

A stylized human figure composed of a grid of white dots on a dark blue background. The figure is positioned in the center-right of the frame, with its arms slightly out to the sides. The dots are arranged in a regular pattern, creating a mesh-like appearance that defines the silhouette of the person. The background is a solid dark blue color.

solute

Weather
forecasting

About SOLUTE

SOLUTE is a multidisciplinary technical engineering consultancy with over 15 years of experience, headquartered in Madrid, with branches in Barcelona, Badajoz, and Toledo.

Throughout our history, we have primarily specialized in the renewable energy sector, particularly in the wind industry, where our capabilities cover all phases of wind farm development. Other sectors in which we specialize include automotive, solar energy, software development, weather forecasting services, and virtual reality, among others. This, along with the development of projects in more than 20 countries and for some of the most important clients in the sectors in which we operate, endorses us as one of the leading engineering consultancies in our country.

Our mission is to provide multidisciplinary solutions on a global scale, through the technical rigor and expertise of our engineers, ensuring the quality and excellence of our work in every project.

We highlight R&D&I as one of the main drivers of SOLUTE, as since the company's inception, we have launched several in-house developed tools, which are now offered as products to our clients. Some of these are Furow, a comprehensive wind resource software; Aphelion, a platform for weather and energy forecasting services applied to the wind sector; and EVE, our suite of virtualization services in industrial environments.

We believe that the best solutions are achieved as a team.

Meteorological Forecast

SOLUTE's forecast services applied to the energy industry are a result of an investment in internal R&D, that has made it possible to obtain highly reliable results that are essential for the planification and decision-making process of our clients. Within this forecast system, extreme events detection (such as wind gust, thunderstorms, ice event, etc.) carries out a major role.

Wind potential study

Detailed modeling of the location, based on orography, roughness and obstacles data.

Wind energy potential preliminary study, including mesoscale data, re-analysis and land stations.

Creation of a **wind energy mapping** of the location using the lineal flow model FURROW, through the extrapolation of frequencies distribution data that results as most representative in the long-term for the hub height. The atmospheric stability effects would be included in case that different levels of temperature information was available.

Wind turbine's layout optimization, taking into account the losses caused by trails as well as other restrictions.

Determination of the **plant annual energy**.

Meteorological campaigns design

Detailed modeling of the location, based on orography, roughness and obstacles data.

Selection of the location in which the wind behaviour is representative of the whole area

Location filtering according to its viability because of external factor: accessibility, access typology, etc.

Possibility of carrying out an **additional remote measurement campaign** through SoDAR or LiDAR in order to complete the information that is available in the location selection process.

Energy and meteorological forecast

Energy and meteorological forecast services adapted to the wind farm production and operation needs. Estimation of the operation conditions with two weeks in advance for the operation strategies design and the energy sale.

Energy forecast: Hybrid Model

Forecast model developed in SOLUTE that joins two types of methodologies: **statistic models**, through the usage of Deep Learning techniques, and high-resolution **physical models** that carries out a regionalization or downscaling of the meteorological conditions, in a way that it adapts to the climatological conditions of the studied location. This combination results in a unique system that places SOLUTE ahead of the industry.

Hybrid model products depending on its maximum forecast horizon:

- **Nowcasting (0-6 hours)**: by means of the constant monitorization of SCADA data, SOLUTE artificial intelligence models provide an adapted forecast whose main application takes place in the intraday market.
- **Short-Range (0-24 hours) & Medium Range (24-96 hours)**: the hybrid model combines the regionalization of meteorological conditions through the use of high-resolution models with statistics and machine learning.
- **Large Range (96-336 hours)**: probabilistic forecast to estimate production scenarios in periods from 1 to 2 weeks. It includes production percentiles for the estimation of uncertainty.

In order to set energy forecast services in motion, the following data is necessary:

- **Geographic location of the wind energy plant**
- **Layout** (which is important for the Nowcasting model)
- **Wind and/or power data series measured in the wind farm.** With these internal forecast services, it is also possible to not have these temporal series, since in that case the casuistic would be solved through the use of a microscale model

Meteorological forecast: LAM Model (3 & 1 km)

LAM (Limit Area Model) **meteorological model** with a resolution of 3 km that covers the Iberian Peninsula. The analysis of the calculated meteorological variables makes it possible to design action windows within the renewable plants' environment.

Development of high-resolution atmospheric models (up to 1 km) on demand for any part of the world.

High-range configuration model that takes into account both the location climatology and complex topography.

High added value forecast with enough resolution capacity for the management of events that would impede the carrying out of O&M activities in the plant: strong gusts of wind, storms and thunderstorms, fog, etc.

Model validation and update reports

SOLUTE carries out a constant monitorization of the described models ability, reliability, accuracy and uncertainty.

