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A review of LEED green building certification systems in Europe and Turkey

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Abstract

This study reviews LEED green building certification system which is used most widely in Turkey and in the world. A LEED green building certificate can be obtained by meeting different criteria of the review system and therefore each LEED certified building can have different features. This study reviewed all new buildings in Europe and Turkey, which have LEED Gold certificates. Additionally, the LEED green building certification system criteria which were met by more than 150 buildings to obtain the certification were listed and the percentages of the criteria that were met in Europe and in Turkey were determined. Based on these percentages, the criteria that were mostly preferred and those that were not generally avoided by certified buildings were shown. And by comparing these percentages the most important differences between in Turkey and Europe were identified and the reasons for these differences were investigated.

Based on the above, it was concluded that the performance of LEED certified buildings in Turkey were poorer than in Europe especially in energy. Although they have the same certification levels, green buildings in Europe are more energy efficient than those in Turkey. In areas such as brownfield redevelopment, light pollution caused by the building, use of certified wood, low VOC (volatile organic compounds) content in floorings and occupant line of sight, buildings in Turkey lag behind the buildings in Europe. In Turkey, regulations and the education level in the industry in these areas are not up to the standards of Europe.

Keywords
LEED, Green building certification system, Green buildings in Europe and Turkey.

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1. Introduction

Reflections of sustainable development in the construction industry have brought forward the concept of green buildings which are designed with social and environmental responsibilities in mind and remain eco-friendly and human-friendly through their life cycle. Along with green building projects, voluntary green building certification systems which allow eco-friendly features of these buildings to be documented, encouraged and promoted have been developed. Green building certification systems are supported by developed countries and seen as an effective tool for the real estate sector to have a sustainable transformation. Similar to what was happening in developed countries, the awareness in Turkey has also increased and many construction companies have started to use green building certification systems that are popular globally in their projects.

In Turkey, especially LEED (Leadership in Energy and Environmental Design) green building certification system is rather widely used. The reasons why LEED green building certification system has become more popular in Turkey are that it is the most widely used system in the world and preferred by multinational companies and the certification process are easier than other systems and the system has a high brand value. LEED green building certification system is expected to become more popular and be used more over time. Therefore LEED green building certification system is important for the real estate sector.

Although there are more LEED certified green buildings in Turkey, which is seen as a positive development for the sector, this also has brought many problems. Identifying and solving these problems will help to improve green buildings in Turkey. One of the most important problems relates to the fact that the energy performance of a certified green building has not been defined. There are ongoing discussions as to which criteria should be used to identify a building as a "green building"; how energy efficient a building with a green building certificate is and whether certification is granted based on objective reviews in Turkey. These ongoing discussions with no answers lead to a distrust for the sector. Given the fact that green building certificates are used as a marketing tool and increase the value of buildings, these uncertainties make people doubt about misinformation and unlawful gains and profits.

The objective of this study is to compare European countries which are more experienced in green building certification systems and Turkey where the history of these systems are relatively new to identify energy efficiency requirements met by certified green buildings; to show the energy performance which should be expected by the sector from certified green buildings; to contribute to the discussions on the performance and the validity of the certified green buildings and about the validity of LEED green building certification system in Turkey.

2. Green building certification systems

Green building certification systems are independent systems that review a building based on certain criteria to determine how "green" it is. The criteria used by these systems which are developed through collaborations of a wide range of government and non-government organizations, industry representatives and scientists provide guidelines about green building design and construction for the industry. Certificates are typically given by independent organizations or government bodies. Content of certificates and identified efficiency criteria develop in parallel to developing building technology and updated laws and regulations and the performance level required to get a certificate regularly goes higher.

Green building certification systems adopt a holistic approach for environmental impact of a building taking into account the building's life cycle. Energy and water consumption, use of resources, waste management, indoor air quality, natural life and ecology, operation and maintenance, innovation and for some certification systems economic and social impacts are the areas covered by green building certi-

fication systems. A project is reviewed based on criteria requirements met by the project and the project is granted a certificate with varying levels based on this review.

