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Framework for Measurement, Reporting and Verification (MRV) of Low Carbon Actions for Local Government

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Developed By:

**ICLEI- Local Governments for Sustainability,
South Asia**

Framework for Measurement, Reporting and Verification (MRV) of Low Carbon Actions for Local Government is prepared by ICLEI -South Asia, under project ***“Integrating Urban Climate Guidelines through Clean Technologies (RE & EE) at the State and City level to build sustainable low carbon cities, Rajasthan & Tamil Nadu”*** funded by ***British High Commission***. This report provides the details on the process of formulation of a MRV framework at city level for the measurement, reporting and verification of the projects undertaken as per the requirement of climate change mitigation actions/plans.

Local governments are invited to use this MRV framework to measure and report their climate change mitigation actions/plans, finance and to verify GHG emissions reductions at local government level. Other stakeholders are welcome to give their comments. All feedback should be sent to iclei-southasia@iclei.org or kavita.singh@iclei.org.

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Abbreviation and Acronyms

AFOLU	Agriculture, Forestry, and Land Use
BAP	Bali Action Plan
BEE	Bureau of Energy Efficiency
CAA	Constitution Amendment Act
cCCR	Carbann Cities Climate Registry
CLCCC	City level Committee on Climate Change
CDM	Clean Development Mechanism
COP	Conferences of Parties
DLCCC	District Level Climate Change Committee
EE	Energy Efficiency
GHG	Green House Gases
IEA	International Energy Agency
ICP	India Community Protocol for accounting & reporting Greenhouse Gas Emissions
IPCC	Inter Governmental Panel on Climate Change
IPPU	Industrial Process and Product Use
LCAP	Low Carbon Action Plan
LED	Light Emitting diode
M & R	Monitoring & Reporting
MoUD	Ministry of Urban Development
MRV	Measurement, Reporting and Verification
NAMA	Nationally Appropriate Mitigation Actions
NAPCC	National Action Plan on Climate change
NMSH	National Mission on Sustainable Habitat
NUDB&I	National Urban Databank and Indicators
NUIS	National Urban Information System
NUO	National Urban Observatory
OM	Operations and Maintenance
QC	Quality Check
RE	Renewable Energy
SLACC	State Level Apex Coordination Committee
UNFCCC	United Nations Framework Convention on Climate Change
ULBs	Urban Local Bodies
USIS	Urban Spatial Information System
VU	Verification Unit

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1. Introduction & Background

The issue of tackling the adverse effects of climate change is now a prime concern globally and requires a sound, robust and practical response for its remediation. As we are already aware of the impact of greenhouse gas emissions to the earth's climate, our emphasis must now focus on reducing the Global GHG emissions to a large extent.

As nations aim for increasingly ambitious climate mitigation goals, they face an intense need to track their greenhouse gas (GHG) emissions reduction targets and actions that reduce emissions.

Cities and metropolitan regions have tremendous potential in reducing and stabilizing the GHG emissions. Many cities in the world are in process of implementing Low Carbon Action Plans (LCAPs) to mitigate the climate change. Such LCAPs are expected to have the potential of contributing to the reduction and to a certain extent limitation of GHG emissions at local level. These plans strive towards initiating and thereafter sustaining a low carbon growth for an economy, aligning economic development with climate change mitigation measures. Many times, such actions go unnoticed, as there is no consistent guidance for monitoring and reporting of these actions in terms of GHGs. This calls for development of robust, consistent, transparent and institutionalized Measurement, Reporting and Verification (MRV) framework/system to analyze local sustainable development efforts of the cities.

To gain recognition and to rectify LCAPs, there is an urgent need to establish MRV framework for tracking reduced greenhouse gas emissions and the actions at city level. Nevertheless, the MRV system is not only applied to emissions reduction but goes beyond it, as it will help in measuring and monitoring of other components like technology, finance and capacity building need and it will also help cities in recording and reporting of data. Such measurement, reporting and verification system not only quantify GHG emissions reductions of cities' local action plans but also help to achieve national reduction targets.

The *India Community Protocol for Accounting & Reporting Greenhouse Gas Emissions (ICP)* is an ICLEI South Asia's initiative with support from Cities Climate Centre, ICLEI Local Governments for Sustainability, World Secretariat, Bonn, Germany. ICLEI South Asia has developed this protocol under the project on ***"Integrating Urban Climate Guidelines through***

Box 1 : Paragraph 1(b)(i)(ii) of Bali Action Plan¹:

The language on "measurable, reportable and verifiable" (MRV) was first introduced during Bali negotiations. The new concept of MRV has emerged in Bali Action Plan (BAP), which has created roadmap to track mitigation actions of both the developed and developing countries.

Paragraph 1(b)(i) of Bali Action Plan: Measurable, reportable and verifiable nationally appropriate mitigation commitments or actions, including quantified emissions limitation and reduction objectives, by all developed country Parties, while ensuring the comparability of efforts among them, taking into account differences in their national circumstances;

Paragraph 1(b)(ii) of Plan (BAP) also includes that nationally appropriate mitigation actions of the developing country in the direction of sustainable development should also supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner.

Source: Report of the Conference of the Parties on its thirteenth session

¹ Source : ***Report of the Conference of the Parties on its thirteenth session, held in Bali***
<http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf>

Clean Technologies (RE & EE) at the State and City Level to build sustainable low carbon cities” in Tamil Nadu and Rajasthan states. This Protocol provides guidance for Indian cities on preparation of the GHG emissions inventory. This is the first such document available for local governments in any developing country. **To carry the ICP forward, ICLEI-SA has proposed a MRV framework for local governments to monitor, report and verify the low carbon actions from the projects in below mentioned sectors covered under ICP.**

- (1) Stationary units (Energy/Electricity consumptions in buildings- residential, commercial, industrial & others)
- (2) Mobile units (Transport sector)
- (3) Waste
- (4) IPPU (industrial process and product use)
- (5) AFOLU (agriculture, forestry, and land use)
- (6) Other indirect emissions.

