# A SIZING TOOL FOR PV STANDALONE SYSTEM

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**ABSTRACT**

This project aims to develop a software for sizing a standalone photovoltaic (PV) systems. The proposed tool has the capability to allow the user to employ meteorological data such as ambient temperature, irradiation data, and peak sun hour (PSH) in designing the PV system. Usually, a micropower system is designed to serve a specific load demand, in this work, the stand-alone PV is modelled with a particular load profile to ensure that the system meets required energy demand. The developed tool is used to determine the feasibility of the stand-alone system in terms of PV size and the estimated total power production. The tool developed with a built in database which stores different types of PV panels, batteries, charge controllers and inverters. The proposed sizing tool was validated based on the real data implemented on the case study for a residential buildings.

**Keywords**: photovoltaic, standalone system, solar radiation, sizing tool

## 1. INTRODUCTION

Carbon dioxide emissions are harmful and dangerous to living things. Based on Carbon Dioxide Information Analysis Centre (CDIAC), fossil fuels produced high emissions of carbon dioxide which is 18.5% or 1551 million metric tons of carbon released from fossil fuels in 2007 [1]. The energy produced by PV system is one of the clean energy sources that does not emit carbon dioxide. Currently, many research works have been carried out to reduce the emissions of carbon dioxide generated from fossil fuel power plants.

Photovoltaic (PV) is a technology that converts solar energy into direct current electricity without undergo any combustion process that may produce environmentally harmful byproducts [2]. In general, the PV system can be classified into stand-alone and grid connected system. The stand-alone system is independent of the power grid hence it is supported by storage batteries or other auxiliary supplies. Conversely, the grid connected system implies a direct connection to the electrical grid; therefore excess energy produced by the PV source can be supplied to the grid or otherwise [3].

Simplicity of the standalone PV design is an advantage of the system to meet the electricity demand. However, to design such simple system will definitely take a lot of time to complete the huge task of calculations. Other than that, manual calculations may easily incur large percentage of errors. Therefore, the use of sizing tool can assist user although have a minimal knowledge about PV system in which they are able to design and predict the output gained from the PV installation. In this work, a residential premise is used as a case study to validate the proposed system configuration.

## 2. RELATED WORK

There are several works been done on PV sizing tool. Sulaiman et al. [4] proposed an intelligent method for optimizing PV size in grid connected system. Evolutionary programming (EP) was used to determine the optimal set of photovoltaic (PV) module and inverter. Ammar et al. [5] proposed an open source tool for characterization of photovoltaic power sources with respect to the state of the battery, load change and climatic parameters variation. The software was developed based on standard algorithms and models.

The solar PV system performance depends upon site parameters, system configuration and load parameters. Therefore, Kushika and Rai [6] presented a solar PV design expert system which determines a composite parameter as a function of latitude and longitude. The parameter combines both site and array characteristics to avoid the problem due to variability of several climatological parameters.Recently a MATLAB based software tool called PV.MY was–developed by Khatib et al. [7] to find the optimal size of PV systems. The software features the capabilities of predicting meteorological variables using artificial neural network (ANN) function.

## 3. PV SIZING TOOL FRAMEWORK

In this work, the sizing tool is developed using GUI platform based on MATLAB software to provide a user friendly interface. The tool can be used to find suitable type of panel, inverter, battery and the configuration of PV array. The overall steps in this work are summarized in the flowchart shown in Figure-1 begins with collecting data and ends with some analysis results on PV sizing performance.

### 3.1. Inverter Sizing

Using this software, user may easily find the suitable size of inverter that matches with the value of maximum AC load demand and AC surge load demand. The total number of inverter required is calculated using the following formula:

Load assesment:

$$S_{inv\_30min} = S_{max\_AC\_demand} \times sf_{inv} \quad (1)$$

The apparent power of inverter during surge demand:

$$S_{inv\ surge} = S_{max\ AC\ surge} \times sf_{inv} \quad (2)$$

Number of inverter: