

GETTING TO THE GREEN FRONTIER

JAYANT SINHA

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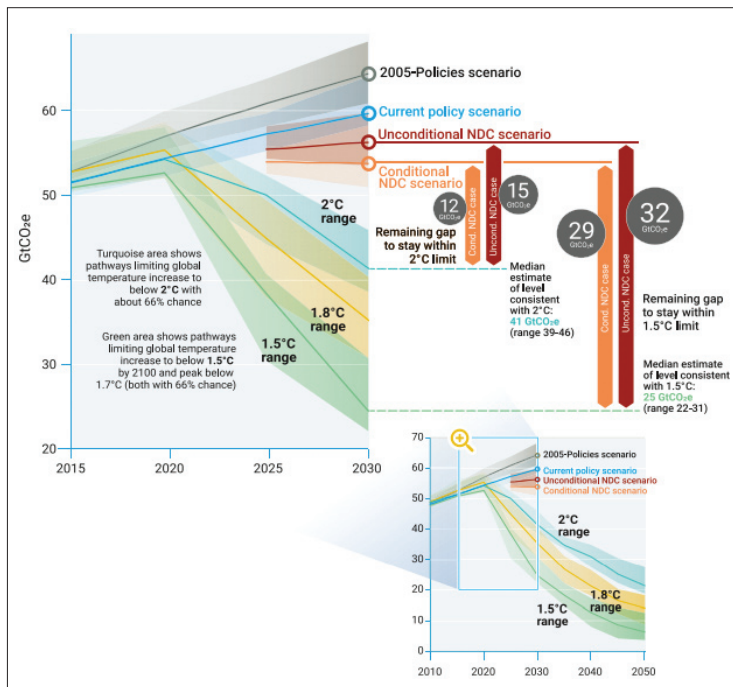
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Executive Summary

India's overarching development goal is to deliver sustainable prosperity to its people. Indians should be able to lead peaceful, fulfilling lives in a clean and green environment. Achieving this goal requires that the Indian economy be simultaneously transformed along two different dimensions. First, India must strive to be globally competitive across a range of key sectors such as infrastructure, energy, financial services, aviation, telecom, and manufacturing. Second, India must also adopt a resource-efficient, low-carbon development pathway to utilise scarce natural resources effectively. Note that the world needs India to be a global leader in combating climate change to achieve the 2 degree Celsius global warming target. In short, India's growth has to be green.

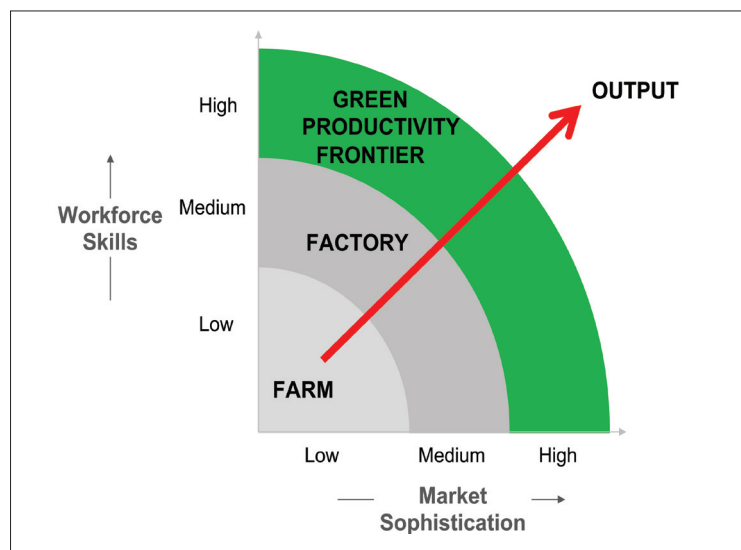
The graph below depicts the global GHG emissions under different scenarios and the emissions gap by 2030.



Source: Emissions Gap Report 2019, United Nations Environment Programme

India's development model will need to take the Indian economy from Farm-to-Green Frontier.

No nation has ever attempted these twin transformations simultaneously. The traditional development model has been a Farm-to-Factory development model with economies transitioning from traditional agriculture to resource-intensive, urban manufacturing. India has to forge a unique and different development model – a development model that will shift India's workforce from agriculture to resource-efficient, globally leading businesses. These super competitive businesses will define the **global technology/productivity frontier** so that they can surpass the production processes of the best companies in the world. In addition, given India's scarce natural resources and the global requirement to minimise carbon emissions, these companies will have to ensure that they use the most advanced green technologies and business models. **India's development model will therefore need to take the Indian economy from Farm-to-Green Frontier.**



There is no country that can serve as a role model for India, owing to its unique resources and needs. However, there are lessons that can be learned from certain economies that have successfully combined economic growth with a full-fledged green transformation. The experience of three such regions—the United Kingdom, California, and Germany is instructive. In this report, the five economic sectors that are responsible for 80% of greenhouse gas (GHG) emissions in each region—power, residential, transportation, industrial and agriculture—have been studied closely and the green transformation maps for each sector have been prepared.

Our study of global best practices reveals five key insights that should inform India's green transformation. These include:

- Deep public support for pursuing a green transformation, which is reflected in electoral outcomes (e.g., support for Green parties, inclusion in political manifestos)
- Specific and stable policy goals laying out GHG emission targets, regular monitoring of green efforts, and willingness to take global leadership on climate change matters
- An appropriate institutional architecture to support the green transformation including legislation, independent monitoring organisations at Federal and provincial levels, dedicated funding agencies, major research programs at leading academic institutions, and expert bodies.
- Unleashing market forces that drive green innovation and world-leading business models.
- Sufficient financing capacity (including establishment of dedicated financial institutions) through public and private sources to ensure that necessary investments are made in low-carbon technologies and production processes

While these insights can help shape how India attempts to reach the Green Frontier, it is also valuable to evaluate India's current efforts to pursue low-carbon strategies in the five major sectors that chiefly drive GHG emissions. This report assesses government policies and actual on-the-ground results in each of the five sectors. The power sector is the key driver of the Indian economy's green transformation, closely followed by residential and industrial sectors. Further, the report evaluates the progress made in the transportation sector, the hardest sector for many developed countries to conquer, and emphasises the need for better monitoring and evaluation in the agriculture sector.

India's most heralded climate policy breakthroughs have stemmed from the transformation that its power sector is undergoing. Given its ambitious renewable energy goals and the exponential growth that has been seen over the past decade, it is easy to see why India's climate policies are so closely tied to the decarbonisation of the power sector. In a span of 12 years, renewable energy has quadrupled – from making up 6% of capacity in 2007 to approximately 23% towards the end of 2019.

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Note that India has made the most progress in an arena that is also most in need of a green transformation. Detailed analyses show that 45% of India's GHG emissions originate from the power sector. This is largely due to the high proportion of coal power plants within India's energy mix – which despite the growth of renewable energy, still make up 60% of India's power capacity and account for more than 80% of its electricity generation. India plans to add 450 GW of renewable energy capacity by 2030, which is much needed, if it wishes to mitigate the deleterious effects of its coal power plants. Finding solutions for clean coal usage as well as carbon capture and storage technologies, will be vital for India's green growth.

The evolution of India's building stock has a crucial role to play in reducing GHG emissions. India's buildings are responsible for around 35% of the total energy consumption and their energy use is increasing at 8% annually. This unprecedented growth in the building stock presents a potential opportunity for achieving reduction in energy use in new residential and commercial buildings through energy efficient measures. There are several legislative measures and market incentives that the Indian government has launched to achieve this end.

The development of a green residential and commercial sector has the potential to transform the energy landscape in the country. The Indian government has taken multiple steps in terms of offering market incentives and introducing behavioural nudges for promoting energy efficiency in the buildings sector. To effectively leverage the residential sector's potential, it appears that a more robust set of regulations may be required along with better adoption, enforcement and compliance.

Transportation is among the lowest GHG emitting sectors in India. Responsible for a little less than 10% of emissions, it is on par with industry and far behind power and agriculture. Despite this, as India grows, reducing transportation-based GHG emissions will likely be a key factor in India's overall climate strategy. The Government of India has launched a wide range of policies aimed at enhancing passenger mobility, fuel efficiency, improving freight transport logistics and promoting rail use and low-carbon transport.

Since many of the policies have only recently been rolled out, it is difficult to ascertain their effectiveness. Despite this, there are numerous positive signs – among them the sizeable financial commitment the

government has made towards its electric mobility schemes. Other policies are just getting started – including the Biofuel policy which achieved only 2% blending as of 2018. There is still more that India can do to reduce its transportation-based emissions – which has proved to be the hardest sector for many developed countries to conquer.

The competitiveness of Indian industrial units is intricately related to energy consumption and its consequent impact on climate change. In several Indian industries, energy is often the single largest expense and energy productivity is hence essential to their survival and growth. However, large scale increase in energy conservation has been limited for Indian industries, particularly in the Micro, Small & Medium Enterprises (MSME) sector. Despite these difficulties, the Indian government has passed a number of policies aimed at creating a cleaner, greener and more energy efficient industrial sector.

The agriculture sector has a crucial role to play in India's path to achieving green growth. With a share of about 16% in the country's overall GHG emissions, agriculture is the second highest emitter in the economy after the energy sector. Moreover, the fact that 50% of the country's labour force is employed in agriculture makes the handling of a green agricultural transformation extremely important. An examination of the schemes introduced in the agricultural sector reveals that the government has done an impressive job in designing policies to achieve the dual objectives of economic productivity and climate mitigation.

Getting to the Green Frontier will fundamentally reconfigure the structure of the Indian economy and reshape investments, generation of jobs, and wealth creation. The process is already underway, and India is moving steadily towards the Green Frontier. India was a prime mover in the Paris COP 21 negotiations and committed to far-reaching Nationally Determined Contributions (NDCs) to reduce carbon emissions. As part of these NDCs, India will reduce carbon intensity (carbon emissions per unit of GDP) to 33-35% below 2005 levels; increase renewable energy contribution to power supply to 40%; and restore 26 million hectares of degraded land. All these goals are to be achieved by 2030.

To further accelerate its progress towards the Green Frontier, global best practices and India's current efforts suggest three major focus

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areas: (1) specific and stable policy goals which set carbon emission targets across sectors; (2) a revamped institutional architecture; and (3) appropriate financing capacity – perhaps through a Green SuperFund.

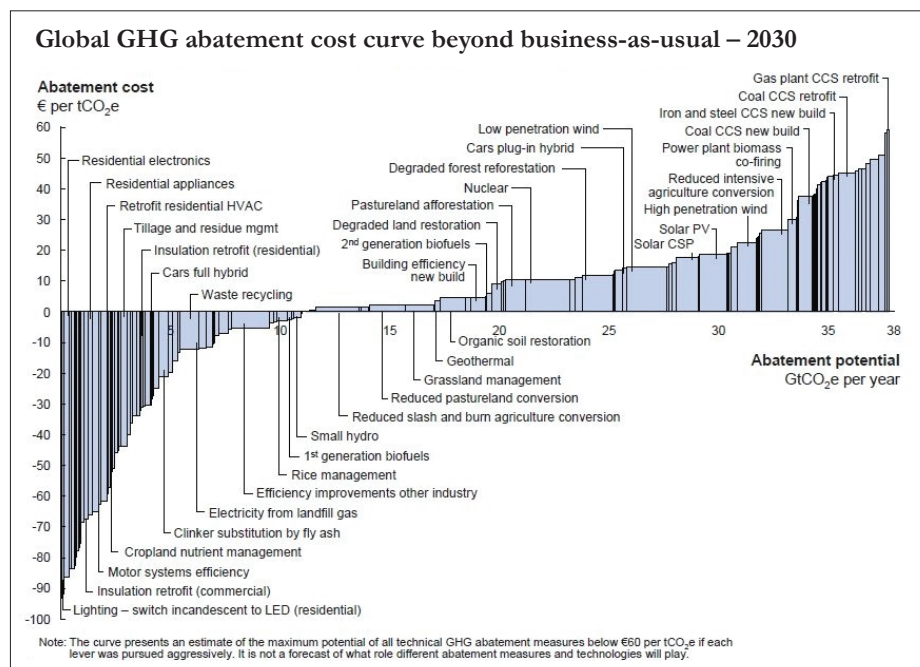
Global and Indian experience strongly indicates that these targets will have to be pursued in a stable manner across decades.