1.1. Need of MRV framework for local governments:

In current scenario, city governments are taking initiatives to implement LCAPs at city level but on the other hand, city governments are not monitoring and reporting the performance of LCAPs and also not verifying the resultant reductions. Because of lack of such system, they are not able to report emission reductions at national and international level. The need of the hour is to sensitize the local governments to collect, monitor and verify data at central level which will help them in better planning and usage of funds. Such a system will ensure that the data calculations are not based on assumptions but recorded through primary data.

The MRV framework needs to be initiated at city level first and then to proceed towards districts, states and eventually the entire nation. This will help in systematically focusing on developing the complete MRV framework for the country through a unit based approach. This process will help in better alignment of efforts undertaken by central /state governments towards mitigation of climate change impacts and the actions taken by local governments.

1.2. Target Users in the Urban Governance Structure

The Indian administration system is a three-tier system comprising the Central government, State governments and Local governments. The urban laws and rules are framed by the central government and are implemented by States with the help of local governments. The constitution divides areas for action in central, state and concurrent lists to define primary action responsibility. The local governance performs at two levels at city level and rural level. At city level we have Municipal Corporations and Municipal Councils depending upon population and area. The main responsibility of all these government institutions is to provide better public amenities to its citizen and to maintain law and order in the state.

The MRV framework is intended for adoption by city governments or local authorities having defined in previous paragraph that exercise jurisdiction over a defined geographic area. MRV framework can also be useful for sub-national entities such as towns, districts and states pursuant to appropriate modifications. Academics, NGOs, or other parties/agencies representing the local authority may also use the MRV framework.

1.3. Purpose of MRV Framework & Objectives

The proposed MRV Framework provides guidance for Indian cities on measuring, reporting and verification of low carbon actions. It also provides qualitative and quantitative information on what GHG mitigation actions are being taken up by different cities. It also gives assurance to stakeholders that mitigation actions meet clear standards and their implementation is carefully measured, progress reported and the results are verified. Such a system aiding the progression of the entire world towards a climate friendly environment, can enable learning and implementation by identifying which policies are effective, and the type of support (financial, technical or capacity building) developing countries need in order to develop and implement climate change mitigation programs.

MRV framework aims at making the cities proceed towards a greener environment effectively and efficiently by taking into account the following:

- Estimation and evaluation of the reduction in cities GHG emissions.
- Enabling appropriate application of Nationally Appropriate Mitigation Actions (NAMAs) by the local bodies with the help of the proposed MRV framework.
- Helping in the utilization of funds for setting up of low carbon projects, while also assessing the usage of funds for existing facilities/projects installed in the cities.
- Receiving support from developed countries in form of finance, capacity building and technological Support

Hence, the MRV framework is needed to provide a strong and robust mechanism to keep a check on the finances used for already existing LCAPs within the cities, help obtain funds for setting up new projects by confirming efficient distribution and utilisation of funds for the same, help in the advancement in the field of technology for the purpose of GHG emissions reductions, capacity building and ensure proper measurement, reporting and verification of LCAPs, in order to progress towards lowering the GHG emissions at the city level. The basic components of Measurement, Reporting and Verification (MRV) are explained graphically in **Figure 1**.

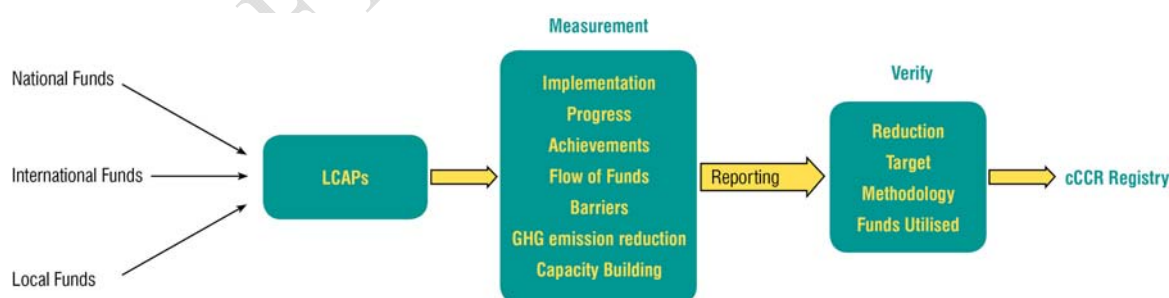


Figure: 1 Components of proposed MRV framework for ULBs

“**Measurement**” is to keep track of 1) Greenhouse gases-- all of the emitted and reduced gases or those avoided through LCAPs and 2) the support provided in the form of financing, capacity building and technologies.

Measurement is the first essential element in an overall assessment of the efficiency in implementing any LCAP. It consists of the collection of essential data needed to conduct reporting and ultimately, verification. What is required for measurement entirely depends on the ultimate claims that are to be made as part of the LCAPs. Although, generally, monitoring will be associated with the measuring of emissions, there are also other elements that may require monitoring.

In the current context ‘measurement’ is often used interchangeably with ‘monitoring’. The two are not the same, however, and are not equally feasible in all contexts. In simple terms, all that can be measured can also be monitored; but not all that is monitored can be necessarily measured quantitatively. As the original texts in the Bali climate negotiations speak of ‘measurement’, this term is used throughout this framework.

“Reporting” is to report progress on GHG emissions reductions and climate-related activities. Reporting measures are necessary to create greater transparency. It can comprise the documentation requirements that are essential for the accountability and transparency. Reporting not only helps assess the information regarding the success of the climate actions under LCAPs but also highlights flaws (if any) in the action plans for further suggestions leading to the improvisation of the actions implemented. It also helps policy-makers to get associated with and arrive at decisions as well as opinions for local climate action and makes local climate action transparent, effective and thus, trustworthy. For reporting to be done at the local government level, it should be on a common standard basis for each city so that when the verification is done by other state officials or of the same state, the data provided are in a comparable layout to avoid any complications.

“Verification” is to verify reported information regarding the various sector specific projects on GHG emissions reductions to ensure its accuracy and also confirm that standard and effective methodologies for monitoring mitigation progress have been applied. Verification allows for accountability and comparability of information which can later help cities and local governments access global climate adaptation and mitigation funds.

