a COP26 Charter of Actions, which will assimilate questions and challenges posed by key sectors in India, propose probable and sector-specific options that can advance climate action and ambition in the country, and also highlight normative implications for the global climate agenda. The outcomes of COP26 and the messages from the Charter will also be discussed at a plenary session at the World Sustainable Development Summit (WSDS) to be organized by TERI on February 16–18, 2022.

Partner Agencies

British High Commission (for events and consultations) – Country Partner
Bloomberg Philanthropies – Premier Partner
Shakti Sustainable Energy Foundation – Premier Partner
Tata Cleantech Capital Ltd. – Premier Partner
The Rockefeller Foundation – Premier Partner

Activities

Pre-WSDS 2021 Webinar Series on Green Finance, Nature-based Solutions, Adaptation & Resilience and Sustainable Mobility (December 2020)
Stakeholder Roundtables on Green Finance, Renewable Energy, Nature-based Solutions, Adaptation & Resilience and Sustainable Mobility (August 2021)
National Conference on COP26 Charter of Actions (October 2021)
Release of COP26 Charter of Actions (November 2021)

Themes

- Equity and Climate Justice
- Green Finance
- Adaptation & Resilience
- Nature-based Solutions
- Business & Industry
- Renewable Energy
- Low Carbon Transport

Organizations

About The Energy and Resources Institute

The Energy and Resources Institute (TERI) is an independent, non-profit organization, with capabilities in research, implementation and outreach. TERI has multidisciplinary expertise in the areas of climate change, natural resources, environment, energy, and sustainable development goals. TERI's research and research-based solutions have had a transformative impact on industries and communities. It has fostered international collaboration on sustainability action by creating a number of platforms and fora. Research gets translated into technology products, technical services, as well as policy advisory and outreach. Headquartered in New Delhi, TERI has regional centres and campuses in Gurugram, Bengaluru, Guwahati, Mumbai, Panaji, and Nainital.

About Bloomberg Philanthropies

Bloomberg Philanthropies invests in 810 cities and 170 countries around the world to ensure better, longer lives for the greatest number of people. The organization focuses on five key areas for creating lasting change: the Arts, Education, Environment, Government Innovation, and Public Health. Bloomberg Philanthropies encompasses all of Michael R. Bloomberg's giving, including his foundation, corporate, and personal philanthropy as well as Bloomberg Associates, a pro bono consultancy that works in cities around the world. For more information, please visit bloomberg.org

About The Rockefeller Foundation

The Rockefeller Foundation is a pioneering philanthropy built on collaborative partnerships at the frontiers of science, technology, and innovation to enable individuals, families, and communities to flourish. We work to promote the well-being of humanity and make opportunity universal. Our focus is on scaling renewable energy for all, stimulating economic mobility, and ensuring equitable access to healthy and nutritious food. For more information, information, sign up for our newsletter at www.rockefellerfoundation.org.

About Shakti Sustainable Energy Foundation

Shakti Sustainable Energy Foundation (Shakti) seeks to facilitate India's transition to a cleaner energy future by aiding the design and implementation of policies that promote clean power, energy efficiency, sustainable urban transport and climate action. Working collaboratively with policy makers, civil society, industry, think tanks and academia, Shakti seeks to catalyse transformative solutions to meet India's energy needs in clean and sustainable ways. For more information, please visit shaktifoundation.in

About Tata Cleantech Capital Limited

TCCL is registered with the Reserve Bank of India ("RBI") as a Systemically Important Non-Deposit Accepting Non-Banking Financial Company and commenced its operations in 2013. As India's only private sector financial institution focused solely on the green finance space, it offers end-to-end business solutions in the clean technology space. TCCL is engaged in the business of offering finance and advisory services across renewable energy, energy efficiency, waste management, power transmission, water, energy efficiency and electric mobility. For more information, please visit tatacapital.com

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Acknowledgment

Keeping in view the importance of COP26, The Energy and Resources Institute (TERI) kick-started the formulation of a knowledge document titled, COP26 Charter of Actions in July 2020. The Charter has been shaped under the annual flagship track II initiative of TERI, the World Sustainable Development Summit (WSDS). The document assimilates questions and challenges posed by key sectors and themes in India, and proposes probable and sector-specific options to advance climate action and ambition in the country.

This journey which has taken over a year has been largely possible due to the support from the Ministry of Environment, Forest and Climate Change, Government of India, and our working partnership with the British High Commission, New Delhi; Bloomberg Philanthropies; the Rockefeller Foundation; Shakti Sustainable Energy Foundation; and Tata Cleantech Capital Limited.

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Dr Archna Negi, Associate Professor, Centre for International Politics, Organization & Disarmament, School of International Studies, Jawaharlal Nehru University; Mr Manish Chourasia, Managing Director, Tata Cleantech Capital Ltd.; and Mr Chandra Bhushan, Chief Executive Officer, International Forum for Environment, Sustainability & Technology.

A special thanks to all our stakeholders who provided us with constructive feedback and encouragement through all the stakeholder roundtables held in August 2021. On the themes of Green Finance, Ms Chandni Raina, Economic Adviser, Climate Change Finance Unit, Ministry of Finance; Mr Archie Young, UK Lead Climate Negotiator, Cabinet Office; Mr Girish Joshi, Chief - Trading Operations & Listing Sales, BSE Ltd.; Ms Namita Vikas, Founder and Managing Director, auctusESG; Ms Priya Shankar, India Director, Climate and Environment Program, Bloomberg Philanthropies; Mr Pankaj Sindhwani, Chief Business Officer, Tata Cleantech Capital Ltd.; Mr Shubhashis Dey, Director, Climate Policy, Shakti Sustainable Energy Foundation; Ms Roshika Singh, Acting Country Manager, International Finance Corporation, India, World Bank Group; Mr Edwin Koekkoek, Counsellor on Energy and Climate Action, EU Delegation India; and Ms Tejaswini Raval-Kamat, Vice President & Head - ESG & Impact, EverSource Capital.

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On the theme of Nature-based Solutions, Dr A Arunachalam, Director, Central Agroforestry Research Institute (CAFRI); Mr Ram Kumar, IFS, APCCF Social Forestry, Gujarat Forest Department; Mr Saurabh Gupta, APCCF, Punjab Forest Department; Mr Sandeep Roy Choudhury, Director, VNV Advisory Services; and Mr Anirban Ganguly, Research Specialist, South Asia Research Hub, British High Commission.

On the theme of Sustainable Mobility, Mr Badri Narayan, CAO (TT & BRU), Northern Railways; Mr Karthick Atmanathan, Professor of Practice, IIT-Madras; Mr Vivek Chandran, Associate Director, Shakti Sustainable Energy Foundation; Mr Jasjit Sethi, CEO, TCI Supply Chain Solutions; Mr Sampath Kumar Velamoor Srinivasan, Head, Business Development, Tata Cleantech Capital; and Ms Haimanti Poddar, Senior Energy, Climate Change & Urban Adviser, COP 26 Zero Emission Vehicle Transition India Campaign Lead, British Deputy High Commission, Kolkata.

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Shailly Kedia, Nivedita Cholayil, Anuradha Mathur, Shreyas Joshi

Executive Summary

EXECUTIVE SUMMARY

COP26 Charter of Actions

The COP26 Charter of Actions is an initiative of TERI. It is an effort to rally for an equitable and ambitious global climate agenda for ensuring planetary resilience at the COP26 and beyond. It a sincere hope that this knowledge document will contribute to a meaningful discussion involving all societal stakeholders, including governments, intergovernmental bodies, civil society, research and academia, and also the youth, our future generation. The Charter is an initiative under TERI's flagship Track-II event the World Sustainable Development Summit (WSDS). The approach for the Charter is descriptive research and stakeholder consultations. The Charter covers the seven themes of equity, green finance, adaptation, nature-based solutions, business and industry, renewable energy, and transport. Five stakeholder consultations were held in August this year for validation and to get further inputs on initial findings. The outcomes of COP26 and the messages from the Charter will also be discussed at a plenary session at the WSDS to be organized by TERI during February 16–18, 2022.

Equity and Climate Justice

A principle-based approach rooted in equity, climate justice, and principles of the United Nations Framework Convention on Climate Change is needed at COP26. The paradigm of equity rooted in per capita emissions and historical responsibility is key. It is imperative that the progress made by countries is assessed considering the principles of equity well before the global stocktake, which is to take place at COP28 in 2023.

Adaptation has to be integral for a global response to climate change, as recognized in the Article 7.2 of the Paris Climate Agreement. However, long-term strategies (LTS) formulated and communicated under Article 4.19 of the Paris Agreement, at the moment, largely focus on mitigation and do not consider adequately adaptation to climate change. Long-term strategies also need to factor climate finance, technology transfer, and in situ and ex situ adaptation measures along with sustainable consumption.

Revised nationally determined contributions (NDCs) pledges and net-zero commitments by a few countries give a glimmer of hope to realize the Paris goals. A higher level of ambition is needed from developed countries, which should move towards being net negative by 2050 and will need to achieve net zero much earlier.

Equity and climate justice need to be the touchstones for climate deliberations in COP26 and beyond. In terms of cumulative CO_2 emissions since 1850, United States alone accounts for 25% of the cumulative emissions, the EU 17%, China 13%, and the UK 4.7%. India's share is just 3.1%. G7 countries alone account for 45% of the cumulative CO_2 emissions. At 1.9 tonnes, India's per capita emissions are less than half the world average and the lowest among G20 countries. India has low per capita emissions but will be an important player in terms of normative and entrepreneurial leadership when it comes to mobilizing national and international climate actions.

India can assume the role of an entrepreneurial leader by leading developments in breakthrough and disruptive technologies. Also, India can be a norm leader by building shared understanding on sustainable consumption, adaptation, and non-anthropocentric notions around equity and climate justice.

If the world needs to get to net zero by 2050, the developed world must become net carbon negative well before that so that the developing

countries have the carbon space to pursue their development imperatives, which will take time. The global goalpost needs to shift to 'net negative' goals of developed countries and to the goal of climate stabilization.

Global negotiations are critical along with climate action at the national and sub-national levels and also in business and industry. It is essential that climate action be understood in both sectoral and cross-sectoral terms, including in areas of finance as well as science, technology, and innovation.

Climate Finance and Green Finance

There is also an urgent need to distinguish climate finance from green finance, the former being a subset of the latter and is a specific area of concern for climate negotiations. The global goals of financing need to be urgently realized and the USD 100 billion target needs to be fulfilled. There is a need for well-defined mechanisms under the new collective quantified goal on finance.

Decision-making processes for state budgeting and national budgeting have the potential to be reformed using NDC- and SDG-aligned budgeting or green budgeting framework. Post COVID recovery, in the short term, there is a critical need to lay the foundations for an enabling environment for green finance while building awareness and capacity of key stakeholders. There is a need to mobilize green finance from the private sector including through environmental, social, and corporate governance (ESG) investing and international finance. Transparency of information through disclosure standards in financial systems is essential.

Adaptation and Resilience

India should develop a National Adaptation Plan as per the provisions of the Paris Agreement. Research gaps need to be addressed by investing in science-based tools and building data sets; moreover, the role of private sector should be augmented in adaptation and resilience building.

A crucial question regarding COP26 is whether COP26 will be an Adaptation COP. Despite the inherent need of adaptation in strengthening climate action, a key area of concern remains the inability to quantify or map the progress in absolute terms. In the absence of such measures, the momentum in addressing adaptation needs may be lost.

Nature-Based Solutions and Agroforestry

Trees outside forest (TOF) form nearly 38% of the carbon sink in forest and tree cover of the country. Agroforestry has a huge potential in India and can contribute more than 2 billion tonnes of CO_2e by 2030 if the government puts in place appropriate incentive mechanisms for farmers or producers.

At the global level, there is a need to factor ecosystem-based approaches by considering terrestrial, coastal, and marine ecosystems. At the moment, there is not enough attention on marine-related nature-based solutions. There is also a need for larger synergies between the provisions of all the three Rio Conventions.

Business and Industry

The growing eminence of sustainability disclosures through Securities and Exchange Board of India (SEBI) introducing business responsibility and sustainability reporting (BRSR) guidelines would motivate many businesses to mainstream ESG and climate action efforts while strategizing their action plans and also aid financial institutions like banks, credit rating agencies, and other financial institutions in investment decisions.

In the medium to long term, the role of industries in developing disruptive technologies, especially in hard-to-abate sectors, would be crucial. Private sector can be leveraged to enhance country's

adaptation efforts and build climate resilient infrastructure complementing the goals of initiatives such as the Coalition for Disaster Resilient Infrastructure.

Renewable Energy

India has consistently stepped up its RE capacity targets to 175 GW by the year 2022 and 450 GW by 2030. For power sector decarbonization through the large-scale deployment of renewable energy, viable energy storage alternatives will be needed to meet evening peak demand. Apart from supply-side measures, there is also a need to boost demand for renewable electricity by pushing technologies such as electric vehicles.

To realize Goal 7 of the SDGs, along with large-scale renewable energy deployment, there is a need to raise awareness and deploy innovative models for ensuring energy access for improved livelihoods and well-being in rural areas through options such as distributed renewable energy.

Sustainable Mobility

There needs to be increased adoption of electrical vehicles for two-wheelers, three-wheelers, and passenger cars, with higher budgetary provision for improving the public transport. Low carbon vehicle technologies need to be identified for long-distance bus operations as well as for the truck and freight industry. It is very important to increase the share of railways in both passenger and freight segments to bring down carbon emissions at the national level. The need of the hour is to revisit and reframe railway policies and operations.

Low carbon transport must be equitable and available to all, not just private vehicle owners. Thus, there is a need to focus on public transport. A common fund for investment in low carbon transport infrastructure can be set up. Decarbonization strategies may include electrification of road vehicles, long-term hydrogen-based fuel cells, increased usage of CNG/LNG and biofuels, enhanced fuel efficiency, and increase in market share of railways particularly in hard-to-abate freight transport.

Ways Forward

The Charter, beyond its space as a knowledge document, is also a medium to help translate principles and ambitions into much needed actions. It builds its messages with an understanding that only global-level climate deliberations can take us so far and that actual, on-ground climate action requires efforts at national and sub-national levels. By analysing and exploring the themes of equity, green finance, adaptation and resilience, nature-based solutions, energy, clean transport, and business action in the Indian context, the Charter highlights the need for cross-sectoral climate action and emphasizes moving beyond rigid silos of unidimensional action to tackle climate change. In the process, it also offers a way forward for the global community for and beyond COP26.

COP26 is said to be our last chance to agree on the ambition level to realize the goals of the Paris Agreement. However, these discussions would need to continue through other future COPs. Through the messages of the COP26 Charter of Action, we hope that TERI can contribute to meaningful deliberations on substantial actions among key stakeholders including the youth for COP26 and beyond. We stand at a critical moment in the history not only of global-level climate negotiations but also of the planet. Every action now will determine the fate of humanity.

Introduction

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Shailly Kedia | Nivedita Cholayil
Shreyas Joshi | Anuradha Mathur

Reviewer

Manjeev Singh Puri

Chapter 1 THE IMPERATIVE OF AMBITIOUS CLIMATE ACTIONS FOR AN EQUITABLE FUTURE

Abstract

Global negotiations and actions are critical for climate change, but their role must be strongly underscored with climate action at the national and sub-national levels and in business and industry. It is essential that climate action is also understood in both sectoral and cross-sectoral terms including in areas of finance as well as science, technology, and innovation. It is with this rationale that The Energy and Resources Institute (TERI) has prepared a knowledge document titled the 'COP26 Charter of Actions' as an effort to rally for an equitable and ambitious global climate agenda. The Charter examines the themes of equity, green finance, adaptation and resilience, nature-based solutions, energy, clean transport, and business actions in the context of India and in the process distils messages for the global community for COP26 and beyond.

1.1 MESSAGE FROM SCIENCE

The message from climate science is clear. Unless both immediate and ambitious climate actions to reduce greenhouse gas emissions are taken, the earth's temperature is set to rise to about 2.7 degrees Celsius by the end of the century. This clearly is beyond the goal of the Paris Agreement. Moreover, for limiting global warming to 1.5°C, a carbon budget of only 300 $GtCO_2$ is remaining (IPCC, 2021).[1] This will run out before 2030, assuming a global annual emission of 40 $GtCO_2$. Figure 1.1 clearly shows that, at the current emission levels, the carbon budget left for limiting the temperature to 1.5°C will run out in 7.5–12.5 years. This is considering 83%, 67%, and 50% likelihood of achieving the temperature goal as depicted in Figure 1.1.

Pledges for emission reductions by countries are specified in the nationally determined contributions (NDCs). The Paris Agreement, through Article 4, paragraph 2, requires each Party to outline and communicate their post-2020 climate actions through NDCs. According to United Nations Framework Convention on Climate Change (UNFCCC), the available NDCs of all 191 Parties taken

1 The IPCC Fifth Assessment Report and the Special Report on Global Warming of 1.5°C and the recently released Sixth Assessment Report use the reference period of 1850–1900 to represent the pre-industrial temperature. This is the earliest period with near-global observations.

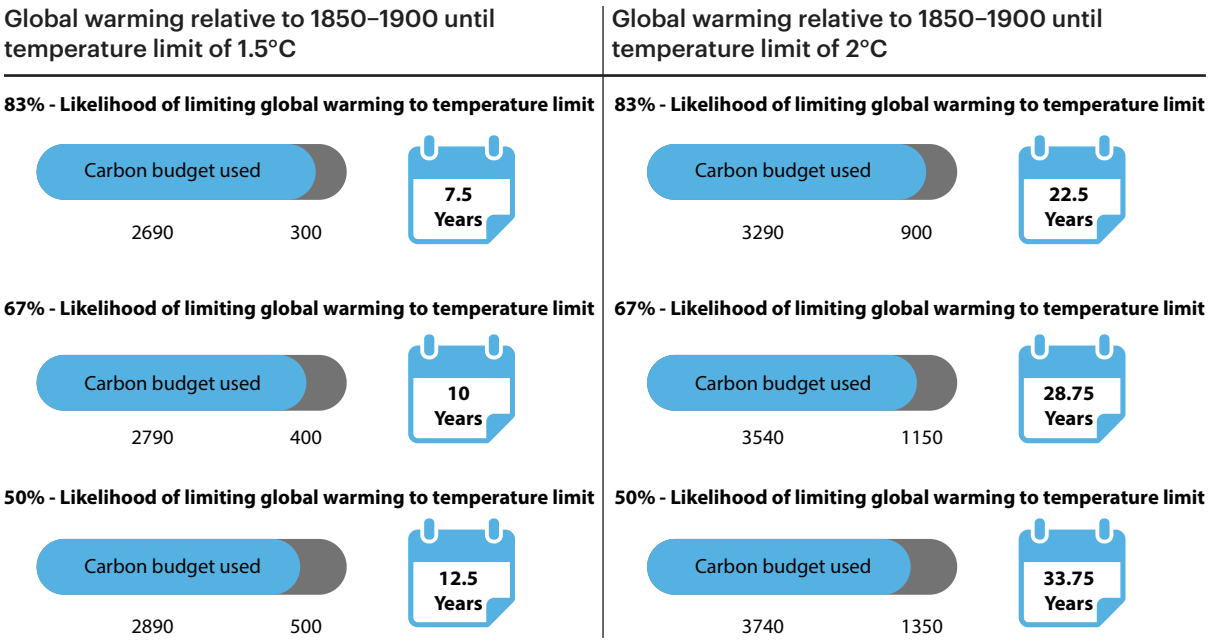

Figure 1.1: Estimated remaining carbon budgets and time from the beginning of 2020 ($GtCO_2$)
Note: The calculation for exhausting climate budget assumes global annual emissions of 40 $GtCO_2$.
Source: Based on data from IPCC (2021)

together will result in a 16% increase in global GHG emissions in 2030 compared to 2010. Limiting the global average temperature increase to 2 degrees Celsius requires a 25% reduction by 2030; 1.5 degrees requires a reduction of CO_2 emissions of 45% by 2030 compared to 2010 levels.

Even with the revised NDCs of 113 Parties and 'net zero' commitments of 70 countries, with a few being hard ones and others mostly aspirational articulation, estimates of emissions reductions are only about 26% by 2030 compared to 2010. Article 4.1 of the Paris Agreement states that 'in order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty'. If, at the global level, the world needs to get to net zero by 2050, many countries will have to be net carbon negative as it can be expected that, owing to development needs and energy needs, many developing countries will still be carbon positive by 2050. The global goalpost needs to shift to 'net negative' goals of developed countries and to the goal of climate stabilization. Climate stabilization is needed to minimize the long-term impacts of climate change, which makes countries in the Global South even more climate vulnerable.

1.2 EQUITY AND CLIMATE CHANGE

A fair share of carbon budget is crucial to global effort sharing. Figure 1.2 shows the

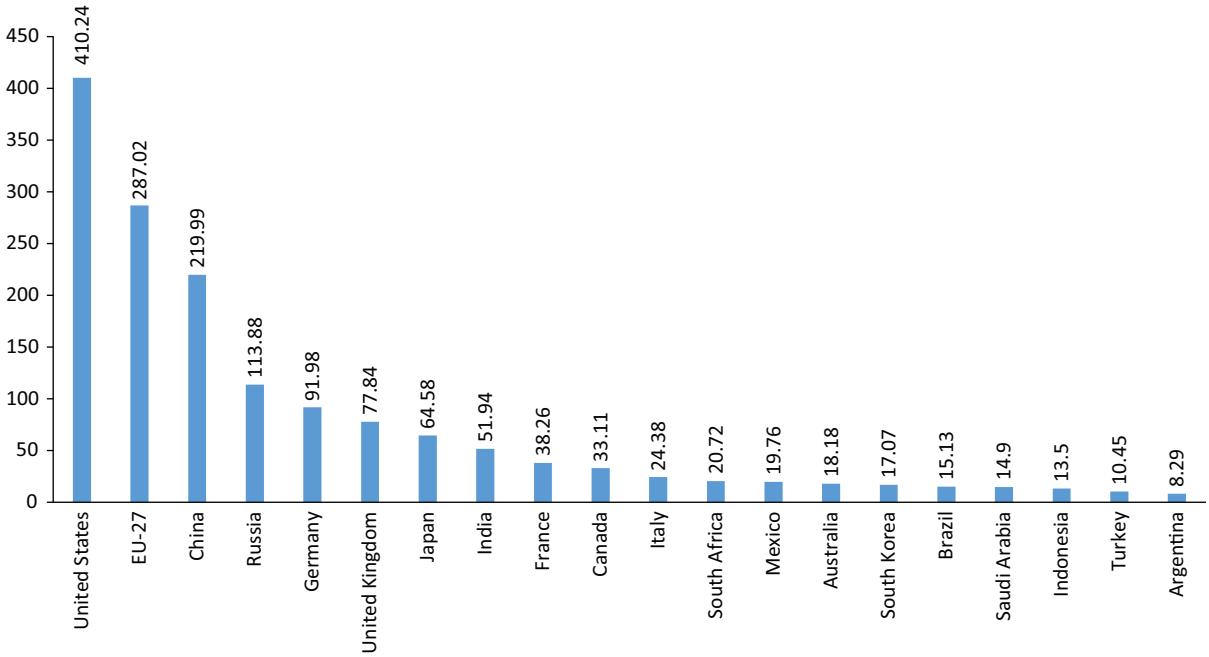

Figure 1.2: Cumulative CO_2 emissions for G20 countries and EU-27 (billion tonnes), 1850–2019

Source: Based on Global Carbon Project (2020)

cumulative CO_2 emissions for G20 countries, including the EU-27, from 1850 to 2019. The cumulative CO_2 emissions are calculated on the basis of emissions produced from fossil fuels and cement.

The total cumulative emissions at the world level are 1.65 trillion tonnes. In terms of cumulative emissions, United States, with 410 Gt, accounts for the highest CO_2 emissions. The EU-27 countries rank second, followed by China, Russia, Germany, United Kingdom, and Japan. Out of the 1650 $GtCO_2$ emitted globally since 1850, United States alone accounts for 25% of the cumulative emissions. EU accounts for 17%, China 13%, Russia 6.9%, UK 4.7%, and Japan 3.9%. India accounts for 3.1% of the cumulative world emissions. G7 countries alone account for 45% of the cumulative CO_2 emissions. Among the G20 countries, India ranks at the eighth position in terms of cumulative CO_2 emissions.

The highest per capita emitters among the G20 countries include Saudi Arabia, Australia, and United States in 2019 (Figure 1.3). United States has per capita emissions of 16.1 tonnes, which is more than thrice the world average. At 1.9 tonnes, India's per capita emissions are less than half the world average and the lowest among G20 countries.

Figure 1.4 shows the annual CO_2 emissions in billion tonnes for 2019. China has the highest annual CO_2 emissions, followed by United States, EU-27, and India. In 2006, China overtook United States in terms of absolute CO_2 emissions. The high absolute emissions for China are also on account of the fact that its economy is heavily reliant on manufacturing. In per capita terms, China's CO_2 emissions are less than half of the per capita emissions of the United States.

Adaptation has to be key for both short-term and long-term climate actions. Article 7.2 of

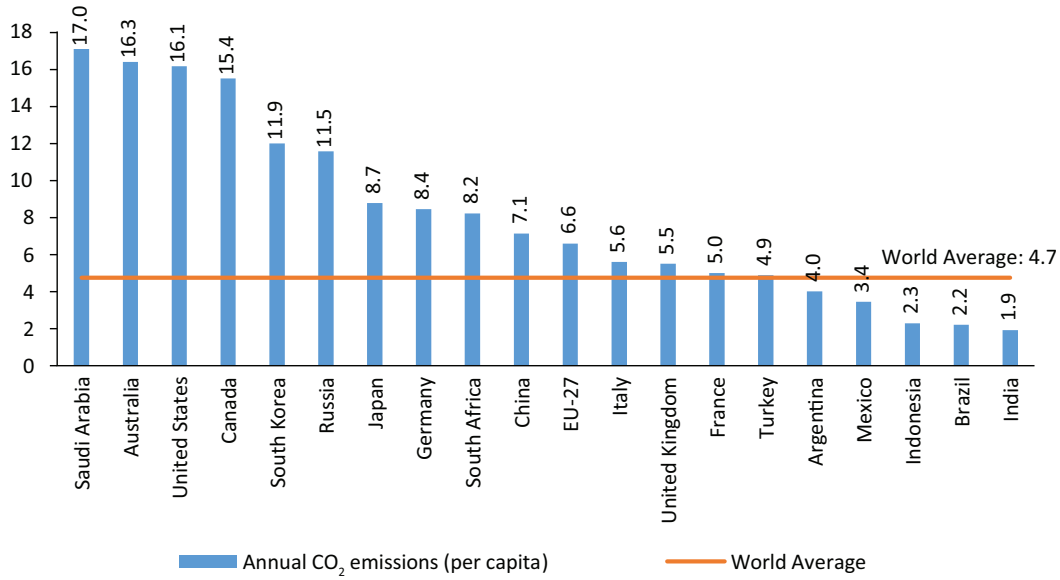

Figure 1.3: Per capita CO_2 emissions for G20 countries and EU-27 (tonnes per person), 2019

Source: Based on Global Carbon Project (2020)

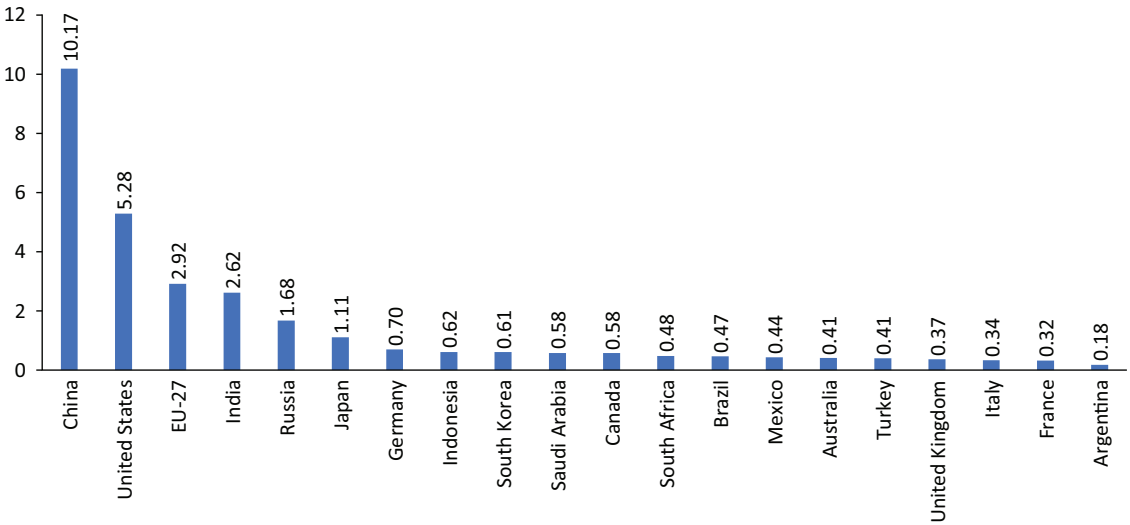

Figure 1.4: Annual CO_2 emissions for G20 countries and EU-27 (billion tonnes), 2019

Source: Based on Global Carbon Project (2020)

the Paris Climate Agreement recognizes the role of adaptation as being key to long-term global response to climate change. However, long-term strategies to be formulated and communicated under Article 4.19 of the Paris Agreement at the moment focuses only on low greenhouse gas emission development strategies and do not consider adaptation. Long-term strategies (LTS) for climate actions need to consider both mitigation and adaptation. LTS submissions by most developed countries set a goal of net zero by 2050. This goalpost needs to change.

1.3 EXPECTATIONS FROM COP26 AND BEYOND

The 26th Conference of the Parties (COP26) under the UNFCCC will be held from 1 to 12 November 2021 in Glasgow and will aim to mobilize the action on mitigation, adaptation, and resilience and strengthen the narrative for better alignment with sustainable development goals. The Glasgow Conference is the first meeting of the Conference of the Parties (COP) to UNFCCC since the Paris Agreement took over from the Kyoto Protocol in 2020.

COP26 is also expected to be a first indication as to whether the Paris Agreement can adequately address the issue of climate change. Some key expectations from the COP26 that would be worthwhile to track to gauge the success of COP26 focus on four broad themes:

» **Defining time frames**: Countries are expected to submit their revised NDCs to the Paris Agreement by 2020. These revised NDCs are expected to raise ambition and lay down stricter pathways to bring down emissions. However, one aspect that still needs more clarity is the issue of common time frames, or how long NDCs will last. The current options include 5 years, 10 years, 5 + 5 years (5-year NDCs, with 'indicative' NDCs submitted as well, among other interpretations), and different time frames for developed and developing countries. This matter is expected to be resolved in Glasgow and is a part of the Paris Rulebook.

» **Internationally transferable mitigation outcomes:** As part of the 'Paris Rulebook', one key aspect that needs clarity will be finding a common ground on Article 6 – a set of three issues that governs the trade in internationally transferable mitigation outcomes, a new market mechanism, and a framework for non-market-based approaches.

» **Climate finance:** Ten years ago, developed countries pledged to provide or mobilize USD 100 billion per year by 2020. The promise remains unfilled. According to the agenda for COP26, the Standing Committee on Finance would publish its fourth biennial assessment and overview of climate finance flows for discussion at the COP and present its assessment of the needs of developing country parties to implement the Convention and the Paris Agreement. This is an important effort and the first time such an assessment has been carried out under the UNFCCC.

» **Adaptation**: In 2019, the African Group requested a new agenda item on the Global Goal on Adaptation, which is enshrined in the Article 7, Paragraph 1 of Paris Agreement. For COP26, the expectations will be around the concrete outcomes for achieving this Goal.

Another agenda item that deserves due importance is the agenda item and proposals on modification of provisions of Article 4 and

provisions concerning the Annex 1 and Annex 2 countries as mentioned in UNFCCC.

1.4 COP26 CHARTER OF ACTIONS

Global deliberations are important, but the real arena for climate action is at the national and sub-national levels and also in business and industry. It is essential that climate action be understood in both sectoral and cross-sectoral terms, including in areas of finance as well as science, technology, and innovation. It is with this rationale that TERI is preparing a knowledge document titled the 'COP26 Charter of Actions' as an effort to rally for an equitable and ambitious global climate agenda. Through consultations and descriptive research, the Charter examines the themes of equity, green finance, adaptation and resilience, nature-based solutions, energy, clean transport, and business actions in the context of India and in the process distils messages for the global community for COP26 and beyond. Figure 1.5 presents the research framework for the study.

There is a need to address the developmental deficit in developing countries while simultaneously taking measures to limit global warming as agreed in the UNFCCC and the Paris Climate Change Agreement. The COP26 Charter of Actions is a knowledge document prepared by TERI. It assimilates questions and thematic options that can advance climate action and ambition in the country and globally. Issues emanating from the COP26 discussions and the Charter would culminate in a review at a plenary session at the World Sustainable Development Summit 2022, which would assess the efforts of international climate negotiations in securing a sustainable future and deliberate on future actions. It a sincere belief that this document will contribute to a meaningful discussion involving all societal stakeholders, including governments, intergovernmental bodies, civil society, research and academia, and also the youth, our future generation. The Charter activities are supported by the British High Commission, Bloomberg Philanthropies, Shakti Sustainable Energy Foundation, Tata Cleantech Capital, and Rockefeller Foundation.

Figure 1.5: Research framework for the study

Source: Compiled by research team

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Equity and Climate Justice

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Chapter 2 IMPLICATIONS OF EQUITY AND CLIMATE JUSTICE FOR INDIA'S LEADERSHIP AND THE GLOBAL FRAMEWORK

Abstract

Equity and common but differentiated responsibilities (CBDR) and respective capabilities are basic organizing principles under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement on climate change. Despite this, the dominant narrative on the issue of effort sharing is solely in the context of greenhouse gas emissions reductions and mitigation efforts by countries with little consideration of these principles. Major approaches to equity and climate justice consider historical responsibility, utilitarianism, grandfathering, contraction and convergence, economic efficiency, and greenhouse development rights. It is imperative that the progress made by countries is assessed in light of the principles of equity well before the global stocktake in 2023. From a developing country perspective, equity needs to also consider adaptation, climate finance, and technology transfer. The chapter identifies leadership for India in areas related to domestic actions and fostering international cooperation by strengthening shared understanding in areas such as adaptation, long-term strategies, just transitions, sustainable consumption, and non-anthropocentric approaches to equity.

2.1 INTRODUCTION

The terms 'equity' and 'justice' are often held to be interchangeable. This perceived identity arises from a fundamental notion of justice as 'equality' and equity as 'equality in terms of opportunities' and that one cannot treat different persons differently on account of irrelevant distinctions between them, such as gender, race, religion, age, or the fact that they live in different countries or in different generations.

Equity is the organizing concept in Principle 1 of Article 3 of the United Nations Framework Convention on Climate Change (UNFCCC) (UN, 1992) with common but differentiated responsibilities (CBDR) and respective capabilities also being noted as fundamental to the Convention. The Paris Agreement, which obliges all nations to take actions in accordance with their national circumstances, is premised on these principles (UN, 2015), and so all actions under the Agreement must be tested against the principles of equity and CBDR and respective capabilities. The differentiation aspect includes the notion of historical responsibilities and polluter pays principle.

The equity argument is based on three premises of (i) differentiated responsibilities considering the root problems of excessive emissions leading to climate change, (ii) bearing of full incremental costs by developed countries, and (iii) socio-economic development and poverty reduction as being overriding priorities of the developing country Parties. Every human being has an equal right to the atmospheric resource and per capita entitlement should be the basis for international climate actions (Dasgupta, 2012, p. 64). The other basis of equity is based on the premise that climate change itself has been due to excessive emissions of developed countries and therefore developed countries should reduce their greenhouse gas emissions and also shoulder the costs of international response measures.

The two conventional framings of equity in climate change are accordingly (i) intergenerational equity – how does humanity ensure a 'fair' division of the carbon resource across members of different generations – and (ii) intra-generational equity – the 'fair' sharing of carbon space across different societies (countries) within a given generation. The initial normative discussions on climate change focused on historical greenhouse gas (GHG) emissions of developed countries and domestic mitigation efforts by developed countries. Over time, climate governance has started focussing itself on future emissions of developing countries and also international mechanisms such as global stocktake and market mechanisms.

Access to affordable and reliable energy is a necessary condition for economic growth and the attainment of human well-being. Given that anthropogenic GHG emissions are mainly the result of fossil fuel usage, a limitation on GHG emissions imposed (or self-imposed) on an economy accordingly implies a binding constraint on both affordable energy use and economic activity. Of course, this argument is valid only so long as GHG-free energy technologies do not reach the level of costs and reliability currently featured by fossils.

2.2 APPROACHES TO EQUITY AND CLIMATE JUSTICE

2.2.1 Historical responsibility

It is undeniable that the problem of climate change is very largely due to emissions of GHGs by currently developed countries in the course of their industrial revolution, based on fossil fuels, which gained rapid pace since the 1850s. The preamble to the UNFCCC accordingly recognizes that the largest share of historical global emissions of GHGs occurred in developed countries. However, attempts are being made to turn historical responsibility on its head and consider the regions that may have the larger share of 'future' emissions. The question of historical responsibility is also deeply intertwined with that of intergenerational equity.

2.2.2 Utilitarian approaches

The philosophical approach of 'utilitarianism' evaluates alternative policies in terms of their net impacts on utility over all members of society. These costs and benefits may occur at different points in time. To bring these flows occurring at different times to a common measure, typically one *discounts* the costs and benefits at each point in time by a *discount rate* to arrive at the present value, called *social discount rate*. There are, however, several issues with such cost–benefit analysis. One is the scale of impacts of the proposed course of action being evaluated leaves the world fundamentally unchanged. That is,

first, not only relative prices of commodities and factors of production (land, labour, capital) remain much the same, but also the action does not result in vast impacts on income distributions, preferences, or market structures. Second, the range of outcomes has well-defined probabilities, meaning that if, for example, one is evaluating a project of building a highway, one may assign probabilities to different levels of traffic flows over a foreseeable, but significant time period. Third, in the timescales involved, perhaps up to 15 years, one may consider how the *present* generation discounts *its* future against *present* consumption (or income) flows. Also, in the intergenerational context, there may be several uncertainties involved considering the huge impacts due to climate change or increasing sophistication and adoption of breakthrough technologies such as large-scale geoengineering.

2.2.3 Grandfathering approaches

Grandfathering is usually considered a transitional arrangement until the world realizes a fairer state of affairs. In the context of climate change, grandfathering implies that prior emissions increase future emission entitlements (Knight, 2013). Developed countries have never offered any ethical justification for grandfathering and avoid using the term. However, a realist justification of grandfathering may concede that although we might prefer otherwise, international climate change treaties need to take account of grandfathering, as otherwise no agreement would be possible. Accordingly, in order to avoid greater injustice, developing countries should live with this injustice, The 'Kind Grandfather' Model as implicitly advocated by Stern (2015) calls for resource and technology flows from rich to poor countries, but not explicitly premised on equity. Their nature and extent would depend upon the priorities of rich country policymakers. The emissions of developed countries would decrease in line with the technological and financing possibilities that retain their standards of living.

