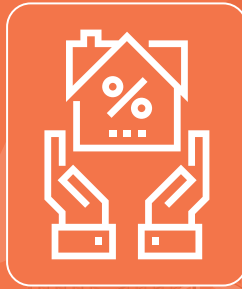




सत्यमेव जयते

Ministry of Housing and Urban Affairs  
Government of India



# Green Building Adoption

## TRAINING MANUAL



Supported by:



Federal Ministry  
for the Environment, Nature Conservation  
and Nuclear Safety

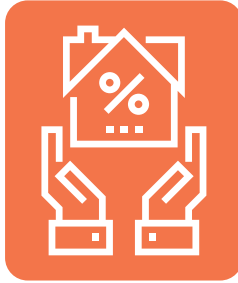
based on a decision of the German Bundestag

ClimateSmart Cities Assessment Framework  
Energy and Green Buildings





Ministry of Housing and Urban Affairs  
Government of India



# Green Building Adoption

## TRAINING MANUAL

### ClimateSmart Cities Assessment Framework Energy and Green Buildings



Supported by:



based on a decision of the German Bundestag

## **Green Building Adoption**

Training manual

### **Developed by:**

Climate Centre for Cities, NIUA in association with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

### **Author**

Alankrita Soni

### **Editors**

Umamaheshwaran Rajasekar, Vaishnavi T G Shankar, T Shrivani and Amanjot Kaur

**Copyright © NIUA (2022)**

2022

### **Contact information**

**Climate Centre for Cities**

**National Institute of Urban Affairs**

1st Floor, Core 4B, India Habitat Centre,  
Lodhi Road, New Delhi -110003, India

Telephone: (91-11) 24617517, 24617543, 24617595

Website: [www.niua.org](http://www.niua.org), [www.niua.org/c-cube](http://www.niua.org/c-cube)





Photo Credits: WWF, 2020

# Executive Summary

On one hand, cities are a significant contributor of carbon emissions aggravating climate change and on the other, cities are considerably impacted by climate disasters. The recently released Global Climate Risk Index 2021 ranks India as the 7th most-affected country from climate-related extreme weather events (storms, floods, heat waves etc.). Further, studies indicate that poor planning and urban management are expected to cost Indian cities somewhere between \$2.6 and \$13 billion annually.<sup>1</sup> Cities are increasingly at the forefront of addressing both urbanization and climate change and to strengthen climate-sensitive urban development, a holistic understanding of the urban development from a climate lens is crucial. The Climate Smart Cities Assessment Framework (CSCAF) launched in 2019 by the Ministry of Housing and Urban Affairs (MoHUA), Government of India aimed to address this gap. This first-of-its-kind assessment with 28 progressive indicators across 5 thematic areas helps cities to benchmark their development, understand the gaps and further prioritize climate relevant development.

With a focus on building local capacities to develop and adopt climate measures, the Climate Centre for Cities (C-Cube) at the National Institute of Urban Affairs (NIUA) initiated a series of training aligned to the thematic areas of CSCAF - Energy and Green Buildings, Urban Planning, Green Cover & Biodiversity, Mobility and Air Quality, Water Management, Waste Management. The focus of the training is to provide a step-by-step approach of conducting studies, assessments and stakeholder consultations, establishing



<sup>1</sup> Mani, M. et al., 2018. South Asia's Hotspots: The Impact of Temperature and Precipitation Changes on Living Standards, WashingtonD.C.: World Bank Group.

committees, developing action plans and implementing relevant measures that not only makes the cities climate resilient but also helps them progress across the assessment of CSCAF.

As government of India aims to be net zero by year 2070, Green buildings play a pivotal role in spurring low-carbon economic growth and securing a transition to clean energy. To achieve these ambitious targets, challenges around low and limited technical capacity to build, operate, and maintain green buildings; lack of green building knowledge; weak enforcement regimes and challenges in developing and implementing consistent standards and requirements for green construction needs to be strengthened.

The training module provides framework and strategies for each of the identified challenges faced by cities in regards to adoption of green buildings. The training module provide guidance to city officials to progress on compliance related to green building adoption. The training module also covers an interactive exercise. The intent of the exercise is to check the readiness of cities in regards to green building adoption. Overall, the module focuses on the policies and regulations, green building awareness, training & capacity building, organizational/ behavioural, availability of green building materials and technologies, and access to financial assistance.





Who is the training manual designed for?



What is the focus of the training manual?



How to make use of this manual?



What are the Learning outcomes of the training?



Scope and limitations of the training

The manual is aimed at officials of urban local bodies who are responsible for adoption of green and energy efficient buildings in their respective cities. It may include architects, town planners, engineers and other senior officials on concerned departments of urban local bodies.

This manual aims to address the various barriers preventing the wider adoption of green and energy efficient buildings. The focus of the training module is to equip city officials on strategies in regards to adoption green and energy efficient buildings in their respective cities.

City officials can use this training manual to understand the measures to be adopted for increasing the number of green buildings in their city. This manual could help concerned stakeholders including city officials identify specific problems in green building adoption and suggest suitable strategies for their wider uptake.

City officials will learn about the CSCAF 2.0 and the details around the indicator on 'Green Building Adoption'. The training manual will be helpful in sensitizing the regulatory agencies, the policy makers, and the building construction practitioners about the various challenges to adoption of green building practices and suggestive measures to address the current challenges.

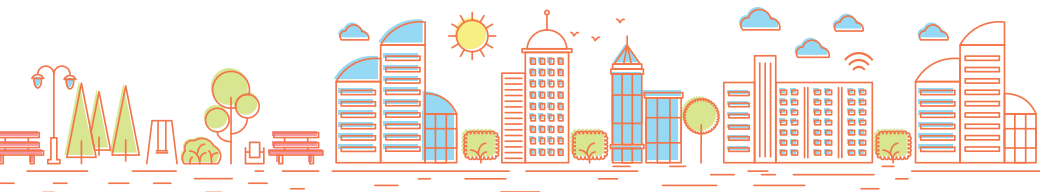
The training module address the measures that need to be taken at city level only. Coordination with the state departments that may be required for green building adoption is limited in the training.

# Contents

<b>Executive Summary</b>	<b>iv</b>
<b>1. Introduction</b>	<b>2</b>
1.1 Aligning with the Climate Smart Cities Assessment Framework	4
<b>2. Green Building Adoption Challenges</b>	<b>8</b>
2.1 Green Building Information	9
2.2 Training and Capacity Building	9
2.3 Behavioural/ Organizational	10
2.4 Green Materials and Technologies	10
2.5 Financial Assistance	11
<b>3. Green Buildings Adoption Strategies</b>	<b>12</b>
3.1 Suggested strategies for cities to overcome policy and regulatory challenges	12
3.2 Suggested strategies for cities to overcome green building information challenges	19
3.3 Suggested strategies for cities to overcome training and capacity building challenges	22
3.4 Suggested strategies for cities to behavioural/organizational challenges	25
3.5 Suggested strategies for cities to green materials and technologies challenges	29
3.6 Suggested strategies for cities to financial assistance challenges	32



<b>4. Interactive Exercise</b>	<b>34</b>
<b>5. Case Studies</b>	<b>40</b>
5.1. Case study on green building code adoption and integration in online building approval system	40
5.2. Case study on green building adoption in Master Plan	42
5.3. Green Building adoption by Municipalities and PWDs	42
5.4. Case study on green building financing programmes	43
5.5. Case study on green building additional cost and pay-back period	44
<b>6. List of Additional Reading Material</b>	<b>46</b>
<b>7. References</b>	<b>48</b>
<b>8. Annexure</b>	<b>52</b>
8.1. Certified Green building Materials and Technologies	52



## List of Figures

Figure 1: Sector wise indicators of the Climate Smart City Assessment Framework 2.0 .....	5
Figure 2: CACAF 2.0 Energy Sector - Indicator 6 – Performance Score, Criteria and Levels .....	6
Figure 3: Green building adoption challenges .....	8
Figure 4: Building approval process with ECBC integration.....	15
Figure 5: Existing and proposed building approval process at city level at pre-construction stage (post green building adoption) .....	16
Figure 6: Existing and proposed building approval process at city level at construction & post-construction stage (post green building adoption) .....	17
Figure 7: List of building approval & compliance documents .....	18
Figure 8: List of Green Rated Buildings in Karnataka .....	20
Figure 9: Suggestive Composition of High-Level Committee .....	25
Figure 10: Examples of Green Building Promotional (Incentive) Schemes.....	26
Figure 11: Telangana Online Building Approval System .....	40
Figure 12: Flow Chart of Online Compliance Procedure followed by the Greater Hyderabad Municipal Cooperation.....	41
Figure 13: Pimpri Chinchwad Navnagar Development Authority building .....	42
Figure 14: CII GreenPro Certification, 2019 .....	53
Figure 15: GRIHA Product Catalogue.....	54

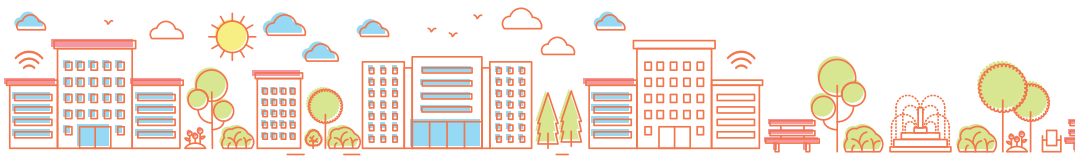




Photo Credits: CHUTERSNAP on Unsplash

## Abbreviations

ASSOCHAM	Associated Chambers of Commerce and Industry of India	FAR	Floor Area Ratio
AMRUT	Mission on Rejuvenation and Urban Transformation	GB	Green Buildings
AP	AP Accredited Professional Professionals	GBC	Green Building Cell
APECBC	Andhra Pradesh Energy Conservation Building Code	GBCI	Green Building Council Inc.
BEE	Bureau of Energy Efficiency	GDCR	General Development Control Regulations
BUA	Built-up Area	GEM	Green and Eco-friendly Movement
CII	Confederation of Indian Industry	GHG	Greenhouse Gas Emission
CP	Certified Professionals	GHMC	Greater Hyderabad Municipal Corporation
CPHEEO	Central Public Health and Environmental Engineering Organisation	GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
CSCAF	Climate Smart Cities Assessment Framework	GRIHA	Green rating for Integrated Habitat Assessment
DA	Development Authority	HAREDA	Haryana Renewable Energy Department Agency
DPMS	Development Permission Management System	HSR	Haryana Schedule Of Rates (HSR)
EABs	Energy Auditor (Buildings)	HVAC	Heating Ventilation Air Conditioning
EC	Environmental Compliance	IFC	International Finance Cooperation
ECBC	Energy Conservation Building Code	IGBC	Indian Green Building Council
EDGE	Excellence in Design for Greater Efficiencies	INDC	India's Intended Nationally Determined Commitments (INDC)
EE&REM	Energy Efficiency and Renewable Energy Management Centre	IT	Information Technology
EIA	Environment Impact Assessment	KECBC	Karnataka Energy Conservation Building Code
ENS	Eco Niwas Samhita	KREDL	Karnataka Renewable Energy Development Ltd
		LEED	Leadership in Energy and



	Environmental Design	STC	State Level Committee
MNRE	Ministry of New and Renewable Energy	TERI	The Energy and Research Institute
MoEFCC	Ministry of Environment, Forest and Climate Change.	ToT	Training of Trainers
MoHUA	Ministry of Housing and Urban Affairs	TSECBC	Telangana State Energy Conservation Building Code
MoP	Ministry of Power	ULBs	Urban Local Bodies
MOSPI	Ministry of Statistics and Programme Implementation	UNFCCC	United Nation Framework Convention on Climate Change
NAPCC	National Action Plan on Climate Change	UNEP	United Nation Environment Programme
NBC	National Building Code	UP NEDA	Uttar Pradesh New & Renewable Energy Development Agency
NIUA	National Institute of Urban Affairs	US GBC	U.S. Green Building Council
PEDA	Punjab Energy Development Agency	WBSCD	World Business Council for Sustainable Development
SDA	State Designated Agency	WGBC	World Green Building Council
SOP	Standard Operating Procedure		
SoR	Schedule of Rates		





# 1

## Introduction

Building construction sector is one of the critical sectors of Indian economy and is the second largest employer after agriculture. Buildings have extensive direct and indirect impacts on the environment. During their construction, occupancy, renovation, and demolition, buildings use energy, water, and raw materials, generate waste, and contribute significantly to environmental impact. As per U.S. EIA's International Energy Outlook 2017, the energy use from buildings is increasing at 8% annually and, in a business-as-usual scenario buildings would account for over 70% of emissions by 2050 (EIA, 2017).

