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LEED Version 4 (v4) Gold Certification Strategies for Existing Office Buildings in the United States

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Abstract: The objective of this study was to evaluate the impact of project/building characteristics on LEED-EB v4 gold-certified projects in the US. LEED project/building characteristics include project size and the number of buildings built before and after the 1973 energy crisis. LEED-EB-certified projects include a score for Location and Transportation credit (LTc1) and scores for Energy and Atmosphere credits (EAcs) (EAc6, "renewable energy and carbon offsets", and EAc8, "optimize energy performance"). From 112 LEED projects, two groups of projects with specific achievements were selected. Group 1 (n_1 = 13) includes high achievements in LTc1 and low achievements in EAc6 and EAc8. Group 2 (n_2 = 13) includes high achievements in LTc1, EAc6, and EAc8. The exact Wilcoxon–Mann–Whitney or Fisher's exact 2×2 test was used to estimate significant differences between two groups. As a result, Group 2 outperformed Group 1 in EAc6 and EAc8 (p <0.001, respectively). Group 1 outperformed Group 2 in project size and the number of buildings built before the "1973 energy crisis" (p = 0.017 and 0.005, respectively). Knowing the project size and the building's construction date can help LEED professionals choose the best certification strategy.

Keywords: LEED-EB v4 gold-certified projects; renewable energy and carbon offset credit; optimize energy performance credit; US

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1. Introduction

1.1. General Point of View

In 1987, the Brundtland Report, "Our Common Future", defined the principle of sustainable development as "…development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [1]. In particular, this principle underlies reducing operational energy (used for heating, cooling, and lighting) in buildings.

It is well known that buildings are the main source of global greenhouse gas emissions, accounting for 30–40% of all operational energy used in the world [2]. However, the problem of reducing operational energy consumption in existing buildings built from 1915 to the present is not trivial.

There are at least two factors that can influence the reduction in operational energy consumption in an existing building: (1) its size and (2) year of construction.

According to [3], different Heating, Ventilation, and Air Conditioning (HVAC) systems are preferable for large and small buildings: central systems (cooling towers) and decentralized systems (packaged air conditioners), respectively. According to [4], different window-to-wall ratios (WWRs) are recommended for large and small buildings, about 50% and 30%, respectively. Therefore, different HVAC systems and WWRs can influence primary energy consumption [5].

Oldfield et al. [6] showed that in the United States, office buildings built before the "1973 energy crisis" consume significantly more operational energy than office buildings built after the 1973 energy crisis. This was achieved through architectural innovations, such as reducing the ratio of the envelope surface area to the volume, using double glazing instead of single glazing, and using natural and mixed ventilation instead of mechanical ventilation [6].

However, developing a systematic approach to solving this problem only began in the 1990s. One component of this systemic approach is the development of Green Building Rating Systems [7]. This study focused on the US Green Building Rating System (USGBC).

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1.2. US Green Building Rating System

In 1993, the USGBC was founded with the specific purpose of creating a system of national standards to stimulate interest in building more sustainably [8]. In 2002, the USGBC launched the Leadership in Energy and Environmental Design of Existing Buildings (LEED-EB) system to reduce operational energy consumption in buildings through LEED certification procedures [9]. The LEED-EB system evolved from a pilot version in 2002 (1.0) to version 4 (v4) in 2013 via versions 2.0 in 2005 and 3.0 in 2009. It should be noted that LEED-EB-certified buildings must be recertified within 5 years to receive a new LEED certificate [10].

The LEED-EB v4 system contains four levels of certification: certified (40-49 points), silver (50-59 points), gold (60-79 points), and platinum (80-120 points). Increasing the certification level from certified through silver and gold to platinum in LEED-certified projects results in reduced environmental impacts from buildings [11].

The LEED-EB v4 system also contains six main categories and two additional categories. Each category consists of one or more credits and has a different number of maximum points (max pts).