2.2.4 Contraction and convergence

The approach of 'contraction and convergence' (C&C) by Meyer (2000) accepts the principle of equal per capita GHG entitlements to carbon space. The equal per capita principle had, however, been anticipated by many analysts (Fujii 1990; Agarwal and Narain, 1991). Ghosh (1993, 2013) provided a formal defence of the principle, showing that it is consistent with major equity norms. Emissions of poor countries could grow, while emissions of developed countries would contract. In the interim countries could trade on the basis of the respective differences from their allocations. This would give a flow of income to developing countries. In due course countries would 'converge' at a sustainable level of emissions. The C&C formulation does not take *historical responsibility* into account.

2.2.5 Economic efficiency approach

Several studies have revealed that the marginal abatement costs of GHG emissions are lower in developing countries and economies in transition, which do not employ the latest advanced energy technologies, than in developed countries that do. In response to the chaotic distribution of abatement costs and/or mitigation responsibilities across countries, proponents of the efficiency principle reply that it does not follow that each country would pay for its full mitigation costs. This principle would then have to be supplemented by sharing the costs of mitigation by countries. Such sharing may be accomplished by financial transfers across countries or by allocations of carbon entitlements to countries from which they may trade to accomplish global economic efficiency.

Although economic efficiency is certainly desirable in climate change mitigation, it is an incomplete principle of equity.

2.2.6 Greenhouse development rights

Greenhouse development rights (GDR) essentially presents a framework for fair allocation of global efforts to be made by various countries to close the 'mitigation gap' between business-as-usual emissions trajectory and the required pathway for stabilizing climate (SEI, 2008). In an operational sense, GDR suggests that countries with relatively high capacity and responsibility should contribute more to future efforts at emissions reduction by providing financial and technological support to countries having the potential to mitigate at lower abatement cost. Countries with relatively low capacity and responsibility can be provided international support to undertake mitigation in excess of their own fair shares of the global mitigation effort. The difficulty with the approach is that it does not address the problem of historical or cumulative emissions effectively and permits the developed countries to maintain the status quo in terms of emissions, while expecting the developing countries to contribute to the mitigation gap.

2.3 IMPLICATIONS FOR GLOBAL STOCKTAKE UNDER THE PARIS AGREEMENT

Countries have submitted their nationally determined contributions (NDCs) in compliance of their obligations under the Paris Agreement. They have also agreed for international scrutiny of their actions under the agreed rules of transparency. The NDCs have been submitted in various time frames commencing from 2021 and ending in 2025 or 2030. These NDCs were announced and pledged in 2015 or 2016 immediately after the signing and ratification of the Paris Agreement. As per the Agreement, countries have to revisit, enhance, or update their NDCs in 2020[1] either in the same time frame or extended time frame. The first global stocktake of the impact of NDCs on the state of climate action will be undertaken in 2023 on the basis of various inputs and information gathered from multiple sources.

In the meantime, the science of climate change as reflected in the internationally agreed and published reports of the Intergovernmental Panel on Climate Change (IPCC) has stressed that the global community must enhance its actions and achieve higher degree of emissions reduction in a shorter time frame if further disasters are to be avoided and the climate is to be stabilized at 1.5 degrees or even at 2 degrees early. The midterm assessment of efforts made by countries that are signatories to Paris Agreement reveals inadequate performance by most major developed countries. The report on NDC synthesis prepared and published by the UNFCCC Secretariat establishes that the total impact of all NDCs submitted by countries will help reduce the global emissions only by 0.5% by 2030 compared to the 2010 level.

The 1.5 degrees Celsius Special Report of IPCC and the Emissions Gap Report 2020 stress the inadequacy of actions by those that are expected to lead. Given this background, the year 2021 presents an opportunity for the signatories to Paris Agreement to raise their ambition in respect of the global goal in a manner that satisfies the principle of equity

1 This means 2021 now as the COP at Glasgow scheduled in 2020 was postponed to 2021 because of COVID.

and CBDR and is in accordance with their responsibility, capability, and their national circumstances. This makes it imperative that the progress made by countries in implementing their NDCs or the adequacy of their actions is judged and assessed in light of the principles of equity and CBDR well before the global stocktake.

2.3.1 Key approaches on equity and effort sharing

There is a need therefore to define a standard methodology that duly identifies achievers and laggards according to the fair share in the efforts to limit global temperature by 2 or 1.5 degrees. However, elucidation of the notion of 'fairness' depends on the interest of various parties, and attempts have been made in recent times to relate it not only to historical responsibility or fair share in available carbon space and capability but also to equality. Most of the developed nations that have already peaked appear to hold a view that equity can be achieved by simply setting targets on the basis of constant emissions ratio, whereas the emerging economies stick to the interpretation of equity in relation to effort sharing on the basis of equal cumulative per capita, holding a dynamic interpretation of CBDR-RC (common but differentiated responsibilities and respective capabilities). The Fifth Assessment Report of the IPCC underscores that in the absence of effort-sharing frameworks, cost-effectively allocating emissions across countries would yield an uneven distribution of mitigation costs (Clarke et al., 2014).

A growing body of work has attempted to propose effort-sharing approaches. Some scholars primarily advocate for differential effort-sharing approaches based on capability, equal per capita approach, greenhouse development rights, equal cumulative per capita, and constant emissions ratio (du Pont et al., 2017; du Pont and Meinshausen, 2018). These approaches downplay the historical responsibility of high emitting nations.

The Germanwatch, NewClimate Institute, and Climate Action Network prepare a Climate Change Performance Index (CCPI) for 57 countries and the EU to provide an overview of the current efforts and progress of the countries analysed (CCPI, 2021). The index is based on actions in the areas of greenhouse gas emissions (40%), renewable energy (20%), energy use (20%), and climate policy (domestic policy 10% and international policy 10%). The composition of weighting 14 indicators across these four areas is used to define the overall performance of the countries. However, the index does not distinguish between the countries according to their capability or responsibility. In ranking countries according to their potential and policy actions only, it fails to take into account their vulnerability, need, risk, and technological and resource constraints. The identification of the potential sectors for emissions reductions also is problematic as these actions dynamically change over short term in different countries.

Climate Action Tracker (CAT) has adopted a slightly different approach and made assessment of the efforts of major countries keeping in view some of the equity in the wake of recent developments and the Paris Agreement. Indicators used by the updated CAT methodology include: policies and action, domestic and internationally supported targets, fair share targets, climate finance, net-zero targets, and land use and forestry (CAT, 2021). Based on its methodology, it categorizes efforts of countries as insufficient, 2 degrees compatible, and 1.5 degrees compatible. Unlike the CCPI, the CAT methodology does

not rank the countries, but it groups them in the categories on the basis of climate action implicit in NDCs, creating a heterogeneous understanding of laggards and achievers. The quantitative assessments of CAT focus more on mitigation efforts and less on adaptation aspects such as loss and damage and support received, which are critical in such assessments.

2.3.2 Need for an alternative approach to stocktake through equity considerations

The dominant framing of equitable effort sharing in climate change between human societies has been to try and stipulate the appropriate norms for sharing of carbon space across countries at each point in time. However, the question of equity in climate change may be framed much more broadly, including the question of ex situ adaptation to (or compensation for) climate change impacts, and response measures include, in addition to in situ adaptation, the issue of migration when habitats are no longer habitable owing to climate change.

None of the existing approaches fully capture the sense of fairness or justice that is critical to establish equity in effort sharing considering adaptation, mitigation, finance, and technology. In the run up to COP 26 and beyond, there is a need for the signatories to the Paris Agreement to agree on establishing a framework for measuring the efforts based on the principles of equity. An alternative approach for measuring equity or fair share in global efforts could be based on a composite index consisting of indicators (with equal weights) that measure progress of each country in respect of mitigation, adaptation, and mobilizing/providing finance in support of global climate actions.

The terrain of equity from a developing country perspective needs to be framed more comprehensively than GHG mitigation and would need to consider aspects related to securing the interest (and involvement) of future generations, obligations of Parties in relation to GHG mitigation, obligations of Parties in relation to adaptation to impacts of climate change, obligations of Parties with respect to loss of livelihoods owing to GHG mitigation actions by others, and obligations and entitlements of Parties with respect to transfer of finances and technology.

Adaptation Although documenting adaptation is a crucial part of the global stocktake review process, the development of an appropriate metric for assessment in this regard is yet to be made. According to the Adaptation Committee (AC), there is no universally approved methodology or a single universal metric or evaluation criteria for adaptation interventions. Some approaches suggest that multiple criteria should be applied to identify adaptation interventions. Given the uncertainties and lack of consensus, an optimal methodology in this regard should include risk and vulnerability assessment of countries.

Mitigation There is no single means of assessing progress or ranking countries on the basis of the fair share of their mitigation action under the UNFCCC. Wide differences in the (i) the years of start of mitigation efforts, (ii) criteria and methodologies adopted by countries to measure the effort, and (iii) different metrics for the criteria make the comparison and ranking a difficult task. Moreover, the emissions data captured for reporting are obsolete. Transparency reporting under Article 13 of the Paris Agreement is not a true measure of equity or fairness in this sense. The measurement of mitigation efforts

should be based on understanding of the drivers, barriers, and challenges governing the transition of a nation's economy to low carbon development. This would require establishing the list of indicators and baseline for all countries that can eventually be the basis for comparing the progress and needs of various countries.

Finance Measuring flow of concessional finance inclusive of the financial flows consistent with the USD 100 billion goal at the global level could be a possible measure. The total annual investments and financial flows in the new and additional activities from the sources need to be captured to assess the progress on mobilization or provision of finance. The progress could be measured in terms of the level of emissions and the damage averted. To ensure the robustness of the measure, accurate and coherent information is needed so that the need for financial assistance required by developing countries and deployment of finance could be assessed in relation to the global goal.

2.4 PATH DEPENDENCY AND COUNTRY CIRCUMSTANCES

Countries do not start from a *tabula rasa* or clean slate when it comes to policymaking, including undertaking GHG mitigation. Economic and agricultural landscapes have developed based on comparative advantage, which in turn have derived in part from endowments such as climatic factors, biophysical conditions, mineral deposits, energy sources, and geographical advantages. To what extent are the economic, technological, and social histories of countries a relevant factor in assigning climate change responsibilities? Three aspects having implications for early or delayed climate action are important. All these aspects are based on the need for a period of 'forbearance' and the need to consider country circumstances.

First is the question of fossil fuel endowments in certain countries and resulting dependence of economic activities. A global regime of climate change may have to consider these response measures, which may take the form of a period of forbearance from rapid implementation of GHG mitigation responsibilities by developed countries.

Second is the question of industrial and infrastructural legacies. These are also referred as 'carbon lock-in' effect and prevent or delay the adoption of low carbon or carbon negative measures. For example, already industrialized countries may face severe economic losses from premature retirement of industrial plant and carbon-intensive infrastructure. Accordingly, it is argued that countries with legacy stock may have a period of forbearance so that losses from premature retirement of plant and building may be avoided.

Third is the question of differences in consumption patterns across countries that depend both upon differences in per capita incomes and specific endowments of the countries – agricultural production (leading to greater or lesser dependence on food of animal origin), climate (leading to higher heating or cooling requirements), settlement patterns (e.g., the automobile dependent central business district – suburb – segregated land use pattern). These have evolved over time without the foresight of GHG emissions reduction related implications. Once again the argument is for a period of forbearance from GHG mitigation responsibilities.

Clearly, there is some merit in each of these arguments. National circumstances of

countries differ widely. On the converse, it is clear that these vast divergences cannot be individually taken care of in any global regime based on easily comprehensible and plausible principles. Further, forbearance to any group of countries will mean that the responsibilities of others for climate stabilization will correspondingly increase, which would be strongly resisted.

What could be a way out of this dilemma? A possible approach could include GHG emissions assignments of countries based on country-level carbon budgets, determined on the basis of a consensually accepted equity norm, till the end date for climate stabilization, rather than a rigid prescription of an emissions pathway defined at each point in time. This would enable each country to work out its actual emissions pathway given its specific circumstances to enable its economy and social structures to adjust to a low carbon future while remaining within its assigned carbon budget.

At present, through the process of NDCs, countries have submitted individual plans but without nationally determined and internationally agreed carbon budget for individual countries. The guiding factors for global deliberations are temperature-related targets and not country-level disaggregated carbon budget targets.

For long-term strategies, it is essential to consider path dependencies along with evolution of governance systems in countries that are responsive to faster transitions of economic and technological systems along with better social connectivity and participation at all levels. Science, technology, and innovation systems will have to be central to long-term strategies, especially when targeting climate stabilization as a long-term goal.

2.5 INDIA'S LEADERSHIP THROUGH DOMESTIC CLIMATE ACTIONS

2.5.1 Policy imperatives

In India's case, the official data of the government reveal that India's total emissions (excluding LULUCF) are still at 2839 Mt of carbon dioxide equivalent and including LULUCF amounted to 2531 Mt of carbon dioxide equivalent (MoEFCC, 2021). As per the data provided by Climate Watch, India makes up 7.8% of global emissions (i.e., 3366.1 Mt of carbon dioxide equivalent)[2]. Per capita emissions of India are considerably low (at 2.47 tCO_2 tonnes of carbon dioxide equivalent) compared to the global average of 6.45 tCO_2 (Climatewatch, 2021). India's per capita emissions are 7 times lower than that of the United States, 3.4 times lower than that of China's, and 3 times lower than the EU (ibid.). India's emissions remain far behind the United States and China (two of the largest emitters) in terms of both total and per capita emissions. Significantly, India's emissions growth has been averaging 3–4% per annum despite the increasing rate of growth of its economy ranging 5–8% in recent years. This indicates increased efficiency in the use of energy resources and decoupling of emissions growth from economic growth.

India is one of the most vulnerable countries in the world and ranks 14 on the Climate Risk Index 2020 released by Germanwatch (Eckstein, Künzel, Schäfer, & Winges, 2018). Given the geographical and climatic diversity, the country is prone to all major natural disasters. The National Institute of Disaster Management (NIDM) notes that

2 The variation is largely ascribable to the difference in the gross or net emissions figures as also the conversion factors adopted by estimating agencies.

about 58.6% of the country's landmass is prone to earthquakes; over 12% (40 million hectares) of land is prone to flooding; of the 7516 km long coastline, close to 5700 km is prone to cyclones and tsunamis; and 68% of cultivable land is prone to droughts. Krishnan et al. (2020) gives evidence of the changing precipitation pattern, increasing sea surface temperature of the Indian Ocean, rising sea level, increasing droughts, and changes in temperatures of the Hindu Kush Himalaya region. Every year extreme events related to weather lead to loss of life in the thousands and economic losses in the billions. Over the last decade, the economic losses related to weather extremes have doubled in India (Singh, Rio, Soundarajan, Nath, & Shivaranjani, 2019). In recent times, these risks have only been magnified, leading to an exacerbation of vulnerabilities. As the development of a populous country like India is marked by dependence on climate-sensitive sectors such as agriculture, water, health, infrastructure, natural ecosystems and forestry, and energy, the socio-economic system of the country is highly vulnerable to climate change and its impacts.

Given India's vulnerability to the impacts of climate change and the developmental context of the country, climate action in India has been embedded in the developmental agenda. Mainstreaming climate action into developmental plans has historically been the approach taken by India. This was exemplified in the launch of the National Action Plan on Climate Change (NAPCC) in the year 2008. Eight missions of the NAPCC take a 'co-benefits' approach to promote development while addressing climate change. The NAPCC covers various sectors that are important for the country (energy, environment, water, agriculture, etc.) with emphasis laid on mitigation, adaptation, and building knowledge and capacity. From 2010 onwards, states in India have begun to develop State Action Plans on Climate Change (SAPCCs) along the lines of the NAPCC. The SAPCCs largely address the issues of adaptation through mainstreaming of actions in developmental plans. They also have soft measures in terms of mitigation targets (Pahuja, Pruthi, Raj, Puri, & Sastry, 2020).

2.5.2 Mobilization of climate finance

India's NDC document had initially estimated that India would need around US$2.5 trillion (at 2014–15 prices) for meeting India's climate change actions between 2015 and 2030 (GoI, 2015). The requirement for adaptation actions between 2015 and 2030 in key areas such as agriculture, forestry, fisheries infrastructure, water resources, and ecosystems was estimated at US$206 billion (at 2014–15 prices). The NDC noted that additional investments were needed for strengthening resilience and disaster management.

Ministry of Finance (2020) has reassessed the financial estimates in this regard. The financial requirement for climate action (including energy, adaptation, and forestry sectors) is estimated to be around Rs. 58.68 trillion (approximately USD 787 billion) in 2020 and Rs. 118.685 trillion (approximately USD 1593 billion) in 2030. As per the analysis given in this report, the total finance availability is estimated to stand at Rs. 29.064 trillion (approximately USD 390 billion), with the share of international and domestic finance at Rs. 9.026 trillion (approximately USD 121 billion) and Rs. 20.037 trillion (approximately USD 269 billion), respectively. The report also notes that scheduled commercial banks (SCBs) contribute the lion's share (43.1%) of India's domestic climate finance. As can be observed, the domestic spending on

climate-oriented expenditure is much higher than the finance being made available from international sources (ibid.).

2.5.3 Paris Agreement and NDC performance

India is amongst the leading countries within G20 on track to meet (and exceed) two out of three of its quantified NDC targets by 2030 – reducing emissions intensity of GDP by 33–35% from 2005 levels and achieving 40% non-fossil fuel electric installed capacity in 2030.

As highlighted in India's Third Biennial Update Report to the UNFCCC, India has already reduced emission intensity of its GDP by 24% between 2005 and 2016 (MoEFCC, 2021). As per data as of November 2020, the share of non-fossil sources in the installed capacity of electricity generation in India was 38.18%. India increased its target on renewable energy installation in 2015–16 to175 GW (to be achieved by 2022). This was ratcheted up further to 450 GW by 2030. There has been a five-time increase in the renewable energy capacity targets by 2030 compared to the current levels of installation (ibid.). India's commitment to steadily move towards large-scale renewable energy is evident in its consistent increase in share of power generation capacity from renewables.

The progress achieved by India in respect of its third NDC target involving 2.5–3 $GtCO_2e$ additional carbon sinks is constrained by resources and physical capacity of its forestry systems. However, the progress is positive. As mentioned, in the Third Biennial Update Report, India's forest and tree cover has increased by 1.3 million ha between 2015 and 2019 assessments conducted by the Forest Survey of India. The Indian State of Forest Report (ISFR) 2019 notes that the total carbon stock in forest was estimated at 26,124 $MtCO_2$, showing an increase of 156.2 $MtCO_2$ as compared to the 2017 assessment (MoEFCC, 2021).

Climate action in India is guided by imperatives of sustainable development. The efforts of the country in this direction are expressed in several other government programmes and schemes that contribute to the overall reduction in emissions relative to the GDP but are not captured directly in the form of sectoral targets as part of the NDC or otherwise. Some of the notable policies and schemes that aid India's efforts to address the issue of climate change are as follows:

- **National Biofuel Policy:** This was first introduced in the year 2009 and has since been updated in 2018. This policy is geared towards achieving 'an indicative target of 20% blending of ethanol in petrol and 5% blending of biodiesel in diesel by 2030'. This policy will not only help in enhancing the country's energy security but also help in addressing environmental issues.
- **India Cooling Action Plan**: India is one of the first countries to develop a comprehensive Cooling Action Plan. The plan recognizes that the issue of cooling is cross-sectoral in nature and is an essential part of economic growth. It is required across sectors – residential and commercial buildings, cold chain, refrigeration, transport, and industries. The plan provides an integrated vision towards cooling across sectors encompassing the reduction of cooling demand, refrigerant transition, enhancing energy efficiency, and transitioning to better technology options with a 20-year time horizon.
- **Pradhan Mantri Ujjwala Yojana Scheme**: This was launched with the aim of safeguarding the health of women and the

household from consumption of unhealthy fuels by providing them with clean cooking fuel in the form of LPG. This not only reduces the consumption of unclean fuels, but also helps in addressing respiratory issues caused owing to usage of unhealthy fuels. The scheme has been a resounding success with multiple benefits across the social and environmental spectrum.

» **National Clean Air Programme (NCAP)**: This programme was launched by the Government of India as a long-term, national level strategy to tackle the air pollution problem across the country in a comprehensive manner. This programme has set out a target to achieve 20–30% reduction in particulate matter concentrations by 2024 keeping 2017 as the base year for the comparison of concentration.

» **Perform, Achieve and Trade (PAT) Scheme**: This scheme was launched by the Bureau of Energy Efficiency (BEE) to reduce energy consumption and promote enhanced energy efficiency among specific energy-intensive industries in the country. The first cycle of the PAT Scheme (2012–2015) managed to reduce the energy consumption of more than 400 energy-intensive enterprises (known as designated consumers) by 5.3%, above the initial target of 4.1%. The Scheme is a precursor to a cap-and-trade scheme for the environmental sector in India. It can easily grow into a voluntary carbon trading platform if suitable amendments in the Energy Efficiency Law is made to permit energy efficiency certificates to be converted into CO_2 saving certificates.

» **National Resource Efficiency Policy (NREP)**: The policy envisions a future with environmentally sustainable and equitable economic growth, resource security, healthy environment, and restored ecosystems with rich ecology and biodiversity. The policy is under evolution and has action plans to be implemented by the respective nodal Ministries under the supervision and guidance of a national agency.

2.6 INDIA'S ENTREPRENEURIAL LEADERSHIP IN FOSTERING COOPERATION

Building on its soft power diplomacy, India in recent times has demonstrated entrepreneurial leadership as a co-founder of intergovernmental organisations and coalitions outside the formal negotiating space of UNFCCC (Table 2.1).

India mobilized 'sunshine countries' (countries that lie completely or partly between the Tropic of Cancer and the Tropic of Capricorn) to come together to form the International Solar Alliance (ISA), with the key aim of reducing the dependence on fossil fuels for energy needs (MEA, 2018).

In addition to ISA, India also launched two new initiatives as part of its efforts to work with the international community, namely, Coalition for Disaster Resilient Infrastructure (CDRI) and Leadership Group for Industry Transition (LeadIT). CDRI, which was launched in September 2019, aims to serve as an international platform to generate and exchange knowledge on mitigating the impact of extreme climate events and other disasters by developing resilience in ecological, social, and economic infrastructure through knowledge transfers, technical support, and capacity building.

TABLE 2.1: India's Entrepreneurial Leadership Through New Organizations/Coalitions

Name of organization/ coalition	Niche area (as compared to other IGOs)	Membership	Role in leadership
International Solar Alliance (ISA), founded in 2015	Solar energy, transfer of knowledge and technology with other solar-rich countries	79 countries have signed and ratified 98 countries have signed	Co-founder with France
Coalition for Disaster Resilient Infrastructure (CDRI), founded in 2019	Resilient infrastructure to face climate change induced disasters	21 countries	Founder
Leadership Group for Industry Transition (LeadIT), founded in 2019	It is a coalition of both countries and companies to foster greater collaboration	16 countries and 18 companies	Co-founder with Sweden

CDRI provides India with a dual opportunity: it enables India to advance its geopolitical and economic agendas, particularly in Africa and the Indo-Pacific region, including among the small island developing states, while at the same time providing a means to meet global sustainability and climate change goals. Government of India had approved INR 480 crore (approx. USD 70 million) to fund technical assistance and research projects on an ongoing basis over a period of 5 years from 2019 to 2024 (MoEFCC, 2019).

India also mobilized support from state actors and business leaders through the LeadIT. LeadIT was launched by the governments of Sweden and India at the UN Climate Action Summit in September 2019 and is supported by the World Economic Forum. It provides a platform for public–private collaboration with the government and the private sector in different countries coming together to work on accelerating low carbon growth and cooperation in technology innovation.

2.7 INDIA'S NORMATIVE LEADERSHIP

An intellectual leader relies on the 'power of ideas' to shape the thinking of the principles in processes of institutional bargaining (Jörgensen, 2020; Young, 1991, p. 307). A normative leader exerts influence through ideas and values and not through military or economic factors (Falkner, 2007). India has been providing normative leadership in setting the international climate change agenda and building a shared understanding among key countries since the negotiations leading to the adoption of the UN Framework Convention on Climate Change through the International Negotiating Committee (INC) for Climate Change in 1990. Indian negotiators took a lead in ensuring that the principle of 'equity' should be the touchstone for judging any proposal in international response measures (Dasgupta, 2012, p. 68). At COP15 in Copenhagen in 2009, India played a key role in drafting the Copenhagen Accord with the United States, China, Brazil, and South Africa after wider negotiations failed to produce agreement on the future climate regime. India played a key role in ensuring that UNFCCC, Kyoto Protocol, and Paris Agreement are equity-based treaties.

Even in the submission ahead of the Paris Climate Change agreement, India reemphasized on the cumulative accumulation of greenhouse gases historically

since industrial revolution has resulted in the current problem of global warming (GoI, 2015, p. 2). While accommodating for emission intensity targets, India has continued to argue for climate justice through an equitable carbon and development space to achieve sustainable development for which there is a need for adherence to the principles of equity and CBDR-RC and other provisions under the UNFCCC (UN, 1992, 2015). It can be seen that over time India has shown flexibility in terms of positions that include more than Third World solidarity and multilateralism in favour of a pragmatic approach based on neoliberal globalism, especially when it came to market mechanisms such as the Clean Development Mechanism (CDM) (Stevenson, 2011).

India's arguments on lifestyles have been hinged on per capita consumption of energy and electricity consumption, which as quoted in India's NDCs was barely one-third of the world's average consumption (GoI, 2015, p. 5). In 2011, as cited in India's NDC, India's per capita consumption of energy was only 0.6 tonnes of oil equivalent (toe) per capita as compared to global average of 1.88 toe per capita (GoI, 2015). India also has emphasized that no country in the world has been able to achieve a Human Development Index of 0.9 or more without an annual energy availability of at least 4 toe per capita, implying that the per capita energy consumption for India would grow in future. From a point of view of climate justice, India's arguments have been hinged on the imperative for increasing per capita energy consumption for achieving higher human development.

India's position on climate justice is also based on the offensive strategy of consumerism in developed countries as being one of the reasons for inequities and climate injustice. On sustainable lifestyles, India has emphasized that the extravagant way of life and extravagant patterns of consumerism are grave threats to the environment. Towards the same, India has emphasized that 'habit and attitude' are as much a part of the solution as technology and finance. India's approach to sustainable lifestyles is also based on the plank of projection of cultural practices in India such as 'Yoga', which advocates for a path of moderation and a sustainable lifestyle (GoI, 2015).

In international climate change negotiations, India has made a strong start by positioning itself as a country that believes in sustainable consumption and lifestyles. However, influencing the global normative frameworks in terms of sustainable lifestyles and adaptation needs a 'shared understanding' among countries that can be built only through political and scientific/epistemic convergence. India should take a lead in driving epistemic and discursive processes aimed at engaging on the topic of sustainable consumption. India can strengthen a shared understanding on the role of nature on aspects related to adaptation, mitigation, and climate stabilization.

The present global consensus in relation to natural ecosystems as stated in Article 2 of the Paris Agreement is pursuing efforts to holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels. As a country that has given primacy to 'Mother Earth', India can also ensure that nature remains an integral component to equity considerations in the global climate change discourse.

Ghosh(2013)discussesseveralquestionsaround anthropocentric versus non-anthropocentric framing of equity in climate change. It is important to consider the purported 'rights' (or

at least the protection of the interests) of other living species, ecosystems including non-living natural entities.-

Box 2.1: Principle 1 of the Rio Declaration

Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.

This Principle reflects the anthropocentric basis of international policy consensus on sustainable development. It maintains that while policymaking may focus on human well-being, the conservation of natural entities is an integral part of such well-being.

Box 2.2: Article 2 of the UNFCCC provides another expression of this international policy consensus

The ultimate objective of this Convention and any related legal instruments that the Conference of Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. [emphasis added]

In terms of Sustainable Development Goals (SDGs), SDG 12 does not sufficiently engage itself on aspects linked to consumerism and sustainable consumption as the global indicators largely focus on aggregate material consumption and upstream measures and not focus sufficiently on downstream issues and consumer lifestyles.

There are two aspects to the sustainability of consumption: (i) the absolute level of consumption and (ii) the GHG emissions implicit in a standard unit of consumption. The question of the choice of consumption goods (and their quantities) at a given level of income is typically framed in economics as a matter of consumer sovereignty. A person's level of income is a matter of the level of development of the society and the rents, wages, and interest earned by the person's assets. However, society may determine that consumption choices be amended on both counts in the wider interests of society: intoxicants may be banned, vaccination for contagious disease may be mandatory, and people may be taxed or given subsidies. Social objectives under certain circumstances accepted by political choice may then trump consumer sovereignty. The imperative of climate change mitigation may also, at least in principle, be invoked by the global system as a ground for limiting consumer sovereignty.

India also needs to play a leading role in redefining just transitions. The term 'transition' has gained increasing currency in political parlance amid plans from governments for transitions to a lower carbon future. However, while the etymology of 'Just' translates into equitability, equality, and fairness, we need to look at transition from the overarching lens of climate change adaption and sustainability. Upon closer analysis what we understand is that given the transnational and sectoral impacts of climate change, transitions associated with both adaptation and mitigation need to be 'just' in nature. The complexity within the aspect climate

change is quite severe, and thus focusing on a singular aspect of transition in order to mitigate the impact of climate change seems disingenuous. Considering the implications of the impacts of accumulated GHG emissions in the atmosphere, adaptation is key to just transitions. Adaptation measures can include both in situ and ex situ measures, such as migration, changes in cropping patterns, and large-scale infrastructure changes. As is the case of mitigation related energy transitions, adaptation related transitions need to be just too and need to consider winners and losers.

2.8 WAYS FORWARD

India's leadership in upholding climate justice and the development imperatives of developing countries is key in global climate negotiations and beyond. It is equally imperative that India takes on commitments through upgraded nationally determined contributions and long-term strategies on adaptation and mitigation and announces these measures and projects itself as a global leader.

India's national and international leadership

India is progressing well with its NDC till 2030. Through its parallel actions in several other sectors, India has raised its ambition domestically and is on track to show more positive results in a framework of effective and meaningful international cooperation. India has complemented its efforts on the international scale by launching initiatives such as the Coalition for Disaster Resilient Infrastructure and the International Solar Alliance. India's position as the co-lead of the Industry Transition Leadership Group provides a further momentum for actions in hard-to-abate sectors. India's domestic actions combined with its global initiatives make it a global leader. Its higher renewable energy ambition at the domestic and international levels is expected to contribute to global emission reductions substantially, if sufficiently supported.

Areas where India can play the role as a normative leader

Table 2.2 depicts India's normative stance in present negotiating strategies along with the state of shared understanding through political and epistemic backing. While India has been able to position itself very strongly in terms of strategies where there is political and epistemic convergence, to be able to

TABLE 2.2: Areas Where India Can Strengthen Its Normative Leadership Further

Areas where India has created a strong shared understanding	Areas that need further epistemic backing for strong shared understanding
» Climate justice and right to development	» Sustainable lifestyles, sustainable consumption, and consumerism
» Overriding priorities of developing countries for sustainable development and poverty eradication	» Need to factor adaptation as a measure of global stocktake, long-term strategy, and just transitions
» Common but differentiated responsibilities and respective capabilities	» Non-anthropocentric notions around equity and climate justice so that nature remains an integral component to equity considerations in the global climate change discourse
» Human development and per capita energy consumption	

Source: Compiled by authors

project itself as a norm leader, it is imperative that India leads in constructive processes that lead to a better shared understanding on aspects related to sustainable consumption, adaptation, and non-anthropocentric notions around equity and climate justice.

Strengthening the role of science, technology, and innovation systems for climate stabilization

Science, technology, and innovation systems will have to be central to long-term strategies, especially when targeting climate stabilization as a long-term goal. Through initiatives such as ISA, CDRI, and LeadIT, it is crucial that India strengthens the call for action on strengthening the research and development of new breakthrough technologies that will contribute to the goals of mitigation, adaptation, and climate stabilization.

Redefining 'just transitions'

To ensure climate justice, there is an urgent need for civil society to call for the factoring of climate change adaptation in the present discourse on 'just transitions', which is being dominated by energy transitions and climate change mitigation.

Holistic consideration of ecosystems

Holistic consideration of ecosystems deserves serious attention. As a country that has given primacy to 'Mother Earth', India can also ensure that nature—as is a part of the global consensus as agreed in Principle 1 of the Rio Declaration and Article 2 of the UNFCCC—remains an integral component to equity considerations in the global climate change discourse.

Implications for global stocktake and need for a critical appraisal of existing frameworks

It is imperative that the progress made by countries in implementing their NDCs or the adequacy of their actions is judged and assessed considering the principles of equity and CBDR well before the global stocktake. India has been a norm leader in terms of highlighting the need to consider equity and CBDR-RC.

Role of sustainable consumption

India should play a leadership role in building a shared understanding among countries around sustainable consumption and lifestyle-related implications of climate action. For this, India needs to go beyond positioning itself to being able to articulate climate action in terms of concrete linkages with responsible and sustainable consumption and production and Goal 12 of the SDGs. Presently SDG 12 does not sufficiently engage itself on aspects linked to consumerism and consumption as the global indicators largely focus on aggregate material consumption and not enough on lifestyles and sustainable consumption. This is an area where India can lead the epistemic and discursive processes in the global discourse to build a shared understanding on sustainable consumption.

Long-term strategies and equity

Article 7.2 of the Paris Climate Agreement recognizes the role of adaptation as being key to long-term global response to climate change (UN, 2015). However, long-term strategies to be formulated and communicated under Article 4.19 of the Paris Agreement at the moment, in terms of communication requirements, focuses only on low greenhouse gas emission development strategies and does not consider adaptation. Long-term climate actions need to consider both mitigation and adaptation. Mitigation measures can contribute to climate stabilization, but ecosystem-based approaches can contribute to both mitigation and adaptation. Moreover, even if the world reaches net zero by mid-century, the earth's

inertia will still lead to climate impacts requiring due consideration of adaptation measures (NASA, 2006). India would need to undertake more evidence-based approaches for strengthening the climate justice discourse through a better engagement with climate change adaptation. This is an area where India can play a leadership role to emphasize the need to consider adaptation in long-term strategies.

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Green Finance

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3 Chapter GREEN FINANCE

Abstract

An increasing global push for faster and deeper mitigation and adaptation action needs to be complemented by better mobilization of green finance. Nudging the financial sector towards a more climate inclusive working is being adopted globally, as well as a faster pace in the Indian policy landscape. However, there is still a lag in allowing this transformative change, where key barriers include lack of standardized definition of green finance, weak regulatory framework, and lack of capacity, all feed into slowing the uptake of a low-carbon or green transition. In this context and with mounting green finance requirements, in the implementation phase of the Paris Agreement, there is a need to focus on feasible means of mobilizing finance from across a broad range of stakeholders. From a long-run perspective, by 2050 it is necessary to ensure that the climate and green lens and filter are mainstreamed on a large scale into investment decisions while ensuring equity from international and domestic sources of financing.

3.1 OVERVIEW

A significant part of existing climate commitments and their enhancement are dependent on green finance. The term 'green finance', as accepted by G20, is used as the umbrella term covering climate finance to refer to the international or locally mobilized (national and subnational) financing, from public or private sources, designed to address climate as well as environmental objectives (Aizawa, 2016). The United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, and now the Paris Agreement have all emphasized the role of finance as a critical enabler of climate actions, with financial mechanisms developed for mobilizing financial assistance from developed parties to be directed to developing countries. A significant part of the existing climate commitments and their enhancement are dependent on green finance, which includes the future carbon markets and trading mechanisms, finance instruments such as green bonds and concessional loans, and public budgetary support.

Under the Paris Agreement (UNFCCC, 2015), the role and scope of finance are multifaceted.

- Article 2.1c of the Agreement takes a comprehensive look at finance, as it requires all Parties to develop investment frameworks, along with supportive policies,

to support the alignment of all domestic and international financial flows with a 'low GHG emissions and climate-resilient development' pathway.

- Article 6 highlights mechanisms for mobilizing finance for raising climate ambition through international cooperation and market mechanisms, including carbon market instruments.
- Article 9 stipulates the provision of financial resources from developed countries to developing countries and states that 'such mobilization of climate finance should represent a progression beyond previous efforts' and goes on to emphasize that 'developed country Parties shall provide transparent and consistent information on support for developing country Parties', so that ambitious long-term climate actions can be planned and implemented.

As a measure to facilitate this financing, under the UNFCCC umbrella, there are at present three primary global climate funds, namely, Global Environment Facility (GEF), Green Climate Fund (GCF), and the Adaptation Fund. There have also been a range of international finance mechanisms developed and deployed in the past, especially the mechanisms developed under the Kyoto Protocol (UNFCCC, 1997), such as the Joint Implementation Mechanism, the International Emissions Trading mechanism (IET), and the Clean Development Mechanism (CDM), which have generated key learning and insights into means of accelerating the mobilization of green finance through international cooperation.

Additional international sources of green finance are multilateral development banks (MDBs) and bilateral finance facilities, including their climate funds such as the World Bank's Climate Investment Fund. The MDBs have especially been emphasizing a green lens to an increasing amount of their global investments and funding, setting ambitious targets for themselves. For example, the World Bank Group announced a new Climate Change Action Plan, committing an average of 35% of the Group's total financing for climate over the period 2021–2025 (The World Bank Group, 2021). Similarly, ADB set a climate financing target of USD 80 billion from 2019 to 2030, with at least 75% of this to support climate change and adaptation by 2030 (Sekine, 2021).

Since the Paris Agreement, issues around green finance have been gaining prominence on the G20 platform. This was most notable under China's Presidency of the G20 in 2016, where the Green Finance Study Group (GFSG) was launched to look into options of encouraging private sector participation in green investments. The GFSG predominantly looked at five key issues: greening the banking system, greening the bonds markets, greening institutional investment, risk analysis, and measuring progress (G20, 2021). Germany's G20 Presidency in 2017 emphasized the need to reach a 'global consensus' on addressing sustainability and climate risks in international finance and under Argentina's Presidency in 2018 the GFSG's scope was further widened, to include sustainability co-benefits of income equality and job creation, by establishing the Sustainable Finance Study Group (SFSG).