First, specific and stable policy goals may need to be established to set detailed carbon emission targets for various sectors. A macro-economic model of the Indian economy that factors in current skills, sectoral connections, relative emissions, and financial constraints is necessary to inform such policy goals going forward. Such a model can then be used to evaluate various different green growth scenarios. Exhaustive simulations will be necessary to evaluate the quantum of projected emissions under the baseline scenario versus the Farm-to-Green Frontier scenario. Decarbonisation approaches in the Green Frontier scenario will drive the growth of green industries, green jobs, green skills, green entrepreneurs, and green finance. It is, therefore, essential to develop a sound, data-driven analytical framework to model and assess the implications of green growth for India. In particular, policy trade-offs among jobs, investment requirements, and growth will have to be studied carefully to understand how different pathways might unfold over the next few decades.

Another key area requiring detailed evaluation is: in what way, and to what extent green transformation will impact employment. While there are no official numbers on the employment generated in renewable energy sectors in India till date, several independent studies estimate that the workforce employed in India's renewable energy sector has increased nearly five-fold in the past five years.

Specific carbon emission targets will help in reducing air pollution and conserve scarce natural resources such as water and land as well. However, global and Indian experience strongly indicates that these targets will have to be **pursued in a stable manner across decades**. Most large emitters and pollutants are associated with long-lived (20-30 plus years useful life) assets. Investments in resource-efficient assets will only be possible if there is sanctity of contracts, pricing stability, and consistent policies that are backed up by the full force of law. Finally, these specific and stable policy goals need to be implemented urgently to avoid carbon lock-in with high-carbon assets and to avoid a large stranded assets problem that will become a financial non-performing assets problem.

The standard global greenhouse gas abatement cost curve, produced by McKinsey, identified 40 different transformations that had differing costs and abatement potentials – ranging from low-cost interventions like LED lighting and real estate insulation all the way up to high-cost and still difficult-to-envisage rebuilds of entire sectors like iron and steel to incorporate potential carbon capture and storage technologies.



Source: Global GHG Abatement Cost v2.0 in 'Pathways to a Low Carbon Economy', McKinsey & Company

Second, India may need to revamp its existing institutional framework for climate governance in order to align it with the country's green transformation. As demonstrated by global best practice, a comprehensive institutional framework could include four levels—Super Sovereign, Sovereign, State/Province and City. Each of these different levels has an important role to play and strengthens the other levels. **An independent Council or Board may also be required to monitor, report, and verify GHG emissions** and ensure that targets are being met. Some of these changes might also require legislative changes and/or revamping existing regulatory institutions.

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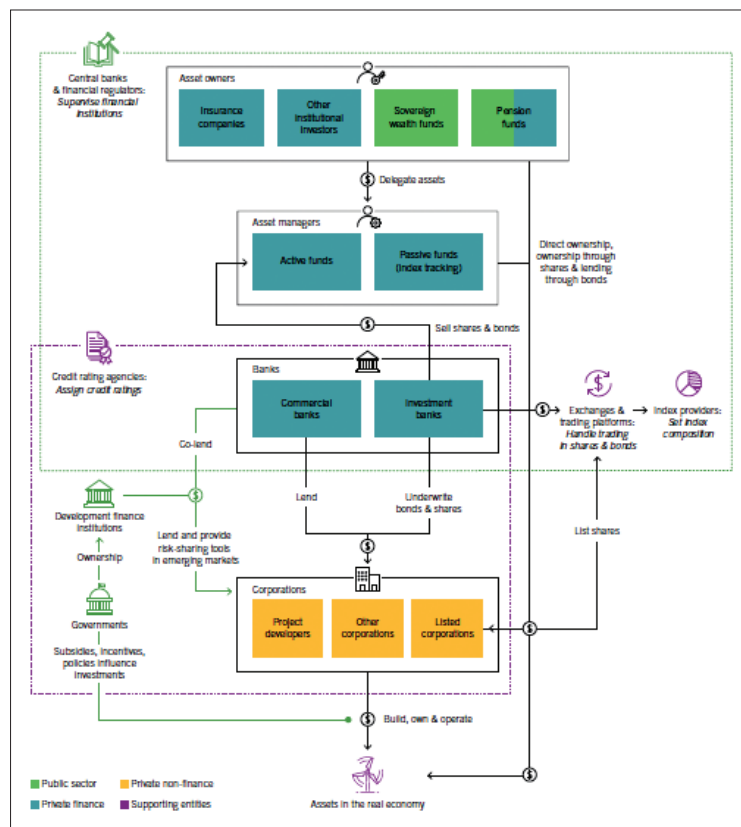
Third, Indian policy makers and entrepreneurs will likely unleash market forces that will drive the growth of solar panels, electric vehicles, superefficient appliances (such as refrigerators and air conditioners), green packaging, and clean coal. Promoting some, or all,

of these green industries is likely to define the momentum of India's green growth. These green industries will require massive investments and appropriate financing capacity will have to be created to support their growth.

To mobilise the private sector to step up investment in clean tech and energy sectors: public policy efforts, governance reform, capacity-building, and regulatory intervention are needed in equal measure.

Preliminary estimates suggest that **India's green growth will require an average investment of \$95 billion to \$125 billion per year** for climate mitigation, thus representing a cumulative need of about \$1.6 trillion between 2020 and 2033. The private sector is likely to play a primary role in financing this green transformation. To mobilise the private sector to step up investment in clean tech and energy sectors: public policy efforts, governance reform, capacity-building, and regulatory intervention are needed in equal measure. Innovative mechanisms, solutions, and green finance instruments will have to be designed to unlock private capital flows. However, to establish market confidence and attract capital, these solutions will require demonstrated economic returns and policy predictability.

The investment chain depicting the interaction of the private sector, public sector and real economy is shown below.



Source: Financing the Low-Carbon Future, Climate Finance Leadership Initiative (CFLI), September 2019

A Green SuperFund could be established to jumpstart green investments by pooling together international and domestic capital. Such a financial institution could play a dual role in intermediating and mitigating risk for global capital, as well as serving as the entity which identifies sectoral priorities and project pipelines. For the first function, the National Infrastructure Investment Fund (NIIF) can serve as a model; the NIIF blends public and private finance in order to reduce perceived risks and catalyse greater funds flow into infrastructure. In general, Indian financial institutions have been very successful in building up new industries such as microfinance, EdTech, and affordable healthcare that have delivered both financial and social returns; however, financial support for green industries will have to be several times larger. Moreover, the Green SuperFund may have to be able to invest across the capital structure (debt plus equity) as well as across the company lifecycle (early stage, growth capital, infrastructure investments, and so on).

A Green SuperFund could be established to jumpstart green investments by pooling together international and domestic capital.

India's future will depend on how fast it can grow while resolving our environmental challenges. Most importantly, it is now the world's third largest carbon emitter and will play a crucial role in getting the planet to a low-carbon trajectory. The government has defined national targets and established a clear framework for action. Now the nation must transform our economy to arrive at the Green Frontier.

Introduction

As India pursues its goal of bringing prosperity to all its people, it must simultaneously embark on a low-carbon trajectory. Simply stated, if India is not able to reduce carbon emissions, the world may not achieve its goal of restricting global temperature rise to 2 degree Celsius by 2100. Therefore, if India follows the typical Farm-to-Factory development model, then the war against climate change will be lost. Equally, if India does not provide sustainable growth and adequate livelihoods for its people, then hundreds of millions of people will be trapped in poverty and the world will not achieve its sustainable development goals. Moreover, India serves as an important role model and its ability to deliver on green growth will provide inspiration to countless other developing countries.

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Rapid urbanisation, the growth of mass services, and industrialisation have been the key forces driving the Indian economy forward. India's carbon intensity per unit of GDP has declined, yet overall carbon emissions have continued to grow. India now has to forge a unique and different development model – one that will shift its workforce from agriculture to resource-efficient, globally competitive businesses.

The purpose of this report is to outline some of the lessons learned from other regions that have pursued such a green transformation. These learnings can provide important signposts to India. The regions selected are: the United Kingdom, Germany, and California. Each of these economies have been able to grow and add jobs, while achieving a low-carbon pathway.

The report is organised as follows:

- The first chapter summarises our research into the comparative green transformations in three relevant regions – Germany, the United Kingdom, and California. All three areas implemented facets of a successful green transformation while cross-

pollinating growth. The section synthesises best practices from these experiences in order to develop broad principles that could guide India's efforts.

- The second chapter outlines India's attempts to date to transform five crucial sectors – the power sector, agriculture, real estate, transport, and industry.
- The third chapter provides some economic implications for India's green growth based on the green transformations that have been affected so far by the United Kingdom, Germany, and California. It also proposes some modelling pathways that could provide further details on how various different green growth pathways might unfold in terms of growth, jobs, and emissions.
- In the final chapter, we outline some implementation considerations. These include changes to the existing climate governance institutional architecture as well as ways to secure necessary financing support for green industries.

ORF has embarked on a multi-year research effort to study how the Indian economy can get to the Green Frontier. The ORF research effort is focused on five major research areas: (1) understanding global best practices by studying different countries/regions that have been able to achieve resource-efficient, economic growth; (2) detailed industry-by-industry analysis to evaluate technologies and production processes that are both job-creating and resource-efficient; (3) discussions with multiple stakeholders to understand adoption barriers and necessary policy initiatives; (4) financing instruments and approaches to accelerate adoption; and (5) granular quantitative modelling of the Indian economy to evaluate different economic growth scenarios across job creation, investment requirements, resource utilisation, and urbanisation impact.

The first report focused on global best practices is being released during the Raisina Dialogue. The research effort underlying this report has been led by Samir Saran and Mihir Sharma, with able assistance provided by Aparajit Pandey and Tanushree Chandra. The team has worked diligently to bring together policy studies, empirical analyses, and legislative materials for each of the three regions studied. To our knowledge, this report is the first comprehensive evaluation

of best practices followed by the regions at the forefront of green growth. Funding for this study has been generously provided by the MacArthur Foundation and other ORF donors.

In the next few months, we will be preparing additional reports on how India can get to the Green Frontier. All comments and suggestions are welcome; we look forward to engaging with experts around the world to put together our reports.

Jayant Sinha
Delhi
January 2020



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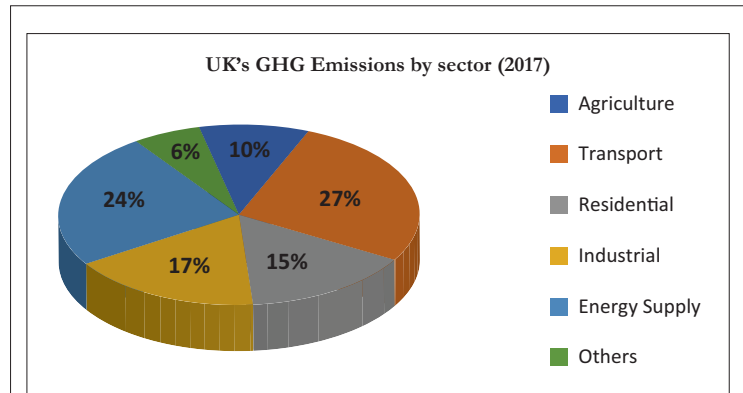
Global Best Practices

As it accelerates its green transformation, India will likely serve as a role model for the rest of the developing world. India's journey is certainly going to be quite unique, yet there is much to be learned from the best practices of other regions that have embarked upon similar green transformation journeys. In a forthcoming study by ORF, the green transformation frameworks for three regions—the United Kingdom, Germany and California—have been examined in detail. These three regions were selected for detailed research because they have demonstrated how to succeed in the green transformation journey—dramatically reducing carbon emissions (decarbonisation) while simultaneously generating economic growth and job creation.

