SHAPING OUR GREEN FUTURE

Pathways and Policies for a Net-Zero Transformation

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Observer Research Foundation
20 Rouse Avenue, Institutional Area
New Delhi 110002
India
contactus@orfonline.org
www.orfonline.org

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Mihir S Sharma and Mannat Jaspal

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Introduction

With the Covid-19 pandemic slowing down and the economy recovering strongly, India's development pathway must now focus on two key areas: climate change and job creation. The next decade will be decisive in achieving these twin goals. The first requires a rapid transition away from fossil fuels as well as adapting to disruptive new weather patterns; the second entails the creation of millions of high-quality jobs every year, for all of India's young workforce. India needs to ensure that its youth have access to employment, while simultaneously shifting to a deep decarbonisation pathway. The failure to address these challenges will likely result in widespread distress, unchecked migration into collapsing cities, and significant social strife. India's actions in the next few years will determine whether its development model can ensure sustainable prosperity for all. The choices are stark, the consequences profound.

India's Decarbonisation Pathways

Pursuing a deep decarbonisation pathway will be a key aspect of achieving sustainable prosperity. India is doing much better than other countries in delivering on its 2015 Paris Agreement carbon emission targets. The country's

carbon emissions to GDP ratio is already down by 39 percent compared to 2005 levels, as against the target of a 33–35 percent reduction by 2030. However, India's GDP is growing strongly, and modelling studies show that its greenhouse gas (GHG) emissions will continue to increase and will likely reach 6–8 billion tonnes of carbon equivalent emissions by 2050.[a]

The Intergovernmental Panel on Climate Change (IPCC) has recommended that the world must reach zero carbon emissions by 2050, to ensure that global average temperatures do not increase by more than 1.5 degrees Celsius above pre-industrial levels. More than a hundred countries have committed to reaching net zero by 2050, including the United States (US). China has announced that it will reach net zero by 2060. To help reach this global goal, India should also transform its current development pathway into a deep decarbonisation pathway. Today, India emits about 3.5 billion tonnes of carbon equivalent GHG emissions per year, including agricultural emissions that are about 1 billion tonnes. Therefore, India should adopt either a low carbon pathway that keeps emissions flat at 3 to 4 billion tonnes per year or an ambitious net zero pathway to reach net zero emissions by mid-century. India has some flexibility and can set a target of net zero by 2050 or 2060. A truly inspirational goal would be to reach net zero by 2047—the hundredth year of Independence.

A Net Zero Pathway

The net zero pathway will require committing to a legally binding net zero target by a fixed year. Such a target, passed by Parliament, will necessitate each ministry and state government to define the annual carbon budgets needed to reach net zero by the mid-21st century. Coordinated policies and actions must be enforced to ensure rapid peaking in carbon emissions and a dramatic decline thereafter. Furthermore, once a target is set, the Central and state governments will have to quickly build the necessary state capacity for monitoring and compliance. India requires trillions of dollars in green investments to reach

[a] These modelling studies incorporate India's goal to install 450 gigawatts of renewable energy by 2030 and all the other green policies announced to date.

a net-zero target by mid-century. Together, a legally binding net-zero target and supportive government policies can lead to massive investments in green technologies and equipment. This, in turn, will thoroughly transform electricity generation, transportation, construction, real estate, agriculture, cement, steel, and many other industries—a largely private-sector transformation, driven by private-sector capital.

Massive green investments will likely drive fast economic growth and create high-quality jobs. Indeed, if India is able to attract sufficient global capital, there will not be any trade-off between development and emission reductions. Further, the green investments will require Indian industries to invest in the most competitive, advanced technologies and business models, and could not only get India to the *Green Frontier*—representing long-term, sustainable prosperity—but also enable it to stay there.

Diplomatically, a legally binding net zero target by the mid-21st century can win India enormous global goodwill and lead to more supportive technology transfer and global trade agreements. More importantly, it will signal to global capital that India is soliciting green investments. A stable government framework and policy predictability are vital to reducing investment risk and attracting global capital.

A Low Carbon Pathway

As an alternative to this ambitious net zero pathway, India can choose to follow one of several low-carbon pathways. The Paris Agreement, and all other international negotiations on climate change, recognise the common but differentiated responsibilities of developing countries compared to those of wealthier countries. Diplomatically, India is not obliged to reduce carbon emissions to net zero by 2050; it could follow a much more gradual path. Instead of carbon emissions peaking by 2030 or so, India's emissions could peak by 2050 or 2060. Emissions could then get to a stable, low carbon level by 2080 or even later.

In support of such low-carbon pathways, India can formulate clear sectoral targets, such as the current 450 GW target for solar energy or various building efficiency standards. This will gradually reduce carbon intensity per unit of GDP. The decarbonisation pathways can also provide a clear roadmap for the private sector for their investment plans, while allowing India to slowly decommission many high-carbon sources such as coal-fired power plants and diesel trucks. With the investment requirements reduced, India will be able to gradually move people out of high-carbon industries such as coal mining and steel production.

Modelling Different Decarbonisation Pathways

Which decarbonisation pathway is better for India? Detailed energy systems and economic modelling is required to evaluate the different decarbonisation pathways. In the past, most decarbonisation modelling approaches have concentrated just on GHG emissions and policies required to reduce emissions. However, for India, it is vital to also understand their economic impacts. What will happen to GDP growth across these decarbonisation pathways? How will jobs in different sectors be impacted? What will be the impact on government taxes and revenues? Will India's balance of payments improve? How large will be the investments required and in which sectors and by when? Will air pollution decline due to the reduction in hydrocarbons usage? What does India have to do in the next decade to get on a deep decarbonisation pathway? These are some of the key questions that need to be explored to understand how India might be able to achieve sustainable prosperity for all.

Over the past few years, three independent expert groups (World Resources Institute, the Climate Policy Lab at the Fletcher School at Tufts University, and Cambridge Econometrics in Cambridge, UK) have evaluated different decarbonisation pathways for India. These expert groups have built detailed energy-systems models and integrated them with input-output macroeconomic models. They have then calibrated these models against actual historical data to ensure that the models provide sensible results across multiple dimensions.[b]

[b] These are completely independent efforts utilising some of the most sophisticated models in the world to study these issues. No other modelling groups appear to have built, tested, or utilised such models to evaluate the economic and health impacts of different decarbonisation pathways for India.

However, such long-term models are not meant to be used for forecasting or making strong predictions. Rather, they are intended to illustrate how different future scenarios might evolve, considering the linkages across multiple dimensions such as energy usage, GHG emissions, transportation choices, industrial growth, job creation, and public- and private-sector investment. Some of these relationships may be linear in nature, others might be non-linear. While making robust predictions across such relationships over decades is not possible, it can be instructive to show the range of possibilities. Moreover, there are many counterintuitive interactions that may result in surprising outcomes that can be captured through such models. For instance, GDP growth might accelerate when the high healthcare costs associated with air pollution are reduced.

Key Policy Levers for Decarbonisation

The modelling studies conducted so far have evaluated many different decarbonisation pathways. Each lower carbon pathway (including net zero pathways) has been compared against a business-as-usual reference pathway, which has some notable characteristics. Most importantly, it assumes a pre-Covid-19 growth projection for the Indian economy. Thus, in the reference pathway, the Indian economy grows at a long-term compound annual growth rate of around five percent between 2020 to 2050, reaching approximately US$15 trillion (in 2018 dollars). This is an optimistic projection that assumes no other global pandemics; zero impact from climate change; and no adverse global crises, such as a financial crisis or conflict. Yet, in the past few decades, India has experienced several global crises and growth slowdowns. Moreover, while the reference pathway includes all the various green policies that have already been announced by the Indian government, it still results in total GHG emissions for India reaching over 7 billion tonnes of carbon equivalent emissions by 2050, with the emissions continuing to increase every year, instead of peaking and then declining. Renewable electricity generation reaches 69 percent of total units generated. Solar power increases to about 430GW but coal-based power generation stays at about 200GW. Electric vehicles account for about 30-35 percent of new sales.

To evaluate the impact of policy interventions, technology cost curves for the deep decarbonisation pathways modelled are the same as the cost curves used in the reference pathway. This, too, may be a conservative assumption in terms of investment requirements. Much more rapid adoption of green technologies will likely result in massive size economies (scale, learning, and network effects) and further drive costs down relative to the reference pathway. Lower costs will naturally result in positive feedback and accelerate market adoption of green technologies. However, these second-order impacts are not captured in these modelling studies.

Detailed modelling indicates that four key policy levers will have to be applied simultaneously to drive deep decarbonisation in India, including in the net-zero pathway. **First**, the electricity generation system will have to be transformed to only renewable sources. Thermal power plants today emit over 40 percent of India's carbon emissions. In the next few decades, India will have to commit to building no new coal-fired plants and retire its existing fleet of thermal power plants. Additionally, along with the generation system, the transmission and distribution systems will have to be rapidly reengineered for large-scale storage and remote evacuation.

Second, India may have to impose mandates to transform petrol and diesel vehicles into zero-emission vehicles. The European Union (EU) has proposed that only zero-emission vehicles will be sold in the EU after 2035. India can decide that year it will switch over to 100 percent electric or biofuels or green hydrogen vehicles, but that decision must be made soon to help manufacturers to plan accordingly. The current FAME and PLI schemes are excellent, but deep decarbonisation pathways require a much more rapid transformation. Current technology trends suggest that large commercial vehicles and aeroplanes will require either biofuels or green hydrogen.

Third, industrial and commercial usage of fossil fuel (in industries such as cement, steel, and fertiliser) will have to be progressively restricted through a carbon emissions trading system. Under such a system, every company (say, above INR 250 crores in revenues) will have to provide exhaustive climate disclosures and will be granted a carbon allowance. The International Financial

Reporting Standards (IFRS) is already working towards this. Europe has shown how this can be done by providing each company with certain carbon allowances and then gradually restricting the allowance every year. Companies can start to reduce fossil fuel usage or else trade with other companies, which have surplus credits, to continue to emit carbon. Moreover, India's carbon trading system will have to be aligned with the EU and other countries to avoid the use of carbon border taxes. Carbon pricing around the world could potentially be differentiated to ensure that there is a clear market incentive to invest in decarbonisation technologies in India and other developing countries first. This will encourage investments to flow to developing countries for decarbonisation, consistent with the climate justice principle of *common but differentiated* responsibilities. A global system for pricing and trading carbon emissions will have to be coupled with import duties, to ensure a level playing field for all countries.

Finally, India will have to restructure its carbon taxes. At present, Central and state governments together are collecting several trillions of rupees (close to a hundred billion dollars) from petrol, diesel, aviation fuel, natural gas, and coal taxes. Additionally, railway coal freight charges are set at high levels to subsidise passenger fares. These various taxes and fees have created significant market distortions. In the next few years, fuel taxes should be brought within the GST framework, and taxation rationalised while ensuring revenue neutrality. In the longer term, as fuel usage drops, tax collections will come down, and carbon tax levels will have to be gradually increased to maintain revenue neutrality. These carbon taxes will have to be aligned with the global carbon-trading system as well.

As India moves to net zero, imports of hydrocarbons[c] will start to decrease, improving energy security. Coal is India's primary domestic fossil fuel. As coal plants are retired and other major users transition away, coal usage will automatically decline. With many decades to plan the transition away from

[c] Over US$150 billion per year of fossil fuels including crude oil, coal, and natural gas are imported every year by India.

coal, India can ensure that it protects all existing direct and indirect workers in the coal economy. Alternative employment through solar energy, healthcare, textiles, agri-processing, and other such industries can be established to create sufficient job opportunities for displaced workers. Further, all negative impacts of coal mining—e.g. destruction of natural habitats, pollution and crime, ravaging of traditional occupations—can be avoided.

Net Zero is Net Positive

All the modelling studies done to date confirm that decarbonisation pathways are better for India compared to the reference pathway. As mentioned earlier, these decarbonisation pathways do not assume that green technologies improve in the decarbonisation pathways relative to the reference pathway. The cost-performance of various green technologies is held constant across the pathways; *only pricing* (through different taxation policies) and *usage* (through mandates and subsidies) are modified. These changes are sufficient to drive very different technology diffusion patterns across the economy, leading to massive reductions in carbon emissions.[d] These emissions remain at today's levels throughout the modelling period.

Every deep decarbonisation pathway for India, ranging from those that flatten India's emissions pathway to net zero by 2050, delivers better outcomes than the reference pathway, including an increase in the GDP, more jobs, lives saved due to air pollutions, investment levels for the economy, and energy imports. The economic logic is simple. Green technologies are more cost-effective than brown technologies now. Massive investments in these green technologies will naturally result in higher GDP growth, higher job creation, and lower energy imports, while reducing carbon emissions and air pollution.

[d] These modelling studies have not evaluated any reduction in agricultural emissions (which account for about 1 billion tonnes on annual carbon-equivalent emissions).

The models show that the various decarbonisation pathways improve the GDP by one to four percent virtually every year, relative to the reference pathway. Job creation is five to eight percent higher every year in the decarbonisation pathways. Cumulative lives saved from lower air pollution range from 5–10 million over 30 years. Additionally, India's energy import bill goes down by hundreds of billions of dollars every year as fossil fuels are substituted by renewable energy, green hydrogen, and biofuels. To achieve these goals, India must spend just an additional US$5–10 billion dollars per year in the next few years. These investments then ramp up by 2030, to an additional US$20–50 billion dollars per year. Massive incremental investments relative to the reference pathway only begin in the 2030s, as the transportation fleet is converted to electric vehicles. Ultimately, in the net zero pathway, India has to invest an additional three percent of GDP per year to get to virtually zero carbon emissions by 2050.

These modelling studies confirm that green technologies drive high-productivity growth in the economy and are more cost-effective than brown technologies. Note that India's competitor economies will invest massively in green industries; indeed, Germany, the US, and China have already begun this green transformation. The latest and most sophisticated green industries (such as solar energy with battery storage, electric vehicles, plant proteins, and biofuels) will define a Green Frontier, representing the most efficient and competitive companies in the world. India, too, must get to this Green Frontier—not only because it helps in decarbonising its economy, but also to compete with other leading economies. Thus, decarbonisation pathways provide superior economic and health outcomes for India, and are also essential for its competitiveness. *Net zero is net positive for India.*

Financing Net Zero

Financing for deep decarbonisation will likely constitute the bulk of India's overall investments in the next few years. For instance, the International Energy Association (IEA) estimates that India requires US$1.4 trillion over the next two decades in financing green energy technologies alone. To put this in context, India's GDP in FY2021 is US$2.7 trillion. The recently announced

PM Gatishakti investment Programme is sized at INR 100 lakh crores, or approximately US$1.3 trillion.

Commercial capital drives the global economy and is many times larger than public funds or impact capital. Green investments must, therefore, compete with brown (non-green) investments to find large markets and generate attractive returns. Typically, when promising new technologies are introduced, commercial investors rush to fund them, expecting that costs will fall dramatically over time. This spurs rapid market adoption and eventually high returns for investors. Due to the sterling work of inventors and engineers, this is exactly what is happening with green technologies.

Consider some examples of decarbonising technologies at the Green Frontier. Renewable power is now cheaper than coal-fired power. Converting to renewable sources, whether at a utility scale or at a retail level, is economically viable for end-users while still delivering a reasonable return on capital for investors. Electric vehicles have a substantially lower total cost of ownership than internal combustion engine vehicles, and their cost advantage continues to increase with the decrease in battery prices and the development of efficient charging infrastructure. Plant-based proteins are cost-competitive with traditional protein sources (such as milk, eggs, and meat), thereby reducing the need to keep large animal herds that generate massive methane emissions. Thus, renewable energy, electric mobility, and plant-based proteins are developing into large industries, with many fast-growing competitors, each attracting substantial commercial investment. The government's role is to maintain a stable and supportive policy environment and help unleash market forces, to ensure that market and competitor dynamics drive India to the Green Frontier. Indeed, it is quite possible that India might have the most cost-effective deployments of these technologies in the world—replicating what it has already achieved in telecom services, fintech, and e-commerce.

Some green technologies are still early in terms of customer acceptance and market adoption, such as offshore wind, battery storage, green hydrogen, biofuels, carbon capture, new nuclear fission and fusion technologies. These technologies are too expensive, or their risks still too high for commercial

deployment. However, when they do become commercially viable, they will likely be crucial in driving decarbonisation. Thus, allowing these immature and risky technologies to be guided purely by market forces may not work in favour of India's decarbonisation targets: governments and markets will have to work in tandem to lower costs and jumpstart new green industries. In cases where an idea has potential (risky) or the cost of deployment is high (costly), executing demonstration or pilot projects can create learnings for private enterprises and create valuable policy lessons for regulators and policymakers.

The Indian government has access to a wide range of policy levers and funding options to jumpstart green industries. For example, it can: (a) absorb the initial capital expenditure of demonstration or pilot projects, (b) offer subsidies for part of the capital or operating costs, (c) mandate or incentivise offtake of the final product, (d) help push for and create technology transfer initiatives between countries, and (e) offer connecting infrastructure or distribution for the new technology. Three different sets of impact capital providers can assist in jumpstarting green industries to complement the role played by the government and the market. First, *advanced countries*, who are deploying capital (grants, aid, loans, equity) to help commercialise new technologies. Second, *philanthropic capital*, which is concerned with long-term social impact and does not judge its performance solely by financial returns. Third, *firms that are committing to net zero targets,* their cash flows now being channelled into green investments.

In the next few decades, India will require trillions of dollars of commercial capital, tens of billions of dollars of impact capital, and hundreds of billions of dollars of public funds to reach the Green Frontier. These immense funding requirements will necessitate India to fully mobilise domestic and global sources of capital, and prime its financing system to support these capital flows.

Ensuring a Just Net Zero Transformation

Deep decarbonisation pathways create more jobs than the reference pathway. Green industries are simply more labour-intensive than brown industries.

Therefore, there is a net job gain as workers shift away from fossil fuel jobs to green energy jobs. Additionally, there is a substantial induced job effect when GDP growth is faster and more robust. For example, more people work in retail industries, for the government sector, and in personal services.

Getting started early is important to avoiding stranded workers and their families. If India has multiple decades to plan for the transition, it can be done smoothly through retirements and gradual reskilling. However, abrupt changes will make it difficult to move millions of workers from one set of jobs to another. Moreover, careful planning is also required to avoid geographic dislocations, since the hydrocarbon economy is typically in rural areas while new green jobs might primarily be created in urban areas. Alternative livelihoods must be established now so that the children of today's workers do not also go into the hydrocarbon economy.

India's Decisive Decade

Today, India can leapfrog the traditional farm-to-factory development model and go straight from farm to the Green Frontier. The next decade will be decisive in establishing its development pathway: Is India going to race to the Green Frontier or is it going to be relegated to a global laggard? To get to the Green Frontier, India must commit in a legally binding manner to the target of net zero by mid-century. This will ensure that investors and entrepreneurs understand clearly that a green transformation will be required and that this is the overall direction for the country. Moreover, India's global partners will then likely provide full support through technology transfers, preferential market access, blended capital, and helping it avoid punitive carbon import duties.

After a net zero goal is declared, the right policies—for renewables, electric mobility, carbon trading systems, and carbon taxes—must be implemented in the next few years. By moving quickly, policy and market bottlenecks can be avoided. Investments will also be lower now than in the future, when the transition will become more abrupt and disjointed. Starting early will allow

businesses more time to plan and prepare. Today's brown assets can also be fully utilised and then retired. If India waits to move later, it will run the risk of significant stranded assets and massive debt write-offs. The time for policy action is now.

No country has achieved sustainability and prosperity simultaneously. Developed countries first became prosperous and are now moving towards a more sustainable economy. Against this backdrop, India's green development will be truly unique. In the next decade, the country must leapfrog traditional development models and bring sustainable prosperity to its people. By undertaking the largest green transformation in the world, India will usher in a zero-carbon, inclusive development model.

The Geoeconomics of Climate Finance

Akshay Mathur and Mannat Jaspal

Introduction

The UN Intergovernmental Panel on Climate Change (IPCC) estimates that an annual investment of USD 2.4 trillion is needed in the energy sector alone until 2035 to limit temperature rise to below 1.5 °C from pre-industrial levels.[1] Indeed, climate finance takes centre-stage in every world climate meeting under the aegis of the United Nations Framework Convention on Climate Change (UNFCCC). Developed countries committed to channel USD 100 billion in climate finance annually by 2020 to developing countries. The commitment for USD 100 billion was first announced in Copenhagen Accord in 2009, formalised in the Cancun Agreements of 2010, and reaffirmed by the Paris Agreement in 2015.[2]

Climate finance can come from a range of sources: bilateral concessional lending, multilateral concessional lending, development finance institutions, and private institutions. What constitutes climate finance, how much has been committed, and where it has been used remain subjects of intense debate. OECD claims that developed countries have committed a total of USD 79.6 billion in 2019 (last available figure).[3] These numbers, however, are being challenged by many developing countries, including India. They argue that climate finance to the developing world is being embellished by unfairly counting pledges instead

of actual flows, therefore overrepresenting 'new and additional' funds and underrepresenting greenwashing allocations, and unnecessarily including non-concessional loans.[4] This was corroborated by an ORF study that found India raised 85 percent of the USD 21 billion for climate finance in 2018 domestically, and that 60 percent of the USD 291 billion of outflow in climate commitments from OECD, was re-invested in OECD countries.[5]

Developing countries must engage in robust dialogue with global stakeholders on how climate finance is mobilised, reported, and leveraged. This article examines the policy and regulatory architectures for global climate finance that preclude multilateral, bilateral, and private capital from committing climate finance to developing countries such as India.

1. Multilateral Development Banks: The Risk Management Imperative

Multilateral Development Banks (MDBs) can provide the necessary catalytic financing for climate adaptation and mitigation. By now, there is agreement that the MDBs must be re-oriented, reconfigured, and recapitalised to enable greater climate finance for developing countries. Are they geared up for such a mission? The USD 2 trillion in total assets held by MDBs is modest compared to the USD 100 trillion in assets under management by the world's largest 500 asset managers and institutional investors.[6]

To enhance the role of MDBs, they can be re-oriented from concessional lending towards facilitating private capital by acting as underwriters. Guarantees allow the "crowding in" of large-scale private commercial capital by providing the necessary hedge for investors and lenders concerned about political and financial risks associated with emerging economies.[7] So far, guarantees have accounted for 45 percent of the total private finance raised by MDBs.[8] Therefore, there is considerable scope for the instrument to be leveraged further.

The G20 2018 Eminent Persons Group report on Global Financial Governance made similar suggestions for scaling the work of the MDBs for mobilising private finance, expanding private reinsurance markets, and building an infrastructure asset class to draw investors.[9] Therefore, there is an opportunity for MDBs to

fulfil their vital role and act as a bridge between private investors and recipient economies and move away from lending to risk mitigation. They can also serve as intermediaries between the real pools of capital and the most productive destinations for those savings.

Another suggestion worth examining is to re-evaluate the capital requirements and corporate governance guidelines for MDBs. Conceptually, MDBs are assessed by credit-rating agencies in the same way as commercial banks. This imposes unnecessary restrictions on lending when MDBs clearly differ from commercial banks on "preferred creditor treatment", "callable capital", and "concentration risk".[10] A 2016 study by S&P concluded that MDBs could "safely lend more" even without threatening their AAA ratings – a step that may enable another trillion dollars in lending.[a] An alternative suggestion has come from the Bank of Italy, which suggests that MDBs could triple their spare lending capacity if the institutions decide to reduce their rating to AA+.[11]

Yet, MDBs remain conservative in their risk assessments. One parameter on which MDBs and S&P differ is the treatment of "callable capital" when calculating risk. Callable capital are the commitments made by the members of the MDBs beyond shareholder equity to support the MDBs in case of crises. As a paper from Overseas Development Institute (ODI) explains, rating agencies include callable capital in their rating assessments of MDBs whereas the MDBs themselves do not do so in their internal models. MDBs face pressure from major shareholders who are reluctant to indicate even the remote possibility that callable capital can be activated.[12] A related study conducted by G24 in 2015 found that MDBs can even be negatively assessed in the event of a decline in the sovereign ratings of their shareholder countries providing the callable capital.[13] Therefore, MDBs remain averse to the idea of tying their assessments to callable capital–a situation that can be changed with political consensus amongst the members.

[a] Includes the Asian Development Bank (ADB), African Development Bank (AfDB), Asian Infrastructure Investment Bank (AIIB), European Bank for Reconstruction and Development (EBRD), International Bank for Reconstruction and Development (IBRD), and Inter-American Development Bank (IBD).

2. International Financial Regulations: The Reporting Imperative

The 2008 financial crisis compelled banking supervisory authorities such as Basel, to set certain macro-prudential policies and international regulatory standards. Although these regulations are mostly developed by, and calibrated for developed countries, many emerging markets and developing economies have gradually adopted these standards.

The direct impact of Basel norms on climate finance to developing nations (or India in particular) is difficult to determine. On one hand, the norms provide a uniform global framework for macro-prudential governance which are welcome for many developing nations, including India. On the other hand, research indicates that specific regulations may have unintended side effects on long-term finance. This, by extrapolation, may also affect climate finance.

For instance, a study by the French Development Agency in 2020 found that Basel 3 standards designed for commercial banks were less relevant for national development banks, which have different structural and risk characteristics. Specifically, levels of capital requirement and the demand for capital quality which may restrain NDBs from providing credit to long-term projects, particularly during times of economic distress. Similarly, liquidity ratios such as the Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR), designed to promote financial resilience and avoid maturity mismatches, respectively, need to be re-examined for NDBs whose sources of funding rely on non-household deposits. This suggests that there is a need to review the Basel framework to account for climate-related risks given the dire need for long-term climate finance.

More recently, the UN, G20, global standard-setting bodies on international finance,[b] and independent initiatives as well,[c] have been working on reporting and disclosure regulations for climate finance.

[b] These include the IASB, BIS, FSB, and IOSCO.

[c] Such as the GRI, CDP, CDSB, GRI, IIRC and SASB.

The G20's work on climate finance is guided by the Sustainable Finance Working Group–a 2021 upgrade of the Sustainable Finance Study Group established in 2018 and the Green Finance Study Group set up in 2016. The agenda of the working group itself is telling of the magnitude of the effort at hand on streamlining regulations for climate finance. The challenges include designing tools for aligning investments towards sustainable goals, addressing disparity in disclosure norms, developing taxonomies and rating methodologies, mainstreaming priorities of nature such as biodiversity, addressing data gaps, and providing a roadmap to international financial institutions for a low-carbon pathway.