The exponential growth of Indian buildings sector and its contribution to climate change plays a critical role in India's actions towards addressing climate related risks and achieving sustainable development goals. Government of India is making a lot of efforts to limit the climate change impact due to development activities.

India's Climate Change Policy is articulated through two key documents.

- The National Action Plan on Climate Change(NAPCC) adopted on June 30, 2008.
- India's Intended Nationally Determined Commitments (INDC) submitted to the UN Framework Convention on Climate Change(UNFCCC) in October 2, 2015. The INDC is a statement of intent on Climate Change action announced in the run up to the Paris Climate Change summit held in December 2015

National Action Plan on Climate Change (NAPCC) has 8 key mission, including the Mission on Sustainable Habitat. One of the objective of this mission is to ensure "Improvements in energy efficiency in buildings through extension of the energy conservation building code". In the framework of its NAPCC, the Indian government has adopted a series of measures among which is a concept of "green & energy efficient buildings". This concept goes beyond the sole approach of energy savings and intends to optimize the demand for water and other natural resources during the construction, operation, renovation and demolition phase.

Mission on Sustainable Habitat is being implemented through below mentioned the four flagship programmes.

- Atal Mission on Rejuvenation and Urban Transformation (AMRUT)
- Swachh Bharat Mission
- Smart Cities Mission
- Urban Transport Programme

*“As per the report prepared by TERI for the Ministry of Housing and Urban Affairs for the COP21 summit at Paris, the successful implementation of the above flagship missions has a potential for mitigation of GHG emission amounting to 133 Million Tonnes CO<sub>2</sub>eq by 2021 and 270 Million Tonnes by year 2031.”*

As per International Finance Cooperation, *“In India, though the concept of green buildings has been around for almost two decades, green buildings constitute for only 5% of the building market”*. Despite the fact that, green buildings has a strong business case with a potential to offer win-win scenarios, the shift towards green and energy efficient building construction is slow, as adoption of green buildings has some challenges (Edge Buildings, 2018). The most common perception is that green building construction costs more. Preference is given to conventional building construction approach, as it is considered as a cheaper option. There is clear lack of value attached to the life cycle benefits of green buildings. Moreover, there is an overall resistance to switch to green buildings at all levels: government, industry and individuals. Green building adoption have some barriers and therefore understanding the various challenges that hinder the propagation of green buildings is extremely important before any suggestive action or measure can be taken to bring in appropriate changes. While the perception of higher costs exist, challenges are also linked to policies and regulations, green building information, organizational/behavioural, training and capacity building, availability of green materials and technologies and access to green finance (Abraham, P. S. & Gundimedda, H. 2017).

Both states and local governments are taking actions to incorporate green building techniques into their policy and planning framework as a foundation for their sustainable future. Today's commitment to climate change mitigation and environment protection has placed pressure on local governments that approves the construction of new buildings and the renovation of existing structures to switch to green and environment friendly building construction practices. As demand for more green and environment friendly buildings increases, local governments/ ULB Officials will need to consider policy changes to reduce the negative impacts and increase the positive impacts of the built environment on the natural environment and local residents of their respective cities. Cities can adapt their policies and regulations to provide a framework for green building practices. The development, adoption, and implementation of green building codes and rating systems is the first step towards green building adoption. Green building adoption, requires an integrated approach across all stakeholders. For this, cities can create green building awareness among all key stakeholders, develop their capacity through training, as well as provide incentives and financial assistance to facilitate quick and easy adoption of green buildings (Were, S. W., Diang'a, S.O., Mutai, A.K. 2015).

### 1.1. Aligning with the ClimateSmart Cities Assessment Framework

In CSCAF, the indicator on Green Building Adoption, focuses on the adoption of green building wherein cities are assessed based on the ratio of green buildings to the total number of buildings approved for construction and occupancy in the city for the assessment year. The assessment is based on this formula:

$$\frac{(A+B+C+D)}{\text{Population of the city (2019 per 10000)}}$$

Where

A={{BUA of Green buildings in the city (Residential)/ Residential occupant load (8 per 100 sq.m of BUA)

B={{BUA of Green buildings in the city (Institutional)/ Institutional occupant load (6.6 per 100 sq.m of BUA)

C={{BUA of Green buildings in the city (Commercial)/ Institutional occupant load (10 per 100 sq.m of BUA)

D={{BUA of Green buildings in the city (Industrial)/ Institutional occupant load (10 per 100 sq.m of BUA)

BUA of Green Buildings in the city = Data from IGBC, GRIHA,GBCI

\* From Model Building Byelaws Chapter 04 (MoHUA). Access the document here: <http://mohua.gov.in/upload/uploadfiles/files/Chap-4.pdf>

Figure 1 Sector wise indicators of the Climate Smart City Assessment Framework 2.0



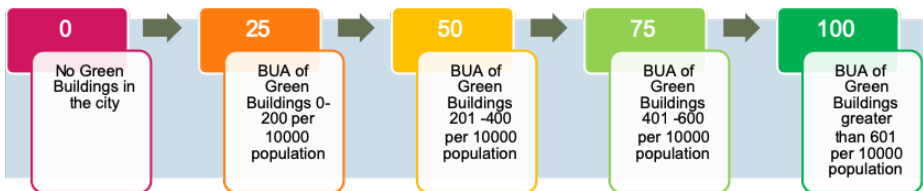
Cities collect data regarding total built-up area of green certified buildings typology-wise as mentioned below

- Residential
- Institutional
- Commercial
- Industrial

Cities can directly collect green building data from green rating agencies and population data from other relevant nodal department including Office of the Registrar General & Census Commissioner, India, Ministry of Home Affairs, Government of India. In CSCAF 2.0, data was centrally collected from Green Rating Agencies – Indian Green Building Council (IGBC), Green Rating for Integrated Habitat Assessment (GRIHA) and Green Building Certification Inc (GBCI).

Maximum score for the indicator is 100 points. Cities will be marked in five levels with scores ranging from 0 to 100. Participating cities are ranked based on performance score achieved as per of measures achieved under the indicator. The measures are progressive levels and aspirational in nature from level '1' to level '5'. Each measure assesses as well as provide guidance to progress and achieve the next highest levels. Cities will be assessed based on below mentioned criteria.

Figure 2: CACAF 2.0 Energy Sector - Indicator 6 – Performance Score, Criteria and Levels







*Photo Credits: Shivan Singh on Unsplash*

# 2

## Green Building Adoption Challenges

Green building adoption challenges could be grouped in six interrelated heads, which suggest the need for holistic and integrated strategies to overcome the challenges. Lack of awareness, resistance of stakeholders to change and higher cost are identified as the most critical challenges to implementing green buildings. Other challenges are related to policies and regulation, capacity building and training, behavioural and organizational, green materials and technologies and financial assistance. The six broad challenges to green building adoption are mentioned below (Were, S. W., Diang'a, S.O., Mutai, A.K. 2015) & (Wienerberger India 2017).

Figure 3: Green building adoption challenges



The below section covers each challenge in details.

### Policies & Regulations

Lack of robust and stringent green building policies, codes and regulations as well as lack of awareness about these policies, codes and guidelines are one of the key barrier to green building adoption in cities. Other deterrent is the lack of awareness of green building policies, codes and regulations among key industry stakeholders.

## 2.1. Green Building Information

Information regarding green and energy efficient building concept options is often incomplete, unavailable, inaccurate, expensive and difficult to obtain and verify. For example, higher perceived cost, limits progress towards green building adoption. Also there is a clear lack in technical know-how, lack of practical information for decision making including energy efficiency features of buildings, green building construction methodologies, energy saving materials, technologies and appliances, etc.

Lack of green building data at city level, including total number of pre-certified/ certified green buildings, green building built-up area typology wise, green building pilot projects and best practice examples etc. There is a clear lack of availability of accurate city wise green building information. Lack of data acquisition and management processes is also a barrier in validating and improving green building adoption.

Lack of information at the end-user level, as it can also influences end users in decision making. Especially in regards to buying/ investing in a green project verses non-green project. Neither do end-users have the knowledge of green buildings, its benefits, how their daily behaviour influences their energy and water consumption, nor is the link between energy, water, resource consumption and the environment is well understood so that they can take informed decision. (Mohanty, B. 2012).

## 2.2. Training and Capacity Building

Building industry involves an important number of stakeholders, who are specialized in specific areas of their profession including architects, planners, engineers, contractors, material and technology suppliers etc. In most cases, there is a disagreement among various stakeholders about what needs to be done and how in regards to green buildings.

This may be because of varied level of knowledge and awareness. Therefore there is a need to reach the wide range of stakeholders in the industry and bring them together, so that they form a network of experts who are able to appreciate and adopt green buildings.

### 2.3. Behavioural/ Organizational

Government plays driving force in governing green building transitions and innovations. Lack of leadership is one of the key challenge in wide-spread adoption of green buildings. An unfavourable organizational culture, lack of internal leadership, lack of goals that aims at green building practices and the lack of or ineffective management pose further challenges in green building adoption.

### 2.4. Green Materials and Technologies

Market for green building materials and technologies is slowly picking up in India. Many material and technology vendors are already manufacturing products that are green and environmentally friendly. However, when the green building market is not mature, manufacturers tend to market less efficient products more, that are “affordable” to their clients. Due to lack of economy of scale; their costs tends to remain on marginally high or is perceived as high and developers and building owners are yet not ready to pay for the perceived high-cost of building materials and technologies.

Creating awareness about new and innovative green building materials and technologies is equally important to facilitate its easy and quick adoption. In addition to new and innovation green building materials and technologies, India is full of indigenous materials, technologies and construction practices that are inherently resource-efficient and environment-friendly. Creating awareness about the ancient know-how, knowledge and skills is equally important. (Mohanty, B. 2012)

Government intervention especially local government may therefore be required to trigger the market transformation towards green building materials and technologies that are best suited to their local market demand. It is important to work on the demand side, supply side will automatically pick up. Few key strategies includes

- Set-up minimum performance standards helps to push inefficient materials and technologies out of the market.
- Develop ecolabel for materials & technologies, which enables the end users in the building sector and manufacturing sector to choose sustainable products, materials and technologies for reducing the environment impacts during the construction, operation and maintenance of their buildings and factories.
- Promote mandatory or voluntary labelling of quality on products that consume energy/ water (e.g. energy or water star rating programmes for products)

## 2.5. Financial Assistance

Lack of financial assistance is another hurdle in adoption of green buildings. Developers face huge financial challenges making green and energy efficient buildings, despite the increasing recognition that green projects can deliver significantly long-term benefits. There is a myth that green building cost more, actual or perceived upfront costs are often a key challenge to green building adoption. Developers tend to avoid investments on green buildings unless the net benefit stream starts flowing in within a year or so. Even though green buildings are feasible and profitable, banks are reluctant to offer green loan products to developers as construction loan and to home buyers as retail loan for investing in green projects. (Mohanty, B. 2012)



*Photo Credits: Manny Becerra on Unsplash*

# 3

## Green Buildings Adoption Strategies

### 3.1. Suggested strategies for cities to overcome policy and regulatory challenges

#### Immediate Initiatives

##### Develop and adopt green building codes & rating systems

Creating polices as well as relevant laws and regulations for effective implementation of green building criteria's in both new and existing building construction is the key for mainstreaming green and ensuring its faster adoption. Cities can adopt, notify and integrate green building codes and rating systems in their local general development control regulations (GDCR) and building bye-laws. Cities can initiate process of green building implementation through notification of following green building codes & green building rating system.

#### Green Building Codes:

- National Building Code (NBC 2016), Bureau of Indian Standards (BIS), Part 11: Approach to Sustainability
- Energy Conservation Building Code (ECBC 2017), Bureau of Energy Efficiency (BEE)
- Eco Niwas Samhita
  - i. Part I: Building Envelop, Bureau of Energy Efficiency (BEE)
  - ii. Part II: Electro Mechanical & Renewable Energy Systems

## Green Building Rating Systems

- Green Rating for Integrated Habitat Assessment (GRIHA)
- Indian Green Building Council (IGBC)
- Leadership in Energy & Environment Design (LEED)
- Excellence in Design for Greater Efficiencies (EDGE)
- GEM Sustainability Certification Rating (GEM)

## Adoption of Energy Conservation Building Code

The building approval process with integration of energy conservation building code is highlighted in the below image. Code development updated & monitoring falls under the purview of the center government (so happens at the national level). The responsibility for enabling and implementing lies with the state and local government. Along with government departments. Violation check & compliance monitoring by state designated agency is done at the state level. ECBC grievances redressal committee is also formed at the state level. ECBC code provision are integrated in the local city building bye-laws. Building construction and permit process at the city level consist of 2 phases. In the first phase, the ULB approval is sought for proceeding with the construction by submitting building's design and construction drawings in accordance with the building bye-laws. This is called design phase compliance. In the second phase – called the post construction phase, Energy Auditor Buildings (EABs) check compliance and provide certificate in intimation to ULBs/ DA's and also send details to State Designated Agency. ULBs/ DAs furnish a No Objection Certificate (NOC) to the building owner or developer after ensuring that the intent of all relevant codes and bye-laws have been met during the actual construction of the project. Developer has to submit a building energy performance report to state designated agency for next 2 years (AEEE, 2017) & (Shandilya, N., Ghorpade, A. G. 2019)

ECBC overall implementation consists of 4 key steps: ECBC Development & Revision/ Updating, Adoption, Implementation and Enforcement.

