

Article

Leadership in Energy and Environmental Design Commercial Interior Version 4 (LEED-CI v4) Gold-Certified Office Space Projects: A Pairwise Comparative Analysis between Three Mediterranean Countries

Svetlana Pushkar 

Department of Civil Engineering, Ariel University, Ariel 40700, Israel; svetlanap@ariel.ac.il

Abstract: Over the past five years, Leadership in Energy and Environmental Design Commercial Interior version 4 (LEED-CI v4)-certified office projects have been intensively studied in the USA and China, but they have not yet been studied in the Mediterranean region. The purpose of this study was to explore office building certification strategies for LEED-CI v4-certified projects in the Mediterranean region. The study design included pairwise comparative analyses between Spain (number of projects (n) $n_1 = 14$), Türkiye ($n_2 = 13$), and Israel ($n_3 = 11$). Cliff's δ and exact Wilcoxon–Mann–Whitney tests were used to process ordinal and discrete data, while the natural logarithm of the odds ratio and 2×2 Fisher's exact tests were used to handle dichotomous data. It was found that Spain and Türkiye outperformed Israel in the Location and Transportation (LT) category due to their desire to reduce the use of private transport. Spain and Türkiye were ahead of Israel in the LTc5 “reduced parking footprint” credit ($p = 0.008$ and 0.0005 , respectively). Israel outperformed Spain and Türkiye in the Energy and Atmosphere (EA) category due to the sum of all six EA credits ($p = 0.086$ and 0.010). Spain overtook Türkiye and Israel in the Materials and Resources (MRs) category due to Spain's increased use of environmental product declarations. Spain and Türkiye were ahead of Israel in the following four MRs credits: MRc1 “long-term commitment” ($p = 0.030$), MRc2 “interiors life cycle impact reduction” ($p = 0.037$), MRc3 “building product disclosure and optimization—environmental product declarations” ($p = 0.029$), and MRc5 “building product disclosure and optimization—material ingredients” ($p = 0.034$). Spain, Türkiye, and Israel showed similarly low levels of achievement in the Indoor Environmental Quality (EQ) category ($p \geq 0.405$). However, Spain and Türkiye outperformed Israel in the following two credits: EQc1 “enhanced indoor air quality strategies” and EQc2 “low-emitting materials” ($p = 0.001$ and 0.060 , respectively). In parallel, Israel outperformed Türkiye in the EQc3 “construction indoor air quality management plan” ($p = 0.026$), and Israel outperformed Spain in the EQc8 “quality views” credit ($p = 0.066$). As a result, a pairwise comparison of the three Mediterranean countries showed that each country has a unique LEED certification strategy. Knowledge of the above green building strategies will be helpful for LEED professionals.



Citation: Pushkar, S. Leadership in Energy and Environmental Design Commercial Interior Version 4 (LEED-CI v4) Gold-Certified Office Space Projects: A Pairwise Comparative Analysis between Three Mediterranean Countries. *Buildings* **2024**, *14*, 815. <https://doi.org/10.3390/buildings14030815>

Academic Editor: Antonio Caggiano

Received: 10 February 2024

Revised: 13 March 2024

Accepted: 15 March 2024

Published: 17 March 2024

Keywords: LEED-CI v4; Spain; Türkiye; Israel; nonparametric statistics



Copyright: © 2024 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

The Leadership in Energy and Environmental Design (LEED) green building rating system was developed by the US Green Building Council (USGBC) and launched in 1998 [1]. LEED is a reliable measurement system for assessing reductions in environmental damage caused by the building sector. For example, LEED-certified office buildings have been shown to produce 50% less greenhouse gases from water consumption, 48% less greenhouse gases from solid waste management, and 5% less greenhouse gases from transportation compared with non-LEED-certified office buildings [2].

The literature review section of this study examined LEED for New Construction (LEED-NC) version 2.2 (v2.2)- and version 3 (v3)-certified projects, as well as LEED for

Commercial Interiors (LEED-CI) v3- and version 4 (v4)-certified projects. LEED v2.2 contains six categories: Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MRs), Indoor Environmental Quality (EQ), and Innovation (IN). LEED v3 additionally contains Regional Priority (RP). LEED v4 contains eight categories: Integrative Process (IP), Location and Transportation (LT), WE, EA, MRs, EQ, IN, and RP [3]. All LEED versions include four certification levels: certified, silver, gold, and platinum [4]. Increasing certification levels from certified to silver and gold and then to platinum in LEED-certified projects reflect more sustainable green buildings [5–7].

The USGBC dataset was used to identify LEED-certified projects [4]. LEED-certified projects can be sorted by country, state/province, rating system, rating version, and certification level. Each LEED-certified project contains the address, title, and LEED scorecard. The LEED scorecard for the LEED-CI v4-certified project contains eight categories: IP, LT, WE, EA, MRs, EQ, IN, and RP. Each LEED v4 category contains one-to-several credits. Each LEED credit has different integer points, ranging from 0 to 25 points. The sum of the credits in each LEED category gives an LEED category score. The sum of all categories equals the total LEED scores [4]. The Green Building Information Gateway (GBIG) database was used to determine that LEED-certified projects were of the office-space type [8].

2. LEED-Certified Projects Using Regional/Country Comparative Analysis

2.1. A General Approach to Reviewing the LEED Literature

The general approach to reviewing the LEED literature involves at least four types of analysis: study design, measurement scales, significance tests, and effect size if necessary. These four types of analyses show cause-and-effect relationships in the progress of LEED certification strategies.

2.1.1. Study Design

In this study, we focused on the comparative analysis of differences between regions/countries in terms of LEED-certified projects at the categorical level. This comparative analysis involved identifying the types of measurement scales and, as a consequence, selecting appropriate significance tests and effect size indexes.

2.1.2. Measurement Scales

It was noted in [9] that the data included both qualitative (nominal (binary) and ordinal) and quantitative (interval and proportional). The LEED dataset contained binary, ordinal, and interval (discrete) scales at the credit level, and it contained ordinal and discrete scales at the category level. The correct choice between parametric and nonparametric tests of significance and effect size indexes is based on accurate knowledge of the measurement scales and, as a consequence, the assumption of normality.

2.1.3. Significance Tests

Because the assumptions of normality for the LEED data at the category level were not met, nonparametric tests of significance were used [10,11]. In this context, the literature review focused on the use of significance tests to compare LEED-certified projects in different regions/countries.

2.1.4. Effect Size Indexes

The result of applying a significance test is a p -value (statistical significance). However, a p -value is dependent on sample size and effect size, while effect size (substantive significance) is independent of sample size [12]. As a result, if a significance test is used for a large sample size, a low p -value may be accompanied by a negligible or small effect size [12,13]. Therefore, when comparing a large number of LEED-certified projects, a nonparametric effect size index should be measured in parallel with a nonparametric significance test.

2.2. A Comparative Analysis of LEED-Certified Projects with Large Sample Sizes Using p -Values without the Effect Size

In 2016, Wu et al. [10] compared four regions (with sample sizes of n_{1-4}): North America ($n_1 = 5037$), East Asia ($n_2 = 77$), West Asia ($n_3 = 79$), and Europe ($n_4 = 60$) in terms of LEED-NC v2.2-certified projects at the categorical level. A nonparametric Kruskal–Wallis (KW) method was applied to estimate the statistical differences among those four regions. The KW test results showed that there were significant differences among the four regions in terms of the SS, WE, EA, MRs, and EQ categories. In the four main categories of SS, WE, EA, and MRs, the p -values were less than 0.0001. However, these results cannot be translated into statistical conclusions for at least two reasons: (1) the four LEED certification levels were combined into one level, which may have obscured the unique LEED certification strategy for each certification level; and (2) processing large sample sizes may simultaneously show both a low p -value and a negligible effect size. Accordingly, a limitation of this study [10] is that a nonparametric test of significance was used without a nonparametric effect size index.

