

Greenomics-Cost Efficiency of Green Buildings in India

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ABSTRACT: The tremendous growth in economic activity across the globe is placing pressure on natural and environmental resources. There is increasing evidence that human activities are causing an irreversible damage to the global environment, which will have an adverse impact on the quality of life of future generations. The rising concern for the environment in response to global warming is driving thinkers to seek sustainable solutions. The real estate industry is a significant contributor to the global warming due to extensive emissions of greenhouse gases (GHGs) from the energy use in buildings. In some countries, the built environment accounts for about 40% of the energy used. Therefore, there is an imperative for the industry to develop sustainable building technologies and green buildings. The construction industry in India is growing rapidly at a rate of 10% compared with the world average of 5.2%. It is observed that buildings in India consume about 20% of the total electricity in the country. Hence, real estate activity in India has a significant impact on the environment and resources. This indicates that there is a real opportunity to develop green buildings in the country. While the environmental benefits of green buildings have been firmly established, green buildings also deliver a range of compelling financial and social benefits. This research attempts to understand and find solutions to these problems. It investigates the cost efficiency of green buildings through a cost-benefit analysis and a study on the payback period of the extra investment in developing green buildings. Starting with the benefits that may be obtained during the design and construction phase, the discussion then shifts to the asset value and returns received by investors and developers. This is followed by the operational benefits such as cost savings, workplace health and productivity, and finally the issue of risk mitigation, which plays a role in every stage of a building's economic life.

KEYWORDS: Green Building, Development.

I. INTRODUCTION

The tremendous growth in economic activity across the globe is placing pressure on natural and environmental resources. There is increasing evidence that human activities are causing an irreversible damage to the global environment, which will have an adverse impact on the quality of life of future generations. **The rising concern for the environment in response to global warming is driving thinkers to seek sustainable solutions.** The real estate industry is a significant contributor to the global warming due to extensive emissions of **greenhouse gases (GHGs)** from the energy use in buildings. In some countries, the built environment accounts for about 40% of the energy used. Therefore, there is an imperative for the industry to develop sustainable building technologies and green buildings.

The construction industry in India is growing rapidly at a rate of 10% compared with the world average of 5.2%. It is observed that buildings in India consume about 20% of the total electricity in the country. Hence, real estate activity in India has a significant impact on the environment and resources. This indicates that there is a real opportunity to develop green buildings in the country.

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II. LITERATURE SURVEY

A Green building should create delight when entered, serenity and health when occupied and regret when departed' – Perhaps this is one of the most inspiring definitions of a Green building, articulated in the book 'Natural Capitalism'. A green building uses less energy, water and non-renewable natural resources, creates less waste and is healthier for the people living inside compared to a standard building. Green Building concept is essentially the increase of efficiency with resources for building activity, which includes energy, waste and materials. An attempt is made to reduce the building impact on the environment and health through better sustainable sites, sustainable architecture, sustainable development and integration of energy conservation. This goes in a long way in the ultimate goal for controlling the global warming and reduction of carbon emissions. A few case studies have been taken into consideration for generalizing and application of the same to one of the investigations. The process highlights the tangible and intangible benefits reaped through the holistic and integrated development ushering in a new era in the way building construction is practiced. The appearance of a Green Building will be similar to any other building. However, the difference is in the approach, which revolves round a concern for extending the life span of natural resources; provide human comfort, safety and productivity. This approach results in reduction in operating costs like energy and water, besides several intangible benefits.

Some of the Salient Features of a Green Building are:

- Minimal disturbance to landscapes and site conditions:
- Use of Recycled and Environmental Friendly Building Materials.
- Use of Non-Toxic and recycled/recyclable Materials.
- Efficient use of Water and Water Recycling.
- Use of Energy Efficient and Eco-Friendly Equipment.
- Use of Renewable Energy.
- Indoor Air Quality for Human Safety and Comfort.
- Effective Controls and Building Management Systems.

Why we make Green Building?

The environmental impact of the building design, construction and operation industry is significant. Buildings annually consume more than 20% of the electricity used in India. Development shifts land usage away from natural, biologically-diverse habitats to hard scope that is impervious and devoid of biodiversity. The far reaching influence of the built environment necessitates action to reduce its impact. Green building practices can substantially reduce or eliminate negative environmental impacts and improve existing unsustainable design, construction and operational practices. As an added benefit, green design measures reduce operating costs, enhance building marketability, increase worker productivity and reduce potential liability resulting from indoor air quality problems. Studies of workers in green buildings reported productivity gains of up to 16%, including reductions in absenteeism and improved work quality, based on "people-friendly" green design. In other words, green building design has environmental, economic and social elements that benefit all building stakeholders, including owners, occupants and the general public.

