

Green Growth and Buildings Sector in India

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1. Introduction

Green growth involves rethinking growth strategies with regard to their impact on environmental sustainability and the environmental resources available to poor and vulnerable groups (Para 3.15, TFC, 2009)

Green growth is about maximizing economic growth and development while avoiding unsustainable pressure on the quality and quantity of natural assets. It is also about harnessing the growth potential that arises from transiting towards a green economy (OECD, 2011).

Construction sector (covering both buildings and infrastructure) is essential for economic growth and development and exerts a lot of environmental pressure (exacerbated when done the conventional way) and consumes natural assets (like top soil, water, wood, stones, and metals/glass/alloys) during construction; and also involves increased consumption of electricity and water.

With this context, green growth in building sector comprises of minimising environmental implications caused due to construction activities and thus, focuses on energy conservation, energy efficiency, integration of renewables, lesser consumption of water and sustainable waste management. It also aims at building resilience (to climate change impacts/extreme events) without compromising the thermal/visual comfort of the inhabitants/users.

The building sector is interdependent and interrelated to several other sectors; and therefore the measures taken to achieve green growth in this sector are bound to have several benefits and co-benefits. The Green Growth vision for the building sector is envisaged to have the following

- Optimal utilisation of land for settlement keeping in mind the eco-sensitivity of various areas
- Nearly Net Zero Buildings (NZEB)¹ by 2047 for both new and existing buildings with emphasis on regional priorities within the country
- Supply of alternative native high performance low-cost materials to high embodied energy materials such as steel, cement, bricks and glass
- Enhanced use of passive design measures and optimal use of active measures for thermal comfort
- Adoption and adaption of alternative construction technologies with lower embodied energy/cost savings/faster construction

Nearly net zero energy buildings (NZEB) is mentioned here as there are considerable constraints in having NZEB in cooling dominant climate and drastic changes in technology (energy efficiency and energy generation through renewables) is required. Other pre-

¹ Net zero in terms of energy , waste and water

requisites of green-growth development such as balanced regional development, improved urban planning, and development in other sectors of the economy are not covered here.

1.1. Urbanisation trends and projected demand for real estate space in India

India is a fast urbanising country. The urban population grew from 290 million in 2001 to an estimated 340 million in 2008 and is likely to increase to 590 million by 2030. There is a distinct disparity observed in the state of urbanisation within the country as seen in Figure 1.

Amongst the five states likely to be urbanised more than 50%, Punjab stands at number five while Himachal is expected to be primarily non-urban with not more than 20% urbanised population by 2030.

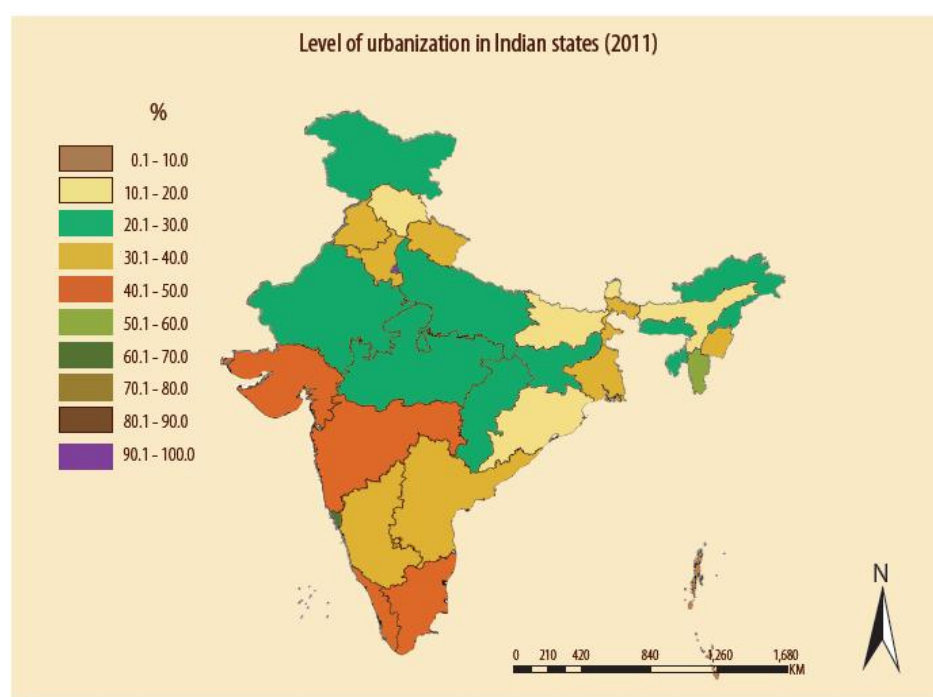


Figure 1: Urbanization in Indian states in 2011

Source: Ruchira and Kansal (2014)

There is no single reliable statistics on correct information on the total built-up area and area added every year for various categories of building types across the country. Different real estate and management companies, research institutes and organizations bring out reports/articles with estimation of existing building stock or estimated area added to the existing building stock every year. There is a wide variation in the numbers estimated in these reports and it is difficult to cross check the accuracy of these numbers as all the estimations are based on secondary data and different methodologies are used for arriving at these numbers.

The real estate demand is likely to be led by the residential buildings, including affordable housing segment. As per a report of the Royal Institution of Chartered Surveyors (RICS),

²McKinsey Global Institute, 2010. India's urban awakening: Building inclusive cities, sustaining economic growth

4127 million m² of real estate space (which includes residential, retail, offices, hotels, health care, and education sectors) is expected to be built between 2012 and 2020³ (Figure 2).

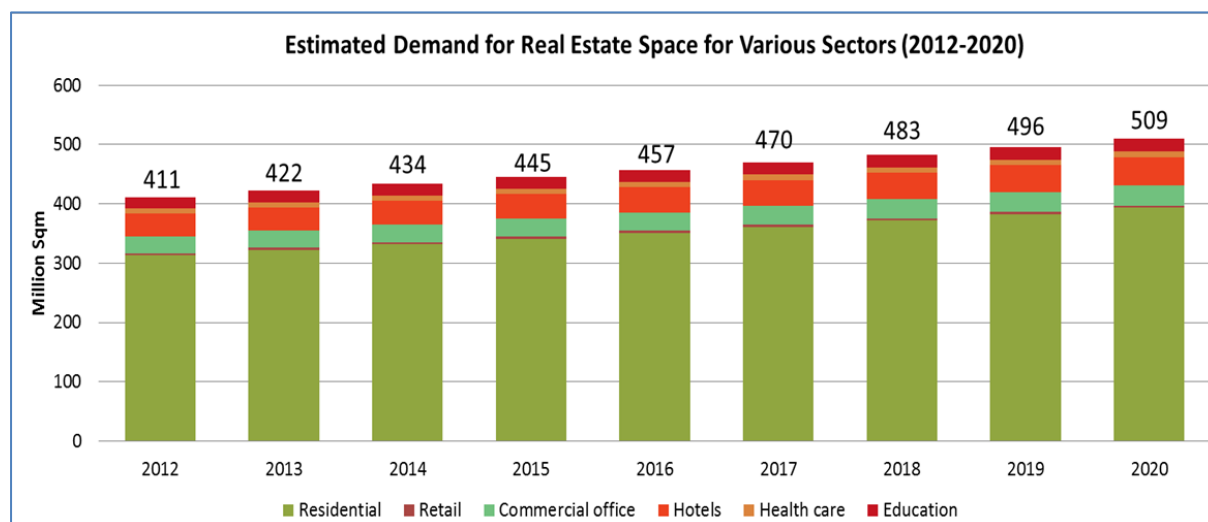


Figure 2: Estimated demand for real estate space for various sectors (2012-20)

Source: RICS (2011)

1.2. Share of construction sector in GDP

Services constitute a major portion of India’s GDP with a 64.8% share in GDP at factor cost (at current prices) in 2013-14 — an increase of 6 percentage points over 2000-01. The share of construction sector in the overall GDP is 7.8%. The CAGR of services sector GDP at 8.5% for the period 2000-01 to 2013-14 has been higher than the 7.1% CAGR of overall GDP during the same period. The GDP contribution of the construction sector is estimated to grow at a CAGR of 9.5-10 percent till 2022 in real terms⁴.

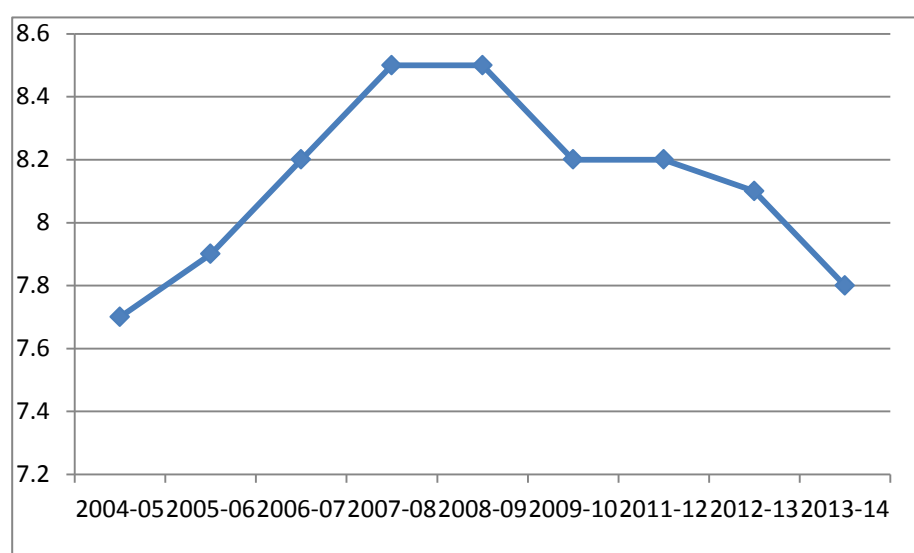
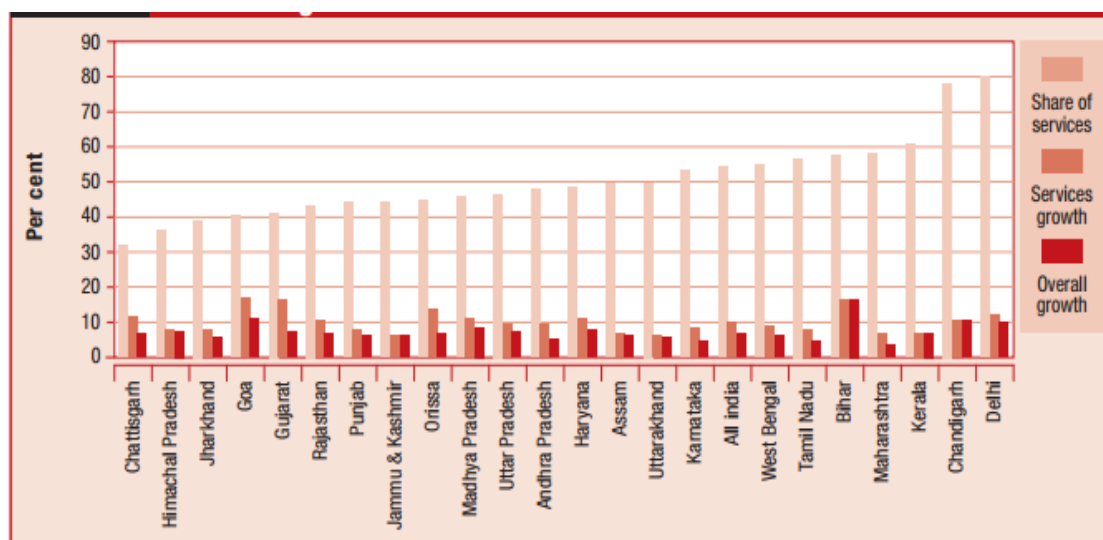


Figure 3: Share of construction sector in GDP at factor cost

Source: Central Statistical Office (2015)

⁴ CW, 2015. The Skill Gap, Hiranandani, N. Construction World, Jan-2015

A comparison of the share of services in the gross state domestic product (GSDP) of different states and union territories shows that the services sector is the dominant sector in most states of India (**Error! Reference source not found.**). Unlike Delhi, Chandigarh, States such as Himachal Pradesh and Punjab have shares below the all-India share.