The six main categories include energy and atmosphere (EA (38 max pts)), location and transportation (LT (15 max pts)), indoor environmental quality (EQ (17 max pts)), water efficiency (WE (12 max pts)), sustainable sites (SS (10 max pts)), and material and resources (MRs (8 max pts)), and the two additional categories include innovation (IN (6 max pts)) and regional priority (RP (4 max pts)). It should be noted that in determining the LEED-EB v4 certification strategy, EQ, WE, MR, and SS credits play a minor role, while LTc1, "alternative transportation" (15 max pts), EAc6, "renewable energy and carbon offsets" (5 max pts), and EAc8, "optimize energy performance" (20 max pts), credits play a major role [12]. In addition, if LEED-EB gold-certified projects are located in a prime urban location (for example, in New York, Chicago, or Washington, D.C.), the LEED “alternative commuting transportation” credit scores are approach or are equal to the maximum due to easy access to alternative transportation systems [13].

Thus, in assessing the two types of LEED certification strategies based on low/high operation energy performance in buildings, it can be helpful to sort LEED-EB v4 gold-certified office projects into two groups—Group 1, i.e., projects with low performance in EAc6 and EAc8, and Group 2, i.e., projects with high performance in EAc6 and EAc8, with LTc1 demonstrating high performance in both groups. Recently, a similar approach was applied to study LEED for commercial interior (LEED-CI) certification strategies in Manhattan, New York, USA, and Shanghai, China [14,15].

1.3. Limitation in LEED System

In 2007, Zimmerman and Kibert, [16] noted that the LEED system uses a “one-size-fits-all” approach for small and large buildings. However, in 2013, Talen [17] suggested that this claim may be incorrect. In 2015, Suzer [18] reviewed the LEED v3 and v4 approaches and noted a need to tailor each LEED-certified project to local conditions.

In 2017, Elzeyadi [19] compared predicted and actual performance in LEED-certified buildings and noted that the LEED certification strategy should not be perceived as a one-size-fits-all approach. In 2020, Ullah et al. [20] studied LEED-certified healthcare buildings in four regions of the United States: the Northeast, Midwest, South, and West. They found that the highest achievements in LEED-certified healthcare projects were made in the fastest-growing areas with good economic conditions in the South. Thus, socio-economic factors can significantly change the LEED certification strategy, which precludes the possibility of applying a one-size-fits-all approach to all LEED-certified projects.

In 2024, Pekdogan [21] reviewed 134 LEED v4 platinum-certified projects in Türkiye and concluded that achieving high project ratings is not a one-size-fits-all process but a multifaceted method that can be approached in different ways.

In 2020, Pushkar [22] compared China and the US in terms of LEED v3 and v4 silver- and gold-certified projects and showed that the differences between China and the US increased from two categories in v3 to four categories in v4. As a result, LEED v4 provides more flexibility than LEED v3 and allows for a focus on environmental priorities specific to certain countries, such as China and the

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United States. Based on this result, it can be assumed that at the country level, as the LEED system develops, the one-size-fits-all approach is being replaced by a more diverse one.

1.4. Unexplored Factors in LEED Certification Strategy

Despite considerable criticisms of the one-size-fits-all approach to using the LEED system, the following factors remain that can influence the choice of LEED certification strategy in the US: the size of the LEED project and the 1973 energy crisis. However, the impact of the LEED project size and year of construction (before or after the 1973 energy crisis) on the choice of LEED certification strategy for LEED-EB v4 office buildings has been poorly studied (regarding the LEED project size) or not studied at all (regarding the 1973 energy crisis).

Only three studies were identified that analyzed the relationship between low and high EAc6 and EAc8 scores in LEED-EB v4 gold-certified office projects. A critical analysis of these studies is presented below.

Two studies analyzed [23,12] LEED-EB-v4 gold-certified office building projects in Europe: 1) a comparison between Finland (Group 1, n = 14) and Spain (Group 2, n = 16) and 2) a comparison between LEED-certified projects with the highest EAc8 scores (Group 1, n = 15) and projects with the lowest EAc8 scores (Group 2, n = 15) in Spain. Both studies showed similar results: low EAc6 scores were associated with high EAc8 scores and vice versa. A limitation of these studies was that the size of the LEED project and the year of construction of the buildings were not considered important variables.

