NABLADOT
P4HEU - COMPETENCES

ANTONIO GOMEZ (R&D MANAGER)
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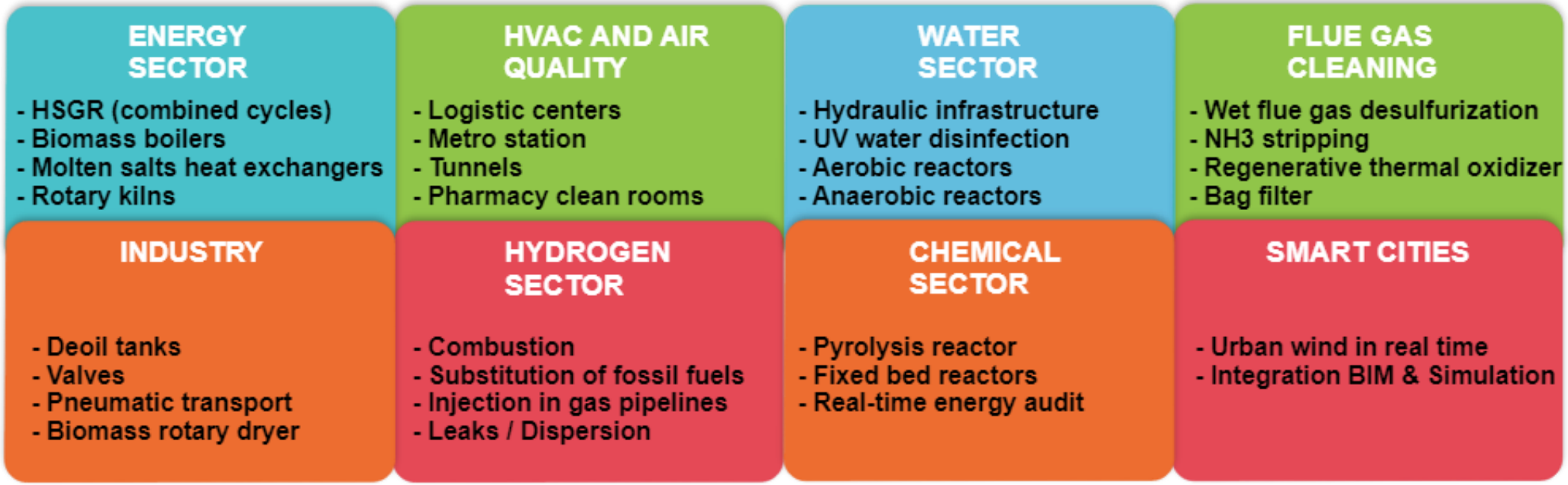
- Established in 2010 by researchers specializing in Computational Fluid Dynamics (CFD) at the University of Zaragoza (2010). We offer:
  - Innovative character
    - We actively engage in research and development projects at both national and European levels
  - Business focus
    - We offer solutions tailored to the technical and economic needs of the companies
- Our team has experience across multiple sectors (see our Projects)



nablaDot: Expertise

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INGENIERÍA COMPUTACIONAL DE FLUIDOS

- We offer a wide range of services:
  - CFD simulation
  - Real time models (CFD simulation & Statisical Analysis & AI)
  - Statistical data analysis
  - Simulation & IoT (Sensors, Cloud Computing, Edge Computing)
  - Digital Twins
  - Collaboration in public funded R&D projects (wide experience in public funded R&D projects at national and European level)
    - Horizon Europe (cascade funding projects)
    - Eranet
    - Eurostars

