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Sustainable Design Rating System Comparison Using a Life-Cycle Methodology

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Abstract

Sustainable design rating systems for buildings emerged in the early 1990s globally as an essential method for improving building performance by focusing on conserving energy and minimizing environmental impact. Due to the complexity of buildings, different sustainable-building rating system definitions, as well as the varied target markets and implementation processes, it is difficult to fairly compare different rating systems. The lack of clear knowledge about the comparative characteristics of each of the sustainable-building rating systems has raised concerns. Are the rating systems comparable? What are the pros and cons for each of the rating systems? This paper compares four sustainable design rating systems—LEED, Net Zero Energy Building, Passive House, and Living Building Challenge—by using a life-cycle assessment framework to gain a holistic understanding of the comparative effectiveness of each of the four systems. Based on available data, a built prototype for each system was chosen to conduct the comparison. The objectives of this paper are to 1) propose a method to compare the different rating systems, 2) estimate the life-cycle primary energy-saving potential of each rating system in comparison to the ASHRAE 2010 baseline, and 3) compare the environmental impact reduction potential of each rating system. Through this project, a systematic approach is utilized to compare and understand the energy conservation and environmental impact assessments across the schemes that have been established.

Keywords: sustainable design rating system, life cycle perspective, comparison, environmental impact, primary energy

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1. Introduction

Growing energy demand across the globe has been accompanied by environmental impacts such as global warming, ozone depletion, and acidification. The Environmental Protection Agency (EPA) in 1970 and the oil scarcity crises beginning in 1973 rose concurrently with sustainable building design practice. Initiatives to reduce the carbon footprint in America were encouraged in those early years by federal tax credits to incentivize energy companies to prioritize renewable resources over fossil fuels. The building sector's green initiatives evolved from there into a robust but complicated web of building standards that propose sustainable building methods, each

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