Note: Data in the case of Goa and Jammu and Kashmir are for 2007-08. Shares in current prices, Growth rate constant prices.

Figure 4: Share of growth of services sector in 2008-09

Source: Economic Survey 2014-15

Real estate and ownership of dwellings with a share of 5.9% in India's GDP grew by 5.6% in 2012-13. Real estate in particular, grew by 26.1%. Housing activities have both forward and backward linkages which not only contribute to capital formation, generation of employment, and income opportunities but also to economic growth. Estimates show that every rupee invested in housing and construction adds 78 paise to the GDP (Economic Survey 2014-15)

Though house prices have skyrocketed over the years in many cities and towns as per the National Housing Bank's RESIDEX index of residential prices in India across cities, few cities like Ludhiana (Punjab) witnessed a 16% decline.

Investments in the real-estate sector have a positive and multiplier impact on allied industries, such as cement, steel, sand, timber and architecture. As per statistics, 78% of the sum spent on the construction of a housing unit gets added back directly to nation's GDP⁵.

1.3. Employment generation by buildings sector

The sector is the second largest employment generator after agriculture with an estimated share of 20-30%⁶. The employment levels in the construction sector increased from 17.54 million in 1999-2000 to 52.16 million by 2009-10 as per the Planning Commission estimates. Confederation of Real Estate Developers' Associations of India (CREDAI) estimates that the

⁵ Cushman & Wakefield, 2014. Housing: the game changer (available at <http://www.cushmanwakefield.com/~media/reports/india/HousingTheGameChanger.pdf>)

⁶ Economic survey of India, 2012-13

employment in the real estate sector was nearly 7.6 million people in 2013. Given the total existing demand for real estate in the country, the number of real estate sector employees could go up to about 17 million by 2025⁷.

1.4. Green growth and buildings

It is widely recognised that the consumption of resources by buildings increases with the level of economic development. Additional factors are population growth, urbanization patterns/level, shift from biomass to commercially available energy carriers, especially electrification, income (a strong determinant of the set of services and end-uses), level of development, cultural features, level of technological development, individual behaviours, availability and financial aspects of technologies/materials.

The sector is a big consumer of resources (energy, water, materials) and generator of pollutants during the construction, operation and demolition phase. Access to adequate shelter/house continues to pose a big challenge for India, in spite of several key programs and initiatives run by the government at national and sub-national levels. Living in inadequate houses and habitat further degrade the environment and also pose grave health implications for the residents and surroundings. It is therefore rightly believed that greening the building sector can help transform into a green economy because of its inter-linkages with all the other sectors of the economy⁸.

The building sector currently consumes 30% of the overall electricity consumption (from utilities) by the country, out of which almost 72% is consumed by the residential sector. A closer look at the electricity consumption pattern of the residential sector shows that fans and lighting consume more than 60% of total the consumption. As per a study⁹, the average household is likely to consume five times more electricity in 2020 than in 2000. An increasing trend of appliance ownership by households is reported which will lead to an increase in fuel demand. With reference to the year 2011, by 2021 the electricity consumption by heating/ cooling appliances and by lighting will grow by 180% and 80% respectively (World Bank 2008).

⁷ Cushman & Wakefield, 2014. Housing: the game changer

⁸ Dr Arab Hoballah, UNEP's chief of sustainable consumption and production, speech at International Green Building Conference (IGBC) in Singapore Sep 2011.

⁹ Residential and Transport Energy Use in India: Past Trend and Future Outlook- LBNL Study January 2009

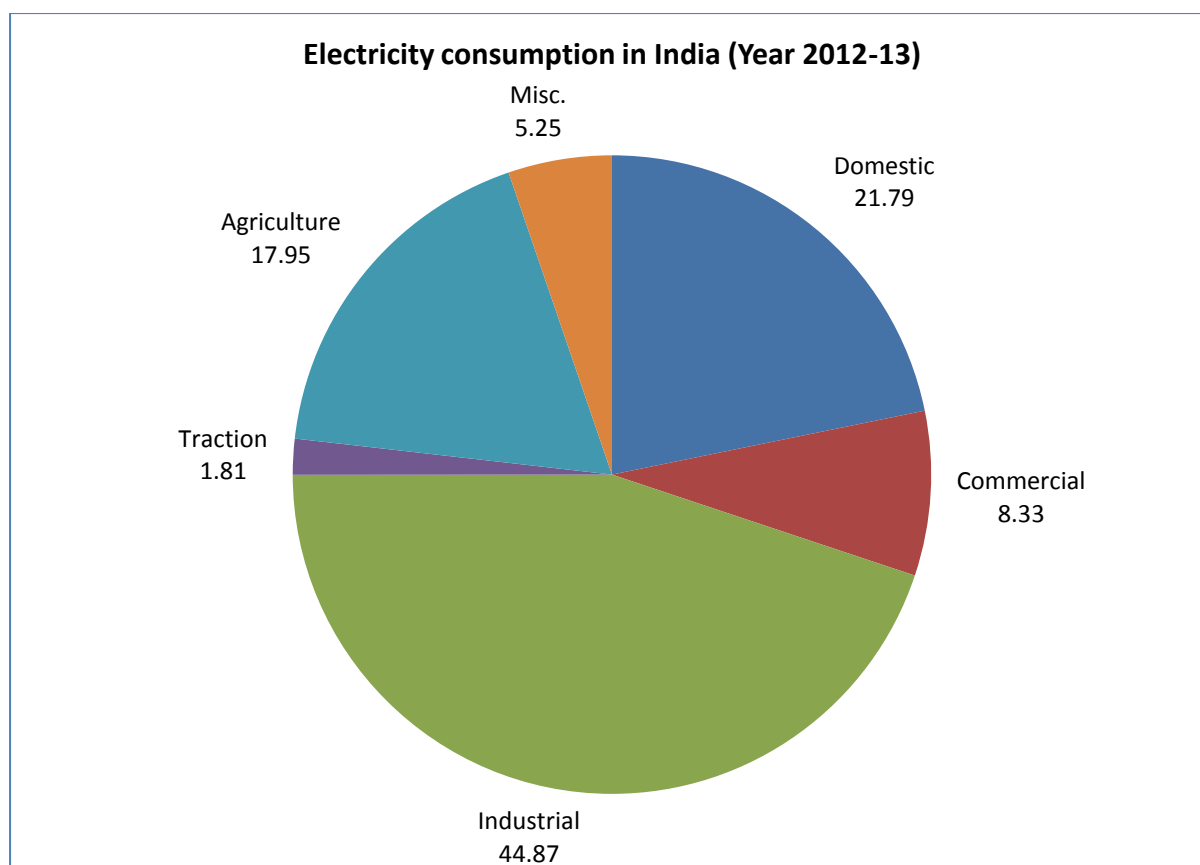


Figure 5: Electricity Consumption in India (2012-13)

Source: Central Electricity Authority, 2014

India like many other developing countries faces several social, economic and environmental challenges for the building sector. Non availability of house and an ever increasing housing requirement need with increasing urbanisation is one of the biggest challenges India face. The Report of the Technical Group on Urban Housing Shortage (Ministry of Housing and Urban Poverty Alleviation, Government of India) estimated the shortage of urban housing in India at 19 million dwelling units for the 12th Five Year Plan (FYP). Close to 95% of this shortage is concentrated in the population identified as Economically Weak Sections (EWS) and Low Income Groups (LIG). Whereas, the total rural housing shortage for the 12th FYP (2012-17) is estimated at 44 million dwelling units.

A large section of the society living in so-called slums, shanties, jhuggies, pavement, rural areas live in unhealthy conditions with poor sanitation facility, inadequate ventilation, poor thermal comfort and non-availability of safe drinking water leading to environmental pollution. This further leads to poor health of the inhabitants, morbidity and mortality, loss of income and productivity. Indoor air pollution from poorly combusted solid fuels combined with poor ventilation is a serious concern in the sector and cause of premature deaths and lung infection. Studies suggest estimated two million premature deaths, particularly in women and children due to exposure to indoor smoke (Wilkinson et al. 2009)

Having an alternative pathway for the building sector is a need of the hour given the increasing urbanisation rate and projections of reaching 50% urbanised by 2030 (McKinsey 2008). Cities, which are already suffering with huge infrastructure gaps in all respects-water

supply, sewage, sanitation, solid waste management, power, will find even greater challenges in meeting the increasing housing requirement for all sectors-specially the marginalised ones. As per the National Housing Bank, factors such as rapid increase in land prices, inadequate infrastructure, absence of long-term loans for borrowers at reasonable rates, limited developer finance and lack of access to housing finance for low-income, rural and informal groups are some of the constraints for affordable housing¹⁰. Although there are several government programmes and self-help groups to push affordable housing, but these have not been able to achieve the desired scale. Funding agencies are often shy to fund low income housing due to unclear land titles, lack of mortgage insurance, inability to assess credit risks and absence of salary/income statements.

Apart from the above, there is another section of the housing sector which essentially caters to the needs of middle and upper income groups and is increasingly becoming more electricity and water intensive due to changing lifestyles, demand for air-conditioners, and penetration of more gadgets and appliances. Due to split incentives, developers are less interested in building green housing.

Building sector also comprises of commercial buildings which include various institutional and industrial establishments such as banks, hotels, restaurants, shopping complexes, offices, and public departments supplying basic utilities. Commercial buildings are often energy and resource guzzlers and therefore, offer ample opportunities to take a greener path in the entire life cycle. Greener commercial buildings besides saving on energy both during construction and operation, save on fresh water use consumption, recycle and reuse of treated wastewater on-site and reduction of waste going to the dumpsite/landfills. The sector poses a lot of opportunities to convert the new construction happening in this sector as resource and energy efficient.

Apart from energy use, buildings sector is also responsible for roughly 12% of fresh water use, generation of an estimated wastewater of 22,900 million litres per day (Mld)¹¹, most of which goes untreated to the very sources of water-rivers, streams and ocean.

India generates more than 40 million tonne of municipal waste annually from urban centers which is collected poorly (average collection efficiency is 72%), transported inadequately (70% cities lack required transportation capacities) and disposed unscientifically (no sanitary landfill for municipal wastes exists). Prevailing solid waste management systems in Indian cities are publically operated through municipalities, which are already overburdened and have not been very effective as far as services are concerned (Ghosh and Kansal 2014) Building construction and demolition waste contribute significantly to the overall waste generation. Buildings are also responsible for a huge quantum of electronic and municipal waste. All of this needs immediate corrective action for all sustainability concerns.