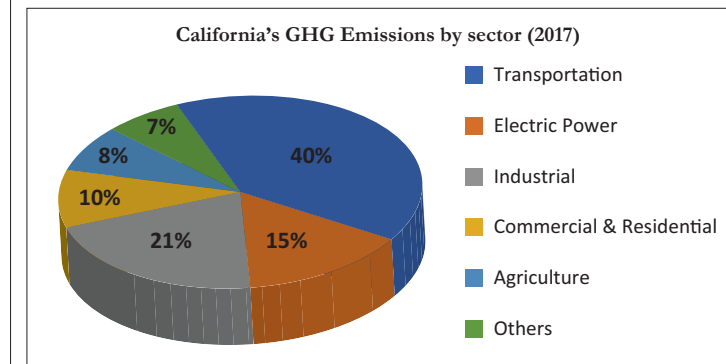
The analysis has been conducted sector-by-sector for each region. Since each economic sector is characterised by its unique technological potential, challenges, and policy needs, it is important to evaluate green transformation across the different economic sectors. The five economic sectors that are responsible for 80% of Global GHG emissions in each region—power, residential, transportation, industrial, and agriculture—have been analysed in this study.

The transformation matrices for each of the sectors examined in the three regions are shown below.¹ Each region selected for detailed study operates as an open market economy – just like India. Thus, green transformation is evaluated in terms of how it has shaped market outcomes and guided the behaviour of market participants. To that end, for each sector, there are four key market levers along which the analysis has been conducted—laws and regulations (the legal framework within which markets operate), financial instruments (including taxes, subsidies, and low cost financing), market mechanisms (such as price floors, feed-in tariffs, and purchase obligations) and behavioural changes (including public marketing and demands from the public). The transformation matrix indicates whether there has been incremental, structural, or no change for each sector across the four levers.

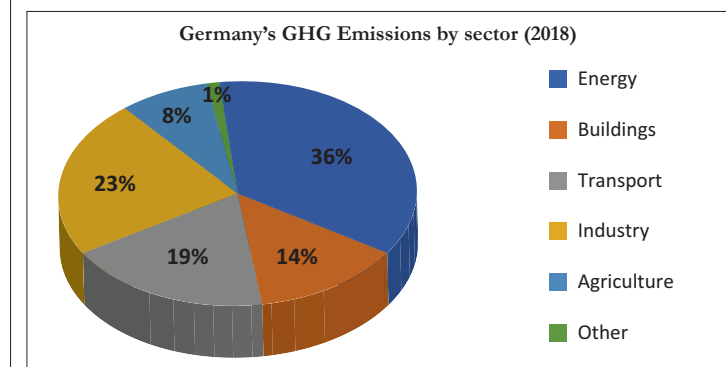
Sectoral breakdown of GHG emissions for the UK, California and Germany (based on latest available figures)



Source: Department for Business, Energy and Industrial Strategy (Other includes Public, Industrial Processes and the Land Use, Land Use Change and Forestry (LULUCF) sectors (LULUCF acts as a net sink of emissions)).



California's GHG Emissions by sector (2017)



Source: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Note: The percentages may not sum to 100% due to rounding

POWER

The power sector emerged as the star performer across the three regions examined in the study. Each region has relied heavily on the use of financial instruments and market mechanisms for catalysing the power sector's green transformation. The use of regulatory levers and behavioural nudges has also been extensive.

As early as 2002, the United Kingdom introduced the Renewable Obligation scheme with an aim to decarbonise the power sector. It required all licensed electricity suppliers to source a certain percentage of their electricity supply from renewable power producers. The scheme brought forward a significant quantum of low carbon generation and provided a big boost to the UK's renewable energy sector. The energy supply sector accounted for approximately a third of the country's GHG emissions at the time of the passing of UK's landmark Climate Change Act (2008). Consequently policymakers prioritised emissions reductions in the power sector in their initial Low Carbon Transition Plan (2009) and all subsequent policy and financial measures. Some of the notable financial instruments employed by the UK in the power sector are the Climate Change Levy (CCL), Climate Change Agreement (CCA), the Contracts-for-Difference (CFD) mechanism, and a mechanism for carbon pricing (EU ETS). As a supplement to the hard policy levers, the government, private sector, and civil society organisations also undertook certain steps to increase awareness and incite behavioural change within the public. The primary policy drivers behind the UK's successful low carbon power sector transformation, however, have been the carbon floor prices and the large scale renewable energy subsidies.

Each region has relied heavily on the use of financial instruments and market mechanisms for catalysing the power sector's green transformation.

Even in the case of California, the power sector is the primary driver of overall emission reduction. The central law that promotes and regulates energy efficiency in the electricity sector in California is the Renewables Portfolio Standard (RPS). First enacted in 2002, the RPS calls for a certain percentage of retail electricity sales to be generated by "RPS-eligible" sources, primarily wind and solar energy. In 2018, the California State Senate enacted Senate Bill 100 (SB 100), also known as the "100 Percent Clean Energy Act, 2018." SB 100 increased the RPS obligation for electricity sellers to 50 percent by 2026 and 60 percent by 2030. It also introduced a bold target by establishing a state policy that "RPS-eligible and zero-carbon resources" supply 100

percent of all retail electricity sales in California by December 31, 2045. In addition to the regulatory levers, financial incentives such as the Net Metering Programme and market mechanisms such as the Renewable Energy Certification Programme have been instrumental in reducing power sector emissions in California.

In a similar vein, at the core of Germany’s climate change policies is the transformation of its power sector. The country’s policies and its intended energy transformation are so well known that the German term for the transformation – *Energiewende* – has become ubiquitous even across the English speaking world. One of the earliest regulatory measures passed by the German legislature was the Ecological Tax Reform Act of 1999 which mandated gradual increases in the tax rates on oil and gas and introduced a levy on electricity. In 2006, the act was amended and the legislature adopted a comprehensive Energy Tax Act, setting up a common fiscal framework for energy products through harmonised definitions, taxation rules, and exemptions. The majority of Germany’s power sector decarbonisation efforts have been focused on financial incentives such as feed-in-tariffs, Contracts-for-Difference (CFD), and carbon pricing.

The power sector’s green transformation in the three regions clearly indicates that it is a key opportunity area for India as well.

Green Transformation Framework: Power Sector														
	Emissions			Laws/Regulations			Financial Levers		Market Mechanism			Behavioural Change		
	2008	2017	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
UK	224	113	-50%		✓		✓	✓		✓			✓	
California	104.5	62.4	-40%		✓			✓		✓			✓	
Germany	466	311	-33%		✓			✓		✓			✓	

The chart has been created by the authors based on available official data.

RESIDENTIAL

For each of the three regions examined in the study, the residential sector accounted for a modest (10%-15%) share in the total GHG emissions. While Germany exhibited a remarkably impressive performance in reducing emissions from residential buildings (44%), California was not able to make significant progress in this sector. The UK was able to achieve an 18% reduction in emissions from 2008 to 2017 but was unable to meet the sectoral target (of 29% reduction) laid out in the Low Carbon Transition Plan. Akin to the power sector,

financial levers were the key drivers of emission reduction for the residential sector.

In Germany, the residential sector's low-carbon transformation can be attributed to a holistic, well-designed suite of measures which includes laws such as the Energy Savings Act (EnEG), Energy-using Products Act (EBPG) and the Renewable Energies Heat Act (EEWärmeG) as well as a host of financial incentives. A key programme launched by the German government, as early as 1999, is the Market Incentive Program (MAP). Sponsored by the Federal Ministry for Economic Affairs and Energy, the MAP is a funding programme that provides financial incentives for the installation of solar-thermal, biomass, and heat-pump-based systems in residential and commercial buildings. Under this private consumers, companies, municipalities, and other eligible parties receive a grant from the state if they replace their old heating system with an energy-efficient solar system. Funding is also provided for setting up heat networks and heat storage units. The low-interest loans and debt release programmes administered by the Kreditanstalt für Wiederaufbau (KfW) Development Bank to promote energy efficient construction have played an important role in accelerating the German residential sector's green transformation.

The UK, however, has lagged behind in achieving the targets set for the residential sector. It appears that the inadequate use of financial levers is one of the key reasons for not being able to achieve targets. The policies implemented by the government have been largely regulatory and legislative, in contrast to their approach to the power sector. The government has allocated minimal amounts of public money to implement change in the residential sector. Instead, their policies have either off-set the cost to the private sector (in the case of ECOs and Private Rented Sector Energy Efficiency) or implemented a somewhat convoluted energy billing system (The Green New Deal). The other policies implemented have been geared strictly towards raising awareness of energy efficiency (Energy Performance Certificates). One of the awareness measures worthy of emulation is the Simple Energy Advice service (SEA). The SEA provides impartial and tailored advice on how people can make their homes greener and cheaper to run. The service consists of an easy-to-use website, supported by a call centre which members of the public may contact for assistance.

In California, residential sector emissions declined by a modest 6% over a span of 11 years (from 2006 to 2017). As seen in the case of the UK, the state’s focus was on introducing regulatory measures (building codes such as California Energy Code and CALGreen) and launching awareness campaigns while the use of financial instruments to promote energy efficiency in construction was largely ignored.

Green Transformation Framework: Residential Sector														
	Emissions			Laws/Regulations			Financial Levers		Market Mechanism			Behavioural Change		
	2008	2017	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
UK	81	67	-18%	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
California	2006	2017	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
	43.8	41.1	-6%	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
Germany	1990	2018	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
	209	117	-44%	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural

The chart has been created by the authors based on available official data.

TRANSPORTATION

The transportation sector is a central driver of carbon emissions across all three regions. Cutting down emissions from automobiles has proven to be one of the most pressing hurdles for the three regions. Our analysis suggests that weak policy responses coupled with an ineffective monitoring mechanism are primarily responsible for the transport sector’s disappointing performance.

In the UK, the government’s initial policy response to curtailing emissions from transportation was tepid as compared to its actions in the other sectors. The financial levers used by the government were focused exclusively on a subsection of transportation—buses. While this helped in reducing GHG emissions from the Buses and Coach Subsector by 30%, the other subsectors remained largely ignored. The financial levers that were not directed towards greening buses were employed towards promoting electro-mobility. While it was certainly a step in the right direction, the impact of ULEVs, EVs, and Electric Vehicle infrastructure will only begin to be felt over the next half decade. However, the policy framework and ecosystem of the UK’s transportation sector does offer key insights on behaviour change, infrastructure planning, innovation in battery storage, vehicle design, and vehicle manufacture. A key policy that was recently introduced in the UK is the Road to Zero Strategy. Launched in 2018, it sets out a plan to move to zero emission vehicles by 2040.

In California, the transportation sector is the largest contributor to the total GHG emissions. Increasing car ownership rates, declining public transport ridership and an unchecked consumer preference for pickup trucks and SUVs as compared to fuel-efficient cars are the three key reasons behind California’s high transport emissions. Similar to the UK, the California government has also introduced a wide range of programs to promote electro-mobility but the positive impact of such programs is likely to be seen with a lag.

In Germany, the challenge of is of a different nature. Over a span of almost three decades, the German government has been able to cut emissions by less than one percent from the transportation sector. Even though the government has undertaken a host of measures to catalyse this sector’s energy transformation, the strategies have failed to achieve the desired outcome. The fact that German automakers, including the German Association of the Automotive Industry (VDA), have consistently opposed the government’s efforts to phase out conventional vehicles and replace them with electric vehicles is one of the primary reasons behind the transportation sector’s unimpressive performance. Time and again, German automakers have endeavoured to distance themselves from restrictive climate policies through their powerful lobbying groups.