- Code development & revision happens at national level. Nodal Agency is the Bureau of Energy Efficiency (BEE), Ministry of Power
- Code adoption i.e. notification and amendment fall under the purview of the state government. To adopt code at the state level, the State Designated Agency (SDA) has been constituted at every state level by BEE under the provisions of the EC Act. In general, State Designated Agency along with Urban Development Departments have the collective responsibility of code adoption.
- While code notification can be solely undertaken by SDA or UDD, amendment of code and incorporating in other building design and construction guidelines (bye-laws, Town and Country Planning rules and regulation, PWD Schedule of Rates (SoR)) require a variety of inputs from technical experts. Incorporation of ECBC technical specifications in the building design, which includes demonstrating compliance to ECBC, is typically the responsibility of technical experts and design professionals like certified architects, engineers, Certified BEE & Green Building Professionals/ Consultants
- The code enforcement includes ECBC compliance check and falls under the purview of Urban Local Bodies. The inclusion of ECBC in building bye-laws, mandates code compliance check during the building approval process leading to code enforcement. The enforcement process includes devising inspections for code compliance at periodic intervals during construction. Third Party Assessor is responsible for conducting inspections.

Below images highlights the existing and proposed building approval process at the city level after green building adoption during the pre-construction, construction and post-construction stage. Also list of green building compliance project documents required at the various construction stages is highlighted below in orange colour (AEEE, 2017) & (Shandilya, N., Ghorpade, A. G. 2019).



Figure 4: Building approval process with ECBC integration

## BUILDING APPROVAL PROCESS WITH ECBC INTEGRATION

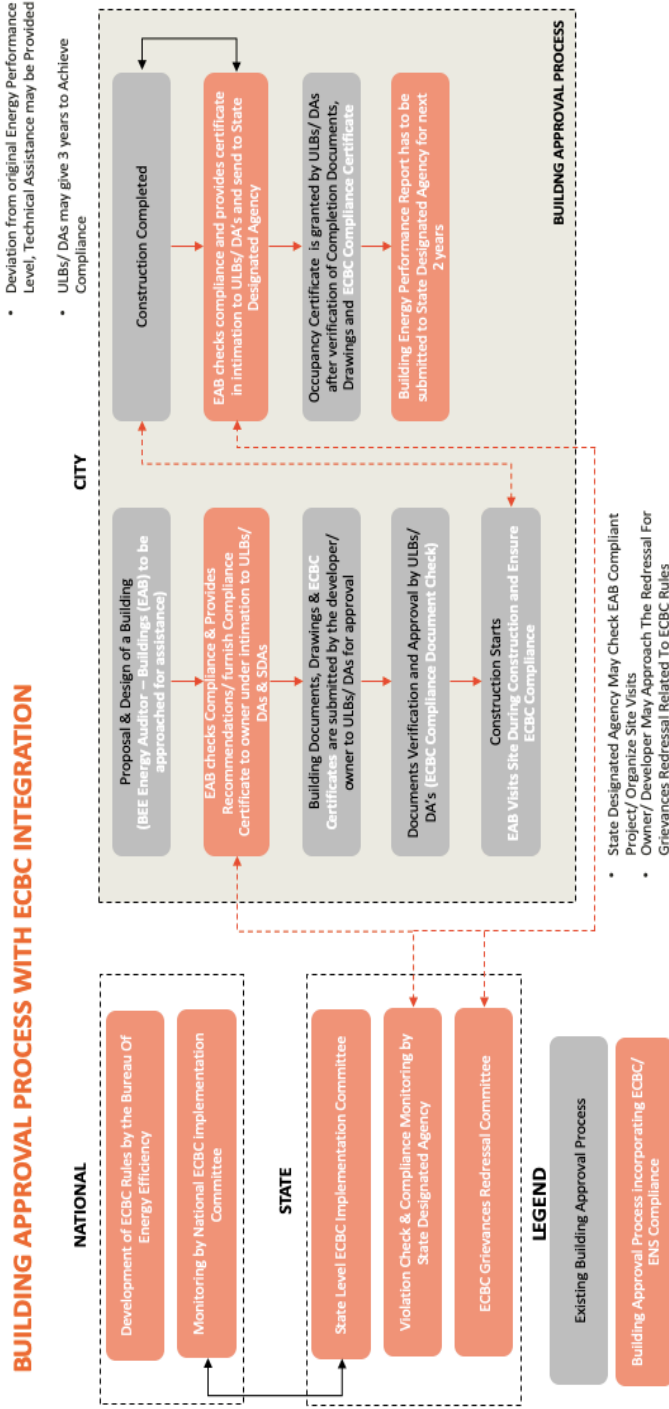


Figure 5: Existing and proposed building approval process at city level at pre-construction stage (post green building adoption)

**EXISTING & PROPOSED BUILDING APPROVAL PROCESS AT CITY LEVEL (POST GREEN BUILDING ADOPTION)**

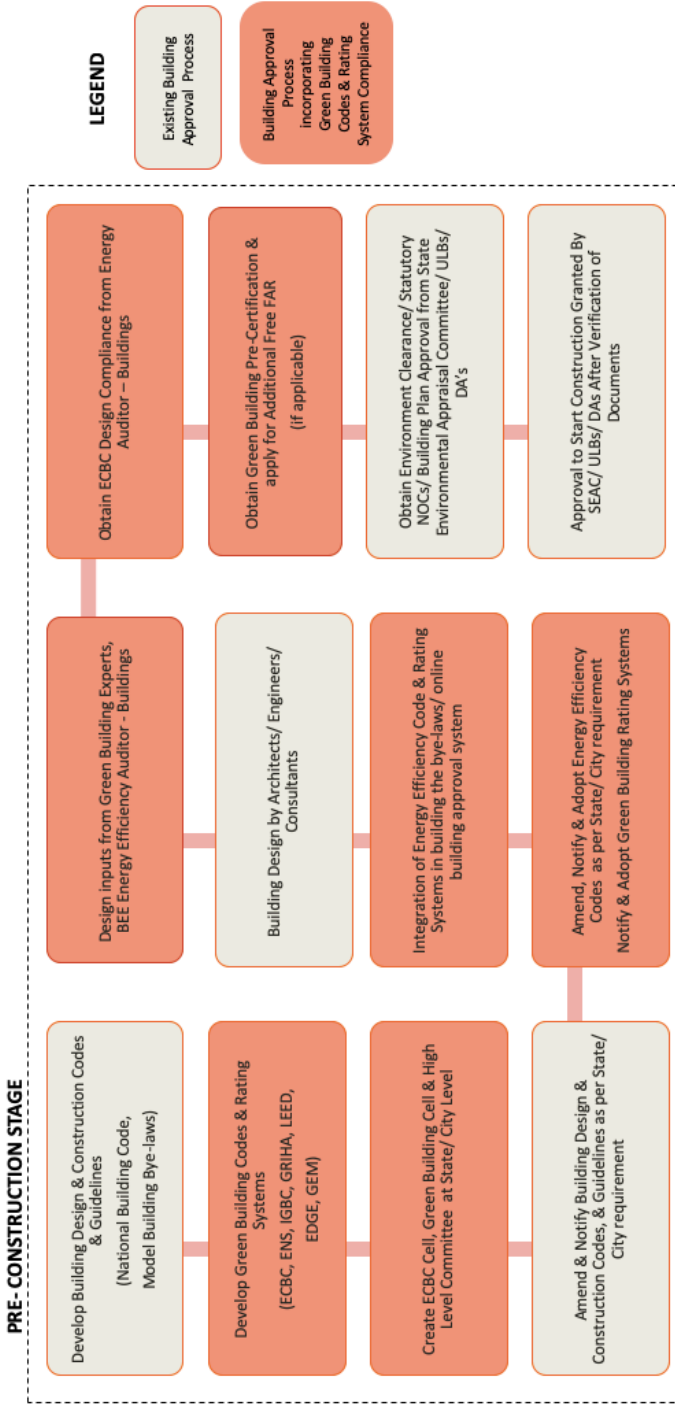


Figure 6: Existing and proposed building approval process at city level at construction & post-construction stage (post green building adoption)

**EXISTING & PROPOSED BUILDING APPROVAL PROCESS AT CITY LEVEL (FOR GREEN BUILDING ADOPTION)**

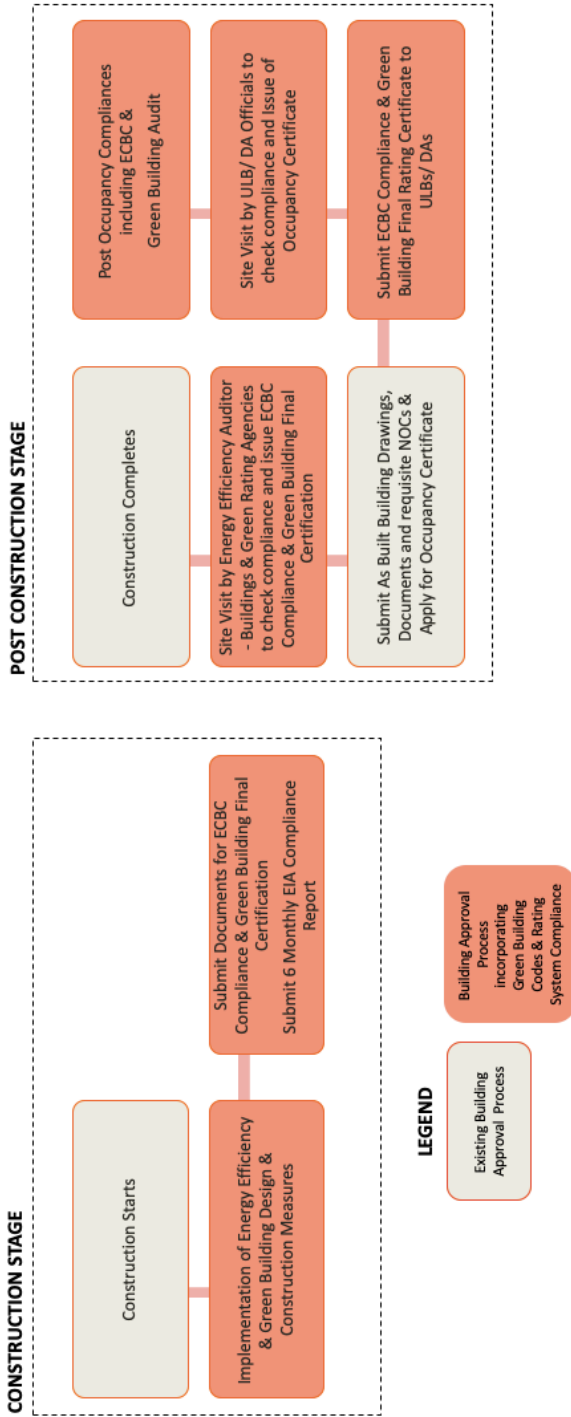


Figure 7: List of building approval & compliance documents

## PROJECT APPROVAL/ COMPLIANCE DOCUMENTS



### **Develop and practice green building promotional schemes**

Develop and impose penalties in case of non-compliance to green buildings norms. Green building compliance can be ensured at the local level by mandating its compliance certificate submission in the online building approval system, as one of the documents to be submitted to ULBs/Development Authority for building approval.

### **Integrate green building codes & rating systems in the online building approval system**

Inclusion of latest provision of green building codes & rating systems in the GDCR and Building Bye-laws is one of the key steps. It is important to note that adoption of green building codes & rating systems is voluntary in nature, but becomes mandatory in state and cities after notification in General Development Control Regulations/ Building Bye-laws.

