Sustainability Assessment Methods in Existing Buildings: Comparative Analysis in Heritage Assets Signed for Public Use in Girón, Ecuador

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Abstract. This paper compares sustainability assessment methods applicable to existing buildings. It also uses the most influential international certifications (BREEAM, LEED and VERDE) and their guidelines to evaluate their application in three heritage buildings in the Girón canton (Ecuador), which allows us to establish that the LEDD BO&M certification is the one with the greatest technical feasibility and professional suitability. Thus, it is known that, with small adaptations to the initial mechanisms, the sustainability of a heritage building could be certified, especially when it is intended for public use, as is the case of the study universe, where through the recommended interventions it is possible to overcome the range of compliance positioned between 8 and 27% up to 80 and 90%. In turn, this is feasible on the basis of guidelines, categories and a valuation system applicable to the sustainable valuation of a heritage building in the context of the study and its peers.

1. Introduction
State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results. At the international level, several methods of sustainable building assessment have emerged, called Building Sustainable Assessment (BSA), which promote the use of responsible practices throughout the building life cycle [1]. These certifications generally focus on new projects and their processes cover four main stages: assessment, inspection and control of construction, post-construction assessment and certification [2]. In the last segment, the BREEAM, LEED, VERDE, CASBEE and QUALITEL types are applicable, depending on the geographical area. In turn, they are defined as the most recognized worldwide [1], however, only the first three include considerations compatible with assets of heritage value.

BREEAM (BRE Environmental Assessment Method) certification is an environment performance assessment system with 10 categories, 62 standards and 116 general credits and 10 additional credits [1]. LEED (Leadership in Energy & Environmental Design) certification is a system developed by the US Green Building Council, based on a checklist of requirements that includes 8 categories, 41 topics, 18 prerequisites and 136 credits [3]. For its part, the VERDE methodology
developed by Green Building Council Spain (GBCe) aims to provide a compliant assessment and disseminate good sustainable practices; it is also known as "Green Certification" and includes 12 impact categories, 35 standards and 6 topics whose expression is graphically reflected in the "5 sustainable leaves" [4].

Despite this diversity of existing certifications, at the Ecuadorian level the practice is not common, whether in new or existing buildings, which is why the research scenario presents itself as fertile and of territorial interest, and considering the case of the canton of Girón (Figure 1), characterized by its cultural heritage, traditions and unique architecture, takes center stage. In fact, in view of the declaration as Cultural Heritage of the Nation (2006), the need for the effective and sustainable conservation of 183 buildings catalogued as heritage assets is evident. Of these, 5.5% belong to the public property regime [5], and their demand for use is high. Consequently, such cases are prioritized for this research. Consequently, three heritage buildings that provide services to the public; the first building is the “Palacio Municipal de Girón”; the second one, the "Museo Casa de los tratados de Girón", and finally, “Antiguo Cuerpo de Bomberos de Girón”.

2. Background

2.1. Certification and heritage buildings

In different cities around the world, the recovery of heritage assets includes perspectives beyond those linked to canonical conservation. In Barcelona (Spain), the intervention in the former Cal'Alier factory was carried out with the aim of achieving a highly sustainable, intelligent and zero-emission building. With this, the LEED Platinum certificate applied to the Catalan industrial heritage building includes automated skylights with ambient sensors, photovoltaic panels, rainwater and grey water collection for vegetation irrigation, predictive systems for energy demand and generation, pneumatic waste collection and intelligent control systems [6].

In a similar case, in Granada (Spain) the building called "Casa del Carbón" or "El Corral del Carbón" was subjected to the HBIM (Historic Building Information Modelling) method, which reflects its current state, existing pathology, structural damage and in turn, provide a database for future interventions [7]. Currently, the “Orquesta Ciudad de Granada”, together with the city council, is managing the LEED sustainable certification for the building based on the needs (cultural center), but at the same time, articulating the iconic condition of the Nasrid period (13th-15th centuries), being the only example of the “alhóndiga” type that is preserved in Spain. It is worth mentioning that the building was restored by Leopoldo Torres Balbás in the early 19th century [8]. Interventionist actions to ensure certification involve contrasting the original values of the work, and the multiple contributions of value coming from the historical intervention and contemporary demands.
In the Ecuadorian context, a relevant case is the “San Ignacio de Loyola de La Compañía de Jesús” church in Quito, this heritage property, dating from 1597 [9], is located in the historic center of Quito [10]. In the same way as in international cases, the building was subjected to the HBIM method, with the aim of getting a close look at its state of conservation and possible conservation interventions; in addition, the HBIM method facilitates the visualization of project alternatives in order to obtain a sustainability certification [11]. In the case of the city of Cuenca (Ecuador), it is known that sustainability standards for heritage housing in the historic center include energy efficiency and indoor environmental quality, considering factors such as energy consumption, temperature, indoor air quality, natural lighting and acoustic comfort [12]. However, to date there is no concrete application capable of being compared with national and international efficiency standards [12].

In Girón (Ecuador), the “Antigüo Cuerpo de Bomberos de Girón”, since 1956, has a preliminary restoration project aimed at recovering the social function it has always had and rescuing its architectural, aesthetic and constructive values. At the same time, previous analyses determine which elements should be replaced or eliminated to guarantee the safety and conservation of the construction without altering the original typology [5]. With this background, the GAD Girón seeks to restore this building while ensuring its conservation and, at the same time, it seeks to provide it with a sustainability certification.

2.2. Certifications and standards to applicable to pre-existing buildings
Although there are several types of sustainability certification, according to their suitability for the case of pre-existing buildings, the most representative at the international level are specific (Table 1). Of these, both LEED and GREEN certification share the assessment standards because they both belong to the same developer (Green Building Council). [3] Therefore, for the present research it is feasible to consider the LEED BO&M - GREEN GBCe method as one.

| Certification | Developers | Categories | Standards | Assessment |
|---------------|------------|------------|-----------|------------|
| BREEAM        | BRE Global Ltd. | 10         | 62        | 116 points |
| LEED          | US Green Building Council | 8          | 18        | 136 points |
| VERDE         | Green Building Council Spain | 12         | 35        | 5 “sustainable sheets” |

From LEED BO&M - GREEN GBCe the application of the default checklist of defined requirements is established. Consequently, 8 categories and 41 thematic areas. To ensure minimum performance levels, 12 prerequisites in 5 categories and as optional measures 39 credits are required to be fulfilled, giving a total of 110 points (Table 2).

| Category                            | Minimum Requirement | Score |
|-------------------------------------|---------------------|-------|
| Location and transport              | 0                   | 15 points |
| Sustainable Plots                   | 1                   | 10 points |
| Water efficiency                    | 2                   | 12 points |
| Energy and atmosphere               | 4                   | 38 points |
| Materials and resources             | 2                   | 8 points |
| Indoor environmental quality        | 3                   | 17 points |
| Innovation                          | 0                   | 6 points |
| Regional priority                   | 0                   | 4 points |
| Total                               | 12                  | 110    |
It is also worth considering the application of BREEAM -NSO-HOUSING 2020 based on its 9 categories, 62 standards and 146 points [13]. The innovation category is also considered, which increases 10 points (Table 3), to define the assessment as results of the circularity, well-being and carbon life cycle indicators.

Table 3. BREEAM NSO HOUSING 2020 BREEAM Assessment Standards.

| Category              | Score | Weighting |
|-----------------------|-------|-----------|
| Management            | 16 points | 12%       |
| Health & Wellbeing    | 28 points | 15%       |
| Energy                | 31 points | 19%       |
| Transport             | 12 points | 8%        |
| Water                 | 11 points | 8%        |
| Materials             | 14 points | 8%        |
| Waste                 | 11 points | 12.5%     |
| Land Use & Ecology    | 12 points | 7.5%      |
| Air pollution         | 11 points | 10%       |
| Total                 | 146 points | 100%      |
| Innovation (additional)| 10 points (+) | 10% (+)   |

Based on this, when applying the technical viability comparison to determine the potential aspects to be considered when assessing a pre-existing building with heritage value, we resort to the coincidences between the types of certifications studied (Table 4). From this, it is determined that, for the present study, it is necessary to assess; Water, Energy, Transport, Materials and Innovation, in order to know the reality of the buildings and the possible interventions capable of providing them with efficient habitability, and in addition, a certification of sustainability without ignoring the particulars of its heritage dimension.

Table 4. Common Assessment Standards

| Category                    | BREEAM – NSO | LEED - BO&M |
|-----------------------------|--------------|-------------|
| Water                       | ✔            | ✔           |
| Energy                      | ✔            | ✔           |
| Transport                   | ✔            | ✔           |
| Innovation                  | ✔            | ✔           |
| Materials                   | ✔            | ✔           |
| Management                  | ✔            | ✔           |
| Health & Wellbeing          | ✔            | ✔           |
| Waste                       | ✔            | ✔           |
| Land Use & Ecology          | ✔            | ✔           |
| Air pollution               | ✔            | ✔           |
| Sustainable Plots           | ✔            | ✔           |
| Indoor environmental quality| ✔            | ✔           |
| Regional priority           | ✔            | ✔           |

When assessing the Water component of the LEED - BO&M certification it should be noted that, as a prerequisite, the building must have indoor water consumption reduction and a water meter. This certification has 4 assessment standards, including the two previous ones with scores of 5 and 2, respectively. The missing standards are; reduction of outdoor water consumption (2 points) and water consumption in cooling towers (3 points). With the maximum possible score (12) and the minimum requirements to guarantee efficient operation, at least 50% of the requirements could easily be covered. While this does not guarantee certification, it does allow immediate action to be taken. For its part, BREEM-NSO evaluates the same water component (9 points), considering consumption (5 points), leak detection and prevention (2 points) and having efficient equipment (2 points). Consequently, the
compliance standards could be higher when considering technical operability based on a use of 140 liters/inhabitant/day. [13]

To assess the Energy component, the LEED - BO&M certification requires as a mandatory prerequisite to have Energy Efficiency Management, Minimum Energy Efficiency, Whole Building Energy Meter and Basic Refrigerant Management. This certification has 8 assessment standards, which are: existing building acceptance - analysis (2 points), existing building acceptance - implementation (2 points), ongoing acceptance (3 points), energy efficiency optimization (20 points), advanced energy metering (2 points), demand response (3 points), renewable energy and carbon offsets (5 points) and finally, improved refrigerant management (1 point). In sum, it defines the maximum score of 38 points through the checklist. BREEM-NSO assesses Energy on 25 points, including energy efficiency (15 points), external lighting (1 point), low carbon design (5 points), energy efficient transport system (3 points), energy efficient equipment (2 points), and drying space (1 point).

The Transport component within the LEED - BO&M certification has a score of 15 points with a single category, it does not include prerequisites, while the BREEAM-NSO certification has five standards for its assessment, which are Accessibility to public transport (4 points), proximity to services (2 points), Alternative modes of transport (2 points), mobility plan (1 point) and home office (2 points); obtaining a score of 11 points. In addition, for the Materials criterion it awards a score out of 8 points, which has two pre-requisites; Ongoing Purchasing and Waste Policy and Facilities Maintenance and Renovation Policy. The Materials category consists of the following credits, Solid Waste Management - Ongoing (2 points), Solid Waste Management - Facility Management and Renovation, Purchasing - Lamps (1 point), Purchasing - Ongoing (1 point), Purchasing - Facility Management and Renovation. (2 points); the BREEAM-NSO certification has 4 assessment standards which are Life Cycle Impact (6 points), Responsible Sourcing of Construction Products (4 points), Durability and Resilience Oriented Design (1 point) and Material Efficiency (1 point); thus, obtaining a score out of 12 points. Finally, the Innovation component, as a singular category, in the LEED - BO&M certification is considered as an additional evaluation criterion which has a valuation of 6 points and has 2 valuation credits which are, Innovation (5 points) and LEED Accredited Professional (1 point). In turn, BREEAM-NSO values Innovation out of 24 points, within two standards, Innovation points approved by BREEAM ES (10 points) and total exemplary level points (14 points).