Green Transformation Framework: Transport Sector														
	Emissions			Laws/Regulations			Financial Levers		Market Mechanism			Behavioural Change		
	2008	2017	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
UK	131	126	-4%	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
California	2006	2017	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
	189	169.9	-10%	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
Germany	1990	2018	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
	163	162	-1%	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural

The chart has been created by the authors based on available official data.

INDUSTRY

Across the three regions, policies enacted for mobilising the industrial sector’s green transformation have significant overlaps with the measures taken to decarbonise the energy sector.

The UK’s policy framework for improving the industrial sector’s performance is well placed to serve as a role model for policy emulation. By offering a robust, well-considered range of financial incentives such as the Carbon Trust Scheme, the Non-Domestic Renewable

Heat Incentive (RHI), and the CRC Energy Efficiency Scheme, the UK government has achieved impressive results. The way in which industry voices have helped shape policy through partnership is a key feature of the UK's approach to climate change mitigation. This is reflected in high business participation in policy initiatives like the Climate Change Agreements and Green Finance Task Force, and the rise of more independent business groups like Carbon Disclosure Project and We Mean Business. Moreover, key stakeholders in the business community regularly attend and play an important role at climate summits.

The way in which industry voices have helped shape policy through partnership is a key feature of the UK's approach to climate change mitigation.

A common trend observed across Germany and California is the limited use of regulatory measures to curtail emissions from industries. Germany's overall strategy has primarily relied on voluntary agreements between the government and the industrial sector—similar to its labour management policies—supplemented by a range of programmes offering financial incentives for energy efficiency investments. Likewise, the German government employs a bouquet of financial instruments to offer incentives to SMEs to invest in energy efficient technologies and upgrades. Financial support to German industries is also provided for a variety of measures, including investments in solar collectors, biomass installations or heat pumps to generate process heat; technology and software for monitoring and controlling energy flows within an energy management system; and the holistic optimisation of production processes. Additionally, Germany also enacted the Compulsory Energy Efficiency Audits in Large Companies Act to measure energy efficiency and emission reduction standards. The Act stipulated that all companies would be audited at random, at least once in four years.

On the other hand, the repercussions of a weak regulatory framework for curbing industrial emissions are clearly evident in California's case. At 4%, the reduction in California's industrial emissions from 2006 to 2017 has been rather disappointing. However, one policy measure that has worked fairly well in California's industrial sector is the cap and trade program. Covering 450 entities, the programme leverages market forces to determine the price of emissions, thereby spurring cost-effective and innovative investment decisions. California's emissions from sources subject to the cap have declined by 8.8% from 2013 to 2016.²

Green Transformation Framework: Industrial Sector															
	Emissions			Laws/Regulations			Financial Levers			Market Mechanism			Behavioural Change		
	2008	2017	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural	
UK	19	11	-42%	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural	
California	2006	2017	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural	
	93.3	89.4	-4%	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural	
Germany	1990	2018	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural	
	283	196	-31%	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural	

The chart has been created by the authors based on available official data.

AGRICULTURE

Since the agricultural sector has a fairly modest contribution to each region’s total GHG emissions, the overall policy response to emission reduction in this sector has been somewhat lacklustre. While there are several strategies that each region has launched to promote sustainable agricultural practices, the use of hard regulatory levers or financial incentives has been rather limited.

In the UK, there has been no progress in reducing emissions in the agricultural sector since 2008. Despite all the programmes and initiatives that the government has introduced, it has been difficult to appraise its effectiveness given the lack of an effective monitoring and evaluation framework. Even in California, the approach towards curtailing agricultural emissions has largely been voluntary. The reliance on a voluntary approach has a critical delivery risk associated with it, which is reflected in the fact that agricultural emissions in California have declined by only 7% over the span of a decade. However, some of the financial levers and market mechanisms employed in the Californian agricultural sector are worthy of emulation. One such strategy is the carbon offsetting program. This allows farms in California to sell offsets for a variety of practices that reduce greenhouse gas emissions. Another key initiative is the Dairy Digester Research and Development Program (DDRDP) which provides financial assistance for the installation of dairy digesters in California. While the policy design and key goals of such schemes are impressive, there is much to be desired when it comes to their implementation.

The performance of the German agricultural sector has been the best among the three regions examined in the study. The 2050 Climate Action Plan highlights three focus areas for Germany’s agricultural sector—restructuring and expansion of organic farming, significant

reduction in nitrous oxide emissions arising from the overuse of fertilisers and a steep cut in ammonia emissions. Germany has also committed to a target of 20% organic land area by 2030. At the 2015 UN Climate Summit in Paris, Germany also joined the “4 per 1000” initiative. The initiative aims to increase soil carbon stocks by 4 percent every year in order to offset the increase of CO₂ in the atmosphere. Even though the German agricultural sector does not have a very strong policy framework as compared to the other sectors, the delivery and implementation of programmes has been relatively more effective as compared to the other regions.

Green Transformation Framework: Agriculture Sector														
	Emissions			Laws/Regulations			Financial Levers		Market Mechanism			Behavioural Change		
	2008	2017	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
UK	45	46	2%	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
California	2006	2017	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
	34.7	32.4	-7%	✓				✓		✓			✓	
Germany	1990	2018	% Change	No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
	90	70	-22%		✓			✓		✓			✓	

The chart has been created by the authors based on available official data.

KEY INSIGHTS FOR INDIA

Our analyses clearly demonstrate that the profound consequences of climate change cannot be solved through legislation only. While laws and regulations can set the context and targets for how markets should operate, they have to be supplemented with additional policies to ensure that market outcomes are shaped to achieve sufficient decarbonisation. Best practice examples from the three regions can guide India in selecting the right policy mix for a green transformation of the Indian economy.

Our study of global best practices reveals key insights that should inform India’s green transformation.

Deep public support for pursuing a green transformation

International best practices indicate that the success of the green transformation is crucially dependent on the extent of public support the green agenda is able to elicit. Policymakers and private citizens have to work in close collaboration to co-create a vision and approach that encapsulates the idea of green growth. The regional case studies

highlight that the core idea of a green economic transformation and its role in steering progressive and positive change must be embedded in electoral agendas and manifestos. To galvanise the transformation, financial instruments, laws, and market mechanisms have to be supported by an overarching narrative that mobilises the entire nation to go green. Overarching narratives of this type are particularly important to counter the lobbying of entrenched interest groups, such as the automotive sector. Political leadership must use the bully pulpit to shape this narrative and create a national mood for the economy's green transformation. The Swachh Bharat Abhiyan has shown how such narratives can mobilise the entire country in pursuit of national goals.

Specific policy goals laying out GHG emission targets, regular monitoring of green efforts, and willingness to take global leadership on climate change matters

A key takeaway from the case studies has been the importance of goal setting and strategy planning in order to enact a climate transformation. Clear examples of this can be seen in the UK and California, which passed the Climate Change Act in 2008 and the Assembly Bill 32 in 2006, respectively, setting clear emission reduction goals for their respective economies. Germany is currently discussing legislation that would also legally bind the government to a certain emissions reduction goal by 2050. International best practices indicate that the best way to enact meaningful climate change reform is through national legislation and jurisdiction, which is binding and has enforcement mechanisms. Moreover, the case studies show that climate change targets should be long-term in nature, with most countries opting for an overall emission reduction goal by the year 2050. This allows for a longstanding target that can be supplemented by short term and medium term goals.

While goal setting and strategic planning are invaluable to an overall Green Transformation Framework, the policy cannot succeed without accountability. It is imperative that an organisation tracks, monitors, and reports on the implementation of green policies. Best international practices have shown that annual update reports are crucial to enact a meaningful climate change strategy. California and Germany have evaluation criteria in place, through which yearly updates are provided.

While goal setting and strategic planning are invaluable to an overall Green Transformation Framework, the policy cannot succeed without accountability.

The United Kingdom is even more stringent in its accountability measures. Not only are there annual evaluations, these examinations are conducted by the Committee on Climate Change, an independent body of experts. The Committee is also endowed with certain powers that allow it to maintain its independence and act as a legitimate auditor.

The case studies highlighted how the three regions were able to galvanise green transformations of their economies and emerge as leaders in the global climate change stage. Acting as pioneers for the rest of the world, they demonstrated how an economy can continue to grow with a clear pathway towards a net-zero carbon future

An appropriate institutional architecture to support a green transformation

An effective institutional architecture is at the core of the green transformation framework. The overall architecture to support the green transformation should include legislative bodies, independent monitoring organisations, dedicated funding agencies, academic institutions with major climate change research programmes, and expert bodies.

Emulating global best practices, this institutional framework should be established over four key levels—super sovereign, sovereign, provincial and local. In the case of Germany and the UK, an apt example of an institutional body at the super sovereign level is the European Union. It not only implements climate policy but also performs the key task of mobilising climate finance. At the sovereign level, the institutional architecture should comprise of not just government bodies but also independent organisations empowered to enact a meaningful climate change strategy. The UK has set a good example in this context through the creation of the Committee on Climate Change, an independent body of experts that is tasked with providing objective analysis of the UK's climate change policies. An institutional architecture for climate mitigation also needs to be developed at the state/province level. For each state, there could be standalone regulatory and financial bodies to monitor and facilitate the functioning of the new markets created by the green transformation. California has done a fairly impressive job at creating such architecture. Even at the local level, California has

enacted legislation (Senate Bill 375) to ensure that cities are directly involved in the development of regional plans to achieve the state's climate targets.

As evidenced by the case studies, the creation of appropriate planning, policymaking, and financial architecture truly hold the key to achieving the green transformation.

Unleashing market forces that drive green innovation and world-leading business models

The case studies demonstrate that market creation is a fundamental principle underpinning the green transformation. Creation of markets (such as the market for electric rikshas or buses) is thus likely to emerge as a necessary and sufficient condition for catalysing India's green transformation. As witnessed in the case of the UK, Germany, and California, market forces unleashed in India must be aligned with India's climate change mitigation priorities. At the same time, they must also be in sync with the unique aspects of the Indian economy and reflective of the changing tastes and preferences of Indian consumers. India may, therefore, choose to create markets that are very different from the ones that the regions examined in the study have chosen. The process of market creation must also be closely interlinked with the ideas of green innovation, green governance and corporate green leadership.

Sufficient financing capacity (including establishment of dedicated financial institutions) through public and private sources to ensure that necessary investments are made in decarbonisation technologies and production processes

International best practices highlight the importance of mobilising green finance to achieve balanced, sustainable and resilient growth. The UK has undertaken several landmark measures such as the establishment of a Green Investment Bank, Green Finance Institute and launch of a Green Finance Strategy to support the growth of green finance. Germany, as the pioneer of the Energiewende, has also taken several steps to integrate the financial sector into its national

climate and energy policy. In Germany, state-owned development bank KfW has been a key contributor to the promotion of green finance, especially through energy efficiency loans to small and medium-sized companies. KfW pioneered the country's green bond market in 2014 and has emerged as one of the most important international issuers of this credit instrument. California has also leveraged financial levers extensively to mobilise the public and private capital necessary to leapfrog to a low carbon economy.

For India's development trajectory to be green, it is therefore important to dovetail the financial sector with the national climate policy and build sufficient financing capacity.

For each of the sectors studied in the regional case studies, financial levers were key drivers of emission reduction. The use of financial instruments such as the Climate Change Levy and Climate Change Agreements in the UK, Net Metering in California, and feed-in-tariffs and CFDs in Germany has played an important role in accelerating the power sector's decarbonisation. In the residential sector, Germany's Market Incentive Program (a funding programme providing financial incentives for energy-efficient installations in buildings) and the KfW's low-interest loan and debt release programmes to promote energy efficient construction have been instrumental to driving down emissions in the sector. Across the three regions, financial instruments such as tax exemptions and purchase grants and have been used extensively in the transportation sector to promote electric mobility. In the industrial sector, the UK has done an impressive job in employing a well-considered range of financial incentives such as the Carbon Trust Scheme, the Non-Domestic RHI and the CRC Energy Efficiency Scheme to reduce emissions. In a similar vein, the German government has leveraged financial instruments to offer incentives to SMEs to invest in energy efficient technologies and upgrades. While the use of financial levers in the agricultural sector has been minimal, California's carbon offsetting programme for farms and DDRDP to promote installation of dairy digesters by providing financial assistance are well placed to serve as role models for policy emulation.

