Title: in detail operational analysis and quantification of power losses due to bat curtailment in wind turbines to refine the wind speed-based model used by DNV in preconstruction of wind farms.

Student: Elena Pradelli

Supervisor TU Delft: Wim Bierbooms

Supervisor DNV: Timothè Dizengremel

MSc track: Sustainable Energy Technology

Background

Birds and bats are observed to be at risk of collision with wind turbines during their fly. In recent years, carcasses of birds and bats have been found underneath wind turbines across North and South America, Eurasia, Africa, and the Austro-Pacific (Hayes, 2019), making this a topic of high concern to safeguard the bat population. A common way to regulate the operation of the wind turbines during bat season is to implement the bat curtailment strategy. This involves shutting down the turbines when bats are expected to be active, according to the recommendation of environmental experts. This usually happens at low wind speed, mild rain, mild to warm temperatures and in only a few months of the year.

Problem description

DNV has a set wind-speed based model to estimate the power losses during bat curtailment. This involves applying filters into long-term hub-height power time series at each turbine location according to the constrains set by the turbine manufacturer for bat protection. One example could be in France where the government recommend turning into shut down mode below temperature of 10°, wind speed of 5 m/s, no rain, in between March to June and August to October, therefore, according to the DNV approach, the turbine power series will be set to zero when these conditions are met. From recent investigations concerns were raised by costumers in the estimation of the power losses using this approach, in fact, the following assumptions are made:

1. Correct readings taken from turbine anemometer.
2. No delay when operation restarts after shutdown.
3. Long term power time series are considered representative enough.

Goal

The aim of this study is to quantify the impact that each of these assumptions have on the actual power losses and to evaluate how different these are from the ones originally calculated by DNV to refine their wind speed-based model.

To achieve this, the measured losses from operational data of wind turbines will be compared with the losses modelled with the met mast data and the sensitivity of the input will be investigated through a study on yearly weather variability.

# References

Hayes, M. A.-M. (2019). A smart curtailment approach for reducing bat fatalities and curtailment time at wind energy facilities. In *Ecological Applications 29(4).*