2.1. LEED green building certification system

There is a wide range of green building certification systems used in the world today. Many countries have developed their own green building certification systems to work better with local conditions. Systems that were developed in some countries including the USA, UK and Germany are used internationally. The popularity and brand value of such certification systems are higher than local/national ones and therefore mostly these certification systems are preferred. In this paper LEED Green Building Certification System which is the most widely used system in Europe and Turkey was reviewed.

LEED (Leadership in Energy and Environmental Design) was developed by USGBC (US Green Building Council) in 1998 and it is the most preferred green building review system in the world. Today, there are almost 50 thousand buildings certified by LEED in the world. The reason for the increase in the number of LEED certified buildings can be increased awareness and knowledge about green building concept and LEED around the world and incentives granted to LEED certified buildings in the USA. In Turkey, the number of LEED certified projects is 171 as of January 2017 and there are 306 projects that are registered but not yet certified. Given the fact that there are around 50 thousand projects registered to obtain LEED certification, it is possible to anticipate that there will be much more LEED certified buildings. Compared to other countries, certification levels in Turkey are mostly Gold and Platinum. There is less number of Certified and Silver level certificates. Turkey became the 9th country to have the highest number of LEED certificates in the world in 2015 (USGBC, 2015).

There are 353 LEED certified projects in Europe as of January 2017. LEED certification seems to be more popular in Germany and Sweden. Germany is the 6th country to have the highest number of LEED certificates in the world. Although these two countries have their own national certification systems, LEED system is preferred.

LEED offers a wide range of certification types that can cover design, construction and operation of all project types (new construction and major renovation, existing buildings, commercial interiors, residential buildings, homes, neighborhood development). Each certification type has requirements unique for that category. After certificate type suitable for the project is chosen, design and operation decisions are taken according to the credit category of the certificate type.

Each type of certificate consists of relevant categories and credits. Each category has specific prerequisites and a variety of credits that projects must satisfy. Total number of points in the category required by a specific type of certificate determines the certificate level. LEED evaluates a project over 110 points and certificate level of the project is determined based on the points earned. There are four certificate levels:

- LEED Certified : 40–49 points
- LEED Silver : 50-59 points
- LEED Gold : 60-79 points
- LEED Platinum : 80 points and above

Categories are as following:

Sustainable Sites: Sustainable Sites credit category encourages projects to be built in existing locations with an established structure, infrastructure, and resources available. The location preferred is intended to be close to various means of mass transportation. This category aims to prevent housing development on open/uninhabited areas; minimize a building's negative impact on eco-systems and waterways; encourage landscape that is in harmony with the natural features of the area and reward smart transport solutions and control rainwater runoff and reduce erosion; and reduce light pollution, thermal island effect and pollution from construction.

- Water Efficiency: The objective of this category is to ensure that water is used more efficiently and wisely

indoors and outdoors. Water efficiency is achieved by several options including choosing the right fittings and fixtures, landscape with reduced irrigation need, use of grey water.

- Energy and Atmosphere: This category rewards a wide variety of energy strategies including commissioning, control of energy use, efficient design and construction, efficient equipment, systems and lighting, renewable and clean energy and other innovative strategies.
- Materials and Resources: This credit category encourages selection of sustainable products and materials. This category supports minimization, recovery and recycling of waste and aims to improve indoor air quality.
- Indoor Environmental Quality: This category focuses on improving indoor air quality, having maximum access to natural sunlight and view, improving thermal control means and acoustics. The goal here is to ensure that occupants work more efficiently and health problems are prevented.
- Innovation: The objective of this category is to reward the use of innovative sustainable features and practices in buildings.

2.2. Previous studies on LEED green building certification system practicess

The literature on LEED green building certification systems both in Turkey and in the world is quite rich. Previous studies include comparative assessments of international and local green building certification systems and their implementations. Mao et al.'s study (Mao et al., 2009), "A Comparison Study of Mainstream Sustainable/ Green Building Rating Tools in the World" compares the international certification systems LEED, BREEAM, SBTool, CASBEE, BCA-GM and ESGB. Awadh (Awadh, 2017), "Sustainability and green building rating systems: LEED, BREEAM, GSAS and Estidama critical analysis" analyzes two internationally applied systems; LEED and BREEAM, and two particularly developed for the gulf region; Estidama and GSAS. Cole (Cole, 2013), "The importation of building environmental certification systems: international usages of BREEAM and LEED" provides a detailed analysis of the BREEAM and LEED implementation provided using data from six specific countries: Chile, Colombia, the Czech Republic, the Netherlands, Sweden, and the United Arab Emirates. The studies show that the LEED certification is the most used system in the world.