The G20 Framework Working Group[d] in 2021 included, for the first time, macroeconomic risks connected to climate change as part of the agenda.[15]

The FSB-led TCFD, established at the request of the G20 to focus on climate-related financial risk disclosures in mainstream corporate filings, has become the most widely referenced work in this field. According to the last status report published in September 2020, TCFD had support from over 1,500 organisations globally, including over 1,340 companies that account for a market capitalisation of USD 12.6 trillion, and institutional investors responsible for assets of nearly USD 150 trillion.[16]

FSB's homework shows that large companies were better at disclosures than smaller ones, and that the energy sector is better than the banking industry. For instance, 42 percent of the companies with a market capitalisation above USD 10 billion disclosed information aligned with the TCFD in 2019, while the average was lower at 15 percent for companies with a market capitalisation of less than USD 2.8 billion.[17] Similarly, a review of 289 banks with a median asset size of USD 54 billion revealed that only 20 to 30 percent of the banks were meeting TCFD guidelines–a disappointing figure especially since 40 to 60 percent of energy firms are readily disclosing as per TCFD guidelines.

[d] The working group is responsible for overall guidance on global macroeconomic policies, global financial imbalances, and global economic growth. It has been co-chaired by India since its inception.

Another area in which TCFD reports low coverage is disclosure on specific metrics on carbon emissions. This is likely due to the unavailability of quality data. The Network for Greening the Financial System (NGFS) has done extensive work in the use cases, metrics and data required by banks, insurers, asset managers, central banks, credit institutions, and pension funds. Their assessments conclude that carbon data available, on which much of green finance is based, is at best incomplete, or subjectively estimated.[18]

The disparities in disclosure guidelines and subjectivity in reporting is making climate finance reporting information incomplete, inconsistent and incomparable. As investors, lenders and insurers rely on data to make informed decisions on capital allocation and risk underwriting, standardising the disclosure and reporting frameworks across jurisdictions will be critical for developing countries to enhance their credibility and bargaining power in the global financial system.

India accounted for 0.05 percent of the global assets in sustainable funds that totalled nearly USD 1.23 trillion in 2020.[19] Green bonds accounted for only 0.7 percent of the nearly USD 8 billion total bonds issued in India during 2018 and 2019—a small proportion compared to the USD 196 billion, USD 63 billion, and USD 35 billion issued in the same period, respectively, by the European Union, China, and the US. Similarly, green lending accounted for a mere 0.5 percent of the USD 5.4 billion of outstanding bank lending in India as of March 2020.[20]

The Reserve Bank of India (RBI) has confirmed that the key reason for the slow uptake of green finance in India is the lack of a standardised global taxonomy and standardised global reporting. RBI has noted that "information asymmetry" is the primary cause of the high cost of bond issuance. In May 2021, the Securities and Exchange Board of India (SEBI) issued its sustainability disclosure, the Business Responsibility and Sustainability Reporting (BSBR), which includes TCFD guidelines, mandatory for FY 2022 for the top 1000 companies in India by market capitalisation. This covers a higher number of companies, up from requiring only the top 100 when it was first introduced in 2012 for BSE and NSE.[21]

Therefore, for India, any effort, whether by the UN or G20, such as the TCFD, will be welcomed if it provides a common taxonomy and reporting standard for the world. Such a taxonomy must be reflective of developing country characteristics, includes both past and forward-looking disclosures, and is, at least in the initial years, voluntary.

3. Institutional Investors: The Returns Imperative

The average annual investment in the renewable energy sector in India has been nearly USD 11 billion for the last five years. For now, several global institutional investors are operating or interested in India, including Singapore-based GIC Holdings, Abu Dhabi Investment Authority, Softbank, Brookfield, CPPIB and CPDQ from Canada, ORIX (Japan), Sembcorp and APG (Holland), Goldman Sachs, JP Morgan, and Morgan Stanley.[22]

Institutional investors are crucial in the fight against climate change. According to data compiled by Willis Towers Watson, institutional investors held over USD 100 trillion in Assets Under Management (AUM) in 2019.[23] Therefore, how these institutional investors channel wealth is an important indicator of the commitment of the financial services industry to climate change.

A January 2021 report by InfluenceMap, a think tank focused on climate finance, found that the equity holdings of the largest asset management groups were misaligned with the Paris climate targets.[24] For instance, many companies were under-investing in green technologies in four climate-critical sectors: automotive; oil and gas production; coal production; and electric power. A more specific study by the same institution in August 2021 on 723 equity funds with over USD 330 billion in total net assets, found that 71 percent of the ESG funds and 55 percent of climate funds were negatively aligned with Paris commitments.[25] This shows that certain financial services firms are not even aligned with the Paris Agreement, let alone financing it.

Even those companies committed to the Climate Action 100+ have been falling short. Climate Action 100+ is an initiative with buy-in from over 600 institutional investors globally with assets of nearly USD 55 trillion and that engages with large companies responsible for carbon emissions.[26] A UN survey of 107 companies, many of them committed to the initiative, found that 70 percent of the companies could not provide evidence of including climate-related disclosure in their 2020 financial statements.[27]

The Indian government has introduced or streamlined various financial regulations to attract capital for green projects, including automatic approval for FDI, strengthening Power Purchase Agreements, establishing Renewable Energy Parks and Green Corridors, and streamlining the bidding processes. It has also made efforts to address investors' concerns for macro-economic resilience, currency risks, and political stability. Nevertheless, weaning large institutional investors away from brown investments will require efforts beyond streamlining financial regulations. For instance, a report by Urgewald reveals that some 4,488 institutional investors have made investments amounting to USD 1.03 trillion in companies associated with the coal value chain. The United States leads the pack with over USD 602 billion worth of investments in the global coal industry, followed by Japan and the UK. Commercial banks too, hold large stakes in the coal industry, with the Japanese banks holding the largest investments followed by the US and UK commercial banks. They collectively hold investments of almost USD 166 billion.[28]

Another report, this one by the Climate Policy Initiative released in 2021, found that 38 of the 60 largest commercial and investment banks have committed to exclude direct financing to coal fired power plants and yet provided USD 52 billion to the 30 largest coal power plant developers in the world.[29] Clearly, commercial banks are still finding it easier to invest in fossil fuels. Without incentives for green projects, any half- baked attempt at greening the financial system will be inefficient.

To that end, it is useful to examine the emerging power of shareholder resolutions. Exxon and Chevron shareholders this year launched a "rebellion" at the annual meetings. Activist investors forced the companies to heed to climate concerns through shareholder voting and resolutions.[30] Similar shareholder

activism for climate is emerging within banks, financial institutions, and manufacturing companies. A case study is the climate strategy adopted by CPP Investments, the firm responsible for investing assets of Canada Pension Plan. It has set itself apart from its peers by supporting 130 resolutions on climate-related shareholder resolutions since 2015.[31] In 2021 alone, CPP supported 19 shareholder resolutions that sought deeper disclosure on climate change risks and opportunities. They also voted at 42 companies against the reappointment of the chair of the risk committee (or an appropriate equivalent committee responsible for climate risks)—their votes resulted in 53 votes against directors, and material commitments and improvements on climate-related disclosures and practices at 17 companies.[32]

4. On Political Consensus for Climate Finance: The Mobilisation Imperative

The green ambitions, promulgated by the global leaders, can only be brought to fruition with a global political consensus on climate-related financial regulations that enable climate action. The policies have to be equitable and representative of a broader group of stakeholders, particularly developing nations such as India, which are pivotal in the fight against climate change. A fragmented effort by political leaders will only cause a setback to the current progress on global climate action. Green Transformation cannot be achieved unilaterally, and this underscores the imperative for mobilising global climate finance for climate action.

Greater cooperation on climate change will require the integration of economic and financial markets, particularly for the developing countries. This in turn requires additional support in financing, capacity building and technology transfer, so that developing countries are able to catch up with the global North without compromising on their economic and social development goals. The transition to a low-carbon future needs to be equitable and just, and the political elites must meet the challenge of fostering a global carbon-neutral recovery strategy.

Private investment for climate change needs to be galvanised quickly and it should complement spending by public agencies. Climate mitigation and adaptation should be the focus of policy and regulatory frameworks to buoy investments in green innovation—this will aid in producing and distributing economically viable technologies, increase efficiency, and reduce risk. In turn, it will create opportunities for governments to create industries, employment, and economic output.

The imperative is for a centralised global platform that will encourage and facilitate active cross-border cooperation across financing, technology transfer, and capacity building. At the same time, a decentralisation process needs to emerge that enables sub-national governments and corporations to set local targets with accountability for achieving climate goals. Such a dual system of centralised resource mobilisation with de-centralised implementation can be instrumental in meeting climate goals.

Furthermore, customers, shareholders and the public are now acutely aware of climate change and are demanding more sustainable policies and practices; climate agenda is no longer dependent on a small group of stakeholders driven by vested interests. Companies and investors are increasingly using ESG criteria when making investment decisions. This should become a central bank-driven mandate for industries to help enhance climate-related disclosures and encourage climate change information dissemination. It will do governments well to heed the concerns of the public and actively contribute to climate mitigation and adaptation on a global scale.

The 26th Conference of Parties (COP26) is an opportunity to develop and galvanise consensus, particularly on climate finance. A green recovery will positively influence all forms of capital—physical, human, natural, and social. If the world can mobilise USD 17 trillion for responding to Covid-19 and reconfigure the international financial architecture to ensure capital reaches where it is most needed, the international community can certainly gather geopolitical consensus for mobilising the requisite capital for fighting climate change. Investing in capacities for climate action will have percolating development benefits which, in turn, will lead to an improved economic world order; this is the message that needs to be promulgated and strengthened.

Financing the Green Transition

Akhilesh Tilotia and Anya Bharadwaj

Introduction

The world is seeing a spate of extreme weather events that are causing ecological and humanitarian disasters, underscoring the magnitude of challenges facing humanity brought about by climate change. The international community is hard-pressed at finding solutions, and the primary challenge to green transition is Green Financing. This article outlines the current global green financing landscape, the role of the State and the Market in sourcing the required investments, and the design of the right instruments and institutions to make the transition a commercial and social success.

Current Green Financing Landscape

In an act of significant foresight at Cancun, Mexico in 2009, developed countries promised to provide USD 100 billion a year of climate finance to the developing world. The commitments read thus: "The financial, technology and capacity-building support agreed in Cancun applies to both mitigation and adaptation actions by developing countries…In the broad context of long-term financial support, industrialized countries committed to *provide* [emphasis added] funds

rising to USD 100 billion per year by 2020 to support concrete mitigation actions by developing countries that are implemented in a transparent way. These funds would be raised from a mix of public and private sources."[1]

The operative word is "provide". Many developing nations expected this to mean that it was a commitment by the industrialised countries to transfer funds to them. It was expected that a significant part of the USD 100 billion a year could flow to funds like the Green Climate Fund (GCF), which can then finance mitigation and adaptation strategies in the developing world.

However, the global North has had a different interpretation of the word "provide". For instance, some have argued that only public finance should count towards the USD 100 billion, while others point out that only grants should be considered. India's Ministry of Finance shares this viewpoint.[2] In a statement from the Organisation for Economic Co-operation and Development (OECD) released in September 2021, the numbers were reported as thus: climate finance provided and mobilised by developed countries for developing countries totaled USD 79.6 billion in 2019, up by 2 percent from USD 78.3 billion in 2018. The increase was driven by a rise in public climate finance, while private and bilateral climate finance dropped.[3]

An OECD report suggests that most of the transfer is in the form of loans. In terms of the financial instruments that underpin public climate finance provided by developed countries (both bilaterally and via multilateral institutions), loans more than doubled from USD 19.8 billion in 2013 to USD 44.5 billion in 2019.[4,5] Grants, meanwhile, fluctuated around USD 10 billion per year in 2013-15 and around USD 16.7 billion in 2016-19. The share of loans and grants were 71 percent and 27 percent, respectively, of total public climate finance provided in 2019. Equity investments increased from USD 0.7 billion in 2013 to USD 1.7 billion in 2019, accounting for only around 2 percent.

With heightened political will on climate change, the nature of the transfers from the developed world to the global South should change along two critical dimensions: (a) lower cost funds or grants; and (b) transfer of technology at low cost which makes mitigation and adaptation easier.

Policies, Tech, and Social Support for Green Investments

Investments in the green transition will be driven by three forces: (1) government policies; (2) technological viability; and (3) social acceptance.

Governments will play a vital role in setting national climate policies, creating internal markets (or taxes) for carbon, and reaching global agreements on carbon tariffs. India, for one, has made its position about "climate equity" clear in various forums. Given the country's low per-capita incomes and carbon emissions, India seeks to achieve a balance between its economic growth commitments to its citizens and its climate responsibility towards the global community. India has been imposing heavy taxes on fossil fuels and is encouraging deployment of renewable energy. As large economic blocs begin to discover their own carbon prices (e.g., EU and China have taken the lead), these could feed into global discussions on carbon tariffs – countries will have to tread cautiously so as not to make this a trade barrier in the form of a carbon border tax.

Green technologies like renewable energy are increasingly becoming more economically viable. Ideas and technologies in other fields are at various stages of development and end-user acceptance, including plant-based meats, battery walls, offshore wind, and green hydrogen: these ideas need nurturing to prove their commercial viability.

Even as political leaders have become more aware of the green imperative, the transition will neither be quick nor painless. Many non-green assets have long economic lives (e.g. coal power plants) and with many jobs associated with them (e.g. the entire service value chain of internal combustion engine or ICE vehicles). Transition challenges like the one caused by a sudden shortfall in intermittent power supply from the North Sea in September, October 2021 from offshore wind projects led to spiraling prices across the energy value chain. Such challenges need to be addressed via significant investments in forecasting, grid balancing, demand moderation, and policy support for the vulnerable if power is in short supply. Skilling into new technologies will require societal and personal investments. This means that the transition to a new green world will require significant handholding by policymakers to make it a "just transition".

Bringing the State and Market together

Renewable power, even without carbon taxes on fossil fuels, is now cheaper than coal-fired power. Converting to renewable sources, whether at a utility scale in the case of solar farms, or at a retail level of rooftop solar, has become more economically viable for end-users while still leaving a reasonable return on capital for the investors. Electric vehicles, for example—with battery prices falling and charging infrastructure increasing—are poised to breach the total cost of ownership (TCO) for consumers compared to ICE vehicles.[6] Plant-based protein sources are now cost-competitive, thereby reducing the need to keep large animal herds that generate massive methane emissions.[7] As these technologies mature, their deployment will be driven by commercial investors seeking appropriate returns. Simultaneously, the government's role in these industries will largely be to unleash market forces and remove the bottlenecks that impede growth.

Other green technologies are at promising stages of development and user acceptance, including offshore wind, battery storage, green hydrogen, and carbon capture. These new ideas and technologies may be more expensive to deploy commercially or carry greater and unknown risks in some geographies. If they eventually become commercially viable, these instruments could make a material difference in facilitating decarbonisation.

At the same time, leaving costly and risky technologies only to market forces may not work relative to the required decarbonisation targets: governments, multilateral institutions, and climate investment funds will have to work in tandem with markets to lower costs and jumpstart industries. In cases where an idea has the potential (but can be risky) or the cost of deployment is high (costly), executing a pilot demonstration project can create learnings for private enterprises and bring valuable policy lessons for regulators and policymakers.

Governments have a wide range of policy levers to jumpstart green industries. They can do the following: (a) absorb the initial capital expenditure of the pilot project; (b) offer subsidies for part of the capital or operating costs; (c) mandate or incentivise offtake of final product; (d) help push for and create technology

transfer initiatives between countries; and (e) offer connecting infrastructure or distribution for the new technology. Private enterprise, on the other hand, may be willing to experiment with demonstration projects on the expectation of a much larger prize, if the technology is commercially validated.

For this to work, different sets of capital providers need to come together to complement the role played by the government and the market. Public capital needs to come from: (a) global multilateral contributions like the Green Climate Fund; (b) bilateral funds between two (or small group of) countries; (c) current multilateral developmental institutions moving their focus to green investment; and (d) national and local government budgets. In 2019, public climate finance from developed countries reached USD 62.9 billion. Private capital will come from: (a) private equity and venture capital funds; (b) philanthropic capital; and (c) firms with non-green cash flows now channelising investments into green ones. In 2019, private climate finance mobilised from developing countries was recorded at USD 14 billion.

Instruments for sharing risks and returns

Capital providers need to create appropriate instruments to: (a) pool capital from those who owe the world a climate debt; (b) transfer it transparently to countries and societies that need capital support in deploying new technologies for a just transition; (c) take risk on emerging technologies – some of which may not succeed; and (d) be patient for a longer period as transitions play themselves out. For the above-mentioned scenarios, financiers can consider the following options:

- **First-loss capital:** Funds willing to take first loss can crowd-in significant amount of other risk-taking capital. A pool of funds in which, say 10 percent of the capital is designated as "first loss" means that the remaining 90 percent of fund contributors can be offered a better risk-return trade-off. Alternatively, payout to such capital takes place only when impact outcomes are met.
- **Guarantees:** This is a force-multiplier instrument. Unlike first-loss capital which requires actual deployment of funds, guarantees are a way to backstop such payouts, as and when the need arises. If run by credible counterparties

like the multilateral development institutions, this can reduce the need to deploy upfront capital. As and when guarantees are needed to absorb any losses from the investment, such guarantees can be honored.

- **Forever funds:** One aspect that constrains investing today is the finite time (ranging from seven to 15 years) for private or government funds. Eventually, funds and their returns must be returned to contributors. Funds which commit to reinvest all (or most of) the proceeds back in furthering green transition can offer a much longer time duration for projects to mature. Specific interventions may vary over the life of the funds, however, that they do not need to be returned can allow such funds to take a longer view of the transition process.

The intermeshing of sources of capital and specific instruments can create a wide range of tools for financing the transition.

Case Study: Green Growth Equity Fund

India is expected to achieve its target of reducing 33-35 percent emissions intensity of its 2005 GDP well before the year 2030.[8] This is an actionable target stemming from India's COP 21 Paris 2015 commitment, which is leading to a lower carbon development pathway for India. The International Energy Association (IEA) forecasts that India requires USD 1.4 trillion in investments over the next two decades in green energy technologies alone. To put this in context, India's GDP in FY2021 is USD 2.7 trillion. These green investments are therefore expected to constitute a significant proportion of India's investments over the next few years.

In April 2018, National Investment and Infrastructure Fund's (NIIF) Fund of Funds, along with the UK's Foreign, Commonwealth and Development Office (FCDO) came together to envision a fund that would invest in green infrastructure in India on commercial terms. The purpose of the fund was to provide impetus across sectors such as renewables energy, energy transmission, clean transportation, water treatment, waste management and other emerging businesses in the clean energy/environment space, such as energy storage/fuel cells.

The Fund, named Green Growth Equity Fund (GGEF), was anchored with commitments of USD 170 million each from NIIF and FCDO and was operationalised as India's first climate fund in 2018. From just a plan, the Fund has now invested in five platform investments across renewable energy (utility scale as well as 'commercial and industrial'), waste management, electric vehicles, water, and wastewater management.

The current fund size is USD 410 million. Additionally, new commitments worth USD 200-300 million are expected from private and multilateral investments including premier global climate focused investors, making GGEF the world's largest single-country focused climate fund in emerging markets. Over the next decade, the businesses supported by GGEF are expected to scale and make greater impact on climate action in India. The success of GGEF demonstrates credible business opportunity that is present in enabling the green economy and mitigation of climate change, in a commercially sustainable manner.

Creating the Right Institutions

The players driving the green transformation – governments, private enterprises, and financiers – need the right institutions to accelerate the market viability of new technologies. Such institutions include specialised venture capital and private equity funds, development finance institutions, and payment guaranty entities (such as the Solar Energy Corporation of India). Defining the decarbonisation impact of new technologies will be crucial for these institutions. Regulators will need to set specific criteria and transparency standards that should be followed by financial institutions to allow them to label the financial instruments under each of these categories. This requires creation of well-defined metrics to help stakeholders assess the quality of intervention (and avoid greenwashing).

The topic of green finance has seen consistent commitment at global forums with ambitious targets. It is now time for a commensurate translation to action. Attracting financing for developing countries at scale will require unprecedented flows. It is public and private cooperation that will power the green transition to become a green revolution.

India's Policy Pathways for Deep Decarbonisation

Easwaran Narassimhan, Tarun Gopalakrishnan, Kelly Sims Gallagher

Introduction

Climate change represents a significant threat to the Indian economy due to already evident heat stress, reductions in freshwater supply, soil drying, more intensive tropical cyclones, monsoons, and sea-level rise, among other impacts. At the same time, global warming creates economic opportunities for India as new technologies and industries required to decarbonise must be developed, manufactured, and deployed at scale. This article identifies specific and concrete policy pathways for deep decarbonisation in India. It emphasises the country's economic opportunities, including job creation, in the transition—as the country becomes competitive in its transition towards a net-zero economy beyond the mid-century.

India's Climate and Development Challenges

Without urgent global action, temperatures are likely to reach 4.9 degrees Celsius by the end of this century, even with current policies in place.[1] Achieving the Paris Agreement's desired goal of 1.5 degrees Celsius warming requires deep and rapid reductions in carbon emissions. Industrialised countries must reach net-zero GHG emissions rapidly. Emerging economies like India need to decouple economic growth from GHG emissions to put their economies on a

low-carbon pathway. These economies, however, face enormous developmental challenges as they attempt to grow in a climate-constrained world. India's climate policy challenge is situated in the context of its urgent need to create millions of new jobs, increase incomes, and improve public health in the next few decades. India's youth constitute about one-third of its 1.38-billion population, and one-third of them remain unemployed at any given time (the prevailing youth unemployment rate is 32 percent). Moreover, four-fifths of its existing workforce of 500 million people are employed in the informal sector.[2] Therefore, any low-carbon transition effort must generate job opportunities while also finding alternative livelihoods for the jobs lost in the fossil-fuel-dependent industries that are expected to decline.

To be sure, India's energy system has changed significantly in the past two decades. The government's efforts to promote renewable energy technologies reflect a high level of policy support. Policy targets are ambitious, aiming to deploy 450 GW of renewables in the electricity system by 2030.[3] In 2017, India added more renewables than coal for the first time in history.[4] The proportion of thermal power capacity decreased from 64.8 percent in 1990 to 57.3 percent in 2018, while renewables increased to 21 percent in the same period.[5] Yet, India's current market share in critical clean energy technologies remains well under its potential. India accounts for 10 percent of the global market for solar, 5 percent of wind, and 1 percent of battery storage.[6] In a deeply decarbonised/net-zero world, India should account for some 30 percent of global solar, 15 percent of global wind, and 12 percent of the battery market.[7] A policy gap exists between current policies and those that would be needed to reach this market potential.

A particular challenge confronting Indian policymakers today is the question of whether or not Indian goods and services can compete in the emerging global landscape of trade-modifying decarbonisation policies. These include the EU's proposed Carbon Border Adjustment Mechanism (CBAM), which threatens $41 billion worth of Indian steel exports,[8] and an unfortunate developing trend of trade disputes over policy support to domestic renewable energy manufacturers.[9] A related question is whether India can become a global leader

in the innovation and manufacturing of deep decarbonisation technologies. Emerging technologies such as carbon capture and storage (CCS) and green hydrogen will require high price signals and R&D investments today for their economic benefits to materialise closer to mid-century.

Policy Pathways for Deep Decarbonisation

India's path to a prosperous low-carbon economy rests on three types of strategies: job creation in low-carbon industries; robust low-carbon economic growth; and peaking, and subsequently reducing, its GHG emissions in a way that does not disrupt development aspirations.

Green job creation has indeed been robust, although it still remains subpar when compared to other countries with large domestic markets. India also has yet to put in place a policy for a just transition of workers from the coal mining and other energy industries, to lighter industry or green jobs. While India's policy efforts have achieved significantly competitive electricity prices from renewables, it has fared relatively poorly in its participation across the global renewable energy value chain.

India's solar PV deployment, for example, depends primarily on imported components from China, whose policy approaches have created big employment gains across both manufacturing and deployment of renewables domestically. As of 2019, India created less than half the number of jobs per MW (full-time jobs per MW cumulative capacity installed) created in China (3.61 jobs per MW vs. 6.57 jobs per MW).[10] Owing to the singleminded focus by state discoms on the cost-effectiveness of renewables deployment, as well as the central government's proclivity for cost-effectiveness over other objectives,[11] industrial development and job creation objectives have taken a back seat.

Economic growth remains modest, especially as India struggles to recover from the Covid-19 pandemic. While growth projections for the coming years are more optimistic,[12] there are continuing concerns about inflation and unemployment-despite-growth which partially predate the pandemic.[13] The Indian government has also yet to articulate a green recovery strategy. Historically, India's "all-of-the-

above" energy policy – encouraging fossil fuels and renewables simultaneously – was justified by the clear need to drastically improve energy access. However, the benefits of this approach are being overwhelmed by the costs of different energy sub-sectors working at cross-purposes, as well as the increasingly clear costs of climate change.

The clearest example is propping up certain coal power plants despite billions of dollars of potential savings (starting today) from their well-managed retirement.[14] Clarifying India's energy future, on the other hand, will have huge potential to deliver employment, income and public health gains.[15] The ongoing research of the authors of this article quantifies and contextualises this potential.

That research, as well as those of other analysts, indicate that India's current emissions trajectory is one of continued slow but steady growth due to its existing limited package of policies that directly and indirectly influence emissions.[16] There are approximately 150 individual policies at the national level that influence India's greenhouse gas emissions in every sector – land use, agriculture, power, transportation, residential, commercial, and industrial. Some of those policies, such as capital subsidies for renewable energy deployment, the National Solar Mission, Perform Achieve and Trade (PAT) pilot energy efficiency trading scheme, and the LED lighting program, have directly limited India's emissions.[17] Many other policies, due to their voluntary or general nature, are less likely to have a significant influence on reducing emissions.[18] India's emissions, while the third highest in the world on a national basis, continue to be one of the lowest of the bigger economies on a per capita basis.[19] Many policy gaps exist, primary among them the absence of comprehensive climate legislation.

Policy Implications

India's efforts to meet its NDC commitments are commendable in many ways. After all, India is one of the few countries whose NDC targets and policies are commensurate with the Copenhagen 2°C goal. Yet, its emissions trajectory shows no signs of peaking under existing policies, and its policies are highly insufficient to meet the 1.5°C goal set under the Paris Agreement.[20] India would need to

implement a comprehensive sequence of climate policies to put its economy on track to achieve, simultaneously—robust economic growth, job creation, and emissions reductions. Research by these authors indicates that India could create tens of millions of new jobs, fuel economic growth substantially above business-as-usual (BAU), and reduce the country's GHG emissions by more than two-thirds the BAU by mid-century if appropriate policies are put in place. The following paragraphs provide specific recommendations for how India could embark on this low-carbon growth trajectory through to mid-century.

Economy wide, India could:

- Shift tax revenues from fossil fuel sales to carbon emissions. Implement a carbon pricing policy that ramps up the direct taxation on carbon emissions from 0 to 6000 INR per tonne by 2050. In doing so, the Indian government's fiscal revenue could increase in the near term, shoring up the government's balance sheet.

