ABSTRACT

There is significant evolution underway in the electric power sector, with increased harnessing of renewable energy sources (RES) and efforts to decarbonize the energy system. Not only has technological innovation driven dramatic capital cost declines in renewable energy systems, favorable policies too have accelerated the deployment of these systems. Further, consumers want to manage energy costs and assure reliability of their electricity supplies. But because consumers producing their own energy independent of energy utility companies is a relatively new and growing trend, there still exist opportunities for research to better understand the trend and generate better insight to aid decision-making .From the consumers' perspective, limited understanding due to little information available means that their decision-making relies on estimation and projections. Most of the done studies are hardly academic in nature and the results of projects' analyses are not generally available to the public. Further, the application of solar PV electrification is site-specific, with a need to understand the site load and its characteristics as well as the prevailing solar energy resource in order to arrive at objective conclusions. This study performed a techno-economic evaluation of solar PV electrification at Kalisasi Village, Mwingi Sub-County, Kitui County, with specific focus on determination and characterization of the electrical load at the site, assessment of the solar energy resource, sizing of the solar PV system and determination of the levelized cost of energy (LCoE). Characterization of the electrical load entailed establishment of average load, peak demand, load factor from the generated daily load curve. Direct normal radiation data obtained from the Global Solar Atlas online application prepared by Solargis under contract from the World Bank helped estimate the solar energy resource. Based on the load profile and supply resource, the system was sized using PV*SOL analysis tool. The LCoE was determined based on annual capital and operations and maintenance costs, system lifetime, discount rate and annual energy delivered by the solar PV system. Results showed that daily load factor for the load in question was 40.7%, with average and peak daily demand being respectively 10.75 kW and 26.42 kW. Further, the solar energy resource at the site can be utilized practically throughout the year, with an annual average DNI of 1658 kWh/m^2/year. The total annual cost (capital plus O&M) of USD 14,681.76 spread over 115,246 kWhr/yr gives an LCoE of USD 0.127/kWhr, equivalent to approximately Ksh. 14/kWhr. This compares favorably with the power from Kenya Power, even cheaper.