2.3. A Comparative Analysis of LEED-Certified Projects Using the p -Value with Effect Size

2.3.1. General Rule of Thumb for Interpreting Effect Size

Described below are three studies that measured effect size. However, without knowing which Cliff's δ values correspond to negligible, small, medium, and large effects, it is impossible to interpret the studies. According to Romano et al. [14], an effect size is considered to be (i) negligible if $|\delta| < 0.147$, (ii) small if $0.147 \leq |\delta| < 0.33$, (iii) medium if $0.33 \leq |\delta| < 0.474$, and (iv) large if $|\delta| \geq 0.474$. It should be noted that the magnitude of an effect is not the only criterion [15]; rather, it is a general rule of thumb when sufficient knowledge has not yet been accumulated [16].

2.3.2. LEED-NC: Comparison Groups with Moderate/Large Sample Sizes

In 2020, Chi [17] used both a p -value and effect size in their study. The p -value was obtained using the Wilcoxon–Mann–Whitney (WMW) nonparametric method. An effect size was obtained using Cliff's δ nonparametric method to measure differences between the USA (n_1) and China (n_2) in terms of construction waste minimization (CWM) performance for LEED-NC v3 2009-certified projects. The CWM includes the sum of six MRs credits: MRc1.1, building reuse—maintain existing walls, floors, and roofs; MRc1.2, building reuse—maintain interior nonstructural elements; MRc2, construction waste management; MRc3, materials reuse; MR4, recycled content; and MR6, rapidly renewable materials [17]. CWM achievement levels were separately estimated at the platinum, gold, silver, and certified certification levels. Regarding the LEED platinum-certified CWM, there was no difference between the USA and China ($n_1 = 55$, $n_2 = 32$, $p = 0.957$, with a negligible effect size, $\delta = 0.01$). Regarding LEED gold-certified CWM performance, the USA outperformed China ($n_1 = 190$, $n_2 = 147$, $p = 0.011$, exceeding the upper negligible level by 0.5%, $\delta = 0.148$; hereinafter, the difference between the upper level of a negligible effect size and the lower level of a medium effect size is presented as 100%). Regarding LEED silver-certified CWM performance, the USA outperformed China ($n_1 = 247$, $n_2 = 89$, $p = 0.004$, exceeding the upper negligible level by 23.5%, $\delta = 0.19$). Regarding the LEED-certified CWM performance, the USA outperformed China ($n_1 = 107$, $n_2 = 29$, $p = 0.011$, exceeding the upper negligible level by 83.6%, $\delta = 0.30$). Therefore, the author of this study concluded that there is most likely no difference between the USA and China in terms of CWM performance at the gold certification level. In this context, a low p -value may not have indicated a substantive significance in the difference between the two groups.

2.3.3. LEED-CI v3: Comparison Groups with Small Sample Sizes

Pushkar [18] estimated the similarity/dissimilarity between Türkiye and Spain in terms of LEED-CI v3 gold-certified projects. In the study, 14 and 11 LEED-CI v3 gold-certified projects were analyzed in Türkiye ($n_1 = 14$) and Spain ($n_2 = 11$), respectively. The

exact WMW test and Cliff's δ effect size index were used to evaluate the differences between Türkiye and Spain. It was found that Türkiye outperformed Spain in the MRs category ($p = 0.0073$ with a large effect size, $\delta = 0.62$). A comparison between Türkiye and Spain showed no differences in the other LEED categories. Accordingly, using small sample sizes ($n_1 = 14$ and $n_2 = 11$) may only result in significant differences if the effect size between two groups is large.

2.3.4. LEED-CI v4: Comparison Groups with Moderate Sample Sizes

Pushkar [19] estimated the similarity/dissimilarity between China and the USA in an analysis of LEED-CI v4 gold-certified projects. In the study, 38 and 36 LEED-CI v4 gold-certified projects were analyzed in China ($n_1 = 38$) and the USA ($n_2 = 36$), respectively. The exact WMW test and Cliff's δ effect size index were used to evaluate the differences between China and the USA. It was found that China outperformed the USA in the IP ($p = 0.007$ with a small/medium effect size, $\delta = 0.32$), LT ($p = 0.0001$ with a large effect size, $\delta = 0.54$), and WE ($p = 0.0001$ with a large effect size, $\delta = 0.79$) categories, while the USA outperformed China in the EA ($p = 0.0001$ with a large effect size, $\delta = 0.53$) and MRs ($p = 0.0002$ with a large effect size, $\delta = 0.48$) categories. Accordingly, using moderate sample sizes ($n_1 = 38$ and $n_2 = 36$) may result in significant differences if a small effect size is demonstrated between two groups. However, in Pushkar's study [19], LEED-certified projects were not sorted by space type, which may have led to false differences/similarities in LEED certification strategies.

2.4. Gaps in LEED Certification Strategies

Comparative analyses of LEED-CI v4-certified projects (the latest version with an acceptable sample size for statistical analysis) in different countries can lead to new knowledge in the field of green building strategies. Each country has its own environmental problems that require appropriate strategies to solve them. LEED certification is a universal measure that reveals the specific strategies of specific countries. This can help the builders of buildings implement the appropriate certification strategy in a short time, and with a limited project cost. Therefore, active research in various countries is urgently needed.

There have been few studies of LEED v4-certified projects in Mediterranean countries. Therefore, the aim of this study was to evaluate the statistical differences among LEED-CI v4 gold-certified office space projects in Spain, Türkiye, and Israel.

3. Materials and Methods

3.1. Research Design

The following steps were taken to compare differences between countries: the LEED-certified projects must be from the same region (i.e., Mediterranean, in which different countries were taken as unpaired groups), the same rating system (i.e., commercial interior (CI)), the same rating version (v) (i.e., v4), the same certification level (i.e., gold), and the same space type (i.e., office). This research design proposed to control all LEED variables, leaving one variable under study: the different countries of the Mediterranean region.

Three steps to perform statistical analysis are described below.

The first step was to select the type of group comparison. If two groups contain the same primary units (i.e., the same LEED-certified projects), then such groups are called paired, and if two groups contain different primary units (i.e., different LEED-certified projects), then such groups are called unpaired. The author of the present study used pairwise-comparison unpaired groups (i.e., comparison of two countries).

The second step was to select the type of statistical analysis. To select the type of statistical analysis, the assumption of normality should be checked. If the assumption of normality of the data was satisfied, then parametric statistical analysis was used, and if the assumption of normality was not satisfied, then nonparametric statistical analysis was used. The author of this study used a nonparametric statistical analysis because the normality assumptions of the LEED scorecard were not met [10,11,17].

The third step was to select the type of nonparametric statistical analysis. The type of nonparametric statistical analysis depends on the type of data.

The LEED scorecard contains dichotomous (binary), ordinal, and discrete (interval) data. Binary data are categorical data that can take exactly two possible values: zero or one [20]. Ordinal data are a categorical data type where the variables have ordered categories and the distances between the categories are not known, while interval data always take numerical values where the distance between two points on the scale is standardized and equal [9].

When processing binary data, the natural logarithm of the odds ratio ($\ln\theta$) effect size [21] and Fisher's exact 2×2 test with Lancaster's mid- p -value were used [22]. When processing ordinal and discrete (interval) data, WMW and Cliff's δ effect size tests were used. If the LEED-certified projects contain tied data, the exact instead of the asymptotic approximation WMW should be used. It is worth noting that the WMW test assesses the equality of group means rather than group medians [23], and the Cliff δ determines the magnitude of the difference between two distributions [24].

When using descriptive statistics, the median, 25–75th percentiles, and interquartile range/median ratio were used instead of the mean, standard deviation, and standard deviation/mean ratio.

3.2. Data Collection

The USGBC and GBIG databases were applied to assemble the required LEED-CI v4-certified office space project data from Mediterranean countries [4,8]. Table 1 shows the number of LEED-CI v4-certified office projects in seven Mediterranean countries: Spain, Türkiye, Israel, Italy, France, Greece, and Egypt (in the remaining Mediterranean countries, no LEED-CI v4 gold-certified projects were found).

Table 1. LEED-CI v4-certified office space number project distribution of the three studied countries at the four LEED certification levels (3 December 2023).

