Replacement of HPS Lamps with LED Lamps for powering Street Lighting Systems in Oman

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Abstract

Global energy transition scenario is going through dynamic changes to meet the net zero objectives set by the nations. As per the COP 28 agreement the doubling of energy efficiency and tripling of the renewable energy generation are vital for meeting the challenge of holding the average global temperature rise well below 1.5^0c than the pre-industrial levels of temperature by 2030.Oman is targeting at net zero emissions by 2050 and towards this, drastic steps both in the energy efficiency improvements and renewable energy integration in power generation is going on. Globally the energy consumption shares of the lighting systems accounts to 19% and 3.9% owes to Street lighting systems. The energy consumption pattern of the outdoor lighting schemes is higher compared to the indoor schemes. So, the energy consumption of street lighting systems of various countries including Oman is a deep concern in fulfilling the net zero objectives. Presently most of the street lighting systems are with high pressure sodium vapor lamps which are characterized by lower luminous efficacy, higher size, higher cost and lower lifespan compared to LED type lightings. This study focused on revealing the technical and economic viability of the replacement of the HPS with LED type of lighting. The problem is analyzed by taking the case of street lighting systems installed in the University of Technology and Applied Sciences, Shinas. The luminous efficacy of LED type lightings is found to be in the range of 114 -160 lm/W, which is very high compared to its counterpart HPS lamps. This aspect of higher luminous efficacy points to the replacement possibility of a 250W HPS lamp with a 70-80W LED lamps affirming with the same lux level requirement and site specifications such as the distance between the poles and width of the road. The project estimated savings of 57% electricity and operational expenses with the replacement of HPS with LED type of street lighting alone. This will provide ample potential for reduction of tons of Greenhouse gas (GHG) emissions from the street lighting scenario itself. Further investment of powering the street lighting system with photovoltaics with battery storage can provide more reduction in the GHG emission. The HPS replacement with LED Lightings and powering with Solar PV/Battery energy storage instead of natural gas-based grid powered HPS in the street lighting loads found to be attractive due to its potential in GHG reduction and simple payback comparing to its base case.

Keywords: HPS lamps; LED Lamps; Solar PV, Techno-economic Study; GHG Emission Reduction.