# CENER

NATIONAL **RENEWABLE**
**ENERGY** CENTRE

GOBIERNO DE ESPAÑA
VICEPRESIDENCIA TERCERA DEL GOBIERNO
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO
MINISTERIO DE CIENCIA E INNOVACIÓN
Ciemat
Gobierno de Navarra
Nafarroako Gobernua

# WHO

**What is CENER**

CENER, the **National Renewable Energy Centre of Spain**, develops applied research in renewable energies, and provides technological support to companies and energy institutions.

**Our mission**

To generate knowledge in the renewable energy field and to transfer it to the industry in order to boost sustainable energy development.

**Our vision**

To be a research centre of excellence in the renewable energies field with international outreach.

## BOARD OF **TRUSTEES**

Spanish Ministry of Science & Innovation
Ministry for the Ecological Transition & Demographic Challenge
Regional Government of Navarre
Ciemat

## **OFFICES**

Headquarters at Sarriguren (Spain)
Sangüesa (Spain)
Aoiz (Spain)
Seville (Spain)

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# Infrastructures

**Headquarters**
Sarriguren

**Wind Turbine Laboratory** - Sangüesa

**Experimental Wind Farm**
Alaiz


**Microgrid**
Sarriguren

**Biorefinery and Bioenergy Centre BIO2C** - Aoiz

**Solar Testing Field** - Imarcoain

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# Figures

**100M€** Infrastructures investment

**240** Staff employed

**20 M€** Income

**> 1000** Clients around the world five continents

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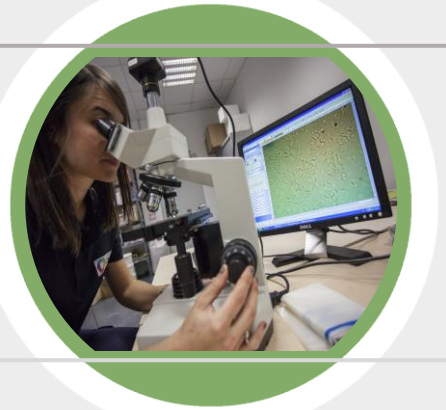
# Flow income from activities

**Commercial** projects

**Competitive** public funding

**Non competitive** public funding

# FOCUS



## R&D

## Technology transfer

## Testing & certification

# CENER

- Renewable Energies Generation
- Energy Conversion & Storage
- Industry Decarbonization & Circular Economy
- Smart and Low Carbon Cities
- Digital Transformation

# GENERATION

OFFSHORE & ONSHORE WIND POWER

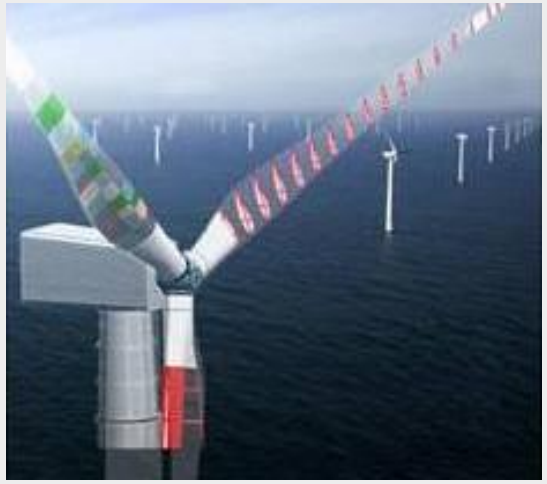
SOLAR ENERGY (PV&CSP)

BIOENERGY

HYBRID PLANTS

SMART GRID FLEXIBILITY

# Offshore and Onshore Wind Power



- Offshore Wind: design and simulation of Floating and Bottom Fixed wind technologies with accuracy adapted to the development stage of every component.
- Wind Turbine and Farm Control: Design and simulation of control that align strategic goals in energy market and turbine health status.
- Blade innovative solutions at every stage of life cycle: airfloils anti-erosion, modular blade, blade adds-on or blade recycling.
- Wind Turbine testing laboratory for blades tips , drive trains, blade materials and unique innovative wind components.
- Experimental Wind Farm, in complex terrain. Six calibrated positions, 5 MW each.

