# Sustainable building: Assessment tool in brazil

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ABSTRACT: The concepts about sustainable development include the environmental, economic and social sustainability, emphasizing the quality of life of people and communities. In the case of Brazil, the investment in this field can be considered as being recent in what to the scientific research is concerned. The country does not have a wide database regarding its five regions, capable of covering aspects such as climate, along with the social, cultural and economic reality. Furthermore, in Brazil does not yet exist an assessment tool that may be able to answer to all the country's questions. In this context, this paper aims to contribute to the development of new assessment strategies by introducing the national panorama of certified buildings and taking into account the current conditions and the differences between the five main regions in which the country is divided: Midwest, Northeast, North, South and Southeast. It is intended to help the professionals that work on this subject and to support sustainable development in the Construction Industry in Brazil.

***Keywords*** *assessment tools, regions of Brazil, Brazilian database, green building.*

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## 1. INTRODUCTION

Brazil is the fifth largest country in the world with 3,287.956 square miles, 5,570 cities, and 27 states divided into five regions (North, Northeast, Southeast, South and Midwest). This division in regions and states enables the planning of political actions directed for regions with similar characteristics.

There are four different time zones, as well as four climatic regions in Brazil (equatorial climate, tropical climate, subtropical climate and quasi arid climate), which explain the different construction practices and building types. In this context, the global interest about the sustainable development in the Brazilian construction industry is promising. However, a definition for this segment is complex as it is divided into many parts despite the several incentives in recent years, which are, however, timid when compared with the rest of the world.

In the last 14 years, the Brazilian GDP per capita increased 21.4%. Economic growth is directly linked with education, being that, currently, higher education is represented by 2,416 institutions, being 87.4% of them private and 12.6% public institutions. The number of graduate students in 2012 has more than doubled when compared with 2002, increasing from 467,972 to 1,050413 professionals. 74,539 of these students belong to the fields of engineering (engineering of production and construction (building) is 7% of the total). However, Leite (2013) states that the number of graduated professionals is not enough since the demand for houses in 2010 has grown 28% when compared to the year 2000. (MEC/INEP (2012))

According to the GBC Brazil (2014), the main concentration of professionals of the construction industry is located in the Southeast, with 67.24% in São Paulo followed by 8.37% in Rio de Janeiro. A general analysis of higher education institutions, both public and private, shows that the situation is not different regarding the students of engineering since the Southeast stands out with 49% of the country's total.

In this context, it is worth mentioning the several global meetings on the topic of sustainable development that have been taking place and the numerous governmental organizations that have offered and periodically updated the Sustainable Development Indicators in accordance with the Commission on Sustainable Development. In Brazil, the Brazilian Geography and Statistics Institute (IBGE) has been undertaking that research since 2002 focusing on four aspects, summarized below (IBGE, 2015):

i) *The environmental dimension*: it refers to the use of natural resources and environmental degradation, and is related to conservation objectives and environmental preservation, being considered as essential for the quality of life of the present and future generations. These issues appear organized in 20 (twenty) indicators arranged according to aspects such as atmosphere, earth, water, oceans and seas, biodiversity and sanitation;

ii) *The social dimension*: it concerns objectives related to the satisfaction of human needs, improvements in the quality of life and social justice. The 21 (twenty one) indicators are arranged by population, labour and income, health,

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education, home and security, aiming to depict the educational level, income distribution and living conditions;

iii) *The economic dimension*: is concerned with the use of natural resources, industrial production and waste management, energy use and its connection with the financial performance of the country. This dimension refers to the efficiency of production processes and changes in consumption patterns, being organized in 12 (twelve) indicators;

iv) *The institutional dimension*: is concerned with the political orientation, the ability and effort spent by governments and society towards the effectuation of changes required for an effective implementation of sustainable development, and is presented in 9 (nine) indicators.

However, the characterization of the Brazilian Building Industry is complex since it involves of a variety of supply sectors along with the fact that some of them do not contemplate aspects of sustainability. Taking in consideration that the adoption of green building practices can minimize the social, environmental and economic impacts in the country, the following topics provide features about the characteristics of five different regions of Brazil, providing an understanding of the Brazilian Building, which is the highlight of this work.

## 2. ASSESSMENT TOOL IN BRAZIL

Many assessment tools have been developed in several countries - United States, Canada, France, Portugal, among others - that involve the assessment of alternative scenarios based on different criteria as, for example, environmental (energy consumption, $CO_2$ emissions, environmental performance), economic (life cycle costs, capital cost, durability), and social (thermal and acoustic cost, quality of the air) (Diakaki et al., 2010; Cox et al., 2014).

