



## **Green Building Rating Systems: Comparative Review of IGBC Green Homes and CASBEE for Detached Homes**

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**Abstract:** *Continuous rise in population levels in the developing world and servicing this need for housing on a large scale should be carried out in a sustainable manner. This has led to green building rating agencies to publish separate rating systems, particularly for the residential and housing sector. This review study aims at comparing two such green building rating systems of the housing sector. CASBEE for homes (Detached Houses) is chosen, as Japan being a developed island nation although having its own problems with regards to lack of housing space for its growing population and constant tectonic activities has come up with unique solutions to these problems that can be adopted in countries with similar issues. IGBC Green Homes being a vastly adopted rating system of the housing sector is compared to CASBEE to have an idea about the shortcomings of each rating system. The green building industry in both countries and the history of sustainable architecture is compared to give a look into the reasons behind adopting green building rating systems. The supporting regulatory framework of both countries along with the method of implementation of the systems is compared. Finally the strengths, weaknesses, opportunities and threats of each rating system are reviewed. This study provides some insight into the gaps present in both systems, and can be used while developing an add-on to the rating systems to ensure that all aspects of sustainability are covered while planning for the new development.*

**Keywords:** *Green Building Rating System; IGBC Green Homes; CASBEE; Sustainability; Similarities; Differences*

### **1. Introduction**

Towards the end of the twentieth century, the world began to realize the full scale of anthropogenic impact on the environment and how the future would be in peril if such human activities that have no regard for the environment, were to continue. The result of this large scale acceptance was that huge organizations and companies the world over began to look at sustainable development as the solution. Sustainable development, as defined by the [1] states that it is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." As such, in order to make real-estate more sustainable, keeping in mind the conservation of natural resources and energy and keeping disposal of waste in check, green building rating systems were formed as certification systems that assure stakeholders that the construction is indeed sustainable.

The principles of sustainable design involve providing technically, economically, and socially pleasing, healthy environments for users, while minimizing environmental damage [2]. Accordingly, green building rating systems were formed in order to guide construction of efficient infrastructure as well as to efficiently reflect the performance of a structure or development. Developing such systems is becoming necessary in the Developing World because of the considerable environmental, social and economic

problems [3]. With this in mind, countries from around the world are developing and modernizing these systems at a regular basis in order that the knowledge base of sustainability on built environment as a whole is improved [4]. According to [5] there exists a unique relationship between urban climate, the anthropogenic causes for the same, its impact and urban living as a response to it. The population is now beginning to adapt to its own anthropogenic-caused pollution and emissions, not but decreasing it to begin with but by working out ways to reduce it after it is caused. The building industry is now being considered as the major user of resources as many segments converge in the construction of a building, which include water management, waste management, energy conservation, air quality, innovation in design etc. [6, 7, 8]. The current Indian green building scenario is governed by a number of rating systems that are controlled by various agencies. Similarly, many countries around the world also have their own green building standards and rating systems. There is no best rating system that can be applicable for all developments, in all regions or geographical zones [9].

This paper aims at comprehensively comparing rating systems from India and Japan that are designed for rating housing developments and homes. IGBC Green Homes that is used in India is compared with CASBEE for Homes (Detached Houses) of Japan.

The two main sections of comparison are the categories/requirements of each rating system and the evaluation criteria used for both systems. Japan has been selected for comparison in this study as the country is in an advanced stage in terms of sustainable development and therefore a lot can be learnt in terms of the tools being used in Japan to reach such a high level of sustainability.

## 2. IGBC Green Homes

The Indian Green Building Council (IGBC) has released its own version for certifying residential structures, called IGBC Green Homes. This rating system in a country like India was the need of the hour, since India which is one of the fastest growing economies in the world, is witnessing a huge growth in terms of development in the field of construction and infrastructure. With the second largest population in the world and an ever expanding middle class with rising disposable income, the housing sector in the country is booming and its rapid growth is immensely contributing to the economy. However, there is a need that although this growth is required and essential, it has to be done in a sustainable manner keeping in mind the environment and natural resources.

IGBC Green Homes and other such rating systems in the country help in indirectly promoting the use of green techniques and concepts by giving sufficient recognition, along with the various other tangible and intangible benefits that are associated with obtaining a green building certification.

IGBC Green Homes is a voluntary certification and covers almost all residential dwellings, whether individual residential units or multi-dwelling residential units. Therefore any residential unit that meets the set of mandatory requirements can apply for this certification. There have been talks that for certain high rises that cross a certain threshold of living space, that this certification may be made mandatory, however no such law has been passed yet. The main attraction as to why there is so much support for such systems is that they address certain national priorities that will benefit the country in the long run. These include energy efficiency and water conservation, the segregation and handling of household waste, reduced dependency on virgin materials and reduction in the use of natural exhaustible resources and fossil fuels. Intangible benefits such as improved health and wellbeing of the occupants is also an added advantage that attracts developers to apply for such a certification.

