NREL
NATIONAL RENEWABLE ENERGY LABORATORY

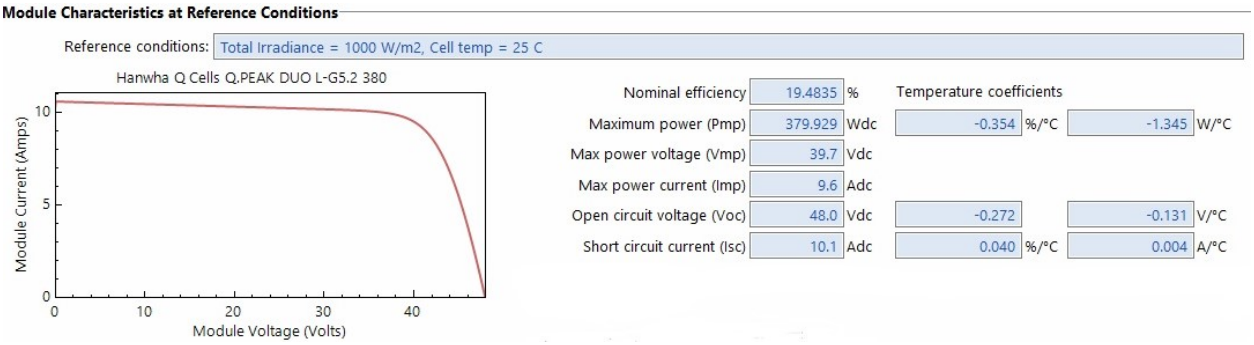
Introduction

The purpose of this document is to provide an estimate of solar energy production at Jack's Solar Garden using the System Advisor Model (SAM). SAM is a free tool developed by the National Renewable Energy Laboratory used for modeling the performance and economics of renewable energy systems[1]. SAM uses pertinent weather and insolation values downloaded from the National Solar Radiation Database (NSRDB)[2]. In this analysis, the hourly insolation data downloaded from the NSRDB contains hourly data for each year between 1998 and 2017. Along with this past yearly observed data, the typical meteorological year (TMY) data was downloaded to provide an estimate of the "mean" energy production[3]. This observed multi-year insolation data files are used to provide 20 years of performance data and to perform a P50/P90 analysis for solar generation at the site.

The type of SAM model used was "Photovoltaic, No financial" and all information came from the electrical one line diagram used for permitting Jack's Solar Farm. None of the defaults in SAM were changed unless otherwise specified by the electrical design. All information is presented to provide the ability to recreate the analysis results.

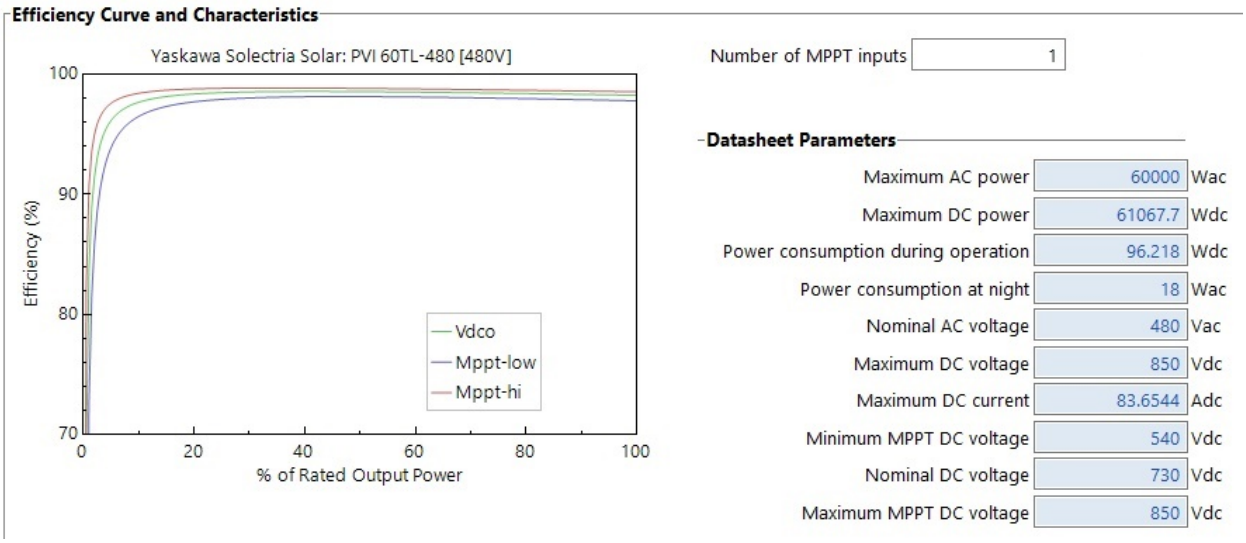
SAM Inputs

- Location and Resource
  - Weather and resource data from NSRDB for: 8102 N 95th St, Longmont, CO, 80504
  - Lat: 40.12175, Long: -105.129621
  - Download data contained hourly insolation and weather data for every hour for each year from 1998-2017
- Module
  - According to electrical design, selected Hanwha Q Cells Q.Peak DUO L-G5.2 380