3. Objectives
The objective of this study is to identify the basic components for a sustainable valuation of pre-existing heritage buildings, through the analysis and comparison of relevant types of certification. The aim of this principle is to determine their suitability or need for specific adaptation in the case of properties located in the canton of Girón (Ecuador), and in this way, to form a basis for the application of certification methods at the local level.

4. Methodology
In order to generate a contribution to knowledge and fulfil the objective of this article, it is proposed to: 1) Apply sustainability certifications compatible with pre-existing buildings to heritage buildings in the Girón canton (Ecuador), and, 2) Identify guidelines, categories and a valuation system applicable to a heritage building in the context of the study and its peers. To this end, a specific bibliographical review of the key words mentioned and the research development in the national and international geographical context are used, without prioritizing the latter. It also includes the gathering of information by means of (indicate how it was done), on the three prioritized case studies.

4.1. Selection of the case studies
The buildings to be evaluated form part of the heritage inventory drawn up by the GAD Municipal de Girón in 2006 through the application of form B1 of the Emerging Register drawn up by the National
Institute of Cultural Heritage (INPC). They correspond to the only three buildings with intensive public use in the historical sense and with a symbolic character (Figure 2), typical of heritage assets. These buildings represent 1.63% of the universe of buildings of heritage value (Table 5), but their use is of interest due to the current and growing dynamics of economic and cultural reactivation worldwide.

| Table 5. Buildings to be Evaluated |
|-----------------------------------|
| **1) Palacio Municipal de Girón** |
| Ownership | Public |
| Location | Elías Astudillo y García Moreno, Esq. |
| Since | 1944 |

A republican style building with an interior courtyard made up of galleries around which the spaces are developed. The main façade has a portal on the ground floor, which functions as a transition between the interior and the public space. Multiple consolidation and maintenance operations have been carried out on this building, which preserves its values and attributes. [5]

| **2) Museo Casa de los Tratados de Girón** |
| Ownership | Public |
| Location | Simón Bolivar y Andrés Córdova, Esq. |
| Since | 19th century |

This building “Casa de los Tratados de Girón”. It was originally a ranch house built at the beginning of the 19th century, so it corresponds to the isolated typology. It is also the place where the peace treaty between Peru and Gran Colombia was signed on February 28th 1829 after the battle fought in the fields of Portete de Girón. The building has a mixed adobe and wood structure, characteristic of popular architecture in Azuay. The exterior portals are articulated with the spaces both on the ground floor and on the upper floor. [5]

| **3) Antiguo Edificio de Bomberos** |
| Ownership | Public |
| Location | Antonio Flor y Julio Calle, Esq. |
| Since | 1956 |

In 1956, it was created as the Health Sub-central, later it took on the functions of the Girón Fire Brigade and the Ecuadorian Red Cross, among others. It is currently owned by the Municipality of Girón and is used as the canton's library. It is also in the process of being refurbished. It is an isolated building with green spaces on its periphery, it has two levels whose spaces are developed around the circulation block, making it the only Art Deco building in the south of the province of Azuay. [5]
While buildings are in an acceptable state of conservation and therefore remain active, the need for physical interventions in the short term cannot be ruled out. In this respect, the inclusion of sustainability parameters offers interesting options.

5. Results
5.1. Evaluation of heritage assets
Once the three buildings have been assessed (Table 7), it can be seen that none of them meet the minimum standards for sustainability certification. The “Museo Casa de los Tratados”, when assessed by the LEDD - BO&M certification and the BREEAM - NSO certification, obtained scores of 22 and 17 points, respectively. On the other hand, the “Palacio Municipal de Girón” obtained 19 and 15 points, and the “Antigüo Cuerpo de Bomberos de Girón” is the building with the worst score in both the LEDD - BO&M certification and the BREEAM - NSO certification, with 7 and 10 points, respectively.