The IGBC Green Homes rating system finds its core from the USGBC certifications, however there is additional focus on the residential sector since the Indian Green Building council set up a core committee whose primary task is to focus on reforms of this sector and to address various aspects of the same. This committee consists of professionals in the field of construction as well as other stakeholders and

industry representatives, including developers, architects, manufacturers, industry experts, homeowners and consultants including others. Hence, under the instruction of this core committee, the rating system continuously evolves and is constantly updated with expert findings and recent industry updates yearly. The rating system addresses six different categories to make buildings more sustainable. Each of the categories possesses certain mandatory requirements and a list of voluntary requirements. The mandatory requirements have to be met, failing which the construction will not be eligible for the certification. The voluntary requirements have certain credits associated with their compliance. The development is awarded such credits which are totaled and a certification of a particular level is awarded [10] (Table 1).

**Table.1:** Threshold criteria for certification/pre-certification levels as per IGBC Green Homes

Level	Individual residential unit	Multi-dwelling residential unit	Recognition
Certified	38-44	50-59	Best Practices
Silver	45-51	60-69	Outstanding Performance
Gold	52-59	70-79	National Excellence
Platinum	60-75	80-100	Global Leadership

Source: India Green Building Council (IGBC), 2015

### 2.1. CASBEE for Homes (Detached Houses)

In Japan, the green building revolution started in 2001 with the initiation of this project jointly carried out by industry, government and academic institutions. The project was supported by the Ministry of Land, Infrastructure and Transport (MLIT) through the Housing Bureau of Japan. This project led to the formation of the Japan Sustainable Building Consortium (JSBC). This consortium adopted CASBEE which is a building assessment tool that is unique to Japan. The Comprehensive Assessment System for Built Environment Efficiency (CASBEE) Rating System proposes a new way to calculate a structures impact on the environment and the surrounding environments impact on the development [11].

Japan being a highly populous country is stretched in its energy demand with more than 500,000 new homes being constructed every year. Therefore the need for conservation of energy and the resulting impact on natural resources is a high priority in the island nation. CASBEE allows the country to do this by promoting it through its MLIT Environment Action Plan of 2004 as well as the Kyoto Protocol Target Achievement Plan of 2005 [12].

CASBEE has its own form of evaluation where it evaluates the buildings performance from two viewpoints [13].

- 1) The quality of the environment of the house (Q), and
- 2) The load that the house has on the external environment (L).

There are three categories under each viewpoint and for a house in Japan to be certified by CASBEE it should receive a high rating from each of these categories.

The purpose of this study is to qualitatively highlight the similarities and differences between the green building rating systems used in Japan as compared to India. For this purpose, the systems of the two countries being used in the residential space are compared. The idea of this comparison is to clearly establish the gaps that are prevalent in the current systems being used in each country and to establish recommendations on improvements of these systems. The qualitative analysis will help in finding out the motivating factors behind green building rating system, market trends for industry implemented in both the countries. This will enhance our understanding towards the supporting regulatory framework and how the implementing agencies of both systems are planning for the future.

### 3. Methodology

To achieve a comparison between the two rating systems, the study relies on the published research material and published reports by agencies of repute in the sector, published papers and sourced data related to green building industry. The published papers covering the implementation of the rating systems in the two countries, the factors and reasons behind the decision to implement such systems in these countries were referred. An in-depth review of the large amount of literature collected is carried out initially in the following process:

- 1) Through search for relevant data
- 2) Critical analysis of the data
- 3) Synthesizing, summarizing and combing through data.
- 4) Personal interview with the industry experts wherever it is feasible to clarify on the content and better understanding of the issues.

The report is then concluded by re-analyzing results of previous studies on the topic. The study is a secondary research study based on the analysis of findings of previous literature on the topic.

*Inclusion Criteria:* Research Papers, case studies, relevant agency websites and published subject matter documents that have both quantitative and qualitative data within the time frame of 1995 to 2017 were taken as a criterion to be considered for analysis.

*Exclusion Criteria:* Research Papers, case studies, relevant agency websites and published subject matter documents that are not current within the above mentioned time frame and also research conducted externally by unverified sources.

For the analysis different sections were divided which gives an idea about the industry overview and market trends along with the regulatory framework practiced in both countries. The analysis is summarized in the form of SWOT analysis of IGBC – Green Homes and CASBEE for Homes (Detached Houses).

### 3.1. Industry Outlook

#### 3.1.1. India

In India, there exist a number of green building rating systems each with their own set of parameters and governed by different agencies. These systems “attempt to assess the issues that influence the performance of a building itself, and in some cases, to assess the impact of the building on its surrounding” [14]. Existing methods can be applied to different regions by addressing additional aspects such as varied climatic conditions and regional variations [15]. These systems have evolved to such an extent that it is not just industries or commercial buildings that seek such certifications, but homes and households as well. For this reason, the organizations that govern such systems, are designing separate specific formats that are applicable to residential complexes, buildings and homes. Throughout the country’s history, it is documented that India has been using traditional materials and building practices for the construction of homes. These materials for housing construction come from various renewable and a number of naturally found sources such as mud, cow dung, clay, bamboo and agricultural residue among others [16]. This trend could be seen in almost all rural areas of the past. However, with the swift spread of urbanization due to rapid industrialization, modern building materials and practices have replaced the traditional ones. These new techniques were initially seen as a modern change and hence were adopted quickly with no thought about the impact they may cause in the Indian scenario. It was only after the international outcry on preserving the depleting natural resources and the environment that the country started looking at the various materials processes and techniques that it uses for construction [17]. Therefore the green building concept that was adopted in India came into being and began to grow only in the late 1990’s. It was then after the turn of the century that rating systems were formed to assist in giving certain fixed guidelines as to how green buildings could be built and what exactly developers should focus on during construction and after occupancy so as to decrease the impact of the construction on the environment [18, 19].

