Renewable Energy Production Forecast

PROJ0016 - Big Data Project

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Scope of the project

Structure

The project is divided in two independent parts:

- Production models : predicting the production from the characteristics of a production unit and the weather at the unit location;
- Identification of production units : for the considered area (Liège), extracting all renewable energy production units and their characteristics.

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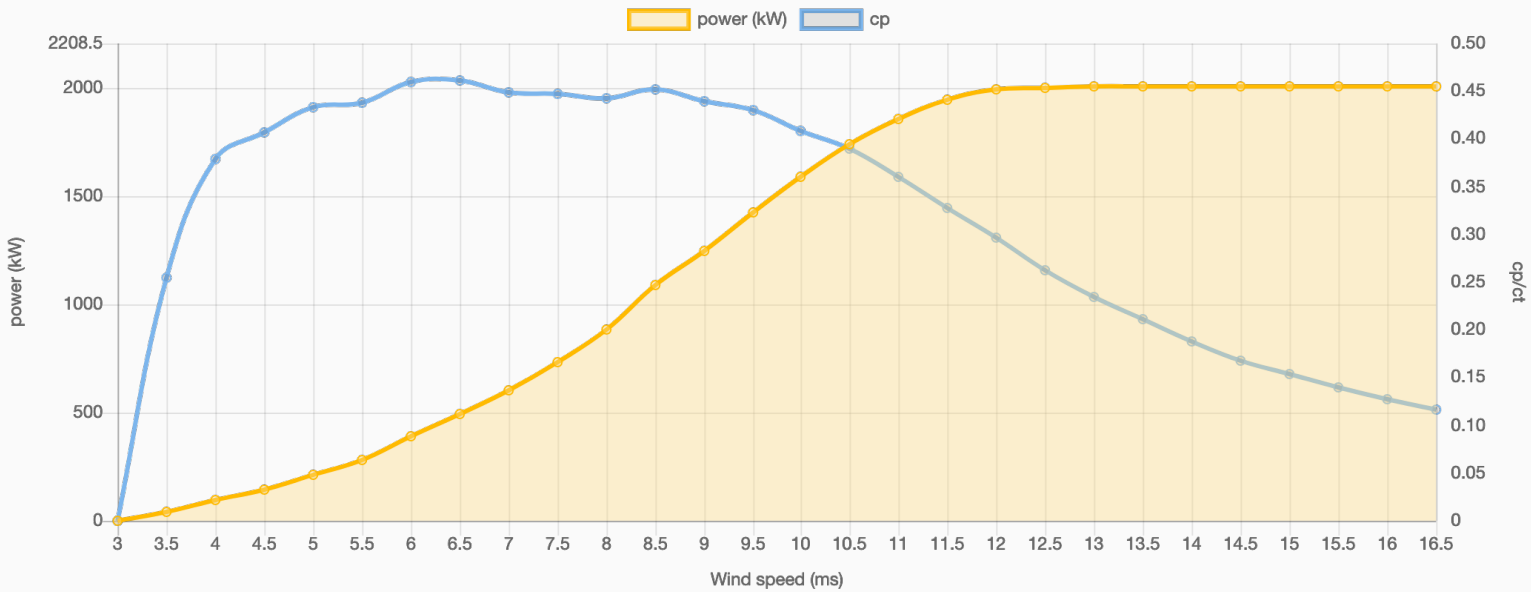
Then, by combining the two parts, we can estimate the production of renewable at Liège tomorrow.

Production models

Initially, we could use theoretical models to predict power production.

- Power curve of wind turbines;



Example of power curve for Vega V90 wind turbine

Production models

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- Power curve of wind turbines;
- Production model of photovoltaic panels with respect to the irradiance, temperature and orientation.

$$Power = f(radiation, orientation, tilt, efficiency)$$

Production units

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- Data from CWaPE is two years old and gives no information on the location, orientation, tilt or model/type for each PV unit.
- We don't want our forecast to be dependent on the availability of data on PV units.

Production units

Thus, it has been chosen to try using satellite imagery. The strength of this approach is that it is not restricted to any area or scale.

Recognition of PV on satellite image using DeepSolar software. [1]

Global production forecast

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$$model + units + weather\ forecast = production\ forecast$$

Global production forecast

To assess the quality of our predictions, we will compare our model with the production data from Elia/APERe[1].

[1] The production measures of Elia and APERe probably don't take into account the electrical production which is not re-injected in the network for PV.

Models

Photovoltaic panels production

- Theoretical model(s);
- `pvlib` Python library [2];
- ...

Wind farms production

- Using the theoretical model;
- ...

Photovoltaic panels units

- Deep learning and computer vision from satellite imagery;
- DeepSolar GitHub repository [1];
- ...

Wind farms units

- Data from electricity provider(s);
- ...

Data

Weather data

- Solar flow, temperatures and forecast (two locations) from the Laboratoire de Climatologie of ULiège;
- Weather data from the Thermodynamics Laboratory from the Aerospace and Mechanical Engineering Department of ULiège;
- Public API's OpenWeatherMap [3].

Photovoltaic panels data

- Production of the photovoltaic panels of the Grands Amphitéatres' parkings (MySQL access to real time and past data).
- Number of photovoltaic panels and installed power per municipality provided by CWaPE [4].

Wind farms data

- All recorded wind farms from Elia [5].
- Data from each electricity supplier having wind turbines also provided by CWaPE.

References

- Zhecheng Wang. *DeepSolar*. URL: http://web.stanford.edu/group/deepsolar/.
- *pvlib-python*. URL: https://github.com/pvlib/pvlib-python.
- *OpenWeather*. URL: https://openweathermap.org/.
- *CWaPE*. URL: https://www.cwape.be/.
- *Données de production éolienne*. URL: https://www.elia.be/fr/donnees-de-reseau/.