## **Continued Initiatives**

### **Practice green building adoption, implementation and enforcement procedures.**

Develop green building adoption, implementation, compliance and enforcement process. Mandate green building codes and rating system compliance in all government office buildings, institutional buildings such as schools, colleges, hospitals and public housings constructed or promoted by Urban Local Bodies. Also regulate the building approval process with the rules and regulations for compliance with green building codes & rating systems.

## **3.2. Suggested strategies for cities to overcome green building information challenges**

### **Immediate Initiatives**

#### **Develop green building codes & rating guides**

Local governments can adopt model codes and also adapt their regulatory framework to encourage green building construction and work towards cultivating responsible environmental management practices. ULBs can adopt or modify applicable national/ state level green building codes and rating systems to adapt to their city's requirements.

Other key step to be undertaken by ULBs is to notify the codes & rating system in state gazette and also integrate it in General Control Regulation Guidelines or Building Bye-laws. To ensure faster adoption, city can create a dedicated green building high level committee and cell within ULB, to provide technical assistance and ensure effective

promotion, adoption, implementation and enforcement of green building in their respective cities. Cities can also start promoting green building codes & rating systems through awareness & training workshops among all relevant stakeholder to encourage faster adoption.

### Develop and disseminate green building knowledge products, manuals, tip-sheets and guides.

Cities can develop green building promotion and communication strategy and accordingly create knowledge dissemination products for creating green building awareness. Green building knowledge dissemination products can include flyers, brochures, manuals, guidebooks, newsletter (monthly/ quarterly) on green building concepts and promotional activates at city level and circulate the same among relevant stakeholders through online/off-line communication media.

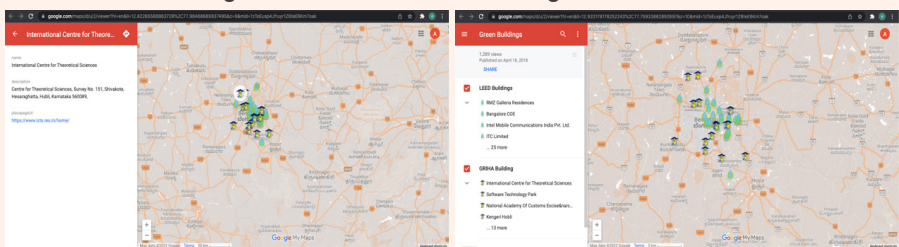
### Develop & disseminate green building design and construction methodology guides.

Cities can develop green building guidelines for design, material and construction methodology and technologies. In addition to this, also develop green building technical documents including guidebooks, manuals, ready reckoners/ tip-sheets on key green building topics and circulate the same among relevant stakeholders through online/ offline communication media.

### Develop Green Building Data Acquisition and Management Process.

Cities can start creating a repository of green building data at city level, including total number of pre-certified/ certified green buildings, green building built-up area typology wise, green building pilot projects and best practice examples etc. And make the data easily accessible or available in public domain by uploading on ULB website. Karnataka Renewable Energy Department have uploaded the list of green rated projects on their website along with map tagging project location and brief project description (KRED, 2022)

Figure 8: List of Green Rated Buildings in Karnataka



Cities can develop digital processes, dashboards to ensure the green building data is captured during the building approval process accurately. Cities can also look at creating a mechanism to tag the green building projects and key green building details during the building approval process at ULBs. Having a robust data acquisition and management system will help acquire accurate green building data and its management.

## Continued Initiatives

### Develop online & off-line awareness activities

Cities can initiate development of online/ offline library on green building rating guides, codes, manuals, reference books, journals, newsletters, tip-sheets etc. and make it accessible to all relevant stakeholders. In addition to this, cities can develop a dedicated website or a webpage on ULB's website dedicatedly on cities green building initiatives. In addition to this, cities can also develop dedicated social media pages to promote green building concept on platforms like Facebook, Twitter, YouTube, Instagram etc. and frequently updated with latest information related to green building promotion and adoption, information on all past, on-going and upcoming green building events in the city. Also upload details of pilot/ demonstration and best practice projects in the city and best practice national/ international case studies on ULB website, webpages or social media pages. All knowledge dissemination products. can be uploaded in free to use and downloadable versions.

### Develop green building pilot & best practice projects and document it for wider dissemination

Cities green building cell can facilitate development of demonstration/ pilot projects at the city level in collaboration with public and private developers to showcase green building concepts and best practices. The same can also be documented in the form of best practice case study booklet. Case study booklet shall also feature best practice projects from pan India as well as international case studies of green buildings and uploaded on ULB website/ web-page in downloadable version. Case study booklet can also detail out list of materials and technologies used in the pilot projects and details of their local suppliers.

Indian Green Building Council in year 2014 had launched a coffee table book series, it is a limited-edition biennial publication and showcases unique IGBC rated green building projects from across India. The book covers project summary, project team details, high resolution photographs, project salient features like passive architectural design, innovative use of recycled and salvaged materials, landscaping, etc. Tangible and intangible benefits as well as experience of the occupants in living and working out of green buildings.

For further details refer

<https://igbc.in/igbc/redirectHtml.htm?redVal=showResourcesnoisgn>

### **Develop green building awareness campaigns targeting at different stakeholders**

Cities can develop public mass awareness campaigns and publicity products including audio-visual presentations, advertisements, hoarding, bill-boards etc. The publicity products can be put up at strategic city locations including main bus-stands, on government buildings etc. Other activities that cities can take up is organize green building competitions & quizzes, design awards to reach out to wider audience and create awareness among general public on green building concept. Cities can also target schools, colleges and universities for creating awareness on green buildings. This will enable educational institutions to develop Industry-ready professionals trained on green concepts and also facilitate industry - academia linkage. Cities can also provide financial support research universities and think tanks for developing new and innovation green building solutions, materials, products and technologies.

### **Develop green building training & capacity building activates targeting at different stakeholders**

Dedicated technical training and capacity building session targeted at various stakeholders can be developed with the intent to make city officials aware about the green building concepts. Develop training modules and conduct training session for various industry stakeholders like government officials, green rating agencies, architects, engineers, consultants, developers, building industry associations, material and technology vendors and building users etc. to create green building awareness to facilitate easier and quick adoption of green buildings.

## **3.3. Suggested strategies for cities to overcome training and capacity building challenges**

### **Immediate Initiatives**

#### **Develop training and capacity building sessions on green building adoption, implementation and enforcement procedures, protocols & methodologies.**

Training and capacity building of the industry professional and practitioners is the key activity to fast track green building adoption at the city level. ULBs can design new training modules based targeted at each stakeholder group training requirement. Develop training programme with the intent to educate and build capacity of industry professionals on green building codes, rating systems, concepts, design, construction, operation as well as on procedures for green building adoption and compliance. Training session shall also be designed to train stakeholders on procedures and processes to ensure green building compliance as per local green building codes and applicable rating systems and also on how to prepare green building compliance documents for submitting in the online building approval system.



### **Develop training and capacity building sessions on best practices on green building design, construction and operation.**

Cities shall impart training and capacity building on best practices related to entire life cycle of building including green building design strategies, construction methodologies, green materials and technologies, operation and maintenance protocols as well as green building procedures and processes for building refurbishment and demolition. Trainings should target all concerned stakeholders involved in various stages including training for architects and engineers at design stage, training of contractors at construction stage, training of building occupants, facility managers or operators on the whole building system operations and maintenance requirements. Cities ULBs shall also procure various green building simulation software's and also conduct training session on the same.

### **Create a pool of Certified Third-Party Assessors/ Auditors/ Green Professionals**

Cities should encourage participation of its officials as well as key industry stakeholders in continued professional development courses that would provide accreditation for green building rating agencies, all green building rating agencies offer accreditation courses for example IGBC/LEED AP Accredited Professional (AP) or GRIHA/ GEM Certified Professional (CP). Professional can become accredited professional by taking green building certification exam conducted almost every month. For further details refer green building rating agency websites (IGBC, GRIHA, USGBC, EDGE, GEM).

## **Continued Initiatives**

### **Conduct training and capacity building activities targeted at different stakeholders.**

Cities can develop training and capacity building activities targeted at all relevant stakeholder's government officials, architects, engineers, planners, developers, material & technology suppliers, home buyers, students etc. Cities green building cell can develop targeted training modules and training material including agenda, technical presentations on various green building topics, exercises (in both online & offline format), hand-outs, feedback forms etc. In addition to this, also prepare training session budgets, gets approval on budget from the high-level committee, prepare training calendar (monthly, quarterly or annually), schedule, duration (half-day, one/two/ three day) and as well as mode (online/ offline) and develop procedure for other logistics. To start with, city ULB's can start conducting monthly or quarterly capacity building and training sessions on green buildings targeted at different stakeholders.

### **Create awareness on green building codes & rating systems.**

City ULB's shall create awareness on green building codes & rating systems among relevant stakeholders, especially among government officials to ensure adoption of relevant green building code provisions in the local building bye-laws and general development control regulations and also integrate it in the online building approval process to ensure its adoption and compliance.

### **Create awareness on green building costs and pay-back period.**

There is a myth in market that green buildings cost more, the decision to adopt green is mostly based on a cost-benefit analysis. Usually, a business's decision to adopt a new concept is based on its evaluation of the benefits to be derived as against the costs and risks involved in the adoption.

These days, green buildings may cost 1-2% extra initially, with the pay-back period of less than 2 years. It is therefore crucial to create awareness among all key stakeholders on green building costs and pay-back period based on life cycle analysis. Cities shall develop training session on green building best practices, along with project cost, trade-off on high versus low cost strategies, no or minimum cost strategies, passive versus active design strategies.

### **Arrange site visits to green building pilot projects**

City ULBs shall identify best practice projects, sign memorandum of understanding with concerned developers for conducting regular site visits to their best practice pilot or demonstrative projects. This will help concerned stakeholders (developers, architects, students, end-users) to physically see and experience green building and also practically understand and learn about green design strategies, construction techniques, new and innovative materials and technologies as well as best operation and maintenance practices. Site visits also help stakeholders to understand green building benefits; risks and uncertainties involved in adoption and implementing of green buildings and also encourage them to adopt green building concept in their upcoming projects in an informed manner.

### **Include green building concepts in educational curriculums**

Cities can work with local educational institutions, (especially architectural and engineering) and encourage them to include courses on green building concepts and integrate them as part of their curriculum or offer as an elective. This will make students aware of the green building concept from a very early stage and enable them to become industry-ready from the beginning of their career. These courses can be designed to train students on green design, construction, operation and maintenance strategies, on new and innovative national and international best practices, innovation materials & technologies. Cities green building cells are design training courses for students or encourage students to take up courses offered by green building rating agencies. For further details refer green building rating agency websites (IGBC, GRIHA, USGBC, EDGE, GEM).

### 3.4. Suggested strategies for cities to behavioural/organizational challenges

#### Immediate Initiatives

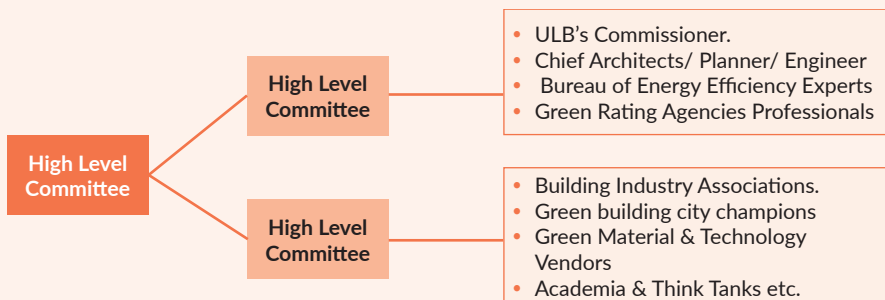
##### Create Green Building High Level Committee & Cell at city level.

Implementation of green buildings policy requires coordination at many levels and among different municipal departments and other levels of government. Through the formation of the high-level committee dedicatedly for green buildings and green building cell, cities can address potential barriers to green buildings including inter-departmental coordination and conflicts by regularly engaging with all concerned departments & their senior officials.

Government leadership accompanied by strong communication efforts by the high-level committee and green building cell in regards to green building concepts and its benefits, at the city level, will go a long way in inspiring confidence among all stakeholders and will facilitate easy adoption of green buildings. In addition to high level committee, cities can also create sub-committees like steering committee to guide and also keep track of all green building related activates in the city, technical committee to provide green building technical input and advice and grievance cell to address any concern related to adoption of green buildings. In case there are any major financial implication or budgetary approval required for their smooth functioning of a green building cell that is beyond the power of the commissioner. Formation of a high level committee may require approval from standing committee of the urban local body.

