Chapter 1
Green Smart Building: Requisites, Architecture, Challenges, and Use Cases

Pijush Kanti Dutta Pramanik
https://orcid.org/0000-0001-9438-9309
National Institute of Technology Durgapur, India

Bulbul Mukherjee
Bengal Institute of Technology, India

Saurabh Pal
Bengal Institute of Technology, India

Tanmoy Pal
Bengal Institute of Technology, India

Simar Preet Singh
https://orcid.org/0000-0002-2443-7835
Thapar Institute of Engineering and Technology, India

ABSTRACT

Non-sustainable buildings have threatened the ecosystem globally. In this chapter, a comprehensive discussion on the green and smart building is presented, considering how the buildings are made green and smart and how they support in developing sustainable cities. Though smart buildings are the positive catalyst towards sustainability, the excessive use of electronic devices puts a check in attaining the overall green goal. This chapter suggests merging green and smart technologies to have green smart building (GSB) with the aim of offering the populations a smart and eco-friendly living. Promises and challenges in attaining this goal are meticulously explored. The GSB concept is discussed in detail, suitably supported with the architectural models of overall and the various components of a GSB. The communication architecture is also presented emphasizing on various entities and activities in different levels of communication between various digital components of a GSB. A few cases have been presented showing practical applications of green and smart technologies in buildings.

DOI: 10.4018/978-1-5225-9754-4.ch001

INTRODUCTION

As a result of continuous urbanization globally, the number of buildings (residential and commercial) is on the steep rise, be it in small cities or the metropolis. In some of the global cities, nearly 50 residents turn up to settle down every hour (State of Green, 2019). This shows the high-rate increase in urban population and the demand and need for buildings, especially the residential buildings. Because of the high density of population in the cities, they have become one of the primary sources of CO_2 emissions. Particularly, the buildings are accountable for more than 40 percent of global energy consumption and an almost equal amount of CO_2 emissions (State of Green, 2019). This is way beyond that of the other two major culprit's - the industrial sector and transportation, which account for 30% and 29% of total energy consumption respectively. In the U.S., about 73% of the country's electricity consumption is attributed to the buildings (BossControls, 2019).

Not only the high energy consumption and CO_2 emissions, but also the inefficiency of today's building plans and constructions, in terms of optimized use of resources and recycling, has posted a great environmental and societal challenge. For instance, in the European Union (EU), nearly 30 percent of total waste generated is accounted to the cast off and waste materials from construction and demolition (State of Green, 2019). According to the Environmental Protection Agency (EPA), in the U.S., around 170,000 commercial buildings are built every year, while 44,000 are demolished (BossControls, 2019). This vast amount of waste materials put pressure on the overall ecology and the environment of the urban structure. The absence of sustainable urban planning sets a big threat to the city's natural resources like water, energy, and clean air as these resources are wanted in large volumes by the buildings (construction and maintenance) and their occupants (operation and use).

The traditional building construction concepts have a significant negative impact on the global environment due to the huge emission of greenhouse gas from this kind of building, huge amount of water uses (13.6% of all potable water is consumed by buildings (BossControls, 2019)) as well as wastewater, using non-sustainable construction materials which produces CO_2 and the building wastes such as plastic, concrete, glass, wood, metals, etc.

To have green and sustainable cities, we need to make buildings green and sustainable. Not only in the new buildings, but it is important to adopt and implement green and sustainable technologies in the existing buildings as well. Green building means to apply green technologies to a building throughout its life cycle, i.e., from construction to operation to demolition so that the negative environmental impact of buildings can be minimized as far as possible. Using sustainable building materials and recycling and reusing these materials, reduce waste significantly. A planned and strategic approach in designing buildings, selecting building materials, and the use of modern, efficient construction technologies is the key to have sustainable buildings.

Besides using sustainable materials, curbing the energy consumption of buildings and reducing CO_2 emissions are the crucial factors for green buildings. Focusing on energy efficiency solutions and operations should be widely implemented in all categories of buildings across the globe. Several existing solutions such as energy-efficient windows, proper insulation, heat/cold regulators, ventilation systems, efficient pumps, smart meters, intelligent management systems, etc., if properly implemented, can reduce energy consumption by 50 percent (State of Green, Energy efficiency in buildings, 2019). Also, a sensible choice of building materials in constructing green buildings can reduce the emission of greenhouse and other harmful gases considerably.