

Green Growth and Climate Change Mitigation in India

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1. Introduction

India is a large developing country where both mitigation and adaptation needs are high as well as at the same time is immensely challenging. This is because India houses 1/6th of the world's population, and in order to meet the basics of human and social development needs, an increase in GHG emissions for a few years would be required. However, given the changing climate, the challenge for India is to reduce the rate of increase of absolute emissions in the economy per unit growth while meeting its development needs. This means that carbon intensity of the economy should fall, which could be achieved through increased sustainable productivity, conservation of resources, technology transformation, accompanied by sustainable consumption behavior (Planning Commission, 2012).

Therefore, India's response to climate change mitigation, by and large, is also a response to its developmental challenges. The Government of India has taken proactive steps (both domestically and internationally) to move beyond the gross domestic product (GDP) approach in order to incorporate for Low Carbon Inclusive Growth (LCIG) pathways (Planning Commission 2014). Accordingly, a number of policy and regulatory instrument have been undertaken to cover a range of sectors, actors and GHG gases within the climate change mitigation policy framework. Multiple policy instruments such as carbon taxes, domestic trading mechanisms, financial incentives are implemented which differs in magnitude from state to state depending upon the states' circumstances. In its endeavor to address the issue of climate change, India is also Party to several international negotiation platforms and mechanisms, reflecting leadership in this sphere.

The paper provides an overview of the climate change mitigation policy framework in India. Section 1 discusses the policies taken up at the national level in promoting green growth and climate change mitigation in India. Section 2 gives a roadmap of emission trends and mitigation policy scenarios projected for the country till 2050s. Section 3 analyzes the status of India's role in the International mechanism on climate change as well as opportunities and barriers that exist.

The rationale for mitigation is follows:

- Given India's vast demography which consumes very low per capita energy at present, nearly 3 times below the world average, it is well articulated that if the growth is to be inclusive, demand for energy must necessarily increase.
- Projected demands for the year 2030s for India indicate a CAGR rate of 8 per cent (from 549 Mtoe in 2011 to 1460 Mtoe in 2031) for the commercial sector between 2011 and 2031 (TERI MARKAL study, ESO (2015) results).
- Given the growth trajectory of India, and limits to its capacity to set-up infrastructure and capabilities for new power projects to match demands, consumption of all energy sources including the fossil fuels will continue to increase in absolute terms. In future, fossil fuels will remain the predominant fuel for India in 2030s, with more than 70% of primary energy coming from fossil based fuels (predominantly coal) in the BAU scenario.

- Percentage share of imports of fossil fuel would also go up to 91% for oil, 66% for coal and 60% for natural gas (TERI 2015). While the share of renewable in the total energy mix remain small, its' share is likely to double in future and will grow in the baseline growth scenarios. Therefore till 2047 nature and share of energy technologies would differ widely than what it is today.

2. Emission trends in India: Carbon intensity of the economy is falling

According to the International Energy Agency (IEA) estimates, the absolute emissions in India have increased continuously over the decade, since 2000s and currently stands at 1954.02 MtCO_{2e} (in 2013), a common trend observed across all developing countries (IEA 2014). According to INCCA (2007), primary emitting sectors in the country are electricity generation, transport, agriculture, industries (particularly iron & steel and cement), buildings, fugitive emissions and waste (Figure 1).

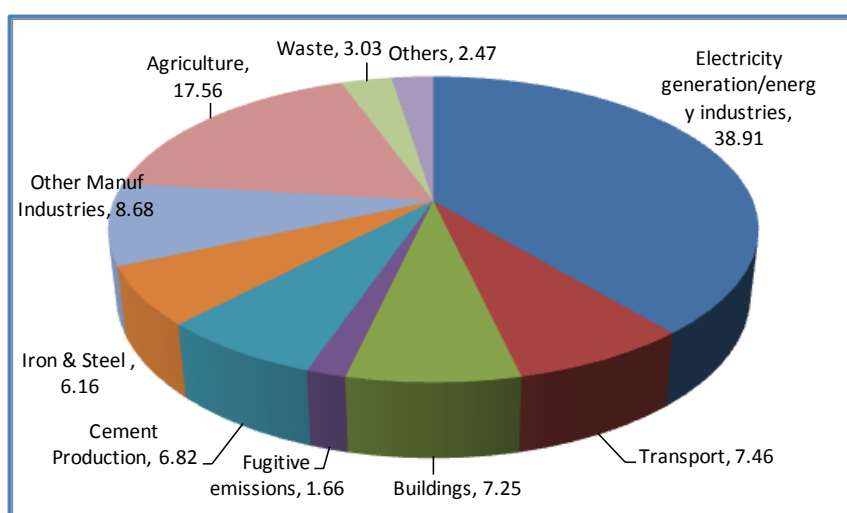


Figure 1 Major emitting sectors in India in 2007 (in percentage)

Source: INCCA (2010)

Since the very beginning, India has shown proactive leadership in climate change mitigation efforts, evident in its falling carbon intensity of the economy in the last couple of years. Domestic mitigation measures have led to an approximate reduction in carbon intensity of Indian GDP in 2012 by nearly 15.1% from the 1990 levels (IEA, 2014) Figure 2).

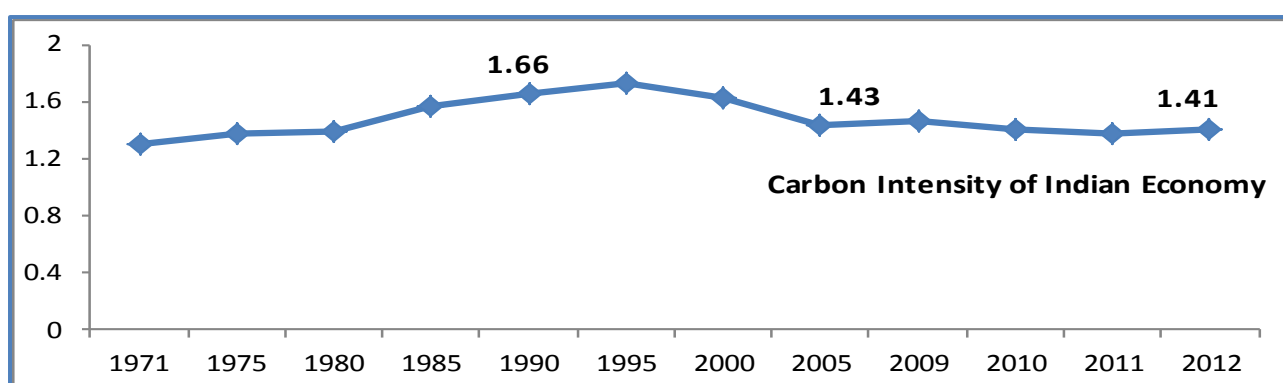


Figure 2 Carbon intensity of Indian GDP (in CO₂/ GDP (kgCO₂/ per 2005 USD))

Source: IEA (2014)

Under the population and GDP growth¹ trends in the country, primary factors leading to the fall in carbon intensity of the economy are the following:

- Large efforts in energy efficiency measures in the country leading to fall in energy demand per unit GDP (energy intensity).
- Increased share of renewable energy where possible to meet energy demand².

Table 1 Energy and Carbon intensity trends in India

	Energy Intensity of Economy (Energy/ GDP) (in TPES/ GDP)	Carbon Intensity of Energy (CO ₂ / energy) (CO ₂ / TPES)
Before 1990s	Falling at slower rate	Increasing at high rate
After 1990s	Falling at faster rate	Increasing at slow rate
% Change between 1990-2012	-37.2%	35.1%

Source: IEA, 2014

3. Relevant ministries and government institutions

India's climate change policy framework is designed in a top-down approach where national governments play a central role in setting targets, institutions, policies for climate change mitigation; as well as extends necessary incentives and support to the states and other local governments. The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal agency responsible for coordinating all activities related to environment and climate change in India. In addition, several line ministries which are actively involved in climate change activities that lie within their jurisdiction.

The Prime Minister's Council on Climate Change (PMCCC) was set up in 2007 as the High Level Advisory Group on Climate Change responsible for formulating and coordinating the

¹ According to the well-established Kaya Identity, CO₂ emissions in a country is a function of its population, GDP, and its carbon intensity of the economy, represented as:
CO₂ Emissions = Population x (GDP/ Population) x (Energy/ GDP) x (CO₂/ Energy) (IPCC AR5)

² Climate change and 12 Five Year Plan document, Planning Commission

assessment, strategies and planning of climate change related activities in the country. The council was reconstituted in November, 2014 under the new Central Government. The council coordinates the action plan and advice the government on proactive measures that can be taken to deal with the challenge of climate change, facilitate inter-ministerial coordination and guide policy in relevant areas. The National Action Plan on Climate Change (NAPCC) was launched by the council in 2008 as a strategic guidance document. The council periodically monitors key policy decisions in the area of climate change. The MoEFCC is the nodal agency responsible for coordinating the implementation of overall NAPCC activities, while each of the eight missions within the plan, fall within the purview of specific nodal implementing ministries (Table 2). After the launch of the NAPCC, civil societies and state governments have also emerged as key stakeholders in the area of climate change, where state governments are given the responsibility to implement NAPCC through their respective state action plans (SAPCC). Ministry of Finance while does not directly involve in policy making on climate change mitigation, it remains an important institution concerning matters related to climate change finance. The Expert Group on Low Carbon Development strategies for inclusive growth was also constituted by the erstwhile Planning Commission of India to identify potential low carbon growth strategies for the country till 2030.

Table 2 Ministries/ Expert Groups responsible for climate change actions in India

Cross Sectoral	Description of participating ministries
Prime Ministers' Council on Climate Change	Prime Minister(Head of Council) Minister for External Affairs, Union Finance Minister, Union Minister for Environment, Forests and Climate Change, Union Minister for Water Resources, River Development and Ganga Rejuvenation, Union Minister for Agriculture, Union Minister for Urban Development, Union Minister for Science and Technology, Union MoS of Power, Coal and NRE, Principal Secretary to PM (Member-convener of this panel), Cabinet Secretary. Foreign Secretary, Secretary, Ministry of Environment, Forests and Climate Change
Expert Group on Low Carbon Strategies for Inclusive Growth	Expert advisory group with domain experts from different areas/ sectors
Ministry of Environment, Forest and Climate Change	Nodal
Ministry of Finance	Cross-sectoral
Sector Specific	
Energy Sector	Ministry of Power, Bureau of Energy Efficiency, Central Electricity Authority, Central Electricity Regulatory Commission, State Electricity Regulatory Commission, Ministry of Power, Coal and Renewable Energy

Cross Sectoral	Description of participating ministries
Transport	Ministry of Urban Development, Ministry of Road Transport and Highways, Central Pollution Control Board, State Pollution Control Board
Industry	Ministry of Industry, Ministry of Iron and Steel, Ministry of Power, Coal and MNRE, BEE
Agriculture	Ministry of Agriculture and Cooperation, DARE
Buildings and waste	Ministry of Urban Development, Ministry of Housing and Urban Poverty and Alleviation
Forest	Ministry of Environment, Forest and Climate Change
Strategic Knowledge Management on Climate Change	Ministry of Science and Technology

Source: Author compilation of list from ministry database

Role of private sector/industry, research institutes, non-governmental organizations (NGOs) and academia has been well established and advocated and these form to be important stakeholders in the climate change mitigation policy framework. With the recognition that policy piecemeal can lead to neglect of significant interactions among important stakeholders, a consultative process of policy and programme formulation is followed in the country. The PMCCC as well as Expert group on LCIG demonstrate national government's efforts towards this endeavor.

4. Key mitigation initiatives at the national level

Since early 1990s, India has in place a detailed policy, legislative and regulatory structure that relates strongly to environmental protection, with both direct and at times indirect impact on GHG mitigation. While early policies revolved around energy security and poverty alleviation (with mitigation co-benefit), the recent government policies since past few years have focused directly on GHG mitigation with developmental co-benefits. Cumulatively, the policies range in wide variety of actions, covering all major emitting sectors. The framework given below contextualizes the overview scenario of climate change mitigation policies in India (Table 3). Specific policies and actions are discussed below.

Table 3 Climate change mitigation policies in India

		Regulatory instrument (Laws, Acts, Policies)	Domestic Market based mechanism	Price Support (subsidies, preferential tariffs)	Carbon Tax	R&D Support	Awareness building/Training support (via labeling, capacity building programmes)	Mandatory codes and standards	Availability of specific Funds	Relevance for International Support Mechanism
Energy Sector										
Alternate	Renewable Energy	✓	✓	✓		✓	✓	✓	✓	NAMAs, CDM
Technological	Clean Coal					✓				NAMAs, CDM
Alternate energy	Hydropower	✓		✓						NAMAs, CDM
	Nuclear	✓				✓				NAMAs, CDM
Industry										
Energy Efficiency and	Large scale	✓	✓			✓	✓			NAMAs, CDM
	SMEs								✓	NAMAs, CDM
Buildings										
Energy Efficiency and	Commercial	✓		✓			✓	✓		NAMAs, CDM
	Residential			✓			✓	✓		NAMAs, CDM
Transport										

		Regulatory instrument (Laws, Acts, Policies)	Domestic Market based mechanism	Price Support (subsidies, preferential tariffs)	Carbon Tax	R&D Support	Awareness building/Training support (via labeling, capacity building programmes)	Mandatory codes and standards	Availability of specific Funds	Relevance for International Support Mechanism
Fuel Efficiency	All	✓				✓	✓	✓	✓	NAMAs, CDM
Forestry										
Carbon Sequestrati	All	✓					✓			REDD+, CDM, NAMAs
Cross Sectoral										
Signals Market away from fossil	Coal Cess	✓			✓				✓	NAMAs
	Energy Pricing	✓								Phase out of fossil fuel subsidy
Strategic Knowledge	Enhanced Scientific knowledge on Climate Change	✓				✓	✓			GHG inventorization

Source: Author compilation from various ministry sources

Note: This is adapted from the World Bank Policy categorization. World Bank divides Domestic policy options into Voluntary Instruments (Capacity Building activities, Labeling, Training Programmes), Regulations & Standards (Building codes, biofuel standards, and Vehicle efficiency standards), Quantity Instruments (Emission Trading Schemes, Tradable Green Certificates), Price Instruments (Taxes, Subsidy, Subsidy reforms); R&D and Innovation Support (Public Funding for R&D, Patent policies).

Detailed policies undertaken by the government towards climate change mitigation are discussed below; the discussion covers the cross-sectoral as well as sectorally targeted policies. The barriers and challenges related to specific policy intervention by the government are also discussed.

4.1 India's five year plans

The five year plans (FYPs) have provided strategic guidance to the government of India in its domestic policies and goals for the proceeding five years. FYPs have considered environment protection/sustainable development/climate change increasingly in its agenda over years. Strategized growth and sustainable development agenda for the sectors such as agriculture, forestry, water, energy and non-renewable resources have featured strongly in the 5th FYP (1974 – 1979), which added further to the sustainable growth of infrastructure including transport, energy, communication and irrigation in the 8th FYP (1992 – 1997). Sustainability from the perspective of environment gained much significance in the 9th FYP (1997 – 2002) onward which eventually translated to climate policy concerns about energy conservation to energy efficiency and mitigation in the 11th FYP (2007 – 2012) and 12th FYP (2013-2017).

The Twelfth FYP (2012-2017) formed the core of faster, inclusive, and more sustainable growth where science and technology were given to play a more critical role through increase in budgetary expenditure from 1% to 2% of GDP. During this, Climate Change Action Programme (CCAP) was set up to advance scientific research, information and assessment of the phenomenon of Climate Change, building an institutional and analytical capacity for research and studies in the area of Climate Change (National Carbonaceous Aerosols Programme (NCAP), Long Term Ecological Observatories (LTEO), and Coordinated Studies on Climate Change for North East region (CSCCNE)). NAPCC and domestic mitigation goals gained momentum to guide the targets and actions through a sustainable development strategy. However, the Government of India has revamped the planning commission which formulated India's Five Year Plans since the beginning and the role of Niti Aayog in India's planning process may get clarity soon.

4.2 International commitments

Climate change agenda for India gained thrust and importance when the legally binding framework was agreed upon by the World's governments including India in 1992 to confront the challenge of climate change through adoption of the United Nations Framework Convention on Climate Change (UNFCCC). At that time, India was a strong advocate of Article 4.7 of UNFCCC which recognizes poverty eradication and socio-economic development as an 'overriding priority of developing countries' and of Article 3.1 recognizing the 'principles of equity and of common but differentiated responsibilities' among nations.

India is also party to the key environmental agreements of the world beginning with the Stockholm Declaration in 1972 to the ratification of Kyoto Protocol in 2002. Keeping its positive and constructive approach for contribution to the global climate change agenda, in the 13th Conference of Parties in 2007, India publically stated its ambition to not exceed its

per-capita emissions at any point beyond those of developed country parties (India's views on paragraph 1(a) of Bali Action Plan). At Copenhagen, in 2009, India demonstrated its seriousness and willingness to take on global leadership, to the extent its capacity permits. It announced its endeavors to voluntarily reduce the emissions intensity of its GDP by 20-25% by 2020 in comparison to the 2005 levels (emissions from agriculture sector will not be part of the assessments of emissions intensity under the Pledge). By March 2014, India recorded the second highest number of CDM projects by any country reinforcing its strong willingness to fight against climate change (1493 out of a total of 7472 projects (1/6th) registered by the CDM Executive Board from India).

Domestically, India introduced legislation and policies to integrate environment protection into development planning over its Twelfth and Thirteen Five Year Plans period. Strongly guided by the principle of CBDR, India will address all key elements of mitigation, adaptation, finance, technology development and transfer, capacity building and transparency of actions in a balanced manner, in its Intended Nationally Determined Contribution (INDC) for the new agreement for post-2020 mitigation goals.

India expressed that a balance in climate actions will not only be a political parity with mitigation but a total parity regarding financial flows, binding status, technology transfers or sense of urgency and commitments. The comprehensive INDC would also project Clean Energy Goal Targets for the country as well as the requirement of support in terms of finance and technology transfers. It would cover all the national missions and other initiatives under National Action Plan on Climate Change as well as State Action Plan on Climate Change.

4.3 National Action Plan on Climate Change

In 2008, NAPCC was launched by the Government of India (GoI) to provide the guiding framework/principles for addressing issues related to climate change mitigation in the country. The action plan identified eight national missions running through 2017 to 2022 highlighting India's most pressing climate concerns and outlines independent targets for emission mitigation within the different sectors. The missions are:

- National Solar Mission(mitigation focus)
- National Water Mission(adaptation focus)
- National Mission on Enhanced Energy Efficiency (mitigation focus)
- National Mission on Sustainable Habitat (mitigation and adaptation focus)
- National Mission on Sustainable Agriculture (adaptation focus)
- National Mission on Sustainable Himalayan Eco-systems (adaptation focus)
- National Mission on Strategic Knowledge Management (mitigation and adaptation focus)
- National Mission for a Green India (mitigation and adaptation focus)

Each individual mission was designed as an umbrella of the existing mitigation policies relevant to the sector to streamline them to meet the common goal of emission reduction. Some of the existing policies were amended in order to strengthen, some new policies were formulated, capability and institutional needs were identified, incentives structures were

designed, and the key stakeholders were identified. A range of policy instruments were identified to create an impetus for mitigation in all target economic sectors. Some of the policy instruments identified to address climate change mitigation are price instruments (such as coal cess and feed-in-tariff), regulatory instruments (legislations), quantity instruments (Renewable Purchase Obligation (RPO), Renewable Energy Certificate (REC), Perform-Achieve-Trade (PAT)), voluntary instruments (awareness building programmes and labeling of appliances), and targeted research and development (R&D) policy support instrument to the different sectors. NAPCC provided a starting point for the various stakeholders and states to engage with the respective missions to build on, develop, expand, enable and implement the required programmes and strategies on climate change.

4.4 State Action Plan on Climate Change

The State Action Plan on Climate Change (SAPCC) in India is the most notable policy reflecting the nature of decentralized climate change mitigation framework of the country. In 2009, the Government of India notified state governments to come up with their own climate change mitigation and adaptation policies, plans and actions aligned with their respective state priorities as well as the NAPCC goals. The states are required to seek prior approval from the MoEFCC before implementation of activities listed therein. As of October 2014, 30 states (including Union Territories) have completed the draft plan; the ministry has endorsed 19 plans and the Expert Committee on Climate Change has considered three. For implementation of SAPCCs, a combined budgetary requirement of INR 11.32 lakh crore (USD 188.66 billion) has been received by the ministry (MoEF, 2014). How much of this, will actually be disbursed from the central budgetary expenditures is not known. However, in alignment with the national priorities, states receive all necessary help from the center needed in implementation of these plans.

