Pembrokeshire Demonstration Zone – Wind Resource Assessment

Introduction

PDZ site

Data

ERA5 datasets are provided by the European space agency for free. It provides the eastward and northward component of wind speed at two different heights – 10m and 100m at an hourly resolution.

ERA5 provides hourly estimates of many atmospheric, land and oceanic climate variables. The data covers the Earth on a 30km grid and resolve the atmosphere using 137 levels from the surface up to a height of 80km. ERA5 includes information about uncertainties for all variables at reduced spatial and temporal resolutions.

Quality-assured monthly updates of ERA5 (1959 to present) are published within 3 months of real time. Preliminary daily updates of the dataset are available to users within 5 days of real time. Due to the latency of the Quality assured ERA5 dataset, currently there is no concurrent period with the FLS data and hence in this report we will only provide concurrency results with the ERA5T (preliminary dataset).

A preliminary ERA5 dataset from 1950 to 1978 is also available on the Climate data store (CDS) (1959-1978 is superseded by the quality assured dataset).

ERA5 combines vast amounts of historical observations into global estimates using advanced modelling and data assimilation systems.

For the sake of brevity, we will restrict our description about the model here, for further details regarding the resolutions and other technical specifications please refer to the ERA5 documentation available at –

https://confluence.ecmwf.int/display/CKB/ERA5%3A+data+documentation

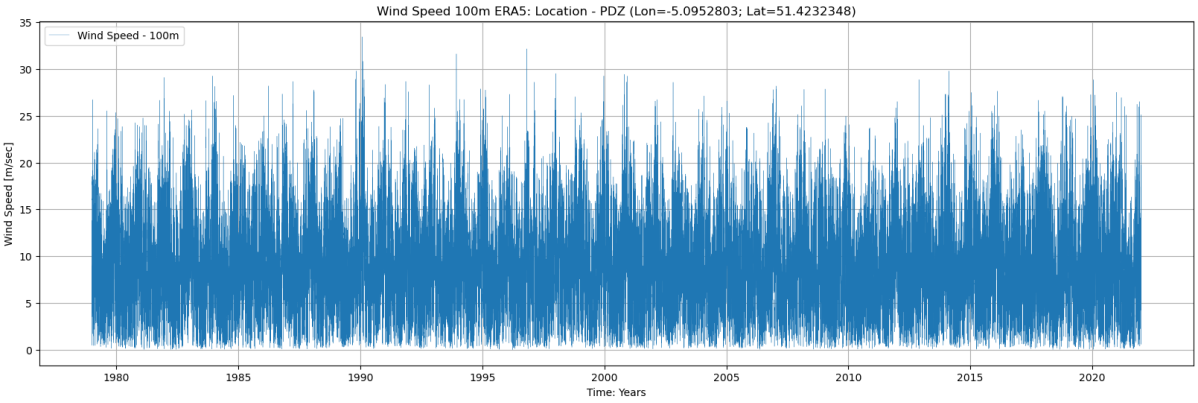
Results

In this section, we will be presenting basic information of the wind resource for this site, including a timeseries plot, wind roses, followed by diurnal, seasonal and monthly variations. Also, the probability distribution of the wind resource is presented with the Weibull shape and scale factors.

Wind Statistics

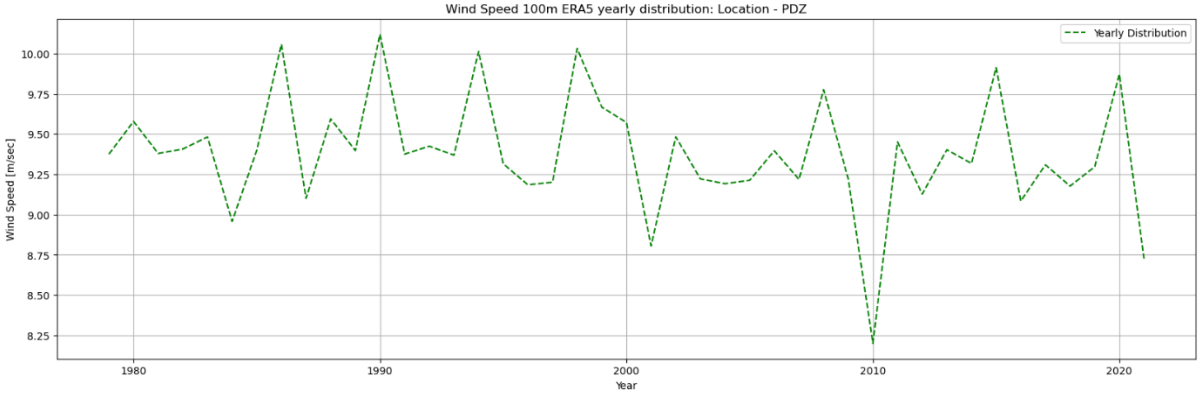
Stats	Wind Speed (m/s)
count	376944
mean	9.381786
std	4.548441
min	0.018512
25%	5.987552
50%	8.937112
75%	12.324524
max	33.425224