As can be seen from global best practices, each one requires enhanced financing. For India's development trajectory to be green, it is therefore important to dovetail the financial sector with the national climate policy and build sufficient financing capacity.

II

Green Transformation Framework: India

COUNTRY OVERVIEW

India is the seventh largest country in the world, with a total land area of 2973190 sq. km.³ The country has diverse climatic conditions due to its topography and the presence of the Himalayan mountain range that separates it from the rest of the Asian mainland. With a population of 1.35 billion, it is the second most populous country in the world.⁴ A significantly large proportion of India's population is economically dependent on climate-sensitive sectors such as agriculture, fisheries, and forestry. Environment protection and climate change mitigation are thus crucial pillars of India's framework for economic development.

TARGETS

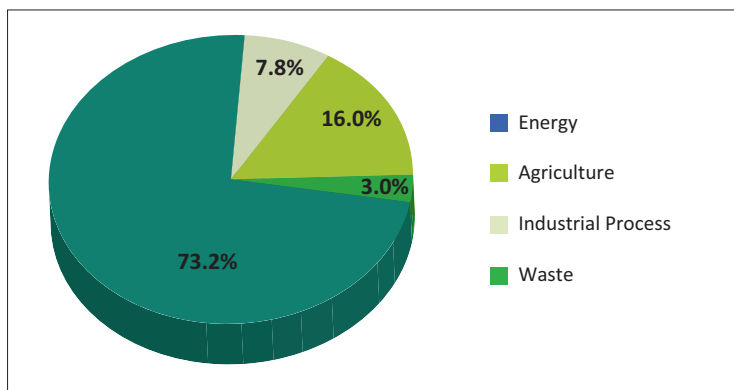
In 2009, in the run-up to COP 15 in Copenhagen, India had committed to reduce its emission intensity by **20 to 25 percent** from 2005 levels by the year 2020. The Second Biennial Update Report (BUR-II) submitted to the United Nations Framework Convention on Climate Change (UNFCCC), reported that India had already reduced its emission intensity by 21% between 2005-2014 and was on track to meet its 2020 target.⁵ As a part of the global effort on post-2020 climate actions, India submitted its **Intended Nationally Determined Contribution (INDC)** in 2015. India has made a commitment to reduce the emissions intensity of its GDP by 33-35% by 2030 from 2005 levels. As a part of its COP21 pledges, India has also committed to ensure that at least 40 per cent of its energy in 2030 will be generated from non-fossil fuel sources. In addition, it has also committed to rapidly increasing its forest cover so that an additional carbon sink equivalent to 2.5 to 3 billion tonnes of carbon dioxide is created by the year 2030.⁶

SECTORAL OVERVIEW

As per the BUR-II to the UNFCCC⁷, in 2014, a total of 26,07,488 Gigagram (Gg) CO₂ equivalent (around 2607 million tonnes of CO₂ equivalent) of GHGs were emitted from all activities (excluding LULUCF) in India. Considering emissions and removals from the LULUCF sector, net emissions were 2,306,295 Gg of CO₂e (2,306

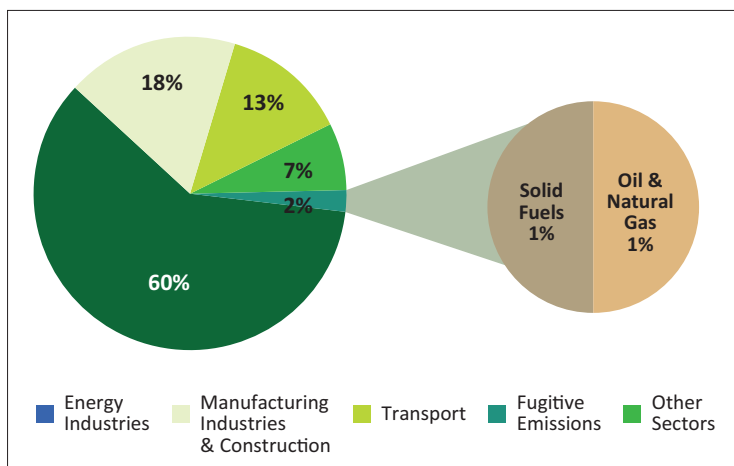
million tonnes of CO₂e).⁸ Out of the total emissions, the energy sector accounted for 73%, Industrial Process and Product Use contributed 8%, agriculture 16% and the waste sector 3%. About 12% of emissions were offset by the carbon sink action of forestland, cropland, and settlements.

Figure 1: Distribution of GHG emissions (Gg CO₂e), by sector



Source: India: Second Biennial Update Report to the United Nations Framework Convention on Climate Change

Figure 2: Distribution of emissions (Gg) across the Energy Sector Categories in 2014



Source: India: Second Biennial Update Report to the United Nations Framework Convention on Climate Change

The total emissions from the energy sector came to 19,09,766 Gg CO₂e which contributed 73% to the total national GHG emissions (excluding LULUCF). The energy sector emitted 92% of the total national CO₂ emissions, a subset of total GHG emissions, in 2014.⁹

POWER SECTOR

India's most publicly heralded climate policy breakthroughs have stemmed from the transformation that its power sector is undergoing. Given its ambitious renewable energy goals and the exponential growth that has seen over the past decade, it is easy to see why India's climate policies are so closely tied to the decarbonisation of the power sector. In a span of 12 years, renewable energy has quadrupled – from making up 6% of capacity in 2007 to approximately 23% towards the end of 2019.¹⁰

India's renewable energy revolution can be attributed to a few key policies. The foundation of the revolution can be seen in the establishment of the National Solar Mission in 2010, which set year wise targets for solar power. The NSM also put in place policies such as the Feed-In Tariff and Renewable Power Obligation, which were essential in propping up a nascent industry that was not able to compete with cheaper energy alternatives at the time. Additional fiscal incentives such as accelerated depreciation tax benefits and the Generation Based Incentive (GBI), allowed renewable energy, especially of the wind based variety, to establish a foothold in the Indian market.

Over the next five years, India's policy schemes stayed largely static, with tweaks such as "Must Run" status, and the Viability Gap Funding Scheme supplementing the generous subsidies provided by the government. The true accelerant for the renewable energy market in India came in 2015, when India announced that it would be adding 175 GW of renewable energy by 2022. The ambitious goal sparked greater interest among the private sector and investors, which together with the decreasing costs of renewable energy materials, marked a turning point. The results were remarkable – from 2015 to 2019, India added 40 GW of renewable energy, showing an almost exponential growth rate.

There are concerns, however, that this growth is not sustainable. The remarkable growth of renewables has coincided with the continued decrease in the price of the raw materials – especially solar panels. While at first blush this might seem to be another positive sign for the industry, the lower prices have resulted in the government reversing many of the policies that helped the sector take off in the first place.

Over the past three years, the government has phased out or drastically reduced the benefits conferred through policies such as Generation Based Incentives, Accelerated Depreciation, and most importantly Feed-In Tariffs.

One of the most appealing features of renewable energy as an investment worldwide has been the guaranteed revenues stemming from Feed-In Tariffs. A steady return on investment over 20 years matches the portfolios of institutional investors almost perfectly. The lower expenses associated with renewable energy projects has motivated the government to move towards auction determined tariff regimes in the interest of cost efficiency. Under different circumstances, this could have been a devastating blow for the renewables sector, but the aforementioned declines in cost have resulted in solar energy achieving cost parity with coal powered plants. In certain areas of India, solar has managed to undercut coal prices by more than 10%.

There are additional concerns that must be dealt with to ensure that India’s renewable energy revolution maintains its upward trajectory. This includes finding solutions to a technologically lagging grid which must minimise its own losses, and find ways to manage the variability of the new renewable energy that is being connected. Actions taken by state governments in recent months have also had a severe impact in investor sentiment for India’s renewable market, with certain states refusing to honour previously signed contracts.¹¹

It is important to note that India has made the most progress in an arena that is also most in need of a climate transformation. As seen in the Overview section, 45% of India’s GHG emissions originate from the power sector. This is largely due to the high proportion of coal power plants within India’s energy mix – which, despite the growth of renewable energy, still makes up 60% of India’s power capacity and accounts for more than 80% of its electricity generation. India plans to add 450 GW of renewable energy capacity by 2030, which is much needed, if it wishes to mitigate the deleterious effects of its coal power plants.¹²

Power Sector											
Laws/Regulations			Financial Levers		Market Mechanism			Behavioural Change			
No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural	
	✓			✓		✓			✓		

The chart has been created by the authors based on available official data.

RESIDENTIAL SECTOR

The evolution of India's building stock holds an important position within the larger landscape of energy and climate change debates. India's buildings are responsible for around 35% of the total energy consumption and their energy use is increasing at 8% annually.¹³ This unprecedented growth in the building stock presents a potential opportunity for achieving reduction in energy use in new residential and commercial buildings through energy efficient measures. There are several legislative measures and market incentives that the Indian government has launched to achieve this end.

One of the most prominent legal measures undertaken by the government in the residential sector is the **Energy Conservation Building Code (ECBC)**. The code is applicable to new commercial buildings with a connected load of 100 kW (or more) or contract demand of 120 kVA or more.¹⁴ The ECBC's primary goal is to set the minimum energy efficiency requirements for new, large commercial spaces. ECBC-compliant buildings demonstrate energy savings of 25 percent over the pre-ECBC-compliant buildings; whereas 'ECBC +' and 'Super ECBC' buildings save up to 35 percent and 50 percent energy respectively. The ECBC rules specify that the code must be adopted by the states and enforced by local governments. However, due to a host of reasons such as lack of human resources, capital and technical expertise, only a limited number of local bodies have been able to adopt and enforce the ECBC standards across the country.¹⁵ It is, thus, crucial to build capacity and create a body of professionals outside the public sector who can undertake third party technical assessments and improve ECBC compliance.

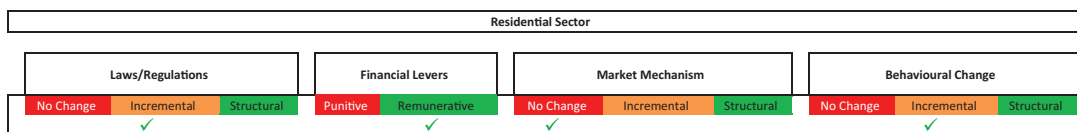
In addition to ECBC, there are several voluntary building standards that have been developed in India to promote sustainable buildings. These include assessment programmes such as the Green Rating for Integrated Habitat Assessment (GRIHA) and Leadership in Energy and Environmental Design (LEED). While each green building code has its unique set of features, it is important to synthesise the key takeaways from each standard for the development of a holistic and comprehensive green building programme.

As a supplement to regulatory measures, the government has introduced several schemes that provide financial incentives to promote

investment in energy-saving appliances in the residential sector. One such scheme is the Bachat Lamp Yojana (BLY). The scheme was launched in 2009 by the Bureau of Energy Efficiency (BEE) to promote energy-efficient lighting in India. It was transformed into the UJALA scheme in 2015 under which energy efficient LED tube lights and fans were distributed to consumers at a subsidised price.

In addition to market incentives, the government has also introduced programmes for energy certification of home appliances through energy labels. In July 2015, The Bureau of Energy Efficiency (BEE) introduced the 'National Energy Labelling Programme' for electrical home appliances. A key objective of this scheme was to provide the consumer an informed choice about the energy saving and thereby the cost saving potential of the relevant marketed product. The government of India has also launched the Smart Meter National Programme (SMNP) to deploy smart meters across the country. The SMNP aims to replace India's 250 million conventional meters with smart meters.