High level committee can include both key members (in-house team members/empaneled experts) and non-key members (guest invitees on need basis)

Figure 9: Suggestive Composition of High-Level Committee

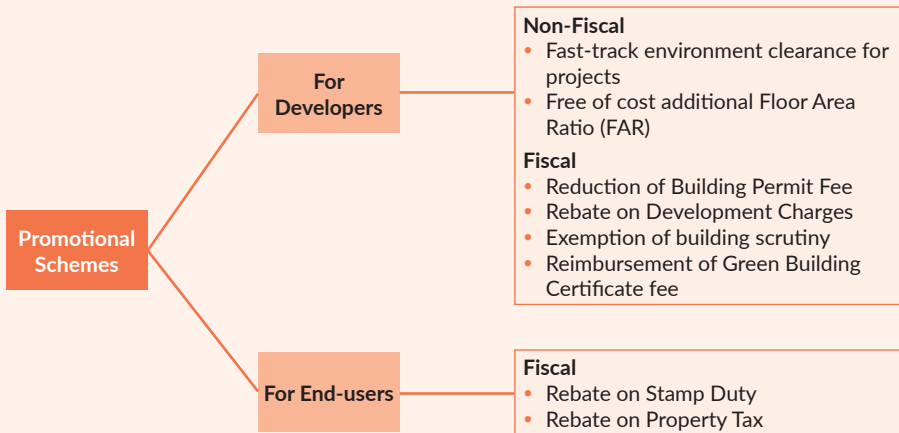


## Design and practice promotional schemes

Green building promotional schemes (incentives) are widely adopted to facilitate the faster adoption and growth of green buildings in the country. Green building incentives can be designed to benefit all key stakeholders in order to encourage and motivate them for going green. Urban local bodies can either endorse or adopt existing promotional, if available at state level or else design new promotional schemes. Next step is to notify such schemes and start implementing it by integrating it in the online building approval system. ULBs shall also create awareness about such scheme among all relevant departments and key stakeholders to encourage them to adopt & practice it. In addition to this, ULBs shall from time to time, take feedback from industry on existing promotional schemes and accordingly update/ modify it if required.

Cities can adopt from wide range of available incentives both fiscal or non-fiscal, already practiced by various states in India. Few existing popular green building incentives practiced by various states in India for green building is as follows

Figure 10: Examples of Green Building Promotional (Incentive) Schemes



In addition to this, develop and practice green building awards, rewards and schemes. the intent of awards and regards is to recognise building-related projects, organisations or individual (architect, engineers, consultants) with outstanding performance and contributions in advocating wider adoption of green building practices in their respective cities (Conserve, 2020).

### Enforce non-compliance penalties

Penalties can also be imposed for non-compliance of green building norms as stipulated by green building codes & rating systems. Urban local bodies can either endorse or adopt existing penalty schemes, if available at state level or else design new penalty schemes for non-compliance of green building norms. Next step is to notify such schemes and start implementing it by integrating it in the online building approval system. ULBs shall also create awareness about such scheme among all relevant departments and key stakeholders to encourage them to adopt & practice it. In addition to this, ULBs shall from time to time, take feedback from industry on existing penalty schemes and accordingly update/ modify it if required.

Few existing popular green building penalty schemes practiced by various state in India, includes

- Building Demolition at developer/ client expense for Non-Compliance of National Building Code/ Bye-Laws
- Hefty Financial Penalty for Non-Compliance of Green Buildings Certification after availing Green Building Free FAR
- No Occupancy Permit: Non-Issuance of Occupancy Certificate

### Set-up grievance redressal mechanism

City ULBs shall set-up a grievance redressal committee/ cell in order to address all issues related to green building adoption, implementation, enforcement, monitoring & verification. Also address all issues related to promotional & penalty schemes. The committee/ cell shall develop a standard operating procedure to address all green building related grievances and shall also unload it on their web-site/ web-page. All the grievances received, after due acknowledgment shall be forwarded to the concerned department who are dealing with the substantive function linked with the grievance for redressal under intimation to the complainant. Depending upon the seriousness of the grievance the committee/ cell follows them up regularly till their final disposal. Green building high level committee shall conduct regular review meetings are held with grievance redressal committee/ cell and all concerned departments to monitor and follow up on grievance so that the disposal of these is expedited.

## Continued Initiatives

### Encourage participation in green building events, workshops, conferences, seminars & trade shows.

Cities urban local bodies can encourage concerned officials/ their in-house team to participate in green building events, workshops, conferences, seminars & trade shows to train them on green building concepts and latest updates. Attending such events will also help city officials become familiar with the latest green building trends being introduced to stay up-to-date and relevant. These events also connect city officials with all relevant industry stakeholders and create a wider network on like-minded people. These events (especially trade shows) are useful also useful for B2B & B2C businesses. Conferences, workshops and seminars are good to reach out to relevant stakeholders and industry champions, learn about green building best practices, new development, innovative solutions, materials, technologies and techniques. Such events also help to gather feedback and recommendation directly from industry representatives of theirs need, as well as useful for gathering feedback on how you improve existing green building policies and practices. It also gives opportunity to city officials to speak directly to industry stakeholders, these are great platform to solicit a huge amount of feedback that can help city officials to better promote the green and energy efficient building concept also fast track its adoption. City officials will be able to establish connect with industry influencers, ULBs can work with these influencers to take the agenda of green buildings forwards and reach out to wider city audience. The personal interaction offered during the event allows city officials to establish a direct, more effective relationship with your industry stakeholders and vice versa

### Monitor green building adoption, implementation and enforcement

Strict regulatory framework, compliance measures and enforcement policies are probably the most effective ways to promote green building adoption. Local authorities have a key role in fast tacking uptake of the green building concepts through development of process for checking the adoption of green building, during the building approval itself. The best way is to integrate the green building compliance check in the online building approval system. It will help authorities tag, track and monitor progress of green building adoption as well as identify defaulter and accordingly penalize them for non-compliance. In addition to this local authority can also introduce mandatory building audit that would propel property owners to uptake green building concepts (Solomon W. et al, 2015).

**Engage and empanel experts including architects, engineers, planners, green building champions, accredited/ certified professional, material and technology vendors, think tanks and research institutes.**

High level committee and green building cell identify industry experts, champions and accredited professionals and empanel them as consultant, guest invitee to avail their expertise in promotion and adoption of green buildings. Empanelment of experts shall be done through proper process of inviting Expression of Interest & Request for Proposal. Experts may include architects, engineers, planners, green building champions, accredited/ certified professional, material and technology vendors, think tanks and research institutes. ULBs shall also develop list of empaneled experts and upload it on their web-site/ web-page.

### **3.5. Suggested strategies for cities to green materials and technologies challenges**

#### **Immediate Initiatives**

**Support green building material & technology research & development.**

Building materials and products are an inseparable part of our built environment. The research on building materials & technologies are going at a large scale, both at national and global level. Research are going on to find out new and innovative possibilities of materials and technological solutions, how much they can endure within, how much they can be beneficiary for built environment and human health. Government departments, private companies, start-ups, research universities and individuals are putting their effort to develop green and environment friendly alternative materials and technologies. The main aspect on which R & D is going on is to reduce the price of materials as well as making it environment friendly. Cities ULBs can also support research and development of local materials and technologies, work with concerned stakeholders to develop directory of available certified green materials and technologies and upload it on their website/ web-page. Cities can also do tie-up's with government and private departments, organizations, universities working in the area of building material and technology research, development & certification. Few leading institutes working the material and technology research are Building Materials and Technology Promotion Council (BMTPC), Central Building Research Institute (CBRI), Indian Institute of Technology (IIT), TARA Nirman Kendra etc. Cities can also work with green rating agencies for certifying green products.

Selection and empanelment of green building vendors i.e. material suppliers & technology solution providers is also critical to help industry stakeholders in adoption of green materials & technologies. ULBs shall develop list of approved material & technology vendors and their materials/ products and start circulating the same among relevant stakeholders through online or offline communication channels. The same shall be uploaded on the ULBs green building website/ webpage in downloadable format.

### **Develop procedure and facility for green building material & technology testing and certification**

Cities urban local bodies can develop research and development, testing and certification facilities for green building materials and technologies. Cities can identify think-tanks, universities to collaborate with for development of new and innovative materials and technologies. Cities can also endorse certified green building product & technologies from IGBC, GRIHA & BEE. In addition to this, cities can engage research and testing labs for benchmarking of green materials & technologies. There is a need for all companies (including building industry) to benchmark their products (material & technology) performance in order to know how well they are performing. It is a method of improving the performance in a systematic and logical way, by measuring and comparing performance of similar materials & technologies and rate/ certify them accordingly.

### **Develop & conduct green building material & technology awareness & training sessions**

City urban local bodies can develop various capacity-building programmes on green materials and technologies to promote its adoption and also to develop enabling environments for green buildings. In order to create market transformation, it is important to raise industry stakeholder's awareness in regards to green materials and technologies, its benefits as compared to non-green materials. Also develop capacity and build knowledge of the ignorant and un-interested building sector stakeholders to trigger the appetite for the demand and supply of green building materials and technologies.

### **Update Schedule of Rates as per green materials**

City PWDs shall review the existing PWD documents including standard specification, schedule of rates, analysis of rates, plinth area rates and provide recommendations on integration of green and energy efficient building measures in these documents to facilitate its compliance. This will help cities to integrate green measures in all building contract, tender documents from the pre-design stage itself, thus, ensuring that energy and resource efficiency becomes an inherent part of the building construction process.



## Continued Initiatives

### Support initiatives to trigger market transformation and make green buildings materials & technologies affordable & accessible.

Local government plays a key role in market transformation, they can support research and development of innovative green building materials and technologies. Many buildings are owned and operated by governments and therefore, market practices can be influenced significantly if governments can set good example by adopting green materials and technologies. Public agencies can lead by examples, by adopting green products in public buildings, encourage procurement of green materials and technologies in government buildings by creating procurement policies and regulations that will mandate use such materials. Other key step is to update the schedule of rates with green building material specifications. This way public sector can make provision for higher-efficiency materials and technologies in their upcoming project, therefore promoting adoption of new and innovative green materials and technologies, kick-start process of market transformation. Other activates that cities can take up for market transformation is by launching public leadership/demonstration programmes followed by replication and dissemination activities, also by setting green building adoption target for all government departments.

### Create synergies with similar programmes like Global Housing Technology Challenge

City urban local bodies can collaborate with various on-going programmes by government ministries, departments, bi-lateral and multi-lateral agencies, to promote research, development and adoption of green materials & technologies. One such initiative by the Ministry of Housing and Urban Affairs is the Global Housing Technology Challenge - India (GHTC-India). It aims to identify and mainstream innovative construction technologies from across the globe for housing construction sector that are sustainable, eco-friendly and disaster-resilient. Other initiative in this direction is the Building Energy Efficiency Programmes by Bureau of Energy Efficiency, Ministry of Power. Development agencies like World Bank, IFC, GIZ, ADB, AFD, DFID etc. also have on-going programmes on building energy efficiency and green building programmes.

### 3.6. Suggested strategies for cities to financial assistance challenges

#### Immediate Initiatives

##### **Develop innovative financial incentives to promote green buildings like tax rebates, grants, subsidies, green mortgages, green bonds, carbon credits etc.**

Formulation of incentive policies like tax rebates, grants, subsidies, green mortgages, discount loans, green bonds, carbon credits, stimulate the green building adoption by developers as well as building owners (Conserve, 2020 & Lucon, O. & Üрге-Vorsatz, D 2014). Cities can either adopt existing fiscal and non-fiscal incentive policies or create their own policies, notify them and start practicing the same by integrating in the online building approval system.

##### **Develop innovative non-financial incentives to promote green buildings like fast track environmental clearance, single window clearance.**

Non-fiscal incentives such as preferential or expedited permitting, density bonuses (such as increased height allowances i.e. Additional Floor Area Ratio) will motivate building sector stakeholders especially developers to adopt green building concept. Building projects invariably takes about almost a year to get various statutory approvals and building permission, this leads to major time delays in projects and has a huge impact on all the stakeholders involved. States governments shall put in place a single window time-bound clearance system for all key building approvals. And in order to streamline the process, cities shall create an online dedicated portal for the same. The single window system will streamline tedious and time-consuming building approval process and helps both developers as well as end-users. Developers will be able to build fast and in timely manner, that in turn will save cost and allow them to pass on the benefits to end-users. End-user, need not go through the hassle of verifying building clearances and approvals (Adlakha N. 2015).

