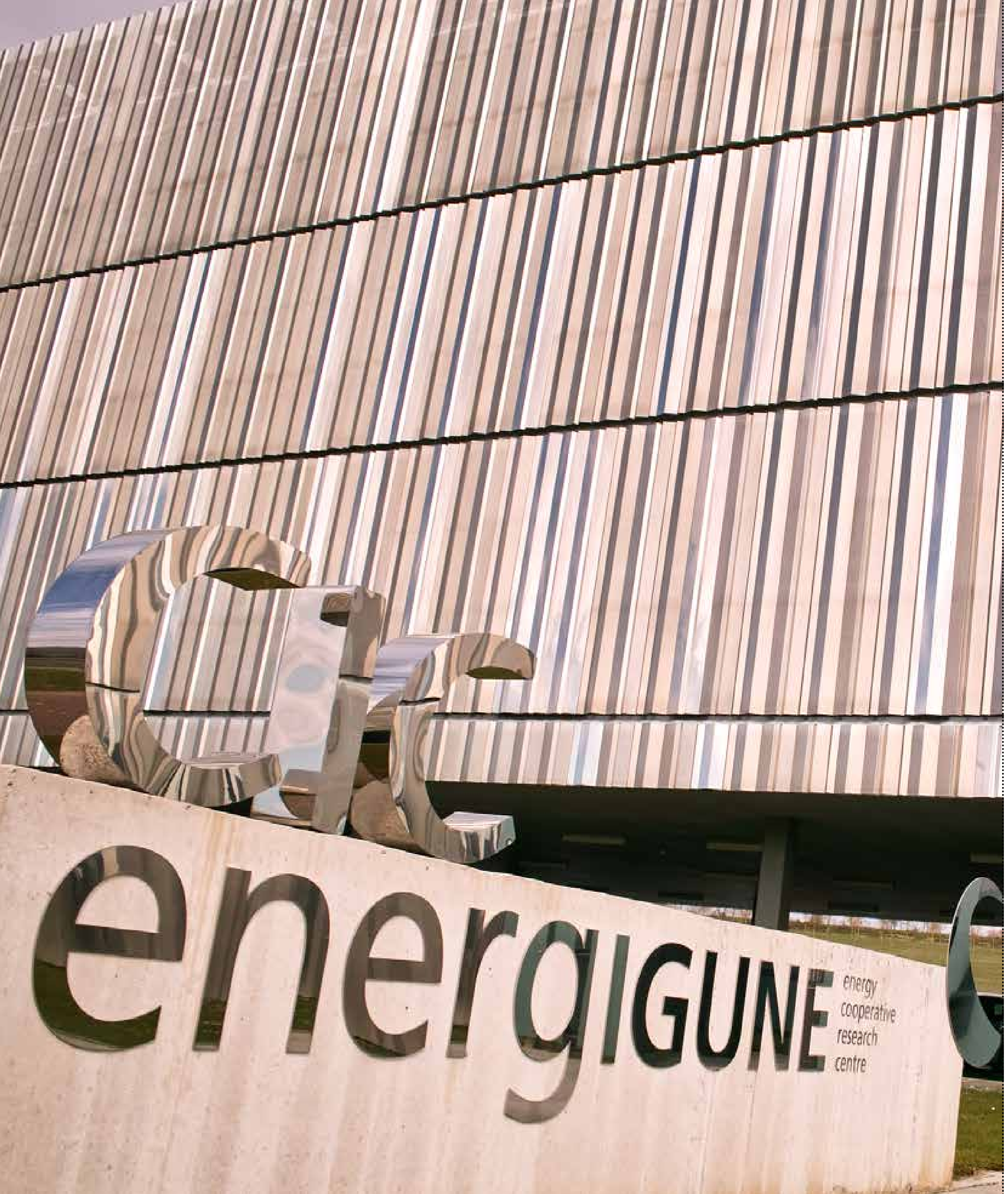
CIC ENERGIGUNE

REPORT OF ACTIVITY 2008-2012

2012 2008


cic
energiGUNE
energy
cooperative
research
centre

The conversion of the Enerlan Foundation to the CIC Energigune Foundation marked the start of our activities. During 2008, following a process of analysis, it was decided to focus the areas of investigation on two methods for storing energy: electrochemical, for batteries and supercapacitors; and thermal, especially for high temperature applications, operating at more than 250° C. The decision to reduce the number of areas of investigation was based on the idea of providing a centre with sufficient critical mass to be able to compete with similar centres working in these fields at an international level; and also taking into account the inevitable adaptation of the energy system in the future, and the fact that the issue of storage will become ever-present in many applications. The centre is also intended to act as a vehicle to increase the competitiveness of energy related Basque companies.