To decarbonise the **electricity sector**, India could:

- Pursue the well-managed retirement of coal power plants and make significant investments in transmission and distribution infrastructure, demand response, and a doubling of storage capacity from BAU projections (450 GW by 2050). These efforts will prepare India's electricity grid to become more flexible and ready for a renewable energy-powered future.
- Implement a carbon-free electricity standard to achieve 90 percent of electricity from non-fossil fuel sources by mid-century. This target is a 20 percentage points increase from the current trajectory of 70 percent renewables under business-as-usual.
- Subsidise costlier emerging technologies such as off-shore wind in the near-term, and then reduce the subsidies as the technology becomes cost-competitive.

In the **transport sector**, India could:

- Incentivise the build-out of electric vehicle charging infrastructure alongside implementing EV sales mandates.
- Implement an EV sales mandate that increases over time along with a gradual decrease in purchase incentives to ensure that the passenger segment (cars

and two-wheelers) can become mostly electric by mid-century.

- Establish stricter fuel economy standards for heavy-duty vehicles in the near term, along with a longer-term policy to convert the fossil-fuel dependent heavy duty vehicle segment to electrification and hydrogen.
- Mode shift at least one-third of passenger vehicle demand to electrified public transport options.

In the **industry sector**, India could:

- Expand the Perform, Achieve, and Trade (PAT) scheme from a pilot program and reduce the energy use across cement, iron, and steel, and chemicals industries by 25 percent.
- Implement a progressive carbon tax that incentivises industries to further reduce their dependence on fossil fuels through material efficiency improvements and conversion to electrification and green hydrogen use.

Decarbonising the transport and industry sectors are more complicated than the power and residential/commercial sectors as technology alternatives are yet to become cost-competitive globally. This challenge, however, is not a reason to wait until technology costs come down. India could use this challenge as an opportunity to invest in the innovation and manufacturing of these technologies and build domestic capabilities to serve both the domestic and global market on components related to technologies such as electric vehicles, battery storage, and green hydrogen for industrial decarbonisation. Decarbonising the industry sector early could create a first-mover advantage that is also likely to increase India's competitiveness in a world of carbon border adjustment prices. Infrastructure investments related to electric vehicle charging infrastructure, industrial energy efficiency improvements are projected to create a significant share of good quality direct jobs in the economy post-2030 provided the government implements the policies necessary to kickstart the transition today.

India's ambitions in the areas of renewable energy, low-carbon transport and energy-efficient buildings and industry are well-documented. While making progress, they are running into headwinds and their potential economic benefits are yet to be fully realised. To address both these issues, existing policies would need to be augmented and supported by three key additional policy types.

First, policies that set clear immediate signals to phase-out polluting and inefficient technologies (e.g., coal thermal power, gasoline vehicles) during the next three decades. Second, policies that raise new types of low-carbon government revenue to compensate for the reduction in carbon-intensive revenue by 2050 and sustain an ambitious development and social investment program. Finally, policies that crowd investment over the next decade into the low-carbon technologies and enable the transition to a prosperous innovation economy. These shifts in focus, which build on India's already existing ambitions, will serve the climate and India's own economic goals.

India's Coal Transition: A Market Case for Decarbonisation

Vivan Sharan and Samir Saran

Introduction

Progress as the world has designed and defined it requires material production which, in turn, requires energy. Historically, therefore, fossil fuels like coal were key in economic growth across geographies. Today the developed economies stand on the edifice of fossil fuels, carbon-intensive industries and lifestyles that have resulted in global warming. The same growth path is now being questioned, and the poor and developing countries are being asked to build, find and fund newer low- and no-carbon models to lift their people out of poverty and achieve their development goals.

Consequently, there are growing calls for India to declare a net-zero year: to offset its carbon emissions by various processes of GHG absorption and removal. India is aware that such calls are irrational, and despite international pressure, has avoided making pledges or setting hard targets, beyond its commitments at the Paris climate conference in 2015. Indeed, "net zero" is not possible with India's current levels of reliance on coal. Its shift away from this fuel will depend largely on the quantum of additional money and resources that can be invested into alternative energy. However, as global climate finance has both under-performed and been subject to clever redesignation, countries such as India remain in dire need of green financing.

In August 2020, UN Secretary-General António Guterres urged India to give up coal immediately. He asked that the country refrain from making any new thermal power investments after 2020, and criticised its decision to hold auctions for 41 coal blocks earlier that year. Similarly, in March this year, in a message to the Powering Past Coal Alliance Summit, the Secretary-General urged all governments to "end the deadly addiction to coal" by cancelling all global coal projects in the pipeline.[1] Pre-pandemic, India had the second largest pipeline of new coal projects in the world. He also called the phasing out of coal from the electricity sector "the single most important step to get in line with the 1.5-degree goal of the Paris Agreement."[2]

For much of human history, photosynthesis was the primary source of mechanical energy.[3] Human and animal muscles powered by food and fodder, made the world go around. Photosynthesis was also at the root of heat energy derived from burning wood. Eventually, coal replaced wood as the dominant source of heat energy, but still represented the energy of photosynthesis stockpiled over hundreds of years. The advent of the steam engine in the 17th century helped humans change the heat energy released from coal, to mechanical energy.

This development also upended the paradigm of material production. According to a recent estimate, coal was accounting for well over 90 percent of energy consumption in England by the mid-19th century, owing in large part to the steam engine.[4] For long, researchers had been divided over the question of whether coal was pivotal to the industrial revolution. Scholars such as Wrigley (2010) regarded the switch to coal as a "necessary condition for the industrial revolution," while others like Mokyr (2009) held that the "Industrial Revolution did not absolutely 'need' steam…nor was steam power absolutely dependent on coal."

A November 2020 paper by Fernihough and O'Rourke might just settle the question: Using a database of European cities spanning the centuries from 1300 to 1900, the authors found that those located closer to coal fields were more likely to grow faster.[5] Those cities, the researchers wrote, "located 49 km from the nearest coalfield grew 21.1 percent faster after 1750 than cities located 85 km further away."

It is no wonder then, that in March this year, International Energy Agency (IEA) chief Fatih Birol said it will not be fair to ask developing nations like India to stop using coal without giving international financial assistance to address the economic challenges that will result from such a move.[6] He noted that "many countries, so-called advanced economies, came to this industrialised levels and income levels by using a lot of coal," and named the United States, Europe, and Japan.

This article explores this line of enquiry by examining the consumption of coal across developed and developing countries, and mapping it against key metrics of energy transition. It finds that countries such as India—with their high dependence on coal and a simultaneous growth spurt in renewables—can be the most effective location for climate finance. This is plausible given that per capita coal consumption in India is still far below that of the developed world, and economic transitions are both inevitable and required to be 'green'.

To be sure, India is struggling with a coal shortage, which has the potential to derail its post-Covid-19 recovery; the same is true for China.[7] Consequently, there is growing scepticism in developed countries, that both India and China will double down on coal and increase production to overcome supply challenges in the future. While such concerns are not unwarranted, they are not unique to the developing world.

Germany, for instance, in the first six months of 2021 ramped up its coal-based generation, which contributed 27 percent of the country's electricity demand.[8] Three factors contributed to this rise: increase in energy demand amidst the successive waves of the Covid-19 pandemic, increased prices of natural gas, and reduction in electricity generation from renewable energy (particularly wind.) Coal is often the bedrock of energy generation, and its use is impacted by complex market processes that cannot be reduced to normative choices.

Energy Use and Coal

Countries of the Organisation for Economic Cooperation and Development (OECD) are using progressively less energy to power their societies. Multiple factors can contribute to this trend, at least in theory. First is the technical improvements in energy efficiency – i.e., the use of less energy to perform the same tasks. Second is the "activity effect", or the changes in energy use because of changes in economic activity. This would also encompass a "structure effect" which relates to changes in the mix of human activities that are prompted by changes in sectoral activity, such as transportation. And finally, there could be weather-related changes in energy use – for instance, more temperate weather can reduce the need for heating or cooling.

The IEA quantifies these effects, and consistently finds that the reduction in energy consumption in the OECD countries is largely a result of technical improvements in energy efficiency. This means that the reduced use of energy in advanced countries is not on account of any significant changes in consumer behaviour—otherwise, the activity effect would be the primary determinant of the fall in energy use. While energy efficiency improvements have driven this fall, the IEA finds that the current rate of improvement is not enough to achieve global climate and sustainability goals. Consequently, the Agency has advocated for "urgent action" to counteract the slowing rate of improvement observed since 2015.[9]

Conversely, developing countries have seen a rapid rise in energy use owing to the activity effect (see Table 1). The increase in economic activity in the developing world is also directly correlated to improvements in life spans and socio-economic progress. While energy use has approximately doubled in countries like India and China from 2005, a large share of global energy efficiency savings is also driven by technical improvements in these countries. However, in the aftermath of the 2008-09 global financial crisis, China implemented a stimulus package that "shifted its manufacturing sector to more energy intensive manufacturing."[10] A similar trend may emerge in China's recovery from the pandemic, that may reduce efficiency gains in the future.

Table 1: Total Energy Consumption (Exajoules)

Country	2005	2009	2014	2020
US	96.42	89.88	92.99	87.79
China	75.60	97.53	124.82	145.46
Germany	14.17	13.15	13.16	12.11
Japan	22.40	19.81	19.22	17.03
India	16.50	21.45	27.79	31.98
World	456.62	481.97	539.56	556.63
OECD	238.34	225.93	229.65	217.11
Non-OECD	218.28	256.04	309.91	339.52
EU	67.37	62.70	059.59	55.74

Source: BP Statistical Review of World Energy, 2021[11]

Equity in Coal

It would appear that OECD countries have managed to cut their dependence on coal over the last 15 years quite precipitously. In particular, this seems true of countries like the US and EU members. Japan, meanwhile, is an outlier, having turned to coal to provide base-load power to substitute nuclear energy. In most years between 2005 and 2020, the fall in coal consumption in OECD countries has outpaced the decline in total energy consumption. In 2020, for instance, coal consumption dropped by around 18 percent whereas total energy consumption fell by around eight percent.

While China has begun to reduce its dependence on coal, it still accounts for the largest share of coal consumption among all nations. China is also home to over half of the world's thermal power plant pipelines – with around 163 GW in pre-construction stage, even discounting the 484GW worth of cancellations since the Conference of Parties at Paris in 2015.[12] China is also one of the last of the biggest providers of public finance for overseas power plants with over 40GW of projects in the pre-construction pipeline.

Simultaneously, coal consumption has remained relatively stable at just under 40 percent of primary energy consumption among non-OECD nations (see Table 2). In these countries, coal consumption tends to mirror total energy consumption. For instance, in 2018 and 2019, total energy consumption increased by three and two percentage points, respectively. India's dependence on coal has also

remained unvarying. These trends suggest that non-OECD countries such as India require to do much more to contribute to a global reduction in coal consumption and therefore towards net-zero GHG emissions. However, there is more to the OECD's reduced coal consumption than meets the eye.

Table 2: Share of Coal in Primary Energy Consumption (%)

Country	2005	2009	2014	2020
US	24	22	19	10
China	73	72	66	57
Germany	24	23	25	15
Japan	21	22	26	27
India	54	55	58	55
World	29	30	30	27
OECD	20	19	19	13
Non-OECD	38	40	39	37
EU	17	16	17	11

Source: BP Statistical Review of World Energy, 2021 and authors' own calculations

Since the Earth Summit in 1992, India and other developing nations have argued for an equity-based approach to GHG reduction, commensurate with domestic capabilities and historical emissions. This approach has often been subject to cross-examination by OECD experts. For instance, in a 2019 report by the Universal Ecological Fund, high-profile experts including a former White House Adviser and a Harvard professor, ranked national climate commitments based on absolute emission curtailment targets.[13] The report clubbed developed and developing countries together in its assessment of the general insufficiency of climate pledges to meet the Paris Agreement's goal to keep global warming below 1.5 degrees Celsius above pre-industrialisation levels. This should not be a surprise, however, as it is only in consonance with the overall trend of Western academic discourse seeking to dilute the equity principle.

It is a principle that should not be set aside just yet, given the persistent differences in per capita fossil fuel consumption between the developed and developing worlds. Despite near doubling over 2005-2020, India's per capita coal consumption is still below the global average (see Table 3). The global

average, in turn, has remained static around this period because the decrease in the per capita consumption of coal in OECD countries has been partially offset by an increase in the per capita consumption in non-OECD countries. However, the per capita consumption of coal in OECD countries still exceeds that of non-OECD countries, despite much higher levels of wealth and, therefore, capability to transition to renewables and other fuels.

Table 3: Total per capita Coal Consumption (KWh)

Country	2005	2009	2014	2020
US	22599.34	18812.92	15740.35	7756.85
China	10872.44	13601.42	16797.06	16300.13
Germany	11578.83	10182.10	11423.13	6140.66
Japan	11041.71	9882.66	10891.46	10088.89
India	1868.88	2393.57	3480.00	3530.87
World	5381.48	5621.29	6222.87	5425.69
OECD	11013.62	9509.45	9009.38	5564.68
Non-OECD	4049.02	4722.97	5600.73	5395.83
EU	10960.70	9013.81	8207.71	4787.28

Source: BP Statistical Review of World Energy, 2021; World Bank and authors' own calculations

Indeed, a large share of the decrease in per capita coal consumption in OECD countries is driven by transition to fuels such as natural gas, that are used to generate electricity, particularly in countries like the US. It accounts for around a 34-percent share of primary energy consumption in the US, and 25 percent in the EU, compared to seven percent in India (and a similar share in China). In contrast, the share of gas in India's energy mix is among the lowest in the world. Even as Prime Minister Narendra Modi wants to more than double the contribution of natural gas to 15 percent of India's energy mix by 2030, the Petroleum Secretary has said that the country cannot rely on natural gas. There are several reasons, including high landed costs relative to coal, complex domestic pricing mechanisms, a lack of pipeline infrastructure and stable supply/import linkages, and the inability of financially stressed electricity distributors to enter into "take or pay" contracts.[16]

India, therefore, requires relatively greater and more aggressive investments in alternative sources of energy than its developed country counterparts that have had decades to transition to fuels like natural gas. Such financial flows to India can prove to be much more effective vehicles for a net-zero trajectory, compared to similar investments in other parts of the world with higher per capita exposure to coal and relatively slower transition pathways to renewables.

Around 72 percent of India's GHG emissions are linked to its energy sector. It is clear, that if OECD countries are aiming to accelerate a global reduction in GHG emissions, they will need to help India finance its energy transition and overcome the many resource-linked barriers to the wide-scale adoption of renewables. The high costs associated with renewable energy storage and grid upgrade requirements, are related resource challenges. Since developed countries are unlikely to be satisfied with per capita equity, they would do well to help India hurdle some of its obstacles.

Financing Energy Transition

According to India's Central Electricity Authority's (CEA) Optimal Generation Capacity Mix, the country's installed capacity will increase to 817 GW with an additional 27GW of battery storage, by 2029-30 (see Table 4). Of this, firm capacity will contribute approximately 395 GW while renewable sources, around 445 GW. Additionally, a July 2021 study has concluded that more efficient use of existing thermal resources could lead to 50 GW of excess coal capacity with respect to current needs of the system. With limited expectations from nuclear and gas resources and deteriorating coal economics, investments in renewable energy storage options are crucial for managing India's base load requirements. This requires unlocking of financial and technological flows from the OECD, particularly since there are several uncertainties associated with the cost of battery storage technology. These include risks linked to supply chains and exchange rates.

Table 4: Optimal Electricity Generation Mix (2029-30)

Fuel Type	Capacity (MW)	%
Hydro (large and imports)	60,977	7%
PSP (Pumped storage)	10,151	1%
Small hydro	5,000	1%
Coal + Lignite	2,66,911	33%
Gas	25,080	3%
Nuclear	18,980	2%
Solar	2,80,155	34%
Wind	1,40,000	17%
Biomass	10,000	1%
Total	8,17,254	
Total Non-Fossil Fuel	5,25,263	64%
Total Renewables (Solar, Wind, Biomass, Small hydro, PSP)	4,45,3015	53%
Battery Storage	27000MW/1,08,0000 MWh	

Source: Central Electricity Authority; The cost trajectory for battery energy storage system is assumed to be reducing uniformly from 7 Cr in 2021-22 to 4.3 Cr (with basic battery cost of $75/kWh) in 2029-30 for a 4-hour battery system

Experts point out that the more renewable energy is introduced into the grid, "the harder and more expensive it will be to use" because of inherent factors such as intermittency. This will need to be offset by investments in a grid that is able to accommodate variable and increased flows of electricity across different regions. The IEA estimates that annual investments in electricity grids will need to "more than double" by 2030 in a conservative scenario where developed countries achieve net zero by 2050, China around 2060, and other emerging and developing economies, by 2070, at the latest.[20] India will also need to explore much wider scale of privatisation of state distribution companies, which now owe generators around USD 20 billion.[21]

The capacity utilisation of India's coal assets has also witnessed a significant decline over the past decade, with power plants running at 53.37 percent plant load factor (PLF) in FY 2020-21 compared to 77.5 percent in FY 2009-10.[22] Several factors have contributed to this, including the rapidly expanding share of renewable energy generation. India's coal story is beset with additional challenges including planned decommissioning of older coal plants (approximately 54 GW of coal plants by 2030).[23] Research indicates that the

cost of retirement ranges between[24] USD 0.41 – 0.59 million per MW, with older thermal units relatively cheaper to decommission. Consequently, maintaining India's coal fleet also requires around USD 106 million in investments, to retrofit existing thermal power plants with Flue Gas Desulphurization units. The deadline for doing so has been extended several times in the past decade and has finally been fixed for 2022 for plants located in populous areas.[25] The combination of underutilised coal plants, increasing costs of plant maintenance and reduction in costs of renewables, provides a unique opportunity to galvanise investments and strategic attention towards a low-coal pathway.

The technologies that will pave the way to such low-coal path are developing rapidly, with significant progress in renewables, battery storage, and green hydrogen, among others. They each require, however, large financial outlays. Moreover, India is still highly dependent on expensive bank lending, which is now hitting sectoral exposure limits, whereas long-term capital is required to finance energy infrastructure. As of April 2020, the exposure of banks and non-bank financial institutions to India's power sector was already around USD 160 billion, roughly the lending necessary to finance the country's renewable energy targets for 2030.[26]

According to the Government of India's 'Energy Compact' submitted to the UN in September 2021, the country required a total investment of USD 221 billion to set up 450 GW renewable generation capacity, including associated transmission and storage systems.[27] However, other research has pegged this investment much higher at USD 661 billion, to build both renewable energy systems and transmission and distribution systems.[28] The IEA also estimates that India requires a total investment of USD 1.4 trillion for clean technologies to help achieve a sustainable development path till 2040.[29] In comparison, developed countries managed a transition away from coal over a longer period of time and with different costs. Investments for clean energy in the Global South needs to be consistently and significantly higher to help achieve the simultaneous goals of SDG 7 (Affordable and Clean Energy) and other development targets.

Advanced countries would do well to recognise that long-term institutional capital is urgently required to help India transition from coal to renewables at scale. What is needed is far more than lip service; nor will change happen only

through negotiations at Glasgow at the COP26. Overall, mainstream sources of international climate finance such as the Green Climate Fund and the Global Environment Facility have managed to provide just over a billion dollars in finance for national projects.30 While there is enthusiasm around green bond financing, the absolute value of issuances towards relevant segments such as renewable energy, is still relatively low at around USD 11.2 billion since 2014.[31] To put it in context, the global issuance of green bonds totalled over USD 305 billion in 2020 alone, specifically for climate-related and sustainability projects.[32]

A high sensitivity to the cost of capital means that other sources of institutional capital are needed to fill the gap, even as the Indian private sector learns to raise green bonds and co-develops green taxonomies with relevant parties. Most OECD financing towards renewables in developing countries is conducted through debt instruments. According to the International Renewable Energy Agency, cumulative transactions and financial flows from the OECD countries towards renewables development in the rest of the world reached USD 253 billion between 2009-2019, of which around USD 228 billion was in the form of debt. India accounted for just under USD 11 billion of the amount, which is less than five percent of the cumulative debt finance by OECD countries.

Table 5: Cumulative Transactions by OECD Countries into Renewables (2009-2019, %)

Debt	90	%
Grants	5	7%
Equity and Shares in Collectives	4	1%
Guarantees and Others	1	1%

Source: International Renewable Energy Agency

OECD members must aim to redirect institutional investments towards India. For instance, their sovereign funds and pension funds must adjust to new business models around energy storage and distribution. There are also many possible designs of new financial instruments that could be explored. These could recognise the different capacities and capabilities in developing countries at the outset. For instance, grants and debt funding could be combined in multiple ways to subsidise loans. The scale of grant involvement could be

directly proportionate to relevant environmental, social and governance factors, and therefore could incentivise more aggressive low-carbon paths. Similarly, new kinds of investment management and rating modalities could be employed to scale up investments where they are most required to offset planetary risks. The availability of innovative long-term finance for India is critical to any meaningful realisation of global net-zero ambitions. India, for its part, must bite the bullet on large-scale power sector reforms, to improve distributional efficiencies and facilitate inward financial and technological flows.

Conclusion

India's current per capita coal consumption is three-fifths that of the OECD average, and one-fifth that of China's. This low per-capita coal consumption in a coal-rich country can and *must* remain the key feature of India's growth, going forward. This article demonstrates, that for India to keep its coal in the ground, more and better financing is needed.

A market case for a green transition in India already exists. The last few years have demonstrated India's appetite, among the public and the political class, for a move towards cleaner growth. What it requires now is what this essay calls for: a higher flow of capital towards crucial green sectors—in particular, a higher level of foreign capital inflows towards these sectors, and a better texture of such capital, moving towards a more patient and equitable finance.

Modelling Decarbonisation Pathways for the Indian Economy

Varun Agarwal, Anshu Bharadwaj, Shubhashis Dey, Ulka Kelkar, Renu Kohli, Nidhi Madan, Koyel Kumar Mandal, Apurba Mitra, Deepthi Swamy

Introduction

For developing countries like India, strong climate action can appear to be a trade-off—one that may come at the expense of robust economic growth. The question that India faces today is this: Will it compromise economic development and job creation if it chooses a low-carbon pathway, or can actions to reduce emissions in different sectors be the foundation of a stronger economy and improved human well-being?

India's long-term development pathway cannot directly borrow the approaches of other countries. For countries that are already industrialised, tackling the challenge of climate change requires decarbonising the existing infrastructure and moderating high consumption. For India, on the other hand, it means creating new green energy infrastructure that meets the needs of its population without locking into fossil-fuel path dependence. For instance, the International Energy Agency's *India Energy Outlook 2021* notes that 60 percent of India's carbon dioxide emissions in 2040 are projected to come from infrastructure, buildings, factories, vehicles and appliances that do not yet exist, pointing to the opportunity to build cleaner. India will also need to plan for transition in the global economy away from fossil fuels, which will cause shifts in technologies, cost and availability of capital, competitiveness, prices, and employment. As India explores a net-zero emissions future, recent studies have shown the

daunting scale of this challenge. Such studies, however, do not always model the macroeconomic implications of climate policies. For example, what could be the impact of climate policies on GDP and jobs? Will the savings in fuel costs, energy imports, improved health, and reduced climate damages outweigh the upfront capital costs? How will a carbon tax affect the government's finances and consumers' cash flow?

The Energy Policy Simulator for India (EPS-India), a free and open-source systems dynamics model for the period 2020–50,[1] explores such trade-offs and economy-wide effects. Created by Energy Innovation LLC and adapted for India in partnership with World Resources Institute India, the EPS-India uses publicly available data and offers hundreds of environmental, economic, and social outputs. Its interactive web interface allows users to create their own policy scenarios with various combinations of policy implementation levers across sectors.

Climate Action Scenarios for India

Through literature review and expert consultations held during 2019–21, the authors created four scenarios of climate action for India (See Table 1).

- **Reference Scenario**, which includes India's ongoing efforts in renewable energy (RE), energy efficiency, and electric mobility, and cost-optimisation of technologies in the electricity and transport sectors.
- **Medium-Ambition Scenario**, which includes sectoral policies that align with India's first Nationally Determined Contribution (NDC) and Sustainable Development Goals (SDGs) targets for 2030, but does not aim for more ambitious decarbonisation in the long term.
- **High-Ambition Scenario**, which includes sectoral policies with high potential for GHG mitigation over the long term, including currently nascent technologies such as hydrogen and battery storage. Policies with proven technologies are phased in linearly from 2020 to 2050, while those relying on nascent technologies are phased in starting from 2025 or 2030.
- **Net-Zero Scenario**, which further raises the policy settings in the High Ambition Scenario to achieve deep decarbonisation over the long term. For example, as given in Table 1, switching to electrification and hydrogen in

industry is increased from 50 percent of fossil fuel use in the High Ambition Scenario to 80 percent in the Net-Zero Scenario; carbon tax is raised from INR 5000 (US$78) per tonne of CO2 to INR 8,000 (US$117) per tonne of CO2 by 2050; EV sales mandate for cars is raised from 40 percent to 100 percent by 2050. Carbon capture and storage is not used in the Net-Zero Scenario.

The model assumes falling technology costs based on a combination of projected global prices and endogenous learning. It finds the least cost options in the electricity and transport sectors, subject to specified policy mandates. All monetary estimates are in 2018 constant prices (1 US$ = 68.42 INR).

Table 1: Key Policy Levers Assumed in 2050 in Four Climate-Action Scenarios for India

Policy levers	Reference Scenario	Medium-Ambition Scenario	High-Ambition Scenario	Net-Zero Scenario
Electrification and hydrogen - % fossil fuels substituted in industrial sector (linearly increasing from 2030)	0	0	50%	80%
Hydrogen production from electrolysis (linearly increasing from 2025)	0	0	100%	100%
Carbon tax per tonne of CO2 in 2050 (linearly increasing from 2020)	0	INR 4,000	11423.13	6140.66
EV sales mandate (% of new sales) Passenger LDV, Passenger HDV Freight LDV, Freight HDV 2-wheeler, 3-wheeler	35%, 23% 14%, 4% 38%, 30%	35%, 23% 14%, 4% 38%, 65%	40%, 50% 30%, 30% 80%, 100%	100%, 75% 75%, 50% 100%, 100%
Material efficiency, longevity and reuse (demand reduction w.r.t. Reference Scenario)	-	Cement: 10% Iron and Steel: 25% Waste: 20%	Cement: 15% Iron and Steel: 25% Waste: 20%	Cement: 35% Iron and Steel: 35% Waste: 35%
% of fossil-free sources in electricity generation (mandated minimum % through a carbon-free electricity standard)	69%	89% (60%)	92% (75%)	99% (80%)

The Medium-Ambition, High-Ambition, and Net-Zero Scenarios yield better outcomes than the Reference Scenario in terms of CO2 emission reduction, health co-benefits, and macroeconomic impacts (See Table 2).