The green building revolution in India began with the formation of the Green Rating System for Integrated

Habitat Assessment (GRIHA) by The Energy and Resources Institute (TERI) and the Ministry of New and Renewable Energy (MNRE) [20]. Following this, the Indian Green Building Council (IGBC) was set up by the Confederation of Indian Industry- Sohrabji Godrej Green Business Centre [21]. From here on out the green building movement in India has expanded in leaps and bounds. Today India has more than 4500 certified green buildings that account for more than 4 billion square feet of built area. These figures are second only to the United States of America which given India being a developing nation is a huge achievement. However, there exists a huge opportunity in the India market as the above figures account for just 5% of the total built up area in India [22].

India being the second largest populated country in the world and the seventh largest in terms of area, there is a huge need to preserve natural resources in order to satisfy the need of the ever-growing population. Green buildings provide tangible as well as intangible benefits that given India's growing resource demands, can prove to be the deciding factor in terms of the country's future. Sustainable development is the need of the hour in the country [17]. Green building rating systems provide a set of guidelines and touch points as to how developers can achieve such sustainable development. Green buildings in India are now being seen as the differentiator for potential customers prior to occupancy. Their ability to preserve natural resources and protect the environment is transforming the real estate industry in India [23] as not only builders know their benefits but potential customers are also aware of their reduced dependency on the environment and the lower cost of living and health benefits in using these buildings compared to others [24].

The real estate industry in India is expected to cross USD 180 billion by 2020 [25] which means that the opportunity for the green building market to expand is huge. With sustainable development being promoted in the real estate sector, the demand for green buildings will increase exponentially which complements the growth of the subsequent rating systems. With the green environmental regulations and demand for healthier neighborhoods in India, the green building sector is expected to grow by 20 percent [26]. According to the present governments ambitious plans for real estate including the smart city mission as well as other rural development agendas, it is said that three fourth of the buildings that are to be constructed by 2030 has not been built yet which shows that ground root development of the green building sector can still be achieved for most buildings rather than refurbishment of current constructions [27]. In the housing sector as well the green buildings movement is spreading at a rapid pace. The old notion of living in joint families or under one roof is slowly dying away and western

architecture for residential complexes is replacing this. Therefore, many of the green building rating systems in India have rolled out a separate version for the residential construction space. These include an affordable GRIHA rating system called SVAGRIHA and IGBC Green Homes among others. According to research, the housing projects already certified by green building certifications in India account for about USD 30 billion to USD 35 billion. The top green building sector by 2030 is expected to be high rise residential towers and residential communities. With the awareness of green buildings growing among the common man along with favorable policy support, the residential green building industry is expected to grow at a rapid pace in the near future [27].

Finally, this sector being a comparatively new industry in the Indian market, it is bound to create a large number of job opportunities as it expands. There is going to be a huge demand for skilled and knowledgeable workforce including other stakeholders such as architects, designers, developers, consultants, technicians and environmentalists among others. Many agencies have also begun separate courses for capacity building and skill building for personnel in order to make the most use of this opportunity which ultimately also enhances the economic development of the country.

### **3.1.2. Japan**

Japan being an island nation in the east, is surrounded by water on all sides. Its growing population and lack of available land to accommodate this rapidly growing population is a cause of major concern in the country. Japan is one of the most technologically advanced countries in the world. Being a leader in the manufacturing segment its focus on rapid industrialization has pushed it to become one of the most advanced countries in the world. After the world wars, towards the latter half of the century Japan reduced its military spending and began focusing on other sectors such as its economy, education and research and development. It was during this phase of rapid industrialization and urbanization that Japan's pollution levels hit the roof. The dangerously high levels of pollution in many of the industrial cities around Japan caused a large number of cases of sicknesses and ill-health not just to the employees working at these industries but also to the surrounding local population [28]. It was only after this, that the government started taking a serious look at the root cause of all the suffering and hence they traced it to the serious pollution levels that were alarmingly high. It was only during the 1990s that the attitude of the government and the locals started to shift towards pollution abatement and sustainable development. The pressure from the government allowed companies as well to rethink their sustainability strategies that focus more on only that development that helps in conserving natural resources, reduces the load on the

environment and improves the overall wellbeing of not only the surroundings but also the people occupying the premises.

Japan now has various energy efficiency initiatives and programs that are taking forward government's mission of sustainability. The programs and initiatives are now bearing fruit. Japan has now in fact turned out to become a leader in the sustainable development space after being rated one of the most transparent nations [29].