In the case of Brazil, there is the Brazilian Sustainable Building Council (www.cbcs.org.br) (CBCS, 2015), as well as several research centres and agencies involved in the issue in question. However, the Brazilian assessment tools are international adaptations and do not properly take into consideration its own characteristics.

In Brazil, the most nominated and commercially accepted assessment tools, given that they analyze a variety of aspects of the building (deployment, water and energy efficiency, environmental comfort, performance of the materials, among others), are:

i) LEED certification (Leadership in Energy and Environmental Design): US Green Building Council (2014) in which Brazil occupies the first position in Latin American and the third among the countries with the highest number of LEED, behind the United States and China (GBTOOL, 2014; Matos, 2014);

ii) AQUA (adapted the HQE (Haute Qualité Environnementale des Bâtiments)): has a less significant application in Brazil (less than 18% when compared with LEED) (Matos, 2014; AQUA, 2014).

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The LEED assessment tool aims to identify the efficiency and environmental performance of the building through an evaluation system based on credits, in different levels of environmental performance: Certificate (minimum 40 points), Silver (minimum 50 points), Gold (minimum 60 points), and Platinum (over 80 points). Emits the following categories (USGBC, 2013) in the following versions: LEED Core & Shell, LEED New Construction & Major Renovation, LEED for Commercial Interiors, LEED Existing Buildings – Operation and Maintenance, LEED Retail, LEED for Schools, LEED for Neighbourhood Development and LEED for Healthcare.

AQUA (adjustment of HQE) is based on the observation of the environmental performance, management and the process of enterprise, giving certification through the meeting of the requirements in a scale ranging from "GOOD" to "EXCELENT". The certification is given to each phase of the design process, building and operation. It is possible to obtain five certification levels: program, conception, building, operation program and operation. It is suitable for houses, schools and offices. (FUNDAÇÃO VANZOLINI, 2009)

## 3. DATABASE YELLOW - GREEN

Taking this assessment tool in consideration, it was created a database about the buildings that are certified and registered as well as their distribution among the Brazilian Regions. This is illustrated in Table 1 and Figure 1, which shows the results of certifications LEEED / Brazil. Therefore, it was observed that by the second half of 2013 the system had already assessed 854 projects in total, being that 169 of them had already been certified and 685 were registered and the certification was in process (GBC, 2014).

Table 1. LEED/Brazil Regions. (Source: GBC Brasil (2014)).

| Regions of Brazil | LEED | | ∑ Region | Level of certification | | | |
|---|---|---|---|---|---|---|---|
| | Certificate | Registered | | LEED | LEED Silver | LEED Gold | LEED Platinum |
| North | 0 | 14 | 14 | 0 | 0 | 0 | 0 |
| Northeast | 9 | 40 | 49 | 3 | 6 | 0 | 0 |
| Midwest | 2 | 23 | 25 | 0 | 0 | 2 | 0 |
| Southeast | 145 | 536 | 681 | 30 | 45 | 61 | 5 |
| South | 13 | 72 | 85 | 1 | 6 | 6 | 0 |
| **∑** | **169** | **685** | **854** | **34** | **57** | **69** | **5** |

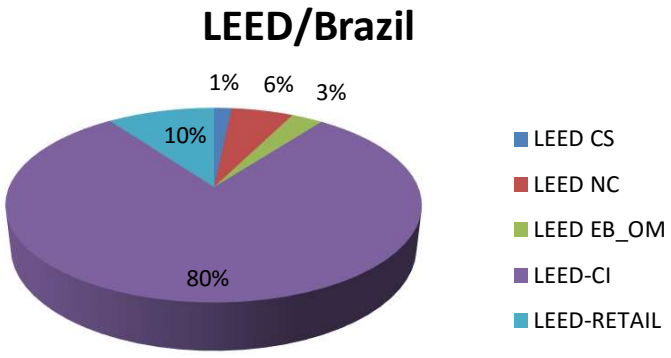


Figure 1 - % LEED in Regions of Brazil.

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Table 1 and Figure 1shows that the south-eastern region of Brazil has a large number of buildings evaluated through the assessment tool LEED. The Southern region goes along with the national average, with 8%. About the LEED version, the LEED CS (core & shell) is the most common, followed by others (LEED New Construction, for example), as it can be seen in table 2.

Table 2 and Figure 2 shows a strong variation between the versions of LEED. In the end of the ranking are Neighbourhood Development and LEED, with 5 (five) projects, LEED for schools with 4 (four) registered and, finally, LEED for Healthcare with only 3 (three) hospitals.