Table 2: Key Outcomes in Four Climate Action Scenarios for India

Scenarios		Reference	Medium-Ambition	High-Ambition	Net-Zero
CO2 emissions (million tonnes)	2020	2,105	2,105	2,105	2,105
	2030	3,305	2,500	2,226	2,492
	2050	5,814	3,513	1,379	372**
Non-fossil electricity capacity (GW) (% share of total capacity)	2030	448 (59%)	461 (67%)	592 (76%)	428 (65%)
	2050	1,598 (75%)	1,383 (82%)	2,053 (90%)	2,439 (96%)
Additional investment above Reference Scenario (2018 US$ billion/yr) (% of GDP)	2030	-	–17.37 (-0.3%)	8.17 (0.1%)	49.40 (0.7%)
	2050	-	25.00 (0.2%)	168.15 (1.1%)	487.17 (3.1%)
Change in GDP w.r.t. Reference Scenario (billon 2018 US$)	2030	-	1.97	64.31	111.08
	2050	-	163.11	227.86	405.73
Change in jobs w.r.t. Reference Scenario (million)	2030	-	10	16	22
	2050	-	29	39	43
Monetised avoided deaths and climate benefits (billion 2018 US$)	2030	-	99.4	109.6	87.7
	2050	-	375.6	691.3	827.2

***No Carbon Capture & Storage (CCS) assumed in Net Zero Scenario*

Climate and Health Benefits

Sectoral decarbonisation policies, implemented together, can significantly reduce emissions, both in the medium term and in the long term (See Figures 1 and 2).

In the Medium-Ambition Scenario, the key policy drivers for emissions reductions are the implementation of a carbon tax and industrial energy efficiency standards and the reduction of demand for cement and iron and steel through material efficiency, longevity and re-use.

In the High-Ambition Scenario, the key policy drivers for emissions reductions are switching from fossil fuel in industrial facilities to a mixture of electricity and hydrogen; production of hydrogen through electrolysis supported by carbon-free electricity generation, and early retirement of otherwise non-retiring coal plants. The early coal-retirement policy can be particularly impactful in the earlier years if implemented from 2021, retiring all pre-existing coal capacity by 2032. In this scenario, CO2 emissions fall to 1,379 million tonnes in 2050.

In the Net-Zero Scenario, the key policy drivers for emissions reductions are switching from fossil fuel in industrial facilities to a mixture of electricity and hydrogen; production of hydrogen through electrolysis supported by carbon-free electricity generation; an economy-wide carbon tax; and electric vehicle (EV) sales mandates. In this scenario, CO2 emissions fall to 372 million tonnes in 2050, without using CCS.

No new coal capacity is added after 2024 in the Medium-Ambition, High-Ambition, and Net-Zero Scenarios due to the increasing cost-competitiveness of RE technologies as well as a carbon-free electricity standard policy, which mandates a minimum percentage of electricity generation from fossil-free sources—60 percent in the Medium-Ambition Scenario, 75 percent in the High Ambition Scenario, and 80 percent in the Net-Zero Scenario.

Figure 1: CO2 Emissions in Different Scenarios (Million Tonnes)

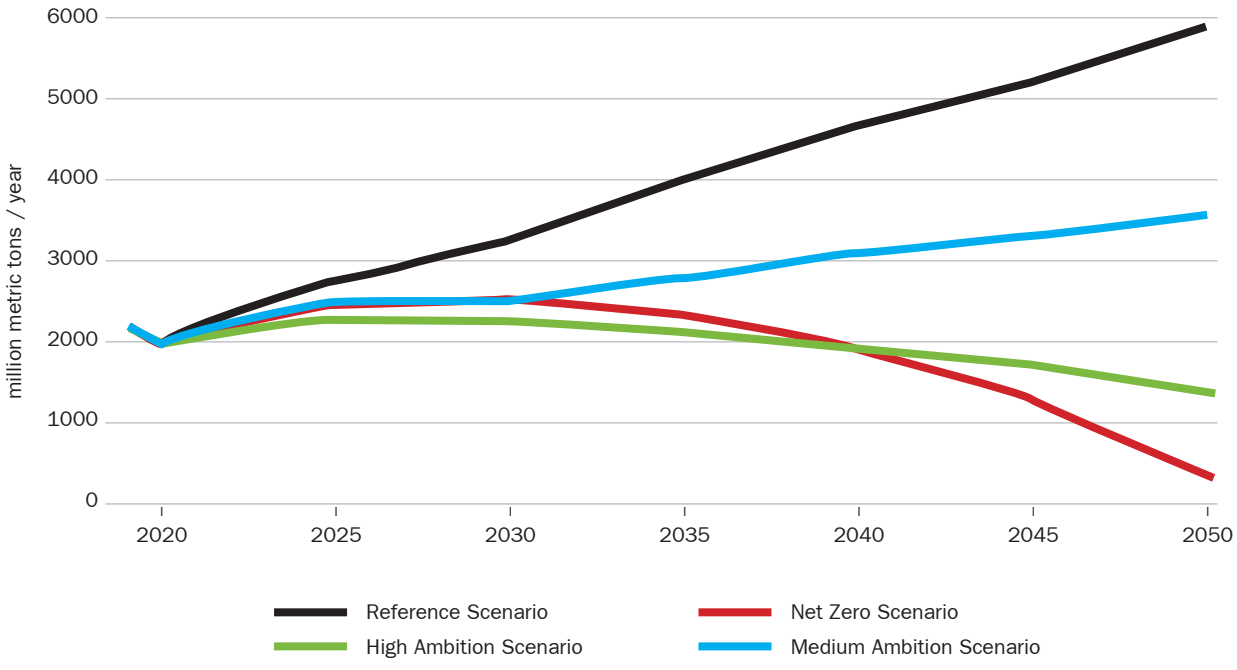


Figure 2: GHG Emissions in Different Scenarios (Million Tonnes)

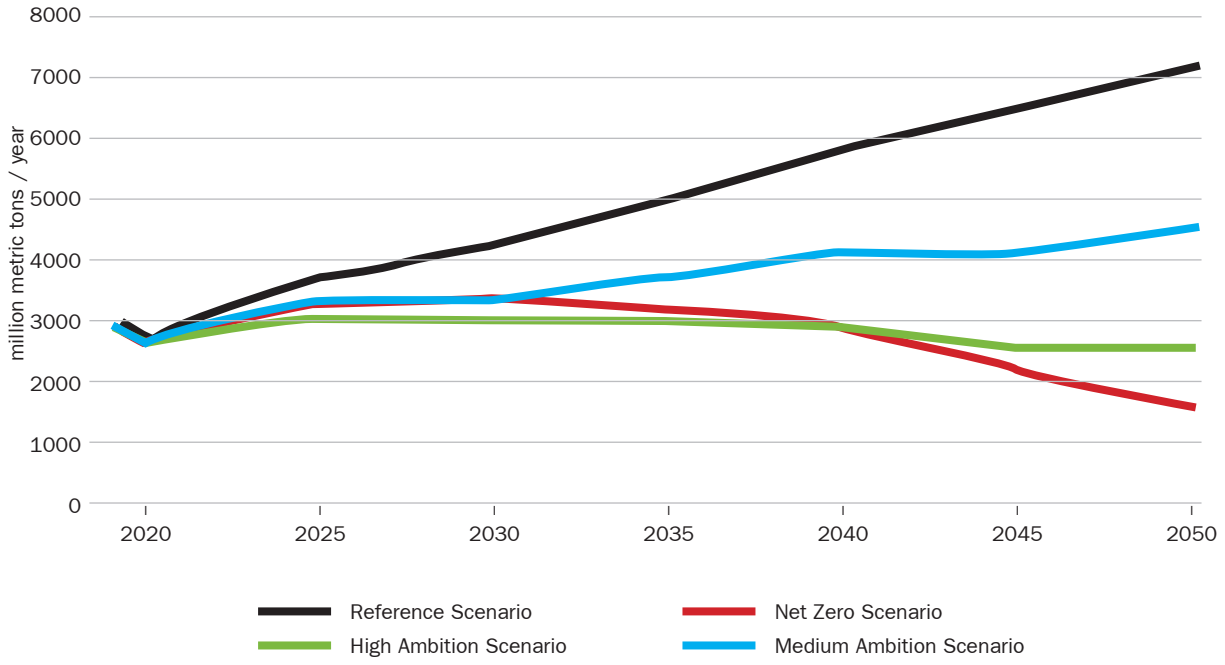
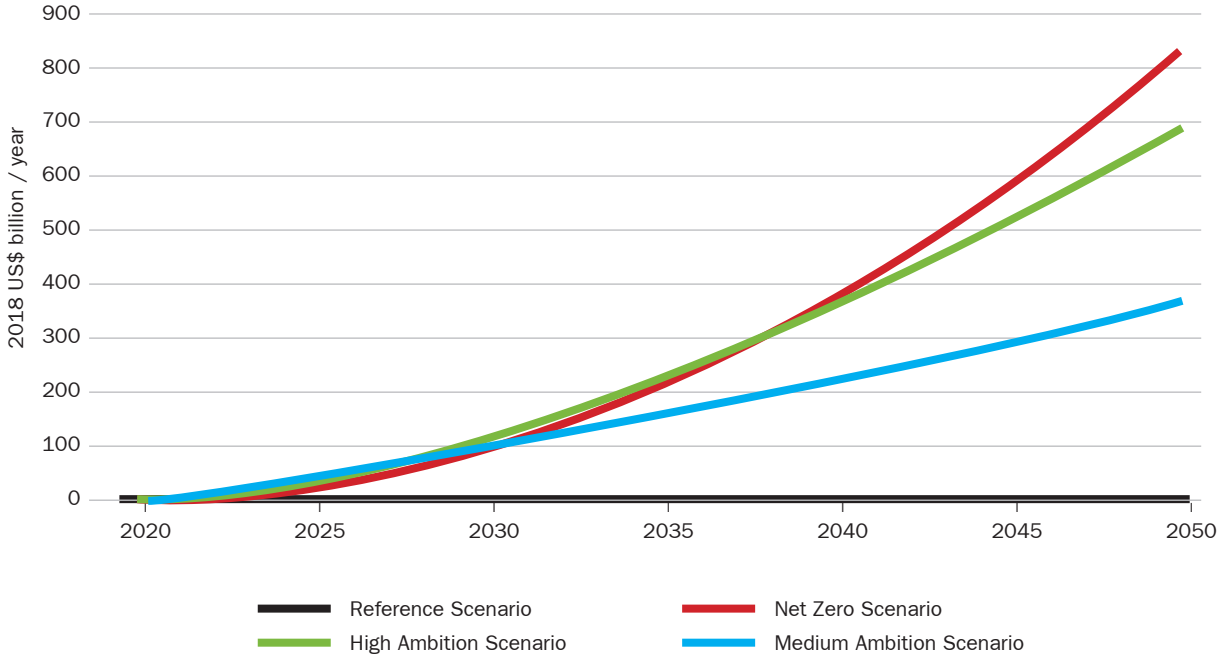


Figure 3: Monetised Avoided Deaths and Climate Damages Relative to Reference Scenario (2018 US$ Billion/Year)

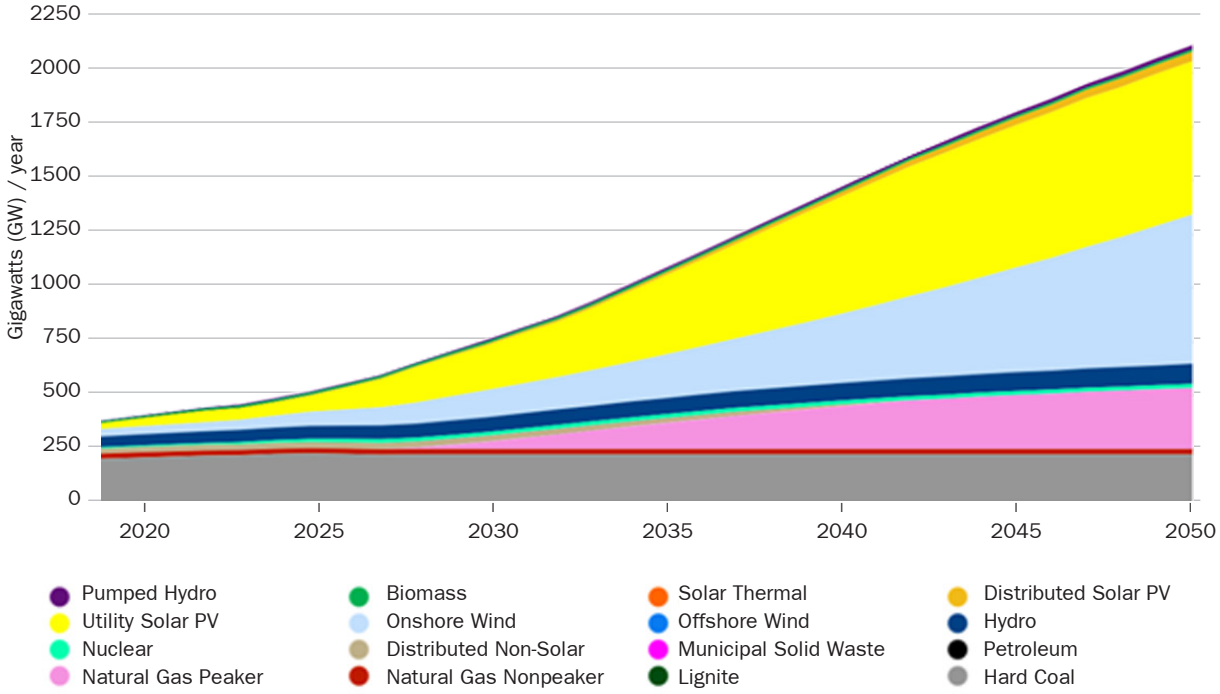


Moreover, these climate policies will yield significant health co-benefits, preventing premature deaths due to air pollution over 2020–50—9.9 million in the Net-Zero Scenario, 9.4 million in the High-Ambition Scenario, and 5.7 million in the Medium-Ambition Scenario. The estimated monetary value of avoided premature deaths and avoided climate damages amount to US$827 billion in 2050 in the Net-Zero Scenario, US$691 billion in the High-Ambition Scenario, and US$376 billion in the Medium-Ambition Scenario (all in 2018 prices). Cumulatively, over the 30-year period from 2020 to 2050, this adds up to US$8,789 billion in the Net-Zero Scenario, US$8,329 billion in the High-Ambition Scenario, and US$5,073 billion in the Medium-Ambition Scenario (all in 2018 prices)[2].

Strategic Sectoral Interventions

Due to the falling costs of variable RE generation technologies (i.e. utility-scale onshore wind and solar PV), the Reference Scenario already includes a significant amount of RE capacity. In 2030, the installed capacity of variable RE and large hydro together amount to about 410 GW, suggesting that market-driven progress alone might not be sufficient to achieve India's ambitious target of installing 450 GW RE capacity by 2030. The share of non-fossil sources (i.e. utility-scale solar PV, wind, hydro and nuclear) in the capacity mix reaches 57 percent in 2030 and 72 percent in 2050 in the Reference Scenario. In terms of electricity generation, nearly 70 percent of the electricity generated in 2050 is from non-fossil sources in the Reference Scenario. In the Net-Zero Scenario, this goes up to 99 percent in 2050. This is important to achieve the mitigation potential of policies that rely on the availability of green electricity, such as electrification in industry, production of hydrogen via electrolysis, and EV sales mandates. Focus on energy storage and grid flexibility will be required to successfully integrate the growing share of variable renewable energy.

Figure 4: Installed Electricity Capacity in Reference Scenario

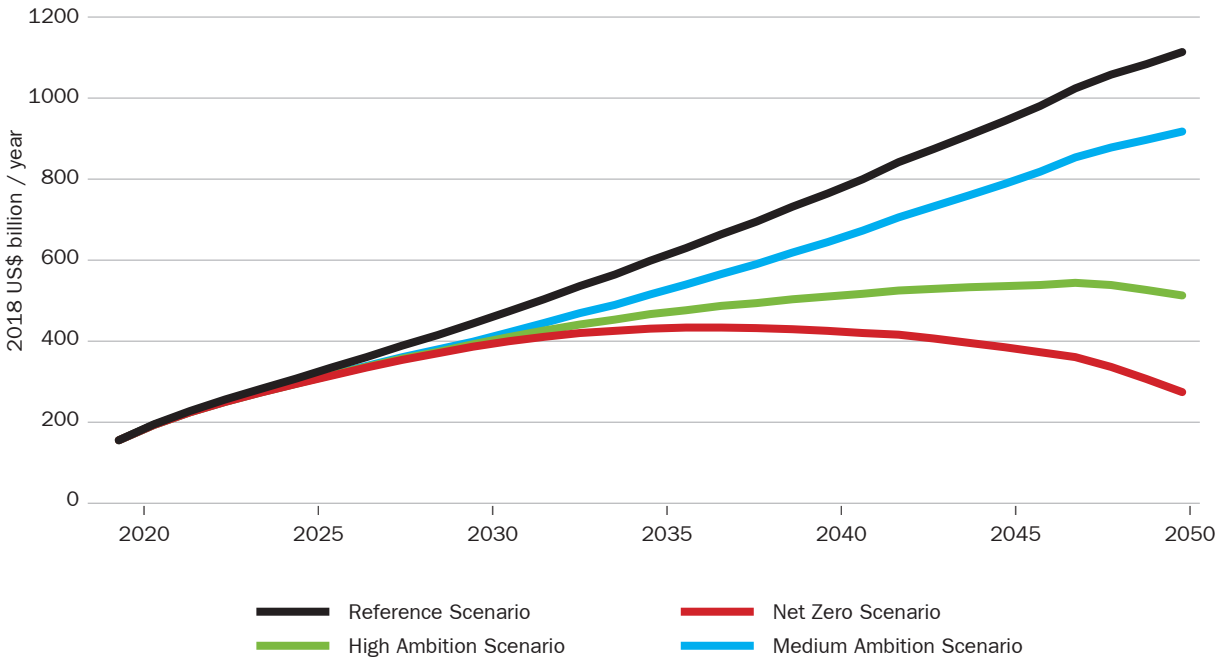


In India, the industry sector is crucial for decarbonisation and requires three key policies for the medium to long term. **First**, an industrial energy-efficiency roadmap, to strengthen and widen the coverage of the Perform–Achieve–Trade (PAT) energy trading scheme and to create incentives for investment in new energy-efficient technologies, particularly for energy-intensive products such as fertilisers. **Second**, guidelines for material efficiency for the construction sector, the certification and creation of formal markets for sustainable building materials, and financial incentives for the use of such materials (e.g. a lower goods and services tax), to realise the targeted reduction in the demand for emissions-intensive industrial products such as cement and steel. **Third**, the use of hydrogen as a fuel, which emerges as key to emissions reduction in the long term and is particularly important for decarbonising hard-to-abate parts of the industry and freight transport sectors. While this is currently at a nascent stage in India, the National Green Hydrogen Mission should create incentives for technology investments for fuel-switching in the private sector, develop hydrogen distribution infrastructure, and work on grid improvements to increase transmission and storage capacity for industrial-scale production of green hydrogen.

Financing the Low-Carbon Transition

The low-carbon scenarios have high capital expenditures on the deployment of clean technologies, but in the medium to long term, they yield increasing cost savings, primarily from reduced expenditure on fuels. The estimated savings in 2050 amount to US$911 billion in the Net-Zero Scenario, US$965 billion in the High-Ambition Scenario, and US$273 billion in the Medium-Ambition Scenario (all in 2018 prices) relative to the Reference Scenario. For instance, the reduction in energy import expenditure is depicted in Figure 5.

Figure 5: Energy Import Expenditure (2018 US$ Billion/Year)



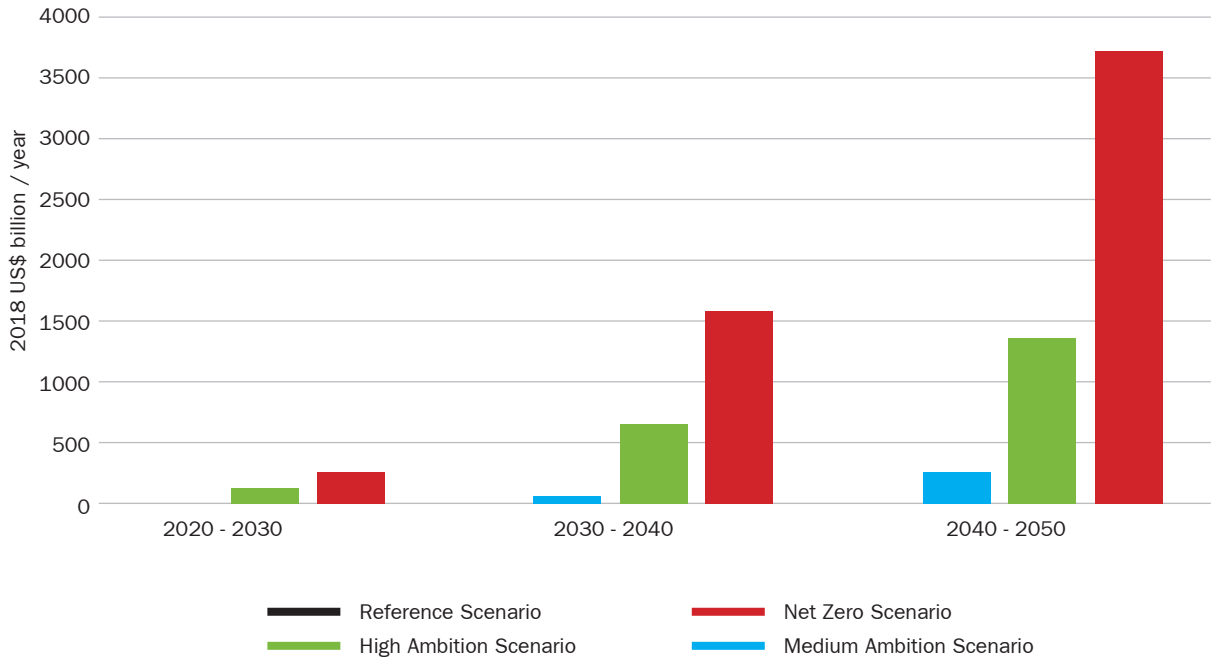
The additional capital expenditure for new technology deployment in the Net-Zero Scenario can amount to US$828 billion over the next 15 years and US$5.6 trillion over the next 30 years (above the Reference Scenario).[3] These magnitudes may seem astonishing, but the annual incremental CapEx amounts are no more than 1.8 percent of the 2035 GDP (US$160 billion) and three percent of the 2050 GDP (US$490 billion). Moreover, a steep and steady decline in expenditures on operation, maintenance and fuels fully outweighs the annual incremental CapEx costs as early as 2035 (–US$120 billion) in the Net-Zero Scenario. In 30 years, such fossil-fuel-linked expenditure reductions could

amount to as much as US$1.4 trillion, illustrating that India's gains from earlier decarbonisation can be very large.

The power sector undergoes a fundamental shift in the High Ambition and Net Zero Scenarios. For example, annual additions of solar- and grid-battery storage capacities increase eight-fold, and of onshore wind capacity increase six-fold by 2050. Annual costs incurred for these technologies could rise from 2.6 percent of the GDP in 2020 to 4.8 percent peak in 2035, thereafter moderating to around 2.5 percent of the 2050 GDP in the Net-Zero Scenario. Annual cost of hydrogen electrolysers for heavy industry decarbonisation quintuples in 15 years to around 0.1 percent of the 2035 GDP and around 0.35 percent of the 2050 GDP. Within heavy industry, significant investments will be required in steel and cement.

Operating and maintenance expenditures, coupled with the lowering of fossil-fuel costs, increasingly defray the costs of capital investments almost halfway to 2035, accelerating the pace to 2050 and releasing internal financing resources. Further, technology costs will fall with adoption through economies of scale and diffusion over time.

Figure 6: Additional Investment Required above Reference Scenario (2018 US$ Billion)



The decarbonisation pathways are mainly private-sector-led, responding to policy incentives including the carbon tax. There are no fiscal implications from subsidies. A 30 percent capital subsidy for rooftop solar is largely offset by reduction in fuel subsidies due to the diminishing use of LPG and natural gas.

In the global climate-action and macroeconomic context, the capital for clean project financing is abundant and at reasonable pricing. Domestic macroeconomic conditions are favourably poised for both private- and public-sector borrowings.

Boost to GDP and Employment

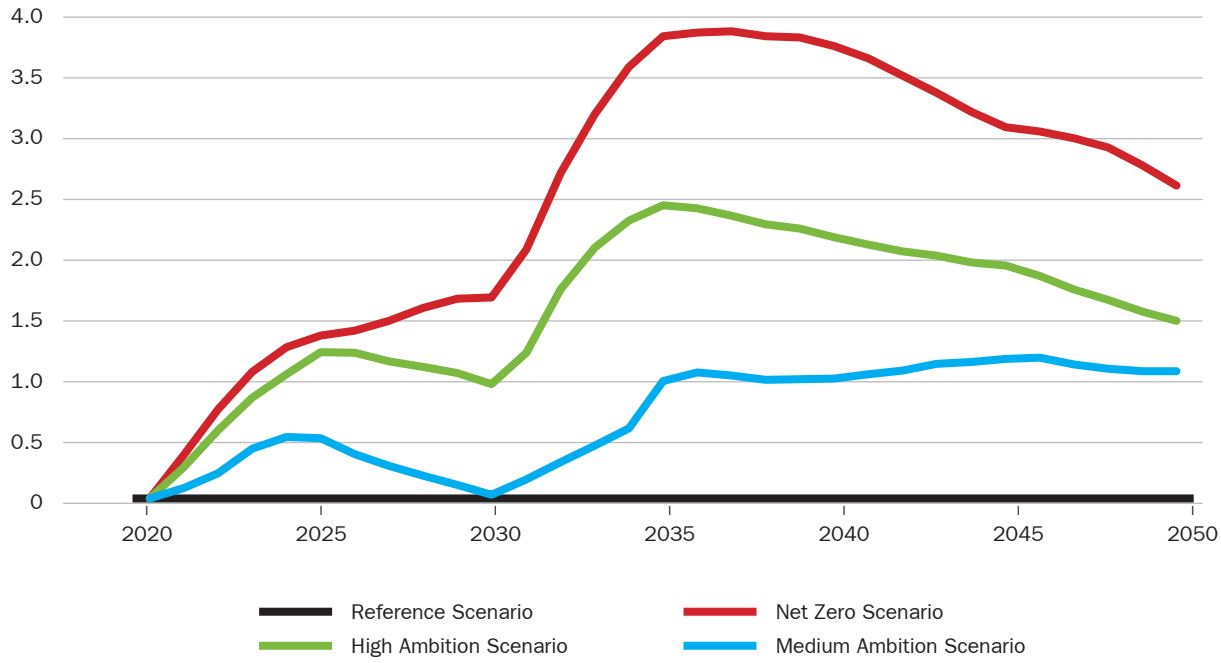
The overall effect of the low-carbon transition on India's economic growth is positive. The GDP in 2050 is projected to be higher than the Reference Scenario by US$406 billion in the Net-Zero Scenario, US$228 billion in the High-Ambition Scenario, and US$163 billion in the Medium-Ambition Scenario (all in 2018 prices). The net positive impact is mainly due to three factors: fresh, additional investments in new technologies and capacities; cheaper RE, transport and maintenance and operation expenses; and a net increase in demand induced by consumption and employment.

