GREENING INDIAN CITIES THROUGH EFFICIENT BUILDINGS

A guidebook for local governments to design and implement green buildings policies prepared by WRI India

Ministry of Housing and Urban Affairs
Government of India

Smart City
MISSION TRANSFORM-NATION

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WRI INDIA

WRI India is a research organisation with experts and staff who work closely with leaders to turn big ideas into action to sustain a healthy environment - the foundation of economic opportunity and human well-being. We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

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Preface

Dear Friends,

Cities are both influential and vulnerable performers in the fight against climate change. Many cities are facing annual threats of extreme events, expected to become worse in the next decade. Local governments must be empowered to mitigate the and adapt to climate change through interventions in key sectors. including buildings.

Buildings accounted for 30% of final energy use and 28% of energy-related CO_2 emissions globally in 2017 (IEA and UNEP 2018). Significant untapped potential exists for India's buildings to be made more energy efficient and resilient through implementation of green building policies and programs.

"ClimateSmart Cities Assessment Framework (CSC-AF)" is aimed at providing a clear roadmap to Indian smart cities towards combatting climate change while planning their actions and investments. WRI India, as a knowledge partner to CSC-AF is glad to share this advisory as a handholding guidance document for the cities.

The advisory provides guidance on developing and implementing two specific types of building efficiency actions - green building codes and green building certification and rating systems. The guidance can be applied to the identification and designing of other types of policy actions as well.

I wish to place my appreciation for this assessment framework and extend my best wishes to all the cities which are part of this initiative.

Sincerely,

O.P. Agarwal
CEO, WRI India

EXECUTIVE SUMMARY

The buildings sector is both a climate culprit and a climate solver. Buildings accounted for 30% of final energy use and 28% of energy-related CO2 emissions globally in 2017; 70% of these emissions are from generation of electricity and heat for use in buildings[1] (IEA and UNEP 2018). In India, buildings were responsible for 25% of total electricity demand in 2018[2]. Under a business as usual scenario, a three-fold increase in final energy consumption in Indian cities between 2020 and 2050 is expected largely driven by demand for cooling and heating in buildings[3] (Chaturvedi et al. 2014).

However, the mitigation potential in buildings sector is also largely untapped. Globally cities are enacting ambitious policies to significantly curtail energy use in buildings through energy efficiency measures and introducing integration of renewable energy generation to decarbonize operational energy use in buildings. The most powerful of these policy measures include mandatory building energy codes and green building certification and rating systems. In India, the Energy Conservation Building Code (ECBC) for both commercial and residential buildings was introduced by the Bureau of Energy Efficiency (BEE) to realize energy savings from new construction by better design and materials. Voluntary rating systems like those from not-for-profit bodies like Green Rating for Integrated Habitat Assessment (GRIHA) council, Indian Green Building Council (IGBC) and Leadership in Energy and Environment Design (LEED) have been adopted by all types of buildings leading to a green building footprint that's amongst the highest in the world.

As cities rise to the challenge of man-made climate change, in India, faster progress needs to be made on accelerating construction of greener, more energy efficient buildings. Historically the levers for climate action by Indian cities have been limited due to the top-down nature of climate policy making. However recent city-centric Government of India (GoI) programmes like AMRUT, Smart cities, Solar cities have given cities the opportunity to develop interest, build capacity and design unique, localized solutions for common developmental problems.

The Climate Smart Cities Framework is aimed at providing a clear roadmap to Indian smart cities towards combatting climate change while planning their actions and investments. The framework describes a list of 30 indicators covering five sectors. The Framework is not a "grading" or "ranking" system comparing the cities, nor is it intended as a sub-mission or strategy for funding activities or projects. Cities must use the measures and indicators in the framework to develop actions and priorities for that specific category.

Under the ''Energy and Green buildings category'', six indicators have been identified:
- Indicator 1: Electrical power from renewable energy sources
- Indicator 2: Per capita and per area electricity consumption for municipal services
- Indicator 3: Per capita fossil fuel (Diesel, Petrol, CNG, LPG) consumption for municipal services
- Indicator 4: Energy-efficient street lighting in the city
- Indicator 5: Level of compliance procedures in place for green buildings
- Indicator 6: Percentage of buildings securing third party green building certification up to minimum level at completion stage.

The indicators 5 and 6 pertain to preparedness in cities to implement green building policies and programs. These indicators have the following specific objectives:
- Indicator 5: This indicator checks the readiness of the city on implementation and compliance procedures of green and energy efficient buildings. The measure is in terms of:
  - Sub indicators 0 and 1- deal with presence of procedures in 1st place.
  - Sub indicators 2, 3 and 4- deal with actual uptake of green building codes and rating systems by measuring the compliance rates- tracking progress on % of new buildings in the city that are code compliant and or green rated
- Indicator 6: To track progress on green buildings in terms of % of built up-area in the city that has been ''green certified''

The guidebook provides guidance on developing and implementing two specific types of policy building efficiency actions- green building codes and green building certification and rating systems. In general, the guidance can be applied to the identification and designing of other types of policy actions as well.

For the purpose of this guidebook, the Energy Conservation Building Code (ECBC) and National Building Code (NBC) are referred to as green building codes. Voluntary rating systems from GRIHA, IGBC and LEED and BEE's star labelling for buildings (including for recently introduced labelling program for residential buildings) are categorized as green building certification and rating systems. While the guidebook is focused on greening new buildings, the guidance presented must be used to evaluate policy actions for existing buildings in Indian cities as well.

Chapter 1 of this guidebook describes the importance of green buildings through their role in climate mitigation and adaptation

Chapter 2 describes buildings governance in India and role of cities as regulators, convenors and owners in improving building efficiency

Chapter 3 describes the menu of building efficiency policy actions that cities can undertake

Chapter 4 provides the five-stage process for green buildings policy implementation, monitoring and tracking progress

Chapter 5 provides case studies from two Indian cities on successful implementation of green building codes and certification programs.

This guide provides local governments in Indian cities, line departments and agencies with the background, guidance and tools to introduce green building codes and certification programs in Indian cities. The primary intended audience is officials from municipal corporations, ULBs, state energy, housing, planning departments and any other relevant agencies and stakeholders playing a role in implementation of green building policies and programs in the city.

1. INTRODUCTION

Untapped mitigation potential in India's buildings

India's building stock is to reach 31.5 billion m2 by 2037 from 16.4 billion m2 in 2017 (AEEE 2018). Of this the commercial buildings floor area is expected to increase by 1.6 times by 2037-38 to 1880 million m² from in 1160 million m² in 2017-18 and residential floor area is projected to increase by 2.7 times to 3090 million m² by
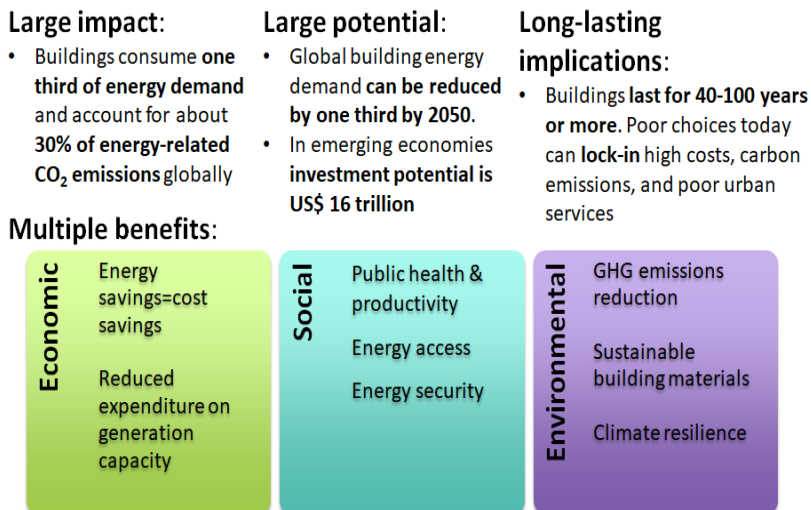
2037-38 (AEEE 2018). Under a business as usual scenario, India's building energy demand will grow by 700% between 2005 and 2050 and associated CO_2 emissions increase tenfold (GBPN 2014). Currently, buildings account for 38% (~208mtoe) of the India's total primary annual energy consumption and 31% (296 TWh) of the total annual electricity consumption with residential and commercial sector having 23% and 8% of total electricity consumption respectively (MOSPI 2018). According to NITI Aayog's India Energy Security Scenarios 2047, in the absence of dedicated efforts to address building efficiency, emissions from commercial buildings sector are expected to reach 610 MT by 2020 and 1370 MT by 2030. In addition to consuming energy, buildings construction sector is also a significant user of water and materials.