Why people are attracted towards Green Building-This question has been posed to several occupants of a green building. Of all the many reasons, three top reasons often cited by those occupying these buildings are the following:

Operational Savings: Green Buildings consume at least 40-50 % less energy and 20-30 % less water vis-à-vis a conventional building. This comes at an incremental cost of about 5-8%. The incremental cost gets paid back in 3-5 years' time.

Daylights & Views: Working in environment with access to daylight and views provides connection to the exterior environment. This has a soothing effect on the mind. Various studies prove that the productivity of people who have access to day lighting and views is at least 12% -15 % higher.

Air Quality: Green buildings are always fresh and healthy. Every Green Building will have to purge continuous fresh air to meet the ASHRAE 62 requirements. The green buildings use interior materials with low volatile organic compound (VOC) emissions.

Benefit of Green Building

A Green Building can have tremendous benefits, both tangible and intangible. The immediate and most tangible benefit is in the reduction in operating energy and Water costs right from day one, during the entire life cycle of the building. The Energy savings could range from 25– 40 % depending on the extent of green specifications. Other tangible savings would be reduction in first costs and enhanced asset value. Intangible benefits of Green Buildings include increasing productivity of occupants' health, safety benefits and a green corporate image. Several Corporate are now seeing Green Building Rating as a tool to enhance marketability.

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THE INSTITUTIONAL FRAMEWORK FOR GREEN BUILDINGS IN INDIA

Over time, ratings systems have developed that classify green buildings according to their performance on a number of set parameters. The first and most widely used ratings system internationally is the American “Leadership in Energy and Environmental Design” (LEED) system. In India, the IGBC has adapted LEED to create LEED India and is responsible for certifying buildings under this system. At present, IGBC offers two certifications for office buildings. They are as follows

Indian Green Building Council (IGBC): Indian Green Building Council (IGBC) is a part of CII-Godrej Green Business Centre, which is actively involved in promoting the Green Building movement in India. The council is represented by all stakeholders of construction industry comprising of corporate, government & nodal agencies, architects, product manufacturers, institutions, etc. The council is industry-led, consensus-based and member-driven. The vision of the council is to serve as single point solution provider and be a key engine to facilitate all Green Building activities in India.

8.1.1 IGBC:

IGBC rates green buildings in four different categories:

1. IGBC GreenFactory Building
2. LEEDIndiaforNew Construction
3. LEED India for Core and Shell
4. IGBC Green Homes

GRIHA

GRIHA - Green Rating for Integrated Habitat Assessment

GRIHA is India’s National Rating System for Green buildings. It has been developed by TERI (The Energy and Resources Institute) and is endorsed by the MNRE (Ministry of New and Renewable Energy). It is based on nationally accepted energy and environmental principles, and seeks to strike a balance between established practices and emerging concepts, both national and international. GRIHA attempts to minimize a building’s resource consumption, waste generation, and overall ecological/environmental impact by comparing them to certain nationally acceptable limits / bench marks. It does so, adopting the five ‘R’ philosophy of sustainable development, namely

- Refuse** – to blindly adopt international trends, materials, technologies, products, etc. Especially in areas where local substitutes/equivalents are available
- Reduce** – the dependence on high energy products, systems, processes, etc.
- Reuse** – materials, products, traditional technologies, so as to reduce the costs incurred in designing buildings as well as in operating them.
- Recycle** – all possible wastes generated from the building site, during construction, operation and demolition.
- Reinvent** – engineering systems, designs, and practices such that India creates global examples that the world can follow rather than us following international examples
- Going by the old adage ‘**What gets measured, gets managed**, GRIHA attempts to quantify aspects, such as:
Energy / power consumption (in terms of electricity consumed in kWh per square meter per year)