The reduction in high-carbon sectors is led by mining and quarrying (particularly coal mining) and manufacturing of coke and refined products. This loss of output is largely recouped by the gain in value-added share of electricity generation and utilities, driven by greater electrification and a clean energy shift. Heavy emitter industries such as Iron and Steel, as well as Cement, which bear major costs of carbon abatement, could together lose marginal value-added share in 30 years.

The motor vehicle manufacturing segment is not adversely impacted by the transition; however, significant within-sector changes due to a shift from internal combustion engine vehicles to EVs will entail costs, changes in business processes, supply chains and skill requirements. Transport and storage, and trade, retail, and repair sectors—which have extensive ancillary linkages to the automobile sector—may shrink marginally by 2050.

In all three low-carbon scenarios, there is a significant net increase in jobs

Figure 7: Percent Change in GDP Relative to Reference Scenario



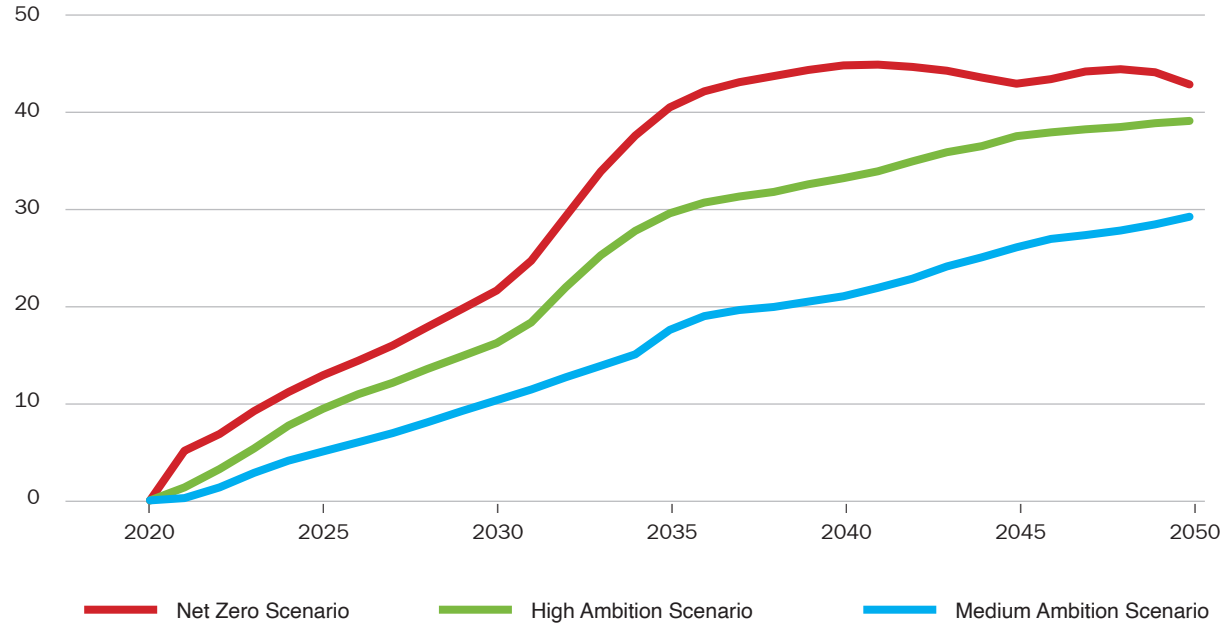
relative to the Reference Scenario. The Net-Zero Scenario has 22 million more jobs by 2030 and 43 million more jobs by 2050 than the Reference Scenario. These include direct jobs (created in an industry due to climate policies), indirect jobs (created within industries that supply the directly affected industry), and induced jobs (created by re-spending of money paid to workers or government because of the growth of the affected industry). The net increase in jobs is predominantly driven by induced economic activity. However, while the employment impact is net positive at the macro level, there could be losses within specific sectors and cross-sector shifts that may not be spatially matched or evenly balanced.[4]

Coal mining, and coke and refined products, are likely to see a reduction in numbers employed (direct and indirect) throughout the 30-year period. Net jobs lost in coal mining relative to the Reference Scenario could be an additional 0.34 million in 2030 and 1.49 million in 2050. The net job reduction in coke and refined petroleum products, which is capital-intensive, could be 0.03 million in 2030 and 0.19 million in 2050. The fossil fuel and utility sector, too, could witness job losses, but these losses will be balanced by job gains in the expansion of clean electricity utilities due to increased electrification in industry, transport, and buildings. Maintenance and repair of motor vehicles, transportation and

storage sectors could witness reductions in direct jobs in the transition but these will be offset by an increase in induced jobs.

Most of the new jobs are likely to be created outside the "losing" sectors, due to concomitant shifts in supply and demand, the expansionary effect of induced demand originating from new activities, and larger boosts from cost-savings in the later years.

Figure 8: Change in Direct, Indirect and Induced Jobs (Millions) Relative to Reference Scenario



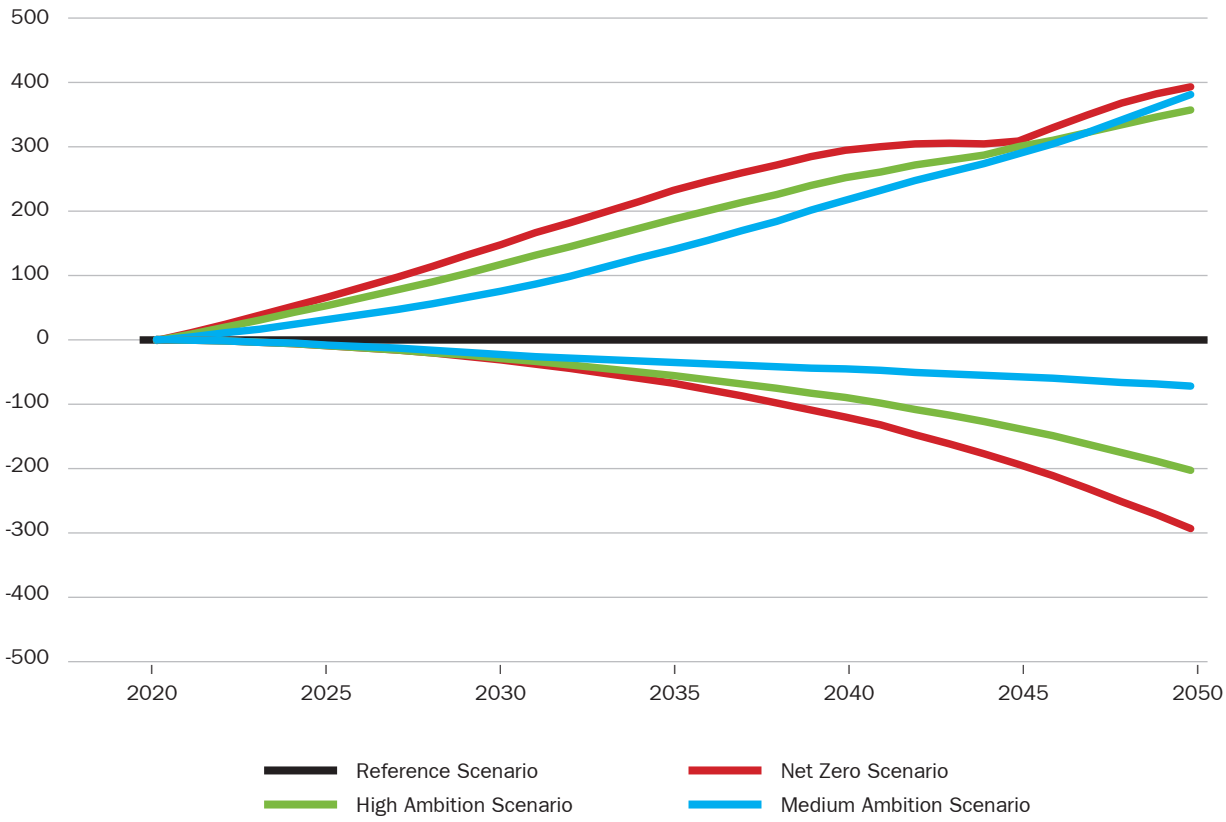
Role of Carbon Tax

It is possible for India to achieve deep decarbonisation in the economy while also boosting jobs and the GDP. However, carbon taxes will play a key role in this. A carbon tax increased in a phased manner over time will be pivotal to offsetting shortfalls in government tax revenue from petroleum products (engendered by the reduction in overall fossil fuel use with time). This can be applied on fuels based on their CO2 emissions and process emissions. The assumed carbon tax rate for the industry in the short term closely reflects the trend of the rising cess on coal.

Most decarbonisation policies tend to displace fossil-fuel use with carbon-free alternatives. Thus, given the associated shortfalls in tax revenues from petroleum products, it is crucial to explore alternate mechanisms for revenue generation for the government. An effectively designed carbon tax in the industry and electricity sectors, implemented while the transition from fossil fuels to clean energy is still underway, can be particularly useful in augmenting government revenues and mitigating potential trade-offs in the economy. Under the various low-carbon scenarios, by 2050, as fossil fuel tax revenue falls by 0.5–1.9 percent of GDP, as compared to the Reference Scenario, carbon tax revenue grows by 2.4–2.6 percent. Redirecting carbon tax revenues towards government spending can, therefore, mitigate the negative impact on induced economic activity, resulting from a significant reduction in government expenditure.

However, carbon pricing must be carefully designed for the equitable balancing of contributions from households, businesses and taxpayers. In the Reference Scenario, a carbon tax is applied on top of already existing petroleum product taxes. The government can first explore alternate mechanisms such as the optimal utilisation of various cesses collected across sectors to reduce the high reliance on fossil-fuel tax revenues. Some components of the current fossil-fuel taxes can be subsumed or redesignated as a carbon tax, but a judicious balance must be struck by keeping in mind the overall cost burden of decarbonisation upon heavy industry, so as to not disincentivise clean-energy adoption. Subsequently, government income can be further augmented through an additional carbon tax to induce economic activity and create additional jobs.

Figure 9. Change in Carbon Tax Revenue and Fossil Fuel Tax Revenue (2018 US$ Billion) Relative to Reference Scenario



Ensuring a Just Transition

In India, climate change is one of multiple stressors and policy priorities, and the focus of climate action has rightly been on the co-benefits for the local environment and human well-being. There is a need, however, to give serious consideration to the challenges and potentially adverse social impacts that climate action might have.

India's RE and EV targets are quite ambitious and will require significant investments in nascent technologies, developing a manufacturing base, ensuring mineral security, and judicious use of land.

It will be necessary to manage job losses in fossil fuel-based industries and provide social protection and safety nets in occupations that are directly at risk from low carbon policies. Further, India will need to ameliorate regional and gendered disparities in access to skills and finance for new green livelihood

opportunities emerging in sectors such as RE, EVs, green buildings, recycling, and land restoration. Special attention will have to be given to the quality of jobs in terms of formal contracts, social benefits, job security, unionisation, etc., especially considering the large share of the informal micro, small, and medium enterprises sector in India. Since job gains will occur in different states and sectors than job losses, coordinated policies by the central and state governments will be imperative.

While the economic ramifications of low-carbon policies will be net positive, they will need to be carefully managed for their effects on vulnerable communities. For example, a carbon tax on the truck and rail transport of goods could have a ripple effect on prices. The withdrawal of free electricity for farmers to rationalise the use of electricity for irrigation could further increase the cost of cultivation. Without revenue recycling, carbon taxes on power generation could make modern energy services unaffordable for poorer households.

Conclusion

Currently, all potential low-carbon scenarios yield better economic outcomes than the Reference Scenario. Deep decarbonisation in the Indian economy is possible while also boosting jobs and GDP and avoiding 9.9 million premature deaths due to harmful air pollution over the next three decades. The low carbon transition will require massive investments in power, industry, transport, and hydrogen. However, it can be ensured that government revenues are neutral, with carbon taxes playing a key role in realising the positive economic impacts on India's GDP and jobs. To be sure, subsidies play a small role, and the transition is primarily driven by industry response to policies such as the carbon tax. Early policy signals (e.g. mandates for renewable energy, electric mobility, and industrial fuels) could accelerate technology adoption by industry, benefiting from decreasing technology costs.

As India moves towards a low-carbon model, the workforce transition will need to be managed carefully over time. With thoughtful policies that build human capital, make prudent investments, and provide social safety nets, the low-carbon transition can also be a just transition.

A Just Path to a Decarbonised Future

Kate Hampton, Mridula Pandey and Shirish Sinha

The new IPCC Sixth Assessment Report clearly states that the coming decades are the planet's last chance to keep global warming below 1.5°C before the end of the 21st century.[1] It underlined the need for economies to decarbonise (i.e., to undertake deep reductions in CO_2 and other greenhouse gas emissions) to save the planet from the manifold consequences of climate change. Indeed, commitments to decarbonisation or clean energy transition have been gaining ground, especially over the past year. Nearly 130 countries, responsible for 73 percent of global GHG emissions, have either announced net zero targets or are considering them.[2] If such goals are achieved in full, global warming could be limited to 2°C by the end of the century.

Decarbonisation aims to shift away from the status quo and rethink the ways by which countries plan and operate their economic systems. The process is underway in many countries that are working to fulfil their commitments under the Paris Agreement and/or net zero targets. However, the current approaches are often technocratic, or the result of a techno-economic assessment of the right set of policies, incentives, and financing. They tend to give only tangential attention to questions related to people, especially the most vulnerable and marginalised.

To reap the benefits of decarbonisation, there is a need to ensure that these transitions are shared in a just and equitable manner while, as the United Nations exhorts, "leaving no one behind". Therefore, to complete the decarbonisation-led transition towards a climate-compatible future, the imperative is for a sustained and persuasive commitment to justice, equity, and inclusion.

Climate Justice and Just Transition

In the context of climate change, the concept of "justice" has many aspects and is understood and addressed differently by different stakeholders. What the international community understands today as "climate justice", and the closely linked concept of "just transition", emerged from the protest movements of the 1980s in the United States (US) against the unjust distribution of environmental hazards within marginalised communities. More recently, "climate justice" has widened the aperture of environmental justice from largely local environmental issues to the global challenge of climate change, and is addressing the distributional outcomes of climate impact and action. In a recent definition by the India Climate Collaborative,[3] 'climate justice' is considered as an acknowledgement that climate change can have disproportionate social, economic, public health and other adverse impacts on the poorest and marginalised populations. It strives to address these inequities directly through long-term mitigation and resilience strategies.

"Just Transition", meanwhile, is focused on securing systemic change that results in a more equitable new system. The opening of the Paris Agreement[4] calls upon governments to take into account "the imperatives of a Just Transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined priorities." This inclusion catalysed further research and enquiry into the subject. The idea has come into prominence in the global North which is looking to address the socioeconomic aspects of transitioning away from fossil fuels.

For instance, in 2018, Canada created a Task Force on Just Transition for Coal Power Workers and Communities[5] to better understand the impacts of phasing out coal, as well as determine the support required by affected communities. The

task force engaged extensively with the affected communities and emphasised on the need for sound policies and planning that take the local context into account and engage with the local communities in the process. In response to the task force's recommendations, in 2019, Canada announced $35 million in support over the next five years to create "worker transition centres" and explore new ways to protect wages and pensions. Earlier, in 2018, Germany appointed a dedicated agency, called the Commission on Growth, Structural Economic Change, and Employment[6] to recommend concrete measures and timelines that can enable the country's energy sector to achieve its emissions reduction targets by 2030, as well as provide a blueprint for Just Transition of the coal workers and mining regions. The Commission recommended supporting workers through various social and labour measures. The German cabinet accepted the roadmap recommended by the Commission, allocating €40 billion through 2038 for coal regions. Spain,[7] too, is considering a Just Transition deal that will replace coal industry subsidies with a sustainable development plan for the regions where coal mining is being proposed to be closed. The deal involved a €250-million plan to train and retrain workers who lost their jobs, provide for early retirement, sustainably restore mining sites, recover forests, and improve infrastructure.

The current discourse on Just Transition suffers from two crucial challenges: it is largely driven by a jobs agenda, and the framing is emerging from a global-North perspective. Much of the current experience in Just Transition is focused on jobs and engagement with formal labour unions. While right in its intent, this narrow focus on formal jobs may not be the best approach for the coal-dependent countries of the global South where the diversity of jobs and livelihood opportunities—and their relationship with the environment—makes the landscape more challenging. Their right to development, the growing energy demands, and arguments of low share of greenhouse gas emissions have further limited the discussions around Just Transition.

Towards a Socially Just Transition

Whether it is the global South or the global North, decarbonisation is progressing and is playing out at the sectoral level. The Children's Investment

Fund Foundation (CIFF) supports clean-energy transition across multiple geographies, with the aim of achieving transformations in the global power system, transport, industry, efficient cooling, and land use and food systems. The CIFF is also now engaging with the idea of ensuring that these transitions are just, fair, equitable, and inclusive. Aware that this will play out differently for different regions and sectors, the CIFF is trying to take a more locally appropriate '**socially just transition**' approach to low-carbon, climate-compatible development that is informed by the experiences and expectations of local stakeholders.

The CIFF's approach has three crucial elements when it comes to a "socially just transition": (i) **Jobs:** creation of more decent and diversity of jobs and livelihood opportunities; providing adequate and sustainable social protection for job losses and displacement; and promoting skills development; (ii) **Equity and Justice:** transition should also address the issues of equity (that between formal and informal workforce at the sectoral level, and that between regions and countries at a broader level) and how the transitions that are supported impact the delivery of justice in terms of distribution of benefits and decision-making; and (iii) **Inclusion:** in essence, creating space for everyone regardless of gender, race, ethnicity, stage of development and more, to take part meaningfully and benefit from such transitions.

Operationalising a Just Transition

While the thinking around what Just Transition means is rapidly evolving, there is a need to move fast to operationalise it. The current decade is the decade of delivery as the international community embarks to fulfil the Sustainable Development Goals (SDGs) by 2030; it is the right time to embed the concept of 'just transition' in development discourse. 'Just Transition' will require a paradigm shift in the global approach to development—a task that is complicated by the fact that countries are currently at different points in their developmental journeys. While countries of the global North are engaging on Just Transition through a mix of policies and strategic measures, low- and middle-income economies that continue to struggle with persistent development challenges will find it especially difficult to move at the same pace.

One thing is clear in the need to promote socially-Just Transitions: Far too much of the conversation has been driven by the global North. The imperative is to start valuing the intellectual capital in the global South because massive populations in those regions will be transitioning as countries take actions to cut emissions.

A highly impactful ground-level study in India[8] sought to understand what "Just Transition" means in the context of India's coal mining areas and the essential components of such a framework. The study draws learnings from Ramgarh, a key coal-mining district in the state of Jharkhand in Eastern India. In Ramgarh, the dependency on coal is significantly high at 27 percent of all households. Of these families, nearly 75 percent were part of the informal coal economy and only 29 percent had formal employment with coal companies. Further, the distributional impact of coal mining has been extremely limited, with the benefits accruing to only a few. There is a huge gap in the availability of basic infrastructure and services in the district: the number of primary healthcare centres is inadequate (able to serve only half of the population) and only 17 percent of rural households have access to piped water. The overall economic status of the district is poor, with 63 percent of households having a monthly income below $135. The focus on coal mining has also limited the development of other sectors and diversification of the economy.

Thus, Just Transition in India will not be a linear question of substituting a 'mono' industry (coal) with its workforce. Instead, it is an economy-wide, locally appropriate transition that provides an opportunity to reverse the 'resources curse' in coal mining areas. The study calls for a Just Transition framework that is implemented at the district level, supported by a well-coordinated effort between the state and central governments.

Another successful study on Just Transition emerges from South Africa[9] in the context of coal phaseout. Eskom, the national utility, is considering a Just Transition Climate Transaction to enable faster decarbonisation of South Africa's coal-fired power sector. The transaction is premised on raising concessional finance from international funders to support the repurposing and repowering of decommissioned power stations while also providing support and employment

opportunities for workers and communities affected by the closure of coal mines and coal power plants. President Cyril Ramaphosa endorsed the detailed planning by Eskom and rallied for similar thinking in the country's platinum and lithium mining sector. Such perspectives from the global South will be instrumental in making Just Transition work for all.

At the same time, there is a need to make the conversation more broad-based to include planning for transitions from a sectoral perspective. Most efforts so far focus on coal jobs and coal workers. It needs to be recognised that attempts for decarbonisation are also underway in other sectors such as transport, land use, and industry. For instance, as electric vehicles start replacing traditional internal combustion engine (ICE)-based vehicles, the transport sector workforce will be directly affected. As the shift towards electric mobility hastens, there will be a rise in demand for electrical and electronic skills and a potential parallel reduction in motor engine and metal working skills. With enhancement in skills required to serve electric mobility ecosystem, the informal workforce involved in servicing ICE vehicles could lose out. Similarly, a move towards clean energy transition in the industries will have repercussions on the jobs and livelihoods of those dependent on the sector who would then need skill development.

The Question of Finance

It is clear that Just Transitions require system-wide planning and support; what is less clear is who pays for it. Countries will need to make resources available to provide immediate support to those who lose out in the process of a transition, to provide reskilling to a section of workers and enable them to find employment, and to develop avenues for sustainable development of the regions and sectors affected to ensure fairness, equity and inclusion of vulnerable, affected communities.

Among the most comprehensive financial planning for this is found in the EU's Just Transition Mechanism, which seeks to mobilise €65-75 billion during 2021-2027 for regions affected by coal phaseout. If there is one lesson from the experience of the global North, it is that the resource requirement is massive. Estimates suggest a similar need in the global South, with South Africa's Just

Energy Transition Transaction[10] aiming to raise $11 billion over the next two decades. This will be pulled from local and international commercial and concessionary financing.

These examples also show that every level of government needs to play a role – from the international, to national and down to the local to ensure a well-financed successful Just Transition. However, the fiscal buffers for many low- and middle-income economies have been exhausted as a result of the COVID-19 pandemic, making it even more difficult to finance an economy that is not only green and resilient but is also just. Carbon taxation, which seems to be the resort to finance such initiatives, is regressive and ends up being a burden on the poor, thus defeating the purpose of justice and equity. Moreover, wealthy countries can afford to redistribute the proceeds of a carbon tax to low-income families to ease the politics of using this instrument, as they have access to other sources of financing for investment. This highlights the inequality hard-wired into the global financial system.

Broadly speaking, donors and international institutions must now make cheap credit available to developing economies to aid recovery. The goal for the next five years, starting in 2021, should be to surpass the $100-billion annual commitment by donors on climate finance[11] and combine international public finance with an enabling environment that will leverage private capital at scale. Massively scaled-up access to SDG-linked blended financial solutions—from grants for project development to concessional finance for infrastructure—would be a game-changer for enabling a just green growth, especially in emerging economies.

At a more operational level, a Just Transition should be supported by multiple stakeholders at different levels. These should include the following:

- Government and private sector support in the form of social protection benefits to affected workers (formal and informal) and communities
- Diversification of livelihood opportunities
- Large-scale support packages for skill development and re-training of the workforce

- A local development fund for sustainable development of the region. An example of this can be found in India's District Mineral Foundation[12] which are earmarked for prioritising livelihood generation and local job creation in mining regions.
- Ensuring access to existing development funding from bilateral and multilateral organisations[13] and global funds such as the Green Climate Fund to support livelihood generation activities especially in low-income countries and to marginalised communities
- Philanthropic capital that unlocks further assistance by supporting creative policy and financing solutions and sharing of best practices

Way Forward

A fair transition towards low-carbon economy is a worthy goal. As the politics of climate plays out, there is evidence that we risk derailing the progress on climate if we are to not adequately address the social injustices that our actions can cause. Climate change-induced extreme events are leaving the vulnerable at even higher risk. Therefore, the world cannot continue to win on climate while excluding groups that are most at risk, in effect creating a more unjust system that serves only a few.

A wide range of stakeholders (allies and opponents alike) must come together to build alliances that further the integration of Just Transition principles in global efforts towards decarbonisation. A Global Just Transition Facility can be a first step in this direction—it could provide the necessary capacity building, promote systems thinking approach and expertise on transition, build on the intellectual capacity that is led by the global South. This should be followed with clear demonstrations of planning and financing at scale across different sectors and countries.

A decarbonised world will truly make sense only if the new system is fair, equitable, and inclusive. The time has not been more right to start working in that direction.

Achieving Net-Zero through Just Transition

Chandra Bhushan

1. Introduction

The global community has limited time to act on climate change mitigation if it wants to avoid the irreversible, catastrophic impacts. Two reports this year have raised the "red alert". First is *Net Zero by 2050: A Roadmap for the Global Energy Sector*, by the International Energy Agency (IEA), which underscores the scale and urgency of action that must be undertaken to ensure that, in the next three decades, all nations remain on-track to meet the goals of the Paris Agreement of 2015.[1] *There is also Climate Change 2021: The Physical Science Basis, Working Group I, Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change,* which warns of the increase in frequency and intensity of extreme weather events that will affect economies and people across the world.[2]

For India—heavily reliant on fossil fuels for its energy needs and industrial growth, while also being highly vulnerable to climatic impacts—the next three decades will be critical in every aspect. At present, about 70 percent of India's primary energy supply relies on two fossil fuels: coal and oil. Of this, coal has a share of 44 percent, and oil, 25 percent (IEA, 2020). While the country is yet to pledge a net-zero emission target at the time of writing this article, two recent modelling studies on India's net-zero pathways provide a glimpse of possible

trajectories to reduce fossil fuels over the next three to four decades.

According to a study by the IEA, India's coal demand must be halved by 2040, and reduced by 85 percent by 2050.[3] Another study, by The Energy Resources Institute (TERI) and Shell, recommends a 60-percent decline in demand for both coal and oil by 2050.[4]

Table 1: Net-Zero Pathway by mid-2060

Fossil fuel sector	Sustainable Development Scenario (SDS)			
	2019	2030	2040	2050*
Coal demand (Mtce)	590	454	298	100
Oil demand (mb/d)	5.0	6.2	5.8	3.48
Natural gas demand (bcm)	63	144	210	150

Source: IEA, 2021.