Development of a green residential and commercial sector has the potential to transform the energy landscape in the country. When measured against global standards, the Indian government has performed reasonably well in terms of offering market incentives and introducing behavioural nudges for promoting energy efficiency in the buildings sector. However, to effectively leverage the residential sector's potential, it is important to develop a more robust set of regulations and ensure better adoption, enforcement, and compliance.



The chart has been created by the authors based on available official data.

TRANSPORT SECTOR

Transportation is among the lowest GHG emitting sectors in India. Responsible for a little less than 10% of emissions, it is on par with industry and far behind power and agriculture as sectors of concern.¹⁶ Despite this, as India grows both economically and in terms of its population, reducing transportation based emissions will be a key factor in India's overall climate strategy.

The Government of India has launched a wide range of policies aimed at enhancing passenger mobility, fuel efficiency, improving freight transport logistics, and promoting rail use and low-carbon transport.

Among these policies are emissions norms, the first set of which were introduced in India for petrol vehicles in 1991 and for diesel vehicles in 1992. These were followed by making the catalytic converter mandatory for petrol vehicles and the introduction of unleaded petrol in the market. The next key milestone in India's transport policy history was the introduction of the **Bharat Stage emission standards**. The **National Auto Fuel policy** was announced officially in 2003 which set out a roadmap for the implementation of the Bharat Stage norms until 2020.

Additionally, policies have been put forth to promote the manufacture and sale of fuel efficient cars to tackle the problem at its origin. This includes the introduction of mandatory fuel economy standards and fuel efficiency labelling for cars as well as the emphasis on the huge potential of bio fuels. The National Policy on Biofuels, launched in 2009 and updated in 2018, set an ambitious indicative target of achieving 20% blending of biofuels with fossil-based fuels by 2030.

In addition to promoting biofuels, the government of India has also introduced several measures to energise the electromobility sector. The most important of these measures was the launching of the **FAME-India** scheme in 2015 to promote hybrid/electric technology in transportation with the goal of reaching 30% EV penetration by 2030. In 2019, the scheme was superseded by FAME II, which improved upon the earlier plans, and took on a more tailored and subtle approach. Understanding the complexities involved with transforming the automobile market to EVs, FAME II aims to first take on India's vast two-wheeler, three-wheeler, and public bus sectors.

Another key policy for the transportation sector is the National Urban Transport Policy (NUTP). Rapid transit (also called the 'metro') systems have been a key component of India's public transportation infrastructure. They have provided consumers with a convenient, cost-effective, and environment-friendly means of transportation. The Kolkata, Delhi, and to a certain extent the Mumbai Metro have all been successful in encouraging wider public transportation usage as well as reducing growth of private-vehicle ownership and congestion.

India has set a number of ambitious goals for itself to reduce emissions in the transportation sector – an area that has been largely ignored or been poorly addressed in our case studies. As many of the policies have only recently been rolled out, it is difficult to ascertain their effectiveness. Despite this, there are numerous positive signs – among them the sizeable financial commitment the government has made towards its electric mobility schemes. There have also been some lapses, however – including the Biofuel policy which achieved only 2% blending as of 2018.¹⁷ There is still more that India can do to reduce its transportation based emissions – which has proved to be the hardest sector for many developed countries to conquer.

Transportation Sector										
Laws/Regulations			Financial Levers		Market Mechanism			Behavioural Change		
No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural
	✓			✓		✓			✓	

The chart has been created by the authors based on available official data.

INDUSTRIAL SECTOR

The competitiveness of Indian industrial units is intricately related to energy consumption and its consequent impact on climate change. In several Indian industries, energy is often the single largest operating cost and energy productivity is hence essential to their survival and growth. However, large scale increase in energy conservation has been limited for Indian industries, particularly in the MSME sector, due to the difficulty in regulation. Despite these difficulties, the Indian government has passed a number of policies aimed at creating a cleaner, greener, and more energy efficient industrial sector.

The National Mission for Enhanced Energy Efficiency (NMEEE) is one of the eight missions under the National Action Plan on Climate Change (NAPCC), adopted by India in 2008. An important initiative introduced by the Indian government under the NMEE to enhance energy efficiency in energy intensive industries is the **Perform, Achieve and Trade Scheme (PAT)**. Under the scheme, energy reduction targets are set for 478 industrial units in 8 energy intensive sectors. Industrial units that are able to exceed their energy reduction target are awarded Energy Saving Certificates or ESCerts while those that are unable to meet their assigned targets are required to purchase ESCerts from the others through a centralised online trading mechanism hosted by the Indian Energy Exchange (IEX). The PAT scheme thus provides an

innovative, market based mechanism to enhance cost effectiveness of energy efficient measures in energy intensive industries.

Another key project pertaining to industry launched in 2011 by the UN and GEF, in partnership with the Indian government, was the **'Promoting energy efficiency and renewable energy in selected MSME clusters in India'** programme. It primarily focused on developing a market environment for introducing energy efficiency (EE) and renewable energy (RE) technologies in 12 selected MSME clusters including Brass, Ceramic, Dairy, Foundry and Hand tools. The GEF and BEE launched an ancillary project called **"Financing of Energy Efficiency at MSMEs"** which had a mandate to increase demand for energy efficiency investments in target MSME clusters and to build their capacity to access commercial finance.¹⁸

Additionally, to promote the growth of industries with low carbon emissions, the Ministry of Environment, Forest and Climate Change introduced a new categorisation of industries based on their pollution load in March, 2016. The new criteria for categorising industrial sectors are based on their score on the pollution index. The Pollution Index (PI) of any industrial sector is a number from 0 to 100 and the increasing value of PI denotes the increasing degree of pollution load from the industrial sector. The new categorisation seeks to promote industrial sectors willing to adopt cleaner technologies, ultimately resulting in generation of fewer pollutants. Another feature of the new categorisation system lies in facilitating self-assessment by industries as the subjectivity of earlier assessment has been eliminated.

The steps taken by the government have been effective by themselves. The PAT scheme is responsible for almost 31 million tonnes of CO₂ emissions reduced – about 2% of India's overall emissions.¹⁹ The effectiveness of the MSME schemes is difficult to judge as the majority of such enterprises make up India's informal sector, and are therefore difficult to audit and track. Yet, it is an important step, given the unique dimensions of the Indian economy. However, India's growing economy is outpacing the policies put in place by the government, and industrial emissions are rising at alarming rates, in counterbalance to other sectors.

Industrial Sector											
Laws/Regulations			Financial Levers		Market Mechanism			Behavioural Change			
No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural	
	✓			✓		✓			✓		

The chart has been created by the authors based on available official data.

AGRICULTURAL SECTOR OVERVIEW

The agriculture sector has a crucially important role to play in India's path to achieving green growth. With a share of about 16% in the country's overall GHG emissions, agriculture is the second highest emitter in the economy after the energy sector. Moreover, the fact that 50% of the country's labour force is employed in agriculture makes the handling of a low carbon transformation an extremely important matter.

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The Indian government has introduced a wide range of schemes to enhance agricultural productivity and promote sustainable and climate smart practices. One of the prominent regulatory measures introduced in the agricultural sector by the Government of India is the National Mission on Sustainable Agriculture (NMSA). It aims to curtail agricultural emissions by reducing emissions from chemical fertilisers, and increasing sequestration through agroforestry while also making the sector more productive, remunerative and climate resilient.

A key programme for promoting holistic horticultural growth is the Mission for Integrated Development of Horticulture (MIDH), a centrally sponsored scheme that came into effect from 2014-15. The scheme aims at boosting horticulture production, improving water-use efficiency through micro irrigation, augmenting farmers' income. It also strengthens nutritional security by reducing the dependency on GHG intensive inorganic fertilisers, by offering the possibility of sequestering carbon, and by reducing methane emissions.

In addition to promoting horticulture, the government has launched a suite of schemes to give an impetus to climate smart irrigation practices. A prominent scheme focusing on creation of irrigation potential through ground water is the Pradhan Mantri Krishi Sinchai Yojana (PMKSY). Under this scheme, state governments are tasked with the responsibility of identifying potential areas where assured ground water irrigation can be provided. Post the identification of

areas, ground water irrigation facility through dug wells, dug cum bore wells, tube wells, and bore wells can be funded for schemes in areas other than those classified as Over Exploited (OE), Critical or Semi-Critical. By focusing on water conservation and recharge and recycling of wastewater, schemes such as the PMKSY play a central role in the creation of a sustainable agricultural landscape.

The government has introduced several schemes to promote farm mechanisation for increasing productivity in the agricultural sector. The National Mission on Agricultural Extension and Technology (NMAET) was introduced to restructure and further strengthen agricultural practices through the aforementioned mechanisation. This has shown a 15-20% reduction in fertiliser usage, along with significant productivity gains, and up to a 50% boost to farmer income levels.²⁰

A government scheme that has had a considerable impact on the reduction of GHG emissions is the National Food Security Mission. The programme essentially focuses on increasing production and productivity in Indian farm areas. It uses a variety of techniques — including crop nutrient management, higher yield crop species, and crop diversification. The programme has been perhaps the most effective agricultural scheme for India from a climate perspective, with results showing between 60-90% energy savings, along with significant conservation of water decrease in cost of production.

An examination of the schemes introduced in the agricultural sector reveals that the government has done an impressive job in designing policies to achieve the dual objectives of economic productivity and climate mitigation. While it is imperative for such schemes to remain in force, their implementation is an area that can definitely be improved upon. For example, despite investing almost Rs 1,500 billion in canal projects for Andhra Pradesh and Maharashtra, the increase in canal irrigated areas within the two states was negligible.²¹ Weak implementation can undo even the most well-designed policies. Therefore, a key recommendation for the government would be to focus its efforts on the development of a robust monitoring mechanism.

Agriculture Sector											
Laws/Regulations			Financial Levers		Market Mechanism			Behavioural Change			
No Change	Incremental	Structural	Punitive	Remunerative	No Change	Incremental	Structural	No Change	Incremental	Structural	
	✓			✓	✓				✓		

The chart has been created by the authors based on available official data.

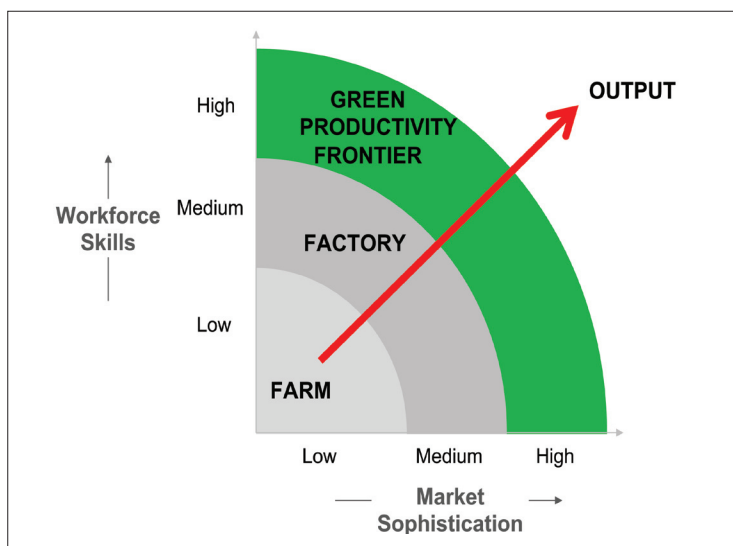
III

Getting to the Green Frontier: Modelling the Pathways

The analysis of the UK, California, and Germany’s green transformation in ORF’s forthcoming study reveals how the three regions were effectively able to combine decarbonisation with economic growth. The numbers on economic growth and emission reduction for the three regions²² strongly refute the oft-quoted assertion that green growth is a zero-sum game. By implementing a well-designed policy mix of regulations, financial instruments, and market mechanisms, the three geographies were able to synergise public intervention with private initiative and grow their respective economies. Along similar lines, the introduction of green structural reforms to kick-start India’s green transformation may well be the stimulus that the Indian economy needs.