III. OBSERVATIONS

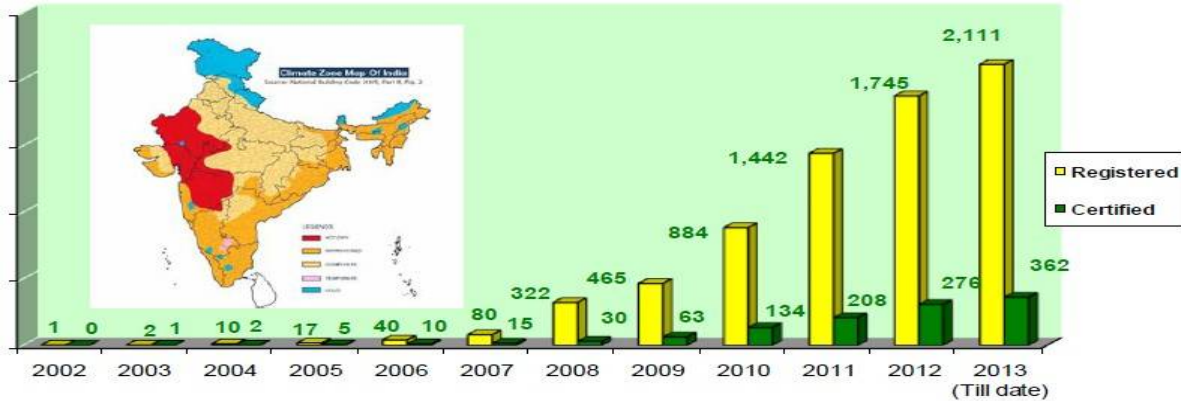
The green building movement in India started with the establishment of the IGBC in 2001, which was an initiative of the Confederation of Indian Industries (CII) along with the World Green Building Council and the USGBC. The first green building in India, CII-Sohrabji Godrej Green Business Centre in Hyderabad, was inaugurated on 14 July 2004. This was a great symbolic achievement. Since then, the number and volume of green buildings in India has been phenomenal. There was 20,000 sq.ft in 2004 and has grown exponentially, with an expected green building footprint of 15 million sq.ft by end-2008. There are 18 LEED certified buildings with a total area of about 8.5 million sq.ft and 195 projects registered for LEED certification with a total area of about 110 million sq. ft as of Fig 9.1 LEED Certified Building foot print in India year-end 2007.

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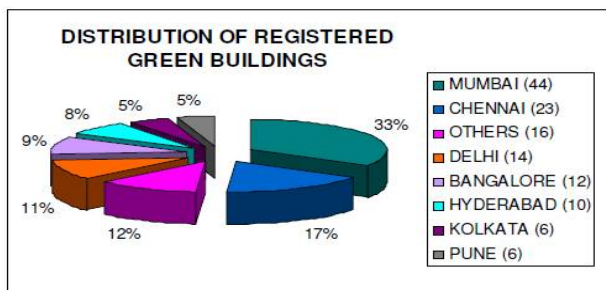
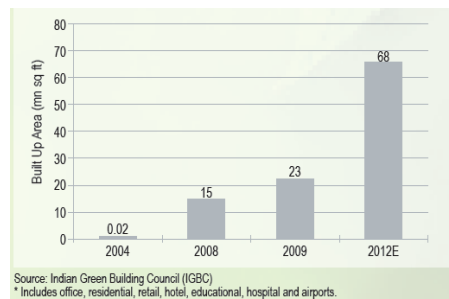
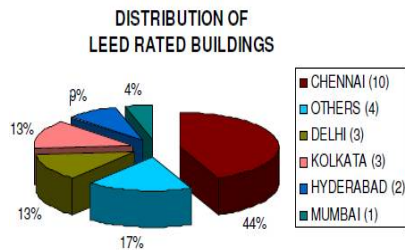
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Green buildings occupy a small but growing share of the Indian real estate market. At present, there are 187 LEED certified projects and another 1350 projects that have been registered with IGBC for possible certification at a later date. Including registered and certified space, IGBC reports a total of 857 million square feet (msqft) of LEED green buildings in 2011 including airports, hospitals and factories. To date 124 buildings are being evaluated for GRIHA and 8 have been certified. The following graph shows the number of green buildings registered with LEED India during 2004-2012.

The **LEED registered** Green buildings are more in Mumbai .



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The interesting thing to be noted is that the number of **LEED rated** buildings is the least in Mumbai. Chennai has the maximum number of LEED Rated Green Buildings.