Timeseries Plot

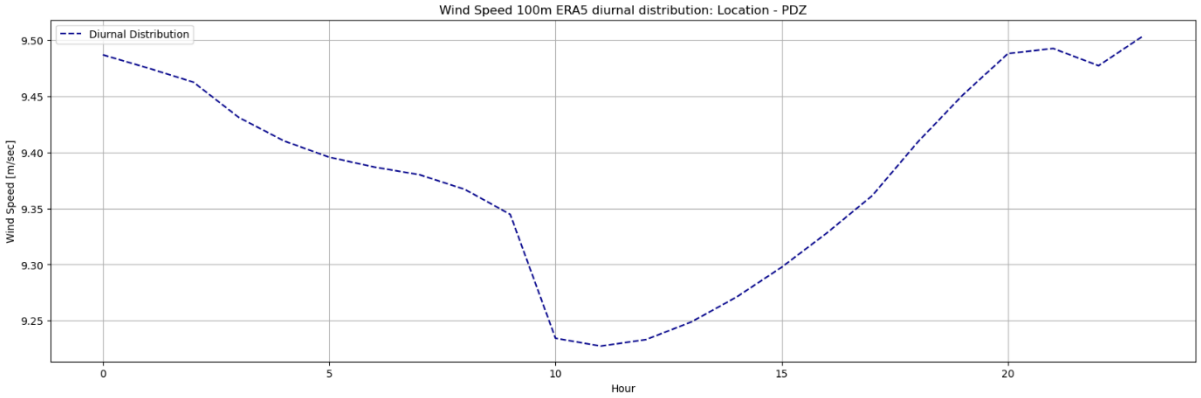


Variations of mean wind speed

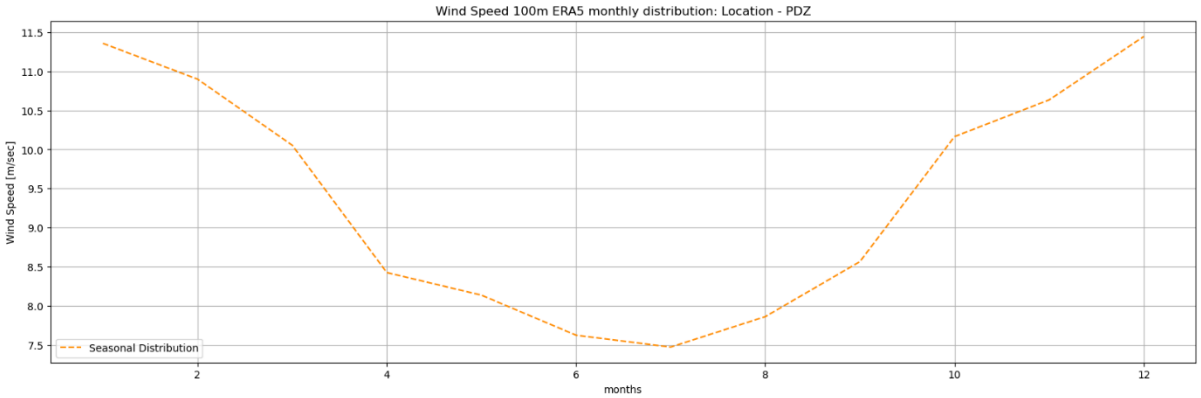
Yearly Variation (1979 – 2021) mean wind speed (m/sec)