Within the decentralized framework of mitigation strategies, while the central government formulates policy approaches at the national level, the actions are realized through the state and local authorities in their respective jurisdictions. India assumes this approach as a critical intervention in translating national level policies and objectives into local contexts for effective delivery. This is because disaggregated climate data, their vulnerabilities and opportunities are well understood at state and local level than at the country level. Through states, national policies reach to a large number of sectors and actors effectively in a manner while addresses state priorities at the same time. In addition, measurement and monitoring at the state level can be taken up more efficiently. For this reason, many of the national policies in India are implemented through the states. Some other standalone programmes are the implementation of renewable purchase obligations, implementation of feed-in-tariffs, setting up of state energy conservation funds, implementation of small and hybrid hydroelectric systems and energy conservation building codes, are some of the fine examples of policies that are implemented through the states. Almost all of these now come together within the larger umbrella of the state action plans.

4.5 Expert Committee Report on Low Carbon Strategies for Inclusive Growth

The Expert Group on Low Carbon Strategies for Inclusive Growth was set up by the Planning Commission, Government of India, in 2010 to suggest low carbon pathways consistent with inclusive growth in India. The high level Expert Group was composed of representatives from relevant government ministries, industry, think tanks and research institutions.

The Expert Group was required to report on the following:

1. Its evaluation of some key alternative low carbon options with an analysis of their cost-benefit, and relative merits and demerits.
2. An Action Plan comprising of critical low carbon initiatives to be undertaken, including sector-specific initiatives, along with a suggested timeline and targets starting 2011, that can feed into the 12th five year plan.
3. List of enabling legislations, rules or policies required to operationalize the low carbon roadmap.

The Expert Group submitted its interim report in May 2011. This report provided a menu of options and showed that it is possible for India to reduce its emission intensity by 20-25% over 2005 levels by the year 2020. The final report, submitted in April 2014, provides a more detailed and longer term assessment of these options, and the macro-economic and welfare implications of the low carbon strategy.

The low carbon strategy assessed that energy efficiencies in households, buildings, industry, and transport play important roles. At the same time low carbon supply technologies, such as solar and wind in the power sector and greater use of public transport and non-motorized transport are critical. Increased sequestration through enlarged green cover through Green India Mission also helps. Reduced local environmental pollution and dependence on imported energy are also identified as benefits of a low carbon strategy. However, the Expert Group recognizes that the additional investment required for a low carbon strategy will leave less investment available for other sectors, resulting in lower GDP.

4.6 National Clean Energy Fund funded through Carbon tax

The Government of India created the National Clean Energy Fund (NCEF) in 2010 for the purpose of financing and promoting clean energy initiatives and funding research in the area of clean energy in the country. The corpus of the fund is built by levying a cess of INR 50 (subsequently increased to INR 100 in 2014 and INR 200 in 2015) per tonne of coal produced domestically or imported.

Till 2014, Viability Gap Funding (VGF) of INR 16,511.43 crore (USD 2.75 billion) has been recommended from the NCEF for 46 projects. NCEF is financing innovative schemes like Jawaharlal Nehru National Solar Mission (JNNSM)'s installation of solar photovoltaic (SPV) lights and small capacity lights, installation of SPV water pumping as well as other mission projects under the National Action Plan on Climate change (NAPCC) and projects relating to R&D to replace existing technologies with more environment friendly ones under National

Mission on Strategic Knowledge for Climate Change (NMSKCC). The scope of NCEF has also been enlarged to cover other eligible projects of the Ministry of New and Renewable Energy (MNRE), which are being implemented under the flagship programmes of 'Grid Interactive and Distributive Renewable Power' and "Research Design, Development in Renewable Energy". In 2014, the Government of India expanded the scope of the NCEF to include financing and promoting clean environment initiatives and funding research in the area of clean environment.

4.7 Initiatives for strengthening state of knowledge on climate change

Energy technologies, economic modeling and forecasting are considered important in planning and preparations of the domestic policies. In this direction, following steps have been taken by the national government:

- a) **Indian Network for Climate Change Assessment:** To enhance knowledge about the impacts of climate change at the national and subnational level, Indian Network for Climate Change Assessment (INCCA) was launched on October 14, 2009. It was conceptualized as a network-based scientific programme designed to assess the drivers and implications of climate change through scientific research and to prepare climate change assessment reports once every two years including assessments for GHG estimates, climate impacts and associated vulnerabilities. INCCA aims at building capacity towards management of climate change related risks and opportunities and to develop decision support system for the government. The first GHG inventory under the programme was prepared for the year 2007, released in May 2010. The assessment was prepared by 83 experts belonging to 19 institutions from across the country (GoI, 2014). Yet, India needs a comprehensive database of GHG emissions for all sectors of the economy including setting up of National Greenhouse Gas Inventory Management Authority (NGIMA) to track trends of GHG emissions from all sectors and at all levels; a National GHG Inventory Management System (NGIMS) for archiving, updating and storing information on GHG emission at any point in time; and mechanisms for voluntary disclosures of GHGs from different installations.
- b) Under the National Action Plan on Climate Change 2008, the Government of India launched a Mission on '**Strategic Knowledge on Climate Change**' for implementation by the Ministry of Science and Technology. The mission was set up with the purpose of creating an institutional system for generating focused data and knowledge in the field of climate change mitigation and adaptation. Key objectives of the mission are to enhance climate change databases; improvise the Regional Climate Models (RCM); and Air Ocean General Circulation Models (AOGCM) among others. It is understood that considerable knowledge resources are available with various Government agencies and R&D institutions which are not presently made available for sharing even with the government. The mission would act as synergy between the various actors of climate change mitigation framework. In this direction, National Data Sharing & Access Policy (NDSAP) has been approved by government to bridge this gap. NMSKCC proposed to set up Global Technology Watch Groups (GTWGs) to help accomplish the task of technology selection, prioritization and ranking in some key strategic areas. Till now, two GTWGs have been set up – one on Solar and other

on Clean Coal Technology. The other areas which are selected are all related to the other 7 missions under NAPCC. In addition, partnership with key public and private players is encouraged.

- c) *Climate Change Action Programme*: Under a Central Government scheme (MoEFCC) on climate change, Climate Change Action Programme (CCAP) was launched during the 12th FYP (Economic Survey, 2013-14). The scheme will be implemented with full funding from the central budget and intends to support actions by the central and state governments and other key stakeholders in areas of climate change. CCAP is envisioned to launch studies and projects to address the challenge of climate change in all dimensions and would also augment activities including Coordination of NAPCC, SAPCC and setting up of an autonomous body called the Rajiv Gandhi National Institute for Climate Change Studies and Actions (NICCSA). The Institute will conduct analytical studies on scientific, environmental, economic development and technological issues related to climate change.

5. Key Interventions in energy supply

5.1 Renewable energy sector

The power grid corporation of India, Indian state owned electric utility company estimated in 2013 that India's demand for power is likely to reach 890,000 Mw by 2050, requiring an installed generation capacity of 1300,000 Mw (as against 240,000 Mw, currently (CEA, 18th EPS Report)). In order to meet this demand, a large share perhaps would need to be delivered through the renewable source of energy.

Strong political signals to promote renewable energy sector is being provided by the government of India. It is mainly in two forms:

1. Allocating short term and long term targets for renewable energy installed capacity addition in the country to be implemented through the states.
2. Allocating monetary support for renewable energy expansion as well as financial support through the markets for RE development.

The primary thrust to the renewable sector in the country came in with the Electricity Act, 2003 which mandated State Electricity Regulatory Commissions with the function of RE promotion in the state. It introduced two crucial policy instruments for the renewable sector in India – the National Electricity Policy (2005) for development of power system based on optimal utilization of resources including renewable sources of energy and the National Tariff Policy of 2006 (Para 6.4) which laid out tariff guidance to be provided by Central Electricity Regulatory Commission (CERC) for promotion of generation of electricity from renewable energy sources and the state electricity regulatory commissions (SERC) responsible for the same at the state level. In 2008, National Action Plan on Climate Change recommended amendments to the earlier policy regimes and subsequently launched targeted missions to promote the renewable energy sector. Some important policy interventions and government activities to promote renewable are discussed below:

- The Electricity Act 2003 mandated State Electricity Commissions (SERC) to fix preferential feed-in-tariffs for distribution utilities to procure RE, which would make it easier for RE power producers to obtain finance for their projects. Nearly all states have fixed FITs for their respective states for particular renewable energy technology. The barriers for its effective implementation have been listed below:
 - **Barrier:** Wide variation in financial parameters like O&M expenses and interest rate are not state specific, which lead to difficulty in determination of the appropriate tariff.
 - **Barrier:** Constant tariff over the control period not reflecting changes in market conditions
- The Electricity Act notified the State Electricity Regulatory Commissions (SERC) to provide targets to distribution companies for obligatory purchase of renewable energy as a percentage of the total consumption of electricity under Section 86(1)(e) of the Act. The NAPCC within its schemes recommended a move from fixed renewable purchase obligation for distribution companies towards a dynamic minimum renewable purchase standard (DMPRS) with escalation each year till a predefined level is reached. It suggested the standard to be set at 5% of total grid purchase starting 2009-10 to increase by 1% each year for 10 years to reach 15% RE share by 2020 for each state. Under the new RE targets of 175 GW set by the Government of India, the proposal to revise the RPO to 20% is being negotiated (IREDA, 2015). In addition, incentives to state level utilities to accelerate solar capacity addition by mandating a three percent solar power target by 2022 are also given. Such specific targets do not exist for any other RE source in the country. However, the barriers for its effective implementation have been listed below:
 - **Barrier:** 28 out of 29 states have such set targets for both solar and non-solar separately, there is an increasing concern over actual compliance. RPO percentages varied from 0.5 percent to 10 percent, depending on the local renewable resources and the electricity distributed in that area (MNRE, 2013).
 - **Barrier:** Physical supply of RE power from one state to another to supply the excess generation is currently not possible. Appropriate transmission system is not available in the country to meet the gap.
- Renewable Energy Certificate (REC) mechanism, a market based instrument, launched in November 2010 under NAPCC to provide flexibility to the utilities in meeting their obligated RPO targets through the trading mechanism. This is one of its kind market based instrument designed by the government of India under its national climate change plan. Under the Mechanism, RECs will be issued to the RE generators for 1 MWh of electricity injected into the grid from renewable energy sources. Grid connected RE Technologies with minimum capacity of 250 KW and approved by MNRE would be eligible under this scheme. There are special power exchanges approved by CERC for exchange of RECs (ABPS Infra 2013). However synergies of the REC mechanism with the FiT mechanism have not been established and operate as uncoordinated mechanisms within the system. Few of the other challenges with the mechanism which need immediate attention are given below:

- **Challenge:** RECs are valid only for one year. As of date, its supply has far exceeded demand even at the floor price. Government will have to set variable targets for states under a set target rules looking at individual state circumstances with respect to renewable potential.
- **Challenge:** Due to oversupply of certificates, RECs expire from the market without being purchased. This at times acts as a disincentive for the generator to produce RE to their maximum potential beyond the specified RPO target for the state.