The Main Players in Indian Green Construction Sector

Broadly speaking, the main players in the Indian green building space are **developers, investors and tenants**. **Developers** ultimately take the decision to build green buildings and may do so for various reasons including responding to market demand from tenants. Once built, some developers hold the building themselves, but increasingly commercial buildings are sold to an **investor** who will then earn rent from leasing the property to tenants.

Tenants may play an active or passive role in the green building market. Some, such as Novartis, drive the market in that company policy requires them to occupy a certain grade of green building. Other tenants are more passive, occupying green buildings as a matter of preference but not requirement, or as a condition secondary to location or rent.

The main stake holders in the green initiatives are :

- Architects
- Students
- Government
- Consultants
- Developers
- Public
- Manufacturers and contractors

IV. EXPERIMENTAL RESULTS WITH TABLES/ GRAPHS/ FIGURES

There is a cost premium in developing green buildings in some cases. The benefits discussed above highlight the economics of green buildings in a broad sense. However, to come up with the cost-benefit analysis of each and every green building, the general criteria cannot be applied. The cost-benefit analysis of any individual building must take into account the following: LEED certification level and corresponding credit points of the building; Investment required to attain each credit; Operational cost savings; Revenue-generation opportunities. Thereafter, a cash flow analysis can be conducted to calculate the payback period and hence, the ROI. It is highly improbable that a building will match the LEED credits of another building as no two buildings are the same. Even if they do, the Systems and processes deployed to achieve a particular credit can differ. Hence, it is extremely difficult to develop a generic cost-benefit analysis for green buildings.

BENEFIT MEASUREMENT AND VALUATION

WATER

Step 1 - Quantification of Benefit:

Reduced Storm water Runoff

The first step in valuing the water benefits from green infrastructure is to determine the volume of rainfall (in gallons) retained on site; this volume becomes the resource unit for all water benefits. When working through the calculations, keep in mind that some of the ranges given are based on the compilation of multiple cases studies and there may be more site- specific numbers to plug into the given equations. Where possible, the guide will suggest strategies for determining site-specific information. Practices that provide water benefits include green roofs, permeable pavement, bioretention and infiltration, trees and water harvesting.

Green Roofs: To quantify the storm water runoff retained from green roofs, it is necessary to know the following information:

- Average annual precipitation data (in inches) for the site
- Square footage of the green infrastructure feature
- Percentage of precipitation that the feature can retain

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The highly site-specific variables influencing the percentage of annual rainfall that a green roof is capable of retaining, listed below, are important considerations:

- The most important variable influencing the runoff reduction performance of the green roof is the depth of the growing media. The deeper the roof, the more water retained in the media.
- The growing media's antecedent moisture content will influence stormwater retention for any given storm event. This means that irrigation practices and storm frequency affect overall performance.
- Local climate variables also influence stormwater retention performance. For example, hotter, less humid climates lead to less antecedent moisture and more storm water retention capacity.
- All else being equal, flat roofs retain more stormwater than sloped roofs.

Size and distribution of storm events affect total stormwater retention. For example, holding the retention rate and annual precipitation constant, a green roof in a place with many small storms retains a greater percentage of the total rainfall than a green roof in a place with fewer, larger storms.

The following equation relies on two conversion factors. The 144 sq inches/square foot (SF) will convert the precipitation over a given area into cubic inches. Then, the factor of 0.00433 gal/ cubic inch (i.e. the number of gallons per cubic inch) will convert that volume of precipitation into gallons, which is needed to quantify the amount

$$\begin{aligned} &[\text{annual precipitation (inches)} * \text{GI area (SF)} * \\ &\% \text{ retained}] * 144 \text{ sq inches/SF} * 0.00433 \text{ gal/cubic inch} \\ &= \text{total runoff reduction (gal)} \end{aligned}$$

of runoff reduced. Empirical studies of green roof storm water retention performance have found that green roofs can retain anywhere from 40 to 80 percent of annual precipitation.