The country then moved forward with sustainable development by emphasizing on pollution reduction through reduced greenhouse gas emissions. In the year 1997, the United Nations Framework Convention on Climate Change extended an international treaty that committed all nations who ratified it to reduce their greenhouse gas emissions considerably. The treaty came to be known as the Kyoto protocol as it was signed in Kyoto Japan. Today, the Japan Sustainable Building Consortium (JSBC) formed under the Ministry of Land, Infrastructure and Transport (MLIT) administers a unique building assessment system known as the Comprehensive Assessment System for Built Environment Efficiency (CASBEE) [30, 31, 32]. CASBEE is spread across Japan through MLIT and the Japan Kyoto Protocol Action Plan.

A major turning point in the successful implementation of Japan's sustainable development initiatives was in the year 2011, when the island nation was struck by an earthquake which subsequently resulted in the formation of a tsunami that hit the coastline of the country causing major damage to property. The Fukushima nuclear power facility that was also hit caused a major energy safety control crisis in the country and pushed the decision makers of the nation to rethink their strategy for the rational and sustainable use of energy not just of industrial consumption but for residential energy consumption as well.

Today the government of Japan is far ahead of the rest of the world in implementing initiatives that are beneficial for the sustainable future of the country. The next step on their agenda is to take significant steps to realize a sound material-cycle society which means that the society itself controls the consumption of its natural resources and helps reduce the impact on the environment through proper waste disposal mechanisms that highlight the need of source reduction, and the need to reuse and recycle waste [33].

### **3.2. Regulatory Framework Support**

#### **3.2.1. India – IGBC**

The green building movement in India has gained a lot of support from many stakeholders in industry and in government. However, till date the adoption has been only voluntary. There are no government

policies or acts that have been laid down that are mandating the adoption of green building standards. Stakeholders themselves are realizing the importance of the need to protect the environment and to conserve natural resources. According to the economic times, as on 31<sup>st</sup> December 2016, India holds the second largest green building footprint in the world covering 4.48 billion square feet. This is however just a small percentage of the total built up and therefore there is still opportunities exists in order to make a significant difference. Although there are no mandatory laws and acts in place, the government has incorporated the NBC – National Building Code of India in 2016 which speaks about various sustainable development features in the built environment. These features are now being recognized in numerous states in their building operation regulations [34]. Furthermore, the Energy Conservation Building Code (ECBC) laid down by the Bureau of Energy Efficiency also promotes the use of sustainable technology that uses less energy for performance. The provisions of the ECBC are mandatory for commercial buildings having a connected load of 500kW or a maximum demand of 600kVA or above [35, 36]. They are also mandatory for buildings having an air conditioned area of 1000 square meters or more. Simple compliance of the provisions under ECBC can help consumers save up to 60% electricity [37]. India also has other laws that complement the green building sector and promote the use of green building rating systems indirectly. These include the Energy Conservation Act 2001, The Environment (Protection) Act 1986, The Wildlife Protection Act 1972, The Forest (Conservation) Act 1980, The Water (Prevention and Control of Pollution) Act 1974, The Air (Prevention and Control of Pollution) Act 1981 and the Indian Forest Act 1927. Although there are no specific legislations that mandate the use of green buildings in any sector, the compliance with such acts does make the development comparatively sustainable. However mere compliance to these acts does not gain any score in the various green building rating systems of India. Various government agencies and councils in India however, are promoting the use of green building rating systems by giving incentives called green incentives for the use of green initiatives in construction of additional or extended built up area. These incentives are in the form of reduced development charges, tax holidays, faster governmental approvals as well as recognition [38, 39]. Government of India and state governments has initiated various incentives for green buildings like fast environmental clearance for green buildings, concessions on premium for additional floor area ration (FAR) for buildings with minimum green building ratings etc. [27].

#### **3.2.2. Japan – JSBC**

Japan, unlike India has certain laws and acts that are laid down for the benefit of sustainable development

and green building construction. The Japanese Ministry of Land, Infrastructure and Transportation (MLIT) and the Ministry of Construction, passed the Japanese Building Standards Law in 1969. The law specifies different methods for the construction of energy efficient buildings using materials that can be recycled after their lifetime and do not generate much waste. This act issues certain codes and guidelines for maintaining the air quality as well as the surrounding topography.

The Building Standards Law (BSL) also prescribes certain development restrictions on new constructions. It divides the land area of Japan into twelve land use zones and specifies the construction techniques and materials to be used for construction in each zone. The country's existing planning system stipulates a number of regulations on a single piece of land. BSL specifies the building coverage ratio (BCR) and floor area ratio (FAR) required in each land zone. It also puts certain height restrictions in place for households to meet certain requirements. This law does not only cover private property but gives specifications for roadways and streets as well [40].

