



aphelion
wind

**Multifunctional
energy and weather
forecasting platform.**



Aphelion.com.es



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About Aphelion

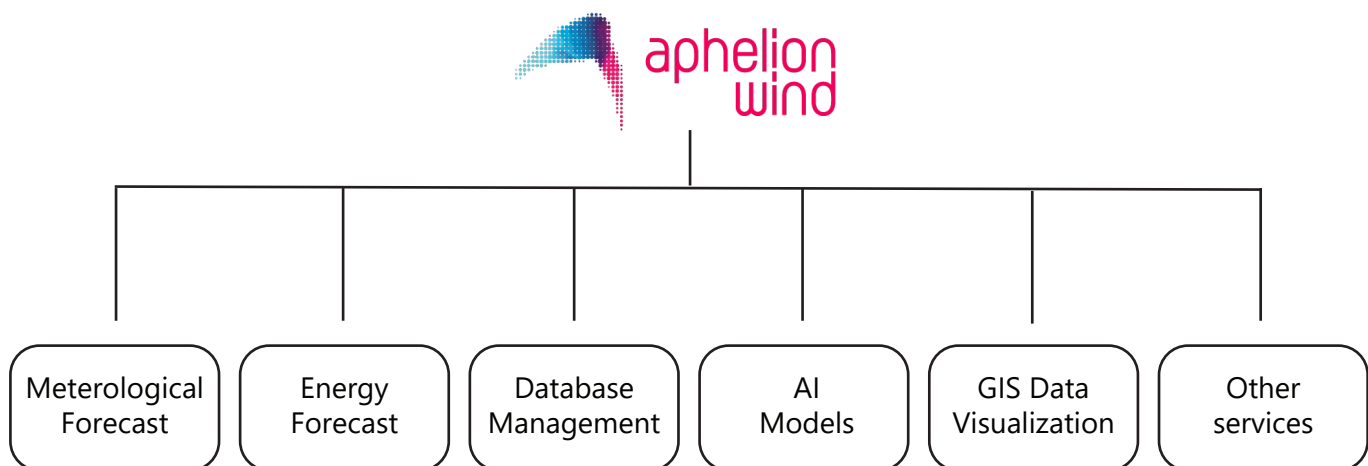


Meteorological forecast services from a multimodel perspective

Aphelion is a platform which offers meteorological forecast services focused on giving support and contributing on the decision-making process within the renewable energy industry.

Our meteorologists, data scientists, and software engineers are specialized in the development of optimization tools to obtain the most accurate forecasts for a wide variety of projects and clients.

From a high-resolution forecasts, Aphelion offers meteorological and energy forecasts as well as weather and climate consultancy services within a two-week time horizon. Furthermore, these services are useful for both company- and particular-driven endeavors.



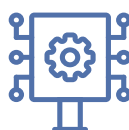
Backed and developed by experts



Meteorologists



Data scientists



Software Engineers

3 | Meteorological models data

6 | Machine Learning Architectures

+ 15 | Meteorologists & WRA experts

+ 10 | Countries where Projects

A photograph of a wind farm at sunset. The sky is a warm, hazy orange, and the ground is dark and textured. Several wind turbines are visible, with the largest one in the center-left foreground. The overall mood is serene and modern.

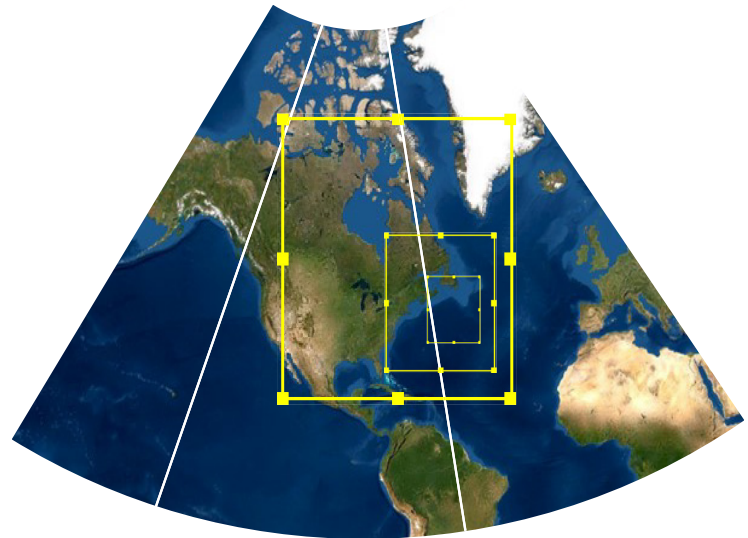
Hybrid Model

Aphelion's engine

The most important meteorological agencies, on a global scale, provide initial data for the hybrid model.

