

# Review Report

## *Strengthening National MRV Systems- Options and Approaches for India*

Submitted to  
UNEP DTU

## DISCLAIMER

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, photocopying, recording or otherwise, for commercial purposes without prior permission of UNOPS. Otherwise, material in this publication may be used, shared, copied, reproduced, printed and/ or stored, provided that appropriate acknowledgement is given of UNOPS as the source. In all cases the material may not be altered or otherwise modified without the express permission of UNOPS.

This publication has been produced as part of a component of the Initiative for Climate Action Transparency project (ICAT) implemented by UNEP DTU Partnership (UDP). The views expressed in this publication are those of the authors and do not necessarily reflect the views of UDP.

## PREPARED UNDER

Initiative for Climate Action Transparency (ICAT) project supported by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the Children's Investment Fund Foundation (CIFF), the Italian Ministry of Ecological Transition (IMET) and ClimateWorks.



The ICAT project is managed by the United Nations Office for Project Services (UNOPS)



## Background

---

This review report is an attempt to review the existing policy, programme and actions being undertaken in areas for mitigation identified in the INDCs and assess the areas where mitigation actions are to be identified and implemented. A funneling approach was used in the scoping phase to shortlist key sectors/sub-sectors and related policies, program and actions. The criterion was to identify sectors/sub-sectors based on maximum GHG reduction potential and contribution to India's NDC goals. Following sectors/sub-sectors were chosen for the detailed assessment and development of MRV approaches:

1. Passenger road transport
2. Large commercial buildings
3. Large utility-scale solar

In the passenger road transport sub-sector, it was recognised that the vehicle fuel efficiency and electric mobility programs have the maximum potential for GHG emission reduction from the transport sector and thus largely contributing in achieving India's NDC target of emission reduction. For detailed assessment and developing MRV approaches, a package of policies that improve fuel efficiency of vehicles will be assessed for developing MRV options. During the scoping phase, it is also recognised that the existing ICAT guidance on transport pricing will not meet the requirements for developing a suitable MRV framework specific to India's transport sector. The reason being, pricing mechanism in India is not a tool for emission reduction and already existing policies like removal of diesel subsidy, dynamic fuel pricing, etc. have not been able to influence fuel consumption. In addition, the focus of the current policies in the transport sector is on the development of public transport infrastructure and energy efficient transport systems, as they have a higher potential for emission reduction and thereby contribute to the overall emission reduction for the country.

In the building sector, it was assessed that the Energy Conservation Building Code 2017 (ECBC) and Standards and Labeling (S&L) Program have the maximum potential both in terms of achieving energy efficiency and GHG mitigation. Therefore, for developing MRV options, the commercial sub-sector along with ECBC and S&L program will be reviewed and further assessed for developing MRV options. This will also help in complimenting BEE's work for assessing the policy impact using ex-post approach.

In the renewable energy sector, it was recognised that the solar sub-sector should be given importance for developing MRV framework for India owing to the overarching national targets set in Jawaharlal Nehru National Solar Mission (JNNSM) and subsequent auction guidelines underpinning tenders focusing on high capacity RE addition. It is recognised that the ground based solar utility projects should be considered for developing MRV framework for a package of policies including incentives, regulations, duties and tenders that influence uptake of these projects. Further, the auction guidelines issued by Ministry of Power, subsequent tenders for ground based large scale utility solar projects, and related policies will

be considered for developing MRV options. Within this, ex-ante assessment till 2022 would be conducted with 2010 as the baseline year for assessment.

The following section of the report details out key policies, programs and actions in each of the above shortlisted sectors/sub-sectors. This will be further discussed with key stakeholders through focused group consultations for finalizing the approach and boundary for the detailed assessment.