Tree Planting: Water interception estimates, determined on a per tree basis, are needed to calculate the amount of storm water runoff reduced from a given project. Therefore, it is necessary to know the number of trees being planted and their size and type. For example, the larger leaf surface area on one kind of tree will intercept more rainfall than will a smaller tree or leaf. In addition, the rate at which trees intercept rainfall is significantly impacted by a site's climate zone, precipitation levels and seasonal variability, which affects evapotranspiration rates.

$$\begin{aligned} &\text{number of trees} * \\ &\text{average annual interception per tree (gal/tree)} \\ &= \text{total runoff reduction (gal)} \end{aligned}$$

Bio retention And Infiltration: Well-designed bio retention and infiltration features capture all or nearly all of the precipitation which falls on the feature and its related drainage area. However, in an urban context, the percentage of rainfall that these features can accommodate depends on available square footage and locally determined maximum ponding times. Determining a more site-specific performance measure requires complex hydrological modeling. The equation for determining the capacity of a bio retention feature requires the following information:

- Area and depth of the bio retention feature
- Relevant drainage area contributing runoff to the infiltration area
- Average annual precipitation data (in inches)
- Expected percentage of retention

These variables also affect the feature's retention percentage:

- Rainfall amount and distribution
- Site irrigation practices
- Temperatures and humidity
- Soil infiltration rate (based on soil type)

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$$\begin{aligned}
 &[\text{annual precipitation (inches)} * (\text{feature area (SF)} + \\
 &\text{drainage area (SF)}) * \% \text{ of rainfall captured}] * \\
 &144 \text{ sq inches/SF} * 0.00433 \text{ gal/cubic inch} \\
 &= \text{total runoff reduction (gal)}
 \end{aligned}$$

The following equation provides a simplified estimate of the potential volume of runoff captured using bio retention and infiltration practices:

To quantify the water retained from permeable pavement, it is necessary to know the following information:

- Average annual precipitation data (in inches) for the site
- Square footage of the green infrastructure feature
- Percentage of precipitation that the feature is capable of retaining

To find a more site-specific percentage, the following factors must be considered:

- Slope of the pavement – flat surfaces typically infiltrate more water
- Soil content & aggregate depth below pavement
- Size and distribution of storm events
- Infiltration rate
- Frequency of surface cleaning

The following equation quantifies the total amount of runoff that a given permeable pavement installation can reduce annually. As with the bio retention and infiltration calculations, the percentage of rainfall that these

$$\begin{aligned}
 &[\text{annual precipitation (inches)} * \text{GI area (SF)} * \\
 &\% \text{ retained}] * 144 \text{ sq inches/SF} * 0.00433 \text{ gal/cubic inch} \\
 &= \text{total runoff reduction (gal)}
 \end{aligned}$$

features can accommodate depends on available square footage and locally determined maximum ponding times
Water Harvesting: Benefits from water harvesting are based on the volume in gallons of storm water runoff stored onsite. To determine this volume, the following information is necessary:

- Average annual precipitation data (in inches)
- Rainfall intensity
- Size of the water-collecting surface (in square feet)
- Capacity for temporary water storage and release
- Frequency of harvested water use for building needs, irrigation or evaporative cooling (e.g. whether the captured rainwater is used before a subsequent rain event)

Applying the following formula provides a basic understanding of how much rainwater could be captured by this practice, both for site specific measurement as well as a cumulative calculation across a community or region

Step 2 - Valuation of Quantified Benefits: Reduced Storm water

$$\begin{aligned}
 &\text{annual rainfall (inches)} * \text{area of surface (SF)} * \\
 &144 \text{ sq inches/SF} * 0.00433 \text{ gal/cubic inch} * \\
 &0.85 \text{ collection efficiency} \\
 &= \text{water available for harvest (gal)}
 \end{aligned}$$

Runoff: The valuation process in the “Water” section is divided into the following four subsections and outlines each separately:

- Reduced Water Treatment Needs
- Reduced Grey Infrastructure Needs
- Improved Water Quality

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- Reduced Flooding

Methods for valuation will only be provided in the “Reduced Water Treatment Needs” and “Reduced Grey Infrastructure Needs” subsections. The other two sections discuss benefits and current research, but they do not present a formal valuation method, given the amount of varying factors required to value these benefits.

Reduced Water Treatment Needs:For cities with combined sewer systems (CSS), storm water runoff entering the system combines with wastewater and flows to a facility for treatment. One approach to value the reduction in storm water runoff for these cities is an avoided cost approach. Runoff reduction is at least as valuable as the amount that would be spent by the local storm water utility to treat that runoff.

