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***Prof. Singh has vast experience in guiding PhD scholars, and numerous publications to his credit.***

# **Designing green buildings for all: understanding cost barriers to ensure effective implementation**

**Theme: Examining cost of green buildings to ensure effective implementation**

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## ***Abstract***

**Resource efficient buildings are key to mitigating the impacts of climate change. While the science of green buildings is well established, policy and market mechanisms exist, and awareness amongst masses is increasing, there is still a need to ensure effective on ground implementation and compliance with relevant codes, standards, and policies. The perception about green buildings being more expensive is one of the main barriers in widespread adoption of the concept.**

**The challenge is eminent especially in residential buildings where the incremental costs (if any) are borne by the private developers while the recurring benefits of lower operating costs are accrued by the occupants. This split incentive (where the economic benefit of going green is not accrued by the developer but passed on to occupants who have not paid additional money due to market competitiveness) has been addressed by 17 States and Union Territories across India, where various mechanisms including**

revision of building byelaws, mandatory compliance, financial incentives, and ground coverage and FAR benefits have been announced for the private sector. Subsequently, the States of Haryana, Uttar Pradesh and Maharashtra have been leading in green building construction, and availing incentives announced by the respective government departments.

Using a case study of residential development from Greater Noida, this paper identifies the incremental cost of executing a green residential project and the role of incentives in offsetting any additional cost.

**Keywords:** *Green buildings, cost, lifecycle cost of buildings, green building policies*

## **Introduction**

India's Intended National Determined Contribution (INDC) under the Paris Agreement (2015) include key commitments towards (i) reduction in the emissions intensity of GDP by 33 to 35 per cent by 2030 from 2005 level, (ii) 40% of power capacity to be based on non-fossil fuels and (iii) creating an additional carbon sink of 2.5 to 3 billion tonnes of CO<sub>2</sub> equivalent through added forest and tree cover by 2030. <sup>(17)</sup>

The India Second Biennial Update Report to the United Nations Framework Convention on Climate Change, states that (i) the emission intensity of India's Gross Domestic Product (GDP) has reduced by 21% over the period of 2005 – 2014, (ii) by March 2018, 35% of power capacity is based on no-fossil fuels, and (iii)

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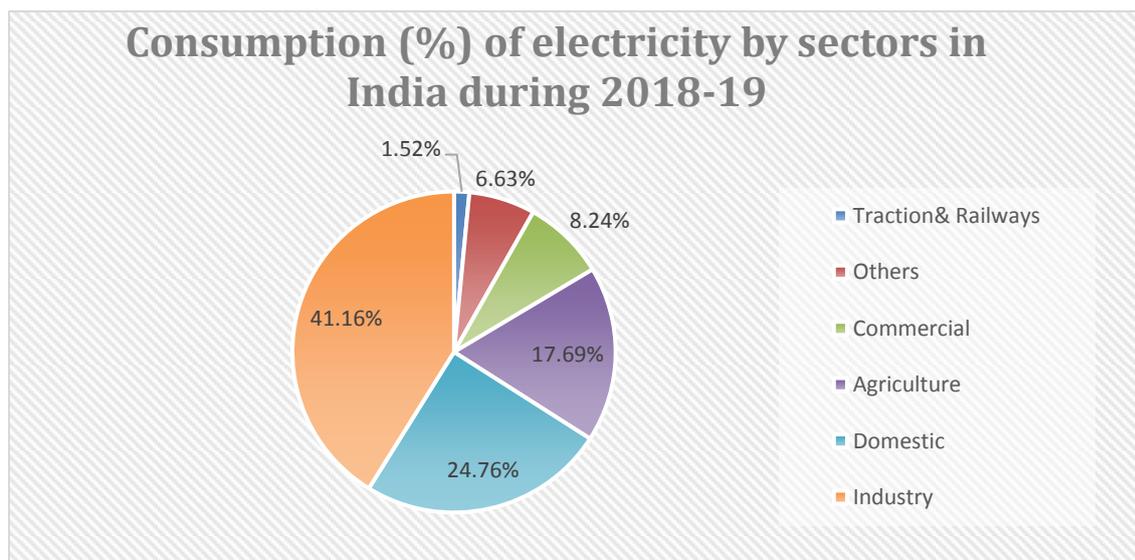
<sup>(17)</sup> *India NDC. INDCs as communicated by Parties. United Nations Framework Convention on Climate Change. [Online] 1 October 2015. <https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf>.*

emissions avoided by forest cover fall by more than half between 2010-14, where tree cover doubles in the same period.<sup>(18)</sup>

The progress by India has also been acknowledged by the United National Environment Program (UNEP) in its Emission Gap Report 2016, where India has been recognized for being on course for achieving its voluntary goals, without purchasing offsets.

Resource efficient buildings are key to mitigating the impacts of climate change.

