Energy analysis of green office buildings in the tropics—Photovoltaic system

Y.H. Yau*, K.S. Lim
Department of Mechanical Engineering, University of Malaya, 50603 Kuala Lumpur, Malaysia

ABSTRACT
This research is to conduct energy analysis of green office buildings in the tropics. According to International Performance Measurement and Verification Protocol (IPMVP), there are four options available in the IPMVP, namely Option (A) Retrofit Isolation: Key Parameter Measurement, Option (B) Retrofit Isolation: All Parameter Measurement, Option (C) Whole Facility and Option (D) Calibrated Simulation. The current research is using Option (A) Retrofit Isolation: Key Parameter Measurement to study the Building Integrated Photovoltaic (BIPV) systems of Malaysia Green Technology Corporation (MGTC) Green Energy Office (GEO) Building. There are four types of BIPV systems being studied, namely System A (polycrystalline silicon), System B (amorphous silicon), System C (monocrystalline glass-glass, semi-transparent) and System D (monocrystalline silicon). The aims of the study are to examine the energy performance and quantify the energy savings of BIPV systems. The key parameters being evaluated are the system efficiency, reference yield, final yield, performance ratio and capacity factor. The methodology used is the actual data collection and analysis. The energy analysis result has shown that System B is having the best performance among all systems, whereas System C has the lowest performance.
© 2016 Elsevier B.V. All rights reserved.

1. Introduction
Due to the advancement in technology, simulation software is widely used nowadays to predict energy generated from renewable systems and model the building energy consumption. The simulation software requires users to input design parameters, and it will simulate the building energy generation or consumption. However, to obtain an accurate prediction, it is imperative that the parameters inputted shall be as close as possible to the actual performance later. One approach to narrow the gap between the design and actual data is to measure the actual data after the system is operating.

Green Building is created using environmental friendly, energy and materials efficient processes. These processes generally start from the site selection, building design, construction, operation, maintenance, retrofitting and deconstruction. The main objective of a green building is to decrease the total effect of the built environment on the human health and the natural environment. This decrease of impact will be gained from the efficient use of energy, water and other resources. Occupant’s health can be safeguarded, and employees’ output can be improved via a better indoor environmental quality, reducing waste and pollution via waste management, and improve the environmental degradation via CO2 emission reduction.

Energy efficiency contributes significantly in reducing CO2 emissions. Increasing energy efficiency is far more effective as compared to the increasing of energy supply in terms of preserving environment. Energy efficiency plays a vital role in improving the commercial and industrial competitiveness. Country with a high-energy efficiency can reduce its dependency on energy imports. This will provide a country’s energy security. Building energy analysis is an activity or a process carried out by the energy analyst to understand the building’s energy behavior and performance. There are various objectives of energy analysis. One of the main objectives is to develop and modify design to cut down energy use and operating cost of a building [1]. This objective can be carried out in a systematic manner through energy performance benchmarking, assessment of Energy Conservation Measures (ECMs) and quantifying energy savings. Other objectives as indicated by Al-Homoud [2] are the study of alternative designs, preparation of yearly energy budgets, meeting the requirements of energy standards and economic optimization. Conventionally, energy analysis ranges from a quick walk-through in a building for identifying problematic areas to a more comprehensive analysis of Energy Conservation...
It is recommended to conduct regular check on cable and water tightness every 6 months.

Every year, all systems should be checked electrically to avoid unusual degradation of system performance.

Whenever data loss detected in the EMS, remedy works shall be carried out to ensure continuity of the data-logging.

For green buildings, which use PV systems to score Energy Efficiency criteria, the sizing of PV systems shall take into consideration of their degradation so that the degradation will not down grade the green building’s rating.

Acknowledgements

The authors wish to thank Mr. Gregers Reimann of IEN Consultants and Mr. Safirol of MCTC for furnishing the technical information and energy data of MGTC GEO Building. The authors would also like to acknowledge the financial assistance of the Construction Research Institute of Malaysia (CREAM), Malaysia, via CREAM Project CREAM/R&D-08/3/2(8) for research work to be conducted at University of Malaya, Kuala Lumpur, Malaysia. Thanks are extended to University of Malaya for awarding UMRG Grant RG030/15AET to the first author for research work to be conducted at University of Malaya. Thanks are also extended to University of Malaya PPP Grants PG111-2012B and PV074-2012A for the partial financial assistance to the co-author, Ir. K.S. Lim for conducting the research work at HVAC&R Lab at the Department of Mechanical Engineering, University of Malaya.

References


