Ciemat

2023 KOREA EUREKA Day

Meet with **SPAIN**

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CIEMAT

GOBIERNO DE ESPAÑA · MINISTERIO DE CIENCIA E INNOVACIÓN · CDTI INNOVACIÓN

Ministry of Trade, Industry and Energy · Eureka TURKIYE · beyond leading technology KIAT Korea Institute for Advancement of Technology · Keit Korea Evaluation Institute of Industrial Technology · KETEP Korea Institute of Energy Technology Evaluation and Planning

CONTENTS

S/T Areas

Energy

- Analysis of Sustainable Energy Systems
- Bioenergy, Bioproducts, and Waste
- Wind and Photovoltaic Energy and Energy Efficiency
- Hydrogen Technologies
- Solar Thermal and Photochemical Technologies
- Science and Technology for Nuclear Fission
- Science and Technology for Fusion Energy

Environment

- Air Quality and Climate Change
- Applied Environmental Hydrogeosciences
- Measurement and Evaluation of Ionizing Radiations
- Soils and Climate Change
- Social Studies

Technologies

- Biomedical Innovation
- Particle Physics and Astrophysics
- Accelerators, Magnets, and Power Electrical Systems
- Medical Applications of Ionizing Radiations
- Scientific Computing
- Materials and Chemistry for Energy Production

Products, services, technologies.

Product 1

Advanced VREs O&M, new materials and recyclability

Product 2

VREs Systems hybridization and grid Integration

Product 3

Energy Efficency

Product 4

Characterization, Modelling & Simulation of systems.

Advanced VREs O&M, new materials and recyclability

PRODUCT 1

Recyclability of wind blades and PV modules

Design, manufacture, tes
demo of 100% recyclable wind blades. (Vitrimers/thermoplastc resins)
Development of recycling process for PV modules (new encapsulating materials/new physical-chemical processes)

New NDT field inspection solutions

UAV boarded technologies
Infrared cameras
US sensors
Radiography (X-ray)
Electroluminiscence

