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ONLINE INFOSESSION:
SPACE4ENERGY

24TH SEPTEMBER 2026

Strategic roadmaps for regional energy transition, forecasting & prediction

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Instituto Tecnológico de Canarias

Tecnología e Innovación para un Desarrollo Sostenible

itc INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

Activity in Renewable Energies

Seeking to maximize the use of renewable energies in islands and isolated regions

- Power Electronics Laboratory **LABEP**
- Solar Thermal Collectors Testing Laboratory **LABSOL**
- Distributed Generation Laboratory **DERLAB**
- Biomass Laboratory and Biodiesel Production Plant **BioenergyLAB**

- Renewable **Hydrogen** Facilities
- **800 m²** Workshop
- **Experimental Microgrid** that integrates wind, PV, hydrogen systems, batteries, desalination plants, EV charging points, etc.

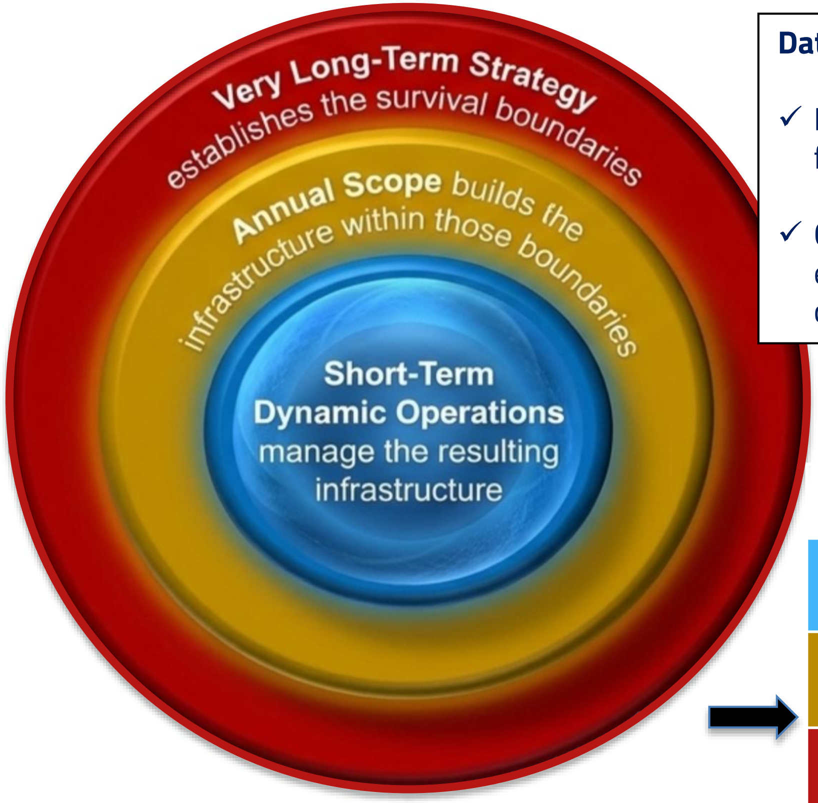
+ outstanding equipment/facilities and qualified team to support the deployment of marine renewable energies and renewable fuels

ITC´s scanning LiDAR

Earth observation data for energy applications

Connecting Copernicus Earth observation with:

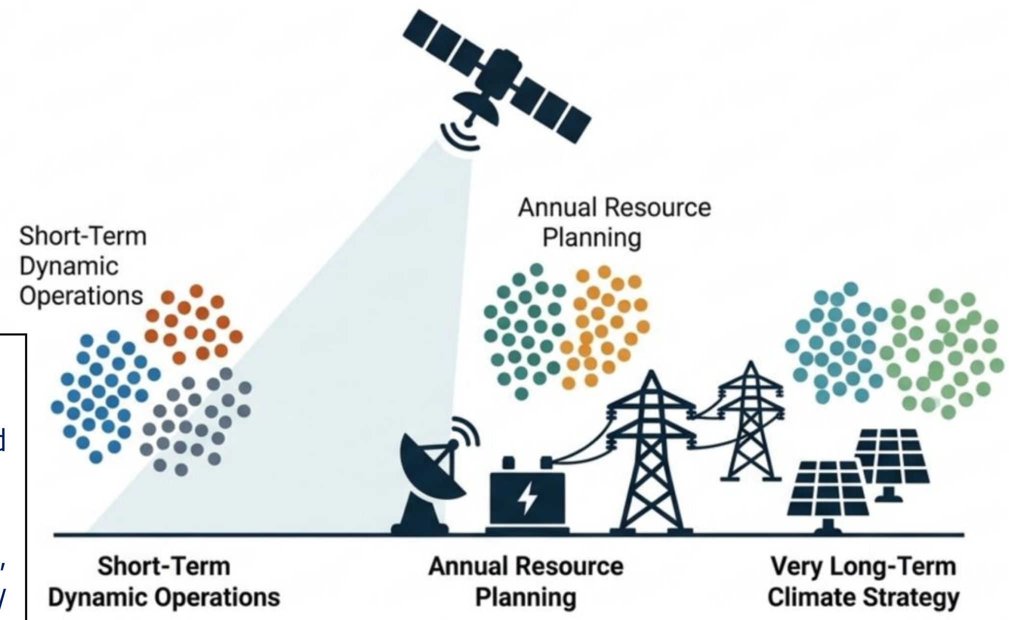
- Real-time EMS dispatch,
- Annual resource allocation (energy planning), and
- Long-term climate adaptation (Climate change studies)



