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RESEARCH ARTICLE

The assessment of buildings and constructions sector of economy proposal: an environmental perspective

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Abstract

Environmental impact assessment methods suffer from an applicability issue which could impede their use and development. The main subject of this article is to present a method to evaluate the applicability of building environmental assessment method in a given country. Here, when we say that a method is applicable in a given country, it means that it could be widely used and that it could produce the expected effects in terms of energy savings, environmental impact minimization, economic gain, etc. So, for this applicability evaluation purpose, the main criteria that affect the building environmental assessment method applicability were identified and were weighted by studying different scenarios. Then, the evaluation method was applied to the Tunisian case. Moreover, in order to contribute to a better understanding of the importance of building environmental assessment method implementation, stakes related thereto are reviewed. It was reported that building environmental assessment method would concur to improve building energy efficiency, enhance social capital, and contribute to environmental, social, and economic stability. In addition, it could be one of the major solutions for the collection of statistical data, which in turn would contribute to the success of projects undertaken as part of the green economy. Eventually, the building environmental assessment could be one of the major green marketing tools and should be taken into account by a company to improve profitability. The developed method and the presented stakes could be a good management and decision making tools and could help legislators and policy-makers for the best implementation of building environmental assessment method.

Keywords Building · Environmental assessment · Applicability · Stakes · Green economy · Green marketing

Introduction

Building environmental assessment is gaining increasing attention in the global context. Many countries have developed or are developing methods and laws related to building environmental assessment (Seinre et al. 2014).

In this context, Bernardi et al. (2017) analyzed the differences between six most adopted building environmental assessment methods. Ade and Rehm (2020) reported interesting information on the rating tools' history and their development process. Lützkendorf (2017) examined six topics in relation to building environmental assessment developments including

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assessment criteria and indicators, legal requirements, and technological progress handling. Fonseca et al. (2017) critically reviewed the merits and drawbacks of environmental impact assessment systems reforming.

Several studies have shown that building environmental assessment had a beneficial effect on the energetic, environmental, economic, and social sectors (Nwodo and Anumba 2019).

Zeynalova (2011) demonstrated the important role of building environmental assessment tool for achieving energy efficiency in context of zero-energy buildings. Chen (2019) has shown that the green certification of a hotel group could improve their environmental and economic performance. Gagnon et al. (1993); Gagnon (1995) and Vanclay (2003) have shown the important role of a building environmental assessment tool in empowering local populations and improving the position of disadvantaged or marginalized society members. Akari (2012) reported that building environmental assessment could boost the economy, which will result in the creation of several jobs.

However, building environmental assessment methods available in numerous countries suffer from an applicability issue which may be related to matters addressed by the method or other factors, such as the institutional, legislative, or economic framework. For example, Nguyen et al. (2017) identified 41 barriers to green building in Vietnam. Doan et al. (2019) identified the significant barriers to Green Star certification uptake in New Zealand as a lack of understanding, cost perception, lack of benchmark projects, lack of client demand, and complex administration. Sulich (2018) found that eco-innovation and corporate social responsibility are the main factors that influence the green development of Poland and should be improved.

In addition, these methods may not give the expected effect. As stated by Rasmussen et al. (2019), this may be due to the fact that decisions made by particular stakeholders for a given situation are not mere options to be selected, but compromises between ideal solutions and applied LCA reality. Also, according to Suzer (2015), some nationally developed methods are used worldwide without being adapted to local geographical, economic, social, and cultural parameters. This could lead to a mismatch between assessment results and region and/or construction site reality.

In order to diminish the discrepancy between expected and obtained effects, many authors suggested to improve some methods and proposed solutions for this purpose. Obata et al. (2019) demonstrated that, although Leadership in Energy and Environmental Design (LEED) is an important tool for sustainable development because of its countless benefits, it needs to be improved in order to push buildings toward a higher sustainability degree. Liang et al. (2019) studied the gap between expected and achieved energy savings after building green certification and gave a number of recommendations to reduce the energy performance gap, such as facility managers' incentives, commissioning, energy performance contracting, and changing occupant behavior. Liu et al. (2019) demonstrated that green office buildings' energy performance gaps could be addressed by more targeted operations management.

Therefore, it is clear from the above studies that, before implementing a building environmental assessment method, it is essential to identify any problems that might impede or constrain the use of this method. For this purpose, a method for evaluating building environmental assessment methods applicability will be presented and solutions for their best implementation or to pave the way for will be proposed.