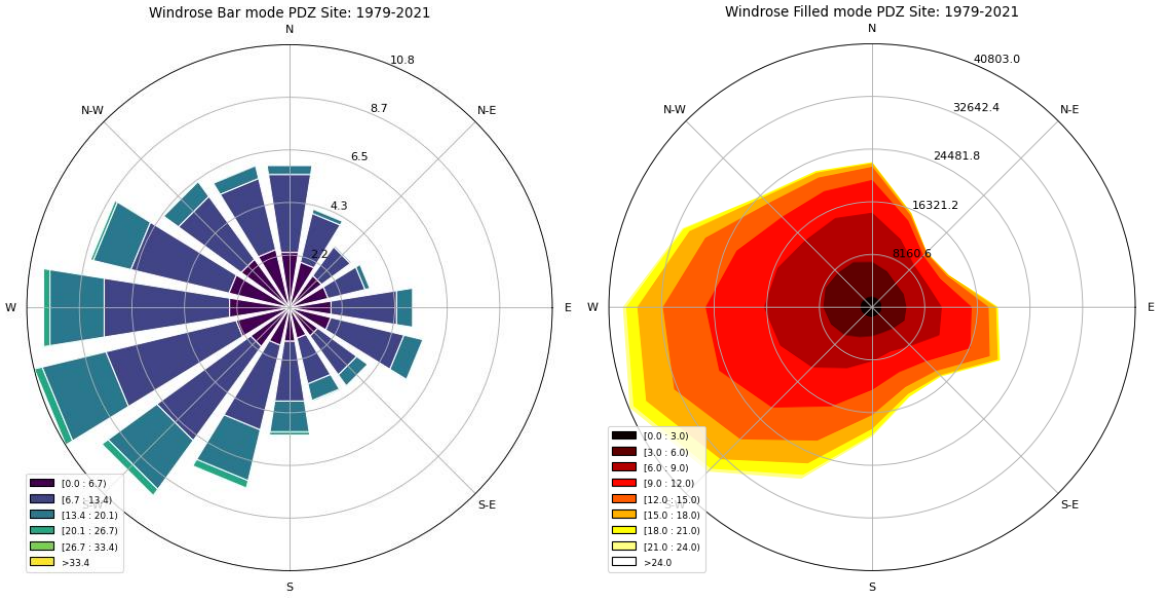
Diurnal Variation of mean wind speed (m/sec)



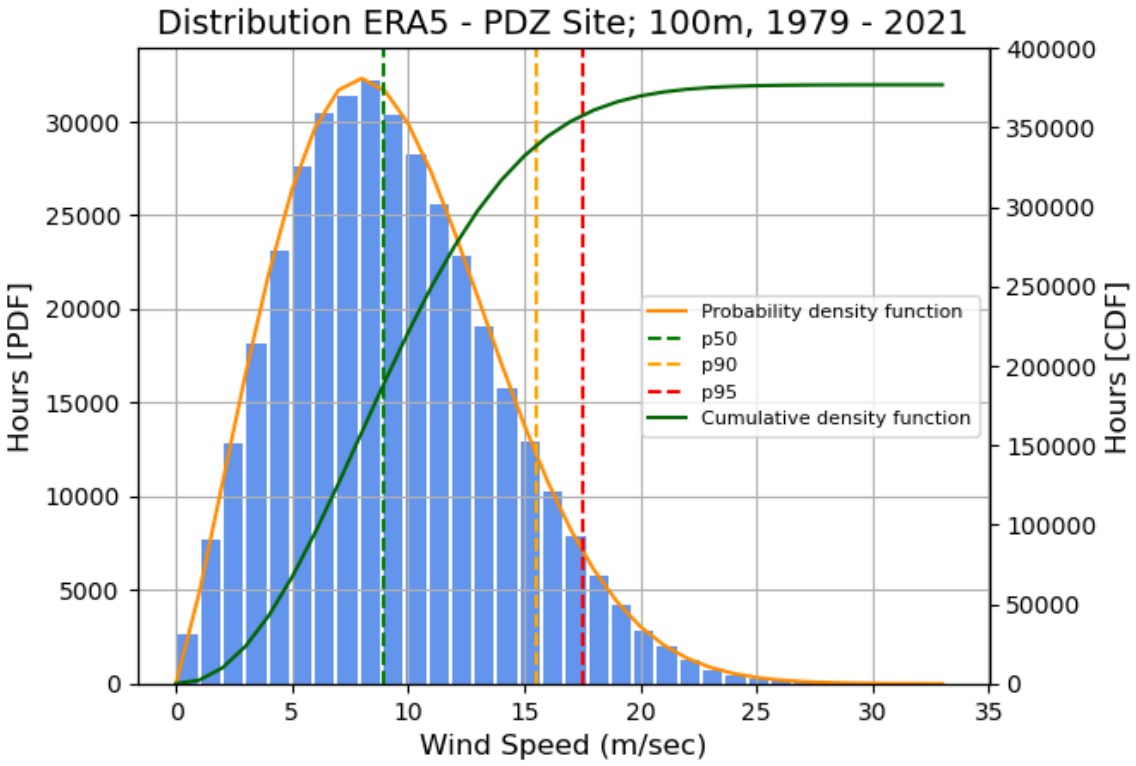
Seasonal Variation mean wind speed (m/sec)