In India as elsewhere in the world, the embodied energy of the building sector is increasing exponentially due to the high rate of construction (10-15%) and poor choices of materials. The traditional burnt clay bricks continue to be the primary raw material for building sector all over India. Brick making consumes fertile top soil from agricultural fields making these

¹⁰NHB, Report on Trend and progress in Housing 2011, National Housing Bank.

¹¹ http://www.sulabhervis.nic.in/Database/STST_wastewater_2090.aspx last assessed on 15.1.2014

unfit for cultivation for many years. Also, brick making process causes a lot of air pollution and GHG emissions. Production of an estimated 170 billion bricks annually consumes around 24 million tonnes of coal and the process emits 61.3 million tonnes of CO₂ into the atmosphere (TERI 2012). Cement and steel are the other two key building materials which are also very resource intensive and account for considerable GHG emissions.

Greening of the building sector requires market push for appropriate green materials - materials with low embodied energy to be made available at affordable costs. It is therefore, imperative that there is an urgent need to look for and develop alternative materials, which are energy efficient and more environment-friendly. Fly ash clay bricks, fly ash lime sand bricks, autoclaved aerated concrete (AAC) blocks are some of the alternatives being promoted. Introduction of the Energy Conservation Building Code, 2007 has also incentivised alternate building materials such as high performance glass and materials. Given the growing penetration of environmental assessment systems such as Green Rating for Integrated Habitat Assessment (GRIHA) and Leadership in Energy & Environmental Design (LEED) and benefits accruing from energy efficient buildings, alternate materials market has a promising future. Use of fly ash in cement in the form of Portland Pozzolana Cement (PPC) is on rise. However, issues continue with maintaining the requisite quality and/or unavailability of fly ash in all regions. Even on the technology front, building sector continues to depend on manpower intensive traditional construction practices, which are slow and highly dependent on skilled labour input - a category already scarce in availability. Of late, several foreign players have started coming to the country given the large market potential. Currently, there are hardly any materials' testing laboratories in the country to provide thermo-physical properties of the high performance materials and products. The country needs a well-drawn strategy at the highest level and an implementation plan to generate local markets for quality materials and products.

In spite of the overwhelming challenges in greening of the building sector, there is a silver lining in the form of potential to generate new green jobs in this sector. Besides, the sector requirement for high performance building materials has the potential for a vibrant industry. The challenge however, remains to make such materials and products available at an economical cost.

This sector also holds a good potential for renewable energy integration. Much work is already happening for mandatory inclusion of solar water heating systems in such buildings. Studies taken up by Greentech Knowledge Solutions for Ministry of New and Renewable Energy indicate some 0.7 million households using solar water heaters. In the hotel and industrial sector, the awareness and penetration of solar water heater is much larger. There is also a big market to introduce building integrated photovoltaic and other renewable energy systems (depending on the feasibility) for electricity generation (off-grid or on-grid) application. The ambitious Jawaharlal Nehru National Solar Mission anticipates covering 20 million sq. m by 2020 under solar thermal collectors. For grid power including rooftop and small plants, 20,000 MW is anticipated to be generated by 2020 through photovoltaic. This shall generate more green jobs besides the various associated environmental benefits.

1.5. Key trends of electricity consumption in the Buildings sector

1.5.1. Residential Sector

Residential sector consumes 22% of the total electricity consumption of India. As per estimates, electricity consumption of residential sector may increase by more than 2 times by 2021

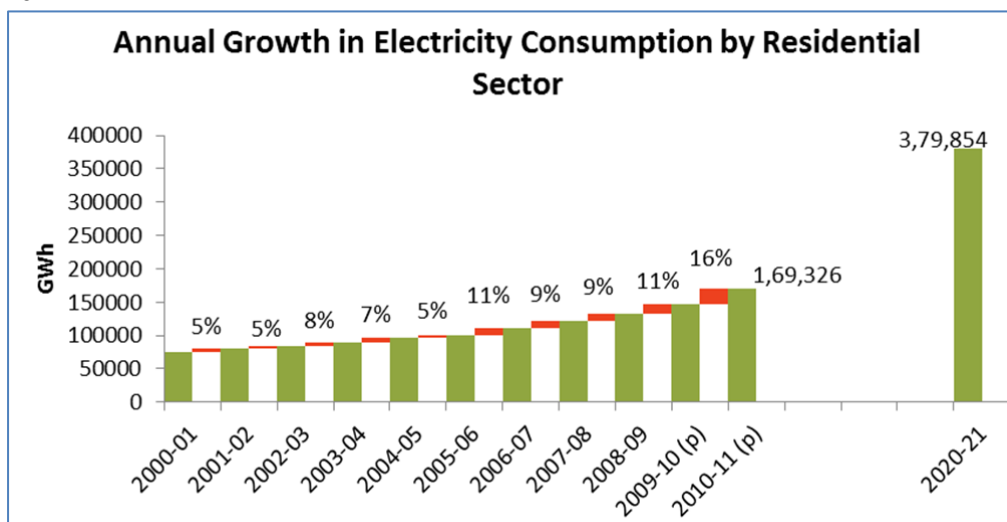


Figure 6: Annual growth in electricity consumption by residential sector

Source: World Bank, 2008 and CEA¹²

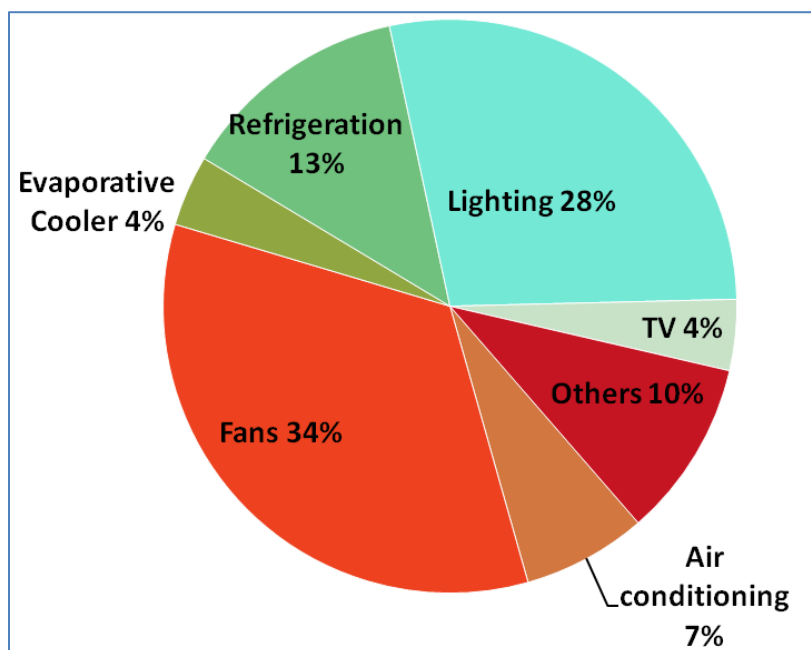


Figure 7: Electricity consumption pattern in residential buildings

Source: BEE, Figure taken from the Interim Report of the Expert Group on Low Carbon Strategies for Inclusive Growth, Planning Commission, Government of India

¹² Electricity Consumption data from year 2000-2011 taken from Central Electricity Authority report; Estimated figure for year 2020-21 taken from a paper on 'Residential Consumption of Electricity in India', Background Paper for India: Strategies for Low Carbon Growth, July 2008, The World Bank

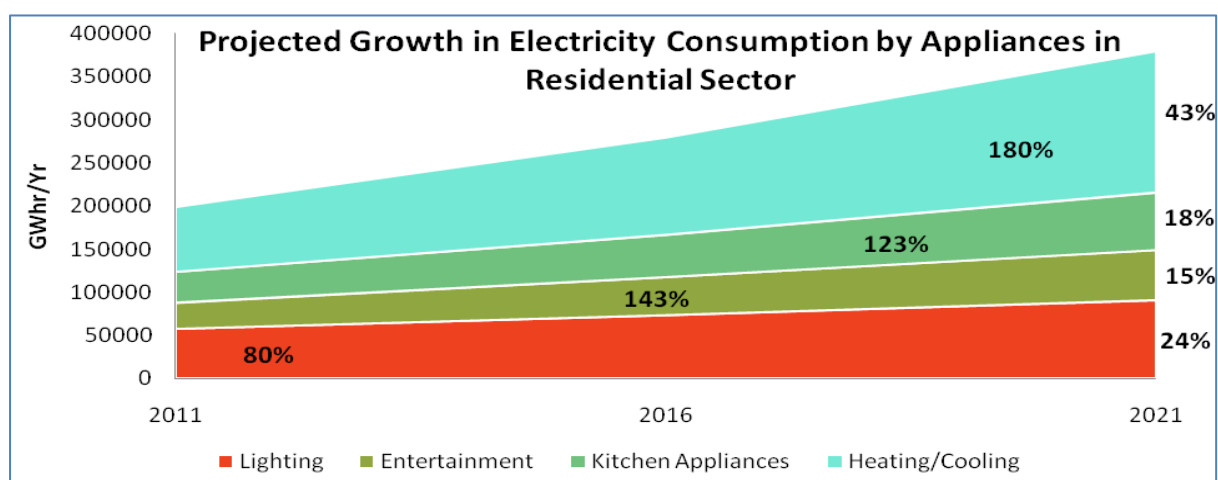


Figure 8: Projected growth in electricity consumption by appliances in residential sector

Source: Residential Consumption of Electricity in India, Background Paper for India: Strategies for Low Carbon Growth, July 2008, The World Bank

A study on “Greenhouse gas emissions from electricity use in buildings in urban India” by TERI estimates that a mandatory phasing out of conventional appliance coupled with mandatory use of star labeled appliances (such as fans, tube lights, air conditioners and compact fluorescent lamps in order of priority and cost effectiveness) by 2020 shall enable avoiding up to 51% emissions from this sector alone¹³. Further savings can be achieved by focusing on more efficient design strategies, daylight integration and low-energy cooling strategies.

1.5.2. Commercial sector

It is estimated that 70% of the commercial sector is yet to be built given the fast urbanizing trends of the country. The sector is witnessing a high annual growth rate in electricity consumption 55% of the energy consumption in the commercial sector is due to heating, ventilation, and air conditioning (HVAC) alone. As per another study, the HVAC market has increased from € 800 Million in 2005-06 to € 1.5 Billion in 2008-09 – nearly double in 4 years¹⁴

¹³ The scope of the study is limited to addressing emissions abated (by electricity use) by 30% of total population in urban areas, and considers appliances used for achieving visual comfort, thermal comfort and water heating only.