In 2021, the impact of project size on the choice of LEED-EB v4 gold certification strategy in the United States was examined for the first time [24]. At that time, there were only 26 LEED-EB v4 gold-certified projects in the USGBC database. The LEED data were divided into two groups based on LEED project size: small (median = 11,625 m^2) and large (median = 49,861 m^2). The small group contained 6 LEED-certified projects, and the large group contained 20 LEED-certified projects. It was shown that an increase in the size of a LEED project is associated with a decrease in EAc6 from 3.0 points (median) to 2.0 points (median) ($p = 0.045$) and in EAc8 from 19.5 points (median) to 16.5 points (median) ($p = 0.076$).

The first limitation of this study was the small overall sample size of LEED-EB v4 gold-certified office projects (n = 26). Therefore, the impact of LEED-EB v4 project size on LEED certification strategy has not been sufficiently studied. The second limitation of this study is that the LEED certification strategy has not been studied in the context of construction prior to or after the 1973 energy crisis.

Therefore, the objective of this study was to evaluate the impact of LEED project size and building construction year (i.e., before or after the 1973 energy crisis) on the choice of LEED certification strategy for LEED-EB v4 gold-certified office projects in the United States.

2. Materials and Methods

2.1. Study Design

LEED data were collected from one country (US), one LEED system (LEED-EB), one version (v4), one certification level (gold), and one space type (office). This design minimizes the influence of uncontrollable factors [25]. It has been previously shown that different countries, LEED systems, versions, certification levels, and space types use different LEED certification strategies [e.g., 26-29].

The current study used an inversion problem-solving approach to identify the causal factors leading to different LEED certification strategies. The author of this study selected two small groups ($n_1 = n_2 = 13$) from one large group (n = 112). Group 1 includes LEED-certified projects with high LTc1 and low EAc6 and EAc8 scores, while Group 2 includes LEED-certified projects with high LTc1, EAc6, and EAc8 scores. The LEED project size and the year the LEED-certified building was built, i.e., before or after the 1973 energy crisis, were then compared between Group 1 and Group 2 to determine whether these two variables impact LTc1, EAc6, EAc8, and overall LEED achievement in LEED-certified projects.

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2.2. Data Collection

Figure 1 displays a flowchart of the collection process and the sample sizes of LEED-EB v4-certified projects in the US.

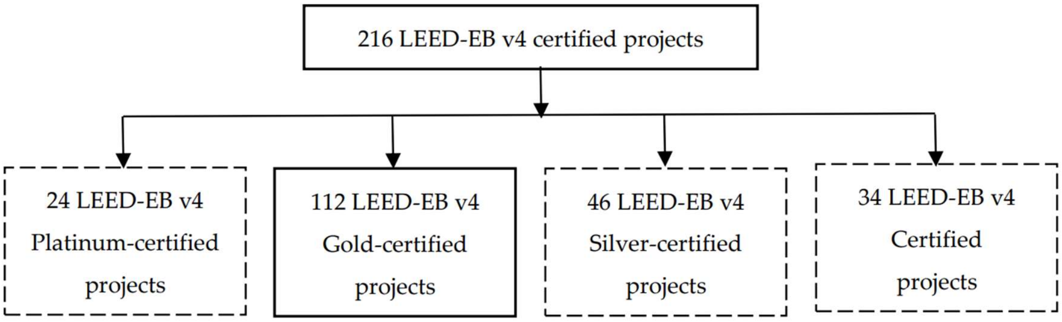

Figure 1. Flowchart of collection and sample sizes of LEED-EB v4-certified projects in the US.

The USGBC and Green Building Information Gateway (GBIG) databases were used to identify 216 LEED-EB v4-certified office space projects in the United States (on 13 July 2024) [30,31]. The USGBC database was used to collect LEED scores. The GBIG database was used to determine whether LEED-certified projects were office buildings. The GBIG database was also used to determine the year of construction of buildings in LEED-EB v4 gold-certified office projects using the Energy Star protocol.

