RG&SA Revista Gestão & Sustentabilidade Ambiental
Artigos

ANALYSIS OF BRAZILIAN LEGISLATION BASED ON WATER EFFICIENCY CRITERIA OF LEED AND AQUA-HQE CERTIFICATIONS

DOI: http://dx.doi.org/10.19177/rgsa.v9e02020224-236

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ABSTRACT

As the global population grows, so grows the water demand, since it is essential for human existence. That is why the main environmental certifications in civil construction comprise a category exclusively for preservation and conservation of water. Even though certifications are becoming well-known, it is the law that determines how cities develop. This article investigates the link between the laws of the capital cities in the South and Southeast regions of Brazil and the water criteria in LEED and AQUA-HQE certifications. It was shown that the certifications are much more strict, quantitative and encompassing than the laws. The reduction in water consumption appeared to be the main concern both in the law and in the certifications.

Keywords: Water efficiency. Certifications. Legislation.

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ANÁLISE DE LEGISLAÇÕES BRASILEIRAS COM BASE NOS CRITÉRIOS DE EFICIÊNCIA HÍDRICA DAS CERTIFICAÇÕES LEED E AQUA

RESUMO

Conforme a população mundial cresce, cresce também a demanda por água, essencial para a vida humana. É por isso que as principais certificações ambientais da construção civil abrangem uma categoria exclusiva para propor medidas de cuidados e preservação da água. Embora as certificações sejam cada vez mais reconhecidas, são as legislações que regem o desenvolvimento atual. No presente artigo analisou-se como as legislações das capitais do Sul e Sudeste brasileiro se equiparam aos critérios das certificações LEED e AQUA-HQE nas categorias de eficiência hídrica. As certificações mostraram-se mais rigorosas, quantitativas e abrangentes que as leis. A redução do consumo de água potável mostrou-se principal preocupação comum entre leis e certificações.

Palavras-chave: Eficiência hídrica. Certificações. Legislação.

1 INTRODUCTION

Urban laws are the collection of politics, legislations, decisions and practices that govern the management and development of the urban environment. The judiciary systems are among the main barriers for mayors and managers when it comes to implementing renovations and overcoming challenges in their cities (UN-HABITAT, 2017). Some cities, such as Seattle, have already implemented plans, programs and legislations regarding sustainable construction (MELCHERT, 2007). Meanwhile, other cities laws still approach the sustainable building topic superficially (RIBEIRO *et al.* 2018).

Sustainable design and construction involve the reduction, or even the elimination, of the negative impacts that buildings may have in the environment (ALLEN; POTIOWSKY, 2008) through sustainable planning, water efficiency, energy efficiency and the conservation of materials and resources (CHAU *et al*., 2010). Thus, methods of assessment of buildings that evaluate and certify sustainable construction have been growing significantly in importance in civil construction (SUZER, 2019). In this regard, the Leadership in Energy and Environmental Design (LEED) and the High-Quality Environment (HQE) certifications stand out.

LEED is an international environmental certification and guide for buildings present in 160 countries. It aims to encourage the transformation of projects, construction and operation of buildings, focusing on sustainability (GBC, 2018). The AQUA-HQE, Alta Qualidade Ambiental, is an adaptation of the HQE™ made by CERWAY and the Vanzolini Foundation, which is the main certifier in civil construction in Brazil. Therefore, it aims to certify high environmental quality buildings according to the country's reality (FCAV, 2016).

Among many other items evaluated in both LEED and AQUA-HQE certifications, it is possible to highlight water, since its efficient use is essential for the future of food, water and energy security (AMORIM *et al*., 2018). In the urban context, the economy reached by demand management programs and rational use of water may have a significant impact on the supply system (WILLIS et al*.*, 2013). This is extremely important since the world water demand has grown meaningfully in the last few years (BUREK *et al*., 2016).

This article aims to analyze how the legislations related to the rational use of water in buildings in the capitals of the regions South and Southeast of Brazil fit in the water efficiency category criteria of the LEED and AQUA-HQE certifications.

2 METHOD

The method used in this bibliographic and exploratory research is based on the methodological steps below.

2.1 Selection of systems of environmental certification

For this research, the most well-known methods regarding evaluation of sustainability were analyzed. The selection of the environmental certification systems considered their applicability nation and worldwide, the availability of bibliographic information and the criteria adopted as reference in each system.

