Analysis of Solar Irradiance Instrumentation, Measurement Techniques and Data.

B.Sc. (Honours) in Instrument Engineering

Department of Physical Sciences

Student: Rachel Howlin

Supervisor: Dr. Catherine Frehill

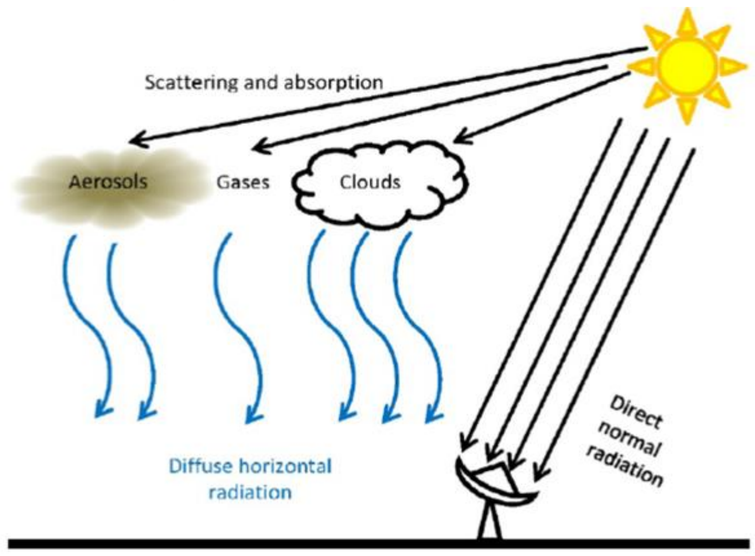
Background

Aim of Project

- The aim of this project was to investigate the techniques and instruments available to measure solar irradiance and to identify online data bases that can be accessed to provide reliable and relevant irradiance measurements.
- The practical portion of the project involved taking irradiance measurements using a pyranometer over the minimum period of four weeks, the data was compared with the previously identified online data bases.

Background Research

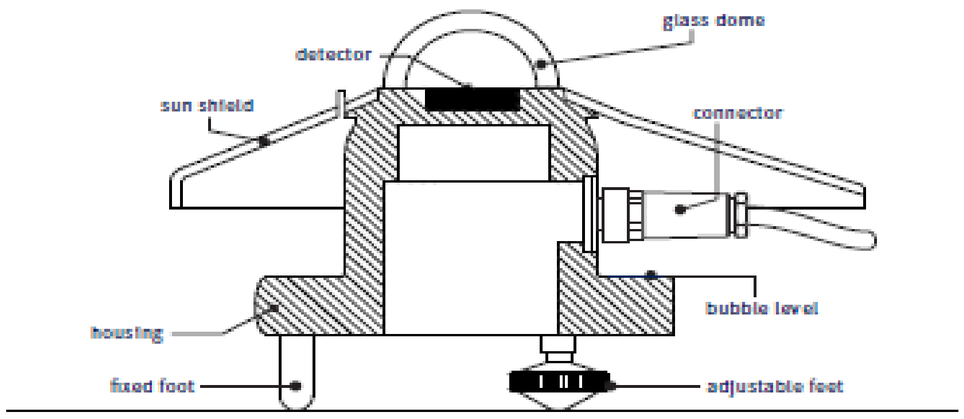
- Key topics to understand:
  - DNI, DHI &GHI.



[1]

Background Research

- Pyranometers
  - A pyranometer is an instrument that measures irradiance. A thermopile pyranometer absorbs incoming radiation onto a blackened horizontal surface, the increase in temperature is measured by the thermocouples connected in series/parallel that makes up the thermopile.



Key parts of the CMP 3 pyranometer

[2]

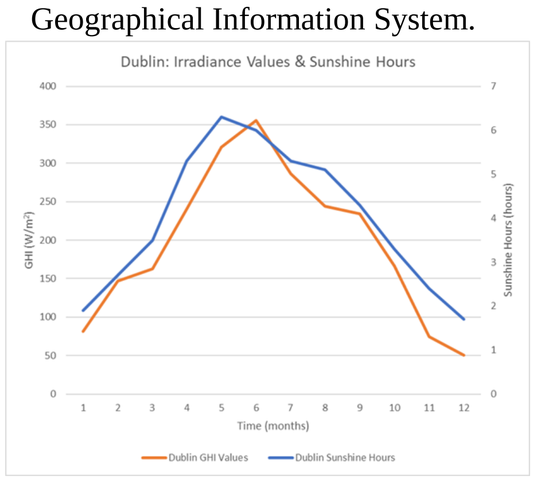
Project Plan

Project Plan

- Complete background research and gain understanding of essential topics.
- Collect data sets from multiple reliable online sources for comparisons and analysis.
- Set-up a pyranometer at home for data collection for a minimum period of four weeks.
- Give an in depth analysis of the online data sets and the pyranometer readings.

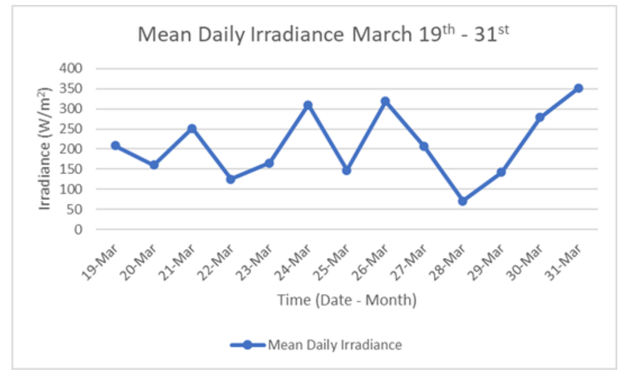
Data Collection

- There were three main sources that were used for this project; Met Eireann, The World Radiation Data Centre and the European Commission Photovoltaic Geographical Information System.