¹⁴ Report on “Tri generation in India- Market Assessment Study, February 2010

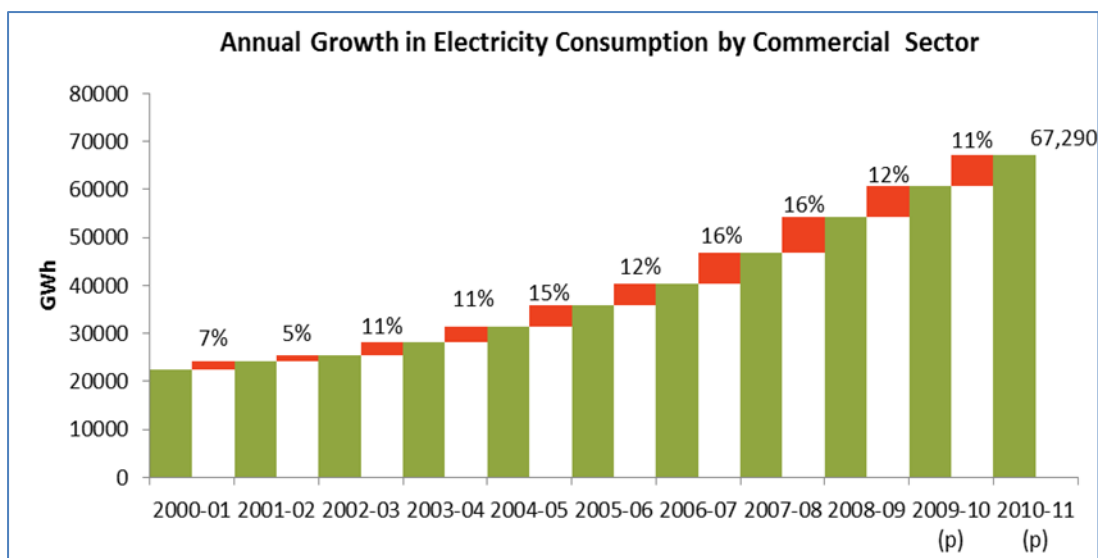


Figure 9: Annual growth in electricity consumption by commercial sector

Source: Interim Report of the Expert Group on Low Carbon Strategies for Inclusive Growth, Planning Commission, Government of India)

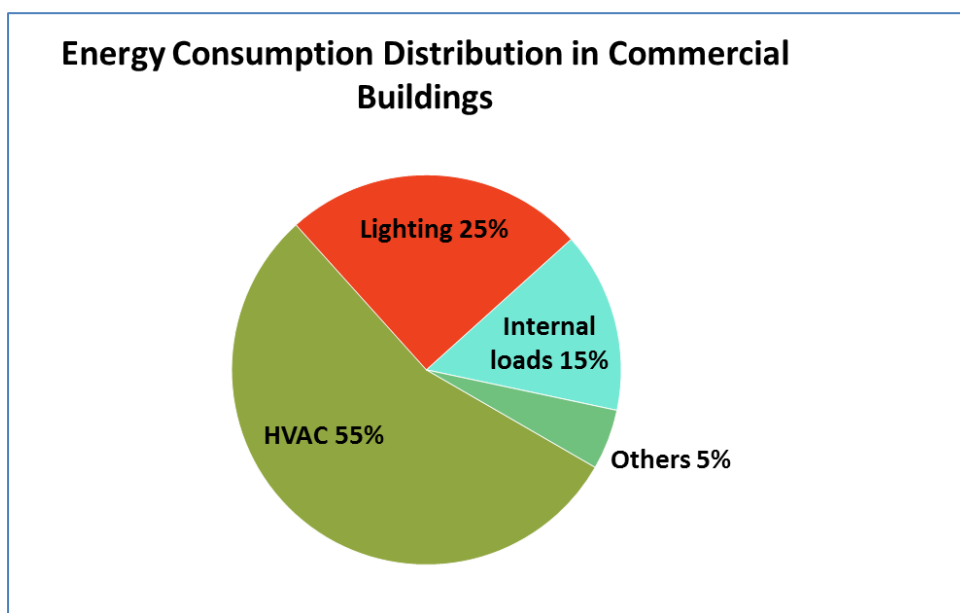


Figure 10: Energy consumption distribution in commercial buildings

Source: Interim Report of the Expert Group on Low Carbon Strategies for Inclusive Growth, Planning Commission, Government of India)

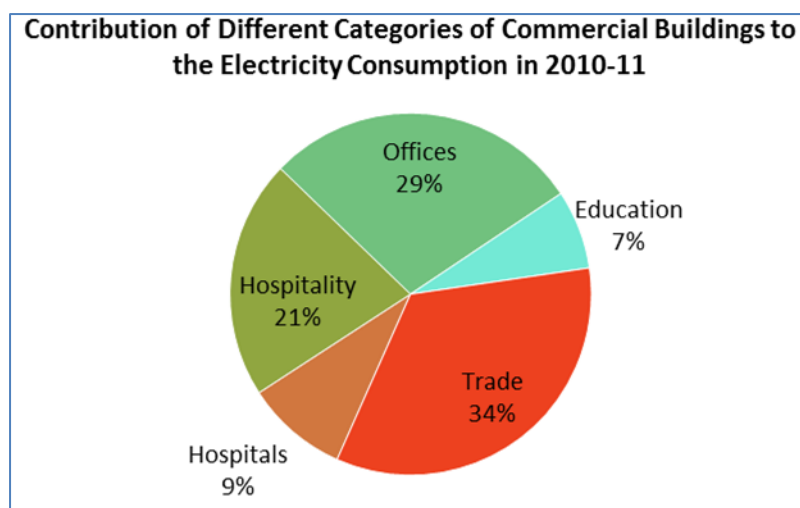


Figure 11: Contribution of different categories of commercial buildings to the electricity Consumption in 2010-11

Source: TERI, 2013.

1.5.3. *Electricity saving potential*

Although, the saving potential of each option may vary with building typology, climate zone, space conditioning needs and the initial base design proposed by the client/designer, on an average it is estimated that the implementation of energy efficient options would help in achieving around 30% electricity savings in new residential buildings and 40% electricity savings in new commercial buildings (WBSCD 2008). The biggest challenge India faces is to achieve the net zero energy building¹⁵ target for new construction (for existing buildings, it is more far-fetched). An empirical study carried out for a typical daytime office building using best available technology for four climatic zones of the country shows that the best performance case gives an Environmental Performance Index (EPI) of nearly 50 and a height of 1-2 floors (to have sufficient roof space for solar PV to generate enough power to meet the demand of the building). This is relevant for yet to be urbanised towns and cities. Highly urbanised areas are coming up with high rise structures (given the scarcity of land in prime areas) where supplementing the entire energy demand with on-site energy generation through clean means is not possible for air-conditioned spaces. In such scenarios, the possible approach could be to increase the share of clean energy from renewable sources in the energy supply basket, achieve maximum energy efficiency in all buildings, utilise all possible open spaces (including available roof tops) for solar photo-voltaic (PV) generation (given the universal feasibility of solar PV across the country). There is thus, an urgent need to give equal emphasis on the various urban planning issues from green growth perspective (including energy efficiency, energy generation, water and waste management) to have a realistic target of net zero settlements (and buildings).

¹⁵ Net Zero Energy Building (NZEB) is a building with greatly reduced energy needs through efficiency gains such that the balance of the energy needs can be supplied by renewable technologies

2. Need and benefits of 'greening' the building sector

Greening the building sector is need of the hour. As the sector is interdependent and interrelated to various other sectors in the economy, greening of this sector has several other benefits. Interventions around energy-efficient buildings, reaps both monetizable and non-monetizable benefits. Some of the benefits include, improvements in energy security, net job creation, elimination, reduction in indoor air pollution-related mortality and morbidity. Climate resilient building further the efforts towards alleviation of energy poverty, and helps in stimulation of higher skill levels in building professions and related trades.

Other key benefits include savings in freshwater withdrawals for energy supply that is later used in buildings (huge amount of water is required for cooling water for thermal power plants); energy use to produce water consumed later in buildings (due to reduced water demand in green buildings and settlements); optimal use of recycled water; improved sanitation; lesser stress on centralized storm management systems; better quality of life and a healthier community. The inter-linkages of buildings sector with other sectors is shown in Figure 12.

India being one of the fastest urbanizing nations with increased construction activities, it is imperative to meet the demands of this fast moving population. Greening of the building sector is therefore, a win-win situation for the nation apart from contributing to the global efforts of mitigating the climate-change impacts.

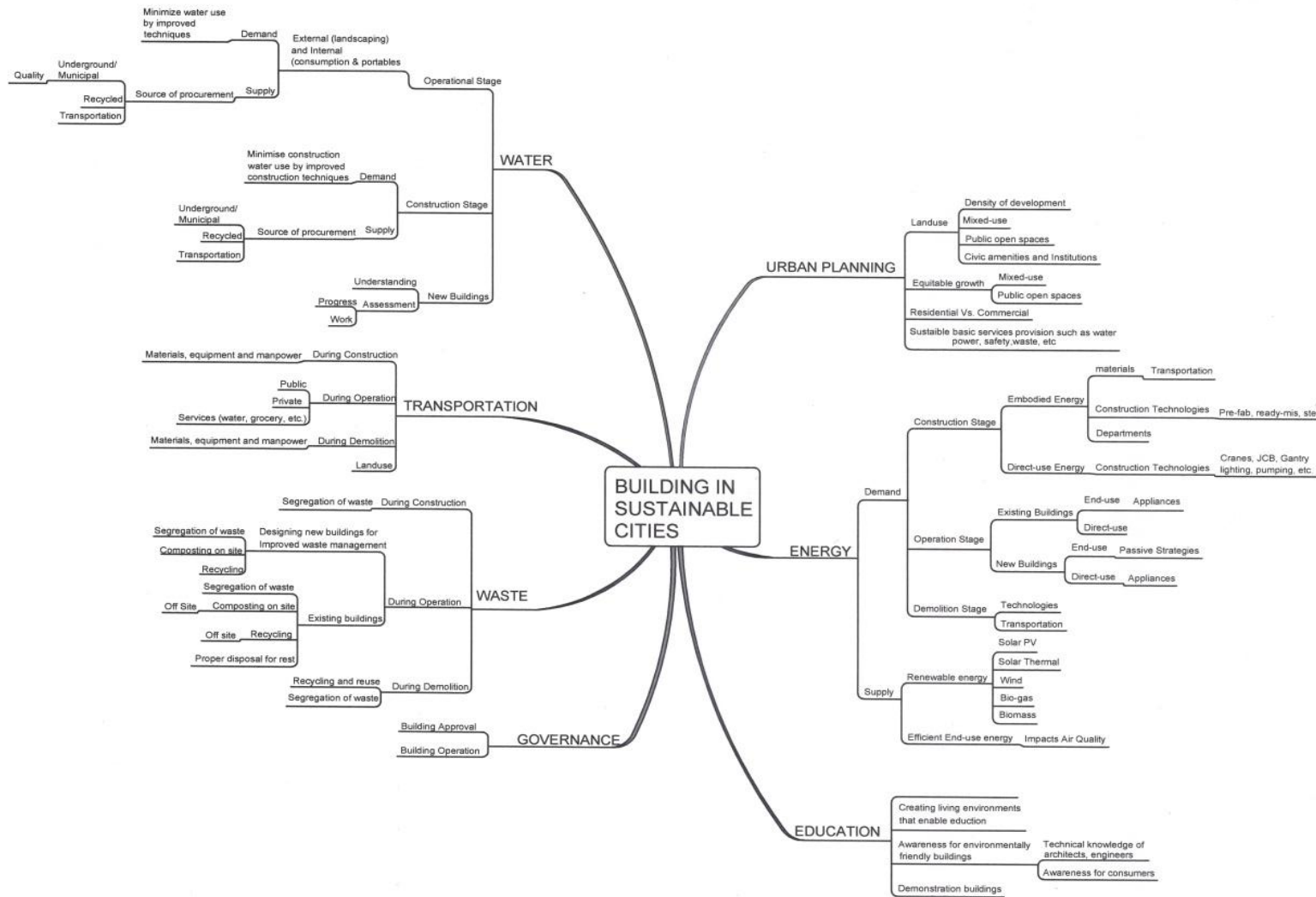


Figure 12: Buildings and its interlinkages with other systems and sub-systems

3. Key stakeholders engaged in building sector

This section provides an overview of the key stakeholders of the Indian building industry with a focus on stakeholders that have a significant role in promoting building energy efficiency in India.