2.2 Identification of the assessment categories

The main characteristics of each certification system were analyzed with the support of Table 1. Then, the assessment categories that focused on water efficiency were chosen.

Table 1: Main characteristics of the environmental certifications AQUA-HQE and LEED.

	AQUA		LEED
Assessment categories	1-Building and surroundings	8-Hygrothermal comfort	1-Location and transportation
	2-Construction products, systems and processes	9-Acustic comfort	2-Sustainable sites
	3-Construction site	10-Visual comfort	3-Water efficiency
	4-Energy	11-Olfactory comfort	4-Energy and atmosphere
	5-Water	12- Indoor environmental quality	5-Materials and resources
	6-Waste	13-Air quality	6-Indoor environmental quality
	7-Maintenance	14-Water quality	7-Innovation
			8-Regional priority
Applicability	Adapted for the Brazilian reality.		Developed for the USA, with international applicability.
Methodology of evaluation	Evolutional assessment, made through auditing during the pre-design, design and execution steps. Development levels grow according to the percentage of accumulated score: Base (B); Good Practices (GP); Best Practices (BP).		Building assessment based on a check-list, in which credits are attributed according to a pre-existing objectives list. The final ranking is obtained by the sum of all points.
Ranking	Global: 14 categories type B		Certification: 40 to 49 points
	Pass: 4 estrelas em nível BP and MP		Silver: 50-59 points
	Good: between 5 and 8 stars in level GP and BP		Gold: 60-79 points
	Very good: between 9 and 12 stars in level GP and BP		Platinum: 80 points or more*
	Excellent: between 13 and 15 stars in level GP and BP		
	Exceptional: 16 stars or more		*Maximum 110 points

Source: Adapted from Cardoso and Pablos (2014).

2.3 Law selection

Regarding laws, the ones related to the rational use and use of alternative sources of water in buildings in the capitals of the South and Southeast of Brazil were selected.

2.4 Scale of law evaluation

In each criterium of the analysis, the scale “Fail to fulfill”, “Fulfills” and “Partially fulfills” was used for LEED. For AQUA, the scales “Score” and “Partially scores” were added due to the structure of criteria. In case the law did not encompass the criterium requirement, the option “Fail to fulfill” was attributed. If the law cited part of the requirements for the criteria, it was considered that it “Partially fulfills” to the criterium. If the law fulfilled all the requirements of score for the criterium, the classification used were “Scores” and, in case it fulfilled only part of the requirements of score, it was ranked as “Partially scores”. Finally, in cases the law encompassed all the requirements, it was considered that it totally fulfilled the criterium.

3 RESULTS

3.1 Choosing the environmental certification systems and the laws related to the rational use of water

In this article, the environmental certification systems for buildings used nationwide in Brazil were chosen: AQUA-HQE and LEED. Regarding the assessment categories, the AQUA-HQE reference guides for Residential (R) and Non-Residential (NR) were analyzed in the category “Water”, Table 2. For the LEED analysis, the category “Water efficiency” was chosen owing to its approach regarding the rational use of water, Table 3.

Table 2: AQUA-HQE – Water category.

	Criterium	Goal
Score	Water metering	To measure water consumption and to monitor it in an indicator panel, aiming to identify possible leaks. (R)
Base and score	Reducing distributed water consumption	To limit the maximum dynamic pressure to 300 kPa, to install elements with reduced water consumption and to safe water in common areas and housing units. (R)

Base and score	Reducing drinking water consumption	To limit the maximum dynamic pressure to 300 kPa, to calculate annual consumption, to install elements with reduced water consumption and to use alternative water sources. (NR)
Base	Need for hot water	To define reference parameters in order to size the hot water production. (R)
Base and score	Managing wastewater	To treat the wastewater properly, aiming to reuse it. (R)
		To control the waste of wastewater according to the regulation NBR 13969 and to study an innovative system to treat them; To foresee the reuse of wastewater. In case of a unitary net, to restrain the waste of rainwater (20-80%). (NR)
Base and score	Managing rainwater	To control the outflow, impermeabilization and infiltration of the site. To foresee a system for rainwater harvesting and to provide information for its maintenance. (R)
		To fight chronic and accidental pollution. (NR)

Source: authors.

Table 3. LEED – Water efficiency category.