COMPETENCES: CFD EXAMPLES

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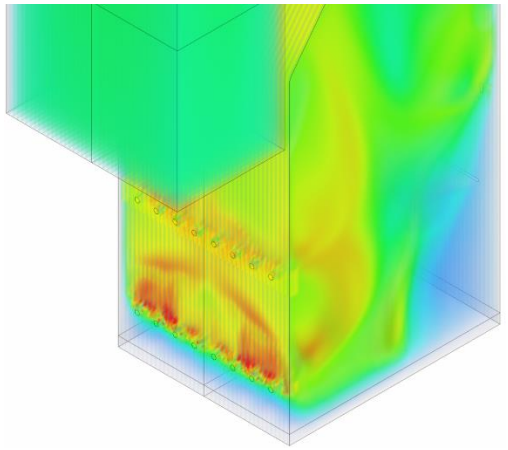
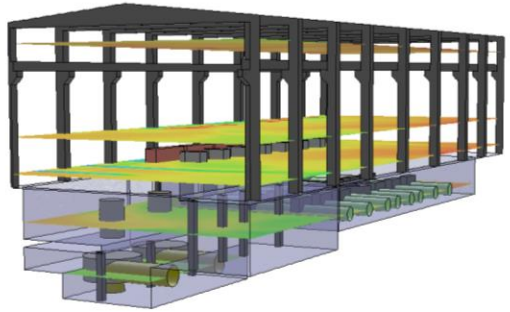
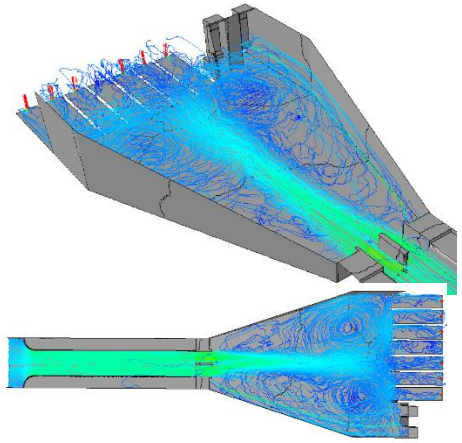
Energy
Biomass boilers



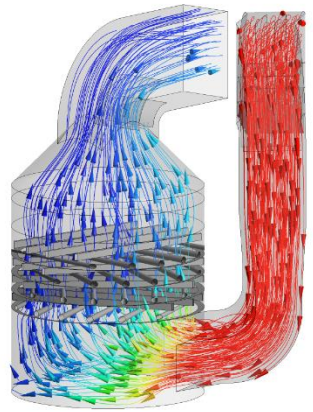
HVAC and Air Qualityç
Logistics warehouses