Country	Certified	Silver	Gold	Platinum
Spain	0	1	14	6
Türkiye	0	1	13	2
Israel	1	3	11	0
Italy	0	1	9	10
France	1	2	4	1
Greece	0	0	3	0
Egypt	0	0	1	0

If the data contained tied observations but $n_1 = n_2 > 10$ and the total sample size (N), $N = n_1 = n_2 > 23$, then the exact WMW test could be used to obtain reliable inferences [20]. Table 1 shows that the gold projects in Spain, Türkiye, and Israel had appropriate sample sizes. Thus, LEED-CI v4 gold-certified office space projects could be statistically estimated through pairwise comparisons between Spain, Türkiye, and Israel in this study.

3.3. Data Presentation

Nonparametric descriptive and inferential statistics were used to assess the pairwise comparisons of Spain, Türkiye, and Israel. The maximum possible points (max points), median, 25th–75th percentiles, effect size, interquartile range (IQR)/median ratio (IQR/M), and p -value are presented in tabular form.

3.4. Data Analysis

If an LEED scorecard contained either an interval score with low variability or ordinal values, then Cliff's δ effect size [24] and the exact WMW test [23] were used. If an LEED scorecard contained dichotomous values, then the $\ln\theta$ effect size [21] and Fisher's exact

2×2 test with Lancaster's mid- p -value [22] were used. All significance tests used a two-sided p -value.

The MATLAB 2013a statistical analysis toolbox was used to perform the exact WMW test. MATLAB 2013a was also used to generate codes for the Cliff's δ test [24], and for the $\ln\theta$ test [21], the Fisher's exact 2×2 test with Lancaster mean p -value was used as described by Cardillo [25].

3.5. Data Interpretation

3.5.1. Median

Based on the maximum score, the median of the LEED categories/credits was ranked into three achievement levels: low, moderate, and high. A low median achievement level was reached when the category/credit median was significantly lower than the median maximum score. A moderate median achievement level was reached when the median of the category/credit approached the median maximum score. A high median achievement level was reached when the category/credit median was significantly higher than the median maximum score.

3.5.2. IQR/M

$\text{IQR}/\text{M} > 0.30$ indicates a high value, and $\text{IQR}/\text{M} \leq 0.30$ indicates a low value. Therefore, a high/low IQR/M may indicate heterogeneity/homogeneity in the LEED data.

3.5.3. Effect Size

Cliff's δ ranged between -1 and $+1$, and $\ln\theta$ ranged from $-\infty$ to $+\infty$. In both δ and $\ln\theta$, (+) indicates that country 1 is larger than country 2, (−) indicates that country 2 is larger than country 1, and 0 indicates overlap or equality. For the $\ln\theta$ test, if one of the proportions in the fourfold table was zero, then 0.5 was added to each observed frequency [26].

Both δ and $\ln\theta$ have three defined levels of effect size. For δ , small is $|0.147|$, medium is $|0.33|$, and large is $|0.474|$ [14]. For $\ln\theta$, small is $|0.51|$, medium is $|1.24|$, and large is $|1.90|$ [27].

3.5.4. p -Value

Historically, the p -value has been interpreted as a dichotomous decision, such as a significant difference, $p \leq 0.05$, or no significant difference, $p > 0.05$, if the significance level is 0.05 [28]. However, Fisher remarked that “no scientific worker has a fixed level of significance at which from year to year, and in all circumstances, he rejects [null] hypotheses; he rather gives his mind to each particular case in light of his evidence and ideas” [29], as cited by [28]. It was recommended that, “in many cases, it may be more important to report the exact p -value and let the readers decide for themselves how important the results are” [30] (cited by [28]). A p -value cannot be interpreted using the Occam's razor principle [31]. Therefore, the p -values in the present study were evaluated according to three-valued logic: “it seems to be positive” (i.e., there seems to be a difference between countries), “it seems to be negative” (i.e., there does not seem to be a difference between two countries), and “judgment is suspended” regarding the difference between two countries [28,32].

3.5.5. Effect Size

Effect size interpretation was not used in the present study because, with small sample sizes, a low p -value occurs if there is a large effect size between two groups. Nevertheless, the effect size in the present study can be compared to the effect size when the sample size is significantly increased.

4. Results and Discussion

4.1. LEED-CI v4 Categories

Table 2 presents analyses of the eight LEED categories and total LEED values.

Table 2. Leadership in Energy and Environmental Design for Commercial Interior version 4 (LEED-CI v4) gold-certified office-space projects at the category level.

Category	Max Points	Spain	Türkiye	Israel	Spain vs. Türkiye		Spain vs. Israel		Türkiye vs. Israel	
		Median, 25–75th Percentiles (IQR/M)			δ	<i>p</i> -Value	δ	<i>p</i> -Value	δ	<i>p</i> -Value
IP	2	0.0, 0.0–2.0 (Inf)	1.0, 0.0–2.0 (2.00)	2.0, 2.0–2.0 (0.00)	−0.16	0.514	−0.62	0.005	−0.51	0.023
EA	38	19.0, 17.0–26.0 (0.47)	20.0, 16.8–23.5 (0.34)	28.0, 23.8–29.0 (0.19)	−0.04	0.877	−0.41	0.086	−0.61	0.010
MRs	13	5.0, 5.0–7.0 (0.40)	3.0, 3.0–4.3 (0.42)	1.0, 0.3–4.0 (3.75)	0.56	0.010	0.80	0.0003	0.32	0.182
LT	18	17.0, 15.0–18.0 (0.18)	16.0, 16.0–17.3 (0.08)	15.0, 15.0–15.8 (0.05)	0.16	0.486	0.46	0.042	0.65	0.002
WE	12	8.0, 6.0–12.0 (0.75)	10.0, 8.0–12.0 (0.40)	8.0, 6.0–12.0 (0.75)	−0.29	0.198	−0.03	0.906	0.22	0.349
EQ	17	6.5, 5.0–8.0 (0.46)	5.0, 5.0–8.0 (0.60)	6.0, 4.0–7.0 (0.50)	0.05	0.820	0.20	0.405	0.20	0.421
IO	6	5.0, 5.0–6.0 (0.20)	3.0, 2.8–5.0 (0.75)	3.0, 2.0–4.0 (0.67)	0.46	0.036	0.55	0.016	0.10	0.709
RP	4	3.5, 3.0–4.0 (0.29)	2.0, 1.8–3.0 (0.63)	4.0, 3.0–4.0 (0.25)	0.56	0.013	−0.10	0.764	−0.65	0.006
LEED total	110	64.0, 61.0–67.0 (0.09)	63.0, 61.5–67.0 (0.09)	66.0, 64.3–66.0 (0.03)	0.18	0.447	−0.23	0.335	−0.30	0.223

Notes: IP, Integrative Process; LT, Location and Transportation; WE, Water Efficiency; EA, Energy and Atmosphere; MRs, Materials and Resources; EQ, Indoor Environmental Quality; IO, Innovation; RP, Regional Priority; IQR/M, interquartile range/median ratio; Inf, result of numerical calculation that is mathematically infinite.

IP showed a low achievement level (0.0) and an infinite (Inf) IQR/M value in Spain, a moderate achievement level (1.0) and a high IQR/M value (2.0) in Türkiye, and a high achievement level (2.0) and a zero IQR/M value in Israel. Israel outperformed Spain and Türkiye in the IP category ($p = 0.005$ and 0.023 , respectively). In [19], IP showed a high achievement level (2.0) and a high IQR/M value (0.5) in China, and it showed a moderate achievement level (1.0) and high IQR/M value (2.0) in the USA. Thus, Israel and China showed the best results, Türkiye and the United States obtained intermediate results, and Spain achieved the worst results.

IP contains one credit, Integrative Process (IPc1), with two points. This credit requires an early analysis of energy and water systems to provide a strong foundation for energy- and water-saving opportunities in the EA and WE categories [3]. IP achievement is associated with EA achievement.

