

WELCOME TO CENER

**WELCOME TO
THE ENERGY OF
KNOWLEDGE**

RENEWABLE ENERGIES ARE AUTOCHTHONOUS, INEXHAUSTIBLE RESOURCES WITH VERY LITTLE ENVIRONMENTAL IMPACT. THEY ARE THE BEST SOLUTION TO COMBAT CLIMATE CHANGE AND THEY HELP ENHANCE SECURITY OF SUPPLY. AS THEY ARE DISTRIBUTED ENERGY RESOURCES, THEY FAVOUR LOCAL DEVELOPMENT AND JOB CREATION

SPAIN 2020:
20%

OF THE CONSUMED ENERGY SHOULD COME FROM RENEWABLE SOURCES, AND THE GLOBAL ENERGY CONSUMPTION AND CO₂ EMISSIONS SHOULD BE REDUCED BY 20%

THE FIRST WIND TURBINE FOR ELECTRICAL GENERATION WAS BUILT BY AMERICAN CHARLES BRUSH (1849-1929) AND IT HAD 144 BLADES MADE OF CEDAR WOOD. IT WORKED FOR 20 YEARS

SOLAR ENERGY RECEIVED BY EARTH REPRESENTS

4,500

TIMES THE CONSUMED ENERGY

“ THE PROPORTION OF NON-HYDRAULIC RENEWABLE ENERGIES IN ELECTRICITY GENERATION WILL GO FROM 3% IN 2009 TO 15% IN 2035... CHINA AND EU WILL LEAD THIS EXPANSION, REPRESENTING ABOUT HALF OF THIS GROWTH”

SOURCE: WORLD ENERGY OUTLOOK/ IEA

“ENERGY CANNOT BE CREATED OR DESTROYED, IT CAN ONLY BE CHANGED FROM ONE FORM TO ANOTHER”

BUILDINGS CONSUME 40% OF ENERGY IN EUROPE. ENERGY EFFICIENCY AND RENEWABLE ENERGIES ARE THE ONLY COST/EFFECT MEASURES TO SOLVE THE PROBLEM



CENER

NATIONAL RENEWABLE
ENERGY CENTRE

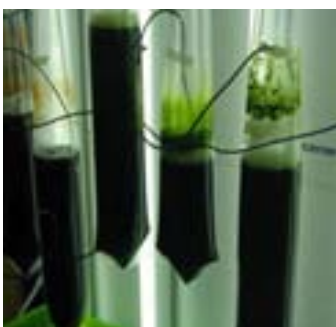
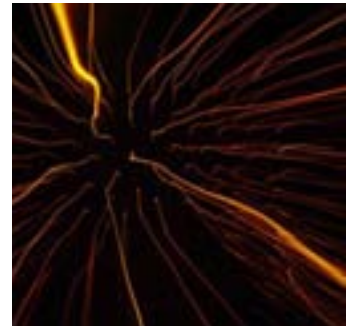
CENER CIEMAT
FOUNDATION

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Research is our tool,
customer satisfaction is
our mission





WHAT IS CENER?

The National Renewable Energy Centre of Spain (CENER) is a technology centre, specialised in applied research and in the development and promotion of renewable energies. It has excellent qualifications and recognised national and international prestige.

The CENER-CIEMAT Foundation started its activity in 2002 and its Board of Trustees is comprised of the Ministry of Economy and Competitiveness, Ciemat, the Ministry of Industry, Energy and Tourism, and the Government of Navarra.

It currently provides services and carries out research work in 6 areas: wind, solar thermal and solar photovoltaic, biomass, energy in buildings and renewable energy grid integration.

Equipped with cutting-edge technological infrastructures, CENER has the most modern laboratories and facilities worldwide. Noteworthy is its Wind Turbine Test Laboratory (a unique infrastructure in the world), its Experimental Wind Farm, its 2nd Generation Biofuel Centre and its Microgrid. CENER's headquarters are located in the City of Innovation (Sarriguren-Navarra) although it has facilities and offices at other locations such as, Sangüesa, Alaiz and Aoiz (Navarra), Seville and Madrid.