3.2 GREEN FINANCE IN INDIA

India's financial requirements for its planned climate commitments can be broadly understood based on its Nationally Determined Contribution (NDC) requirements, which were prepared in 2015 for COP21 at Paris. The NDC states the requirement of USD 2.5 trillion at

2014–15 prices (~INR 187 thousand crores) for reaching the climate goal between 2015 and 2030 (or ~USD 170 billion per year). However, an assessment of the total green finance tracked in India for the 2016–2018 period identified the finance flows to be USD 38 billion (INR 248 thousand crores), which is just a little over 20% of the average annual requirements (Sinha, Jain, & Padmanabhi, 2020). The tracked green finance was primarily from domestic sources, with the share of tracked international public green finance being just about 10% for both FY 2017 and FY 2018, with a large majority of it being from MDBs. National public sources of green finance include budgetary allocations, national funds, public sector banks, as well as market mechanisms, combined with fiscal instruments and policy interventions.

Table 3.1 shows the various sources of green finance in India. It should be noted here that commercial finance institutes in India are already a key source of green finance, with 40% of the domestic green finance tracked being sourced through these (Sinha, Jain, & Padmanabhi, 2020). An issue of concern is the observed decline in allocations for India from international climate finance flows. For example, India's allocation in the GEF7 replenishment cycle (2018–2022) was USD 47.24 million, a significant decrease from GEF6 at USD 87.88 million (MoEFCC, 2021). This highlights the major challenge that India faces, that of mobilizing increasing amounts of green finance from its domestic sources – both public and private while trying to leveraging the small slice of international finance as a strategic catalyst for its efforts.

The green finance flows for climate interventions in the past have been almost entirely focused on mitigation actions,

TABLE 3.1: Sources of Green Finance in India

	Sources	Examples
International sources	Special climate funds	» Green Climate Fund, Adaptation Fund, Global Environment Facility (under the UNFCCC) » Climate Investment Fund (outside the UNFCCC)
	Multilateral/bilateral funds	» World Bank, IFC, Asian Development Bank » UN organizations » Bilateral organizations (e.g., KfW, JICA, DFID, AFD)
	Private sector	» Commercial banks » Private equity investors » Multinational companies
Domestic sources	Government programmes	» Budgetary allocations at the national and state levels » Programmes under the NAPCC missions
	National funds	» National Adaptation Fund for Climate Change » National Clean Energy and Environment Fund
	Public banks and non-banking finance companies	» State Bank of India » IREDA, IDFC
	Development finance institutions	» NABARD » SIDBI
	Private sector	» Commercial banks, equity investors » Corporates

Source: Compiled by authors

primarily in the areas of clean energy, energy efficiency, and sustainable transport, with adaptation getting minimal dedicated support from international finance. Most of the support for adaptation actions comes from budgetary allocations under specific sectoral policies. In a country like India, which as per the Global Climate Risk Index 2021 ranked as the seventh most climate affected country with the highest absolute losses in terms of purchasing power parity in 2019, this is a critical gap in the green finance landscape, which leads to the climate vulnerabilities and damage from climate events not being adequately addressed.

India recognizes that its demand for green finance is massive, especially as it looks to build a climate-resilient sustainable economy. To achieve this, India has taken several measures at the domestic level for mobilizing green finance. With evolving capital markets for green finance in the country, green financial solutions are being developed through both debt and equity instruments. Some key channels and instruments being leveraged are as follows:

- Loans and grants are provided by national development finance institutes, such as NABARD and SIDBI, or national funds, such as National Clean Energy and Environment Fund and National Adaptation Fund.
- Green bond in India has seen growth in the past few years, becoming the second largest issuer (after China) among emerging markets (Amundi Asset Management and International Finance Corporation, 2021). The instrument is increasingly being used by different stakeholders, ranging from non-financial private corporates and private banks to public sector backed entities.
- Credit enhancement schemes, such as partial risk guarantee facilities, are being developed for specific green objectives. For example, IREDA's 'Credit Enhancement Guarantee Scheme', which has been developed as a partial credit guarantee instrument for raising bonds by project developers against operationally viable and commissioned renewable energy projects (IREDA, n.d.), the India Solar Generation Guarantee Facility (developed by Asian Development Bank), or the India Infrastructure Finance Corporation Limited (IIFCL) has developed a 'credit enhancement scheme' for funding viable infrastructure projects (Jain, 2020).
- International collaborative initiatives such as the Green Growth Equity Fund, where the UK and the Indian government invest in green infrastructure projects from India's prioritized National Infrastructure Pipeline.
- India is also a founding member of the International Platform on Sustainable Finance (IPSF).

The other approach taken in India is by endeavouring to develop a comprehensive policy framework for supporting climate actions.

3.3 EXISTING POLICY MEASURES IN INDIA TO MOBILIZE GREEN FINANCE

Mobilizing green finance is a systematic process involving multiple stakeholders such as government, financial institutions, and regulatory agencies, and multiple sectors and industries. An analysis shows that industries such as hard-to-abate sectors, energy, and infrastructure, as well as social sectors such as agriculture and water use, are prioritized for green policy-led interventions in India. Climate programmes and initiatives, leveraging specific finance mechanisms and

fiscal instruments, have been developed to complement the existing policy interventions in these sectors to add a green perspective to these. Some key policy instruments are given in Table 3.2.

From a climate interventions perspective, India's National Action Plan on Climate Change (NAPCC), prepared in 2008, is the overarching umbrella under which most of its climate initiatives are framed. The NAPCC's

TABLE 3.2: Types of Policy Instruments and Measures in India

Policy instruments	Sector	Initiative/policy	Green finance advantage
Capital subsidy	Energy/ Renewable Energy	Grid-Connected Rooftop Solar Scheme (Phase-II)	Subsidy available on grid-connected solar system (without battery system)
	Energy/ Agriculture	KUSUM	Providing solar irrigation pumps to farmers at a subsidized rate
	Transport	Faster Adoption and Manufacturing of Hybrid and Electric vehicles (FAME-II)	Sustainable mobility through subsidization of adoption of electric vehicles
Market-based mechanism	Energy/ Renewable Energy	Renewable Energy Certificates (RECs)	A market-based mechanism to promote renewable energy by facilitating compliance of renewable purchase obligation (RPO)
		Perform, Achieve and Trade (PAT) Scheme	A market-based compliance mechanism to accelerate improvements in energy efficiency in energy-intensive industries
	Petroleum and Natural Gas	Ethanol Blended Petrol (EBP) Programme	Promote the use of alternative and environment-friendly fuels and to reduce import dependency for energy requirements
Public procurement	Cross-cutting	Green Room Air Conditioners (Government e-Marketplace (GeM))	Encourages Sustainable Public Procurement in India as a catalyst for market transformation towards sustainable cooling. Also enables move towards circular and green economy
Social insurance	Agriculture	National Agriculture Insurance Scheme	Risk management scheme in the agriculture sector to provide financial help to farmers in the event of crop failure

Source: Adapted from TERI (2021)

eight broad missions, covering both climate adaptation and mitigation perspectives, act as the guiding principles for priority interventions for the different regions of the country (GoI, 2008). Policies, schemes, and actions implemented under the missions have different sources of funding, mostly from the specific ministries or central budget allocations. Under the NAPCC, climate actions at the subnational level were proposed in the form of the State Action Plan on Climate Change (SAPCC), with schemes and programmes designed and centered on sectors essential to the climate profile of the state. Thus, national and subnational governmental programme-based grants are one of the main sources of climate and green finance in the country (Ministry of Finance, 2020).

These policy interventions can be further developed to impact the financial or investment landscape in these sectors, to directly influence the mobilization and flow of green finance. For this, the regulatory landscape, as a driver of green finance can play a critical role. India has gradually been pushing for a philosophy of responsible business and this has been embedded in the National Voluntary Guidelines on Social, Environmental and Economic Responsibilities of Business, which was released in 2011. Further, in 2012, India's regulatory body for the stock exchange, Securities and Exchange Board of India (SEBI), mandated the top 100 listed entities by market capitalization to file Business Responsibility Reports on their social and environmental impacts, and this list has now grown to top 1000 entities to report using the proposed Business Sustainability Reporting Guidelines to be mandated from 2022. Disclosure requirements have also been encouraged through SEBI's 2017 guidelines for green bond issuance. Reserve Bank of India (RBI) has also taken steps to support green finance initiatives by, for example, including the small renewable energy sector under its Priority Sector Lending scheme. RBI also joined the Network for Greening the Financial System (NGFS) in April 2021 to become part of the global network of central banks, sharing their best parties and contributing to mobilizing finance to support a green and sustainable transition of the economy.

As seen in Figure 3.1, over the last decade, there has been an increasing regulatory focus on facilitating and enabling green finance in India.

3.4 SCOPE FOR RAISING AMBITION

Across the world, signals for a fundamental shift towards climate-resilient low-carbon or carbon neutral economic pathways are increasingly becoming evident. Leading global financial sector actors have recognized these and started to take strong proactive steps to align their investments with the principles of sustainable and green finance. Providing reliable information to and by financial institutions is needed to facilitate financing of industry transitions, resilience building, and strengthening the biosphere.

Various multi-stakeholder initiatives aimed at integrating climate change and sustainability goals into the operational priorities of various sectors have been introduced globally for green finance. These include the following:

- UN's Principles for Responsible Banking (PRB) and Principles for Responsible Investment (PRI)
- Network for Greening the Financial System (NGFS)

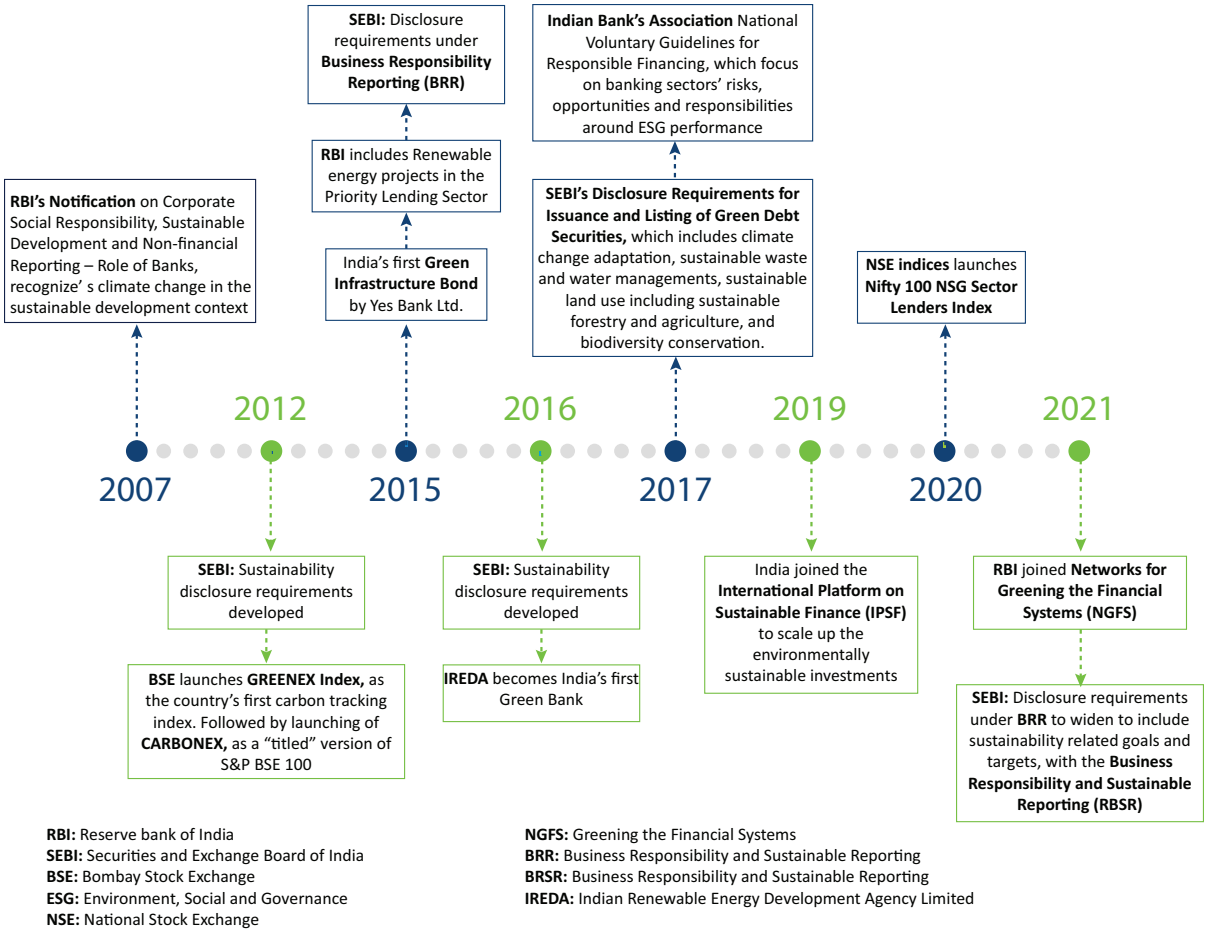

FIGURE 3.1: Regulatory framework and norms for greening the Indian financial sector

Source: Adapted from TERI (2021)

- Task Force on Climate-Related Financial Disclosures (TCFD)
- Sustainable Stock Exchanges Initiative
- Sustainable Banking Network

In recent years, there has been a significant rise in endorsements for these initiatives. For example, in its latest status report, TCFD stated that over 1500 organizations, representing a combined market capitalization of USD 12.6 trillion and around USD 150 trillion in assets, have supported the adoption of their recommendations for integrating climate risk assessments and disclosing these (Financial Stability Board, 2020). In the same vein, the UN reported over 3000 signatories in 2020 for its Principles for Responsible Investment, representing over USD 100 trillion in assets under management (UN PRI, 2020). This trend is also supported in India; however, the Indian financial sector has been slower in progressing towards integrating a climate change perspective in their businesses. Only 47 companies from various sectors such as energy, industrial, and financial are supporting and implementing the disclosure recommendations made by the TFCD (Financial Stability Board, 2021). This also points to the need to broaden the scope of climate finance to 'green finance' and

emphasize including the achievement of SDG-related indicators.

Embedding environmental, social, and governance (ESG) principles as a norm for financing decisions will facilitate ESG alignment with the broader development objectives and facilitate deeper engagement of the private sector in the national climate and sustainability plans. There is a vast scope for leveraging green finance mechanisms, such as green bonds, carbon market instruments, climate funds, and financial technology, to achieve SDG-related co-benefits, which would make it more relevant for a developing nation like India, especially in the context of the pandemic recovery. Financial institutions such as commercial banks play a prominent role in mobilizing investments for financing green projects. Recently, ESG funds are one of the most innovative instruments used in India, which have been shown to manifest impressive returns. Investment in these funds integrates ESG criteria apart from other financial parameters. Although ESG funds are still at a nascent stage in India, about five top rated funds have been launched in the last 2 years.

This apart, stock exchanges act as financial intermediaries in promoting sustainable investments. There is already strong evidence of the role played by stock exchanges in developed economies. Some of the sustainable financing products offered by these exchanges include sustainable indices, ESG bond segments, and ESG listing agreements in addition to providing ESG-related guidance. Some of the financial products offered by stock exchanges in India such as the Bombay Stock Exchange and National Stock Exchange include Greenex, Carbonex, and ESG India Index. These indices consider environmental indicators such as GHG emissions apart from market capitalization and other financial parameters. The performance of these indices acts as a barometer to assess the green performance of listed companies.

With this growing Indian involvement, there is a scope for a transformative change in the Indian economy, led by a green transition of the financial sector and investments by the high-emitting sectors and industries. From a sectoral perspective, environmentally sustainable projects, as understood under the purview of green financing, include renewable energy projects such as solar, wind, and biogas; clean transportation that involves lower greenhouse gas emission; energy-efficient projects like green building; and waste management that includes recycling, efficient disposal, and conversion to energy. Other projects defined as sustainable under the disclosure requirement for Green Debt Securities include climate change adaptation, sustainable waste and water management, and sustainable land use including sustainable forestry and agriculture, and biodiversity conservation. To finance these projects, capital markets play a significant role in generating the funds through the use of various financial instruments such as regulatory instruments, including taxes and subsidies; market-based instruments (MBIs), such as bonds, equity, and green/ESG funds; and official development assistance, such as grants and loans.

There is, however, a need to broaden the scope of green investments, which till now have been largely focused on developing renewable energy capacity, with smaller amounts being directed to sustainable transport, energy efficiency, and climate change adaptation.

The scope for widening the sectoral reach of green investment to other sectors is viable through the green financial instruments

being developed globally. For instance, there is a large scope for green bonds to be issued across a wide range of unconventional investment sectors, such as forestry and marine conservation. But with the limits of traditional bond issuances, it is difficult to finance such climate projects. However, there are several pioneering green finance mechanisms introduced in the last few years, which can be learned from and designed to suit India's needs. An example of this is the first climate resilience bond launched by the EBRD in 2019 worth USD 700 million. The funds are to be directed to fund typically underfunded areas such as climate-resilient infrastructure in the water, energy, transport, and communications sectors; climate-resilient agriculture and ecological systems; and climate-resilient businesses and solutions. Another example is IFC's forest bond, launched in 2016, which allows corporates to offset carbon emission through direct investments in forest conservation at no additional cost of due diligence. Under this, the sale of the carbon credits will be used to provide financing for wildlife conservation, creating sustainable livelihood opportunities and other benefits for local forest-dwelling communities (Swati & Singh, 2018).

Another area that is mostly left unexplored in terms of green finance is that of the circular economy. The circular economy offers innovative mitigation solutions that can significantly enhance the climate ambition of countries (Bardout & Hoogzaad, n.d.). There is a need to build the capacity and understanding of funding agencies, national financial institutions, and policymakers, to assess the enhanced business case of circular business/operating models, and accordingly do a cost–benefit analysis of such opportunities. This would enable them to prioritize businesses with sustainable technologies, non-linear supply chains, and regenerative business models, which emphasize reuse and recycling of materials and can also help align investment portfolios strongly with the UN SDG Agenda (UNEP, 2020).

An important step towards a broader understanding of climate actions and their financial requirements can be undertaken through 'Green Finance Windows', which acts as a more focused green investment bank. India already took a step in this direction, when at the COP25 in Madrid IREDA announced its intent to create a green window for catalyzing private investment to the underserved areas in India's clean energy segment (Kwatra & Sandhu, 2020).

3.5 BARRIERS AND GAPS TO MOBILIZING GREEN FINANCE

Despite these various national efforts in financing sustainable growth initiatives, there are considerable gaps in the existing regulatory framework, capacity building, and financing mechanisms that deter the progress in this area. There is a need to mobilize capital and mainstream sustainability into a financing structure. However, the key issues are as follows:

- **Definitional inadequacy:** The existing regulatory framework of green finance is extremely sporadic in India, with no specific structure defining or regulating climate finance either. There is no existing policy or regulation that provides an overarching framework to address the various related aspects. A major barrier in this regard is the lack of a universally accepted definition of green finance. While there are several other definitions, disclosure, and

reporting practices by companies, they do not necessarily align with the specific goals and NDC commitments. This alignment is possible only through developing a green finance taxonomy or sustainable finance taxonomy to define economic activities that contribute to the environmental objectives. For example, the EU Sustainable Taxonomy framework is a robust and usable tool for companies and investors to invest in activities that significantly contribute to climate change mitigation and adaptation among other environmental objectives. This requires undertaking various stakeholder consultations across companies, investors, and regulators.

- **Lack of regulatory framework**: Lack of a well-developed institutional framework for green finance deters progress in India. Although there have been several efforts in the regulatory framework on green finance, there is a lack of an overarching and all-inclusive mechanism to drive sustainability efforts. This is evident in the various sporadic efforts made by the regulatory bodies, banking institutions, and corporate to acknowledge green growth. A weak regulatory landscape can also be linked to the lack of sufficient disclosure standards. Developing clear disclosure standards allow investors, lenders, and other financial intermediaries to identify and manage climate risk.
- **Inadequate capacity:** Barriers exist in terms of the lack of adequate demand for sustainable products. The sustainability market is a niche in India. The capital market is not yet ripe to integrate sustainability factors into investment portfolios. One of the reasons for this is the lack of awareness of green issues and the associated short-term risks. The other important reason for underdeveloped markets is the pre-conceived notion of high upfront costs to be borne by developers. Moreover, investor's apathy towards green investments is also due to the long payback period in such projects.
- **Limited uptake of new financial instruments:** The adoption of green financial instruments at the required scale has been slow. This can especially be seen in the area of private equity, which is still an under-explored area with high potential in green finance. Equity finance is limited in quantum from a green perspective in India. Bond instruments also have not been developed to be able to reach their full potential, with incentives for green bonds largely missing leading to low private sector participation. The lack of adoption of green financial instruments can also be attributed to the high cost of certification, verification, and due diligence for green projects.
- **Wariness with international carbon markets and instruments:** While it is clear that carbon finance can play an important role in enabling these developments, the status of carbon prices in India at present is volatile and underdeveloped. Earlier, under the Kyoto Protocol commitments, India had one of the highest numbers of projects under CDM after China. CDM has been the biggest issuer of carbon credits measured in certified emission reductions (CER), with almost 50% issuances from projects in renewable energy, industrial gases, and fugitive emissions. However, this phase was

short-lived. Uncertainty regarding the international carbon market, lack of robustness of monitoring and verification mechanisms, lack of environmental integrity, and economic slowdown have led to a steep decline in credit prices. With an excess supply of credits and lack of any demand, a huge volume of these carbon credits remain unsold. According to certain sources, approximately 4 billion credits remain unsold globally, of which India holds 750 million worth of CERs. Contrary to compliance mechanisms like CDM, voluntary carbon markets are known to offer some advantages over the CDM owing to lower transaction costs, a shorter time frame for project approvals, and increased emphasis on Sustainable Development Goals (SDGs). However, owing to a lack of proper monitoring and verification of credits, there is a lack of acceptance by investors. This, in turn, adversely impacts project development for carbon mitigation actions by the private sector.

3.6 ROLE OF INTERNATIONAL COMMUNITY IN ENSURING EQUITY THROUGH FINANCE

International measures to promote appropriate green financing of the transition to a green economy shouldn't come at the cost of developing countries' competitiveness and should ensure equity and financial inclusion. Equity in the finance aspect is linked to the 'common but differentiated responsibility' principle, which underpins the Paris Agreement and which implies that the developed/advanced economies have the moral responsibility to direct funds to the developing economies in support of their climate actions. This acts as a form of redressal for the injustice of the advanced economies that have used fossil fuels for their development, which has resulted in developing economies being severely impacted by adverse climate impacts and yet not being able to rely on fossil fuels for their development, in the interest of global welfare.

This can also be seen from the critical finance goal under UNFCCC, where developed countries are to provide USD 100 billion annually by 2020 for mitigation and adaptation actions to developing parties. Over the last few years, there has been a range of assessments done regarding this goal, resulting in a range of figures for annual climate finance mobilization. However, this target has still not been met. This role of the international community in providing the required funds, but lacking in delivery, has highlighted the fundamental issue of finance – the lack of clarity about what qualifies as climate finance and thus can be counted towards the climate finance commitments of Parties. There is a need to push for the USD 100 billion target, where the donors especially need to deliver on this, with many working on a delivery plan on meeting this goal and aiming to surpass it for the 2025 timeline. There is a need to make certain that climate finance is developed as new and additional finance, with predictability and transparency of flows to ensure integrity. This especially becomes important when considering the internationally discussed financial targets. A precursor to ensuring international targets are met is defining and assessing the targets set under the long-term finance (as finalized under COP19), as well as developing a well-defined mechanism under the new collective quantified goal on finance (as introduced in

COP24). There is a need to ensure a proper definition of the two so that concrete short-term finance milestones can be put in place and the issue of mobilizing climate finance is not left only with a commitment time frame that is far in the future.

This also feeds into the need of ensuring equity in the mobilization finance. An under-addressed aspect of climate finance justice is the issue of funding being largely directed for mitigation aspects, with a significantly lower amount being given for climate adaptation, and yet lower amounts for loss and damage owing to climate change, which is being experienced by developing economies. Vulnerable developing economies usually have much lower GHG emission footprints; on the other hand, adaptation activities are critical for them to cope with climate impacts, and thus adaptation finance is more relevant for them. This issue has been brought to the forefront over the past few years, resulting in the leading multilateral organizations, and some bilateral funders too, announcing their intent to increase focus on adaptation activities.

Additionally, ensuring equity should also be supported by accelerating grants for technology development and deployment and creating wider awareness. Digitizing service-oriented businesses to enable green would allow a just transition, which should be integrated from the policy to finance spectrum.

The highly contentious nature of the green finance issue needs to be stabilized through international community action, especially when considering the 'rule book' for most articles. Article 9 was largely agreed upon at COP24 in Katowice, with only Article 6 remaining at a stalemate, and the rules and modalities for it are yet to be framed. Clarity on Article 6 mechanisms, which are aimed at enhancing ambition through international cooperation, could prove to be a breakthrough for the adoption of transformative climate actions in India.

Box 3.1: Role of International Community

There are major investment gaps in critical economic growth areas such as off-grid renewable energy for the agriculture sector, energy efficiency for MSMEs, resilient infrastructure for rural development, and technology uptake and implementation for improving operational efficiencies of high-emitting industries. At the same time, all these areas have the potential to generate sizable amounts of robust carbon mitigation assets and leverage these to become largely self-sustaining in terms of finance. In this context, international and domestic green finance can play a catalytic role, enabling a green transition while also helping developing countries like India to achieve key developmental and socio-economic goals. The international assistance especially comes in light of Article 4.7 of UNFCCC, which specifies the need for climate finance and technology to be provided by developed countries to developing countries. India is leveraging several initiatives but needs international support to scale them up.

3.7 FUTURE ACTIONS AND RECOMMENDATIONS

Green finance is the central issue for enabling climate actions and low-carbon transitions, covering both private and public finance.

While public finance has a primary role to play in mobilizing this, private finance also has a big role to play in generating the trillions of dollars of low-carbon investment that is needed around the world. Public finance can be used to mobilize this vital private financing for green projects and create an enabling environment for green finance in India. For this, there is a need for supportive governance and institutional framework in place, which allows for inter-agency and inter-state decision-making, as well as international cooperation for sharing resources and expertise. Table 3.3 outlines a roadmap for green financing in India.

3.7.1 Immediate focus

In the immediate term, the focus will be on economic recovery from the pandemic. In face of this shift in priorities, the constrained public budgets, and the probable fall in the finance available for addressing climate change, the issue of re-stimulating green finance becomes one of utmost urgency. The need of the hour, as articulated by many leading voices in this area, is to understand and design frameworks for a 'green' economic revival, one which is just and equitable, safe, and resilient (socially, environmentally, and economically). For designing such a green recovery, emphasis needs to be laid on the prioritization of public investments in green sectoral interventions.

*Aligning government spending with climate objectives*Decision-making processes for state budgeting and national budgeting have the potential to be reformed by using SDG-aligned budgeting or green budgeting framework, for better alignment of government spending with environmental objectives and sustainable development goals, and to maximize the impact of budget allocations. This can also serve as a starting point for transitioning to the integration of environmental concerns and concepts into development planning and budgeting. India should capitalize on the emerging global cooperation opportunities

TABLE 3.3: Roadmap for Green Financing

COVID recovery (immediate)	Short term (until 2025)	Medium term (until 2030)	Long term (until 2050)
» Aligning government spending with climatic objectives and SDGs	» Standardizing green taxonomy » Enabling networking platforms for sectoral engagement » Facilitating information	» Strengthen the policy and regulatory framework » Transparency of information through disclosure standards » Developing green finance packages, instruments, and markets » Mobilizing green finance from private sector	» Large-scale mainstreaming of green lens into investment decisions

Source: Compiled by authors

to ensure sustainable financing for long-term climate actions, chart green recovery pathways, frame a suitable response for climate emergencies, and enhance the overall resilience of the economy.

3.7.2 Short-term focus

Post the COVID recovery, in the short term, there is a critical need to lay the foundations for an enabling environment for green finance while building awareness and capacity of key stakeholders to effectively participate in this. Some initial steps to transition towards an overall green financial system in India can be as follows:

Standardizing a green taxonomy: One of the first steps to internalize environmental externalities and reduce risk perception is developing a standardized green taxonomy and generating awareness around it. This has to be accompanied by a harmonized definition of what constitutes green finance, from a national context and aligned with international standards. Defining green finance and developing a standardized taxonomy helps direct investors and financial institutions to allocate capital towards priority climate relevant activities and areas that are not conventionally perceived as green, such as infrastructure, manufacturing, and transport. Several studies in India have pointed to this gap and suggested measures for addressing it, which has resulted in a NITI Aayog led national initiative. Creating a standardized green investment taxonomy should be followed by structured and targeted awareness-building exercises for key segments, such as the high-emitting industries, financial sector, and subnational governments.

Enabling networking platforms for sectoral engagement: Capacity development of the private sector, through industry associations, to understand climate risk assessments for their regions and sectors is a way forward that should be done in parallel to other financing actions. There are several sectoral and regional industry associations existing in India that can form effective platforms and allow for dialogues between a range of stakeholders from private sector actors. To initiate meaningful engagement with the private sector, a sectoral approach for developing low-carbon growth pathways, including the supporting investment roadmaps, can be adopted for the priority climate sectors. This will enable the inclusion of relevant financial instruments to direct financing to the sector and its decarbonization activities and can include a mix of green bonds, result-based finance, or blended finance vehicles, deployed with the help of the relevant government ministries and public sector agencies.

Facilitating information to support investment decisions: There is a need to develop institutional capacity, both at the government level and for the private and financial sector, for adopting a green lens for long-term investment decisions. This first requires a rigorous process, including climate risk assessments, to appraise and select projects for investment by assessing the economic, social, fiscal, environmental, and climate-related costs and benefits. Access to robust, relevant, and updated information is the fundamental requirement to form responsive investment strategies for decarbonization and integration of a climate lens. Lack of access to such information poses a significant barrier to investments and there is a need to address this gap. NITI Aayog's 'Strategy for India @ 75' also lays a strong focus on robust data as the means for improving governance in its aim to 'revamp its data systems and analysis so that all policy interventions and decision-making are based on evidence and real-time data'

(NITI Aayog, 2018). Such initiatives need to be built on and enhanced. For this, the capacity of relevant government departments needs to be developed for providing adequate information around vulnerabilities, risk assessments, cost of inaction, and estimation of benefits. This information needs to be then shared effectively across a multitude of key stakeholders, especially those from the high-emitting industries and the corporate sector.

3.7.3 Medium-term focus

In the medium term, which follows the timeline of up to 2030, there is the need for a mechanism or system in place, where both the demand side and the supply side of green finance are structured and lead to a smooth flow of finance for relevant activities in the interest of sustainability, climate, and economic growth of the country. There is a need for finance and investment measures that have a tangible impact on achieving India's climate goals. While there is a wide range of changes required, and options for these, to mobilize finance and transition to green financial systems, India needs to prioritize these to identify the most effective ones given the climate urgency.

Strengthening the policy and regulatory framework for climate investments: India requires a strong and enabling governance framework for climate actions to strengthen and mainstream green finance. Governance framework plays a central role in setting the stage for mobilizing climate investments from domestic sources, both public and private. Strong policy guidelines also help financial institutions comprehend their responsibilities towards greening the finance sector by putting a price on the risk of inaction and increasing the rate of return of climate and green investment (Trabacchi & Mazza, 2015). With climate change being one of the biggest negative economic externalities facing mankind, the economic theory proposes two forms of action to tackle this externality. Policymakers can adopt a regulatory-based approach (command and control measures) or an incentive-based approach (market-based mechanisms) to overcome the externality. Government departments need to find the right balance between mandatory and voluntary frameworks, using a 'carrot and stick' approach with regulations and incentives, to enhance mobilization of climate investments. The regulatory landscape should be developed to help mobilize finance away from carbon-intensive sectors, and policies should be developed to provide financial incentives like tax breaks or risk guarantees or supportive de-risking instruments such as partial risk guarantees and risk insurance to encourage green investments.

Greening financial institutions: Banks are the primary source of formal credit in emerging markets like India, and so they need to play an important role in mobilizing the necessary private sector debt financing for green investments. But banks need support in the form of consistent policy support and regulatory guidance covering both the risks and the opportunities for climate financing. Ideally, the aim should be to develop investment roadmaps for supporting a green transition for priority sectors. Moving to low-carbon alternatives often requires high upfront costs, which can act as a barrier, but the lifetime costs of the solutions are relatively lower, an understanding that needs to be further built on and assessed. This makes it important to look at financing as a whole for the full project tenure and develop financing products that are tailored accordingly. This would require more fundamental changes in the existing processes and systems, and

here a clear and supporting role by the state becomes paramount.

Transparency of information through robust disclosure standards: Regulatory mandates can also be used for encouraging the adoption of mechanisms like climate risk assessments, stress testing or scenario analysis for financial institutions and mandating climate risk disclosures.

Developing green finance packages, instruments, and markets: Green finance includes several financial products and services, which can be broadly understood as investment, banking, and insurance products (Green Finance Platform, n.d.). The financial market should be developed with the right instruments to encourage the uptake of these products. Market-based instruments, for example, can be developed to address market failure. MBIs that can be developed trading instruments like emissions trading; fiscal incentives like corrective taxes or direct subsidies; debt-based and equity-based instruments like green bonds; and early market development instruments like green procurement (Glemarec, 2011). This also needs to be complemented with green policy instruments like blended finance or result-based financing. Additionally, there is also a need to strengthen the already existing climate initiatives for different sectors that have not been tapped to their potential yet. For instance, there is a need for creating holistic incentive package for green MSMEs, which besides financial incentives also includes the facilitation of technology access and intellectual property-based resources and handholding support in areas such as marketing green MSMEs.

While the market for innovative financing mechanisms is a niche in India, there is potential for several underfunded issues. For example, blue bonds are an emerging financing tool for investing in ocean resources, which also has the capacity for private capital mobilization. Although there is a strong business case for issuing blue bonds in developing countries like India, the lack of bankable projects supported by revenue models deters such investments. Since public finance has more capacity to take risks in the development of new markets, investment in new technologies, and penetration into newer and often more vulnerable regions, MDBs and bilateral green funds, in cooperation with the national and subnational governments, can help open such investment sectors by supporting research and pilot projects.

There is also a large scope of replicating and scaling up measures that India already has experience with. One such approach is using demand aggregation for different sectors and markets. India has seen success in this under national energy efficiency programmes of Energy Efficiency Services Limited. But the model has not been tapped to its potential in other segments, such as climate-smart agriculture solutions, MSMEs, and cold chains for enhancing food security. Such programmes can be designed with international climate finance support, and green finance through domestic public and private sources can be mobilized for its scale-up.

Mobilizing green finance from the private sector: Private finance is critical for enabling ambitious climate actions, but there is very little of it existing on the ground, especially in developing countries, for sectors besides the energy sector. Mobilizing private finance requires a mix of policy support, regulations, and risk mitigation instruments for incentivizing private climate investments. Public finance needs to rethink its role as a catalyst to plug the viability gap, provide guarantees, and

so on to leverage increased private finance. Public finance should be aimed at de-risking new and marginal sectors key for climate ambition. A major barrier for the private sector in undertaking deep decarbonization activities is the perception of high risk and the additional costs for developing these. To mitigate this, de-risking mechanisms are required and international finance with public financial support can help address this barrier by providing risk mitigation support in the form of first-loss guarantees in debt and equity investments, subsidized insurance premiums for climate-resilient assets, and the traditional grants and concessional loans. A further area to explore would be supporting the pioneering sectoral interventions, such as large demonstration projects deploying new technological solutions or initiating supply chain restructuring to enable circularity of material use, through blended finance vehicles. Garnering private sector interest to support such climate interventions has been a major challenge, with very few companies having the drive and wherewithal to do so without external drivers or support. Through a blended finance approach, international funders can support private sector actors at different scales of operations, encouraging them to explore viable new operational models. This will also enable bringing in technical expertise to include elements of carbon finance and create carbon assets, which would help opening an additional finance stream for project implementers.

3.7.4 Long-term focus

The barriers to financing the low-carbon or green transition are not stand-alone problems with single solutions. These problems are closely intertwined with the state of consumer preferences, behavioral choices, available technologies, commercial viabilities, and existing regulatory mechanisms. These can be addressed in the long term under the overall aim of transitioning to a domestic financial system that can support a comprehensive range of climate interventions up to 2050. Such a green financial system would entail the promotion of standardized green finance practices, the market development to support green investments at the national level, and finally a comprehensive national sustainable finance roadmap.

Mainstreaming green lens into investment decisions: A critical part of such a system would be achieved by mainstreaming climate investments or a green lens in all investment decisions. A way of achieving this is by making climate risk assessments a norm for financiers. To further lay a foundation for transformative climate actions, investing in research and development of low-carbon technologies and operational solutions needs to be encouraged and supported. This would have a positive impact on supporting underfunded solutions with high impact potential, such as circular economy initiatives, and nature-based solutions for enhancing resilience and sustainability.

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Adaptation and Resilience

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Chapter 4 CLIMATE RESILIENT AND JUST ADAPTATION

Abstract

The Adaptation and Resilience chapter of the Charter of Actions presented ahead puts forth the need to recognize the skewed impacts of climate change on vulnerable groups owing to existing socio-economic inequalities. While acknowledging the initiatives undertaken by the state in addressing adaptation concerns, the chapter also emphasizes the need to mainstream climate action in existing developmental interventions. Along with ensuring the need for mainstreaming climate action, it is crucial that these transitions deliver just and equitable adaptation outcomes. Since changes in the climate cut across all sectors, solutions can be yielded by cross-cutting interventions that can address these compounding risks. The way forward consists of developing targeted strategies to be implemented in the short, medium, and long term that were based out of extensive consultations with stakeholders at all levels from different regions of the country, thereby highlighting and addressing varying vulnerabilities faced across India.

4.1 OVERVIEW

The evolving climate policy narrative in the Global South has emphasized the need for recognizing the disproportionate impact of climate change on vulnerable regions and people and thereby exacerbating the existing socio-economic inequalities and widening the developmental differences. The Paris Agreement has put forth a global goal on adaptation (Article 7.1) that emphasizes on 'enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and adequate response in the context of the aforementioned temperature goal' (UNFCCC, 2015). The Global Commission on Adaptation (GCA) flagship report reiterates that adaptation is currently a social, political, and economic necessity (Global Commission on Adaptation, 2019). While it is imperative to limit rising temperatures, the benefits of addressing adaptation cannot be ignored any longer. The effects of climate change are already decelerating developmental outcomes and increasing disaster risks across the globe.

There are widespread calls for embracing transformative adaptive pathways that are adept at decision-making under increasingly uncertain and interrelated climate and

social challenges arising across scales. Transformative adaptive pathways should also engage with climate-related inequities by addressing underlying power structures and dynamics. The economic imperative for climate change adaptation is also compelling. The GCA report released in 2019 argues that investing in adaptation leads to avoided losses (in terms of lives and assets), economic benefits, and environmental benefits. The investment of USD 1.8 trillion globally from 2020 to 2030 in five adaptation priority areas, that is, early warning systems, climate resilient infrastructure, improved dry land agriculture, mangrove protection, and resilient water resources, can generate USD 7.1 trillion in net benefits (Global Commission on Adaptation, 2019).

