Resilient Energy Assessment (REA)

User Manual

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1 Introduction

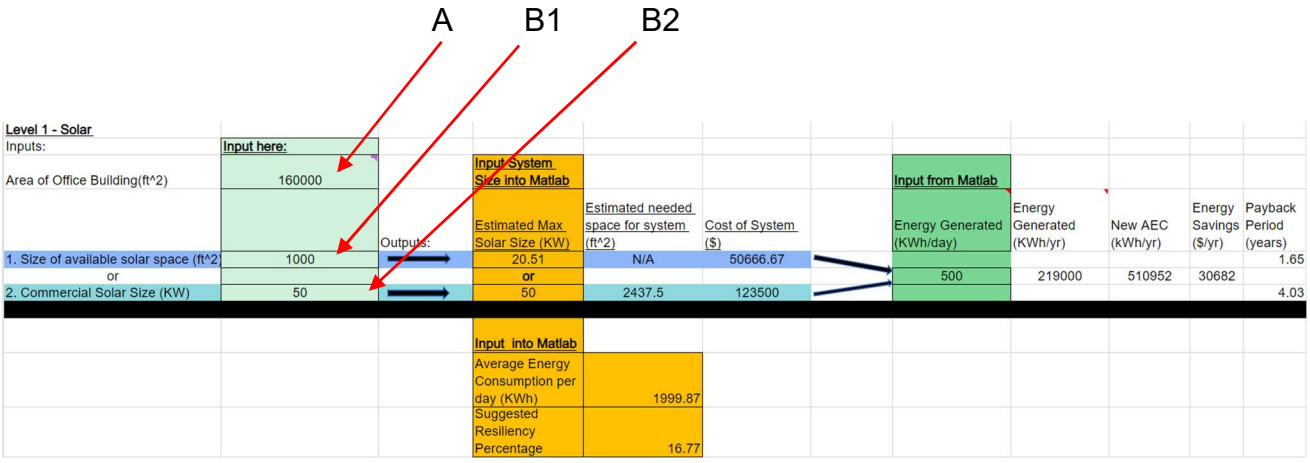
The Resilient Energy Assessment (REA) is a toolkit that users can use to evaluate their electrical needs and resiliency if they are considering implementing solar panels and/or battery storage into their building's electrical system. The tool outputs the cost of the entire solar PV system, energy savings per year, the payback period, the new average energy consumption (AEC), and the size of the battery storage. The outputs will determine if implementing the solar and battery modules will meet the desired resiliency criteria.

Resiliency is the ability of power systems to withstand low-probability high-impact incidents (such as a power outage) in an efficient manner while ensuring the least possible interruption in supply of electricity, and further enabling a quick restoration to the normal operation state.

2 Excel Tool

The Excel part of the toolkit analyzes the solar panel sizing and outputs.

The user must provide two inputs—the area of the building the user wants to install solar panels on in square feet (A) and either the available size of solar space the user has in square feet (B1) or the commercial solar panel size the user wants to use in kilowatts (B2).



Once the user provides the inputs, Excel performs all the calculations for the cost of the system, energy savings per year, the payback period, and the new average energy consumption. The calculations are based off average energy consumptions for typical building types, found in an official 2008 energy consumption report. The excel tool also provides a suggested resiliency load percentage based off equipment we determined to be critical.

The excel tool needs to be used in conjunction with the MATLAB calculator. Boxes highlighted in orange must be inputted into the MATLAB calculator and the darker green box requires the energy production output from MATLAB to be inputted back into the excel tool.

3 MATLAB Tool

The MATLAB tool will output solar PV sizing and energy generation estimates based on the excel tool's outputs. The solar generation output will be inputted back into the excel tool to complete the cost-benefit calculator of the solar PV. The MATLAB tool then proceeds to calculate the battery sizing required for the inputted resiliency needs. Battery storage charges from the solar panels and can provide power to a system during a power outage.

After running the MATLAB tool a prompt to input the array size will appear in the command window. The user should input the array size from the excel sheet.

```
Command Window
>> REA_MatlabCalculator_Scenario1
What is the kW size of the system?
```

After the size is inputted, the tool will output the estimated panels needed for the array and the energy generation that will be inserted back into the excel tool.

```
What is the kW size of the system?200
The number of panels needed is about 556
The system will generate about 935.23 kWh on this day
```

The tool will then ask for daily load consumption and critical load percentage. These values can either be taken from the estimated and suggested values given in the excel tool or from the user's own data.

```
What is your Estimated Daily Consumption (kWh/day)?2000
What Percentage of your load is critical?50
```

The estimated battery sizing will then be outputted alongside a plot depicting how the battery would charge and discharge with the solar generation and load.

```
The battery will need at least 249.9 kWh capacity
The battery will need a continuous power rating of at least 125.0 kW
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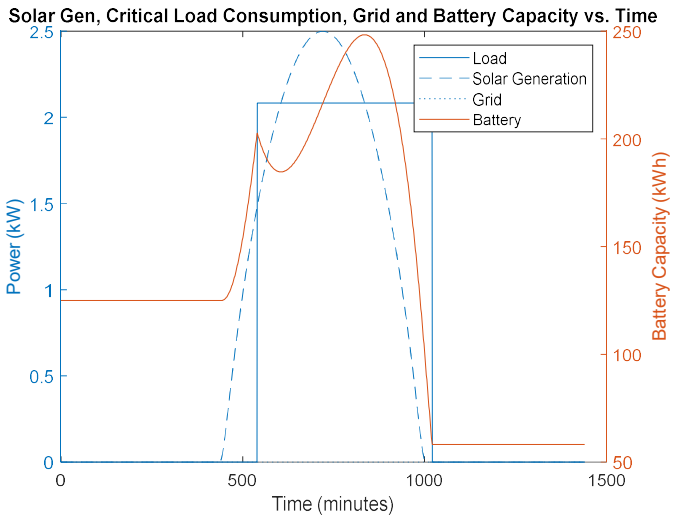

4 Other Considerations

Many variables in the MATLAB code can be changed to fit different projects, locations and scenarios. For a complete list of these variables that affect the output of the tool reference the calculations section in our REA tool report.

The algorithm used to determine our battery sizing assumes the battery has some capacity level that is reserved purely for grid outage scenarios. The suggested capacity is the minimum capacity needed to just barely provide enough energy to the load over a 1-day grid outage. The tool does not consider realistic scenarios where there is excess solar generation and the battery is completely charged up. While in regular grid operation this energy may be able to be fed back into the grid, in a grid outage scenario excess energy will most likely not be able to be fed back into the grid. More technical consideration is required when designing a solar PV and battery system. This toolkit gives the user a rough estimation of what size and cost range may look like if the project is considered.