Data Inputs:

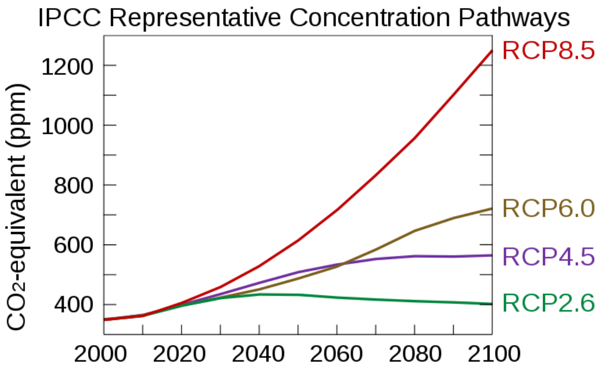
✓ Meteorological data (such as wind, solar) used for RES forecasting.

✓ Climate variables (temperature, humidity, expected rainfall, drought) used for energy consumption forecasting



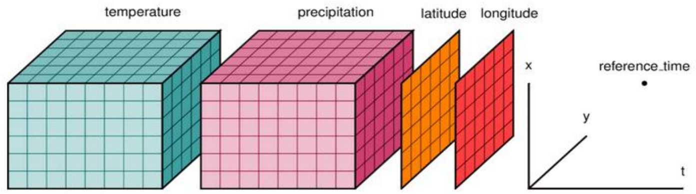
	Projection	Data source	Primary use	Strategic action
	Short-Term	Short-term weather forecast	Energy Management System	Adjust set-points of generator and storage
	Annual Scope	Historical reanalysis dataset	Energy Planning	Estimate required generation vs Demand Side Management
	Long-term projections	Climate scenarios	Risk and vulnerability assessments	Define climate adaptation strategies

Very Long-Term: Climate Change Scenarios



RCP

- 4 Climate Change scenarios.
- They are distinguished in the concentration of Greenhouse Gases.
- Labeled according to the degree of radiative forcing (W/m2).

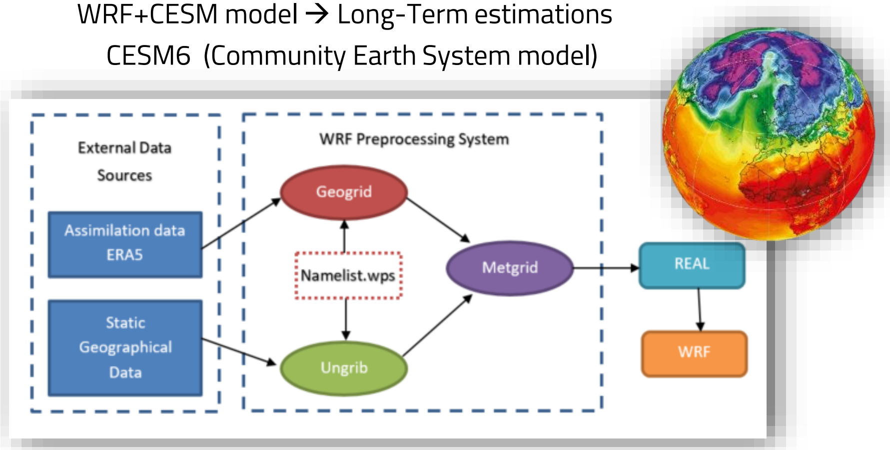


Data structures of **xarray**

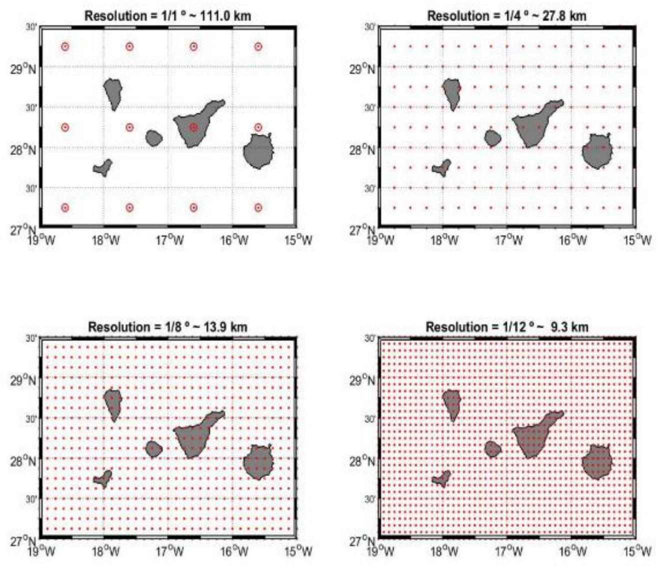
Climate Change Model

WRF+CESM model → Long-Term estimations

CESM6 (Community Earth System model)