WHAT DO WE OFFER?

CENER´S WORK FOCUSES ON THREE DIRECTIONS:

Development of TECHNOLOGY through R&D&I projects, promoting the generation, acquisition and dissemination of scientific knowledge and technical know-how for the industrial sector.

TECHNICAL SUPPORT SERVICE and Provision of highly qualified SERVICES to perform tests and certify components.

Preparation of REPORTS as well as technical and economic feasibility studies.

THE R&D&I PROJECTS CONDUCTED AT CENER COVER THE ENTIRE ENERGY GENERATION PROCESS USING RENEWABLE RESOURCES:

Determination of the Renewable Resource

Development of Simulation and Design Tools

Development of Energy Generation Technology.
Definition and Execution of Tests on Components and Complete Systems

Technological Risk Assessment

Economic Feasibility Study of the Projects

Development and application of Regulation



This effort is carried out with a two-fold purpose: to favour the Competitiveness level of companies in the renewable energy sector, satisfying their R&D&I needs, while at the same time, fostering the Technological and Commercial Development of Renewable Energies.

Permanent contact with customers permits their individual and collective needs to be assessed, as well as their perception of our products and services, to continuously improve them and thus provide the best service.

To achieve this, CENER is committed to achieving results and obtaining customer satisfaction.

All of which is conducted in accordance with the criteria established by international regulations and following demanding standards, in order to ensure maximum quality in the service provided, in efficiency and in research.

As part of the internationalisation strategy we can highlight the participation in the European Energy Research Alliance (EERA). CENER participates in different joint research programmes on renewable energies together with the main European R&D&I centres. On the other hand, CENER forms part of the major European Technology Platforms led by industry. This outstanding international presence in the forums, which contribute to defining the European energy strategy, permits CENER to exercise an influence on the definition of the topics and research priorities on renewable energies both in a national and european scenario.

The Wind Energy Department provides services and conducts high technological value R&D projects for the wind industry. It bases its scientific and technological capacity on its participation in major international, European and national R&D projects, on its activity in leading technical and scientific forums, as well as on the advanced laboratories and test equipment that it offers the sector.

Its extensive collaboration network, with the different players in the sector, enables it to provide a high-value response to its wide array of customers: Manufacturers of wind turbines and components, wind promotion companies, project financing entities and public administrations.

CENER's activities cover a broad spectrum, among which we can highlight: knowledge generation in control, aerodynamics, composites, boundary layer and turbulence, meteorology, sensorisation, material mechanics, structures, hydrodynamics or integrated simulation of the wind turbine; knowledge transfer via the development of specialised technical software; support to its customers' R&D processes; as well as aid in the validation and certification of complete components and wind turbines.

ACTIVITY AREAS AND SERVICES

SUPPORT TO THE DESIGN OF WIND TURBINE COMPONENTS

- Support to aerodynamic and structural design or optimisation
- Characterisation of materials and coatings, oriented towards validation and certification.
- Development of own aerodynamic profiles and assistance in experimental testing of customers' profiles.
- Development of advanced controllers (by way of example: Smartblades, use of new feedforward sensor system).
- Application of control methods and tools (by way of example: Tuning closed-loop identification).
- Assistance in the design of floating platforms with mooring lines (hydrodynamics, aeroelasticity, structural). Offshore structure simulation and optimisation.