# Solar Energy (PV and CSP)

- Development of components for solar energy: PV cells and modules, Collectors, Heliostats, receivers
- Measuring and characterization devices: Ad-hoc (optoelectronic) devices
- Innovative solar systems: AgroPV, Solar Desalination, Air-based CSP
- Modeling and simulation software: Optical, Thermo-fluid dynamics, electric/electronic, financial and more
- Solar Resource Assessment and PV/CSP energy yield
- Conceptual design, optimization, pre-engineering and techno-economic feasibility analysis
- Materials and coatings for energy

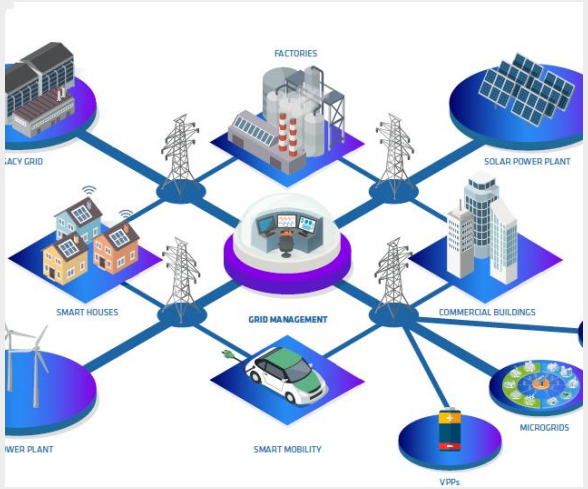
# Solar Energy (PV and CSP)

- Accredited testing laboratory and experimental sites
  - PV Modules and Balance of System (BoS)
  - High temperature solar thermal components
- Inspection services on-field
  - Components testing & calibrations
  - Dron inspections
  - Plant audits

# Hybrid Plants

- Plant design sizing for any generation and demand tech.
- Market price based operation strategy.
- Technical & Economic studies.
- Sensibility studies to resource variability, technical configuration and prices.
- Energy control & management system.

# Smart Grids Flexibility



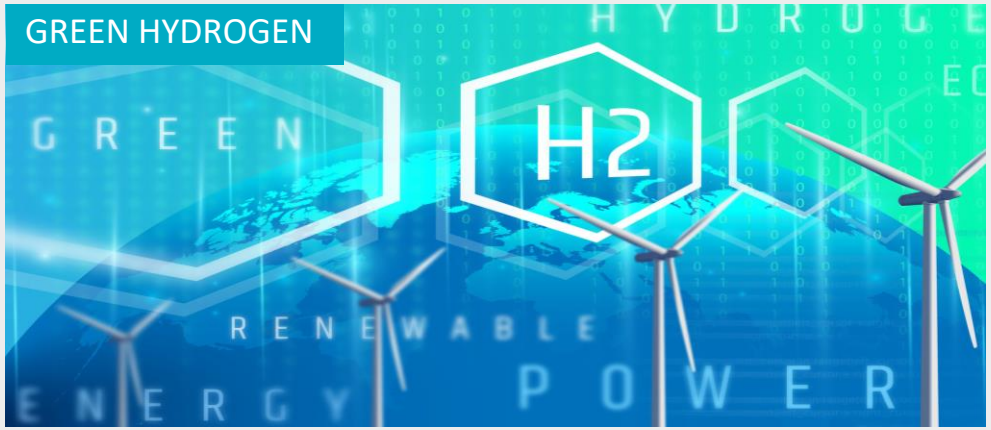

- Control and EMS development
- HIL simulation
- Virtual model simulations
- Energy Comunities
- Power Electronics tests & development
- VE charge management and control systems
- Power Flow Studies

