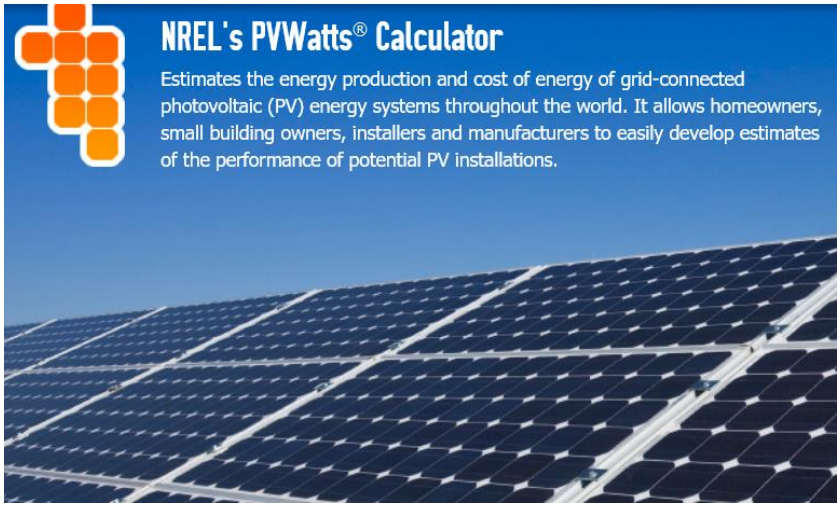
Energy Engineer for a Day

Click here for an instructinal video to support the task

Introduction

How can engineers support society to be more sustainable? Depending on where we are in the world, we have different needs (heating in the UK, space cooling and water desalination in the UAE) and access to different renewable energy resources (Solar in the UAE, Wind and Wave in Scotland, Biomass in Malaysia). An **Energy** Engineer designs systems to match renewable energy resources with the "service level needs" of the customer. As an **Energy** Engineer for a Day, you will design your own Solar Energy System, accounting for the local climate conditions, predicting the energy yield of the system and even estimating the financial viability of the design.

Background



It will be important to predict the performance of your solar energy system. You will need to calculate the expected energy yield (kWhrs) from the system over its lifetime and to analyse how well it will meet the service level needs of the customer/community from the available renewable energy resource. The economics and financial viability of a renewable energy system is often key to its success. An **Energy** Engineer will need to consider the capital investment and costs associated with the operational and maintenance of their design. The best designs will be affordable, and have a good return on investment. So, while you will try to design to maximise the energy generated by the system, one challenge will be to balance this with a design that is good financial prospect and attractive for investment.

There are a wide range of software available that will help you to characterise the performance of your system and to conduct the financial analysis for you. For this task, we will use PVWatts Calculator from NREL (National Renewable Energy Laboratory).

The software will require some siting information (location in the world; latitude and longitude) and from this, it will predice the path of the sun each day of the year at your location; refer to Appendix 1 to make your own Solar Motion Demonstrator. By specifying your location, the software will also be able to access weather data (Typical Meteorological Year, TMY) from a database. It may also ask for some local topological information that would also influence the performance of the system. As you will see below, I have chosen to design a solar energy system for the Dubai Campus of Heriot-Watt University, but we encourage you to choose you own location.

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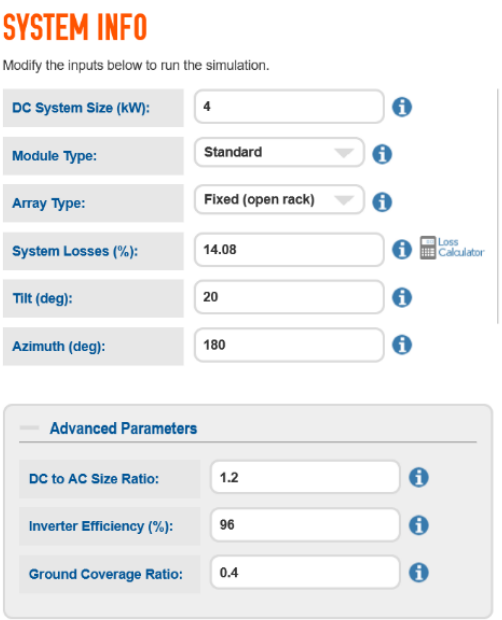
The Task