To get international recognition and to raise the finance for implementing the projects, cities can also report their GHG emissions reduction, commitments and implemented low carbon actions on web based global reporting platform Carbonn Cities Climate Registry (cCCR) <http://citiesclimateregistry.org/>. The carbonn Cities Climate registry are online platforms for reporting and displaying cities' local climate activities and achievements.

1.4. Eligible Projects under proposed MRV framework

Projects taken up under various LCAPs for the purpose of obtaining the desired reduction in the GHG emissions would be eligible under the proposed MRV framework along with analysis and monitoring of fund/finance for the implementation of those projects in the city. This will include the projects covered under six sectors identified in ICP. Few indicative projects are:

Indicative examples of Renewable Energy (RE) projects:

- a. Solar water heater installations
- b. Biogas generation plants
- c. Solar PV roof top installations
- d. Any other projects on renewable energy,

Indicative examples of Energy Efficiency (EE) projects:

- a. Replacing incandescent bulbs with high efficient LED lighting system
- b. Replacement of various inefficient equipment in processes, such as water supply, sewage and sewerage, treatment of waste water, etc
- c. BEE Star rated EE equipments (Fans, Air conditioners, Refrigerators, EE pump etc.)
- d. EE street lighting etc

2. Process Flow & Principles of proposed MRV Framework:

2.1. Process Flow

The key components of proposed MRV process are given below:

- Clear identification of an entity or entities by Urban Local Bodies (ULBs) responsible for implementing, measuring, reporting and verifying mitigation actions and determination of the appropriate roles and responsibilities.
- Establishment of a system for collection of all relevant data, sources, and methodologies, including any models used for projections. All sectors should follow the sector/project specific guidelines for monitoring the data and methodologies. Monitoring templates for some of the projects are given in the **Annexure 1**. Monitoring template for fund/finance utilization is also given in **Annexure 2**. It can be further modified depending upon the requirement.
- Appropriate selection of performance indicators to measure progress in implementation of mitigation actions, procedures for reporting and collecting performance indicator data. Systematic reporting system/structure should explain methodologies for data collection, uncertainty analysis, quality control and quality assurance. Such reporting system can be established by local government, which can serve two functions. First, they identify the information that is important for an assessment of mitigation actions. Second, they ensure that the information provided can be compared and verified. Standardized accounting and reporting format that has been proposed for emissions reduction under ICP is given in **Annexure 3**.
- A system of quality assurance and control to ensure reliability of data and performance indicators.
- A process for verifying implementation of actions and the relevant performance indicators. Verification of local mitigation actions/project depends on three key factors: (1) the degree to which reported data is capable of being verified; (2) the entities who conduct the verification, and (3) the manner and system under which verification is performed. Verification can be performed either on the basis of direct observation or through indirect indicators. Direct observation includes periodical on site inspection. Verification should be carried out by local government for the following activities,
 - Methodology used in monitoring and reporting
 - Implementation of the technology/measure
 - Implemented countermeasures for mitigation
 - GHG emissions calculation methodology and emissions factors applied
 - Reduction targets achieved
 - Fund utilization, if applicable

- Accuracy of data collection method
- Outcome of the Action plan
- Verification of LCAPs can be done in three ways by local governments
 - i) Self verification, where cities verify their own LCAPs.
 - ii) Intercity verification system, in such system city verification report can be verified by the identified partner city.
 - iii) Third party verification, where verification can be done through nationally or internationally accredited auditor.
- A process for reporting information in a way that is transparent, consistent, comparable, and complete, that will be made available to the public through global reporting platform Carbons Cities Climate Registry (cCCR) <http://citiesclimateregistry.org/>.
- Process flow of MRV is given in **Figure 2**

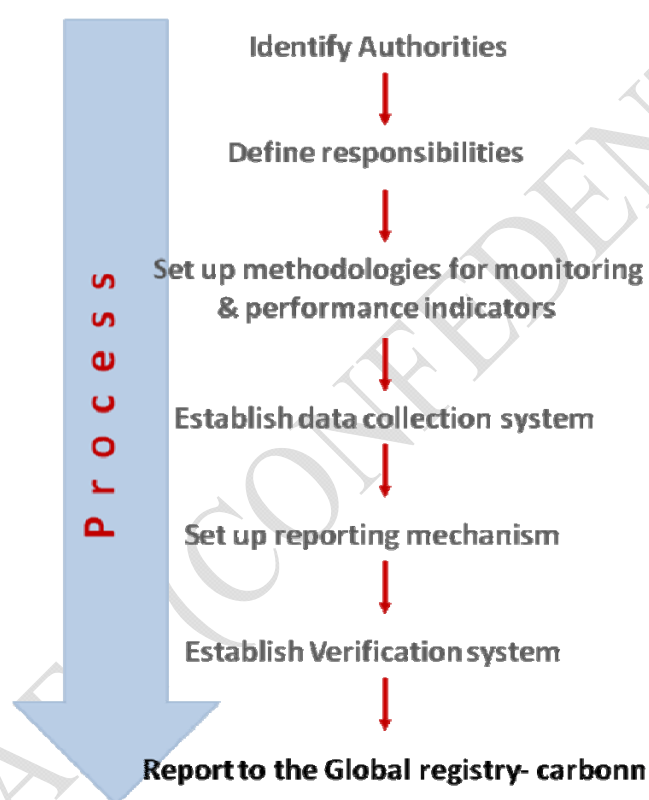


Figure 2: Process flow of MRV

2.2. MRV Principles

MRV principles defining good practice for the purpose of emissions calculations and emissions reduction actions in MRV framework are as follows:

1. Consistency: Data, methods, criteria, and assumptions should allow meaningful and valid comparisons of the GHG emissions reductions achieved by different projects;
2. Transparency: Sufficient information should be disclosed to allow reviewers to make decisions about the credibility and reliability of GHG emissions reduction claims with reasonable confidence;

3. Accuracy: Uncertainties and bias should be reduced as far as is practical. Greater accuracy in estimating GHG emissions reductions will help ensure credibility of reduction claims;
4. Conservativeness: Conservative assumptions, values, and procedures should be used to ensure that GHG emissions reductions are not over-estimated; and
5. Practicality and efficiency: Whenever possible, minimize transaction costs.