Japan is an island nation positioned over fault lines and therefore is susceptible to a huge amount of earthquake activity. The country has a history being devastated by a large number of earthquakes thereby losing a lot of life and property. It is therefore imperative that construction in Japan in earthquake proof and can stand major seismic activity. As such the country has also released the New Earthquake Resistant Standards 1981, which are field tested methods of construction known popularly in the country as "shin-taishin". It is said that in the 1995 Hanshin earthquake, only 0.3% of the shin-taishin constructed buildings were damaged. These codes specify the strength for beams, pillars and walls and the dampening system required in the buildings. These codes are classified into three types. They are (1) Taishin – basic earthquake resistant. These are the mandatory requirements for all construction. (2) Seishin – These are optional codes that can be added on to Taishin but are recommended for high rise and extremely tall buildings. This method is much more expensive but the techniques suggested here can absorb heavy vibrations as well. (3) Menshin – This is another add-on for base dampening of the building. The latter two methods are costly but are much safer options. Buildings that are constructed in compliance to these earthquake building codes are issued a certificate of proof for potential buyers which also adds to the price of the building.

Another regulatory measure that promotes the construction of green buildings and the use of green building certification systems in Japan is The Basic Act on Establishing a Sound Material Cycle Society 2000. The function and basic objective of this act is to create societies that consume natural resources in their own controlled manner in order to reduce the impact

of the development on the environment [41]. It works on the premise that all waste generated can be recycled and reused in some way thus reducing the burden on the environment and society at large. The act focusses on source reduction as the primary way of reducing waste, followed by reuse of parts and products and recycling of disposed material.

Apart from the above three laws that help in promotion of green buildings in Japan is its own Basic Environment Law 1993 that enacts out a Basic Environment Plan for the preservation and conservation of the natural environment. The country also has the Air Pollution Control Act, Water Pollution Control Law, Soil Contamination Countermeasures Law, Noise Regulation Law, Vibration Regulation Law and the Offensive Odor Control Law.

### 3.3. Trend Analysis

The aim of providing a trend analysis is to compare the technology, investment, regulatory and user application trends of both rating systems, so as to highlight the current status of both systems and the direction in which they are headed in the future.

### 3.4. IGBC Green Homes

**Technology trends:** Encourages the use of new methods and techniques through its innovation and design process that enables developers and project planners to get a chance to be awarded extra points for exemplary performance shown in initiatives that are apart from those mentioned in the rating system [21].

Formed with the consultation, contribution and participation of a core committee that comprised of industry, government and academia along with a long list of specialists from various organizations across the country [42].

Transfer of information and data from United States Green Building Council (USGBC) for the promotion of green building rating systems in India [43].

**Investment trends:** The high initial investment that has to be put in by project developers is still seen as a negative factor that discourages the widespread adoption of such rating systems in areas where the price of realty is low [44].

Complete return on investment can be achieved in two to three years after occupation in the residential sector due to many factors that pay-out early such as improved water usage and increased energy efficiency.

Large scale spread of investment is hindered due to the lack of awareness of green building rating systems among new developers and the lack of knowledge about the numerous benefits of green building rating systems financially as well as on human health and the environment [45].

An initiative by the government that may push investment in the housing sector in a sustainable manner is the smart city mission that has been adopted by the government that ensures housing for all by the year 2022.

**Regulatory trends:** There is a lack of direct regulatory support in India that mandates the use of green building rating systems for the construction of residential developments [46]. However there does exist indirect regulatory support for green construction, through National Building Code India 2016, Energy Conservation Building Code (ECBC) and the various other environmental laws that have been mentioned in the regulatory section mentioned above.

**User Application trends:** There is now beginning to be a rapid growth in the use of green building rating systems, as developers have begun to experience the benefits of their construction. Buildings account for one third of energy use and similar portion of total greenhouse gas emissions [47].

The Indian Green Building Council (IGBC) has also started the IGBC Green League which was established with the aim of promoting the use of green building rating systems and to encourage capacity building within the sector.

Many developers are now constructing green buildings and making use of green building rating systems as a form of advertising for their development. Associating their brand with green initiatives is now being used to promote developments and increase the prices of homes [48].

### 3.5. CASBEE for Homes (Detached Houses)

**Technology trends:** The assessment and calculation method incorporated in this rating system is used in conjunction with presently existing systems in Japan, such as the Japan Housing Performance System (JHPS). This is done to provide some sort of standardization and to allow the evaluation method to be a simple input-output system for easy incorporation and dissemination among developers. This system was developed specifically to service the needs of all stakeholders and therefore it was formed in consultation with industry, government and academia, keeping in mind all their needs and concerns and incorporating them into the system [13].

**Investment trends:** For the incorporation of advanced green initiatives, techniques and practices in the building process, the initial investment is still seen as a large amount and hence acts as a hindrance to the in-depth application of this system to all households [49]. Similar to what is being done in IGBC Green Homes; the developers that adopt this system are using it as a tool for branding their construction hence increasing the marketability of the development and ultimately raising the price of the construction. Due to the fact that Japan is subject to large amounts of

tectonic activity there is a mandatory compliance required for certain basic standards. These are incorporated is CASBEE and hence the investment that is put by developers for incorporating these basic practices are being adopted rigorously.

**Regulatory trends:** Japan being a nation susceptible to a large amount of tectonic activity has put in place certain laws and standards that are mandatory for all construction so as to avoid damage of property in the occurrence of such activity. The Building Standards Law of 1969 is one such law that is mandated for all construction. The country has also laid down certain guidelines to aid developers in the construction of safe and sturdy developments which are included in the Earthquake Building Code [50].