	Criterium	Goal
Requirement	Outdoor water use reduction	To eliminate or reduce in at least 30% the irrigation of the land by the selection of certain species of plants and irrigation system efficiency.
Requirement	Indoor water use reduction	To reduce water consumption in 2% compared to the baseline using hydro sanitary efficient devices.
Requirement	Building-level water metering	To meter the building total use of water through the installation of permanent water meters.
Credit	Outdoor water use reduction	To eliminate or reduce in at least 50% the irrigation of the land using alternative water sources and of intelligent programming technology.
Credit	Indoor water use reduction	To reduce water consumption in 25-50% compared to the baseline using hydro sanitary efficient devices and alternative water sources.
Credit	Cooling tower water use	To conserve water for refilling the cooling tower while controlling microbes, corrosion and crust in the water system of the condenser.
Credit	Water metering	To install permanent water meters for two or more water subsystems such as irrigation, hydro devices, hot water and recovered water.

Source: GBC (2018).

Regarding the laws, the ones which aim to establish a program of conservation and rational use of water in buildings were chosen. Among the cities analyzed, Belo Horizonte was the only one that did not have any legislation with this goal. Therefore, for this city, the legislation regarding the reuse of water in

buildings was chosen. Table 4 presents the selected legislations, the year when they were published and a brief description. The laws in Curitiba, Florianópolis, Porto Alegre e Rio de Janeiro highlight that not fulfilling the provisions implies in the refusal of the building permit for new buildings.

Table 4: Laws related to the rational use of water in buildings.

Capital	Statutory law	Description	Applies to
Curitiba PR	10785/2003	Create the program of conservation and rational use of water in buildings in Curitiba - PURAE.	New buildings.
Florianópolis SC	8080/2009	Establish the program of conservation, rational use and reuse of water in buildings.	Buildings, including social housing
Porto Alegre RS	10506/2008	Institute the program of conservation, rational use and reuse of water.	Buildings, registration for incentive.
Vitória ES	7079/2007	Establish the program of conservation, reduction and rationalization of the water use in public buildings.	New public buildings.
Belo Horizonte MG	10840/2015	Encompass the reuse of water in public and private buildings.	Public and private buildings.
Rio de Janeiro RJ	5279/2011	Creates the program of conservation and rational use of water in buildings.	New buildings.
São Paulo SP	14018/2005	Establish the city program of conservation and rational use of water in buildings.	New buildings.

Sources: Curitiba (2003); Vitória (2007); Porto Alegre (2008); Florianópolis (2009); Rio de Janeiro (2011); Belo Horizonte (2015); São Paulo (2015).

3.2 Comparative table of the laws' contents regarding the water efficiency criteria

The legislation was analyzed based on the criteria of the categories "Water", from the certification AQUA-HQE (Table 5) and "Water efficiency", from the certification LEED (Table 6).

Table 5: Analysis of the laws based on the AQUA criteria.

	Curitiba (PR)	Florianópolis (SC)	Porto Alegre (RS)	Vitória (ES)	Belo Horizonte (MG)	Rio de Janeiro (RJ)	São Paulo (SP)
Criterium	Law 10785/2003	Law 8080/2009	Law 10506/2008	Law 7079/2007	Law 10840/2015	Law 5279/2011	Law 14018/2005
Water metering	Scores partially	Fail to fulfill	Scores	Fail to fulfill	Fail to fulfill	Fail to fulfill	Partially scores
Reducing distributed water consumption	Partially fulfill	Partially fulfill	Partially fulfill	Partially fulfill	Fail to fulfill	Partially fulfill	Fail to fulfill
Reducing drinking water consumption	Partially fulfill	Partially fulfill	Partially fulfill	Partially fulfill	Fail to fulfill	Partially fulfill	Partially fulfill
Managing wastewater	Fulfill and score	Fail to fulfill*	Fail to fulfill*	Fail to fulfill*	Fulfill	Fulfill	Fail to fulfill*
Managing rainwater	Fail to fulfill*	Fail to fulfill*	Fail to fulfill*	Fail to fulfill*	Fail to fulfill	Fail to fulfill*	Fail to fulfill*

*Cases of fail to fulfill the base criterium although they would score otherwise. Source: Authors.

The criterium for hot water need, which was not mentioned in any legislation, was removed from Table 5. The water metering criterium scored partially in the cities where individualized metering is required. However, only Porto Alegre mentions a system to monitor the water consumption and, therefore, fully scores. The distributed water consumption reduction was mentioned and partially fulfilled, according to the parameters of the AQUA-HQE Residential, by all analysed legislations except for Belo Horizonte and São Paulo. In this criterium, none of the legislations proposed a limit for the maximum dynamic pressure of the system, a base item.

