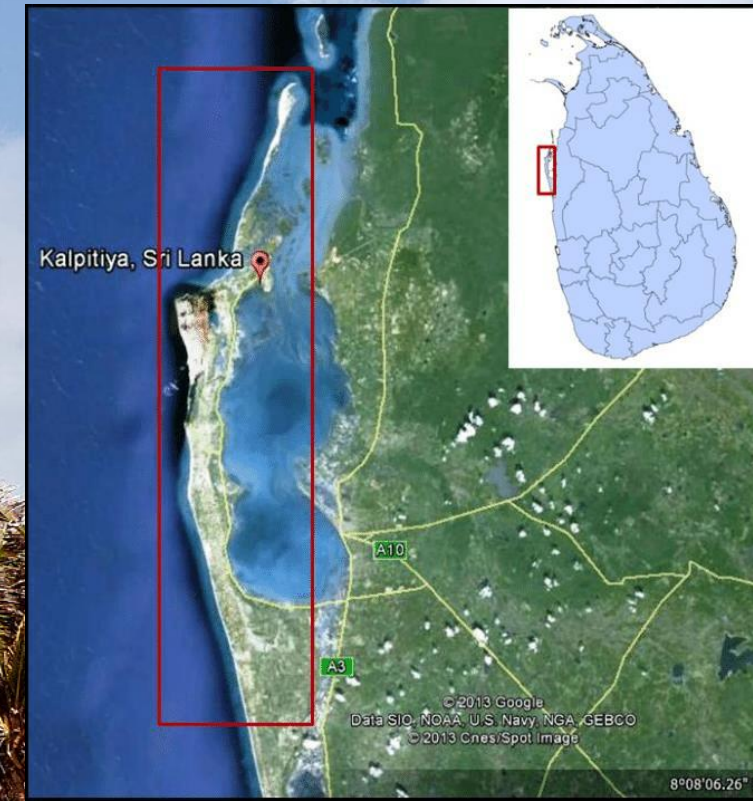# DEVELOPMENT OF WIND POWER PREDICTION MODELS

- **Name of the wind plant – Musalpetti Wind Power (Pvt) Ltd.**

- **Location- Kalpitiya**

- **Capacity – 10 MW**
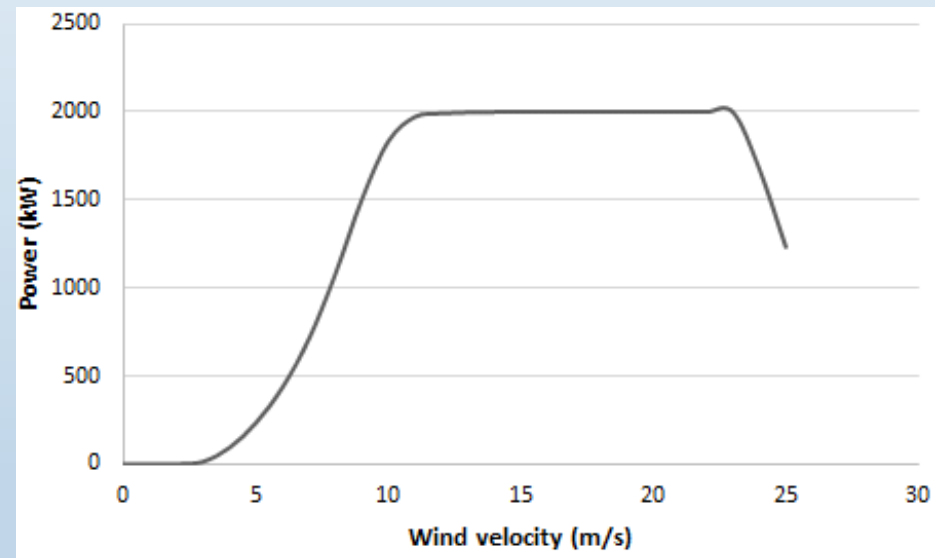
- **Number of turbines - 5**

18.04.2025

Turbine Details

- **Make** - Siemens Gamesa
- **Country** - Spain
- **Model** – G97
- **Capacity/Rated power** – 2 MW
- **Rotor diameter** – 97.0 m
- **Hub height** – 90 m
- **Cut-in wind speed** – 3 m/s
- **Rated wind speed** – 11 m/s
- **Cut-out wind speed** – 25 m/s

wind power generation

$$P = 0.5 D_{air} A V^3$$

D_{air} = air density (in kg/m^3),

A = swept area of wind turbine (in m^3)

V = wind speed (in m/s)

