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Opportunities and challenges for distributed generation with rooftop photovoltaic (PV) for Uganda: a case study crusader house, Kampala

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ABSTRACT

Distributed generation with rooftop PV technology is increasingly attracting attention as a strategy to enhance energy security for cities and as a critical climate-change mitigation intervention globally. In order to interrogate the strategy for a developing country context, the study applies a case study approach to explore responsive business models as well as related opportunities and challenges of DGRTPV deployment in Uganda, given the country's advantage of abundant solar radiation as a result of favourable location across the equator. The study substantiates on the research question which focuses on rooftop PV business models, policy and legislation environment, energy efficiency interventions and financial mechanisms for expedited adoption of the technological innovation for commercial buildings in Uganda. In order to substantiate on the working hypothesis, interviews were conducted with key informants from the case study building-occupants and property manager, MEMD, ERA, KCCA, and UMEME. Data were collected using semi-structured interviews as well as energy audits and energy performance simulations of the case study building based on Excel and Design-Builder Energy-Plus software in order to ascertain performance under alternative intervention scenarios.

The case study building consists of two blocks (the main block which is 5 storeys and the annex which is 4 storeys) and is grid-connected, but has standby generator with diesel consumption of up to 4,800 litres/year. The building was built in 1988 for the main block and 1993 for the annex and no energy efficiency interventions have been implemented so far. Overall, the baseline energy consumption is at 191,127.5kWh/year excluding diesel generation at 100,000kWh/year (2010 blackouts were 8 hours per day but at present, the generator is used for only 2 hours per day). Simulations, manual calculations, and economic feasibility appraisals were applied to guide on the viable energy efficiency and photovoltaic (PV) interventions. This resulted into viable energy reduction of 90,404.5kWh/year with a payback period of 0.6 months for lighting systems and additional energy efficiency interventions. Rooftop PV generation evaluation indicated an output of approximately 124,328.75kWh per year with the payback period of 7.6 years.

Overall the study finds that the roof space area (610m^2) of the building offers potential for generating surplus electricity which can be fed to the grid when responsive policy/regulatory environment is effected. The solar service business model is prioritised as the most viable given the current policy/regulatory landscape for Uganda as well as envisaged policy changes in the short term. Given Uganda's low-carbon electricity generation mix, the study finds that opportunity for carbon emission reduction for the building would mainly arise from the displacement of the standby diesel generator whose current emission is estimated at 4,000kg/year. The study therefore concludes that DGRTPV deployment is now mature for scale-up in commercial buildings for Uganda.

Keywords: Policy and legislation, business model, distributed generation, energy efficiency, CO_2, and rooftop PV