TECHNO-ECONOMICS OF SOLAR PVT ROOF TOP SYSTEM FOR SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT

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ABSTRACT: *The presents study is about the comparison of the Solar PV and Solar PVT systems as a building integrated unit in a storage unit for agricultural places. The analysis is carried out using EQUEST software. It is seen that the solar PVT system because of its take-away heat from the under-side of the PV module, this system has a higher efficiency at a lower cost price than separate similar efficiency of PV and Solar Thermal systems.*

INTRODUCTION

SOLAR energy can supply and or supplement many farm energy requirements. (1) The solar panels have found use in industrial as well as agricultural and rural sector (2). PV systems may be much cheaper than installing power lines and step down transformers in applications such as electrical fencing, lighting, and water pumping. And where utilities charge for new lines, a PV generating system is often much cheaper for the land owner than paying for a new line (3). Comparing to solar PV and solar thermal technology, hybrid solar photovoltaic/thermal (PVT) technology that produces both electricity and thermal energy under sunlight simultaneously is relatively new (4). In areas with no utility lines, PV systems are often cheaper and require less maintenance than diesel generators, wind turbines, or batteries alone. (5). Hence it is the aim of the paper to simulate and compare the performance of a PV integrated and PVT integrated solar roof and evaluate its techno-economical feasible study towards sustainable agriculture and rural development.

METHODOLOGY ADOPTED

The room considered here for simulation is a building integrated solar system storing of harvested grains.

The comparison is done with the two cases:

Case (i) Roof integrated with PV system. Case (ii) Roof integrated with PVT system.

Specifications of the room:
Total area : 800 sq. ft
Floor - 0.350 W/sq m k
Window to Wall Ratio -30%
Glass (Single pane) -1.22 W/sq m k
Total no of panels – 300
Wattage of each panel - 80 Wp
Panel efficiency - 14%
External Wall - 0.124 W/sq m k
Roof - 0.063 W/sq m k
SHGC - 0.25
Specification of PV panel:
Total no of arrays – 6
Total no of cells in each panel - 36
Total Installed Capacity - 24 kWp

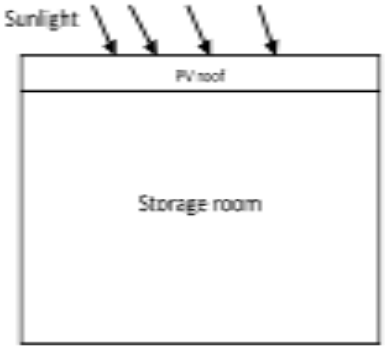

Figure 1: Case (i) Roof Integrated with PV System

Figure 2: Case (ii) Roof Integrated with PVT System

Figure 1 shows the system considered with building integrated solar PV panels and the electricity generated is used to supply for the need of the storage facilities. Figure 2 shows the system considered with PVT collector where air is considered to be the working fluid to take away the heat form the underside of the PV panels. The heated air can be used directly as ventilation air or used to transport the heat to a buffer (6). Here the heated air is used to dry the harvested grains which are stored in the storage room. Computation of the performance is done using EQUEST software. EQUEST consists of DOE-2 derived engine. EQUEST provides very accurate simulation of such building features as shading, fenestration, interior building mass, envelope building mass and the dynamic response of differing heating and air conditioning system types and controls.

RESULT

Figure 3 shows the comparative electrical consumption (EC) in *kWh* per year for the two systems considered.

It can be seen that the electricity consumption in the PV roof system increases from 15.23% to 17.31% the reason due to the energy reduction used

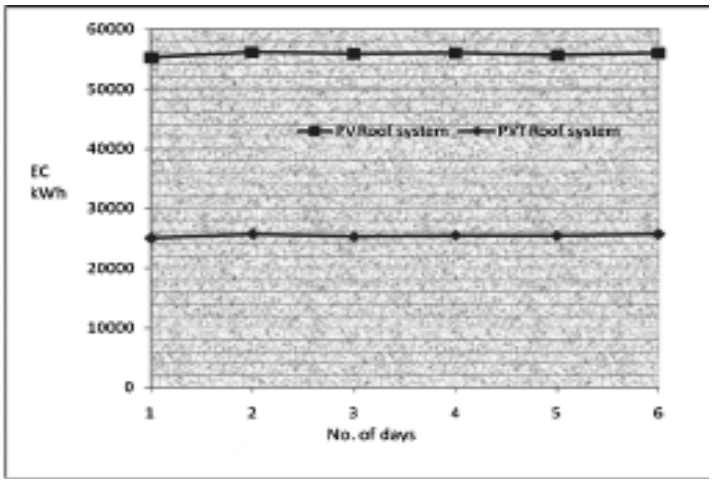

Figure 3: Comparison of Two Systems

in heating air for drying purposes in PV system is supplied by the heat taken by the hot air by cooling the underside of PV panel in the PVT system. By providing this, the cooling of the PV panel is done and thereby the efficiency of the panel does not decrease with respect to increase in temperature. Also, the solar heat is utilized for low temperature applications and thereby electricity is conserved.

CONCLUSION

Simulated result shows that using PV/T system can be used in applications like storage room where it serves as multipurpose applications. Since the unit is building integrated, this is a conservatory for agricultural storage units where electricity is derived from the PV panel and the heated air supplies the heat needed for drying of grains which otherwise will be spent conventionally. Hence this system will be a sustainable solution towards conserving electricity especially in all rural places where grid connectivity is not cost effective solution. Also this PV/T roof-top system will be a boon in the place where huge power cuts occur during day time.

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