

## Chapter 6

# Green Building Efficiency and Sustainability Indicators

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### ABSTRACT

*A rapid change in technology trend and lifestyle around the globe has induced a drastic increase in energy production, delivery, distribution, and consumption. That forced building planners, designers, scholars, researchers, and practitioners to come up with a sustainable solution within constrained economic and environmental dimensions. With a proper definition and usage of efficiency and sustainability dimensions in terms of green building design and construction, global challenges (global warming, climate change, poverty, global health and education, etc.) can be mitigated, leading to long-run sustainability. This chapter presents indicators to define, manage, measure, and enhance efficiency and sustainability phenomena for proposing a green building. A primary objective of this study is to identify influencing factors and set forth viable indicators and framework in terms of energy-efficient green building from different standpoints hiring innovative tangible and non-tangible tools and technique.*

### INTRODUCTION

Energy consumption is an indicator of the economic growth of a nation. According to International Energy Outlook (IEO), world energy consumption will increase by 53% between 2008 and 2035 (Jeffs, 2017). Energy efficiency in building refers to save energy for producing the same service or useful output (Patterson, 1996). According to (Liu and Mi, 2017), buildings consume 40% of the total energy and emit 30% of the greenhouse gases (GHGs) worldwide. Therefore, since many decades' energy efficiency

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and management in the building remains an interesting topic for researchers around the globe. Recently, energy consumption in buildings estimated one-third of total primary energy resources (Danish, Senjyu, Ibrahimi, Ahmadi, & Howlader, 2019). Therefore, energy efficiency and saving become a matter of focus on well-managed energy consumption and supply.

Measuring building energy efficiency is a problematic endeavor due to lack of definitive-quantitative measurement (McNeil & Rue du Can, 2016). While, a series of energy efficiency indicators facilitate to assess a building energy efficiency. As a matter of fact, efficiency and sustainability indicators are not solely data or simple information that can be defined conveniently (International Atomic Energy Agency, 2005). Efficiency and sustainability indicators in the context of a green building are beyond basic statistics to deal with an in-depth analysis of multidimensional aspects. Hence, these indicators establish a relationship between a parameter's variables to regulate important aspects related to green building efficiency and sustainability. These dimensions are associated with green building behavior in term of energy production, delivery, distribution, and consumption; considering efficiencies (technical, technological, ecological, and etc.) and sustainability pillars (economic, social, institutional, technical, and environmental).

As a matter of fact, by proper application of the proposed efficiency and sustainability indicators within management disciplinary, which backed by theories and practices, it can offer the practitioners, scholars, researchers, scientist, and students with an exhaustive investigation from every aspect of a situation to adapt in real-life challenges. This chapter offers the opportunity to understand a systematic approach of efficiency and sustainability indicators and their proper application. As well as, to diminish energy losses by any means, and ensure efficiency and reliability, reduce pollutant emissions, and buoyant socio-economic development. Besides, this chapter explores efficiency and sustainability dimensions in detail along with the importance of state-of-the-art building innovations.

The background section explores previous studies on deployment of renewable energy in term of sustainable building, followed by energy-efficient building indicators and examples. This section as a glance at the literature looks for assessing world-wide practices and success stories of the green building in order to figure out an optimum solution to be fit problems in this chapter. Next section discusses the significance of efficiency and sustainability indicators. This section deals with four main subsections: scoping objectives, elucidating boundaries, develop indicators, indicators localization, which are mainly associated with economic, environmental, technical, regulatory, social, and efficiencies constraints. This section sums up with an appropriate roadmap for development of efficiency and sustainability indicators by ensuring affordability, accessibility, marketability, efficiency, durability, conform, and many other aspects. The Efficiency and Sustainability indicators formulation section offers a roadmap for a green building planning, design and implementation based on measurable and manageable indicators. This section aims to provide a viable framework for development and considering applicable indicators for a green building. The following section describes the green building framework backed by different approaches and sceneries: consensual-based approach, efficiency oriented-based approach, and sustainability oriented-based approach. This section aims to propose an emerging solution for an energy-efficient building based on an exhaustive investigation of different approaches. Then, energy-efficient green building within real-life scenarios and practical case studies are discussed. As well as, this section explores the criteria for deployment of renewable energy in an energy-efficient building. Building Sustainability

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