While India's INDC are not binding to sector specific mitigation obligation or action, the goal is to reduce overall emission intensity, improve energy efficiency of the economy over time, and protect vulnerable sectors of economy and segments of society. Key priority areas identified for achieving India's INDCs include, "promoting energy efficiency in the economy, notably in industry, transportation,



**Figure 1: Total consumption of electricity by sectors in 2018-19**

<sup>(18)</sup> Ministry of Environment, Forest and Climate Change, Government of India. *Second Biennial Update Report to the United Nations Framework Convention on Climate Change. United Nations Framework Convention on Climate Change. [Online] December 2018. MoEFCC. (2018). India: Second Biennial Update Report to the United Nations Framework.*

buildings and appliances".<sup>(19)</sup>

Considering the above achievements and given the fact that domestic and commercial sectors consume about 33% of electricity<sup>(20), (21)</sup> in India (Figure 1<sup>(22)</sup>), it can be concluded that the building sector has played a key role in progress towards achieving the INDCs. This has been accomplished through a definite plan of action for clean energy and energy efficiency in various sectors, with key focus on implementation of policies through green building rating systems and other mechanisms.

As per Graham and Rawal<sup>(23)</sup> and TERI<sup>(24)</sup>, the role of the building sector (residential and commercial) in meeting India INDC targets for 2030 will be further significant. Electricity demand in residential and commercial buildings sectors is predicted to rise by 5 folds and 3 folds respectively by 2032<sup>(25)</sup>. Furthermore, energy efficiency in the building sector is likely to be the largest contributor (after industry) in further reduction of emissions intensity of Indian GDP by 2031.

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<sup>(19)</sup> See reference 1.

<sup>(20)</sup> Ministry of Statistics and Programme Implementation, Government of India. Ministry of Statistics and Programme Implementation. Energy Statistics 2019. [Online] March 2019.

[http://www.mospi.gov.in/sites/default/files/publication\\_reports/Energy%20Statistics%202019-finall.pdf](http://www.mospi.gov.in/sites/default/files/publication_reports/Energy%20Statistics%202019-finall.pdf).

<sup>(21)</sup> Bureau of Energy Efficiency, Government of India. Report on Impact of Energy Efficiency Measures for the year 2018-19. Bureau of Energy Efficiency, Government of India. [Online] March 2020.

[https://beeindia.gov.in/sites/default/files/BEE%20Final%20Report\\_1.pdf](https://beeindia.gov.in/sites/default/files/BEE%20Final%20Report_1.pdf).

<sup>(22)</sup> Central Electricity Authority, Ministry of Power, Government of India. Growth of Electricity Sector in India from 1947-2019. Central Electricity Authority. [Online] May 2019.

[http://www.cea.nic.in/reports/others/planning/pdm/growth\\_2019.pdf](http://www.cea.nic.in/reports/others/planning/pdm/growth_2019.pdf).

<sup>(23)</sup> Achieving the 2°C goal: the potential of India's building sector. Graham, Peter and Rawal, Rajan. 2018, Building Research & Information.

<sup>(24)</sup> The Energy and Resources Institute (TERI). Energy Efficiency Potential in India. Indo German Energy Forum. [Online] August 2018.

[https://www.energyforum.in/fileadmin/user\\_upload/india/media\\_elements/publications/09\\_Energy\\_Efficiency\\_Potential\\_in\\_India.pdf](https://www.energyforum.in/fileadmin/user_upload/india/media_elements/publications/09_Energy_Efficiency_Potential_in_India.pdf).

<sup>(25)</sup> See reference 5

Policy mechanisms and incentives for green buildings exist.

Various ministries including the Ministry of Power (including Energy Efficiency Services Limited (EESL) and Bureau of Energy Efficiency (BEE)), the Ministry of New and Renewable Energy, the Ministry of Housing and Urban Poverty Alleviation (including the Central Public Works Department (CPWD), Bureau of Indian Standards (BIS)), and the Ministry of Environment, Forests and Climate Change have played a crucial role in designing policies and incentives for projects to incorporate resource efficiency through green building rating systems, in turn meeting India's INDCs (Figure 1).



**Figure 1: Green building policy framework instituted by the Government of India; Source: Priyanka Kochhar**

**Table 1: GRIHA linked incentives at State and Municipal levels to achieve national goals and international commitments; Compiled by Priyanka Kochhar from information available at (26) and other State/ Municipal body websites**

S.No	State	Year	Type of incentive	Municipal Body	Description
1	Andhra Pradesh	2017	Financial incentives	Municipal Administration and Urban Development Department	Urban local bodies shall provide following incentives to projects that follow "Andhra Pradesh Energy Conservation Building Code (APECBC) and are GRIHA/IGBC/ LEED India rated buildings: (a)20% Reduction on permit fees. (b)Payment of impact fee and development charges to be paid in four equal instalments before the completion period of the construction as given in the building permit order. (c)If the property is sold within three years, one-time reduction of 20% on duty on transfer of property.
		2015	Financial incentives	Industries and Commerce Department	Industrial Development Policy 2015-2020 promotes adoption of sustainable green measures across industries. The State Government will provide 25% subsidy of total fixed capital investment of the project (excluding cost of land, land

<sup>(26)</sup> **GRIHA India. GRIHA Incentives. GRIHA India. [Online]**  
<https://www.grihaindia.org/griha-incentive>.

					development, preliminary and pre-operative expenses and consultancy fees) for the industries that obtain GRIHA rating with a ceiling of INR 50 crore. 25% subsidy on total fixed capital investment of the project (excluding cost of land, land development, preliminary and preoperative expenses and consultancy fees) for buildings which obtain green rating from GRIHA/LEED/IGBC. This incentive is applicable for MSME and large industries.
2	Delhi	2013	Ground coverage and FAR incentive	Delhi	Delhi Development Authority to provide free of cost 1% to 5% extra ground coverage and FAR for GRIHA projects of more than 3000 sqm plot size. In case of non compliance of above after obtaining occupancy certificate, penalty at market rate to be levied for incentive FAR by land owning agency.
3	Chandigarh	2015	Mandatory compliance	Chandigarh Administration	Chandigarh Administration has adopted CWPD guidelines for placing minimum three star GRIHA rating in all public building in future
4	Goa	2019	Mandatory compliance	Department of Town &	TCP Board in its 163rd meeting held