WindRose



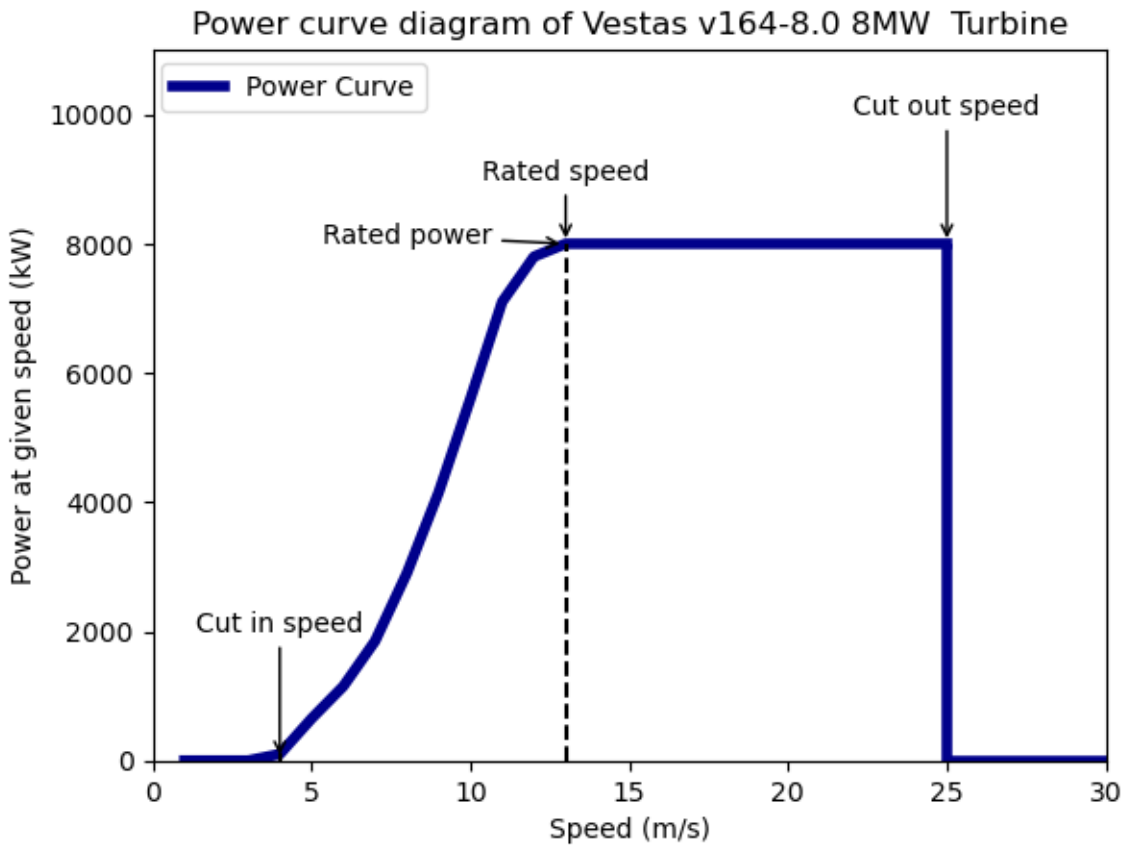
Wind Speed distribution – Weibull parameters, P50, P90, P95 wind speeds



Weibull K Parameter=2.171, Weibull A Parameter=10.589, P50=8.945, P90=15.549, P95=17.552