India is a highly diverse country with respect to its geography, topography, and even climate. It is separated from the rest of Asia by the Himalayan range in the north, and as we move southwards it tapers off into the Indian Ocean sandwiched between the Bay of Bengal on the east and the Arabian Sea on the west. Owing to its vast extent, it is also home to multiple agro-climatic and biodiversity zones. With such diverse systems in place, driving a shift to a more resilient society becomes even more imperative. Additionally, there is a felt need for undertaking subnational climate action that is reflective of the regional and local diversity in terms of vulnerabilities and risks faced as well as their capacity to undertake adaptation interventions. Majority of the world's vulnerable population reside in the country with very little or no access to resources that can enable resilience to climate risks and its impacts. In India, two-thirds of the population are dependent directly or indirectly for their livelihoods on climate-sensitive sectors such as agriculture and allied sectors. Among other varying impacts of climate change, across the different regions of the country, one significant impact has been on the Indian monsoons. The effects on monsoons have severe and almost detrimental consequences for the agriculture sector at large, with effects penetrating down to food security and even livelihoods. With more than half of the agricultural systems being rainfed in India, a slight change in monsoon patterns can cause serious disruptions in productivity. Even though these changes are not limited to any one country, they will have varying consequences for different regions around the world, with developing countries bearing a disproportionate chunk of risks and vulnerabilities. This is because of existing vulnerabilities of poverty and unemployment that lead to issues of access to facilities such as water supply, food security, and increased instances of disease outbreaks.

A key vulnerability faced owing to climate change in India is the changes experienced in the monsoon season. Being a largely agrarian society with a majority of the population of rural India, depending on agriculture as a major source of livelihood, the changes in the Indian monsoon will have severe consequences on the livelihoods of a large chunk of the population.

The sustainability and efficacy of developmental processes in the country is intrinsically linked to integrating climate change adaptation in the long-term development strategy at all levels of development planning in a country. It is imperative that policies, plans, and vision at the national level should recognize the economic, social, environmental, and health risks arising from climatic events. The move towards a climate resilient development pathway would therefore need to envisage a long-term adaptation strategy, in synergy with development plans, that is cognizant

of the evolving socio-economic and climatic scenario of the country (Denton et al., 2014).

The prevalence of widespread development deficits and accelerating levels of socio-economic inequalities in the country also indicate that the impacts of climate change as well as climate action including adaptation measures will be disproportionally felt by the marginalized and the poor. Hence, it is imperative that the discourse on adaptation should shift from an incremental step-by-step approach to a more 'transformative action' as well as wider systemic changes that address social, economic, and ecological concerns in a holistic fashion. This mandates the need for a just transition to transformative adaptation pathways in the country that ensures long-term social, economic, and ecological sustainability.

The chapter on 'adaptation and resilience' of the COP26 Charter will aim to provide a roadmap for climate just and resilient adaptation pathway in India. The chapter takes a holistic approach towards adaptation and resilience from a 'systems thinking' framework that recognizes the intersections between various sectors will enable a more transformative change, embedded within a just transition frame.

4.2 POLICY FRAMEWORK IN INDIA

The geographical location and the diversity of regions make India very sensitive to the changes in the climate (Patra, 2016). India is a developing country and a low-income one at that, thereby housing a major share of some of the most vulnerable population to climate impacts in the world (Dubash, Khosla, Kelkar, & Lele, 2018). With a large section of the country's population dependent on climate-sensitive sectors such as agriculture and fisheries, as a primary source of livelihood and sustenance, the vulnerability of India to impacts of climate change is very high. The country has already seen a massive surge in extreme events and disasters in the recent past, with issues of risk management becoming more complex in the face of compounding risks. This mandates the need for a strong policy landscape in the country to further climate action.

Before the formulation of the National Action Plan on Climate Change (NAPCC), India's strategy towards climate change was largely contextualized in response to extreme events and disasters. Much of India's work focused on repair and rehabilitation after disaster scenarios. The Prime Minister's Council on Climate Change set up in 2007 was one of the first entities to be established in India to tackle the issue of climate change. The NAPCC drafted in 2008 to identify and address the risks faced due to climate impacts was the first formal step towards addressing climate action in India (GoI, 2008). The document was one that cut across sectors and regions in order to advance climate action in the country through both adaptation and mitigation efforts (Dubash, Khosla, Kelkar, & Lele, 2018).

Being one of the most vulnerable countries to the impacts of climate change, India has to put considerable focus on the adaptation aspect of it. However, it is being increasingly realized that while mitigation policies should be framed and undertaken at the national level, it is recommended to follow a bottom-up approach while designing policy instruments for the adaptation aspect. This need arises out of the country's diversity in terms of geography, terrain, and climate zones that face a multitude of threats from climate change. As adaptation interventions are localized in nature, engagement of state and

local governments is crucial. The subnational actors are best suited to deal with the localized impacts of climate change owing to several factors that include, but are not limited to, their proximity to the area of impact, their understanding of local conditions and terrains, and their past experiences in dealing with similar situations of crises.

The NAPCC set in motion the formulation of the policy landscape on climate change in the country. Soon after the launch of the NAPCC, the Central government called upon state governments to draft their own State Action Plans on Climate Change (SAPCC) to map out local vulnerabilities and to enable states to identify adaptation and mitigation interventions. It was envisaged that the actions and interventions identified in SAPCCs would feed into the various missions of India's NAPCC and NDC commitments.

The SAPCC documents helped states in India link global climate projections to their region-specific impacts and identify their local vulnerabilities along with the availability of resources to deal with these issues effectively. The document also allows the states to focus on their key sectors while framing policies and designing interventions for climate adaptation and mitigation. The process started in 2009, when the Central government came out with a notice for all states to prepare their own action plans on climate change. All the states drafted and got their action plans approved by 2015. This was followed by the Central government's notice on the need to revise and update SAPCCs in order to take into consideration new developments in climate science and its projected impacts. There were, however, many challenges faced in the implementation of the action plan. These were largely around the availability of adequate resources, both technical and financial, and the lack of adequate institutional capacities. The subnational governments also deal with developmental needs and requirements of regions. As such in many cases, developmental needs and priorities override climate considerations. However, it has increasingly been observed that climate proofing of existing developmental interventions could be a key to furthering climate action at local levels in India. There is also a felt need to work towards ensuring skill development and technical capacity building at local levels to ensure that climate concerns can be addressed adequately.

The impacts of climate change have been observed to be highly localized and region specific in nature. As such, policies on climate change adaptation need to adopt a bottom-up approach of identifying vulnerabilities and risks followed by designing of strategies for dealing with them. The rural areas of India are highly susceptible to climate change due to their dependence on climate-sensitive sectors such as agriculture as a primary means of livelihood. A majority of the population in rural areas does not have alternative livelihood options and as such are very vulnerable to climate change impacts. These impacts of climate change are further exacerbated by existing vulnerabilities in rural areas that include poverty, low education levels, nutritional deficiency, and so on.

India's long coastline also has several villages along it where the primary source of livelihoods is fisheries, which is also a climate-sensitive sector. Additionally, the coastal areas also face threats of sea level rise and its impacts. The eastern coast of India is also highly prone to cyclones and tsunamis. As sea surface temperatures are increasing globally, there is a heightened risk of increased frequency and intensity of extreme events and disasters.

This significantly increases the vulnerability of the communities living along the coastline. It also poses a huge threat to the existing infrastructure in the region.

The damage to infrastructure in developing economies due to climate change has risen significantly. This is a huge drain on existing resources as repair and reconstruction work has to be undertaken. This requires adaptation planning at the local level addressing regional vulnerabilities and risks.

The international climate regime has also witnessed the change in the role of sub- and non-state actors as key players. Their importance and significance stem from their understanding of complex and cross-cutting issues at the ground level. As global climate projections are varying in their impacts across regions and geographies, the regional and local players have the required knowledge about existing structures and capacities in place to address them effectively.

The global goal on adaptation as envisaged by the Paris Agreement in 2015 aims to enhance the adaptive capacity, build and strengthen resilience, and reduce vulnerabilities to climate change effectively across the world. Among the developing countries facing the threat of climate change, India must lead by example and capacitate vulnerable groups to adapt to climate risks and disasters. As part of India's attempt to further adaptation action to address existing and projected risks, the National Adaptation Plan is currently being formulated with adequate consideration for the existing regional variation and unique local conditions.

4.3 JUST TRANSITIONS FOR ADAPTATION

The Paris Agreement and the 2030 Agenda for Sustainable Development have succeeded in putting forth ambitious goals and targets that enable transition to climate just low carbon sustainable development pathways. In this context, the concept of '*just transitions*' that emphasize on the need to root these transitions in the principles of equity and justice has gained momentum. The term has largely been used in the context of climate change mitigation where labour-friendly measures are recommended while undergoing energy transitions to cleaner and sustainable energy sources. However, effects of climate change including slow onset climatic variability and increasing disaster incidences have led to adverse developmental outcomes and increasing levels of socio-economic marginalization in vulnerable areas across the globe.

The flagship report of the Global Commission on Adaptation makes the case for adaptation clear by arguing that (i) agricultural yields are likely to be reduced up to 30% by 2050 adversely affecting the 500 million small farmers across the globe, (ii) climate change can lead to significant shortage of water resources for around 5 billion by 20250, and (iii) forced displacement of hundreds of millions of people in coastal cities owing to sea level rise and storm surges and finally the impacts of climate change can push more than 100 million people within developing countries beyond the poverty line by 2030 (Global Commission on Adaptation, 2019). However, scholars have also widely documented the climatic impacts are experienced differentially by different socio-economic groups and different regions (Wisner, 2016). This is also true of climate change adaptation action that may lead to uneven distribution of costs and benefits across social groups and regions.

Unequal and unjust adaptation can occur owing to (i) transferring of risks and

vulnerabilities by powerful actors to powerless actors. Some actors may take advantage of the urgency of adaptation to elicit power or economic gains at the expense of others. (ii) Maladaptive practices that are sustainable only in the short run and can potentially lead to adverse impacts in the long run. Inserting a justice lens in adaptation planning should be deep rooted in the recognition of socio-economic vulnerabilities and ensure just and equal participation of multiple stakeholders. Existing adaptation interventions are largely of a technocratic nature and exclude a vast majority of stakeholders from the planning and implementation process. While incremental responses to climate change adaptation are often made through technological interventions and business as usual practices (e.g., building higher dykes to combat sea level rise), these practices do not necessarily tinker with existing systems and largely reflects a silo approach. However, more recently scholars have engaged with the transformative potential of adaptation placing a critical focus on the questions of power and preferences that often dictate the outcomes of adaptation action. Even though incremental responses are critical from the point of immediate risk mitigation, there is a need to engage with the transformational potential of adaptation where adaptation can be envisaged as an opportunity to put forth 'novel policy options and position adaptation firmly as a component of development policy and practice'. Transformational adaptation has the potential to directing fundamental change at the existing socio-ecological system addressing root causes such as sociocultural and economic structures and questions of power and agency.

Just transitions in adaptation should account for (i) uneven distribution of climate risk and adaptive capacity, (ii) historical contributions to causing climate change, and (iii) structural and systemic inequality, as these may also be exacerbated by the effects of climate change. A just transition to adaptation should incorporate the distributional, recognitional, and procedural dimensions of justice. The distributive dimension should incorporate a fair distribution of the costs and benefits of adaptation, while the procedural dimension should engage with effective participation of multiple stakeholders experiencing risks in the decision-making process. Both these dimensions call for recognitional justice that involves a thorough understanding of the diverse vulnerabilities, exposure, and adaptive capacities. Justice in climate change adaptation calls for attention to the two dimensions of justice: distributional and procedural. In addition, it has to be emphasized that while adaptation actions happen at a local scale in today's globalized world, adaptation can have cascading, systemic, and cross-border effects. Hence, multilateral cooperation is essential for effective and climate just adaptation solutions.

4.4 WHAT DOES JUST TRANSITIONS IN THE CONTEXT OF ADAPTATION MEAN FOR INDIA?

Just transitions for India should include transitions to a climate resilient development pathway, prioritizing adaptation and mitigation. With an economy closely tied to its natural resource base and climate-sensitive sectors such as agriculture, water, and forestry, India faces a major threat because of the projected changes in climate (Dubey, 2012). While the

rural resource-based communities are primarily vulnerable to climate change, Indian cities are also increasingly facing the effects of climate induced disasters due to increasing rural–urban migration, rapid population growth, high levels of socio-economic inequalities, and the lack of climate resilient infrastructure (Revi, 2008; Sharma & Tomar, 2010). Climate change is predicted to result in 50 million more poor people to India than there otherwise by 2040 (Jacoby, Rabassa, & Skouas, 2011). It is also one among the most disaster prone countries in the world with as many as 1.2 billion people exposed to fragile landscapes prone to hazards such as floods, cyclones, and droughts (Kapur, 2011). The increasing frequency of heatwaves, floods, droughts, and water crisis among others has reiterated the need to strengthen adaptation initiatives in the country.

India's development context largely shapes the effects of climatic impacts and vulnerabilities as well as adaptation outcomes. Hence, it is critical to envisage adaptation solutions that have development co-benefits and vice versa. The new economic reforms India embarked in 1991 followed a development model that favoured modern capital intensive agriculture and commercial exploitation of resources. The state reduced public investment in agriculture, which explains the decline or stagnation of consumption shares of rural agrarian classes (Kapur, 2011).

The distribution of political and purchasing power with wealth or in other words the manner in which assets, income, and access, to resources are distributed determines the distributional consequences of environmental change as well as decisions about managing it (Boyce, 2004; Wisner, 2016). Small farmers and agricultural workers are vulnerable. The rapid withdrawal of state subsidies and the absence of social safety nets have made this community extremely vulnerable to climate change.

In countries like India where 60% of the population depend on agriculture, large landholders with strong social capital and large asset bases are able to resist climate change induced stresses and migration, while small and marginal farmers and landless labourers are forced to move in the face of climate-related stresses (Kavi Kumar & Viswanathan, 2013). These group of marginalized, unskilled migrants with poor social networks and political agency often end up in precarious and insecure jobs and find accommodation typically in the informal squatter settlements scattered throughout the city. The informal settlement dwellers are also disproportionately affected by climatic changes and disaster events owing to the location of these settlements on low-lying areas and the precarious nature of their employment. For instance, majority of informal settlement dwellers including construction, brick kiln workers, or waste pickers are disproportionally affected by extreme temperature. Thus, developing a just transition framework for adaptation in the Indian context should be reflective of the current and emerging rural urban realities. In addition to intra-country initiatives, there needs to be a renewed focus on climate diplomacy for adaptation at the global level that can address the technological and financial gap the country is facing.

4.5 MAJOR SYSTEMS IN INDIA FOR ADAPTATION CONSIDERATION

The impacts of climate change are cross-cutting across sectors and key systems. As

such, policy approaches to tackle the issue need to be sensitive and accommodative of several aspects that encompass the climate system and socio-economic systems. India, like most developing countries, also has significant focus on its developmental priorities. In order to ensure a low carbon and resilient development pathway, it is crucial to consider issues that are complex, interconnected, and require interventions at the temporal and spatial levels. India's development pathway is contingent and largely dependent on climate-sensitive sectors, such as agriculture, water, health, and infrastructure. The following sections highlight the challenges and issues faced by different sectors owing to impacts of climate change.

4.5.1 Agriculture and food supply

The impacts of climate change will have severe consequences on agriculture and the food system. While overall food production in India may keep pace with the food requirements of a growing population, several studies suggest that climate change already have discernible effects on crop production, with associated consequences for water resources and pest/disease distributions. The Economic Survey 2018 of Government of India has carried out a detailed analysis of the impact of climate change on the Indian agriculture sector. One degree rise in the temperature will have an impact of fall in agriculture income by 6.2% during the kharif season and 6% during rabi in unirrigated areas of the country. Along with that a 100 mm reduction in the average rainfall would result in fall in the income of farmers by 15% during kharif and 7% during the rabi season. Considering the fact that 67% of the net sown area is rainfed agriculture, these impacts are going to be huge for Indian farmers. The non-irrigated rainfed farming areas accommodate 84% of the rural people of the country. This itself suggests the potential impacts of climate change on agriculture production, rural economy, and thereby the overall gross domestic production growth of the country.

4.5.2 Water

The water systems of the country are heavily dependent on precipitation. With a large population, India's water resources are stretched very thin to accommodate the needs of all sections of the population. With increased instances of extreme events and water-related disasters such as floods and droughts, impacts on existing water resources are quite high. The changes in the temperatures also affect the rates of glacial and snow melt, thereby affecting the water flow in major river systems of the country including the Ganga and the Brahmaputra. The impacts on these river systems would have consequences on irrigation of agriculture and thereby on food systems and consequently on food security. The instances of droughts and floods in the country have increased in both intensity and frequency. The depleting groundwater levels add to the stress on water resources. Therefore, there is a felt need to adopt an inclusive and participatory water resources management plan for the country that would address and reflect the differences in challenges faced by different regions.

4.5.3 Health

Climate change poses significant threats to the health of people across the globe. With changes in temperatures, precipitation patterns, and the increased intensity and frequency of disasters, instances of heatwaves, water and vector-borne diseases, and so on are increasing. Along with increased temperatures, the country is also battling with issues of the urban heat island effect. Such temperatures are usually accompanied by high levels of humidity and the increased moisture

in the air creates a conducive environment for the spread of vector-borne diseases. Such instances will further be exacerbated by reduced nutritional intake due to low access to basic services of food and water due to threats posed by climate impacts, especially for the economically weaker sections of the population.

4.5.4 Natural environment

The natural environment is one of the most climate-sensitive sectors globally. Several species of flora and fauna are found in the country owing to the existence of extensive and diverse habitats. Out of 34 biodiversity hotspots, India is home to four. However, the impacts of climate change on these habitats will be a major threat to the existence of these species. The climate risks faced by different habitats will also be different. The Himalayan belt, the Indian coastline, deltas, forests, mangroves, and so on will face severe consequences of climate change and therefore require immediate protection from climate impacts. There are also co-benefits in protecting these systems as they act as a shield against climate impacts on the population, livelihoods, and the overall society. These systems also face threats from anthropogenic factors. As such, nature-based solutions and adaptation interventions based on ecosystems to enhance the resilience of communities can be a major step forward in this regard.

4.5.5 Cities/urban

Cities and urban areas have become some of the most vulnerable entities to climate change impacts. As the country is developing, urban areas are expanding along with the population living in urban areas. These urban systems have increasingly started facing issues of flash floods, waterlogging, heatwaves, urban heat island effect, and so on that will be exacerbated by climate change. India has a long coastline and some of the major cities of the country with a high density of population are situated along the coast. This increases their vulnerability to climate change significantly owing to aspects of sea level rise and associated risks such as coastline erosion, damages to existing infrastructure, and increased instances of coastal flooding and occurrence of cyclones, tsunamis, and so on. Within urban spaces, there are also large informal settlements that have little or no access to basic facilities of water supply and so on and are located in the most vulnerable regions of the city, thereby increasing their risks manifold. This necessitates the need for urban planning and policy formulation at the city level in order to address vulnerabilities of all sections of the population residing in cities.

Across all themes, a major cross-cutting issue that emerges is that of disaster risk reduction and the need to enhance climate resilient infrastructure. Covering diverse landscapes and terrains, India is prone to almost all major disasters that include, but are not confined to, earthquakes, floods, droughts, cyclones, tsunamis, and so on. The country also has faced multiple risks in the same time frame in the recent past. This necessitates the need to develop cross-cutting interventions that can address compounding risks faced by different geographical regions in the country simultaneously.

Devising appropriate adaptation strategies for an ecologically sustainable and climate resilient development pathway will have many elements including risk and vulnerability assessments, strategic research and technology demonstration, absorption of improved technology and best practices, creation of physical and financial infrastructure

and institutional framework, facilitating access to information, promoting capacity building, and improving resilience and coping capacity of vulnerable communities. Climate change has been linked to systemic changes that will affect the lives and livelihoods of millions. Thus, transformative strategies to develop the resilience of key systems to changing climate need to start by mapping the dependence of people across sectors and key systems. Forests and trees, for instance, also support household nutritional well-being, improve soil fertility, meet energy demand, and provide medicine.

4.6 RESOURCING ADAPTATION

The inherent uncertainty in climate change adaptation owing to the evolving socio-economic, ecological, and development context in the country makes adaptation a resource intensive exercise. This shines a spotlight on adaptation requirement beyond the traditionally required 'finance' domain. Accounting for 'resourcing of adaptation' ensures that work is put towards building more inclusive institutional structures and regulatory framework and development of social and human capital along with a well-managed fiscal mechanism.

In India, adaptation planning has had budgetary allocation through the traditional developmental plans at national and subnational levels. However, even the gap in developmental-adaptation continuum is underscored in most policies and interventions because of components such as development of human resources and natural resources management existing in silos. In India, the National Adaptation Fund on Climate Change (NAFCC) was launched in 2015 to support climate actions at the national level and to also support the state governments to develop and implement their respective climate action plans (MoEFCC, 2015). However, the reality is that the targeted adaptation efforts in the country have been few and far between. The reasons behind the paucity of adaptation efforts have been not just the lack of requisite and continuous financing but also the lack of needed knowledge and capacity development. It is also to be understood that adaptation interventions often require a number of different government agencies to work across different levels. The lack of clarity in mandates and the ineffective coordination between different governmental agencies make this difficult.

The NDC of India pegs the fiscal requirements of adaptation efforts at around USD 206 billion (at 2014–15 prices) between 2015 and 2030 for implementing adaptation measures in key climate-sensitive sectors such as agriculture, forestry, fisheries, water resources. This is over and above the growing fiscal requirements to build resilience and for disaster risk reduction. However, according to the Climate Funds Update, climate adaptation in India has seen only 4.4% of total climate funding, while nearly 91.04% is targeted towards mitigation. With increasing instances of climate induced disasters further exacerbating the existing socio-economic, infrastructural, and institutional vulnerabilities, it is crucial that reallocation of funds happens in a way such that adaptation planning and programmes receive direct funding. It is also imperative for adaptation planning to be cognizant of cross-cutting concerns such as gender and inequality across climate-sensitive sectors such as agriculture, water, and disaster risk management systems.

4.7 WAYS FORWARD

Despite the inherent need of adaptation in strengthening climate action, a key area of

concern remains the inability to quantify or map the progress in absolute terms. In the absence of such measures, momentum in addressing adaptation needs must not be lost. On the contrary, efforts should be made to raise ambition and upscale ongoing adaptation initiatives. This upscaling could stem from categorizing adaptation strategies into short (2025), medium (2030), and long-term (2050) interventions that can be undertaken based on predefined timelines. In the short term, adaptation interventions could involve prioritization and mainstreaming of developmental interventions with adaptation co-benefits that can be continued up to 2025 in order to raise the scale and coverage of adaptation action in the country. In the medium term, policies should focus on addressing gaps of existing interventions and identification of new areas for adaptation. Lastly, focus on the long term could be on devising entirely new strategies arising out of recent assessments and risk identification which could address climate risks.

All in all, a National Adaptation Plan needs to be formulated for the country that is reflective of regional and local diversity and can be devised on a bottom-up approach, with subnational actors taking the lead and the Central government providing the platform for the same. Being a party to the Paris Agreement, India is required to develop a National Adaptation Plan to address increasing vulnerabilities and risks to climate change.

4.7.1 Strategies and measures needed by 2030

Building capacities at both institutional and community levels to deal with the cascading and compounding impacts of climate change is strongly advocated as a measure to be undertaken in the short/medium term.

- The need for integrating climate change adaptation and disaster risk reduction and designing disaster management plans at the district levels is a key area where synergies between developmental interventions, disasters, and climate risks can be built and enhanced.
- There is a felt need to address research gaps by investing in science-based tools and building data sets to ensure smooth flow of information and interaction between scientific bodies and policymakers.
- It is also important to augment the role of the private sector and incentivize their involvement in adaptation and resilience building. This could be accelerated by ensuring greater political interest and ambition in adaptation and resilience.

4.7.2 Strategies and measures needed by 2050 (long-term strategies)

As mentioned above, long-term measures would involve planning for new initiatives through a process of careful review of the challenges faced in the implementation of short- and mid-term strategies. Long-term planning for adaptation would also imply taking into consideration the latest available knowledge on the climate change discourse. In the long term, the role of private investors and organizations will be key along with their willingness to help and contribute being at the helm of the debate.

4.7.3 Implications for equity/just transitions

With the passage of time, decision-making processes in the adaptation domain must become more inclusive and participatory through effective engagement of stakeholders at all levels. Equity and just transitions require the critical support from the international

community in terms of resources, both technical and financial, along with capacity enhancement of communities in the countries of the Global South.

An integral aspect of enabling just transitions and equity in climate change action is the creation of a skilled workforce to enable a smooth transition to renewable energy technologies. In the case of mitigation, for instance, a shift from the coal to renewable energy technologies in inevitable in the long run. Therefore, a roadmap to ensure that issues of the labour force involved in the emission intensive sectors are addressed and taken into consideration for enabling a transition that is just and equitable is required.

Adaptation, as an aspect, is highly localized and context specific in nature. As such, even as issues are now being addressed at the decentralized levels, there is a felt need to incorporate aspects of socio-economic vulnerabilities as well. This stems from the need to address differential and compounded vulnerabilities that exist at the societal level.

4.7.4 Role of the international community

Even though the country is replete with examples that reflect how climate change has been tackled by various levels of governance, the support from the international community and organizations in terms of both technical and financial capacity support is crucial to their successful completion. Through example-led solutions and peer learning approaches, knowledge and information sharing to combat climate change can be encouraged.

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Nature-based Solutions

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Chapter 5

NATURE-BASED SOLUTIONS AND ROLE OF AGROFORESTRY

Abstract

Nature-based solutions (NbS) are the actions to protect, sustainably manage, and restore natural or modified ecosystems. While technological solutions for mitigating and adapting climate change are expensive, NbS are low-cost methods that address societal challenges effectively and adaptively and provide human well-being as well as biodiversity benefits. India probably is the world leader in demonstrating the success of NbS. These solutions can be demonstrated in various sectors where the suggested solution would take into account the commitments made in the Paris Climate Agreement. For achieving India's Nationally Determined Contributions in forestry, afforestation approach involving large-scale plantation on non-forest land through agroforestry practice becomes crucial. Agroforestry is seen as an emerging NbS in India as it improves farm resilience due to the increased farm diversification, self-sufficiency, reduced production costs, improved community resilience, and enhanced mitigation through, for example, carbon sequestration and reduced mineral fertilizer needs. Thus, the promotion of agroforestry through various policies and plans will not only enhance the income of farmers but also help India to move forward towards carbon neutrality. .

5.1 OVERVIEW

Nature-based solutions (NbS) are interventions designed around the management, conservation, and enhancement of natural resources that yield multiple environmental, social, and economic benefits and co-benefits. The concept of NbS was introduced towards the end of the 2000s to highlight the importance of biodiversity conservation for climate change mitigation and adaptation (MacKinnon, Sobrevila, & Hickey, 2008; IUCN, 2009). As per the formal definition adopted by International Union for Conservation of Nature (IUCN), NbS are defined as 'actions to protect, sustainably manage and restore natural or modified ecosystems, that address societal challenges (e.g., climate change, food and water security or natural disasters) effectively and adaptively, simultaneously providing human well-being and biodiversity benefits' (IUCN, 2016). Figure 5.1 describe the conceptual framework on NbS as a term for ecosystem-related approaches.

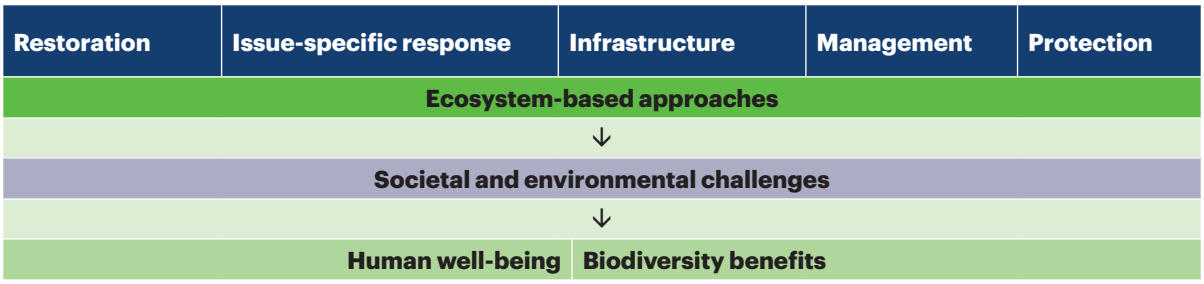

FIGURE 5.1: Conceptual framework on NbS for ecosystem-based approach for nature-based solutions

Source: Adapted from Cohen-Shacham, Walters, Maginnis, & Janzen (2016)

NbS is an umbrella term that encompasses various approaches that put nature at the centre of designing solutions that build climate resilience and create sustainable economies. It could account for one-third of the solutions for climate change and provide $170 billion worth of benefits in ecosystem services by 2030, according to Food and Land Use Coalition (FOLU) (Pharo et al., 2019). This concept covers a whole range of ecosystem-related approaches, all of which address societal challenges.

In preparing for the Climate Action Summit called by the United Nations Secretary-General on 23 September 2019, NbS Coalition put out a global call for initiatives on how NbS can be enhanced and scaled up (UNEP, 2019). A summary of examples of initiatives and best practices on NbS from around the globe is given in Table 5.1.

TABLE 5.1: Compendium of Contributions on Nature-Based Solutions

Type	Initiatives
People's movement for nature conservation	» Global Campaign for Nature, initiated by Costa Rica organization » Mobilizing and empowering youth on nature and climate
Agroecology and agribusiness-based conservation solution	» Sustainable Rice Landscapes Initiative of WBCSD, FAO, GIZ, SRP, and IRRI » Environmentally sustainable development using bamboo and rattan by International Bamboo and Rattan Organisation (INBAR) » Initiative of ActionAid International to make agriculture fit for purpose in an era of climate change » Opportunities for Collaboration with the Food, Agriculture, Biodiversity, Land-Use, and Energy (FABLE) Consortium » Global Network for Crop–Livestock Combination and Recycling » Carbon-neutral tea production in China
Conservation with indigenous people	» Tlaxcala Declaration from the 4th International Indigenous Peoples Corn Conference » Securing indigenous peoples and community land rights as a nature-based solution to climate change » Conservation and sustainable use by titling indigenous peoples land » Community forestry campaigns for restoring degraded lands in NepalSecuring rights of indigenous communities to secure nature-based solution for climate actionLarge-scale forest conservation with indigenous people in the highly threatened southeastern Amazon of Brazil

Type	Initiatives
Aquaculture and marine resource based remediation	» Zone Libellule: a nature-based wastewater treatment technique leveraging the self- purification capacity of wetlandsAdaptation strategies for fisheries and aquaculture to combat climate changeMacroalgae farming an ocean-based solution to reduce climate changeSeaweed aquaculture for CO_2 reductionSustainable management of Morocco's marine resources » Develop, promote, and scale-up Ocean Thermal Energy Conservation (OTEC) » Coral Reef Rescue – building climate resilient reefs and communities » Great Sea Reef Conservation and Climate Resiliency Program » Developing marine carbon sequestration economy » Rally for Rivers: Indian movement to revitalize dying rivers
Positive impact of urban ecology on environment	» Making Cities Resilient by Integrating Nature-Based Solutions into Urban Planning » Integral ecosystems in city planning and landscape architecture » Bringing Concrete to life – Enhancing Natural Processes on Concrete Based Coastal and Marine Infrastructure (CMI) » Municipal natural asset management as a means to ensure the viability of natural systems
Forest restoration initiatives	» Restoring forests and lands as a crucial response to climate change and sustainable development » Community forestry campaign for restoring degraded land in Nepal » Action to increase mangrove habitat 20% by 2030: the Global Mangrove Alliance » Peatland rewetting, restoration and conservation offering a low-cost, low-tech, high impact nature-based solution for climate change
Carbon stock approach for conservation	» Recarbonization of global soils » Employing natural processes to turn CO_2 permanently into rock through Back to Earth Initiative » REDD + Acceleration Facility (RAF): Scaling Finance for Tropical Forest Protection » Global Action on Desert Vegetation Restoration for Carbon Sinking to Tackle and Mitigate Climate Change
Sustainable financing mechanisms for conservation	» Mainstreaming natural capital accounting for climate change policy » Developing sustainable financing mechanisms for Mediterranean marine protected areas » Zero-budget natural farming for nature-based solution of climate change

Source: Compiled by authors

NbS simultaneously enable the achievement of all United Nations Sustainable Development Goals (SDGs) by promoting the delivery of bundles of ecosystem services together generating various social, economic, and environmental co-benefits (Martín, Giordano, Pagano, Keur, & Costa, 2020). The benefits delivered by NbS vary not only across spatial and temporal scales but also among societal groups. The report 'nature in all goals' published by WWF in 2019 highlight some levers to catalyze NbS for the SDGs. These include mainstreaming nature into decision-making, building multi-stakeholder partnerships, and strengthening good governance so that the agency, dignity, and human rights of at-risk communities inform global action on the 17 goals (WWF, 2019).

5.2 NATURE-BASED SOLUTIONS AND CLIMATE CHANGE NEGOTIATIONS

Research has shown that 20 conservation, restoration, and improved land management actions increase carbon storage and/or avoid greenhouse gas emissions across global forests, wetlands, grasslands, and agricultural lands. Natural climate solutions (NCS) can provide 37% of cost-effective CO_2 mitigation needed through 2030 for a >66% chance of holding warming to below 2°C. One-third of this cost-effective NCS mitigation can be delivered at or below 10 USD/MgCO_2 (Griscom et al., 2017). At the COP 21 in Paris in December 2015, Parties to the UNFCCC decided to strengthen the global response to the threat of climate change through the adoption of the Paris Agreement. It aims to accelerate action and investment to hold the increase in global average temperature to well below 2 degrees Celsius above preindustrial levels, increase the ability to adapt to the adverse impacts of climate change, and make financial flows consistent with a pathway towards low greenhouse gas (GHG) emissions and climate resilient development.

The Paris Agreement in its Preamble explicitly recognizes 'the importance of the conservation and enhancement, as appropriate, of sinks and reservoirs of the greenhouse gases referred to in the Convention' (UNFCCC, 2015). It acknowledges the significance of ecosystems for climate change mitigation and adaptation as well as their broader societal value in general. These include 'biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems' (UNFCCC Article 4.1(d)). The Paris Agreement also notes 'the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity, recognized by some cultures as Mother Earth' (Preamble). It then includes, in various articles, several explicit references that are directly relevant to NbS (Seddon et al., 2019). While the concept of NbS is rooted in climate change mitigation and adaptation, it is understood as an umbrella term for simultaneously addressing several policy objectives (Pauleit, Zölch, Hansen, Randrup, & Konijnendijk van den Bosch, 2017).

5.3 CONTEXTUALIZING NBS FOR ACHIEVING NDCS IN THE INDIAN CONTEXT

At the 19th COP in Warsaw in 2013, all the countries were required to prepare Nationally Determined Contributions (NDCs) and present them in COP 21 in Paris. Government of India presented its NDCs as it felt it was balanced and comprehensive. By 2030, India has committed to reduce the emissions intensity per GDP by 33–35% from the 2005 level and create an additional carbon sink of 2.5–3 billion tonnes of CO_2 emissions through additional forest and tree cover (Government of India, 2015). To achieve this target, there have been structured processes in the form of National Action Plan on Climate Change, State Action Plans on Climate Change, and so on. There are extensive programmes undertaken to enhance the forest and tree cover, ecosystem services, and co-benefits through sectoral and integrated approaches by various Ministries. Legislations in India that are directly or indirectly connected to support NbS are given in Table 5.2.

NbS for India need to be evolved by reinventing these existing solutions with climate perspective. There have been a

TABLE 5.2: Direct and Indirect Indian Legislations on NbS

Forest (Conservation) Act, 1980	Payment for Ecosystem Services
Indian Forest Act, 1927	Green Highways Policy, 2015
Compensatory Afforestation Fund Act, 2016	Policy for Enhancement of Urban Greens
National Rural Employment Guarantee Act, 2005	National Biodiversity Action Plan
National Forest Policy, 1988	Pradhan Mantri Ujjwala Yojana
National Environment Policy, 2006	Pradhan Mantri Krishi Sinchayee Yojana
National Bamboo Mission	National Agroforestry Policy, 2014 and Sub-Mission on Agroforestry
Wildlife (Protection Act), 1972	Corporate Social Responsibility Rules, 2014
National Agroforestry Policy, 2014	National Agricultural Policy, 2000
Biological Diversity Act, 2002	National Mission for Sustainable Agriculture
Panchayats (Extension to the Scheduled Areas) Act, 1996	Rashtriya Krishi Vikas Yojana
Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006	Integrated Watershed Management Programme
Green India Mission (GIM)	Van Bandhu Kalyan Yojna
National Afforestation Programme (NAP)	Other schemes of Ministry of Environment, Forest and Climate Change, Ministry of Rural Development, Ministry of Panchayati Raj, Ministry of Agriculture and Farmers Welfare, Ministry of Tribal Affairs, among others
Financial allocation by Finance Commission for forestry and plantation activities	Swachh Bharat Abhiyan

Source: Compiled by authors

number of NbS attempted and proposed for various sectors to tackle climate change. Conceptual framework of NbS in Indian context can be visualized as shown in Figure 5.2.

In the Indian context, NbS can be demonstrated in various sectors where the suggested solution would take into account the commitments made in the Paris Climate Agreement, and hence the contribution of the particular NbS towards achievement of NDCs could be accounted.