First, the evaluation criteria will be identified and the weighting method will be exposed. Then, the developed method will be applied to the Tunisian case and compared to results obtained by a deep analysis.

Furthermore, in order to help policy-makers and legislators when deciding about building environmental assessment method implementation, stakes related thereto will be outlined.

This article will be divided into four parts. In the first part, the world's best-known building environmental assessment methods will be presented. In the second part, the problems encountered by various building environmental assessment methods will be exposed and the applicability evaluation criteria will be identified. In the third part, the Tunisian context will be analyzed and the applicability of an official building environmental assessment method will be examined. In the fourth part, stakes related to the implementation of building environmental assessment method will be outlined.

Presentation of the best-known environmental assessment methods

Since the field of building environmental assessment tools is vast, it is important to specify which category of method will be concerned by this study and to present their framework and their context. In this section, three of the world's best-known methods will be presented. Feedback from these methods will be discussed in section "Feedback from various existing building environmental assessment methods and identification of applicability evaluation criteria".

BREEAM (Building Research Establishment Environmental Assessment Method)

It is a building environmental assessment method launched by BRE (Building Research Establishment) in Great Britain in 1990. A version of this method, called EcoHomes, has been developed for residential buildings. It assesses new residential buildings or those undergoing major renovation, both at the

design stage and after construction. This version served as a basis for the development of the code for sustainable housing CSH (Code for Sustainable Homes). From May 2008, this code became mandatory for all new single-family dwellings in England and a certificate of this code had to be included in the HIP (Home Information Pack). This code differs from the BREEAM (Building Research Establishment Environmental Assessment Method) common system in the main categories, rating levels (level 1 to 6, where 6 is the highest), weightings, and objectives to be achieved (Mötzl and Fellner 2011). Today, BREEAM is the most widely used environmental label for buildings, with more than 570,484 certified buildings and more than two million registered for certification in 85 countries around the world (BREEAM website 2019). BREEAM has the advantage of being easily adaptable to the regulations and conditions specific to each region. BRE has given an important boost to the development of international and transnational systems through the implementation of tools like GBTool, that is called today SBTool. It is a flexible system operating on Excel and adaptable according to local conditions and building types specific to each region (Mötzl and Fellner 2011).

LEED (Leadership in Energy and Environmental Design)

It was introduced in 1998 by the USGBC (U.S. Green Building Council). Then, in 2009, the LEED (Leadership in Energy and Environmental Design) certification program was led by the GBCI (Green Building Certification Institute) (Mötzl and Fellner 2011). This method has been adapted to the different building types and regional specificities. The LEED environmental assessment is conducted through the allocation of points for the various aspects of environmental design in each of the seven categories considered by the method. It should be pointed out that in the different categories taken into account by the LEED method, there are mandatory and non-mandatory characteristics, and the allocation of points is only for non-mandatory characteristics. Until December 2019, 45,852 buildings were certified (Green Building Information Gateway 2019) on more than 96,149 buildings registered for LEED certification in 167 countries and territories (U.S. Green Building Council 2015). GBCI coordinated the work of global certification bodies with expertise in validating international (ISO-compliant) standards and ensured high-quality certification and third-party verification of buildings under the LEED rating system (Mötzl and Fellner 2011).

HQE (High Environmental Quality)

HQE (High Environmental Quality) is the French system for building environmental assessment. It was initiated in the early 1990s and developed under the aegis of the PCA (Construction Architecture Plan) thanks to the work of ATEQUE (Environmental Quality Assessment Workshop) and a dozen of experimental realizations in the field of social housing (REX HQE) (Moch and Persello 2007). Then, HQE association, of which the ADEME (French Environment and Energy Management Agency) is a founding member, assured its development.

The awarded label varies according to the type of assessed building. The "NF Bâtiments Tertiaires - Démarche HQE®" label covers offices, commercial buildings, hotels, healthcare, hospitals, logistics centers, etc. It is issued by Certivéa, a subsidiary of the CSTB (Scientific and Technical Centre for Building). The label "NF Maison Individuelle - Démarche HQE®" applies to individual houses and is managed by CEQUAMI. As for the label "NF Logement - Démarche HQE®," it is applied to multi-residential buildings and is issued by CERQUAL (Mötzl and Fellner 2011).