Furthermore, similar to the Indian perspective, Japan also has its own environment laws that are explained in the regulatory section above. Another law that promotes green construction is The Basic Act on Establishing a Material Cycle Society which was passed in the year 2000. Such a law complements green building construction as it promotes recycling and zero waste disposals.

**User Application trends:** Unique to Japanese society, it is an obligation by law to build houses that are social assets that complement society positively rather than have a negative impact on society. The construction of any development in Japan should not strain the natural resources or its surrounding environment. It should however add value to society at large [13].

Japan being an island nation whose population is continuously on the rise, sees an increase of around 500,000 houses built every year. Therefore the potential market for green building rating systems in Japan is huge and highly beneficial for the residential sector.

The recent string of earthquakes and tsunamis in the island nation caused billions of dollars' worth of property damage and this has been a major driver in the growth of green building rating systems in the country, with certification of houses on the rise [50].

### 3.6. Method of Implementation

IGBC Green Homes is a green building rating system released by the Indian Green Building Council in order to spread and encourage green building practices in the residential sector in India. This rating system provides a checklist of environment preserving, natural resource conserving and waste management practices that are beneficial for the surrounding environment and for occupant wellbeing [51, 52]. It is a fact the ever expanding housing sector in India is also hugely contributing to the country's economy in a big way. Therefore there is a need for sustainable development in the sector, in order to promote this growth in a sustainable and efficient manner.

This rating system is a consensus based and voluntary system established to address certain aspects of the country that are highly prioritized so as to achieve sustainable development and enable healthy living for the occupant.

This rating system is designed mainly for the residential sector and addresses six main features of residential complexes [53] as below:

- Site Selection and Planning
- Water Efficiency
- Energy Efficiency
- Materials and Resources
- Indoor Environmental Quality
- Innovation and Design Process

Each of these six categories has certain mandatory requirements and a couple of voluntary requirements. In order to receive the rating, all the mandatory requirements have to be complied with along with whichever voluntary requirements are possible. A checklist is formed with the points that were given to each voluntary requirement, being totaled. Based on the sum of all the points, the rating (Table 1). The Indian Green Building Council (IGBC) is responsible for issuing certifications and conducting inspections. They may review and reconsider certification at any time during the commissioning or operation or occupancy stage of the residential complex.

In case of Japan, CASBEE which is a system developed by the Japan Sustainable Building Consortium (JSBC) is used for ranking and evaluating buildings in terms of their energy and environmental performance [54]. The rating system is formed in collaboration with many stakeholders, taking into consideration the suggestions and claims brought in by government, industry and academia. The Building Standards Act is the backbone for the formation of this rating system. According to the Building Standards Act, it is the legal obligation of every citizen residing in Japan to develop and construct houses and homes that are beneficial to society at large. CASBEE encompasses the BSA which includes environmental standards, earthquake resistance standards and ventilation standards among others. CASBEE for Homes (Detached Houses) is voluntary by nature. The local government bodies use it as a platform for evaluation as part of the application procedure for obtaining a permit prior to construction or occupation. This rating system is in place to evaluate houses which are based on two viewpoints Q and L as explained in earlier sections. Each of the above viewpoints has three scoring items in them [13, 54]. They are:-

- Q1 – Comfortable, Healthy and Safe Indoor Environment
- Q2 – Ensuring a long service life
- Q3 – Creating a richer townscape and ecosystem
- LR1 – Conserving Energy and Water

- LR2 – Using Resources sparingly and reducing waste
- LR3 – Consideration of the global, local and surrounding environment

Five points are assigned to each scoring item, which is then summed up and converted to points on a scale of 1 to 100. Furthermore, the Building Environment Efficiency (BEE) is calculated using the following formula:  $BEE=Q/L$ . This value is then plotted on a graph whose y-axis is environmental quality and x-axis is environmental load. Accordingly, a five star rating system is assigned to the obtained score (Table 2). Point weightage to each of the scoring items is mentioned below:-

**Table 2: Point Weightage to Scoring items**

Items	Points	Items	Points
Q1	45	LR1	35
Q2	30	LR2	35
Q3	25	LR3	30
<b>Total</b>	<b>100</b>	<b>Total</b>	<b>100</b>

Source: IBEC 2016

Higher the rating obtained for load reduction initiatives (LR); the better CASBEE score can be obtained. High rating for Q and low Rating for environmental load (L) is also good. CASBEE does not consider or evaluate aesthetics, costs or individual lifestyle preferences.

### 3.7. SWOT Analysis

SWOT Analysis is used as a tool to identify internal strengths & weakness and opportunities & threat arising from the external environment for the IGBC Green Homes standard as compared to that of the CASBEE for Homes (Detached Houses) standard. The results of SWOT analysis can provide an important assessment of the macro environment and the aspects of micro environment that can provide insights to meet the objectives of this study.