3. Institutional Framework for implementation of proposed MRV Framework for Local Governments:

Establishing clear long term institutional arrangements, roles and responsibilities is essential in order to design, establish and manage an MRV framework. MRV might be highly centralized and coordinated across various government entities for the coordination of administrative and technical duties, quality checking of reported measurements and fulfillment of procedural requirements. MRV framework for LCAPs that are characterized as a specific measure is likely to be the responsibility of a single entity in charge of implementing that measure, but specific tasks may be delegated to other entities. For example, the Bureau of Energy Efficiency (BEE) may be responsible for implementing and overseeing national energy efficiency standards, but on ground implementation and verification of these standards may be conducted by local agencies. Given below is the institutional framework for implementation of MRV at city level:

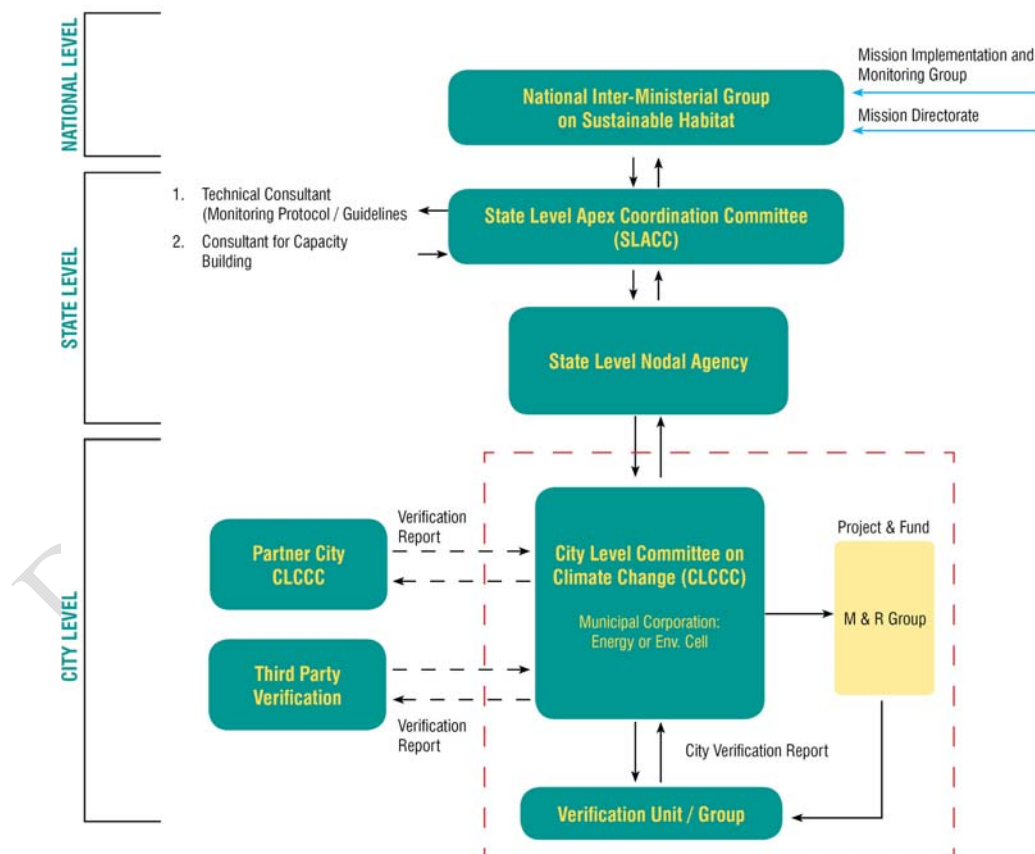


Figure 3 Institutional structure for MRV framework

Government of India has prepared the National Action Plan for Climate Change (NAPCC) under Prime Minister's Council on Climate Change and eight missions have been proposed under this Action Plan (**Box 2**). It was a major initiative taken by the Indian Government towards addressing the climate change concerns through establishment of dedicated sectoral missions (NAPCC,2008). As a part of this, it was felt Monitoring and Evaluation mechanisms are essential for effective implementation of these missions and accordingly mechanisms have been developed for each mission.

Box 2 Eight missions proposed under National Action Plan for Climate Change

- 1) National Solar Mission
- 2) National Mission for Enhanced Energy Efficiency
- 3) National Mission on Sustainable Habitat
- 4) National Water Mission
- 5) National Mission for Sustaining the Himalayan Ecosystem
- 6) National Mission for a "Green India"
- 7) National Mission for Sustainable Agriculture
- 8) National Mission on Strategic Knowledge for Climate Change

Source: NAPCC (2008)

This is likely to be a be a critical aspect in India's initiatives towards mitigating climate change and requires greater clarity regarding the systems, processes, institutional set up and role of relevant institutes. Institutional frame work for monitoring the National Mission on Sustainable Habitat (NMSH) has already been proposed. A detailed institutional arrangement for monitoring and implementation of NMSH is given in **Box 3**. The National Committee under NMSH will guide the state and local level committees for the development of MRV guidelines and protocols for the local governments and their implementation. NMSH mainly focus on residential and commercial building sector, water supply and waste management, urban transport and urban planning but for RE and EE projects there is a need to involve experts from relevant departments and agencies.

Box 3 : National Mission on Sustainable Habitat

The National Mission on Sustainable Habitat aims to promote sustainability of habitats through improvements in the energy efficiency of buildings, urban planning, improved waste management systems, and promoting public transport by making appropriate changes in the legal and regulatory framework.