## Renewable Energy

The following table highlights the sector's policies/guidelines selected for the assessment:

| S.no. | Scheme   | Description   | Achievement  | Capacity Addition –Top 3 states   |
|-------|--|---|--|---|
| 1     | Scheme for setting up over 300 MW of Grid-Connected Solar PV Power Projects by Defence Establishments under Ministry of Defence and Para Military Forces with Viability Gap Funding under Phase-II/III of National Solar Mission | The Defence establishments, which are located in the border area and remote locations use diesel as the primary source of energy. In some areas they pay very high tariff. Solar power is clean source of energy and can replace diesel power generation to a large extent. Potential of Solar Energy in cantonment and Military Stations are approximately 5000 MW and in Ordnance Factory Boards (OFB) are 950 MW. Ordnance Factory Board (OFB) and other Defence Establishments agreed to set up solar power projects on the large tracts of land and vacant rooftops which they own. The Union Cabinet has approved the Scheme in its meeting held on 10th December, 2014. The Ministry has issued Administrative Approval on 07th January, 2015. | In-principle approval of 357.5 MW has been given to different Defence Organisations. Out of this, 22 MW has been commissioned so far | Telangana – 15 MW   |
| 2     | Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects  | This scheme envisages supporting the States in setting up solar parks at various locations in the country with a view to create required infrastructure for setting up of Solar Power Projects. The solar parks will provide suitable developed land with all clearances, transmission system, water access, road connectivity, communication network, etc. This scheme will facilitate and speed up  | As on 31.12.2017, a total of 35 Solar Parks in 21 States have been approved with a solar power capacity of 20514 MW                  | Rajasthan – 4350 MW<br>Andhra Pradesh – 4000 MW<br>Madhya Pradesh – 2750 MW |

|     |  |   |  |  |
|-----|--|---|--|--|
|     |  | installation of grid connected solar power projects for electricity generation on a large scale. All the States and Union Territories are eligible for benefitting under the scheme   |  |  |
| 3   | Viability Gap Funding (VGF) Scheme                 | Solar Energy Corporation of India (SECI) has allocated 4,835 MW of project capacity under the VGF route, whereby a capital subsidy is provided to project developers bidding for projects at a predetermined tariff. As of March 31, 2017, another 785 MW of tenders under SECI VGF scheme are under process.   |  |  |
| 3.1 | 750 MW VGF Scheme under JNNSM Phase-II, Batch-I    | Solar Energy Corporation of India (SECI) has implemented the first VGF scheme of 750 MW, under JNNSM Phase-II, Batch-I for setting up large scale ground-mounted solar PV projects on pan-India basis. After a transparent selection and award process, project capacity of 680 MW could successfully achieve financial closure. This entire capacity has been commissioned and projects are under commercial operation.                                      | As of 31.12.2017, a total of 680 MW has been commissioned in 7 states across India.        | Rajasthan – 355 MW<br>Madhya Pradesh – 220 MW<br>Gujarat – 40 MW |
| 3.2 | 2000 MW VGF Scheme under JNNSM Phase-II, Batch-III | <ul style="list-style-type: none"> <li>Guidelines issued on dated 04th August 2015. Power purchased by SECI @ Rs. 4.43/kWh (PPA) and sold to buying utilities @ Rs. 4.50/kWh (PSA).</li> <li>Bidding have been carried out amounting to Rs. 1515 Crore out of the total approved scheme allocation of Rs. 2100 Crore.</li> <li>2 categories: DCR (250 MW) &amp; Open (1750 MW). Project Size is Minimum 10 MW up-to 50 MW (in multiples of 10 MW).</li> </ul> | Total 300 MW Capacity reported as commissioned in Maharashtra, at non-solar park locations | Maharashtra – 300 MW   |