Given the growth in floor-space, and increased intensity of energy use and service level requirements in the commercial sector, India must address efficiency in this sector. There is a great opportunity today to shape tomorrow's cities and buildings and avoid "locking in" inefficiencies by applying resource efficient planning and design to buildings. It is estimated that India's building sector can reduce global energy-related CO_2 emissions by 8%, achieved 1) deployment of building energy codes certifications, ratings and labelling programs, (2) encouraging (3) building capacity to implement these measures and (4) investing in good quality data on building stock and energy use, all of which will create sufficient conditions for investments in building efficiency (Graham and Rawal 2018)

Benefits of building efficiency

Efficient buildings can also help improve the quality of life of millions of people with greater comfort and improved indoor and outdoor air quality. Figure 1 describes some of the benefits of improved efficiency in buildings.

Additionally, buildings must be designed and operated in such a way that they address the local climatic and geographic concerns of the city which essentially includes the water and waste management. Green buildings offer the cities to be more climate resilient, environment friendly and energy efficient space with an energy savings up to 40-50% compared to the conventional buildings.

Figure 1 | **Benefits of Building Efficiency**

Large impact:
- Buildings consume **one third of energy demand** and account for about **30% of energy-related CO$_2$ emissions** globally

Large potential:
- Global building energy demand **can be reduced by one third by 2050.**
- In emerging economies **investment potential is US\$ 16 trillion**

Long-lasting implications:
- Buildings **last for 40-100 years or more.** Poor choices today can **lock-in** high costs, carbon emissions, and poor urban services

Multiple benefits:

Economic	Social	Environmental
Energy savings=cost savings Reduced expenditure on generation capacity	Public health & productivity Energy access Energy security	GHG emissions reduction Sustainable building materials Climate resilience

Building efficiency policy landscape in India

Several policy level interventions were made by the central government to improve building energy efficiency in the country at different point of times during the last two decades. The Energy Conservation Building Code (ECBC) developed by the BEE is one such forward step taken in this direction. While the initial versions of the ECBC were mainly focussed on the commercial buildings, a new code Eco Niwas Samhita or ECBC-R has been developed exclusively for residential buildings. While the federal nature of the policy enables the states to modify the code to best suit the regional and local climatic conditions, most of the states have not succeeded in implementing the code effectively. While many studies have clearly acknowledged the significant energy savings potential (25-30%) of the ECBC complied buildings, the building community is yet to realize the big benefits they choose to miss by continuing the conventional building design, constructional and operational practices. The salient features of the ECBC 2017 includes the following.

- Technology neutral
- Renewable Energy Integration
- Incremental energy performance levels
- Applicability to various categories of buildings and passive Design Strategies

Apart from ECBC, voluntary building rating systems also play a crucial role in raising awareness and popularizing green design. Green building rating programs like GRIHA (Green Rating for Integrated Habitat Assessment) has been adopted by the Ministry of New and Renewable Energy to rate a building on the degree of its sustainability quotient. Other green building rating systems like Indian Green Building Council (IGBC) rating programs, Leadership in Energy and Environmental Design (LEED) etc. also play a significant role to improve the building efficiency. Apart from the building design strategies, the government has also taken initiatives to improve the efficiency of building appliances which have a major impact on the building's overall performance. BEE has introduced the Standard and Labelling (S&L) programme to provide the consumer an informed choice about the energy saving and thereby the cost saving potential of the relevant marketed product. The scheme targets display of energy performance labels on various energy intensive equipment and appliances and lays down minimum energy performance standards.

2. BUILDINGS GOVERNANCE IN INDIA AND ROLE OF CITIES

In India, buildings are a state subject and laws and regulations that govern building construction are under the ambit of State Urban Development Departments (UDD) that are guided by the Ministry of Housing and Urban Affairs (MoHUA). The National Building Code 2016 was developed by the Bureau of Indian Standards, a national standards body working under the aegis of the Ministry of Consumer Affairs,

food and public distribution. The NBC lays out guidance on building construction including green requirements pertaining to energy use, waste and water management. The ECBC has been developed by BEE which a body under the Ministry of Power (MoP), and the responsibility of providing implementation support in cities rests with BEE's state counterparts, the State Development Agencies (SDAs).

Implementation of all buildings related policies and programs occurs at the city level and to a large extent guided by model regulations and rules provided by the national ministries and their counterparts at the state level.

So, while local governments, primarily the ULB, hold the authority to implement and enforce policies, their approach is heavily influenced and guided by requirements from national and state governments. Globally local governments have taken up three types of roles in implementing policy actions depending on their ability or powers to implement (Figure 1). Figure 2 depicts the implementation process for ECBC in India from the national to local levels. At the city scale, local governments/ULBs in India play the following key roles:

- Regulator: Participating in the code adoption and enforcement process through
  - Empanelment of third-party assessors for ECBC compliance
  - Integrating ECBC into building approvals systems
  - Developing a monitoring mechanism to ensure code compliance
  - Incentivizing or penalizing compliance or non-compliance

- Convener/facilitator:
  - Organizing capacity building programs for ULB officials
  - Creating awareness in builders or developers and other private sector stakeholders on the code process
  - Engaging with consumers, building occupants and tenants through public platforms and workshops

ULBs in India also can play the influence building efficiency policies as investors or owners by taking advantage of their ownership of buildings. ULBs can lead by example by taking actions to improve efficiency of energy use in buildings directly under their control.