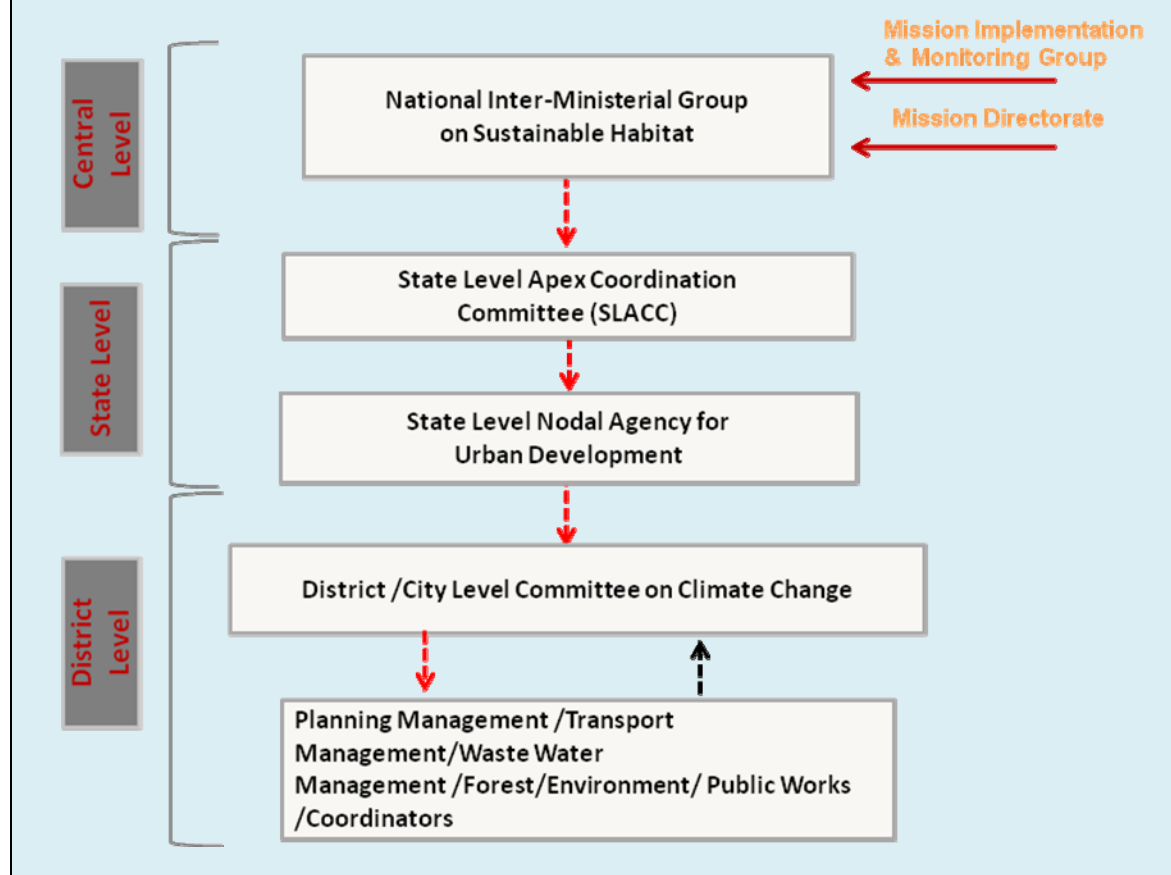
Institutional Frame work

At the central level, the NMSH envisages a National Inter-Ministerial Group on Sustainable Habitat headed by the Secretary (Urban Development), with representation of all ministries. The IMG shall set policies for implementation, monitor and review progress and suggest correctives where necessary. It shall also sanction projects/activities in pursuance of the objectives of the mission. A Mission Directorate will be set up in the Ministry of Urban Development (MoUD) to carry out day-to-day monitoring of all activities and receive proposals from legislative bodies at all levels. The Directorate will be assisted by all relevant institutions in the area. At the state level, the activities will be coordinated by a State Level Apex Coordination Committee (SLACC) headed by the State Chief Secretary. These state coordination committees will be supported by state nodal agencies which would invite project proposals, appraise them and manage and monitor the mission. At the district level, a District Level Climate Change Committee (DLCCC) shall be headed by the District Collector with the district planning committees to be

strengthened to mainstream climate change vulnerabilities into their five-year and annual plans wherever possible

Monitoring:

The NMSH will be monitored at the apex level by the National Inter-Ministerial Group on Sustainable Habitat, which will act both as the implementation and also as the monitoring group. The Mission Directorate will also be under it. These institutions at the central level will be assisted by the State Level Apex Coordination Committees (SLACC) at the state levels with the state nodal agency for urban development under it. These will monitor the progress of NMSH at the state level. At the district level, there will be a committee on climate change under which different committees would be formed for planning management, transport management, waste water management, forest management, and management of environment, public works and other coordination mechanisms to be set up.



City Level Committee on Climate Change

City Level Committee on Climate Change (CLCCC) as proposed under NMSH will be responsible for the effective implementation of the monitoring and evaluation system to track the project goals, progress and fund utilization activities in cities. Under CLCCC, it is proposed to set up a Monitoring and Reporting (M&R) Group that would comprise of 2-3 technical experts (engineers) and a finance expert, who would be responsible for the monitoring and reporting of the projects and funds management. The monitoring and reporting group will ensure the quality assurance and control. Quality Check (QC) activities include general methods such as accuracy checks on data acquisition and calculations, use of approved standardized procedures and

guidelines developed by technical consultant under state level committee. The M & R group would compile the data of the all sectors in the standardize formats and send to the Verification Unit, also proposed to be set up.

Verification Unit could comprise of 3-4 technical experts from various sectors. As stated in the earlier section, verification of LCAPs can be done in three ways - self verification, inter-city verification and third party verification. In self verification system CLCCC can verify LCAPs on their own and can directly send their Verification Report to the State Level Committee. Another option available for cities is to go for inter-city verification system. They can send their Verification Report to a partner city for verification. The verification unit of the Partner CLCCC could verify it through very limited sampling and send verification report to that city. In the third party verification system, city can identify an international accredited organization to audit and provide the Verification Report.

For the transparency of the system, and to facilitate effective implementation of MRV system, it is suggested that data exchange facilities be created between respective CLCCCs and National Urban Information System Scheme (NUIS). NUIS details are given in **Box 4**.

Cities can upload the LCAPs and GHG reduction detail on global registry at Carbons Cities Climate Registry (cCCR) <http://citiesclimateregistry.org/>. Cities can also upload and download data on NUIS.