STAKEHOLDERS	
National Ministries	MoHUPA, MoUD, MoEF, MNRE, MoP, BEE, DST
Other Federal Institutes	CIDC, NBO, BIS
Sub-national ministries/departments/PSUs	State Government and Local Authorities, CPWD, PWDs, RITES Ltd., HUDCO
Building Sector Associations	e.g. NAREDCO, CREDAI, IGBC, GRIHA Council, IPA, Builders Association of India
Private Sector Building/Construction Organisations/service providers	Developers, Architects, consultants, facility managers
Financial Institutions	NHB, HFC, Banks, MFCs, FDI
Research & Academia	e.g. IITs, IISc, CBRI, Building Centers, CEPT University, TERI, Development Alternatives, IIHS, TIFAC
Manufacturers and suppliers of building materials/products	Several

Acronyms

MoHUPA-Ministry of Housing and Urban Poverty Alleviation
 MoUD-Ministry of Urban Development
 MoEF- Ministry of Environment & Forests
 MNRE-Ministry of New and Renewable Energy
 MoP-Ministry of Power
 BEE-Bureau of Energy Efficiency
 DST- Department of Science & Technology
 CIDC-Construction Industry Development Council
 NBO-National Building Organisation
 BIS-Bureau of Indian Standards
 CPWD-Central Public Works Department
 PWD-Public Works Department

HUDCO-Housing & Urban Development Corporation Limited
NAREDCO-National Real Estate Development Council
CREDAI-Confederation of Real Estate Developers' Associations of India
IGBC-Indian Green Building Council
IPA-Indian Plumbing Association
NHB-National Housing bank
HFC-Housing Finance Companies
MFC-Micro-finance companies
FDI- Foreign Direct Investment
IIT-Indian Institute of Technology
IISc-Indian Institute of Science
CBRI-Central Building Research Institute
TERI-The Energy & Resources Institute
IIHS-Indian Institute of Human Settlements
TIFAC- Technology Information, Forecasting and Assessment Council

3.1. Central government

3.2. The Ministry of Housing and Urban Poverty Alleviation

The Ministry of Housing and Urban Poverty Alleviation (MHUPA) is responsible for formulating policies, sponsoring, supporting and monitoring of programmes related to Housing in India. MHUPA coordinates the activities of various central ministries, state governments and other nodal authorities concerning all the issues related to housing in the country.

3.3. National Buildings Organization

The National Buildings Organisation (NBO) is as an attached office under the Ministry of Housing and Urban Poverty Alleviation for technology transfer, experimentation, development and dissemination of housing statistics.

3.4. The Ministry of Urban Development

The Ministry of Urban Development is the apex authority of Indian government for formulating policies, supporting and monitoring programmes and coordinating the activities of various central ministries, state governments and other nodal authorities for all urban development issues in the country.

Attached office: Central Public Works Department

Central Public Works Department (CPWD) is the premier construction agency of the Government and is responsible for planning, construction and maintenance of government buildings. They are also responsible for regular updation of standards, schedule of rates and specifications for public works.

3.5. The Ministry of Power

The Ministry of Power is primarily responsible for the development of electrical energy in the country. The ministry is concerned with perspective planning, policy formulation, processing of projects for investment decision, monitoring of the implementation of power projects, training and manpower development and the administration and enactment of legislation in regard to thermal, hydro power generation, transmission and distribution. It is responsible for the Administration of the Electricity Act, 2003, the Energy Conservation Act, 2001 and to undertake such amendments to these Acts, as may be necessary from time to time, in conformity with the Government's policy objectives.

3.6. Bureau of Energy Efficiency (BEE)

BEE is a statutory body under the Ministry of Power, Government of India. It was set up by the government under the provisions of the Energy Conservation Act 2001. The mission of the BEE is to assist in developing policies and strategies with a thrust on self-regulation and market principles, within the overall framework of the Energy Conservation Act, 2001 with the primary objective of reducing energy intensity of the Indian economy. The states & UTs have identified State Designated Agencies (SDAs) to assist in implementation of the various schemes and programmes developed by BEE under the EC Act. To promote energy efficiency in both existing and new commercial buildings, several initiatives have been taken up by BEE, such as promotion of Energy Conservation Building Code (ECBC) implementation, energy auditing and implementation of energy efficiency measures in existing government buildings and a star rating scheme for existing buildings based on their actual performance.

3.7. Ministry of New and Renewable Energy

The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters related to new and renewable energy. The ministry has been promoting energy efficient / solar buildings in the country since its inception through a wide range of programs

3.8. Ministry of Environment and Forest

The Ministry of Environment Forests and Climate Change (MoEFCC) is the nodal ministry of the Government of India for the planning, promotion, co-ordination and overseeing the implementation of India's environmental and forestry policies and programmes. MoEFCC provides environmental (Environmental Impact Assessment) clearance to large construction projects.

3.9. The Construction Industry Development Council

The Planning Commission, Government of India jointly with the Indian Construction Industry has set up Construction Industry Development Council (CIDC) as an apex organization to take up and promote activities for the development of the Indian construction industry. The council started functioning from August 1996 and has taken up several important projects related to issues of concern vis-à-vis the Industry. The council provides the impetus and the organizational infrastructure to raise quality levels across the industry. This helps to secure wider appreciation of the interests of construction business by the government, industry and peer groups in society.

3.10. State governments

Various state government ministries (energy/ renewable energy/ environment/ housing) have formulated policies and implemented programs for promoting building energy efficiency in their states.

3.11. Local governments

The local governments at the city level that is the municipal corporation/ municipality/ development authorities formulate the building bye laws for building construction within the city municipal limits. Local authorities of a few cities have modified their building bye-laws to incorporate building energy efficiency/green building features. Local authorities of few cities (Pimpri Chinchwad Municipal Corporation) and Pune Municipal Corporation have formulated policies like discount in premium amount of building permission charges, discount in property tax, increased floor area ratio, to promote energy efficient buildings.

3.12. Associations

3.12.1. *The Confederation of Real Estate Developers Associations of India (CREDAI)*

Established in 1999, the Confederation of Real Estate Developers' Associations of India (CREDAI) brings together more than 9000 real estate developers from 152 city chapters across 23 states of India. As the apex body for private sector developers, CREDAI has developed into a preferred platform with regard to national discourse on housing and habitat through its close and deep networking with government, policy makers, investors, finance companies, consumers, real estate professionals and developers.

3.12.2. *The Builders Association of India*

Builders' Association of India (BAI) formed in 1941 in Pune, is a private association to safeguard the interest of the construction workers. During last more than 70 years since its inception, BAI movement has grown in leaps and bounds and at present has 130 centres spread over the length and breadth of the country, with its headquarters at Mumbai. With a direct membership of 13,000 constructors and indirect membership of 50,000 through various regional associations affiliated to it, BAI by virtue of its size represents the core construction industry. It safeguards the interests of the Indian construction industry against

unjust government legislations and at the same time promotes adherence to fair government legislations by its members.

3.12.3. Indian Plumbing Association

Indian Plumbing Association (IPA) (a private body) is the apex body of plumbing professionals in India. Established in 1993 with the objective to promote development of plumbing and building services industry, IPA membership is open to everyone engaged directly or indirectly with the construction industry. Through its association with the International Association of Plumbing and Mechanical Officials, IPA has taken several efforts in bringing in water efficiency at building level. It provides a platform for dissemination of information and exchange of ideas on matters related to the plumbing profession and facilitates better interface between the plumbing community, government/quasi government agencies, statutory bodies, non-governmental organisations (NGOs) and private agencies.

3.13. Developers

3.13.1. Government

A significant proportion of the properties in India are developed by the Government. Central ministries/ departments and state ministries/ departments construct buildings for their own usage or as part of their development plans- offices, housing colonies, hospitals, schools, universities. Various city development authorities and state housing boards play a significant role in planned and organized growth of cities. They are involved in planning, development and management of housing and commercial properties; urban restructuring and allotment of sites for public utilities. One of the main objectives of all development authorities and housing boards is to provide housing and basic amenities to the economically weaker sections of the society at an affordable price.

3.13.2. Private developers and builders

There are thousands of private real estate developers and builders involved in real estate development and building construction projects in India ranging from companies listed in the stock exchange to individuals.

3.13.3. Public sector undertakings and private companies

A lot of construction is done by public sector undertakings and private companies to build buildings for their own usage.

3.13.4. Individual plot owners

Individual plot owners construct buildings for residential or commercial purposes on the plots owned by them.

3.13.5. Service industry

The service industry comprises of various agencies and service providers like planners, architects, structural engineers, mechanical and electrical engineers, contractors, energy consultants, and energy auditors. Design and construction and maintenance of energy efficient buildings require an integrated effort from all the above mentioned agencies.

Energy Service Companies (ESCOs) also have a major role to play in improving energy efficiency in buildings. There are more than 130 ESCOs listed with BEE.

3.13.6. Manufacturers and suppliers of building materials and equipment's

Easily available and affordable energy efficient building construction materials and electrical appliances are extremely important for growth of energy efficient building industry in India. Although market of such products is still immature in India, in the last few years there has been a noticeable improvement in the market in terms of availability of products. Energy efficient electrical appliances/equipment's of many leading companies/ brands are now available in the market. The number of manufacturers and suppliers of insulation materials, high performance glass, heat reflective paints, and energy efficient masonry units, is slowly increasing.

However, there is still a huge market potential for energy efficient products, equipment's and technologies, in India.

3.14. Electricity utilities

There are several ways in which electricity utilities can contribute towards reducing the end-use electricity consumption in residential and/or commercial buildings like introducing time of day tariff , demand response , installation of smart meters, incentives to consumers for reducing electricity bills, and educating consumers to reduce electricity consumption. Further, the Government of India has established the India Smart Grid Task Force (ISGTF) and the India Smart Grid Forum (ISGF) for the development and deployment of smart grid related activities in India (TEDDY 2013-14)

3.15. Financing Institutions

3.15.1. Bank lending

Loans from banks are the biggest source of capital for real estate companies in India. Since 2005, banks have shown enthusiasm in providing finance to real estate sector. Banks provide finance to the real estate sector in the following modes:

- Direct finance: Finance provided to individuals or groups of individuals including co-operative societies
- Indirect finance: Loans to housing finance institutions, developers, housing boards and other public housing agencies.
- Investment in bonds of National Housing Bank (NHB)/HUDCO

3.15.2. *Private equity and fund houses*

Private equity players have been very active in the real estate sector especially in housing from the past few years. The investment for the project is made through private equity real estate fund which pools capital from investors. This fund has a certain life span ranging from 5 to 10 years which includes the investment period when the properties are acquired, followed by a holding period during which active asset management is carried out. At the end of this period the investors makes an exit after the acquired properties are sold.