The model combines sequentially:

- Wide NWP database (historical and operative).
- Dynamical downscaling through limited area models. High-resolution topography database for accurate representation of wind flow at surface.
- Statistical downscaling through machine and deep learning algorithms optimization.



Machine learning + WRF Model

All strategies convert a general forecast into a local forecast

Aphelion WRF Model

**High-resolution modeling
O&M**
(3 km - 1 km)

Global coverage
MQWRF allows optimization of
WRF model at any site

Assimilation system
for 3D-VAR data

Lateral conditions
from ICON and GFS models

Mesoscale reconstructions
for ERA supplier data

Periodic validation reports
KPI: NMAE, RR2, RMSE and IEV

Machine Learning

Aphelion uses advanced machine learning techniques to convert weather data into energy forecasts. Thus, these can be leveraged for the decision-making process involved in intraday and day-ahead markets.

The forecasting models implemented in Aphelion can be calibrated to calculate uncertainty estimations for production assessment scenarios in the form of percentiles.

Cutting-edge artificial intelligence to estimate accurate wind power forecasts


Automated prediction system robust against unexpected events and failures

Agility and scalability

Intuitive user interface to visualize forecasts

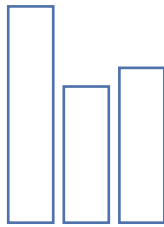


Aphelion Wind offers multi-view features regarding machine learning model visualization, including a model comparison tool to allow users to visualize forecasts of all models in one graph.

A large, white wind turbine stands prominently in the foreground, its three blades extending across the frame. The sun is low on the horizon, creating a warm, golden glow that silhouettes the turbine and illuminates the sky. The background shows a vast, flat landscape of fields and distant hills under a clear, hazy sky. The overall mood is serene and hopeful, suggesting a sustainable future.

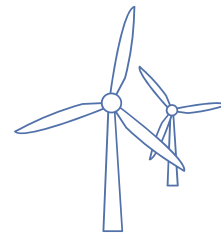
Energy forecasting for wind farms

Potential customers



Energy traders

To optimize transactions
within the electricity markets



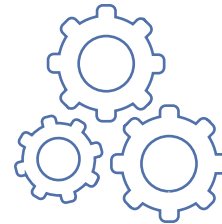
Wind farm operators

To maximize assets
profitability



Grid operators

To successfully manage renewable
energies integrations



Build phase

To ensure logistics and O&M
activities

NWP (Numerical Weather Prediction)

We have access to a large NWP database, which contains a wide variety of meteorological models based on both regional and global levels, such as:

- GFS (25 km)
- ICON (7 km)
- WRF (9 km)
- Database increase in progress

Machine Learning Architectures

Most companies develop their meteorological forecasting models using just one architecture, only adjusting hyperparameters and specific features. The Aphelion team carefully tailors their architectures from scratch, allowing us to build a wide variety of forecasting models adapted to all location specifications (e. g. , onshore, offshore, complex terrain). Furthermore, advanced feature engineering techniques, typically used by data scientists, are applied taking into consideration our knowledge in atmospheric physics to bring the best of both worlds together. Such efforts have led us to provide our customers with forecasts for the short, medium and long range. We can provide forecasts from the next minutes and hours up to one week ahead, reaching highly accurate forecasts selecting the most suitable model from our pool of in-house architectures.

