

SUCCESS CASE 33.2024

Windy Smart Grid

MACHINE LEARNING TO
FORECAST GRID DAMAGES
AND OUTAGES CAUSED BY
STORM WINDS



WINDY IN A NUTSHELL

Windy is an Enedis innovation that marks a real breakthrough in the preparation of the **operational response to storms**. In order to accelerate grid restoration following an event, Enedis' goal was to better **anticipate the impact of storms on the public distribution network**. Using a statistical model calibrated with historical data, Windy relies on weather forecasts to **accurately predict 90% of incidents on medium-voltage (MV) overhead lines** caused by a windstorm at the national, regional or departmental level. The aim is to pre-mobilize teams and equipment as effectively as possible.

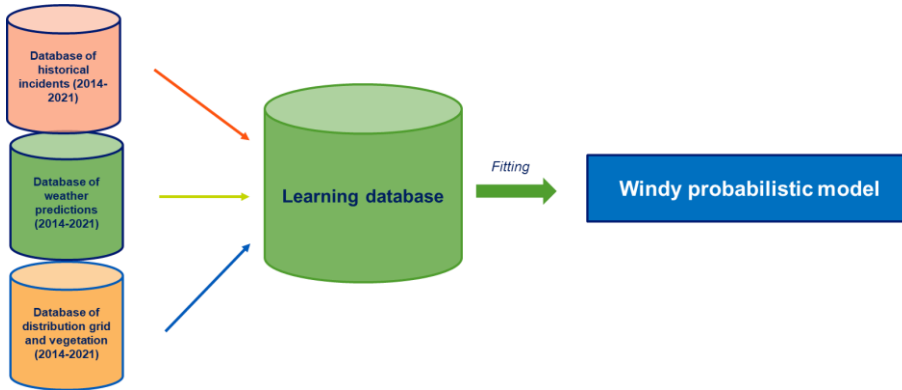
THE CHALLENGE

Storms are likely to cause widespread outages due to damages on exposed overhead MV distribution lines. Accurate prediction of their impact on the grid is key to pre-mobilize repair crews and suitable equipment, thus ensuring the most effective response.

The effective impacts of a storm on the distribution grid depend on the wind's force and direction as well as the type of employed materials and the surrounding vegetation. To restore power to customers as quickly as possible, it is crucial to accurately anticipate the volume of outages and possibly call for backup crews and pre-position equipment before the incident.

THE SOLUTION

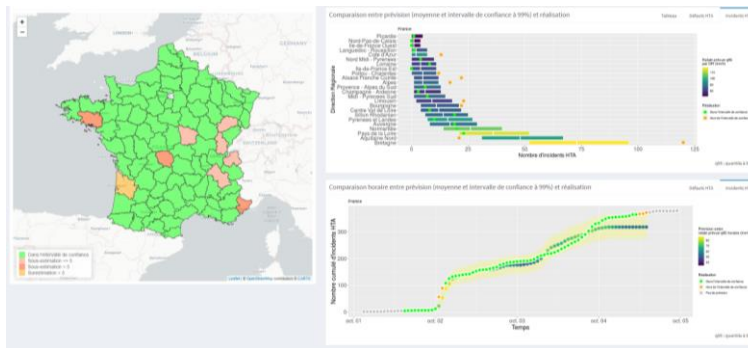
Windy Smart Grid is an incident forecasting tool. Using historical data, including weather predictions, distribution grid information, and recorded incidents, a probabilistic model has been calibrated to predict the outage probability of each MV feeder during a storm. The platform retrieves future weather forecasts every 6 hours and uses the calibrated model to provide outage predictions over the whole covered time horizon. An alarm can be activated up to 96 hours in advance in anticipation of a high number of outages.



Principle of the learning process of Windy Smart Grid.

MAIN ACHIEVEMENTS

The first version of Windy Smart Grid was developed in 2019-2020 and successfully tested through 2021 and 2022. The tool was industrialised and entered into operation in 2023. Its results are now available to all regional distribution control centres of Enedis.



Main user interface of Windy, displaying the expected number of outages per department.

Windy Smart Grid has provided very reliable information over its first years of operation. Among other events, storms like Aurore (causing outages for over 250,000 customers) and Ciaran (resulting in outages for 1 million customers) have had a significant impact on the French distribution grid. The forecasts generated by Windy helped Enedis to prepare accordingly, saving several hours in service restoration. Following this success, Enedis is currently evaluating a similar approach based on machine learning techniques to forecast grid damages caused by high-temperature events.

KEY SUCCESS FACTORS

- Construction of a historical database comprising grid state, weather predictions, and incidents over several years.
- Selection of a tailored probabilistic model and pertinent variables to optimise outage prediction accuracy.