[1] https://sam.nrel.gov/
[2] https://nsrdb.nrel.gov/
[3] "The data are considered "typical" because the entirety of the original solar radiation and meteorological data is condensed into one year's worth of the most usual conditions. Although a TMY can be thought of as an average, the methods used to calculate it consider many factors beyond a simple calculation of average values, including solar resource data and weather data such as wind speed and ambient temperature." from https://nsrdb.nrel.gov/tmy

- Inverter
    - From CEC Inverter database for Solectra Solar PVI 60TL



- System design
    - Number of inverters: 16
    - DC/AC ratio: 1.30 (calculated)
    - Modules per string: 18
    - Strings in parallel: 182
    - Number of modules: 3,276
    - Total AC capacity: 960 kWac (calculated)
    - Total inverter DC capacity: 977 kWdc (calculated)
    - Nameplate DC capacity: 1,244 kWdc (calculated)
    - 1-axis tracker
    - Azimuth: 180 deg (South)

Results

Using the TMY resource data, the inputs above, and default PV system losses, SAM calculated a yearly energy production of **2,538 MWh** in year one for the system at Jack's Solar Farm. This results in a capacity factor of 23.3% and the monthly energy production profile is shown in Figure 1 below. The TMY data consists of mean monthly weather and insolation data for the 1998-2017 period (January data is from 2014, February data is from 2002, etc.). As each month is the representative mean over the 20-year time period, the TMY data is a representation of the overall mean for weather over the time period, resulting in a conservative estimate of system performance. Note that SAM model results do not predict future performance but are used to provide a high-level estimation.

To ensure that TMY data is representative of the weather data, system production was calculated for each year between 1998 and 2017 using observed data. Shown in Figure 2 is the yearly energy production for the system for each year from 1998-2017. The statistical values of yearly energy

production (including the TMY data) are shown in Figure 3. The maximum energy production from 1998-2017 was 2,678 MWh while the minimum was 2,439 MWh. The mean energy production over this time period was 2,561 MWh, which is comparable to the results using TMY data.