The next step was to sort the LEED projects into four certification levels: platinum (n = 24), gold (n = 112), silver (n = 46), and certified (n = 34). The division into four certification levels is necessary because each certification level has its own unique set of LEED certification strategies. Combining the four certification groups into one group would result in a misleading description of the LEED certification strategy. Therefore, to achieve the objective of the study, the author focused only on LEED v4 gold-certified office projects since other certification levels contain a small number of projects.

2.3. LEED Gold-Certified Data Sorting

The author applied low-/moderate-/high-valued logic to the percentage of average score (PAS) results as the ratio of achieved points to maximum points [32] for LTc1, EAc6, and EAc8 to sort the three types of LEED certification strategies. Table 1 shows the boundaries of the three performance levels, low, moderate and high, for LTc1, EAc6 and EAc8.

Table 1. The percentage of average score (PAS) for LTc1, EAc6, and EAc8 using low-/moderate-/high-valued logic.

LEED-EB v4 credit	Max points	Low	Moderate	High
LTc1: alternative transportation	15	0–39	40–67	68–100
EAc6: renewable energy and carbon offsets	5	0–40	41–59	60–100
EAc8: optimize energy performance	20	0–55	56–89	90–100

Figure 2 shows that Groups 1 and 2 are fundamentally different from each other, while Groups 3 and 4 occupy an intermediate position between Groups 1 and 2.

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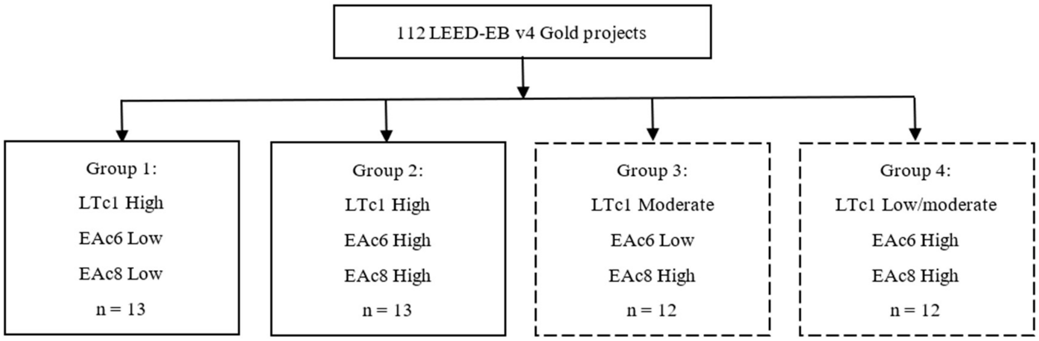

Figure 2. Flowchart of sorting LEED-EB v4-certified projects into four groups according to LTc1, EAc6 and EAc8 using low-/moderate-/high-valued logic.

Therefore, the author of this study focused only on a comparative analysis between Group 1 and Group 2.

Groups 1 and 2 each contain 13 LEED-EB v4 gold-certified office building projects with the following inputs: LEED project size, year of building construction, and scores for the three key LEED credits: LTc1, EAc6, and EAc8 (Appendix A, Tables A1 – A2).

The exact Wilcoxon–Mann–Whitney (WMW) or Fisher's exact 2×2 test was used to estimate significant difference between Group 1 and Group 2 in terms of LEED scores, LEED project sizes, and the construction years of LEED buildings. Details of the statistical analysis used are presented below.

2.4. Statistical Analysis

The results of the Shapiro–Wilk test showed that the normality assumption was not met for the LEED project sizes in Group 1 and Group 2 ($p = 0.0117$ and 0.0002, respectively). Therefore, nonparametric rather than parametric statistics should be used.

When the LEED scores and LEED project sizes were presented on ordinal or interval scales, the exact WMW rank test [33] and Cliff's δ nonparametric effect size analysis [34] were used to compare differences between the two groups. Although the LEED data contained tied observations, in their original study, Bergmann et al. [33] showed that if the sample size was $n_1 = n_2 \geq 12$, then the exact WMW procedure was acceptable.