##### **Develop financial incentive programs targeted at Developers, Architects, Engineers, Consultants and Building Users.**

City ULBs and Development Authorities shall develop green building incentives targeted at all key stakeholders including developers, architects, engineers, consultants and building users. It will help green building adoption and also expedited growth in green building. Few existing green building financial incentives includes project tax rebates, stamp duty rebates, exemption of building scrutiny fee, reduction in building permit fee etc. (LEED 2014). The coverage of government incentives should also be widened to include the promotion of adoption of green materials and technologies.

## Continued Initiatives

### **Work with financial institutions & encourage them to develop innovative green financing products.**

Cities can work with financial institutions (banks, housing finance companies) through relaxed policies, guidelines to encourage them to develop innovative green financing products to accelerate the uptake of green buildings. Few innovative green financing products includes construction finance at low interest rate for green buildings, green mortgages, green home improvement loans etc. It can also include benefits like offering better financial terms such as lower interest rates and longer tenors. Financial institutions can also access new sources of finance through green bonds, green securitizations, and green credit facilities for potentially reducing their cost of capital.

### **Capitalize technical and financial assistant available at the state/ national level from other government schemes.**

Cities can take advantage of various technical and financial schemes and programmes available at state and national level targeted to build capacity, provide technical and financial assistance, fiscal and non-fiscal incentives to promote green and energy efficient buildings.

### **Explore tie-up with bilateral/ multilateral agencies for development funds, soft-loans, green finance opportunities.**

There are various on-going bilateral/ multilateral programmes on promoting adoption of green and energy efficient buildings. Cities with support from the state departments can tie-up with these agencies to explore opportunity to develop programme providing technical assistance, credit line, grant support to promote create green building awareness, build capacity, develop green materials and products and promote green building adoption.

# 4

## Interactive Exercise

The aim of the exercise is to brainstorm key challenges faced by cities in regards to green building adoption and categorised them in six board categories including policies & regulations, green building information, training and capacity building, behavioural/ organizational, green materials and technologies, financial assistance. The intent is to also allow city officials brainstorm solutions, strategies and key tasks to be taken up by ULBs to overcome existing green building adoption challenges in their respective cities. The exercise is in three parts:

- Activity 1 is designed as closed ended Q&A Exercise
- Activity 2 is designed as Challenges Mapping Exercise
- Activity 3 is designed as Strategy/ Solution Mapping Exercise.

The exercise supports in evaluating the current status of cities in regards to adoption of green building and also identify key green building adoption challenges faced by cities, categorised in six board categories including policies & regulations, green building information, training and capacity building, behavioural/ organizational, green materials and technologies, financial assistance. Also let participants brainstorm solutions to overcome existing problems. To help participants, possible solutions are listed in the stick note tags.

## Exercise Details

The exercise is design in three parts, as mentioned below:

**Activity 1** is designed as closed questions i.e. yes/ no. Question are designed to evaluate preparedness and progress of cities in regards to green building adoption. Question includes:


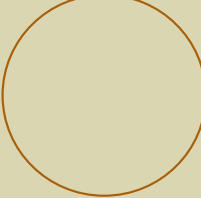

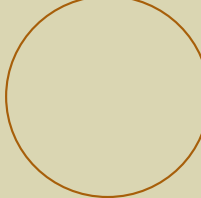

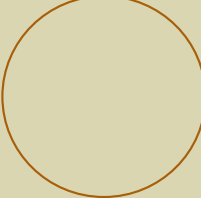

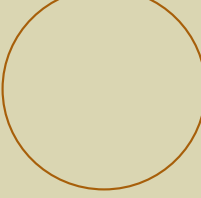

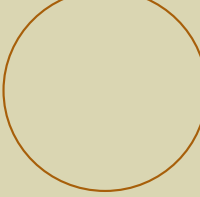

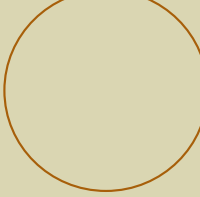
- Have you city integrated the green building compliance procedure in the online building approval system.
- Have your city initiated any green building awareness, capacity building and training activates.
- Does your city have a process in place to capture new green building built-up area (typology-wise).
- Does your city have a process in place to capture existing green building built-up area (typology-wise).

**Activity 2** is designed to identify key challenges faced at local/ city level in regards to green building adoption. It is also in the form of closed question and answers. City officials are required to identify key green building challenges and categories them as policies & regulations, green building information, training and capacity building, behavioural/ organizational, green materials and technologies, financial assistance.


**INSTRUCTIONS**

Identify key green building adoption challenges in you city and accordingly place “Star” ★ in the circles.

Maximum time allocated for this activity is 10 Mins.

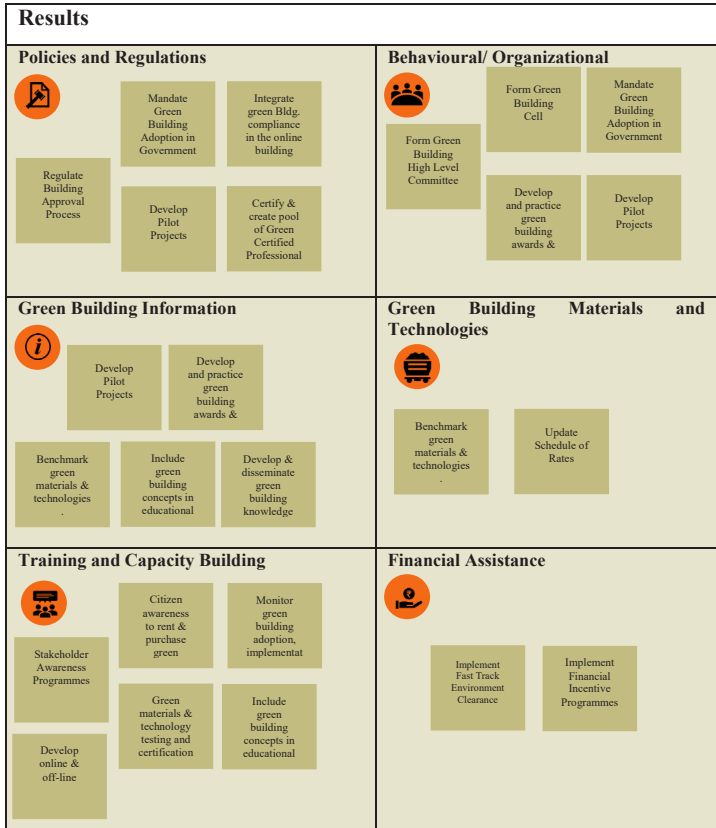
<b>Template</b>		
<p><b>Policies and Regulations</b></p>  	<p><b>Behavioural/ Organizational</b></p>  	<p><b>Green Building Information</b></p>  
<p><b>Green Building Materials and Technologies</b></p>  	<p><b>Training and Capacity Building</b></p>  	<p><b>Financial Assistance</b></p>  

**Activity 3** is designed to allow city officials brainstorm and learn about various possible solutions, strategies and tasks under each challenge category as identified in activity two, that needs to be undertaken by city ULBs to address barriers to green building adoption as well as to facilitate fast track adoption of green buildings in their respective cities.

<p><b>INSTRUCTIONS</b></p> <p>Identify solutions for each challenge from the “Sticky Tags” and drag and drop it in the appropriate box.</p> <p>Use “Blank Tags” to add other solutions and drag and drop it in appropriate box.</p> <p>Maximum time allocated for this activity is 20 Mins.</p>	<p><b>Blank Tag</b></p> 
---	---

<b>Template</b>	
<p><b>Policies and Regulations</b></p> 	<p><b>Behavioural/ Organizational</b></p> 
<p><b>Green Building Information</b></p> 	<p><b>Green Building Materials and Technologies</b></p> 
<p><b>Training and Capacity Building</b></p> 	<p><b>Financial Assistance</b></p> 

Form Green Building Cell	Develop Pilot Projects	Mandate Green Building Adoption in Government	Integrate green Bldg. compliance in the online building approval system	Update Schedule of Rates	Form Green Building High Level Committee	Develop & disseminate green building knowledge products
Benchmark green materials & technologies.	Stakeholder Awareness Programmes	Develop online & off-line awareness activities	Implement Financial Incentive Programmes	Green materials & technology testing and certification	Implement Fast Track Environment Clearance	Train financial institutions to develop green financing products
Develop and practice green building awards & rewards schemes	Citizen awareness to rent & purchase green buildings	Regulate Building Approval Process	Certify & create pool of Green Certified Professionals	Monitor green building adoption, implementation and enforcement	Include green building concepts in educational curriculums	Green materials & technology testing and certification



Form Green Building Cell	Develop Pilot Projects	Mandate Green Building Adoption in Government Buildings	Integrate green Bldg. compliance in the online building approval system	Update Schedule of Rates	Form Green Building High Level Committee	Develop & disseminate green building knowledge products
Benchmark green materials & technologies.	Stakeholder Awareness Programmes	Develop online & off-line awareness activities	Implement Financial Incentive Programmes	Green materials & technology testing and certification	Implement Fast Track Environment Clearance	Train financial institutions to develop green financing products
Develop and practice green building awards & rewards schemes	Citizen awareness to rent & purchase green buildings	Regulate Building Approval Process	Certify & create pool of Green Certified Professionals	Monitor green building adoption, implementation and enforcement	Include green building concepts in educational curriculums	Green materials & technology testing and certification





*Photo Credits: Alexander Abero on Unsplash*

# 5

## Case Studies

### 5.1. Case study on green building code adoption and integration in online building approval system

Telangana Energy Conservation Building Code Guidelines (TSECBC) has prescribed compliance guidelines for adoption of ECBC, 2017 in buildings codes & also mandated its compliance through the online building plan approval system permission system at ULB Level. The Greater Hyderabad Municipal Corporation (GHMC), Government of Telangana has integrated building energy efficiency compliance into the Development Permission Management System (DPMS) for buildings approval with the aim to streamline building approvals. To obtain a building construction permission, a building application and ECBC compliance forms must be submitted through the online DPMS (NRDC 2017).

Figure 11: Telangana Online Building Approval System

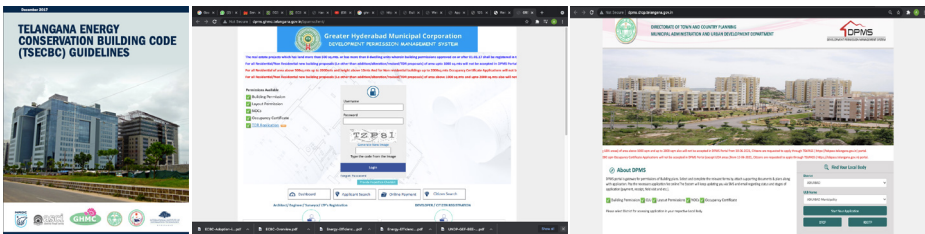
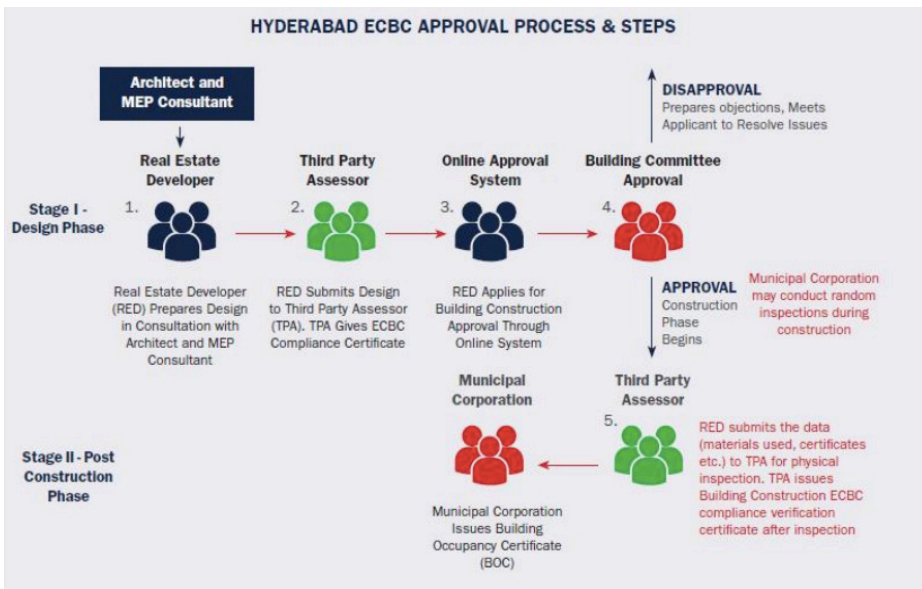


Figure 12: Flow Chart of Online Compliance Procedure followed by the Greater Hyderabad Municipal Cooperation





