



# Economic cost analysis of LED over HPS flood lights for an efficient exterior lighting design using solar PV



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## ABSTRACT

The demography and demand for exterior/outdoor lighting surrounding area have renewed a sense of expectation and exploration regarding the glory of India in exterior lighting design utilizing solar photovoltaic (PV) systems. The illumination topology has encouraged the civic community to develop an alternative for an attractive and decorative exterior area, for example, shopping precincts, household lighting, parking slots, stadiums and industrial appliances. In addition to stipulated energy expenditure and economy tariff vision, energy conservation and a building efficiency policy should be considered for PV. There is a strong need to promote renewable energy based on electricity demand and power shortage to meet the exigency source. This paper attempts to illustrate an innovative light design model frame based on building criteria to fulfil consumer and energy demands, to economize cost optimization, to enhance efficiency without interruption and, most importantly, to provide quality flood light for exterior/outdoor lighting design. Moreover, using the Lithonia Visual (LV) software and the HOMER software based computer analyser and photometric tools, an attempt will be made to build a healthy lighting blueprint with assorted appliances.

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## 1. Introduction

There is a concern for wide-reaching exterior neighbourhood luminosity surrounding civic areas and amenities for light dexterity. Consequently, a well-designed technique is expected to enhance an effective solution for many dilemmas faced such as visual capacity, sturdiness, frown, depletion of radiant fatal, elucidation level, abandoned lighting fixture outlook, panic of crime, antisocial behaviour, financial viability and mostly diminution of energy consumption. Often, conventional lighting systems have confined inquisitiveness and are dominated by environmental interior building energy individually or in cooperation with their relative fields and others. The exploration of an assorted type of efficient lighting system has captured the illumination field from 1975 to 1990. Since the 1990s, illumination optimization has focused on visual recital and neglected visual comfort zone along with light thrashing. In recognition of these needs, many researchers and engineers have taken steps towards designing a mix

of lighting systems to generate maximum quality lighting by means of commercial endorsement and electricity savings with minimal ecological impact [1,2].

In the ever growing urban and domicile users, shopping mall, parking slot, arena, roadway, passageway, pretence illuminating, all-purpose light building, are associated with global lighting and receive an overwhelming optimistic response across the lighting community. India's energy consumption is rapidly increasing, depending on the geographic position and the growth of the population that requires feeding electricity to amenity areas. The total production capacity of power in the grid is only approximately 9110 MW, which is not sufficient for potential demand at peak periods of daylight. The aforementioned lack of conventional resources in the grid and regular power outages cannot meet the demand of exterior and interior lighting, especially during dusk and nightfall [3,4].

The emergent populace in India is suffering an energy deficiency due to diverged fossil fuels such as natural gas, hydal and thermal power. This crisis is a huge concern for mitigating an inadequate electric supply for domestic, commercial and industrial appliances. Throughout the last decade, an average of only 50.5% of the overall generated power has been supplied for urban utility that is insufficient for fulfilling the desirous requirement in the heyday of

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1992–2007, which disturbed a total production scenario and influenced economic anxiety [6,16]. In that scenario, the power drop affected revenue and tariffs for economic lighting design development. For this reason, energy for all initiatives has been vital in the accelerating the urgent need to increase modern energy access as non-conventional resources, such as solar, tidal, onshore and offshore wind, that can fulfil the shortfall capacity and give energy efficient potential output lighting in a hazy, nocturnal period [23] and that can be referred to as a new renewable henceforth.

This paper has addressed the Indian LED flood lighting diaspora for historical solid-state lighting for exterior/outer facades to change the evening footprint. The renewed LED flood light has high-quality colour rendering (CR), utmost enlightenment, optimum light effectiveness, negligible light pollution and hazardous greenhouse impact.

The objective of this paper is to evaluate the economic-cost analysis (ECA) and energy savings that is new and high quality and a reimbursement flood lighting fixture with the help of the Lithonia Visual software and HOMER software. In a fragmented and complex global industry, there is a coherent transitional path from solid-state (traditional) lighting technologies to futuristic light emitting diodes (LED) that can be a fast and proficient way to save electricity and money [7].

Correspondingly, ECA is an easy calculation process that involves different cost facets arising from the fixture installation of utensils, conveyance, maintenance, daily grid charge and energy consumption. Intended for decoration purposes of exterior lighting, ECA is the best option of the analyser for the total life cycle cost of light over lumen hour. An assortment of policy based on daylight, miniature and obscurity harvesting is also presented, and relevant design aspects such as the effects of flood light characteristics, properties of shading fixtures, reflectance of exterior surfaces, tilting, setback, ceiling and mounting height have been considered for fruitful exteriors [17,18].

