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Overview of Cost Studies on Conventional and Green Residential Buildings

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Abstract

In this paper, the authors have summarized seven residential buildings designed with cost and construction considerations from both conventional as well as LEED standpoints. While the latter obviously brings with it a higher initial price tag, it was observed that this initial cost is not only offset in the decade following construction but has the added benefits of tremendous cost savings in the decades to follow, not to mention the mindful stewardship of the world's precious natural resources as well as the preservation and enhancement of the environment for mankind.

Keywords: Residential buildings; Green buildings; LEED features; Cost analysis; Sustainability

Introduction

Green buildings are an environmentally friendly approach to building design seeking to minimize negative impacts upon occupants as well as the environment. In addition to benefits upon human health and the environment, green buildings also use less water and energy over more conventional structures, with their designs resulting in higher levels of indoor air quality, and the life cycles of involved materials, such as furnishings and furniture being more optimally extended [1]. The largest primary source of energy consumption comes from buildings, with an estimated one-third (33%) associated cost of all energy-related carbon dioxide emissions worldwide [2]. Energy consumption in buildings is mainly due to the use of lighting, heating and cooling, power and overall poor insulation. While the initial cost of a green building may be higher, potential benefits will eventually outweigh those up-front costs. The realized trade-off between time, quality, and price, is ultimately what is sought and eventually justifies its purpose and value as the better design approach [3].

This paper seeks to summarize the findings of the authors' recent investigations on the cost studies between conventional and green residential multistory buildings. In these research endeavors, architectural and structural designs were initially carried out, and then the same buildings were subsequently upgraded to include green features for LEED (Leadership in Energy and Environmental Design) certification. Greenification of the residential structures under investigation was based upon the LEED scorecard as set forth by the U.S. Green Building Council [4] (see Figure 1). Based on the points earned, different levels of LEED certification, i.e. Certified, Silver, Gold, and Platinum, were achieved.

Case Studies

A summary of seven case studies involving greenified buildings with various LEED features is provided in Table 1. The typical LEED elements involve: solar panels, high efficiency glass windows, appliances and fixtures, LED lighting, green roofs, HVAC, and rainwater collection and distribution systems. The buildings in this study averaged 2.4 floors with a 4,600 square footage. Moreover, the average number of years to breakeven was found to be ten years with a rate of average percentage reduction being approximately 1.7%.

Concluding Remarks

In an effort to enhance the case for proliferating the usage of green buildings in modern day construction, this study took under consideration seven large-scale residential buildings having LEED features added along with associated costs and numbers of years to breakeven, relative to their more conventional counterparts. It was found that such buildings will provide the users with a cost savings trend realized in the following decade after the completion of construction. Given that most households will live in their abodes for around a half a century, the monetary savings over the course of those forty years will far outweigh the added initial costs for implementing such sustainable features. Of course, the greatest impact is the enhanced livability to the residents while positively interacting in a mindful manner with the surrounding environment.

Table 1: Summary of seven case studies of green buildings with LEED features and statistics.

Reference	No. of Stories	Square Footage	LEED features	Percentage increase in Cost for Greenification	No. of Years to Breakeven	Rate of Average Percentage Reduction in Breakeven per Year
AlSadi et al. [5]	2	4,000	Green roof Solar panels Rainwater management system Enhanced ventilation Permeable pavers High-performance windows Fluorescent lighting	30	15	2
DiTommaso et al. [6]	2	4,000	Solar panels High efficiency hardwood High efficiency LED lighting High performance glass windows and doors Star energy appliances High efficiency HVAC High efficiency plumbing High efficiency stove / oven High efficiency fireplace Eco-friendly house wrap Eco-friendly installation High efficiency water heater	3.77	9	0.42
Pormehr et al. [7]	2	3,400	Solar panels R-30 & R-21 insulation Recycled mix concrete Recycled mix insulation Thermal windows Nest AC control system Additional meter & sub-meter Energy star labeled appliances LED Lighting Water treatment	40	9	4.44

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Sukiasian et al. [8]	2	3,400	Solar Panels Heat Recovery Energy Star Appl. Insulation High Thermal windows LED Lighting Natural Day Lighting/ Skylight Automated controlling and Monitoring System Wastewater Heat recovery System Low maintenance land-scaping Water Saving Shower Heads Low flow Toilets	11	10	1.1
Grams et al. [9]	3	6,000	Solar panels, Rain barrels, Vegetation on the roof HVAC Three-story tall glass curtain wall	6.3	8	0.79
Saini et al. [10]	3	9,300	HVAC Rainwater system includ-ing rain barrels Green roof Solar panels LED lighting	11	12	0.92
Alcaraz et al. [11]	3	2,200	Solar panels Rain tank Energy efficient windows	16.21	7	2.3

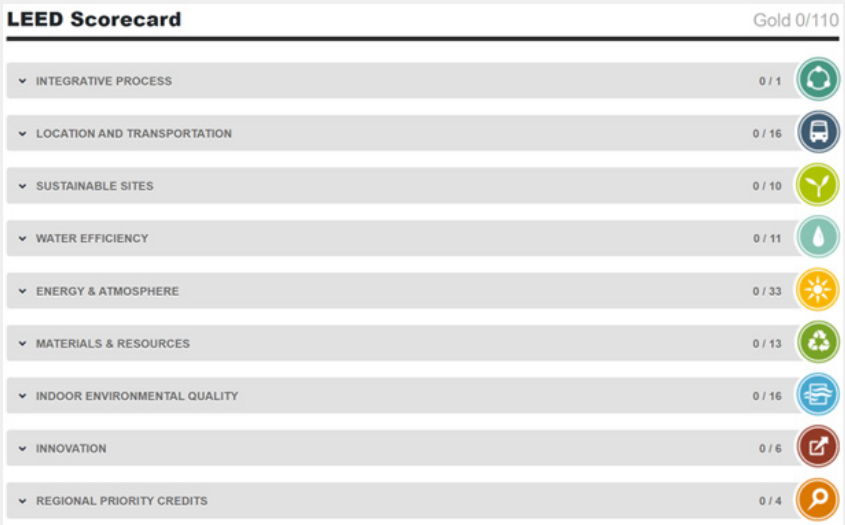

Figure 1: LEED scorecard [4].

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