|     |   |   |  |                  |
|-----|---|---|--|------------------|
|     |   | <ul style="list-style-type: none"> <li>• State-specific tenders based on the demand from State. Projects could be set up either in the Solar Parks and or outside the solar park.</li> <li>• VGF up-to Rs. 1.31 Crore per MW (DCR) and Rs. 1 Crore per MW (Open) is being provided.</li> <li>• Average bided VGF under the open category is 63.27 lakh/MW and DCR category is 1.11 Crore/MW.</li> <li>• RfS have been issued for 2410 MW capacity in 7 States/UTs (Maharashtra, Uttar Pradesh, Andhra Pradesh, Chhattisgarh, Karnataka, Puducherry and Himachal Pradesh), LoI placed: 2295 MW, PPA signed: 2295 MW &amp; PSA signed: 2425 MW (As on 31.12.2017).</li> </ul> |  |                  |
| 3.3 | 5000 MW VGF Scheme under JNNSM Phase-II, Batch-IV | The scheme is proposed to be implemented by SECI in four tranches of 1250 MW each, spread over four years, up to FY 2018-19. This scheme also provides for purchase of solar power by SECI from selected developers at a fixed tariff of Rs. 4.43 per kWh for 25 years and supply to DISCOMs at Rs. 4.50 per kWh (including trading margin of 7 paise per unit). The projects are being set up either in the solar parks being developed by states or outside the solar parks   | In the FY 2017-18 (up to 31.12.2017), NIT has been issued for 3975 MW capacity. LoI have been issued for 750 MW and PPAs have been signed for the same capacity. Financial Closures have been achieved for 445 MW. 250 MW has been commissioned. | Gujarat – 250 MW |
| 4   | Installation of 15000 MW Grid-Connected           | The Government of India (through Cabinet approval on 25.02.2015) has approved the Implementation of Scheme for setting up   | Currently Tranche-I, is under implementation. In Tranche-I, which is Batch-II  |                  |

|     |   |  |  |  |
|-----|---|--|--|--|
|     | Solar PV power plants through NTPC Ltd.   | 15,000 MW of Grid connected Solar PV Power projects under National Solar Mission through NTPC/NVVN in three tranches as follows:<br><br>Tranche-I: 3,000 MW: 2014-15 to 2016-17<br>Tranche-II: 5,000 MW: 2015-16 to 2017-18<br>Tranche-III: 7,000 MW: 2016-17 to 2018-19   | of Phase-II of National Solar Mission, 3000 MW capacity of solar PV power plants will be based on bundling of solar power (3000 MW) with unallocated thermal power (1500 MW) in the ratio of 2:1 (in MW terms), for which the required 1500 MW unallocated thermal power has been made available by the Ministry of Power.   |  |
| 4.1 | 3000 MW Grid connected solar PV power projects under NSM phase-ii, batch-II, Tranche-i – ‘state specific bundling scheme’ | Under this Scheme, this is part of Tranche-I of Batch-II of Phase-II of National Solar Mission, 3 GW capacity of solar PV power plants are being set up based on the mechanism of bundling of solar power (3 GW) with unallocated thermal power (1500 MW) in the ratio of 2:1 (in MW terms), for which the required 1500 MW unallocated thermal power has been made available by the Ministry of Power | Implementation (as on 30.11.2017):<br>Notice Inviting Tender Published for full Tranche-I of 3,000 MW.<br><ul style="list-style-type: none"> <li>• Reverse auction completed: 3000 MW.</li> <li>• Power Sale Agreement (PSA) Signed with State Discoms: 2750 MW</li> <li>• Letter of Intent issued to successful bidders: 2750 MW</li> <li>• Power Purchase Agreements (PPAs) signed: 2750 MW</li> </ul> | Andhra Pradesh – 1250 MW<br>Rajasthan – 650 MW<br>Karnataka – 600 MW |