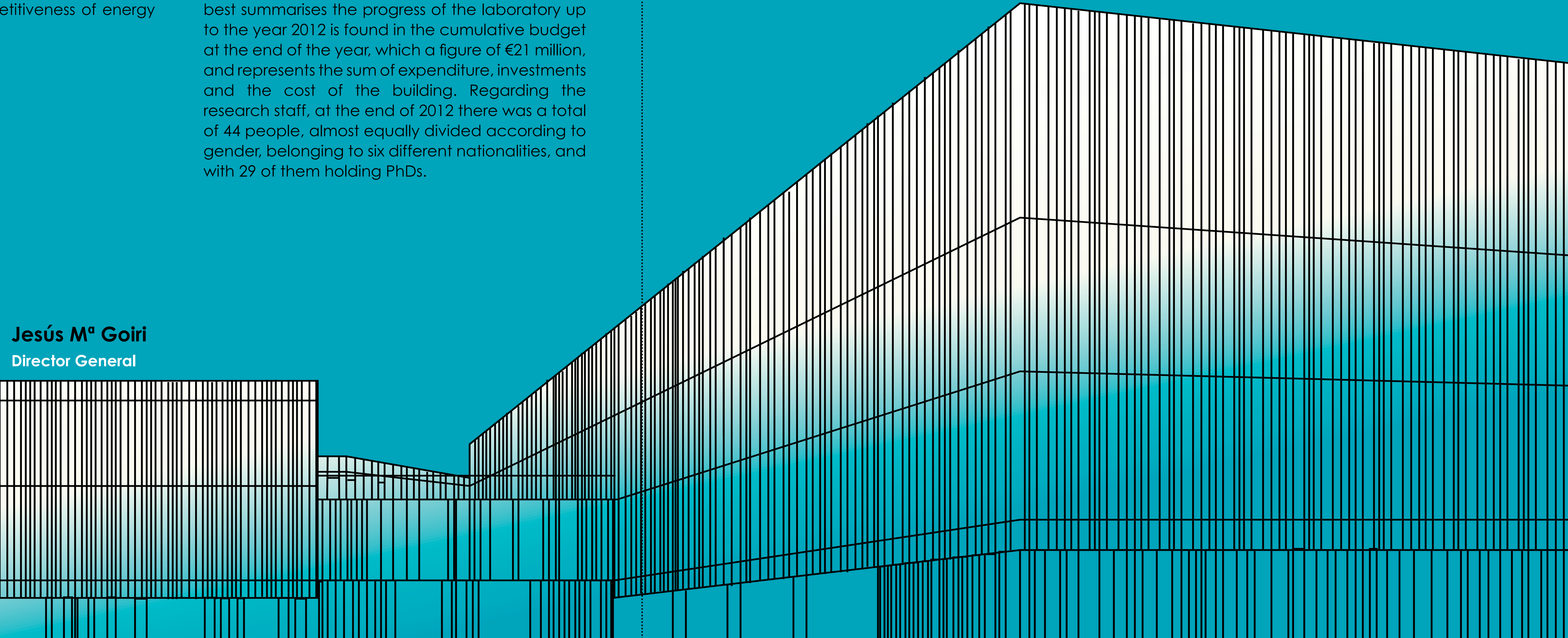
Jesús Mª Goiri
Director General

Milestones to highlight during the period 2008-2010 include the allocation and construction of the CIC Energigune laboratories in Miñano, Vitoria-Gasteiz; parallel efforts to design and equip the laboratories; and even more crucially, the recruitment of the first scientific staff; the setting up of the various advisory committees; and the selection of the scientific directors for each area. Outstanding among all of this was the appointment of Professor Teófilo Rojo as head scientist of the Electrochemistry laboratory section, the endeavours to acquire the scientific equipment, and the work to define the management of the laboratory, led by the Director of Corporate Development, Mr José Castellanos.
The official opening of the laboratory took place on 10 June 2011, in the presence of the Basque regional president Patxi López. The number that best summarises the progress of the laboratory up to the year 2012 is found in the cumulative budget at the end of the year, which a figure of €21 million, and represents the sum of expenditure, investments and the cost of the building. Regarding the research staff, at the end of 2012 there was a total of 44 people, almost equally divided according to gender, belonging to six different nationalities, and with 29 of them holding PhDs.

With respect to the parameters that measure the productivity of a research centre, it should be noted that after the first full year of operation CIC Energigune had produced 26 publications in high impact journals, a European project, and had applied for four patents, one of them shared with the German DLR. As many as 63 researches participated in conferences during the period, and 14 events were organised, among which I would highlight "Power our Future", held at the Palacio de Villa Suso, Vitoria-Gasteiz, which was attended by 140 delegates and saw 28 papers presented by authors of the highest level within the field of electrochemistry.

In conclusion I would note that the period 2008-2012 has seen the creation of an entirely new laboratory to work in a high-profile field with great industrial importance – the storage of energy – which has a research staff of the highest quality, and whose future importance is beginning to be acknowledged by the international scientific community working in our field. The situation in which we find ourselves at the end of 2012 indicates that it will be possible for the research centre to achieve the goals for 2016 envisaged in the Strategic Plan approved by the Board of the CIC Energigune Foundation that will situate the centre among the most prominent in its field in Europe.

Vitoria-Gasteiz



1 CIC Energigune today

CIC figures

CIC Energigune is a cooperative research centre founded in 2007 with its headquarters in the Basque Country. Created thanks to the investments of the Basque Government and several leading companies in the energy sector, it aspires to become a true international leader in the field of energy and contribute to the industrial competitiveness of Basque companies.

Since its inception, CIC Energigune has aimed to establish itself as a leading institution in the oriented basic research of materials for energy storage, and by generating knowledge and technology to support the existing major industrial activity in the Autonomous Community of the Basque Country.

The CIC Energigune project constitutes a challenge that will not only provide additional value in terms of research, but also a competitive positioning in key areas of the energy sector, given that it complements the resources of the industry and existing services in the country.
This thanks to the investments of the Basque Government, through the Ente Vasco and several companies that are part of the Basque industrial fabric, leaders in the energy sector.

	2008	2012	2016
Investment	0	€24M	€43M
Researchers	0	38	68
High impact publications	0	26	60
Projects with industry	0	2	10
European projects	0	1	12
Financing	98/2/0	95/3/2	70/20/10
Patents	0	4	12
Participation in conferences	0	56	150
Events organised	0	16	40
% women / % men	0/100	47/53	50/50

* Not including doctoral and master's students.

1.2 CIC Energigune's Mission and Vision

Since its inception, CIC Energigune has had a very specific mission that directs its activity. From this has developed, in outline form, the philosophy that governs CIC Energigune in the pursuit of its goals.

Mission

To play a **leading** role in the international scientific scene, focusing on basic research in energy-related **materials** and **oriented** towards storage applications, contributing to the **industrial competitiveness** of Basque companies, through:

- Excellent and high impact research;
- Transfer of technology and knowledge to local industry;
- Coordination of research efforts and technology in the Basque Country (relating to storage).

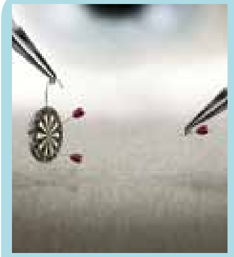
Vision 2008 - 2012

To create solid foundations so that CIC Energigune becomes an international centre of excellence.

Strategic objectives

- To develop first-rate **infrastructures** that allow for excellent research and contribute to attracting talent.
- **To define the** long-term **areas of research**.
- To attract world-class talent to lead the areas of research.
- To establish priorities and **develop the scientific capabilities** and critical mass that will facilitate research in the long term future.
- To encourage the **development of** highly qualified **researchers** and innovative infrastructures.
- To ensure the provision of adequate funding to achieve implementation of the CIC.

During 2012 the process of strategic definition was carried out for the period 2012 to 2016; and it is worth highlighting, as outstanding features of the strategic plan, the involvement of all stakeholders and CIC staff in the process of definition, and the comparisons with leading research centres, to incorporate their best practices and specify a future review to check compliance with the defined vision.
In this period, the centre aims to consolidate its standing as an international leader among the **top five in its field of activity, creating a measurable impact on the industry** while maintaining the same mission that was initially defined, revolving around the following guiding principles:

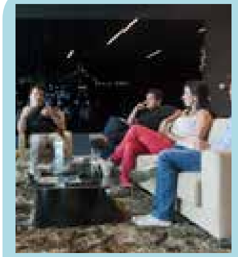


Targeting and guidance:

Concentration of research activity in materials science for energy storage, maintaining a long-term, stable and shared vision.

High standards:

In research, in the attracting of talent, in the development of infrastructures and in the management of the centre.

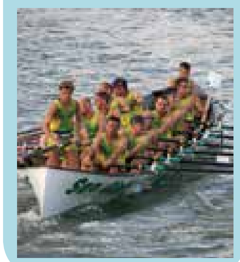


Attractive and a life project:

Opportunities for a challenging and motivating professional career, with strong appeal for both young talent and experienced researchers, in a facilitating work environment.

Cooperation and openness:

Smooth interaction and in-depth collaboration with the local and international scientific communities.



Measurable local value:

Commitment to the Basque Country, aligning the efforts of R&D with the needs of the local participants and promoting the development of industrial activity.

1.3 Purpose and commissioning of CIC Energigune

It should be noted that in the Basque Country there is an important industrial base in the energy sector, with more than 300 companies, almost 25,000 employees and 16,000 million euros in turnover; and this, along with more than 180 million euros of public-private investment in energy R&D, has supported the birth and commissioning of CIC Energigune.

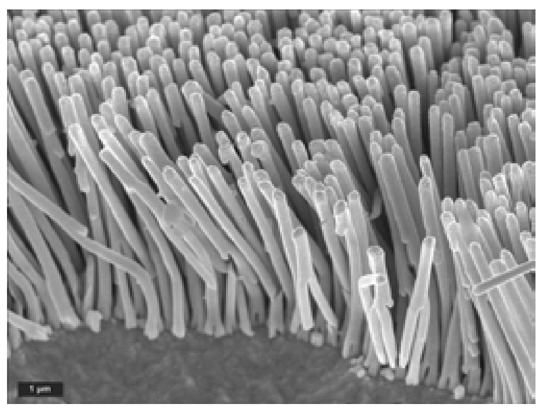
Institutional and business context

CIC Energigune is a new energy research centre which aims to become an international benchmark in its field. The centre has the backing of public institutions and administrations, and of companies directly related to the energy sector.
To a large extent, CIC Energigune is responsible for meeting the targets set in the Energy Strategy of the Basque Country 3E 2010 and 3E 2020 (confirmed by the Energibasque 2020 plan of 2012). Its work will be decisively important in promoting new global business groups operating in new market niches and will help position the Basque Country as a major reference in research excellence in the area of energy and sustainability.

3E Plan
as a general policy for the development of energy

Strategic Plan of the Energy Cluster
as a framework of requirements and objectives for companies

PCTI2010
as a general policy for the development of science, technology and innovation



Overview of the sector

Overview of the sector

Companies	356	
Overall turnover in the energy sector / ... in the Basque Country	€44 206 M	€15 469 M (35%)
Workers in the energy sector / ... in the Basque Country	68 625	25 378 (36%)
Scientific - Technological Agents	7	
Business R&D units		10
Overall spending on R&D in the energy sector / ... in the Basque Country	€324 M	€188 M (58%)
Workers in R&D in the energy sector / ... in the Basque Country	2 948	1 905 (65%)

* Source: Energibasque report.
Data from 2010/2011.

PRINCIPAL MILESTONES IN THE HISTORY OF CIC ENERGIGUNE

In the late 1990s and during the first half of the 2000s: increase in energy research and creation of Enerlan

- The enormous importance of the energy challenges results in a growing interest and increased investment in the energy sector in the Basque Country.
- Enerlan is founded in 1996 with support from the Department of Industry of the Basque Government, EVE, DFA, Iberdrola, MCC, Sener and Idom. The corporate goal was to promote R&D in the field of energy technology . From 1997, the Ikerlan Energy Unit (IK4) moves to the premises of Enerlan and leads its research activities into alternative generation and thermal systems and combustion.

2008: launch of the project and identification of the strategic lines of research

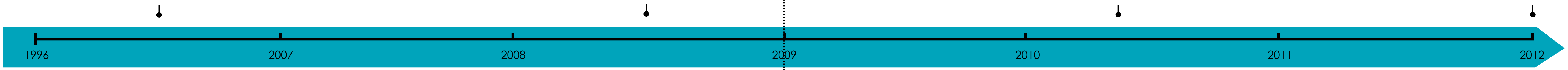
- The director general and the director of Corporate Development join the project and commissioning of CIC Energigune begins.
- The two strategic research areas of CIC Energigune to date are defined: electrical energy storage (EES) and thermal energy storage (TES).