There are many academic studies on LEED green building certification systems both in Turkey and in the world. The following studies investigated the LEED certification process : Aksakal (Aksakal, 2009) "An Approach for the the Design Process in Green Building Projects: Leed V4 Certification Process", Ozcan and Temizbas (Ozcan et al., 2010) "Green Building" and Sumer (Sumer, 2013) "Green Building Management Processes and A Case Study on Project Management Processes in LEED and BREEAM Practices in Turkey". The study of Adiloglu et al. (Adiloglu et al., 2010), "ESER Green Building " reviews the requirements of LEED certification met and work done in the building, ESER which is the first building with LEED Platinum certificate in Turkey. Aktas's study (Aktas, 2013) " Converting Existing Buildings to Green Buildings: Implementations In Turkey " reviewed 8 existing buildings with LEED certification in Turkey and discussed the difficulties involved in the process of obtaining LEED certification. Ozturk's study (Ozturk, 2015) "Analysis of Green Building Certification Systems" compares LEED and other green building certification systems. In his book "Green Building Cost and Financial Benefits" which was the first comprehensive work on the cost of LEED certification Kats (Kats, 2003) made a cost analysis for 33 LEED certified buildings in the USA. Mapp et al.'s study (Mapp et al., 2011) "The Cost of LEED—An Analysis of the Construction Costs of LEED and Non-LEED Banks" and Nyikos et al.'s study (Nyikos et al., 2012), "To LEED or Not to LEED: Analysis of Cost Premiums Associated With Sustainable Facility Design" and Ugur and Leblebici's study (Ugur et al.,2015) "Review of

the Effects of Green Building Certification Systems on Construction Costs and Property Values" investigated the cost of LEED certification system. Diamond's study (Diamond, 2011) "Evaluating the energy performance of the first generation of LEED-certified commercial buildings" and Turner and Frankel's study (Turner et al., 2008) "Energy performance of LEED for New Construction Buildings" investigated LEED and energy efficiency. Potbhare and Korkmaz (Potbhare et al., 2009) in their study titled "Adaption of Green Building Guidelines in Developing Countries based on US and India experiences" investigated the development process of LEED certification system and how it is used in developing countries.

3. A review of LEED green building certification system implementation in Europe and Turkey

In this section, the method to review LEED Green Building Certification System Implementation in Europe and Turkey was explained and then implementation and principles in Europe and Turkey were compared and reviewed (Baştanoğlu, 2017).

3.1. Method

In this section of the study, the objective is to compare European countries which are more experienced in green building certification systems and Turkey where the history of these systems are relatively new to identify energy efficiency requirements met by certified green buildings; to show the energy performance which should be expected by the sector from certified green buildings; to contribute to the discussions on the performance and the validity of the certified green buildings and about the validity of LEED green building certification system in Turkey.

As discussed in section 2, LEED green building certification has prerequisites and optional credits for different categories. Each credit has a certain point. In order for a building to get credit points, it should meet the credit requirements described in detail in the LEED reference book. If most of the credit requirements are met, full points can be obtained and if not no point can be obtained. Some credits have percentages determined according to the level of performance of the building. A certain part of the credit point can be obtained according to the requirements met by the building. LEED reference book (USGBC, 2017) was used as the source for LEED categories and credits.

In order to make a sound comparison, all new buildings with LEED Gold and LEED NC (New Construction) certificates in all European countries and in Turkey until 2017 were included. Out of 158 buildings included in the review, 52 are in Turkey and 106 are in Europe. Information about the buildings included in the review was obtained from the American Green Buildings Council data base (USGBC, 2017). LEED credit points that these buildings earned to be LEED Gold certified were identified and achievement percentages of each credit in Europe and Turkey were calculated using weighed average as the number of buildings in Turkey and Europe is different and a comparison was made based on these percentages.

Based on these percentages, the requirements which should be expected to be met by new buildings with LEED Gold certification in Europe and Turkey were explained and differences between Europe and Turkey about how LEED credit points were gained were explained.