The references guides, which form the basis of the HQE® approach in the building sector, were made public in November 2001 during the "First Meeting of the HQE® Approach." It is the SME (environmental management system) and the DEQE (explicit definition of environmental quality). The SME concerns management throughout all stages of design and construction, while the DEQE defines the fourteen targets addressed by the approach (Moch and Persello 2007).

The main objective of this approach is to improve buildings' longevity, minimize environmental loads due to construction activities, and provide healthy and comfortable buildings (Mötzl and Fellner 2011).

In 2009, CSTB (Scientific and Technical Centre for Building) and its subsidiary Certivéa signed a Memorandum of Understanding to work with BRE (Building Research Establishment) to develop a pan-European building environmental assessment method (Mötzl and Fellner 2011).

Feedback from various existing building environmental assessment methods and identification of applicability evaluation criteria

From available methods feedback, some weak points, mentioned below, have been reported. The major disadvantages encountered during the application of existing building environmental assessment methods are both their subjective nature making the obtained results user dependent and the long building evaluation process (Cole 1999; Haapio and Viitaniemi 2008). In order to eradicate these problems, designers are constantly improving their building environmental assessment methods. The new version of BREEAM In-Use International, for example, is available via an online interface and therefore saves time over the building evaluation period.

In order to standardize the building environmental assessment practices between the different users of the repository, a technical guide is provided with this latter. This expands the benchmark between certified buildings (Sinteo 2015). Büyüközkan and Karabulut (2018) suggest to use group decision-making techniques and other analytical methods that can deal with uncertainty, conflicting indicators, and linguistic evaluations to address the method's subjectivity.

Another defect mentioned in several studies on the building environmental assessment methods is their results presentation. Sometimes, presented results do not allow the user to situate the building according to its performance level or to know which target is below the required level of performance. Therefore, the assessment method would not be able to orient the user toward the optimal solution and could even lose credibility as to the displayed results (Cole 1999; Haapio and Viitaniemi 2008). In this context, Cole (1999) indicates that the separation between qualitative and quantitative targets when presenting the results would allow a better user interpretation. Haapio and Viitaniemi (2008) add that a poor results presentation combined with measurement uncertainties and the dependence of certain methods on the evaluated building types could lead the user to an evaluation error. Also, they support the idea that building environmental assessment methods should line up with a standardized rating system and database. Indeed, when analyzing several building environmental assessment methods, they found it difficult, if not impossible, to compare the results given by different methods. This is confirmed by Hossain and Ng (2020) as they state that, due to a lack of data representativeness in several regions of the world, significant discrepancies have been observed between studies making building environmental assessment results not very helpful for decision-making.

Sometimes, some evaluation criteria are not applicable and therefore become penalizing for some buildings. This observation has obliged some methods to adapt and/or modify their rating system such as GBTool or BREEAM (Cole 1999; Sinteo 2015).

Cole (1999) argues that one of voluntary assessments' premise is that if the market is endowed with good information and mechanisms, an enlightened client group could provide leadership in environmental responsibility and others will follow to stay competitive. It is therefore clear that a good communication system is essential to ensure an increased use of building environmental assessment methods. This is confirmed by a recent study conducted by Shan et al. (2020) regarding the critical success factors for small contractors in carrying out green building projects.

Recent studies have shown that the availability of building environmental regulation would promote and consolidate the use of building environmental assessment methods (Jha-Thakur and Fischer 2016; Gabe 2010; Arts et al. 2012). Gabe (2010) confirms that voluntary methods such as LEED are used more for advertising purposes than for optimizing environmental performance. Arts et al. (2012) reports that the 2011 regulations introduced in Scotland and later in England and Wales contributed to the consolidation and updating of the building environmental assessment methods.

A study conducted by Ballu and Toulouse (2010) showed that the main factor that hindered the use of energy-efficient products was the initial investment cost. Therefore, in order to encourage consumers to use these products and therefore to comply with possible environmental regulations, it is necessary to set up financing mechanisms through subsidies. These subsidies will have a beneficial effect on the use of building environmental assessment methods if they cover both the equipment and study costs. However, even if it does not cover study costs, they would still have a positive effect on the use of building environmental assessment methods if a building environmental regulation was implemented. Cease et al. (2019) demonstrated that financial support could incentivize stakeholder to use building environmental assessment methods.