Generation for an individual Vestas 8MW Turbine

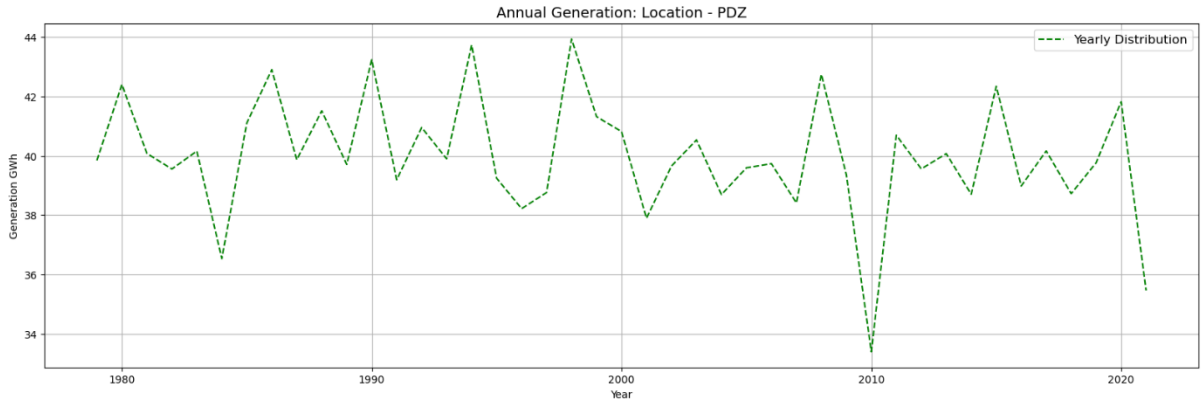
The power curve of an 8MW Vestas v164-80 was used to get an indicative figure of energy generation and capacity factor. However, it is worth noting here, that this capacity factor is only for one turbine and doesn't consider wake losses and other losses, and hence can be a significant overestimate.



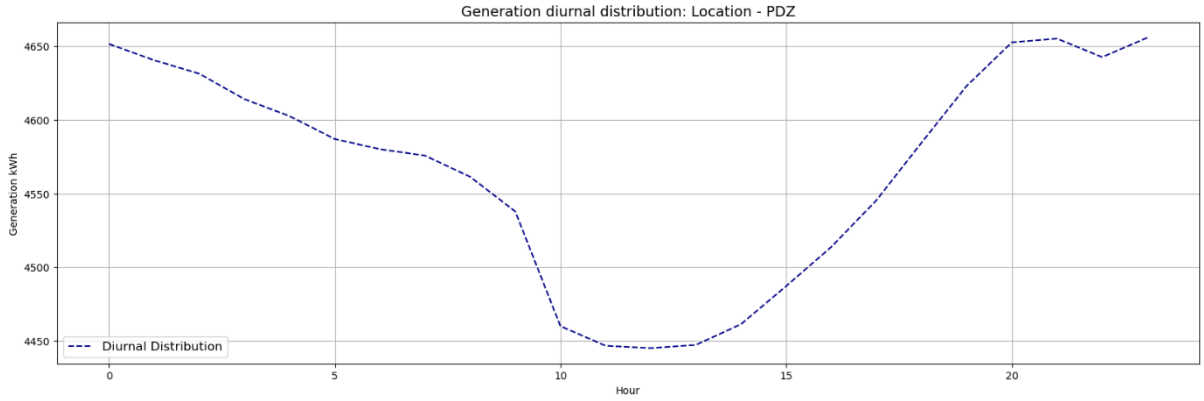
Speed Class	Power at given speed	Hours	Frequency (%)	Power production distribution	Energy yield
1	0	2685	0.007132	0	0
2	0	7898	0.020979	0	0
3	0	13206	0.035078	0	0
4	100	18692	0.049651	0.049651	1869200
5	650	23910	0.063511	0.412821	15541500
6	1150	28233	0.074994	0.862429	32467950
7	1850	31312	0.083172	1.53869	57927200
8	2900	32060	0.085159	2.469619	92974000
9	4150	32437	0.086161	3.575669	134613550
10	5600	30757	0.081698	4.575099	172239200
11	7100	28353	0.075313	5.347193	201306300
12	7800	25480	0.067681	5.279132	198744000
13	8000	22473	0.059694	4.775507	179784000
14	8000	18618	0.049454	3.956321	148944000
15	8000	15393	0.040888	3.271009	123144000
16	8000	12322	0.03273	2.618422	98576000
17	8000	9756	0.025914	2.073148	78048000
18	8000	7391	0.019632	1.570586	59128000
19	8000	5427	0.014415	1.153236	43416000
20	8000	3823	0.010155	0.812387	30584000
21	8000	2534	0.006731	0.538474	20272000
22	8000	1702	0.004521	0.361675	13616000
23	8000	1023	0.002717	0.217387	8184000
24	8000	617	0.001639	0.131112	4936000
25	8000	369	0.00098	0.078412	2952000
				Total Generation (kWh)	1719266900
				Total Generation (GWh)	1719.2669
				Capacity Factor	57%