The central government with support from states is also considering setting up a verification mechanism to ensure that renewable power is actually procured. This would be known as the Power Procurement Verification Mechanism. In case of default in securing RPOs by Utilities, obligation penalties could also apply. SERC may direct obligated entity to deposit fees into a separate fund called the RPO Deficiency Fund. This fund could also purchase REC at forbearance price and act as the purchasers of the last resort. This would also help in securing supply of RE energy by reviving market for expiring Certificates and achieve the complementarity between RPO and RECs in this way.

India in its 2014 renewable energy goal announced that in order to meet the global climate ambition, it aims to increase its total installed renewable energy capacity to 175,000 MW by 2022. 100,000 MW of this would come from solar power, 60,000 MW from wind energy, 10,000 MW from small hydro power, and 5,000 MW from biomass-based power projects. In 2050, Renewable power's contribution to the humungous demand estimated by the PGCIL is likely to stand at 485,000 Mw by 2050. Several fiscal incentives and policy push have been given in this direction by the government to secure growth in renewable energy production.

Realizing the need for large scale development of desert solar power & its grid integration up to 2050, Ministry of New and Renewable Energy (MNRE) entrusted POWERGRID to make an assessment of renewable generation potential in India's desert regions of the states of Rajasthan (The Thar), Gujarat (Rann of Kutch), Himachal Pradesh (Lahul&Spiti valley) & Jammu and Kashmir (Ladakh) and evolve infrastructure requirements including transmission for up to 2050 time horizon, with phased development plans. The study came up with a plan called Desert Power India-2050. It estimated, 300,000 Mw renewable energy could be developed as part of the desert power plan. A bulk of this capacity – 223,000 Mw - is envisaged to be created in Thar Desert alone (PGCIL, 2013).

- The government has also laid several specific missions and policies to promote specific sources of RE in the country. The two Missions – the National Solar Mission which aims to develop a solar industry in India that is capable of delivering solar energy competitively against fossil options within the next 20-25 years and the Nation Water Mission have a bearing on targeted policies to promote these sources of energy in the country. Outside of NAPCC, wind and biomass are also promoted as important sources of RE for Indian Energy Mix. Where cost-effective and reliable, integration of different renewable energy technologies such as biomass, wind with solar is currently explored.

- The government is playing an active role in promoting the adoption of renewable energy resources by offering various incentives, such as generation-based incentives (GBIs), capital and interest subsidies, budgetary expenditure, viability gap funding, concessional finance and fiscal incentives.
- The National Solar Mission aims to promote the development and use of solar energy for power generation and other uses, with the ultimate objective of making solar energy compete with fossil-based energy options.
- The objective of the National Solar Mission is to reduce the cost of solar power generation in the country through long-term policy, large scale deployment goals, aggressive R&D and the domestic production of critical raw materials, components and products. Support to power utilities through the bundling of solar power with conventionally produced electricity, to reduce the average per-unit cost of solar power (Primarily via NTPC VidyutVyapar Nigam (NVVN)).
- Renewable energy is becoming increasingly cost-competitive compared to fossil fuel-based generation. Impetus to research and development in the solar sector is provided through creation of Solar Energy Research Advisory Council (SERAC).
- Wind energy equipment prices have fallen dramatically due to technological innovation, increasing manufacturing scale and experience curve gains.
- Prices for solar modules have declined by almost 80% since 2008 and wind turbine prices have declined by more than 25% during the same period.
- The government has created a liberal environment for foreign investment in renewable energy projects. The establishment of a dedicated financial institution – the Indian Renewable Energy Development Agency, makes for renewed impetus on the promotion, development and extension of financial assistance for renewable energy and energy efficiency/conservation projects.
- The mandate of the Solar Energy Corporation of India (SECI) allows wide-ranging activities to be undertaken with an overall view to facilitate the implementation of the National Solar Mission and the achievement of targets set therein. The SECI has the objective of developing solar technologies and ensuring inclusive solar power development throughout India.
- To promote deployment of offshore wind farms up to 12 nautical miles from coast set up under the “National Offshore Wind Energy Policy” of 2013. The Planning Commission suggested setting up of National Wind Energy Mission for effective formulation and implementation of policies at center and state levels under NAPCC.
- Government identified investment opportunity in Small hydro which has installed capacity of 3.8 GW and an estimated potential of 19.7 GW.
- The Ministry of New and Renewable Energy (MNRE) has been supporting the promotion of bio-energy programmes since mid-1990s through initiatives such as the Village Energy Security Programme (VESP) and National Biomass Cook-Stoves Initiative, 2009. The ministry has planned to initiate the National Bioenergy Mission in association with State Governments, Public & Private

sectors and other stake holders as the ninth Mission under NAPCC. The mission will offer a policy and regulatory environment to facilitate large-scale capital investments in biomass-fired power stations, aim at improving energy efficiency in traditional biomass consuming industries, seek to develop a bio-energy city project and provide logistics support to biomass processing units which will also encourage development of rural enterprises. It will also propose a geographic information system (GIS)-based National Biomass Resource Atlas to map potential biomass regions in the country.

- Currently, the national grid faces a difficulty in absorbing renewable electricity due to issues related to its storage, intermittency and the varying voltage for transmission. In this direction, the government of India is preparing the blue print for the 'green energy corridor' project to facilitate the flow of RE into the national grids. The corridor will be built across seven states over the next five to six years. The project would aim at strengthening the distribution network across the country making it 'smart' to handle fluctuations (MoP 2013). The Green corridor would also improve upon the open access mechanism where the renewable energy can be traded both intra-state and inter-state. Financial investment worth INR 43,000 crores would be required for project implementation. India is in talks with Germany for making its grid compatible for distributing renewable energy using state of art technology transfer. A system such as this, would aid in strengthening the RPO obligation further in the country by facilitating physical exchange of energy across states.
- Government promotes distributed decentralized renewable energy systems/technologies to enhance energy access and coverage under the Rural Electrification Policy (2006) Rooftop PV and small Solar Power Generation Programme (RPSSGP) and its 'Energy Access' scheme.
- **Manufacturing support:** In order to encourage indigenous manufacturing of components used in solar power generation, GoI has mandated for all projects a 100% PV modules manufacturing in India from 2010-11. Further, GoI also mandated 100% of cells used in indigenous modules to be manufactured in India from 2011-12. However, this must be supported by an appropriate manufacturing policy in the country which helps in gradual indigenization of such manufacturing techniques.
 - **Barrier:** The JNNSM has come under the scrutiny of the World Trade Organization (WTO) following US complaints against India's domestic content requirement on procurement of solar cells and modules. The critical issue of multiplicity of institutions at different levels of scrutiny acts as potential barrier of implementation of effective mitigation policies at the country level and therefore needs solution.

5.2 Other clean energy technologies

To meet India's energy needs, a significant capacity addition in utility based generation would be in thermal coal based power plants for which government in its policies is largely targeting efficiency in thermal power production, minimization of T&D losses, and use of clean coal technologies.

- Government has planned for Fifty per cent of coal based capacity addition in Twelfth Plan and 100 percent coal-based capacity addition in Thirteenth Plan through super-critical units (Planning Commission, Vol1, XII FYP). India is therefore experimenting with newer technologies in the thermal power sector such as the Ultra Super Critical technology, a joint effort of BHEL, NTPC and IGCAR, expected to be deployed in XIII FYP; Integrated Gasification Combined Cycle (IGCC) technology to make coal based power generation 10% more efficient; combined natural gas based power generation which would reduce CO₂ emissions to 50%. Another potentially promising technology is coal bed methane which may also be developed in next plan period.
- Prioritization of coal linkages will be a necessary step to incentivize adoption of super-critical technology. The government is in the process of finalizing the proposal for coal linkage rationalization and swapping arrangements of about 40 thermal power projects in the country, a move that is expected to save up to INR 6,000 crore in logistics cost (Reuters, 2014).
- NAPCC suggests that the transmission losses which account to about 25% energy should also be brought down by adopting HVAC and HVDC transmission technologies in the country. No concrete plans are out yet. In some states transmission and distribution (T&D) losses are even as high as 60%.
- NAPCC assumes prime importance of these projects in particular for electrification of remote hilly areas where grid electricity is not feasible. National Electricity Policy, 2005 recognized Hydro Generation as an important clean and renewable source of energy in the country. It is also considered that harnessing hydro potential would also lead to speedy economic development of states in India particularly North-Eastern States of the country, Himachal Pradesh and Jammu & Kashmir. Central government is committed to policies that ensure financing of viable hydro projects and offer requisite services via Central Public Sector Undertakings like National Hydroelectric Power Corporation (NHPC) to State Governments.
- The present installed nuclear power capacity is 4780 MW comprising twenty reactors. On progressive completion of nuclear power reactors under commissioning and construction currently, 5300 MW will be added to the existing capacity, taking the total installed nuclear power capacity to 10,080 MW by the year 2018-19 (DoAE 2014). More nuclear power projects based on both indigenous technologies and with foreign technical cooperation are planned in future (beyond XII Five Year Plan(FYP)). With the progressive increase in nuclear power generation capacity the share of nuclear power in the overall electricity generation in the country is expected to grow gradually. However, since 2010, a fundamental incompatibility between India's civil liability law and international conventions limits the foreign technology penetration in this sector.

6. Key Interventions in energy demand

6.1 Energy efficiency in industry

Energy efficiency measures in energy sector alone can bring about 25,000 MW of capacity creation and avoided emissions in India. Energy intensity of the Indian economy has fallen over the decade which is a huge success towards meeting climate change mitigation

ambitions of the government. For all industries taken together for energy efficiency, the mitigation potential would be much higher (Ministry of Power, 2013). And as a first policy choice in the path towards energy security and mitigation, government must be encouraging industry and consumers to use energy more efficiently.