EA showed moderate achievement levels (19.0 and 20.0) and high IQR/M values (0.47 and 0.34) in Spain and Türkiye, respectively, and it showed a high achievement level (28.0) and a low IQR/M value (0.19) in Israel. Israel outperformed Spain and Türkiye in the EA category ($p = 0.086$ and 0.010 , respectively). In [19], EA showed a low/moderate achievement level (16.0) and a low IQR/M value (0.25) in China, and it showed a moderate/high achievement level (22.5) and a high IQR/M value (0.58) in the USA. Thus, Israel showed the best results; Spain, Türkiye, and the USA achieved intermediate results; and China had the worst results.

MRs showed low achievement levels (5.0, 3.0, and 1.0) and high IQR/M values (0.40, 0.42, and 3.75) in Spain, Türkiye, and Israel, respectively. Israel showed an extremely high IQR/M value of 3.75. An extremely high value may indicate that there are at least two different subgroups within this group. Spain outperformed Türkiye and Israel in MRs ($p = 0.010$ and 0.0003 , respectively). In [19], MRs showed a low achievement level (3.0) and a high IQR/M value (0.67) in China, and MRs also showed a low/moderate achievement level (5.0) and a high IQR/M value (0.50) in the USA. Thus, Spain and the USA showed the best results, China and Türkiye achieved intermediate results, and Israel showed the worst results.

The MRs category contains several points that require a life cycle assessment (LCA) to demonstrate the sustainability of a product [3]. LCA includes hundreds of processes

(resources and power) and productions (emissions and unwanted or unusable materials) that are consumed/emitted throughout a product's whole life cycle (production, service, and demolition stages). It is a time-consuming and labor-intensive process [33]. Thus, an analysis of MRs credits could clarify Spain's better performance compared with Türkiye and Israel.

LT displayed high achievement levels (17, 16, and 15.0) and low IQR/M values (0.18, 0.08, and 0.05) in Spain, Türkiye, and Israel, respectively. However, Spain and Türkiye outperformed Israel in the LT category ($p = 0.042$ and 0.002 , respectively). The analyzed LEED-certified projects were located in the high-density urban cities of Madrid, Spain (3.2 million people in an area of 604 km^2 , giving urban density of $5300/\text{km}^2$) [34]; Istanbul, Türkiye (15.4 million people in an area of 5313 km^2 , giving urban density of $2910/\text{km}^2$) [35]; and Tel Aviv, Israel (1.4 million people in an area of 176 km^2 , giving urban density of $8000/\text{km}^2$) [36]. It is possible that, in the aforementioned densely populated cities, more public services and transport options required for the LT category can be easily accessed [37].

In [19], LT showed a high achievement level (17.0) and a low IQR/M value (0.06) in China, while LT showed a high achievement level (17.0) and a high IQR/M value (0.35) in the USA. China outperformed the USA in the LT category ($p < 0.001$). Thus, Spain and China showed the best results, Türkiye and the USA achieved intermediate results, and Israel showed the worst results.

WE showed a low/moderate achievement level (8.0) and a high IQR/M value (0.75) in Spain and Israel, and a moderate achievement level (19.0) and a high IQR/M value (0.40) in Türkiye. There were no differences in WE between countries ($0.198 \leq p \leq 0.906$). The WE category has one credit, WEc1. WEc1 is associated with reduced indoor water use, and it is likely impacted by water scarcity in Mediterranean climates with high temperatures and low rainfall levels. In Spain, there is a tight balance between existing water resources and current needs, including for drinking water [38]. Türkiye's water shortage situation has been aggravated by strong population growth [37]. Israel, despite undertaking desalination of the Mediterranean Sea to obtain drinking water, is also experiencing rapid population growth, which is exacerbating the problem of water shortages [39]. Therefore, the issue of water conservation is of high priority in these three countries.

In [19], WE showed a high achievement level (12.0) and a low IQR/M value (0.17) in China, while WE showed a moderate achievement level (6.0) and a high IQR/M value (0.33) in the USA. Thus, China showed the best results; Spain, Türkiye, and Israel showed intermediate results; and the USA obtained the worst results.

EQ showed low achievement levels (6.5, 5.0, and 6.0) and high IQR/M values (0.46, 0.60, and 0.50) in Spain, Türkiye, and Israel, respectively. There were no differences in the pairwise comparisons between Spain, Türkiye, and Israel in the EQ category ($0.421 \leq p \leq 0.820$). The EQ category contains occupant-related credits such as adequate lighting (EQc6), appropriate thermal comfort (EQc5), air quality (EQc1 and EQc3-4), and acoustic performance (EQc9) [3].

In [19], EQ showed a low/moderate achievement level (7.0) and a low IQR/M value (0.29) in China, while EQ showed a low achievement level (6.5) and a high IQR/M value (0.62) in the USA. Thus, China showed the best results; Spain, Israel, and the USA showed intermediate results; and Türkiye achieved the worst results.

IO showed a high achievement level (5.0) and a low IQR/M value (0.20) in Spain, and it showed moderate achievement levels (3.0 and 3.0) and high IQR/M values (0.75 and 0.67) in Türkiye and Israel, respectively. Spain outperformed Türkiye and Israel in the IO category ($p = 0.036$ and 0.016 , respectively). It can be assumed that in Spain innovative building technologies are more actively used in LEED-certified projects than in Türkiye and Israel.

In [19], IO showed a high achievement level (5.0) and low IQR/M value (0.20) in China and a high achievement level (5.0) and high IQR/M value (0.40) in the USA. Thus, Spain

and China showed the best results, the USA showed intermediate results, and Türkiye and Israel obtained the worst results.

RP showed high achievement levels (3.5 and 4.0) and low IQR/M values (0.29 and 0.25) in both Spain and Israel, respectively, and it showed a moderate achievement level (2.0) and a high IQR/M value (0.63) in Türkiye. Spain and Israel outperformed Türkiye in the RP category ($p = 0.013$ and 0.006 , respectively). It can also be assumed that in Spain and Israel, RP credits are more actively used in LEED-certified projects than in Türkiye.

In [19], RP showed moderate/high levels (3.0 and 3.0) and high IQR/M values (0.33 and 0.33) in both China and the USA. Thus, Spain and Israel showed the best results, China and the USA achieved intermediate results, and Türkiye showed the worst results.

The summarized results obtained in this study for Spain, Türkiye, and Israel, as well as the results obtained previously [19] for China and the USA, are presented in Table 3. Table 3 showed three-valued logic results for these five countries in terms of LEED-CI v4 gold-certified projects at the categorical level.

Table 3. Three-valued logic results (best, intermediate, and worst) comparing the current study with [19] in terms of LEED-CI v4 gold-certified projects at the categorical level.

Category	The Current Study			[19]	
	Spain	Türkiye	Israel	China	USA
IP	Worst	Intermediate	Best	Best	Intermediate
EA	Intermediate	Intermediate	Best	Worst	Intermediate
MRs	Best	Intermediate	Worst	Intermediate	Best
LT	Best	Intermediate	Worst	Best	Intermediate
WE	Intermediate	Intermediate	Intermediate	Best	Worst
EQ	Intermediate	Worst	Intermediate	Best	Intermediate
IO	Best	Worst	Worst	Best	Intermediate
RP	Best	Worst	Best	Intermediate	Intermediate

Spain achieved the best results four times (MRs, LT, IO, and RP), intermediate results three times (EA, WE, and EQ), and the worst result once (IP). Türkiye achieved intermediate results (IP, EA, MRs, LT, and WE) five times, and the worst results (EQ, IO, and RP) three times. Israel achieved the best results (IP, EA, and RP) three times, intermediate results (WE and EQ) twice, and the worst results (MRs, LT, and IO) three times. China achieved the best results (IP, LT, WE, EQ, and IO) five times, intermediate results (MRs and RP) twice, and the worst result (EA) once. The USA achieved the best result (MRs) once, intermediate results (IP, EA, LT, EQ, IO, and RP) six times, and the worst result (WE) once. Thus, a comparative analysis of the descriptive statistics between countries was found to be a relevant method for assessing LEED certification strategies.

4.2. LEED-CI v4 Categories

4.2.1. Location and Transportation

Table 4 presents analyses of the five LT credits (LTc1-5).