Generation profile

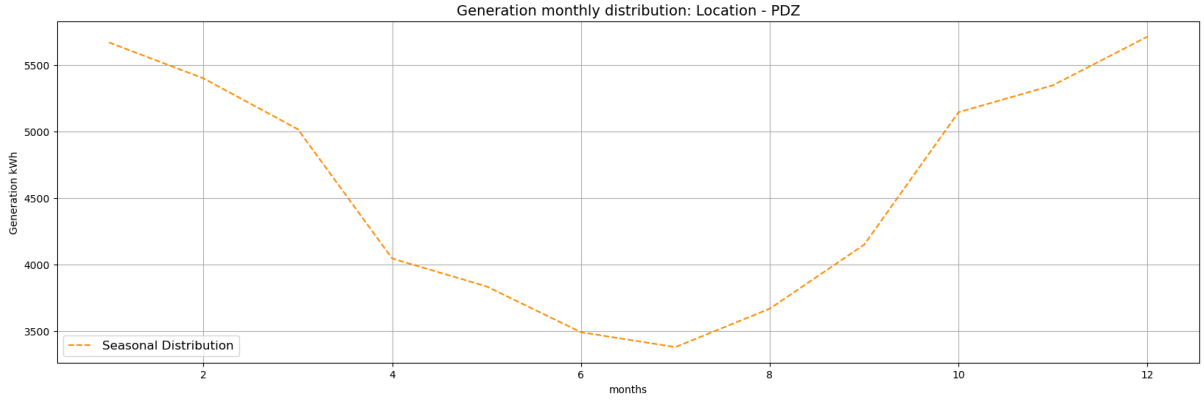
Yearly Variation (1979 – 2021) generation (GWh)

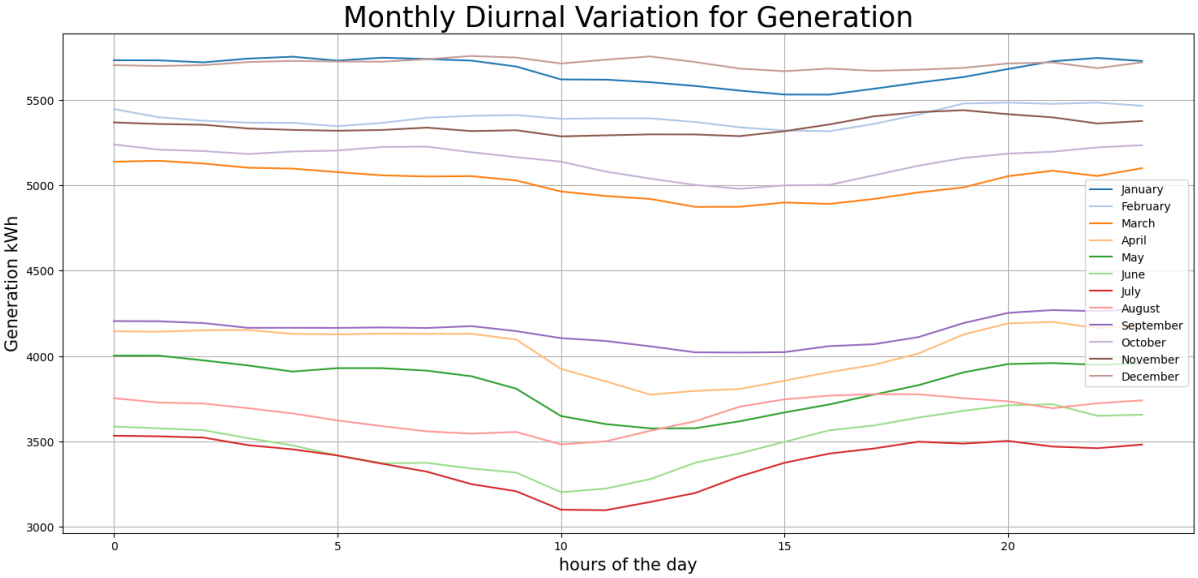


Diurnal Variation generation (kWh)



Seasonal Variation generation (kWh)




Monthly Diurnal Variation for Generation
Generation kWh
hours of the day
January
February
March
April
May
June
July
August
September
October
November
December