Sustainable habitats in the context of both urban and rural areas become important for visualizing NbS in India. Key challenges for sustainable habitat in India are lack of capacity and value chains that can support green infrastructure, uncoordinated response from different government bodies, and lack of access to verified and validated eco-friendly building materials (Ghosh & Kansal, 2014). In the urban context, waste management has become a critical issue and options such as composting, land farming, biomethanation, wetlands (natural and man-made), algal ponds, phytoremediation, and microbial remediation have emerged as NbS models. Such approaches work better in a decentralized manner since they have aspects related to resource recovery, thereby contributing to circular economy. These

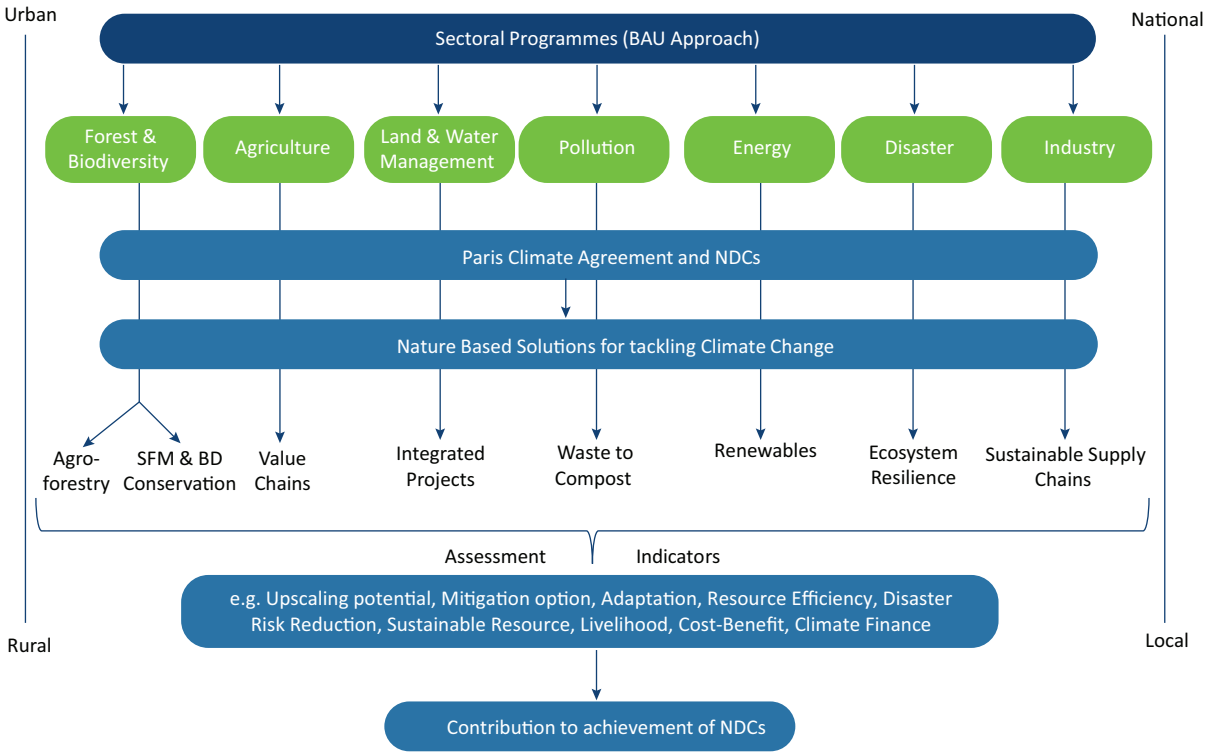

FIGURE 5.2: NbS assessment framework in the Indian context

Source: Compiled by authors

models create livelihood opportunities but are weaker in policy and regulatory provisions. The reduction in pollution through such solutions is critical for climate mitigation.

Food production chains, value chains, and supply chains have the potential to support safe and environmentally benign food production and building resilience at the local level. Some of the production pathways include organic agriculture, sustainable agriculture, and eco-agriculture. In recent years, conservation agriculture and zero budget natural farming are being promoted in India.

The analysis of case studies presented by IORA Ecological Solutions and Vertiver (2021) suggests that NbS investments such as crop diversification, community-based fodder banks, soil and water conservation structures, crop residue management, nutrient management, zero tillage, effective agro-advisory, weather-based crop insurance would yield maximum benefits and co-benefits to enable food security. Other aspects such as sustainable supply chains for agriculture, fisheries, Non-timber forest products (NTFPs), minor forest produce (MFPs), livestock management, and creating market linkages for naturally farmed products will also contribute to food security and generate inclusive and sustainable livelihoods. All such interventions need policy and regulatory support since they have very high potential impacts on climate mitigation and adaptation and livelihoods of substantial population. In rural context, supply chain of MFPs sustaining livelihoods of the forest-dependent community of more than 300 million people has robust policy and regulatory framework through Forest Rights Act, 2006 (Biswas, n.d.), Panchayat Extension

to Scheduled Areas Act, 1996, and financial support through schemes like minimum support price (MSP) for MFP by Ministry of Tribal Affairs. Sustainability of the resource, quality standards, and local value addition are some of the challenges in implementation and they also are decisive factors for carbon sequestration.

Box 5.1: Zero Budget Natural Farming System in Himachal Pradesh

State Government of Himachal Pradesh has introduced an ambitious scheme 'Prakritik Kheti Khushhaal Kisaan Yojana', which envisions enhancing farm income in harmony with nature by adopting low-cost climate resilient zero budget natural farming system (ZBNF). This system would not only improve soil fertility, water infiltration, and porosity but also discourage the use of fertilizers and pesticides besides reducing environmental pollution.

Source: GoHP (2020)

In case of land and water management works the integrated approach as demonstrated through implementation of several watershed management projects within the framework of Common Watershed Guidelines, 2011 have successfully demonstrated the utility as NbS in India. Such activities include rainwater harvesting, afforestation/reforestation of catchments, groundwater recharge, resilient crop planning, and spring shed development, wetland restoration, river basin conservation and rejuvenation, and building institutional and technical capacity to implement such activities would yield the maximum benefits and co benefits under an NbS approach for water security as well as sustainable land management.

Similarly, the use of renewable energy in the form of solar and biogas is a well-established solution for reducing carbon emission. Inducing resilience through various interventions of natural resources and ecosystem management is an important strategy for climate proofing and enhancing the sequestration potential of ecosystems. For industry, NbS may be proposed in the form of sustainable supply chains for sourcing the material. For example, marketing of the produce and value addition through clean energy sources should be strengthened. Further, agro-business investing in landscape restoration techniques with smallholder farmers should be encouraged to ensure a healthy, long-term supply chain. Each proposed NbS for every sector has enormous potential to evolve and upscale at the national level in India. Within the agriculture, forestry, and other land use (AFOLU) category, NbS involve the protection, restoration, and sustainable use of forests, grasslands, mangroves, wetlands, and other ecosystems. In the forestry sector, the interventions within the forest areas through techniques of sustainable forest management (SFM) and models of agroforestry outside forest areas are important sectoral NbS. Indian forests have been degrading owing to several anthropogenic pressures in the form of firewood, grazing, and small timber. At the same time, there has been a ban on green felling of mature trees in most states in the country. As a solution to these problems, agroforestry is seen as an emerging NbS. Agroforestry plantations cater the most to the domestic demand. At present, more than 80% demand of timber is met from the agroforestry sector (TERI, 2020). Agroforestry is also able to improve farm resilience due to the increased

farm diversification, self-sufficiency, and reduced production costs. They can also improve community resilience and enhance mitigation through carbon sequestration and reduced mineral fertilizer needs. Figure 5.3 shows the benefits of agroforestry as NbS.

Farmers in India are vulnerable to environmental, climate, and weather-related stress, including climate change. There is an increase in understanding of the benefits of agroforestry systems as NbS at both farm and landscape scales and incorporating trees on farms through agroforestry systems has emerged as having the potential to enhance the resilience of smallholders to current and future climate risks including future climate change. Further, in terms of adaption, agroforestry plays a significant role in water control (e.g., increase water retention, recycling, and irrigation efficiency) and thermoregulation (e.g., shading and sheltering for livestock).

» Water retention is improved by woody perennials as they increase porosity, thus reducing water run-off. The water soil extraction reduces the flooding risk, acting as barrier against unpredictable flooding.

» Water recycling is fostered because some tree species absorb water from deep soil layers and make it available in more superficial soil layers, thus permitting enough humidity to allow pasture to grow.

» Water efficiency can be improved if woody perennials are placed in such a way that the negative impact of wind desiccation on crops is reduced. The presence of trees in grasslands is key to provide shelter to livestock.

» Some agroforestry actions also help to improve farm resilience such as the extension of the grazing season as a result of the reduction in the impact of droughts in herbaceous vegetation when growing under trees. This provides animals a forage bank for fodder shortage periods. The leaves pruned by trees can be used as forage when both drought and frost reduce forage availability.

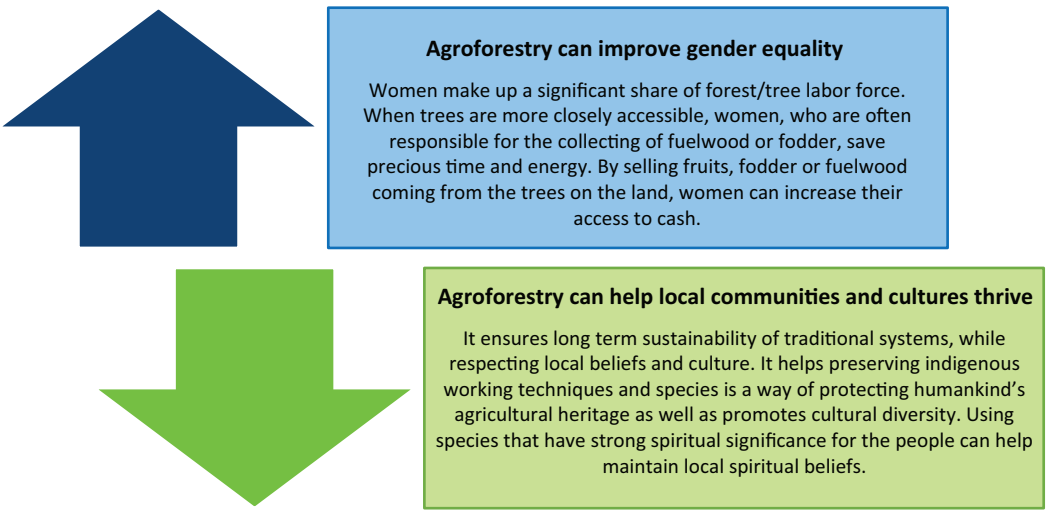

Figure 5.3: Benefits of agroforestry as NbS

Source: Compiled by authors

» Moreover, the shade reduces damage to arable crops associated with extreme heats. Finally, understorey grazing in forest stands reduces the use of fuel and therefore fire risk, increasing resilience in high risk periods associated with specific weather conditions.

However, the present form of agroforestry is limited to a few states and too few species and there is a huge scope for extending it to a large part of the country. Thus, there is a need to upscale agroforestry in India as one of the solutions to not only fulfil the domestic timber demand but also sequester additional CO_2 to contribute to the India's forestry NDC target of 2.5–3 billion tCO_2e sequestration.

The next section analyses the potential of agroforestry as NbS, which would not only cater to the domestic timber demand but also generate several co-benefits, including additional carbon sequestration.

5.4 POTENTIAL OF AGROFORESTRY TO ACHIEVE NDCS OF INDIA

Agroforestry provides an important opportunity to India for all the challenges it is facing, whether increasing the tree cover and carbon sequestration obligations, rehabilitation of degraded land, crop diversification, supporting the micro, small and medium enterprises (MSME) sector, or providing livelihoods to people. The current area under agroforestry in India is estimated to be 25.31 mha or 8.2% of the total reported geographical area of the country. The total area under cropping in India is about 200 mha (ICAR CRIDA, 2016). The total forest and tree cover is 80.73 mha, which is 24.56% of the total geographical area of the country, out of which approximately 9.5 mha area is under trees outside forest (TOF) (FSI, 2019). National Forest Policy, 1988 recommends 33% forest cover in the country. There is limited scope of increasing the area under natural forests by additional 8% to achieve the target forest cover. According to IFSR (2003), the culturable non-forest area is 218.8 mha. This area can become the potential area to enhance forest and tree cover of India through agroforestry. As regards the addition to carbon sequestration potential, the total net carbon sequestration from major agroforestry species such as eucalyptus trees is 9.64 tonnes/ha/year with 5-year rotation cycle (Sarangle, Rajasekaran, Benbi, & Chauhan, 2018). Therefore, 8% additional potential area under agroforestry (i.e., 25 mha) would sequester approximately 241 million tonnes/year of CO_2 equivalent annually.

Such numerous benefits provided by agroforestry especially for combatting climate change are well recognized by the Indian policy regime and are rapidly evolving. The National Policy for Farmers, 2007 encourages agroforestry for the efficient nutrient cycling, nitrogen fixation, organic matter addition, and drainage improvement along with appropriate production and marketing. The Government of India (GoI) has launched several other schemes/projects, such as the National Bamboo Mission (NBM) under the Ministry of Agriculture, Rashtriya Krishi Vikas Yojana (RKVY), National Horticulture Mission (NHM), and National Policy on Biofuels, wherein integrating forestry components on farmlands has been given the much needed thrust. The National Bank for Agriculture and Rural Development (NABARD) provides financial and banking institutional support for social forestry, farm forestry, and afforestation of wastelands. Furthermore, the National Agroforestry Policy (NAP), 2014 came in limelight to address the issues of quality planting material, tree insurance,

restrictions on transit and harvesting, marketing of agroforestry produce, research, and extension. It also provides an opportunity for self-reliance in the need of timber for the country through agroforestry. It identifies the following critical issues responsible for restricting the growth of agroforestry sector in the country:

- Lack of integrated farming systems approach
- Restrictive regulatory regime and inadequate attempts at liberalization of restrictive regulations
- Dearth of quality planting materials
- Lack of institutional finance and insurance coverage
- Weak market access for agroforestry produce
- Lack of a suitable institutional mechanism

India still follows the provisions of the National Forest Policy, 1988, which encourages the maximization of substitution of wood, while the present policy view of the Ministry of Environment, Forests and Climate Change (MoEFCC) is to grow wood and use wood that will in turn help more carbon sequestration. Agroforestry can play an important role in this context. The utilization of timber reinforcement from agroforestry species as replacement of steel and concrete reinforcement is also gaining immense importance today, mainly on account of the improvement in the economical aspect combined with ecological benefits. With the advancement of science and technology and the tight supply of timber, new methods have been devised by Indian Plywood Industries Research and Training Institute (IPIRTI) for the processing of wood and non-wood composites to make it more durable and usable in terms of building materials. Thus, there remains an important opportunity for the growth of agroforestry, which would be a win-win situation in every aspect of ecosystem services enhancement, conservation of natural forests, and catering to domestic timber demands.

But lack of conducive environment to promote timber production from home-grown trees through agroforestry is exerting fiscal pressure as wood and wood products are being imported from other countries. India has been the net importer of wood and wood products, which is adding an economic burden of over INR 396.99 billion (Table 5.3). India's domestic demand of roundwood equivalent is expected to be 153 million m^3 in 2020 from 50 million m^3 in 2000 (WWF, 2012).

TABLE 5.3: Value of India's Wood and Wood Product Imports from FY 2010–11 to FY 2019–20

Year	Import in billion (INR)
2011	168.95
2012	240.78
2013	276.57
2014	309.81
2015	334.13
2016	330.4
2017	328.2
2018	388.5
2019	428.41
2020	396.99

Source: Statista (2021)

Owing to lack of supportive provisions to grow, transport, and market timber, farmers are not ready to start domestic production. These include various regulatory problems for growing timber species classified as 'forest species' outside notified forest lands (on private lands), where growers require a 'felling and transportation permit' for harvesting timber.

There is an urgent need to remove these regulatory restrictions at least for those

species that are widely adopted under agroforestry systems and providing raw materials to the wood-based industries. The Bansal Committee (constituted by the Ministry of Environment, Forests and Climate Change, GoI in July 2011 to study the regulatory regime and felling and transit regulations for tree species grown on non-forest/private lands) recommended relaxation in transit and felling permission for the species preferred by farmers and agroforesters. Implementing this action plan in the Policy will encourage active participation of farmers and help in increasing the tree cover and raw materials to wood-based industries as well as environmental security. Furthermore, the NAP, 2014 also identified 20 most important tree species preferred by farmers in different parts of the country to be exempted in the first phase from such restrictions.

As per the NAP, 2014, only 10% of quality planting material reaches the resource-poor remote regions. Thus, quality assurance of genetically improved planting stock, particularly for long-rotation timber species, is crucial for safeguarding the interest of farmers and industries. There is a need to invest in research for developing high yielding clones of indigenous species so as to diversify the scope of agroforestry for timber production and at the same time not restricted to wood products based on just eucalyptus, poplar or subabul. Apart from this, superior quality seeds obtained from seed orchards and seed production areas (clonal seed orchards, seedling seed orchards, vegetative multiplication garden) have a positive impact on productivity of plantations. Wood-based industries (WBI) can be also made self-reliant for procuring indigenously grown timber through agroforestry plantations. This will enhance the livelihood opportunities of farmers and help them earn additional income through multicropping.

5.5 FUTURE ACTIONS AND RECOMMENDATIONS

It is important to understand the latest status of forests and tree resources in India before preparing a roadmap to achieve the forestry NDCs of India. As per India State of Forest Report (ISFR, 2019), we have the scope of converting around 20 mha open forest and part of moderately dense forest into dense forest. In this case, agroforestry is strongly advocated as the afforestation approach for the non-forested land. The Forest Survey of India has highlighted that TOF form nearly 38% of the carbon sink in forest and tree cover of the country. Further, agroforestry, if managed in a climate smart manner, has a potential of achieving two-thirds of India's forestry sector NDC targets (TERI, 2020). The responsibility of Central Government is policy and planning, while the responsibility of state governments is management, development, and conservation of forests. Therefore, the targets have been assigned and further rationalized among the states based on the area under forest cover and the potential area under agroforestry as shown in Table 5.4.

Agroforestry can contribute more than 2 billion tonnes of CO_2e by 2030 if the government provides farmers minimum support price (MSP) of timber produced by them. Owing to lack of the MSP, whenever there is a glut in the market, farmers have to sell timber at throwaway prices. However, agroforestry can supplement farm income by selling carbon credits in carbon markets, enable risk reduction, and contribute towards climate resilience. TERI is engaged is demonstration activities such as pilots to promote agroforestry as NbS in three agroforestry dominant states of India, namely, Punjab, Haryana, and Gujarat. These

Table 5.4: Proposed Distribution of NDC Target for Indian States and Union Territories and State-Wise Financial Outlay Needed for Achieving NDCs Through Area Under Forest Cover and Agroforestry Sector Till 2030

State	Area under forest cover (sq. km)	Potential area under agroforestry (sq. km)	Target (in million tonnes of CO_2e)	Total grant (in million USD/ year)	Total grant (in million USD) till 2030 (taking 2015 as baseline year)
Andhra Pradesh	28,147	16,730	183.22	476.4	7,145.8
Arunachal Pradesh	66,964	180	197.79	514.3	7,713.9
Assam	28,105	2,670	98.61	256.4	3,845.6
Bihar	7,299	7,950	69.22	180.0	2,699.5
Chhattisgarh	55,547	6,990	205.18	533.5	8,002.0
Goa	2,229	110	7.21	18.7	281.1
Gujarat	14,757	10,890	108.79	282.9	4,243.0
Haryana	1,588	3,520	25.82	67.1	1,006.9
Himachal Pradesh	15,100	0	44.36	115.3	1,729.9
Jammu and Kashmir	23,241	940	73.92	192.2	2,882.9
Jharkhand	23,553	5,340	101.28	263.3	3,949.9
Karnataka	37,550	12,930	188.01	488.8	7,332.4
Kerala	20,321	940	65.34	169.9	2,548.4
Madhya Pradesh	77,414	13,450	308.24	801.4	12,021.3
Maharashtra	50,682	19,160	264.03	686.5	10,297.0
Manipur	17,346	0	50.95	132.5	1,987.2
Meghalaya	17,146	0	50.37	131.0	1,964.3
Mizoram	18,186	0	53.42	138.9	2,083.5
Nagaland	12,489	50	36.99	96.2	1,442.5
Odisha	51,345	8,040	199.15	517.8	7,766.7
Punjab	1,837	4,200	30.64	79.7	1,194.8
Rajasthan	16,572	20,510	171.94	447.0	6,705.6
Sikkim	3,344	80	10.30	26.8	401.9
Tamil Nadu	26,281	6,880	118.55	308.2	4,623.4
Tripura	7,726	260	24.26	63.1	946.1
Uttar Pradesh	14,679	19,710	161.57	420.1	6,301.2
Uttarakhand	24,295	740	75.82	197.1	2,956.8
West Bengal	16,847	4,050	73.83	192.0	2,879.3
Puducherry	53.67	20	0.28	0.7	10.8
Delhi	192.41	60	0.93	2.4	36.1
Total	680,836.08	166,400	3000	7800	117,000

Source: ISFR (2017) and Rizvi et al. (2014)

states are agriculture intensive with traditional rice–wheat cropping system. Box 5.2 is a brief exhibit on the agroforestry project by TERI in Gujarat.

However, the productivity of this system has declined in certain areas owing to depletion of nutrient reserves and occurrence of their deficiencies, dropping of underground water table, and resurgence of insects and diseases due to overexploitation. Different tree species are traditionally grown in the various agro-climatic zones of these states and adopted by farmers in their agriculture fields as block and boundary plantations. This practice of agroforestry can be promoted widely to provide various co-benefits along with mitigating impacts of climate change.

Box 5.2: Pilot Agroforestry Project in Gujarat

TERI has initiated a pilot to promote agroforestry in four social forestry circles spread across five districts of Gujarat, namely, Ahmedabad circle (Anand and Kheda districts), Mehsana circle (Mehsana district), Godhra circle (Panchmahal district), and Bharuch circle (Surat district). The potential of carbon sequestration is expected to be around 3 million tonnes of CO_2 equivalent for a crediting period of 10 years. The annual emission reduction is expected to be 300,000 tCO_2e. Agroforestry plantations are spread across 11,150 ha with around 84,83,416 (close to 85 lakhs) plants planted benefitting 9781 farmers across 948 villages. It is expected that voluntary emission reductions (VERs) will generate in the first cycle of 5 years roughly around ₹365 crore. The second set of VERs will be generated at the end of the second cycle, that is, after 10 years.

Source: Compiled by authors

Other recommendations to promote agroforestry in the country are to generate quality planting material (QPM) and increase its supply to farmers; establish a statutory and institutional mechanism for certification of QPM (planning stock and clonal plants); and put in place an accreditation system for nursery planting stock – for reference National Horticulture Board has developed a protocol for accreditation of nurseries set up for supply of QPM. Legal provisions already exist in our country for certified seeds/plant materials for agri-crops, but such practices are almost non-existent as far as forest reproductive material (FRM) is concerned and need to be developed for agroforestry and forestry species. On multiple platforms, experts and organizations have highlighted the need for collaborative research on QPM, need for provenance and field trials in various locations, creation of a network of QPM registries, development of a national QPM Registry, and extension of technology of QPM production to farmers. Private sector has been using high yielding clones of many fast growing species such as poplar, eucalyptus, casuarina, and leucaena and this has been achieved by intensive and continuous in-house R&D on selection and development of high yielding clones and varieties. These recommendations also have been part of a report by a high-level expert committee under Ministry of Environment, Forest and Climate Change to formulate a strategy to increase the green cover/tree cover outside recorded forest areas (tree outside forests) and particularly agroforestry (MoEFCC, 2018).

Regular timber markets should be established to ensure transparent timber trade and prevent exploitation of farmers. Harvesting and transportation of agroforestry produce need to be made less stringent and working plans should be prepared for agroforestry

works; the National Working Plan Code 2014 also covers this aspect (working plan officer (WPO) may prepare a separate strategy as a new chapter that is not a general prescription of working plan to address the concepts and issues related to TOF) (MoEFCC, 2014).

Thus, with agroforestry as a NbS, we can support the climate adaptation of vulnerable people in India and at the same time meet several of the global sustainability goals. It will not only enhance the income of farmers but also help the states in India to move forward towards carbon neutrality.

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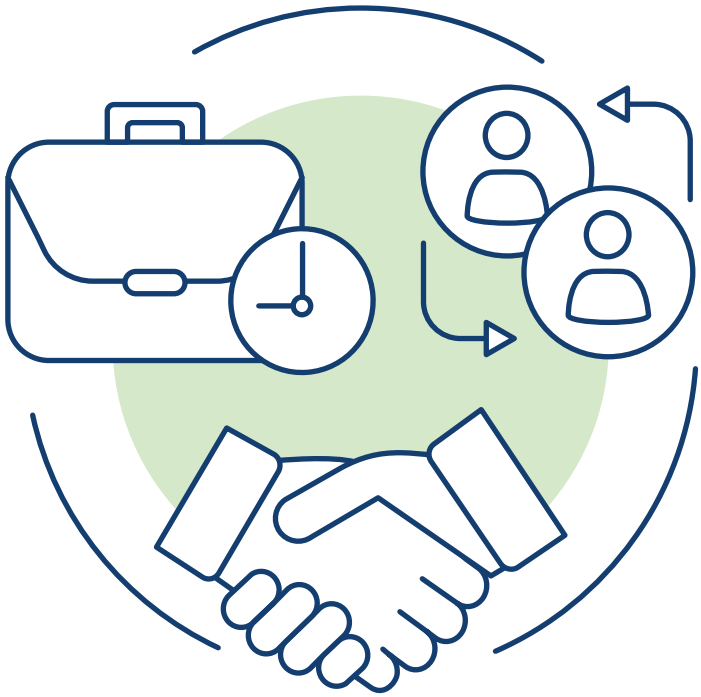


Chapter 6

CLIMATE ACTIONS FOR BUSINESS AND INDUSTRY

Abstract

Indian businesses are uniquely positioned to create low carbon sustainable economy and have embarked on a number of voluntary initiatives on climate change that can significantly contribute towards achieving India's NDC goals. Despite the pandemic and associated economic uncertainties, Indian businesses are at forefront of committing to climate actions and emission reduction targets. Increasing collaborative approach between policymakers and industry will help develop more effective emissions reduction policies for industry and inspire greater climate action.

6.1 INTRODUCTION

As the world strives to fast-forward the economy in an attempt to recover from the pandemic, a number of studies are stressing the importance of green recovery essential to close climate action gaps. According to UNEP estimates, a green pandemic recovery could result in the reduction of 25% of the predicted 2030 greenhouse gas emissions and bring the world closer to meeting 2°C goal of Paris Agreement of the climate change (UNEP, 2020a). The world leaders are recognizing that global challenges do not respect borders. As the world moves forward for COP 26 negotiations, the key priorities of global leaders as reiterated during Leaders' Summit in April 2021 and G7 meeting held in Cornwall in June 2021 are building back better from the pandemic and uniting efforts to address climate change. The G7 meeting recognized the need for future generations by supporting a green revolution that creates jobs, reduces emissions, and aims to keep global temperatures below 1.5 degrees Celsius (The White House, 2021).

As call to action on climate change and building back better gains momentum, India must take fast action to protect lives and revitalize the economy. A large commitment from the business sector can be leveraged as an opportunity to accelerate India's sustainable aspirations for building a low carbon economy. With greater understanding of impacts of climate change and integrating climate risks, stakeholders such as investors, rating agencies, governments, civil societies, customers, and employees are all asking companies to take actions through adapting their products, business models, and investments. These will assist India in

not only combating the pandemic, but also restoring its economy by creating jobs. As share of the manufacturing sector is bound to increase substantially, this would generate 100 million jobs in industry. The extent to which businesses consider higher emissions targets and climate change imperatives when designing their economic responses to pandemic is expected to have long-term implications on reducing CO_2 emissions.

6.2 CALL FOR ACTION: ACTIONS BY INDIAN BUSINESSES DEMONSTRATING LEADERSHIP

The role of business and industry has been recognized by Paris Agreement and they are instrumental in bridging the gaps of set emission targets (UNFCCC, 2015). In 2020, UN Environment's emission gap report observed that there is a huge gap between announced long-term climate targets and short-to-medium term initiatives to accomplish them. The report also reflects and reiterates the role of non-state actors in bridging the gap between country's current policy commitments and the level of ambition required to meet the goal. India is the only G20 country to be on track to meet its climate change mitigation commitments and to be assessed as '2°C compatible' by Climate Action Tracker with the prospect of upgrading to '1.5°C compatible' by undertaking enhanced mitigation and adaptation measures (Climate Action Tracker, 2020).

Voluntary climate initiatives in the corporate sector contribute significantly to India's transition to a low carbon growth path. A recent study suggests that prevailing climate commitments of just 50 leading Indian companies can reduce the country's total greenhouse gas emissions by almost 2% below national projections for 2030 and can contribute significantly to India's NDC target of achieving 33–35% reduction in emissions intensity by 2030 (Hingne, Sheikh, Agarwal, & Adhia, 2021). Since 2001, the Council for Business Sustainability of The Energy and Resources Institute (TERI) in India has been engaging corporate leaders in climate action (Chan, Ellinger, & Widerberg, 2018). Indian corporations are setting their own emission reduction targets; for example, India ranks sixth among countries with corporate commitments on science-based targets (SBTi). By 2020, there was an increased SBTi commitment of 52 companies observing growth of 37% from 2019. The Indian corporate sector is also participating in programs such as RE100, EV100 and EP100, adopting an internal carbon pricing, setting net-zero emission targets by joining UNFCCC backed Race-to-Zero Campaign and Race to Resilience Campaign, Amazon's Climate Pledge, Industry Charter for Near Zero Emission Ambition by 2050 instituted by TERI to deliver faster emission cuts in key areas, increasingly adopting adaptation measures, and driving the necessary transformation required for energy and industry transitions.

Since 2017 there has been an increasing and upward trend of participation of Indian businesses in voluntary carbon markets (VCM). A total of 918 projects are registered from India under various mechanisms/certification schemes in the voluntary carbon market. It is projected that there is mitigation potential of 200 million tCO_2 in the decade 2021–2030 across all carbon market mechanisms (Clean Development Mechanism (CDM), Voluntary Carbon Standard (VCS), and Gold Standard) (MoEFCC, 2020).

Box 6.1: Low Carbon Transition: Leadership of India Inc.

The Ministry of Environment, Forests and Climate Change (MoEFCC) hosted an India CEO Forum on Climate Change to 'create long-term and sustainable collaboration between the Government and the commercial sector' in November 2020. During the Forum, a Declaration of the Private Sector on Climate Change was endorsed by 24 business leaders and the MoEFCC (PIB, 2020a). These organizations have voluntarily pledged to move towards carbon neutrality.

India's largest conglomerate Reliance Industries Limited has announced net-zero targets by 2035. The company plans to build solar capacity of at least 100 GW (gigawatts) by 2030, contributing to over a fifth of India's target of 450 GW at the end of this decade. The organization plans to make India a hub of low cost solar manufacturing by setting up 'global scale integrated photovoltaic giga factory' with the initial capacity of 4 GW. In addition, it has plans to invest in carbon capture and storage technologies as well as hydrogen infrastructure in the country. Adani Group has plans to triple its renewable energy generation, foray into hydrogen production, power data centres with renewable energy by investing USD 20 billion over next 10 years.

A number of firms representing Indian industry have announced net-zero targets and started their journey towards embracing low carbon transition. Some of the leading groups include Mahindra & Mahindra Ltd., HDFC Bank Ltd., TATA Group, Wipro Ltd., JSW Energy Limited, Dalmia Bharat Group, Toyota India, ReNew Power, and Infosys.

Source: Compiled by authors

Box 6.2: Initiatives of India Inc. for Accelerating Adoption of EVs

Indian industry is rapidly transitioning towards taking measures to reduce emissions within their supply chains. The significance of integrating resilience in supply chains of organizations has increased manifold after pandemic and with increased frequency of climate-related episodes.

A number of organizations have announced targets for integrating EVs within their freight operations, while a number of organizations are coming forward to switch to 100% EVs for their operations. The growing EV market along with an enabling supportive policy framework presents an opportunity for industry to completely reimagine their supply chain operating models. Indian industries have an immense potential to influence and encourage their suppliers, customers, employees, and partners to switch to electric vehicles. Some of the leading e-commerce giants are showcasing leadership while transitioning their last mile deliveries to 100% EVs.

Source: Compiled by authors

In order to meet the emission reduction targets, the industry sector has taken various proactive strides in adopting mitigation measures, such as increased uptake of renewables, transition to cleaner fuels, and energy efficiency initiatives, for example, the inclusion of circular economy principles. Bureau of Energy Efficiency (BEE) estimates have shown that the country has energy saving investment potential of ₹840,000 to 1262,000 crore by 2031. The energy saving investment potential is found to be highest in the industrial sector (BEE, n.d.). Perform, Achieve and Trade (PAT Scheme) was

launched by BEE to enhance cost-effectiveness and improvements in energy efficiency in energy-intensive designated consumers (DCs). Till date, BEE has rolled out six PAT cycles, with a total of 1073 DCs covering 13 energy-intensive sectors. It is projected that the total energy savings of about 26 Mtoe translating into avoiding of about 70 Mtoe of CO_2 will be achieved by March 2023. Apart from large industries, the Micro, Small, and Medium Enterprises (MSME) sector is also an important constituent of the Indian industry sector. BEE has taken many initiatives in collaboration with various organizations (World Bank, UNIDO, SIDBI, etc.) to improve the energy efficiency of the MSME sector in the country. The initiatives led to the total energy savings of 0.022 Mtoe and avoided emissions of 0.124 $MtCO_2$ in 2018–19.

The business community has realized that they are not immune to climate risks. They are increasingly taking measures to integrate climate risks in their overall corporate risk frameworks. They are signing up global frameworks; for example, Task Force on Climate-Related Financial Disclosures (TCFD) and as many as 37 Indian corporations have signed the TCFD recommendations and 220 companies made climate-related disclosures in 2020 according to CDP (CDP, 2021). The Reserve Bank of India (RBI) has joined the Network for Greening the Financial System, a 62-member group (voluntary group of central banks) with the aim to assist members in developing policies that incorporate environmental and climate risk resilience in the financial industry (George, 2021). Figure 6.1 shows key developments on climate action concerning corporates in India since Paris Agreement.

There is a growing demand amongst investors and stakeholders of businesses for accountability of their social and environment impacts. Reporting frameworks and non-financial disclosures have evolved in India from Business Responsibility Reporting (BRR), Corporate Social Responsibility (CSR), National Guidelines on Responsible Business Conduct (NGRBC), and now Business Responsibility and Sustainability Report (BRSR). At present, BRSR guidelines would be an effective compliance tool for a company's non-financial disclosures and shall be applicable to the top 1000 listed entities (by market capitalization).

Box 6.3: Industry Charter for Near Zero Emissions Ambition by 2050 Instituted by TERI

Industry Charter for Near Zero Emissions Ambition by 2050 instituted by TERI, launched during Climate Week NYC 2020, is a platform for Indian industry to voluntarily commit themself to decarbonization measures and work together in key thematic areas that can make a 'zero carbon' future a reality for India. The Charter aims to work on seven focused thematic areas that include renewable energy, energy efficiency, low carbon supply chains, technology interventions, resource efficiency, and policy perspectives to support Indian industry sector to integrate low carbon measures within different verticals of operations.

The Charter represents the intent of signatories to make their companies exemplars of low or zero carbon technology solutions within their sectors and gradually bring more heavy industry sectors into the fold of the Charter. At present, the Charter has commitment from 33 signatories.

Source: A TERI-CBS initiative for corporates

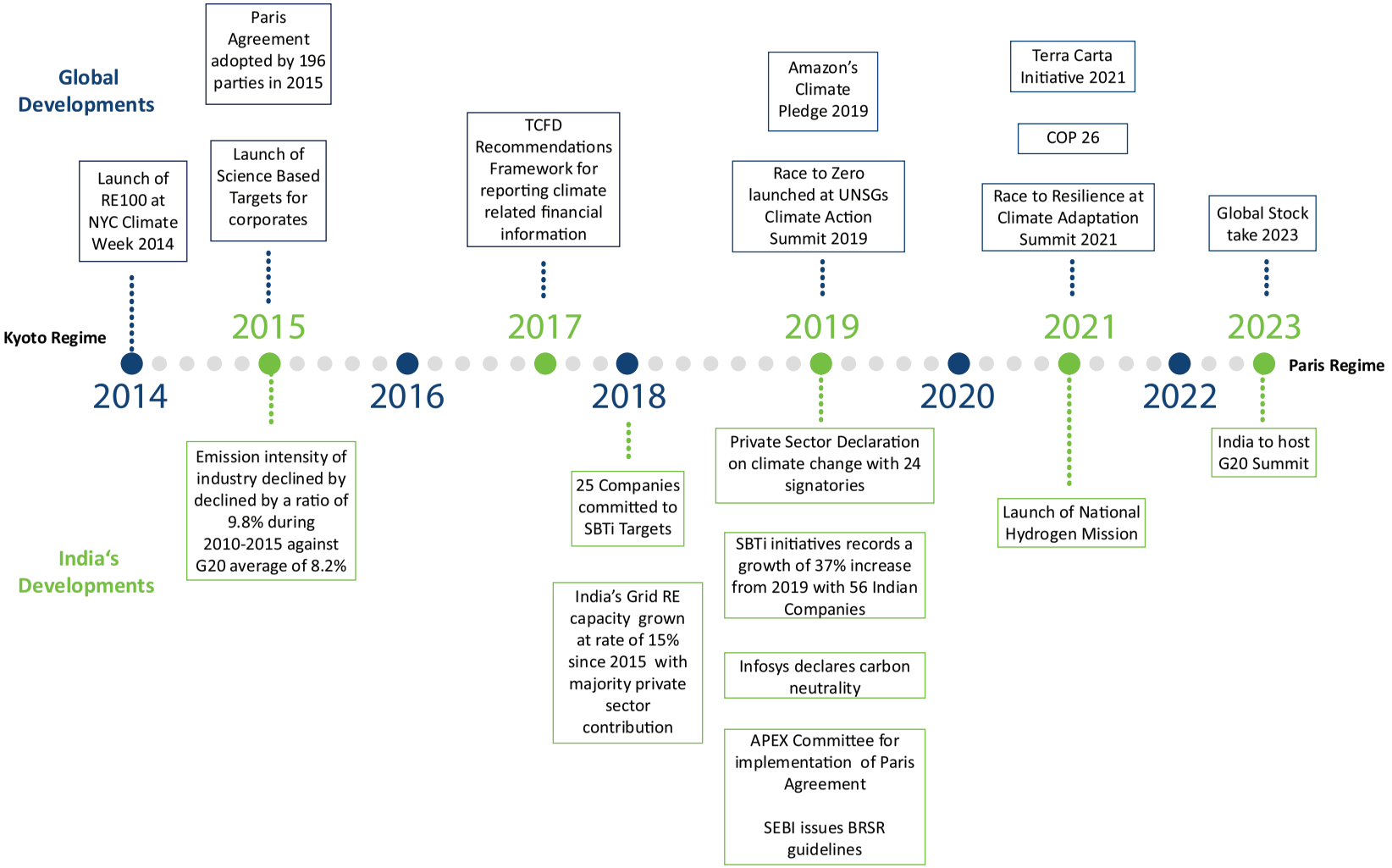


FIGURE 6.1: Key developments on climate action concerning corporates in India since Paris Agreement

Source: Compiled by authors

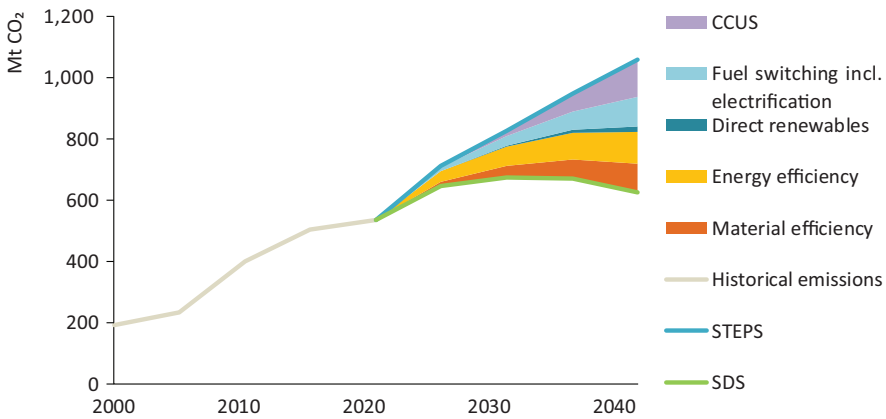
The sustainability reporting increases the access to capital and value creation, reduces the financial risks, enhances the access to markets and market share, and is helpful in 'social license to operate' (SEBI, 2020).