The steps of the methodology is shown on the Figure 1.

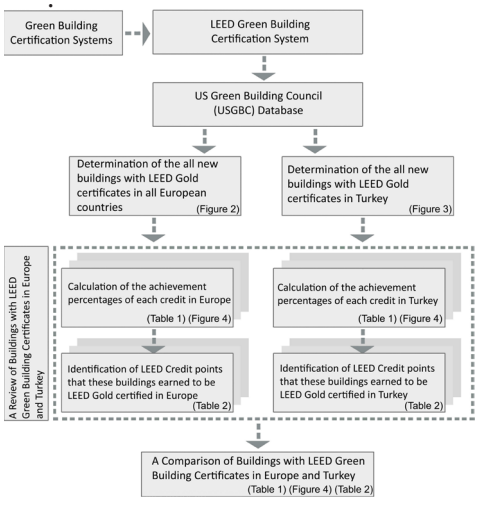

Figure 1. *The steps of the methodology.*

3.2. A review of buildings with LEED green building certificates in Europe and Turkey

106 LEED Gold certified new buildings in 18 European countries were reviewed in this study. Germany, Spain and Sweden have the highest numbers of LEED Gold certified new buildings. Poland and Finland come after these three countries. Serbia, Greece and Norway have only one LEED Gold certified new building each and most of these are office buildings.

In Turkey 52 LEED Gold certified new buildings in 10 cities were reviewed. Most of these buildings were office buildings and they are predominantly in Marmara Region, especially in Istanbul and Kocaeli.

Examples of LEED Gold Certified buildings in Turkey and Europe can be seen in Figure 2 and Figure 3.

Categories and credits in LEED certification system and achievement percentage of them in Europe and Turkey are shown in Table 1. Decrease in water consumption, optimum energy performance, on-site renewable energy and innovation in design were calculated on a scale therefore averages of these points were given.

3.3. A Comparison of buildings with LEED green building certificates in Europe and Turkey

In this study, all LEED Gold certified new buildings in European countries and Turkey were reviewed and as the

Figure 2. *Examples of LEED Gold Certified buildings in Europe (USGBC, 2017) (Photos: Url 1-8).*

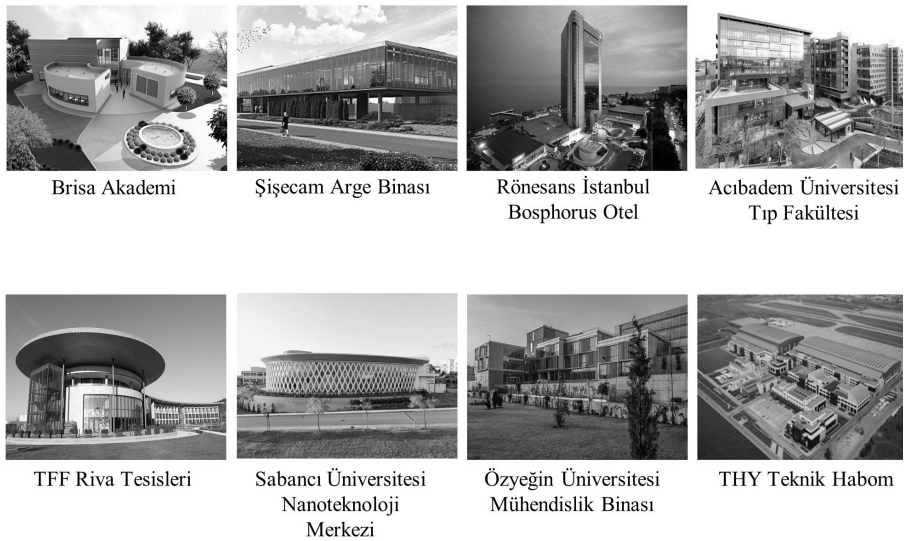

Figure 3. *Examples of LEED Gold Certified buildings in Turkey (USGBC, 2017) (Photos: Url 9-16).*

