Integrative Design of Hybrid Solar Technologies for Air Conditioning in Hot and Humid Environments

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Introduction

Air conditioning is one of the major energy consumption items in Dubai and countries with the same environmental conditions. Providing the majority of the air conditioning energy demand by renewable technologies will be a major step toward sustainable and green communities. The Sustainable City (TSC) in Dubai is currently under design, construction, and development by Diamond Developers Company (DD) with the most recent and innovative sustainable standards and technologies. This work is a solar design for the Center of Excellence Building at TSC. The American University of Beirut (AUB) participated in this research.

Project

Center of Excellence Building located in TSC in Dubai (marked in red). The ground floor size is 4300 m² and contains three floors. It has an auditorium with around 600 people capacity.

Solar Thermal Driven Air Conditioning

Thermal-driven single stage absorption chillers and dehumidification system will be used for air conditioning.

Hybrid Solar Technologies

Evacuated tube solar collectors for integration with absorption chiller

PV and PV/T panels to provide electrical and hot water demand of the Center of Excellence Building

Building-Integrated Solar Technologies for windows and façade. Shad analysis was performed by System Advisor Model Software

Life Cycle Analysis of Solar Technologies

A combination of solar thermal, photovoltaic, and building integrated solar technologies can provide all of the electrical and cooling demand of the Center of Excellence Building. We recommend 1764 PV panels, 4120 evacuated tube solar collectors and two single stage absorption chillers with capacities of 230 and 270 refrigeration ton (RT).

Summary

A combination of solar thermal, photovoltaic, and building integrated solar technologies can provide all of the electrical and cooling demand of the Center of Excellence Building. We recommend 1764 PV panels, 4120 evacuated tube solar collectors and two single stage absorption chillers with capacities of 230 and 270 refrigeration ton (RT).

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Social/Behavioral Study

Thermal Comfort

Thermal comfort is a subjective evaluation of one’s satisfaction with the thermal environment. Comfort roughly equates to thermal neutrality, whereby occupants are neither losing nor gaining heat from their environment, but instead, are able to maintain equilibrium with the ambient conditions.

Life Cycle Analysis

Integrative Design

Air Conditioning

Solar Technology

Thermal Energy

Electrical Energy

Life Cycle Analysis of Solar Technologies

The thermal comfort modeling for February (left) and March (right) using the comfort tool and ASHRAE-55-2010 standard.