Support for the design a Renewable Energy System based on Solar Photovoltaics can be accessed here and as follows:

1) In your web browser navigate to https://pvwatts.nrel.gov/ to access the PVWatts Calculator from NREL (National Renewable Energy Laboratory).
2) Enter your location of interest; I have chosen the Dubai Campus of Heriot-Watt University in Knowledge Park, as you can see in the image below. Click on "Go to System Info"

3) Use the "Draw Your System" link to open a map, navigate to the precise location you want and draw the area you wish to use to install some PV Panels.
4) The Solar Energy System will comprise of standard components (and default values); you can modify these with the specifics of the components to predict their performance over their lifetime. Complete the "System Info" section and give a much detail as possible, but feel free to use default values if you are not sure about them. Refer to the i (information icon) for more details. These are also discussed in the instruction video.
5) As cost and financial viability are also very important in Energy Engineering, also complete the "Retail Electricity Rate" section to determine if your design is a good investment.
6) Keep track of any assumptions you make; these can be tested later to see if your design can be improved.
7) Click on "Go to PVWatts Results" to see the performance of your design. Here you will be able to download a spreadsheet that indicates the weather conditions and the system performance (energy yield) on a daily or monthly basis.



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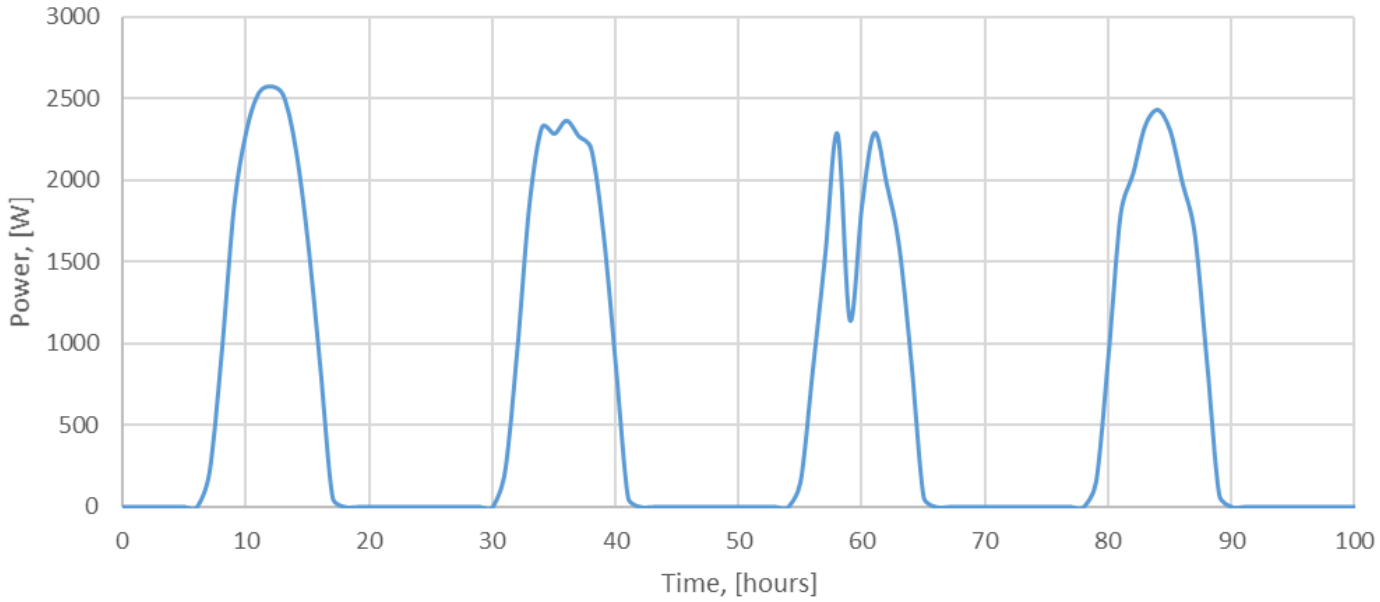
8) Plot the results to visualise the system performance. An example if given below (plotted in Excel) for the first 4 days of the Typical Meteorologcal Year (TMY).