NCAR CESM Global Bias-Corrected CMIP5 Output to Support WRF/MPAS Research
ds316.1 | DOI: 10.5065/D6DJ5CN4



Temperature

Increase in annual average **air temperature**

OBSERVED

	SEA LEVEL	PICO DEL TEIDE
Annual average	20° - 21°	below 4°
Maximum	24°	below 10°
Minimum	18° *Slightly bellow in Fuerteventura and Lanzarote	below -2°

PROJECTED

	RCP 2.6 -4.5		RCP 6.0	RCP 8.5	
Annual average	**2100** ↑ 1° - 1.44°		↑ 2°	↑ 2.68°	
Maximum	**2045-2054** ↑ 1 ° to 1.8°	**2090-2099** ↑ 2° to 2.5°		**2045-2054** ↑ 1° to 1.8°	**2090-2099** ↑ 3° to 4.5°
Minimum	**2045-2054** ↑ 0.5 ° to 2°			**2045-2054** ↑ 0.5° to 2°	

Increase in sea level

WILL RISE

FROM

15CM TO 30 CM **by 2100** **under RCP 2.6**

40CM TO 70 CM **by 2100** **under RCP 8.5**

Precipitation

Decrease in annual precipitation; decrease in winter precipitation

ANNUAL AVERAGE ↓

Specially in MOUNTAIN AREAS with larger annual rainfall

Winter precipitation is **more relevant** for total precipitation

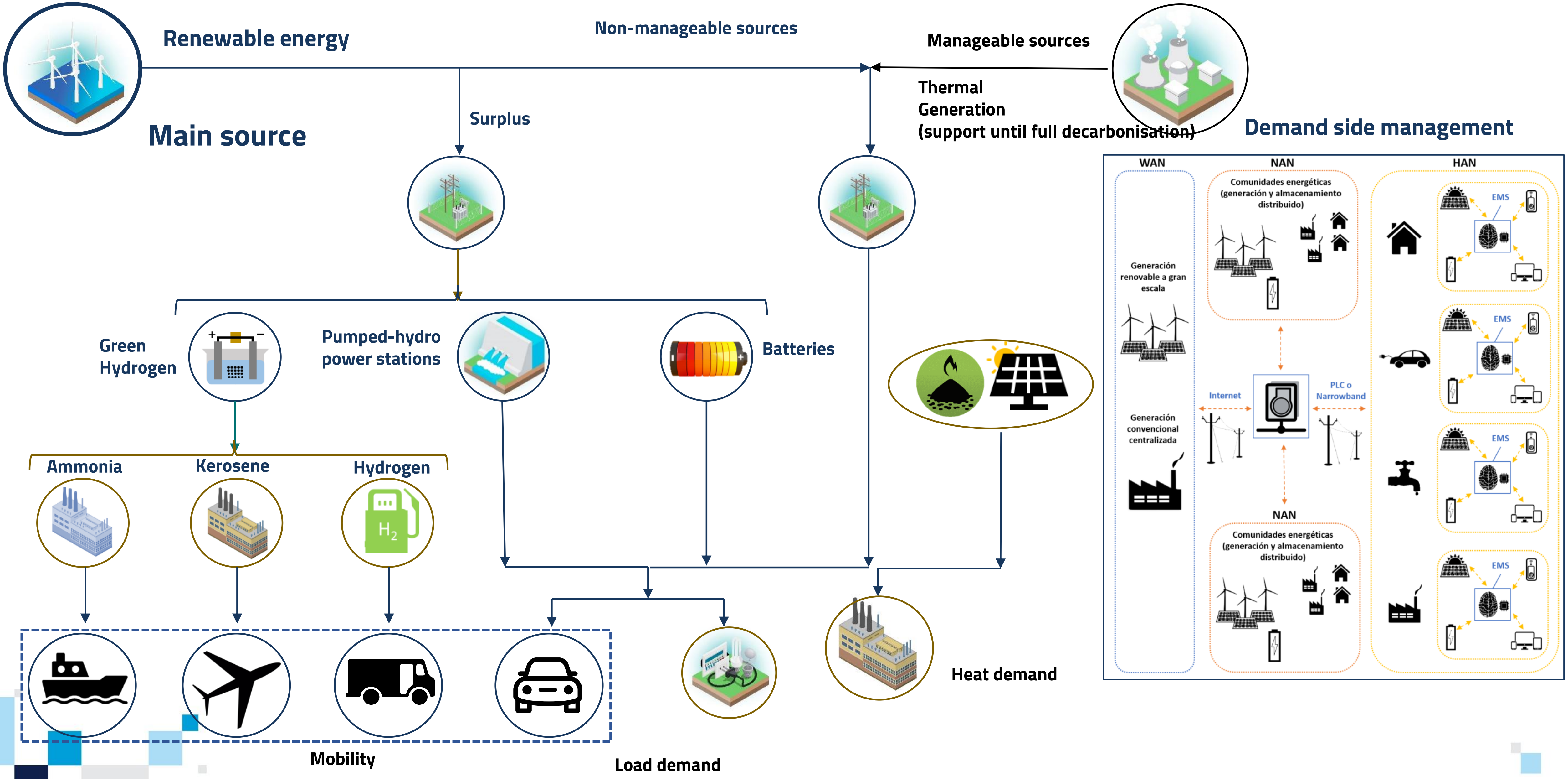
Results are only statistically **significant for small areas** in the islands.