Functions of the City Level Committee on Climate Change to implement the proposed MRV Framework are given below:

- Prepare city specific LCAPs and establish communication links with the state level committee/SLACC for the approval of the LCAPs.
- CLCCC will have extensive communication with the private sector and stakeholders for implementing LCAPs
- Responsible for implementation of MRV system/guidelines prepared by state level committee.
- Coordination with state governments/central government to access funds from different funding organizations.
- CLCCC of the each city would be responsible for formation of Monitoring and Reporting group and provide technical guidance to M & R group needed to operationalize the MRV system.
- Coordinate with M & R group to ensure the streamlining of data and flow of information
- Keep track of flow of funds from both national and international sources.
- CLCCC will also establish Verification Unit (VU) comprising of 3-4 government authorised technical experts from various sectors and guide VU to verify the reports.
- CLCCC will also approve the final MRV report of any LCAPs.
- CLCCC can decide on choice of type of verification system and responsible for final verification report.
- CLCCC would be responsible to coordinate with partner city CLCCC for the verification process, in case of inter-city verification system and also periodically inform state level committee for the verification process and results.

- CLCCC would be responsible to co-ordinate with third party for the verification, in case of third party verification, and provide them required data in required standardized format.
- CLCCC can modify the LCAPs based on MRV reports.
- For the transparency, CLCCC can establish system for the disclosure of emissions reduction under MRV.

Box 4 : National Urban Information System Scheme

The Ministry of Urban Development has launched the National Urban Information System (NUIS) Scheme in March, 2006 on National Mission Mode. The Scheme comprises of broadly two major components under a single umbrella i.e. a) Urban Spatial Information System (USIS) to meet the spatial requirements of urban planning and b) National Urban Databank and Indicators (NUDB&I) to develop town level urban database.

The major objective of NUIS Scheme is to establish a comprehensive information system in the urban local bodies for planning, management and de-centralized governance in the context of implementation of the 74th Constitution Amendment Act (CAA). One of its objectives under the National Urban Databank and Indicators (NUDB&I) component includes designing and establishing a comprehensive data bank and integration of these parameters to support planning and derive indicators for National Urban Observatory (NUO) for monitoring the health of urban settlements. Also capacity building among town planning professionals for the use of modern automated methods would be carried out under this initiative.

The focus of the National Urban Data Bank and Indicators (NUDB&I) is to collate and analyze data for various key areas such as socio-economic development, land use, transportation, housing, infrastructure, environment and governance. The ULBs with the assistance of State Nodal Agencies would develop town level urban database for all towns which are linked to the spatial database generated under USIS. The spatial and attribute databases thus generated will be useful for preparation of Master/Development plans; detailed town planning schemes and serves as decision support for e-governance. Identified project implementation frame work is given in the below flow chart.

Additional functions of Central level Committee to implement the proposed MRV framework are given below:

- Establish State Level Committee in each state for the development of state specific MRV system and ensure that such system follows international guidelines and standards.
- Design Nationally Appropriate Mitigation Measures and guide State Level Committee/SLACC to adopt these NAMAs.
- Report to UNFCCC for the details of NAMAs and MRV system as well as the achieved reduction targets under NAMAs.
- Periodically review the activities of the state level committees.
- Establish a system for the verification and review the verification reports provided by the states.

- Designate 3rd party consultant for the macro level verification.
- Coordinate with national and international funding agencies to help the state level committees or local government to access the funds and also keep track on the fund utilization activities through the MRV system.
- Committee would also coordinate with state level committee of each state for the NAMAs/LCAPs and MRV procedure and status/results/achievements.

Additional functions of the State Level Committee to implement the proposed MRV framework are given below:

- Establish communication links with the National Committee for the approval of the MRV guidelines/protocols.
- Committee would be responsible for the approval of LCAPs of the cities.
- Coordinate with different funding agencies and governments – International, national and local for the funding procedures.
- It should engage technical consultant to prepare project specific MRV guidelines and also ensure that it follows international standards. Also it will work closely with central committee for approval of developed MRV guidelines.
- State committee would also responsible to disseminate the MRV guidelines to the CLCCC in each city.
- It would be also responsible to appointment of consultant for the capacity building at city/local level for implementation of MRV guidelines developed by technical consultants.
- This committee would also coordinate with CLCCC for implementation of MRV guidelines.
- Steering committee would be responsible for the periodical review of the MRV system and redefining them when required.
- Provides guidance to the CLCCC needed to implement the MRV system in the city.
- Steering committee should provide detailed guidance on the preparation of reports, including reporting formats, templates.
- It would keep track on cities MRV process and output of the cities mitigation measures as well as achieved GHG emissions reduction.
- Keep track of flow of funds from local national and international sources and update central committee about the fund utilization activities.
- It would also be responsible for reviewing the verification report of the each city and update national committee about the progress of the LCAPs of the each city.
- It would communicate the final verification report of cities to national level committee.

4. Conclusions

Cities account for 70-80% of global carbon dioxide emissions. The impact of Greenhouse Gas emissions has resulted in serious and adverse impacts on the climate in many parts of the world. This has resulted in exacerbating stress in the urban environment. Our emphasis must now lie on reducing the emissions to the maximum extent feasible. However, measures for emissions reductions in cities are initiated by the application of LCAPs, but no concrete actions are taken to

evaluate these actions. Hence, there arises a need to prepare a framework for Measurement, Reporting and Verification of the various LCAPs applied at local government level.

The MRV framework defined here will help the cities in assessing the progress made by the cities towards a low carbon development and hence, contribute towards encouraging the reduction in their carbon footprints. It would help the local governments to meet their respective objectives and measures to contribute to the climate mitigation policies as well as track the efficiency of the implementation of various LCAPs. The MRV framework will also evaluate and compare progress with respect to other cities, towards their commitments and goals to the national government. The MRV framework will also ensure a systematic monitoring of the city's major emitting sources. The MRV system would promote effective mobilisation and use of required funds assistance from various countries and institutions and thus, aid the developing countries in resolving global problem of GHG emissions by implementing various climate friendly projects.