DEVELOPMENT OF SOFTWARE FOR CUSTOMER'S IN-HOUSE USE

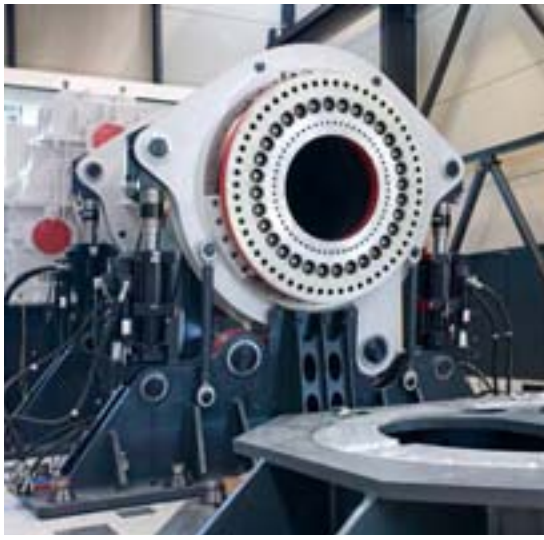
- Aerodynamic codes for 2D and 3D, including compressible regime and deformable profiles.
- Process simulation code for the manufacture of composites.
- Detailed design application tools to make transparent complex calculation in client engineering.
- Dynamic Fluid Codes for advanced simulation of flows in wind farms (by way of example: Boundary layer, turbulence or forest cover).
- Codes to calculate winds and extreme phenomena.
- Dynamic simulation of the wind turbine-foundation assembly, in offshore conditions, anchored to ground and floating, including anchor lines.

SUPPORT TO THE VALIDATION OF COMPONENTS AND WIND TURBINES

- Wind turbine field test according to IEC61400 and MEASNET.
- Test on complete Drivetrain in 6 dynamic functional DOF and accelerated ageing test, up to 8 MW of main action.
- Test on complete nacelle in 1 dynamic DOF up to 8 MW.
- Test on power electronics and generators in 1 dynamic DOF up to 8 MW.
- Static and fatigue test on wind turbine blades according to IEC61400.
- Rental of positions for prototypes at Alaiz Experimental Farm.

SUPPORT TO THE DEVELOPMENT AND OPERATION OF WIND FARMS.

- Assessment of resources via traditional methods and by advanced CFD both onshore and offshore. Extreme velocity and hurricane path studies. Generation of virtual power plants in areas without measurements for long-term correlation. Execution and analysis of measurement campaigns with Lidar.
- High-resolution and statistical anomaly wind and production wind energy maps.
- Numerical calibration for power curve.
- Wind farm prediction system for daily and intra-daily markets, applicable anywhere in the world.



WIND TURBINE TEST LABORATORY

Located in Sangüesa (Navarra), the Wind Turbine Test laboratory (LEA) is an infrastructure engaged in performing tests and trials on wind turbines, ranging from tests on components to tests on complete wind turbines, according to international standards. It also complements the research work of the National Renewable Energy Centre, in the field of wind energy.

The LEA incorporates five cutting-edge test laboratories, which include: Blade Test Laboratory, Powertrain Test Laboratory (including the Powertrain Test Bench, Generator Test Bench, Nacelle Test Bench and Nacelle Assembly Bench), Composite Materials and Processes Laboratory. In addition Field Testing is carried out on Wind Turbines.

EXPERIMENTAL WIND FARM

Located in Sierra de Aláiz (Navarra), here field testing on wind turbine prototypes and their certification is conducted. It has 6 calibrated positions to install prototypes of wind turbines of up to 5 MW each, and 6 additional 120-metre high, meteorological towers.

The test infrastructures of the Wind Energy Department permits a reduction in the time required to launch new prototypes onto the market, reducing uncertainty thanks to the support of CENER throughout all phases: from the design to the validation in the laboratory and finally at the experimental farm.



THE CENER WIND TURBINE
TEST LABORATORY
COMPRISES THE LATEST
GENERATION OF EXPERIMENTAL
FACILITIES FOR
PROTOTYPE DEVELOPMENT:

WIND TURBINE TEST LABORATORY (LEA)

BLADE TEST LABORATORY

POWERTRAIN TEST LABORATORY AND ELECTRICAL TESTING

(Including: Powertrain Test Bench, Generator Test Bench,
Nacelle Test Bench and Nacelle Assembly Bank)

COMPOSITE MATERIALS AND PROCESSES LABORATORY

WIND TURBINE FIELD TESTING

EXPERIMENTAL WIND FARM

PHOTOVOLTAIC SOLAR ENERGY

The R&D&I activities focus on aspects related to photovoltaic cells, where work is carried out on the characterisation and integration of new materials, and the development of production processes, as well as on the innovation and improvement of other photovoltaic installation components, such as trackers, inverters and photovoltaic modules for specific applications.