Reduced Grey Infrastructure Needs:Green infrastructure practices can reduce the volume of water needing treatment as well as the level of treatment necessary. Therefore, utilizing these practices can reduce the need for traditional or grey infrastructure controls for storm water and combined sewer overflow (CSO) conveyance and treatment systems, including piping, storage and treatment devices. Similar to the approach taken in other sections of this guide, the value of reducing grey infrastructure derives from the benefits transfer method of avoided costs resulting from the use of green infrastructure. While the case studies below give examples of how these costs can be compared, it is beyond the scope of this guide to determine exact cost savings. This is due to the many site-specific variables that effect the monetary values involved, such as soil types, rainfall distribution patterns, peak flow rates and local materials costs.

Improved Water Quality:Using green infrastructure for storm water management can improve the health of local waterways by reducing erosion and sedimentation and reducing the pollutant concentrations in rivers, lakes and streams. These effects, in turn, lead to improved overall riparian health and aesthetics—indicators of improved water quality and channel stabilization.

The impacts of green infrastructure on water quality, while well documented, are too place- specific to provide general guidelines for measurement and valuation. The water quality improvements associated with green infrastructure, furthermore, are not of sufficient magnitude to be meaningful at the site scale. This benefit, therefore, is best evaluated in the context of watershed-scale green infrastructure implementation, accompanied by hydrologic modeling, to estimate changes in sedimentation and pollutant loads resulting from a green infrastructure program.

Regulators measure water quality in a variety of ways. Damaging pollutants carried by storm water runoff typically include nitrogen, phosphorous and particulate matter. Water quality monitors can measure concentrations of dissolved nitrogen and phosphorous, as well as total suspended solids (TSS), usually in milligrams per liter. In economic valuations, water *clarity* is often used as a proxy measure for water *quality*. While only an approximate measure, water clarity strongly correlates with the presence of phosphorous, nitrogen and TSS pollution. Suspended particulates directly decrease water clarity, while high concentrations of nitrogen and phosphorous lead to eutrophication—a process whereby increased nutrients in waterways lead to algae blooms which cloud the water and decrease dissolved oxygen. In extreme cases, eutrophication can lead to hypoxic conditions, characterized by the absence of sufficient oxygen to support any animal life. Water clarity is typically measured using the Secchi disk test, in which a black and white patterned disk is lowered into the water until no longer visible; this depth is considered the water clarity depth.

Reduced Flooding:By reducing the volume of storm water runoff, green infrastructure can reduce the frequency and severity of flooding. The impact of green infrastructure on flooding is highly site and watershed specific, and thus this guide does not provide general instructions for quantifying the reduction in flood risk resulting from a green infrastructure program. There are several ways to assess the value of reduced flood risk provided by green infrastructure practices on a watershed-scale once the risk impacts have been modeled. Some studies use hedonic pricing to examine how flood risk is priced into real estate markets; others use the insurance premiums paid for flood damage insurance as a proxy for the value of reducing the risk of flood damage; others take an avoided damage cost approach and still others have employed contingent valuation methods. The most robust literature on the economic valuation of flood risk uses hedonic pricing methods to investigate the housing price discount associated with floodplain location. Most of these studies estimate the impact on residential home prices of locations inside or outside of the 100-year floodplain. Those considering implementing a green infrastructure program

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who are able to model resulting changes in floodplain maps—in particular, to identify the area where annual flood risk is greater than one percent and can be reduced to less than one percent through the use of green infrastructure—can apply the results of these studies to get an estimate of the range of value provided by green infrastructure's flood risk reduction impact.

Green concept in Hyderabad:

Though the concept of 'green buildings' has been around for some years, most constructions in the city are conventional. This is largely due to the 'myth' that the former is costlier affair. Conventional builders do not want to professionalise the designing process of architecture, water management, energy management etc. The future of real estate strongly associates with 'Green Buildings'. Despite the fact that almost all real estate developers acknowledge it, only a handful of them are able to follow. Launching a green project, from a real estate developer's perspective, is commercially unviable and thus not necessary. And they are right to a large extent. Since green projects require a relatively higher level of initial capital expenditure, developers find it difficult to go ahead unless they are supported by meaningful incentives from the government. Recognising the role of local bodies in promoting environmental-friendly practices in real estate development, the Greater Hyderabad Municipal Corporation (GHMC) has taken steps in the right direction. The Corporation is providing 10 per cent concession on property tax on using solar water heating equipment. Furthermore, an additional concession of 10 per cent is granted on developing water harvesting infrastructure. The Corporation has also reduced the impact fee for developers who adopt environment-friendly practices in their projects. Nevertheless, Hyderabad has always been a centre of excellence in terms of green buildings. The CII-Sohrabji Green Business Centre is one of the few buildings, which was awarded the 'platinum' rating by the Leadership in Energy and Environmental Design (LEED) way back in 2004. It was the greenest building in the world in that era. Today, more than 20 buildings are certified by LEEDs in Hyderabad. Although the number of green buildings is growing steadily, there is a lot to be done vis-à-vis India's global footprint in this segment – and Hyderabad looks like a torchbearer indeed.