When building construction years were presented on a binary scale (before and after the 1973 energy crisis), Fisher's exact test using a 2 x 2 table with Lancaster's correction [35] and the natural logarithm of the odds ratio (lnθ) (i.e., the effect size test) [36] were used to compare differences between the two groups. Because buildings take several years to construct, buildings built only after 1980 were counted as "built after the 1973 energy crisis". According to [35], the minimum sample for Fisher's exact test, using a 2 x 2 table with Lancaster's correction, is $n_1 = n_2 = 3$.

2.5. Effect Size and p-Value Interprotations

In both δ and lnθ, (+) indicates that Group 1 outperformed Group 2, (–) indicates that Group 2 outperformed Group 1, and zero indicates no difference between the groups. Cliff's δ effect size ranges between −1 and +1 [34], and lnθ ranges from minus infinity to plus infinity [36]. The Cliff's effect size is considered (1) negligible if $|\delta| < 0.147$, (2) small if $0.147 \leq |\delta| < 0.33$, (3) medium if $0.33 \leq |\delta| < 0.474$, and (4) large if $|\delta| \geq 0.474$ [37]. The lnθ effect size is considered (1) negligible if $|\delta| < .51$, (2) small if $0.51 \leq |\delta| < 1.24$, (3) medium if $1.24 \leq |\delta| < 1.90$, and (4) large if $|\delta| \geq 1.90$ [38].

Three-valued logic was used to interpret two-sided p-values: either there is a difference between the two groups, there is no difference between the two groups, or judgment regarding the difference between the groups is suspended [39,40].

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3. Results

3.1. Comparison of Two Sorted Groups

Table 2 shows a comparative analysis of Group 1 and Group 2 across the three key LEED credits.

Table 2. Three key LEED credits in LEED-EB v4 gold-certified office projects in the United States.

LEED-EB v4 credit (Max Points)	Median, 25–75th Percentiles		*p*-Value (Cliff's δ)
	Group 1 ($n_1 = 13$)	Group 2 ($n_2 = 13$)	
LTc1: alternative transportation (15)	15.0, 14.5–15.0	14.0, 12.0–15.0	0.199 (0.27)
EAc6: renewable energy and carbon offsets (5)	0.0, 0.0–0.0	3.0, 3.0–4.0	<0.001 (-1.00)
EAc8: optimize energy performance (20)	7.0, 6.0–9.0	20.0, 18.8–20.0	<0.001 (-1.00)
LEED total [1]	60.0, 60.0–61.0	67.0, 62.0–68.3	<0.001 (-0.88)

Note: [1] the minimum score to achieve LEED Gold certification for a project is 60.

LTc1, alternative transportation, requires the use of public transportation such as buses, subways, ridesharing, and green vehicles instead of conventional cars [41]. No significant difference was found between Group 1 and Group 2 in LTc1 (p = 0.199). Projects in both groups are being implemented in New York, Chicago, Washington D.C., Los Angeles, Denver, Boston, and San Jose (Appendix A, Tables A1 and A2), cities with developed urban environments and considerable accessibility to public transportation. Therefore, it is not surprising that both groups had similar high LTc1 achievements.

EAc6, renewable energy and carbon offsets, requires that part of a building's operational energy be produced using renewable energy sources, such as solar panels and wind turbines, or through a green energy purchase contract [41]. EAc8, optimize energy performance, requires a building's energy consumption to be reduced by 26-45% compared to the national average [41]. As shown in Table 2, Group 2 outperformed Group 1 in EAc6 and EAc8 (p < 0.001, respectively). If a LEED-EB v4 gold-certified office project achieves low scores in EAc6 and EAc8 and high scores in LTc1, the overall LEED score meets the minimum requirements for gold certification (Group 1). If a LEED-EB v4 gold-certified office project achieves high scores in EAc6, EAc8, and LTc1, the overall LEED score exceeds the minimum score for gold certification by 11.7% and, therefore, can achieve the platinum level upon recertification (Group 2).

The factors (the size of LEED-EB v4 gold-certified projects and the construction year of LEED-certified buildings) that influenced the differences in the EAc6 and EAc8 scores between the two groups are analyzed below.

3.2. Factors Affecting the Difference in Energy Credits

3.2.1. LEED Project Sizes

Table 3 shows that Group 1 outperformed Group 2 in LEED project size ($p = 0.017$).

Table 3. Size of LEED-EB v4 gold-certified office projects in the United States.

Variable	Median, 25–75th Percentiles		p-Value (Cliff's δ)
	Group 1 ($n_1 = 13$)	Group 2 ($n_2 = 13$)	
Project size (m^2)	45,782, 21,225–73,644	15,922, 11,153–36,719	0.017 (0.54)

The size of the LEED project from Group 1 is almost three times the size of the LEED project from Group 2 ($p = 0.017$). Thus, it can be confirmed that decreasing the size of a LEED project results in differences between Group 1 (low EAc6 and EAc8 scores) and Group 2 (high EAc6 and EAc8 scores). In terms of EAc6, renewable energy and carbon offsetting, it can be assumed that this credit may be more effective in smaller buildings than in larger ones. This is because, for example, compared to larger buildings, smaller buildings have a higher roof-to-building size ratio. Therefore, solar panels are more suitable for small buildings than for large ones. In terms of EAc8, optimize energy

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performance, as explained earlier, larger buildings use central HVAC systems (boilers and chillers to heat and cool the air, respectively), while smaller buildings use decentralized HVAC systems (stand-alone packaged air conditioners) to heat and cool the air) [3]. Decentralized HVAC systems are more flexible in regulating energy consumption for different offices, while centralized systems do not have this ability and supply all offices with the same energy density. Thus, smaller buildings have more opportunities to optimize energy consumption than larger buildings [24]. This may be one explanation for why Group 2 LEED-EB-certified projects were more energy-efficient than Group 1 LEED-EB-certified projects, as shown in Table 2.

3.2.2. LEED Project Construction Years

As shown in Figure 3, the results of Fisher's exact test using 2 x 2 tables show a significant difference, with a large effect size for the buildings built before 1973/buildings built after 1980 ratio between Group 1 and Group 2 ($p = 0.005$; $ln\theta = 2.52$).

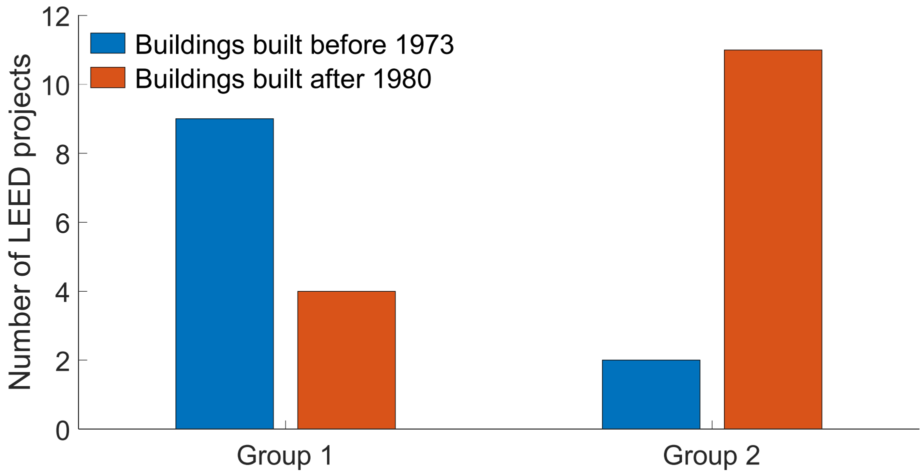

Figure 3. The relationship between two LEED energy efficiency strategies (i.e., Groups 1 and 2) in existing office buildings and buildings constructed before and after the 1973 energy crisis in the United States.