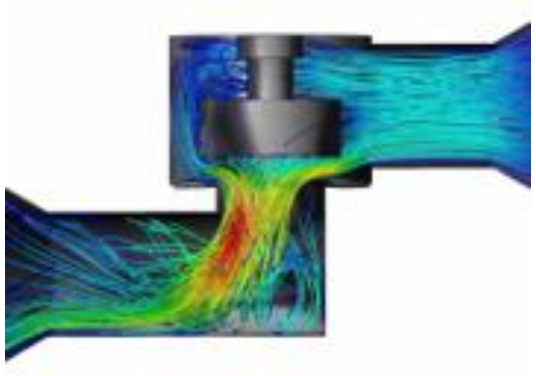
Water sector
Hydraulic infrastructures



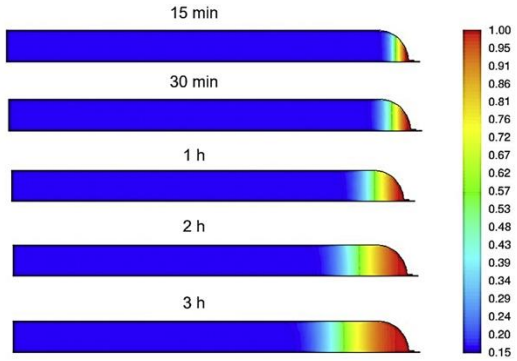
Flue Gas Cleaning
Desulphurisation



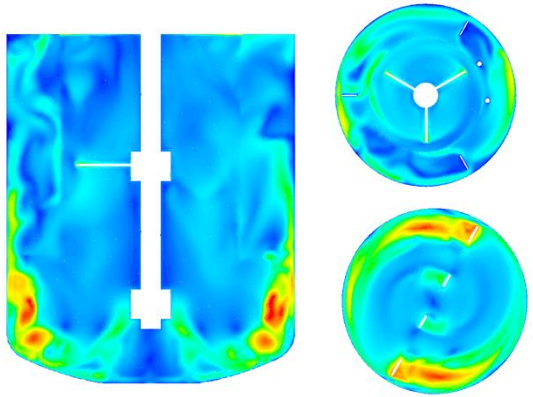
Industry
Valves



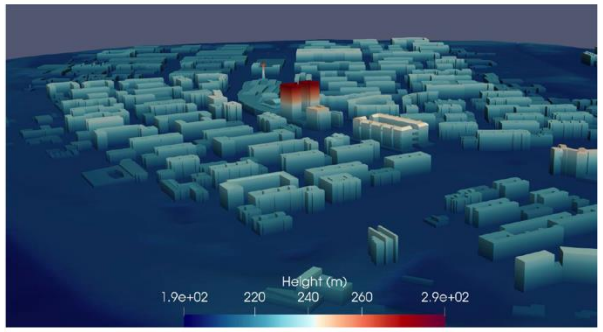
Hydrogen
Hydrogen injection



Chemical sector
Pyrolisys reactor



Smart Cities
Wind forecast in real time



COMPETENCES: HIGH RESOLUTION OF URBAN WIND IN REAL TIME

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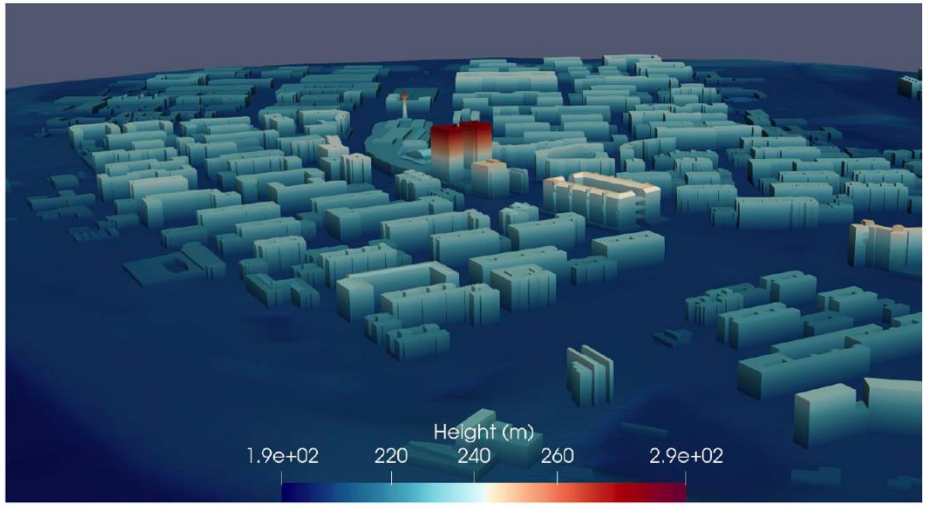
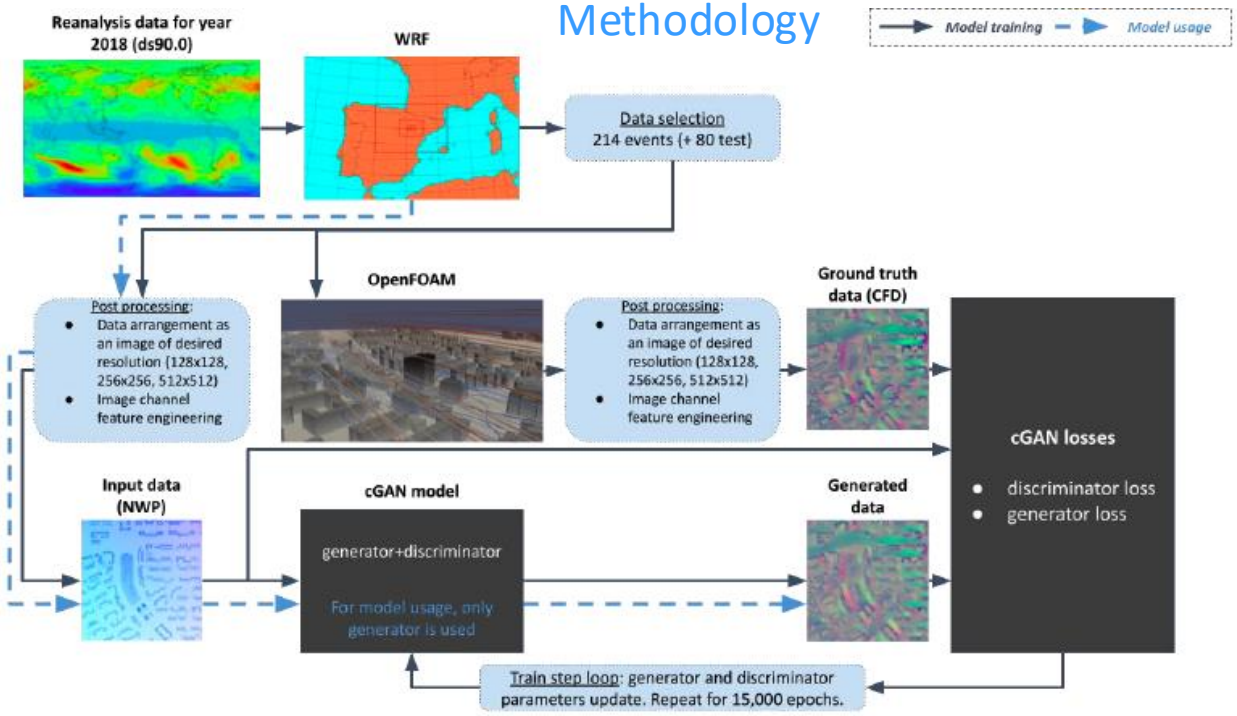
- We have developed a methodology for the calculation of urban wind (~ 1-2 m resolution) in real time. The methodology combines:
  - Numerical Weather Prediction Models
  - Computational Fluid Dynamics
  - Artificial Intelligence
- Calculation time reduced from 8-10 hours to seconds