The R&D&I activity is complemented with component validation and certification services, including for electricity generation photovoltaic plants.

Thanks to the diverse technical qualifications of its members, the Department includes activities that vary from the study of cell materials and technologies, to the photovoltaic installation once finished and producing energy.

The Department is made up of two knowledge environments: Photovoltaic systems and photovoltaic cells.

THE AREAS OF ACTION WHERE THE RESEARCH IS CARRIED OUT AND SERVICES ARE PROVIDED ARE

TECHNICAL AND ECONOMIC ASSESSMENT on the feasibility of PV plants, including execution and commissioning phases. Complete due diligence of PV plants. Design and preliminary projects of PV power plants.

TESTS ON PHOTOVOLTAIC MODULES. CENER is a laboratory accredited by ENAC for testing all PV module technologies (IEC-61215, IEC-61646, IEC-62108 and IEC-61730), and it forms part, as a Testing Laboratory (TL), of the Certification Body Testing Laboratory (CBTL) scheme of the IECEE.

CENER has an agreement with Underwriter Laboratories (UL) for testing PV modules, whereby they recognise all tests performed by CENER under IEC and UL standards.

Tests on operating conditions of PV INVERTERS (including PO 12.3) and verification of main parameters.

OPTICAL, ELECTRICAL AND STRUCTURAL CHARACTERISATION of materials for PV cell manufacture.

Testing and characterisation of PV cells with diagnoses to improve efficiency aspects.

PROCESS AND TECHNOLOGY DEVELOPMENT FOR PV CELLS (wafer-based silicon in industrial size of 15cm x 15cm)

Consultancy and bankability studies on production environments of PV components (materials, cells, modules). Technical assessment and viability analysis.



INFRASTRUCTURES

- Photovoltaic module test laboratory
- Pv inverter laboratory
- Characterisation of photovoltaic cells and materials Laboratory
- Pilot line for the PV cell production process

HIGH, MEDIUM AND LOW TEMPERATURE SOLAR THERMAL ENERGY

The Solar Thermal Energy Department offers technological services and performs applied research activities related to the thermal use of solar energy. Its main objective is to contribute to the improvement of solar thermal technologies and thus facilitate their market penetration.

The R&D&I activities focus on the development of tools for the simulation and calculation of components and complete solar thermal plants, the design of advanced components and new measurement techniques. Large-scale models are also developed to determine the solar resource and for its short-term prediction.

THE AREAS OF ACTIONS WHERE IT CARRIES OUT RESEARCH AND PROVIDE SERVICES ARE:

Assessment and characterisation of systems and components, including tests according to standard.

Measurement and characterisation of solar radiation.

Modelling, Simulation and Design of low, medium and high temperature components and systems (Thermosolar Power Plants - TSPP).

Development and adaptation of computer tools for the optical analysis of energy systems and components.