O'Faircheallaigh (2010) reports that public participation in building environmental assessment is of great importance. It enables citizens to contribute to government decision-making through the reporting to decision-makers and provides an educational function that enables citizens to better understand their governmental system. As a result, it could facilitate successful implementation of projects or programs and enhance the application and use of building environmental assessment methods. Another beneficial effect of public participation in building environmental assessment was reported by Stender and Walter (2019). They stated that it could develop the sense of belonging among residents and strengthen social networks within the estate. However, the number of participants should be moderated. According to Brandt and Svendsen (2013), while the informational value of meetings can be useful to policy-makers, it may decrease as the number of participants increases.

The development of methods presented in section "Presentation of the best known environmental assessment methods" is in some way due to the existence of a specialized institutional framework. Indeed, the availability of an organization promoting and monitoring the implementation of a building environmental regulations or supporting high environmental value project would promote the use of building environmental assessment methods through communication, grants, or training. In addition, specialized staff would support the various stakeholders through training and speeding up the processing time. The agency "ADEME," for example, has contributed to the success of several programs and is an important pillar in the development and promotion of building environmental assessment methods such as "HQE" (Moch and Persello 2007).

Moreover, implemented environmental programs play an important role in the development of environmental assessment methods. Some methods such as HQE have been created under an environmental program.

Finally, six applicability evaluation criteria have been identified from the above analysis. Table 1 presents these criteria and provides a description for each one.

Weighting of each criteria is made based on its degree of importance. This weighting is presented in Table 2.

The criteria weighting was made according to different scenario results. From this different scenario, we were able to identify mandatory and optional criteria and to classify the evaluation criteria from the most important to the less important.

For example, if in a given country, an environmental impact assessment tool and institutional and legislative frameworks are available and fulfill all the indicators described in Table 1, but institutional framework does not fulfill the indicators; it is obvious that the implementation of this environmental tool would be difficult. From this point of view, we can confirm that institutional framework criteria are more important than institutional or legislative framework criteria.

The same analysis has been made for a scenario where tool, institutional framework, and subsidies criteria fulfill the indicators but legislative framework does not. From this analysis, we find that legislative framework criteria are more important than subsidies criteria. This is due to the fact that legislative framework would make the application of a given environmental impact assessment tool mandatory while subsidies will only support the application of such tool.

Furthermore, communication systems and environmental programs criteria would only support the application of a given environmental tool. Also, they are somehow linked to criteria such as a legislative or institutional framework. For example, if a building environmental assessment law is published, it will be a kind of communication systems for building environmental assessment tool. Then, we could classify communication systems and environmental programs criteria as optional criteria.

Eventually, building environmental assessment tool applicability evaluation is made as follows:

- Low applicability level: each mandatory criterion should have a minimum score of 80%.
- Medium applicability level: each mandatory criterion should have a minimum score of 80% and each optional criterion should have a minimum score of 50%.
- High applicability level: each mandatory criterion should have a minimum score of 90% and each optional criterion should have a minimum score of 90%.

Tunisian case: situational analysis and ways to improve the applicability of an official building environmental assessment method

In order to evaluate the applicability of an official building environmental assessment method in Tunisia, an overview of the current Tunisian situation in terms of laws, programs, tools, and institutional frameworks that can motivate and/or facilitate the application of an official building environmental assessment method is essential.

Environmental protection has a prominent place in Tunisian politics. The active participation of Tunisia in international conferences and programs for the environment and the adoption of conventions and protocols relating thereto

Table 1 Applicability evaluation criteria

Criteria	Description (indicators)
Tools	- Results presentation (separation between qualitative and quantitative targets). - Line up with standardized rating system and database. - Minimize measurement uncertainties. - Avoid subjective nature. - Applicability of evaluation criteria and independence on the evaluated building.
Institutional framework	- Development of the institutional framework. - Experts in building environmental assessment availability.
Legislative framework	- Availability of legislative framework.
Subsidies	- Availability of funding mechanisms.
Communication systems	- Information about notation system and advantage. - Availability of communication mechanisms: advertisement, conference, sponsoring… - Public participation in building environmental assessment.
Environmental programs	- Implementation of environmental programs.