# Bioenergy

- Process and product development, simulations, development trials up to TRL7, and supply & validation of batches of:
  - Solid biofuels: torrefied pellets from biomass & agrobiomass
  - Advanced biofuels: from hydrolysis & fermentation, SAF from HTL & pyrolysis, biomethane from CO2 fermentation…
- Feedstocks: biomass, biowaste, sewage sludge, CO2, etc
- Characterization of feedstocks, solid biofuels and final products
- Modelling and assessing ashes behavior in combustion

# CONVERSION & STORAGE

GREEN HYDROGEN




CHEMICAL ENERGY STORAGE (P2X)

ELECTRICAL STORAGE

THERMAL STORAGE

LOW TEMPERATURE THERMAL STORAGE IN BUILDINGS

# Green Hydrogen


- Production plant design: techno-economic analysis, process diagram, equipment design & power electronics.
- Ad-hoc control & management systems, adaptable to project & client requirements
- Technical & economic studies of the overall $H_2$ value chain
- SOFC & SOEC technology development
  - Cells and stack fabrication: pilot production processing
  - Structural and electrochemical testing & validation
  - Advanced stack & system designs through multi-scale modeling

# Electrical Storage

- Storage design, Sizing & Simulation
- Control & Management systems
- Tests of different technologies
- Model & Management Algorithms development

# Chemical Energy Storage (P2X)

- Development of P2X processes, proofs of concept, development trials, process optimization and validation
- Power to Gas with biological syngas /CO2 methanation for methane production

# Thermal Energy Storage (TES)

- Design and development
- Modeling, simulation and optimization
- Advanced energy management strategies
- Testing and characterization of TES systems and components

# Low Temperature Thermal Storage in Buildings

- Design and simulation of innovative solutions
- Thermally Activated Building Structures (TABS) for heating and cooling
- Seasonal storage of low temperature (District heating)
- Cold storage. Design and simulation of advanced solutions with phase change materials (PCMs)

# DECARBONIZATION & CE

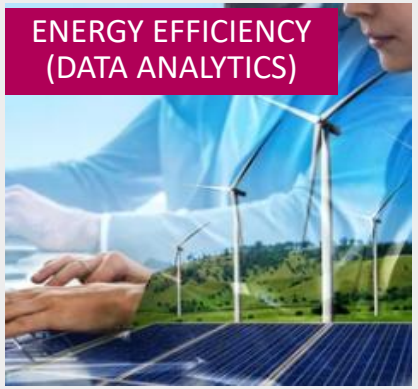
BIOWASTE VALORISATION

BIOBASED PRODUCTS

REUSE & CHEMICAL RECYCLING

LCA & TECHNOECONOMIC ANALYSIS


ENERGY EFFICIENCY (DATA ANALYTICS)



INTEGRATION OF RE IN THE INDUSTRY

# Biomass & Biowaste Valorisation

- Main feedstocks
  - Lignocellulosic biomass
  - Agro-food industry residues
  - Urban biowaste, sewage sludge, HORECA…
  - Industrial biowaste, Kraft lignin

# Into Biobased Products

- Process development, simulations, development trials, optimization & validation of process and product. Pathways:
  - Biomass & biowaste to Sugars
  - Sustainable sugars to biobased polymers & bioproducts
  - Protein fraction to biofertilizers or bioestimulants
  - Lignin to bioaromatics & derived additives
- Ad-hoc downstream. Separation and purification technologies development

# Reuse and Chemical Recycling

- Technology development for recycling mixed waste containing plastics, including composites to fuel & chemicals through hydrothermal liquefaction or pyrolysis

# LCA and Technoeconomic Analysis


- Techno-economic evaluation starting from TRL 3-4
- Environmental & Social Sustainability assessments of biofuels, biomass power & heat, biobased products, bioprocesses, & P2X

# Energy Efficiency in Industry (Data Analytics)

- Modeling and analysis of energy consumption to estimate energy savings and CO2 footprint.
- Big-data analysis. Detection and diagnosis of high consumption anomalies.
- Development of data visualization platforms. Integrating GIS, energy measurements and modelling.
- Development of AI algorithms to support decision-making and systems management