Machine learning models' features

In-house forecasting
models adapted to
nowcasting scenarios

Powerful learning
methodologies suitable
for tabular data

Detection of spatiotemporal
patterns of weather and
energy data

Feature engineering to
process data to the utmost
quality

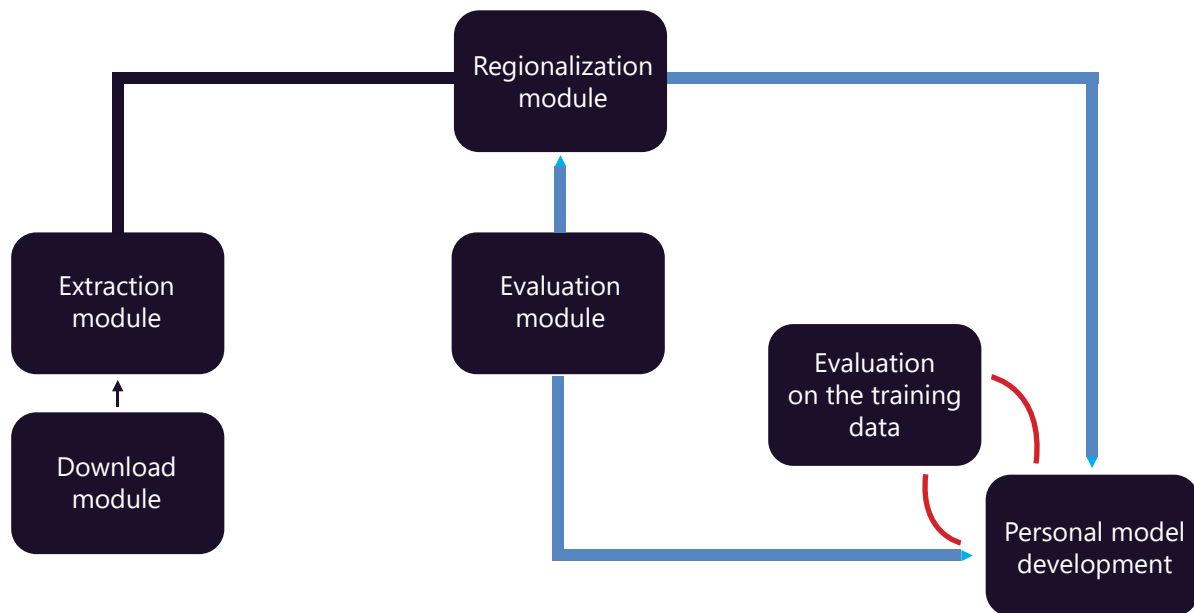
Ensemble forecasting
- strength is diversity

Forecast evaluation and validation



Weather data are carefully analyzed, evaluated and validated following a well-established and automated workflow to ensure their accuracy and validity. That procedure is performed using MLOps tools, making a difference between the meteorological data and the energy data validation.

MLOps Aphelion



Once a new asset (such as a wind farm or a wind turbine) is inserted by the client, the MLOps system automatically trains all available in-house machine learning models, evaluating their accuracy for different time horizons (+24, +48, +7d). Afterwards, the forecasting model is deployed operationally to provide up-to-date energy forecasts.

Meteorological Data Validation

Variables	MAE	BIAS	RMSE	R2
q	0.85	-0.38	1.40	0.84
HR	9.67	-1.87	16.12	0.85
HRq	10.73	-4.82	17.63	0.85
T	1.68	-0.72	2.85	0.78

GFS 25 km

Variables	MAE	BIAS	RMSE	R2
q	0.32	-0.15	0.56	0.98
HR	4.32	0.13	7.75	0.96
HRq	4.17	-1.89	7.40	0.98
T	1.06	-0.28	1.84	0.89

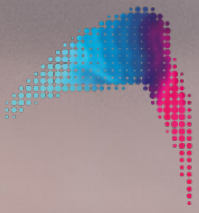
GDPS 15km

Variables	MAE	BIAS	RMSE	R2
q	0.50	-0.33	0.84	0.94
HR	5.60	-1.46	9.81	0.94
HRq	6.28	-4.36	10.74	0.94
T	1.01	-0.65	1.71	0.90

Aphelion WRF 9km

Variables	MAE	BIAS	RMSE	R2
q	0.38	-0.21	0.67	0.96
HR	4.87	-1.19	8.77	0.95
HRq	4.44	-2.62	7.92	0.97
T	0.77	-0.29	1.32	0.95

Aphelion WRF 3km



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wind



Aphelion Wind home

Aphelion Wind is the ultimate and optimal solution for wind farm operators, energy traders, and more.

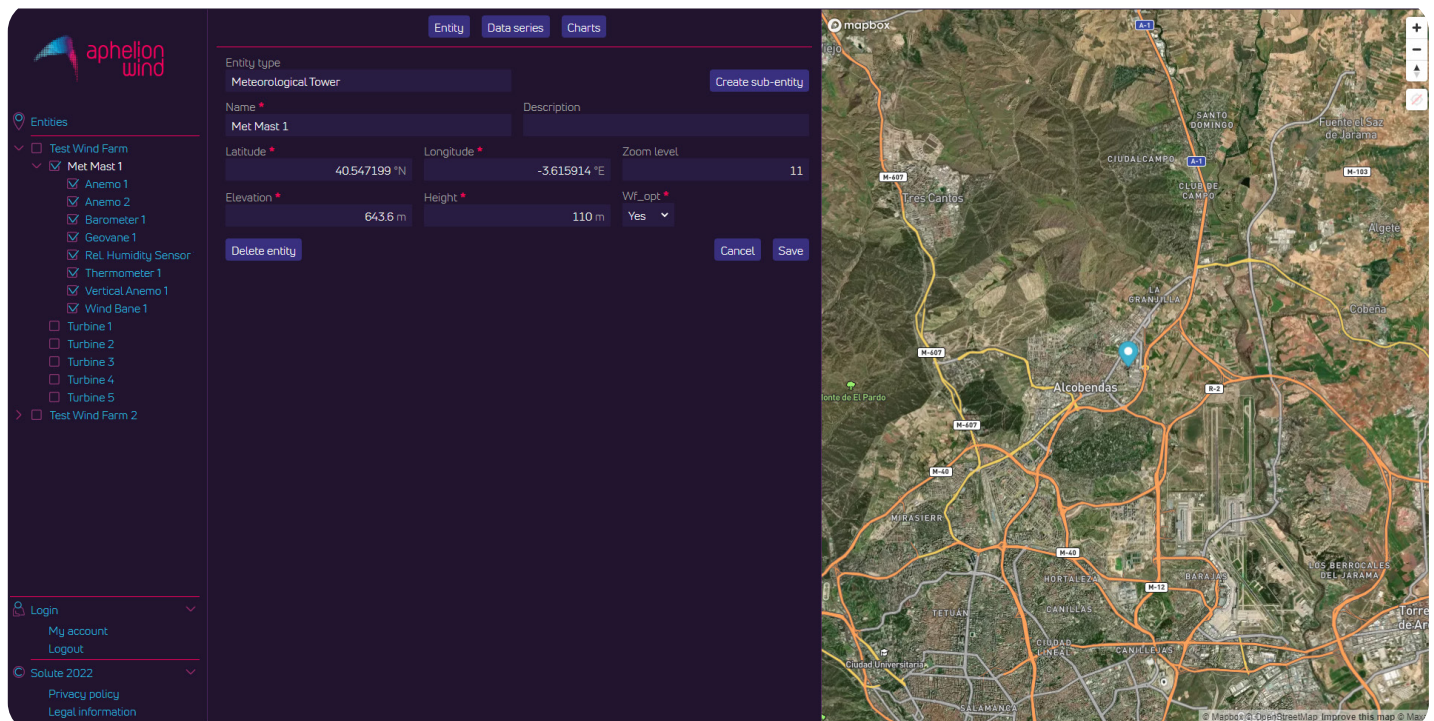
Its user-friendly interface will enhance the users' experience. Furthermore, technical online support will always be available in case users request further details on the platform's extensive list of capabilities.

Automatic software with in-house machine learning models and ad-hoc functionalities

Online technical support

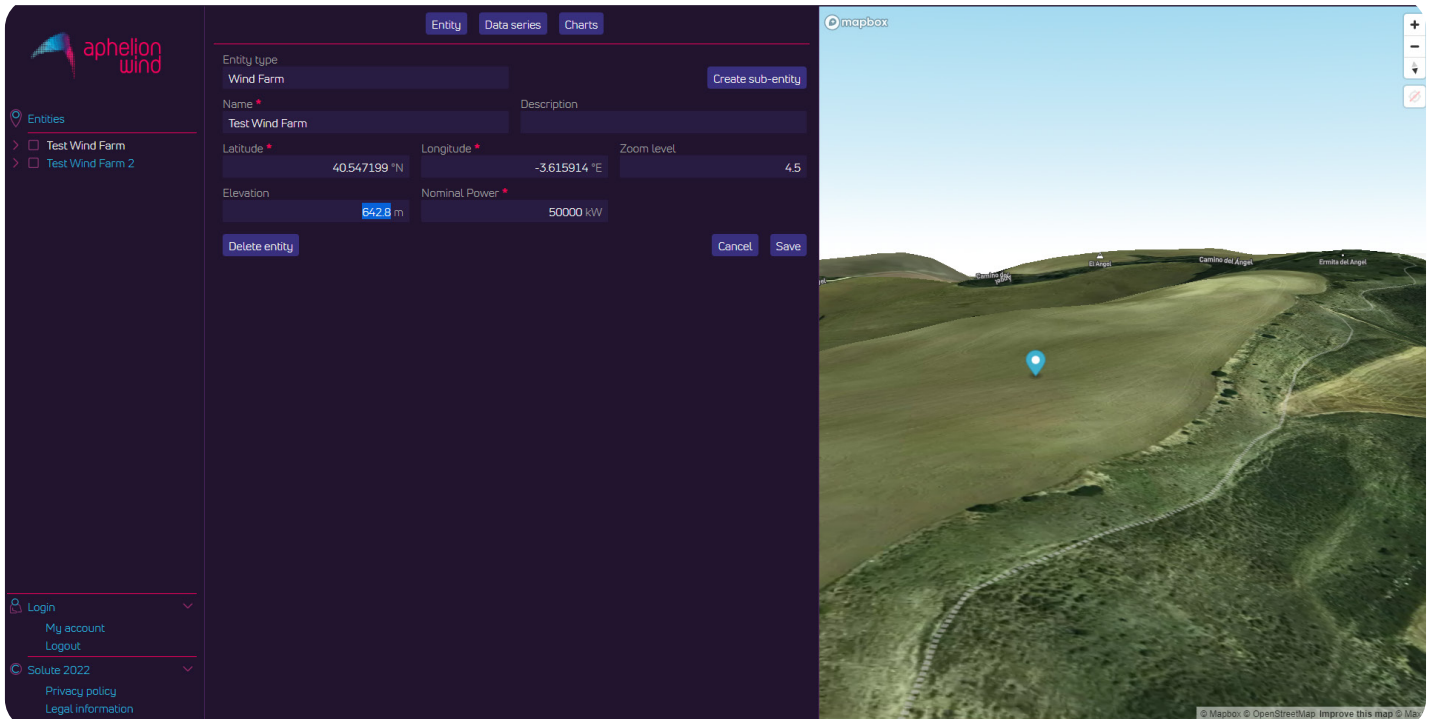
Customizable forecast horizons, updates, granularity and time resolution

Wind farm and wind turbine production forecasts



Besides the technical capabilities of the prediction platform, the simple and intuitive interface of Aphelion Wind is its best asset.

Designed to be used from left to right, the main dashboard allows user to control variables, wind farms, turbines, among other elements. Moreover, a central module will give users easy access to add properties and must-have data to eventually see a site's location on the always-on 2D and 3D map. Aphelion Wind also has a unique feature of assigning different permissions and actions per user type. That way, tasks can be monitored at all times.



3D maps will allow users to have a better understanding of a site's location and also extract additional information directly from the platform.

Aphelion's API features

Easy access to Aphelion database

Easy to include in other solutions

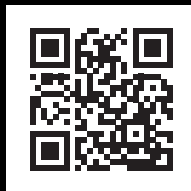
Individual accuracy

Data safety guarantee





**Accurate wind and solar power
forecasting services for energy markets.**



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