Source: Authors' own elaboration

Table 2 Applicability evaluation criteria and indicators weighting

Criteria	Indicators	Weighting	
		Indicators	Criteria
Tools	Results presentation (separation between qualitative and quantitative targets). *(Maximum score) – (Maximum score) × (Percentage of criteria containing qualitative and quantitative targets)	8	30
	Line up with standardized rating system and database. *(Maximum score) × (Percentage of criteria similar to criteria of standardized rating system)	5	
	Minimize measurement uncertainties. * < 2% = 2 ; < 5% = 1 ; > 5% = 0	2	
	Avoid subjective nature. *(Maximum score) × (Percentage of non-subjective criteria)	5	
	Applicability of evaluation criteria and independence on the evaluated building. *All criteria are applicable = 10; one non-applicable criterion = 5; more than one non-applicable criterion = 0	10	
Institutional framework	Development of the institutional framework. * Nonexistent institutional framework = 0; existent institutional framework but not well organized = 12; excellent institutional framework = 15	15	25
	Experts in building environmental assessment availability. *No expert = 0; insufficient number of experts = 5; sufficient number of experts = 10	10	
Legislative framework	Availability of legislative framework. *Not available = 0; available but not well developed = 10; good legislative framework = 20	20	20
Subsidies	Availability of funding mechanisms. *Not available = 0; < 20% = 10; > 20% = 15	15	15
Communication systems (optional)	Information about notation system and advantage. *No information = 0; medium information = 1; sufficient information = 2	2	5
	Availability of communication mechanisms: advertisement, conference, sponsoring… *Not available = 0; available = 1	1	
	Public participation in building environmental assessment. *No participation = 0; medium participation = 1; high participation = 2	2	
Environmental programs (optional)	Implementation of environmental programs. *No program = 0; few programs related to environmental program (renewable energy) = 2; environmental program availability = 5	5	5

Source: Authors' own elaboration

*Weighting method

(Kyoto Protocol) confirm this fact (Ministry of Foreign Affairs 2019).

Since 1989, in order to implement environmental upgrading programs, Tunisia has developed an important institutional framework. The covered themes are wastewater management by the "Office National de l'Assainissement" (ONAS), waste management by the "Agence Nationale de Gestion des Déchets" (ANGED), coastal protection by the "Agence de Protection et d'Aménagement du Littoral" (APAL), environmental prevention and pollution control by the National Agency of Environment Protection (ANPE), environmental management by the "Observatoire Tunisien de l'Environnement et du Développement Durable" (OTEDD), and environmental technologies by the "Centre International des Technologies de l'Environnement de Tunis" (CITET) (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH 2013; Portail du gouvernement tunisien 2019). Similarly, in order to reduce the energy consumption at the national level, the National Agency for Energy Management (ANME) was created in 1985.

Therefore, it appears that Tunisian institutional framework is well developed. However, improvements should be done at the organizational level and in the training of experts in building environmental assessment. A lead agency could be created by the merger of the ANPE and the ANME. Given the close link between energy and environmental analysis, the merger would allow the simultaneous treatment of both themes (energetic and environmental). Thus, administrative tasks will be facilitated, the processing time minimized, and the future application of a building environmental regulation that encompasses both energy and environmental aspects of the building will be supervised by one organization instead of two (ANPE and ANME). Such mergers have already taken place in several countries such as France where the French Environment and Energy Management Agency (ADEME) is formed from the merger of several organizations, such as the Agency for Air Quality (AQA), the French Agency for Energy

Management (AFME), and the National Agency for the Recovery and Disposal of Waste (ANRED) (JORF 1990).

In addition to this institutional framework, and as specified in section "Feedback from various existing building environmental assessment methods and identification of applicability evaluation criteria," it is necessary to establish funding mechanisms through subsidies. Two funds have been set up in Tunisia: the Depollution Fund (FODEP) for financial support to environmental programs implementation (Portail du gouvernement tunisien 2019) and the National Energy Management Fund (FNME) to support energy management action through the granting of subsidies (Osman 2012). Regarding the mechanisms for granting these subsidies, mechanisms similar to those used for granting subsidies for thermal insulation as PROMO-ISOL or for the use of renewable energy as PROSOL TUNISIA could be implemented (Bahri 2009; Baccouche 2014). Given the success of the latter in terms of simplifying administrative formalities and encouraging investment, the application of such mechanisms for a building environmental program could be a good choice.