Thus, for LEED-EB v4 gold-certified office projects, low EAc6 and EAc8 scores are associated with buildings built before the 1973 energy crisis, while high EAc6 and EAc8 scores are associated with buildings built after the 1973 energy crisis. In other words, in Group 1, buildings built before 1973 outnumber buildings built after 1980, and in Group 2, buildings built after 1980 outnumber buildings built before 1973.

The higher energy efficiency of Group 2 projects can be explained by taking into account the energy standard that emerged as a result of the 1973 energy crisis. In this respect, the U.S. Department of Energy was created in accordance with the recommendations of the Energy Policy and Conservation Act of 1975 [42,43] and the Energy Policy Act of 1992 [44,45]. At the federal level, the U.S. Department of Energy has developed the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) voluntary energy codes for commercial and residential buildings [46]. At the same time, many states have introduced their own rules and regulations regarding energy consumption in buildings. The first building energy efficiency standards were adopted in California in 1978. Energy regulations were then issued in other states including Arizona, Georgia, Illinois, Iowa, Massachusetts, and New York [47].

Energy savings depend largely on the following parameters: the orientation of the building, the ratio of windows to walls (the "transparency" of the facade), the type of glazing, and the thermal mass of the wall and its insulation [48]. In buildings constructed before the 1973 energy crisis, these parameters were often designed with architectural and aesthetic characteristics in mind rather than energy efficiency issues. The problem is that some parameters, such as the orientation of the building

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and the transparency of the facade, cannot be changed even when reconstructing an existing building [5]. It should be noted that the trade-off between building architecture and building operational energy reduction is a key issue in modern building design [49].

Thus, it may be supposed that due to the emerging standardization of energy consumption, offices built after the 1973 energy crisis are more energy-efficient than those built before the 1973 energy crisis. This may be another reason why the Group 2 projects were more energy-efficient than Group 1 projects (Table 4).

4. Conclusions

LEED professionals use two fundamentally different LEED certification strategies for LEED-EB v4 gold-certified office projects in the US.

The first type of LEED certification strategy involves a combination of high achievement in LTc1 (median = 15.0) and low achievement in EAc6 and EAc8 (median = 0.0 and 7.0, respectively), resulting in a number of total LEED points (median = 60.0) that is the minimum to achieve LEED gold certification. This strategy is associated with LEED-certified projects that (i) have a large LEED project size (median = 45,782 m^2) and (ii) were built before the 1973 energy crisis.

The second type of LEED certification strategy involves a combination of high achievements in LTc1 (median = 14.0), EAc6, and EAc8 (median = 3.0 and 20.0, respectively), resulting in a number of total LEED points (median = 67.0) significantly higher than the minimum to achieve LEED gold certification. This strategy is associated with LEED-certified projects that (i) have a small LEED project size (median = 15,922 m^2) and (ii) were built after the 1973 energy crisis.

Thus, there are at least two factors in parallel that influence the limitation of the energy savings potential in LEED-EB v4 gold-certified projects: (i) the increase in project size (median) from 15,922 m^2 to 45,782 m^2 and (ii) whether the building was constructed before or after the 1973 energy crisis.

Appendix A

Table A1. Group 1: US-LEED-EB v4 gold-certified office projects with high LTc1 and low EAc6, and EAc8 performance with a Percentage Average Score (PAS).

