

Assessing Building Rooftop Potential for Solar Photovoltaic Energy and Rainwater Harvesting: A Sustainable Urban Plan for Atlantis, Western Cape

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Abstract : The ongoing load-shedding in most parts of South Africa, combined with climate change causing severe drought conditions in Cape Town, has left electricity consumers seeking alternative sources of power and water. Solar energy, which is abundant in most parts of South Africa and is regarded as a clean and renewable source of energy, allows for the generation of electricity via solar photovoltaic systems. Rainwater harvesting is the collection and storage of rainwater from building rooftops, allowing people without access to water to collect it. The lack of dependable energy and water source must be addressed by shifting to solar energy via solar photovoltaic systems and rainwater harvesting. Before this can be done, the potential of building rooftops must be assessed to determine whether solar energy and rainwater harvesting will be able to meet or significantly contribute to Atlantis industrial areas' electricity and water demands. This research project presents methods and approaches for automatically extracting building rooftops in Atlantis industrial areas and evaluating their potential for solar photovoltaics and rainwater harvesting systems using Light Detection and Ranging (LiDAR) data and aerial imagery. The four objectives were to: (1) identify an optimal method of extracting building rooftops from aerial imagery and LiDAR data; (2) identify a suitable solar radiation model that can provide a global solar radiation estimate of the study area; (3) estimate solar photovoltaic potential overbuilding rooftop; and (4) estimate the amount of rainwater that can be harvested from the building rooftop in the study area. Mapflow, a plugin found in Quantum Geographic Information System(GIS) was used to automatically extract building rooftops using aerial imagery. The mean annual rainfall in Cape Town was obtained from a 29-year rainfall period (1991- 2020) and used to calculate the amount of rainwater that can be harvested from building rooftops. The potential for rainwater harvesting and solar photovoltaic systems was assessed, and it can be concluded that there is potential for these systems but only to supplement the existing resource supply and offer relief in times of drought and load-shedding.

Keywords : roof potential, rainwater harvesting, urban plan, roof extraction

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