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A Deployable Modular Mini-Grid for Electrification in Rural Areas

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With the challenge of supplying electricity to rural regions in South Africa, where the logistical cost of installing a utility line is not economically viable, photovoltaics (PV) for power generation offers a solution to rural electrification. However, pervious pilot projects executed by government and private institutes utilized only DC systems for electrification in typical “solar home systems”. These systems only allowed for battery charging, and in some cases transporting of batteries between households and a charging station. In addition, the use of DC powered appliances is expensive, and does not truly allow for uninterrupted electrification. The deployment of the designed modular hub units will effectively provide AC power to the households and improve livelihoods of the residents.
This paper discusses the design and implementation of an experimental modular mini-grid for AC electrification in remote rural areas. The mini-grid system comprises of AC and DC coupled photovoltaic systems sized for optimal power generation. The heart of the mini-grid is the deployable hub unit that comprise of a DC PV system coupled to the inverter system. These units can provide up to 4 households at a local site. A network is created by coupling more of the hub units together, which in turn, communicate with each other and manage the energy flow to the connected households. The linking of this network to a larger AC coupled PV system aids to increased generation capacity and meet higher instantaneous load draws. The DC and AC systems work together to meet the required loads and effectively charge the battery banks.
This paper discusses the mini-grid configuration and uses the pilot installation at the Nelson Mandela University study energy flow and consumption. This is achieved by using programmable loads that simulate the consumption profiles of 4 rural households that make up a mini-grid unit. The generation profile information obtained is then used for design optimization and identify acceptable power use assignment for end users.

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no

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