|   |  |  |  |  |
|---|--|--|--|--|
| 6 | Scheme for setting up of 1000 MW of Grid connected Solar PV power projects by CPSUs and Govt. organizations under various Central/State Schemes/Self use/3rd Party sale/Merchant sale with Viability Gap Funding (VGF) under Phase-II of NSM | The Ministry launched the above scheme in January 2015 to set up 1000 MW of Grid Connected Solar PV Power Project by CPSUs and Govt. Organizations with VGF. Under the Scheme, MNRE, as on 15.12.2017, has allocated about 963 MW capacity to 12 different CPSUs/ Govt. Organisations within the sanctioned funds of Rs.1000 Crore for this scheme.  | As of 15.12.2017, a total of 963 MW has been sanctioned, out of which 765 MW has been commissioned and VGF released by MNRE amounts to Rs. 583 Cr.   | Andhra Pradesh – 255 MW<br>Madhya Pradesh – 229 MW<br>Rajasthan – 180 MW |
| 7 | Solar RPO  | The Electricity Act (EA), 2003 mandates that State Electricity Regulatory Commissions (SERC) promote renewable energy within their respective state. Under EA 2003, the SERCs set targets for obligated entities to purchase a certain percentage of their total power requirement from RE sources. This target is termed as the Renewable Purchase Obligation (RPO). Entities with an RPO target, which are required to purchase RE, are called ‘Obligated Entities’. The following entities are generally obligated in the State, namely: (i) Distribution Licensees, (ii) Captive Consumers, and (iii) Open Access users. | Recently, India’s power ministry has increased the RPO target from 17% now to 21% by 2022. As per the new norms, all entities that fall under the RPO should procure 10.5% of their total electricity from solar sources, up from 6.75% now and another 10.5% of their power from non-solar renewable sources by 2022, up from 10.25% now. |  |

## **FOCUS STATE**

Based on capacity addition as the criteria for preliminary evaluation, it is evident that Rajasthan and Andhra Pradesh are top states with high capacities installed/commissioned/upcoming, with 5535 MW for Rajasthan and 5275 MW for Andhra Pradesh. Therefore, it would be worthwhile to look into either. In a further approach, analyses of parameters such as policy details and alignment of state policies with central policies for auction, schemes other than central schemes, favourable state regulations, tariff determination, incentives, tax reliefs and subsidies would aid in zeroing in on the focus state for assessment.

We will also conduct preliminary discussions with experts in the sectors to finalise a State based on our initial assessment on the growth/incentives provided to promote solar energy in the two States; Rajasthan and Andhra Pradesh.

## Transport

---

India's transport sector is highly dominated by road transport and accounts for 90% of the passenger movement and 67% of the freight traffic<sup>1</sup>, thus accounting for very high fuel consumption and CO<sub>2</sub> emissions. Presently, the growth rate of Indian vehicle fleet is exceeding the growth rate of economy. The growth rate and increasing density of vehicle population can be attributed to rising urbanization, which in turn leads to increased energy consumption subsequent carbon emissions. The current trend of population growth and urbanization, along with increased use of private motorized vehicles is adding pressure to India's meager energy resource base. Thus, it has become imperative to adopt instruments that can improve energy efficiency and thereby regulate energy demand and consequent emissions from transport sector, in particular passenger road transport. In this context, this MRV framework for transport will focus on the two key measures in the context of passenger road transport sector: Vehicle Fuel Efficiency Program and Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme. Both these measures are aimed at improving vehicle technology and have the potential to reduce emissions from India's passenger transport segment.

### **1. Vehicle Fuel efficiency Program:**

In the total energy demand arising from the transport sector, road transport sector accounts for a significant share. As per the study done by the Petroleum Planning & Analysis Cell (PPAC) of the Ministry of Petroleum & Natural Gas (MoPNG), road transport, in particular private and commercial passenger vehicles consume around 38% of the diesel and two-wheelers and cars consumed 95.75% of the total petrol. Going by these estimates, in 2017-18, the total high speed diesel consumption by road passenger vehicles was around 30.8 million tonnes (MT) and total petrol consumption by cars and two-wheelers was 25 MT (TERI Analysis).