SEASONAL PRECIPITATION ↓

	RCP 2.6	RCP 4.5-6.0	RCP 8.5
Annual average	↓ 10 ± 5%	↓ 19 ± 4% **to** 24 ± 5%	↓ 37 ± 5%

This reduction maybe related with a migration of the Azores high-pressure system in a warmer climate

Planning the decarbonisation of Islands

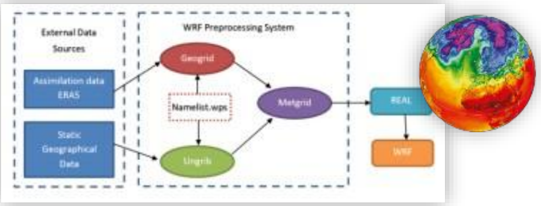


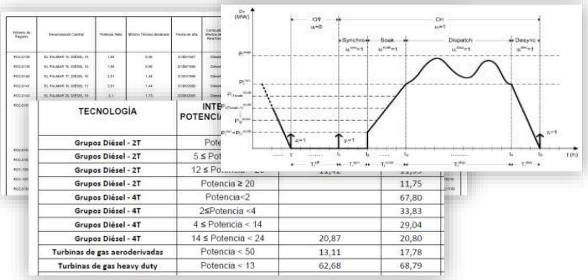
Annual scope. Using COPERNICUS data for energy planning

Input data

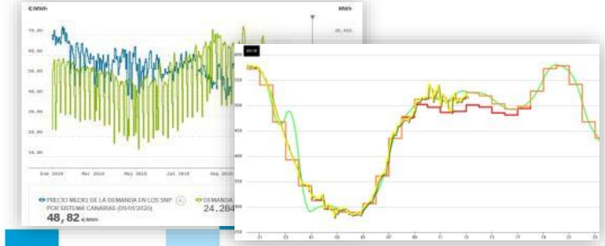
Renewable resource

Long-term climate estimates (WRF + ERA5 + MCP) or RES-generation profiles





Energy-demand data & generation costs



Model execution

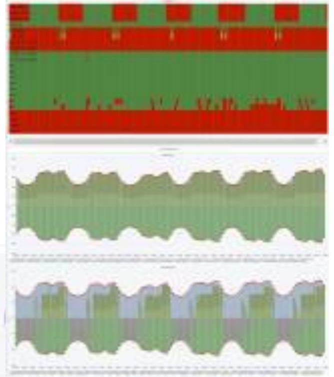
Mixed Integer Linear Programming

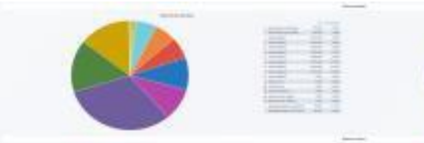
Target function:

$$
\begin{aligned}
min \sum_{t\epsilon T} \Bigg[\sum_{i\epsilon I} \Bigg[\Bigg[\sum_{f\epsilon F} C_{if} \cdot e_{ift} + NLC_I \cdot (u_{it} - u_{it}^{syn}) + \sum_{m\epsilon M} C_{it}^{m} \cdot r_{it}^{m} \Bigg] \cdot \left(\frac{T_{step}}{60}\right) + \sum_{l\epsilon L} SUC_i^l \cdot y_{it}^l + SDC_i \cdot z_{it} \Bigg] \\
+ \sum_{g\epsilon G} \Bigg[C_{gt} \cdot \mathrm{pt}_g^{Import} + \sum_{m\epsilon M} C_{gt}^{m} \cdot r_{gt}^{m} \Bigg] \cdot \left(\frac{T_{step}}{60}\right) \\
+ \sum_{b\epsilon B} [C_{bt} \cdot pbt_{Discharge}] \cdot \left(\frac{T_{step}}{60}\right) \\
+ \sum_{p\epsilon P} \Bigg[VLL_{pt} \cdot pt_{pumping} + \sum_{m\epsilon M} C_{pt}^{m} \cdot r_{pt}^{m} \Bigg] \cdot \left(\frac{T_{step}}{60}\right) \\
+ \sum_{h\epsilon H} [VLL_{ht} \cdot pt_{Houses}] \cdot \left(\frac{T_{step}}{60}\right) + \left(\frac{T_{step}}{60}\right) \cdot VLL_t \cdot d_t^{LNS} + \sum_{t\epsilon T} [Pr_t \cdot Pt_{inefficiency}] \\
+ \sum_{t\epsilon T} [pbt_{Discharge} \cdot Pt_{avaibility}] \Bigg]
\end{aligned}
$$