LTc1 showed zero points of achievement in all three countries. According to [3], LTc1 is associated with LEED neighborhood development awards points for a project's location within the boundaries of a previously certified LEED neighborhood development project. This means that the analyzed LEED-certified projects were not related to neighborhood development.

Both LTc2 and LTc3 showed high achievement levels in Spain, Türkiye, and Israel. There were no differences between the three countries for either LTc2 or LTc3 ($0.519 \leq p \leq 0.917$ and $0.283 \leq p \leq 1.000$, respectively). According to [3], LTc2 is associated with the surrounding density and diverse uses, a credit that requires the development of a project in a densely populated area within 800 m walking distance of services such as supermarkets, banks, and medical clinics. LTc3 is associated with access to quality

transport, a credit that requires being able to walk from a project to a public transport stop—400 m to bus stops and 800 m to train stations.

Table 4. Location and Transportation (LT) credits in the three studied Mediterranean countries.

Credit	Max Points	Spain	Türkiye	Israel	Spain vs. Türkiye		Spain vs. Israel		Türkiye vs. Israel	
		Median, 25–75th Percentiles			$\delta/\ln\theta$	<i>p</i> -Value	$\delta/\ln\theta$	<i>p</i> -Value	$\delta/\ln\theta$	<i>p</i> -Value
LTc1 ^a	18	0.0, 0.0–0.0	0.0, 0.0–0.0	0.0, 0.0–0.0	0.07	1.000	0.07	1.000	0.00	1.000
LTc2 ^a	8	8.0, 8.0–8.0	8.0, 8.0–8.0	8.0, 8.0–8.0	−0.08	0.519	−0.06	0.897	0.02	0.917
LTc3 ^a	7	7.0, 7.0–7.0	7.0, 6.8–7.0	7.0, 7.0–7.0	0.14	0.538	−0.06	1.000	−0.23	0.283
LTc5 ^a	2	2.0, 0.0–2.0	2.0, 1.0–2.0	0.0, 0.0–0.0	0.00	1.000	0.58	0.008	0.76	0.0005
LTc4 ^b	1	0.0, 0.0–1.0	0.0, 0.0–1.0	0.0, 0.0–0.0	0.52	0.567	1.22	0.157	0.69	0.503

Notes: LTc1, LEED for neighborhood development location; LTc2, surrounding density and diverse uses; LTc3, access to quality transit; LTc4, bicycle facilities; LTc5, reduced parking footprint. ^a Cliff's δ and the exact Wilcoxon–Mann–Whitney test were used to estimate the differences between groups. ^b The natural logarithm of the odds ratio ($\ln\theta$) and Fisher's exact test 2×2 table were used to estimate the differences between groups.

LTc5 showed high achievement levels in both Spain and Türkiye, but it showed a low achievement level in Israel. Spain and Türkiye outperformed Israel in LTc5 ($p = 0.008$ and 0.0005 , respectively). According to [3], LTc5 is related to parking area reductions, a credit that requires a reduction in car dependency by reducing the availability of parking spaces. LTc5 can be considered a practice of the theory described by the requirements of LTc3. This is because LTc3 considers possible daily transit services for LEED-certified projects with buses, trams, railways, or ferries. However, LTc5 considers real undeveloped parking spaces. Therefore, LTc5 can serve as a manifestation of the real attitude of a country's residents towards the desire to reduce the use of private transport in favor of public transport. Spain and Türkiye showed equally high achievement levels in both LTc3 and LTc5, while Israel showed a high achievement level in LTc3 and a low achievement level in LTc5.

LTc4 showed low achievement levels in Spain, Türkiye, and Israel. There were no differences between these three countries ($0.157 \leq p \leq 0.567$, respectively). According to [3], LTc4 is associated with bicycle facilities and encourages countries to create bicycle infrastructure, including bicycle trails, storage, and shower rooms. In cities with convenient public transportation, placing bicycles near LEED-certified office projects may not be practical.

Reference [19] considered two LT credit strategies: (1) to the achieve maximum possible points in LTc2, LTc3, and LTc5 with zero IQR/M, a strategy applied in China; and (2) to achieve the maximum possible points in LTc2, LTc3, and LTc5 with $0.15 \leq \text{IQR/M} \leq 2.0$, a strategy used in the USA. In this context, for LTc2 and LTc3, Spain, Türkiye, and Israel mirrored China's strategy certification. For LTc5, Spain followed the USA's strategy certification; Türkiye used a combination of both strategies; and in Israel, 9 out of 11 LEED-CI v4 gold-certified projects did not use the LTc5 credit. LTc4 was not popular in the three Mediterranean countries studied or in the previously studied China and the USA. It is possible that low/high-achievement LT credits depend more on the location of buildings than on the country-specific LEED-CI v4 certification strategy [40].

4.2.2. Energy and Atmosphere

Table 5 presents analyses of the five EA credits (EAc1–6).

EAc1 showed high achievement levels in Spain, Türkiye, and Israel. However, Spain outperformed Türkiye in EAc1 ($p = 0.078$). There were no differences in EAc1 between Spain and Israel or between Türkiye and Israel ($p = 0.171$ and 0.236 , respectively). According to [3], EAc1 is used to monitor the performance of energy and water consumption systems.

EAc2 showed moderate achievement levels in Spain, Türkiye, and Israel. There were no significant differences between the three countries ($0.296 \leq p \leq 0.816$). According to [3], EAc2 is related to energy metering, which is aimed at identifying incremental energy savings by tracking energy consumption at the building and system levels. Therefore,

monitoring and accounting for energy consumption to save energy consumption has the same priority in LEED-certified projects in these three countries.

Table 5. Energy and Atmosphere (EA) credits in the three studied Mediterranean countries.

Credit	Max Points	Spain	Türkiye	Israel	Spain vs. Türkiye		Spain vs. Israel		Türkiye vs. Israel	
		Median, 25–75th Percentiles (IQR/M)			$\delta/\ln\theta$	<i>p</i> -Value	$\delta/\ln\theta$	<i>p</i> -Value	$\delta/\ln\theta$	<i>p</i> -Value
EAc1 ^a	5	4.5, 0.0–5.0	4.0, 0.0–4.0	4.0, 4.0–4.0	0.41	0.078	0.26	0.171	−0.29	0.236
EAc2 ^a	2	1.0, 1.0–2.0	1.0, 1.0–2.0	1.0, 1.0–1.0	0.06	0.816	0.19	0.296	0.14	0.463
EAc4 ^b	1	0.0, 0.0–0.0	1.0, 0.0–1.0	1.0, 1.0–1.0	−1.77	0.036	−3.60	0.001	−1.83	0.114
EAc3 ^a	3	0.0, 0.0–1.0	0.0, 0.0–0.0	0.0, 0.0–0.0	0.29	0.114	0.18	0.490	−0.09	0.917
EAc5 ^a	2	0.0, 0.0–2.0	0.0, 0.0–2.0	0.0, 0.0–1.8	−0.01	1.000	0.05	0.967	0.06	0.889
EAc6 ^a	25	13.5, 11.0–19.0 (0.59)	15.0, 10.8–21.3 (0.70)	20.0, 17.5–22.8 (0.26)	−0.09	0.710	−0.45	0.055	−0.31	0.211

Notes: EAc1, enhanced commissioning; EAc2, advanced energy metering; EAc3, renewable energy production; EAc4, enhanced refrigerant management; EAc5, green power and carbon offsets; EAc6, optimize energy performance; IQR/M, interquartile range/median ratio. ^a Cliff's δ and the exact Wilcoxon–Mann–Whitney test were used to estimate the differences between groups. ^b The natural logarithm of the odds ratio ($\ln\theta$) and Fisher's exact test 2×2 table were used to estimate the differences between groups.

EAc4 showed a low achievement level in Spain and high achievement levels in both Türkiye and Israel. Türkiye and Israel outperformed Spain in EAc4 ($p = 0.036$ and 0.001 , respectively). According to [3], EAc4 is associated with enhanced refrigerant management, which requires the installation of refrigerants with low ozone depletion and global warming potential levels. More research is needed to understand these differences between the three countries.