***Table 1**. LEED Credits and achievement percentages of buildings in Europe and Turkey (Baştanoğlu, 2017).*

Category/Credit Name (Points)		Percentage in Europe	Percentage in Turkey
SUSTAINABLE SITES (26p)		**%71**	**%73**
Prerequisite 1	Construction Activity Pollution Prevention		
Credit 1	Site Selection (1p)	%90	%88
Credit 2	Development Density and Community Connectivity (5p)	%69	%62
Credit 3	Brownfield Redevelopment (1p)	%35	%0
Credit 4.1	Alternative Transportation—Public Transportation Access (6p)	%91	%100
Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms (1p)	%88	%96
Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles (3p)	%92	%98
Credit 4.4	Alternative Transportation—Parking Capacity (2p)	%67	%73
Credit 5.1	Site Development—Protect or Restore Habitat (1p)	%35	%23
Credit 5.2	Site Development—Maximize Open Space (1p)	%68	%75
Credit 6.1	Stormwater Design—Quantity Control (1p)	%45	%62
Credit 6.2	Stormwater Design—Quality Control (1p)	%42	%44
Credit 7.1	Heat Island Effect—Non-roof (1p)	%70	%79
Credit 7.2	Heat Island Effect—Roof (1p)	%59	%71
Credit 8	Light Pollution Reduction (1p)	%26	%10
WATER EFFICIENCY (10p)		**%79**	**%80**
Prerequisite 1	Water Use Reduction—20% Reduction		
Credit 1	Water Efficient Landscaping (4p)	%92	%96
Credit 2	Innovative Wastewater Technologies (2p)	%62	%83
Credit 3	Water Use Reduction (4p)	3,1/4	3,3/4
ENERGY AND ATMOSPHERE (35p)		**%49**	**%41**
Prerequisite 1	Fundamental Commissioning of Building Energy Systems		
Prerequisite 2	Minimum Energy Performance		
Prerequisite 3	Fundamental Refrigerant Management		
Credit 1	Optimize Energy Performance (19p)	11,8/19	8,0/19
Credit 2	On-Site Renewable Energy (7p)	0,6/7	0,9/7
Credit 3	Enhanced Commissioning (2p)	%57	%44
Credit 4	Enhanced Refrigerant Management (2p)	%79	%90
Credit 5	Measurement and Verification (3p)	%66	%88
Credit 6	Green Power (2p)	%29	%17

Category/Credit Name (Points)		Percentage in Europe	Percentage in Turkey
MATERIALS AND RESOURCES (14p)		**%30**	**%39**
Prerequisite 1	Storage and Collection of Recyclables		
Credit 1	Building Reuse—Maintain Existing Walls, Floors, and Roof (3p)	%0	%0
Credit 2	Building Reuse—Maintain 50% of Interior Non-Structural Elements (1p)	%83	%85
Credit 3	Construction Waste Management (2p)	%1	%2
Credit 4	Recycled Content (2p)	%60	%98
Credit 5	Regional Materials (2p)	%79	%98
Credit 6	Rapidly Renewable Materials (1p)	%2	%10
Credit 7	Certified Wood (1p)	%19	%4
INDOOR ENVIRONMENTAL QUALITY (15p)		**%56**	**%52**
Prerequisite 1	Minimum Indoor Air Quality Performance		
Prerequisite 2	Environmental Tobacco Smoke (ETS) Control		
Credit 1	Outdoor Air Delivery Monitoring (1p)	%51	%37
Credit 2	Increased Ventilation (1p)	%73	%71
Credit 3.1	Construction IAQ Management Plan—During Construction (1p)	%88	%96
Credit 3.2	Construction IAQ Management Plan—Before Occupancy (1p)	%49	%50
Credit 4.1	Low-Emitting Materials—Adhesives and Sealants (1p)	%68	%77
Credit 4.2	Low-Emitting Materials—Paints and Coatings (1p)	%88	%94
Credit 4.3	Low-Emitting Materials—Flooring Systems (1p)	%43	%21
Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products (1p)	%15	%0
Credit 5	Indoor Chemical and Pollutant Source Control (1p)	%46	%60
Credit 6.1	Controllability of Systems—Lighting (1p)	%45	%52
Credit 6.2	Controllability of Systems—Thermal Comfort (1p)	%44	%42
Credit 7.1	Thermal Comfort—Design (1p)	%75	%87
Credit 7.2	Thermal Comfort—Verification (1p)	%58	%75
Credit 8.1	Daylight and Views—Daylight (1p)	%42	%35
Credit 8.2	Daylight and Views—Views (1p)	%62	%33
INNOVATION AND REGIONAL PRIORITY (10p)		**%78**	**%86**
Credit 1	Innovation in Design (5p)	3,3/5	3,9/5
Credit 2	LEED Accredited Professional (1p)	%98	%100
	Regional Priority (4p)	%96	%100