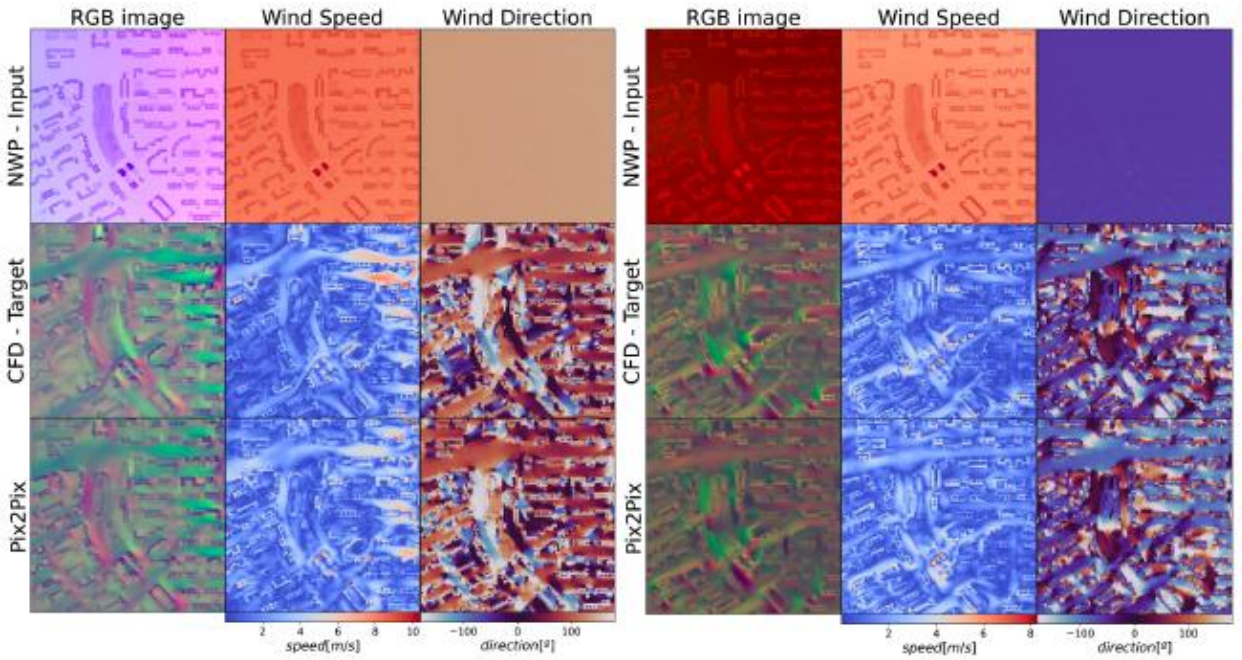
ZARAGOZA (ACTUR DISTRICT)



Methodology



Results



COMPETENCES: HIGH RESOLUTION OF URBAN WIND IN REAL TIME

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- Multiple Applications
  - Small wind energy
  - Air Quality
  - Forecast of extreme events
  - Smart cities
  - …

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Adversarial image-to-image model to obtain highly detailed wind fields from mesoscale simulations in urban environments

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Numerical weather predictions
Image-to-image
Deep learning
Conditional generative adversarial network

ABSTRACT

We propose a conditional Generative Adversarial Network (cGAN) that can produce detailed local wind fields in urban areas, comparable in level of detail to those from Computational Fluid Dynamics (CFD) simulations, that are generated from coarser Numerical Weather Prediction (NWP) data.