Both EAc3 and EAc5 showed low achievement levels in Spain, Türkiye, and Israel. There were no differences between the three countries in either EAc3 or EAc5 ($0.114 \leq p \leq 0.917$ and $0.889 \leq p \leq 1.000$, respectively). EAc3 is associated with renewable energy generation, requiring the installation of renewable energy systems in the building it serves, and EAc5 is associated with green energy and carbon offsetting, requiring the signing of a minimum five-year contract to order green energy from renewable energy sources from the grid [3]. In fact, both EAc3 and EAc5 have the same goal: to increase the share of renewable energy and, as a consequence, reduce energy production from fossil fuels. More research is needed to understand why the EAc3 and EAc5 achievement levels were low in these three countries.

EAc6 showed a moderate achievement level and a high IQR/M value in Spain, a moderate/high achievement level and a high IQR/M value in Türkiye, and a high achievement level and a low IQR/M value in Israel. Israel outperformed Spain ($p = 0.055$), and there were no differences between Spain and Türkiye and between Türkiye and Israel ($p = 0.710$ and 0.211 , respectively). The high IQR/M values for EAc6 in both Spain and Türkiye may indicate heterogeneity in the EAc6 achievement levels of each of these countries. However, to test this hypothesis, it will be necessary to triple the sample size in each group [41,42]. EAc6 is associated with reducing energy consumption for heating, cooling, and lighting relative to a building reference defined in accordance with ANSI/ASHRAE/IESNA 90.1-2010 [3].

A comparison between the current study and [19] showed that the USA outperformed China, Spain, Türkiye, and Israel in EAc1 and EAc5; China and Israel outperformed the USA, Spain, and Türkiye in EAc4; and Israel outperformed China, the USA, Spain, and Türkiye in EAc6. It should be noted that the high IQR/M coefficients in the USA (0.77), Türkiye (0.70), Spain (0.59), and China (0.40) reflected the existence of at least two LEED certification strategies in the above countries: a low or high level of achievement in the optimize energy performance credit from the EA category [6]. Recently, these two LEED certification strategies were evaluated in Manhattan, New York (USA) [41], and Shanghai (China) [42].

4.2.3. Materials and Resources

Table 6 presents analyses of the five MRs credits (MRc1–6).

Table 6. Materials and Resources (MRs) credits in the three studied Mediterranean countries.

Credit	Max Points	Spain	Türkiye	Israel	Spain vs. Türkiye		Spain vs. Israel		Türkiye vs. Israel	
		Median, 25–75th Percentiles			$\delta/\ln\theta$	p -Value	$\delta/\ln\theta$	p -Value	$\delta/\ln\theta$	p -Value
MRc1 ^b	1	1.0, 0.0–1.0	1.0, 0.0–1.0	0.0, 0.0–0.0	0.12	0.847	2.09	0.030	1.97	0.029
MRc2 ^a	4	1.0, 0.0–3.0	0.0, 0.0–1.0	0.0, 0.0–0.8	0.46	0.032	0.47	0.037	0.02	1.000
MRc3 ^a	2	1.0, 1.0–1.0	1.0, 0.8–1.0	0.0, 0.0–0.8	0.02	1.000	0.51	0.029	0.50	0.041
MRc5 ^a	2	0.0, 0.0–1.0	0.0, 0.0–0.0	0.0, 0.0–0.0	0.43	0.020	0.43	0.034	0.00	1.000
MRc4 ^a	2	0.0, 0.0–1.0	0.0, 0.0–0.3	0.0, 0.0–0.0	0.16	0.481	0.35	0.112	0.15	0.431
MRc6 ^a	2	2.0, 1.0–2.0	2.0, 0.0–2.0	1.0, 0.3–2.0	−0.01	0.866	0.19	0.433	0.15	0.497

Notes: MRc1, long-term commitment; MRc2, interiors' life cycle impact reduction; MRc3, building product disclosure and optimization—environmental product declarations; MRc4, building product disclosure and optimization—sourcing of raw materials; MRc5, building product disclosure and optimization—material ingredients; MRc6, construction and demolition waste management. ^a Cliff's δ and the exact Wilcoxon–Mann–Whitney test were used to estimate the differences between groups. ^b The natural logarithm of the odds ratio ($\ln\theta$) and Fisher's exact test 2×2 table were used to estimate the differences between groups.

MRc1 showed moderate achievement levels in both Spain and Türkiye and a low achievement level in Israel. Spain and Türkiye outperformed Israel in MRc1 ($p = 0.030$ and 0.029 , respectively). There were no differences between Spain and Türkiye ($p = 0.847$). MRc1 is associated with long-term commitment, a credit that requires tenants to commit to remaining in the same location for a minimum of 10 years to reduce the environmental impact of producing renovation materials and transporting tenants [3]. Committing to renting office space in a city like Tel Aviv for such a long period of time can be challenging because Tel Aviv has the highest cost of living of any city in the world [43]. In addition, purchase/rental prices are increasing from year to year. Thus, Israel's low achievement level in MRc1 is understandable.

MRc2 showed low achievement levels in Spain, Türkiye, and Israel. However, Spain outperformed Türkiye and Israel in MRc2 ($p = 0.029$ and 0.037 , respectively). MRc2 is associated with reducing the life cycle impact of interiors, requiring the reuse of a significant portion of internal nonstructural elements and designing them to be as movable or removable as possible [3]. Consequently, despite the low popularity of MRc2 in these three countries, this credit was found to be more actively used in Spain and Türkiye than in Israel.

MRc3 showed moderate achievement levels in Spain and Türkiye and a low achievement level in Israel. Spain and Türkiye outperformed Israel in MRc3 ($p = 0.029$ and 0.041 , respectively). MRc3 is related to building product disclosure and optimization—environmental product declarations.

MRc5 showed low achievement levels in Spain, Türkiye, and Israel. Spain outperformed Türkiye and Israel in MRc5 ($p = 0.020$ and 0.034 , respectively). MRc5 is related to product disclosure and the optimization of material ingredients.

MRc4 showed low achievement levels in Spain, Türkiye, and Israel. There were no differences between these three countries in MRc4 ($0.112 \leq p \leq 0.481$). MRc4 is related to product disclosure and the optimization of the sourcing of raw materials.

MRc3–MRc5 require the use of construction materials from manufacturers who can demonstrate that their product was optimized through LCA [3]. This means that local cement/concrete manufacturers need to study their product and optimize it from an environmental point of view. As can be seen from the low interest in obtaining these LCA credits in Türkiye and especially Israel, there are very limited numbers of such manufacturers in these two countries.

MRc6 showed high achievement levels in Spain, Türkiye, and Israel. There were no differences between the three countries ($0.433 \leq p \leq 0.866$). MRc6 is related to construction and demolition waste (C&DW) management, so it requires diverting construction and

demolition waste from landfills towards reuse and recycling [3]. By taking responsibility for conserving natural resources, LEED encourages the development of sustainable waste management. High achievement levels in this area were achieved despite high C&DW treatment prices in Spain, limited C&DW treatment facilities in Türkiye, and some illegal C&DW discharges in Israel [44–46].

The comparison of [19] and the current study in terms of the proportion of non-zero/zero achievements in the six MRs credits was different for each country. The USA had 5/1, Spain had 4/2, Türkiye had 3/3, and China and Israel had 1/5. When analyzing previous version 3 (v3) of LEED-CI gold-certified projects in terms of the proportion of non-zero/zero achievements in nine MRs credits, Spain had 4/5 and Türkiye had 2/7 [18].

4.2.4. Indoor Environmental Quality

Table 7 presents analyses of the five EQ credits (EQc1–9).

Table 7. Indoor Environmental Quality (EQ) credits in the three studied Mediterranean countries.