The laws that partially fulfill the criterium of reduction of the drinking water consumption do not specify the demand of water for sanitary use; instead, they only aim to reduce it. Additionally, they limit the use of distributed water without mentioning performance values to be obtained and, consequently, do not score. None of the legislations analysed mentions the base item of this criterium, which

refers to the determination of the global consumption of distributed and drinking water.

Curitiba, Belo Horizonte and Rio de Janeiro fully fulfill the criterium regarding the management of wastewater, while the other cities do not mention the treatment of waste water. Finally, all the laws, except the one from Belo Horizonte, foresee a system for harvesting rainwater. Nevertheless, none of them scores in the criterium for rainwater management of the AQUA-HQE Non-residential since they do not encompass management of retention and/or infiltration, base items of this criteria. It is important to add that Belo Horizonte's law, which has a different approach then the others, is the only one that mentions the regulation NBR 13969 as a reference.

Table 6. Analysis of the legislations based on the LEED certification.

	Curitiba (PR)	Florianópolis (SC)	Porto Alegre (RS)	Vitória (ES)	Belo Horizonte (MG)	Rio de Janeiro (RJ)	São Paulo (SP)
Criterium	Law 10785/2003	Law 8080/2009	Law 10506/2008	Law 7079/2007	Law 10840/2015	Law 5279/2011	Law 14018/2005
Outdoor water use reduction	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill
Indoor water use reduction	Partially fulfill	Partially fulfill	Partially fulfill	Partially fulfill	Fail to fulfill	Partially fulfill	Partially fulfill
Building-level water metering	Fulfill	Fail to fulfill	Fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fulfill
Outdoor water use reduction*	Partially fulfill	Partially fulfill	Partially fulfill	Partially fulfill	Partially fulfill	Partially fulfill	Partially fulfill
Indoor water use reduction*	Partially fulfill	Partially fulfill	Partially fulfill	Partially fulfill	Partially fulfill	Partially fulfill	Partially fulfill
Cooling tower water use*	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill
Water metering*	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill	Fail to fulfill

*Optional criteria (credit). Source: Authors.

The first mandatory criterium is not fulfilled by the analyzed legislations since they neither mention a system of irrigation of the land nor the selection of

certain species of plants for outdoor water use reduction. Almost all the laws, except for the Law 10840/2015 from Belo Horizonte/MG, mention the reduction of indoor water use through water efficient devices; however, as also observed in the AQUA-HQE comparison, they do not mention a percentage of minimum reduction for the consumption. Some of the appliances mentioned in the legislations are: low-flush toilet; showers and wash basins with fixed flow volume and faucets with aerator. Therefore, the criterium reduction of indoor water use was partially fulfilled in most cases

Curitiba, Porto Alegre and São Paulo's laws mention the installation of water meters for individual metering of the volume of water used per housing unit, in condominium buildings. Thus, most laws fail to fulfill the mandatory criterium of water metering in condominium buildings, on account of they do not mention this subject at all.

Regarding the reduction of water use indoor and outdoor optional criteria, the laws mention the use of alternative sources of water, but do not specify a percentage of reduction in the consumption – as proposed in the criteria. Hence, these criteria were partially fulfilled by the laws.

The laws present alternatives for the reuse of water in activities that do not require drinking water (irrigating yards and gardens, washing clothes, cleaning vehicles and sidewalks). Additionally, they mention the reuse of waste water in the water closets.

Finally, the laws do not encompass matters of cooling tower water use and water metering for two or more subsystems (irrigation, water devices, hot water and so on). As a result, the last two criteria were not fulfilled.

4 CONCLUSIONS

In this article, the laws related to the rational use of water in buildings in the capitals of the states located in the South and Southeast regions of Brazil were compared to the criteria of water efficiency of the certifications LEED and AQUA. It was shown that the laws are little quantitative when compared to the certifications, since the laws do not establish values to be reached (e. g. percentage of water use reduction). Due to the lack of details, whenever the laws fulfill a criterium, they do it only partially – with few exceptions.

Some criteria presented in the certifications are not even mentioned in the laws analyzed. Future work could explore the national and state laws aiming to identify guidelines related to water efficiency and, therefore, propose improvements.

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RG&SA ISSN 2238-0753
Revista Gestão & Sustentabilidade Ambiental