In all three cases, compliance with the requirements is poor. Thus, the “Palacio Municipal de Girón” reports 24.05%, the “Antigüo Cuerpo de Bomberos de Girón” 8.86% and the “Museo Casa de los Tratados de Girón” 27.86% compliance with the requested specifications, confirming that none of the buildings studied meet the minimum standard. On the other hand, by means of the BREEAM - NSO Certification, the “Palacio Municipal de Girón”, complies with 18.51%, the “Antigüo Cuerpo de Bomberos de Girón” with 12.34% and finally, the “Museo Casa de los Tratados de Girón” obtains 20.98% of the established specifications, that is to say, it does not have access to this type of certification under current conditions either.

On the previous point it is established that, when considering LEED - BO&M certification, there are different situations in the assessed assets, although all of them limit the achievement of the certification. At the same time, it can be said that, in the Water, Energy and Transport components, both in the LEDD - BO&M certification and in the BREEAM - NSO certification, it is feasible to improve the situation through the use of strategies that do not alter the conservation of the heritage, however, their implementation requires a particularized study. Therefore, in detail it is known that:
Table 6. Valuation of heritage buildings

| Certification       | Indicator | Palacio Municipal de Girón | Antiguo Cuerpo de Bomberos de Girón | Museo Casa de los Tratados de Girón |
|---------------------|-----------|----------------------------|-------------------------------------|-------------------------------------|
|                     | Water (12)| 7                          | 2                                   | 9                                   |
|                     | Energy (38)| 8                          | 5                                   | 8                                   |
|                     | Transport (15)| 0                           | 0                                   | 0                                   |
|                     | Materials (8)| 4                           | 0                                   | 5                                   |
|                     | Innovation (6)| 0                           | 0                                   | 0                                   |
| **Total (79 points)** |           | **19**                     | **7**                               | **22**                              |
| BREEAM – NSO        | Water (9) | 3                          | 1                                   | 4                                   |
|                     | Energy (25)| 2                          | 2                                   | 3                                   |
|                     | Transport (11)| 9                           | 6                                   | 10                                  |
|                     | Materials (12)| 1                           | 1                                   | 1                                   |
|                     | Innovation (24)| 0                           | 0                                   | 0                                   |
| **Total (81 points)** |           | **15**                     | **10**                              | **17**                              |

a) “Palacio Municipal de Girón”, evaluated through the LEED - BO&M Certification, obtains a score of 19 out of 79 points. When analyzing the Water component, the building complies with the mandatory prerequisites, obtaining a score of 7. The Energy component obtains 8 points out of a possible 38, as it does not comply with the prerequisites of Energy Efficiency Management and Basic Refrigerant Management. The Transport component also fails to meet the requirements and therefore scores 0 points. In Materials and Resources, the building obtains a score of 4 points, however, it does not comply with the prerequisites; finally, in the Innovation category, it does not comply with the established parameters either. For this reason, and by accumulating 19 points, the “Palacio Municipal de Girón” does not obtain the LEED - BO&M sustainability certification, according to the minimum standards required in pre-existing buildings. On the other hand, when evaluating the building through the BREEM- NSO certification, 15 out of 81 points were obtained. In the Water component, it scores 3 out of 9 points; in the Energy component, 2 out of 27 points; in the Transport component, 9 out of 11 points; and in the Materials component, it scores 1 out of 12 possible points; finally, in the additional component Innovation, no points are scored, and in general, by reporting 15 points, the “Palacio Municipal de Girón” does not obtain this sustainability certification either (Table 6).

b) “Antiguo Cuerpo de Bomberos” building when evaluated through the LEED - BO&M certification, obtained a score of 7 out of 79 possible points. In the Water component it obtains 2 out of 12 points, as it does not comply with the prerequisites, in the same way in the Energy component it obtains 5 out of 38 points, being the non-compliance with prerequisites the cause; when evaluating the Transport component, the building obtains 0 out of 15 available points, a similar case occurs in the Materials component where it obtains 0 out of 8 possible points. Finally, in the Innovation component it obtains 0 out of 8 possible points, therefore, the “Antiguo Cuerpo de Bomberos” does not comply with the LEED - BO&M certification. In a similar scenario, the evaluation of the heritage property through the BREEAM- NSO
certification defines a score of 10 out of 81 points, reflecting in the Water component a score of 1 out of 9 possible points, in the Energy component 2 out of 25 points, in the Transport component 6 out of 11 possible points, in the Materials component it obtains a score of 1 out of 12 points, in the additional component Innovation it obtains no score. In other words, “Antigüo Cuerpo de Bomberos” cannot be accredited for LEED - BO&M certification, nor for BREEAM-NSO certification, as it does not meet the minimum prerequisites, and the demands for intervention become indispensable to realize such a status in the medium or long term, provided that a significant investment is possible.