Note: IEA provides data only till 2040. For 2050, an extrapolation has been done assuming that coal will reach zero by 2055, oil by 2065, while gas use in 2065 remains similar to 2020. At these consumption levels, India will reach net-zero by 2065.

Table 2: Net-Zero Pathway by 2051

Primary energy requirement (Mtoe)	2021	2051
Coal	505	216
Oil	222	89
Gas	53	149
Nuclear	19	45
Hydro	21	33
Solar	93	876
Wind	27	548
Bio/Waste/Other	92	204

Source: TERI and Shell, 2021.

Phasing down the production and use of coal and oil will have a heavy bearing on the sectors that are reliant on them. In addition to a rapid shift from coal-based thermal power to renewable electricity—a transition underway in India—also necessary is the re-invention of downstream sectors, especially steel, cement, automobile and fertilisers. However, the rapid energy transition and industrial transformation required to address the climate crisis cannot be

an isolated technological exercise. The nature of the Indian economy, where informal workers account for 90 percent of the workforce,[5] requires that the re-invention of energy and economic pathways be a socially responsible exercise. It must take into consideration the distribution of the workforce in various sectors, the livelihood dependence of local communities on these sectors, and the socioeconomic conditions of fossil-fuel-dependent areas and their resilience. The question of a "just transition" therefore becomes extremely important.[6]

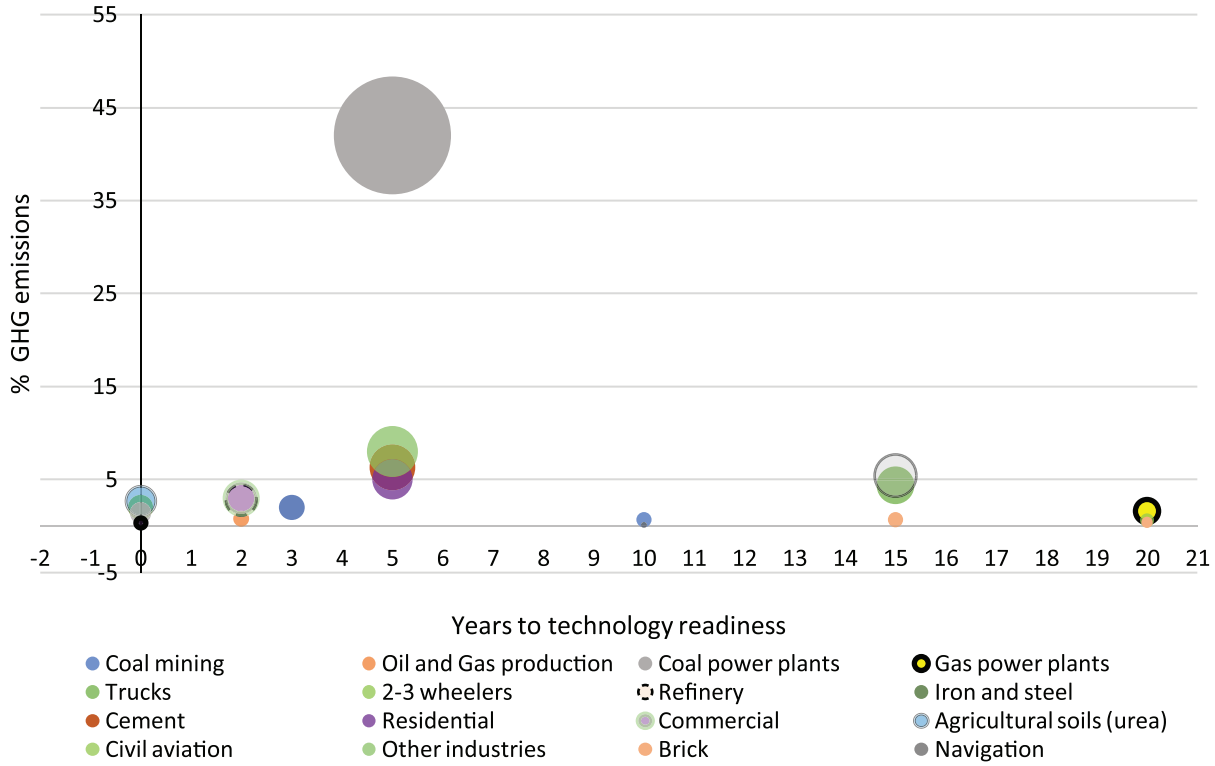
2. A Sector-Wide Outlook for Just Transition

In India, coal dominates the primary energy mix.[a] However, the consideration for a just transition cannot be only focused on coal. To achieve the net-zero emission targets through transformative changes, over the next three to four decades, just transition should be planned for all sectors that have competitive alternative technologies with significant emission reduction potential.

For example, an assessment of greenhouse gas (GHG) emission reduction potential and the availability of alternative technologies suggests that the sectors that need to be prioritised for a just transition include coal mining, thermal power plants, road transportation, other industries, and agriculture soil (urea use). These sectors collectively emit 64 percent of India's GHG, and 90 percent of the technologies required for their transition will be commercially available within the next five years (See Figure 1). This makes the next 10 years crucial for planning a just transition. In other coal-dependent sectors such as steel and cement, just transition will be viable only in the 2030s. The remaining industries and agriculture soil are likely to see a progressive transition.[7]

[a] Renewable energy-based sources are rapidly catching up.

Figure 1: Emissions versus Technological Readiness



3. Potential Impacts and Priorities

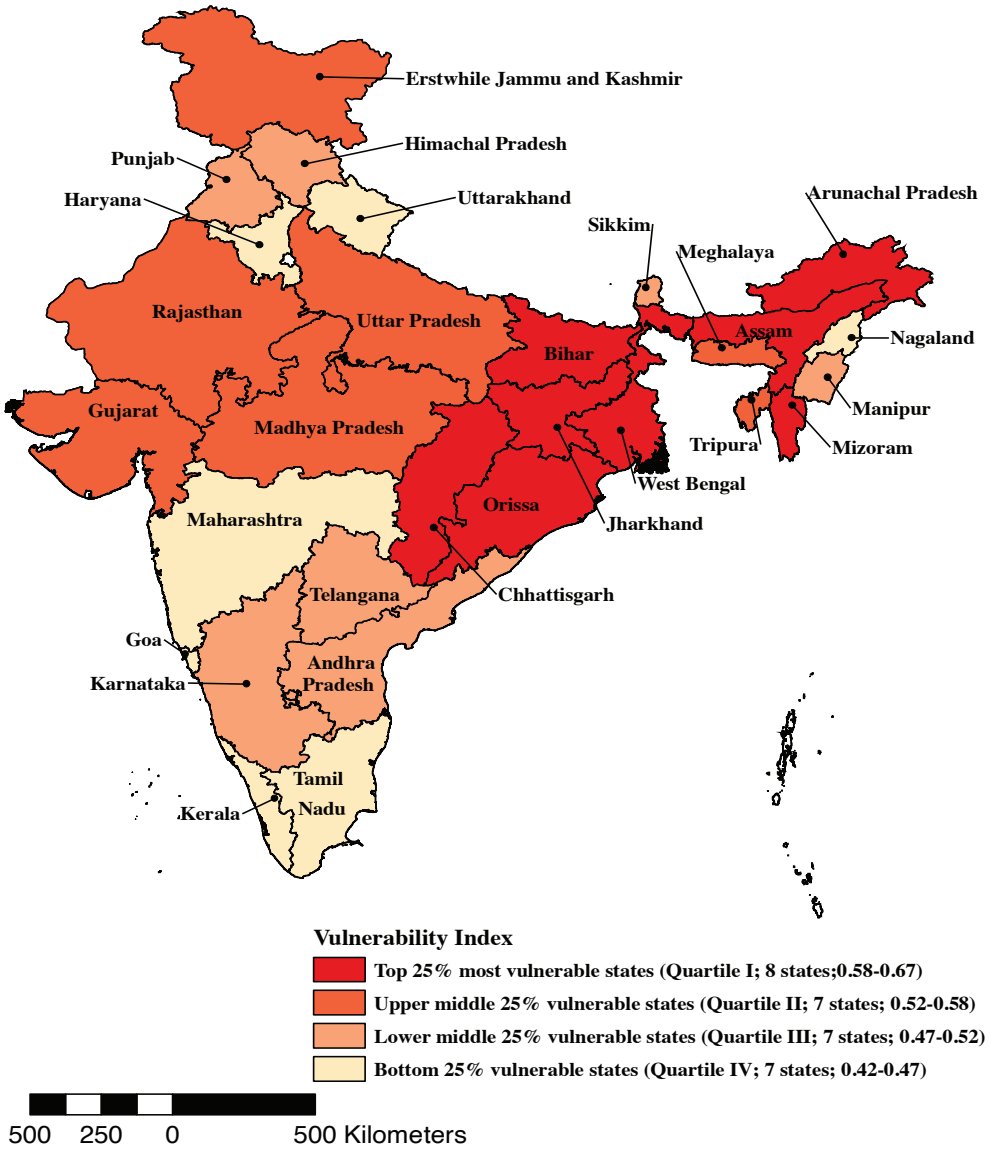
The transition to clean energy in India will have a huge impact on fossil-fuel communities and economies across the country. Three parameters—spatial impact, workforce impact, and revenue impact—provide an understanding of what a clean energy transition will look like and what it will entail.

3.i Spatial Impact: Out of the 718 districts in India, 120 have a significant proportion of fossil fuel or fossil-fuel-dependent industries—coal mining, oil and gas production, thermal power plants, refineries, steel, cement, fertiliser (urea), and automobile. These districts together have a population of approximately 330 million, i.e. 25 percent of the country's total population. During the next two to three decades, energy transition will affect all 120 districts to varying degrees,[8] but over the next decade, *just transition* planning should be prioritised for the 60 that account for 95 percent of coal and lignite production,

60 percent of thermal power capacity, and 90 percent of automobile and automobile component manufacturing. About one-third of these districts are concentrated in the coal belt of Jharkhand, Chhattisgarh, Odisha and West Bengal.

To be sure, the states and districts that will face the most difficult challenges in clean energy transition in this decade are also those that are extremely vulnerable to climate change impacts (See Figure 2).[9] This is due to the districts' high proportion of below poverty line population,[10] compounded by the poor state of healthcare, education and living standards.[11]

Figure 2: Most Vulnerable States to Climate Change



3.ii **Workforce Impact:** A clean energy transition in the coming decades (See Table 3) will impact the approximately 21.5 million people who work in fossil-fuel and fossil-fuel-dependent sectors in India. The impact will be worst for the informal workforce, which is nearly four times the formal workforce.[12] The informality is particularly high in sectors such as coal mining, steel, cement, and fuel retail, and the majority of such workers are low-skilled, have poor education, and earn low incomes.

An energy transition will have three primary types of impact on the workforce, which must be addressed through appropriate transition planning.

- Job loss due to declining production and eventually closing down of operations;
- Increased retraining and reskilling requirements for the existing workers due to changes in production processes or repurposing of facilities; and,
- Skilling of the new workforce to meet the requirements of new low-carbon industries.

Table 3: Estimated Workforce (in Million)

Sectors	Informal Employment	Formal Employment	Total Employment
Coal mining	1.8	0.8	2.6
Coal-based thermal power	0.05	0.13	0.18
Iron and steel	2.6	0.3	2.9
Cement	1.2	0.2	1.4
Oil and gas excluding refineries	NA	0.12	0.12
Refineries	0.08	0.04	0.12
Fuel retail	0.96	0.14	1.10
LPG distribution	0.01	0.09	0.10
Fertiliser	0.2	0.02	0.22
Automobile	NA	NA	12.8
Total	**6.9**	**1.8**	**21.5**

Source: C. Bhushan and S. Banerjee, Five R's: A Cross-sectoral landscape of Just Transition in India, 2021.

3.iii Revenue impact: Fossil fuel transition will have a significant impact on public revenue at the Centre and state levels. Coal, oil, and gas collectively contribute 18.8 percent of the total revenue receipts of the Central government

and about 8.3 percent of the total revenue receipts of the state governments. Approximately 91 percent of revenue contribution is from the oil and gas sector; coal contributes only nine percent.[13] Therefore, from a just transition perspective, oil and gas sector transition will have a far significant impact on public revenue as compared to the coal sector.

The revenue loss from coal mining, however, will affect the state governments, particularly in states where coal mining is concentrated. For states, the main source of coal-based revenue is royalty and contributions from the District Mineral Foundation (DMF). In most top coal states, such as Jharkhand and Chhattisgarh, the share of direct revenue from coal mining (considering the PSUs, which are the major operators) is about five to six percent of the total state revenue.[14] Furthermore, many states and Union Territories earn a significant amount of revenue through sales taxes on petrol and diesel. Collectively, the sales taxes from petrol and diesel in some of these states, such as Odisha and Madhya Pradesh, are much higher than the coal mining revenue (See Table 4). Consequently, automobile transition due to electrification of vehicles, which is already significant for two-wheelers that consume 60 percent of petrol,[15] will cause considerable revenue loss for states.

Table 4: Sales Taxes from Petrol and Diesel, and Direct Revenue from Coal Mining

State/UT	Sales Tax/VAT from CPSEs (INR Billion)		Coal Mining Taxes and Revenues of PSUs (INR Billion)
	Petrol	Diesel	
Chhattisgarh	12.67	24.84	32.21
Jharkhand	8.97	20.19	39.92
Madhya Pradesh	28.71	38.75	34.10
Odisha	15.79	38.39	29.10

Source: C. Bhushan and S. Banerjee, "Five R's: A Cross-sectoral landscape of Just Transition in India," 2021.

4. What Will Just Transition Entail?

'Just transition' in India will necessitate a development intervention to minimise negative impacts of an energy and industrial transition on the fossil-fuel dependent states, districts, workers, and the local community. To this end, the following five factors (5Rs) will be crucial:

i. Restructuring of the economy and industries;
ii. Repurposing of the land and infrastructure;
iii. Reskilling existing and skilling new workforce;
iv. Revenue substitution and investments in just transition; and,
v. Responsible social and environmental practices.

4.i Restructuring of the Economy and Industries: The fossil-fuel districts will require a restructuring of economic and industrial activities to diversify the economy. Currently, most of the coal districts in India are mono-industry districts, which undermines the potential of other sectors. For example, in the Korba district of Chhattisgarh, which accounts for about 20 percent of India's coal production, mining contributes to nearly 50 percent of the district's GDP. Even in districts such as Ramgarh of Jharkhand, where 50 percent of the mines are considered unprofitable, coal and coal-based industries contributes over 40 percent of the district's GDP.

A well-designed industrial restructuring plan, supported by appropriate fiscal instruments, can facilitate a transition with minimum disruption. This will involve formulating appropriate industrial policies by the concerned state governments as well as district development plans in consultation with local institutions. Furthermore, economic and industrial restructuring should harness the potential of local resources. In many fossil-fuel districts, there is substantial scope for boosting the local economy and creating sustainable industries based on agricultural and forest products, aquaculture, dairy, and sustainable tourism. For instance, India's top coal mining districts have over 31 percent forest cover on average, which is 10 percent higher than India's total average.

4.ii. Repurposing of the Land and Infrastructure: One of the biggest challenges to developing new industries is the availability of land and its acquisition. This can be addressed by repurposing land and infrastructure from existing fossil fuel industries. An estimated 0.45 million hectares (ha) of land is available with coal mining and major coal allied industries, including coal-based power, iron and steel, and cement. Indeed, coal mines and power plants alone hold about 0.3 million ha of land.[16]

Land reclamation also creates both immediate and long-term economic opportunities. In the short term, land reclamation and redevelopment will require the engagement of large numbers of skilled and unskilled workers, creating direct employment. In the long term, well-planned infrastructure projects with complementary investments can have far-reaching benefits for the local economy.[17]

4.iii. Reskilling existing and skilling new workforce: To offset the impact of job losses from a fossil-fuel transition and to aid the workforce impacted by the restructuring of industries and repurposing of facilities, a progressive skilling plan will be necessary. Sectors that will experience the highest number of job losses include coal mining, coal-based power, automobile ancillary industries and refineries, given their progressive phasing down of operations in the coming decades. Alternative job opportunities must therefore be created for these sectors on priority. In the other sectors, a well-planned reskilling and skilling programme will avoid job losses. Additionally, timely intervention through reskilling and retraining can help informal workers to get readily absorbed in alternative income opportunities.

4.iv. Revenue Substitution and Investments in Just Transition: The Central government must plan for the substitution of public revenue from fossil fuels, with the state governments playing a role in just transition financing through public revenue. In this context, both DMF funds and GST compensation tax is crucial. The most significant tax on coal is the GST compensation cess (originally instituted as the coal cess to fund green energy transition), levied at INR 400 per tonne on the dispatch of coal and lignite; in 2019–20, it amounted to an estimated INR 400 billion. However, this cess will lapse in

2022, providing an opportunity to reverse this to coal cess and use it for just transition in coal-mining areas. Similarly, DMF funds available for place-based investments must be aligned to just transition investments, which currently have a cumulative accrual of about INR 185 billion in the coal-mining districts.[18]

4.v. Responsible Social and Environmental Practices: Just transition must include responsible social and environmental practices, capitalising on the opportunity to reverse the resource curse and form a new environmental and social contract between the people, the government, and the private sector.

Over the years, resource extraction has led to pollution, ecological destruction, and large-scale displacement and deprivation of local communities in India—rendering many fossil-fuel (particularly, coal) regions poor and underdeveloped. Moreover, local communities have been alienated and often excluded from decision-making processes. The "new contract" should address these issues—ensuring inclusive decision-making, poverty alleviation, fairer income distribution, and investments in human development and social infrastructure at the social level, and ecological protection and restoration of the environment. This will, in turn, enhance sustainable livelihoods and income opportunities.

For the next three to four decades, just transition must be planned as a strategic development intervention. Such a transition cannot be executed hastily, and a long-term road map must be developed that will consider both the emission reduction targets and the opportunities in hand. This would usher in a transformative change that is inclusive, just, and viable.

Perspectives on a Green Taxonomy for India

Renita D'Souza

Introduction

If current patterns are not reversed, global temperatures will likely rise by greater than 3°C above pre-industrial levels by 2100—this will be a significant breach of the limit of 1.5°C set by the Paris Climate Agreement. The priority of the COP26 summit is to urge nations to be ambitious in updating their 2030 targets and commitments to climate action.[1]

India is the third largest carbon emitter, the second most populated country that is projected to reach its peak population of 1.6 billion by 2048,[2] and one of the fastest growing economies in the world. By adopting a development pathway consistent with the 1.5°C-target amidst its pursuit of becoming a USD 5-trillion economy, India will be pivotal in the global calculus of climate change mitigation. It can motivate its peers to heighten their climate action and set a pioneering example of circumventing the complex trade-offs between environment and growth.

India's transformation into a USD 5-trillion economy that remains 1.5°C-compatible, will have to be underpinned by an increase in efficiencies in energy and resource use. This green transformation requires massive investments in the most advanced green technologies and business models, as

well as in green infrastructure. This transformation is estimated to require an annual investment of USD 200 billion on green infrastructure alone (or 7-8 percent of GDP), and a climate-smart investment of USD 300 billion.[3]

It is a task easier said than done. The investment peculiarities of green ventures prevent their risk-return profile from aligning with the principles of lending that guide conventional financial institutions.[4] Moreover, such institutions in India are under stress, a state that has been aggravated by the prolonged COVID-19 pandemic.[5] Financial institutions that thrive on financing underserved investment needs—by leveraging financial innovation, in general, or investment instruments, in particular—naturally lend to green projects. Their customised solutions to green projects have included the use of credit enhancement, aggregation and securitisation, blended finance, Payment for Ecosystem Services (PES), Reducing Emissions from Deforestation and forest Degradation (REDD+), and debt-for-nature swaps.

India must tap foreign private capital to achieve its green transition, given the hefty requirement for green investments, its underdeveloped financial markets, and a dearth in domestic institutional investment.[6] Such global capital is abundant: a collective Asset Under Management (AUM) of USD 81.7 trillion under the 1715 signatories to the Principles for Responsible Investment (as of April 2018);[7] some 534 sustainability indexed funds overseeing a combined USD 250 billion (as of the end of the second quarter of 2020);[8] and the impact investment market worth USD 715 billion.[9] However, global private finance accounted for a meagre five percent of tracked national green funds in India for the years 2016-17 and 2017-18.[10]

This can be attributed to the high-risk perception of green finance, which is accentuated in the context of emerging economies like India. Compounding the risk perception is the absence of a green taxonomy, which standardises what constitutes as green finance and provides a rulebook for determining the eligibility of economic activities/projects/assets for such finance.

Guiding Principles for a Green Taxonomy

A well-defined taxonomy will reduce the incidence of information asymmetry, rule out plural interpretations of green finance, and minimise the risk of greenwashing. It will provide a transparent understanding of the environmental footprint of economic activities underlying investments.

A green taxonomy can provide the guidance and confidence sought by investors in making environmentally conscious investment decisions. It can provide visibility to capital-starved green sectors, allowing them to attract requisite investments away from renewable energy, which currently accounts for 80 percent of green finance in India.[11] It can be the touchstone for Financial Institutions (FIs) and companies in managing and monitoring the environmental quotient of their financial profile while allowing regulators like the Securities and Exchange Board of India (SEBI) and the Reserve Bank of India (RBI) to oversee these entities by mandating disclosures that align with the taxonomy. It can be the reference for strengthening SEBI green bond guidelines that currently allow for multiple definitions of "green" investments.[12] It can facilitate standardisation of data collection, reporting, and impact measurement methodology involved in the construction of ESG indices.[a] It can also be the government's barometer for tracking the compatibility of environmental outcomes with the vision of global net-zero, while showing the way to appropriate corrections in the case of deviations.

The development of an Indian green taxonomy can borrow insights from existing taxonomies. This essay illustrates this by reviewing some of those taxonomies and deriving learnings that, when tailored to accommodate domestic circumstances, can implicate salient principles for the Indian taxonomy.

[a] ESG Investing incorporates environmental, social and governance factors alongside financial factors in the investment decision-making process. Environmental, social, and governance (ESG) criteria refer to a set of benchmarks applied by investors to appraise a company's operations while screening potential investments. ESG indices provide a benchmark of companies that perform well on ratings based on environmental, social, and governance practices.

Principle 1: A green taxonomy should be developed in a way that has a multipronged impact on green finance.

The taxonomies developed by China,[13] Mongolia,[14] and European Union (EU) countries[15] standardise the notion of "green", and identify the impacts of such standardisation as the objectives of the taxonomy.

The structure of an Indian taxonomy can be comprehensive enough to generate multiple positive outcomes creating an additive impact on green finance flows. These outcomes have been discussed above.

Principle 2: The taxonomy should focus on India's most pressing environmental challenges.

There is a significant overlap in the environmental objectives of most taxonomies (e.g., Bangladesh,[16] China, Mongolia, Malaysia,[17] and EU). These include climate change mitigation and adaptation, pollution prevention and control, resource efficiency, conservation of natural resources, and ecosystem/ biodiversity conservation. However, the taxonomies diverge in their inclusion of certain sectors and the mechanisms used to achieve specific objectives—merely reflective of the differences in the countries' prerogatives and obligations. India's taxonomy must focus on its pressing environmental challenges.

As mentioned briefly earlier, India is the third largest carbon emitter in the world, accounting for 2.62 billion metric tonnes or 7.2 percent of total global CO2emissions in 2019 India is the second most polluted country globally, with Delhi being the most polluted capital city, and 22 of the country's cities listed in the world's 30 most polluted.[19] About 70-80 percent of surface water in India is contaminated and unfit for consumption.[20] India is being confronted by the worst water crisis in its history: 21 of its cities will have exhausted their groundwater reserves by 2020. Moreover, 40 percent of India's population will have no access to drinking water by 2030.[21] India's per capita ecological footprint is 1.19 hectares while its per capita biocapacity is 0.43 hectares, implying a biocapacity deficit of 0.76 hectares.[22] More than 90 percent of biodiversity hotspots in India have been lost.[23]

The taxonomy must include the environmental objectives of climate change mitigation, reducing air and water pollution, addressing water scarcity, and arresting ecosystem/biodiversity losses. These are serious challenges in sectors such as energy, manufacturing, transport, agriculture, waste, and buildings.[24] The taxonomy may thus focus on these sectors to maximise the positive environmental outcomes expected to be generated from the taxonomy.

Principle 3: The taxonomy must be anchored in Nationally Determined Contributions, key national plans and policies for environmental action, and national norms and standards.

Almost all national and regional taxonomies (e.g., China, Mongolia, Bangladesh, Malaysia, Egypt,[25] and EU) take into account Nationally Determined Contributions (NDCs), national plans and policies for environmental action, as well as national norms and standards.

For the technical screening criteria, the Indian taxonomy must rely on pollution standards set by the Central Pollution Control Board (CPCB) under the Ministry of Environment, Forests & Climate Change (MOEF&CC); water consumption norms set by the MOEF&CC and Ministry of Jal Shakti; and the Environmental Impact Assessment (EIA) protocol defined by the MOEF&CC. The monetary valuation of ecosystem services may also be used for assessing ecosystem and biodiversity losses.[26]

Principle 4: The eligibility criteria must be technology agnostic and 1.5°C-compatible.

Unlike the taxonomies of Bangladesh, Malaysia and China, India's own must establish screening criteria for determining eligibility for green finance. Akin to the EU taxonomy, the Indian version must be technology agnostic. Such a taxonomy provides the freedom to choose between alternative pathways to green transition and prevents it from being redundant amidst technological innovations.

Like the Climate Bonds Initiative (CBI)[27] taxonomy, India's must use the latest climate science for its technical screening criteria relating to GHG emission thresholds. The criteria should be consistent with 1.5°C, rather than 2°C.

Principle 5: The taxonomy should be harmonised with international standards.

Existing Indian standards may be revised to be at par with international benchmarks within the scope provided by domestic circumstances. For example, unjustifiable exemptions, standardised terms of reference, standard questionnaire for the public hearing process, and introduction of "deemed" clearance have compromised the authenticity of the EIA protocol.[28] While attempting an overhaul of this protocol, it may be augmented by including Cumulative Impact Assessment in line with the International Finance Corporation (IFC) Performance Standard 1: Assessment and Management of Environmental and Social Risks.

Principle 6: Alignment of tracking of green finance and disclosure norms with the taxonomy.

The MDB-IDFC Principles,[29] and the taxonomies of Malaysia, Egypt, and the EU, highlight the need for tracking climate/green finance through transparent and well-defined disclosures and reporting.