9) Analyse the data and change some of the system design specification to improve/optimise the design. This could include changing location, or any of the "system info" to increase energy output or increase the financial savings of the system.
10) Plot your original design vs your improved/optimised design and upload graphs and images to the "Engineer for a Day" Padlet

Where in the world are our Engineers for a Day?

Heriot-Watt University is a Global Institution with campuses in the Edinburgh, United Kingdom (Latitude 56°); Dubai, United Arab Emirates (Latitude 25°) and Putrajaya, Malaysia (Latitude 3°).

Our Engineers for a Day join us from across the world….so please add you location to this dynamic map of the world.

Appendix 1: Create your own Solar Motion Demonstrator

Follow these step-by-step instructions to create your own Solar Motion Demonstrator:

1) Cut out the compass and frame in the figures below
2) Cut out and remove the black notch above the North part of the compass
3) Create a fold along the Fold 1 and Fold 2 line.
4) Apply Glue to the upper right quadrant of the inner circle of the frame (where indicated)
5) Glue to the compass to the frame, ensuring it is exactly centres and aligned (North notch aligned with 0° on the frame)

The following steps demonstrate the sun path at a specific time of the year, for a particular latitude.

6) Fold the inner circle to align the compass platform with the latitude (where you are in the world)
7) Attach a clip to the frame, aligned with the month of the year you want to demonstrate
8) Fold the outer frame (Fold 1) over and back to show the sun path.