- Energy Conservation Act was enacted in 2001 established the Bureau of Energy Efficiency (BEE) to provide the national policy framework and direction for energy-efficiency initiatives, including advisory services which related mainly to Industry and Buildings sector
- The 2008 National Action Plan on Climate Change (NAPCC) sets specific performance requirements on lowering energy use in large energy-consuming industries; establishes the Performance, Achieve and trade (PAT) scheme—the trading of energy savings certificates; reduces taxes on energy-efficient appliances; and provides financing for demand-side energy-saving efforts in municipal buildings and agricultural pumps.
- The National Mission on Enhanced Energy Efficiency broadened the scope of the EC Act 2001 which was later amended in 2010 to provide for more stringent compliance norms. NMEEE increased the number of designated consumers from 9 to almost every industrial sector group in the country. These units were required to employ ‘certified energy managers’ and report energy consumption and energy conservation data annually. The mission envisages a potential reduction in CO₂ emissions of 98.55 million tons annually from industries with an avoided capacity addition of over 19,000 MW of electricity.
 - NMEEE established Perform, Achieve and Trade (PAT) Mechanism, a market based mechanism to enhance cost effectiveness of improvements in energy efficiency by mandatory specific energy consumption decreases, certification of energy savings that could be traded. The mechanism is estimated to bring about reductions in emissions by 605 million tons (approx. 16% below BAU emissions) by 2030s. In the first cycle of PAT (2011-2014) about 8.97 MTOE reductions are targeted in 3 years from energy intensive industries in 462 DCs in 8 energy intensive sectors. Barrier: Given the range of firms with respect to source and quality of raw materials, product mix location of plant, scale of operation, processes, vintage and capacity utilization, careful monitoring and verification of the PAT scheme is envisaged in the plan. The NMEEE also aims at expanding the scope of the scheme to SMEs in coming years. In this pursuit, support from state nodal agencies would be crucial in providing necessary support with data and management of the programme.
 - Market Transformation for Energy Efficiency, Energy Efficiency Financing Platform (EEFP) to stimulate necessary funding by capturing future energy savings, and Framework for Energy Efficient Economic Development (FEEED) to provide necessary fiscal incentives were given for. BEE has been putting in place a government supported standard methodology that covers the entire project chain from audit to MRV. The government is seeking expansion of the platform through MoUs with public sector banks.

- Energy efficiency measures for industries have also been notified in the National Manufacturing Policy of 2011.
- BEE is planning to set up financing protocol tool for India to reduce finance related skepticism of market players.
- In June 2010 the Government of India announced its intent to establish a Partial Risk Guarantee Fund (PRGF) to provide commercial banks with partial coverage of risk exposure against loans issued for energy-efficiency projects for the first movers. The guarantees plan to cover a maximum of 50 per cent of the loan amount or INR300 lakhs—whichever would be the lesser value. However, this fund is yet to be developed, structured and deployed, and it is unlikely to happen in the immediate term.
- **Energy Conservation Fund:** The Indian government launched a new fund aimed at providing state governments with financial help to promote energy efficiency. The Energy Conservation Fund will be formed by contributions from the state governments which can later request for grants to promote energy conservation programs. The funds are explored as an alternative to PAT to address energy efficiency in all Non-PAT industrial clusters particularly the SME clusters. Planning Commission recommends that while PAT continues to evolve, it would be useful to envisage a combined 'energy efficiency package' consisting of PAT and ECF, implemented through BEE, enlarging the coverage of energy efficiency schemes in Industry. The legal provision for this already exists under the EC Act 2001. The collections for the fund could be supplemented by international funding, as well as block grants from the Central Government through the NCEF (LCCR 2014). Energy use and technology gap study for SMEs has been completed in 20 clusters and is in progress in another 5 clusters. Capacity building activities are now underway to inculcate energy efficiency practices in SMEs with support of experts.
- **Process related emission reduction in Industry** -Planning Commission has recommended several technological improvements in the Iron&Steel and Cement sectors in the country which are the two major emitting clusters within the industries. For Iron&Steel industries, techniques such as coke dry quenching techniques, use of pulverized coal, top pressure recovery turbines, recovery of blast furnace gas, and the technique of preheating the steel scrap; are used to achieve savings of 23.9 MTCO_{2e} by 2020 and 74.6 MtCO₂ by 2030. In Cement sector, techniques for control of kiln operations and use of high efficiency fans and crushers in the manufacturing are expected to avoid upto 5.8 and 23.3 MtCO₂ emissions during 2020 and 2030 respectively.

6.2 Energy efficiency in Buildings

Energy efficiency and conservation measures can bring about 30% to 40% energy reduction in new buildings and 20% to 30% in case of existing buildings. With an expected 5 fold increase in construction of buildings in coming decades, the energy efficiency measures in buildings holds significant importance from climate change mitigation perspective. To facilitate rapid penetration of energy efficiency measures in buildings, supply push for EE

through code and standards were supported by creating demand pull factors such as consumer awareness building.

- **Comprehensive Energy Labeling Programme for Appliances:** Under the broader framework of EC Act (2001), India launched a comprehensive energy labeling programme for appliances in May 2006 within which a comparative rating was started for high energy appliances as well as the central government was given powers to prohibit manufacture and sale of products not meeting the efficiency standards. It is currently a hybrid of both mandatory policy for manufacturers and awareness building programme for consumers. Energy labels are currently notified for 10 equipment/appliances, which are air conditioners, tubular fluorescent tube lights, refrigerators, distribution transformers, motors, geysers, ceiling fans, color TVs, agricultural pump sets and LPG stoves, of which the first 4 are being notified under mandatory labeling from 6th January, 2010. BEE also planned to coordinate a consumer education campaign to publicize the new labels, allowing consumers to make informed purchase decisions (BEE, IEA). The programme now seeks to include 20 high-energy appliances/equipments by 2012. A second tightening norm has come into force from January 2014. However, in order to create a demand pull for energy efficient appliances, there is a need to bring down the cost of these appliances by encouraging manufacturers to bring down the costs through provisions of differential tax relief. Some of the benefits for manufacturers could also be brought about in the 'Make in India' initiative of the government. The scheme has a potential for 30% energy savings from buildings.
- **Super-Efficient Equipment Programme (SEEP):** Under the NMEEE Mission, SEEP is envisioned for implementation during the 12th Five Year Plan (2012–17) for expanding the sale of super-efficient fans, light emitting diode (LED) lighting, and tube lights for their large-scale adoption. Awareness building activities on the same are being taken up by BEE.
- **Energy Conservation Building Code (ECBC), 2007:** ECBC was launched to address the design of new, large commercial buildings (at present having a connected load of 100 kw and above), to optimize the building's energy demand based on their location in different climatic zones. Compliance with ECBC was voluntary initially, but a number of states are adopting it as a mandatory requirement (currently it is mandatory in 7 states and 16 more states are in a process of enacting the legislation to do so). Under NMSH, compliance with ECBC was strengthened for all new as well as old commercial buildings in all states to be implemented by the year 2017. Nearly 30% energy savings from buildings can be achieved through this measure. Discussions regarding strengthening ECBC further are under consideration by various building associations taken up in consultation with relevant government ministries and state authorities. Recommendations regarding setting of flexible performance based codes rather than technology/options prescriptions would help in better compliance as well as lower compliance cost and provide appropriate incentives for innovation.
- **Green ratings of buildings:** Three major green ratings are currently implemented in India – TERI's GRIHA, Bureau of Energy Efficiency (BEEs) Star Rating, and Indian Green Building Council (IGBC's) Leadership in Energy and Environmental Design

(LEED) to provide public recognition to energy efficient buildings, in order to create a market pull factor for demand of energy efficient buildings. While BEE Star Rating is a mandatory requirement for public buildings, GRIHA and LEED are voluntary in nature. All three rating agencies use different sustainability criteria to rate buildings in India and have adopted ECBC codes as the minimum compliance requirements. As the benchmark energy performance of commercial buildings also requires energy performance of various elements of building, BEE has initiated an energy rating programme for window facades and insulation, thus equipping the end consumer with a more informed choice. BEE has developed an online portal for managing the building information data for energy audit and star rating of buildings.

- **Barrier:** Due to high upfront cost of such buildings, demand for them is currently low among the end consumers. The expert group on energy efficient buildings suggested on opening a special window in housing finance companies and banks to provide loans to ESCOs and owners for new construction as well as retrofitting of old buildings. There is imperative need to build capacities of builders and other stakeholders to realize the potential of energy saving through an integrated design process.
- **Special housing finance:** NMSH holds strong emphasis on innovative financial models for quicker adoption of energy efficient lighting and space conditioning technologies; and adoption of green buildings into the bank's housing finance schemes. Recently, the National Housing Bank (NHB) and KfW Development Bank jointly introduced an energy efficiency certificate programme for residential buildings in India in 2010. The certification is based on the use of an assessment tool developed by Fraunhofer Institute and The Energy and Resources Institute (TERI). Under the Promotional Programme for Energy Efficient New Residential Housing, primary lending institutions (PLIs) are eligible to receive NHB-Refinance for home-owner loans to fund the purchase of certified energy-efficient apartments. Similar window of support could also be opened in housing finance companies and banks to provide loans to ESCOs and owners for retrofitting of buildings. Carbon-market financing can also be seen as a potential opportunity to enable access to some of energy efficient technologies and measures in the buildings sector.
- **Research and Development:** The National Mission on Sustainable Habitat focuses on strong R&D needs for development of energy efficient products for different building applications. The SAC-C (Scientific Advisory Committee of the Cabinet) has recommended the launch of a National Networked Initiative for R&D on the development of the next generation of light-emitting diode (LEDs), particularly white LEDs.
 - **Barrier:** This would require a push for technology transfer from developed countries and resolving the associated challenges of intellectual property rights (IPRs) and its additional costs.

6.3 Low carbon transportation

- India's Integrated Energy Policy recognized the increased role of railways in the transport of both passengers and freight in future decades.