2010: Intensifying the search for talent and commissioning of the CIC building

- Incorporation of the scientific direction of EES, while the search for talent continues and by the end of the year CIC Energigune has successfully appointed 17 researchers.
- Commissioning of the CIC building; start of the installation projects for the laboratories and investment in the appropriate equipment.

2012: increase in research activity, launch of new lines of research and commissioning of the extended CIC

- The CIC continues on its course with new lines of research. Outstanding in this year is the launch of the activities of the extended CIC.



2007: Formal foundation of CIC Energigune and initial strategy 2008-2012

- The promoters of Enerlan, along with relevant players in the Basque energy sector — Gamesa, Guascor, Naturgas, Cegasa, Tecnalia, IK4 and the Energy Cluster — drive its conversion into CIC Energigune, the seventh Basque centre for cooperative research, which will make alternative energy the focus of its work.
- Initially there are six priority lines of research that define CIC Energigune: thermal energy storage, hydrogen and fuel cells, biomass and biofuels, and marine energy; but, with the objective of focussing efforts during the period 2008-2012, a strategic decision was made to establish the idea of energy storage as the guiding principle for the centre, and in two specific modes: electrochemical and thermal.

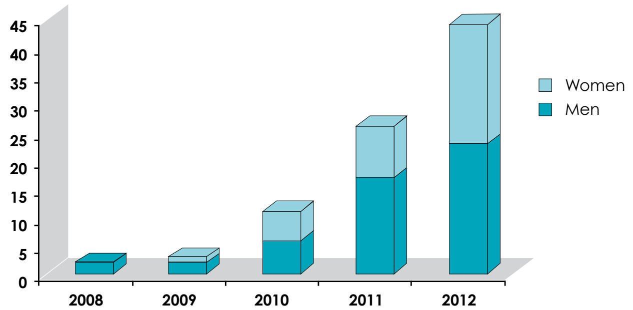
2009: Definition of the operating model and search for talent

- The operational model of CIC Energigune is defined in detail and a distinction is drawn between the physical and the extended CIC.
- The various scientific committees are formed. In addition, the search for talent, both local and international, is established as a principal objective.

2011: Inauguration of CIC Energigune and initiation of the research activities

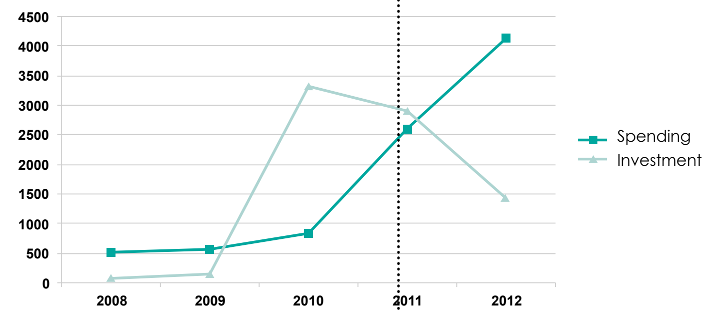
- On 10 June 2011 Energigune CIC is officially inaugurated.
- The search for talent continues: by the end of the year CIC Energigune has 25 researchers.
- Research activities are beginning to bear fruit: the first patent is awarded and the first pre-proposals are presented to the FP7 programme, with positive feedback.
- The amount invested between 2008 and 2011 for the launch of CIC Energigune — infrastructure, research equipment and costs for the initiation phase of the projects — rises to 19 million euros.

Number of people



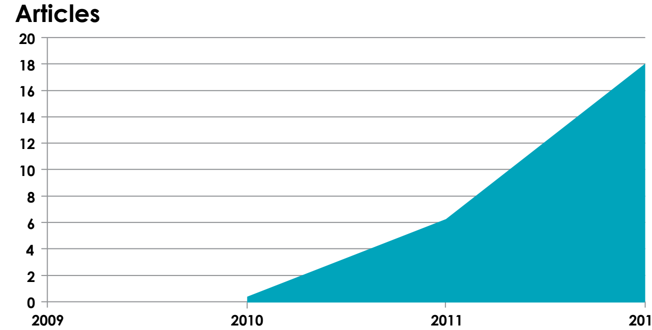
* Information as at 31 December.

Annual budget



* Audited data. In thousands of €. Includes amortization expense

Articles



Articles in journals with a high impact rating

1.4 Sponsors and location

Members of the board of trustees of CIC Energigune

2 Organisation of CIC Energigune

2.1 Development of the physical CIC Energigune

During the period 2008-2012, all efforts have been directed at developing the physical CIC, especially its two main areas of research into energy storage. Below you can see a summary of the subjects that these two fields encompass.
From among the different possible types of energy storage, CIC Energigune has initially focused its efforts on electrochemical storage and thermal storage:

Types of energy storage:

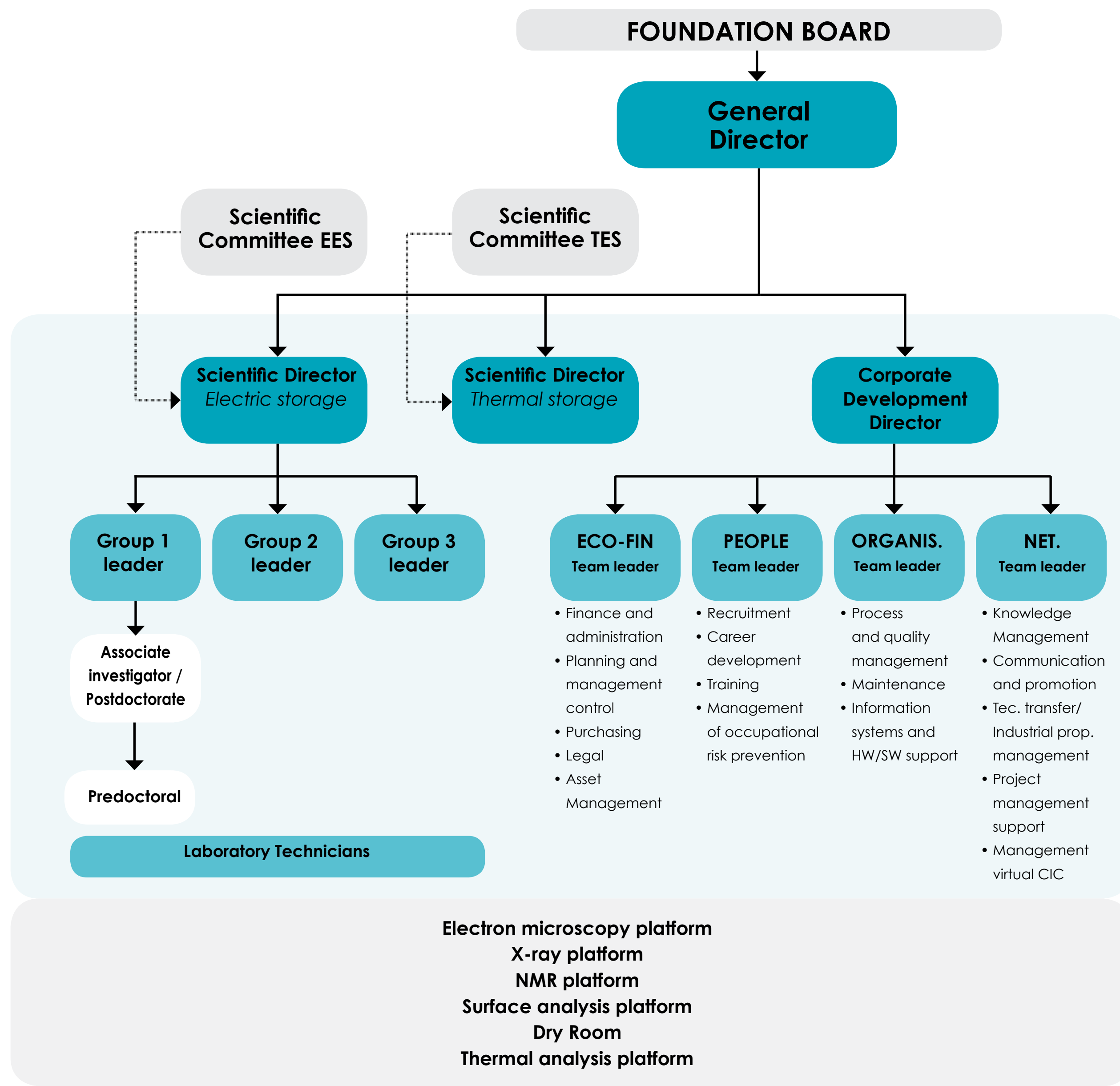
• Electrochemical storage	EES: ENERGY STORAGE; BATTERIES AND SUPERCAPACITORS
• Thermal storage	TES: THERMAL ENERGY STORAGE
• Mechanical storage	
• Chemical storage	
• Energy storage by means of superconducting magnetism.	

Additionally, and with the aim of achieving critical mass, efforts have been oriented within electrochemical storage towards stationary and mobile applications. In the field of thermal storage, efforts have focused on applications of Concentrated Solar Power (CSP), energy efficiency for industry and heat recovery from high-temperature industrial processes.

Accordingly, the research groups that have been defined in each field are as follows:

	Groups	Applications
EES (batteries and supercapacitors)	• **Structure and surface analysis** • **Solid electrolytes** • **Simulation and Modelling Studies** • **Sodium-based batteries** • **Lithium-based batteries** • **Capacitors** • **Prototyping and industrial development**	**Mobile:** - Hybrid electric and electric vehicles. - Railway (metro, tram) - Lifting: Cranes and lifts **Stationary Storage** - Uninterruptible Power Supply (UPS) - Renewable distributed generation and energy storage. - Regulation of networks
TES Thermal energy storage	• **Phase change materials.** • **Nanoscale materials.** • **Thermal storage materials.** • **Modelling and simulation.** • **Thermochemical cycles for high temperature heat storage systems.**	- **CSP** - **Energy efficiency for industry** - **High Temperature industrial processes**

2.2 Organisational model



EES committee members

Dr Ander Laresgoiti (Former Ikerlan Scientific Director) · **Dr Imre Gyuk (DOE)** · **Dr John Owen (Univerity of Southampton)**

Dr Petr Novak (PSI) · **Dr Steve Visco (Polyplus Battery Company)** · **Dr Jean Marie Tarascon (University of Picardie)**

TES committee members

Dr Greg Glatzmaier (NREL) · **Dr Eduardo Zarza (PSA)** · **Dr Manuel Tello (UPV)**

Dr Michael Epstein (Weizmann Institute of Science) · **Dr Rainer Tamme (DLR)** · **Dr Elena Palomo (CNRS)**

2.3 Research organisational model

The organisational model chosen to carry out the research work of CIC is based on a two-dimensional matrix scheme.
On one axis are the groups as units of knowledge, defined by a set of skills, competencies and common knowledge that researchers are specialised in. These units also determine the internal structure of communication regarding evaluation, permits and approvals. The group units lead and can collaborate in different lines of research. Their time frame is not fixed.
On the other hand, on the other axis, are the lines of research functioning as management units. These are defined following an internal proposal for a line of research — when important innovations, the objectives and the technical strategy, the resources, the industrial landscape, the possible avenues of financing etc., are identified — and they focus on the resolution of specific problems within a certain time frame, either medium or long term. More than one group may be involved In these lines of research, but the milestones must be well defined. In addition, each line of research will have a person who is responsible (Research Line Manager).