3.15.3. *Foreign direct investments (FDI)*

FDIs are investments made in home country by foreign companies. According to the Department of Industrial Policy & Promotion (DIPP), the Construction Development sector received a total Foreign Direct Investment (FDI) equity inflow of INR 1,052 bn (USD 22.8 bn) during April 2000 to September 2013. This amount to an 11.1% share of the total FDI equity inflow and is the second highest amongst all sectors¹⁶. However, post the economic recession in 2008, the sector has been attracting lesser FDI equity with only 6% in 2012. To overcome the various issues, the new government at the Centre has notified in Dec, 2014, the foreign direct investment (FDI) policy in the construction sector to stimulate overseas investment in real estate. The revised policy simplifies rules to make it easier for investors to enter the market, sell assets or transfer their stakes, and repatriate proceeds before the completion of a project. The new rules include reducing the built-up area requirement for FDI in construction projects to 20,000 sq. m from 50,000 sq. m and the lowering the minimum capital requirement to \$5 million from \$10 million. The government permits 100% FDI in the construction development sector.

3.15.4. *External commercial borrowing*

External Commercial Borrowings (ECB) is a mechanism used in India to assist the Indian corporations and PSUs (Public Sector Undertakings) in accessing foreign money. It include commercial bank loans, buyers' credit, suppliers' credit, securitized instruments such as Floating Rate Notes and Fixed Rate Bonds, credit from official export credit agencies and commercial borrowings from the private sector window of Multilateral Financial Institutions such as International Finance Corporation (Washington), Asian Development Bank (ADB), and Australian Foundation Investment Company (AFIC), ECBs cannot be used for investment in stock market or speculation in real estate. For infrastructure and Greenfield projects, funding up to 50% (through ECB) is allowed.⁵⁴ Since January 2009, ECB route has been opened for the development of integrated townships.

3.15.5. *Housing finance*

In the organized sector there are two main sources of housing finance- commercial banks (in the public and private sector) and the housing finance companies (HFCs).

The commercial banks are regulated by the Reserve Bank of India (RBI) and the HFCs are regulated by the National Housing Bank (NHB). Under the Reserve Bank of India Act, the Banking Regulation Act and the Foreign Exchange Management Act, RBI has been given

¹⁶ Cushman & Wakefiled, 2014. Housing: The game changer

power to license banks and other non-bank finance companies. Under the National Housing Bank Act, 1987 and the housing finance companies' directions, NHB can license all housing finance companies.

Following is a list of all the sources of long term finance for housing:

- Scheduled commercial banks
- Scheduled cooperative banks
- Regional rural banks
- Agriculture and rural development banks
- Housing finance companies and
- State level apex cooperative housing finance societies

4. Policies and interventions

Several policies have been formulated by policy makers to mainstream energy efficiency and green buildings in India. These policies directly or indirectly address the issue of building energy /green measures.

There are a number of policies on managing energy demand and supplementing supply through the use of renewable energy, which contribute to climate mitigation by reducing or avoiding GHG emissions. Many of these policies are contained in the FYPs developed by the Planning Commission to guide economic policy in India¹⁷

4.1. National Policies

4.1.1. *The Jawaharlal Nehru National Urban Renewal Mission*

The programme was initiated to improve the quality of life and infrastructure in the cities and it covered a total of 63 cities initially, which were later increased to 68. The mission has helped focus attention of policy makers in all three tiers of the government on the challenges facing the cities and towns of India and created dynamism in a sector that has long suffered neglect. The government of India is in the process of launching a new urban development mission. This will help develop 500 cities, which includes cities with a population of more than 100,000 and some cities of religious and tourist importance. Four fundamental activities are part of this, viz., the provision of safe drinking water and sewerage, use of recycled water for growing organic fruits and vegetables, solid waste management and digital connectivity.

¹⁷ 12th FYP covers 2012-2017

4.1.2. *The National Urban Housing and Habitat Policy, 2007*

This policy aims to bridge the gap between the supply and demand of housing and infrastructure in the country. This policy intends to promote sustainable development of habitat in the country with a view to ensuring equitable supply of land shelter and services at affordable prices to all sections of society. The core focus of this policy is to provide affordable housing for all, with a specific focus on lower income group (LIG) and economically weaker section (EWS).

4.1.3. *Real Estate Investment Trusts (REITs) & Infrastructure Investment Trusts (INVITs)*

REITs will provide the necessary support to the sector in terms of required large scale investments.

4.1.4. *Real Estate Regulation and Development Bill, 2013*

The Real Estate Regulation & Development Bill has been formulated to bring in transparency and efficiency in the real estate sector. The Real Estate Regulation & Development bill is a path breaking law that is expected to bring uniform regulatory environment to the sector and protect consumers from unfair practices. It is a pioneering initiative to protect the interest of consumers, promote fair play in real estate transactions and ensure timely execution of projects.

4.1.5. *Model State Affordable Housing Policy for Urban Areas, 2013*

The aim of this policy is to create an enabling environment for providing 'affordable housing for all' with special emphasis on EWS and LIG and other vulnerable sections of society. The policy further aims to promote Public Private People Participation (PPPP) for addressing the shortage of adequate and affordable housing.

4.1.6. *Smart Cities*

The Government of India in the Union Budget 2014-15, has announced a project to develop 'One Hundred Smart Cities' as satellite towns of larger cities by modernizing the existing mid-sized cities in the country. INR 70.6 Billion has been allocated in the current fiscal year for the same. The following has also been announced in the budget in relation to smart cities, to encourage development of 'Smart Cities'. These will also provide habitation for the neo-middle class, requirement of the built-up area and capital conditions for FDI is being reduced from 50,000 sq. m. to 20,000 sq. m., from USD 10 Million to USD 5 Million respectively. To further encourage this, projects which commit at least 30% of the total project cost for low cost affordable housing will be exempted from minimum built-up area and capitalisation requirements.

4.1.7. *Integrated Energy Policy*

The Integrated Energy Policy provides a broad, overarching framework for guiding the policies governing the production and use of different forms of energy from various sources. The energy policy in India focuses on 'energy for all' and intends to build an environmentally-friendly sustainable energy supply policy.

Since India's conventional energy reserves are limited, the Integrated Energy Policy stresses energy efficiency and conservation, particularly electricity generation efficiency, transmission, distribution and end-use. Studies show that implementation of Demand Side Management (DSM) options to reduce demand for electricity through energy efficient processes, equipment, lighting and buildings can help reduce the demand by an estimated 15% by 2031-2032, a reduction of 152 million tonnes of oil equivalent (i.e. 381 metric tonnes of Indian coal) in coal requirement.¹⁸

As per the Policy, significant energy saving potential is available in the building design, construction, heating, ventilation and air-conditioning (HVAC), lighting and household appliances sectors.¹⁹

4.1.8. *Environmental Impact Assessment Notification (EIA) issued by the Ministry of Environment and Forests*

Environmental Impact Assessment (EIA) is an important management tool for ensuring the optimal use of natural resources for sustainable development.

The Ministry of Environment and Forest has issued the Environmental Impact Assessment (EIA) Notification, 2006, which makes environmental clearance mandatory prior to construction for the development activities listed as below in table 1.

¹⁸ Publication on: Green Buildings – Policy and Practices in the EU and India, produced by Euro consult Mott MacDonald in cooperation with The Energy and Resources Institute (TERI)

¹⁹ [tp://envfor.nic.in/legis/eia/so1533.pdf](http://envfor.nic.in/legis/eia/so1533.pdf)

Table 1: Building type and built-up area listed under MOEF notification for EIA

Type of building	Built up area
Building and construction projects	≤ 20,000 sqm ≥1,50,000 sqm of built up area
Townships and large area development projects	Built up area ≥ 1,50,000 sqm

4.1.9. *Fast track environmental clearance for green projects*

As per the Office Memorandum number 19-58/2011-IA.III dated 10th May 2011 issued by Ministry of Environment and Forest (MoEF) a procedure to enable fast track environmental clearance for buildings and construction sector projects having green rating (Pre-Certification or Provisional Certification) under the rating programmes of GRIHA and IGBC has been proposed. According to the scheme, projects demonstrating integration of environmental norms in the building plan shall get priority for their consideration, out of turn, by the expert appraisal committee or State Level Expert Appraisal Committee as the case may be.

4.1.10. *The Energy Conservation Act, 2001*

Considering the vast potential of energy savings and benefits of energy efficiency, the Government of India enacted the Energy Conservation Act, 2001. The Act provides for the legal framework, institutional arrangement and a regulatory mechanism at the Central and State level to embark upon energy efficiency drive in the country. Five major provisions of EC Act relate to Designated Consumers (DC), standard and labelling of appliances, Energy Conservation Building Codes, Creation of Institutional set up (BEE) and establishment of Energy Conservation Fund. The EC Act was amended in 2010 and one of the amendments of the Act was to include Commercial buildings having a connected load of 100 kW or contract demand of 120 kVA and above under the purview of ECBC under EC Act.²⁰

4.1.11. *Energy Conservation Building Code*

The Energy Conservation Act (2001) led to the formation of the Bureau of Energy Efficiency (BEE) that started the formulation of the Energy Conservation Building Code (ECBC).

- The scope of Energy Conservation Building Code is to provide minimum energy standards for buildings having a connected load of 100kW or contract demand of 120kVA. It aims to reduce baseline energy consumption by setting minimum energy performance standards for new commercial buildings, including for building envelopes, mechanical systems and equipment, including heating, ventilation and air conditioning (HVAC) systems, interior and exterior lighting system, service hot water, electrical power and motors.

²⁰http://www.powermin.nic.in/acts_notification/energy_conservation_act/introduction.htm

- Under section 14 (p) of the Energy Conservation (EC) Act, 2001 as amended by the Energy Conservation (Amendment) Act, 2010, the Central Government may, by notification, in consultation with the Bureau of Energy Efficiency (BEE) prescribe ECBC for efficient use of energy and its conservation in the building or building complex having a connected load of 100 kW and above or contract demand of 120 KVA and above. Under Section 15 (a) of the EC Act, the State Government may, by notification, in consultation with BEE amend the ECBC to suit local or regional climatic conditions and may, by rules made by it, specify and notify ECBC with respect to use of energy in the buildings. Central government and state governments may, by notification, in consultation with BEE, have power to direct owner or occupier of building, being a designated consumer to comply with provisions of ECBC for efficient use of energy under section 14 (r) and 15 (b) respectively. The Central Government is also empowered to include such buildings in the list of DCs under section 14(e).

Many states such as Rajasthan and Odisha have already notified ECBC; other states like Karnataka, Uttarakhand, Uttar Pradesh, Punjab have amended ECBC; and states like Kerala and Gujarat are in the process of amending the ECBC. The union territory of Puducherry has notified building bye-laws for ECBC compliant construction for commercial buildings. In order to check compliance towards ECBC, BEE has developed a web based on line tool, 'EC Onirman', which can be used at the design stage.

4.1.12. Ministry of New and Renewable Energy Scheme on "Energy Efficient Solar/ Green Buildings"

Ministry of New and Renewable Energy, Government of India, had launched a scheme on 'Energy Efficient Solar/ Green Buildings' which promotes the Energy Efficient Green Buildings in the country with the promotional incentives. This programme has a provision for annual awards to Urban Local Bodies (ULBs), green buildings having maximum renewable energy installations and to architects and design consultants.

4.1.13. GRIHA mandatory for central government projects

According to an official circular released by the Ministry of New and Renewable Energy on 17th September 2009, all new buildings of central government / public sector undertakings shall comply with the mandatory guidelines and benchmarks of at least a GRIHA (National Rating System endorsed by the Ministry of New and Renewable) 3 star rating. In view of this, Ministry of New and Renewable Energy along with The Energy and Resources Institute, Central Public Works Department and other organizations are arranging various awareness generation and capacity building programmes for of architects, engineers, urban planners and other professionals of the building industry.