Address	Project name	Certification date	Year constructed	LTc1 (PAS)	EAc6 (PAS)	EAc8 (PAS)
655 3rd Ave, New York, New York, 10017	655 Third Avenue	July 09, 2019	1958 [1]	15 (100)	2 (40)	7 (35)
675 3rd Avenue, New York, New York, 10017	675 Third Avenue and 205 East 42nd Street	September 16, 2019	1966	15 (100)	2 (40)	4 (20)
231 S. LaSalle Street, Chicago, Illinois, 60604	231 South LaSalle	July 31, 2023	1924	15 (100)	0 (0)	9 (45)
485 Lexington Avenue, New York, New York, 10017	485 Lexington Avenue Recertification	January 14, 2019	1958	15 (100)	0 (0)	6 (30)
114 West 47th Street, New York, New York, 10036	114 W47th St - Recert	June 23, 2022	1989	15 (100)	0 (0)	6 (30)
1133 15th Street NW, Washington, District of Columbia, 20005	1133 15th Street Recertification	January 17, 2024	1969	15 (100)	0 (0)	0 (0)
330 North Wabash Avenue, Chicago, Illinois, 60611	330 North Wabash Avenue	May 22, 2019	1971	15 (100)	0 (0)	9 (45)
1133 Connecticut Ave NW, Washington, District of Columbia, 20036	1133 Connecticut Ave	June 06, 2022	1989	15 (100)	0 (0)	8 (40)

617 W 7th Street, Los Angeles, California, 90017	617 W 7th St	December 19, 2023	1923	15 (100)	0 (0)	7 (35)
523 West 6th Street, Los Angeles, California, 90014	PacMutual Building Recertification	January 21, 2020	1921	13 (87)	0 (0)	9 (45)
6350 Walker Lane, Alexandria, Virginia, 22310	Metro Park 2	September 07, 2021	2000	11 (73)	0 (0)	8 (40)
1200 17th Street, Denver, Colorado, 80202	Tabor Center	October 28, 2021	1985	11 (73)	0 (0)	7 (35)
2550 South Clark Street, Arlington, Virginia, 22202	Presidential Tower	January 12, 2021	1970	15 (100)	0 (0)	11 (55)

[1] https://www.durst.org/properties/655-third-avenue.

Table A2. Group 2: US-LEED-EB v4 gold-certified office projects with high LTc1, EAc6, and EAc8 performance scores and Percentage Average Scores (PASs).

Address	Project name	Certification date	Year constructed	LTc1 (PAS)	EAc6 (PAS)	EAc8 (PAS)
University of California, Santa Barbara, California, 93106	UCSB Student Resource Building	March 21, 2016	2007 [2]	15 (100)	5 (100)	18 (90)
741 Technology Dr, San Jose, California, 95110	Concourse V - 1741 Technology	September 08, 2022	1999	15 (100)	4 (80)	20 (100)
197 Clarendon Street, Boston, Massachusetts, 02116	Berkeley/Clarendon	July 17, 2018	1922 [3]	15 (100)	4 (80)	20 (100)
535 Boylston Street, Boston, Massachusetts, 02116	535 Boylston v4 EB	October 03, 2018	1963	15 (100)	4 (80)	20 (100)
121 Spear Street, San Francisco, California, 94105	Rincon Center Recertification	March 30, 2022	1988	15 (100)	3 (60)	18 (90)
114 W 47th St, New York, New York, 10036	114 W47th St	April 03, 2017	1989	15 (100)	3 (60)	18 (90)
1220 Howell St., Seattle, Washington, 98101	Met Park North	January 23, 2020	2000	14 (93)	3 (60)	20 (90)
2033 Gateway Place, San Jose, California, 95110	2033 Gateway Place	January 03, 2020	1988	13 (86)	3 (60)	20 (100)
4101 Reservoir Road, Washington, District of Columbia, 20007	French embassy	March 10, 2018	1983	12 (80)	3 (60)	19 (95)
2001 Gateway Place, San Jose, California, 95110	2001 Gateway Place	January 03, 2020	1981	12 (80)	3 (60)	20 (100)
201 Redwood Shores Parkway, Redwood City, California, 94065	Towers At Shore Center	October 14, 2019	2000	12 (80)	3 (60)	19 (95)
2077 Gateway Place, San Jose, California, 95110	2077 Gateway Place	January 03, 2020	1984	11 (73)	3 (60)	20 (100)
2099 Gateway Place, San Jose, California, 95110	2099 Gateway Place	January 03, 2020	1985	11 (73)	3 (60)	20 (100)

[2] https://srb.sa.ucsb.edu/about;

[3] https://www.energystar.gov/buildings/certified_buildings_and_plants/b_1075946.

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