Moreover, the availability of specialized legislation is essential for the promotion and development of these methods. These laws should be developed in collaboration with civil society to ensure the smooth implementation of future projects or programs and to boost the use and application of building environmental assessment methods (as specified in section "Feedback from various existing building environmental assessment methods and identification of applicability evaluation criteria") (O'Faircheallaigh 2010). In this context, it appears that Tunisia has promoted energy efficiency and renewable energies at the expense of the building environmental aspect. No law relating to building environmental aspect was promulgated. In contrast, several laws relating to building energy aspect exist: the law of August, 2, 2004, amended by the law of February, 9, 2009, to pave the way for the self-generation of electricity from renewable energies (Bahri 2009) and the decrees of July, 23, 2008, and June, 1, 2009, fixing the minimum energy-saving technical specifications, respectively, for construction and extension projects of office buildings and similar and for construction and extension projects of residential buildings (Journal Officiel de la République Tunisienne 2008, 2009). Therefore, it is essential that Tunisia develops adequate environmental regulations and this should be done in collaboration with civil society for the reasons mentioned above.

Concerning implemented programs, once again, it appears that Tunisia has promoted energy efficiency and renewable energies in disregard of the building environmental aspect. Several programs related to energy efficiency and renewable energy have been set up such as the triennial (2005–2007) and quadrennial (2008–2011) energy management programs, the presidential program (2009–2014), and the Tunisian Solar Plan (2010–2016) (Bahri 2009). These programs give concrete expression to the national policy of energy management and of renewable energy promotion followed by the Tunisian State. In contrast, few environmental programs have been established. The Environment-Energy Program (PEE), launched in January 2009 and aiming to align Tunisian companies with national and international environmental requirements and to improve their competitiveness, would be the only program implemented to date that supports companies in the implementation of ISO 14001, ISO 50001, and the Tunisian "Ecolabel" (for tourist accommodation service) (Institut national de la normalisation et de la propriété industrielle 2009; Energy Environment Program 2009). Nevertheless, other projects in collaboration with other countries or international organizations have been undertaken. A twinning project between France, Germany, Portugal, and Tunisia has served as a support for the Tunisian administration for the development and promotion of eco-construction (Larbi 2014). Since 2003, Tunisia has launched an environmental program in collaboration with GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH 2013). The main themes of this program are communication and environmental education, competence decentralization, technology transfer, and environmental prevention. One of the consequences of this program is the development of regional plans for the environment and sustainable development. These plans, through their participatory character, would boost the communication on the environmental theme (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH 2014).

In addition, as specified in section "Feedback from various existing building environmental assessment methods and identification of applicability evaluation criteria", a good communication system boosts the use of building environmental assessment methods. Therefore, it is essential to have a good communication system not only to promote the use of these methods but also to gain feedback from the various stakeholders, which will be useful to develop and update these methods. The twinning project between France, Germany, Portugal, and Tunisia, mentioned above, contains a rather interesting communication component, defining the communication strategy for eco-construction development (Larbi 2014). This strategy could be a good communication strategy for an official building environmental assessment method.

Furthermore, in order to avoid making the same mistakes, the tool or method that will be used for building environmental assessment should take into account feedback from other internationally available tools, such as BREEAM, LEED, and HQE. Also, this tool should be in line with a standardized database and scoring system (or as close as possible to those methods where appropriate). Then, the tool that will be made available to design offices should present clear results to direct the user toward the optimal solution and to avoid leading him toward an evaluation error. The evaluation criteria must be

carefully chosen according to building type and regional conditions. Among other things, it is necessary to rely on a tool with no subjective character, in order to make the obtained results user-independent. In order to standardize the building environmental assessment practices between different users of the tool, a technical guide could be provided.

In Tunisia, several building design and/or simulation tools are available such as CLIP and CHEOPS for simply designed buildings and EQUEST for more complex buildings (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) 2012; Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH 2014; Thermal and energy regulations of new buildings in Tunisia 2009). Concerning environmental assessment tools, in 2013, a new label called ECO-BAT has been developed by the ANME in partnership with ADEME and with the assistance of the design offices ALCOR and ECOTECH (ANME 2013). This label is still not implemented but seems to include targets corresponding to the Tunisian priority stakes while retaining its ease of use.

Finally, it appears that Tunisia nowadays has a fairly mature thermal regulation. This finding comes from the success of the building energy management programs initiated by the Tunisian government and the availability of adequate tools, laws, and institutional frameworks. However, institutional and legislative frameworks and communication with professionals and the general public need to be improved. After consulting the ANME, this latter confirms the difficulty of checking the conformity of buildings with thermal regulations, which takes sometimes quite a long time, due to the lack of human resources. Other professionals and individuals assert the difficult access to information (Gherib and Berger-Douce 2008), hence the need to improve the means of communication. Also, a recent study demonstrated the need to update the Tunisian thermal regulations (Zainine et al. 2016).