By means of the study of key statistics, both related to continuous variables and categorical variables, reports about the models' status are elaborated including graphs such as Taylor's Diagram, which contribute to a better understanding of the service quality by the client.

Constant improvement of predictive algorithms and periodic update of operative

Long term temporal series reconstruction by means of mesoscale models and/or artificial intelligence.

Development of AI self-developed methodology in order to reconstruct wind speed and direction from 1980 to the present, allowing to obtain a higher representativeness of the wind turbine that can be used in long-term specific studies.

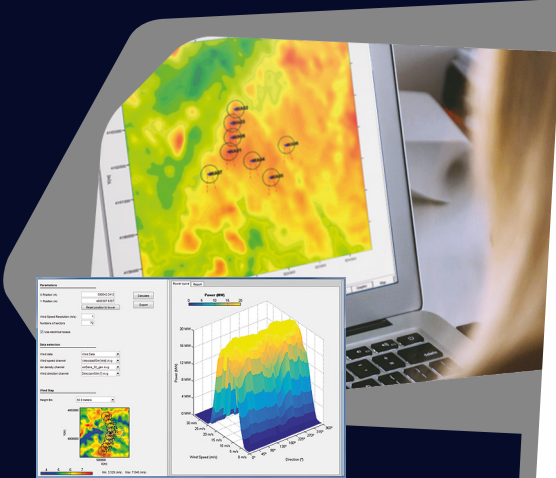
Development of self-developed mesoscale models based on LAM models, which make it possible to reconstruct temporal series by means of dynamic regionalization, that can also be refined through AI procedures.



Our products

Our mission is delivering solutions on a global, multidisciplinary level through our technical rigor and our engineers' knowledge, with R&D as our backbone.

The result of more than 15 years listening to different stakeholders' problems is the development of products for the renewable energy industry, in the shape of software, hardware and services.



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furow

WRA and Wind farm design software

Furow is a complete and exhaustive wind energy software, which possesses features directly with wind resource assessment calculations, wind farm modelling and project development at any given stage. Furthermore, its compatibility is flexible while working with other software, therefore, allowing users easy access to share and compare information

- Data analysis
- Wind resource assessment calculation (lineal model & CFD)
- Micrositing



aphelion

Multi-function weather and energy forecast software

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

From a high-resolution forecast, Aphelion offers meteorological and energy forecast as well as climate consultancy within a two-weeks' time horizon. Moreover, these capacities can be useful for both companydriven and particular-driven services.

Hybrid forecast model + Machine Learning

- ▶ Up to four multi-view maps with different models and variables
- ▶ Extensive range weather forecast (up to 16 days)
- ▶ Short-term weather forecast (0-72 hours)
- ▶ Four daily forecast updates and detailed meteograms

Aphelion Wind

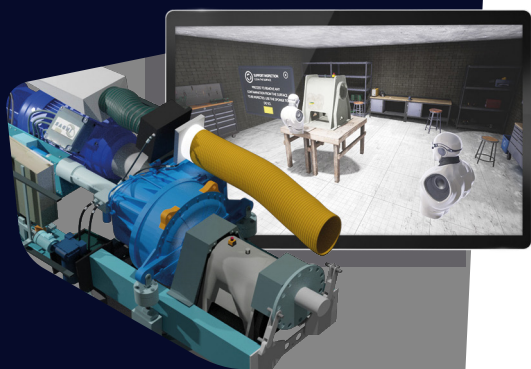
- ▶ Automatic software with +5 machine learning architectures and ad-hoc features
- ▶ Wind farm and wind turbine forecast
- ▶ Customizable forecast ranges, updates, granularity, and time resolution
- ▶ ML models can calculate uncertainty estimations for production assessment scenarios (p90, p10, among others)

EVE

Enhanced Virtual Environments

Virtualization and digitalization services for industrial sectors

- High detail 3D laser scanning
- Virtual tours with embedded technical information
- Maintenance tasks digitalized in tablet device for field guidance
- VR platform for operation and emergency instruction
- Multi device and multiplayer options



Predictive maintenance platform for renewable farms

Deep Learning on the Edge and IA algorithms combined for an optimization of the maintenance interventions in renewable energy farms

- Asset sensorization and monitoring
- Remote cloud monitoring
- Predictive maintenance IA algorithms
- Big data techniques for traceability, accessibility and analysis
- Real-time processed on edge data uploaded to servers (IoT+edge computing)



Comprehensive wind turbine inspection

TSR Inspector

TSR Wind customers' cloud software platform for inspection data processing and management.

EOLOS

External blade inspection robot with high resolution photo camera, capable of climbing any metal surface by permanent magnets

CERBERUS

Remote inspection of blade interiors by small mobile robot with 3 high resolution video cameras to access impossible places for technicians.

KRATOS

Bidirectional magnetic coupling robot designed to climb any metal surface and follow the welding cords using an NDT ultrasound equipment



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