In addition to this, emissions linked with increased transport energy demand remain a key concern for India's mitigation targets. As per IEA estimates, in 2015 India's transport sector accounted for 13.2% of the overall CO<sub>2</sub> emissions from fuel combustion by different sectors. Within Indian transport sector, road transport accounted for the highest share of 87%<sup>2</sup>. In this context, implementing **fuel economy norms and emission standards** are being recognized as effective regulatory instruments by Indian Government to reduce the average fuel consumption by vehicles. This in turn will be instrumental in reducing India's oil import dependency and GHG emissions.

### **Direct or Indirect Impacts:**

- **Fuel Economy Standards:**

In January 2014, the Government of India notified the country's first fuel economy standards for light-duty passenger vehicles (LDVs) with Gross Vehicle Weight (GVW) under 3500 kg.

---

<sup>1</sup> <http://morth.nic.in/showfile.asp?lid=3141>

<sup>2</sup> [https://uic.org/IMG/pdf/handbook\\_iaa-uic\\_2017\\_web3.pdf](https://uic.org/IMG/pdf/handbook_iaa-uic_2017_web3.pdf)

The fuel efficiency standards for LDVs are expected to reduce CO<sub>2</sub> emissions by 50 million tons by 2030<sup>3</sup> and will achieve energy savings of 22.97 MTOE by 2025<sup>4</sup>.

- **Emission Standards:**

In April 2017, Bharat Stage IV (BS IV) emission standards were implemented across the country for all vehicle categories. The implementation of BS IV was a major step towards addressing the issue of extremely high levels of pollution across Indian cities. The implementation reduced the limit on sulfur content in petrol and diesel to 50 ppm from 150 and 350 ppm respectively. With the implementation of BS VI norms by 2020, it is expected to further reduce sulfur content up to 10 ppm for both diesel and petrol<sup>5</sup>

### **Existing MRV approaches:**

- **Fuel Economy Standards:**

The Bureau of Energy Efficiency (BEE) under the Ministry of Power is the regulatory body and the designated agency for formulating the Fuel Economy norms for LDVs (GVW < 3.5 tons) and Heavy Duty Vehicles (GVW > 12 tons). The Ministry of Road Transport and Highways (MoRTH) is responsible for implementing these standards. The target fuel consumption for both LDVs and HDVs is determined in terms of l/100km.

The standards for LDVs, which was implemented in April 2017 is based on Corporate Average Fuel Economy (CAFE)<sup>6</sup>, which set the annual corporate average CO<sub>2</sub> emission target for new cars at 130g/km in 2017 and 113g/km in 2022 for every automaker. The standards for HDVs for new vehicles manufactured from April 2018 onwards will be tested on the basis of constant speed fuel consumption.

- **Emission Standards:**

In 2013, under the 'Auto Fuel Vision and Policy 2025', MoPNG rolled out the emission and fuel roadmap up to 2025 which led to the implementation of BS IV norms across the country. The norms set the emission targets for Carbon Monoxide (CO), Hydrocarbons (HC), Nitrogen Oxide (NOx) and Particulate Matter (PM) in terms of g/km and also set the sulphur content limit for both diesel and petrol. Subsequently, a new draft notification announced by MoRTH in 2016 has proposed the pan India implementation of BS VI by 2020.

### **Existing data collection systems, monitoring systems:**

- **Fuel Economy Standards:**

The Ministry of Road Transport and Highways (MoRTH) has enforced the Fuel Economy Standards and it also specifies the provisions related to testing and calculation methodologies,

---

<sup>3</sup>

<http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCC%20C.pdf>

<sup>4</sup> [http://www.ecmaindia.in/Uploads/image/84imguf\\_Sh.SaurabhDiddiMs.DeepshikhaWadhwa\(BEE\).pdf](http://www.ecmaindia.in/Uploads/image/84imguf_Sh.SaurabhDiddiMs.DeepshikhaWadhwa(BEE).pdf)

<sup>5</sup> <https://www.transportpolicy.net/standard/india-fuels-diesel-and-gasoline/>

<sup>6</sup> Based on sales-volume weighted average for every automaker

reporting, conformity of production and consequence of non-compliance in consultation with other concerned ministries. In any fiscal year the manufacturers and importers shall comply with the average fuel consumption standard. In case of HDVs, to ensure conformity of production as per the specified norms a check will be conducted by the ministry once in every two years.