Figure 2 | **Local Government Roles, Policy Actions, and Typical Ability to Implement (Source: WRI 2016)**
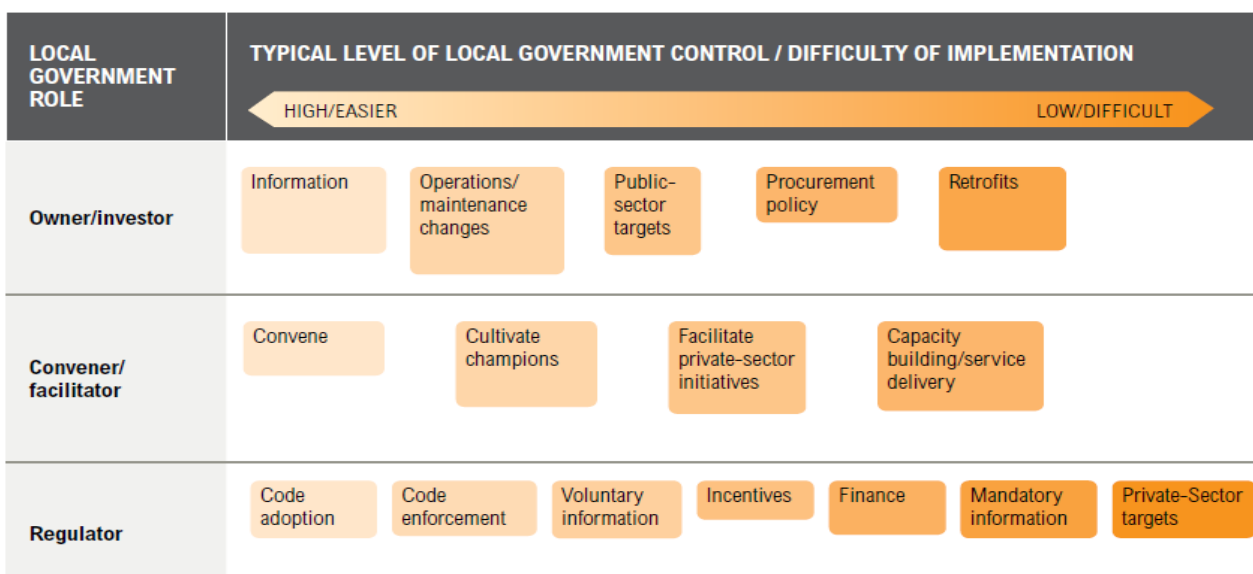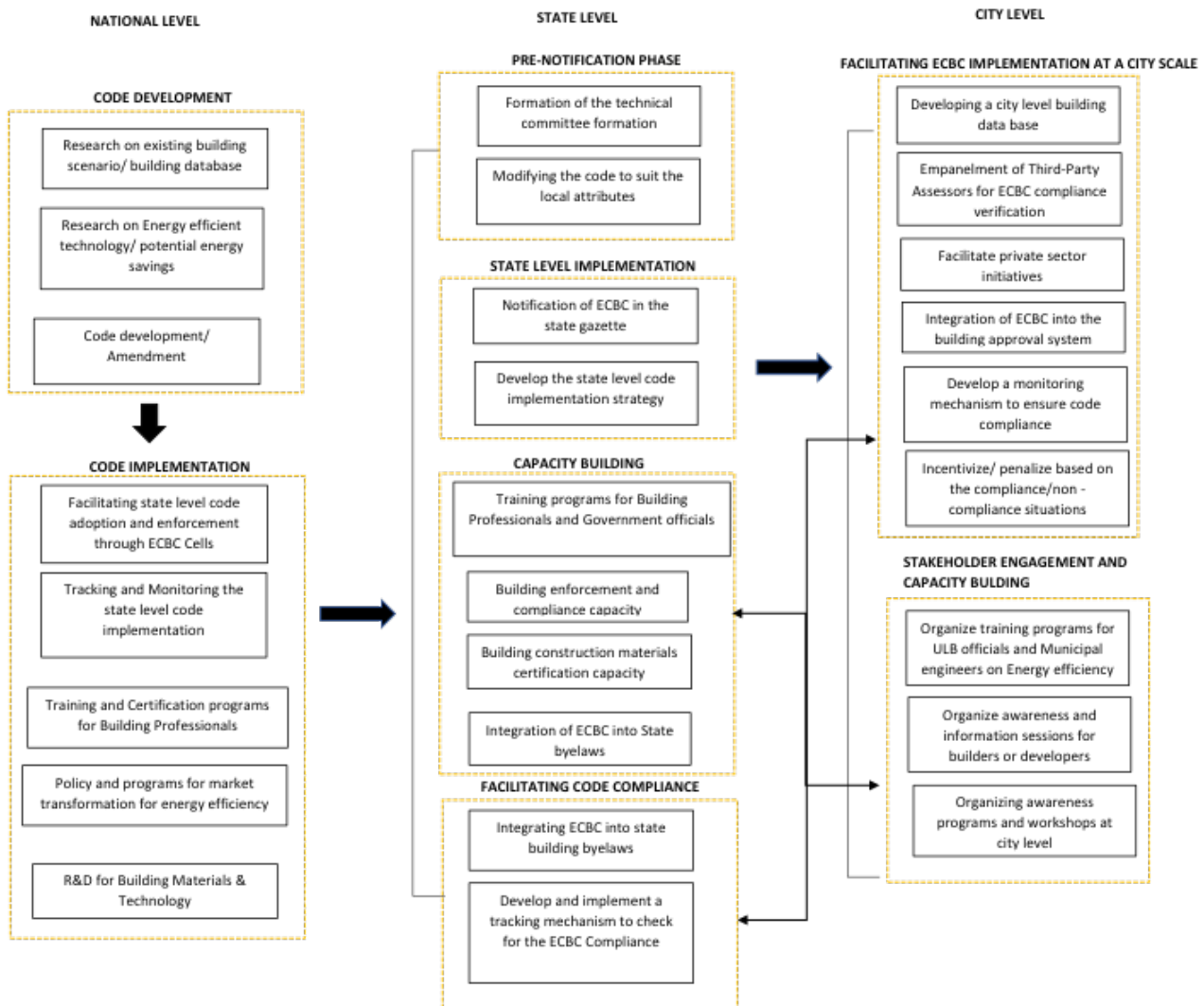
Figure 3 | **Implementation process for ECBC in India**

NATIONAL LEVEL

CODE DEVELOPMENT

- Research on existing building scenario/ building database
- Research on Energy efficient technology/ potential energy savings
- Code development/ Amendment

CODE IMPLEMENTATION

- Facilitating state level code adoption and enforcement through ECBC Cells
- Tracking and Monitoring the state level code implementation
- Training and Certification programs for Building Professionals
- Policy and programs for market transformation for energy efficiency
- R&D for Building Materials & Technology

STATE LEVEL

PRE-NOTIFICATION PHASE

- Formation of the technical committee formation
- Modifying the code to suit the local attributes

STATE LEVEL IMPLEMENTATION

- Notification of ECBC in the state gazette
- Develop the state level code implementation strategy

CAPACITY BUILDING

- Training programs for Building Professionals and Government officials
- Building enforcement and compliance capacity
- Building construction materials certification capacity
- Integration of ECBC into State byelaws

FACILITATING CODE COMPLIANCE

- Integrating ECBC into state building byelaws
- Develop and implement a tracking mechanism to check for the ECBC Compliance

CITY LEVEL

FACILITATING ECBC IMPLEMENTATION AT A CITY SCALE

- Developing a city level building data base
- Empanelment of Third-Party Assessors for ECBC compliance verification
- Facilitate private sector initiatives
- Integration of ECBC into the building approval system
- Develop a monitoring mechanism to ensure code compliance
- Incentivize/ penalize based on the compliance/non - compliance situations

STAKEHOLDER ENGAGEMENT AND CAPACITY BULDING

- Organize training programs for ULB officials and Municipal engineers on Energy efficiency
- Organize awareness and information sessions for builders or developers
- Organizing awareness programs and workshops at city level

3. UNDERSTANDING POLICY ACTIONS TO PROMOTE GREEN BUILDINGS AT CITY SCALE

The policy measures to promote greener efficient buildings can be divided into eight types of actions (WRI 2016) described below:

- Action area 1: Building efficiency codes and standards: Cities are built upon a foundation of building codes. Well-designed codes and standards requiring minimum levels of energy efficiency in design, construction and/or operation of building systems can cost-effectively decrease energy expenses over buildings' lifetimes. Because they have such an impact on improving efficiency, energy-related building codes are on the increase around the world. Examples Energy Conservation Building Code (ECBC) and BEE's S&L program

- Action area 2: Efficiency improvement targets: Local governments must set clear energy reduction targets to improve building performance across cities, or at least in government-owned buildings. Governments can also introduce voluntary targets to incentivize private sector action.

- Action area 3: Performance information and certifications: Transparent, accurate, reliable and accessible energy performance information for a building is a pre-requisite for establishing baselines and benchmarking. The market can function if there is clear data differentiating performance. Increasing the transparency of building performance enables building owners, managers and occupants to make informed real estate transactions, improve building performance and track performance against targets. Ratings and

certificates create opportunities to publicly reward and promote energy excellence, enhancing the market value of high-performing buildings. Examples in India include certification systems by GRIHA and IGBC

- Action area 4: Incentives and Finance: City-level leaders have opportunities to make strategic investments in building efficiency and can work with national and private sector financial institutions to help overcome inertia and spur new investment in buildings. Financing to help cover upfront costs can spark greater investment.
- Action area 5-Government leadership by example: Successful government policies in one city should be shared among other urban areas to improve building efficiency while creating greater demand and acceptance for building efficiency.
- Action area 6- Engaging building owners, managers and occupants: Local governments should engage private-sector building owners and occupants through partnerships, competitions and awards, user-feedback and energy management activities.
- Action area 7- Engaging technical and financial services providers: The public and private sectors should work together to train the local workforce to implement energy reduction strategies. Engaging service providers enables them to meet demand for building efficiency projects and create good jobs.
- Action area 8- Working with utilities: Governments can tap utility-customer relationships to provide better data and make efficient technologies more accessible.

This guidebook focused on two building efficiency policy instruments- Green building codes and Green building rating systems and certification programs.

- Green building codes - NBC 2016 and ECBC 2017. These establish a minimum performance standard for the building and can cover large parts of the building stock if made mandatory.
- Green building rating systems and certification programs- LEED, IGBC, GRIHA, BEE star labelling- These help building owners, tenants or lessee make decisions and give builders or developers an opportunity to build reputation and sell premium services.

4. FIVE STAGE PROCESS TO IMPLEMENTING GREEN BUILDINGS POLICIES

The specific package of policy actions that the city decides to implement must be based on thorough assessment of city's priorities, capacity and building stock situation. A five- stage process is recommended for cities to implement actions which will define and improve the city's progress on green buildings.