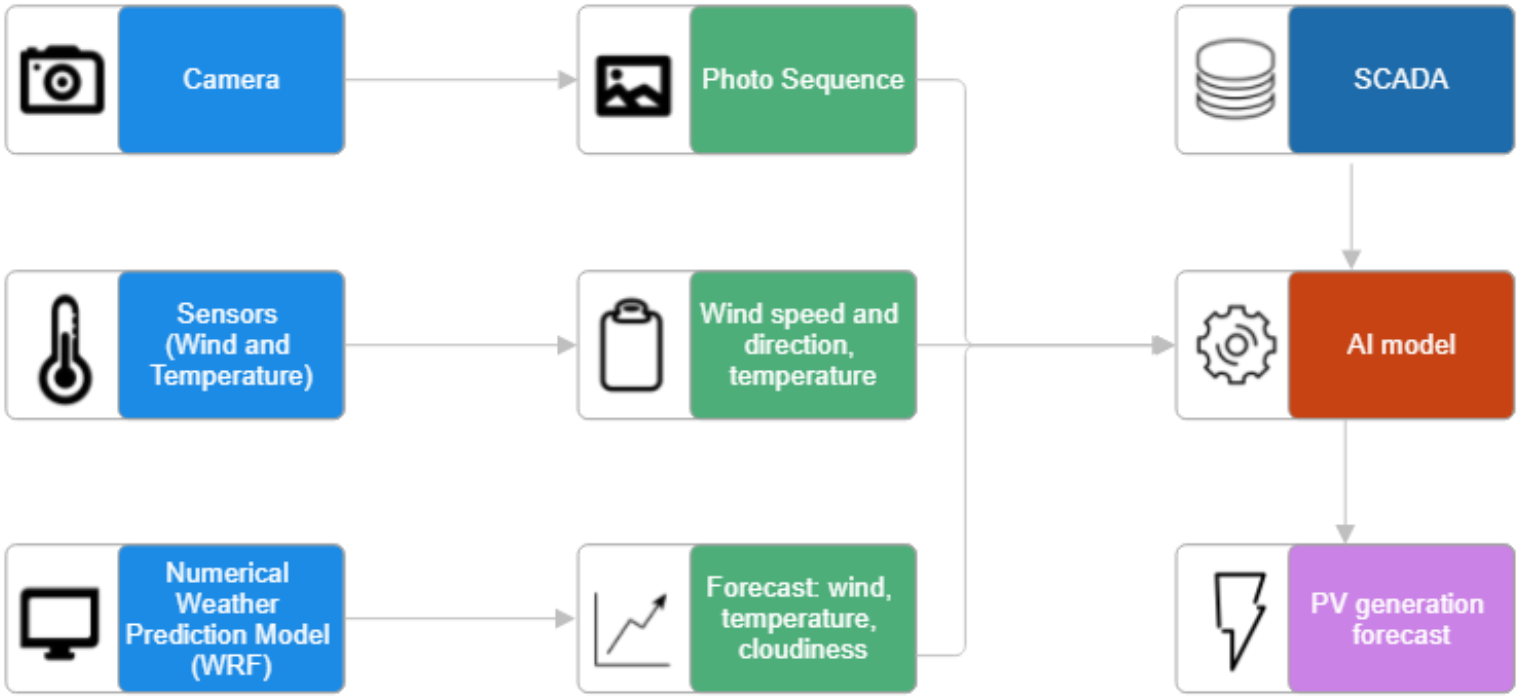
In our approach, the cGAN is trained using NWP data as input and CFD as targets. Both CFD and NWP data are presented to the network as images, using an image-to-image model based on Pix2Pix to transform coarse meteorological conditions into detailed local wind fields.

The methodology is tested in a residential district in a large Spanish city, Zaragoza. The model predictions show significant agreement with the actual CFD results, while reducing the computational time from eight hours to seconds. Feature engineering of image channels effectively reduces the model error, especially in the wind direction, achieving a mean absolute error in the wind speed of 0.35 m/s and a wind direction error of 27.0°.