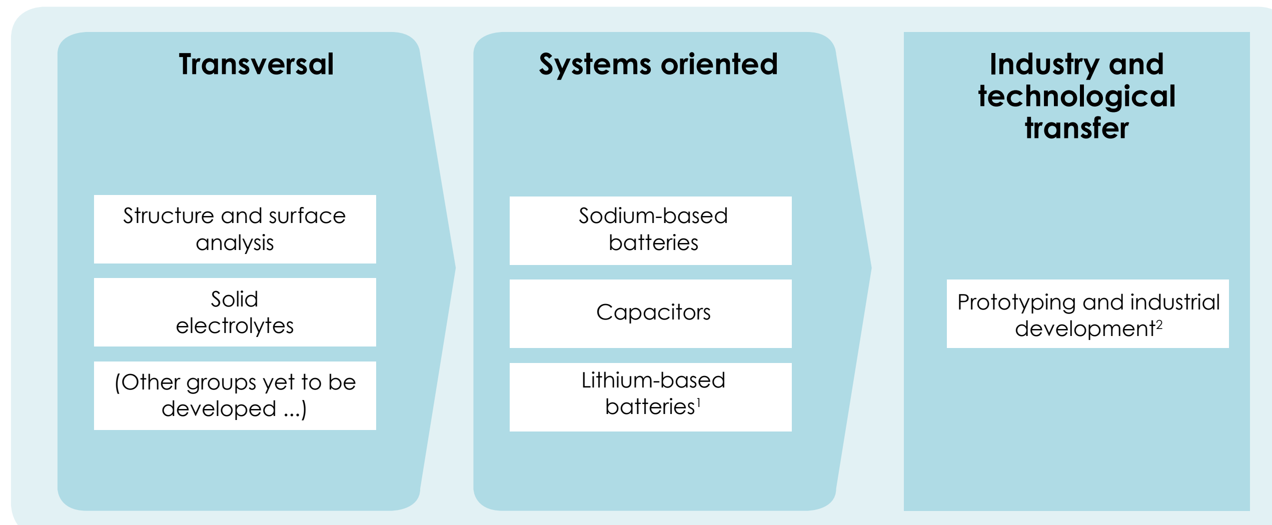
In parallel with the Lines of Research and the Research Groups the activity of the CIC is also supported by the Technological Platforms.
These platforms, with state-of-the-art equipment and facilities, will strengthen not only research at the CIC but also that of the RVCTI agents, based on a premise of open access for such agents.

The definition of the model is based on the following basic premises:

- Avoid isolated departmental structures
- Facilitate the search for synergies between different groups and lines within the organisation.
- Encourage the promotion of multidisciplinary teams, providing flexibility and allowing the availability of the different specialised skills that are required to solve complex problems.
- Convert the lines of research into management units that are defined and recognised within the organisation, promoting the proactive management of projects.

2.4 Organisational model of the electrical energy storage (EES) area

Group Dimension, areas of knowledge and specialisation



1 The current state of this technology is more mature and closer to the industry.
2 In development

Members of each group:

Transversal: structure and surface analysis

The group combines competence and expertise in crystallography, surface science and electrochemistry to analyse the role of the structure, microstructure and surface chemistry in the performance of the cycles and the capacity rating of the energy storage materials A multi-technique strategy is followed, based on the use of advanced tools — X-rays, neutrons and electrons — to study the mass of material; and high-resolution photoemission spectroscopy is used to study the outermost region of the surface, in both cases under ex situ and in situ electrochemical cycles.

Transversal: solid electrolytes: ceramic and polymeric

Solid electrolytes will be an important focus for CIC Energigune because advances in solid electrolytes will not only improve the safety and manufacture of lithium-based batteries (Li-ion , Li-S) by allowing a completely solid design, but will also help with the robustness of lithium-air batteries, resolving the problems associated with liquid electrolytes. The biggest challenges for solid electrolytes are the conductivity and the temperature range, especially at very low temperatures. The two main lines of research are related to ceramics and polymeric electrolytes.

Systems oriented: sodium-based batteries

The group is focused on the development of low-cost systems for stationary storage applications through strategic work with anodes, cathodes and electrolytes based on sodium-ion chemistry.

Systems oriented: lithium-based batteries

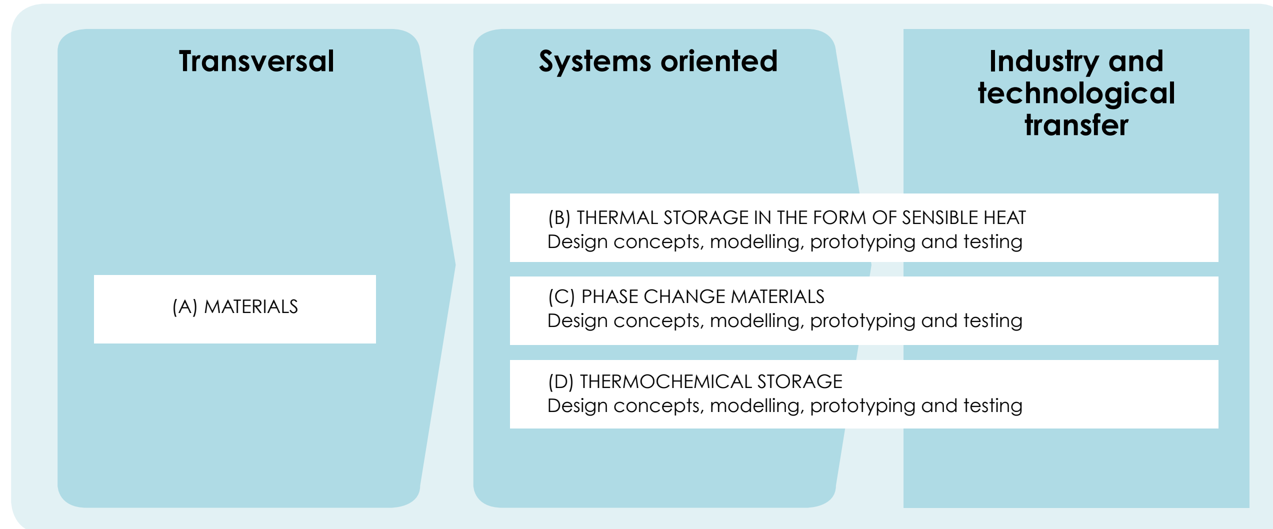
The group conducts basic research on lithium-based batteries, as a proven component, with the aim of making advances in terms of energy density, safety and cost reduction, which could lead to a revolution in energy storage technologies. In this area two lines of research are pursued: Li-air and post mortem analysis of batteries.