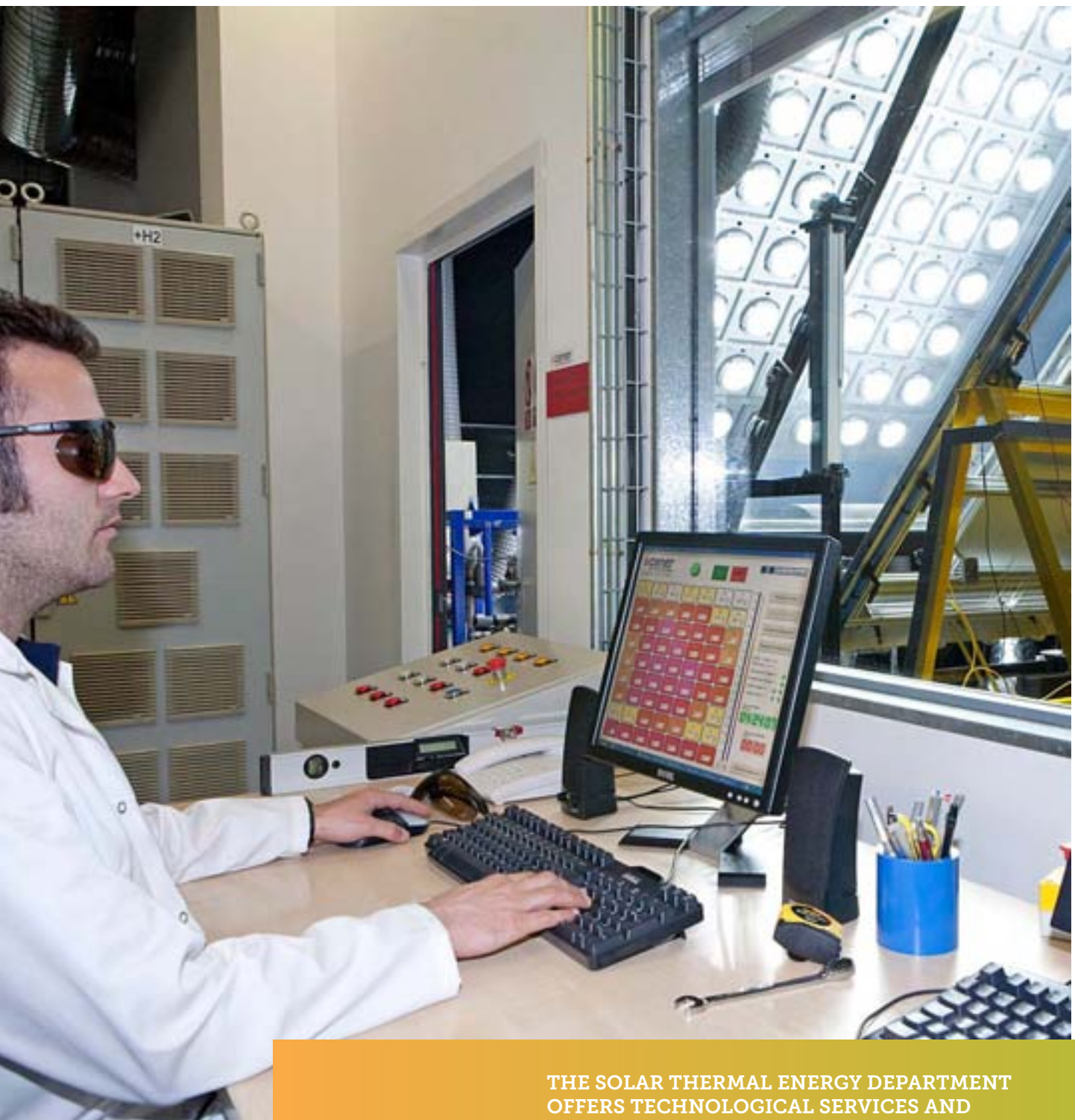
Technical and economic feasibility studies of TSPP and optimisation studies.

SOLAR THERMAL TEST LABORATORY

Characterisation tests are performed on collectors and systems for domestic applications, characterisation tests on thermosolar power plant components, characterisation of bespoke sensors for solar radiation and general or special tests.

INFRASTRUCTURES.

BSRN Station (Baseline Surface Radiation Network)
Outside Sensor Calibration Laboratory
In-House Collector Test Laboratory
Outside Collector Test Laboratory
Outside Solar System Test Laboratory
In-House Thermosolar Power Plant Component Laboratory
Parabolic Cylinder Collector Receiver Tube Test Laboratory



**THE SOLAR THERMAL ENERGY DEPARTMENT
OFFERS TECHNOLOGICAL SERVICES AND
PERFORMS APPLIED RESEARCH ACTIVITIES
RELATED TO THE THERMAL USE OF SOLAR
ENERGY**

BIOMASS ENERGY

The CENER Biomass Department performs applied research activities in the field of biomass energy, providing services and technical advice to all the agents of the sector: operators and developers of biomass plants, public entities, local administrations and autonomous communities. Its aim is to contribute to the improvement of the technical-economic conditions of use of this type of energy. Thus, both the services and the R&D&I activities are designed in agreement with the needs detected and the market requirements.