python™

PYOMO

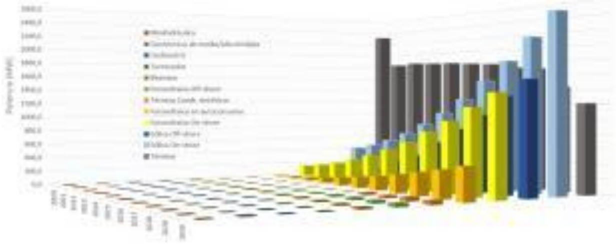




Results

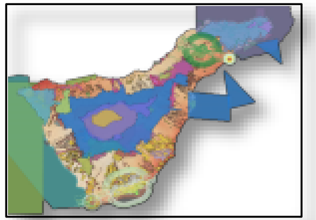
Power optimization

- Minimizing operating costs.
- Optimizing the size and operation of generation and storage units.
- Reserve requirements.
- Demand-side management



- CO_2 mitigation.
- Energy efficiency.
- Energy- and electricity-demand coverage.
- RES integration
- Long-term planning (different scenarios)
- EV's deployment

Minimizing land occupation



ISLA: Insular energy System Long-term Assessment tool

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The energy planning model (EPM) developed by ITC provides a comprehensive optimization model for long-term energy-system planning. The model determines an optimal mix of generation capacity to satisfy energy demand at least cost while respecting strict technical constraints

Key features

- 15-minute time step over one or several years.
- Open source (Python, Pyomo).
- Wide range of technologies (thermal, renewable, interconnections, storage including PHES, batteries, H_2).
- Case-specific technical constraints.
- Possibility of including several simulation scenarios.

What does the EPM do?

- Long-term energy planning.
- Minimizing operating costs.
- RES maximization.
- Energy balance simulations.
- Optimizing the size and operation of storage, renewable and thermal units.
- Management of reserve requirements.
- Renewable integration studies.
- CO_2 mitigation.
- Demand-side management.
- Measure EVs’ impact.

What do you need?

- Renewable-generation profiles (or climate data).
- Energy-demand profiles and generation costs.
- Energy-system data (unit costs, available units, unit size, etc.).

Short-term dynamic operation. From Forecasting to Real-time Energy Management

BIOGREENFINERY PLATFORM

- ✓ **Main goal**: Analyse the fuel alternatives for decarbonisation of transport sector
  - Green Hydrogen
  - Green Ammonia
  - Other synthetic fuels

- ✓ **Off-grid stand-alone solution:**
  - Wind power
  - Solar power
  - Biodiesel (Used Cooking Oils)
  - Batteries

Wind and solar resource assessments and energy forecasting

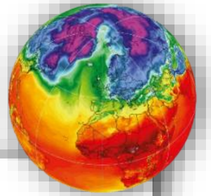
Execution of meteorological and meteoceanic models for the prediction of wind, sun, waves and other variables involved

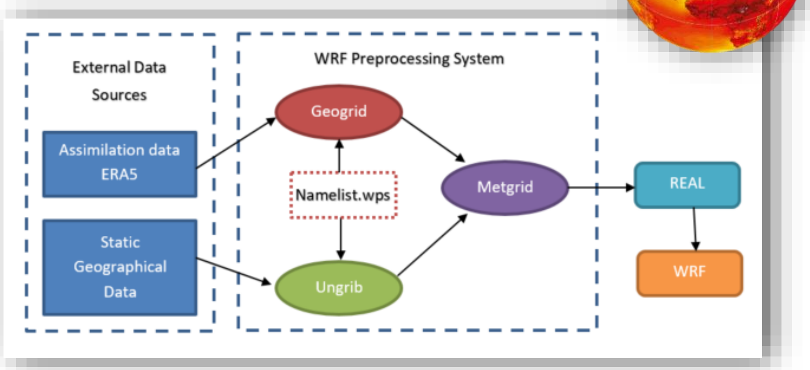
Precise optimization of the location of each wind turbine from an energy point of view. It allows justifying the distance between wind turbines with objective and specific criteria.