Tools for analysis, detection, characterization and classification of defects

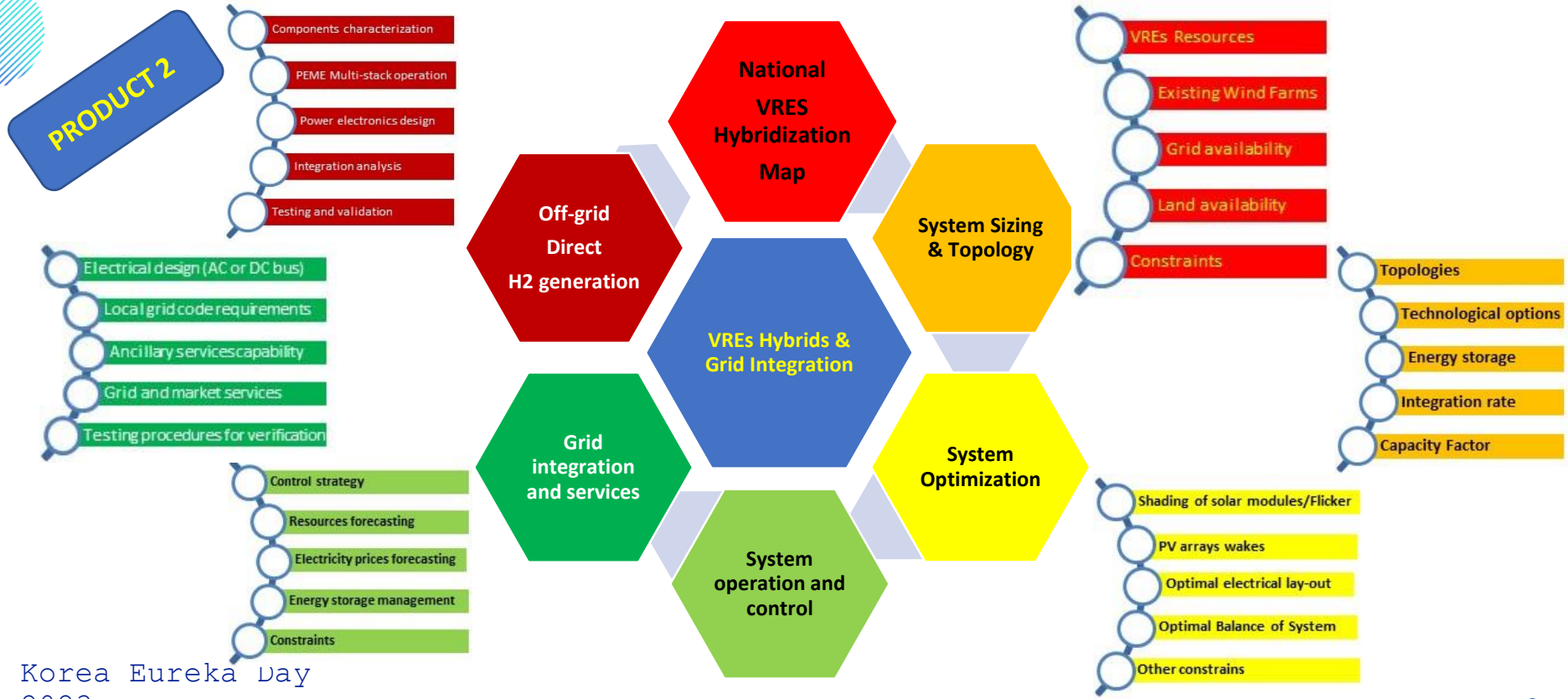
Analysis of failure modes
Strategy for characterization and classification of defects
Accelerated fatigue and degradation test
SoH and EoL determination models
Repairing procedures validation

1) Emerging Materials for a Low Carbon Economy and a S&C Environment.
Safe and sustainability by design
Circular and eco-friendly
Smart and multifunctional

2) Device Integration of Novel Materials.
Photovoltaic devices
Photocatalytic devices
Electrochemical storage devices

3) Tandem Devices and Technology Hybridization.
Tandem
Multifunctional

VREs Systems hybridization and grid Integration



Energy Efficiency

PRODUCT 3

Advanced design of cities, building and envelops

- *Optimizing and innovating in the energy design of cities, buildings and envelopes.*
- *Adaptation of urbanised areas to climate change and mitigation of GHG emissions*

Energy integration in cities, building and envelops

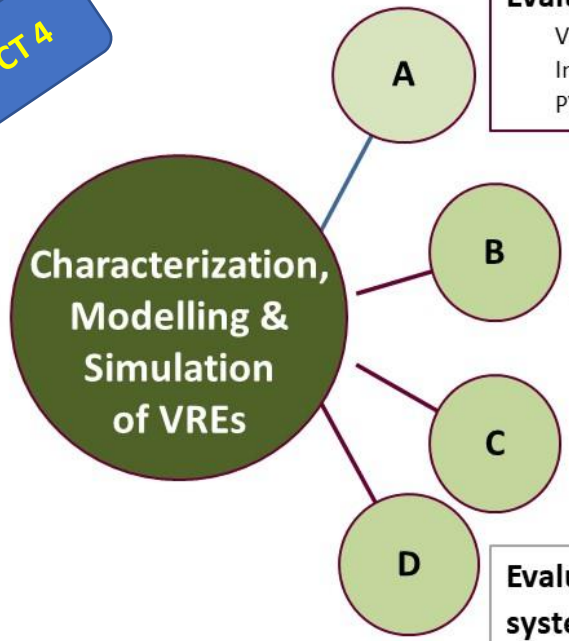
- *Energy systems for buildings and cities. Thermal systems and networks.*
- *Energy systems for buildings and cities. Power systems and networks.*

Sustainable technology development

- *Technology to improve of comfort, both indoor and urban.*
- *Technology to improve of environmental quality, both indoor and urban.*

Characterization, Modelling & Simulation

PRODUCT 4



Evaluation and development of simulation models and tools

VRES Resources: measurement, traceability, simulation and LT prediction
Interaction with climate parameters
PV and Wind turbines components modelling and simulation.