The R&D&I activities include the development of solid bioenergy vectors, energy crops, and life cycle and sustainability studies. Bioalcohol production processes are developed based on alternative raw materials, as well as microalgae cultivation, extraction and conversion processes. On the other hand, work is carried out to optimise gasification processes and other thermo-chemical processes.

The Department activities cover the entire energy use chain of agricultural and forest biomass and the recovery of waste, from resource assessment to energy generation technologies.

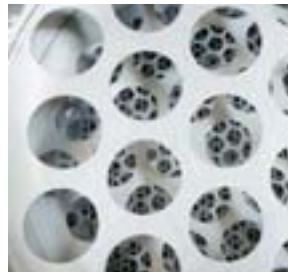
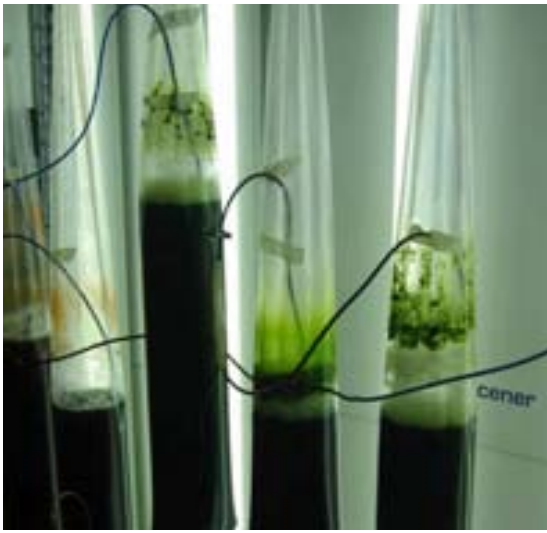
THE AREAS OF ACTION OF THE DEPARTMENTS ARE: ASSESSMENT, PRODUCTION AND SUSTAINABLE MANAGEMENT OF BIOMASS.

BIOFUELS.

It develops R&D&I activities and technical services to obtain solid biofuels, biodiesel and bioethanol, as well as for the energy recovery of microalgae.

THERMO-CHEMICAL APPLICATIONS:

- Roasting, for the production of bioenergy vectors.
- Gasification.



BIOFUEL LABORATORY

The following activities are carried out in this laboratory: biomass characterisation, pretreatment of lignocellulosic materials, enzymatic hydrolysis and fermentation, biodiesel and/or bioethanol characterisation and chromatographic techniques.

2nd GENERATION BIOFUEL CENTRE - CB2G

This centre is designed to develop and validate new 2nd generation biofuels production processes on a pre-industrial scale (bioethanol and biodiesel), to help reduce the time required to launch these processes onto the market and the risk associated with them. At these facilities, it is possible to process a wide range of biomasses (herbaceous and woody), include a wide range of pretreatments for the different biomasses and conversion processes, have the capacity to develop production processes for a wide range of 2nd generation biofuels, and operate continuously in endurance tests, simulating industrial conditions, so that the results obtained and the developments carried out can be applied at an industrial scale.

ENERGY IN BUILDINGS

This area engages in the study of energy applications in urban environments, placing special emphasis on the integration of renewable energies and energy efficiency into buildings. In this way, it brings us a step closer to the scenario of zero-energy buildings, and of smart cities and low emissions.

It carries out projects for public administrations and private enterprises, collaborating with architects, manufacturers and energy service enterprises, developing technical consultancy and R&D work, aimed at applying energy saving criteria and integrating renewable energies into urban environments.

All of this is possible thanks to the high qualifications and specialisation of its technicians, and to the across-the-board application of all the issues and technologies that are developed at CEER.

THE MAIN LINES OF ACTION INCLUDE:

- Energy and environmental consultancy in buildings
- R&D projects related to energy in building
- Integration of renewable energies into buildings.
- Technical due diligence in energy efficiency projects
- Development and optimisation of construction elements and systems



Construmat Award 2005

Award-winner as one of the best buildings presented at the International Conference GBC / Sustainable Building 2005, in Tokyo.