The framework attempts to lay down the foundation for cities level MRV framework and suggests a number of elements for a possible conceptual framework to "link" local mitigation actions with national mitigation actions, including practical considerations for how cities might measure, report and verify progress. The framework focuses on monitoring and reporting of low carbon actions by urban local bodies along with fund utilization. Also, this institutional framework defined here would help local governments to establish systematic structure at local level to track the progress of the implemented projects and funds under each sector. Such a system at local level would not only help local governments but also help State and Central governments to keep track of the mitigation actions identified under the various missions.

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Annexure 1: Monitoring templates

A. Monitoring template for Electricity generation from Renewable Energy

Applicable for following technologies: Solar PV, Wind mills, hybrid systems, biogas systems

Name of the project				
Location				
Project owner				
Technology employed				
Rated electrical Capacity (kW, MW)				
Capacity (For biogas plants), m ³				
Other technical details, if any				
Date of installation				
Date of commissioning				
Energy meter specification				
Number of days of operation				
Reasons for non-operation				
S. No	Parameters to monitor	Units	Values	Source
1	Gross electricity generation (A)	kWh/MWh		Energy meter
2	Electricity consumption by auxiliary equipments (B)	kWh/MWh		Energy meter
3	Net electricity generation ²	kWh/MWh	A-B	Energy meter
4	Biogas generation, if applicable	m ³		Flow meter
5	Other fuel usage by auxiliary equipments			
Supporting documents				
If mode of utilization of electricity is Export to grid		Joint Meter Reading (JMR), Electricity generation Report issued by State Electricity Board		

² Net electricity generation = Gross electricity generation – electricity consumption by the project (includes electricity/other fuel usages for running auxiliary equipments of renewable energy technologies).

If mode of utilization of electricity is Captive consumption	Electricity adjustment reading from monthly electricity bill issued by State Electricity Board
Calibration of meters, if any	
Monitoring frequency	
Archiving (Paper/electronic)	
QA/QC procedures, if any	
Person responsible for monitoring	

B. Monitoring template for Energy Efficiency (EE) measures

Applicable for following EE measures: Retrofitting, replacement, installation of new technology and other energy conservation measures

Name of the project				
Location				
Project owner				
Type of EE measure				
Description of EE measure				
Other technical details, if any				
Date of installation				
Date of commissioning				
Energy meter specification, if any				
S. No	Parameters	Units	Values	Source
1	Hourly electricity consumption of the installed energy efficiency equipment/measure (A)	kWh/hr		Manufacturers specification for new installations/Measured values certified by authorized personal
2	Historic hourly electricity consumption of the energy efficiency equipment/measure (B)	kWh/hr		Manufacturer's specification of discarded equipments/Measured values certified by authorized personal

3	Energy consumption ³ (C)	kWh		Energy meter
4	Hours of operation (D)	Hours	$C \div A$	Calculated value
5	Baseline energy consumption (E)	kWh	$D \times B$	Calculated value
6	Net energy savings	kWh	$E - C$	Calculated value
Supporting documents				
Readings from the corresponding energy meters could be entered in log books, which in turn could be certified by higher officials.				
Calibration details, if any				
Monitoring frequency				
Archiving (Paper/electronic)				
QA/QC procedures, if any				
Person responsible for monitoring				

C. Monitoring template for hot water generation

Applicable for following technologies: Solar Water Heaters, other hot water generation systems

Name of the project	
Location	
Project owner	
Technology employed	
Capacity (lpd)	
Other technical details, if any	
Date of installation	
Date of commissioning	
Flow specification	
Number of days of operation	
Reasons for non-operation	

³ The time duration could be defined as per the requirements of usage (Viz. weekly, monthly or annual basis)

S. No	Parameters to monitor	Units	Values	Source
1	Hot water flow/utilization (F)	m ³		Flow meter/others
2	Mass of water used (m)	kg	F x 1000	-
3	Specific heat of water ⁴ (C _p)	K Cal/kg°C	1	-
4	Average temperature of hot water (T1)	°C		Measured value using thermometer /others
5	Feed water inlet temperature (T2)	°C		
6	Energy gain by the project (Q)	K Cal	m x C _p x (T1-T2)	Calculated value
7	Efficiency of the baseline equipment in case of replacement (E1)	%		Manufacturers specification of the discarded equipment
8	Efficiency of the baseline equipment in case of green field project (E2)	%		Manufacturers specification ⁵
9	Energy savings	K Cal	Q ÷ E1 or Q ÷ E2	Calculated value
Supporting documents				
The readings could be entered in log books, which in turn could be certified by higher officials.				
Calibration of meters, if any				
Monitoring frequency				
Archiving (Paper/electronic)				
QA/QC procedures, if any				
Person responsible for monitoring				

⁴ Suitable specific heat values have to be substituted if other heating medium is used

⁵ Manufacturers specification of most commonly used equipment for hot water generation at the time of installation the project

Annexure 2: Templates for monitoring & reporting for fund/finance projects

1. Project title
2. Fund allocated
3. Equity portion
4. Loan amount
5. Funding agencies Interest rate
6. Project payback period
7. Yearly expenses
8. Any government subsidy (if yes, the amount)
9. Fund utilized this financial year
10. Fund remaining
11. Any other additional fund/support required etc.

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Annexure 3: ICP 2012 Accounting and Reporting Pilot Framework

ICP No.	IPCC Class	Scope	GHG Emissions Sources	Accounting Approach	Notation keys				GASES						Total GHGs tCO ₂ e	Data Quality		
					IE	NE	NO	NA	CO ₂	CH ₄	N ₂ O	HFC	PFC	SF ₆		H	M	L
I.			Stationary Units															
I.1			Residential Buildings															
I.1.1	1A4b	1	Direct Emissions (Scope1)	In-Boundary Fuel Combustion														
I.1.2		2	Energy Indirect Emissions (Scope2)	In-Boundary Energy Consumption														
I.2			Commercial/Institutional Facilities															
I.2.1	1A4a	1	Direct Emissions (Scope1)	In-Boundary Fuel Combustion														
I.2.2		2	Energy Indirect Emissions (Scope2)	In-Boundary Energy Consumption														
I.3			Energy Generation															
I.3.1.	1A1	1	Direct Emissions (Scope1)	In-Boundary Fuel Combustion														
I.3.2		2	Energy Indirect Emissions (Scope2)	In-Boundary Energy Consumption														
I.4			Industrial Energy Use															
I.4.1	1A2+1A5+1A4c	1	Direct Emissions (Scope1)															
I.4.2		2	Energy Indirect Emissions (Scope2)	In-Boundary Energy Consumption														
I.5			Fugitive Emissions															
I.5.1	1B	1	Direct Emissions (Scope1)															
II.			Mobile Units															
II.1			On-Road Transportation															
II.1.1	1A3b	1	Direct Emissions (Scope1)	In-Boundary Fuel Combustion														
II.1.2		2	Energy Indirect Emissions (Scope2)	In-Boundary Energy Consumption														