				<b>Country Planning</b>	<b>on Monday evening approved Green Building concept, which will come into force from January 1, 2019. Government has decided to tie up with Indian Green Building Council (IGBC) and The Energy and Resources Institute (TERI) to set up guidelines. Government buildings, commercial projects and hotels with built up area of more than 2000 sq metres will compulsory have to go green.</b>
<b>5</b>	<b>Gujarat</b>	<b>2017</b>	<b>Additional FAR/ FSI incentive</b>	<b>Urban Development and Urban Housing Department</b>	<b>The Gujarat Comprehensive Development Control Regulations-2017 shall apply to the land development and building construction in the entire state. The Competent Authority shall offer some incentives in the rate of chargeable FSI for rating certified green buildings as 5% discount in the total payable amount (the owner shall have to apply for GRIHA rating certification prior to commencement of the project).</b>
		<b>2015</b>	<b>Financial incentives</b>	<b>Industry and Mines Department</b>	<b>Scheme for assistance to encouraging green practice and environmental audit</b>

					to MSME. Industrial buildings of more than 2000 sqm built up area with green rating under GRIHA/IGBC/LEED can get up to 50% of consulting charges or 2.5 lacs, whichever is less.
		2015	Additional FAR/ FSI incentive	Ahmedabad Urban Development Authority	Comprehensive Development Plan 2021 lists out the various regulations for procedure, planning and performance to regulate buildings. The Competent Authority shall offer some incentives in the rate of chargeable FSI for rating certified Green buildings as 5% discount in the total payable amount (the owner shall have to apply for GRIHA rating certification prior to commencement of the project).
6	Haryana	2019	Mandatory compliance	Haryana Renewable Energy Development Agency	The city has issued G.O as regards to construction of Green buildings in compliance with approved National Rating Systems like GRIHA particularly in Government/PSUs buildings.
		2017	Additional FAR/ FSI incentive	Department of Town and Country Planning	The Haryana Building code 2017 incentivizes GRIHA/IGBC/LEED rated projects. Buildings with 1star

					to 5 star GRIHA shall be eligible for 3%, 6%, 9%, 12% and 15% additional FAR respectively, and buildings with Silver, Gold or Platinum by LEED/IGBC shall be eligible for 9%, 12% and 15% additional FAR. The applicant has to pay only Infrastructure Development Charges on additional FAR granted as incentive.
7	Himachal Pradesh	2017	Additional FAR/ FSI incentive	Town and Country Planning Department	Additional 10% FAR for projects which are granted Gold / Platinum rating by IGBC and Four Star/ Five Star by GRIHA Council.
8	Jharkhand	2017	Additional FAR/ FSI incentive	Urban Development and Housing Department	Depending on the level of rating achieved, GRIHA/IGBC rated projects of all building uses (except plotted residential) shall be awarded additional FAR up to 7%.
9	Kerala	2011	Mandatory compliance	Public Works Department	GRIHA/ LEED mandatory for all government projects, and private projects (other than residential buildings with plinth area less than 500Sq.m) to go for GRIHA certification. Small residential buildings may get rated by SVA GRIHA or IGBC Green Homes.
10	Maharashtra	2018	Financial incentives	Urban Development	2.5% to 7.5% rebate in development

				<b>Department</b>	<b>charges for developers with projects availing 3 Star, 4 Star, 5 Star GRIHA rating or Silver, Gold, Platinum LEED rating from GBCI. The consumers will be eligible for a property tax rebate between 5% to 10% for the same levels of green ratings.</b>
		<b>2017</b>	<b>Additional FAR/ FSI incentive</b>	<b>Urban Development Department</b>	<b>Pune Municipal Corporation (PMC) and Pune Metropolitan Region Development Authority (PMRDA), Government of Maharashtra provide additional FAR of 3%, 5% and 7% for Green Buildings rated as Silver, Gold and Platinum respectively by IGBC/GBCI, Three Star, Four Star, Five Star by GRIHA Council, 30-30-30/40-40-40/50-50-50 by EDGE respectively.</b>
		<b>2016</b>	<b>Mandatory compliance</b>	<b>Public Works Department</b>	<b>LEED/GRIHA or any other (i.e. including EDGE) to be followed for all new and existing (requiring major repairs) government buildings constructed by PWD Maharashtra.</b>
		<b>2015</b>	<b>Financial incentives</b>	<b>Pune Municipal Corporation</b>	<b>GRIHA/SVA GRIHA/IGBC rated project developers will get 5%,10%, 15% discount on the premium charges (payable to the</b>

					corporation) as per 3Star/ Silver, 4Star/ Gold, 5Star/ Platinum rating awarded by the GRIHA Council/IGBC.
		2011	Financial incentives	Pimpri Chinchwad Municipal Corporation	Incentives launched under MNRE scheme on "energy efficient solar/green buildings". As per the scheme, depending on the level of GRIHA/ SVA GRIHA rating, the project developer to avail discount in Premium between 10% to 50%. Additionally, occupants to avail property tax (between 5% to 10%) benefit based on the final rating.
11	Odisha	2018	Incentive as per State policy	Bhuvneshwar Development Authority (BDA)	LEED/GRIHA/IGBC have been incentivized as per applicable State Government policy In pursuance of the National Sustainable Habitat Mission on Energy Efficiency in Building, the Authority shall encourage for adoption of Leadership in Energy and Environmental Design (LEED) / Green Rating for Integrated Habitat Assessment (GRIHA), Indian Green Building Council (IGBC) and Energy Conservation Building Code (ECBC) (for Odisha ECBC Code and Guidelines - 2011 refer Annexure-