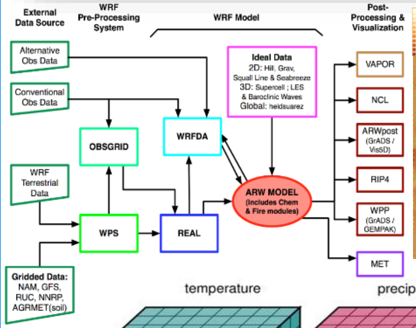
Execution of energy analyzes including Digital Terrain Model (DTM) prepared with LIDAR data to evaluate the influence due to proximity to the coast.

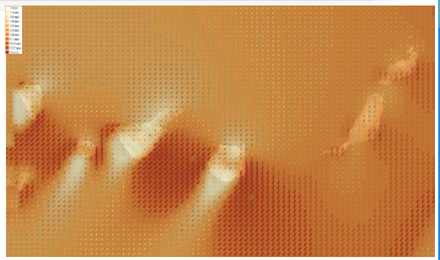
Renewable resource estimate

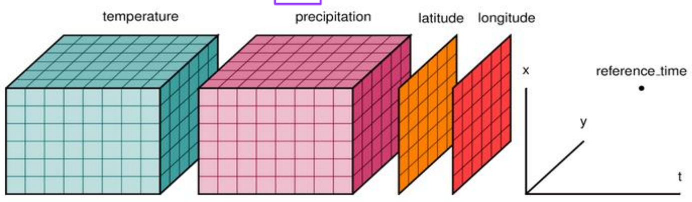
WRF+ERA5 Model → MCP (Long Term analysis)







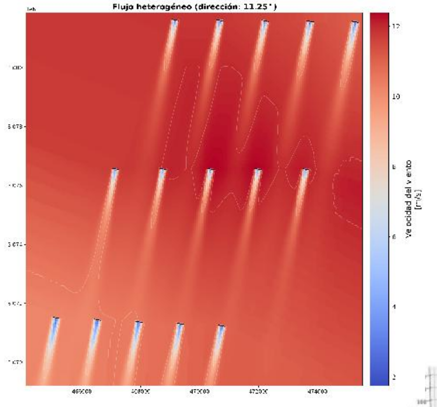


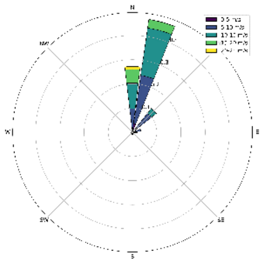


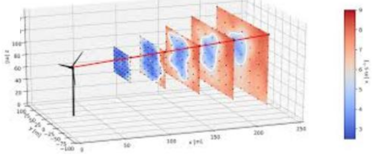
Data structures of xarray

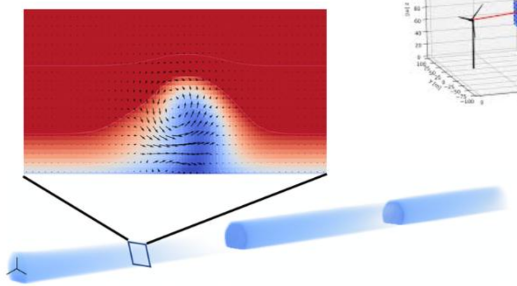
Position optimization using CFD models – Computational Fluid Dynamics

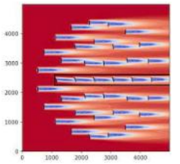
- It guarantees the **highest level of detail technically feasible** today (WRF+ERA5, MCP and CFD).
- Joint influence taking into account the **specificities of each zone** (wind turbine size, easements, etc.).
- Representation based on **GIS** .





