Understanding the Factors that Affect the Utilization of Photovoltaics in High Atmospheric Dust Concentration Region

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Project Scope

The objective of this project was to develop a model that describes dust accumulation in order to understand the factors that affect the utilization of PVs in an area with high dust concentrations.

Introduction

Effective capturing of solar energy is of immense importance as part of finding a solution for the ever-increasing demand for power coupled with the depletion of **resources** of fossil fuels. The location of Masdar city in the UAE is associated with relatively high levels of atmospheric dust concentrations. This causes high rates of **dust** accumulation on solar collectors, which leads to: a drop in the total energy yields, difficulty in predicting the power output and time and cost associated with cleaning solar collectors. Therefore, minimizing the amount of dust that accumulates on top of the solar collectors is of great importance for solar energy utilization in general and for the Masdar Initiative and Masdar City in particular.
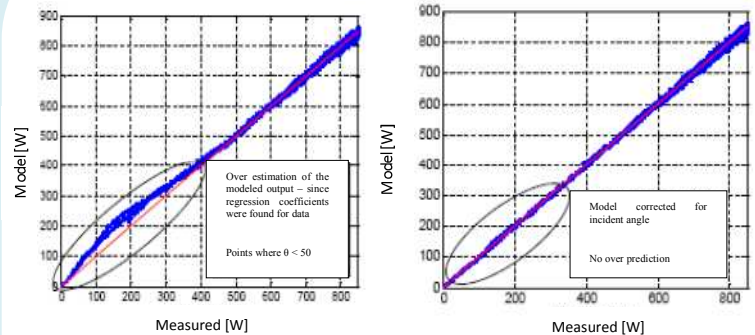

Experimental Setup

A Mono-crystalline PV module connected to the grid through a maximum power point tracker (MPPT) was tested.

The current was measured using a Hall Effect transducer (LEM), and the voltage was measured using a simple voltage divider. Licors were used to correct for the spectral mismatch.
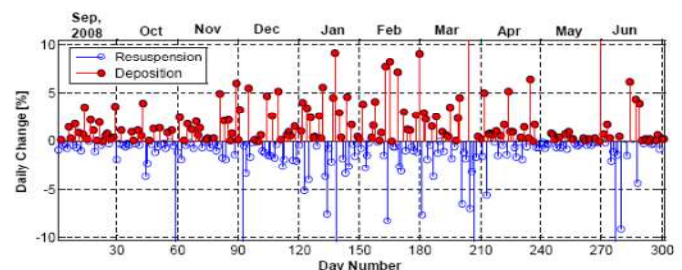

PV's Maximum Power Output Modeling

A simple regression model and a methodology to correct the model for the effect of the incident angle were developed. The model should be further verified by using a year's data of power output. Also the model can be generalized to be used with different PV technologies. This needs data collection of the power output of different PV technologies

Modeling of Dust Accumulation

Self Cleaning Surface Testing

Comparing the daily energy output of a coated and uncoated module at the PV test field located at Masdar City.
It was found that:
1. Surface characterization shows that the coating forms a nano-structure that gives the hydrophobic property.
2. Coating did not affect the transmittance of light and the dust accumulation.
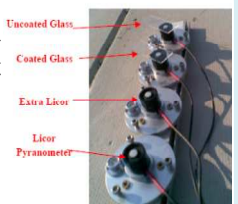
Summary

1. A simple regression model and a methodology to correct the model for the effect of the incident angle were developed.
2. Daily mean values for weather conditions were related to daily variation in the normalized energy difference.
3. A functionalized commercial coating that was claimed to reduce the accumulation of dust on PVs. both indoor and outdoor testing was conducted.

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