(*) Student at UPV-EHU

Systems oriented: capacitors

Electrochemical capacitors and supercapacitors that store energy using ion adsorption (electrochemical double layer capacitors) or fast faradaic surface reactions (pseudocapacitors). Within this framework, the main research of our group is related to the development of microporous materials with a high surface area of activated carbon, which could potentially increase the energy density of the system while maintaining the power and reducing the cost. Other lines of research include the development of new nanostructured pseudocapacitive materials (oxides, nitrides and polymers) and low dimensional nanocarbons (carbon nanotubes and graphene).

Research focus 2012-2016



2.5 Organisational model of the thermal energy storage (TES) area

Group Members:

Thermal energy storage (TES) area

The area of TES (thermal energy storage) is in the team formation phase and its consolidation will continue in the next strategic plan for 2012-2016. So far, four areas of research have been defined: transversal research on materials for sensible heat storage; materials for latent heat storage and materials for thermochemical storage; investigation of systems using models, simulation and design concepts; testing and transfer to applications in the field of industry and technology transfer.

2.6 Organisational model CIC DECO

Process-oriented approach

The management model of the centre is based on process management with a philosophy of continuous improvement and total quality management (EFQM).
In this context, and as a distinguishing feature, the first stage saw the identification of the stakeholders of each of the macro processes:

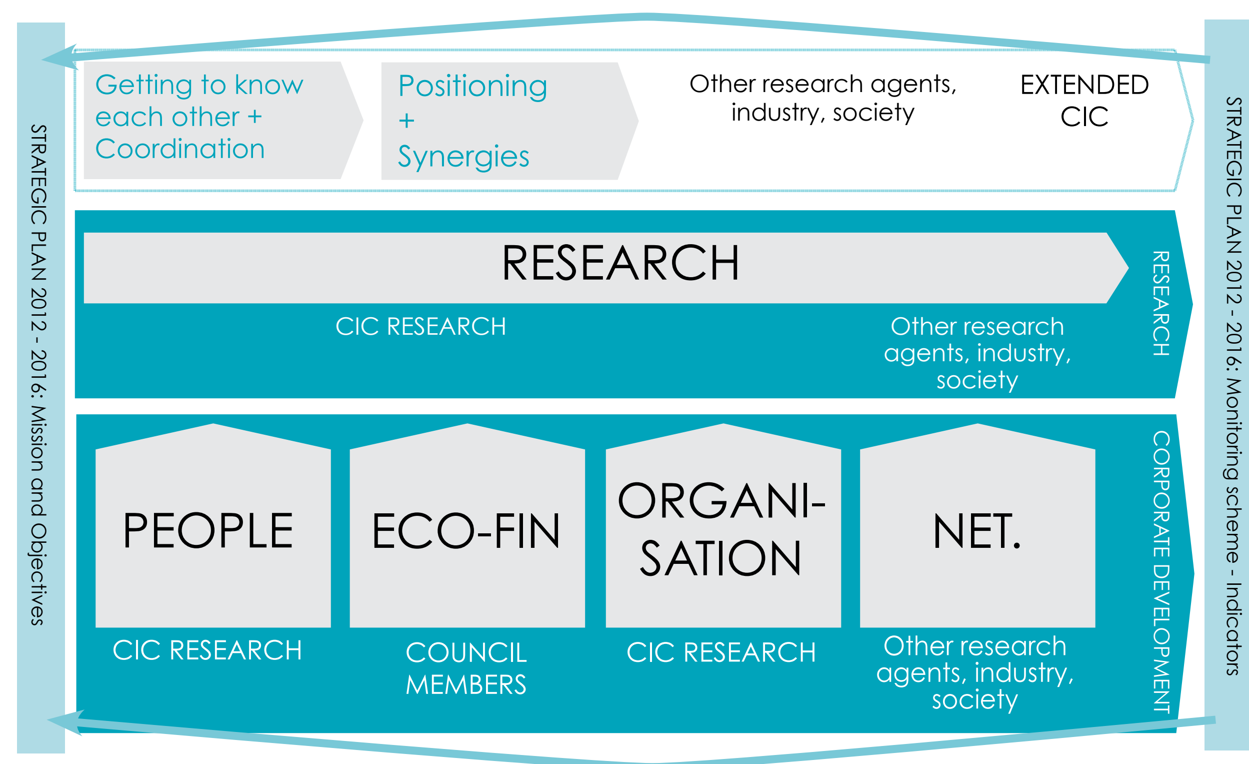
- CIC personnel.
- Board Members (companies and institutions).
- Other research agents.
- Local industry.
- Society in general.

This management model revolves around five interrelated macro processes, for each of which the main stakeholder is identified .

Each of the processes involves a principal area of activity of the CIC:

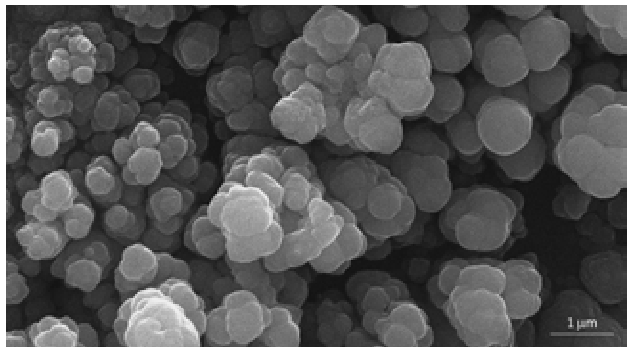
- PEOPLE: This regulates all aspects related to people, from attracting talent to policy development and retention of staff (training, career development linked to evaluations) to the management of former members (CIC alumni club).
- ECO-FIN: This process encompasses the financial management of the centre, from budget management, purchasing management and monthly reporting, to the analytical information regarding the management and justification of projects .