India’s unique development model will necessarily have to be a Farm-to-Green Frontier transformation.

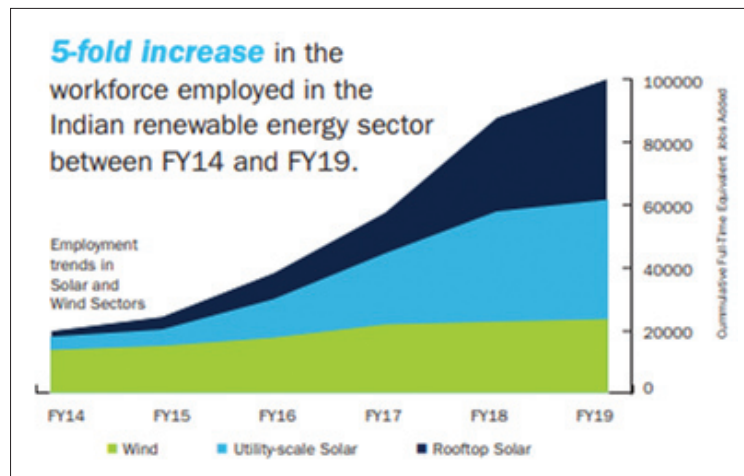
India’s green transformation is likely to be quite different from those witnessed in the case of the UK, California, or Germany. While these regions are already highly developed and at the global technology/productivity frontier, India is still a low middle-income developing country. The developed world followed the classic Farm-to-Factory development model, but India has to leapfrog directly from farm to the global technology/productivity frontier. Only companies that operate at this frontier can compete successfully in an open global market economy. At the same time, the climate change imperative implies that India will have to simultaneously also adopt the best green technologies. Thus, *India’s unique development model will necessarily have to be a Farm-to-Green Frontier transformation.*



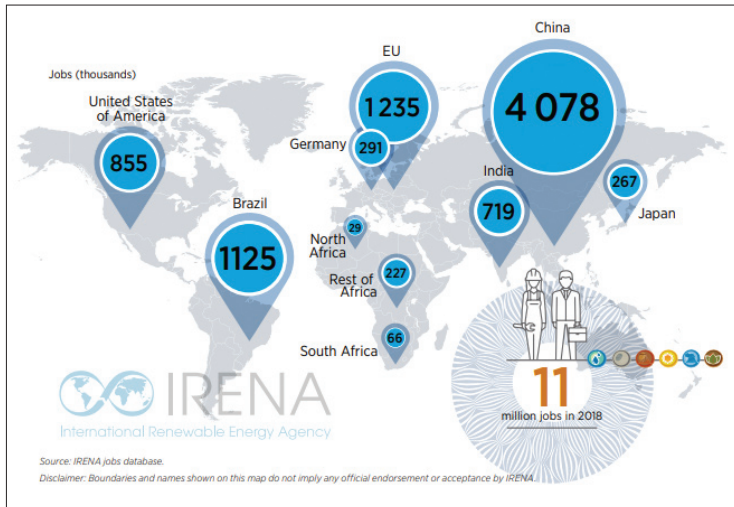
A central question confronting policymakers is the quantum of projected emissions under the baseline scenario versus the farm-to-green frontier scenario. Decarbonisation approaches in the green transformation scenario will drive the growth of green industries, green jobs, green skills, green entrepreneurs, and green finance. It is therefore essential to develop a sound, data-driven analytical framework to model and assess the implications of green growth for India.

While the precise policies that will shape India’s green transformation cannot be pinpointed, it is apparent that the transformation will result in fundamentally reshaping the Indian economy. A crucial element of the transformation will be the creation of green industries. Indian policymakers and entrepreneurs will have to unleash market forces that will drive the growth of solar panels, electric vehicles, superefficient appliances (such as refrigerators and air conditioners), and green packaging. Promoting some, or all, of these green industries is likely to define the momentum of India’s green transformation.

Another key question is in what way and to what extent the green transformation will impact employment. While there are no official numbers on the employment generated in renewable energy sectors in India till date, several independent studies estimate that the workforce employed in India’s renewable energy sector has increased nearly five-fold in the past five years.²³



Source: *Powering Jobs Growth with Green Energy*, Council on Energy, Environment and Water, Natural Resources Defense Council and Skill Council for Green Jobs²⁴



Source: IRENA jobs database

Additionally, a 2019 Report released by the International Renewable Energy Agency (IRENA) ranks India among the top six countries that have created the maximum number of green jobs. IRENA estimates that employment in the renewable energy sector stood at 719,000 at the end of 2018 in India.²⁵

There is no doubt that a host of new jobs in India's new green industries will be created as the economy surges along its projected green growth trajectory. However, a holistic assessment of the impact of the green transformation must also factor in the jobs that will be lost in conventional energy sectors as the transformation gathers momentum. A similar assessment that will have to be made is whether the quality (in terms of remuneration and nature of work) of the new green jobs will be better or worse than conventional jobs destroyed. As discussed in detail in ORF's forthcoming study, for each of the three geographies, there are opposing views about the green transformation's net impact on employment. There are studies that establish that the number of new jobs created is more than the number of conventional jobs rendered redundant by the transformation. At the same time, there are analyses that provide evidence to support the exact opposite claim. There are also studies that point out that the net employment impact of the green transformation is more or less neutral. Therefore, as stated above, India needs to develop a robust modelling framework to quantify the green transformation's impact on the labour market.

The creation of new green jobs will inevitably be linked to an increased

A critical challenge for Indian policymakers as clean energy jobs expand in India will be development of new avenues for training and skilling the workforce.

demand for a new set of specialised skills. A critical challenge for Indian policymakers as clean energy jobs expand in India will be development of new avenues for training and skilling the workforce. The Government of India has already set the wheels in motion by establishing the Skill Council for Green Jobs in 2015. This is promoted by the Ministry of New and Renewable Energy (MNRE) and Confederation of Indian Industry (CII). The primary goal of the Skill Council is to identify skilling needs of service users and service providers within the Green Businesses sector and implement nationwide, collaborative skills development and entrepreneur development initiatives. India will have to level up its skilling ambitions to further leverage the linkages between green interventions and economic development.

Another important question is the manner in which the financial sector will be engaged to fund India's green transformation. Preliminary estimates suggest that India's climate finance ambitions will require an average investment of \$95bn to \$125bn per year for climate mitigation, thus representing a cumulative need of about \$1.6tn between 2020 and 2033.²⁶ The private sector is likely to play the primary role in financing this green transformation. To mobilise the private sector to step up investment in clean tech and energy sectors, public policy efforts, governance reform, capacity-building and regulatory intervention is needed in equal measure. Innovative mechanisms, solutions and green finance instruments will have to be designed to unlock private capital flows. However, to establish market confidence and attract capital, these solutions will require clear economic returns and policy predictability.

There is no denying the fact that the battle against climate change will be an expensive one, for India as well as the rest of the world. According to a report by the World Economic Forum, it would need an added investment of around \$0.7 trillion per year to sustain the challenges posed by climate change.²⁷ India, however, can help the world win this battle on a frugal climate budget. India's solar ambition has the potential to transform its energy structure currently dominated by coal and lead the way for a new era of low carbon development in developing countries across the world. Second, by tapping into its vast labour force, India can mass produce mass aggregate and mass process for the rest of the world. The whole world will, therefore, benefit from the positive spillovers created by a resource and energy efficient,

clean and green India. The velocity of India's green transformation and the fashion in which it gathers momentum matters to the world. Given the crucial role India is going to play in curtailing global GHG emissions, investing in India's endeavour to go green appears to be the world's best chance to mitigate climate change.

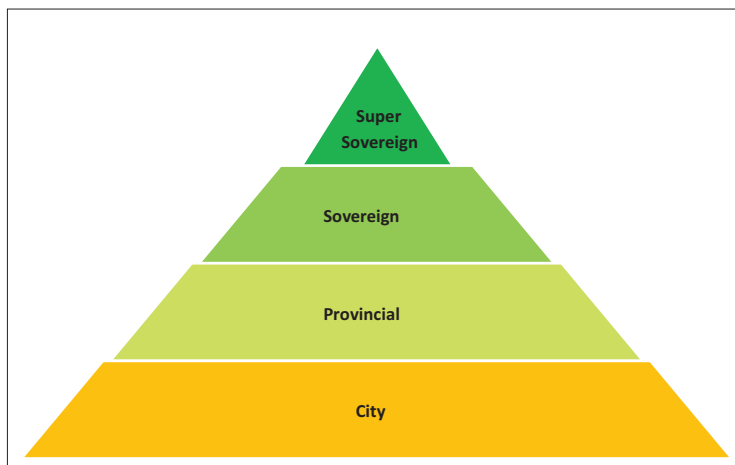
IV

Getting to the Green Frontier: Implementation Considerations

The effective implementation of India's green transformation roadmap is crucially dependent on the underlying institutional architecture. A review of India's existing architecture reveals that it was only post-2007 that institutions for climate governance were established in India. Prior to 2007, climate policy in India was seen as a foreign policy issue. Implementation of climate mitigation and adaptation strategies was handled collaboratively by the Ministry of External Affairs (MEA) and Ministry of Environment and Forests (MoEF). It was only in 2014 that the Ministry was renamed and the term 'Climate Change' was added to its name.

From 2007-09, in response to global pressure to develop institutions for climate mitigation, there was a rapid rise in climate change institutions in India. A prominent development was the creation of the Prime Minister's Council on Climate Change in 2007. The Council's first major contribution was the release of the National Action Plan on Climate Change (NAPCC) in 2008. The release of the NAPCC set a range of activities in motion. While the current political leadership in India has made notable efforts in expanding and strengthening India's institutional architecture for climate governance, the existing framework will have to be revamped further in order to align with the country's ambitious green transformation requirements.

As the regional case studies have demonstrated, an effective institutional framework may be established over four levels. The first is at the super sovereign level – an apt example of this would be the European Union in the case of Germany. The second layer is at the level of the sovereign, entrusted with the key task of cohesive and



holistic policy making. The third level comprises of provinces/states, and the fourth level comprises of cities and local bodies.

Institutional architecture on the super sovereign level does not seem relevant for India upon first glance. However, there are key institutions that can be set up at this level to help the mobilisation of climate finance. Taking a cue from the United Kingdom's Green Finance strategy, and more specifically, its Green Investment Bank, India could create its own Green SuperFund at the Super Sovereign level. While Green Funds have traditionally been sovereign in nature, the Green SuperFund could aggregate funding, from international and certain domestic sources, to create a climate impact investing fund. Such an organisation could focus on deploying funds across a variety of sectors including renewable energy, clean coal, public transportation, electric vehicles, and agriculture. The investment philosophy of such an organisation would be capital-structure neutral, allowing for flexibility and tailored approaches to account for financing needs on an industry-by-industry basis. Given its sectoral diversity as well as the multiple sources of funding that are anticipated for the body, a Green SuperFund will also mitigate certain risk factors that investors would have if they were to invest in only one sector or one project.

Institutional architecture on the sovereign level is perhaps the most important layer to be implemented. Institutions needed at the level include not only dedicated Ministries to deal with climate change issues, but also independent bodies empowered to enact a meaningful climate change strategy. The United Kingdom has demonstrated the importance of this through its creation of the Committee on Climate Change, an independent body of experts that is tasked with providing objective analysis of the UK's climate change policies. Additionally, the Committee is also tasked with ensuring regular government reporting to Parliament, and has the power to call for a judicial review if they feel the government is not on track to meet its long term climate goals. It can critique the government's assertions, alert the electoral base if there are transgressions, and perhaps most importantly act as a long-term anchor.

An institutional architecture for climate mitigation also needs to be developed at the state level. For each state, there could be standalone regulatory and financial bodies to monitor and facilitate the functioning of the new markets created by the green transformation. California

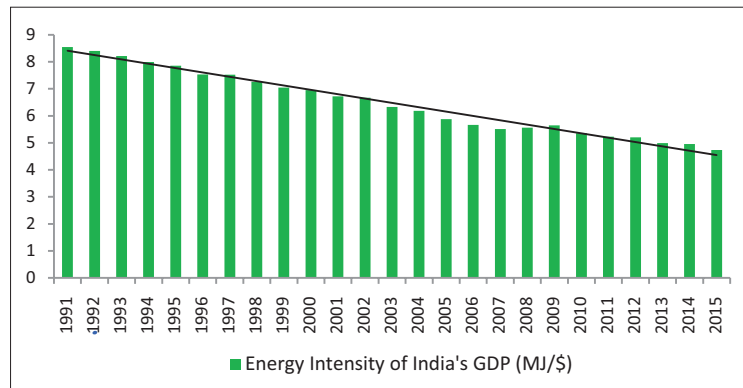
has done a fairly impressive job at creating such architecture. For instance, the state's cap and trade program is predominantly applicable to the industrial sector. The California Air Resources Board (CARB) is tasked with the responsibility of enforcing and implementing the program. The auction proceeds generated from cap and trade are deposited in a fund called the Greenhouse Gas Reduction Fund (GGRF) which in turn is regulated by the California Environmental Protection Agency. The GGRF invests the auction proceeds from the state's cap-and-trade program in a diverse set of projects under a program called California Climate Investments. These projects, themselves, are coordinated and controlled by more than twenty state agencies. An institutional framework of this kind clearly demonstrates that markets will function smoothly and institutions will effectively receive and release funds into the economy provided with the correct state level institutions. For India, this is even more important given the extensive rights afforded to states by the constitution.

India should consider appropriate institutional arrangements at local levels as well. There are notable examples of this from California, where legislation has ensured that cities are directly involved in the development of regional plans to achieve the state's climate targets. The legislation in question, Senate Bill 375, also requires cities to create Metropolitan Planning Organisations (MPOs) to adopt a sustainable community's strategy.²⁸ Beyond just policy making and planning apparatuses, cities also need institutional architecture that can allow them to act as separate financial bodies. The existence of a financial architecture in California, has cleared the path for many cities to take on a pioneering role in the mobilisation of finance. There have been more than \$5 billion in Green Municipal Bonds issued as of 2017, through the cities of San Francisco, Los Angeles, and San Diego to name a few.

TWIN TRANSFORMATIONS

India has seen trend of declining energy intensity of its gross domestic product (GDP) since 1981, particularly since 1991. In 2015, energy intensity for India was 5 megajoules per dollar (MJ/\$) of GDP. In 1991, energy intensity of GDP was 8.5 MJ/\$ in 2015, it had gone down to 5 MJ/\$.²⁹ In that same period, its GDP increased manifold. The government has said that it expects the Indian economy to reach

Energy Intensity of India's GDP (MJ/\$)



Source: World Bank Open Data

If current trends are sustained, India will be the first such economic powerhouse to have achieved such size without intensely burning fossil fuels to power its growth.

the \$5 trillion level by 2024-5.³⁰

India will be the first such economy that has not depended upon a high level of fossil fuel burning per dollar of GDP. In 1991, China's energy intensity of GDP was 21 MJ/\$, and in spite of improvement since, when it was at India's current level of per capita income, China's energy intensity of GDP was about double India's current intensity.

Indeed, in the early part of the decade of the 2030s, India aspires to become a \$10-trillion economy.³¹ If current trends are sustained, it will be the first economic powerhouse to have achieved such size without intensely burning fossil fuels to power its growth. It is a unique development challenge, and unparalleled in economic history. It is also vital for the world's battle against climate change that India succeed in developing a low-carbon growth pathway.

In order to achieve this growth, it will be necessary to utilise economic and technological transformations that are already underway both in India and globally.

The first such transformation is the growth of the platform economy. What are the macro-economic and growth implications of platformisation? While these have been studied at the firm or sectoral level, whole-economy models of such changes are rare. Broadly, platformisation represents a change in the mode of growth from being the consequence essentially of an engagement between labour and the production economy to include the engagement between labour

and the consumption economy. Efficiency gains are concentrated on the consumption side of the equation, through better structured matching algorithms that reduce transaction costs. Hidden assets – such as idle houses and worker time – are more efficiently utilised. This re-evaluation of the value of assets and thus of firms means that a new financial architecture is also evolving that seeks to understand and finance enterprises that have a different life cycle from those that went before.

Platform economies, which incorporate efficiencies in the use of assets across the spectrum, may thus be inherently greener and less energy intensive than previous economic paradigms. India's shift to a platform-based economy and the dynamism associated with mass services provide a very different path to prosperity than that associated with mass manufacturing and the production economy.

Meanwhile, the green transformation is gathering apace in certain crucial industries. As discussed above, India's ambitious solar power capacity targets are ensuring an overall change in the power generation mix. Other ongoing changes also reveal an India-specific green transformation: the growth of rooftop solar, for example, and the interest in solar-powered pumps and household goods. The role once played by regional utilities is partly being substituted by personal devices.

Thus the movement to the technology/productivity frontier, and the green transformation put together lay out a possible path forward for the Indian economy – a path to the Green Frontier.

LESSONS AND PLANS

In seeking to manage and meld its twin transformations and forge a path to the green frontier, India has no real precedents to call upon. As argued above, no other country has created a \$10 trillion economy while simultaneously working on a low-carbon transformation. However, there are pockets of experience to call upon – places where a technological transformation and the green transformation have gone hand in hand, and in part strengthened each other.

This paper has identified three economies from which lessons can be learned.

In Germany, there was an industry-led economic transformation, the *Energiewende*. While its success across industries is open to debate, there is little doubt that the dynamism of the German industrial economy has aided its green transformation.

The United Kingdom's economy is dominated by finance, and the re-engineering of the financial sector and the development of new fintech solutions has underpinned its low-carbon transformation strategy. It would not be an exaggeration to say that its transformation plan is expressed most clearly and prominently through the carbon budgets that are the purest statement of its long-term climate strategy. The existence of carbon budgets provides clarity and stability to the UK's low-carbon transformation, and thus serves as a crucial input for financial investors.

California, meanwhile, is where the Fourth Industrial Revolution is taking hold. The state is pioneering attempts to deal with income and human capital inequality while also addressing livelihoods in the context of platformisation and the low-carbon transformation.

The first step, however, must be to create a proper analytical structure of the Indian economy on the threshold of the technological and green transformation. This effort, which would ideally take the form of a macro-economic model that builds in current skills, sectoral connections, relative emissions, and financial constraints can then inform government policy going forward.

The second step must be the imposition on this model of various scenarios about future growth and transformation. What is the baseline scenario? What changes will be catalysed by greater platformisation, financialisation, and technological change in various sectors?

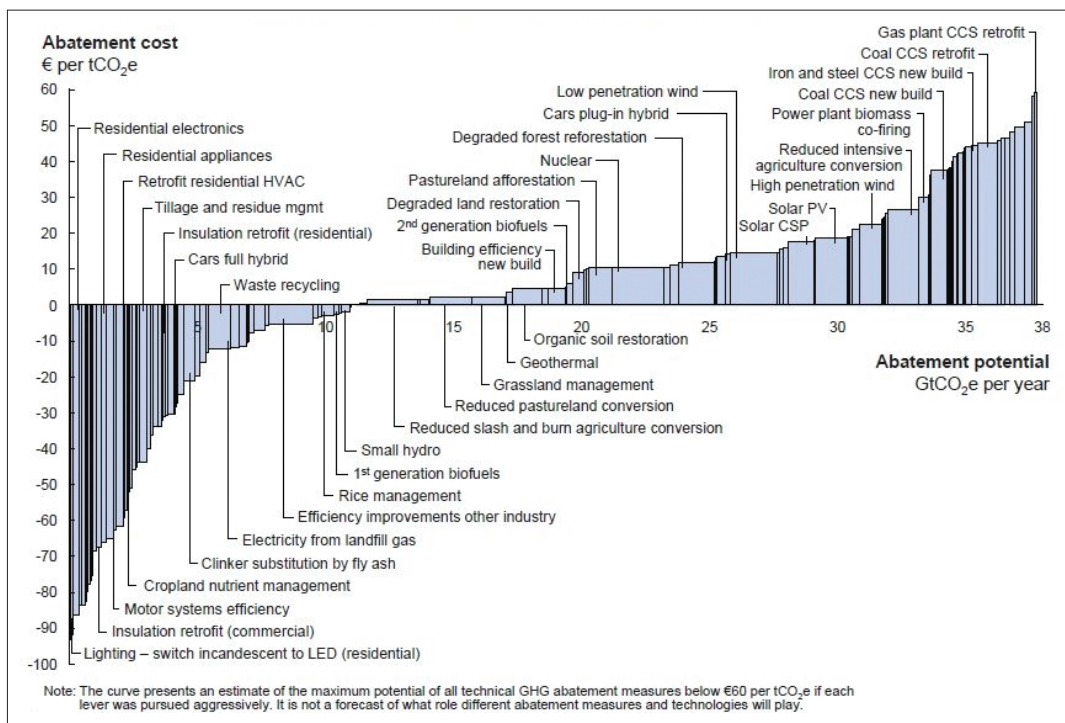
The UK has created a Department for Business, Energy and Industrial Strategy that seeks to combine planning for growth, business development, energy transformation, and also industrial policy. The next (third) step in India, too, must be to identify the sectors that will provide a growth impetus going forward and that will smoothen India's pathway to the Green Frontier. Any institutional recommendations

that emerge from the model would thus have to incorporate more collaborative decision-making at the highest level.

Choosing the industries which are likely to drive the green transformation will require a careful and realistic assessment of the state of technology and expectations from future innovation balanced by potential gains to growth, productivity and emissions reduction/abatement. The standard global greenhouse gas abatement cost curve, produced by McKinsey, identified 40 different transformations that had differing costs and abatement potentials – ranging from low-cost interventions like LED lighting and real estate insulation all the way up to high-cost and still difficult-to-envisage rebuilds of entire sectors like iron and steel to incorporate potential carbon capture and storage technologies.³²

Indian analysis must build on and indigenise this analysis. It should divide sectoral interventions into three parts (a) those that are already doing well, and need continued supportive policy such as the expansion of LED lighting, energy efficiency in appliances and

Global GHG abatement cost curve beyond business-as-usual – 2030



Source: Global GHG Abatement Cost v2.0 in 'Pathways to a Low Carbon Economy', McKinsey & Company

solar power; (b) those that are low-hanging fruit where lessons can be easily incorporated from elsewhere, such as residential insulation, tillage and agricultural residue management, and reforestation; and (c) the new sectors that will require intensive, long-term financial commitment that draws on global capital, such as storage technology, high-penetration renewables and smart metering, and – at the very edge of possible technological futures – carbon capture and storage.

Finally, the new institutional arrangement that will support the Indian transformation must include financial structures that ensure risk mitigation for Indian and global capital and the efficient allocation of funds to the leading sectors identified under the transformation strategy. This could perhaps take the form of a Green SuperFund. Such a body can play a dual role in mediating and clarifying risk for global capital, as well as serving as the body which identifies sectoral priorities and project pipelines. For the first function, the National Infrastructure Investment Fund can serve as a model; the NIIF blends public and private finance in order to reduce perceived risks and catalyse greater funds flow into infrastructure.

ENDNOTES

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The Indian economy needs to achieve sustained economic growth over the next decade in order to provide better living standards for its people, while simultaneously working on a low-carbon transformation. This publication draws upon experiences from three jurisdictions which have been leaders in climate policy—the United Kingdom, Germany and California—to identify global best practices which can inform the Indian government’s policy decisions regarding economic growth.



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