In contrast, although Tunisia has an important environmental institutional framework, environmental programs remain focused on sanitation, waste management, coastal protection, and discharges monitoring due to economic activities. Unfortunately, the building sector is not given proper consideration yet. Nevertheless, some projects such as the twinning program between France, Germany, Portugal, and Tunisia, cited above, are encouraging and demonstrate the beginning of interest for the building sector. Moreover, the unavailability of building environmental regulation and adequate subsidy mechanisms is a sufficient reason to question the success and the development of an official building environmental assessment method in Tunisia. The "ECO-BAT" label, even though it is an important step in the transition from building energy evaluation to building environmental assessment, could unfortunately not evolve without supporting laws and financial mechanisms.

Using the applicability evaluation method presented in section "Feedback from various existing building environmental assessment methods and identification of applicability evaluation criteria", the results exposed in Table 3 have been obtained.

As each mandatory criterion did not reach a minimum of 80%, we could say that the environmental assessment tool (ECO-BAT) is not applicable at the moment.

At this step of the study, it is clear that there is a good agreement between results obtained by the applicability evaluation method and results obtained by the above deep analysis of the Tunisian case.

Stakes of building environmental assessment method implementation

According to the study carried out by Zeynalova (2011), BREEAM Commercial European scheme could be an efficient tool to boost the required energy efficiency for net zero site energy building target during operation for the ambitious projects. This statement is valid for both new and existing (refurbished/reconstructed) buildings. One important finding by Marique and Rossi (2018) concerning refurbished/reconstructed buildings is that the in-depth renovation of this buildings leads to lower environmental indicators compared to their full reconstruction. Concerning the Tunisian case, Ben Achour (2013a, b) argues that energy efficiency would constitute an important source of energy savings (about 80%). According to the ANME, the expected energy savings potential over the period 2008/2011, whose achievement rate attempted 80%, is 2500 ktoe (Bahri 2009; Ben Tamansourt 2012). In total, 86% of achieved energy savings are the result of improved energy efficiency. The building sector represents 43.5% of this potential against 21.8% for the industry. This highlights the importance of improving buildings' energy efficiency, which would be stimulated by the application of a building environmental assessment method.

Stakeholders tend to focus too much on building envelope and not on technical facilities. As a consequence, the potential role of building automation is not sufficiently emphasized. Building environmental assessment methods include envelope, facilities, and building management. Thus, several energy-saving techniques can be used to improve the building energy efficiency. Also, this could allow avoiding posterior interventions such as the case of the Federal University of Bahia in Brazil that have had subsequent interventions in which ventilation openings have been closed for the installation of air conditioning units (Costa et al. 2019).

One of the strengths of building environmental assessment, put forward by Gagnon et al. (1993); Gagnon (1995) and Vanclay (2003), is the important role in empowering local populations and improving the position of disadvantaged or marginalized society members. Another beneficial aspect of building environmental assessment is the economy boost,

Table 3 Results of the evaluation of building environmental assessment tool applicability in Tunisia

Criteria	Indicators	Weighting	
		Indicators	Criteria
Tools	Results presentation (separation between qualitative and quantitative targets).	8/8	23/30
	Line up with standardized rating system and database.	1/5	
	Minimize measurement uncertainties	1/2	
	Avoid subjective nature.	3/5	
	Applicability of evaluation criteria and independence on the evaluated building.	10/10	
Institutional framework	Development of the institutional framework.	12/15	17/25
	Experts in building environmental assessment availability.	5/10	
Legislative framework	Availability of legislative framework.	0/20	0/20
Subsidies	Availability of funding mechanisms.	0/15	0/15
Communication systems (optional)	Information about notation system and advantage.	1/2	3/5
	Availability of communication mechanisms: advertisement, conference, sponsoring…	1/1	
	Public participation in building environmental assessment.	1/2	
Environmental programs (optional)	Implementation of environmental programs.	2/5	2/5

Source: Authors' own calculation based on interviews with ANME and ANPE agency staff

resulting in the creation of several jobs (Akari 2012; Sulich et al. 2020). If the effect of reducing the impacts on climate change is added to the previous two points, the application of a building environmental assessment method would improve social capital and contribute to environmental, social, and economic stability. This statement is confirmed by a study conducted by Pardo-Bosch et al. (2019) about building retrofitting projects implemented in three different European cities. They show that the benefits of these projects outweigh their cost. Some of these benefits are reducing public budget allocations in certain areas such as energy poverty, attracting private investment, and engaging citizens. Additionally, according to Testa et al. (2011), if well-designed "direct regulation" is implemented with building environmental assessment, it could have a positive impact on innovation and intangible performance.