### 3.8. IGBC rating System

**Strengths:** The building sector contributes up to 30% of global annual greenhouse gas emissions and consumes up to 40% of all energy. The high growth prospective in growing economies and the inefficiencies makes them suitable for green building standards [55]. The raising concern of climate change in the international society has put a pressure on Indian government to develop regulations to control emissions from urban infrastructure [56]. The IGBC Green Homes standard thus becomes a tool to mitigate risks from evolving regulations and helps develops meet the compliance obligations. The adoption of the standards reduces operating costs and improves worker productivity [57]. The Indian Green Building Council (IGBC), part of the Confederation of Indian Industry (CII) was formed in the year 2001 with backing of the USGBC. USGBC has a global presence and experience that goes back decade to support the development of the standards. The use of



standards has proven to increase occupant performance by 6- 26%, reduce respiratory diseases by 9- 20% [55]. The provision of waste recycling and minimization bring in resource efficiency that further provides an impetus for adoption of the standards.

**Weaknesses:** The efforts to make an infrastructure green involve investment in technology and sourcing of materials that are harmless to environment. It has been observed that many times the project cost have increased as high as 18%, which demotivates the project proponent to opt for the standards [57]. The Indian regulations of Energy Efficiency and Building code (ECBC) are voluntary codes which are under acceptance from different states in India. However, these regulations are still not mandated by many states and the absence of such regulations hinder the progress of the adoption of standards. The Indian green building industry has increased the share in the past decade but still fails to capture the interest of small realtors due to lack of awareness [58].

**Opportunities:** The market size of green buildings in India grew at a CAGR of 30% between 2013 and 2016. Currently, India has the second largest green footprint (under the registered category) which in absolute terms comes to 3.59 billion square feet, only next to the United States which has 138 billion square feet area under the LEED (Leadership in Energy and Environment Design) certification system. Given the growing awareness and much sought-after resource efficiency among both the developers and occupiers, the market size for green buildings is expected to rise to 10 billion ft<sup>2</sup> by 2022 [59]. The smart city vision of Ministry of Urban Development of Government of India has facets that make provisions for adoption of green buildings. One of the key strategies for combating climate change in INDC submitted by India is by developing climate resilient urban centres. The Indian government has launched programs for rejuvenation of urban areas by Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and National Heritage City Development and Augmentation Yojana (HRIDAY). This further provides the necessary impetus for green infrastructure rating systems. The Indian government has undertaken concrete steps for making smart cities a reality with the recent announcement of 98 aspirants. These smart cities will compete with each other to come up with holistic plans for becoming model cities [60].

**Threats:** The presence of different kinds of green building rating system in India such as GRIHA, EDGE leaves the customer ambiguous and makes the choice difficult. Building sector in India is controlled by private sector. There are no regulations in India that mandate the use of green building rating systems for private builders [61]. Violations of the building norms are reported by many incidents in India which makes the case for any guidelines related to green building invalid. The investors in India aim at returns

in short term and the equator principle of investing has not yet become popular among Indian investors yet. Therefore, there is no special preference towards investing in green buildings or relevant certification.

#### 4. CASBEE for Homes (Detached Houses)

**Strengths:** CASBEE rating system clearly shows the building performance with regards to quality of the environment and load(strain) of building on the environment. Provision of life cycle analysis (LCA) and credit for analysis using rule of thumbs that depends on the major building elements are related to life cycle CO<sub>2</sub> emissions [62]. A robust mechanism of evaluating according to the credits after assessing the introduced materials that are useful for resource preservation like recyclable materials and renewable materials strengthens the rating system over others. In summary, 'environmentally friendly buildings' evaluates the effort for the CASBEE assessment because it evaluates the resources along with its introduction, preservation, recyclability, availability and suitability [63]. Indicators of indoor air quality and provision of counter measures against chemical contaminants [62, 64] ensures environment friendly building ratings certifications [65]. Emphasis on initiatives taken by the developer to reduce load on environment, not ignoring the demolition stage under LCA [63], comprehensive scoring mechanism that takes into account all environmental, social and economic aspects along with regulatory support adds strength to the CASBEE rating system.

**Weaknesses:** The major weakness in the CASBEE rating system, also advocated by other researchers is adoption is limited to Japanese building market and lack of international body and council affiliations [66]. Apart from that CASBEE has no international benchmarking at all and therefore does not benchmark findings with any external rating system. As per [67], in CASBEE system for land selection, there are no points dedicated for the same. The land in Japan being a hilly considered to be poor for building makes land and site selection a crucial aspect in the construction sector. Also there is no significant difference in evaluation of different building sectors like residential, non-residential, university buildings, public buildings or commercial [66, 68]. The focus on evaluation of aesthetics and cost of individual lifestyle and preference is also appears to be missing or misplaced.

**Opportunities:** In spite of weaknesses and strength of CASBEE rating system in Japan, it has many opportunities. The exceptional case of involving LCCO<sub>2</sub> in its evaluation and credit scoring encourages the policy documents to include it as a tool. It has been use in many policy document of different organisations like MLIT action plan 2008. Also included in the Kyoto Protocol Target Achievement Plan 2008 for energy efficiency improvement in houses and buildings [69, 70]. Due to focus on kyoto

protocol achievement plan and awareness among the large contractors interest seeing it as a market potential of sustainability gets massive promotion of CASBEE in Japan. Due to massive initiatives and policies both at national and local levels for the climate change and Kyoto Protocol target achievement plan, public masses are well aware of the issue and motivated for improvement [71]. Japan builds 500,000 new homes every year. It is estimated from the Global Real Estate Sustainability Benchmark (GRESM), that there is hike of 36% from 2014 in leasing agreements incorporating green lease terms [72]. Therefore huge potential for implementing residential green building rating system.