ICP No.	IPCC Class	Scope	GHG Emissions Sources	Accounting Approach	Notation keys				GASES						Total GHGs tCO ₂ e	Data Quality		
					IE	NE	NO	NA	CO ₂	CH ₄	N ₂ O	HFC	PFC	SF ₆		H	M	L
II.1.3		3	Indirect Emissions from Transboundary On-Road Inter-City or International Transportation Trips that Originate and/or Complete their Journey Within the Community (Scope3)															
II.2			Railways															
II.2.1	1A3c	1	Direct Emissions (Scope1)	Proportional Fuel Combustion														
II.2.2		2	Energy Indirect Emissions (Scope2)	Proportional Energy Consumption														
II.2.3		3	Indirect Emissions from Transboundary Inter-City or International Railway Trips that Originate and/or Complete their Journey Within the Community (Scope3)															
II.3			Water-Borne Navigation															
II.3.1.	1A3dii	1	Direct Emissions (Scope1)	Proportional Fuel Combustion														
II.3.2		2	Energy Indirect Emissions (Scope2)	Proportional Energy Consumption														
II.3.3		3	Indirect Emissions from Inter-City or International Water-Borne Navigation Trips that Originate their Journey Within the Community (Scope3)															
I.4			Aviation															
II.4.1	1A3aai	1	Direct Emissions (Scope1)	Proportional Fuel Combustion														
II.4.2		2	Energy Indirect Emissions (Scope2)	Proportional Energy Consumption														
II.4.3		3	Indirect Emissions from Inter-City or International Aviation that Originate and/or Complete their Journey Within the Community (Scope3)															
II.5			Off-Road															
II.5.1	1A3eii	1	Direct Emissions (Scope1)	In-boundary Fuel Combustion														

ICP No.	IPCC Class	Scope	GHG Emissions Sources	Accounting Approach	Notation keys				GASES						Total GHGs tCO ₂ e	Data Quality		
					IE	NE	NO	NA	CO ₂	CH ₄	N ₂ O	HFC	PFC	SF ₆		H	M	L
III.			Waste															
III.1			Solid Waste Disposal															
III.1.1	4A	1+3	Option-1: First Order Decay (FOD) Method - Direct (Scope1-Current Year) and Indirect (Scope3-Previous Years) Emissions from Landfills Located Within the Community Boundary (excluding emissions due to incoming waste from other communities)	In-boundary Waste Generated and Proportional Waste Treated														
III.1.2		1+3	Option-2: Methane Commitment (MC) Method - Direct (Current Year) and Indirect (Scope3-Future Year) Emissions from Landfills Located Within the Community Boundary (excluding emissions due to incoming waste from other communities)	In-boundary Waste Generated and Proportional Waste Treated														
III.1.3		3	Indirect Emissions (Scope3) from Community Wastes Deposited in Landfills Located Outside the Community Boundary	Proportional Waste Treated														
III.3			Biological Treatment of Waste															
III.3.1	4B	1	Direct (Scope1) Emissions from Biological Treatment of Waste in the Community Boundary (excluding emissions due to incoming waste from other communities)	In-boundary Waste Generated and Proportional Waste Treated														
III.3.2		3	Indirect Emissions (Scope3) from Biological Treatment of Wastes Outside the Community Boundary	Proportional Waste Treated														
III.4			Incineration and open burning															
III.4.1	4C	1	Direct (Scope1) Emissions from Incineration and Open Burning of Waste in the Community Boundary (excluding emissions due to incoming waste from other communities)	In-boundary Waste Generated and Proportional Waste Treated														
III.4.2		3	Indirect Emissions (Scope3) from Incineration and Open burning of Wastes Outside the Community Boundary	Proportional Waste Treated														

ICP No.	IPCC Class	Scope	GHG Emissions Sources	Accounting Approach	Notation keys				GASES						Total GHGs tCO ₂ e	Data Quality		
					IE	NE	NO	NA	CO ₂	CH ₄	N ₂ O	HFC	PFC	SF ₆		H	M	L
III.5			Wastewater Treatment and discharge															
III.5.1	4D	1	Direct (Scope1) Emissions from WWT and discharge in the Community Boundary (excluding emissions due to incoming waste from other communities)	In-boundary Waste Generated and Proportional Waste Treated														
III.5.2		3	Indirect Emissions (Scope3) from WWT and discharge Outside the Community Boundary	Proportional Waste Treated														
IV.			Industrial Processes and Product Use (IPPU)															
IV.1	2A+2B+2C+2E	1	Direct Emissions from Industrial Processes	In-boundary Production														
IV.2	2D+2F+2G+2H	1	Direct Emissions from Product Use	In-boundary Product use														
V.			Agriculture, Forestry, and Land Use (AFOLU)															
V.1	3	1	Direct Emissions from AFOLU	In-boundary areas														
VI.			Other Indirect Emissions															
VI.1		3	All other Scope3 Emissions from all sources															
VI.2		3	All transboundary Scope3 emissions due to exchange/consumption of goods and services															
			ICP BASIC (tCO₂e)		IE	NE	NO	NA	No. of occurrence and ICP No. for Notation Keys (out of 28 entries)									
			ICP BASIC+ (tCO₂e)						Sources included in BASIC+ (out of 5 data entries)									
			ICP EXPANDED (tCO₂e)						Sources included in EXPANDED									
			Scope1															
			Scope2															
			Scope3															