## 5.2. Case study on green building adoption in Master Plan

### Chandigarh Master Plan 2031

#### Adaption of Green Rating Systems

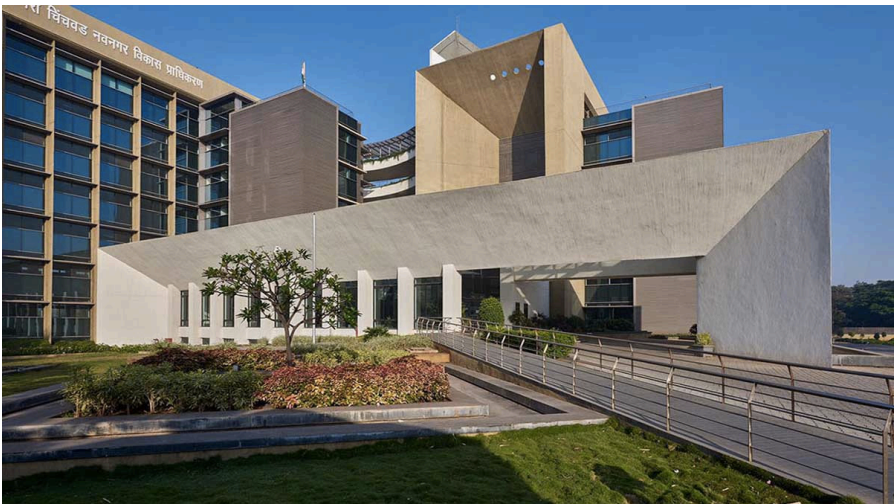
- CPWD Guidelines - mandatory 3 Star GRIHA Rating in all public/ government buildings
- Adoption of Green Building Concepts in the Building Designs of the City
- Chandigarh Master Plan 2031 have adopted sustainability measures related to:
  - i. Site Level Measures
  - ii. Material Conservation
  - iii. Indoor Environment Quality
  - iv. Water Efficiency
  - v. Energy Efficiency
  - vi. General Guidelines.
- Focus on developing comprehensive Sustainable Plan to monitor green building implementation and bench marking its positive features to help receive incentives.

## 5.3. Green Building adoption by Municipalities and PWDs

### Pimpri Chinchwad Municipal Corporation (PCMC) Green Building Initiatives

- PCMC has adopted GRIHA Green Building Rating System.
- Pimpri Chinchwad Navnagar Development Authority building is a certified green building with GRIHA 5 Star Rating.

Figure 13 Pimpri Chinchwad Navnagar Development Authority building



- PCMC also offers following green building incentives to promote adoption of green buildings in the PCMC area.
  - vii. Discount in premium for Developers of 10% , 20%, 30%, 40/% 50% for the project registered on or after January, 2011 for SVA GRIHA 1 Star – 5 Star Rating respectively
  - viii.Reduced property tax for home owners of SVA GRIHA – 5% , 8%, 10%, 12%, 15% for GRIHA 1 Star to 5 Star Rated Projects respectively.
  - ix. Discount in premium for Developers of 10% , 20%, 30%, 40/% 50% for the project registered on or after January, 2011 for GRIHA 1 Star – 5 Star Rating respectively
  - x. Reduced property tax for home owners of SVA GRIHA – 5% , 8%, 10% for GRIHA 3 Star 4 Star & 5 Star Rated Projects respectively.

Public Works Department (PWD), Government of Maharashtra has also mandated that the renovation of existing buildings and the development of all new government buildings in Maharashtra shall be carried out as per the Green Building Concepts (IGBC, 2015).

#### 5.4. Case study on green building financing programmes

Project Name: Efficiency in Buildings

Commissioned by: Federal Ministry of Economic Cooperation and Development (BMZ)

Country/ Region: India

Lead Executing Agency: National Housing Bank

Project Detail: KfW, the German development bank, extended a line of credit of EUR 50 million to the National Housing Bank (NHB) in year 2010, which channels the funds to commercial banks which provide loans for energy efficient homes (NHB, 2014).

- New residential buildings that, demonstrate energy saving as compared to standard building receives a certificate that entitles the buyer to avail subsidised loan.
  - i. Demonstrate at least 18% energy saving (with implementation of passive measures)
  - ii. Demonstrate at least 30% energy saving (with implementation of active measures)
  - iii. Loan refinanced by the National Housing Bank to commercial banks which pass on benefits to energy efficient home owners
- Programme eligibility assessment is based on the Energy Efficiency calculated with the tool, developed by Fraunhofer and TERI.
- It targeted approximate 2000 housing loans extended by various Primary Lending Institutions (PLIs) for energy efficient units aggregating to Rs. 380 crore (approx.).

State Bank of India (SBI) in year 2019 has signed a loan agreement with KfW, the German development bank, for \$277 million dollars (about Rs 1,958 crore) for establishing an energy-efficient housing programme in India (Economic Times, 2019)

- Builders and home buyers will be financed for developing and purchasing energy-efficient residential projects that achieve at least 25 per cent energy savings in comparison to standard reference buildings.
- In addition to the \$277 million dollar loan facility, KfW will also extend a grant of 1.5 million euros to SBI as a technical assistance package.
- The technical assistance funds will be used for supporting SBI in the preparation, implementation and monitoring of the programme.
- Further, an investment grant of 10 million euros has also been provided for incentivising builders to develop energy efficient housing projects that achieve significantly higher levels of energy savings vis-a-vis standard reference buildings (that is at least 40 per cent savings).

### 5.5. Case study on green building additional cost and pay-back period

The KGEYES Eternity Project is an IGBC Certified (Gold Rated) Project in Chennai. The below mentioned project details highlights the additional green building cost for a typical residential multi-story project and the approximate pay-back period.

- Built Up Area: 1,31,000 sq.ft.
- Dwelling Units: 86 Nos.
- Project Cost : Rs. 19.65 Crores
- Year of Completion: 2018
- Green Investment: Rs. 30 lakh approx.
  - i. Cool Mortar – 4.24 Lakh
  - ii. STP 15KLD – 12.25 lakh
  - iii. Dual Plumbing Line – 4.25 Lakh
  - iv. Organic Waste Composter (Khambas) – 0.33 lakh
  - v. Green Education – 2 lakh
  - vi. Miscellaneous – 7.32 lakh (Alternative DG set etc.)
- Incremental Cost : 1.8 %
- Payback : less than 1 Year

Green building additional cost & pay-back has gone down drastically in past few years (Agarwal, P. 2020). As per studies conducted by IGBC, additional green building cost and pay-back period from year 2009 – 2021 is mentioned below:

2009:	8% - 12% Additional Cost; 3-5 Year Payback
2011:	4% - 6% Additional Cost; 2-3 Years Payback
2021:	1% - 2% Additional Costs; <1 Year Payback

Here are the list of few green measures with zero cost and with marginal additional cost.

### **Measure with zero cost**

- Passive Design Features to Enhance
  - o Daylighting, Ventilation & Energy Efficiency
- Green Materials
- Water Efficient Fixtures
- Rainwater Harvesting (Mandatory as per Bye-laws)
- Green Procurement Policies

### **Measures with marginal cost**

- Electric charging facility for vehicles
- Efficient Air-Conditioning System
- High SRI Paint on Roof
- Toilets for Differently Abled
- Organic Waste Converter
- Water & Energy Metering

# 6

## List of Additional Materials

List of Readings for each Chapter including and not limited to

### 1. Technical documents as mentioned in the ToR

- i. Climate Smart City Assessment Framework Brochure; MOHUA; 2020  
[https://www.niua.org/csc/assets/pdf/key-documents/phase-2/CSCAF-2.0-Brochure\\_24042020.pdf](https://www.niua.org/csc/assets/pdf/key-documents/phase-2/CSCAF-2.0-Brochure_24042020.pdf)
- ii. Climate Smart City Assessment Framework 2.0 Booklet; MOHUA; 2020  
[https://www.niua.org/csc/assets/pdf/CSCAF\\_2\\_Booklet.pdf](https://www.niua.org/csc/assets/pdf/CSCAF_2_Booklet.pdf)
- iii. Climate Smart City Assessment Framework: Cities Readiness Report, MOHUA2021 <https://heyzine.com/flip-book/31ddf6adfe.html#page/1>

### 2. Technical Documents for Green Building Adoption

- i. Green Building Adoption Challenges.  
<https://www.ijert.org/research/challenges-faced-by-practitioners-in-the-adoption-of-green-building-concepts-a-case-of-nairobi-city-county-IJERTV4IS020550.pdf>  
<https://digitalcommons.lmu.edu/cgi/viewcontent.cgi?article=1228&context=cate>
- ii. ECBC Code Adoption  
[https://www.niti.gov.in/sites/default/files/energy/ECBC\\_report.pdf](https://www.niti.gov.in/sites/default/files/energy/ECBC_report.pdf)  
<https://www.in.undp.org/content/dam/india/docs/pub-EnE/Rolling%20out%20ECBC%20Codes.pdf>
- iii. TSECBC Green Building Adoption  
[https://www.cecp-eu.in/uploads/documents/ace-e2/S2\\_P2\\_Rajkiran\\_Implementation-of-ECBC.pdf](https://www.cecp-eu.in/uploads/documents/ace-e2/S2_P2_Rajkiran_Implementation-of-ECBC.pdf)
- iv. Green Building Knowledge Dissemination Products uploaded online - Karnataka Renewable Energy Development Limited, Government of Karnataka  
<https://kredl.karnataka.gov.in/new-page/ECBC%20Commercial/en>
- v. Green Building Incentives  
GRIHA Council: <https://www.grihaindia.org/griha-incentive>



- vi. IGBC GreenPro Certification: <https://igbc.in/igbc/redirectHtml.htm?redVal=showGovtIncentivesnosign#:~:text=The%20Industries%20%26%20Commerce%20Department%20offers,for%20MSME%20and%20large%20industries.>
- vii. Green Building Materials & Technologies  
CII-IGBC GreenPro Certification [https://www.ciigreenpro.com/GRIHA Product Catalogue](https://www.ciigreenpro.com/GRIHA_Product_Catalogue), Retrieved from <https://www.grihaindia.org/products-catalogue>
- viii. Green Buildings Market Intelligence India Country Profile (IFC)  
<https://edgebuildings.com/wp-content/uploads/2018/05/India-Green-Building-Market-Intelligence.pdf>
- ix. Green Building Adoption in Master Plan  
<https://chandigarh.gov.in/sites/default/files/documents/sustain.pdf>

### 3. Relevant videos

- i. Climate Smart Cities Assessment 2.0 Process Video; National Institute of Urban Affairs; 2021; Retrieved from <https://www.youtube.com/watch?v=WHq7ZTtPrsk>
- ii. Green Building Movement in India - The Journey Since 2001; IGBC Online; 2011; Retrieved from <https://www.youtube.com/watch?v=ugGPJ0QYs1A>
- iii. Green buildings - The GRIHA way; Teri; 2015; Retrieved from [https://www.youtube.com/watch?v=Fp-KRz\\_fNSc](https://www.youtube.com/watch?v=Fp-KRz_fNSc)
- iv. What is green building?; USGBC (U.S. Green Building Council); 2015; Retrieved from <https://www.youtube.com/watch?v=MyI0tsx3wDs>

Telangana ECBC Implementation

[https://www.youtube.com/watch?v=gY28\\_jaepMg&t=1003s](https://www.youtube.com/watch?v=gY28_jaepMg&t=1003s)

# 7

## References

- Abraham, P. S. & Gundimeda, H. (2017). 'Greening' the Buildings - An Analysis of Barriers to Adoption in India, Cities and the Environment (CATE): Vol. 10: Iss. 1, Article 10 <https://digitalcommons.lmu.edu/cate/vol10/iss1/10>
- Adlakha N. (2015). Why we need single window clearances, PropertyPlus, Retrieved from <https://www.thehindu.com/features/homes-and-gardens/why-we-need-single-window-clearances/article7688650.ece>
- AEEE, (2017). Roadmap to fast track adoption and implementation of energy conservation building code (ECBC) at the urban and local level, Alliance for an Energy Efficient Economy, Retrieved from <https://aeee.in/our-publications/kumar-s-singh-m-kachhawa-s-pandey-a-2017/>
- Agarwal, P. (2020), Presentation on IGBC Rating for Residential Buildings, Indian Green Building Council, IGBC
- Anzagira L.F., Duah, D., Badu, E. (2019) A conceptual framework for the uptake of the green building concept in Ghana, Scientific African, Science Direct, Retrieved from <https://www.sciencedirect.com/science/article/pii/S2468227619307525>
- Behjat Hojjati, B. (2017). Buildings energy consumption in India is expected to increase faster than in other regions, Today in Energy, U.S. Energy Information Administration, Retired from <https://www.eia.gov/todayinenergy/detail.php?id=33252>
- Conserve, (2020). Government Incentives for Green Building Projects, Conserve Consultants, Retrieved from <http://www.conserveconsultants.com/government-incentives-green-building-projects>
- CPHEEO, (2019). National Mission on Sustainable Habitat, Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Affairs, Government of India, Retried from <http://cpheeo.gov.in/index.php>
- Devi, S. (2020). Building Materials Directory Programme- A database of Energy Efficient Building Materials for India, Eco Niwas Samhita, Retrieved from <https://www.econiwass.com/blog-details-12.html>