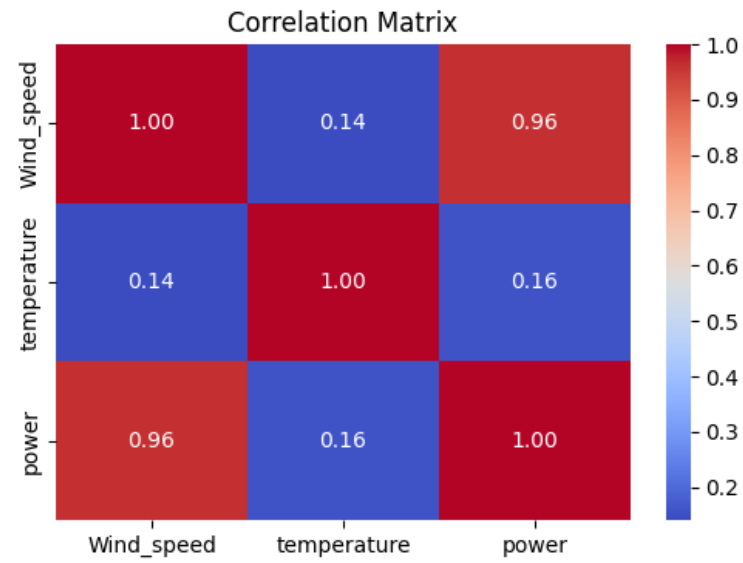Power generation = F (Wind Speed, Ambient Temperature)
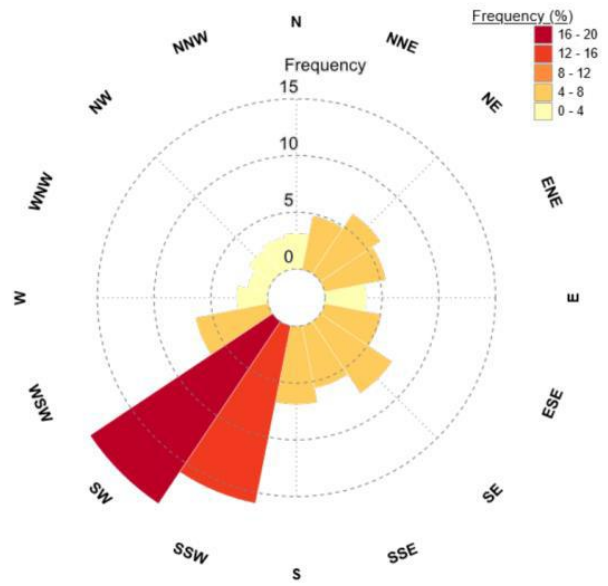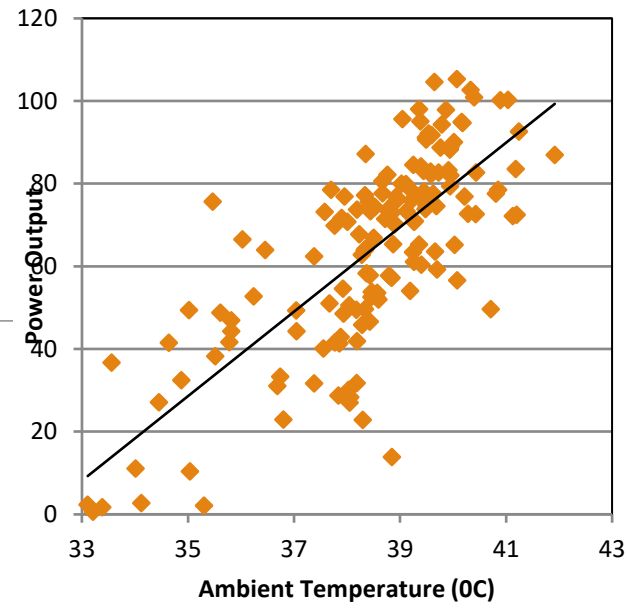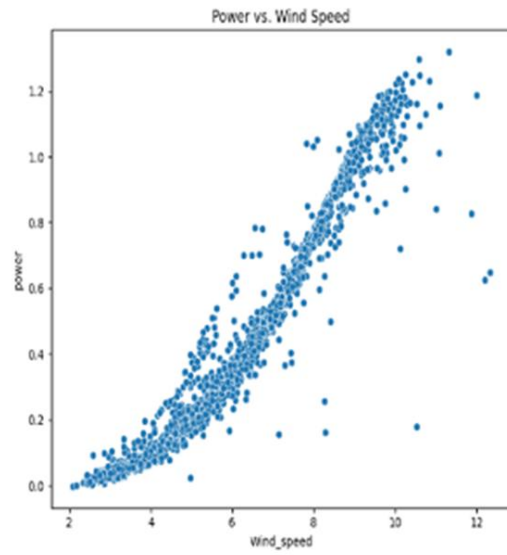
Data set