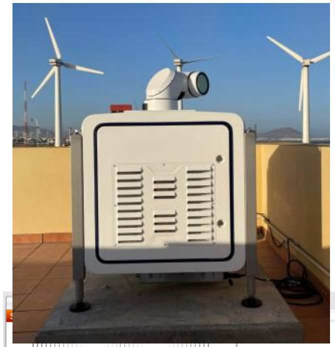


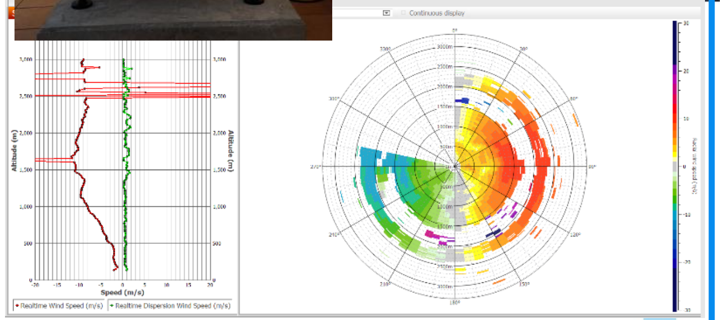




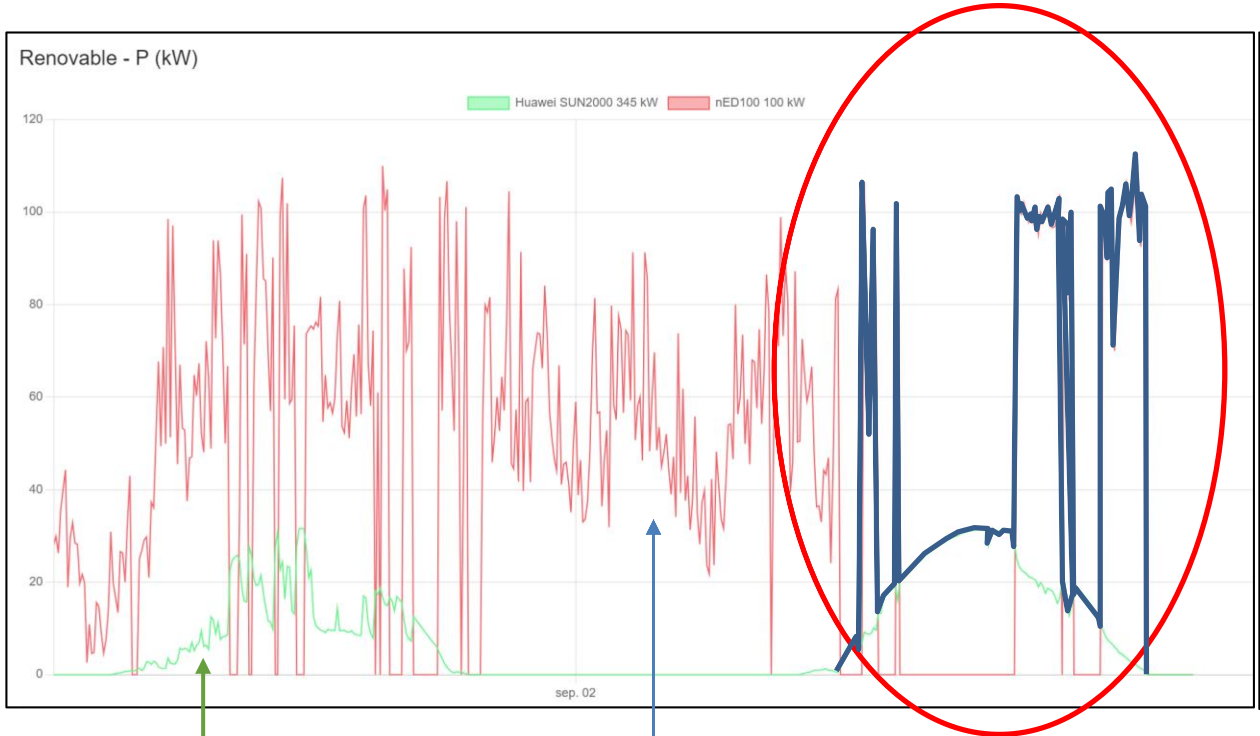
We have a LiDAR scanning system to measure wind resources up to 20 km from the emission point

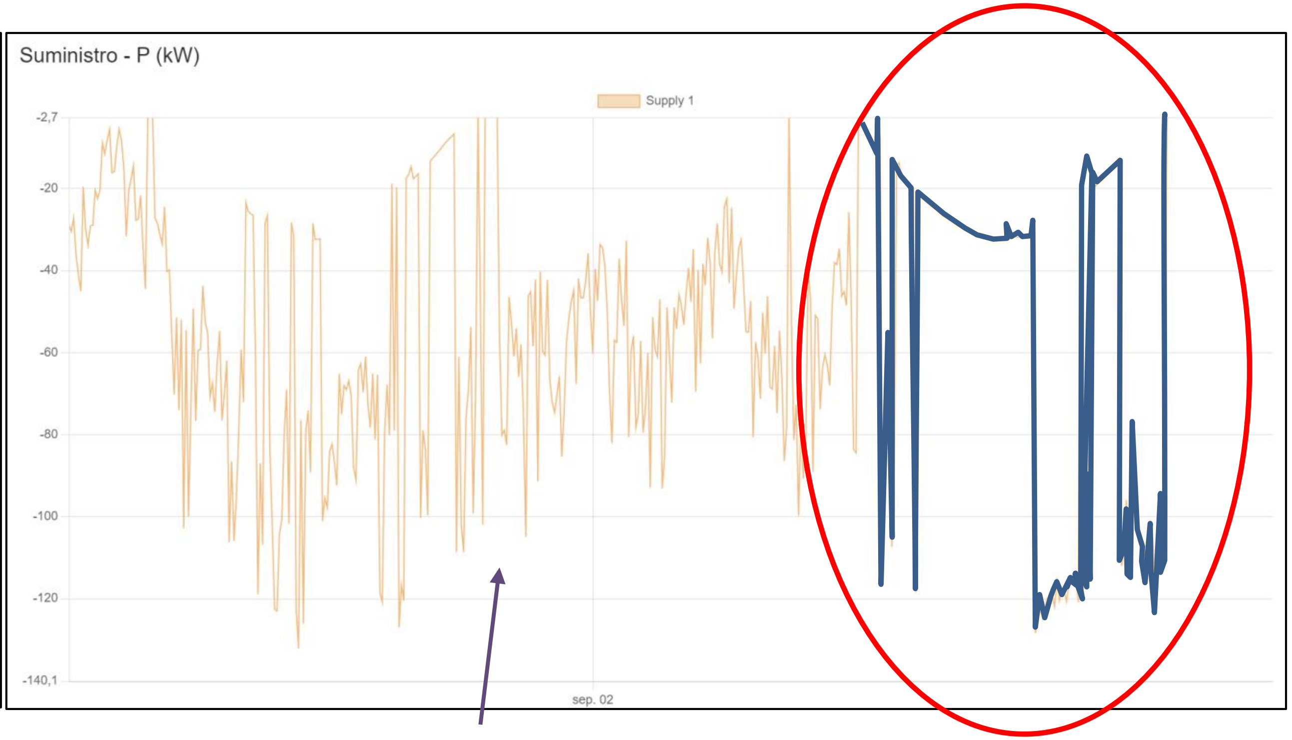
- LIDAR to measure the wind along the entire southeast coast of Gran Canaria (campaign currently underway).
- Produces measurements with high spatial resolutions.
- Measurements up to 300 meters. Analysis of wakes, vortices, turbulence.