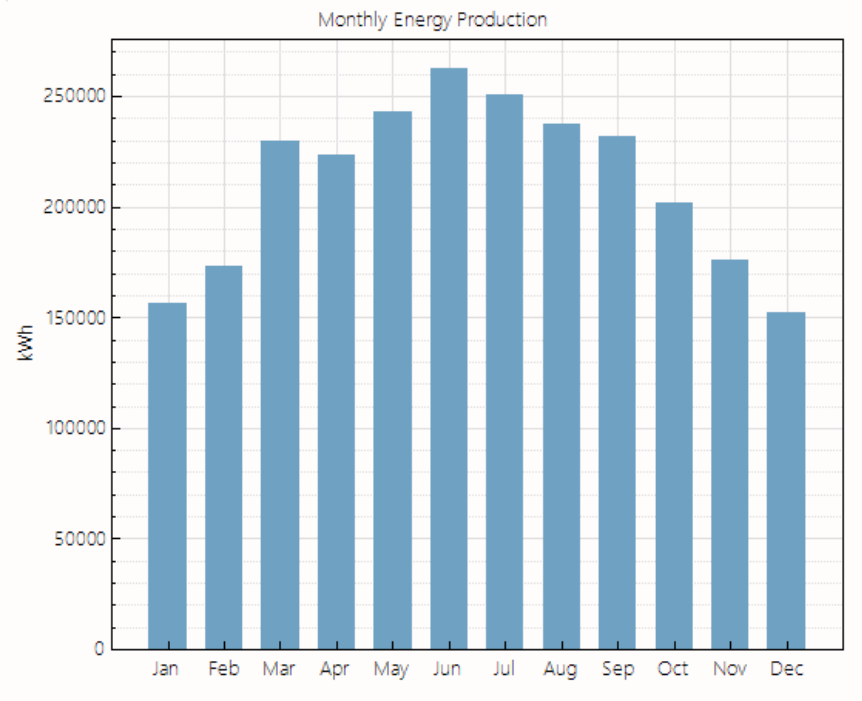


Figure 1: Monthly Energy Production based on TMY data

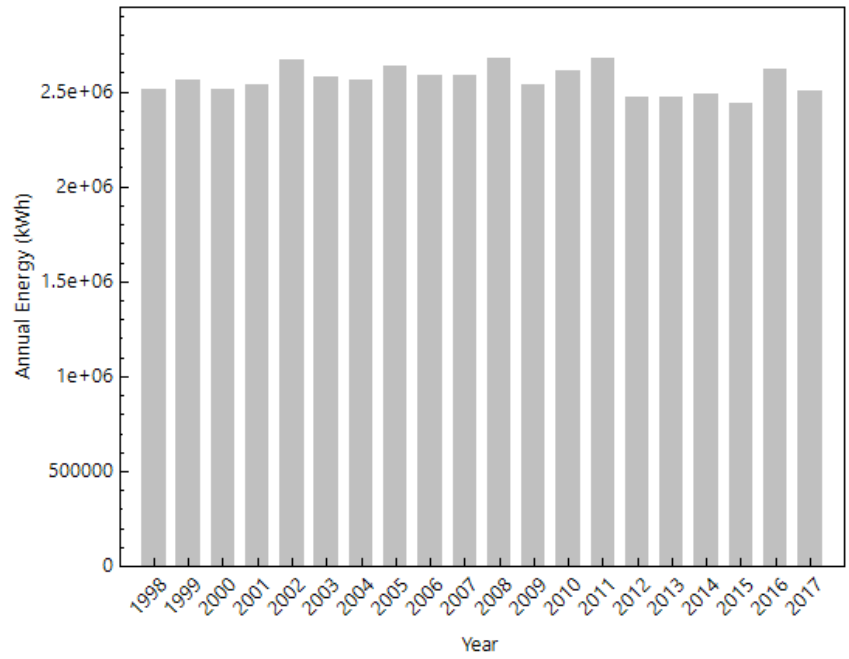


Figure 2: Annual Energy Production ranges based on observed weather data, 1998-2017

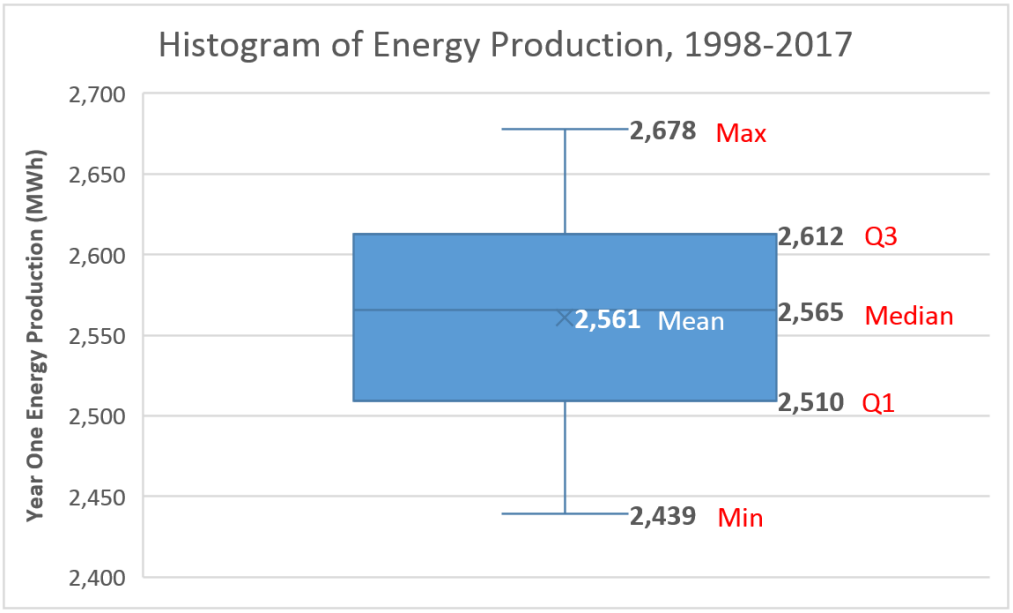


Figure 3: Annual Energy Production Statistics, based on 1998-2017 and TMY weather data

Contact

For additional information please contact:

Jordan Macknick
Lead Energy-Water-Land Analyst
Principal Investigator of the InSPIRE research project: https://openei.org/wiki/InSPIRE
Phone number: 303-275-3828
E-mail: jordan.macknick@nrel.gov