- National Mission on Sustainable Habitat direct mitigation options for transport sector have been identified further some of which include enhanced shares of public transport or rail based movement, fuel efficiency improvement, and increased adoption of biofuels.
- The government also prepared the National Hydrogen Energy Road Map³, approved in 2006 for large scale penetration of hydrogen propelled vehicles in the market, though not expected till a few decades from now.
- **National Policy on Biofuel:** The government of India has provided strong push to biofuels in the country since the Power Alcohol Act in 1948. In an attempt to revitalize biofuel blending in India, the government launched its **National Policy on Biofuel (2009)** which provided for a more detailed mandates, fiscal and policy support to the sector. The policy proposed increasing the blending targets to 20% blending of biofuels (both biodiesel and bioethanol) by 2017 (MNRE 2008). Setting-up of any new infrastructure for storage and distribution would be declared as a priority sector for the purpose of lending by financial institutions and banks. Several incentives such as 100% foreign equity, taxes and subsidies, excise duty concessions, Market Support Prices and Market Purchase Prices were envisaged as part of the policy. The Policy also envisages setting up of the National Biofuel Fund (MNRE, 2008). Currently, the government is also facilitating R&D support for biofuel blending with diesel/gasoline which could be consumed in existing vehicle designs.
- **Scaled adoption** of Auto Fuel Policy: *One of the most successful policy direction for fuel efficiency in India has been in aggressively adopting* fuel emission standards in the country through enactment of the Auto Fuel Policy of 2002 (MoPNG 2003), implemented by the Central Pollution Control Board (CPCB). Since April 2010, the country has adopted to the better fuel standards under Bharat Stage IV norms which was implemented in 13 major cities while BS III norms was scaled to the rest of the country⁴. In order to comply with the increasingly stringent auto fuel specification, oil companies have made major investments for technological up-gradation over past decade. The policy was initially adopted for air quality monitoring concerns which assume huge climate change mitigation co-benefits.
- In December 2012, the Government of India constituted an Expert Committee for drafting the AutoFuel Vision and Policy-2025 for the country (MoPNG 2014). By the end of XII FYP, the Expert Committee has recommended a roadmap for rolling out Bharat Stage-IV (BS-IV), equivalent of Euro-IV, by 2017 and BS-V (Euro-V) auto fuels by 2020 in the entire country. The estimated investment for creating new facility to produce BS-IV and BS-V auto fuels is approximately INR 80,000 crore (approx. USD 12.9 billion)⁵. Concurrently, BEE(2011) has put in place regulatory signals for manufacturers to continuously reduce the average fuel consumption of cars as well as labeling of new cars with information of their fuel consumption for consumer awareness.

³ National Mission on Sustainable Habitat

⁴ National Mission on Sustainable Habitat, 2010

⁵ India's progress in combating climate change, December 2014

- **Increase in Rail Passenger Traffic:** Railways currently support 11 percent of passenger activity and contributes to just 5 percent of passenger transport emissions, while road contribute to 4 percent passenger activity and contributes to over 20 percent of total passenger transport emissions (NAPCC, 2008). Therefore, India has placed increased attention on railways for its climate change mitigation benefits as it is by far the most efficient mode of transport. Indian Railways have set out the Vision for capturing 50% of the freight moving over 300 kilometres and more than 70% of the bulk cargo moving in large volumes in the same distance range by 2020 (Indian Railways, 2009). Rationalization of freight rates for financial viability of railways is crucial to maintain its competitiveness to road transport (NAPCC).
- **Dedicated Freight Corridor:** GoI initiated the Dedicated Freight Corridor project by setting up a special purpose vehicle called Dedicated Freight Corridor Corporation of India (DFCCIL) in 2006. The DFC project is expected to result in over 10000km of dedicated rail routes over six key corridors connecting India's four largest cities. The first phase of two corridors is expected to be complete by 2016-17 (PC, Vol1).DFCs would allow trains with heavier loads to be moved at higher speeds with significantly reduced transit times and maximum speeds of freight trains up to 100 kmph. It has also been estimated that the introduction of such DFCs would help to reduce the overall emissions from freight transport (LCCR, 2014). Along with the development of logistics parks, would aid in faster transformation of Railways as a service provider.
- **National Electric Mobility Mission Plan 2020:** Towards Low Carbon Growth endeavors, in 2013, government launched the National Electric Mobility Mission for 2020 to promote growth of domestic manufacturing capabilities in electric mobility in the country. As per the government projections, 6-7 million units of new vehicle sales of the full range of electric vehicles, leading to resultant liquid fuel savings of 2.2 – 2.5 million tonnes and substantial lowering of vehicular emissions by 1.3% to 1.5% can be achieved as compared to a baseline scenario in 2020.
 - **Barrier:** Large scale R&D and charging facilities would need to be placed which would require huge investments in infrastructure in the country to the tune of INR 13000 – INR 14000 Crore over the next 5-6 years. Electric vehicles in the form of electric-rickshaws have started making appearances in several urban centers across the country, though in largely unregulated conditions to meet unmet public transport demands.

7. Other interventions

7.1 Forestry and Carbon Sinks

Since early 1900s, India had well-articulated the importance of preserving its forests in order to maintain the ecological balance of the country as well to protect the livelihood issues of its dependent population. As the concerns for climate change gained importance, the potential role of forests in natural sequestration of CO₂ came to be increasingly realized. India has in place a robust and comprehensive policy and legal framework to manage its forests on the lines of modern scientific management techniques. Since India's Independence, forest protection framework has been strengthened through enactment of the Forest Conservation Act (1980), Wildlife Protection Act (1972), the Environment Protection Act (1986), and most importantly the National Forest Policy (1988). Particularly from the viewpoint of carbon mitigation, these policies were targeted at expanding and improving the tree coverage as well as preventing deforestation of the existing forest cover. The State of the World's Forests reports (FAO, 2011) records a net increase of 0.5% per annum over 2000-2010⁶ for India while the global figure of forest cover registered a 0.13% per annum decrease.

Through initiatives like the National Afforestation Programme (NAP) together with programmes in agriculture and rural development sector taken up during the 9th and 10th FYP the government aimed at adding/improving 1 mha of forest and tree cover every year. Concurrently in the 11th FYP, the national government also proposed to increase the forest coverage by 1% a year through 2012, from 24%⁷ in 2005 to 33% in 2012 (Planning Commission), under the NFP 1988. All these policies together have transformed forestry into a net sink of CO₂. From 1995 to 2005, carbon stocks stored in our forests are estimated to have registered an annual increment of 37.68 million tons of carbon sequestration or 138.15 million tons of CO₂ equivalents (LCCR 2014). This annual removal by forests is enough to neutralize 9.31 percent of total GHG emissions estimated for the year 2000 (Kishwan, et al. 2009).

As a more ambitious approach, the Ministry of Environment and Forest (MoEF) estimated that a REDD+ program⁸ for India has a potential to incentivize a capture of over 1 billion tons of additional (other than that from the ongoing social forestry and national afforestation programs) forest carbon over the next three decades and provide more than USD 3 billion as carbon service incentives (MoEF 2011). In favor of a comprehensive REDD+ mechanism, Government of India drafted the National REDD+ Policy as well as launched the National Mission for a Green India under the National Action Plan on Climate Change in 2008. The mission aimed at (a) increasing the forest/tree cover on 5 million hectare of forest/non-forest land, (b) improve quality of forest cover on another 5 million hectare of land by 2021, to improve ecosystem services, increase forest based livelihood income, and enhance CO₂ sequestration, (c) reforest 6 million hectares of degraded forest lands. The mission envisages achieving it through training of staff, reduced fragmentation of forests, enhanced PPP in forestry, up-scaled community based initiatives, and formulation of forest fire management

⁶ Kumar, D. 2014. *Climate Change, Forest Carbon Sequestration and REDD-Plus*. Economics and Political weekly. Vol - XLIX No. 21

⁷ Ministry of Environment and Forests, 2005; "Forest Survey of India", Government of India

⁸ Further details are available in next section

strategies. The incremental annual mitigation potential of the Mission is estimated to be about 55 MtCO₂ in the year 2020 (MoEF&CC, GOI, 2010). However the need is felt that since implementation of plans and programme within this sector would require huge financial support, government could allocate adequate resources domestically through NCEF, private sector corporate social responsibility (CSR) or approach the international funding institutions for support. Under the guidance of MoEF&CC, the pilot phase of Green India Mission is taken up for implementation in the state of Andhra Pradesh.

7.2 Government policies with GHG mitigation co-benefits

Energy pricing is a critical policy instrument that promotes efficient use of energy and provides necessary signals for selection of appropriate energy technology mix. The administered prices implemented by the government for fossil fuels, lower than the market price, fails to reflect the full opportunity cost of energy systems. In addition, the economic drain on account of subsidies for fossil fuels put a huge fiscal burden on India of the order of 2.2% of GDP each year. To do away with this, India recently in 2014 phased out the subsidies on diesel while the government deregulated the price of petrol in June 2010. These would correct for market signals driven towards cleaner sources of energy supported by the National Clean Energy Fund and ease up fiscal money given towards the fossil fuel subsidies.

8. Barriers in achieving India's greenhouse gas mitigation plans

While sector specific barriers remain to be addressed sectorally with support from the central government, there are some other overarching issues which need immediate attention to meet India's ever increasing goals with respect to addressing climate change and achieving green growth.

1) Institutional barriers

- a. Integrating the objectives of NAPCC and SAPCC in addition to domestic mitigation goals/ambition has been difficult primarily due to lack of proper institutional capacity and models to address these issues.
- b. In some cases, the issues between central and state governments remain difficult to resolve due to jurisdictional issues.

2) **Lack of appropriate markets:** India lacks standardized baselines for energy efficiency mainly due to lack of appropriate data till today, which are critical to starting a market for energy efficiency in India. Baselines form the basis of reliable and comparable investment grade audits that investors and banks need to evaluate the bankability of energy efficiency projects. This would act as an auto-mode for energy efficiency EE market in India. Once the markets for energy efficiency gather speed, development banks can play a crucial role in providing credit guarantees to first movers — especially to the banks who will be willing to take on the risks of early investment in energy efficiency. Such guarantees are particularly important given that the bankability of an Energy Service Company (ESC) needs to be based on future energy services and associated cash flows rather than on the value of the asset or collateral in question.