Regulators such as the RBI and SEBI should mandate financial market participants to delineate the environmental goals met by underlying investments for each financial instrument (i.e., bonds, equity, and loans), and the proportion of such investments that are taxonomy-aligned, expressed as a percentage of the investment into an instrument, fund, or portfolio. The Ministry of Corporate Affairs must mandate companies to disclose the proportion of their revenues and turnover as well as capital and operational expenditures aligned with the taxonomy, disaggregated by economic activity, and enlist the environmental objectives achieved by economic activities.[30]

Principle 7: Regular reviews and updates of the taxonomy.

The Mongolia, China, and CBI taxonomies underscore the importance of timely updates to incorporate changes in development levels, technology, policy, standards and environmental conditions. This principle must be included in the Indian taxonomy.

Other Issues

Owing to the heterogenous nature of farms and the lack of feasibility of tracking GHG emission, air and water pollutants as well as water consumption at the farm level, the taxonomy may include a pre-specified set of sustainable agricultural and livestock farming practices suitable for the Indian context, as opposed to quantitative technical screening criteria. Sustainable agricultural practices include organic farming, agroforestry, natural farming, System of Rice Intensification (SRI), and precision farming. Sustainable livestock farming practices include better pasture management, improvement in animal nutrition and genetics, improved manure management, fertiliser management, and animal health planning. The MOEF&CC, Ministry of Agriculture & Farmers Welfare, and Ministry of Fisheries, Animal Husbandry & Dairying should task the Indian Council of Agricultural Research (ICAR) to conduct research for finding substantial, reliable and robust evidence in favour of sustainable agricultural and livestock farming practices. Such research would also delineate a set of essential practices which, when deployed collectively, will yield appreciable environmental gains across various biophysical conditions in India.[31]

The culture of poor compliance across sectors exposes the implementation of the taxonomy to the risk of "greenwashing". Violation of industrial pollution norms and the EIA protocol can be remedied by setting up incentive-compatible mechanisms of compliance. Minimising greenwashing in the transport sector, for example, would require replacing chassis dynamometer and Constant Speed Fuel Consumption (CSFC) tests with engine dynamometer tests in verifying compliance with CO2 emissions thresholds.[32] It also necessitates a gradual phasing out of preferential treatment to electric vehicles in such verification,[33]

delinking of financial incentives of type approval and Conformity of Production (COP) testing agencies from vehicle manufacturers' need to demonstrate compliance,[34] and establishing the carbon-neutrality of bio-fuels before including activities related to such fuels in the taxonomy.

Conclusion

The introduction of a national taxonomy will display India's aspiration of ramping up its contribution to the global net-zero vision. At present, green finance in India is still a "cottage industry". Articulating a taxonomy will help "industrialise" green finance, transforming it "from a trickle to a flow" which will in turn influence India's ambitious green transition.

A Green New Deal Must Be Global

Mihir S Sharma

Introduction: 'Ambition' vs. Reality

In recent years, climate ambition has increased in many parts of the world. Many emerging and developed economies have either formally or informally revisited the Nationally Determined Contributions (NDCs) they set out following the December 2015 Paris Agreement; by the end of 2020, 75 Parties to the Agreement had published a new or updated NDC.[1] Yet estimates by the United Nations (UN) demonstrate that this is still insufficient. The February 2021 NDC Synthesis Report notes: "While the majority of nations represented increased their individual levels of ambition to reduce emissions, their combined impact puts them on a path to achieve a less than 1 per cent reduction by 2030 compared to 2010 levels. The Intergovernmental Panel on Climate Change, by contrast, has indicated that emission reduction ranges to meet the 1.5°C temperature goal should be around 45 per cent lower."[2]

This deficit in ambitions is a consequence of the basic structure of the Paris Agreement. While a major step forward, it is structured around national rather than global efforts. Climate change, however, is a global problem: anthropogenic climate change works through emissions that underlie a globalised economy; in the absence of the sort of cataclysmic global event that returns all nations to something approaching autarky, climate change needs a global solution.

The Paris Agreement is not a global solution, since it creates little incentive to ensure that efforts at mitigation of carbon emissions are focused on areas where they will have the most effect. It is difficult to construct a coherent global effort to control carbon emissions out of nationally determined contributions; the effort has organically reinforced a system in which climate change efforts are coordinated by national governments to focus specifically on mitigation and adaptation mechanisms within their own national borders.

This emphasis on domestic efforts has thus created perverse incentives for many governments. If climate ambition has indeed increased on paper, it is partly because across the world, the political class has discovered that increasing domestic spending on programmes that supposedly address climate change can also create "co-benefits" that are politically palatable and can increase their electoral popularity. The motivating political logic of such "green new deals"—as have been announced or are being campaigned for in many geographies—is thus not exclusively, or even primarily, addressing climate change. Rather it is the co-benefits of increased spending—whether in raising investment in the domestic economy from previously anaemic levels, or in the creation of "green jobs", or the supposed strategic need to dominate the growth sectors of the future. This is the central reason why, in spite of these claims of greater climate ambition, the actual effect on emission reductions of these national efforts is completely insufficient.

Domestic green new deals are thus at best only of tangential assistance to the global fight against climate change. It is a new global green deal that is required.

The Failure of Public Green Finance

Sceptics about multilateral climate action, whether populists or climate-deniers, are right about one fact: that action on curbing emissions just within OECD countries will not be enough. Indeed, further reductions in OECD emissions are necessary to keep global temperature rises under control; but they may not be sufficient. If countries from the global south—whether India, Indonesia, or their peers—proceed on a carbon-intensive development path, they would render climate action by wealthier countries moot.

Yet, from that unarguable fact, the sceptics draw an incorrect conclusion: that common global action is impossible or infeasible. This false conclusion has long been the greatest threat to creating a global consensus around stronger climate action. Yet, by defining themselves in opposition to this undoubted threat, the supposed supporters of green multilateralism have created an equivalent threat themselves. By raising domestic ambitions and setting domestic targets that the sceptics oppose, climate-friendly developed polities have failed to consider the need to catalyse and support action in the global south.

The difference in levels between the support that is required and that which has been delivered is risible. For India alone, meeting just its current Paris Agreement commitments would require $2.5 trillion in climate finance in the years up to 2030; that would imply a threefold increase in investment flows.[3]

These requirements dwarf any official financial commitments, including from the current United States administration. This is the important context for President Joe Biden's claim to restore US support for the Green Climate Fund, the official conduit for such support from public money. This additional financing, even if it receives Congressional approval, will amount at best to $11.4 billion a year for the entire emerging world;[4] actual appropriations in April 2021 included only a $1.2 billion contribution.[5]

Official climate finance is even less impressive when it is laid against the size of overall budgetary demands in developed economies, including for infrastructure bills in the United States and the European Green Deal. If the US can only set aside 0.3 per cent of its $3.5-trillion "build back better" budgetary proposal for global support on climate change, it is hard to escape the conclusion that it is not seriously proposing to regain leadership on climate action.

'Green New Deals' and Crowding Out

The problem with domestic-focused green deals is deeper than their short-changing of official climate finance. It is now well understood that such official climate finance paid for directly by Western government treasuries–through the Green Climate Fund or other instruments–fail to match up to the scale of

investment required. In 2018, the Report of the Global Commission the Economy and Climate concluded that the world would invest $90 trillion in infrastructure in the years up to 2030. Much of this will come from private capital, not official sources. If Paris Agreement targets are to be met or exceeded, this infrastructure investment must be "greened"; yet developing countries that are forced to invest in infrastructure out of their own resources, and with minimal access to high-quality global pools of finance, will inevitably de-prioritise climate criteria when evaluating these investments. In other words, global capital must be directed towards these investment opportunities in the emerging world.

Deploying global capital to green investments in emerging economies is not only necessary for achieving agreed-upon climate goals, it is also the most efficient use of climate finance. It is easy to understand this intuitively: Were an omnipotent central planner considering the distribution of a limited amount of climate finance across the world, with the objective of maximising the tonnes of greenhouses gases abated per dollar, then the most economically efficient outcome would be to equalise the marginal impact on emissions of every dollar across projects and areas. This is no theoretical problem, but central to the question of how to construct plausible and efficient strategies towards carbon neutrality. Considerable research on carbon abatement curves has demonstrated wide geographical variance in the dollar cost of each ton of carbon abated. Even within the United States, this can vary between $105 in New Jersey and $31 in Texas for rooftop solar.[6] Cap-and-trade or carbon pricing systems within economies seek to create similar economic efficiency.

As several essays in this volume make clear, for much of the emerging world, including India, Southeast Asia, and Africa, a low-carbon development path will only be possible if they can find the resources that they need. Global private capital – the mobilised savings of citizens in wealthier countries – is the only possible origin of these resources. If OECD governments are struggling to directly harvest some of these savings and direct them across national borders, then climate action requires the private sector, specifically international finance, to do so in their place. That is the primary climate imperative in 2021.

The problem is that proponents of domestic green deals want, in fact, to do the exact opposite of this imperative. Those savings are to be appropriated under large spending programmes to go to work locally, not globally –creating domestic jobs and infrastructure rather than directly addressing the global problem of climate change. Vast issuances of green bonds by developed-world governments — such as the $290 billion of European green bonds planned[7] — will mop up the capital available for green projects, crowding out similar projects in developing countries.

These factors have given the clear impression to the developing world that the authors of developed-country "green new deals" are more interested in domestic political and policy ends than in addressing the climate crisis — which is merely being seen as a useful excuse for reshaping the domestic economy.

Even some developed-world climate activists have noted this slipperiness in policy objectives. Speaking to the United States Congress in 2019, Greta Thunberg warned: "Of course a sustainable transformed world will include lots of new benefits. But you have to understand. This is not primarily an opportunity to create new green jobs, new businesses or green economic growth. This is above all an emergency, and not just any emergency. This is the biggest crisis humanity has ever faced."[8]

Forcing OECD savings and profits to stay home and be corralled for domestic government spending, instead of putting them to work on greening the growth of the developing world, is unlikely to aid in a global green transition, and is in fact likely to make it more difficult to achieve the ends of the Paris Agreement.

A Green Marshall Plan?

The phrase "a global green new deal" was first used by the United Nations Environment Programme in 2009, when it sought to pressure G20 governments into spending the $3 trillion-plus of stimulus packages designed in the wake of the global financial crisis on climate-sensitive sectors like sustainable transport and renewable energy. Yet today's green new deals are substantively different not just in that they are not "global", as the UNEP desired. They also depart

from the original "new deal" concept itself. After the 2008 crisis, just as when Franklin D. Roosevelt first introduced "new deal" spending in the 1930s, there was a large amount of spare capacity in the economy. Government investment could create the conditions to use that capacity, and the hope in 2009 was that that capacity could, at low cost, be directed towards greening the recovery.

The situation in 2021 is very different: far from there being excess capacity, the global economy is characterised by bottlenecks in supply chains and cascading inflationary pressures. Over the long run, greener trajectories will save money and create new livelihoods and ladders to prosperity for individuals, regions and countries. Unlike in the original "new deal", however, a global green transition is not simply about putting unused capital to work: it will require claiming and repurposing resources that are already effectively employed in the more carbon-intensive sections of the economy.

In other words, in the short run, it will cost money, it will create some losing sectors and geographies that will require compensation, and it will need to allow these resources to flow more freely across national boundaries. Green new deals may be easy to sell in domestic politics because they are framed as simple "win-wins". That is obviously deceptive. If there was in fact a simple, universally beneficial solution for climate change, it would already have been implemented.

More than green new deals, what the world needs is a Green Marshall Plan: just as, after the Second World War, finance and talent were routed towards rebuilding those areas devastated by the conflict, today valuable financial and administrative capacities should be directed towards the geographies and projects that will most effectively lead to a global green transition.[9] The good news is that, if some effort is put into designing and harmonising the relevant financial regulations and structures, this effort will pay for itself. Several essays in this volume engage with what these regulations and structures might look like, and how multilateral diplomacy can help make them happen.

There are multiple ways in which developed and developing countries can work together to ensure that capital flows into global green infrastructure are

structured more efficiently from the point of view of carbon abatement — while also providing a reasonable return to the owners of capital. One such possibility is the creation of a green project pipeline: pre-approved projects in emerging economies in which geographical risk has been underwritten by public money or grant capital. The effect of reducing the cost of capital just for solar projects in African countries would be considerable. Currently, the cost of capital means that the production of green electricity in Africa is 35-percent lower than it should be according to standard models; managing this risk would allow the continent to reach net zero 10 years faster than it would otherwise.[10] The focus of multilateral climate diplomacy must be on developing and institutionalising mechanisms that would allow private capital to speed up the green transition in capital-starved areas of the world.

Conclusion

The purpose of this essay is not to discourage efforts towards further decarbonisation in the developed world. In fact, such efforts need to be stronger, with legally mandated targets that force a swifter trajectory to net zero in the areas than can afford it. The argument is that efforts in better-off high-emissions economies must take into account the capital requirements of the rest of the world if they are to be considered genuine efforts to push the world as a whole towards net zero. Climate change is a global problem, and global carbon neutrality must be the aim. Domestic green new deals that do not address the costs of carbon abatement in the developing world, or which make those costs higher, cannot be viewed as signs of commitment to combating climate change. They are little more than domestic political bargains with marginal impact on the larger fight.

As it stands, the Paris Agreement is not working and will not work, owing to the perverse incentives it has created for domestic politicians. Its structural focus is misplaced: national targets and national efforts supplemented by ensuring the flow of capital across national boundaries, and support for decarbonisation efforts in the economies that simultaneously are least able to afford it and where high-carbon growth trajectories look most attractive. There can only be one green new deal, and it will have to be global.

Endnotes

The Geoeconomics of Climate Finance

1 Delmotte et al. (eds.). Global Warming of 1.5°C. IPCC, 2018. pp 22.d

2 The Independent Expert Group on Climate Finance. *Delivering on the $100 Billion Climate Finance Commitment and Transforming Climate Finance.* United Nations, 2020. pp 22.

3 OECD. *Climate Finance Provided and Mobilized by Developed Countries.* https://www.oecd-ilibrary.org/sites/03590fb7-en/1/3/1/index.html?itemId=/content/publication/03590fb7-en&_csp_=b6cad02d0eb457a81fa094a9ec2d21cc&itemIGO=oecd&itemContentType=book#section-d1e239. 2019.

4 Climate Change Finance Unit. *Climate Change Finance, Analysis of a Recent OECD Report: Some Credible Facts Needed.* Department of Economic Affairs, Ministry of Finance, Government of India, 2015. pp 2.

5 Chandra, Tanushree. "Climate Finance: An Explainer." *Observer Research Foundation.* 07 December. https://www.orfonline.org/expert-speak/climate finance-an-explainer/.2020.

6 The Rockefeller Foundation. Reimagining the Role of Multilateral Development Banks. The Rockefeller Foundation, 2021

7 Humphrey, Chris, and Annalisa Prizzon. *Guarantees for development: A review of multilateral development bank operations.* ODI, 2014. pp 27.

8 The Independent Expert Group on Climate Finance. *Delivering on the $100 Billion Climate Finance Commitment and Transforming Climate Finance.* United Nations, 2020. pp 22.

9 G20 Eminent Persons Group on Global Financial Governance. *Making the Global Financial System Work For All.* Washington DC: Heinrich Böll Stiftung, 2018. pp 39.

10 G20 Eminent Persons Group on Global Financial Governance. *Making the Global Financial System Work For All.* Washington DC: Heinrich Böll Stiftung, 2018. pp 39.

11 Humphrey, Chris. *All hands on deck: how to scale up multilateral financing to face the Covid-19* crisis. https://odi.org/en/publications/all-hands-on-deck-how-to-scale-up-multilateral-financing-to-face-the-covid-19-crisis/. 09 April, 2020.

12 Humphrey, Chris. *The case for an external review of multilateral development bank capital adequacy.* https://odi.org/en/insights/the-case-for-an-external-review-of-multilateral-development-bank-capital-adequacy/. 20 March, 2021

13 Humphrey, Chris. *Are Credit Rating Agencies Limiting the Operational Capacity of Multilateral Development Banks?* G24, University of Zurich, Intergovernmental Group of Twenty Four, 2015. pp17.

14 Gottschalk, Ricardo, Lavinia B. Castro, and Jiajun Xu. 2020. *Financial regulation of national development banks - NDBs.* AFD editions, 2020. pp 14.

15 G20 Italia. *G20 discusses economic risks from climate change, digitalization and economic recovery.* https://www.g20.org/g20-discusses-economic-risks-from-climate-change-digitalization-and-economic-recovery.html. 15 June, 2021

16 TCFD. *Task Force on Climate-related Financial Disclosures.* TCFD, 2020. pp 68.

17 TCFD. *Task Force on Climate-related Financial Disclosures.* TCFD, 2020. pp 13.

18 Network for Growing the Financial System. *Progress report on bridging data gaps.* Network for Greening the Financial System Technical document, NGFS, 2021. pp15.

19 SEBI. *Business Responsibility and Sustainability Reporting by listed entities.* SEBI. 2021.

20 RBI Bulletin. "Green Finance in India: Progress and Challenges." *RBI.* 21 January, 2021.

21 Securities and Exchange Board of India. “Business responsibility and sustainability reporting by listed entities.” https://www.sebi.gov.in/legal/circulars/may-2021/business-responsibility-and-sustainability-reporting-by-listed-entities_50096.html. May 10, 2021.

22 Ministry of New and Renewable Energy, Government of India. *Standing Committee on Energy.* Lok Sabha. 2021.

23 Willis Towers Watson. *Global asset manager AuM tops US$100 trillion for the first time.* https://www.willistowerswatson.com/en-GB/News/2020/10/global-asset-manager-aum-tops-us-dollar-100-trillion-for-the-first-time. 19 October, 2020.

24 Influence Map. “How the sector performs on portfolios, engagement, and resolutions.” https://influencemap.org/report/Asset-Managers-and-Climate-Change-cf90d26dc312ebe02e97d2ff6079ed87. January 2021.

25 Influence Map. “Climate Funds: Are They Paris Aligned?” *An analysis of ESG and climate-themed equity funds.* https://influencemap.org/report/Climate-Funds-Are-They-Paris-Aligned-3eb8334726794984708430 6dae01c7b0. August 2021.

16 Climate Action 100+. *Global Investors Driving Business Transition.* https://www.climateaction100.org/.

27 Davidson, Barbara, and Rob Schuwerk. The glaring absence of climate risks in financial reporting. Carbon Tracker Initiative, Flying Blind, Principles for Responsible Investment (UNPRI), 2021. pp 27.

28 Urgewald. *Groundbreaking Research Reveals the Financiers of the Coal Industry.* Embargoed release GCEL finance research. pp 2.

29 Climate Policy Initiative. “Coal Power Finance in High-Impact Countries.” Energizing Finance Research Series, 2021. pp 11.

30 The Guardian, *ExxonMobil and Chevron suffer shareholder rebellions over climate.* https://www.theguardian.com/business/2021/may/26/exxonmobil-and-chevron-braced-for-showdown-over-climate. May 2021.

31 FSB. Task Force on Climate-related Financial Disclosures, Status Report, 2020. pp 61

32 CPP executives, interview over a virtual platform, October 2021

Financing the Green Transition

1 United Nations Framework Convention on Climate Change (UNFCC), “Financial Technology and Capacity Building Support,” UNFCC website, https://unfccc.int/tools/cancun/financial-technology-and-capacity-building-support/new-long-term-funding-arrangements/index.html

2 Department of Economic Affairs (DEA), Government of India, *Climate Change Finance, Analysis of a Recent OECD Report: Some Credible Facts Needed,* November 2015, DEA website,https://dea.gov.in/sites/default/files/ClimateChangeOEFDReport_0.pdf

3 Organisation for Economic Co-operation and Development (OECD) , *Climate Finance Provided and Mobilised by Developed Countries: Aggregate Trends Updated with 2019 Data*, September 2021, Paris , OECDLibrary, 2021, https://doi.org/10.1787/03590fb7-en.

4 Climate Finance Provided and Mobilised by Developed Countries, September 2021

5 Climate Finance Provided and Mobilised by Developed Countries, September 2021

6 NITI Aayog and Rocky Mountain Institute (RMI), *Mobilizing Finance for EVs in India,* March 2021, RMI, 2021, https://rmi.org/insight/mobilizing-finance-for-evs-in-india

7 McKinsey & Co., “Alternative proteins: The race for market share is on”, McKinsey Insights, https://www.mckinsey.com/industries/agriculture/our-insights/alternative-proteins-the-race-for-market-share-is-on

8 United Nations Framework Convention on Climate Change (UNFCC), *India’s Third Biennial Update Report to the UN,* February 2021, UNFCC, 2021, https://unfccc.int/sites/default/files/resource/INDIA_%20BUR-3_20.02.2021_High.pdf

1 Raftery, Adrian E., Alec Zimmer, Dargan MW Frierson, Richard Startz, and Peiran Liu. "Less than 2 C warming by 2100 unlikely." *Nature climate change* 7, no. 9 (2017): 637-641.

2 International Labor Organization, *Women and Men in the Informal Economy: A Statistical Picture, (Third Edition)*, 2018, https://www.ilo.org/global/publications/books/WCMS_626831/lang--en/index.htm

3 Shreya Jai, "Government to Ease Land Acquisition, Finance for Renewables to Meet 450 GW Target", *Business Standard,* September 27, 2019, https://www.business-standard.com/article/economy-policy/govt-to-ease-land-acquisition-finance-for-renewables-to-meet-450-gw-target-119092501326_1.html

4 Tim Buckley and Kashish Shah, *India's Electricity Sector Transformation Momentum Is Building; Peak Coal In Sight*, Institute for Energy Economics and Financial Analysis–IEEFA, 2017, http://ieefa. org/wp-content/uploads/2017/11/India-Electricity-Sector-Transformation_Nov-2017-3. pdf.

5 Central Electricity Authority, *Report on Optimal Generation Capacity Mix for 2029-30*, *2020*, https://www.cea.nic.in/old/reports/other/planning/irp/Optimal_mix_report_2029-30_FINAL.pdf

6 International Energy Agency, *India's Market Size and Global Share in Clean Energy Technologies*, 2021, https://www.iea.org/data-and-statistics/charts/india-s-market-size-and-global-share-in-clean-energy-technologies-2019-and-in-the-stated-policies-scenario-2040

7 Ibid.

8 Nikhil Ghanekar, "Explained: Why India is protesting EU's 'discriminatory' carbon border tax. *Business Standard*.", July 8, 2021, https://www.business-standard.com/article/economy-policy/explained-why-india-is-protesting-eu-s-carbon-border-tax-121070800216_1.html

9 "Solar case: US appeals against WTO panel's ruling in favour of India", *Economic Times*, August 16, 2019, https://economictimes.indiatimes.com/industry/energy/power/solar-case-us-appeals-against-wto-panels-ruling-in-favour-of-india/articleshow/70701213.cms?from=mdr

10 International Renewable Energy Agency, *Renewable Energy and Jobs – Annual Review 2020*, *September 2020,* https://www.irena.org/publications/2020/Sep/Renewable-Energy-and-Jobs-Annual-Review-2020

11 Quitzow, Rainer. "Assessing policy strategies for the promotion of environmental technologies: A review of India's National Solar Mission." *Research Policy* 44, no. 1 (2015): 233-243. ; Behuria, Pritish. "Learning from role models in Rwanda: Incoherent emulation in the construction of a neoliberal developmental state." *New Political Economy* 23, no. 4 (2018): 422-440.

12 UNCTAD, *Trade and Development Report 2021, UN Conference on Trade and Development*, *2021* https://unctad.org/webflyer/trade-and-development-report-2021

13 Victor, Vijay, Joshy Joseph Karakunnel, Swetha Loganathan, and Daniel Francois Meyer. "From a Recession to the COVID-19 Pandemic: Inflation–Unemployment Comparison between the UK and India." *Economies* 9, no. 2 (2021): 73.

14 Ashish Fernandes and Harshit Sharma, *The 3Rs of DISCOM Recovery: Retirement, Renewables and Rationalisation*, Climate Risk Horizons, 2020, https://www.climateriskhorizons.com/research/CRH_3Rs-of-discom-recovery_Final-1.pdf

15 Shobha Anand Reddy and Pooja Vinicia D'Souza, "By Creating Green Jobs, Indian Towns Can Save The Environment And Their Economies", *India Spend*, September 2, 2019, https://www.indiaspend.com/by-creating-green-jobs-indian-towns-can-save-the-environment-and-their-economies/

16 Climate Action Tracker, "India: Country Summary", https://climateactiontracker.org/countries/india/; India's Climate Policies, ed. Narassimhan, E., Bhandary, R., Williams, E. & Zhang, F., in the Climate Policy Lab's National Climate Policy Inventories, www.climatepolicylab.org/data. The Fletcher School, Tufts University.

17 Malhotra, Abhishek, Ajay Mathur, Saurabh Diddi, and Ambuj D. Sagar. "Building institutional capacity for addressing climate and sustainable development goals: achieving energy efficiency in India." *Climate Policy* (2021): 1-19.

18 Narassimhan et al., *India's Climate Policies*

19 World Bank, "CO2 Emissions: Metric Tons Per Capita", https://data.worldbank.org/indicator/EN.ATM.CO2E.PC

20 Climate Action Tracker, "India: Country Summary"

Financing the End of Coal: The Market Case for Decarbonising India's Energy Sector

1 "UN Chief Calls for Immediate Global Action to Phase Out Coal." *Unfccc.int. UN*, March 2, 2021. https://unfccc.int/news/un-chief-calls-for-immediate-global-action-to-phase-out-coal.

2 T. Jayaraman, and Tejal Kanitkar. "Reject This Inequitable Climate Proposal." The Hindu. *The Hindu*, September 18, 2020. https://www.thehindu.com/opinion/lead/reject-this-inequitable-climate-proposal/article32634171.ece.

3 Tony Wrigley. "The Industrial Revolution as an Energy Revolution." VOX, CEPR Policy Portal, July 22, 2011. https://voxeu.org/article/industrial-revolution-energy-revolution.

4 Wrigley, "The Industrial Revolution as an Energy Revolution", 2011

5 Alan Fernihough and Kevin Hjortshøj O'Rourke. "Coal and the European Industrial Revolution," *The Economic Journal,* November 4, 2020, https://academic.oup.com/ej/article/131/635/1135/5955447

6 "IEA Chief Backs India on Coal, Says No Exit without Financial Support," *The Economic Times*, March 3, 2021, https://economictimes.indiatimes.com/industry/energy/power/iea-chief-backs-india-on-coal-says-no-exit-without-financial-support/articleshow/81313624.cms?from=mdr

7 Laura He and Manveena Suri. "China and India Face a Deepening Energy Crunch," *CNN*, October 12, 2021, https://edition.cnn.com/2021/10/12/economy/china-india-coal-power-shortages-intl-hnk/index.html

8 Deutsche Welle. "Germany: Coal Tops Wind as Primary Electricity Source," *DW.COM*, September 13, 2021, https://www.dw.com/en/germany-coal-tops-wind-as-primary-electricity-source/a-59168105

9 "Energy Efficiency 2020," IEA, 2020, https://iea.blob.core.windows.net/assets/59268647-0b70-4e7b-9f78-269e5ee93f26/Energy_Efficiency_2020.pdf.

