Call for Proposals – Long Term Wind Energy Forecasting

Renewable energy sources are intermittent sources of power and highly dependent on weather and climatic conditions. Variations in power generation pose multiple operating constraints like requiring primary and spinning reserves, complicated power production planning and balancing power etc. They also have commercial implications on financial planning, cash flow and downtime scheduling etc.

Forecasting of weather patterns can help plan long-term and short-term operations of wind turbines. State-of-the-art forecasts can also have a significant economic impact. ReNew Power owns and operates over 50 wind farms with installed capacity close to 3GW (as of 31 March 2019). A reliable forecast system for each of the farms would add robustness to financial planning at ReNew.

Typically, forecasting models employ weather observations for initial conditions, include physics based weather prediction models, numerical methods, machine learning and AI etc. to forecast evolution of weather system. These models typically also incorporate long-term climatology data. Terrain data is then used to model and forecast wind speed variability at each turbine site. Standard statistical models correct for systematic biases and error patters and give a probability distribution of energy produced by each wind farm for the duration of the forecast.

Objective: Build wind speed and wind energy forecasting models based on weather and climatology data, numerical and physical models.

Deliverables: Models to forecast wind speed and wind energy generation with the following characteristics:

- **Spacial Granularity:** 200mx200m grid for each of the sites, for all the following weather forecasts.
- **Long term forecast**: 20x yearly distributions (probability density functions) for each of the sites, of hourly mean wind speeds, i.e. how many hours in the particular year would the mean wind speed be in a specific bin. These forecasts should take into account multi-yearly and multi-decadal climatic trends such as El Nino events.
- **Year-ahead forecast**: 12x monthly PDFs for each of the sites, of hourly mean wind speeds
- **Month-ahead forecast:** 28-31x daily PDFs for each of the sites, of hourly mean wind speeds
- **Validation of the models:** The models' performance will be evaluated against multiple error parameters: Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE) and Root Mean Square (RMS) error , etc.
    - Month-ahead forecasts will be validated with actual data in the first year after forecast models are ready.
    - Year-ahead forecasts will use both actual data as well as hindcast data of previous years.
    - Long term forecasts will be validated on hindcast data.

Engagement model: Faculty / Faculty + students +/ postdocs

Time frame: 1-1.5 years