Credit	Max Points	Spain	Türkiye	Israel	Spain vs. Türkiye		Spain vs. Israel		Türkiye vs. Israel	
		Median, 25–75th Percentiles			$\delta/\ln\theta$	<i>p</i> -Value	$\delta/\ln\theta$	<i>p</i> -Value	$\delta/\ln\theta$	<i>p</i> -Value
EQc1 ^a	2	2.0, 1.0–2.0	2.0, 1.0–2.0	1.0, 0.3–1.0	0.00	1.000	0.65	0.002	0.70	0.001
EQc2 ^a	3	0.0, 0.0–2.0	0.0, 0.0–1.5	0.0, 0.0–0.0	0.02	0.984	0.43	0.034	0.38	0.060
EQc3 ^b	1	1.0, 1.0–1.0	1.0, 0.0–1.0	1.0, 1.0–1.0	2.09	0.046	−0.94	0.720	−2.70	0.026
EQc8 ^b	1	1.0, 0.0–1.0	1.0, 0.8–1.0	1.0, 1.0–1.0	−0.29	0.839	−2.29	0.066	−2.04	0.152
EQc4 ^a	2	1.0, 0.0–2.0	1.0, 0.0–1.0	1.0, 0.0–2.0	0.29	0.196	−0.01	1.000	−0.30	0.209
EQc6 ^a	2	0.5, 0.0–1.0	1.0, 0.0–1.0	1.0, 0.3–1.0	−0.04	1.000	−0.27	0.303	−0.23	0.401
EQc5 ^b	1	0.0, 0.0–0.0	0.0, 0.0–1.0	0.0, 0.0–1.0	−0.98	0.275	−1.61	0.134	−0.63	0.549
EQc7 ^a	3	0.0, 0.0–1.0	1.0, 0.0–2.0	0.0, 0.0–0.8	−0.23	0.291	−0.12	0.621	0.38	0.117
EQc9 ^a	2	0.0, 0.0–0.0	0.0, 0.0–0.0	0.0, 0.0–0.0	−0.07	0.500	−0.23	0.500	−0.16	0.500

Notes: EQc1, enhanced indoor air quality strategies; EQc2, low-emitting materials; EQc3, construction indoor air quality management plan; EQc4, indoor air quality assessment; EQc5, thermal comfort; EQc6, interior lighting; EQc7, daylight; EQc8, quality views; EQc9, acoustic performance. ^a Cliff's δ and the exact Wilcoxon–Mann–Whitney test were used to estimate the differences between groups. ^b The natural logarithm of the odds ratio ($\ln\theta$) and Fisher's exact test 2×2 table were used to estimate the differences between groups.

EQc1 showed high achievement levels in both Spain and Türkiye and a moderate achievement level in Israel, while EQc2 showed low achievement levels in all three countries. Spain and Türkiye outperformed Israel in both EQc1 and EQc2 ($p = 0.002$ and 0.001 ; $p = 0.034$ and 0.060 , respectively). EQc1 is associated with the use of strategies to improve indoor air quality, and EQc2 is associated with the use of low-emission materials. According to the results of this study, Spain and Türkiye pay more attention to EQc1 and EQc2 than Israel.

Both EQc3 and EQc8 showed high achievement levels in Spain, Türkiye, and Israel. Spain outperformed Türkiye, and Israel outperformed Türkiye in EQc3 ($p = 0.046$ and 0.026 , respectively). Israel also outperformed Spain in EQc8 ($p = 0.066$). EQc3 is associated with indoor air quality management plans for construction, and EQc8 is associated with quality views. Spain and Israel showed better achievement levels in EQc3 compared with Türkiye, while Israel showed a better achievement level in EQc8 compared with Spain.

EQc4 showed moderate achievement levels in Spain, Türkiye, and Israel. EQc6 showed a low achievement level in Spain and a moderate achievement level in both Türkiye and Israel. EQc5, EQc7, and EQc9 showed low achievement levels in Spain, Türkiye, and Israel. No differences were found between the three countries in EQc4–7 and EQc9 ($0.134 \leq p \leq 1.000$). These low levels of achievement in five of the nine EQ credits are not satisfactory because employees in offices spend about 90% of their time indoors, and their well-being can be impaired by low levels of thermal, light, and acoustic comfort [35].

Comparisons between [19] and the current study in terms of the proportion of non-zero/zero achievement on the nine EQ credits did not differ significantly between countries. China and Türkiye had 6/3, while the USA, Spain, and Israel had 5/4. When analyzing the previous version 3 (v3) of LEED-CI gold-certified projects in terms of the proportion of

non-zero/zero achievements in the 16 EQ credits, it did not differ significantly between Türkiye and Spain. Türkiye had 8/8, and Spain had 7/9 [18]. Thus, in both version 3 and version 4, the trend towards achieving EQ credits for Türkiye and Spain did not change.

5. Conclusions

- Spain and Türkiye outperformed Israel in the Location and Transportation (LT) category. The granting of this credit requires reductions in parking areas, and both Spain and Türkiye are more active than Israel in reducing the use of private transport in favor of public transport.
- Israel outperformed Spain and Türkiye in the Energy and Atmosphere (EA) category thanks to the sum of all six EA credits.
- Spain outperformed Türkiye and Israel in the Materials and Resources (MRs) category due to its use of environmental product declarations for building products, material ingredients, and raw materials.
- Spain, Türkiye, and Israel showed similarly low achievement levels in the Indoor Environmental Quality (EQ) category.

6. Limitations

The current study contained at least three limitations. First, the small sample size allowed us to detect a significant difference only when there was a large effect size. Second, other LEED rating systems need to be analyzed to gain more complete information about green building strategies. Thirdly, we must obtain qualitative and quantitative assessments from the specialists who led the LEED-certified projects.

Funding: This research received no external funding.

Data Availability Statement: Publicly available data sets were analyzed in this study. The data can be found here: <https://www.usgbc.org/projects> (USGBC Projects Site) (accessed on 20 December 2023) and <http://www.gbig.org> (GBIG Green Building Data) (accessed on 20 December 2023).

Conflicts of Interest: The author declares no conflict of interest.

References

1. Ade, R.; Rehm, M. The unwritten history of green building rating tools: A personal view from some of the ‘founding fathers’. *Build. Res. Inf.* **2020**, *48*, 1–17. [CrossRef]
2. Mozingo, L.; Arens, E. Quantifying the Comprehensive Greenhouse Gas Co-Benefits of Green Buildings. 2014. Available online: <https://ww2.arb.ca.gov/sites/default/files/classic/research/apr/past/11-323.pdf> (accessed on 8 January 2023).
3. LEED v4 for Interior Design and Construction. 2019. Available online: https://www.usgbc.org/sites/default/files/LEED%20v4%20IDC_07.25.19_current.pdf (accessed on 5 February 2024).
4. USGBC Projects Site. Available online: <https://www.usgbc.org/projects> (accessed on 5 February 2024).
5. Wu, P.; Song, Y.; Shou, W.; Chi, H.; Chong, H.Y.; Sutrisna, M. A comprehensive analysis of the credits obtained by LEED 2009 certified green buildings. *Renew. Sustain. Energy Rev.* **2017**, *68 Pt 1*, 370–379. [CrossRef]
6. Pushkar, S.; Verbitsky, O. LEED-NC 2009 Silver to Gold certified projects in the US in 2012–2017: An appropriate statistical analysis. *J. Green Build.* **2019**, *14*, 83–107. [CrossRef]
7. Pham, D.H.; Kim, B.; Lee, J.; Ahn, A.C.; Ahn, Y. A Comprehensive Analysis: Sustainable Trends and Awarded LEED 2009 Credits in Vietnam. *Sustainability* **2020**, *12*, 852. [CrossRef]
8. GBIG Green Building Data. Available online: <http://www.gbig.org> (accessed on 5 February 2024).
9. Stevens, S.S. On the theory of scales of measurement. *Science* **1946**, *103*, 677–680. [CrossRef] [PubMed]
10. Wu, P.; Mao, C.; Wang, J.; Song, Y.Z.; Wang, X.Y. A decade review of the credits obtained by LEED v2.2 certified green building projects. *Build. Environ.* **2016**, *102*, 167–178. [CrossRef]
11. Wu, P.; Song, Y.; Wang, J.; Wang, X.; Zhao, X.; He, Q. Regional Variations of Credits Obtained by LEED 2009 Certified Green Buildings—A Country Level Analysis. *Sustainability* **2018**, *10*, 20. [CrossRef]
12. Sullivan, G.M.; Feinn, R. Using Effect Size—Or Why the P Value Is Not Enough. *J. Grad. Med. Educ.* **2012**, *4*, 279–282. [CrossRef]
13. Dunkler, D.; Haller, M.; Oberbauer, R.; Heinze, G. To test or to estimate? P-values versus effect sizes. *Transpl. Int.* **2020**, *33*, 50–55. [CrossRef] [PubMed]