Post-pandemic India is well positioned to rebuild greener. The creation of domestic demand through manufacturing capacity for solar and energy storage has a potential to generate ₹294,000 crore by 2030 through import substitution. Energy efficiency initiatives and best practices for MSMEs have a saving potential of ₹15,000 crore every year (Shankar & Avni, 2020). Some of these feasible measures could create demand and jobs catalysing private sector investments for a low carbon economy of India. Even in tough times of pandemic, Indian corporates are forward-looking and have set ambitious goals and reaffirmed their commitments for building resilient and low carbon economy.

6.3 POTENTIAL AREAS OF COLLABORATION

6.3.1 Call to action on decarbonizing industrial sector

Coal remains the primary energy source constituting 44% of share of India' energy mix. Among end use sectors, India's industry sector has been the main source of energy demand growth since 2000. According to IEA scenarios, the energy consumption of Indian industry as the end use sector would grow from 36% to 41%. Industry would account for almost two-thirds of India's coal demand and become the major source of growth in emissions and India's emissions could rise by 50% by 2040 in a business as usual scenario. Therefore, IEA scenarios for 2040 predict the potential of multiple technological options including the use of direct renewables, fuel switching, material efficiency, and carbon capture, utilization and storage (CCUS) to reduce industrial CO_2 emissions (Figure 6.2).



Multiple technologies and policy approaches are deployed in the SDS to bring down India's industrial CO_2 emissions.

FIGURE 6.2: IEA predicts a range of technology and policy approaches to bring down India's industrial CO_2 emissions

Note: CCUS: carbon capture, utilization and storage; STEPS, Stated Policies Scenario; SDS, Sustainable Development Scenario.

Source: IEA (2020)

The analysis lays out that 25% of emissions reductions, more than 100 $MtCO_2$ in 2040, are achieved through improvements in energy efficiency. Early deployment of the best available technologies is the best way to reduce energy consumption and enable the retrofitting of abatement technologies (IEA, 2020).

The case of transitioning to technologies and just transitions becomes strong as coal is the major source of air pollution in the country contributing to half of sulphur dioxide emissions, 30% of nitrogen oxides, and 20% of particulate matter (Ramanathan, 2021). The cost advantage indicates that India has opportunities to save money by switching from coal plants to renewables and a recent analysis by TERI reflects that 26–32% of variable renewable (i.e., wind and solar) electricity (and more than 45% of non-fossil electricity) can be integrated with minimal additional costs by 2030 (Spencer & Awasthy, 2020).

Government is already working on a roadmap and initiative of *Aatma Nirbhar Urja* for Atma Nirbhar Bharat and has invited Indian industry to join *Aatma urja* initiatives as partners in progress for transformation of the energy sector. Government has initiated actions to increase share of natural gas from 6.2% to 15% by 2030. The initiative on 'One Nation One Gas Grid' has also been launched to expand natural gas grid and introduce rationalized tariff for making natural gas (PIB, 2020b). The industry has a pivotal role to play in India's transition to gas-based economy in the near term and a hydrogen-based economy in the long term.

6.3.2 Call to action on renewables by industry

In the past, Indian industry has achieved remarkable milestones and made the country the fourth largest wind installed capacity through private sector investments backed by fiscal and non-fiscal incentives. The expansion of India's wind energy sector has resulted in strong ecosystem, project operation capabilities, and manufacturing base of 10,000 MW per annum. India is showcasing leadership in achieving its renewable energy targets and has recently surpassed 100 GW of installed renewable energy capacity.

A number of studies have shown the benefits of corporates procuring renewables, bringing large capital flows, positive impacts on jobs, strengthening and resilience in supply chains, and cleaner and more resilient energy systems. The corporate procurement of renewables has a very large potential in India that needs to be promoted. With the support of state agencies, commercial and industrial (C&I) sector can become a significant contributor for achieving renewable energy targets catalysing financial requirements for the growth of the sector and also contributing to the ecosystem development of new and emerging technologies for grid integration.

In August 2021, Ministry of Power announced guidelines for green energy open access rules providing a choice to consumers to purchase and consume renewable energy as per their requirements through various modes, whether it is through own generation from renewable energy sources, by procuring renewable energy through open access from any developer, by the purchase of renewable energy certificates, or by the purchase of green hydrogen (PIB, 2021). This choice would be helpful for commercial and industrial sectors as well as larger Indian industry to embrace transition to renewables. In addition, a new announcement trading of electricity with forward contracts and derivatives would help in strengthening the landscape of power markets, bringing newer

products in power/commodity exchanges. This will attract increased participation from generation companies, distribution companies, and large consumers.

As India's electricity demand would continue to grow and is projected to be between 2000 and 2900 TWh by 2030 according an analysis by TERI, the role of energy storage would assume significance that will enable renewables penetration of 16–20% by 2025 (RMI, 2019). Central Electricity Regulatory Commission observes that storage would play a significant role in improving the operating capabilities of the grid, lowering power purchase cost, addressing the variability and intermittency of renewables, and enabling to cater to peak demand. The International Energy Agency (IEA) in its India Energy Outlook 2021 highlighted that the nation has the potential to become a 'world leader' in battery storage, projecting that it could add 140–200 GW of battery capacity by 2040 – the largest of any country. Central Electricity Agency in 2019 estimated that India will require 27 GW of grid connected battery storage by 2030.

Globally, the costs of grid connected battery storage have been declining. The government has taken various proactive measures to promote next generation technologies by approving an outlay of `18,000 crore to promote advance chemistry cell battery storage in addition to the promotion of solar PV modules under the ambit of the production linked incentive (PLI) scheme. The increased uptake of renewables

Box 6.4: Aggregator for Green Jobs Fostering Industry–Academia Partnerships

Collaboration between industry and academics is critical for technology innovation and progress. While industry frequently focuses on solutions with the immediate commercial value, academia focuses on developing new knowledge through research and skill building, and the two can work together to speed up the development of new products and processes. For example, IIT Delhi launched a maiden initiative on electric mobility that retrofitted an old vintage Beetle car of 1948 model into an electric vehicle.

The Skill Council for Green Jobs is one of the world's largest skills mapping, training, and support systems to train 150 million people in newly created green jobs according to national standards. According to the ILO (International Labour Organization), India's transition to a green economy could create 3 million jobs in the renewable energy sector alone by 2030.

According to an economic modelling study conducted by Garrett-Peltier (2017), it has been estimated that on average $1 million spent on fossil fuels creates 2.65 full-time equivalent (FTE) employment, whereas the same amount spent on renewables or energy efficiency creates 7.49 or 7.72 FTE jobs. As a result, shifting $1 million from brown to green energy will result in a net increase of five jobs. Industrial energy efficiency supports 7.41 FTE jobs (3.98 direct, 3.43 indirect) for every $1 million spent on energy efficiency; smart grid, which combines electrical grid upgrades with energy saving end use technology, supports 6.76 FTE jobs (3.66 direct, 3.10 indirect), and mass transit and freight rail supports 8.93 total FTE jobs (6.16 direct, 2.77 indirect).

Source: Compiled by authors

along with in-house manufacturing of solar modules and new battery technologies would aid in building a competitive industry regime to promote advance electric grids, rooftop solar, and electric vehicles. Solar Energy Corporation of India (SECI) is implementing multiple renewables and battery storage auctions that mandate round-the-clock (RTC) RE power supply. India took the historic and encouraging step towards round-the-clock renewable power supply in May 2020 with discovered tariff of `2.90/kWh by ReNew Power through a RTC tender. In order to mainstream battery storage and promote manufacturing, the participation of a number of stakeholders through market development is essential. These stakeholders including commercial and industrial sector and states with large load centres coming forward along with participation of PSUs. The role of the government is also crucial to create an enabling environment for growth of next generation technologies.

Renewable energy technologies can provide a tremendous opportunity to create domestic jobs and industry–academia partnerships can be leveraged for skilling opportunities and preparing India's workforce to support transition to cleaner technologies.

6.3.3 Potential role of decarbonized fuels: hydrogen economy

Industry is the major user of hydrogen both globally and in India. Green hydrogen has significant potential to displace fossil fuel usage in manufacturing and facilitate decarbonization of the economy, improving energy security, reducing import costs, and decarbonizing energy supply. Currently, it is being used in primarily three sectors, namely, fertilisers, refineries, and petrochemicals. There are new sources of hydrogen demand within Indian industry, which includes iron and steel, as a fuel in transportation and potentially replacing fossil fuels as a source of industrial heat. The most efficient way to reduce emissions from industrial heat processes is through direct electrification using renewable electricity. In the power sector, hydrogen could be a cost-effective way of providing inter-seasonal storage in a high variable renewable electricity system from 2040.

Because of its cross-sector applications, green hydrogen has potential to radically reduce emissions in a number of sectors, thereby catalysing India's transition to climate action leadership. To maximize the benefits of hydrogen technologies, a cross-sectoral approach is required that takes into account the case of shared infrastructure, aggregating energy system impacts and overlapping inter-ministerial coordination (Spencer & Awasthy, 2020). For example, a single hydrogen production hub could supply to a number of end users, thus lowering the costs of supply. The shared responsibilities between different stakeholders and public–private partnerships to de-risk deployment would also support the development of a hydrogen economy, which includes funding to early stage research, as well as demonstration projects for hydrogen technologies along with Indian industries. Organizations including ACME, Reliance, Adani Group, Indian Oil Corporation, and NTPC have announced plans to embrace hydrogen as a fuel in different sectors. Participation of private investors evaluating hydrogen opportunities in their portfolios and launching early stage innovation funds to scale up production would be critical for a conducive framework for achieving rapid cost reductions. The announcement of National Hydrogen Mission is timely to begin the pathway of developing a hydrogen economy aligning with Government's vision of Make in India and Atmanirbhar Bharat.

6.3.4 Call to action to enhance adaptation and resilience initiatives

Businesses are increasingly taking proactive measures to respond to climate change in both operational and strategic terms. The impact of COVID-19 has exposed the vulnerabilities of businesses to their operations and climate change impacts are expected to further exacerbate the situation, including disrupting business operations, increasing costs of maintenance and materials, and raising insurance prices.

As companies are integrating climate-related risks in their corporate risk frameworks, the future success of the private sector may depend on not only successful mitigation initiatives but also adaptation initiatives. As per the analysis of Global Commission on Adaptation in 2019, investments to a tune of $1.8 trillion in five key areas to climate-proof businesses and broader economy between 2020 and 2030 could generate benefits up to $7.1 trillion. A study commissioned by the United Nations Environmental Program (UNEP, 2020b) estimates that the annual requirement for climate change adaptation and resilience investment could vary between US$140 and US$300 billion by 2030 and from US$280 to US$300 billion by 2050. Indian businesses face internal climate risks, such as sustaining production and supply chains, while ensuring market competitiveness and regulatory compliance. Addressing these risks will be essential to sustaining viable and profitable businesses, while contributing to building the adaptive capacity of the country. With the right approaches and models, these risks can be converted into significant opportunities. Figure 6.3 shows the five approaches for private sector participation in climate change adaptation.

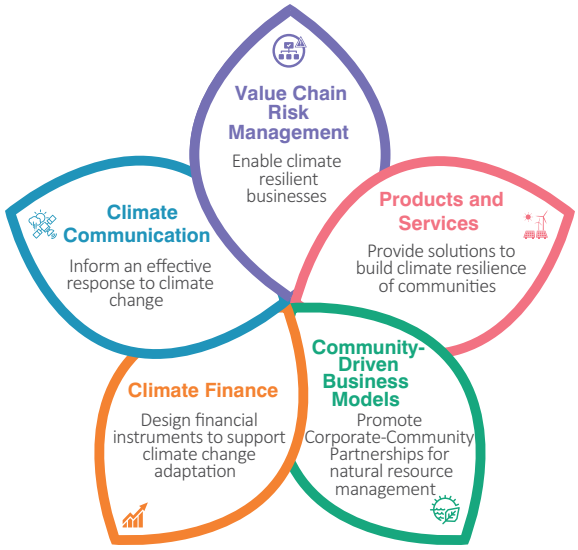


FIGURE 6.3: Five approaches for private sector participation in climate change adaptation

Source: Government of Maharashtra (2017)

The public sector has an important role to play in helping to prepare a framework for companies across sectors and industries to collaborate. Governments can play a key role in addressing the barriers for private sector financing for adaptation initiatives through the following measures (World Bank, 2021).

- Adopting localized climate risk and vulnerability data available
- Developing effective institutional arrangements for multi-sector adaptation planning
- Strengthening financial incentives (or reducing risks/costs) for private participation—through public finance instruments such as blended finance, credit enhancement, and other targeted risk reduction or revenue-boosting measures.

The public–private partnerships would need to be prioritized to support and enhance climate adaptation efforts supported by international partners and they could provide

a strong incentive to private sector to finance adaptation and resiliency (CPI, 2018).

Food and Land Use Coalition, a community of businesses, governments, and research and technical organizations, works on solutions for agriculture sectors. Natural Capital coalition provides organizations with tools to identify, measure, and value their impacts and dependencies on natural capital, social capital, and human capital to inform their decision-making.

These approaches for integrated and collaborative efforts would aid organizations to implement effective adaptation solutions, develop a better ability to manage and mitigate risks, decrease costs, increase profits, and explore new market and reputation as a responsible corporate citizen.

6.3.5 Collaborations with Coalition for Disaster Resilient Infrastructure for resilient infrastructure

Set up in 2019, CDRI (Coalition for Disaster Resilient Infrastructure) is an alliance of national governments, UN agencies and programmes, multilateral development banks, funding instruments, the private sector, and knowledge institutions that works to make new and existing infrastructure systems more resilient to climate and disaster risks. The Coalition will provide a platform for private sector organizations to share experience, expertise, and best practices on resilient infrastructure design, construction, and operation, given that the private sector is becoming a more important actor in infrastructure development around the world. According to World Bank, every dollar ($1) invested in resilience would bring benefit of four dollars ($4 benefit), and therefore life cycle analysis of infrastructure and cost benefit analysis is crucial.

Infrastructure resilience, being a cross-sectoral issue, requires the participation of a range of economic actors – including the national and sub-national governments, development organizations, financial institutes, and the private sector. Adapting and building resilience in infrastructure assets is necessary for the private sector, considering the evident impacts and physical risks of climate change related events on business activities. In 2021, European Union formally joined CDRI and United States pledged $9.2 million support to the organization to support innovations and best practices.

Public–private partnerships are important for mobilizing private capital and supporting

Box 6.5: Coalition for Disaster Resilient Infrastructure and Role of Businesses

CDRI has collaborations with two international networks to mobilize and develop a business case for the private sector for investing in resilient infrastructure:

1. **Coalition for Climate Resilient Investments:** It is a first of its kind private sector led coalition for climate resilient investment. It consists of companies from across the value chain with US$5 trillion of assets under management alongside government and multilateral organizations.
2. **ARISE:** A Private Sector Alliance for Disaster Resilient Societies, it is a network of private entities led by UN Office for Disaster Risk Reduction (UNDRR).

Source: Coalition for Disaster Resilient Infrastructure web-site

public institutions to advance investments in resilient infrastructure (UNDRR, 2020). The collaboration between different stakeholders can be strengthened for a comprehensive disaster risk financing strategy to bring governments and industry on board to effectively mitigate post-disaster losses and build back better. These collaborations would also ensure efforts to integrate climate risks and disaster resiliency into infrastructure investment decisions, advancing efforts for policy dialogues, co-creating roadmaps for resilient infrastructure, and encouraging peer learning.

Box 6.6: Emergence of Sustainability Linked Bonds Markets

The International Capital Market Association (ICMA), which has an objective to build a common framework within sustainable capital markets, published Sustainability Linked Bonds (SLBs) principles in June 2020. These bonds can be used by all types of issuers and designed to bring credibility, transparency, and progressive ambition to SLBs. SLBs incentivize externally verified sustainability (ESG) objectives through predetermined KPIs and sustainability performance targets (SPTs). SLBs are gaining traction among Indian issuers. UltraTech Cement has already issued such bonds this year and Adani Electricity Mumbai Ltd is close to launching its bonds.

Funds raised by Indian firms via sustainable bonds issued in the overseas market have seen a sharp spike in 2021. Ten Indian firms have raised $4.64 billion via sustainable bonds so far this year, a fivefold jump from $950 million raised by just two firms in 2020 according to a data analysis by Refinitiv, a London Stock Exchange Group business. Indian firms have an immense potential to tap into global sustainable bond markets, which is expected to hit a new record high of $850 billion in 2021, observing a 59% jump from 2020 according to Moody's investor analysis.

Source: Refinitiv and Moody's investor analysis

6.3.6 Mobilizing finance for green investments

Finance is a critical enabler for climate action and acceleration of low carbon transition. The industry is working collaboratively to accelerate financing by following a systematic and consistent approach while also working individually on new products and models to enable financing for delivering a low carbon economy. There are various vehicles and instruments developed in India for investments and raising capital through equity and debt.

Since 2015, India has been issuing green bonds. Since January 1, 2018, India has issued green bonds worth approximately $8 billion, accounting for about 0.7% of all bonds issued in the Indian financial market. The outstanding amount of Green Bond proceeds allocated to support the financing of such projects in India as of June 30, 2019 is anticipated to be US$640 million (RBI Bulletin, 2021). According to the Economic Survey 2019–20, India became the world's second largest market for green bonds in the first half of 2019, with $10.3 billion in transactions, as issuers and investors continued to adopt policies and strategies aligned with sustainable development goals.

There are various credit enhancement schemes, or partial risk guarantee facility can be deployed to improve the credit profile of

a structured financial product or transaction. The India Infrastructure Finance Company Limited (IIFCL) also launched a dedicated scheme known as the 'credit enhancement scheme' for funding viable infrastructure projects with project bond tenors above 5 years. Because of the successful outcomes of this mechanism, the government can consider collaborations and setting up a dedicated fund along with the private sector to provide partial guarantees for green investments.

The potential of blended finance could be explored to scale private sector financing in different models for mobilizing green investments. In 2020, the Sustainable Finance Collaborative was created by the Department of Economic Affairs (DEA), Ministry of Finance, Government of India in conjunction with the United Nations Development Programme India to build an ecosystem for India's sustainable finance architecture. It addressed issues such as barriers to deploying new and innovative financing, such as impact investing, the role of blended finance instruments, green finance instruments for sustainable development, the need for a taxonomy of environmentally sustainable activities, corporate sustainability disclosures, and preparing the financial sector for climate change risks (MoF, 2020).

6.4 GLOBAL COLLABORATIONS TO ADVANCE BUSINESS ACTIONS

6.4.1 Call to action on industry transitions: leveraging global platforms

Supporting low carbon industry transition is a priority for the Government of India and for the Indian industry itself. This led to India playing a key role in the Industry Transition Track at the UN Secretary-General's Climate Action Summit in 2019, where the 'Leadership Group for Industry Transition' (LeadIT) was initiated by India and Sweden to drive global transformation in hard-to-decarbonize and energy-intensive sectors. Similarly, India is a member of Mission Innovation, the main intergovernmental platform addressing clean energy innovation through action-oriented cooperation. Given the opportunities in India's green hydrogen space, a coalition of energy and industrial firms named India H2 Alliance (IH2A) was formed for commercializing hydrogen technologies and creating a hydrogen economy.

Coalitions of industries would facilitate the near-term action (prior to 2030) required for a low carbon industrial transition, focusing on improving the efficiency of existing processes and the deployment of existing technologies and best practices. In order to drive industry transitions, research and development (R&D) funding, risk mitigation policies, and co-funding of large prototypes and demonstration projects are needed to decrease the cost of capital. In addition, end uses still at the demonstration stage may need dedicated mission-driven innovation programmes with clear timelines and collaboration with the private sector to accelerate their commercialization (IRENA, 2020). An example of this could be a full-scale demonstration hydrogen based direct reduced iron (DRI) process for green steel manufacturing in India.

6.4.2 Collaborative approach for R&D and dedicated green finance for industry transitions and emerging technologies

While transitioning of the electricity sector to a lower carbon pathway has been successful

to various degrees across the globe, heavy industry is a sector where progress on green transition is lagging relative to efforts required to combat climate change. These industries are the growth drivers for a growing economy like India, but they are also amongst the highest emitters of CO_2 and are capital intensive with long lifetimes, making it vital to urgently take measures to transition them to low carbon pathways (TERI, 2020).

Box 6.7: Research and Innovation Leadership by EU

There is increased budget allocation in Horizon Europe program, the InvestEU fund under the EU Green Deal aims to mobilize investments for research and innovation (R&I). These budget allocations could immensely aid in facilitating global cooperation on demonstrations and pilot testing of new and emerging technologies. R&I investment directed to research organizations, universities, and innovative technology companies is a key component of EU's strategy, complemented with appropriate framework conditions, market regulations, and supply of required skills and low cost capital.

This presents an opportunity to create new partnerships between Indian industry, academia with programs on research and innovation, and industries located in EU. These collaborations would facilitate to leverage mutual strengths for implementing new technologies, bringing down the costs, and encouraging innovation and industry transitions.

Source: Fragkiadakis, Fragkos, & Paroussos (2020)

Research and development is crucial for new and emerging technologies. In order to chart a domestic pathway towards low emissions, a collaborative approach for research and development is required, particularly for hard-to-abate sectors. This should be complemented with policies to promote innovation and technology demonstration of crucial technologies such as HIsarna, CCUS, and hydrogen based steel production. These technologies would require global cooperation for research, development and demonstration, engagements with international consortiums, and dedicated green finance for these technologies. The induction of these technologies is also crucial to hedge the risks against imposition of climate border adjustments and trade measures.

Along with research and development, a facilitative mechanism for dedicated green finance would be required to advance global efforts for these technologies. In India and most of the developing economies, financing industry transition has not been an area of focus. According to a recent study, in 2017 and 2018, 80% of green finance in India was targeted at the power generation sector, with the other major recipients being mass rapid transit systems under sustainable transport and energy efficiency for power transmission (CPI, 2020). This also results in the lack of demand for green products and the lack of a well-developed market for green products. This weak ecosystem for green products creates finance-side barriers pertaining to the limited capacity of financiers to finance the higher cost green transition of hard-to-abate sectors. A collaborative approach for research and development and identification of enablers for financing of new and emerging generation technologies would be crucial for transitions required by both developed and developing economies.

6.5 FUTURE ACTIONS AND RECOMMENDATIONS

Indian industry is well placed to provide complementarity to India's NDC's efforts. In this decade of climate action, Indian industries have the potential, scale, and resources to contribute to India's climate change efforts and implementation of NDCs.

In the near term, the focus would be on economic recovery from the pandemic. The growing eminence of sustainability disclosures through SEBI introducing BRSR guidelines would motivate a large number of businesses to mainstream ESG and climate action efforts while strategizing their action plans and aid financial institutions such as banks, credit rating agencies, and financial institutions in investment decisions. The near-term actions by the Indian industry would facilitate institutional capacities for both private and financial sectors, including integrating a green lens to long-term investment decisions and climate risk assessments.

The roadmaps to decarbonize the industrial sector with inclusion of sector-specific targets (especially for hard-to-abate sectors) for industries in the NDC commitment will help in strategizing ways to decarbonize the sector. For example, the transition of the power sector has been targeted under NDCs. Innovative sector-specific policies would aid in strategizing ways to move towards disruptive technologies by 2030.

While India has committed to the NDC until 2030, it will require a long-term strategy to reduce emissions while pursuing sustainable growth and development. It is crucial to highlight, however, that the success of a long-term strategy is contingent not only on the lessons learned from short- and medium-term development strategies, but also on international cooperation and coordination. As a result, the accelerated change necessitates worldwide financial and technological cooperation (Krishnan, 2020). In the medium to long term, the role of technologies would come into play. Technological advancements will directly reduce emissions by bringing in efficiency, monitoring progress toward targets, and creating new solutions through innovation and entrepreneurship. Global collaborations for industrial decarbonization with European countries would facilitate knowledge sharing alongside the technology transfer. In the long term, industrial decarbonization will transform India towards sustainable futures and further towards deep decarbonization.

Key levers to accelerate and support industry actions and key asks from the international community are discussed next.

» Lever 1: Strengthening regulatory framework to accelerate private sector contribution to energy and industry transitions

Through continuous stakeholder engagements, government can continuously improve policy environment to enable private sector participation in achieving renewable energy targets, promoting battery storage technologies, restoring financial health of distribution utilities, power procurement planning, and supporting an enabling ecosystem to drive industry transitions. For India, a multi-pronged approach of policy framework for the industrial sector could be helpful. An supporting framework for corporate procurement of renewables would play a significant role in achieving India's 2030 renewable energy targets of 450 GW while promoting battery storage technologies. In addition, green policies focused on small and medium scale industries are important, which

would help in adoption of green practices, reduction in energy consumption, and increase in efficiency and quality of products. Policies to ensure availability of low cost financing to invest in new technology and sharing of investment risks will serve forward-looking industries as a motivation to move towards low carbon transition.

Key Asks at COP 26: Create a movement to recognize efforts of the commercial and industrial sector to transition to renewable energies.

» Lever 2: Leveraging private sector for adaptation initiatives and resilient infrastructure

Private sector can be leveraged to enhance country's adaptation efforts and building climate resilient infrastructure complementing the objectives of CDRI led by India. The fundamental barrier to adaptation initiatives is the lack of an appropriate regulatory framework – including policy focus, guidelines, and rules for mandating and encouraging climate resilient infrastructure, which leads to lack of financing.

Key Asks at COP 26: Global collaborations for advancing adaptation initiatives and financing climate resilient infrastructure with Indian business and industry.

» Lever 3: Dedicated green financing and the role of private finance

As India nears its goals for fulfilling its NDC commitment that lies at the heart of the Paris Agreement, there is a substantial requirement of finance to fund green transition efforts and industry transition. For example, the parliamentary panel report earlier this year estimated the requirement of ₹2.61 trillion (₹261,000 crore) more to fund the balance energy capacity to meet the target of 175 GW by 2022 and the present investment in renewables sector averages around ₹823 billion (₹82,300 crore) (MNRE, 2021). The gap could be closed by leveraging private capital flows, promoting FDI investments under the automatic route, and providing a guarantee to investors to develop clean energy infrastructure in the country. Mobilizing private finance requires a mix of policy support, regulations, and risk mitigation instruments for incentivizing private climate investments. To mitigate the associated risks, de-risking mechanisms are required and international climate finance with public finance support can help address this barrier by providing risk mitigation support.

Climate bonds have played a significant role. Co-financing/guarantees is another mechanism that attracts the private sector to invest in climate change adaptation and resilience projects and innovative insurance products, for example, weather index insurance, could be developed by private sector owned insurance companies. The private sector finance could be leveraged to its maximum extent through collaborations and co-financing instruments, especially for adaptation initiatives in India (Timilsina,, 2021). An ecosystem for dedicated green financing needs to be developed that would provide adequate support to domestic initiatives and bring down the cost of technologies. For example, adequate funds for viability gap funding mechanisms could aid in bringing the costs and advancing several low carbon initiatives towards commercial viability.

Key Asks at COP 26: Enable access for dedicated green financing to support implementation of low carbon technologies.

» Lever 4: Focus on technology deployment and innovation

A commercialization grant or one-time technology adoption incentive for new technologies would also help in achieving scale. Technologies that include material efficiency and energy efficiency in turn aid in lowering carbon emissions in the near-term and long-term scenarios within different industrial subsectors. For India to become a manufacturing hub, which aligns with the objective of Atmanirbhar Bharat and Make in India initiative, the manufacturing sector needs to adopt competitive technologies that are energy efficient, resource efficient, advanced, and low carbon in nature. The internal drivers within the manufacturing sector should be able to drive the organization to adopt green practices and competitive technologies. The external drivers include alignment of organization's goals with national and international ambitions. For hard-to-abate sectors, innovation and technology demonstration of crucial technologies such as Hlsarna, CCUS, and hydrogen based steel production is important for decarbonisation. These technologies would require global cooperation for research, development and demonstration, corporate buyer's club, engagements with international consortiums, and dedicated green finance for these technologies and global engagements should also facilitate demand for low carbon products.

Key Asks at COP 26: Facilitative mechanism for emerging green technologies and leveraging partnerships for India. Garner global commitments and support towards transfer of technology and innovations and creation of demand for low carbon products.

» Lever 5: Focus on research and development

A framework for building partnerships with governments, private sector, and academia along with global counterparts would accelerate research and development within different sectors. In order to chart a domestic pathway towards low emissions, a collaborative approach for research and development is required particularly for hard-to-abate sectors. India is a good partner to facilitate global partnerships and collaborations on advancing research and development in various sectors.

Key Asks at COP 26: Garner support for global cooperation on research and development.

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Renewable Energy

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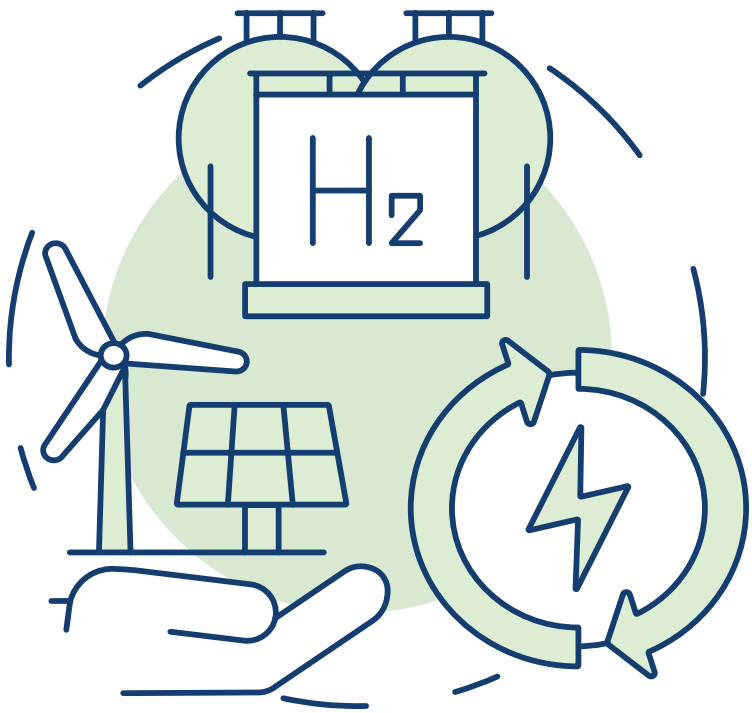

Chapter 7 RENEWABLE ENERGY

Abstract

Today, around 80% of the total energy requirement in India is met through fossil fuels with a significant contribution from imports of oil and gas. The decarbonization of the energy-intensive sectors such as mobility, industries, and power thus becomes inevitable to mitigate the rise in emissions and ensure a clean and continued sustainable growth of the country. The electricity sector in India is undergoing transition owing to consistent efforts towards achieving the country's nationally determined contribution (NDC) targets, increasing consumer expectation coupled with changing consumer behaviour, various supply-side technology innovations and price discoveries. The decline in the cost of renewable energy (RE) technologies and that of energy storage holds promise that the transition may be sustainable or it could even witness acceleration depending on the trajectory of cost decline. India has consistently stepped up its RE capacity targets to 175 GW by the year 2022, and 450 GW by 2030. These national targets are aligned with India's climate commitments made at the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC), also known as the Paris Agreement, which came into force in November 2016. This chapter will discuss options and policy imperatives for India to meet the 450 GW by 2030 renewable target.

7.1 INTRODUCTION

7.1.1 Overview of the energy sector in India

Policies in India's energy sector had been focused on completing the goal of taking affordable electricity to all villages and households, overcoming power shortages, and completing the transition to the use of modern commercial energy. Since the turn of the millennium, electricity access has increased from less than 60% of the population to near universal access (World Bank, 2021). Average rural power supply duration increased from 12.5 hours in 2014–15 to 18.5 hours in 2019–20 (MoP, 2021). Reliance on firewood, crop residue and cattle dung as a cooking fuel has decreased, with the share of Indian households using LPG as their primary cooking fuel increasing from 28.5% in 2011 to 71% by March 2020 (Mani, Agrawal, Jain, & Ganesan, 2021).

Energy use has doubled since the year 2000. However, demand growth has been slower

than the rate of economic growth (Bardhan, Debnath, & Jana, 2019). This is partly due to India's economic growth being led more by services rather than manufacturing and partly due to the effectiveness of the ambitious policies and programmes pursued over the past two decades to promote energy efficiency and reduce the energy intensity of India's economic growth trajectory through the Bureau of Energy Efficiency (BEE). India has at the same time also sought to reduce the carbon intensity of its economy. These efforts have spanned across sectors and have included improving access to clean cooking energy through the Pradhan Mantri Ujjwala Yojana; increasing industrial energy efficiency through schemes such as the Perform, Achieve and Trade (PAT) Scheme; promoting energy conservation practices and efficient appliance usage for residential, municipal, and agricultural consumers; decarbonizing the transport sector through electrification of railways, promotion of electric vehicles and improving emission standards of vehicles; and establishing minimum energy performance standards for buildings.

Energy needs have been primarily met by traditional fossil fuel sources. Around 80% of the total energy consumption (MoSPI, 2021) for power generation, industry heat requirements, and mobility is met through fossil fuels, with imports of oil and gas constituting a significant share in the overall mix, as shown in Figure 7.1. The power sector is currently dominated by coal-based power plants, which account for 60% of the total generation capacity (389 GW) and around 75% of the total electricity generation in India. While per capita emissions in India are less than half of the world average, and its share in cumulative global emissions (excluding land-use) is less than 4%, the scale of India's developmental and thus energy needs would be enormous in the coming decades (Ritchie & Roser, 2020). Its choices for meeting future energy demand would be critical for climate change. India has embarked on an ambitious energy transition for reducing the carbon intensity of its economy. It has launched a number of initiatives to increase the share of clean energy technologies in the electricity sector, with the result that renewable energy, excluding large hydro, in India now contributes to approximately 11% of the total generation and accounts for ~102 GW installed capacity. Figure 7.2 shows India's installed capacity over the years.

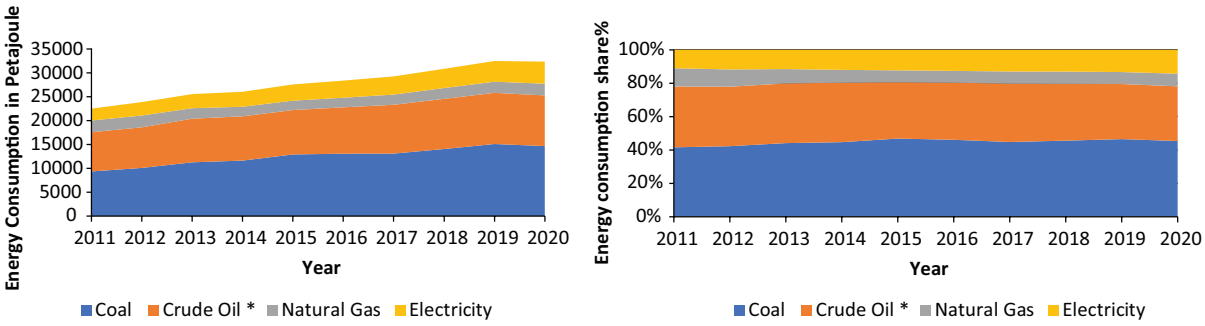

FIGURE 7.1: Source-wise energy consumption in India, 2010–2020

Note: Coal also includes electricity generation from coal; electricity includes hydro, nuclear, and other renewable energy sources

Source: Based on MoSPI (2021)

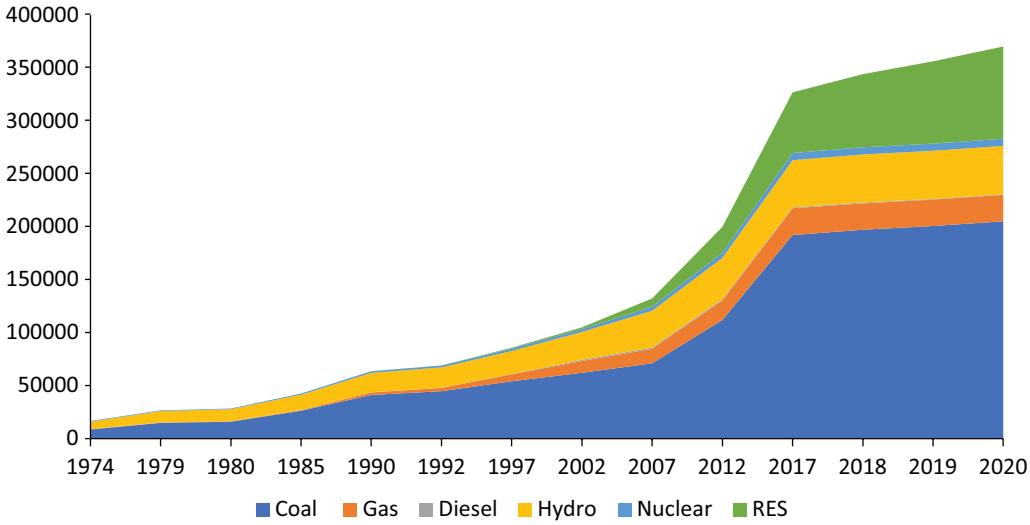

FIGURE 7.2: Installed capacity in India over the years (MW), 1974–2020

Source: Based on Central Electricity Authority (2021)

7.1.2 Progress of renewables in India's electricity sector

The importance of renewable energy sources in India's transition to a sustainable energy base was recognized as early as the 1970s (TERI, 2015). In 1982, India became a pioneer and set up a separate Department of Non-Conventional Energy Sources (DNES) under the Ministry of Energy. This was later made into a separate Ministry of Non-conventional Energy Sources (MNES), which has since been renamed as the Ministry of New and Renewable Energy (MNRE) making India the first country to set up a ministry dedicated to renewable energy (Bardhan, Debnath, & Jana, 2019).