4.1.14. GRIHA Compliance mandatory for all building of CPWD (Central Public Works Department)

Central Public Works Department issues an official circular on 16th March 2009 which states that all constructions undertaken by CPWD shall be green. In view of this, all projects

undertaken by CPWD shall comply with GRIHA guidelines and benchmarks and shall be at least internally certified as green by CPWD Officers.

To facilitate the process, CPWD has introduced the approved guidelines regarding green buildings in CPWD Works Manual 2007 under chapter 1, section-6 as 6.18 titled “Green Building Norms” and has also made necessary changes in their specifications and estimates for inclusion of ECBC and GRIHA related parameters. Few states PWD and relevant public agencies involved in construction sector are also undertaking similar changes.

However, the pace of change by most of the states for adoption/adaption of their specifications as per ECBC requirements and other high building performance requirements is abysmally slow.

4.1.15. GRIHA Incentives/mandates

Various development authorities, state governments and municipal corporations have introduced financial/non-financial incentives to promote green buildings (adoption of GRIHA rating system). Some of these are²¹:

- Government of Sikkim has adopted GRIHA for all the Government and semi-Government structures, including those belonging to autonomous bodies like Boards, Corporation, Companies and Public Sector Undertaking (PSU).
- Jaipur Development Authority has notified that the buildings constructed on plot area more than 5,000 m² will be eligible for an additional 5% floor area ratio (FAR) free of charge if they get 4 or 5 star rating from GRIHA.
- NOIDA and Greater NOIDA have incentivized GRIHA projects (on a plot of more than 5000 sq m and above) with free of cost 5% additional FAR for projects for complying with 4 or 5 Star GRIHA Rating.
- The developers in Pimpri Chinchwad Municipal Corporation get discounts on the premium amount of building permission charges, as per the level of rating awarded by GRIHA. A Discount of 10% in property tax for home owners is also offered.
- The Department of Housing and Urban Development, Government of Punjab has notified that an additional 5% floor area ratio free of charges shall be permissible to buildings that provide relevant certificates from the Bureau of Energy Efficiency or from GRIHA (Green Rating for Integrated Habitat Assessment).
- Ministry of Urban Development issues a notification for local authorities to incentivize and provide 1% to 5% extra ground coverage and FAR for projects of more than 3000 sqm plot size on basis of GRIHA evaluation.
- National Building Code

²¹ Assessed at www.grihaindia.org

The National Building Code of India (NBC), a comprehensive building Code, is a national instrument providing guidelines for regulating the building construction activities across the country. It serves as a Model Code for adoption by all agencies involved in building construction works, be they Public Works Departments, other government construction departments, local bodies or private construction agencies. The Code mainly contains administrative regulations, development control rules and general building requirements; fire safety requirements; stipulations regarding materials, structural design and construction (including safety); and building and plumbing services.

The Code was first published in 1970 at the instance of Planning Commission and then revised in 1983. Thereafter three major amendments were issued, two in 1987 and the third in 1997²². Recently, harmonization of ECBC with National Building Code (NBC) 2005 has been finalised by including a chapter “Approach to Sustainability” to cater to the changing needs.

In spite of its comprehensiveness, the Code is not adopted usually by the various agencies either in framing of the bye-laws or in practise by the building community.

4.1.16. National Policy on Data Sharing

The policy has come in to effect since February 2012. The objective of this policy is to facilitate the access to, Government of India owned, shareable data and information in both human readable and machine readable forms through a network all over the country in a proactive and periodically updatable manner, within the framework of various related Policies, Acts and Rules of Government of India, thereby permitting a wider accessibility and use of public data and information. The National Data Sharing and Accessibility Policy will apply to all data and information created, generated, collected and archived using public funds provided by government of India directly or through authorized agencies by various ministries /departments/organizations /agencies and autonomous bodies.

4.2. Urban Planning Measures

4.2.1. Model town and country planning Act,1960, Ministry of Urban Development

The Act has provisions for preparation, implementation and enforcement of comprehensive master plans for urban areas of various states covering all important planning issues such as land use, zoning, infrastructure and green areas. This also constitutes a board in the matter of providing advice on the planning and plan formulation of the local planning authorities in the states.

The states may incorporate the provisions made in the Model Law in their respective state town and country planning legislation.

Essentially, various green growth strategies and vision should come in the master plan and development plans itself. There is an urgent need to include several green growth strategies in the preparation of such plans itself.

²² <http://www.bis.org.in/sf/nbc.htm>

4.2.2. *Urban Development Plans Formulations and Implementation Guidelines (UDPFI), Ministry of Urban Development*

Model guidelines for urban development plan formulation and implementation, suggests 4 interdependent plans –Perspective plan(Long term 20-25 years), Development Plan (5 years, medium term), Annual Plan for resource mobilization and implementation, Plans for projects/schemes identified under the development plans, provides contents of plan, planning process, fiscal mobilization, and spatial norms and standards.

Besides, there are several policies and programs having components of ‘green growth in building sector’ overlapping with other sectors. Some of them are National Water Policy, National Urban sanitation policy, rules for managing municipal solid waste and electronic waste. Some of them are being covered in the respective sections in this paper.

4.2.3. *Interventions on rainwater harvesting (storage and recharge), storm water management through sustainable urban drainage systems (SUDS), integration of biodiversity with built-up area, integration of renewables at building scale (thermal heating and electricity generation)*

Several states and local corporations have mandated or incentivised adoption of solar thermal systems, rainwater harvesting, and provision of wastewater treatment systems for a certain built-up area and above. There are varying success stories in different regions and areas. There has hardly been an instance of consciously integrating storm water management through SUDS to avoid the ever-increasing urban flooding problems and alleviate ground water recharging issues. Integration of bio-diversity and improvement of quality of life is not attempted anywhere in the country (except for individual gated townships/campus development by private developers).

5. Barriers in greening the building sector

The sector faces several barriers to greening the building sector. The current focus of the several efforts at national and sub-national levels (at a disaggregated level) is limited to only energy efficiency and some bit of measures to introduce rainwater harvesting (for storage and/or recharge) with limited success. The increased influence of glass architecture for commercial buildings is very much on the rise in urban India, which results in non-sue of daylight (due to excessive glare), large cooling loads, increased energy and water demand. The regulatory frameworks for implementation of various codes and standards are extremely inadequate. Subsidised energy prices, water prices and basic services provision are some strong barriers, although these subsidies are meant to increase the access for certain population groups (thus creating major obstacles in removing such public subsidies). Many states are still unable to provide electricity for not more than 5 hours a day. In such cases, renewable energy projects should be a priority. Many places do not have access to adequate quality and quantity of water along with depleting groundwater issues and flooding during storm events. Municipal solid waste management is a perennial issue across the country. Lack of knowledge among policy makers (due to lack of integration and looking at a holistic perspective), architects, engineers, service providers, inadequate

capacities (skill development in the construction sector), lack of robust financial systems to facilitate green growth changes, absence of green financial products are some of the problems faced by the country.

Data collection, collation and analysis is a major obstacle. There is no data available for accurate determination of the existing building stock in India. Energy/water performance benchmarking for key building typologies for various climatic zones of the country needs to be done. BEE had done an extensive exercise of few hundred buildings of only commercial type (eco-III program) but given the scale and diversity of the sector this needs to be done at a wider scale and this also needs to be extended for residential buildings.

Construction approvals processes are extremely tedious across the country (on an average takes 18-36 months) and is considered as one of the biggest problems of the real estate sector in the country leading to project delays, cost escalation of the projects which then get passed on to buyers, lesser FDI in the sector. If and when added layers of 'green growth' (e.g., mandatory EE compliances, and indoor air-quality) will be added in the existing system of approval processes, it will result in further delays. However, talks are on to have a single window shorter time clearance for all infrastructure and construction projects.

For a developer, gathering the initial funding poses a big challenge, especially for new entrants; curtailing the housing supply to a large extent. The RBI has set threshold for the total maximum exposure to real estate, including individual housing loans and lending to developers for construction finance, for banks at 15%, which is quite low and is considered to be one of the biggest financial barriers faced by the sector²³. Absence of long term funding from banks is forcing developers to look at alternative sources of funds, most of which do not offer affordable interest rates and hence, the supply is being stifled.

The recent Reserve Bank of India's cut in reserve repo rate by 25 bps is expected to boost the construction sector as banks will now be able to get loans at reduced rate²⁴.

Capturing the potential of energy generation through rooftop solar power is a priority for the new government. Several solar rooftop projects have been commissioned recently such as Institute of Technology, Kanpur-192 kWp, Ansal University-100kWp, Medanta Medicity Hospital 500kWp. Projects are often financed through 100% equity infusion, with inflow split in three phase-pre, mid and post construction.

Error! Reference source not found.2 discusses the barriers, solutions and market opportunities to foster green growth in buildings sector

Table 2: Barriers, Solutions and market opportunities to foster green growth in buildings sector

Barriers	Solutions	Market Opportunities
<i>Financial barriers</i>		
Lack of capital investment required for covering	Attractive financing solutions for developers investing in	Develop attractive finance models to provide finance to developers for

²³ Cushman & Wakefield, 2014

²⁴ Three reasons why RBI governor Raghuram Rajan cut repo rate by 25 bps Assessed at [http:// articles.economictimes.indiatimes.com/ 2015-01-15](http://articles.economictimes.indiatimes.com/2015-01-15)

Barriers	Solutions	Market Opportunities
incremental cost due to energy efficiency/green measures for developers Lack of finance for projects for energy saving companies (ESCOs) Developers do not get direct benefit from investing in green buildings (split incentives)	green buildings and ESCOs	investing in green buildings/ to provide finance to ESCOs for investing in building energy efficient (EE) projects
Lack of confidence of financial institutions to fund ESCOs/ non-clarity on implementation of green financial products	Successful pilot projects Detailed project reports quantifying potential energy/water savings to be submitted along with loan application	Implement pilot projects to demonstrate successful implementation of green measures in new buildings/ retrofit programs
Notion that green buildings are expensive and not financially feasible	Publicize the fact that green buildings are financially feasible	Using existing data on financial feasibility of green buildings to promote the financial feasibility
Concerns that incremental expenditure on 'green' may reduce funds available for buying the property for the end-users	Life cycle costing of the property & potential savings on annual electricity/water bills, to be made available to the buyers along with the property brochure Attractive financing solutions for home buyers investing in green homes	Commission study on life cycle costing of green homes and make it available to home buyers; emphasis on non-monetary benefits like adequate quality/quantity of water, preventing urban flooding, and better sanitation conditions. Incentives for individuals buying a green home- concession in interest rate, waiver of processing fees
High cost of efficient products and equipment	Incentives for manufacturers to invest in energy efficiency/water efficiency and mechanisms to promote wider availability of such products; Competitiveness and increase in supply will reduce the prices of such products	Design programs to increase penetration of Green products and equipment in the Indian market
<i>Institutional barriers</i>		
Lack of institutional capacity to implement green building programs at the end user level	Capacity building at local and state level government officials An effective monitoring & verification system to ensure successful implementation	Organization of capacity building programs at different levels Development of an effective monitoring & verification system