- **Emission Standards:**

MoRTH is the nodal authority for setting up the emission standards while states and municipalities are responsible for their enforcement. Government owned autonomous testing agencies are responsible for type approval and conformity of production (COP) certification for new vehicles<sup>7</sup> at the manufacturing stage.

In case of inspection and maintenance for on-road vehicles, only commercial vehicles undergo periodic checks while private motor vehicles are currently not required to undergo any such inspections.

## **2. Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME):**

Considering the fact that transport sector in India is a major consumer of crude oil and road transport accounts for more than 80% of the fuel consumption. Emissions from transport sector are also a cause of concern and therefore, the government is focusing on partnering with industries to invest in sustainability mobility solutions (Gulati, 2012) . Hence, as a part of initiating and implementing these solutions the National Electric Mobility Mission Plan (NEMMP) 2020 was launched by Government of India in 2013 and it aims to achieve national fuel security by promoting hybrid and electric vehicles in the country. Through the mission the government targets to gradually ensure a vehicle population of about 6-7 million electric/hybrid vehicles in India by the year 2020. Under the mission, the FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) scheme was launched in 2015 with an annual outlay of 75 Cr.

Government is coming out with a composition of fiscal and monetary incentives to promote the uptake of the policy:

- Demand creation by incentivising buyers to purchase electric/hybrid vehicles by providing monetary support.
- Focus on in house technology development and domestic production
- Supply side incentives
- Promoting charging infrastructure

### **Direct or Indirect Impacts:**

The direct impact as outlined by the Government will be expected savings of 9500 million litres of crude oil equivalent to INR 620 billion. savings if targeted sales will be reached. Government with the help of composite schemes and incentives aims to make hybrid and electric vehicles to

---

<sup>7</sup> <https://www.transportpolicy.net/standard/india-compliance-and-enforcement/>

be the first choice of buyers which will further ensure to provide a clean and gasoline free transportation option to the people and will eventually reduce the oil import burden.

**Existing MRV approaches:**

National Automotive Board (NAB) under the Department of Heavy Industry (DHI) is responsible for overseeing the uptake status of EVs and the subsequent fuel savings and CO<sub>2</sub> reductions.

**Existing data collection systems, monitoring systems:**

Ministry of Heavy Industries & Public Enterprises, Department of Heavy Industry (DHI) along with consultation from National Automotive Board (NAB) will be implementing the policies and recommendations. The funding for any new schemes will be done either through augmentation of already existing funds or through new allocations. The proposal of schemes/initiatives, reviewing and monitoring of various initiatives will be done by NATRiP Implementation Society (NATIS)/ National Automotive Board (NAB) with the support of the Working Group on Demand & Supply with representation from all the stakeholders. NATIS/NAB will also be responsible for the recommendations of the course corrections, if required, for the consideration and decision of the National Council Electric Mobility (NCEM) and National Board for Electric Mobility (NBEM) (Gulati, 2012).

India's fast paced development has come up at a cost of unsustainable energy use and fuel consumption, the increased transport demand has resulted in increased environmental impacts. Hence, the way transport sector of India shapes its expansion trajectory will determine the future sustainability of the crucial resources and the ecology. Considering India's response towards development of policies towards 2030 mitigation goal in the transport sector and its endeavor towards a low carbon economy this study will broadly focus on the policies which will increase the efficiency of the passenger road transport sector; Fuel Economy and Emission Standards in particular will play an important role towards this direction. Apart from this, the study will also look into the electric mobility framework of the Indian Government. The analysis will further look into the related policies and programs for these two major initiatives and their implementation pathway.