14. Romano, J.; Corragio, J.; Skowronek, J. Appropriate statistics for ordinal level data: Should we really be using *t*-test and Cohen's *d* for evaluating group differences on the NSSE and other surveys? In Proceedings of the Annual Meeting of the Florida Association of Institutional Research, Cocoa Beach, FL, USA, 1–3 February 2006; Florida Association for Institutional Research: Cocoa Beach, FL, USA, 2006; pp. 1–33.
15. Durlak, J.A. How to select, calculate, and interpret effect sizes. *J. Pediatr. Psychol.* **2009**, *34*, 917–928. [\[CrossRef\]](#)
16. Volker, M.A. Reporting effect size estimates in school psychology research. *Psychol. Schools* **2006**, *43*, 653–672. [\[CrossRef\]](#)
17. Chi, B.; Lu, W.; Ye, M.; Bao, Z.; Zhang, X. Construction waste minimization in green building: A comparative analysis of LEED-NC 2009 certified projects in the US and China. *J. Clean. Prod.* **2020**, *256*, 120749. [\[CrossRef\]](#)
18. Pushkar, S. The Effect of Regional Priority Points on the Performance of LEED 2009 Certified Buildings in Turkey, Spain, and Italy. *Sustainability* **2018**, *10*, 3364. [\[CrossRef\]](#)
19. Pushkar, S. Evaluating LEED commercial interior (LEED-CI) projects under the LEED transition from v3 to v4: The differences between China and the US. *Heliyon* **2020**, *6*, e04701. [\[CrossRef\]](#)
20. Collett, D. *Modelling Binary Data*; Chapman & Hall: London, UK, 2002.
21. Bland, J.M.; Altman, D.G. The odds ratio. *BMJ* **2000**, *320*, 1468. [\[CrossRef\]](#) [\[PubMed\]](#)
22. Routledge, R.D. Resolving the conflict over Fisher's exact test. *Can. J. Statist.* **1992**, *20*, 201–209. Available online: <https://www.jstor.org/stable/3315468> (accessed on 22 January 2024). [\[CrossRef\]](#)
23. Bergmann, R.; Ludbrook, J.; Spooren, W.P. Different outcomes of the Wilcoxon-Mann-Whitney test from different statistics packages. *Am. Stat.* **2000**, *54*, 72–77.
24. Cliff, N. Dominance statistics: Ordinal analyses to answer ordinal questions. *Psychol. Bull.* **1993**, *114*, 494–509. [\[CrossRef\]](#)
25. Cardillo G: MyFisher22. Available online: <http://www.mathworks.com/matlabcentral/fileexchange/15434-myfisher22> (accessed on 14 March 2024).
26. Fleiss, J.L. *Statistical Methods for Rates and Proportions*, 2nd ed.; Wiley: New York, NY, USA, 1981.
27. Chen, H.; Cohen, P.; Chen, S. How Big is a Big Odds Ratio? How big is a big odds ratio? Interpreting the magnitudes of odds ratios in epidemiological studies. *Commun. Stat. Simulat. Comput.* **2010**, *39*, 860–864. [\[CrossRef\]](#)
28. Hurlbert, S.H.; Lombardi, C.M. Final collapse of the Neyman-Pearson decision theoretic framework and rise of the neoFisherian. *Ann. Zool. Fenn.* **2009**, *46*, 311–349. Available online: <https://www.jstor.org/stable/23736900> (accessed on 22 January 2024). [\[CrossRef\]](#)
29. Fisher, R.A. *Statistical Methods and Scientific Inference*; Oliver & Boyd: Edinburgh, UK, 1956.
30. Gotelli, N.J.; Ellinson, A.M. *A Primer of Ecological Statistics*, 2nd ed.; Sinauer Associates: Sunderland, MA, USA, 2004; ISBN 9781605350646.
31. Beninger, P.G.; Boldina, I.; Katsanevakis, S. Strengthening statistical usage in marine ecology. *J. Exp. Mar. Biol. Ecol.* **2012**, *426*–*427*, 97–108. [\[CrossRef\]](#)
32. Hurlbert, S.H.; Lombardi, C.M. Lopsided reasoning on lopsided tests and multiple comparisons. *Aust. N. Z. J. Stat.* **2012**, *54*, 23–42. [\[CrossRef\]](#)
33. Curpen, S.; Teutsch, N.; Kovler, K.; Spatari, S. Evaluating life cycle environmental impacts of coal fly ash utilization in embankment versus sand and landfilling. *J. Clean. Prod.* **2023**, *385*, 135402. [\[CrossRef\]](#)
34. Zarco-Soto, I.M.; Zarco-Perinan, P.J.; Sanchez-Duran, R. Influence of climate on energy consumption and CO2 emissions: The case of Spain. *Environ. Sci. Pollut. Res.* **2020**, *27*, 15645–15662. [\[CrossRef\]](#) [\[PubMed\]](#)
35. Makineci, E.; Kart Aktaş, N.; Akburak, S.; Özdemir, E.; Kul, A.A. Expectations of the people living in metropolises from recreation areas: Case study—Istanbul. *Forestist* **2023**, *73*, 145–153.
36. Cenral Bureau of Statistics, Regional Statistics. Available online: <https://www.cbs.gov.il/en/settlements/Pages/default.aspx> (accessed on 14 March 2024).
37. Thomollari, X.; Toğan, V. Credit Success Rates of Certified Green Buildings in Turkey. *Teknik Dergi.* **2020**, *10063–10084*, 580.
38. Gómez Martínez, G.; Pérez Martín, M.Á. Water Management Adaptation to Climate Change in Mediterranean Semiarid Regions by Desalination and Photovoltaic Solar Energy, Spain. *Water* **2023**, *15*, 3239. [\[CrossRef\]](#)
39. Cahn, A.; Katz, D.; Ghermandi, A. Analyzing Water Customer Preferences for Online Feedback Technologies in Israel: A Prototype Study. *J. Water Resour. Plann. Manag.* **2020**, *146*, 06020002. [\[CrossRef\]](#)
40. Pushkar, S. Life-Cycle Assessment in the LEED-CI v4 Categories of Location and Transportation (LT) and Energy and Atmosphere (EA) in California: A Case Study of Two Strategies for LEED Projects. *Sustainability* **2022**, *14*, 10893. [\[CrossRef\]](#)
41. Pushkar, S. LEED-CI v4 Projects in Terms of Life Cycle Assessment in Manhattan, New York City: A Case Study. *Sustainability* **2023**, *15*, 2360. [\[CrossRef\]](#)
42. Pushkar, S. Life-Cycle Assessment of LEED-CI v4 Projects in Shanghai, China: A Case Study. *Sustainability* **2023**, *15*, 5722. [\[CrossRef\]](#)
43. The Economist Intelligence Unit; the Research and Analysis Division of The Economist Group; the Sister Company to The Economist Newspaper. Available online: <https://espresso.economist.com/54bca850f1d973d680f529625844e378> (accessed on 14 March 2024).
44. Colmenero Fonseca, F.; Cárcel-Carrasco, J.; Martínez-Corral, A.; Kaur, J.; Llinares Millán, J. Diagnosis of the Economic Potential within the Building and Construction Field and Its Waste in Spain. *Buildings* **2023**, *13*, 685. [\[CrossRef\]](#)

45. Ulubeyli, S.; Kazaz, A.; Arslan, V. Construction and Demolition Waste Recycling Plants Revisited: Management Issues. *Procedia Eng.* **2017**, *172*, 1190–1197. [[CrossRef](#)]
46. Seror, N.; Portnov, B. Estimating the effectiveness of different environmental law enforcement policies on illegal C&D waste dumping in Israel. *Waste Manag.* **2020**, *102*, 241–248. [[PubMed](#)]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.