numbers of buildings reviewed in Europe and Turkey were different, weighted averages were used to calculate percentages of LEED credit requirements met and comparison was made accordingly. For each category, criteria requirements that were met by higher and lower number of buildings in Europe and those that were met by similar percentages of buildings in Europe and Turkey were determined.

The average achievement percentage of each credit and category of 158 buildings in Europe and Turkey are compared according to the Table 1 and Figure 4. Number of points achieved in category is compared according to the Table 2.

- Sustainable Sites category is an important category with 26 points in total; similar points were gained in Europe (18.5 points) and in Turkey (19 points). It is possible to conclude that achievement rate of points is higher in this category compared to others. No points were earned for Brownfield Redevelopment credit under this category in Turkey. The reason for this is that mostly well-developed lands are used.

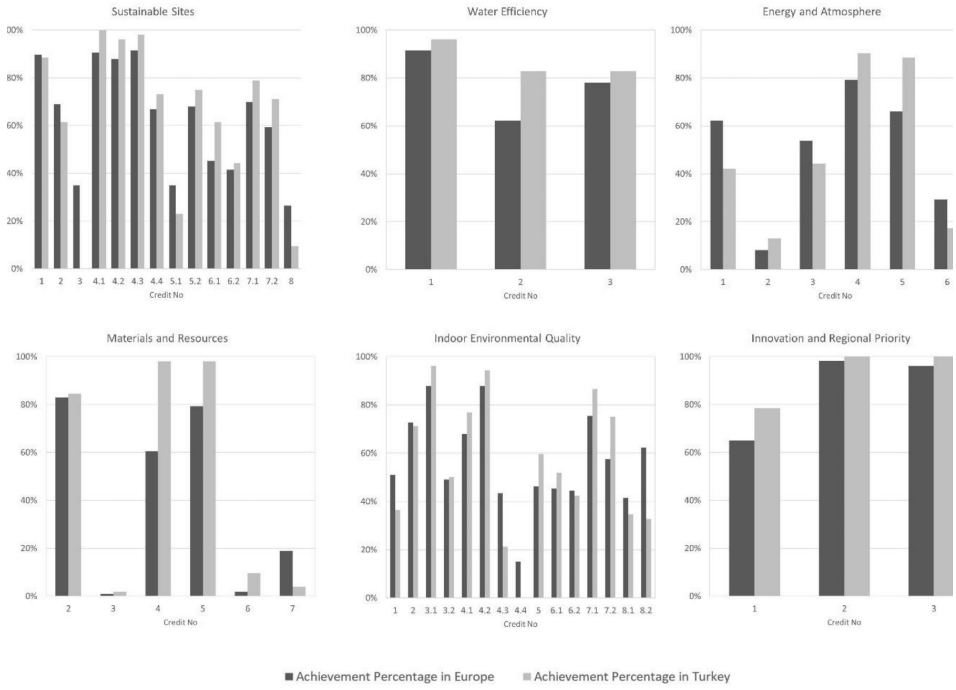

***Figure 4.** The credit achievement percentages of buildings in Europe and Turkey all categories in LEED certification system.*

- Water Efficiency category includes 10 points. Credit requirements in this category were met by 79-80% of the buildings in Europe and Turkey and therefore 7.9 points and 8.0 points respectively were earned. It is possible to conclude that achievement rate of points is higher in this category compared to others.
- Energy and Atmosphere category has the highest number of points (35 points) in all of the categories. Since this category both has the highest number of points and includes energy related requirements which have become increasingly important, this category has a major impact on LEED certification. The average in Europe is 17.3 points and in Turkey it is 14.6 points in this category. Based on the above information it can be concluded that LEED Gold certified new buildings in Europe have better performances in energy efficiency and relevant requirements. Additionally, points earned in this category are lower than the others. On-site renewable energy credit requirement is met at a very low percentage both in Europe and in Turkey. It is understood that there are difficulties in Renewable energy applications. Materials and Resources category includes 14 points. Credit requirements are met by 30% of the buildings in Europe and 39% of the buildings in Turkey. It is possible to conclude that achievement rate of points is significantly lower in this category compared to others. Almost no points have been earned from the credit requirements, Building Reuse and Material Reuse in this category. It is believed that these systems are newly developed and therefore harder to meet.
- Indoor Environmental Quality category includes 15 points. LEED Gold certified new buildings in Europe had average 8.5 points and in Turkey average 8.3 points. The credit requirement for Low emission materials-composite wood products in this category was met by a low percentage of buildings in Europe and no points were earned in this credit in Turkey.