Eulogizing optimization of energy economic development and cost effective lighting, suitable and truthful quality lighting systems can control and generate maximum illumination and lumen output throughout the landscape via LVS on a PC. LVS is capable of producing diminutive light interference beyond the boundary in a particular area where fixtures are mounted. Conversely, the HOMER software calculates an energy development index based on the lighting system with solar photovoltaic power.

## 2. Methodology

### 2.1. Framework of exterior flood light design

A feeble lighting industry and inflation have hindered India's cost-effective and energy savings recovery. Fortunately, renewable sources in India have improved electricity access from 2007 onwards. Moreover, geographical structures of India persist towards solar PV, which is a better option for edifice urban electrification and is a green standby for domestic, commercial and industrial appliances.

A dexterous imperative is required in this realm to hasten the development of flexible, clean and resource related systems to address global lighting of a household or small or large diligent, emerging locality. Concerning individual spaces for smart, attractive, reduction of light effluence and light infringe, healthy and green impact, the flood lighting trends are paying attention to beautify the outer look [5,19]. The efficiency of a solar photovoltaic is a need based on emanating a climate-specific, sun-drenched era.

Literary review has admonished numerous techniques regarding flood lighting design and economic viability related to

solar PV. Advanced flood lighting systems for exteriors are well equipped with controls that maximize the use of available solar resources. This complex footstep can enrich the texture, ballast, and fumes of exterior lights for unfaltering and commercially efficient energy at night [20].

Power shortages and monetary crises have an inevitably negative impact on exterior illumination. The utmost energy efficient LED and OLED designs are penetrated by regulation and enlightenment, have become more precise, and endure only 10% energy efficiency and a maximum wastage of green end product. Advanced technical proficiency based in European and Asian countries (China, Japan, and Germany, UK, USA, Thailand) have clogged up conventional lighting production including halogen, MH, and HPS light for adorning the exterior outlook.

From 1975 to 1990, energy-efficient lighting systems were dominated by the level of lights, contortion, visual performance, standard colour rendering index (CRI) and comfort colour coherent temperature (CCT), light pollution, health and environment-friendly problems. All collective issues were a large dilemma for lighting designers. In the 1990s, the vision of quality lighting systems moved towards the global market for interior and exterior lighting design. Especially for exterior lighting design, methods and tools are needed to produce integrated lighting technologies that provide quality lighting luminaries and control with minimum environmental impact and energy savings. The leading smart LED light has minimized inferiority in visibility, quality, glare, pollution efficiency, thermal issue and the toxicity of CO<sub>2</sub> and mercury. However, exterior lighting systems require adorned lighting during evening and hazy periods. So, instead of using the whole day per annum for electric services, a solar resource is the best preminent power system and is appropriate for small-scale remote appliances.

### 2.2. Data for exterior lighting design

#### 2.2.1. Source of energy-efficient lighting design

The pressure for global economy recovery is needed for an optimized, simple, cheap and innovative transition from survival model to growth illuminating model frame, which is concentrated on building the stepping stones to a future growth and development of urban and rural communities. This section addresses a variety of energy competent regulations from past decades to the present. For promoting an accelerated power generation from non-conventional resources, India's Energy Advisory Board (IEAB) has established a solar energy building policy from mid-2004 to 2005 that is projected towards energy demand and supply design for household, commercial and decorating purposes. For most of the decade up to 2008, an electric survey has reported a generation of PV plants associated with the grid in India, having a capacity of power generation from 7.6 to 13.5 GW that was boosted up to 21.5 GW by 2009. Concurrently, by January 2014, the popularization of solar PV sharply increased to 2208.36 MW for the end demand of end users.

The literature reviewed is particularly about the electrical power survey (EPS) in India and a comparative increase in electric tariffs of the grid from the year 2006–2007 to the year 2011–2012 by 39.7% and from the year 2012–2013 to the year 2016–2017 by 43.7% [22]. Recently, using energy and building programs at Jawaharlal Nehru National Solar Mission (JNNSM), the Indian government has intended a new and advanced deployment of solar energy for illuminating, cost-effective and trade appliances in households with a target of 20,000 MW by 2022.

Moreover, energy safety management has reported a loss of 7–713 MW of generation capacity of fossil fuel plants for power expenditure in dams and lighting appliances and national security in a grid. En route-of mitigating the outstanding diminutive fall in

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