Pyranometer Home Set-up

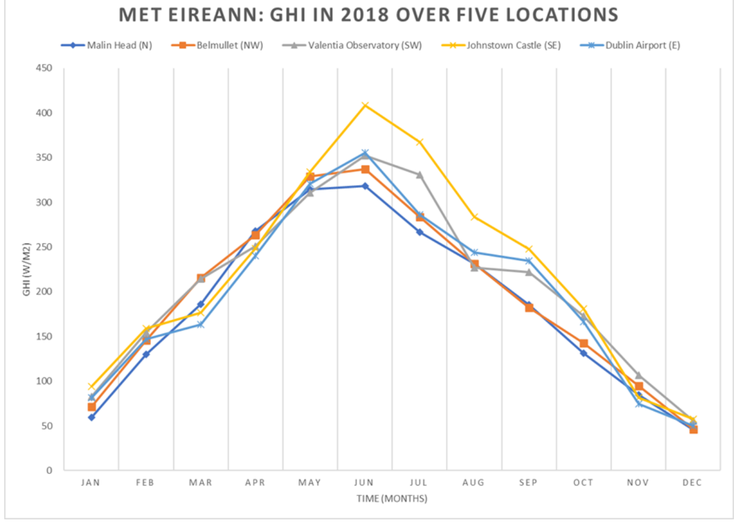
- The pyranometer was connected to a data logger which stored the measurements until they were transferred to the PC.
- It was set up to take readings every 10 minutes and was left for 5-7 days before being brought back in to transfer the data.
- The data was downloaded to a text file and easily converted into an excel spreadsheet where it was compared alongside the online measurements.

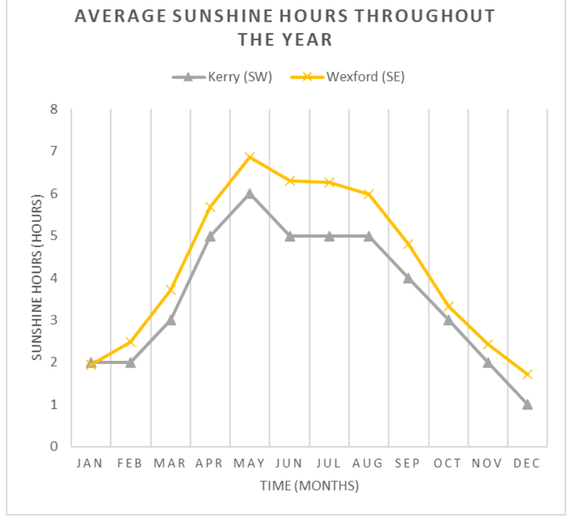


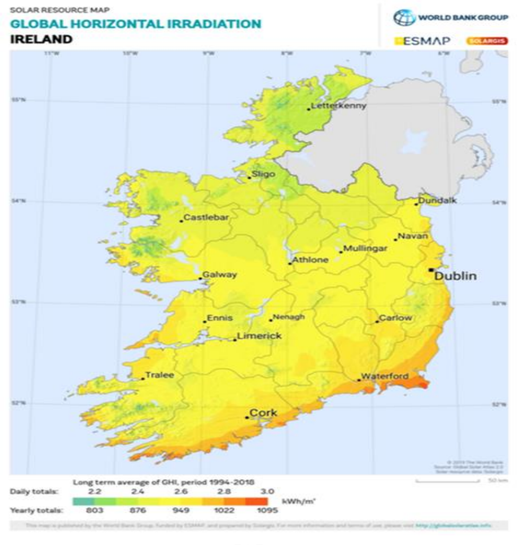
Results

Results

- The outcome of this project was that the South-East of Ireland has the higher irradiance values and most sunshine hours.
- This is due to its latitude and weather conditions. Its latitude affects the sun angle and how intense the irradiance is.
- The South-East avoids a lot of the rain and cloud cover that is in the West of Ireland leading to more sunshine hours and direct irradiance.







[3]

Size 36 Font: Heading e.g. References

[1] Heller, P., 2017. The Performance of Concentrated Solar Power (CSP) Systems : Analysis, Measurement and Assessment, Elsevier Science & Technology, Cambridge. [online] Pages 40-42, Available at: https://ebookcentral.proquest.com/lib/cit-ebooks/reader.action?docID=4860950&ppg=122 [Accessed 5 February 2021].

[2] Kippzonen.com. 2013. The Working Principle of a Thermopile Pyranometer - Kipp & Zonen. [online] Available at: https://www.kippzonen.com/News/572/The-Working-Principle-of-a-Thermopile-Pyranometer#.YCWVi2j7SUl [Accessed 11 February 2021].

[3] Globalsolaratlas.info. 2021. Global Solar Atlas. [online] Available at: https://globalsolaratlas.info/map?c=-55.677584,-92.460938,2&a=-1.595089,25.299877,-1.595089,30.740255,9.145146,30.740255,9.145146,25.299877,-1.595089,25.299877 [Accessed 16 February 2021].