Real situation as example of Demand Side Management strategies





Hydrogen production

Solar power

Wind power

The EMS adjusts hydrogen production according to existing RENEWABLE PRODUCTION

100% GREEN HYDROGEN IN AN ISOLATED SYSTEM

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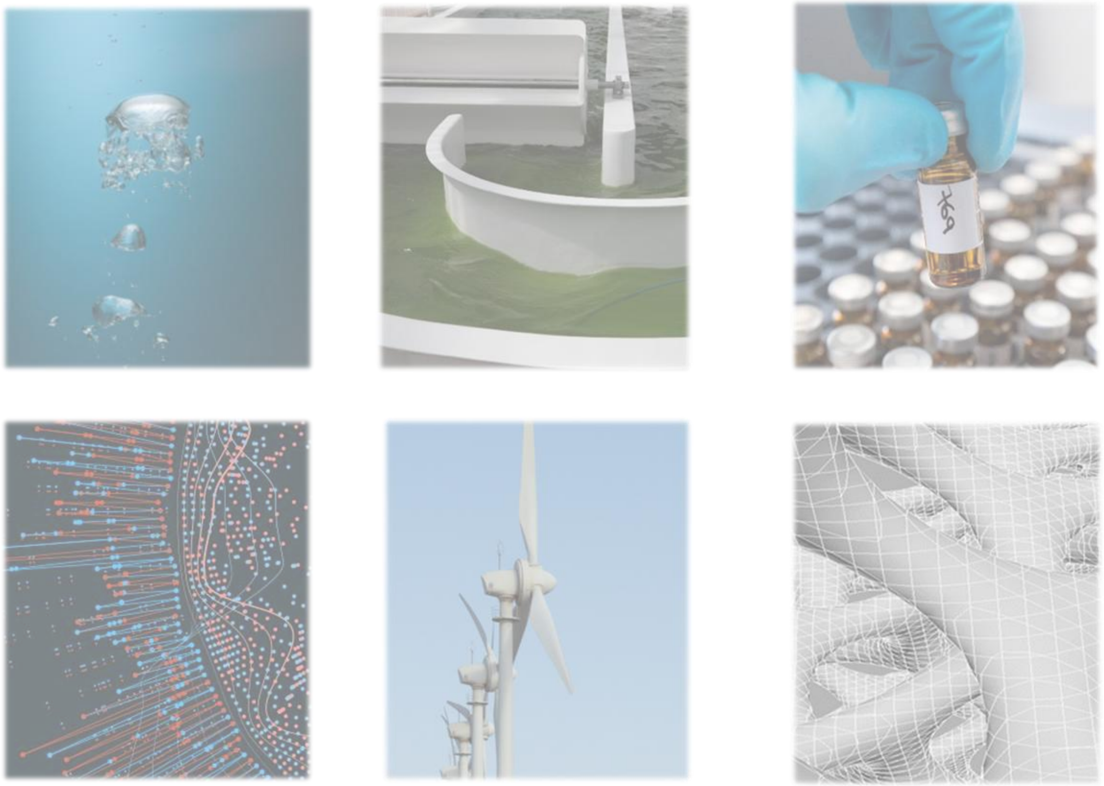

Thank you!

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