c) “Museo Casa de los Tratados” building through LEED - BO&M certification, it can be seen that the property complies with the prerequisites of the Water and Energy component, obtaining 22 out of 79 points. In the first case, the building complies with the mandatory prerequisites, thus obtaining a score of 9. The Energy component obtains 8 out of 38 feasible points, as it does not comply with the prerequisites of Energy Efficiency Management and Basic Refrigerant Management. In the Transport category, it also fails to meet the prerequisites for Energy Efficiency Management and Basic Refrigerant Management, and therefore scores 0 out of 15 points. In the Materials component, the building scored 5 out of a possible 8 points. Likewise, in the Innovation component it also fails to meet the established parameters, and is awarded 0 points. In turn, for this and the previous reasons, the “Museo Casa de los Tratados” does not obtain LEED - BO&M sustainability certification. On the other hand, when the building is assessed by means of BREEAM-NSO certification, it obtains a score of 17 out of 81 available points. In the Water component it obtains 4 out of 9 points, in the Energy component it obtains 3 out of 25 points, in the Transport component it obtains 10 out of 11 points, in Materials it obtains 1 out of 12 possible points; finally, in the Innovation category it obtains no points. Therefore, by reporting 17 out of 81 points, the “Museo Casa de los Tratados” does not obtain the BREEAM - NSO sustainability certification either.

5.2. Standards for pre-existing buildings of heritage value

With regard to the current state of the assessed heritage assets, the need for minor and major interventions is evident. In the first case, and applicable to both certifications, these are improvements that should not interfere with the conservation of the heritage elements, consequently with their intrinsic values and the attributes that maintain the historical link with the society in which they are inserted.

According to LEED - BO&M certification; 1) Provision of bicycle parking spaces, 2) Drip irrigation systems, 3) Advanced energy meters, and, 4) Maintenance of electrical installations. In turn, according to the BREEAM-NSO certification, it is required; 1) Provision of advanced electricity meters, 2) New installations throughout the building, 3) Provision of spaces for bicycle parking, 4) Provision of points for recharging electric means of transport, 5) Provision of sanitary parts with water-saving systems, and, 6) Adaptation of cut-off systems to prevent leaks. On the other hand, as major interventions and in order to obtain certification are required, in the case of LEED - BO&M it is determined that:

a) “Palacio Municipal de Girón”, in the LEED - BO&M certification, in the Water component it obtains 7 out of 12 possible points, the provision of a drip irrigation system, would allow the building to obtain 12 points, in the same way in the Energy component, the building obtains a qualification of 8 points out of 38 possible points, the qualification could be improved by providing advanced energy meters and carrying out maintenance of electrical installations in the building, by carrying out these activities the qualification would increase 30 points; In a similar scenario, the provision of bicycle parking spaces would increase the rating in the Transport component to 15 points, thus scoring 69 out of a possible 79 points. This would result in LEDD - BO&M certification, without altering the preservation of its heritage dimension (graph 1).
b) “Antiguo Cuerpo de Bomberos” could improve the fulfillment of certification requirements by working on the Water component, obtaining 2 out of 12 possible points, the provision of a drip irrigation system, sanitary parts with saving systems and the provision of water meters, would allow the building to obtain 12 points in this component, in the same way in the Energy component, the building obtains a qualification of 5 points out of 38 possible points: The rating could be improved by the provision of an advanced energy meter, new installations and the optimisation of energy efficiency, thus allowing the building to score 38 points. Similarly, the provision of bicycle parking spaces would increase the rating in the Transport component by up to 15 points out of 15 points, so that 65 out of a possible 79 points could be obtained, thus achieving LEDD - BO&M certification, without altering the conservation of its heritage.

c) “Museo Casa de los Tratados” scored 22 out of 79 points, as well as working on the provision of spaces for bicycle parking, the use of drip irrigation systems, the provision of advanced energy meters and the maintenance of electrical installations. The rating of the water component would also be improved from 9 to 12 points, the energy component from 8 to 38 points and the transport component from 0 to 15 points, obtaining a rating of 70 out of 79 points, and with this, access to LEED - BO&M certification would be achieved.