## Buildings

---

Building stock in India is expected to reach about 10,400 million sq meters by 2030 as compared to year 2005 (Environmental Design Solutions Ltd, 2010). With the growing infrastructure requirement, the need for energy from the buildings is also expected to grow exponentially. Buildings are responsible for consuming close to about 40% of the electricity and are projected to consume 76% by 2040 (Center for Science and Environment, 2014). In artificially conditioned buildings, about 60%-70% of the energy is linked to space cooling and providing comfort to its occupant. Therefore, it becomes important to acknowledge the policies and code which could help India, to tap the growing energy demand from the buildings and parallelly meet its obligations submitted to UNFCCC. ECBC and star labeling program for buildings are the two most important policies lined by the government of India in the biennial report submitted to UNFCCC to tap the GHG mitigation from the buildings sector. The present scope of work will focus on analyzing the potential impact of various policies and their implementation pathways. The present scope will target large new commercial building and will analyze impact of various as a policy package. The various policies which would be analyzed to develop an MRV mechanism for building sector are as detailed below

### **1. Energy Conservation Building Codes (ECBC) 2007 (Revision 2017)**

The Energy Conservation Building Code (ECBC) was developed by Govt. of India for new commercial buildings on 27th May 2007. ECBC sets minimum energy standards for new commercial buildings having a connected load of 100kW or contract demand of 120 KVA and above. While the Central Government has powers under the EC Act 2001, the state governments have the flexibility to modify the code to suit local or regional needs and notify them. Currently eight States and Union Territories (Rajasthan, Odisha, UT of Puducherry, Uttarakhand, Punjab, Karnataka, Andhra Pradesh and Telangana) notified and adopted the code for their states.

### **2. BEE Star Rating Program for Buildings**

The voluntary scheme for star rating of commercial buildings was developed with an aim to create a market pull for energy efficient buildings and wider adoption of ECBC. Currently the scheme is applicable to Day use Office Buildings, Shopping Malls and BPOs. The star rating for Hospitals was also included with a statistical model using regression and distribution analysis to rate the actual performance of the hospital building.

### **3. National Buildings Energy Efficiency Programme**

National Buildings Energy Efficiency Program was launched to bring the investment of 1000cr for retrofit of large government and private buildings, the scheme will be implemented by Energy Efficiency Services Limited (EESL), a JV under the administration of Ministry of Power, Government of India. The Energy Efficient Buildings Programme has two business models:

- The ESCO (Energy Servicing Company) model, where the entire upfront investment is done by EESL which is paid back by the building owner from the energy saving resulted by the intervention.
- The other model is PMC (Project management consultancy), where onetime payment cost of services is paid to EESL who then support the complete project implementation. *(Official document of the program not found, only press release and program outreach material is available)*

### **Direct or indirect impacts**

The building sector is both independent and interrelated to various other sectors therefore measures taken to achieve energy efficiency and green growth in the sector is bound to have multiple benefits and co-benefits providing both social, economic and environmental benefits

#### 1) Social Benefits

- Safe living conditions
- Thermally and visually comfortable living conditions
- Better indoor quality

#### 2) Economic Benefits

- Creation of Green Jobs
- Lower electricity bills for tenants
- Lower construction cost for Developers
- High property value for developers

#### 3) Environmental Benefits

- Maximize Energy Savings. It is estimated that Energy Efficient (EE) buildings can save up to 20%-50% energy (United Nations Development, India Programme, 2011)
- Reduced GHG Emissions
- Combatting Climate Change

### **Existing MRV approaches:**

At present there is no MRV framework established or followed in the country to check the compliance of the building sector with the code.

Buildings in India come under the purview of state government. Therefore a code existing at central level is required to be adopted by the state government to make the code applicable. Once the code is made mandatory by the state government, it is then the responsibility of the State Development agencies (SDAs) for implementation and enforcement of code at municipal level. The enforcement authority is generally with the municipal authorities in form of building byelaws,

which form the basics of requiring clearances for construction of buildings. The local building department has jurisdiction for determining the administrative requirements relating to permit applications. Due to lack of capacities and relevant information.