***Table 2**. Number of points achieved category (Baştanoğlu, 2017).*

Category Name	Total Points	Points in Europe	Points in Turkey
SUSTAINABLE SITES	26p	18,5p	19p
WATER EFFICIENCY	10p	7,9p	8p
ENERGY AND ATMOSPHERE	35p	17,3p	14,6p
MATERIALS AND RESOURCES	14p	4,3p	5,6p
INDOOR ENVIRONMENTAL QUALITY	15p	8,5p	8,3p
INNOVATION AND REGIONAL PRIORITY	10p	7,8p	8,6p

- Innovation and Regional Priority category has 10 points. LEED Gold certified new buildings in Europe had average 7.8 points and in Turkey average 8.6 points. It is possible to conclude that achievement rate of points is high in this category.

Green building features were identified based on the comparison of every category and credit requirements met by the buildings reviewed in Europe and Turkey and the differences between the buildings in Europe and Turkey were determined. According to the findings of the study, some credit requirements were met by similar percentages of buildings in Europe and Turkey whereas others were met more either in Europe or Turkey.

The credit requirements that were met by a high percentage of buildings both in Europe and Turkey are those about location selection. Most of the LEED green certified buildings are at city centers and close to mass transportation access points. Based on the above findings, it can be concluded that LEED certified buildings are centrally located buildings with high values.

Credit requirements that do not entail high costs are met by high percentages of buildings both in Europe and in Turkey. Low cost credit requirements such as water efficient landscape design, waste management during construction were met by most of the buildings. Additionally, credit requirements such as outdoor bicycle racks, green car parks were met by a high percentage of buildings although they are not widely used. Credit requirements about chemical content of paints were also met by a high percentage of buildings and this indicates that paint manufacturers comply with LEED standards. As services of LEED consultant companies were used during construction of the buildings, these credit requirements were met by almost all buildings.

Some credit requirements were met by a very low percentage of buildings both in Europe and in Turkey. Most notable of these credit requirements are renewable energy production and purchase of green energy. Despite common belief, the likelihood of having a renewable energy system such as solar panels on a LEED certified green building is very low. Gurgun et al. (Gurgun et al., 2016) "Performance of LEED Energy Credit Requirements in European Countries" analyzes practices in European countries based on credit performances and it is shown that onsite renewable energy options were the least addressed energy efficiency solutions, probably because they are costly and not easy to find. This seems to be the biggest misperception about LEED green building certification systems in the real estate sector. This misperception causes problems during development and marketing of green buildings.

Users/occupants also assume that renewable energy systems are available on green buildings during marketing and promotion activities for these buildings. Furthermore, buildings with green building certification which do not use renewable energy lead to discussions about reliability of these certification systems. Credit requirements about material selection were met only by a very low percentage of LEED certified green buildings. It can be possible that the construction industry has difficulty in meeting the criteria about LEED certified wood products, renewable materials, composite wood products.

Turkey should focus on the criteria requirements that were met less in Turkey compared to European countries. LEED Gold certified new buildings in Turkey do not meet especially energy performance requirements as much as those in Europe. Although they have the same certification levels, green buildings in Europe are more energy efficient than those in Turkey. It can be concluded that Turkey somewhat lags behind Europe in designing energy efficient buildings. The main reason behind this problem is lack of enough regulation. Unless required by law, developers avoid meeting the criteria with high initial investment costs. It is also possible to say that passive energy efficiency strategies are less used in architectural designs in Turkey. As well as new laws and regulations about energy efficiency, awareness should be raised among industry stakeholders.