Strategies to increase the reliability of models

Estimation of variability of wind flow and solar radiation
Uncertainty evaluation of the measurement techniques
Development of adapted data quality control procedures

Characterization of PV and Wind devices

Implementation of international standards
Improvement of currently available characterization techniques
Application of advanced testing procedures
Development of optimal data acquisition and analysis procedures.
Methods for ensuring working/testing conditions

Evaluation, development and improvement of models for specific systems and complete power plants

Development of in-house, collaborative and open source software tools and methodologies
Development of digital twins

Main challenges and solutions.

Challenge 1

Sustainability VREs and Operation and Maintenance.

Challenge 2

VREs System integration

Challenge 3

Energy Efficiency

Challenge 4

Characterization, digitalization and modelling

Challenge 1

COST and ENVIRONMNEMENT IMPACT REDUCTIONN

Sustainability VREs and Operation and Maintenance

- Sustainable materials in design and recyclability by design
- Solutions for lifetime extension
- Monitoring technologies
- Automation for O&M
- Digital tools for control and monitoring
- Predicting environmental parameters
- Digital solutions for smart operations
- Sensor technologies diagnostic and response

Challenge 2

MANAGEABILITY AND FLEXIBILITY OF THE POWER SYSTEM

VREs System integration

- Hybrid AC/DC microgrids
- Diversification of renewable energy generation (Hybrid power plants, P2X, Sector Coupling)
- New LT Energy Storage Solutions (I-CAES, REDOX)
- New ST Energy Storage Solutions (Flywheels, Ultracaps)
- New Hybrid Energy Storage Solutions (ST/MT/LT, Electricty + Heat,..)
- Integrated control and monitoring systems
- System simulation,
- Field testing procedures.

Challenge 3

ZERO EMISSION ENERGY SYSTEM

Energy efficiency

- Methodologies for optimisation of the energy design of buildings
- Modular and "plug and play" components for refurbishment.
- New products and processes for new and existing buildings
- ICT for “building-to-grid” and “building-to-building” interactions
- Envelope adaptive to a dynamic environment
- Integration of renewable energy sources in buildings and cities.
- Urban availability of renewable energy sources (geothermal, solar and wind).
- Methodologies and tools for the adaptation to climate change
- Decision matrices based on the analysis of the energy behaviour of components, buildings and neighbourhoods

Challenge 4

DIGITALIZATION OF ENERGY SYSTEM

Characterization, modelling and simulation

- Integrated forecasting of power production and demand
- Digital tools for control and monitoring
- Integrated verification of models for the balance of plant and turbine and PV array and energy storage
- Reinforce mesoscale models and wind resource assessment in ‘complex terrain’
- Energy modelling. performance assesment and control.
- Supercomputing multipurpose environment for simulation of building and cities
- Development of dynamic models predicting reliable energy fluxes in cities
- Procedures for experimental energy performance through system identification techniques (D&V).

Ideas for a Korea – Spain collaboration

Idea 1

Electricity and heat microgrid.

Idea 2

Direct H2 generation with wind turbines.

Idea 3

Advanced materials.(PV and Wind)

IDEA 1

Electricity and heat microgrid

1

Development of microgrids for electricity and heat

Energy

- Development of 100% RES microgrid for heat and electricity supply.
- Microgrid control and monitoring
- Hybrid generation system: Small Wind Turbines, PV, Geothermal
- Integrated forecast tools
- Energy Storage systems
- Testing procedures and research infra structures for smart grids system con trollers
- System simulation of smart grid contr ollers

IDEA 2

Direct H2 generation by wind turbines.