## Bibliography

- Berardi, U. (2017). A cross-country comparison of the building energy consumptions and their trends. *Resources, Conservation and Recycling*, 123, 230-241.
- Center for Science and Environment. (2014). *Energy and Buildings*. New Delhi: CSE.
- Centre for Science and Environment. (2013). *ENERGY AND BUILDINGS*. New Delhi: Centre for Science and Environment.
- Environmental Design Solutions Ltd. (2010). *Reducing GHG Emissions in the Building Sector in India*. New Delhi: Environmental Design Solutions Ltd.
- Global Buildings Policy Network. (2013). *The Potential for Change in India: How to achieve Deep Savings in Energy Consumption from Buildings and CO2 Mitigation*. Global Buildings Policy Network.
- GOVERNMENT OF INDIA, MINISTRY OF URBAN DEVELOPMENT. (2016). *HANDBOOK OF URBAN STATISTICS*. New Delhi: GOVERNMENT OF INDIA, MINISTRY OF URBAN DEVELOPMENT.
- Gulati, V. (2012). *National Electric Mobility Mission Plan (NEMMP)2020*. New Delhi: Department of Heavy Industry, Government of India.
- Hoffman, A. J., & Henn, R. (2008). Overcoming social and psychological barriers to green buildings. *SAGE*, 21(4), 390-419.
- MoEF, GoI. (2015). *India: First Biennial Update Report to the United Nations Framework Convention on Climate Change*.
- MoRTH. (2018). *Road Transport Year Book 2015-16*. New Delhi: GoI.
- Nielsen. (2013). *AI India Study on Sectoral Demand of Diesel & Petrol*. New Delhi: Petroleum Planning and Analysis Cell.
- United Nations Development, India Programme. (2011, February 4). Energy Efficiency Improvement in Commercial Buildings. *United Nations Development, India Programme, Global Environment Facility Program Development*, p. 83.
- Berardi, U. (2017). A cross-country comparison of the building energy consumptions and their trends. *Resources, Conservation and Recycling*, 123, 230-241.
- Center for Science and Environment. (2014). *Energy and Buildings*. New Delhi: CSE.
- Centre for Science and Environment. (2013). *ENERGY AND BUILDINGS*. New Delhi: Centre for Science and Environment.
- Environmental Design Solutions Ltd. (2010). *Reducing GHG Emissions in the Building Sector in India*. New Delhi: Environmental Design Solutions Ltd.

- Global Buildings Policy Network. (2013). *The Potential for Change in India: How to achieve Deep Savings in Energy Consumption from Buildings and CO2 Mitigation*. Global Buildings Policy Network.
- GOVERNMENT OF INDIA, MINISTRY OF URBAN DEVELOPMENT. (2016). *HANDBOOK OF URBAN STATISTICS*. New Delhi: GOVERNMENT OF INDIA, MINISTRY OF URBAN DEVELOPMENT.
- Gulati, V. (2012). *National Electric Mobility Mission Plan (NEMMP)2020*. New Delhi: Department of Heavy Industry, Government of India.
- Hoffman, A. J., & Henn, R. (2008). Overcoming social and psychological barriers to green buildings. *SAGE*, 21(4), 390-419.
- MoEF, Gol. (2015). *India: First Biennial Update Report to the United Nations Framework Convention on Climate Change*.
- MoRTH. (2018). *Road Transport Year Book 2015-16*. New Delhi: Gol.
- Nielsen. (2013). *AI India Study on Sectoral Demand of Diesel & Petrol*. New Delhi: Petroleum Planning and Analysis Cell.
- United Nations Development, India Programme. (2011, February 4). Energy Efficiency Improvement in Commercial Buildings. *United Nations Development, India Programme, Global Environment Facility Program Development*, p. 83.