					<b>VI) rating certification for new and existing buildings. The incentive for the same would be based on applicable State Government policy as applicable from time to time.</b>
<b>12</b>	<b>Punjab</b>	<b>2018</b>	<b>Mandatory compliance</b>	<b>Department of Local Government</b>	<b>Integration of GRIHA/ LEED/ IGBC within "Punjab Municipal Building Bye-Laws 2018". Incentives applicable as per notification issued in 2016</b>
		<b>2016</b>	<b>Additional FAR/ FSI incentive</b>	<b>Department of Local Government</b>	<b>An additional 5% Floor Area Ratio (FAR) free of charge for projects which are rated Gold or above by IGBC/ Gold or Platinum by LEED/Four Star or above by GRIHA shall be eligible for 5% additional free of cost FAR incentive.</b>
		<b>2016</b>	<b>Mandatory compliance</b>	<b>Public Works Department</b>	<b>Wherever client department specifically requires, the building shall be planned and designed as a green building as per the standards of TERI-GRIHA Rating or Indian Green Building Council Rating system and the additional cost shall be included in the estimates.</b>
		<b>2013</b>	<b>Additional FAR/ FSI incentive</b>	<b>Department of Housing and Urban Development</b>	<b>An additional 5% free of charge FAR shall be permissible to buildings with relevant certificates from GRIHA. In case</b>

					the promoter fails to submit maintenance certificate after a period of every five years from the Competent Authority, the defaulter can be penalized at the rate of 200 percent of additional floor area ratio permitted.
13	Rajasthan	2019	Additional FAR/ FSI incentive	Urban Development Department	Projects achieving Platinum equivalent will be eligible for 15% free of cost extra BAR (Building Area Ratio), Gold equivalent for 10% free of cost extra BAR, and Silver equivalent for 7.5% free of cost extra BAR. If green building norms are not met, and the above BAR is built, then a "betterment tax" will be applicable on the extra BAR. During approval, development tax will be deposited for the extra BAR, which will be reimbursed on submission of IGBC/ GRIHA/ LEED rating documents.
		2015	Additional FAR/ FSI incentive	Department of Urban Development & Housing, Department of Local Self Government	Criteria for selection of partner in development of affordable housing projects in joint development agreement gives additional weightage to developers who have completed/ ongoing projects with IGBC/ GRIHA.

					<b>Additional FAR of 5% shall be provided in case of green building construction as per the provision of prevailing building byelaws subject to obtaining certification from the authorised agencies such as IGBC, LEEDS etc.</b>
		<b>2014</b>	<b>Additional FAR/ FSI incentive</b>	<b>Jaipur Development Authority</b>	<b>Buildings with plot area more than 5000 sqm will be eligible for an additional 5% FAR free of charge if they get 4 or 5 star rating from GRIHA</b>
<b>14</b>	<b>Sikkim</b>	<b>2015</b>	<b>Mandatory compliance</b>	<b>Building and Housing Department</b>	<b>All the Government and semi-Government structures in the State (Residential, Non-residential, Healthcare, Institutional, Industrial, Recreational etc) including those belonging to autonomous bodies like Boards, Corporation, Companies and Public Sector Undertaking (PSU) shall conform to minimum 3 Stars GRIHA rating for propagating sustainable development in the State</b>
<b>15</b>	<b>Uttar Pradesh</b>	<b>2016</b>	<b>Additional FAR/ FSI incentive</b>	<b>Greater Noida Industrial Development Authority</b>	<b>Additional 5% FAR free of charge for projects which are rated as Gold or above by IGBC/LEED.</b>
		<b>2015</b>	<b>Additional FAR/ FSI incentive</b>	<b>Uttar Pradesh Housing and Urban</b>	<b>Free of cost additional 5% FAR for projects complying</b>

				<b>Planning Department</b>	<b>with 4 or 5 Star GRIHA rating</b>
		<b>2015</b>	<b>Additional FAR/ FSI incentive</b>	<b>Housing and Urban Planning Department</b>	<b>Additional 5% FAR free of charge for projects which are rated as Gold or above by IGBC or LEED (new and existing buildings undergoing retrofitting). Applicable to buildings on site more than 5000 sq. m.</b>
		<b>2011</b>	<b>Additional FAR/ FSI incentive</b>	<b>NOIDA and Greater NOIDA local bodies, Uttar Pradesh</b>	<b>Noida and Greater Noida have incentivized GRIHA/LEED projects on plots of minimum 5000 sqm with free cost 5% additional FAR (on existing FAR - so if the exiting FAR is 2.5% then its 5% of the 2.5% and not 5% total) for those complying with 4 or 5 Star GRIHA Rating/ Gold or Platinum LEED Rating.</b>
<b>16</b>	<b>Uttarakhand</b>	<b>2017</b>	<b>Additional FAR/ FSI incentive</b>	<b>Mussoorie Dehradun Development Authority</b>	<b>Private buildings which comply to rating systems and which successfully secure ratings from GRIHA / LEED / IGBC / BEE shall be eligible to receive extra F.A.R free of cost in the range of 10%, 20% and 30% for Silver/ Gold/ Platinum LEED Rating or 3 Star/ 4 Star/ 5 Star GRIHA Rating.</b>
		<b>2017</b>	<b>Mandatory compliance</b>	<b>Mussoorie Dehradun Development</b>	<b>All Government / State Government / Semi-Government</b>