Table 2. Versions of LEDD x Regions of Brazil (GBC Brazil (2013)).

| LEED Versions | Regions of Brazil | | | | | Brazil |
|---|---|---|---|---|---|---|
| | North | Northeast | Midwest | Southeast | South | Σ |
| LEED CS | 5 | 18 | 11 | 314 | 45 | 393 |
| LEED NC | 3 | 24 | 10 | 241 | 31 | 309 |
| LEED EB_OM | 6 | 2 | 2 | 55 | 3 | 68 |
| LEED-CI | 0 | 2 | 0 | 49 | 4 | 55 |
| LEED-RETAIL | 0 | 1 | 1 | 15 | 0 | 17 |
| LEED ND | 0 | 1 | 1 | 2 | 1 | 5 |
| LEED FOR SCHOOLS | 0 | 1 | 0 | 2 | 1 | 4 |
| LEED HC | 0 | 0 | 0 | 3 | 0 | 3 |

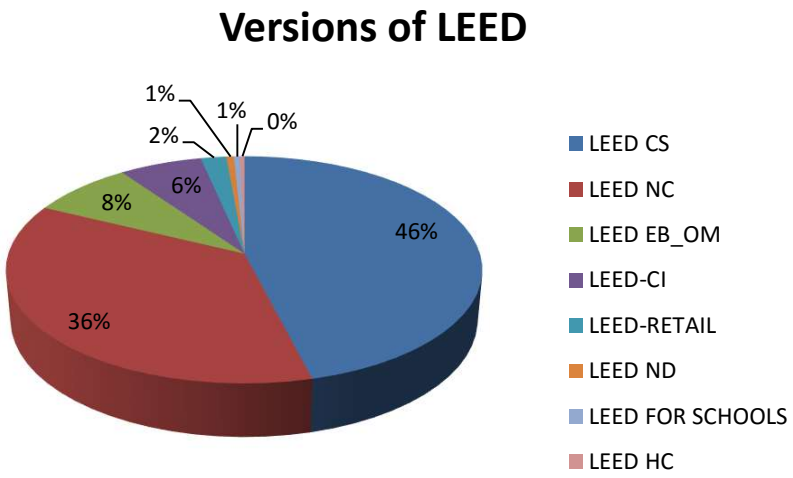


Figure 2 – Versions of LEED.

The AQUA assessment tool (adapted to HQE) performs the verification in two moments: management system (SGE) and Environmental quality of building (QAE). The first moment ensures the implementation of the second and it is organized in four steps (Appointment, Operation, Management, Learning). In the second moment, the QAE analysis is executed in order to evaluate the project and the building (i.e., Project, Conception, Building, Operation and Use). (FUNDAÇÃO VANZOLINI, 2013)

Tables 3 and 4, Figure 3 and 4 show the buildings certified by the AQUA assessment tool. The south-eastern region of Brazil has the largest number of nominations even though all

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regions in Brazil have employed this assessment tool. The concernment for Home Building is evident flowing the school building.

Table 3. AQUA assessment tool in Brazil (QAE e SGE). (FUNDAÇÃO VANZOLINI, 2013).

| **Region** | **AQUA** | | **∑** | **Levels of Certification** | | | | |
|---|---|---|---|---|---|---|---|---|
| | QAE | SGE | | Project | Conception | Building | Operation | Use |
| North | 2 | 6 | 8 | 5 | 3 | 2 | 3 | 2 |
| Northeast | 1 | 12 | 13 | 12 | 7 | 1 | 1 | 0 |
| Midwest | 1 | 6 | 7 | 6 | 3 | 1 | 1 | 1 |
| Southeast | 12 | 123 | 135 | 120 | 46 | 12 | 16 | 5 |
| South | 2 | 5 | 7 | 3 | 2 | 2 | 4 | 2 |
| **∑** | **18** | **152** | **170** | **146** | **61** | **18** | **25** | **10** |

Table 4. AQUA assessment tool for each region of Brazil. (FUNDAÇÃO VANZOLINI, 2013).

| AQUA assessment tool | Regions | | | | | ∑ |
|---|---|---|---|---|---|---|
| | North | Northeast | Midwest | Southeast | South | |
| Home Building | 1 | 3 | 0 | 54 | 0 | 58 |
| School | 0 | 4 | 3 | 41 | 0 | 48 |
| Operation/ Use | 3 | 1 | 1 | 14 | 4 | 23 |
| Commercial | 3 | 4 | 2 | 7 | 2 | 18 |
| Accommodation and leisure | 1 | 1 | 1 | 9 | 0 | 12 |
| Neighborhood | 0 | 0 | 0 | 6 | 0 | 6 |
| Industry | 0 | 0 | 0 | 3 | 1 | 4 |
| Renovation | 0 | 0 | 0 | 1 | 0 | 1 |