- 3) **Financial constraints:** For India, finance is a critical challenge in implementing GHG mitigation interventions in the country. While the government has set up domestic support instruments to generate resources for promoting clean energy projects through NCEF, VGF, PRGF, budgetary resources, taxes and subsidies, the estimates for the range of funds required suggest that this may not be enough. Though renewable energy and energy efficient technologies have become cheaper over recent decade there, still remain significant barriers to investments such as complete unavailability of funds to invest and limited willingness to pay among the end consumers for these products who largely fall within the upper middle to lower income classes. Government needs to devise appropriate incentive structures to leverage private finance into the sector as well as be proactive in seeking funding for mitigation projects through climate finance.
- 4) **Technological constraints:** While India's experience so far with the mitigation policies suggest that while a positive momentum towards clean development is certainly achieved in the recent years, in order to overcome the time as well as scale barrier with mitigation, technological breakthroughs would hold the key (Mathur and Shrivastava 2015). To be able to realize the transformation of the Indian economy towards cleaner means of production and growth, it is important that firstly,
 - a. Alternate technology options are available to India which are the commercially viable technology options across the different sectors of intervention,
 - b. A rapid scale-up of these technologies are possible through various supporting policy instruments and financial availability,
 - c. Supporting infrastructure can be set-up for diffusion of the newer technologies,
 - d. Capacities are built at appropriate levels with appropriate skill-sets to adapt to new interventions and use of available opportunities facilitating cleaner growth modes.
 - e. Beyond these, very often the available technologies globally are not directly suitable to the Indian conditions and neither is globally chosen mitigation pathways. For example, the clean coal technologies in India do not generate same level of efficiency with the Indian coal types. Hence, technology transfer opportunities coupled with research and development is extremely important for the country to be able to transfer and deploy the best technology options available.
 - f. Issues related to IPR in the international negotiations is very critical for a country like India which hold huge capacity to adopt, innovate, install and upscale newer technologies made available to them to meet the globally shared vision on climate change mitigation.
- 5) Government is focused on energy efficiency and renewable energy technology additions; it would however need to lay an overall thrust on energy conservation as a goal. This would come with large scale awareness building and social responsibility building among all end consumers - individuals, firms or households. While the government only looks at energy intensity of the economy as the function of energy efficiency, the intensity would also go down if energy wastages in the economy are curbed. As per the the government reports, MNRE, close to 27,000 MW of electricity goes waste due to AT&C losses in the country. In addition, if accounted for the behavioral related loss in energy due to lack of energy management systems in place at households, businesses,

and industries, the numbers would be humungous which is very well not accounted for at present.

- 6) There is lack of ready compendium of actions which have both adaptation and mitigation synergies which would be crucial for readiness for a country like India.

9. Opportunities for mitigation

9.1 NAMAs as a support mechanism for mitigation

The response of Indian industries towards the Clean Development Mechanism showed the possibility of leveraging finance to trigger the dynamism towards low carbon and green practices. With the developments in the NAMA mechanism and global progress with experimentation with NAMA projects, the Indian government may also consider NAMAs as a means to reduce its greenhouse gas emissions. A coordinating office for implementing NAMAs is established in the Indian Ministry of Environment. Under the Indo-German cooperation, on behalf of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), GIZ advises the Indian Ministry of Environment on carrying out NAMAs in India and on technical and institutional issues. The technical support includes conducting feasibility studies on the waste and forestry sectors. The NAMA plans that are subsequently formulated on the specific activities should ideally build on existing Indian Government programmes or policies. At the same time, they should promote implementation of the NAMAs and provide incentives for emission reductions. In order to develop realistic plans, there is a need for innovative financial solutions, which use publicly – and potentially internationally – available funds as a catalyst to make investments that have a mitigation impact.

In an event jointly organized by the Ministry of Railways and the Asian Development Bank (ADB) in 2009, it was suggested that the Vision 2020 for the Indian Railway could be considered as a NAMA. The estimated implementation cost is INR 800 crore. Since, this is a vision document and India is politically committed to achieve its aspirational goals, it was suggested that it may be considered as domestic-NAMA, however, the possibility to explore financial support for some parts of the Vision and hence consider them as supported NAMA was also proposed. In the same meeting, the Ministry of Environment and Forest expressed their consent to this initiative and also indicated that the government is soon likely to come out with a NAMA strategy for India.

9.2 REDD+ as a support mechanism for mitigation

While India has been in forefront in shaping the evolution of the comprehensive concept of REDD+ at the international level, it needs much more to do domestically to ensure purposeful implementation of REDD+. It faces the challenge of constructing the National Forest Reference Level, a National Forest Monitoring System comprising independent MRV and safeguards information systems. India must prepare itself technically, politically and institutionally to participate effectively in the future negotiations with a view to safeguarding its national as well as the interests of its local communities dependent on forests.

In 2013, the Ministry of Environment and Forest (MoEF) constituted the Expert Committee with leading experts on REDD+ of the country to formulate the National REDD+ Policy and strategy to lay down the broad contours of the policy, processes, methodologies,

responsibilities and institutions essential for implementing REDD+ in the country (Table 4). The Expert Committee in 2014 drafted the National Policy and Strategy document and recently released a 'reference document' for REDD+ implementation in India. The reference document discusses recommendations to address the various implementation barriers in REDD+, including the need for capacity building across all levels of the government, expert organizations, civil society, other organizations and local communities. Other definitional as well as baseline issues have also been discussed in the report.

It is imperative that forests are defined in a way that helps FSI to standardize and harmonize definition of forests and deforestation relevant to REDD+ with the definition of FSI. In this respect India has attempted to develop definitions of REDD+ elements and assessed their implications in the Indian context (Table 5). This will be useful in negotiating the definitions of these terms in the UNFCCC in future.

Table 4 Institutional structure for REDD+ mechanism in India

<i>Levels</i>	<i>Institution</i>	<i>Supporting Institution</i>	<i>Functions</i>
<i>National Level</i>	<i>Establishing National REDD+ Authority in the MoEF under a National Steering Committee on REDD+, serviced by REDD+ Cell</i>	<i>-Government, Semi-Government and Non-government technical & scientific institutions (FSI, ICFRE, IIFM, IISc and others working in the field of REDD+) -Concerned ministries, Finance Ministry, MoRD, MoA, MoTA, Planning Commission, MNRE, MoP, MoT, Ministry of Water Resources, MoPR, MoST</i>	<i>Preparation of National Inventory and Action plan indicating (i) A National Reference Level, (ii) A National Monitoring & Reporting System, (iii) To support creation of Sub-National Level REDD+ architecture/ institutional framework with relevant stakeholders (iv) initiating REDD+ pilots for learning.</i>
<i>State Level</i>	<i>REDD+ Cell at State Level, under State Forest Departments</i>	<i>All other relevant organizations</i>	<i>Defining roles and responsibilities of institutions at the national and sub-national levels for Implementing policies relevant for REDD+ activities; guide formulation, development, funding, implementation, monitoring & evaluation of REDD+ activities in the states.</i>
<i>Local/District Level</i>	<i>-</i>	<i>Forest divisions, other line departments, NGOs / Civil society Organizations, Gram Sabha (JFMC supported by Gram Sabha or Eco Development Committee), private sector organization, Industries and others</i>	<i>Implementation and benefit distribution</i>

FSI – Forest Survey of India; ICFRE - Indian Council of Forestry Research and Education; IIFM - Indian Institute of Forest Management; IISc – Indian Institute of Science MoRD – Ministry of Rural Development; MoA - Ministry of Agriculture; MNRE - Ministry of New and Renewable Energy; MoP – Ministry of Power; MoT – Ministry of Tourism; MoTA – Ministry of Tribal Affairs; MoWR – Ministry of Water Resources; MoPR - Ministry of Panchayati Raj; MoST – Ministry of Science and Technology; JFMCs - Joint Forest Management Committees

Source: MoEF Draft National Policy and Strategy on REDD+, 2010

Table 5 REDD+ elements and potential for India

<i>Activity</i>	<i>Definition</i>	<i>Potential to generate carbon revenue</i>	<i>Implications/challenges</i>
<i>Deforestation</i>	<i>The direct human induced conversion of forested land to non-forested land</i>	<i>Large</i>	<i>-Attribution of deforestation to drivers will be a challenge - The rate of forest loss has been changing over different assessment periods</i>
<i>Forest Degradation</i>	<i>Transition from higher to lower tree crown density and/or removal of lower canopy biomass or disturbance of soil, leading to reduction in carbon stocks</i>	<i>Large</i>	<i>- Difficult to identify locations - Difficult to monitor changes in carbon stocks</i>
<i>Conservation</i>	<i>Maintenance of area under existing forests to conserve, maintain, and even enhance the high carbon stocks</i>	<i>Large</i>	<i>-</i>
<i>Sustainable Management of Forests</i>	<i>Management of forests to sustain the biomass productivity, even if subjected to harvest or other management practices leading to no long-term loss, even increment in carbon stocks</i>	<i>Limited</i>	<i>-Currently not feasible to estimate area subject to SMF</i>
<i>Enhancement of Forest Carbon Stocks</i>	<i>Conservation of non-forest or degraded forests to forests through afforestation, reforestation, restoration forestry and forest management practices, leading to enhancement of carbon stocks</i>	<i>Large</i>	<i>Additionality would be an issue</i>

Source: MoEF, Reference Document for REDD+ in India, 2014

Till now, MoEF has initiated 8 pilot REDD+ projects in Uttarakhand (Musoorie), Uttar Pradesh (Sonbhadra), Madhya Pradesh (Chhindwara), Orissa (Angul), West Bengal (Sunderbans), Nagaland, Gujarat and Rajasthan.

For India, there exists strong possibility of investments in specific REDD+ actions, but India needs to address these issues and gaps before it could be REDD+ ready.

One of the barriers to effective implementation of REDD+ in India is that the country needs a mechanism to strengthen the cross-sectoral cooperation among relevant stakeholders for successful planning and implementation of REDD+.

- a) *Setting up state REDD+ cells are a prerequisite to ensure proper implementation of activities. There is need of an effective communication strategy for involving communities and*

other relevant stakeholders in protection, management, monitoring of forests, and for carrying out measurements to assess the REDD+ performance.

- b) Capacity needs to be built for communities in protecting and sustainably managing the forest resources, and to participate in the REDD+ measurements.
- c) Lack of definition of REDD+ universally and at country level

The National REDD+ Strategy suggests channelizing funds for REDD+ projects from all possible sources including the budgetary support for REDD+ cell; international funding from multilateral, bilateral channels like World Bank, GEF, FAO, JICA, USAID etc.; project based funding; domestic funding from public sector/private sector support through CSR; funding through National Clean Energy Fund (NCEF) or CAMPA Funds. The government has set itself a time frame of 3 years to achieve REDD+ readiness in the country in accordance with the National REDD+ Policy and strategy framework wherein the Policy document will be reviewed every 3 years to update it in accordance to the latest UNFCCC decisions and agreements.