				<b>Authority</b>	<b>buildings including those belonging to autonomous bodies like boards, corporations, public sector undertakings shall confirm to minimum 4-star GRIHA rating OR GOLD IGBC LEED to propagate green building construction. The concerned Architect shall submit affidavit for the implementation of the above provision.</b>
<b>17</b>	<b>West Bengal</b>	<b>2018</b>	<b>Additional FAR/ FSI incentive</b>	<b>Department of Urban Development &amp; Municipal Affairs</b>	<b>10% additional Floor Area Ratio F.A.R. for "Green Building" as per provision LEED 'Gold' or higher level of LEED certification. Completion certificate for building linked to final certificate from GBCI</b>
		<b>2016</b>	<b>Additional FAR/ FSI incentive</b>	<b>New Kolkata Development Authority</b>	<b>Additional 10% FAR for projects Precertified/ Provisionally Certified as Gold or above by IGBC/ Four Star or above by GRIHA.</b>
		<b>2015</b>	<b>Additional FAR/ FSI incentive</b>	<b>Department of Municipal Affairs</b>	<b>10% additional FAR for green buildings which have been granted 4 star rating or higher under GRIHA rating system or Precertified/ Provisionally Certified as Gold or above by IGBC.</b>

The green building rating systems have been instrumental in embedding and executing resource efficiency in the building sector through transforming mechanisms for financial transactions. The National Housing bank (NHB), SIDBI and IIFL Home Loans have promoted the concept of green residential buildings (i.e., rated through GRIHA, IGBC, LEED, EDGE) through various financial structures and technical support programmes for developers, primary lending institutions (PLIs) and home buyers. These initiatives are linked to green building rating systems to ensure effective implementation on ground <sup>(27),(28)</sup>. Though these programmes, namely the 'Promotional Programme for Energy Efficient New Residential Housing in India'<sup>29</sup> financial incentive by SIDBI<sup>30 31 32</sup>

Market mechanisms for mainstreaming of green buildings also exist.

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<sup>(27)</sup> *Soni, Alankrita. Role of Financial Institutions in promoting green buildings. [interv.] Priyanka Kochhar. 20 March 2020.*

<sup>(28)</sup> *Kool, Amor. IIFL Kutumb initiative. [interv.] Priyanka Kochhar. 19 August 2020.*

<sup>29</sup> *National Housing Bank. Report on Trend and Progress of Housing in India 2014. National Housing Bank website. [Online] 2014. [https://www.nhb.org.in/Publications/T&P\\_English\\_FINAL.pdf](https://www.nhb.org.in/Publications/T&P_English_FINAL.pdf).*

<sup>30</sup> *A Review on Green Building Movement in India. Manna, Dibas and Banerjee, Sulagno. 2019, International Journal of Scientific and Technology Research, pp. 1980-1986.*

<sup>31</sup> *A Review on Green Building Movement in India. Manna, Dibas and Banerjee, Sulagno. 2019, International Journal of Scientific and Technology Research, pp. 1980-1986.* <sup>(31)</sup> *Economic Policy Forum. Promoting sustainable and inclusive growth in emerging economies: Green Buildings. Economic Policy Forum. [Online] 2016. <https://economic-policy-forum.org/wp-content/uploads/2016/02/Sustainable-and-Inclusive-Growth-Green-Buildings.pdf>.*

<sup>32</sup> *Yes Bank TERI BCSD. YES BANK – TERI BCSD Survey of Green Real Estate Sector 2014. Yes Bank. [Online] 2014. [https://www.yesbank.in/pdf/researchandinitiatives\\_awardsandrecognition\\_pdf3](https://www.yesbank.in/pdf/researchandinitiatives_awardsandrecognition_pdf3).*

financial incentives by SIDBI incentives by National Housing Bank and Agency Française de développement (AFD) through SUNREF India <sup>(33)</sup>, and launch of 'Kutumb' platform for green affordable housing by IIFL Home Loans <sup>(34)</sup>, the financial institutions (FIs) have embedded implementation of energy efficiency measures with various finance transaction mechanisms for specific stakeholder groups. The work done by the FIs over the past two decades further lays the foundation for green climate fund instruments and green bonds to benefit the PLIs and end users in future where not just individual components such as solar water heaters and efficient equipment/ products get financed but

Awareness and knowledge amongst stakeholders are

real estate as a sector would benefit by incorporating green building features in their design. It is also required that the impact of schemes proposed and implemented in the past two decades is

evaluated and studied for addressing any gaps and making future initiatives more effective.