COMPETENCES: SOLAR PV NOWCASTING

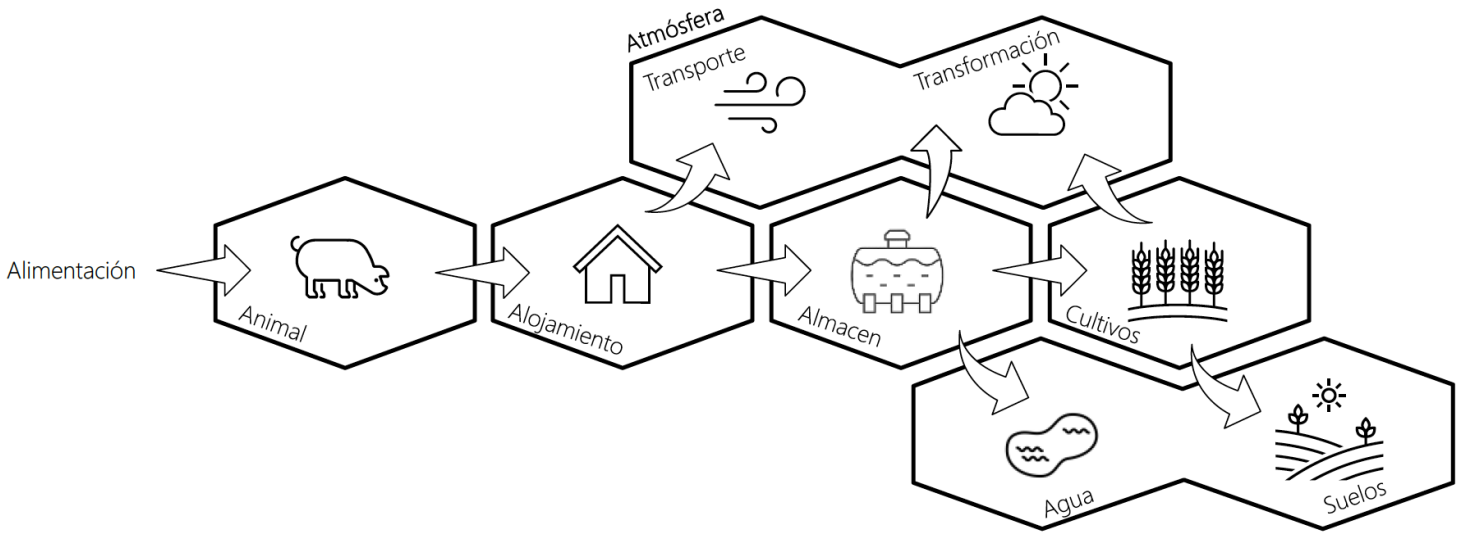
NABLADOT::() INGENIERÍA COMPUTACIONAL DE FLUIDOS

+ Methodology for short-time forecasting - **Nowcasting** (from minutes to hours) - of power generation in photovoltaics power plants
+ Nowcasting approach based on the combination of:
  + Real-time local data
    + Satellite data, sky photographs, sensor data
  + Weather forecast simulations
  + AI techniques
+ Applications for Smart Communities



COMPETENCES: INCREASING THE SPATIAL AND TEMPORAL RESOLUTION OF SATELLITE DATA

- Increasing the resolution of satellite data combining:
  - Numerical Weather Prediction models
  - Computational Fluid Dynamics
  - Aritificial Intelligence techniques
- Application: NH_3 emissions from the farm sector and its influence on aerosols (PM2.5)