**Threats:** The increasing cost of green buildings due to high initial investment cost associated with the technological aspects related to green buildings [71]. Other renowned agencies are also forming their own green building rating systems in Japan. LEED, an internationally recognized standard are widely followed and are taking into account the Japanese commercial and cultural norms to strengthen their presence in country [72]. Illegal housing in overpopulated rural areas with lack of permission from the authorities poses major threat in the development and implementation of green buildings system in the country.

#### 4. Future Prospects

##### 4.1. Green Building Sector in India

India is one of the fastest developing nations in the world, with its continuously growing population, expanding middle class and growing disposable income of the common man. The age old culture of entire families staying under the same roof is phasing out and is being replaced by a culture where every member of the family looks for a new dwelling place after a certain age. This trend shows that the already vast real estate industry is bound to grow by leaps and bounds. With the growing need for housing, there is an even greater need that this demand be met in a sustainable way. The way forward to this end is through green building certification for all forms of residential developments including gated communities, residential towers and row houses among others.

As time passes newer technologies, methods and techniques are being discovered and are being made available to society. These may initially have a high investment cost, but are bound to make processes more efficient in a way that the environment is preserved and natural resources are conserved. Therefore these new technologies, methods and techniques not only have to be implemented but have to be added to the current rating systems in order to ensure proper sharing of information in which the best practices are being used throughout the country. The Indian Green Building Council also keeps updated with the latest technologies and standards and updates

its rating systems on a continuous basis. All of IGBC's rating systems undergo a standard periodic review to incorporate the latest changes of the industry in their rating systems. The IGBC also promotes capacity building in order to spread the use of green building standards and to increase the number of their skilled workforce that take part in inspections, reviews and accreditations.

##### 4.2. Green Building Sector in Japan

Japan, known as the technology hub of the world, is constantly innovating and finding new technologies and processes to get things done in a more efficient manner. The need for sustainable development in the real estate sector grew from concerns of natural resource exhaustion and flourished into a branding tool for real estate developers throughout the country to bump up prices. With the support of government policy, this green buildings market is bound to grow even further and expand to all corners of the island nation. CASBEE for Homes (Detached Houses) was formed primarily for new constructions of detached houses. The Japan Sustainable Building Consortium is now working on a green building standard that will be applicable not only for new construction but for redevelopment and refurbishment of existing households as well. The next versions which will be released are said to be aimed at all sectors of housing which include duplex houses, societies and collective housing among others, so as to come out with a whole new version of CASBEE for Homes that addresses the need of all types of households. The future in Japan is to move towards a sound material cycle society and hence the JSBC aim of capacity building through CASBEE Accredited Professional Rating System is being carried out.

#### 5. Conclusions

Although the IGBC – Green Homes and CASBEE for Homes (Detached Houses) are two green building rating systems that are both used for the residential space, they are both very different. The underlying need for these systems in their respective countries arose due to different reasons. In India, the need for sustainable development to promote cost reduction during the operation phase and the high price of utilities in the country has engineered the growth of the green building sector. However, in Japan, the need to build sustainable housing that could withstand natural disasters and at the same time cause little stress on a nation whose natural resources are depleting were the main drivers for this sector.

Coming to the regulatory support of both the countries, it is clear that Japan has more stringent framework in place that directly deals with green buildings and promotes their growth by ensure that the public build sustainable developments that have social benefit. In India, although many environmental laws are in place along with building codes and energy conservation building codes, there are no acts

that directly support the use of green buildings or make them mandatory for some sectors in the country.

The implementation methods of both the rating systems are also very different with the IGBC – Green Homes being more of a checklist method that follows set parameters on the system and awards points for conformance. However the CASBEE system is a more scientific method that not only calculates the quality of the environment but also the environmental loading by virtue of the construction. It also considers the various initiatives that are conducted to meet the end result. Use of LCCO<sub>2</sub> is exceptionally best practice for CASBEE including all the stages till demolition stage of construction.

Both systems are being implemented in countries in which the demand for housing is ever increasing. The implementing agencies of both rating systems have similar plans for taking their system forward. They have both begun initiatives to promote capacity building and skill development in the sector. They are also continuously updating their systems in order to incorporate the latest methods and techniques. Finally Japan wishes to increase the reach of its rating system by including all kinds of residential developments in the system.

This article laid the foundation basics understanding the two systems but empirical system with application of appropriate tool would possibly present more robust picture of two systems and challenges to strengthen the system of ratings. This comparative study is based on literature study including working papers, various reports, published papers, and therefore a quantitative research of the study is further needed. Use of appropriate tool for empirical research and focusing of building specific sectors is advocated to strengthen the study objectives. Present study suggests comparison of these rating systems with other like LEED and GRIHA as a further scope of work.

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