Moreover, despite the many environmental activities undertaken by Tunisia mainly focusing on urban areas (sanitation, waste management, pollution control, etc.), their impacts on environment and people's living quality are however not commensurate with the investments and expected objective levels (Akari 2012). This may be due to the unavailability or the disparate nature of the statistical data relating to these projects. A building environmental assessment could be one of the major solutions for statistical data collection, which in turn would contribute to the success of projects undertaken as part of the green economy.

Furthermore, building environmental assessment could be one of the major green marketing tools and should be taken into account by a company to improve profitability. According to FuiYeng and Yazdanifard (2015), eco-label, eco-brand, and environmental advertisement are part of the green marketing tools. Building environmental assessment could play the role of these three marketing tools. Indeed, a company working in the building sector could use building environmental assessment to advertise their awareness of the environmental concerns and could use it as an eco-label or eco-brand to prove the ecofriendly aspect of their product (building).

In addition, as stated by FuiYeng and Yazdanifard (2015), marketing mix is essentially the different means developed by a company to put goods or services on the market. In green marketing, environmental concern must be a key element of marketing mix. The concept of the marketing mix referred to as 4P's includes components such as the product, the price, the location, and the promotion. This notion has been developed and extended for products as well as for services, adding three other components such as people, physical evidence, and process to make up the 7P's. This statement demonstrates the important role of building environmental assessment to show the environmental concern of the company (in the building sector).

According to Boztepe (2012), green marketing could help a company improve profitability by fostering communication about and by the practice of the green business process. These latter could be done by building environmental assessment as it integrates a green process component and the relative eco-label could be an important communication tool.

Eventually, building environmental assessment could help in avoiding greenwashing because it is consistent with branding tools of the sustainable organization as presented by Macalik and Sulich (2019).

Conclusion

The main objective of this study was to present an environmental assessment tool applicability evaluation method.

For this purpose, the defaults faced by the various building environmental assessment methods available internationally and barriers that have hindered their use or development were analyzed. Based on this analysis, the evaluation criteria have been identified and the weighting method has been exposed. Then, the developed method has been applied to the Tunisian case and compared to results obtained by a deep analysis. A good agreement between results obtained by the applicability evaluation method and those obtained by a deep analysis has been found.

It came out that the environmental assessment tool (ECO-BAT) is not applicable at the moment. Indeed, given the unavailability of building environmental regulation and adequate subsidy mechanisms, the success and development of an official building environmental assessment method in Tunisia could be questioned. Even if the "ECO-BAT" label constitutes an important step in the transition from building energy evaluation to building environmental assessment, it could unfortunately not evolve without supporting laws and financial mechanisms.

Among other things, the institutional framework and communication systems would not constitute major obstacles to the applicability of an environmental assessment method. It has been shown that the Tunisian institutional framework is only suffering from a lack of organization and of specialized staff. Solutions have been proposed, such as the merger of ANME and ANPE.

Concerning the communication systems, programs in collaboration with other countries and international organizations would provide a good basis for the implementation of an efficient communication system.

Furthermore, implementation of building environmental assessment method could be positive from an energy point of view by helping to improve the building energy efficiency and would enhance social capital and contribute to the environmental, social, and economic stability of Tunisia.

Also, building environmental assessment could be one of the major solutions for the collection of statistical information, which in turn would contribute to the success of projects undertaken as part of the green economy.

Finally, building environmental assessment could be one of the major green marketing tools and should be taken into account by a company to improve profitability.

Eventually, the proposed environmental assessment tool applicability evaluation method is a preliminary method. Its limitations are primarily related to the subjective nature of few criteria (such as institutional and legislative framework criteria). In the future, such limitations might be overcome by proposing quantitative criteria or transforming qualitative criteria to quantitative ones.

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Authors' contributions The main idea of the project was formulated by Zainine. All the authors contributed to the study conception and design. The engineering aspect of the paper has been studied by Zainine, Mezni, and Guizani. The economic aspect has been studied by Baeshen and Rahmoun. Data collection was performed by Zainine and Mezni. The first draft of the manuscript was written by Zainine and all the authors commented on previous versions of the manuscript. All the authors read and approved the final manuscript.

Data availability The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict interests.

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