Stage 1: Commitment

Goal: The goal of this step is to ensure that the city leadership develops a formal commitment to implement a policy package aimed at increasing share of green buildings in the total building stock of the city. A public commitment from the local government agencies creates awareness in stakeholders on the forthcoming policy and related preparatory activities.

Recommended activities: Depending on the city the commitment may come from the mayor and or commissioner of the municipal corporation and/ CEO of smart city SPV or any other agency as the state government may deem fit for this role. High level political support is critical to ensure to seek coordination and collaboration between the different departments. It is important that a single government agency leads the policy development process with inputs from other government agencies and stakeholders.

The commitment articulated by the local government should describe in broad terms

Figure 4 | **Recommended five-stage process for green buildings policy development, implementation and tracking progress**

Stage 1: Commitment → Stage 2: Assessment → Stage 3: Development → Stage 4: Implementation → Stage 5: Monitoring and Reporting

the overall vision of the green buildings policy measures (whether codes and/certification program) and the targets to be achieved along with realistic timelines for the policy development and implementation stages. Cities may choose to select targets based on the Smart Cities Assessment framework. The commitment can be announced through a kick-off meeting inviting participation of relevant government agencies, departments and building sector stakeholders and media. The meeting can be used to deliberate over preliminary ideas on priority areas for the city (e.g. targeted at only new commercial buildings of a certain size or new public buildings), potential barriers and the resources available from the local government to fulfil the commitment. Depending on the participation in the meeting and stakeholder representativeness, an expert committee/working group can be constructed comprising volunteers from different stakeholder groups. This group can be leveraged by the city for the subsequent stages in the policy implementation process.

Stage 2: Assessment

Goal: The goal of this stage is to establish building sector baselines for the city, understand benefits and potential barriers and map stakeholders and the resources needed. At the end of the assessment stage, the city must be able to respond to the following questions:

- Who are the stakeholders that need to be engaged in this process?
- What type of buildings are coming up in the city? What are their growth rates?
- Which type of buildings have the highest total floor area in the city? What are the trends in their distribution across the city
- Which type of buildings must be prioritized under the green buildings policy package?
- What is the market for green building materials, products and services in the city?
- What could be the potential barriers or challenges to the policy development and implementation process?

Recommended activities: To achieve this goal, cities may take the following steps: (1) Setting up a policy development committee (2) Collect data and information to establish building sector baselines and (3) identifying possible barriers

(1) Setting up a committee

Under the guidance and leadership of the local government agency of the city and available resources staff or department from within the ULB, local CSO or academic institution, or consulting firm can be appointed as a convener to lead the policy development process in close coordination and collaboration with all

Figure 5 | **Stakeholders to be engaged in policy development process in the city**

Stakeholder category	Sub-categories
Government	State government departments- Town and Country Planning, Departments of energy, planning, finance and Housing
	Municipal government- Municipal Corporation/Municipal Councils, Departments of buildings, architecture, town planning, engineering
	Smart City SPV
	City development authorities and trusts
Civil society	Academic institutions
	Civil society organizations, NGOs, IGBC chapters
	Architects associations
	Resident Welfare Associations, Apartment federations and associations
Builders or developers	Builders (private and public)
	Builder associations (e.g. CREDAI, BAI)
Building managers & occupants	Facility managers/facility management companies
	Building occupants (e.g. large businesses that occupy buildings, technology/IT parks)
Products and service providers	Architects, green building experts and consultants
	Manufacturers and suppliers of building materials and contracting services
	Energy Service Companies, RE service companies
	Banks, financial institutions
Utilities	Energy utilities
	Water utilities

relevant stakeholders. The convening agency should constitute a committee comprising of volunteers from the kick-off meeting (during the commitment phase), and relevant line departments and agencies, CSOs and academia, private sector stakeholders (builders, developers, service providers, vendors etc.) can be constituted to build buy-in into the policy development and implementation process. An indicative list of the types of stakeholders at the city level who must be engaged is given in figure 2. However the city based on its circumstances and capacity to engage can develop its own list of stakeholders for the committee.

The committee can choose to develop a workplan of activities for completing the steps in the policy development process. The convening agency must take the lead in developing products and materials for inputs and advise from the committee.

Creating institutions for policy development process- Example of ECBC implementation in Andhra Pradesh

In case of implementation of the ECBC in Andhra Pradesh, an administrative and technical lead agency was created in the form of a "technical committee" under a government order. The committee included senior representatives from state line departments and agencies (Muncipal Administration and Urban Development, Energy, Town and Country Planning, state's chief architect, non-state technical experts). The state's chief Secretary appointed local public academic institution Administrative Staff College of India (ASCI) as the committee's convener.

2) Collect data and information to establish building sector baselines:

The convening agency must compile data and information to conduct a establish a strong building sector baseline for the city. A baseline analysis of buildings in the city will be helpful to identify which buildings must be targeted

Data/information	Ideal	Data source
Total building floor area in the city (m²) by building type	Breakdown of built-area for each building type (e.g. for residential buildings, split by apartment buildings, indepdent houses or detached units, public housing etc.)	Municipal property tax records for existing buildings from the revenue department; geospatial data on landuse landcover
City building stock	Total number of existing buildings and new buildings added every year by building type for at least 5 years (e.g. number of new hotels or offices or apartment complexes added to city every year)	Municipal buildings department, reveneue department or e-governance cell maintaining record of building permits (construction permits, occupancy certificates) given
High growth areas, new townships or developments	Areas of heavy building construction activity and the types of buildings in those areas; Numbers of planned buildings under large government schemes (e.g. affordable housing)	Municipal land and revenue records, geospatial datasets, master plans by development authorities, government schemes and programs
Electricity use in buildings	Electricity consumption data for at least 3-5 years at an aggregate level for different building type or sub-type (e.g. total electricity consumed by government offices)	Power utility/DISCOM

Data/information	Ideal	Data source
On-site renewable energy generation in buildings	Data on number of buildings with on-site solar rooftop and number of buildings with open access PPAs with off-site/remote solar PV	Power utility/DISCOM
Number and types of buildings by sanctioned load (kW)	This helps in to identification of % of buildings that fall under the purview of ECBC in the city.	Power utility/DISCOM
High growth areas, new townships or developments	Areas of heavy building construction activity and the types of buildings in those areas; Numbers of planned buildings under large government schemes (e.g. affordable housing)	Municipal land and revenue records, geospatial datasets, master plans by development authorities, government schemes and programs
Market for green building materials, products and services	A breakdown of all green building materials and products, their volumes and their costs and a directory of major suppliers, manufacturers or vendors	Meetings and workshops with product vendors and service providers to understand market size and preparedness for a green buildings policy. (e.g. IGBC has its own catalogue of city-specific suppliers and service providers)

first and which policies must be priortized. Information that can be a part of the baseline and possible data sources includes the following:

If the city has the resources, it may choose to conduct a sample survey of energy performance of existing and new buildings in the city covering different typologies, sizes and vintages. The performance benchmarks in terms of Energy Performance Index (EPI) for major building types will be useful in identifying priority building types for the policy and establishing specific energy savings/performance improvement targets. Since building codes and green building rating systems cover new buildings, a energy performance benchmarking and disclosure program, provides buyers, tenants, consumers to make more informed choices about the buildings they occupy. Cities in India, can pilot a benchmarking program covering hospitals, hotels, major offices (e.g. technology and IT parks) and public buildings to understand the status of existing buildings, assess energy savings opportunities and introduce targeted schemes (e.g. a program for retrofits covering specific building types).

(3) Understanding benefits and potential barriers

An attempt must be made to assess the potential benefits from green buildings policy implementation. Based on the assessment of baseline building stock and energy use characteristics, it is possible to approximately estimate potential energy, emissions, impact on peak loads and cost savings from codes or rating systems implementation. Although it is important to note that it is important to understand that the benefits of green buildings policy adoption vary greatly by audience. Producing factsheets on potential benefits from the green buildings policy specific to the city for specific audiences may have the greatest impact and further instil buy-in to the policy.

The barriers to improving energy efficiency in buildings are well-known. Most of these are common to enegry efficiency in general. Table 1 lists some of the most common barriers to green buildings programs and policies in Indian cities. Some barriers might be specific to the city itself. These must be captured by the institution.