# Integration of RE in the Industry

- Modelling & Simulation
- Conceptual design, optimization, pre-engineering and techno-economic feasibility analysis.
- Components & systems testing.
- Monitoring and performance evaluation

# LOW CARBON CITIES

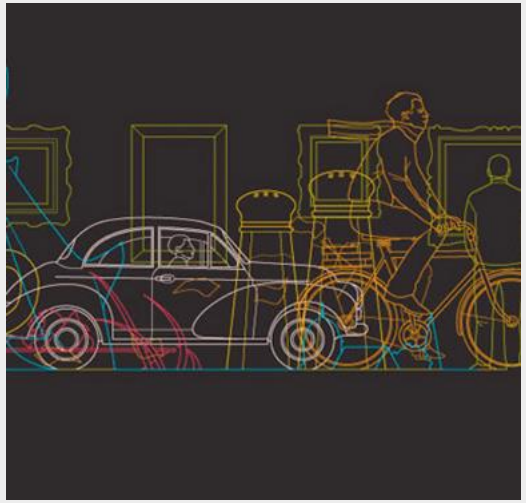
SMART AND LOW CARBON CITIES

POSITIVE ENERGY BUILDINGS

SUSTAINABLE HEATING AND COOLING

GRID INTERACTIVE EFFICIENT BUILDINGS & SMART ENERGY

# Smart and Low Carbon Cities



- Technical support in the urban energy planning. Design and simulation of decarbonization scenarios for districts and cities.
- Development of strategies, methodologies, tools and technical solutions for urban regeneration projects.
- Technical support for Renewable Energy Communities - REC: concept development, scenario simulation, system optimization, and development of tools for REC energy management.
- Development of smart energy monitoring, data visualization and management platforms

# Positive Energy Buildings

- Development of energy concepts towards Positive Energy Buildings – PEB
- Advanced energy modeling of innovative solutions on PEBs. Calibrated simulations and Digital Twins of buildings
- Assessment of RES generation potential in buildings and evaluation of technologies according to cost/optimal criteria.
- Development of knowledge - based decision making tools. Economic and environmental impact studies. Cost-optimal analysis

# Residual Heat Recovery

- Assessment of the potential for utilization of waste heat from thermal processes for HVAC applications in buildings.
- Evaluation of the potential integration of waste heat from different sources (industry, sewage and water supply networks,…) into district scale infrastructures (district heating and cooling).
- Design and simulations of waste heat recovery in data centers for HVAC applications

# Grid Interactive Efficient Buildings & Smart Energy

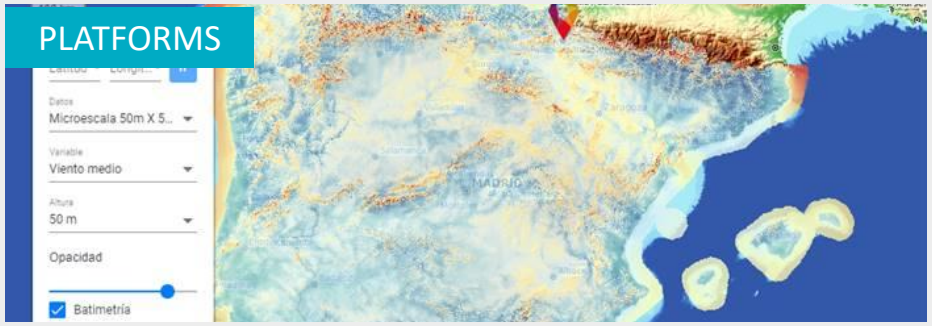
- Design and assessment of demand flexibility for energy systems in buildings. Simulation of demand flexibility scenarios.
- Development, simulation and assessment of smart control strategies, using advanced Model-Predictive and Data-Driven adaptive control algorithms.
- Development of the grid-interactive concept integrating the building to grid communication in the real time energy decision making process.

# DIGITAL

BLOCKCHAIN

GreenLedger

PLATFORMS




POWER PLANT DIGITAL TWIN

ENERGY MANAGEMENT SYSTEM (EMS)

# Thank you for your time!

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