- Economic Times, (2019). India, Germany ink pact for Rs 1,958 crore finance to develop energy-efficient housing programme, Retrieved from <https://economictimes.indiatimes.com/news/economy/finance/india-germany-ink-pact-for-rs-1958-crore-finance-to-develop-energy-efficient-housing-programme/articleshow/72770834.cms?from=mdr>
- Edge Buildings (2018), Green Buildings Market Intelligence India Country Profile, International Finance Cooperation Retrieved from <https://edgebuildings.com/wp-content/uploads/2018/05/India-Green-Building-Market-Intelligence.pdf>
- EIA (2017) Buildings energy consumption in India is expected to increase faster than in other regions, Today in Energy, US Energy Information Administration Retrieved from <https://www.eia.gov/todayinenergy/detail.php?id=33252>
- Hoffman A., et al. (2008). Overcoming the Social and Psychological Barriers to Green Building; Organization & Environment 21(4), 390-419. Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.576.3878&rep=rep1&type=pdf>
- KREDL (2022). Green Rated Buildings in Karnataka (GRIHA & LEED), Karnataka Renewable Energy Department Limited, Retrieved from <https://kredl.karnataka.gov.in/new-page/ECBC%20Commercial/en>
- LEED (2014). Good to know: Green building incentive strategies, USGBC, Retrieved from <https://www.usgbc.org/articles/good-know-green-building-incentive-strategies-0>
- Lucon, O. & Üрге-Vorsatz, D (2014). Buildings. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Retired from [https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc\\_wg3\\_ar5\\_chapter9.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter9.pdf)
- Mohanty, B. (2012). Low Carbon Green Growth Roadmap for Asia and the Pacific, UNITED NATION Publication, Retrieved From <https://repository.unescap.org/bitstream/handle/20.500.12870/4013/ESCAP-2012-PB-Buildings-policy->

[recommendations.pdf?sequence=1&isAllowed=y](#)

- NHB (2014). Report on Trend and Progress of Housing in India 2014, National Housing Bank, retrieved from [https://www.nhb.org.in/Publications/T&P\\_English\\_FINAL.pdf](https://www.nhb.org.in/Publications/T&P_English_FINAL.pdf)
- Nikyema, G. A. (2020) "Barriers to the Adoption of Green Building Materials and Technologies in Developing Countries: The Case of Burkina Faso" . All Dissertations. 2648. Retrieved from [https://tigerprints.clemson.edu/all\\_dissertations/2648](https://tigerprints.clemson.edu/all_dissertations/2648)
- O.P. Agarwal, Greening Indian Cities Through Efficient Buildings, WRI INDIA, MOHUA, Retrieved from [https://www.niua.org/csc/assets/pdf/RepositoryData/Energy\\_&\\_Green\\_Building/Greening\\_Indian\\_Cities\\_through\\_efficient\\_buildings.pdf](https://www.niua.org/csc/assets/pdf/RepositoryData/Energy_&_Green_Building/Greening_Indian_Cities_through_efficient_buildings.pdf)
- Shandilya, N., Ghorpade, A. G. (2019) ECBC Compliance in Indian Cities- Handbook (Supporting Sustainable built environment under Smart City Mission), ICLEI- local governments for Sustainability, South Asia (ICLEI South Asia), Retrieved from <https://shaktifoundation.in/wp-content/uploads/2019/07/Handbook-ECBC-compliance-in-Indian-Cities.pdf>
- WBCSD (2009). Energy efficiency in buildings: Transforming the market, World Business Council for Sustainable Development, Geneva. Retrieved from <https://docs.wbcsd.org/2009/08/EEB-TransformingTheMarket.pdf>
- Were, S. W., Diang'a, S.O., Mutai, A.K. (2015) Challenges Faced by Practitioners in the Adoption of Green Building Concepts: A Case of Nairobi City County, Department of Construction Management, School of Architecture and Building Sciences Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya, Retrieved from <https://www.ijert.org/research/challenges-faced-by-practitioners-in-the-adoption-of-green-building-concepts-a-case-of-nairobi-city-county-IJERTV4IS020550.pdf>
- Wienerberger India (2017), Green Buildings, Top 6 Challenges Hindering Rapid Adoption Of Green Building Practices In India, gosmartbricks, Retrieved from <https://gosmartbricks.com/top-6-challenges-hindering-rapid-adoption-of-green-building-practices-in-india/>
- WWF(2020),Rajkot - Efficient cooling is key, World Wide Fund For Nature, Retrieved from [https://wwf.panda.org/wwf\\_news/?2825766/Rajkot--Urban-Solution-case-2021](https://wwf.panda.org/wwf_news/?2825766/Rajkot--Urban-Solution-case-2021)



*Photo Credits: Joshua Tsu on Unsplash*

# 8

## Annexures

### 8.1. Certified Green building Materials and Technologies

#### CII GREENPRO CERTIFICATION

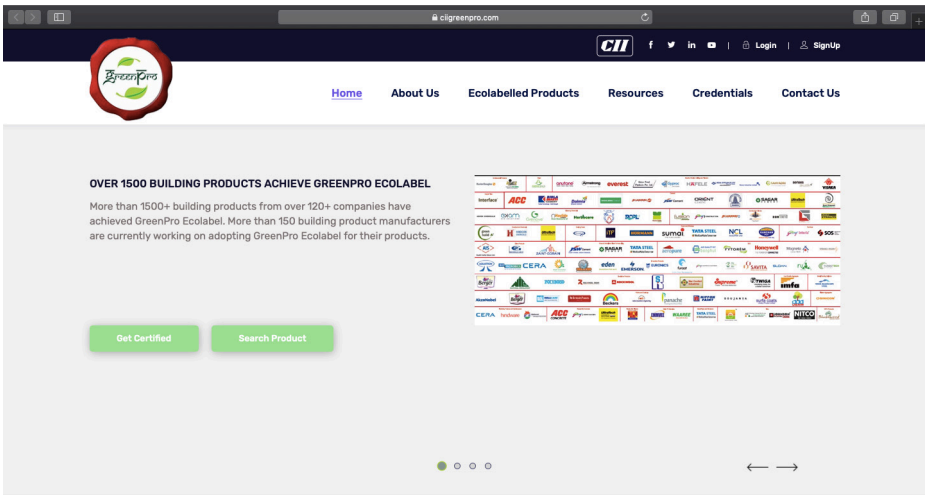
“GreenPro is a Type - 1 Ecolabel which enables the end users in the building sector and manufacturing sector to choose sustainable products, materials and technologies for reducing the environment impacts during the construction, operation and maintenance of their buildings and factories” (GreenPro 2019).

- 1500+ Building Products from over 120+ companies have achieved Green Pro Ecolabel.
- 150+ Building Product manufacturers are currently working on adopting Green Pro Ecolabel

GreenPro certified products are environment friendly and has lower environment impact. It contributes significantly for enhancing the performance of green buildings. It also empowers industry stakeholders with product sustainability information and steer them towards adoption of green and environment friendly products. The GreenPro certified products can be accessed at below mentioned link.

Weblink: <https://www.ciigreenpro.com/>

Figure 14: CII GreenPro Certification, 2019

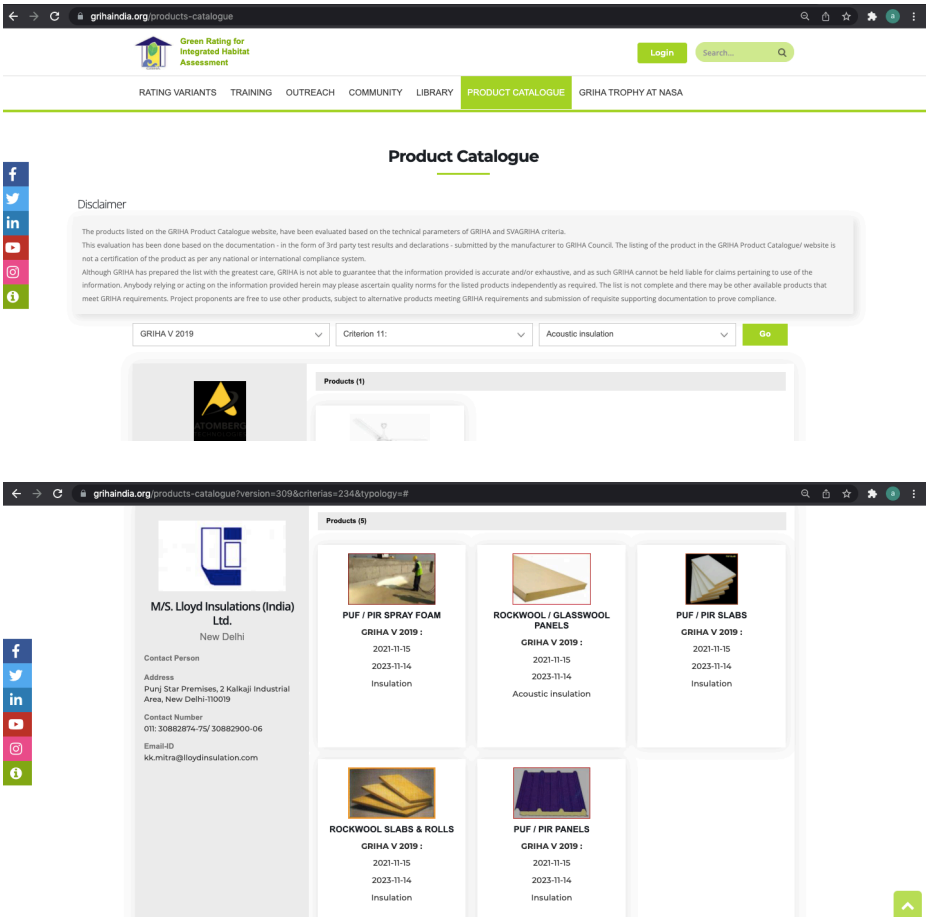


# GRIHA Product Catalogue

It is an online product catalogue which has been developed to provide all necessary information to industry professionals on green building products which can be used in order to make buildings GRIHA compliant. The products have been evaluated based on the technical parameters of GRIHA green building rating criteria's. The evaluation of product is done based on documents proof submitted by material manufacturer esp. 3rd party test results and declarations. Developers, Architects, Engineers, Contractors can use this catalogue to shortlist green products. The catalogue can be accessed at below mentioned link.

Weblink: <https://www.grihaindia.org/products-catalogue>

Figure 15: GRIHA Product Catalogue



Source: <https://www.grihaindia.org/products-catalogue>



## Bureau of Energy Efficiency – Eco Niwas Samhita - Building Materials Directory Programme

GIZ and BEE, Under Indo German Energy Programme is developing Energy Efficient Building Materials Directory. It will be a database of energy efficient building materials that can guide users to choose energy efficient materials in their construction in both commercial and residential sectors.

It is being developed in form of a tool – a user friendly interface to help user easily search their desired products and get all the details about the project . It will also allow the user to filter the Building Materials Directory according to category of product, use & application, availability at project site as per location. Database will categorise materials as per different climate zones of India, and will help user know about the energy efficient building materials available in their locality and this will lead to create awareness about using Green and Energy Efficient Building Materials.

“This tool will include all important Key Performance Indicators and details required for users to make informed choices such as product description, category, use, product ID, Embodied Energy, Energy Savings for different climatic conditions, cost savings, CO2 Savings, cost range of finished product. This tool will also allow the user to contact the manufacturer of the product and access their details like website, email id, authorized dealers, product certifications and availability. From this tool, one can compare the energy savings with respect to other materials in the same category. From this directory, Users can simply quantify energy savings, CO2 savings and money savings, based on choice of energy efficiency measures incorporated by them in their building design and material selection” (Devi, S. 2020).

This Energy Efficient Building Materials Directory will be integrated to the professional tool of EcoNiwas Website([www.econiwass.com](http://www.econiwass.com)).

Weblink: <https://www.econiwass.com/blog-details-12.html>







**Ministry of Housing and Urban Affairs  
Government of India**