Table 2 | **Common barriers to green buildings in Indian cities (adapted from WRI 2016)**

Type of barrier	Summary
Institutional	■ Limited technical and human capacity at the local level to implement actions ■ Weak inter-departmental and inter-agency coordination to ensure policy coherence (at different levels of government) between various energy policy goals, or across scattered energy efficiency initiatives) ■ DSM regulations notified by electricity regulatory commissions in different states have not been adhered to by the utilities ■ Government and the private sector rarely collaborate in public-private partnerships to tackle building energy efficiency
Technical	■ Inability to understand or select across competing materials, equipment choices, lack of trust in performance of projects ■ Lack of technical capacity in Indian construction sector to use new materials or get training; migratory nature of construction workforce prevents developers from providing training. ■ Inadequate supply chain for energy efficient materials or limited awareness on the availability and accessibility of local suppliers ■ Many cities may not have local technical experts or firms to deliver energy efficiency projects.
Market	■ Price distortions prevent consumers from valuing energy efficiency. ■ Split incentives- transactions where economic benefits of energy savings do not accrue to those who invest in energy efficiency (e.g. building owners pay for investments in energy efficient buildings ■ High transaction costs due to lack of standardized tools and methods to calculate and measure energy costs versus investments ■ Dispersed and diffuse market structure with multiple locations and small end-users ■ Multiple industries—construction, efficiency, energy industries—are involved in building efficiency, posing a multi-sectoral challenge ■ Low electricity tariffs discourage energy efficiency investments
Financial	■ High upfront costs and dispersed operational benefits discourage investors ■ Perception that energy efficiency investments are complicated and financially risky ■ Perception in the financial sector that financial returns from energy efficiency are non-existent or exaggerated ■ For building owners (in both residential and commercial buildings), a lack of external finance ■ For financial institutions, small transaction sizes may require bundling of buildings or improvement measures to make them suitable for financing ■ In commercial buildings, organizations rely on constrained internal capital and operational budgets
Awareness	■ Lack of awareness in smaller builders and contractors on codes and standards, energy efficiency guidelines, certification and rating programs ■ Lack of sufficient information and understanding on the part of consumers/tenants/building owners to make well-informed consumption and investment decisions ■ Lack of information about the energy performance of buildings ■ Energy information may not be provided or analysed by end-users, energy providers, or other implementing agencies ■ Benchmarks for performance may not exist ■ Perception that energy efficiency measures make buildings more expensive

Stage 3: Development

The development stage is the most important stage of the policy implementation process. The outputs of the assessment stage must be used to develop a roadmap or action plan for implementing the green buildings policy package.

Goal: Develop an action plan for green buildings policy implementation

Recommended activities: The roadmap development should be a participatory process led by committee. Given the inter-departmental nature of buildings policies, coordination amongst different departments is key to the success of the policy. The action plan must describe the following:

- A. What should be the policy type, scope and targets?
- B. How should the policy/policies be implemented?
- C. What institutions arrangements and governance framework is needed to implement the policy or policies?

A. What should be the policy type, scope and targets?

Type of policy: Whether the city wants to implement a green buildings certification and rating system or mandate building codes for certain types or size of buildings. City can choose to implement both policies with defined timelines and targets, but it must be clear about the objectives, rationale and available capacity for both policy instruments. Some considerations:

- Codes are regulatory tools, that are enabled usually through mandatory building bye-laws. They set minimum standards of energy efficiency to be achieved by all new buildings, the code compliance ''certificate'' coming from the local municipality or ULB. Both the NBC 2016 and ECBC 2017 (commercial) and 2018 (residential) can be identified by the city as the green building code of choice. Green building certifications and rating systems like those from GRIHA or IGBC are administered by private agencies with the certificate being awarded by the agencies. It will come at a cost to the builder or developer.
- With respect to green building codes, the local government has the responsibility to enforce and develop rules for enforcement unique

to its local circumstances. It can also make codes mandatory due their regulatory nature, but it does not have the power to make third party green buildings certification and rating systems mandatory that are often expensive to achieve, unless the local government offers an incentive or discount on certification costs. Only some buildings may be able to meet the pre-certification costs.
- Green building certification and rating systems typically prescribe ''beyond code'' energy performance, covering more aspects of the buildings lifecycle process e.g. IGBC rates green buildings in terms of a) Sustainability of Site b) Effective & Efficient use of Water on site & during operations c) Energy efficiency d) Material & Resources and e) Indoor Environment Quality.

The question that cities must consider from a policy perspective are the following:
- Which green buildings policy (codes and certification/rating systems) and why?
- Which of these is best as a voluntary policy and which of these is best for a mandatory policy?

Codes tell you what to do and Rating systems tell the world how you did (Burt et al. 2012)

Green building codes like the ECBC 2017 and 2018 or NBC 2016 are designed to be implemented as a regulation requiring minimum standards of energy performance. Green building certification and rating systems like those by GRIHA and IGBC are aspirational in which the prerequisites are linked to a minimum number of credits, mandatory to earn a certification.

Codes and rating systems are difficult to compare since the former is aimed at instructing the design and construction of the building, while the latter evaluates the success of the design and construction against desired outcomes within a comprehensive framework. It is incorrect to assume that satisfying mandatory requirements under the code is equivalent to meeting the certification prerequisites. It is flawed to compare certified buildings to code compliant buildings with the assumption that the former is better. The IGBC, GRIHA and LEED certification and rating systems by default specifies meeting ECBC requirements on energy efficiency as prerequisites.

The top-down nature of building codes development and adoption in India i.e. the BEE develops the code, the state notifies a customized version of the code, and incorporates into building bye-laws that are enforced by municipal corporations at the city scale, leaves little opportunity for Indian cities to participate in the adoption process of ECBC or NBC.

Some considerations:
- The policy development committee must carefully deliberate on the type of policy that can be implemented within the power and jurisidictions of the city municipality. The city must also ensure that the policy or policies identified are backed by law.
- Cities that belong to states which have not notified ECBC may consider a phased approach introducing some key code provisions in the building bye-laws, like those with high impact on energy use be made mandatory in phase 1 to gradually build capacity to implement.
- Cities can also decide on introducing code requirements focused on specific parts of buildings. For e.g. prescriptive requirements of cool roofs or green roofs from ECBC 2017 or on maximum permissable Window to Wall ratio (WWR) for buildings of certain types and sizes. The city may also choose to prescribe a minimum standards for building equipment to be installed in buildings (e.g. mandating use of LEDs or only BEE 5-star rated water pumps in commercial and residential buildings)
- In Indian cities, commercial buildings like office buildings are often built as core and shell buildings where the builder builts the basic structure, shell or envelope of the building and provides core services like elevators, water pumping and lighting systems. The builder does not control the design and equipment used by tenants after occupancy. To some extent this gap is addressed by precertification in case of green building rating and certification systems (e.g. IGBC, GRIHA) or certications specifically for "Core and Shell" buildings (e.g. LEED). For

ECBC or NBC, similar checks have to be built in certifying/verifying compliance at different stages of the building's life cycle.
- If the city chooses to implement green building certification and rating systems, available in the market, it will need to engage with the providers of these systems

Policy scope: The assessment phase should tell the city the types of buildings it should prioritize for the policy coverage. If the city has conducted a benchmarking study, comparing this information against building stock and trends in floor area growth rates can help identify policy priorities.