- Data of five turbines

- Data are available from July 2023- August/ 2024

- Interval of data: 10 mins

- Variables :
  - Date, time
  - Power (kW)
  - Average wind speed (m/s)
  - Average air temperature (^{o}C)
  - Nacelle position (Wind direction)

X Minutal Full Report

Gamesa

From	4/1/2019
To	6/30/2019

WindFarm	Device	Date	Act. Pwr. Avg. 10M (kW)	Air Temp. Avg. 10M (ºC)	Nacelle Posit. Avg. 10M (º)	Wind speed Avg. 10M (m/s)
SENOK	G97_04	4/1/2019 12:00:00 AM	344.383	30.6	196	5.604
		4/1/2019 12:10:00 AM	301.926	30.55	196	5.384
		4/1/2019 12:20:00 AM	355.322	30.503	196	5.738
		4/1/2019 12:30:00 AM	335.663	30.455	196	5.557
		4/1/2019 12:40:00 AM	320.842	30.412	196	5.576
		4/1/2019 12:50:00 AM	355.288	30.422	196	5.717
		4/1/2019 1:00:00 AM	355.398	30.369	196	5.682
		4/1/2019 1:10:00 AM	251.504	30.298	196	4.989
		4/1/2019 1:20:00 AM	207.617	30.265	196	4.819
		4/1/2019 1:30:00 AM	128.385	29.985	178	4.052
		4/1/2019 1:40:00 AM	164.927	29.764	171	4.514
		4/1/2019 1:50:00 AM	188.679	29.733	173	4.668
		4/1/2019 2:00:00 AM	162.964	29.772	173	4.396
		4/1/2019 2:10:00 AM	164.982	29.846	173	4.516
		4/1/2019 2:20:00 AM	245.994	29.919	173	5.13
		4/1/2019 2:30:00 AM	278.411	29.948	174	5.313
		4/1/2019 2:40:00 AM	269.318	29.9	174	5.252
		4/1/2019 2:50:00 AM	272.309	29.883	178	5.128
		4/1/2019 3:00:00 AM	141.2	29.774	176	4.281
		4/1/2019 3:10:00 AM	93.315	29.721	177	3.799
		4/1/2019 3:20:00 AM	236.887	29.587	177	5.248

Power vs. Wind Speed
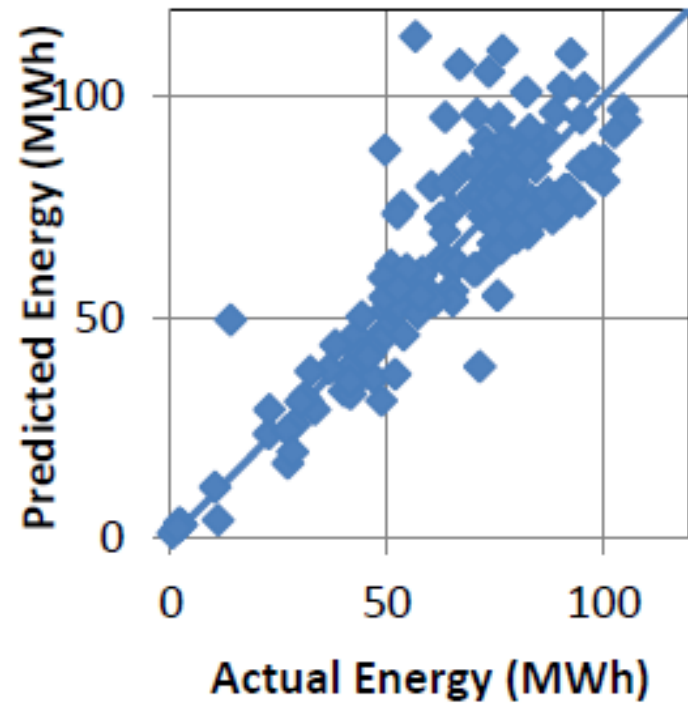

Wind rose

Correlation Matrix

PREDICTION MODELS

- Linear Regression
- Polynomial Regression
- Decision Tree Regression
- Support Vector Regression
- Random Forest
- Gaussian Process Regression (GPR)
- Feed Forward Backpropagation Neural Network (FFBPNN)
- Cascade-Forward Backpropagation Neural Network (CFBPNN)
- Recurrent Neural Network (RNN)
- ANN
  - Levenberg-Marquardt (LM)
  - Scaled Conjugate Gradient (SCG)
  - Bayesian Regularization (BR)
- Extra Tree
- XGBoost
- Gene Expression Programming

PERFORMANCE EVALUATION

MAE
MAPE
RMSE
R
Nash number
BIAS

THANK YOU!