COMPETENCES: DIGITAL TWIN

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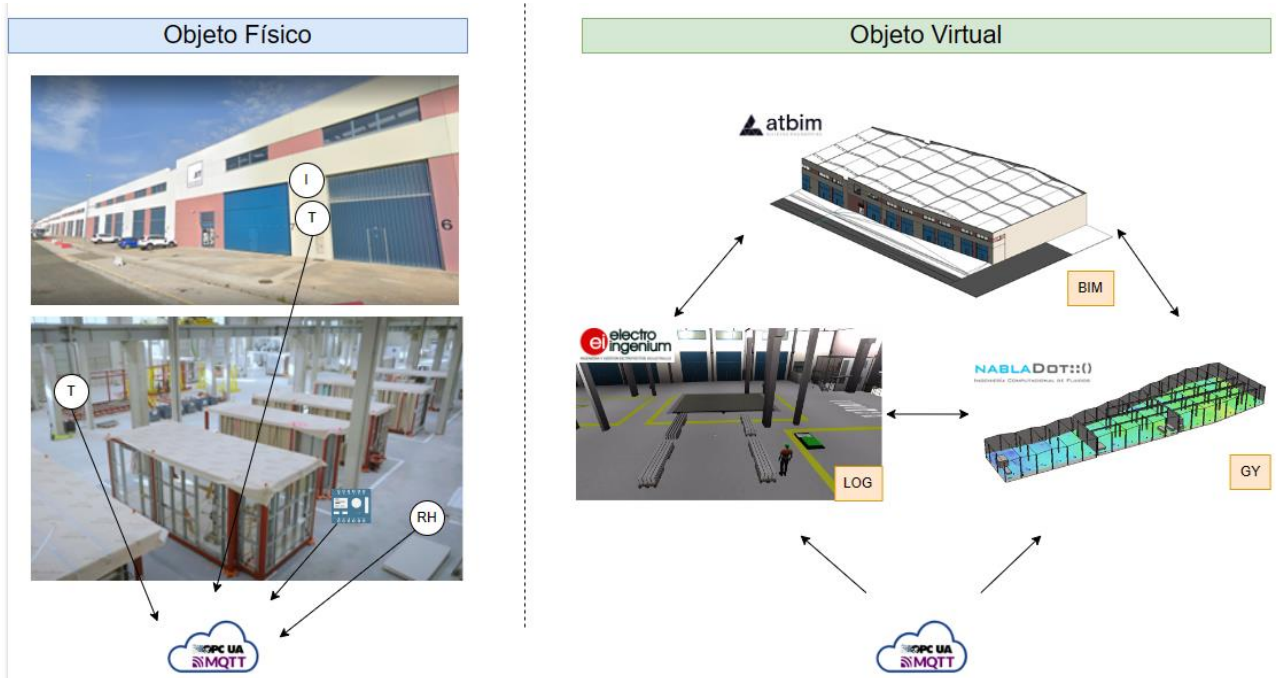
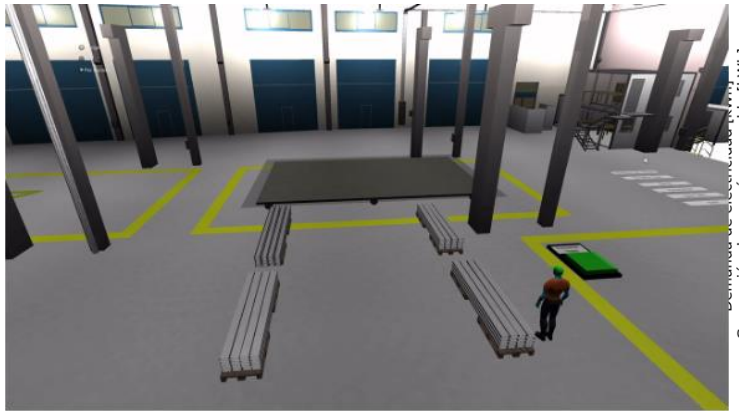
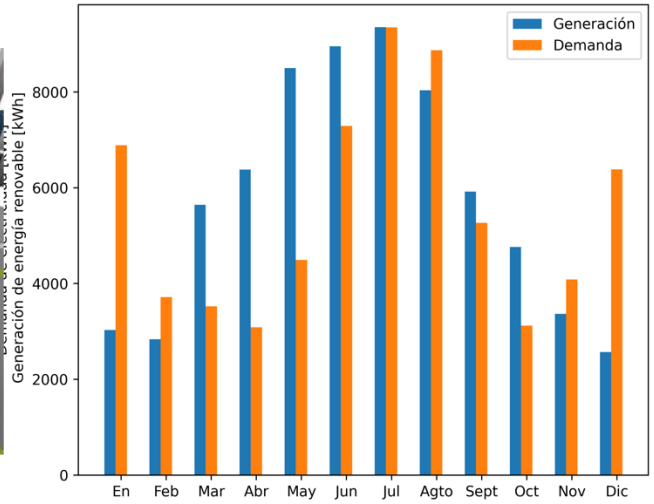
- Integration of BIM models, logistics models, and simulation
- Applied to the manufacturing industry (also applicable to other types of buildings or group of buildings (district).
- Characteristics:
  - Detailed geometry
  - Automatic communication with sensors /SCADA sensors and automated systems
  - Automatic data processing
  - Real-time simulations of the building performance: prediction of energy consumption/production, thermal comfort, and air quality
  - Planning of optimal operation configuration based on simulation results and data analysis
  - Communication with other buildings and establishing optimal operation of the buildings group







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