The green building certification agencies have played a crucial role in equipping professionals with knowledge and skills required for design, construction, and operation of certified green buildings <sup>(35)</sup>, <sup>(36)</sup>, <sup>(37)</sup>. By conducting nation-wide training programmes and

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<sup>(33)</sup>Bank, Sunref India-National Housing. Sunref India affordable green housing : GRIHA incentive. GrihaIndia. [Online] <https://www.grihaindia.org/sites/default/files/pdf/Griha-incentives/sunref-general.pdf>.

<sup>(34)</sup>Loan, IIFL Home. Kutumb – Green Affordable Housing. IIFL Home Loan. [Online] 2019. <https://www.iifl.com/kutumb/>.

<sup>(35)</sup>See reference 18

<sup>(36)</sup>Ministry of New and Renewable Energy, Government of India. Ministry of New and Renewable Energy, Government of India. Annual Report. [Online] 31 March 2020. <https://mnre.gov.in/img/documents/uploads/0ce0bba7b9f24b32aed4d89265d6b067.pdf>.

workshops, and developing a cadre of professionals equipped with green building credentials (including GRIHA Certified Professionals, GRIHA Evaluators <sup>(38)</sup>, LEED Green Associate, LEED AP with specialty, LEED Fellows <sup>(39)</sup>, Indian Green Building Council Accredited Professional <sup>(40)</sup>, EDGE Experts and Auditors <sup>(41)</sup>, and GEM Certified Professional <sup>(42)</sup> the certification agencies provide for inclusion of qualified professionals as part of various project tender requirements. For example, the Request for Proposal for “Comprehensive Consultancy Services for North Zone Office Building Design” <sup>(43)</sup>, requires that “The bidder should have at least one of the team members as GRIHA/ LEED Accredited Professional” <sup>(44)</sup>. Similarly, the Expression of Interest for “Empanelment of Consultants for Comprehensive Engineering Services” requires “The consultants shall have at least one LEED AP or IGBC AP or GRIHA Trainer or GRIHA Evaluator in their team.” <sup>(45)</sup>

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<sup>(37)</sup> Lok Sabha Secretariat. LSS Committee Energy. Standing Committee on Energy (2017-18). [Online] March 2018.

[http://164.100.60.131/lsscommittee/Energy/16\\_Energy\\_32.pdf](http://164.100.60.131/lsscommittee/Energy/16_Energy_32.pdf).

<sup>(38)</sup> GRIHA India. The GRIHA Community. GRIHA India. [Online] <https://www.grihaindia.org/griha-community>.

<sup>(39)</sup> U.S.Green Building Council. LEED professional credentials. U.S.Green Building Council. [Online] <https://www.usgbc.org/credentials>.

<sup>(40)</sup> Indian Green Building Council. IGBC Accredited Professional Examination. Indian Green Building Council. [Online] <https://igbc.in/igbc/redirectHtml.htm?redVal=showIgbcApnospign>.

<sup>(41)</sup> Green Business Certification Inc. EDGE Experts & Auditors. Excellence in Design for Greater Efficiencies. [Online] <https://edge.gbci.org/auditors>.

<sup>(42)</sup> The Associated Chambers of Commerce and Industry of India. GEM CP. Green Assocham. [Online] [https://www.green-assochem.com/cms.php?id=19&menu\\_id=26&title=gem-cp](https://www.green-assochem.com/cms.php?id=19&menu_id=26&title=gem-cp).

<sup>(43)</sup> Bhubaneswar Municipal Corporation. Request for Proposal (RFP) for Comprehensive Consultancy Services for North Zone Office Building Design. Bhubaneswar Municipal Corporation. [Online] 8 December 2017. [http://portal2.bmc.gov.in/Files/Keyprojects\\_22122017122721PM.pdf](http://portal2.bmc.gov.in/Files/Keyprojects_22122017122721PM.pdf).

<sup>(44)</sup> See reference 31

<sup>(45)</sup> HITES. HLL Infra Tech Services Limited ‘HITES’. HITES (A Fully Owned Subsidiary of HLL Lifecare Limited, a Government of India Undertaking). [Online] May 2017. [http://hllhites.com/uploads/tenders/\\_882113102.pdf](http://hllhites.com/uploads/tenders/_882113102.pdf).

In the notification issued for 'integration of environmental condition in building bye-laws' <sup>(46)</sup>, MoEFCC has notified empanelment of Qualified Building Environment Auditors (QBEAs) for the purpose of certification regarding incorporation of environmental conditions in buildings, where Indian Green Building Council has been identified as one of the agencies for the "process of accreditation, training, and renewal" <sup>(47)</sup> of QBEAs.

In addition to skill development amongst students through design competitions such as the GRIHA Trophy at NASA <sup>(48)</sup> the green building rating systems have been integrated into the formal curriculum of architectural schools across the country <sup>(49)</sup> to ensure students are equipped with theoretical and practical knowledge about green building concepts to make meaningful contribution as professionals.

Implementation of LEED Lab as part of the Bachelor's degree in Architecture (B.Arch) curriculum at a prominent Central University of India enables students to assess the performance of an existing building facility, with the goal of certifying the building with LEED for Building Operations and Maintenance (LEED O+M) process themselves. <sup>(50)</sup>

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<sup>(46)</sup> Ministry of Environment Forests and Climate Change. Notification on Integration of Environmental Conditions in Building and Construction Sector. Ministry of Environment Forests and Climate Change. [Online] 9 December 2016. <http://moef.gov.in/wp-content/uploads/2017/07/Building-and-Construction.pdf>.