Typical policy priorities in cities globally (C40 cities and Tokyo Metropolitan Government 2014)

In a review of ten case studies from major cities around the world, the C40 Cities Climate Leadership Group and Tokyo Metropolitan Government jointly found that most building efficiency programs chose the following priorities:

· Commercial buildings rather than residential

· Regulatory instruments (e.g. codes) that prevailed over or developed in conjunction with voluntary policies (e.g. green buildings rating systems)

· Large buildings instead of small and medium-sized buildings due to more capacity in owners of large buildings to comply with policy mandates

However the city may also decide apply the policy measures, at a minimum to new government or public buildings. This demonstrates leadership and creates a market pull. Policy scope is important to determine based on assessment data on building stock and energy use. For e.g. some cities may not have many buildings that can be covered under the traditional scope of

Figure 6 | **Indicative roadmap to implementing green building policies and programs in the city (Source: WRI 2016)**
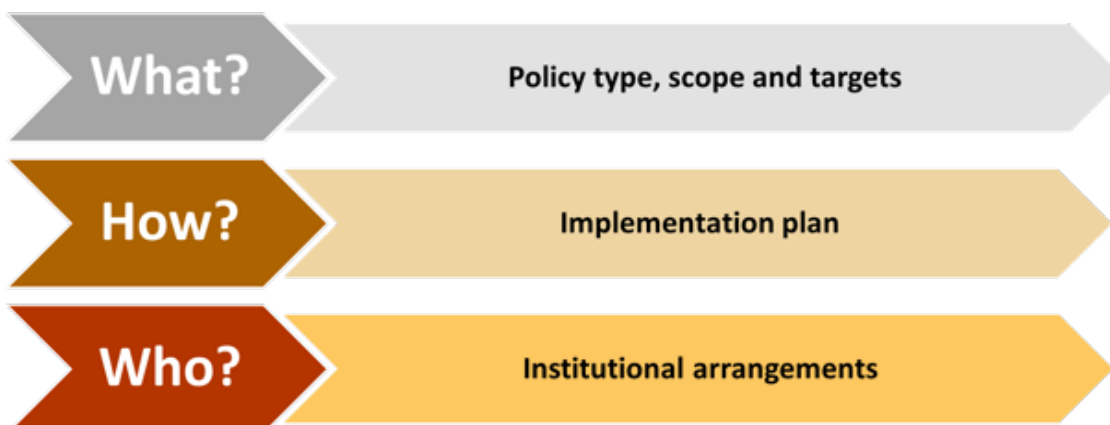
ECBC (100kW connected load/120kVA contract demand) and they may want to consider mandating code for smaller sized buildings or based on the built/floor area.

Targets: As per the Climate Smart Cities Assessment framework, cities can measure progress on the two indicators for green buildings by measuring their performance on the targets from levels 0 to 4. Based on this framework, cities may choose to select targets for the buildings covered in the scope of the policy and the type of policy.

The levels and targets specified are indicative at best and cities must strive to achieve more than the targets. For e.g. it is not necessary that cities only consider third-party green building certification policies but also have the flexibility to combine their achievements on green building code compliance as an indicator of progress.

It is important the city determines initial targets for both indicators 5 and 6 based on the outputs of the assessment exercise and deliberations in the committee. This gives the city a goal to work towards.

B. How should the policy be implemented?

At the implementation stage, the policy package is translated into specific actions. Based on the selected green buildings policy (green building codes or rating systems and certifications or a combination of both) an implementation plan must be developed by the convening agency with inputs from the committee members. It must be noted that the pathways for implementing green building codes will be quite different from that of a green buildings rating and certification scheme, the latter being controlled by a non-state certification body.

The implementation plan must respond to the following questions:
- What are the steps in the implementation process?
- What capacity and resources are needed for implementation?
- What are some enablers?

Steps in the implementation process:

For green building codes - Depending on the stage of ECBC implementation process in the state, the city's pathway to implementing ECBC varies. If the state has not notified ECBC, the city ULB can still choose to introduce some code provisions

Table 3 | Indicators for green buildings in the Climate Smart Cities Assessment Framework

Indicator 5	Level of compliance and implementation procedures in place for green buildings				
Levels	0	1	2	3	4
Targets	Compliance procedures only available at state level	Inclusion of ECBC and other certified green buildings in notified city DCRs	Third party certification given up to 5% of new buildings sanctioned in the city under any green building certification	Third party pre-certification given to 6-10% of new buildings sanctioned in city under any green building certification	Third party pre-certification given to more than 10% of new buildings sanctioned under any green building certification
Indicator 6	Percentage of buildings securing third party green building certification up to minimum level at completion stage				
Levels	0	1	2	3	4
Targets	No green buildings certified	Up to 10% Built-up-area (BUA) in the base year are certified	Up to 40% BUA in the base year are certified	Up to 60% BUA in the base year are certified	All buildings in the base year are certified

as requirements in the building bye-laws or Development Control regulations (DCRs), in collaboration with the urban development authority and the state Urban Development Department. But if the state has notified ECBC and incorporated into building bye-laws or DCRs, the city should immediately initiate process of ECBC implementation through a notification of the ECBC rules.

For ECBC 2017 for commercial buildings BEE has developed ECBC rules, notified in 2018 that provide guidance to states on the procedures and rules to ensure ECBC compliance by buildings in the state. At the city scale, these procedures need to be further broken down into a step-by-step process that city officials can easily understand and follow. This process must consider the three stages of the building cycle:

- Design stage
- Construction stage
- Completion or occupancy stage

In some cities, compliance with codes during a fourth stage of post occupancy or operational stage is also evaluated to develop "performance or outcome-based codes".

Some considerations:
- In a traditional approach of building code enforcement, builders or developers pay an inspection fee to code officials as a part of construction or occupancy permits. However, the success of the Third-Party Assessor (TPA) model where a private third-party agency will review and inspect buildings at different stages to monitor compliance has gained popularity. The TPA model helps build enforcement capacity rapidly since third-parties typically have more technical expertise in handling complex technical issues on the ground compared to ULB staff which will need to be trained and resourced. Figure 7 describes a possible model for implementing a TPA model for enforcing ECBC provisions in the city.
- In India, the only example of code enforcement on the ground is from Greater Hyderabad Municipal Corporation (GHMCs). It has used a third-party assessor (TPA) model to help code enforcement and improve code compliance. The Telangana State ECBC Technical Guidelines which describe the TPA model. GHMC's TPA model is a two-tiered approach where TPAs empanelled with the government of Telangana inspect the building at the (1) Design stage where TPAs review the drawings and specifications and (2) Post construction phase where TPAs review the ECBC compliance forms and conduct a physical inspection of the building to ensure ECBC compliance with submitted plants and simulation report.