2

Development of power conditioning system

Energy

- Development of power electronics. Topology
- Control strategy for offgrid application
- PEM Electrolyzer multistack
- Integration of hydraulic compression
- Integration of seawater desalination
- Response of PEM EZ to the operating conditions of renewable energies.
- Degradation analysis.
- Electrical Model: static and dynamic response of the EZ.

IDEA 3

Advanced sustainable materials

3

Development of new PV and Wind Blade materials.

Energy

Efficient PV materials.

- Selective contacts
- Alternative light absorbers
- Cadmium-free PV windows
- Hybrid materials
- Metal oxides and co-catalysts
- Immobilized thin films
- Functional construction materials

Sustainable PV and Wind Blade Materials

- Recyclable materials.
- Composites based on waste materials
- Photodegradable materials
- Accelerated lifetime tests

Multifunctional and smart materials

- Chromogenic metal oxides
- Nanostructured multilayer coatings
- Materials to enhance spectral exploitation
- Z-scheme materials
- 3D structures by additive manufacturing

SUstainable and CirCular Economy SyStem for windBLADE

SUCCESS BLADE Project

Objective: The proposal aims to revalorise current downcycled or wasted products from the wind energy sector through a disruptive technology: the use of a new thermoplastic liquid resin, AKELITE patented by CSIC group, for the manufacturing of 100% circular and sustainable wind turbine blades.

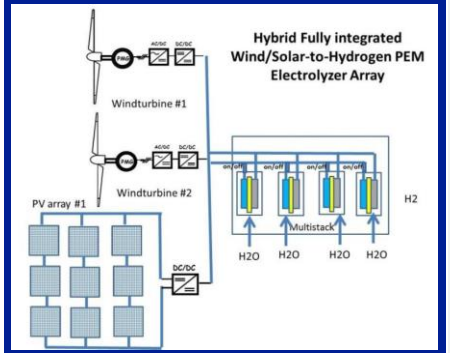
Partners: (Original project)

CIEMAT (WindbBlade manufacturing, testing and recycling procedure), CSIC (Recyclable resin design, manufacturing and testing) and Girona University (experimental characterisation and modelling of structural long-fibre reinforced composite materials)

Potential collaboration: Korean Small Wind turbine manufacturer.

Generation of green hydrogen with low temperature multistack direct coupled to renewable energy

GreenH2CM-LIA1 Project



Objective: Experimental facility for hydrogen generation (multi stack) directly coupled to hybrid renewable generation (solar PV and/or wind) and using a single modular electronic power conditioning system.

Partners: (Original project)

CIEMAT (Wind turbine, photovoltaic array and PEM/AEM electrolyzer simulation, sizing, development of system control, integration in real system (small and medium scale (lab and field test)), testing and characterization of PEM/AEM electrolyzers, modeling of electrolyzers. Integration. design, development and testing of power converters. integration of the generation system and hydrogen (medium scale). Analysis of Integration of water treatment and compression system.

Carlos III University. Power electronics. Control and system simulation.

Potential collaboration: Korean wind turbine manufacturer

Hybrid RES AC/DC Smart grids: Electricity and Heat

- CEDER has a total installed generation power of 230 kW, of which a large part comes from renewable energy sources.
- The electricity is distributed by a 5-km 15-kV power line. That line feeds seven transformation centres which reduce the voltage to 400V. The centre can be disconnected from the utility grid in order to perform off-grid tests.
- The Centre is provided with the infrastructures and equipment to define a micro-grid where carry out the necessary R&D tasks in the development of: generation based on **renewable energies; energy storage technologies** (both off-grid and connected to the mains); and low power generation systems - either isolated or interconnected - in **distributed generation** (DG). The micro-grid is complemented with a **monitoring and communication** grid.

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Thank you!