Bioenergy, wind, and hydro initially led the RE sector development in India. Hydropower has been one of the earliest power generating sources in India, with the first plant commissioned in the hills of Darjeeling in 1897. Classified into small and large hydro plants based on the station capacity, India currently has 46 GW installed capacity of large hydro and 4.7 GW of small hydro power (Central Electricity Authority, 2021), and in 2020 became the world's 5th largest hydropower producer (International Hydropower Association, 2020).

India initiated a national wind power programme in 1984 with wind resource assessment, demonstration projects, and industry-utility partnerships, and by 1992, grid quality wind power generation became the thrust area of the MNES. By 1998, India had achieved the fourth highest wind installed capacity in the world, a position it has held to this date due to the consistent expansion of the wind industry (Rajsekhar, Hulle, & Jansen, 1999). As of March 31, 2021, the installed capacity of wind was 39.25 GW (MNRE, 2021).

The growth of Solar PV till 2008 was limited to off-grid applications for rural electrification. The National Solar Mission was launched by the Government of India in 2010 under the National Action Plan for Climate Change (NAPCC) to promote solar power and domestic solar manufacturing capacity. Schemes

bundling then very expensive solar power with cheaper thermal power and providing viability gap funding were offered to promote large-scale solar projects, with additional incentives such as accelerated depreciation, tax holidays, excise duty exemption, and waivers on inter-state transmission charges and transmission losses to reduce the tariff.

The year 2015 marked a landmark transition in India's ambition to accelerate solar power development. The target for solar PV installation by 2022 was increased from 20 GW to 100 GW. Additional commitments towards capacity targets for wind, bioenergy and small hydro were also made, aggregating to an overall target of 175 GW even prior to COP21 in Paris. A historically low emitter, during COP21, India made ambitious commitments to decarbonization. India's Intended Nationally Determined Contribution (INDC) envisaged reducing the emission intensity of GDP by 33–35% by 2030 from 2005 level, achieving 40% of electricity generation capacity from non-fossil fuels by 2030, and creating an additional carbon sink of 2.5 to 3 billion tonnes (MoEFCC, 2015).

As shown in Figure 7.3, the installed renewable generation capacity has, over the past few years, increased at a fast pace, posting a CAGR of 17% between FY14 and FY20. Moreover, solar installed capacity surpassed wind in 2021, achieving a share of 43% of total RE capacity and record-breaking low tariff at ₹1.99/kWh (USD 27/MWh) (*Hindu Business Line*, 2020). The total installed renewable energy capacity in India, excluding large hydro, has crossed the milestone of 100 GW recently, and India currently stands at 4th position in the world in terms of installed RE capacity, 5th in solar, and 4th in wind in terms of installed capacity (MNRE, 2021).

In this chapter, we begin with a review of the existing policy landscape before moving on to discuss these challenges, future actions, and recommendations.

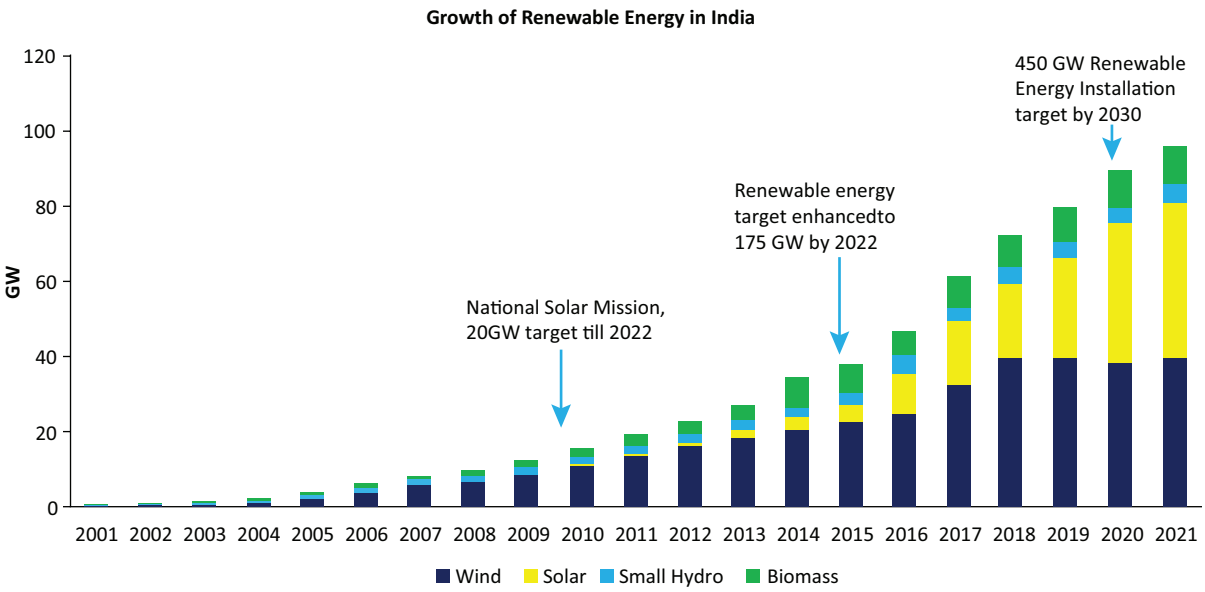

FIGURE 7.3: Growth of RE addition over the years

Source: Based on Central Electricity Authority (2021)

7.2 POLICY MEASURES

Promotion of Renewable Energy Generation and Purchase Mandated by Law

The Government of India explicitly underlined the role of electricity generation from renewable energy sources in the Electricity Act, 2003, the new self-contained legislation replacing the hitherto existing electricity laws. The Act mandates the State Commissions to promote generation of electricity from renewable sources of energy and also to specify a percentage of total consumption of electricity in the area of a distribution licensee for purchase from such sources. To develop the low-carbon technology ecosystem, the Government of India (GoI) has over the years taken policy and regulatory initiatives, market reforms, financial incentives and support mechanisms to encourage and facilitate the adoption of renewable electricity at increasingly lower costs. Salient ones are described below:

7.2.1 Policy support for RE uptake

Renewable purchase obligation coupled with a facilitating market mechanism

In pursuance of provisions in the Act, the Tariff Policy, 2005 prescribed fixing a minimum percentage of purchase of renewable energy by the appropriate commissions. Renewable Purchase Obligation (RPO) is a policy mechanism under which all electricity distribution licensees, captive consumers, and open access consumers are obligated to purchase a specified percentage of power from RE sources. Consequent to upscaling of RE target to 175 GW by 2022, the Ministry of Power (MoP) from time to time, specifies long-term growth trajectory of RPO targets for solar and non-solar power. To facilitate compliance of RPO, market based Renewable Energy Certificate (REC) mechanism is available. Launched in 2010, RECs unbundle the electricity component from the environmental attributes of renewable energy, and allow both to be traded separately, addressing the mismatch between availability of RE sources and the requirement of the obligated entities to meet their RPO targets (Sidhu & Jain, 2021). More than 59 million RECs have been sold on the Indian Energy Exchange (IEX) and the Power Exchange of India (PXIL) since commencement of trading.

Maximizing use of renewable energy and socializing the attendant costs

Wind and solar power have been accorded 'must-run' status under the Indian Electricity Grid Code 2010, preventing their curtailment except for conditions that threaten grid stability, and have also been exempted from the interstate transmission system charges and losses for interstate sale of solar and wind power. While extending the exemption in respect of interstate transmission charges for solar and wind plants to be commissioned up to end of June 2025, such pumped storage hydro plants and battery energy storage systems have also been given this benefit. In addition, lower corporate tax rates for developers, investment in transmission infrastructure and support for solar parks have helped reduce project development and land acquisition risks (IEA, 2021).

Piggy-backing costlier RE power on cheaper thermal power to give a thrust to its uptake

In order to facilitate grid connected solar power, the first phase of the National Solar Mission provided for a scheme of "bundling" the then relatively expensive solar power with cheaper thermal power from the unallocated power of NTPC coal-based stations that was available at the disposal of the GoI (MoP, 2020).

Domestic manufacturing to meet the scale and security of supply

To promote domestic manufacturing, the GoI has prescribed a preference for procurement

of locally- manufactured solar PV modules. Sourcing of solar PV cells and modules, which are supported by government subsidy (such as for PM KUSUM), solar PV cells and modules are mandated to be sourced domestically. The government has also introduced Production Linked Incentive (PLI) Schemes for high-efficiency solar modules and advance chemistry cell battery technologies (MNRE, 2021). The 'National Programme on Advanced Chemistry Cell (ACC) Battery Storage' targets development of manufacturing capacity of 50 GWh, with the aim to facilitate demand creation for battery storage in India and attract more investment.

Facilitating consumer participation and providing choice to promote green energy

While policies for utility-scale solar have seen significant capacity addition, the deployment of rooftop solar has so far been modest. In an attempt to ensure large-scale adoption of solar rooftop systems, the GoI has approved the distribution of central finance assistance (CFA) among the residential consumers (40% CFA for systems under 3 kW and 20% CFA for systems between 3 kW and 10 kW) for setting up 4000 MW of grid-connected solar rooftop projects under the Phase-II of Grid Connected Rooftop Solar Programme (Cabinet Committee on Economic Affairs, 2019).

Visionary approach to address emerging requirements and harness new technologies

Apart from the CFA support, various efforts have been made towards the adoption of the RE sources and advanced metering infrastructure (AMI) in the power system. The GOI under the banner of the Energy Efficiency Services Limited (EESL) introduced the Smart Meter National Programme (SMNP) to replace conventional meters with smart meters. While the offtake of the scheme has been limited, smart meters allow for more flexible and real-time management of demand and will be useful in moving towards time-of-day pricing.

The government has announced a National Hydrogen Mission to promote hydrogen generation from green power sources and develop manufacturing capabilities for hydrogen and fuel cell technologies (MNRE, 2021).

Grid operation and balancing

Flexibility requirements for variable renewable energy (VRE) integration can be substantially met through supply side interventions, new market products and reforms in power systems operation (Palchak, et al., 2017; Spencer, Rodrigues, Pachouri, Thakre, & Renjith, 2020). This section discusses initiatives undertaken in this regard.

Taking note of the emerging flexibility requirements, the Central Electricity Regulatory Commission (CERC) has prescribed 55% technical minimum and improvement in ramp rates for coal plants supplying power across state boundaries.

While the tariffs of wind and solar power declined appreciably, the in-firm nature of VRE called for procurement of balancing power by distribution companies (DISCOMs) to provide grid stability and to meet its requirements during hours/periods of non-availability of renewable energy. The Ministry of Power guidelines for Procurement of Round-The-Clock Power from Grid Connected Renewable Energy Power Projects, provided for 'bundling' of coal-based thermal power with renewable energy in a bid to provide round-the-clock power to the distribution company (DISCOM), thereby obviating the need for DISCOMs to balance power (MoP, 2020).

Recognizing the supply and demand incongruity due to the rising VRE share,

introduction of real-time market operation is a boon for the stakeholders facilitating balancing the intraday variability through the power market. As the interstate power trade grows, the scope for balancing this demand due to extreme events including outage or overloading still remains; and hence the need for contingency reserves to balance demand persists. A Green Term Ahead Market (GTAM), which allows RE plants to sell generation in the power exchange beyond long-term power purchase agreement, has also been introduced to facilitate procurement of green power through transparent bidding. CERC has proposed market-based mechanism and battery storage to support secondary and tertiary ancillary services (CERC, 2021). In order to bring temporal granularity in operation, the system operators have been mooting for a 5-minute scheduling, metering, and accounting.

7.2.2 Sub-national implementation

India has made noteworthy progress towards achieving the ambitious clean energy targets by promoting 'green' energy. This has been made possible with various interventions undertaken at the national as well as sub-national levels. Different states additionally have targets and policies to drive renewable generation, electric mobility, and energy efficiency. India's states and union territories show significant variation in resource availability, policy implementation, and renewable penetration. For example, concerted efforts to increase wind and solar capacity in Karnataka, have meant that these generation sources now account for 29% of its annual electricity generation (Tim & Shah, 2018; Nuwal & Som, 2021) (and nearly half of its total generation capacity). In Tamil Nadu and Gujarat, solar and wind account for 18% and 14% of annual electricity generation, respectively (IEA, Niti Aayog, 2021).

Some municipal corporations too have been proactive in promoting renewables and sustainable energy practices. Surat Municipal Corporation undertook promotion of renewable generation by encouraging residential rooftop solar; and powering civic services such as water distribution and treatment plants, health care centres, and schools with renewable energy (Mathur, 2019). Rajkot's initiatives to improve uptake of renewable energy and expand sustainable mobility infrastructure (among others) saw its award as the national winner of WWF's Global One Planet City Challenge in 2020 (Ren21: Renewables Now, n.d.). The Prime Minister has asked the States to have at least one solar city where all houses have rooftop solar energy plants, and all electricity needs of the city are fully met from solar energy or other renewable energy sources (MNRE, n.d.). The MNRE had requested all states/UTs to select one city, either the capital city or a renowned tourist destination, to be developed as solar city. As of now, 21 States had declared 23 cites as solar cities across India (MNRE, 2021; National Smart Meter Program Dashboard, 2021).

7.2.3 Policy initiatives for energy efficiency

Promoting energy efficiency has been an important component in India's sustainable development policies. The GoI initiated the National Mission for Enhanced Energy Efficiency (NMEEE) as one of the 8 missions under the NAPCC, and has implemented various energy-efficiency schemes through the BEE, including the successful Unnat Jyoti by Affordable LEDs for All (UJALA) programme, standards and labelling programme, etc.

As per an independent report by the BEE, India has already reduced the energy intensity of its economy by 20% compared to 2005 levels,

and seen total electricity savings of 113.16 billion kWh in 2018–19, which is 9.39% of the net electricity consumption (MoP, 2020).

7.2.4 Policy support for greening the transport sector

India has made concerted efforts to make the transport sector green through e-mobility and increasing the proportion of the biofuel blend in petrol and diesel. The Central as well as State Governments are promoting the use of electric vehicles in the country through financial incentives. FAME-I and FAME-II were GoI's flagship schemes to incentivize faster adoption and manufacturing of electric vehicles. Under FAME-I, a total of 280,000 vehicles were given incentives (MoHIPE, 2015). The second phase (2019–22) targets supporting 7090 electric buses (e-bus), 5 lakh electric three-wheelers (e-3W), 55,000 passenger cars (including strong hybrids) (e-4W), and 1 million electric two-wheelers (e-2W) (MoHIPE, 2019). Figure 7.4 shows the year-wise share of EV sales in total vehicle sales in India.

The MoP introduced guidelines for Electric Vehicle Charging Infrastructure that focus on enabling faster adoption of EVs, promoting

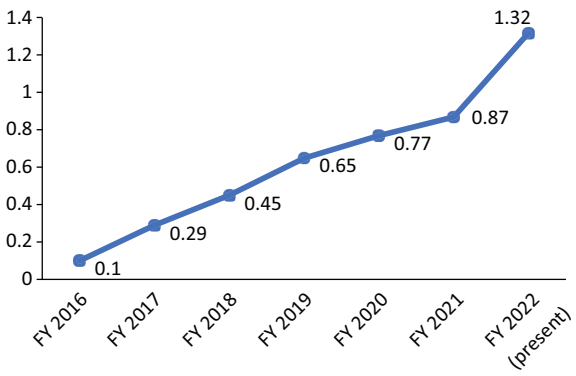

FIGURE 7.4: Share of EV sales in total vehicle sale in India (%)

Source: Vahan Dashboard, MoRTH (2021)

affordable tariff, and creation of support for EV charging infrastructure on December 14, 2018, which were revised on October 1, 2019 (MoP, 2019).

7.3 RENEWABLE AMBITIONS AND CROSS-CUTTING CHALLENGES

7.3.1 Global challenge and India's efforts

The IPCC Special Report calls for global net human-caused emissions of carbon dioxide to fall by about 45% from 2010 levels by 2030 and 'net zero' by 2050 (IPCC, 2018). Moreover, their recently released report 'Climate Change 2021: The Physical Science Basis' estimates that adhering to a remaining carbon budget of 500 Giga-tonnes of carbon dioxide equivalent ($GtCO_2eq$) from 2020 onwards has a 50% probability of restricting temperature rise to less than 1.5°C (IPCC, 2021).

Along with ensuring clean energy, achieving all the objectives of Goal 7 under the Sustainable Development Goals (SDGs) is also an imperative. For the same, the role of global alliances and multi-stakeholder initiatives to mobilize support and garner momentum is key. One such multi-stakeholder initiative is listed in Box 7.1.

India is on track to meet its Paris agreement commitments. It has further increased the scale of its ambition on climate action, deciding to increase installed renewable energy capacity to 450 GW by 2030 (The Weather Channel, 2020). While integrating such large shares of intermittent renewable technologies is challenging, the high degree of flexibility in operation, planning in terms of peak load management, and adequate reserve margins

BOX 7.1: Global Energy Alliance for People & Planet

The Global Energy Alliance for People & Planet is bringing together pre-eminent philanthropic, government, donor, multilateral development bank, development finance institution, and private sector partners to build a unique international platform to accelerate an equitable energy transition in emerging and developing economies. The alliance will drive action on:

- **Carbon emissions**: Avoiding and averting over 3 billion tonnes of greenhouse gases
- **Energy access**: Extending clean, reliable, productive-use energy to 1 billion underserved people
- **Job creation**: Creating tens of millions of green jobs that generate inclusive economic growth

At its core, The Global Energy Alliance for People and Planet is focused on delivering transformational projects that will accelerate and scale an equitable energy transition across the emerging and developing world. By concentrating on the most catalytic use of its philanthropic capital for policy and regulatory enablement, project development, project financing, and energy-enabled economic development, the alliance will work with countries that have demonstrated visionary leadership to deliver a clean energy future that benefits both people and planet.

Source: Contributed by Rockefeller Foundation

are possible to achieve. A key challenge of India's renewable energy transition lies not only in the scale of transformation needed in nearly all the aspects of the power system, but also the speed.

7.3.2 Step increase in capacity addition

At present, RE capacity (~102 GW) in India is 25% of the total installed capacity of ~389 GW, contributing ~11% of the total electricity generation mix. TERI has carried out national (Spencer, Rodrigues, Pachouri, Thakre, & Renjith, 2020) and sub-national studies (Spencer, Rodrigues, Pachouri, Thakre, & Renjith, 2021) providing scenarios that could guide policy planning for deep decarbonization of the Indian power sector. TERI studies bring out that India can integrate shares of solar and wind up to 40% of total electricity generation—approximately four times their current contribution—at no extra system (generation) cost by 2030. To achieve the 450 GW of renewable capacity, India will need to add an average of 40 GW a year, which is a formidable task in view of the fact that its best performance has so far been approximately 12 GW in a year.

Encouraging deployment of more decentralized solar power generation through the provision of financially viable feed-in tariffs would lead to a rapid increase in renewable solar power capacity in India's 600,000 villages. This would also lead to the improvement in the finances of the DISCOMs as their actual cost of delivering power to villages is far higher than an attractive feed-in tariff for solar power generated in the kW range. This would also considerably reduce the need for additional investments in transmission. It would make the achievement of the highly ambitious goal of 450 GW of RE capacity easier.

The Government has come up with draft rules for green energy open access. This is a

timely and laudable initiative as it would give consumers choice to use renewable energy. This would allow consumers who are keen to switch over to the use of green energy to do so and accelerate India's transition to a fossil fuel-free economy. The number of consumers who would choose to consume only renewable energy would grow as more and more people would like to personally make a difference.

7.3.3 Variability caused by RE in grid operation

Accommodating such high shares of renewables will require a significant change in the flexibility of the power system. According to a TERI study, in 2030, wind and solar generation would rise from less than 15% of total generation in non-solar hours to more than 50% of generation in solar hours. This is depicted in Figure 7.5. This supply side variability is further compounded by increasing variability in demand on account of changing consumption patterns, increasing urbanization and new sources of load such as electric vehicles. Addressing this variability will require developing a portfolio of cost-effective supply, demand, and grid operation strategies to meet daily, monthly and seasonal balancing requirements.

Supply-side flexibility can come from the dispatchable hydro fleet and coal fleet, which, by varying their output during the course of the day, can provide significant flexibility. It would be necessary to identify thermal power stations/units which can meet the more stringent flexibility requirements, for example achieving a technical minimum of 40% or even 30%, or two-shift operation. Hydro plants can also provide peak support during the mornings and evenings, though the availability of hydropower varies with the season, and is also subject to other requirements such as irrigation and flood control.

Daily peaking requirements can also be met through battery energy storage systems and gas. While the current high investment costs of battery energy storage systems require high annual cycling for them to be cost-effective, falling technology costs will make this option increasingly attractive. Gas can potentially play a limited role as a peaking fuel, due to limited domestic availability and high costs of imports (Spencer, Rodrigues, Pachouri, Thakre, & Renjith, 2021).

The increasing share of variable renewables will result in greater interstate transfers of power as well as their direction. Transfer of power from areas of excess power generation

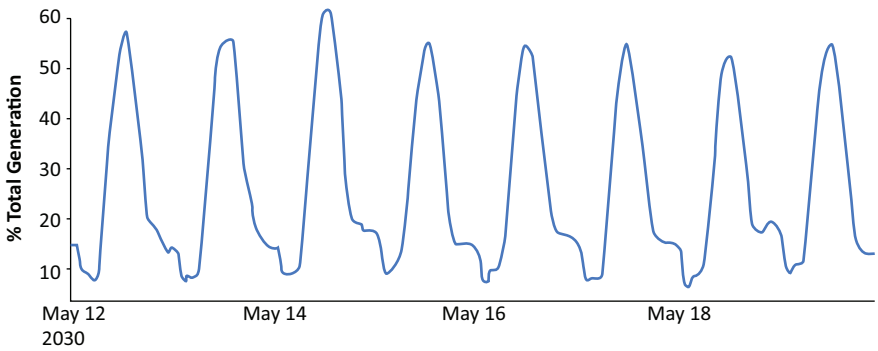

FIGURE 7.5: Daily share of VRE (wind and solar) in total generation, 2030

Source: TERI Analysis

to areas of high demand during times of power deficit is needed. TERI's research indicates that high RE penetration by 2030 could require more than 40% of total Indian electricity demand being met by electricity that crosses an interstate border during high solar hours (Spencer, Rodrigues, Pachouri, Thakre, & Renjith, 2020).

Demand-side measures for load shifting and peak shaving are considered to be among the most cost-effective measures. Implementation of time-of-day tariffs will provide a price signal to encourage consumption when more electricity is available and reduce the extent of storage or curtailment, which may be necessary in a high-renewable regime. As the system transitions from 'flat' tariffs, more complex agreements for voluntary demand reduction or curtailment, peak demand limitation could be considered to contribute to peak load management (Udetanshu, Pierpont, Khurana, & Nelson, 2019).

7.3.4 Advance planning for infrastructure development

While individual solar panels and wind turbines are modular in nature, development of transmission infrastructure associated with RE has long lead time and land acquisition also poses challenges. Planning for a high renewables system will therefore require advance planning for transmission, land acquisition, siting of renewables, informed by trade-offs between centralized and decentralized renewables, and between different options such as battery storage and extension of transmission system.

7.3.5 Policy support for the RE integration at the sub-national level

Electricity is a 'concurrent' subject under the constitution of India, with both Central and State governments having jurisdiction in its development, regulation, and operation. State governments are responsible for the development and regulation of the power sector in the respective state, setting tariffs, and building out intrastate transmission infrastructure. State grids are, however, also deeply enmeshed in the regional and national grid, power utilities in the state buy and sell electricity across state borders through various modes including the pan-India power exchanges utilizing the interstate transmission system.

Enabling decarbonization will require policies, measures and initiatives at the sub-national levels as well.

State-level studies for near-/short-/medium as well as long-term would be necessary to develop greater understanding of state-specific nuances, and the state-specific RE development strategy and action plan including policy and regulatory initiatives as well as building institutional capacities. Advanced power sector models for least-cost optimization of power system operations and capacity expansion planning could play an increasingly important role in helping states integrate high degree of renewables and optimize their overall operations and power procurement costs.

The transition to greater RE share will also lead to a range of co-benefits that have not been quantified systematically yet. An assessment of co-benefits could also complement the dialogue around just transition and help in informed dialogue.

7.3.6 Socio-economic implications of just transitions

Coal mining is a major source of employment and revenue for states such as Jharkhand, Odisha, Chhattisgarh, West Bengal, and

Madhya Pradesh, where coal mining takes place. A transition towards a cleaner electricity system will have implications for the communities dependent on the coal economy as well as revenue streams of the State and Central governments. There are varying estimates of direct and indirect employment in the coal sector with one estimate being around 4 million (Pai, 2021); apart from supporting over half million pensioners. The coal sector is a major contributor to government revenues, with state governments in Jharkhand, Chhattisgarh, and Odisha estimated to receive over 5% of their revenue from the coal sector, and state-owned Coal India Limited and NTPC alone estimated to contribute around 3% of the federal government's total revenue receipts (Pai, 2021).

The implications of the energy transition away from coal for affected stakeholders would need to be carefully addressed. A TERI study mapped the impact of coal mine closures and the socio-politico-economic linkages of towns and communities dependent on coal and found significant implications for social equity and distributional impacts (Gupta, 2021). A 'just transition' requires considering a broad range of social and economic aspects, geographic locations, diverse stakeholders, and time horizons.

7.4 FUTURE ACTIONS AND RECOMMENDATIONS

High renewable integration in the Indian power system is desirable not only from the lens of climate action, but also as a least-cost supply option to cater to future demand. In this section, we discuss some recommended actions and policies which can assist India's transition.

7.4.1 RE integration and policy support at state level

As Central as well as State Governments have jurisdiction in electricity policy, a coordinated approach to formulate short- and long-term policy to increase the VRE share assumes critical importance. Formulation of State-level action plans which holistically estimate nature and extent of demand growth in different sectors and plan optimal supply and demand management options for a rapidly increasing share of renewable energy is now essential. Coordinated planning to integrate various state-level plans with national goals to facilitate large-scale, long-distance power flow across states to optimally locate and utilize generation capacity would become more important. States would need to give greater emphasis on demand forecasting, integrated resource planning, and capacity building, which could be facilitated with the exchange of best practices among the utilities, supplemented by capacity building support by academic and research institutions. They would also need high quality granular data and analytics as well as improved tools, advanced algorithms, and data management support.

7.4.2 Enhancing flexibility and reserve support in the power system

As a high VRE share in the generation requires balancing the demand both diurnally and seasonally, there is an urgent need to increase power system flexibility. This could be achieved through a balanced portfolio of demand side flexibility with suitably designed price signals, supply side flexibility, and storage. By 2030, India would also require a significantly high quantum of energy storage to manage the variability and pumped storage hydro plants may be an economic option for providing long-term energy storage for

seasonal balancing. Moreover, the falling costs of battery energy storage systems could make it increasingly economic for meeting daily balancing requirements. Continued development/strengthening of pan-India grid duly taking note of potential transmission constraints would be a strong enabler. Maintaining reserve capacities and 'climate proofing' infrastructure through investments in infrastructure and redundant capacity would also help ensure reliability in the face of adverse eventualities, especially with the increased frequency and intensity of high-impact events.

Rapid innovations and advances in technologies and materials have seen decline in the costs of clean energy technologies and efficiency improvements. However, given the diversity of solutions emerging, especially in storage technologies, developing technology agnostic pilot projects and market mechanisms for price discovery would be crucial. Successful pilots would provide important learnings on opportunities and challenges and encourage deployment of promising technologies. Government support and industry innovations for domestic manufacturing, including for clean energy technologies such as solar PV and battery storage systems would also be important to address concerns of energy security and also to cater to the scale of domestic demand.

7.4.3 Boosting electricity and renewable demand

Being surplus in generation capacity with a huge renewable expansion plan, this is the right time to electrify more end-use sectors simultaneously encouraging efficient energy utilization. Periodic review and recalibration of policy support for giving requisite thrust to e-mobility, increasing the use of electricity to substitute the use of fossil fuels especially coal in industrial processes, electric cooking, etc., would help in reducing carbon intensity. Changing electricity consumption patterns through pricing policies can further incentivize demand management. For example, price signals, which promote EV charging during high RE periods would more sustainably accommodate their increasing load on the grid. Progressively expanding the scope for institutional and large retail consumers to access electricity markets and mechanisms to enable purchase of 'green' power to reduce their 'carbon footprint' could also promote renewable generation.

7.4.5 Long-term strategies on climate action

India should now begin work on feasible pathways from a 450 GW capacity in 2030 to a fossil fuel-free electricity system along with cost implications with different assumptions of costs of RE generation and its storage costs. The first milestone would be for all additional demand to be met by renewables with storage. This would require significant breakthroughs in innovation for cost reduction of energy storage technologies for daily as well as seasonal peaks during times in the day when RE generation is minimal and demand peaks occur. Green hydrogen offers considerable promise. India has decided to be in the forefront of the new hydrogen economy and has launched a National Hydrogen Mission.

The next step would be to phase out coal-based generation in a planned manner while ensuring just transitions. This would be a formidable challenge. The costs for this would be substantial. Options for reducing these costs and finding resources for the transition would need wide stakeholder consultations and patient consensus building.

7.4.6 Support from global communities

Accelerating a clean energy transition in India will need a massive increase in investments. India's ability to accelerate its energy transition would depend on the success of storage technologies.

The provision of viability gap funding (VGF) from international/multilateral organizations/ sources through a capital subsidy for pilot/ demonstration projects in developing countries for promising storage technologies, both grid level as well as micro-grids using RE will help to bridge the time gap between developed and developing countries moving down the cost curve on storage technologies.

India has evolved a cost-effective technology development, start-up and innovation ecosystem. Collaboration between institutions and firms in the developed countries with their counterparts in India has the potential for becoming a win-win partnership for all. This needs to be facilitated and pursued.

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Low Carbon Transport

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8 Chapter LOW CARBON TRANSPORT

Abstract

Transport is among the fastest growing and energy-intensive sectors in India. Driven by economic growth and a low base, passenger and freight transport is estimated to grow three and sevenfold by 2050, respectively. The sector could become a major constraint in carbon emission mitigation efforts of the country. Significant efforts have already been made in line with the focus areas of the NDCs with mixed results. Decarbonization strategies in order to achieve near zero carbon emission may include electrification of road vehicles, long-term hydrogen-based fuel cells, increased usage of CNG/LNG and biofuels, enhanced fuel efficiency, and increasing market share of railways particularly in hard-to-abate freight transport. Increased investments in low carbon transport technologies, namely, railways, riverine transport, and coastal shipping, may help in transport decarbonization efforts. The chapter identifies gaps and areas for higher ambitions and suggests a charter of actions in the short and long term, primarily with the objective of assisting policymakers to define priority areas for decarbonization and take remedial actions.

8.1 OVERVIEW

Transport activity in India has grown rapidly since 1992, when the United Nations Framework Convention on Climate Change (UNFCCC) was first opened for signatories. According to TERI analysis, passenger and freight activity has grown by eightfold and sixfold, respectively, since then as shown in Figure 8.1. This has been driven by increasing economic activity and consumer demand, reflected in the sevenfold increase in the GDP per capita during the same period (World Bank, 2020). Despite the rapid growth, the transport sector is often seen as a lag on economic activity.

Over the years, there has been a complete transformation in how people and goods move. A major shift has occurred towards road transport, especially since 1990s. According to TERI analysis, the road sector accounts for around 70% and 95% of the total land transport activity for freight and passengers, respectively (Figure 8.2). This has led to a rapid increase in the on-road vehicles in the country, especially two-wheelers.

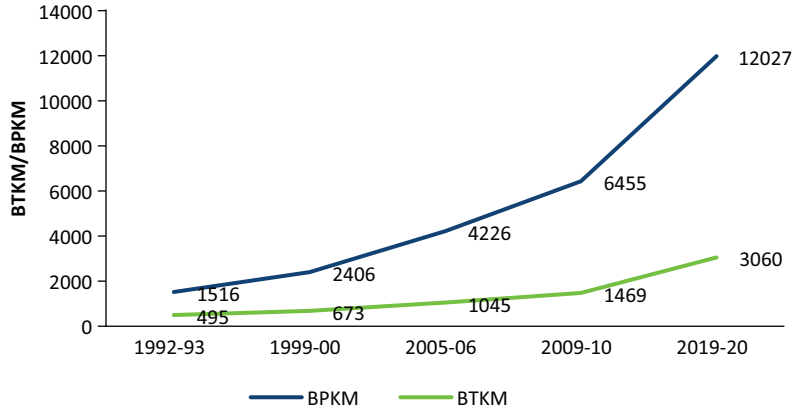

FIGURE 8.1: Accelerated Ggrowth in Ttransport Aactivity

Source: TERI analysis

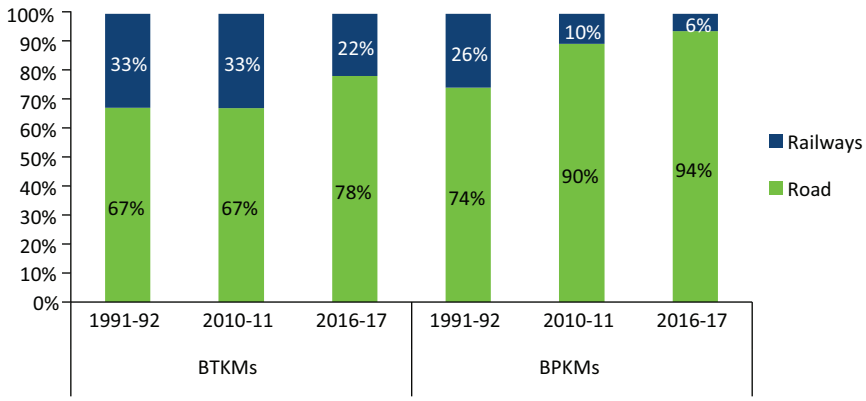

FIGURE 8.2: Increasing share of road in land transport

Source: TERI analysis

CO_2 emissions from the transport sector have grown fivefold since 1992 and stand at around 300 million tonnes ($MtCO_2$) annually (MoEFCC, 2021). India is among the five countries with the largest emissions from transport. However, the present emissions are still well below the top two emitters, namely, the United States and China. Motorization rate in India in 2016 was less than 50 vehicles per thousand people, much lower than other countries and likely to grow much faster (MoRTH, 2018). At around 11%, the share of transport in overall emissions is also much lower in India than developed countries such as the United Kingdom and the United States (Figure 8.3). This is also likely to rise in the future.

In India, buses and Heavy Commercial Vehicles (HCVs) account for less than 10% of the total vehicle stock but responsible for the largest share of emissions within the transport sector (Figure 8.4). Together they are estimated to account for almost 60% of the total CO_2 emissions (Figure 8.5).

In the last few decades, policymakers have largely focussed on expanding transport infrastructure to meet increasing demand.

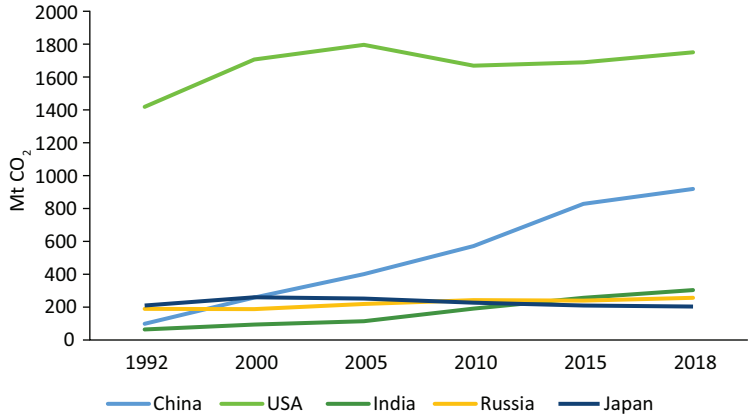

FIGURE 8.3: Emissions from the transport sector in major countries

Source: TERI analysis based on IEA data

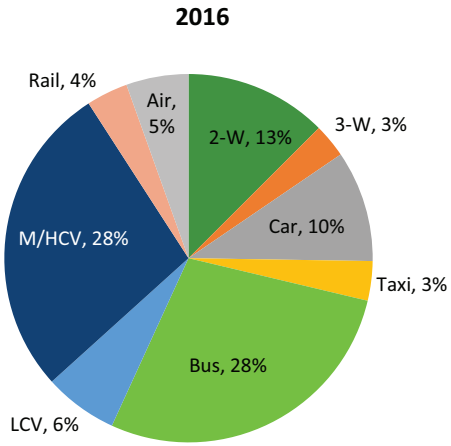

FIGURE 8.4: Energy consumption by transport category in India

Source: TERI analysis

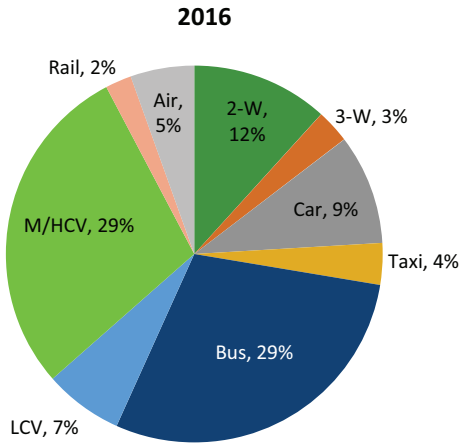

FIGURE 8.5: CO_2 emissions by transport sector category in India

Source: TERI analysis

The main strategy has been augmenting infrastructure for all transport modes. The road sector has seen the largest outlay, leading to a massive growth in road connectivity. An estimated 44% of all transport funds are allocated for the road construction alone (Sharma & Rajput, 2017). As a result, the total road network grew at a CAGR of 3.9% between 2007 and 2017, leading to a road density of 1.48 km/sq km, higher than most other comparable countries (TIFAC, 2016).

Given the increased urbanization, specific attention has been given to urban transport infrastructure. The National Urban Transport Policy, Jawaharlal Nehru Urban Renewal Mission (JNNURM), Smart City Mission (SCM), and Atal Mission for Rejuvenation and Urban Transformation (AMRUT) are some recent urban policies with a focus on transport. However, bulk of expenditure by city governments on transport infrastructure still focuses on building new roads, bridges, and flyovers (SSEF, 2017).

The Indian aviation sector has also witnessed significant growth in traffic and simultaneous infrastructure development in the last two decades. India has about 680 aircrafts and over 150 airports. During the pre-COVID-19 phase, that is, 2019–20, the Indian aviation recorded 275 million domestic passengers and 67 million international passengers. The aviation sector is also expected to grow at a rapid pace in the next decade.

8.2 DECARBONIZATION POLICIES

Transport-specific pledges as part of India's NDC are given in Box 8.1. They highlight the broad strategies being followed for decarbonization.