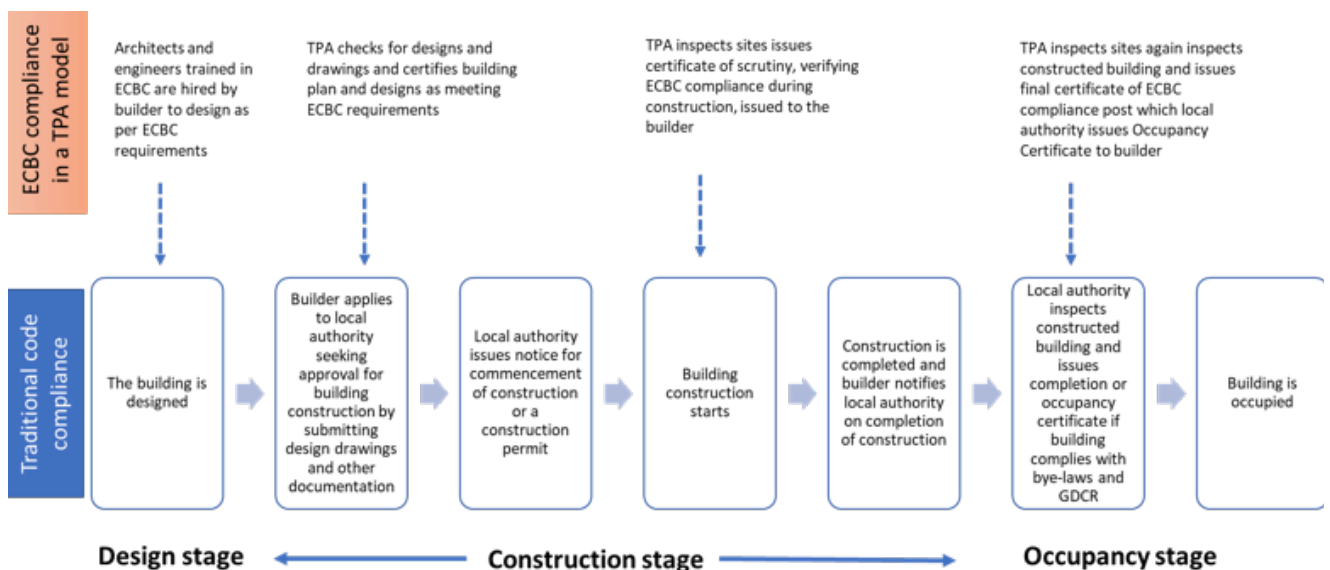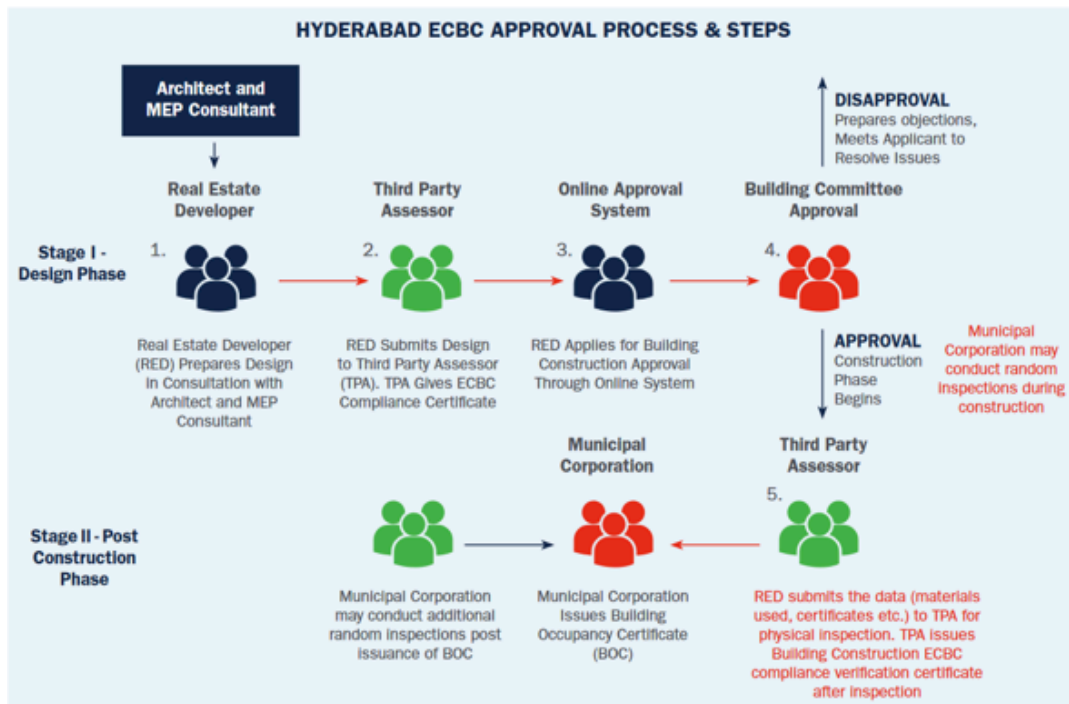Figure 7 | **Possible TPA model for ECBC enforcement in cities**

Figure 8 | **ECBC approval process and steps in Hyderabad, Telangana (Source: NRDC 2016)**

For green building certification and rating systems: Cities can sign an MoU with the third-party certification/ratings agency to support the implementation of a green buildings certification and rating program for the city. The certification body must commit to resources and hand-holding ULB officials for enforcement. Steps in the implementation of such a policy include:

- Notification of the policy or certification scheme by the ULB
- Setting up of procedures, milestones and institutional arrangements
- Project feasibility assessment, review of design and construction by certification body and ULB to obtain pre-certification
- Evaluation of compliance of constructed building with the requirements and award of certificate

Any penalties for noncompliance with the green buildings policy must be deliberated by the committee and made a part of the implementation procedures or processes.

What capacity and resources are needed at each step?

The capacity needs for the green buildings policy can be categorized into (1) human resources (2) financial resources and (3) information and awareness resources

Human resources: In case of green building codes, training can be given by ECBC Cells on demand from the city. Even if the city decides to adopt a TPA model for ECBC enforcement, the compliance machinery also comprises ULB staff on-the ground. These need to be trained to respond to queries and concerns from builders. Check-lists and protocols during inspections need to be prepared specific to the city, preferably in the local language and simplified to address varying technical capabilities. In the initial stages, the city must budget for additional staff resources, ramping up enforcement machinery to ensure robust compliance with ECBC. Going forward, a training of trainers' model can be developed comprising of new and old enforcement personnel from ULB to continue building capacity.

In case of green building certification and rating schemes, specific awareness, training and capacity building programs must be organized regularly by the ULB and the certification body (GRIHA/IGBC/LEED). Within the ULB, a green buildings cell may be constituted staffed with at least two personnel to support implementation of the third-party green buildings certification scheme.

These training programs must respond to the needs of the ULB personnel and done regularly,

some of these requiring mandatory attendance form officials. For other stakeholders, training cum awareness programs must be conducted.

Financial resources: The success of the green buildings policy will be also dependent on the budget and resources allocated by the city. It is important that the committee deliberates the financial strategy of the policy actions without which progress will not be made by the city on its targets. It is recommended that the financial resources needed for the policy package be divided into phases in the following way:

■ Readiness phase- Mobilizing municipal budgets, external grants and funding to the city to mobilize financing for the policy development process. Since a market may take years to create, investing time and resources in the early stages of policy development is critical.

■ Demonstration phase- Resources needed in the early stages of policy implementation, whether it is for building staff capacity, adding more staff, establishing platforms for dissemination of knowledge and information on the policy aspects, create awareness on policy benefits and impacts and engaging effectively with stakeholders or financing demonstration projects (new buildings designed as per green buildings policy). The goal will be to build buy-in and create confidence in markets that the local government is serious about the policy and wants to promote green buildings in the city

■ Critical-mass phase- When the policy implementation reaches a certain level of maturity, resources may be needed for further market development and scaling up. This could involve creating financial instruments that could meet financial needs of a large type of buildings, achieving the scale needed to transform the market. For e.g. cities have used green bonds to finance building energy efficiency projects.

Information and awareness resources: With any kind of green buildings policy, the common concerns in stakeholders, particularly builders or developers is the availability of green products and materials, their suppliers and service providers. The local government must establish a platform through a website to disseminate this information as transparently as possible. In case of ECBC, a comprehensive database of vendors and their empanelment

with the state Designated Agency (SDA) can be obtained.

Information on the policy timelines, processes and procedures, penalties for non-compliance and any other relevant information must be made available online.

Awareness programs must be conducted in the city to build capacity in all stakeholders and disseminate information regarding the policy's benefits, potential impacts and process for compliance. Factsheets and brochures targeted at specific stakeholder audiences must be developed to engage them in the policy's implementation.

What enablers are needed?

Cities may choose to develop an incentive structure to promote green buildings policy and overcome any economic barriers. The incentives typically reduce the upfront costs and can include- discounts on property taxes, discounts on premiums, faster building permits. While additional Floor Area Ratio (FAR) has been used by several cities to promote green buildings, in the context of Indian cities, FAR incentives must be carefully examined with respect to carrying capacity of land in the city, available densities and infrastructure capacities.

C. Institutional arrangements and governance framework for implementation

The implementation of green buildings policy requires coordination at many levels and among different municipal departments and other levels of government. When one department sets a policy, ensuring policy is understood and does not conflict with policies of other departments is necessary. Through the formation of the committee, the city can address these potential barriers by engaging with stakeholders in the beginning of the policy development exercise. It is also good practice to adhere to principles of good governance: transparency, participation, accountability and capacity.

Transparency: By providing comprehensible information on the policy process, timelines, regular reports and updates. The clear delineation of roles and responsibilities must be documented and made available publicly for access to stakeholders.

Participation: Public hearings are a good way to get common people interested and engaged on new policies. Creating formal spaces for participation of public, and establishing mechanisms to invite participation and channels for regular inputs from stakeholders ensures policy implementation is participatory.

Accountability: A mechanism for monitoring policy progress, and systems for redressal of concerns or grievances builds trust in stakeholders.

Capacity: Local government personnel must also be trained to practice principles of good governance.

Stage 4: Implementation

The city must uses the outcomes of the development stage to formally approve and fund the green buildings policy package. Once the policies are adopted, the enforcement and verification steps of policy implementation must be conducted in accordance with the policy design. An effective outcome of the implementation stage includes both the achievement of the targets and also data collected at the verification step to enable future policy improvement.

Stage 5: Monitoring and reporting

Tracking progress on the policy goals and targets is important for continous improvements to the policy. The design of the monitoring and reporting system is dependent on the scope of the policy, the timeframe and level of details needed for reporting progress.