Figure 3. Valuation of heritage buildings with LEED - Bo&M.

Similarly, when analyzing heritage buildings through BREEAM - NSO certification, it becomes essential to carry out minor interventions that do not alter the conservation of the built heritage, it can be determined that:

a) “Palacio Municipal de Girón” obtains a rating of 15 out of 81 possible points; that is, 3 out of 9 points in the Water component. This score can be improved by means of new installations, the provision of sanitary fittings with water-saving systems and the adaptation of cut-off systems to prevent leaks. The intervention would obtain a full score, 9 points. Similarly, in the energy component, a score of 2 out of 25 points is obtained. This score can be improved through the provision of advanced electricity meters and the renovation of installations to obtain a full score, 25 points. Finally, in the Transport component, the provision of bicycle parking spaces and charging points for electric transport could improve the score from 9 to 11 points. In turn, with all the improvements, the rating would increase to 46 out of 81 available points, thus achieving BREEAM - NSO certification.

b) “Antiguo Cuerpo de Bomberos”, obtains an initial rating of 10 out of 81 points, which could be improved through the Water component, by including new installations, provision of sanitary
parts with saving systems, a rating of 9 out of 9 possible points would be obtained, in the same way in the Energy component a rating of 2 out of 25 points is obtained, this rating can be improved through the provision of advanced electric energy meters and the renovation of installations throughout the building. Finally, in the Transport component, the provision of spaces for bicycle parking and the provision of points for recharging electric transport could improve the score from 6 to 11 points, by providing the building with these improvements, the score would increase to 46 out of 81 available points. “Antiguo Cuerpo de Bomberos” would achieve the BREEAM - NSO certification.

c) “Museo Casa de los Tratados”, obtained a score of 17 out of 81 points, broken down as follows, the Water component 4 out of 9 points, the Energy component 3 out of 25 points, the Transport component 10 out of 11 points, the Materials component 1 out of 12 points and in the Innovation component no points: this score can be improved by the provision of advanced electricity meters, renovation of installations throughout the building, provision of spaces for bicycle parking, provision of recharging points for electric means of transport, provision of sanitary fittings with water-saving systems and adaptation of cut-off systems to prevent leaks, These improvements would give the Water component 9 points, the Energy component 25 points, and the Transport component 11 points, giving it a score of 46 out of 81 available points, and thus the “Museo Casa de los Tratados” would achieve BREEAM - NSO certification without altering its heritage conservation characteristics.

![Figure 4](image-url)  
**Figure 4.** Valuation of heritage buildings with BREEAM - NSO.

6. Conclusions

This paper presents a comparative analysis of the most relevant international sustainability assessment certifications, which present conditions for their use in pre-existing buildings of heritage value. When applied to three heritage buildings for public use in Girón (Ecuador), it can be seen that the methods give greater importance to the environmental dimension and that there are common themes such as Water Efficiency, Energy Resources, Transport, Materials and Resources and Innovation. When evaluating the buildings through LEED - BO&M and BREEAM - NSO certifications, it can be seen that none of the buildings in their current state meet the minimum rating; however, it is possible to obtain a certification without altering the heritage dimension through basic actions that contribute to physical conservation and efficient use in collective and intensive terms.

By carrying out minor actions, such as the provision of spaces for bicycle parking, drip irrigation systems, advanced energy meters, maintenance of electrical installations, provision of sanitary parts...
with water saving systems and adaptation of shut-off systems to prevent leaks, it is possible for the three buildings to obtain a sustainability certification. However, obtaining a LEED - BO&M certification requires less intervention in heritage buildings, which is a point in favour in this segment of architecture.

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