10 "Energy Efficiency 2020", 2020

11 "Statistical Review of World Energy 2021," BP, 2021, https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf

12 "China: Home to over Half the World's Coal Pipeline," *E3G*, September 14, 2021, https://www.e3g.org/publications/no-new-coal-china-overview/

13 "The Truth behind the Climate Pledges," FEUUS, n.d., https://feu-us.org/our-work/behind-the-climate-pledges/

14 This goal requires a 50-percent reduction in global GHG emissions by 2030.

15 "High Prices Could Slow India's Transition to Gas," *The Economic Times*, October 20, 2021, https://economictimes.indiatimes.com/industry/energy/oil-gas/high-prices-could-slow-indias-transition-to-gas/articleshow/87165103.cms?from=mdr

16 M. Ramesh, "Why Gas Is Not Just Hot Air," *The Hindu BusinessLine*, May 30, 2021, https://www.thehindubusinessline.com/opinion/books/why-gas-is-not-just-hot-air/article34683384.ece

17 Angela Picciariello, Sarah Colenbrander, Amir Bazaz, and Rathin Roy, "The Costs of Climate Change in India - Cdn.odi.org." ODI, June 2021, https://cdn.odi.org/media/documents/ODI-JR-CostClimateChangeIndia-final.pdf

18 Karthik Ganesan and Danwant Narayanaswamy, "Coal Power's Trilemma," CEEW, July 2021, https://www.ceew.in/sites/default/files/CEEW-study-on-thermal-decommissioning-coal-electricity-power-plants.pdf

19 Jonathan Kay, "Tangled Wires: Preparing India's Power Sector for the Clean Energy Transition," Carnegie Endowment for International Peace, August 4, 2021, https://carnegieendowment.org/2021/08/04/tangled-wires-preparing-india-s-power-sector-for-clean-energy-transition-pub-85072

20 "Financing Clean Energy Transitions in Emerging and ..." IEA. IEA, 2020, https://iea.blob.core.windows.net/assets/6756ccd2-0772-4ffd-85e4-b73428ff9c72/FinancingCleanEnergyTransitionsinEMDEs_WorldEnergyInvestment2021SpecialReport.pdf

21 IEA, “Financing Clean Energy Transitions in Emerging and ...”, 2021

22 “Power Sector at a Glance ALL INDIA.” Ministry of Power, October 21, 2021, https://powermin.gov.in/en/content/power-sector-glance-all-india

23 Aditya Lolla, “India - Peaking Coal?” *Ember*, February 16, 2021, https://ember-climate.org/project/peak-coal-india/

24 Vaibhav Pratap Singh and Nikhil Sharma, “Mapping Costs for Early Coal Decommissioning in India ...” CEEW, July 2021, https://cef.ceew.in/solutions-factory/publications/CEEW-CEF-mapping-costs-for-early-coal-decommissioning-in-india.pdf

25 “Flue Gas Desulphurisation: A Rs 80,000 Crore Investment Opportunity,” *The Financial Express*, June 11, 2020, https://www.financialexpress.com/opinion/flue-gas-desulphurisation-a-rs-80000-crore-investment-opportunity/1987779/

26 Alan Yu, Kanika Chawla, and Rita Cliffton, “Renewed U.s.-India Climate Cooperation,” *Centre for American Progress*, February 18, 2021, https://www.americanprogress.org/issues/green/reports/2021/02/18/495999/renewed-u-s-india-climate-cooperation/

27 “SDG7 Energy Compact of the Government of India ... - Un.org.” UN, September 22, 2021, https://www.un.org/sites/un2.un.org/files/energy_compacts-_india-_22nd_september_2021.pdf

28 Rohit Gadre, Atin Jain, Shantanu Jaiswal, Vandana Gombar, and Dario Traum, “India’s Clean Power Revolution.” *Bloomberg*, June 26, 2021, https://data.bloomberglp.com/professional/sites/24/2020-06-26-Indias-Clean-Power-Revolution_Final.pdf.

29 “India Energy Outlook 2021,” IEA. IEA, 2021, https://iea.blob.core.windows.net/assets/1de6d91e-e23f-4e02-b1fb-51fdd6283b22/India_Energy_Outlook_2021.pdf.

30 “GCF Data- Interactive Map on Programme and Project-Level Data by Country,” Unfccc.int. UNFCCC, n.d., https://unfccc.int/climatefinance/gcf/gcf_data; “India at a Glance,” Global Environment Facility, August 24, 2016, https://www.thegef.org/country/india.

31 Shreyas Garg, Rishabh Jain, and Gagan Sidhu, “Financing India’s Energy Transition through International ...” CEEW. CEEW, August 2021, https://cef.ceew.in/solutions-factory/publications/financing-india-energy-transition-through-international-bond-markets.

32 Mark D. Holmes and Elena Millerma, “Energy Transition: How to Finance the Race to Net-Zero,” White & Case LLP, August 5, 2021, https://www.whitecase.com/publications/insight/us-leveraged-finance-road-ahead/energy-transition-how-finance-race-net-zero.

Modelling Decarbonisation Pathways for the Indian Economy

1 https://india.energypolicy.solutions.The model structure and data sources are described in https://www.wri.org/research/tool-designing-policies-achieve-indias-climate-targets.

2 This uses estimates of the Social Cost of Carbon and the Value of a Statistical Life for India.

3 This assumes no discounting of investments made in the future.

4 The macroeconomic impacts in the model are calculated based on the transaction relationships between the industries in the economy in India’s input-output (I/O) tables, as of 2015. The future impacts are based on the static industrial classifications considered in the 2015 I/O table and are assumed to not change over time.

A Just Path to a Decarbonised Future

1 IPCC, 2021, *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*

2 Climate Action Tracker, Global Update- Climate summit momentum, May 2021, https://climateactiontracker.org/documents/853/CAT_2021-05-04_Briefing_Global-Update_Climate-Summit-Momentum.pdf

3 A Lexicon on climate Justice in Justice Adda, https://www.justiceadda.com/climatejusticelexicon

4 United Nations, Paris Agreement, 2015, https://unfccc.int/sites/default/files/english_paris_agreement.pdf

5 Government of Canada, *Final Report by the Taskforce on Just Transition for Canadian Coal Power Workers and Communities,* December 2018, https://www.canada.ca/en/environment-climate-change/services/climate-change/task-force-just-transition.html

6 Federal Ministry for Economic Affairs and Energy, *Final Report by Commission on Growth, Structural Change and Employment*, January 2019, https://www.bmwi.de/Redaktion/EN/Publikationen/commission-on-growth-structural-change-and-employment.pdf?__blob=publicationFile&v=3

7 World Resources Institute, "Spain's National Strategy to Transition Coal-Dependent Communities", https://www.wri.org/just-transitions/spain

8 iForest, *Just Transition in India: An inquiry into the challenges and opportunities of a post-coal future*, 2020

9 Terence Creamer, ANC offers strong endorsement of Eskom's just energy transaction, September 7th, 2021, Engineering News, https://www.engineeringnews.co.za/article/anc-offers-strong-endorsement-of-eskoms-just-energy-transaction-following-lekgotla-2021-09-07/rep_id:4136

10 Leonie Joubert, South Africa's energy crisis team unveils finance plan that could bring a just transition, 21 Oct 2019, Energy Transition, https://energytransition.org/2019/10/south-africas-energy-crisis-team-unveils-finance-plan-that-could-bring-a-just-transition/

11 India urges G7 nations to keep their climate finance promise, June 14th 2021, Livemint, https://www.livemint.com/news/world/india-asks-g-7-to-fulfill-100-bn-promise-towards-climate-change-11623599833880.html

12 Chinmayi Shalya, *District Mineral Foundation (DMF): Implementation Status and Emerging Best Practices,* (Centre for Science and Environment), 2020, https://iforest.global/wp-content/uploads/2021/04/DMF-Implementation-Status-and-Emerging-Best-Practices.pdf

13 The World Bank Group on "Transitions at the Heart of Climate Challenge", May 2021 https://www.worldbank.org/en/news/feature/2021/05/24/transitions-at-the-heart-of-the-climate-challenge

Achieving Net-Zero through Just Transition

1 International Energy Agency, *Net Zero by 2050: A Roadmap for the Global Energy Sector*, Paris, France, 2021, https://www.iea.org/events/net-zero-by-2050-a-roadmap-for-the-global-energy-systemInternational.

2 Intergovernmental Panel on Climate Change, *Sixth Assessment Report*, 2021, https://www.ipcc.ch/assessment-report/ar6/.

3 Energy Agency, "India Energy Outlook 2021," IEA, Paris, France, 2021, https://www.iea.org/reports/indiaenergy-outlook-2021.

4 TERI and Shell, "India: transforming to a net zero emissions energy system," Shell, 2021, https://www.shell.in/promos/energy-and-innovation/india-scenario-sketch/_jcr_content.stream/1617850096430/4dc1d51b4d29c3dfea47f0a57e9eef62000a021b/india-transforming-to-a-net-zero-emissionsenergy-system-scenario-sketch-report.pdf.

5 Labour Bureau, Ministry of Labour and Employment, "Employment in Informal Sector and Conditions of Informal Employment," Vol. IV, 2013–14, Government of India, 2015, https://labour.gov.in/sites/default/files/Report%20vol%204%20final.pdf.

6 E. Morena, D. Krause and D. Stevis (eds.), *Just Transitions: Social Justice in the Shift Towards a Low-Carbon World* (London: Pluto Press, 2019).

7 C. Bhushan and S. Banerjee, "Five R's: A Cross-sectoral landscape of Just Transition in India," *International Forum for Environment, Sustainability and Technology (iFOREST)*, New Delhi, 2021.

8 C. Bhushan and S. Banerjee, "Five R's: A Cross-sectoral landscape of Just Transition in India."

9 Department of Science and Technology, "Climate Vulnerability Assessment for Adaptation Planning in India Using a Common Framework," Ministry of Science and Technology, Government of India, https://dst.gov.in/sites/default/files/Full%20Report%20%281%29.pdf.

10 ibid

11 C. Bhushan and S. Banerjee, "Five R's: A Cross-sectoral landscape of Just Transition in India."

12 Venumuddala, V.R. (2020). NSS data as cited for Informal Labour in India. Indian Institute of Management, Bangalore. https://arxiv.org/pdf/2005.06795.pdf

13 Prayas (Energy Group), "Energy: Taxes and Transition in India," Working Paper, 2021, https://www.prayaspune.org/peg/publications/item/485-energy-taxes-and-transition-in-india.html.

14 C. Bhushan and S. Banerjee, "Five R's: A Cross-sectoral landscape of Just Transition in India."

15 S. Anup and A. Deo, "Fuel consumption standards for the new two-wheeler fleet in India," *International Council on Clean Transportation*, 2021, https://theicct.org/sites/default/files/publications/fuel-consumption-2w-india-aug2021.pdf.

16 C. Bhushan and S. Banerjee, "Five R's: A Cross-sectoral landscape of Just Transition in India."

17 Parikh, V., Jijo, M. & Aritua, B. (2018). How can new infrastructure accelerate creation of more and better jobs? World Bank Blogs. https://blogs.worldbank.org/jobs/how-can-new-infrastructure-acceler¬ate-creation-more-and-better-jobs.

18 Ministry of Mines, DMF/PMKKKY dashboard. Government of India, 2021, https://mines.gov.in/writereaddata/UploadFile/DMF_Collection.html.

Perspectives on a Green Taxonomy for India

1 "COP26 EXPLAINED," UN Climate Change Conference of the Parties (COP26) 2021, https://2nsbq1gn1rl23zol93eyrccj-wpengine.netdna-ssl.com/wp-content/uploads/2021/07/COP26-Explained.pdf

2 Anuradha Mascarenhas and Kabir Firaque, "Explained: Why world population is projected to peak early and shrink soon after," *The Indian Express*, July 18, 2020, https://indianexpress.com/article/explained/explained-what-forecast-of-shrinking-populations-means-for-india-and-world-6507785/

3 Annapurna Mitra, Tanushree Chandra, Nandini Sarmaand Ria Kasliwal, *A Green Investment Architecture for India: Building a Bridge for Global Capital*, Observer Research Foundation, June 2020, https://www.orfonline.org/wp-content/uploads/2020/06/ORF_Report_GreenInvestmentBanking.pdf

4 Swati Agarwal and Tamishka Singh, *Unlocking the green bond potential in India*, The Energy and Resources Institute (TERI), 2017,https://www.teriin.org/projects/nfa/files/Green-Bond-Working-Paper.pdf; Saurabh Ghosh, Siddhartha Nath and Abhishek Ranjan, "Green Finance in India, Progress and Challenges", *RBI Bulletin*, January 2021, Reserve Bank of India, https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/04AR_2101202185D9B6905ADD465CB7DD280B88266F77.PDF

5 "A Green Investment Architecture for India: Building a Bridge for Global Capital."

6 "A Green Investment Architecture for India: Building a Bridge for Global Capital."

7 Jayant Sinha and Tanushree Chandra, *Getting to the Green Frontier Faster: The Case for a SuperFund,* , Observer Research Foundation, July 2020, https://www.orfonline.org/wp-content/uploads/2020/07/ORF_Report_Superfund.pdf

8 Insights from the Quantum Investment Team, "ESG indexes are only as good as the underlying data used to construct them and are rightly under increasing investor scrutiny", the Quantum Advisors, November 11, 2020, , https://www.qasl.com/post/esg-indexes-a-stumbling-block-for-india-investors (accessed September 10, 2021)

9 Dean Hand, Hannah Dithrich, Sophia Sunderji and Noshin Nova, *Annual Impact Investor Survey 2020*, Global Impact Investing Network, 2020, https://thegiin.org/assets/GIIN%20Annual%20Impact%20Investor%20Survey%202020%20Executive%20Summary.pdf

10 Shreyans Jain, Rajashree Padmanabi and Jolly Sinha, *Landscape of Green Finance in India,* Climate Policy Initiative, September 2020, https://www.climatepolicyinitiative.org/wp-content/uploads/2020/09/Landscape-of-Green-Finance-in-India-1-2.pdf

11 "Landscape of Green Finance in India"

12 Securities Exchange Board of India, *Disclosure Requirements for Issuance and Listing of Green Debt Securities*, SEBI Circular CIR/IMD/DF/51/2017, 2017, https://www.sebi.gov.in/legal/circulars/may-2017/disclosure-requirements-for-issuance-and-listing-of-green-debt-securities_34988.html

13 People's Bank of China, National Development and Reform Commission, and China Securities Regulatory Commission, *Notice on Issuing the Green Bond Endorsed Projects Catalogue (No. 96 [2021], PBOC, NDRC, CSRC),*, PBOC, NDRC, CSRC, April 2021, https://www.climatebonds.net/files/files/the-Green-Bond-Endorsed-Project-Catalogue-2021-Edition-110521.pdf

14 The Financial Stability Commission of Mongolia, *Mongolian Green Taxonomy*, December 2019, http://toc.mn/post/116

15 EU Technical Expert Group on Sustainable Finance, *Financing a Sustainable European Economy*: *Taxonomy Technical Report,* European Commission, June 2019 https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/190618-sustainable-finance-teg-report-taxonomy_en.pdf

16 Sustainable Finance Department, Bangladesh Bank, *Sustainable Finance Policy for Banks and Financial Institutions,* Bangladesh Bank, December 2020, https://www.bb.org.bd/mediaroom/circulars/gbcrd/dec312020sfd05.pdf

17 Bank Negara Malaysia, *Climate Change and Principle-based Taxonomy*, Central Bank of Malaysia, April 2021, https://www.bnm.gov.my/documents/20124/938039/Climate+Change+and+Principle-based+Taxonomy.pdf

18 Manu Moudgil, "In India, the rich cause seven times more emissions than the poor," Scroll.in, January 20, 2021, https://scroll.in/article/984472/in-india-the-rich-cause-seven-times-more-emissions-than-the-poor; Data on Annual CO_2 emissions, Our World in Data (OWID), https://ourworldindata.org/grapher/annual-co2-emissions-per-country?tab=chart&region=World

19 Press Trust of India (PTI), "22 Of The World's 30 Most Polluted Cities Are In India: Report", *NDTV*, March, 2021, https://www.ndtv.com/india-news/22-of-the-worlds-30-most-polluted-cities-are-in-india-delhi-most-polluted-capital-city-report-2392028

20 Vikas Dimble and Priyank Hirani, "Water pollution is killing millions of Indians. Here's how technology and reliable data can change that", World Economic Forum, October, 2019, https://www.weforum.org/agenda/2019/10/water-pollution-in-india-data-tech-solution/#:~:text=As%20India%20grows%20and%20urbanizes,a%20tiny%20fraction%20adequately%20treated.

21 Bhasker Tripathi, "40% of Indians will have no access to drinking water by 2030: NITI Aayog," *Business Standard*, June 25, 2018,business-standard.com/article/current-affairs/40-of-indians-will-have-no-access-to-drinking-water-by-2030-niti-aayog-118062500074_1.html

22 Data on ecological footprint by country for the year 2021, the website of World Population Review, https://worldpopulationreview.com/country-rankings/ecological-footprint-by-country

23 Bulbul Dhawan, "Biodiversity loss: India has lost 90% of area under four biodiversity hotspots, 25 species extinct, finds study", *Financial Express,* June 8, 2021, https://www.financialexpress.com/lifestyle/science/biodiversity-loss-india-has-lost-90-of-area-under-four-biodiversity-hotspots-25-species-extinct-finds-study/2267618/

24 Ministry of Environment, Forest and Climate Change, *India Third Biennial Update Report to The United Nations Framework Convention on Climate Change*, MOEF&CC, Government of India, 2021 https://unfccc.int/sites/default/files/resource/INDIA_%20BUR-3_20.02.2021_High.pdf

25 CIB, Green Bond Framework, CIB Egypt, May 2021, https://www.cibeg.com/-/media/project/downloads/about-cib/cib-corporate-responsibility-formerly-community/corporate-sustainability/green-bond/green-bond-framework-v3.pdf

26 Nilanjan Ghosh, "Sustainability as Corporate Strategy: Importance of the Values of Ecosystem Services for Businesses", in *Economics, Management and Sustainability: Essays in honour of Anup Sinha*,ed. Partha Ray, Runa Sarkar and Anindya Sen(Singapore: Springer, 2018), 171-186, https://www.researchgate.net/publication/328156580_Sustainability_as_Corporate_Strategy_Importance_of_the_Values_of_Ecosystem_Services_for_Businesses_Essays_in_Honour_of_Anup_Sinha

27 Climate Bonds Initiative, *Climate Bonds Taxonomy*, Climate Bonds Initiative, January 2021 https://www.climatebonds.net/files/files/CBI_Taxonomy_Tables-2June21.pdf

28 Manju Menon and Kanchi Kohli, "From Impact Assessment to Clearance Manufacture", *Economic and Political Weekly*, Volume 44, no.28(2009), https://www.researchgate.net/publication/261891240_From_Impact_Assessment_to_Clearance_Manufacture

29 Common Principles for Climate Mitigation Finance Tracking, June 2015, https://www.eib.org/attachments/documents/mdb_idfc_mitigation_common_principles_en.pdf

30 EU Technical Expert Group on Sustainable Finance, *Financing a Sustainable European Economy*: *Taxonomy Technical Report*

31 EU Technical Expert Group on Sustainable Finance, *Financing a Sustainable European Economy*: *Taxonomy Technical Report*

32 *Constant-speed fuel consumption testing of heavy-duty vehicles in India*, International Council on Clean Transportation (ICCT), November 2015, https://theicct.org/sites/default/files/publications/PosBrief_CSFC_nov2015.pdf , Anumita Roychowdhury, Vivek Chattopadhyaya, Shambhavi Shukla and Tanushree Ganguly, *BS-VI Readiness and Roadmap in India*, Policy Brief, Centre for Science and Environment, September 2019, https://www.researchgate.net/publication/336085377_Bharat_Stage_VI_BS-VI_READINESS_AND_ROADMAP_IN_INDIA_Policy_Brief_Centre_for_Science_and_Environment",

33 Shikha Rokadiya, Zifei Yang and Anup Bandivadekar, *Incentivizing Electric Vehicles to Meet Fuel Consumption Standards for Passenger Cars in India*, International Council on Clean Transportation (ICCT), May 2019, https://theicct.org/sites/default/files/publications/ICCT_EV_standards_India_20190604.pdf

34 Zifei Yang, Rachel Muncrief, and Anup Bandivadekar, *Global Baseline Assessment of Compliance and Enforcement Programs for Vehicle Emissions and Energy Efficiency,* International Council on Clean Transportation (ICCT), November 2017, https://theicct.org/sites/default/files/publications/PV-C&E-global-baseline-assessment_ICCT-report_14112017_vF.pdf

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1 United Nations Climate Change, United Nations Framework Convention on Climate Change, https://unfccc.int/news/greater-climate-ambition-urged-as-initial-ndc-synthesis-report-is-published.

2 United Nations Climate Change, United Nations Framework Convention on Climate Change.

3 Kanika Chawla and Anurabha Ghosh, *Greening New Pastures for Green Investments*. (New Delhi: Council on Energy, Environment and Water, 2019), https://www.ceew.in/sites/default/files/CEEW-Greener-Pastures-for-Green-Investments-20Sep19.pdf.

4 Ella Nilson, "Biden Announces US will Increase Funding to Help Developing Nations Confront the Climate Crisis," *CNN*, September 24, 2021, https://edition.cnn.com/2021/09/21/politics/biden-climate-change-global-funding/index.html.

5 Joe Lo, "Joe Biden's $1.2bn Budget for Green Climate Fund Falls Short of Campaigner Demands," *Climate Home News*, https://www.climatechangenews.com/2021/04/13/joe-bidens-1-2bn-budget-green-climate-fund-falls-short-campaigner-demands/.

6 S. Julio Friedmann, Zhiyuan Fan, Zachary Byrum, Emeka Ochu, Amar Bhardwaj, and Hadia Sheerazi, *Levelized Cost of Carbon* Abatement*: An Improved Cost-Assessment Methodology For a Net-Zero Emissions World* (New York: Center on Global Energy Policy, Columbia University SIPA, 2020), https://www.energypolicy.columbia.edu/sites/default/files/file-uploads/LCCA_CGEP-Report_101620.pdf.

7 Jill Ward, "First Green EU Bond to Spur Absolute Riot of Investor Demand," Bloomberg, October 9, 2021, https://www.bloomberg.com/news/articles/2021-10-09/first-green-eu-bond-to-spur-absolute-riot-of-investor-demand.

8 *Guardian News*, "Greta Thunberg Testifies to Congress over Climate Crisis – Watch Live," September 18, 2019, Youtube Video, 2:01:27, https://www.youtube.com/watch?v=icKlNgLuqzU.

9 Mihir Sharma, 'The Green New Deal Isn't Global Enough," *Bloomberg Quint*, March 17, 2019, https://www.bloombergquint.com/gadfly/green-new-deal-won-t-solve-global-climate-change.

10 Nadia Ameli, Olivier Dessens, Matthew Winning, Jennifer Cronin, Hugues Chenet, Paul Drummond, Alvaro Calzadilla, Gabriel Anandarajah, and Michael Grubb. 'Higher Cost of Finance Exacerbates a Climate Investment Trap in Developing Economies', *Nature Communications* No. 12, 4046 (2021), https://www.nature.com/articles/s41467-021-24305-3.pdf.

About the Authors

Varun Agarwal is Senior Program Associate – Climate, World Resources Institute India.

Anshu Bharadwaj is Chief Executive Officer at Shakti Sustainable Energy Foundation (SSEF).

Anya Bharadwaj is an Analyst at the National Investment and Infrastructure Fund (NIIF), India.

Chandra Bhushan is President & CEO, International Forum for Environment, Sustainability and Technology (iFOREST).

Shubhashis Dey is Director (Climate Policy) and leads SSEF's Climate Policy, Clean Energy Finance and Energy Efficiency Programmes.

Renita D'Souza is a Fellow at Observer Research Foundation, Mumbai.

Kelly Sims Gallagher is Professor and Academic Dean at The Fletcher School, Tufts University.

Tarun Gopalakrishnan is a predoctoral scholar at the Climate Policy Lab at The Fletcher School, Tufts University.

Kate Hampton is Chief Executive Officer at the Children's Investment Fund Foundation (CIFF).

Mannat Jaspal is Associate Fellow at Observer Research Foundation.

Ulka Kelkar is Program Director-Climate, World Resources Institute India.

Renu Kohli is an independent economist, previously with the Indian Council for Research on International Economic Relations, IMF, and RBI.

Nidhi Madan is Senior Programme Manager (Climate Policy) at SSEF.

Koyel Kumar Mandal is Chief of Programmes at SSEF.

Akshay Mathur is Director of ORF Mumbai and Head of the Geoeconomics Studies Programme.

Apurba Mitra is Program Head, Climate Policy, World Resources Institute India.

Easwaran Narassimhan is a joint postdoctoral scholar at the Climate Policy Lab at The Fletcher School, Tufts University and Belfer Center for Science and International Affairs, Harvard University.

Mridula Pandey is an Analyst (Climate) at the CIFF.

Samir Saran is the President of Observer Research Foundation.

Vivan Sharan is Visiting Fellow at Observer Research Foundation.

Mihir S Sharma is Head of ORF's Centre for Economy and Growth Programme.

Jayant Sinha is the Chairperson of the Standing Committee on Finance and a Lok Sabha MP from Hazaribagh, Jharkhand.

Shirish Sinha is Director (Climate) at the Children's Investment Fund Foundation (CIFF).

Deepthi Swamy is Consultant, Climate Program, World Resources Institute India.

Akhilesh Tilotia is Principal at National Investment and Infrastructure Fund (NIIF), India.

Climate scientists have warned that the world must reach zero carbon emissions by 2050 if global average temperatures do not increase by more than 1.5 degrees Celsius and set off catastrophic changes to the climate. Many countries have set target dates for decarbonising their economies; India's is 2070. What will this mean for the global economy? Can "net zero" be a net positive for Indian and global growth? And what are the development pathways that must be put into place in the next few years to turn this new climate ambition into a new, greener development paradigm? What are the changes to the multilateral architecture, to international regulation, and to local laws that must be undertaken if ambitious targets are to be achieved — or, indeed, exceeded? And how can we ensure that the transition is just and inclusive? This collection of essays and papers provides modelling and analysis that begin to answer some of these questions.

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