Barriers	Solutions	Market Opportunities
Different government ministries/ departments are taking green building initiatives. These comprise of Ministry of Power, Ministry of New and Renewable Energy, Ministry of Environment and Forest, Ministry of Urban Development, and Building centers. Lack of co-ordination amongst different initiatives.		
<i>Technological barriers</i>		
The market of green products is immature at present; there is limited availability of green building materials Lack of willingness amongst manufacturers to invest in such products/missing links in supply chain of green products/materials	Introduce incentives for manufacturers to invest in water/energy efficiency/decentralized wastewater and solid waste management- import duty relaxation, reduced tax, and excise duty. Mechanisms to promote wider availability of energy efficient products	Design programs to increase penetration of green products and equipment/materials/construction technologies in the Indian market
No certification system for green building products and limited information on performance levels	National Certification system/body for assessing performance levels of green/EE materials & products and providing certification.	
Lack of subject experts- Architects/ services consultants/ building Energy Auditors/sustainable urban drainage Systems (SUDS) designers/rain water harvesting designers	Introduction of Specific Courses on Green Buildings in leading architecture/engineering colleges Exam for building energy auditors Building a pool of water and waste auditors along with a successful business model (such as introduction of mandatory audits)	
<i>Regulatory Barriers</i>		
Absence of mandatory energy efficiency standards or codes; provisions of SUDS; rainwater harvesting; soil erosion/sedimentation control, biodiversity	Building regulations to integrate all such necessary provisions as per the local needs	Organization of capacity building programs at different levels Development of an effective monitoring & verification system Revision of Municipal Building

Barriers	Solutions	Market Opportunities
		Bye laws to incorporate such features
Lack of policy on construction materials/technologies	Keeping in view the huge construction material requirement (including high embodied materials such as bricks, cement, steel, glass) vis-à-vis availability of natural virgin material sources, a policy needs to be made to find alternative solutions and ways to promote the same.	
Absence of standards for alternative materials/technologies	Building centres to work along with BIS for generating such standards within a given (short) time frame	
No energy efficiency standards or codes for Industrial buildings	Development of energy efficiency code/ (modification of ECBC) for industrial buildings	Develop benchmarks for energy consumption in industrial buildings Modify ECBC for industrial buildings
Specific standards/approach for mixed mode buildings (a typology most prevalent in India)	Development of a code/standards for mixed mode buildings	
Lack of effective implementation of ECBC	Capacity building at local and state level government officials	Organization of capacity building programs at different levels
	Development of effective monitoring & verification system	Development of an effective monitoring & verification system
	Energy efficiency features to be integrated in all building construction related documents/ manuals followed by central/ state and Local governments	Revision of all building construction related documents/ manuals followed by central/ state and local governments, to incorporate building energy efficiency features
Subsidized water tariffs/no tariffs for sewage/waste management	Tariffs to reflect the actual cost of providing such essential services	
Energy subsidies	Gradual removal and cross-subsidizing only the low-income/economically weaker section	
	<i>Information barrier/ capacity building</i>	
Lack of skilled manpower	Enhance capacities of the skill development institutions across the country as per the changing needs of the country	

Barriers	Solutions	Market Opportunities
Lack of focus on following the fundamental principle of good design	Creating awareness amongst engineers, architects, builders and end users about climate responsive building design	Organise awareness campaigns/ programs at different levels
Data collation, analysis, monitoring and verification systems	Devising a holistic system with a key nodal agency	
Lack of data on actual building stock, energy/water consumption/waste generation by different building sectors, lack of benchmarks for water efficiency, energy efficiency, biodiversity	Setting up of a system for data collection Devise methods to integrate collection of information related to building energy efficiency/water efficiency/wastewater/waste generation in the existing data collection system in India City specific/region specific inventory of native flora and fauna freely available in public domain for consumption by consultants and end-users	Develop a program on setting up of a system for data collection-top-bottom and bottom-up; database on supply chain of green/alternative materials/technologies
Lack of information on benefits and co-benefits of Green Buildings	National and sub-national extensive media campaign; advertising various pilots executed by various agencies and building centres across the country	

The following section makes suggestions and proposes interventions for greening of the building sector; and are only meant for urban areas, and does not cover for the rural areas.

6. Ways forward

Short-term

- Ensure all new construction for commercial buildings (as defined by the ECBC) to be ECBC compliant
- Monitoring of the certified buildings for at least 12 months
- Benchmarking program for all commercial and non-commercial building typologies
- Vision plan for green materials and construction technologies to be ready by 2020; this should have a regional flavour and well researched with active stakeholders engagement from across the country ; one of the objectives to also focus on high quality fast

construction for mass housing (given the increasing housing demand-supply gap for low-income and economically weaker sections)

- Extensive multi- media awareness campaign across the country on the benefits of green buildings
- Upscaling of financial programs such as NHB's 'Energy Efficient Homes'
- Extension of energy efficient star labelling scheme to water-efficient products
- Removing various financial barriers for accelerated financing of green projects
- Integrating 'green features' (not necessarily energy efficiency) in all the ongoing and proposed schemes programs for affordable and social housing
- Target of 50% greening of rooftops and public spaces in all urban areas to prevent urban heat island effect; In the first phase, important cities (3-4) may be taken for greening
- Identification of outdoor and indoor species most suitable for pollution control with minimal upkeep/maintenance and water consumption;
- Residential building code formulation at national level and assistance to each state for state customisation by 2020
- Devising an existing building retrofit program by 2018 (based on the baseline exercise)
- Evolution of ECBC for the next phase
- Exclusive substantial financial allocation for R & D on green buildings and new materials; revitalising/strengthening all the buildings centers and facilitating establishment of new institutes as Centres of Excellence; regional presence of such Centres of Excellence in all regions of the country; Incentivizing the R & D and innovating initiatives
- Capacity building program targeting all the stakeholders in line with the changing needs of the market. This includes architects/ services consultants/ building energy auditors/ Sustainable Urban Drainage Systems (SUDS) designers/rain water harvesting designers
- Focused program for skilled labour-masons, plumbers, electricians who can use new materials and construction technologies; this requires institutional reforms at federal and state levels

Medium-term

- All existing and new commercial buildings to be compliant with the new ECBC with more stringent targets (drawing heavily from the benchmarking exercise done in phase 1-2020)
- All new residential buildings to follow residential building code

- Implementation of vision plan for green materials and construction technologies
- CoEs on buildings to introduce high performance green materials (with less embodied energy and longer life) and implementation of materials/construction technologies for mass housing
- New retrofit program for making residential buildings
- At least 25% of all existing and new commercial buildings to be net zero/zero plus energy/waste/water buildings
- Extension of greening of rooftops and public places to all cities and towns based on experiences gained from Phase I-2020
- A focused program on introducing lifestyle changes towards sustainable consumption
- All financial institutions, banks and housing finance and micro-finance companies actively engaged in greening of the building sector
- Continued capacity building program evolving with the changing codes/standards requirements

Long-term

- 100% of all existing and new buildings to be net zero/zero plus energy/waste/water buildings
- Automation for all the basic services at micro and macro level to optimise efficiency
- Green neighbourhood planning and green master plans executed for all cities and towns
- Lifestyle changes introduced in the masses for a low carbon lifestyle due to intensive awareness building over the years
- The buildings and city plans adopt climate resilience at all levels

International studies done by Global Energy Assessment (GEA) and International Institute for Applied Systems Analysis (IIASA) show quantitative evaluations of multiple benefits of even a single energy-efficiency initiative in buildings in various countries. It specifically highlights the importance of mandating state-of-the-art efficiency levels instead of simply introducing the building codes and accelerating energy retrofits (GEA 2012) The significant barriers faced by the sector can be mostly overcome or mitigated through policies, measures and innovative financing schemes. A combination of carrots, sticks and tambourines (measures attracting attention such as public leadership programs) and balanced regional development to transform the building sector towards a less-resource consuming sector is required.

Greening of building sector offers great economic and environmental opportunities and enormous challenges. At the same time, it is the need of the hour, especially for a country

like India where the sector contributes significantly to GDP, is a huge employment generator, energy consumer, water consumer, wastewater and waste generator. Solutions to remove some of the barriers are have been discussed in Table 2. Some of the key action points which are required in the context of green growth in India for the building sector have also been listed below:

- Enabling conditions for affordable housing-land and finances to overcome the social barrier for a greener economy.
- Retrofit measures to make the existing building stock energy efficient and water wise, to overcome the various environmental challenges posed by the sector.
- New stock to be built on the principles of green buildings to accrue social, environmental and economic benefits
- Efficient appliances; penetration of renewable energy with special focus on building integrated PV as well in order to bring in equity (energy access) and reduce the environmental implications and externalities associated with conventional electricity generation
- Alternate building materials which perform equal or better than the conventional ones to bring in environmental sustainability
- Setting of materials testing laboratories as per the requirements of green buildings and setting protocol and uniform methodology responding to the needs of the country; national certification system/ body for assessing performance levels of such materials & products and giving certification to prevent the market from falling in a trap of 'greenwash'
- Strategy and implementation plan at national level on promotion of green materials and replacement of high embodied materials with low embodied materials- a must for India given the high construction rate
- Capacity building at various levels including skilled manpower for enabling green construction, Local and State level government officials in order to implement the green growth strategies in building sector
- Attractive financing solutions for developers investing in EE buildings, ESCOs, communicating through various media the benefits of green buildings at no incremental cost, life cycle costing of the property & potential savings on annual electricity bills to be made available to the buyers along with the property brochure, Attractive financing solutions for Home buyers investing in EE housing, attractive financial models for affordable housing sector, access to finance by the under privileged, to overcome the various financial barriers faced in greening of the sector.
- Incentives for manufacturers to invest in energy efficiency products and mechanisms to promote wider availability of energy efficient products and providing extended support with improved technology

- Implementation of ECBC and associated institutional mechanism (monitoring and verification protocol) to deliver the same for better implementation and reap the real benefits of energy efficiency achieved
- Incorporation of green/ EE features in municipal bye laws and all related documents followed by central/state governments; which is necessary for achieving the environmental benefits associated with greening of building sector.

EE measures undertaken at a slow rate and integration of various essential green measures is currently missing at a national and sub-national policy. There is a need of integrating green measures such as storm water management, wastewater management, rainwater harvesting, low impact development strategies, use of appropriate construction materials and technologies along with intensive measures targeting energy efficiency and renewable integration (both for thermal applications and generation of electricity) should be the vision as part of green growth strategy.

This could be phased out as medium term and long term plans with an overall target of achieving the following:

- Near Net zero (energy, water and waste) buildings by 2047 (regional priorities to be set as per the existing situation)
- Use of appropriate low energy materials and construction technologies
- Skill development of construction sector by 2020

Development of simple and few indicators instead of a long wish list separately for new and existing construction is proposed for monitoring the progress of the targets.

- EPI for key building typologies (residential and commercial)
- Installed capacity of renewables at building scale
- Fresh water usage intensity (litres per capita) for key building typologies (residential and commercial)
- Percentage of buildings managing Biodegradable municipal solid waste on-site
- Percentage of buildings covered by door-to-door collection of segregated waste (at least in two categories-wet and dry) facility
- Percentage use of native/naturalised species of plants (to attract biodiversity and other co-benefits)
- Extent of discharge of untreated sewage from each building/neighbourhood
- National Construction Materials and Technology Policy by 2017

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