RENEWABLE ENERGY GRID INTEGRATION

Its aim is to research and develop the systems that will permit greater and better renewable energy integration into the electricity grid. Analyses are performed in the department, of problems that might arise in the electrical system due to an increase in the penetration of renewable energies in the energy mix, proposing measures aimed at a proper management of the system, including distributed generation and energy accumulation systems.

THE AREAS OF ACTIONS WHERE IT RESEARCHES AND PROVIDES SERVICES ARE:

HIGH VOLTAGE AREA

It studies aspects related to the protection of installations against atmospheric discharges, such as lightning bolts:

The main activities are:

Lightning protection

- Lightning discharge risk assessment of installations
- Design of lightning protection and prevention systems

Design of grounding systems

- Complex soils
- Frequency behaviour

GRID INTEGRATION AREA

It develops activities to solve and improve the integration of RES into the grid, combining theoretical and experimental analyses.

Its main activities are:

- Analysis of the performance of machines and wind farms when faced with transitory phenomena and above all with voltage dips;
- Distributed Generation Systems. Design of smartgrids;
- Power flow studies in stationary and dynamic regime with specific software (PSS/E).

ENERGY STORAGE AREA

It develops activities related to the study and integration of energy storage systems as a fundamental solution for energy management, permitting a greater integration of hard-to-manage renewable energies into the grid.

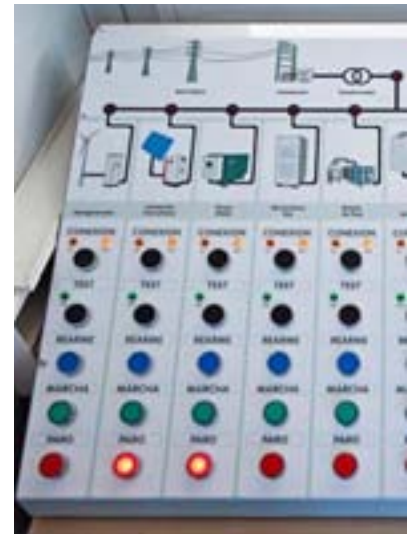
Its main activities are:

Study of different Energy Storage Systems

- Electrochemical systems: Hydrogen technologies, Flow batteries, Conventional and Advanced batteries;
- Others: Flywheel, supercapacitors, ...
- Virtual Energy Storage and Energy Management: Energy storage in Cold warehouses, Desalination, Electric Vehicles, electrolyzers, ...

Technical and economic feasibility studies of Energy Storage Systems and Renewable Energies integration. Development of preliminary project designs.

- Simulation and Experimental Studies on renewable plants (wind farms and photovoltaic energy) with ESS.
- Study of energetic scenarios in the medium-long term.



MICROGRID

The microgrid developed by CENER is focused on industrial applications and its main objective is to cover the energy consumption in industrial estates.

It has been designed as a demonstration pilot plant and as a test bench for different technologies: power generation, energy storage and control systems.

The microgrid comprises renewable generation systems (wind power and PV energy) and conventional power generation, energy storage devices (flow and advanced batteries, supercaps, etc.), as well as programmable and real loads, such as industrial estate lighting, LEA loads, etc.

TECHNICAL COMMITTEES

Representative of Spain in the Renewable Energy Working Party
(International Energy Agency)

Task 11 Operator Agent of the Implementing Agreement on Wind Energy
(International Energy Agency).

Chairman of the SolarPACES Technical Committee
(International Energy Agency)

European Energy Research Alliance (EERA).

Technological European Platforms (TP Wind, etc.).

European Renewable Industry Associations.

Member of MEASNET.

Representative of Spain on the Executive Committee for the Implementing
Agreement on Photovoltaic Systems (International Energy Agency).

European Wind Energy Academy node for Spain

Member of sub Committee 82 of the PV IEC Standard

Member of sub Committee 88 of the Wind Energy IEC Standard

Member of the AENOR Technical Committee 94 on Solar Thermal Energy

CEN Working Group Energy Demand Management Committee

AEN/CTN41/SC9 Sustainable Construction (AENOR Committee)