Box 8.1: Transport in India's NDC

- Increase share of rail in land transport from 36% to 45%
- Reduce 457 million tonnes of CO_2 emissions through building DFCs (dedicated freight corridors)
- National Electric Mobility Mission Plan 2020 (NEMMP) to promote faster adoption and manufacturing of hybrid and electric vehicles
- Promote growth of coastal shipping and inland transport
- Focus on 'moving people' rather than 'vehicles' through mass rapid transit systems and mass urban transport projects
- Develop 140,000 km of green highways
- Improve fuel efficiency
- National Biofuel Policy

Source: Based on GoI (2015)

8.3 PROGRESS TOWARDS NDCS AND SCOPE FOR RAISING AMBITION

8.3.1 Fuel efficiency

Corporate Average Fuel Economy (CAFE) norms introduced in 2017 have shown good results for passenger cars. Under these norms, the weighted average CO_2 emissions from a manufacturer's production line must be less than 130 g/km till 2022 and below 113 g/km thereafter. The results have been encouraging so far. Estimates suggest that the fleet average CO_2 emission for FY 2018–19 was 121.9 g/km (ICCT, 2020).

For commercial vehicles, the progress has been less encouraging. The Bureau of Energy Efficiency (BEE) notified fuel efficiency standards for commercial vehicles above 12 tonnes in 2017. Standards for vehicles between 3.5 and 12 tonnes were notified in 2019. However, compliance has not been very encouraging. Manufacturers had objections related to standards being imposed on individual vehicles and not the whole fleet. There was also a major issue with the testing system related to using lab-based tests compared to simulations. This has led to some bottlenecks in the implementation of these standards.

8.3.2 Electric mobility

Electric mobility has been promoted in a big way. The NEMMP by the Department of Heavy Industries (DHI) has set the stage at a national level. This has been followed by around 21 states with notified or draft EV policies. The most significant step has been the purchase incentives provided under the Faster Adoption and Manufacturing of

(Hybrid and) Electric Vehicles (FAME) scheme. This has been complemented by additional purchase incentives from state EV policies. Focus has also been on incentivizing charging infrastructure and indigenous manufacturing of e-vehicles and batteries.

Despite the policy push, actual EV sales have remained below the ambitious targets. Only around half a million EVs have been sold so far against the NEMMP target of 6–7 million EV sales by 2020 (Figure 8.6). Furthermore, 95% of EV sales have been limited to two-wheelers and three-wheelers. In some segments, EVs have already achieved cost parity on a total cost of ownership basis, especially two- and three-wheelers. However, EVs still have significantly higher upfront costs and financing options are limited, leading to consumer reluctance. There is also a shortage of EV models in the market when compared to the plethora of options available for internal-combustion- engine (ICE) vehicles.

Apart from purchase incentives, the availability of charging infrastructure is one of the most important factors for EV adoption. The NEMMP has provided a policy framework and fiscal subsidies to set up EV charging infrastructure. Recently, INR 10 billion has been approved for facilitation of charging infrastructure under FAME-II. Some state governments have also declared incentives for facilitation of EV charging infrastructure. The amendments are being made in national and state building bye-laws for allocating a dedicated space for EV charging infrastructure at parking places. The states have also set the targets to establish the charging infrastructure along the highways at particular distances.

Countries with successful EV adoption have an estimated minimum 100 charging stations per million population (Slowik & Lutsey, 2018). At present, DHI has sanctioned 3397 charging stations under FAME-II, out of which only 934 are operational. In comparison, China already has 5.1 million public charging stations available as of 2020. It is evident that India has a very long way to go for facilitation of charging infrastructure.

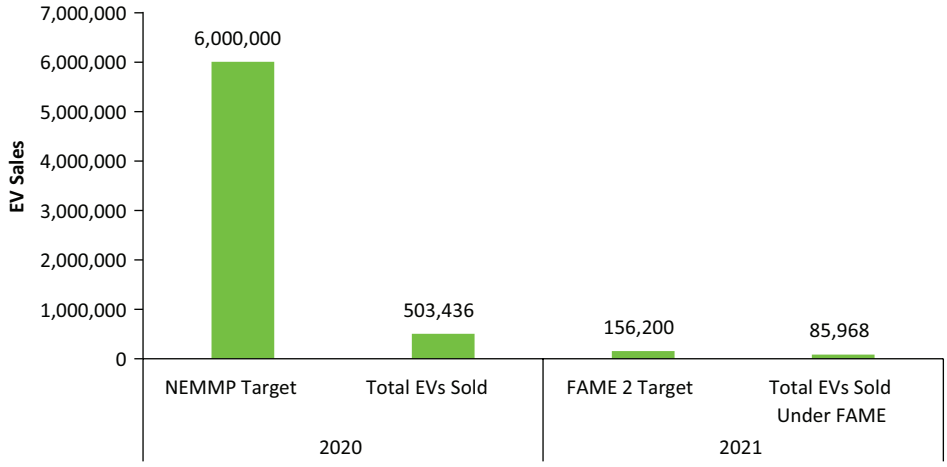

FIGURE 8.6: EV targets and sales in 2020 and 2021

Source: Compiled from multiple sources

The states have also focused on setting up charging infrastructure on the highways in order to ensure the smooth intercity movements. But looking at the current availability of public charging stations, intercity movement seems difficult. Currently, all the charging stations are concentrated in certain urban agglomerations such as New Delhi, Bombay, and Bengaluru. The skewed availability of charging infrastructure acts as a major negative point for adoption of EVs.

There is significant scope to improve adoption of electric mobility going forward. The battery prices are expected to come down further, making EVs more cost-effective and leading to higher adoption. Once a critical mass of on-road EVs is achieved, adoption could be faster. Some of the opportunities and challenges are highlighted in Figure 8.7.

8.3.3 Expanding mass urban transit system

There has been a significant increase in the length of metro network in the last two decades. As of 2021, 786 km of metro network has been constructed in India (Figure 8.8). Delhi metro has the largest length of 389 km as per the latest statistics from the Delhi Metro Rail Corporation Ltd. This has been made possible owing to increase in investments in the metro sector and budget allocation for metro projects. As an example, nearly three-quarter of Delhi's transport budget was spent on metro construction till 2010 (Sahai & Bishop, 2010). Going forward, national infrastructure plan envisages USD 123.56 billion investment in urban mass transit systems.

☑ Scope for raising ambition	☒ Challenges
• Rapid advanced in battery technology • Strong targets for renewable energy adoption • Dynamic automobile industry • Strong government policies	• Achieving critical mass of charging infrastructure • Lack of financing options • Dependence of imports for raw materials • Consumer reluctance

FIGURE 8.7: Scope for raising ambition and challenges

Source: Compiled from multiple sources

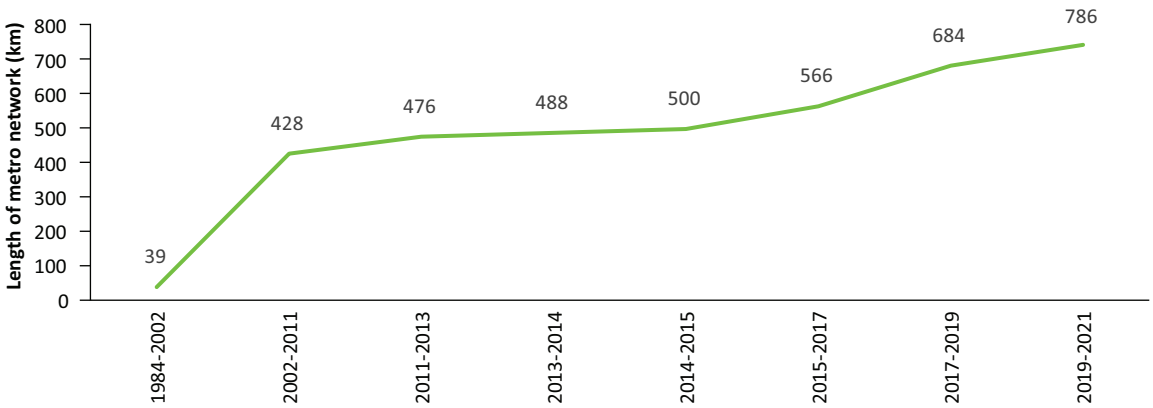

FIGURE 8.8: Length of metro network over the years

Source: Compiled from statistics of the existing metro systems

8.3.4 Public bus system

The public bus system in India has been underfunded for a long time. Of the total registered vehicles on Indian roads, the share of buses stands at 0.7%, of which the total number of buses owned by public transport undertakings stand at approximately 150,000 (MoRTH, 2020). This has led to a major supply gap. India has only 1.2 buses per 1000 population, much lower compared to similar countries. Furthermore, a large part of the bus fleet is overage, leading to poor fuel efficiency and discomfort for passengers. The average age of state transport undertakings (STUs) fleet was 6 years with a maximum of 13.85 years (Bihar SRTC) in 2016–17. The overage vehicle fleet accounted for 27.25% of the total fleet size.

This has led to a decline in the traditionally high modal share of buses. The Centre for Science and Environment (CSE) estimated that the share of public transport across 14 cities is likely to reduce from 75.7% in 2000–01 to 44.7% in 2030–31 (Chowdhury & Dubey, 2018). The share of public transport across cities varies (Figure 8.9). The prevalence of buses in India is still low (Figure 8.10). The shift away from public transport has led to an

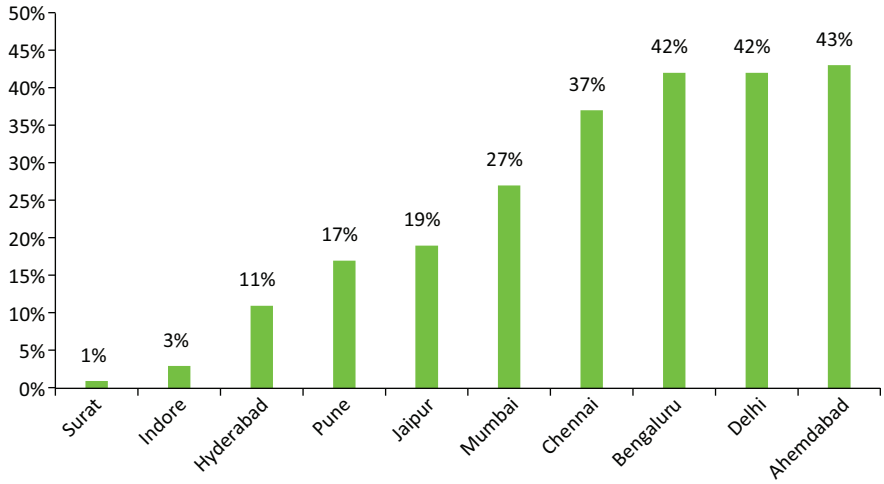

FIGURE 8.9: Share of public transport trips in various cities in India in 2014

Source: WRI (2014)

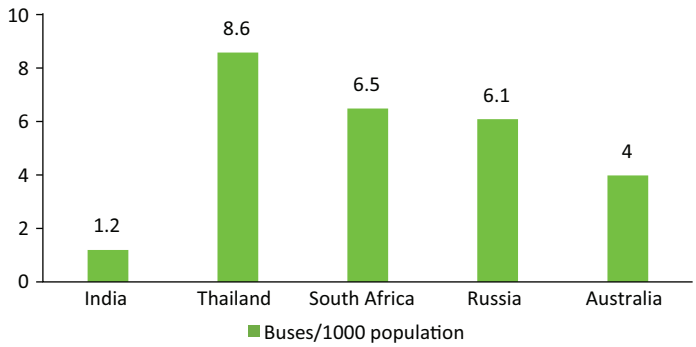

FIGURE 8.10: Prevalence of buses in India, Thailand, South Africa and Australia in 2017

Source: NITI Aayog and the Boston Consulting Group (2018)

unprecedented boom in the private vehicles in cities and the overall increase in the motorization rate.

Some of the areas requiring substantial additional efforts are as follows:

» **Bus procurement:** A 2016 study found that Indian cities would require investment to the tune of $15.4 billion to procure new buses to meet expected demand. The issue arises because STUs run at constant operating losses that hamper their ability to invest in improving their fleet.

» **Intermodal connectivity:** Safe and accessible non-motorized transport to provide effective first and last-mile connectivity options for public transport is essential. Actual investment in pedestrian and cycling infrastructure has been minimal. A recent study found that only 2% of the transport budget in five major cities was devoted to non-motoriszed transport (NMT) infrastructure.

» **Improving customer experience:** User-centric approach is required to improve bus services. Better route planning and cleaner buses are essential. A recent study found that cleanliness was one of the main reasons for users not choosing buses. In addition, IT services will need to be leveraged to provide real time information and integrated payment systems to improve ease of using buses.

8.3.5 Modal shift to rail

In contrast to the NDC goals, the share of rail has been continuously declining. Present estimates suggest that the share of rail in freight movement is around 27% (Ministry of Railways and RITES, 2020), much lower than the 36% share determined in 2005 (Planning Commission, 2013). Infrastructure bottlenecks have been the major cause for the decline in the modal share of rail.

Since the 1960s, freight and passenger loading by railways has increased by 1344% and 1642%, respectively. However, route kilometres have grown only by 23% and track doubling has increased only 289%. The lack of infrastructure augmentation to deal with the growing demand has led to significant operational constraints (Table 8.1). Recently, there have been some positive developments in terms of infrastructure augmentation. Since 2015, investments have been stepped up after the government announcement of a $137 billion dollar five-year investment plan. Since then the running track has increased by around 10,000 km. Additionally, around 6000 coaches and 40,000 wagons have been added to the rolling stock, a major increase. Electrification efforts have also received a significant boost. More than 25,000 km of running track has been electrified since 2015.

DFCs are a major part of the push for increasing the movement of freight by rail. The Eastern and Western DFCs were approved in 2006 and are at different stages of completion. The total length of the Western DFC is 1506 km, out of which 641 km has already been completed. The Eastern DFC is 1337 km with 451 km already completed. Overall, financial contracts valued at Rs 56,952 crore has been awarded and cumulative progress of 71% has been made (DFCCIL, 2021). It is expected that the majority of DFCs can be commissioned by June 2022, but COVID-19 pandemic is likely to cause delay. Further, four more DFCs have been proposed as per the National Rail Plan, 2020.

The railways are well poised to play an important role in decarbonization. Some of the major areas for improvement are given in Table 8.1.

TABLE 8.1: Reasons for Declining Rail Share

Passenger	Freight
» Increased competition from air travel for long-distance services » High transit times and lack of punctuality » Cleanliness » Safety » Lack of premium services » Complicated ticketing process » Security » Lack of modernization of coaches	» Artificially high tariffs » High transit times » No guaranteed delivery times » Failure to modernize rolling stock as per demand of logistics sector » Lack of customer-oriented marketing policies » Capacity constraints and lack of mechanization in terminals » Minimal role of aggregators for multi-modal movement

Source: Compiled by authors

8.3.6 Inland water transport

Despite having an extensive river network, the modal share of inland waterways (IWTs) has been traditionally low, which is below 1%. The National Waterways Act, 2016 was a clear indication of the government's emphasis on IWTs. This has led to a steady rise in actual goods transported on the waterways, increasing from 55.47 million tonnes in 2016–17 to 73.64 million tonnes in 2019–20 (IWAI, 2021).

However, there have been some issues while developing waterways. Of the 37 waterways to be developed by 2019, work has begun only on 16 of them and most are still at early stages (Dharmadhikary & Verma, 2021).

8.3.7 Solutions for hard-to-abate road segments

Electric vehicles are the most prominent zero-emission technology at present. However, all vehicle segments may not be easily amenable for EVs in a cost-effective manner. Table 8.2 gives the segment-wise potential of EVs across multiple criteria. Electrification is not an obvious cost-effective option for the vehicles having higher range and loading requirements. Specifically, long-distance medium and heavy commercial vehicles fall into this category. This segment accounts for a large share of carbon emissions, and identifying the most cost-effective pathways for these segments

TABLE 8.2: Segment-Wise Factors Affecting EV Penetration

	Battery weight penalty	Total cost of ownership (TCO)	Range anxiety	Investment in charging infrastructure
Two- and three-wheelers	Low	Already competitive	Low	Low
Passenger cars	Low	Already competitive	Moderate	Moderate
Light commercial vehicle (LCV)	Moderate	Likely to be competitive	Moderate	Moderate
City bus	High	Likely to be competitive	Moderate	Low
Intercity buses	High	Likely to be competitive	Very high	High
Heavy-duty vehicle (HDV)	High	Difficult to achieve cost parity	Very high	Very high

Source: TERI analysis

will be essential for increasing ambition for low carbon transport.

In addition, the aviation and shipping sectors also lack in zero or low emission options. The overall activity in these segments is limited at present but expected to grow significantly.

Heavy-duty vehicles require dense energy sources to reduce the weight penalties and component costs. As a result, low carbon fuels with higher density might be appropriate for these segments. Natural gas (LNG/CNG) could be a relevant solution, requiring only minimal changes to ICE drivetrain technologies. However, this would increase import dependency. Further, since these are not completely zero-emission fuels, technology lock-ins would be a risk as well. The adoption of fuel cell vehicles and EVs will depend on the level of technological advances and ability to produce vehicles and fuels indigenously. For shorter distances such as drayage and mining operations, EVs could be the relevant solutions. However, for long-distance use, there is a lack of clarity regarding the best options. Box 8.2 depicts equity considerations for the transport sector.

Box 8.2: Equity Considerations in the Transport Sector

India ranks 122nd in the world in terms of per capita income and this should be taken into account while investing in transport infrastructure. Public investment should elevate the most affordable and accessible modes of transport. Increasing road connectivity for rural areas is essential. However, in urban areas there needs to be a balance between infrastructure for private vehicle use, andpedestrian, and mass transit. This pathway is different from higher income countries which have focused on infrastructure for private vehicles.

Female labour force participation remains as low as 20% in India. A necessary but not sufficient condition to improve this is to create more women-friendly public transport systems. Surveys have shown that safety issues are the main concern inhibiting women from using public transport systems. Better security, reserved areas, and women-only buses can help improve this. It is also essential to provide safe first and last mile options. This will require planning terminals and bus stations keeping in mind security concerns. Proper lighting on walkways, CCTV cameras, emergency helplines, and night security guards are some solutions that can be implemented by city agencies.

Employment in the transport sector, especially logistics, remains male dominated. Working conditions are skewed towards male participants. Employers should focus on increasing female participation in offices, warehouses, and as drivers. This will require physical changes to provide a safe working environment; equipment and layout may also need to be adapted in some cases to make it more suited to women. Changing mental perceptions will be just as important, and people responsible for hiring must be sensitized and encouraged to hire more women.

Source: Compiled by authors

8.4 FUTURE EMISSION TRAJECTORIES

Figure 8.11 shows the emission trajectories for the road transport sector till 2050, identified as part of an earlier TERI analysis. Without significant interventions, CO_2 emissions from road transport are expected to increase 73% by 2030. The alternate scenarios assessed different decarbonization strategies in isolation, with focus on the passenger segment. Till 2030, the most effective solution was found to be efficiency improvements, reducing annual emissions by 25%. The next most effective strategy was found to be electrification, which can reduce emissions by 18%.

The modelling results till 2050 highlight the scale of the challenge. In the 'reference scenario', emissions skyrocket to 1447 million tonnes for the year 2050, an almost fivefold increase from 357 million tonnes in the year 2020. This growth is necessary for India to achieve its social objectives of providing a decent standard of living for all citizens. This is quite different from other developed countries where emissions are expected to peak before 2050 as saturation levels are reached for different vehicle segments. This backdrop needs to be considered before altering any climate targets or trying to align with other countries that have already announced net-zero emission targets by 2050. In 2050, electrification clone is found to be an effective strategy resulting in the reduction of annual emissions by 318 million tonnes when compared to the 'reference scenario'. However, electrification is not considered for the freight sector since technology for these segments wais still at a very nascent stage for these categories.

Efficiency improvements also show significant potential, reducing annual emissions by 304 million tonnes. The most important factor is that this is considered as a solution for the freight sector, thus leading to large reductions even for moderate assumptions. This highlights the importance of identifying solutions for the freight sector.

Modal shift also has significant potential, but once again the shift is considered only for the passenger segment to public transport and rail. Going forward, modal shift to rail could

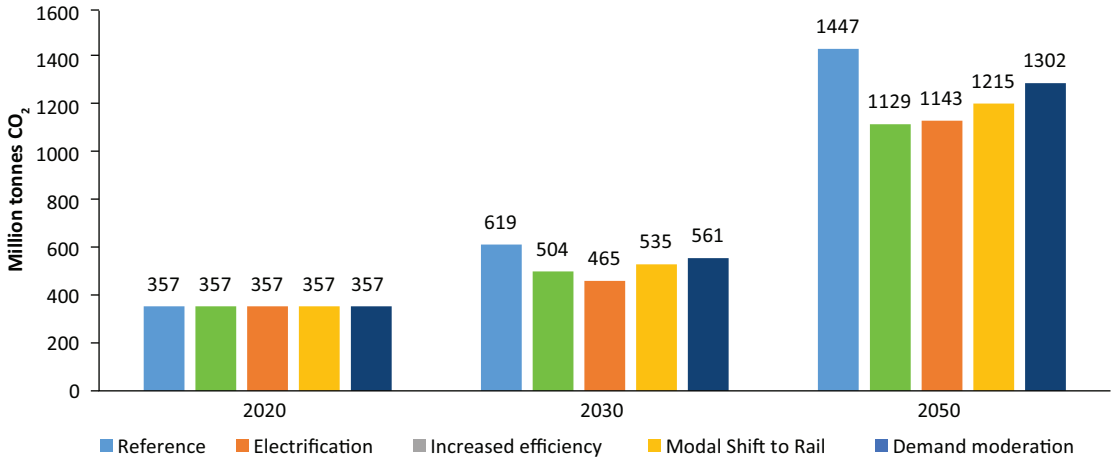

Figure 8.11: Relative CO_2 emission reduction from decarbonization strategies

Source: TERI analysis

be a good option for freight movement, considering 60% of the goods movement consists of bulk goods, suitable for rail movement. An additional integrated scenario incorporating all these strategies together found that emissions could be reduced by 47% by 2030 and 46% by 2050.

Another recent study by TERI found that a combined strategy of electrification of easier transition segments, moderate uptake on LNG and FCVs for freight sector, and modal shift to rail could reduce emissions by 37% in 2050. Clearly, the expected growth trajectory suggests that complete decarbonization of transport is unlikely to happen by 2050.

8.5 FUTURE ACTIONS AND RECOMMENDATIONS

This section provides an overview of the key messages that need to be taken into consideration as the decarbonization efforts move forward.

8.5.1 Broad considerations

» Rapid growth in passenger and freight demand is expected till 2030. Transport activity is unlikely to peak by 2050.

» Dependence of the road sector and private modes of travel is likely to keep increasing without significant interventions.

» Accelerated uptake of EVs can be expected in the two-wheelers, three-wheelers, passenger cars, LCVs, and urban buses by 2030.

» Low carbon technologies for freight segment, especially HDVs, remain limited. These segments account for around 40% of emissions and solutions will need to be identified.

» Railways track capacity and rolling stock will increase substantially by 2030. There will be the need to enable modal shift by improving competitiveness with the road sector.

» Public bus system will require significant additional investment for procuring buses and improving services.

» Accessibility of public transport needs to be improved through investment in pedestrian and cycling infrastructure and transit-oriented planning.

» There is a need to identify long-term low carbon solutions for the aviation sector.

We suggest next a charter of actions for policymakers that would be required to raise ambitions in the transport sector.

8.5.2 Passenger segment

Increased adoption of EVs for two-wheelers, three-wheelers, and passenger cars

» Regulatory targets for OEMs (original equipment manufacturers) to shift to manufacturing of electric vehicles in easy-to-transition segments, especially two-wheelers.

» Large-scale investment to establish charging and swapping stations in public places.

» Awareness campaigns to highlight the benefits of EVs and provide practical information related to vehicle availability and charging infrastructure.

» Encourage larger banks to share initial risk of financing EVs with smaller banks and NBFCs with better monitoring capabilities.

» Promote indigenous manufacturing of batteries and charger components by identifying stable sources for raw materials and providing economic incentives.

» Establish courses in premier public institutions related to electric mobility to develop knowledge base.

Improve public transport

» Prioritize increased budgetary provision for public transport.

» Ensure implementation of pedestrian and cycling related objectives highlighted in national-level urban policies through economic incentives and competitions.

» Encourage public sector banks to provide priority lending to STUs at subsidized interest rates.

» Increase subsidies for e-buses under the FAME-II scheme.

» Explore non-fare revenue generation for STUs such as land monetization and advertisement revenues.

» Employ qualified staff for managing different operational aspects of STUs such as project management, contract management, and route planning.

» Tie up with IT companies to provide better IT enabled service for customers. This includes better scheduling, live data availability, and online payments.

Identify low carbon vehicle technologies for long-distance bus operations

» Pilot projects to determine cost and technical feasibility of low carbon technologies such as hydrogen, LNG, CNG, and EVs.

» Implementation of fuel efficiency standards for buses.

» Increased subsidies for buses under the FAME-II incentives.

» Explore technology agnostic incentives for manufacturing low carbon buses. This would require subsidies to be provided based on carbon emission reductions alone.

Modal shift to railways

» Establish more high-end medium-distance passenger services that can compete with air travel.

» Improve operating ratio for passenger services, increase rates for loss-making services, and shut down lines with low utilization.

» Address safety and cleanliness issues.

8.5.3 Freight segment

Identify cost-effective low carbon technologies for the trucking sector

» Direct funding and support for research organizations involved in low carbon technology research, such as fuel cells, battery technology, and storage technology.

» Engaging in international collaborations for knowledge transfer related to electric, hybrid, and fuel cell vehicles.

» Push truck OEMs to set targets for shifting away from the manufacture of diesel-based trucks and buses.

» Technology agnostic economic incentives for low carbon trucks could facilitate the uptake of the most cost-effective technologies.

Improve efficiency of the trucking sector

» Collaboration with automobile industry to implement the commercial vehicle fuel efficiency standards notified in 2019.

» Introduce economic incentives to promote the scrapping of older trucks.

» Improve the location of warehousing through better data collection related to the origin and destination points. This can be aided by leveraging existing data available from the GST e-way bill system.

» Relook at biofuel policy. Identify enabling cost-effective pathways for second-generation biofuels.

Enabling modal shift to railways

» Expedite delivery times of infrastructure projects, especially the upcoming DFCs.

» Adopt a more business-like approach to freight tariff setting. Tariffs should be based on existing competition rather than internal principles.

» Better implementation of station-to-station rates to decentralize freight tariffs and capture location-specific business.

» Tie up with aggregators to create sustainable multi-modal business models for containers and parcel movement.

» Improve terminal operations by incorporating global best practices related to terminal planning, mechanization, and so on.

8.5.4 Long-term actions

This section highlights some long-term issues that will require action now and in the future.

» **Establish institutions for holistic transport planning:** The transportation sector is at the beginning of a period of significant disruptions. However, the responsibility of implementing different strategies lies with different Central and State agencies. To coordinate actions for the transport sector, there is a need to have a specific institution within the Central and State governments for transport planning. The National Transport Development Policy Committee Report, 2014 had already put forward a roadmap for implementing this.

» **Coordinated investment in low carbon infrastructure**: Going forward, stricter criteria will need to be involved while assessing investment in transport infrastructure. There should be a focus on the lowest cost options while giving higher importance to investment in low carbon infrastructure. This will necessitate some judgments regarding the ideal modal mix as well as the segment-wise potential of alternate fuel options. Better coordination among different government agencies at Central and State levels will also be essential.

» **Increase transport planning and project execution capacity**: There is a lack of technical knowledge base for transport planning in government agencies. As a result, several policies and roadmaps often do not get executed on the ground. The lack of implementation of comprehensive mobility plans for cities is a good example of this. There is a need to either augment technical capacity within existing institutions or create separate institutions for transport planning.

» **Sustain revenues for investment in transport infrastructure**: Petroleum taxes contributed over 2% of GDP in the last decade (Mukherjee, 2019). During 2010–2017, on average 45% of India's union taxes (from customs and excise duties) and 26% of state taxes (from sales tax) were collected from the petroleum sector. Reduced consumption of these fuels could seriously affect government revenues. To ensure that the loss in revenue does not affect investment in decarbonization infrastructure, alternate sources of revenue will need to be established. Congestion pricing, limiting subsidies, and user access charges for using public infrastructure could be some of the strategies for mitigating this.

8.5.5 Actions for the international community

Supporting investment in enabling infrastructure

Enabling low carbon technologies in the road sector will require transformative measures such as investment to propel infrastructure development. The investment will be required at all points in the supply chain of new fuels: production, transport, and retail. However, India faces a stronger budget constraint compared to other developed countries owing to its development needs. Thus, foreign governments and industry will need

to support investment in India through direct investment in projects as well as low interest loan. A common fund for low carbon transport can be set up, with contribution of higher income countries matching the investments made by India.

Differentiated approach

India must be allowed to pursue its own path given the unique nature of its transport sector:

- Existing high share of public transport and non-motorized transport must be maintained.
- Equity aspects must be considered, given the low per capita income in India, and infrastructure investment must focus on providing mobility for all, not just private vehicle owners.
- Indigenous production of new technology vehicles must be encouraged to allow most cost-effective solutions.

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Conclusion

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9 Chapter COP26 AND BEYOND

Abstract

The core message of the COP26 Charter of Actions is the urgency of action that will drive meaningful action. A key is acknowledging the gravity of climate change, but more importantly the enormous possibility of positive action. The Charter then underscores the criticality of action both in name and in principle, underscoring the possibility for India to assume the position of a leader in the global south and rally support to further responsible mitigation and more crucially – adaptation action. The Charter, beyond its space as a knowledge document, is also a medium to help translate principles and ambitions into much-needed action. It builds its messages with an understanding that global-level climate deliberations can take us only so far, and that actual, on-ground climate action requires efforts at national and sub-national levels. By analysing and exploring the themes of equity, green finance, adaptation & resilience, nature-based solutions, energy, clean transport, and business action in the Indian context, the Charter highlights the need of cross-sectoral climate action and necessitates moving beyond rigid silos of unidimensional action to tackle climate change. In the process, it also offers a way forward for the global community for and beyond COP26.

9.1 IN BRIEF

Throughout the nine chapters of the Charter, the common thread has been the need for urgency and climate justice. The science has been there for decades pounding at our doors urging us to listen, to act, before it's too late not only for humanity, but for the countless other species in the biosphere that have either been sidelined or found themselves invisible owing to our hubris.

In a special session on "Youth, Science and Climate Action" hosted by TERI ahead of COP26, Mr Frans Timmermans, Executive Vice-President, European Commission underscored the greatest challenge that the world faces today with regards to climate action. "Time is our biggest challenge," he highlighted. Findings from the sixth assessment report by the Intergovernmental Panel on Climate Change (IPCC) has made it clear that if immediate, ambitious, and large-scale action is not taken now, it would be impossible for us to limit global warming as envisaged under the Paris Agreement.

The core message of the COP26 Charter of Actions is the urgency of action that will drive meaningful action. A key is acknowledging the gravity of climate change, but more importantly the enormous possibility of positive action. The Charter then underscores the criticality of action both in name and in principle, underscoring the possibility for India to assume the position of a leader in the global south and rally support to further responsible mitigation and more crucially – adaptation action.

However, in this process, the Charter's messages do not lose sight of the bigger picture. Climate change is a global threat, and one that warrants concerted global action. In his Ministerial Address at the National Conference on the COP26 Charter of Actions, Hon'ble Union Minister of Environment, Ministry of Environment, Forest and Climate Change, the Government of India Mr Bhupender Yadav emphasized that, "Equity and climate justice are the touchstones of any global climate response. Concerted actions are needed in terms of cooperation between all countries especially with developed countries taking a lead on climate action through mitigation, adaptation, and providing support to developing countries in terms of climate finance, capacity building, and technology transfer."

Thus, while India's actions are vital in helping keep the global average temperature rise within the Paris Agreement goals, ensuring climate justice and developmental imperative for itself and other countries in the global south as well is of paramount importance. Perhaps, having "Implications of Equity and Climate Justice for India's Leadership and Global Framework" as one of the foremost chapters of the Charter of Actions then further underpins the need to recognize, absorb and imbibe these principles as we move towards fruitful climate action.

The Charter, beyond its space as a knowledge document, is also a medium to help translate principles and ambitions into much-needed action. It builds its messages with an understanding that global-level climate deliberations can take us only so far, and that actual, on-ground climate action requires efforts at national and sub-national levels. By analysing and exploring the themes of equity, green finance, adaptation & resilience, nature-based solutions, energy, clean transport, and business action in the Indian context, the Charter highlights the need of cross-sectoral climate action and necessitates moving beyond rigid silos of unidimensional action to tackle climate change. In the process, it also offers a way forward for the global community for and beyond COP26.

Mobilizing support, raising ambition and urging for action is what the Charter intends to disseminate through its seven instrumental themes. To reiterate the need of intersectional, cross-sectoral and concerted climate action, the following is a succinct summary of the key messages from each of the themes covered in the Charter of Actions.

9.2 EQUITY AND INDIA'S LEADERSHIP

With the next global stocktake scheduled for COP28 in 2023, it is crucial to assess the progress made by countries considering the principles of equity well before the next stocktake. From the perspective of a developing country such as India, the terrain of equity needs to be framed more comprehensively than mitigation. This process of framing would also need to consider

aspects related to adaptation, climate finance, and technology transfer.

To give equity and climate justice their due, long-term climate actions will also have to incorporate within themselves—adaptation along with finance and technology needs in addition to mitigation. The discourse on 'Just Transition' needs to be redefined with civil societies factoring adaptation to it.

India can assume the role of an entrepreneurial leader by leading developments in breakthrough and disruptive technologies. It can also be a norm leader by building shared understanding on sustainable consumption, adaptation and non-anthropocentric notions around equity and climate justice.

9.3 CLIMATE FINANCE AND GREEN FINANCE

There is an urgent need to distinguish climate finance from green finance, the former being a subset of the latter and is a specific area of concern for climate negotiations. Targets set under the long-term finance need to be defined and assessed. Greater clarity on Article 6 mechanisms of the Paris Agreement is also warranted.

In the short term, post the COVID-19 recovery, there is a demarcated need to lay down foundations for an enabling environment for green finance, including shared taxonomies, while simultaneously building awareness and capacity of key stakeholders. The global goals of financing need to be urgently realized, crucially starting with the fulfilment of the USD 100 billion target. Additionally, there is a need for well-defined mechanisms under the new collective quantified goal on finance.

Decision-making processes for state and national budgeting have the potential to be reformed using frameworks aligned with the budgeting of NDCs, SDGs, or those of green budgeting.

Mobilizing green finance from the private sector including through Environmental, Social and Governance (ESG) investing and international finance is also warranted. There is also a need for greater transparency of information through disclosure standards in financial systems.

9.4 ADAPTATION AND RESILIENCE

India should develop a National Adaptation Plan, as per the provisions of the Paris Agreement. Research gaps need to be addressed by investing in science-based tools and by building datasets. Furthermore, private sector's role in adaptation and resilience building should be augmented. Address the challenges faced in implementing short and mid-term strategies will be key in meaningful climate action efforts.

A crucial question regarding COP26 is whether COP26 will be an Adaptation COP. Adaptation is key to the long-term global response to climate change as recognized by Article 7.2 of the Paris Agreement. However, long-term strategies formulated and communicated under Article 4.19 of the Paris Agreement at the moment only focus on low greenhouse gas emission development strategies and do not consider adaptation as a key focus area to combat climate change.

Despite the inherent need of adaptation in strengthening climate action, a key area of concern remains the inability to quantify or map the progress in absolute terms. In the absence of such measures, momentum in addressing adaptation needs may be lost. Global support in the form of knowledge and

information sharing, technical and financial capacity will be crucial for substantial climate action.

9.5 NATURE-BASED SOLUTIONS AND AGROFORESTRY

Trees Outside Forest (TOF) form nearly 38% of the carbon sink in forest and tree cover of the country. Agroforestry has a huge potential in India. It can contribute to more than 2 billion tonnes of CO_2-eq by 2030 if the government puts in place appropriate incentive mechanisms for farmers or producers.

Nature-based solutions (NbS) would require ecosystem-based approaches that consider terrestrial, coastal, and marine ecosystems. Carbon markets need to be strengthened to enable large-scale implementation of NbS. Farm resilience needs to be improved through diversification and carbon sequestration.

9.6 BUSINESS AND INDUSTRY

The growing eminence of sustainability disclosures through SEBI introducing Business Responsibility and Sustainability Reporting (BRSR) guidelines would motivate many businesses to mainstream ESG and climate action efforts while strategizing their action plans. Additionally, it will also help financial institutions like banks, credit rating agencies, and other financial institutions in making their investment decisions.

In the medium to long-term, the role of industries in developing disruptive technologies, especially in hard-to abate sectors, would be crucial.

Private sector can be leveraged to enhance country's adaptation efforts and build climate resilient infrastructure complementing the goals of initiatives such as the Coalition for Disaster Resilient Infrastructure.

9.7 RENEWABLE ENERGY

India has consistently stepped up its RE capacity targets to 175 GW by the year 2022, and 450 GW by 2030. Apart from supply side measures, there is also a need to boost demand for renewable electricity by pushing technologies such as electric vehicles.

For power sector de-carbonization through large-scale deployment of renewable energy, viable energy storage alternatives will be needed to meet evening peak demand.

To realize Goal 7 of the SDGs, along with large-scale renewable energy deployment, there is need to raise awareness and deploy innovative models for ensuring energy access for improved livelihoods and well-being in rural areas through options such as distributed renewable energy.

9.8 SUSTAINABLE MOBILITY

Low-carbon transport must be equitable and available to all, not just private vehicle owners.

A common fund for investment in low-carbon transport infrastructure can be set up.

Improve the technical knowledge base and build capacities for transport planning including non-motorized transport.

9.10 WAYS FORWARD

COP26 is said to be our last chance to agree on the ambition level to realize the goals of the Paris Agreement. However, these discussions

would need to continue through other future COPs. Through the messages of the COP26 Charter of Action, we hope that TERI can contribute to meaningful deliberations on substantial actions among key stakeholders including the youth for COP26 and beyond. We stand at a critical moment not just in the history of global-level climate negotiations but also of the planet. Every action now will determine the fate of humanity.

Global deliberations are important, but the real arena for climate action is at the national and sub-national levels and also in business and industry. It is essential that climate action be understood in both sectoral and cross-sectoral terms, including in areas of finance as well as science, technology, and innovation. The COP26 Charter of Actions is a knowledge document prepared by TERI that assimilates questions and thematic options that can advance climate action and ambition in the country and globally. The Charter examines the themes of equity, green finance, adaptation and resilience, nature-based solutions, energy, clean transport, and business actions in the context of India and in the process distils messages for the global community for COP26 and beyond.

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