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Investigating the feasibility & impact of a solar array for Wits West Campus by using historical solar and power data

Singh, Ajeshni

2016

http://hdl.handle.net/10539/22659

Singh, Ajeshni (2016) Investigating the feasibility & impact of a solar array for Wits West Campus by using historical solar and power data, University of the Witwatersrand, <http://hdl.handle.net/10539/22659>

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Abstract

This dissertation uses historical electrical consumption/load and actual solar radiation data to design a solar array for the University of the Witwatersrand's West Campus. The array must meet the campus's minimum demand as selling excess generated power back to the utility is not possible at this stage. The financial and spatial impact of adjusting the size of the array, design losses and cloud cover are also investigated. In addition to this, the influence on the payback period of financial variables such as taxes, electricity and start-up costs are also explored.

The solar array system design process starts by determining the amount of power that the array must produce or supplement. Thereafter, load estimates and electrical consumption figures that are provided by utility bills or measured with load monitoring equipment are analysed. Furthermore, system losses are factored in which ultimately increases the size of the array. Once all the input variables are analysed, the amount of available solar radiation in the area where the array will be installed is required to determine the amount of energy that the array can produce. Several free databases with this information are available but it is found that this data over predicts the availability of solar radiation.

The University has been monitoring the electrical consumption of West Campus since 2012 and solar radiation data is also available for this site. Comparing the satellite derived and measured datasets found that the ground monitored data is 25 % more accurate and therefore better suited for designing a solar array. Individually adjusting the design and financial variables changes the payback period between 3 – 17 %. Combining all the variables can reduce the payback of option 1 from 9.6 years to 6.1 years.

Clear legislation needs to be developed for the uptake of renewable energy resources and supported by better rebates for renewable users and harsher taxes for non-renewable users. Should legislation change and if additional capital is available, a larger array will benefit the University more and should be installed as the difference between payback periods is not significant. This is mainly due to decreased costs associated with a higher yield. The financial benefits of a larger array will also be more lucrative if better rebates are enforced.