The effective rent for green buildings is higher

There are some differences being observed in the rental market for green and non-green buildings. Green building investors are able to lease their buildings to tenants quicker and with better covenants. Vacancy is also reportedly lower.

These factors impact the valuation of the building because they change the effective rent. For example, if a green and non-green building both lease at a rent of Rs. 32 psqft but the green building is able to lease the building three months faster than the non-green property, the effective rent for the green building over the life of the lease is Rs. 32.80 psqft. This rate is effectively a 2.5 percent premium on the market rent which results in an increased valuation of about 2 percent. This implicit premium will only be observed if there is an increase in demand for green over non-green buildings. Non-green buildings may be forced to give additional discounts to attract tenants in this scenario.

Developers choosing to build green

A positive reaction to green buildings is being reflected in a significant portion of new and pipeline projects being registered with the IGBC. As discussed above, many of the larger developers who represent a significant share of the real estate market are committed to building green.

Owners choosing to build green

Higher re-sale price is one. The prospect of energy-efficient mortgages is enticing too. Besides, superior air quality within the house, enhanced comfort and perceptibly lower utility costs make it a hard-to-refuse proposition.

Benefit of builders

The quality of green buildings far exceeds that of traditional construction. This gives builders an edge over their competitors. Besides the competitive advantage, higher quality construction ensures reduced call-backs and warranty claims. Moreover, there's perceptibly less construction waste in addition to reduced labour and material costs and lower purchase cost of construction equipment.

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Valuation vs. worth

Professional valuers must rely on rental values and other information that is available at the time of valuation and hence are not valuing green buildings differently than their non-green counterparts. However, investors may assign a higher worth to green buildings if they factor in their expectations of higher rent or lower reversionary rate. Moreover, current valuation techniques rely heavily on rental values and do not factor in changes in operating costs which are in fact quite significant. The analysis below compares the net present value (NPV) of the electricity and maintenance costs of two offices in Mumbai where one is LEED Gold certified and the other is a traditional building.

It is found that electricity and maintenance costs are 149 and 12 percent more respectively over the lifetime of the

	Electricity (NPV)	Maintenance (NPV)
Green	83	159
Non-Green	208	179
Savings	149%	12%

Source: IDFC Internal building data, IDFC analysis

Assumptions: We assume that all costs will escalate at 5 percent a year. We use a discount rate of 10 percent over a 10 year lease period.

Comparison of net present value (NPV) of expenditure in green vs non-green office (Rs/sqft)

traditional asset. Water costs are included in maintenance. Annually, electricity costs are 0.9 percent of total rental for a non-green building versus 0.3 percent for a green building. Therefore, new valuation techniques are developing to reflect the often large operating savings.

V. CONCLUSION

The concept of developing green buildings is envisaged as a voluntary action. Hence, the Government was unable to take any proactive action to make the development of green buildings mandatory. However, it has launched the Energy Conservation Building Code (ECBC) under the National Building Codes and Standards. This code is voluntary and is applicable to buildings or building complexes that have a connected load of 500 KW or a contract demand of 600 KVA, whichever is greater. This code addresses the minimum performance standards for a building's energy efficiency, which cover building envelope, Mechanical systems and equipment, service hot water heating, interior and exterior lighting and electrical power and motors. This is an excellent initiative, which will enable the design of high performance buildings. However with the growing awareness on sustainability within India, competency among consultants in the construction and real estate industry will increase. This will in turn facilitate developers with their professional support. As the green building phenomenon grows in India, concerns about the availability of information and local materials will eventually improve. However, the prospect of a recession in the real estate sector and the need to modify the green building criteria to suit local standards can still cast a shadow of uncertainty over the development of green buildings.

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