<sup>(47)</sup> See reference 51

<sup>(48)</sup> National Association of Students of Architecture. Trophies. National Association of Students of Architecture. [Online] 2013. [https://nasaindia.co/trophy/griha#collapse-two-link1\\_11\\_one1](https://nasaindia.co/trophy/griha#collapse-two-link1_11_one1).

<sup>(49)</sup> Council of Architecture. Architectural Education. Council of Architecture. [Online] 11 August 2020. <https://www.coa.gov.in/showfile.php?lang=1&level=1&sublinkid=748&lid=599>.

<sup>(50)</sup> Jamia Millia Islamia. Press Releases. Jamia Millia Islamia A Central University. [Online] 6 August 2019. [https://www.jmi.ac.in/upload/publication/pr2\\_English\\_2019August6pdf.pdf](https://www.jmi.ac.in/upload/publication/pr2_English_2019August6pdf.pdf).

Considering the above, while the science of green buildings is well established, policy and market mechanisms exist, and awareness amongst masses is increasing, there is still a need to ensure effective on ground implementation and compliance with relevant codes, standards, and policies. The perception about green buildings being more expensive is one of the main barriers in widespread adoption of the concept.

Table 2 <sup>(51)</sup> below indicates percentage savings in resource consumption achieved by green rated buildings when compared to

Perception about green buildings being more expensive is one of the main barriers in widespread adoption of the concept.

conventional buildings. Indicative increase in initial cost of green rated buildings, which may in part be set off by incentives (mentioned in Table 1) is also mentioned. This study by TERI may be analysed further because while the concept of

assessing only initial increment cost has been used, benefits and cost savings are accrued over the life of the building.

Therefore, it is important to consider life cycle costs as opposed to initial incremental costs alone when making decisions about designing and constructing a green building.

**Table 2: Resource savings and incremental costs incurred by rated green buildings**

Certification Type	Commercial					Residential				
	Energy Savings (%)	Water savings (%)	Solid Waste reduction (%)	Waste Water reduction (%)	Cost Increment (%)	Energy Savings (%)	Water savings (%)	Solid Waste reduction (%)	Waste Water reduction (%)	Cost Increment (%)
Green Case	10	40-46	46	28-43	0.7-2.5	35	36-41	46	52-67	0.7-2.2
GRIHA 1 star	36	69-100	51	67-76	2.5-6.6	43	47-72	51	58-81	2.6-3.8
GRIHA 3 Star	54	69-100	55	72-86	6.5-11.9	57	57-83	55	66-88	4.8-5.2
GRIHA 5 Star	61	75-100	60	86-92	9.7-14.8	64	68-90	60	85-88	6.5-7.7
IGBC Silver	36	43-83	46	52-66	3.4-8.1	39	76-97	51	98-100	2.3-5.8
IGBC Gold	53	76-100	46	83-91	5.7-11.9	54	77-97	55	95-96	6.6-9.9
IGBC Platinum	56	76-100	51	83-91	9.1-15.1	59	77-94	60	95-97	6.7-7.7

<sup>(51)</sup>The Energy and Resource Institute. *Formulation of Policy Incentives for Promoting Green Buildings in Tamil Nadu*. TERI. [Online] 2016. <https://www.teriin.org/sites/default/files/2018-03/2014BG08%20CMDA.pdf>.

In addition to the financial savings <sup>(52)</sup>, 10 million square metres of GRIHA 5-star certified project can save enough electricity to power about 1,00,000 urban homes, save enough water to meet needs of 22,000 urban homes, provide 6MW PV installation to enhance supply and provides monitored data to ensure and strengthen compliance, which are not considered when initial incremental costs are considered.

### **Residential buildings: cost, benefits, and incentives for green buildings**

The challenge of considering only additional incremental cost (Table 2) as a decision-making metric is eminent especially in residential buildings where the initial incremental costs are borne by the private developers while the recurring benefits of lower operating costs are accrued by the occupants.

This split incentive (where the economic benefit of going green with possible extra expenditure is not accrued by the developer but passed on to occupants who have not paid additional money due to market competitiveness in spite of additional steps taken by the developer) has been addressed by 17 States and Union Territories across India (Table 1), where various mechanisms including revision of building byelaws, mandatory compliance, financial incentives, and ground coverage and FAR benefits have been announced for the private sector.

As per information collected by the author, the States of Haryana, Uttar Pradesh and Maharashtra have been leading in green building construction, and availing incentives announced by the respective government departments. NOIDA in Uttar Pradesh with

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<sup>(52)</sup> *GRIHA Council. Awareness programme: MCCIA-GEF initiative on GRIHA. Pune : GRIHA Council, 2013.*

over 100 green buildings <sup>(53)</sup>, Pimpri Chinchwad Municipal Corporation (PCMC) in Maharashtra with over 60 GRIHA projects <sup>(54)</sup> and the State of Haryana with over 30 green buildings <sup>(55)</sup> are ahead of other States in the process of receiving green rating linked additional FAR incentives as listed in Table 1.

### Case study for residential sector

A project in NOIDA (where maximum number of projects are availing the green building incentive) has been identified for further study. The DAH group (i.e., private developer) PSI Energy, i.e., the green building consultants and project team of NX-One project have been interviewed to gain information on the role of incentives in offsetting any additional costs incurred by them in design and construction of GRIHA rated project.