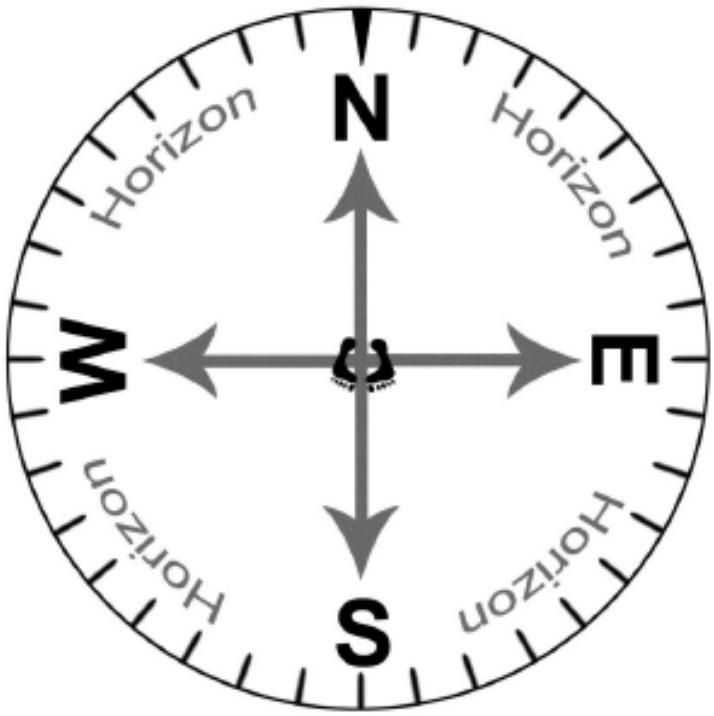


Figure 1: Compass

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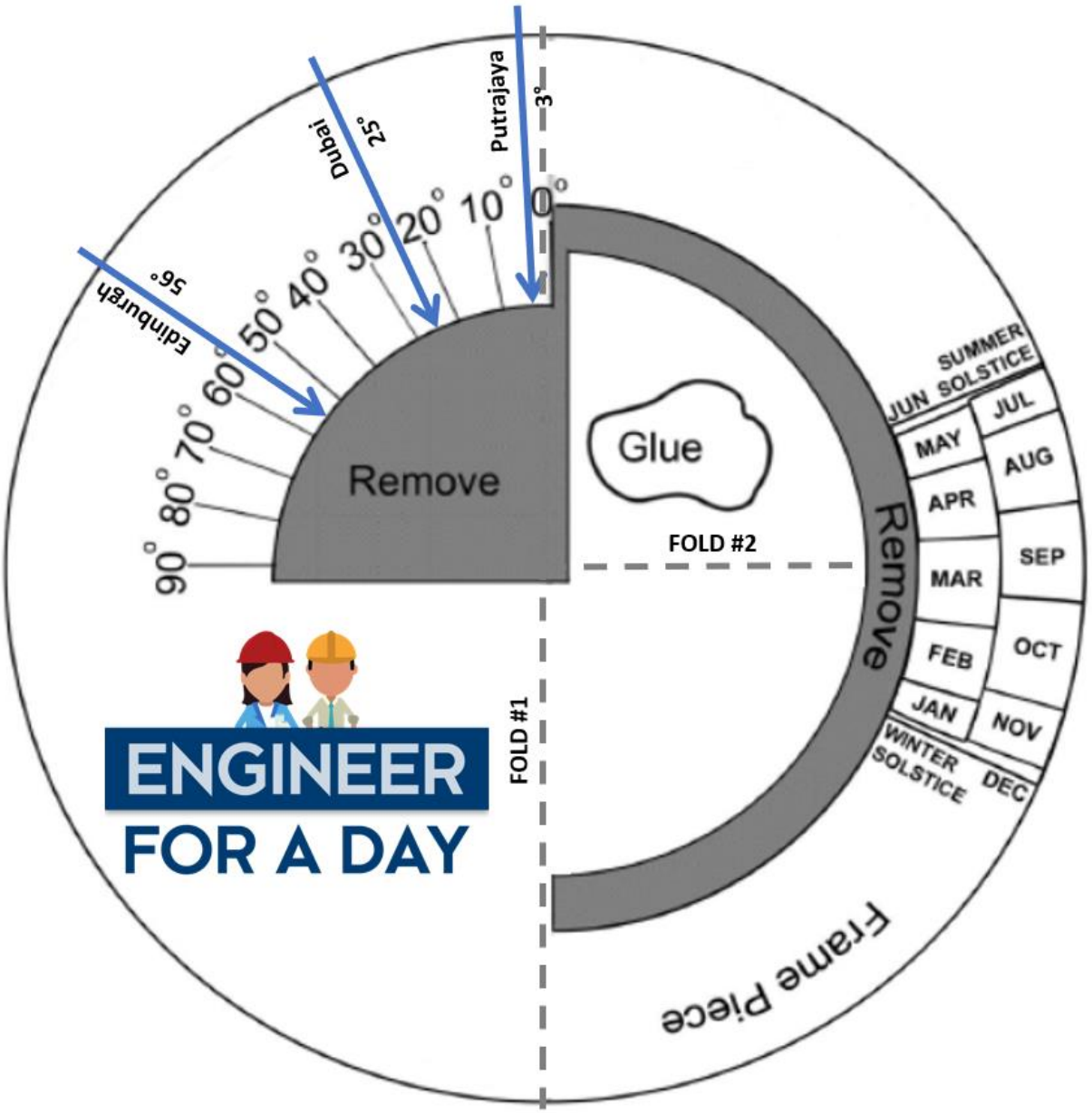

Figure 2: Frame

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