Turkey is also not up to the level of Europe in brownfield redevelopment credit. LEED certified green buildings developed on industrial areas after rehabilitation met the relevant criteria in Europe whereas none of the buildings in Turkey met these criteria. Assessment of land and underwater pollution, and relevant measures taken are not sufficient to meet LEED criteria. Relevant regulations should be developed, and the industry's awareness should be improved in Turkey.

The credit requirements for "Views" credit which is about occupant line of sight to outside was also met by a low percentage of buildings in Turkey compared to those in Europe. Given the fact that most of LEED certified green buildings are located at city centers, the reason for not meeting the requirement of line of sight can be lack of regulations on urban planning. In Turkey, there are more buildings which have living spaces in basement or buildings that are close to one other which significantly limits line of sight. It is recommended to develop regulations on urban planning to achieve more line of sight in buildings.

Turkey performs also poorer in criteria about chemical contents of floorings and wood products. It can be said that a lower percentage of materials in Turkey meet LEED certification standards when compared to Europe. It is expected that material manufacturers will develop more environmentally friendly products as the demand for such products increase. In addition to the above mentioned credits, the percentages in Turkey are not as high as those in Europe for measures against light pollution caused by buildings. It seems that developers ignore this green building feature in order to achieve the look they want for their buildings. This study found that some of the criteria requirements are met at a higher percentage in Turkey. Especially in water efficiency, grey water and water harvesting, more buildings in Turkey met the requirements

than in Europe. It can be concluded that awareness about water efficiency in Turkey is high and the industry can meet these criteria. Part of the criteria requirements which are met by a higher percentage of buildings in Turkey than in Europe were evaluated only based on declarations in LEED green building certification system. Credit requirements such as preparation of measurement and verification plan, conducting thermal comfort survey were evaluated based on declarations. As no on-site audit is used in LEED Green building certification system, these points can still be earned even if these credit requirements are not met. This can be considered as a problem in LEED green building certification system and it is recommended that there should be systems to check and verify that a building actually meets criteria requirements to prevent such arguments.

Overall, it is seen that the most important parameters in green building practices are the local regulations related to green building, education level of the project team and the construction costs of green building.

4. Conclusion and recommendations

In general, all green building certification systems have a similar review system. Each certificate has prerequisites and optional criteria about design, construction and operation. A building's certification level is determined based on the percentage of optional criteria met, and buildings can have green building certificates by meeting different criteria provided that they achieve a certain percentage. This system gives flexibility in certification process and allows that different type of buildings can have certificates based on different conditions. However, in this case since the same criteria are not valid for every project, every green building does not have the same features. For example, there is a minimum level for energy efficiency which certification systems require however this level is not very high and does not give a project significant benefits. A building with an energy efficiency that is not high can have the same certificate level with a building that have a high energy efficiency level but does not meet other criteria. A building that does not have a very high energy efficiency can be perceived as a high efficiency building just because it is certified. This causes confusion and uncertainties about the features that are expected in a certified building in the real estate sector. The consequences of such confusion and uncertainties which directly affect the real estate sector include false presumptions about the costs of development of green buildings which discourage developers from developing green buildings and misinformation provided to customers and unfair benefits while selling and renting green buildings. In order to avoid the above problems, features of a certified green building should be described, used and marketed correctly in the real estate sector. Furthermore, there have been some discussions about the validity of these certificates because of these uncertainties and a lack of trust has built up for certified green buildings in Turkey due to the reason that on-site audit is not done in these certification systems. These discussions and lack of trust prevent correct use of certificates and discourage green buildings. It is suggested that the benefit of LEED certification system would be enhanced if the minimum mandatory performance threshold of each criteria is increased above the industry standards. This will enforce the practitioners to implement all green building strategies instead of cutting corners to achieve the certification without having positive impact in all categories.

When differences in implementation of the certification system in Europe and Turkey were reviewed, regulations on energy efficiency, urban planning and brownfield redevelopment should be enacted. Additionally, construction of a green building requires multi-disciplinary work. Therefore, all disciplines involved in different stages of construction should be given training on green buildings. Inspection and control of the requirements declared to be met, development of evaluation criteria in line with urban planning principles and giving more importance to renewable energy systems can be among the recommendations to improve LEED green building certification system.

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