Tracking progress on policy targets: To monitor and report on the targets as per the CSA framework, the city needs to establish a baseline year and comprehensively collect building stock data specifically on the number of new buildings constructed and the total built-up area (BUA) from the baseline year onwards. This requires the city to have strong IT based systems for buildings approval and floor area information. Manual records on building stock growth will be tedious to compile across offices, therefore a completely digital system for tracking number and built area of buildings in the city must be established.

Progress on ECBC compliance- The progress on ECBC implementation can be measured directly by the ULB since as it recieves data on ECBC compliance as a part of issuance of Occupancy certificates. This data for a certain building type, as defined by the scope of the ECBC policy and the information on the number of new buildings constructed in the city will indicate % code compliance rate. The same information (number of buildings compliant and total number of new buildings) can also be converted into built-up area in m2 to give an indication of % of built-area in the city that is covered by code compliance.

Progress on third-party green building certification schemes- The third party certifying agency must share the data on number of buildings certified and their footprint with the ULB.

Tracking progress on policy goals: It is good practice to track performance of the policy itself, whether the objectives of energy savings are being met. Cities may choose to conduct another benchmarking study with a sample of buildings, analyze their energy-related characteristics, consumption and overall enegry performance and comapre the results to the benchmarking study done at the beginning of policy design stage.

Case Studies

1. Implementation of ECBC in Hyderabad

Hyderabad is India's fourth largest city by population and a centre of the domestic IT industry. The rapidly developing economy has induced high speed growth in the real estate market which is driving the energy consumption in the city beyond levels that are considered sustainable over the long term. The presence of many energy-conscious organization along with the local and international NGOs working in the city has helped to push the local government towards energy efficiency in buildings through focussed efforts to become the first urban local body (ULB) in India to have mandatory ECBC compliance through online building approval system. The GHMC Town and Country Planning has integrated building energy efficiency compliance into the Development Permission Management System (DPMS) for buildings approval.

Subsequent to the announcement of the code processes by the state government, state has formed a steering committee to construct draft byelaws, develop software which incorporates other local codes, and to undertake administrative capacity development. The technical committee's efforts were mainly focussed on developing an ECBC implementation strategy for the state through the following steps.

- Building bylaws modification
- ECBC compliance mechanism
- Capacity building and training, and
- Demonstration projects
- Incorporate lessons from other states that have adopted the ECBC

Hyderabad's efforts to reduce building energy intensity are note-worthy mainly because they appear to be in part driven by Hyderabad's real estate market conditions and the efforts of progressive city leaders. Thoughtful planning of the city administration to address the concern of ECBC compliance verification for the large set of new buildings through facilitating third party assessment also deserves a special mention.
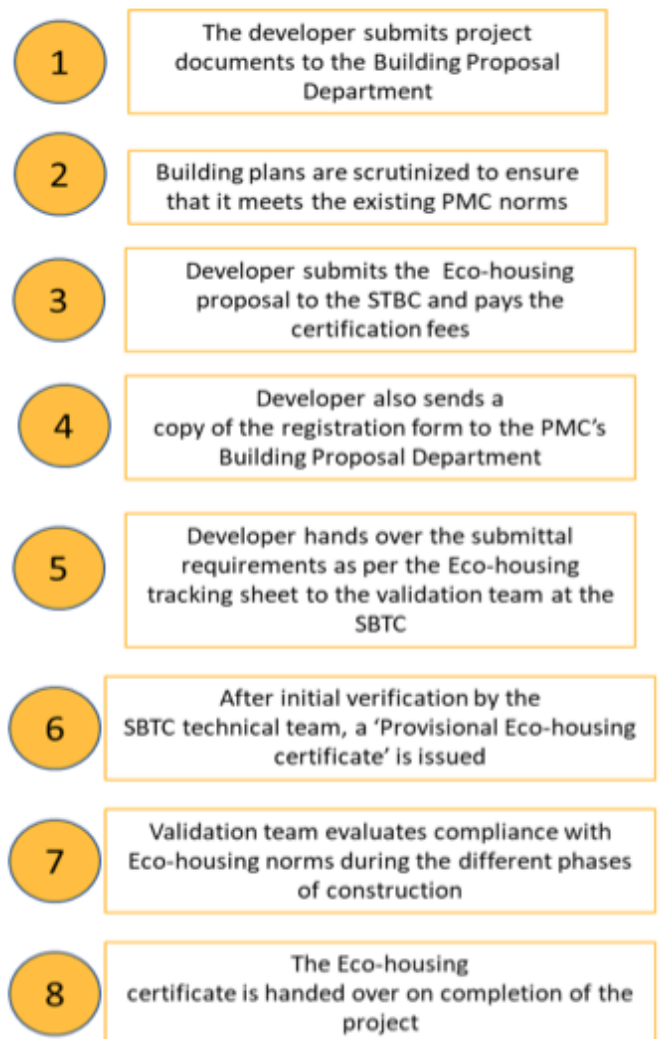
Key features that helped the city to implement ECBC

- Collaborative efforts of energy efficiency champion organizations and individual experts along with the ambitious government administration
- Support of the state government for strengthening the Energy Conservation activities in the state which will be monitored quarterly by State Energy Conservation Committee (SECC)
- Focussed efforts of the Technical committee formed to implement the ECBC at ULB level
- Empanelment of Third-Party Assessors for ECBC compliance verification
- Capacity building programs for more than 750 participants which includes government officials from town & country planning, municipal bodies, electricity utilities etc. and private people like Architects, Real Estate Developers and Engineers etc.
- Effective Implementation of the Online Building Approval System by Incorporation of ECBC
- Formation of Building approval committee to review the submitted projects and to ensure that the ECBC compliance requirements are fulfilled

- Effective outreach and promotional programs for creating awareness on the benefits of building energy efficiency

2. Eco-housing Program of Pune Municipal Corporation

The Eco-housing program launched by the Pune Municipal Corporation (PMC) is among the best examples of a building rating program designed by a Municipal Corporation. The program promoted the implementation of environment friendly practices, energy efficient products, and techniques by the building construction industries. The Eco-housing assessment criteria for Pune city was developed by the International Institute for Energy Conservation (IIEC) in association with The Energy Resources Institute (TERI), and Science and Technology Park (STP) under technical assistance from United States Agency for International Development (USAID).

Figure 9 | **Different stages of certification**

1. The developer submits project documents to the Building Proposal Department

2. Building plans are scrutinized to ensure that it meets the existing PMC norms

3. Developer submits the Eco-housing proposal to the STBC and pays the certification fees

4. Developer also sends a copy of the registration form to the PMC's Building Proposal Department

5. Developer hands over the submittal requirements as per the Eco-housing tracking sheet to the validation team at the SBTC

6. After initial verification by the SBTC technical team, a 'Provisional Eco-housing certificate' is issued

7. Validation team evaluates compliance with Eco-housing norms during the different phases of construction

8. The Eco-housing certificate is handed over on completion of the project

The program mainly focussed on improving the performance of residential projects in the following areas and the credits are being awarded based on the combination of voluntary and mandatory measures adopted by the project in each of these categories.

- Site Selection
- Environment Architecture
- Efficient Building Materials
- Solar Water Heaters
- Water Conservation
- Segregation of Waste
- Other Innovative Measures

This program sets another example of yielding success from collaborations and collective efforts. While the Sustainable Building Technology Centre (SBTC) serves as the apex body for the certification of Eco-housing projects, the International Institute for Energy Conservation (IIEC) together with the Science and Technology Park (STP) and Bhanuben Nanavati College of Architecture (BNCA) validated projects registered for Eco-housing certification.

For promoting sustainable building practices, a concession of 10 – 50% on total premium was offered to the developers depending on the rating achieved. 25% of the applicable rebate was given when building proposal is approved and the remaining can be claimed after the project is complete and certified.

Key features of the Eco-Housing program
- Incentives for promoting environment friendly design practices in building industry
- Collaborative efforts of champion organizations and Pune Municipal Corporation (PMC)
- The focus has been given to residential projects ranging from residential buildings/ building complexes and single-family residences
- Eco-housing incorporates environmental considerations at every stage of the residential building construction
- The program offers financial benefits, environment, community and infrastructure benefits, and benefits associated with health and increased productivity as compared to conventional buildings

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