Photovoltaic Breadth

Photovoltaic Introduction

Photovoltaic (PV) cells capture the suns energy using chemical means to convert the energy into usable electricity. This analysis focuses on the use of thin films of material for the conversion of energy. There are four main types of thin film technology which are cadmium telluride, copper indium diselenide, amorphous silicon, and thin film silicon. This converted solar energy is converted directly into direct current electricity which needs to be converted to alternating current through the use of an inverter. Currently photovoltaic and solar energy in general has a very high initial cost and is very inefficient. Solar technology obviously works best in areas where sun light is abundant which is primarily in places closer to the equator. However, with the recent energy crisis, more northern countries are promoting the use of solar technology.

Photovoltaic Design

The use of PV cells in this case is based on the fact that the highest electrical peaks occur in the summer months due to the cooling process of buildings. Even though the location of the buildings is at a fairly high latitude, the use of PV cells will help offset the peak electrical load during the summer. Also, with the implementation of thin film amorphous silicon (a-Si) PV cells that are in the form of roof shingles, the buildings with their south facing gabled roofs make for a good implementation of this technology. The PV cell units act the same as shingles while producing DC electricity.

These photovoltaic roof shingles will also be analyzed in a RETscreen spreadsheet program. The cells were analyzed to determine how much power output will come from the units.

The initial step was to get a basic idea of what type of unit would work for this PV shingle integration. The units decided on are Uni-Solar's SHR-17 Solar Shingle. These units have a 20 year warranty, are designed for up to a 60 mph wind, and have a capacity of 17 Watts. This is the model which was used in the RETscreen model.

The effectiveness of the PV cells was tested to determine the economic feasibility and how much power can be produced given the 18° slope of the roofs. Also, the orientation of the buildings are 18° west of south, where south is the solar azimuth. In the analysis, the project location is the first criteria selected for weather and solar data. Next, the PV array is selected which includes the module type, manufacturer, efficiency and losses. The manufacturer's data for the Uni-Solar model SHR-17 is given in the data base and the previously mentioned efficiencies and losses are given. From this information, the renewable energy delivered to the load is 49.073 MWh annually. The solar resource and system load gives the weather data and the monthly average daily radiation for a horizontal surface for the location.

A cost analysis is then performed for the particular PV cell. It was found that each shingle costs $170.28. With this cost information entered, it is now possible to get a payback period for the information entered. It was found that there is a simple payback period of 12.4 years and 8.9 years to a positive cash flow. The PV shingle manufacturers data and RETscreen calculation can be found in Appendix G.