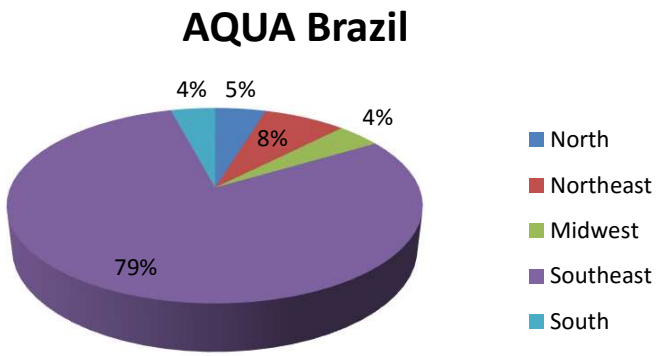


Figure 3 - % AQUA in Regions of Brazil.

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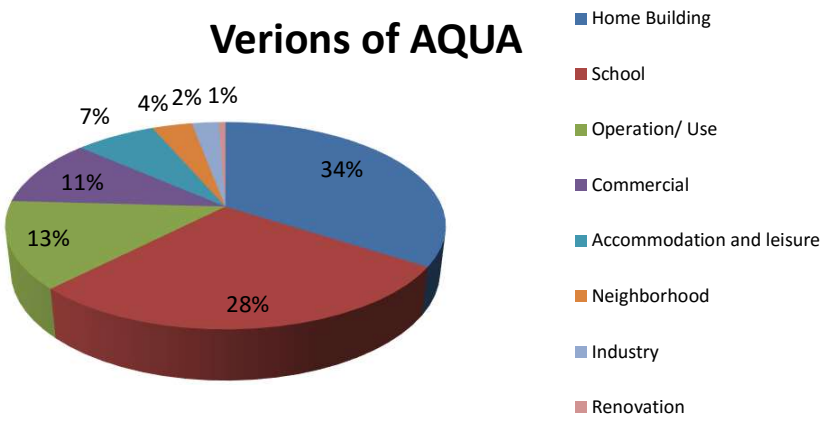


Figure 4 – Versions of AQUA.

## 4. ANALYSIS ABOUT ASSESSMENT TOOLS IN BRAZIL

Through the databases presented it is possible to verify that:

i) LEED/ Brazil and AQUA assessment tools totalize 1024 certified buildings in Brazil;

ii) LEED assessment tool is employed in 854 buildings, being that 169 of them are certified and 685 are in process of certification, while AQUA assessment tool is employed in 170 buildings;

iii) Brazil is the first sustainable building (or green building) country in Latin American, the fourth country with LEED assessment tool in 2013 after the USA, China and Arab Emirates, respectively.

iv) USGBC (2010) indicates that the LEED Brazil assessment tool is 0.8% of the world index;

v) AQUA assessment tool is employed in 170 buildings, being 18 of them assessed for Environmental quality of building (QAE) and 152 for management system (SGE);

vi) The south-eastern region of Brazil has 79.8% of the certified buildings (LEED and AQUA). The southern and north-eastern regions in Brazil have 9.0% and 6.0%, respectively, and the Midwestern regions of Brazil have 3.1% and, at the end, the northern region of Brazil with 2,1% of green buildings;

vii) The LEED assessment tool mostly used is the LEED CS because "the builders" seek to add the importance of the certificate in the final price of "the chamber";

viii) The AQUA assessment tool is mostly used in home buildings because LEED/ Brazil does not have the particular version for the Home Brazil building;

ix) LEED Brazil implements the documental analysis without the presence of the author while the AQUA assessment tool carries out the monitoring of the performance, i.e., from the project to the occupation of the building;

x) The certificate is interesting for the promotion and marketing of the project and also encourages new businesses;

xi) The number of "green buildings" in Brazil is low because the deployment cost of the assessment tool is high. Other reasons are the inexistence of an assessment tool based on the state-of-the-art methodologies that takes

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standardization into account and also the lack of qualified professionals on the subject of assessment tools;

xii) Finally, the sustainable building in Brazil is greater in the building market, i. e., "sustainable construction is the regulation of the building industry because it differentiates the product and integrates demand to user".

## 5. CONCLUSIONS

In this context, contributions for the Brazilian construction industry and for the political consolidation of "green building" are very important. However, the building's design will be possible with the introduction and consolidation of environmental changes, both in the social and in the economic aspects, including the building process.

Analyzing the Brazilian territory and its regional differences - associated with public policies that, in this case, include the financial and technical incentives in all principles of sustainable development – as well as its socio-economic inequalities, are important indicators in the reinforcement of "Green Building Brazil". The assessment tool guide in the Brazilian and in the international civil construction industry usually follows four steps: quantification of the performance of the building at the level of each indicator; standardization of parameters; collection of parameters and sustainable scores for global assessment.

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