9.3 Role of Carbon Markets in India

The clean development mechanism has been characterized by a period of impressive growth from 2006 to 2012 followed by a sharp decline. India has been a very important market for CDM registering the second largest number projects in the world. However, investor's interest and participation in the mechanism declined primarily due to lack of carbon credit buyers internationally owing to the lower level of ambition of parties that are parties to the Kyoto protocol with commitments inscribed in Annex B. These translated into the crash in CER prices from over 20USD in 2008 to nearly USD 0.30 in 2014. Due to this, investments in new CDM projects are nearly non-existent in the country as well as worldwide.

However, over the past year, the CDM Executive Board has worked continuously to improve CDM for which programme of activities (PoA) approach is a good example. Unlimited number of activities can be administered under a single programme within PoA. The approach is well received by countries who want to avail benefits of the market mechanism. India's Delhi Metro Rail Corporation (DMRC) has been recently registered as the world's first transport sector project under the Program of Activities (PoA). This will make the DMRC the managing entity of all other metros in the country for fast tracking Clean Development Mechanism registration of all the upcoming rail-based metro systems in India. The first project in this PoA will reduce approximately 6.3 lakh tonnes of carbon dioxide equivalent annually from Phase-3 operations of DMRC. PoA programme in the sector of energy efficiency can be easily designed to seek international finance through the markets.

9.4 Climate finance

- Yet, urgent up--scaling of finance and technology availability through GCF, GEF and other sources would be required to fulfill mitigation pledges by the country. During the preparatory talks for the Conference of the Parties meeting at Lima, several developed countries including some developing countries like the Mexico committed money to the Green Climate Fund (GCF) totaling just below \$10 Billion.

- With the USD 10 billion commitment to GCF close to Lima Climate Talks in 2014, the GCF secretariat has started accepting applications from developing countries for disbursement of funds. It is urged that the countries quickly convert their pledges into actual deposits so that the disbursement can start by the middle of the next year. The fund is expected to give equal weightage to both mitigation and adaptation projects. In this regard, India could be well prepared ahead of time to submit its own proposal for funding from the GCF. From India, NABARD has been accredited by GCF as the channel to deploy funds to developing countries (GCF, 2015).
- One of the financial services gaining tremendous interest among investors is the 'green bonds'. Green bonds are fixed income, liquid financial instruments that are easy to invest, and the funds they raise are dedicated exclusively to climate-mitigation and adaptation projects, and other environmentally beneficial activities. This provides investors an attractive investment proposition as well as an opportunity to support environmentally sound projects. Green bonds help in accessing the \$80 trillion bond market and expanding the investor base for climate-friendly projects worldwide. The green bond market took off properly in the year 2013, and it has been growing since, as investments in environmentally friendly opportunities gain popularity. The market for green bonds went up from close to USD 11 billion issuances in 2013 to about USD 35 billion so far this year and has broadened the investor base for clean development.

9.5 Bilateral cooperation on clean technology and climate change

India has been successful in establishing bilateral relations with several countries on key areas of environment and clean technology for strategic international cooperation. India's renewable energy programme has received huge recognition in recent years. Many countries evinced interest in India for cooperation in new and renewable energy. The focus of interaction for cooperation has been to explore opportunities for promoting knowledge sharing, support investments and R&D cooperation; promotion of industry engagements and capacity building activities, taking up joint research design and development, and establishing institutional linkages between institutions of India and other countries.

- Some major cooperation between 2007 and 2013 on new and renewable energy have been with Denmark; South Africa and Brazil for Cooperation in Wind Resources; Indo-Iceland Renewable Energy Cooperation; New and Renewable Energy Cooperation with Australia; Canada; Italy; Mexico; Philippines; Thailand; Chile; Scotland; Spain; Iran; Sweden; Uruguay; Egypt; Bangladesh; Rwanda; and the United States of America.
- In addition, interaction with USA and Japan for cooperation in New and Renewable Energy is pursued under India-US Energy Dialogue and India-Japan Energy Dialogue, respectively. The Ministry of New and Renewable Energy and Japan Bank for International Cooperation (JBIC), the Japanese policy based financial institution. The objective of the MoU is to promote development of renewable energy projects, including canal-top solar power projects on pan-India basis in general and Gujarat in particular.
- Particularly with United States, The U.S.-India Energy Dialogue was launched in May 2005 to promote trade and investment in the energy sector, and held its last meeting in

March 2014 in New Delhi. India and USA already has a robust program of cooperation, including the highly successful U.S.-India Partnership to Advance Clean Energy (PACE) umbrella program, renewed in 2015 with extended funding for three existing research tracks of solar energy, building energy efficiency, and advanced biofuels for five years and launching a new track on smart grid and grid storage technology. Policy dialogues are being held to expand the technical work on clean energy and low greenhouse gas emissions technologies. The two countries recently in January 2015 concluded negotiations on a five-year MOU on Energy Security, Clean Energy and Climate Change to carry the work forward, to be signed as early as possible at a mutually-agreed upon date⁹. Within the programme, the Export-Import Bank is exploring potential projects for its MOU with the Indian Renewable Energy Development Agency for up to \$1 billion in clean energy financing.

- India is also involved in Interactions with EU for cooperation in New and Renewable Energy, pursued under India-EU Energy Panel. A multilateral cooperation framework called Asia-Pacific Partnership on Clean Development and Climate (APPCDC) enables interaction for cooperation with USA, China, South Korea, Japan, Canada and Australia¹⁰. What is specifically needed is support through international cooperation for implementation of large demonstration projects in India which will in turn facilitate shifts in energy markets as well as help build the soft skills and capacities in the country.

10. Ways forward

Short-term

- As power generation augments in India, Planning Commission's findings suggest that the absolute emissions in the country will continue to grow till 2020
- Government will implement policies listed in the NAPCC policy document (Planning Commission, 2014)
- No particular emission reduction from waste and agriculture are estimated till 2022.
- For the implementation of the National Action Plan on Climate Change alone, the Planning Commission has estimated a total outlay of INR 2,30,000 crores till the Thirteenth FYP (by 2022) which continues to increase as other ambitious targets are set by the government for middle and long-term goals. This is in addition to the INR 11,32,000 Crores needed to be generated/disbursed for the implementation of the SAPCCs cumulatively till 2022.

Medium-term

- Absolute GHG emissions in the country will continue to grow in 2030s

⁹ <http://www.whitehouse.gov/the-press-office/2015/01/25/fact-sheet-us-and-india-climate-and-clean-energy-cooperation>

¹⁰ For more details, read < <http://mnre.gov.in/schemes/support-programmes/international-cooperation-3/> >

- Rise in absolute emissions in the country would primarily be on account of the growing energy demand in the country up till 2030s mainly met with the consumption of fossil fuels
- Planning Commission's Low Carbon Committee Report, 2014 suggests
 - Super critical and ultra super critical coal plants should account for at least half of the coal based power generation capacity.
 - Increased capacity of renewable in energy share
 - Increased capacity of nuclear in total energy
 - DFCs along the quadrilateral linking the four metropolitan cities and their diagonals. Approx. 17% emission reductions can be achieved in 2030 over 2007.
 - Implementation of Euro 6 standards in All India by 2030s
 - All states and urban local bodies to mandate ECBC for commercial buildings and residential apartments. Approximately 131 MtCO₂ emissions can be avoided in 2030.
 - Inventories of GHG gases such as CO₂, CH₄, N₂O, HFCs, PFCs and SF₆ to be prepared and reported annually.
 - The approximate cost to the economy of low carbon strategies is about US \$ 834 billion (in constant 2011 dollars) over twenty years from 2011 to 2030. This is about 1.5 per cent of the cumulative GDP over this period (LCCR, 2014). Cumulative investment in the energy sector particularly between 2007 and 2030 is almost 50 percent higher in the LCIG scenario as compared to the BIG scenario.

Table 6 National policies and actions to achieve low carbon growth targets in 2020 and 2030

	2005 (MtCO ₂ e)	2011(MtCO ₂ e)	2020 (MtCO ₂ e) (Reference Scenario)	2030 (MtCO ₂ e) (Reference Scenario)	2030 LCIG (Policy Scenario) (MtCO ₂ e)
Absolute GHG emissions	1570	1790	3537	5500	4300
Per capita emissions	1.43	1.38	2.67	3.64	2.6
Emission intensity below 2007	-	-	-23%	-32%	-46%

Note: This excludes Agriculture process emissions in accordance with the international commitment India has made.

Source: TERI MARKAL study, ESA (2015) results

Long-term

- In the reference scenario, India's emissions could increase from 1500 MtCO₂ in 2007 to almost 8000 MtCO₂ (in 2050)¹¹.
- In the low-carbon policy scenario, an emissions level at 2400 MtCO₂ by 2050, equating to about 1.3 tCO₂ per capita is envisaged.
- The low carbon policy scenario shows that the majority of emissions savings, relative to the reference scenario, occur in the electricity generation and industry sectors. In particular, selection of biomass-based power generation with CCS makes the electricity sector carbon-neutral by 2040 and carbon-negative by 2050, effectively subtracting emissions from the other sectors of the Indian economy which use electricity. The result of these technologies is that the total emissions for India are relatively flat at about 2400 MtCO₂ after 2020¹².
- The scenario presented estimated total cost of nearly 2.4% of the total GDP of India which is equivalent to about USD 200-400 billion per year till 2050.

¹¹ <http://www.imperial.ac.uk/media/imperial-college/grantham-institute/public/publications/institute-reports-and-analytical-notes/India%27s-emissions-pathways-to-2050---summary-report.pdf>

¹² http://www.metoffice.gov.uk/media/pdf/b/f/AVOID_WS2_D1_41.pdf

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A unique developing country institution, TERI is deeply committed to every aspect of sustainable development. From providing environment-friendly solutions to rural energy problems to helping shape the development of the Indian oil and gas sector; from tackling global climate change issues across many continents to enhancing forest conservation efforts among local communities; from advancing solutions to growing urban transport and air pollution problems to promoting energy efficiency in the Indian industry, the emphasis has always been on finding innovative solutions to make the world a better place to live in. However, while TERI's vision is global, its roots are firmly entrenched in Indian soil. All activities in TERI move from formulating local- and national-level strategies to suggesting global solutions to critical energy and environment-related issues. TERI has grown to establish a presence in not only different corners and regions of India, but is perhaps the only developing country institution to have established a presence in North America and Europe and on the Asian continent in Japan, Malaysia, and the Gulf.

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