### Green building rating linked incentives by Greater NOIDA

In 2010, as part of the General Provisions for building projects, Greater NOIDA included additional free FAR for LEED certified projects constructed on plot size of more than 5000 sqm. <sup>(56)</sup>, <sup>(57)</sup> Subsequent amendments in 2012, and 2019 went on to include incentives for projects certified by GRIHA and IGBC as well.

As per the incentive scheme, Greater NOIDA awards free cost 5% additional FAR (on existing FAR - so if the exiting FAR is 2.5% then its 5% of the 2.5% and not 5% total) for those complying

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<sup>(53)</sup> Goyal, Mukesh. How many projects have availed the green building incentive in Noida. [interv.] Priyanka Kochhar. 1 September 2020.

<sup>(54)</sup> Karmarkar, Ketki. How many projects in PCMC have availed the GRIHA incentive. [interv.] Priyanka Kochhar. 1 September 2020.

<sup>(55)</sup> Singh, Hitender. How many projects have availed the green building rating linked incentive in Haryana. [interv.] Priyanka Kochhar. 1 September 2020.

<sup>(56)</sup> GRIHA Council. NOIDA and Greater NOIDA embrace GRIHA. GRIHA incentives. [Online] 20 October 2012. <https://www.grihaindia.org/noida-and-greater-noida>.

<sup>(57)</sup> Goyal, Mukesh. How many projects have availed the green building incentive in Noida. [interv.] Priyanka Kochhar. 1 September 2020.

with 4 or 5 Star GRIHA Rating/ Gold or Platinum LEED/IGBC Rating.

### Case study 1: GRIHA 4 Star NX-One project, Greater NOIDA

The GRIHA pre- certified NX-One (Photograph 1) mixed-use project of

approximately

3,38,402.6 sq m built up area <sup>(58)</sup> and cost of

Rs. 800 crores <sup>(59)</sup>

availed 5% additional free of cost FAR of

11,745 sq m. The cost

of free of cost

additional FAR <sup>(60)</sup> provided to the project (calculated as per the compounding fee letter of NOIDA <sup>(61)</sup>, using rate of purchasing commercial/ residential FAR) is approximately Rs. 76.8 crores to the developer. The projected incremental cost (since the project is still under construction) incurred to meet requirements of GRIHA 4 Star (including SRI tiles, fly ash bricks, double glazing, roof insulation, BEE rated ceiling fans, solar PV power plant and automation for HVAC) are approximately Rs. 69.45 crores <sup>(62)</sup>.

Thus, the additional cost incurred by the project (Rs. 69.64 crores) is absorbed by the value of free FAR incentive (Rs. 76.8



*Photograph 1: GRIHA 4 Star pre certified NX-One, Greater Noida, Uttar Pradesh*

<sup>(58)</sup> Sadarangani, K Shankar. NX-One, Noida. [interv.] Priyanka Kochhar. New Delhi, 12 September 2020.

<sup>(59)</sup> Uttar Pradesh Real Estate Regulatory Authority. View Projects. Uttar Pradesh Real Estate Regulatory Authority. [Online] 14 September 2020. <https://www.up-rera.in/viewprojects>.

<sup>(60)</sup> Goyal, Mukesh. How many projects have availed the green building incentive in Noida. [interv.] Priyanka Kochhar. 1 September 2020.

<sup>(61)</sup> As per discussion with NOIDA Authority officials (See reference 60), compounding fee for projects in Greater NOIDA is same as compounding fee for projects in NOIDA.

<sup>(62)</sup> Sadarangani, K Shankar. NX-One, Noida. [interv.] Priyanka Kochhar. New Delhi, 12 September 2020.

crores) for GRIHA rated NX-One project in Greater NOIDA. The local body has been able to effectively address the problem of incremental cost for green buildings and incentivise private players to adopt green buildings.

## **Discussion**

It is understood that project developers incur additional initial cost while complying with strategies for resource efficiency and green rating. Several government agencies and local bodies offer incentives for private developers of residential developments so that the issue of spilt incentives can be addressed, and incremental costs can be offset.

Most recently, the Delhi Development Authority has released the Draft of Master Plan of Delhi (MPD) 2041, which mandates green buildings for any future construction in Delhi NCR. Such policy initiatives enable any additional green building linked expense to become the norm by making it the baseline.

Similarly, the Central Public Works Department (CPWD) and Public Works Department (PWD) in Maharashtra (among others) have announced integration of design strategies to achieve resource efficiency. Subsequently, the CPWD Works Manual, Plinth Area Rates and Delhi Schedule of Rates (i.e., documents used to estimate project costs and seek approval for construction) have been revised to include the Energy Conservation Building Code (ECBC) and Green Rating for Integrated Habitat Assessment (GRIHA Rating).

Even though these institutional projects incur an initial incremental cost, the benefits are more significant than initial incremental costs. Additionally, the occupant is also the owner

**and hence reaps the environmental and cost saving benefits of initial investments.**

**However, to facilitate decision making, life cycle cost analysis is required to understand the significance of each cost component and the impact on total cost of the project. Evaluation of LCC considers single investment cost, capital replacement costs, energy consumption costs, annual recurring costs, and residual costs, which consolidates to form the total cost.**

### **Conclusion**

**It is important for decision makers to consider life cycle costs (LCC) of projects so that various cost components are considered during decision making.**