In this context, it is worth highlighting the efforts in the procurement process which, on the one hand, ensures a transparency consistent with the Law on Public Sector Contracts, without sacrificing flexibility and providing some autonomy to researchers for small purchases of consumables through an appropriate system of approvals and budgetary limits.



Stakeholders in the process

- ORGANISATION: Within this sphere are all issues relating to the operational management of the centre, from the maintenance of the building to the management of IT and including all matters related to the prevention of occupational risks, which is a key issue for the centre.
- NETWORKS: This is the process that regulates the relationship of the CIC with third parties. In this area, the year 2012 saw the definition of the process of technology transfer, which was submitted and approved by the board of trustees, and whose principal characteristics are as follows:
  - Efforts to maximize the added value that the CIC brings to the industry.
  - Establishment of different vehicles for technology transfer.
  - Participation of researchers in the results obtained by the generated IP.
- RESEARCH: The goal of this process, the principal process of CIC Energigune, is the systematisation of research aimed at achieving the objectives that have been defined while avoiding the dispersion of efforts.

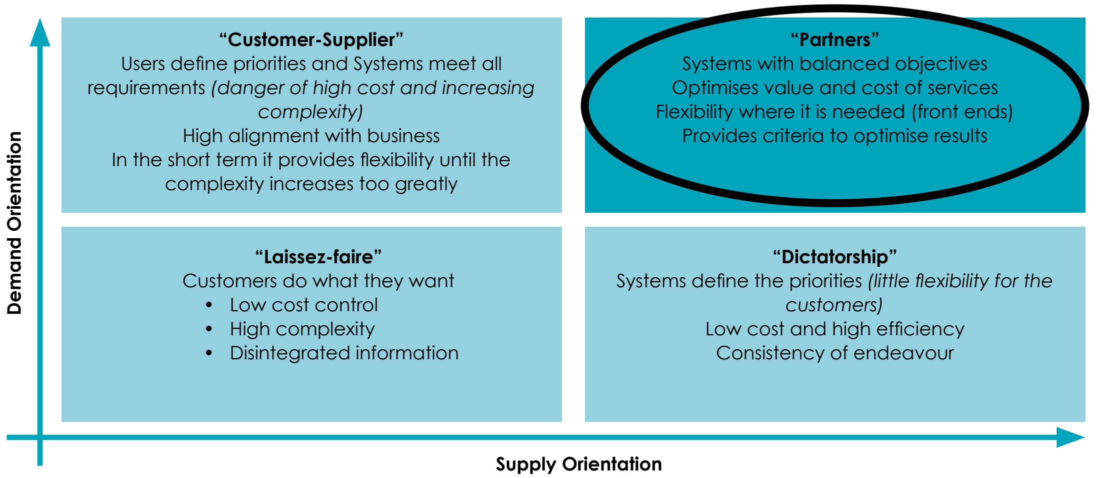


ERP AS A SUPPORT TOOL FOR THE MODEL AS A WHOLE

During 2011, and consistent with the map of defined processes, a requirements analysis and selection of tools for management of the centre was carried out; and following the evaluation of the different alternatives Microsoft Dynamics NAV was selected. The implementation process was completed in early 2012, and within the system all the economic and financial management is now incorporated, from the budget process to the specification of the analytical management of the lines of research (budget definition, reporting and justification of support programmes).

DECO-RESEARCH RELATIONSHIP MODEL

- Consistent with the objectives and values that have been established it is essential to adopt an approach based on the idea of "partners" between different research teams, both among themselves, and with the teams responsible for corporate services.



3 Infrastructure

The building

CIC Energigune is endowed with state-of-the-art facilities in which work can be carried out with the highest guarantee of quality: it is an environment that facilitates both the work being carried out and the exchange of information, something critical in a centre such as the CIC. A description of the main building and its facilities is provided below.

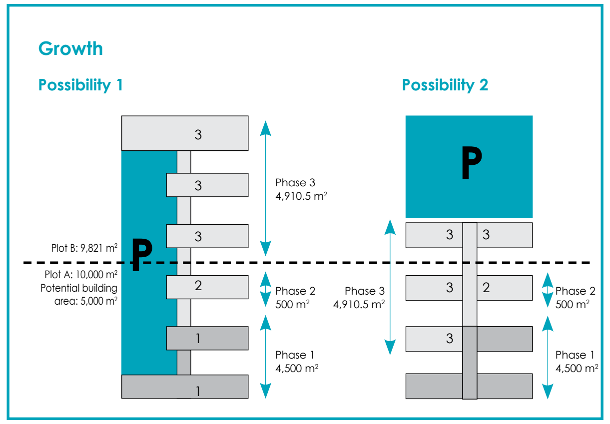
CIC Energigune is set up as group of modular buildings connected to each other by a functional and communications backbone supporting the centre's activity. The work areas were designed to foster informal interprofessional relations to encourage the researchers to share their knowledge in a relaxed atmosphere.
The larger building, opposite the main artery of the Parque Tecnológico de Álava, contains the reception, the laboratories associated with EES, equipment platforms (electron microscopy platform, surface analysis unit, X-ray diffractometry platform and magnetic resonance platform), as well as the mechanical and electronic workshop, the training and seminar area and administration offices.
Apart from the facilities on the ground floor of Building A, there is an important part of the facilities on the roof of the whole complex, a photovoltaic electric system with output capacity of up to 100 kW.
The smaller building houses the laboratories associated with TES and the area's special equipment.
Between both buildings (A and B), CIC Energigune has total capacity for 110 jobs, of which 100 will be researcher posts.

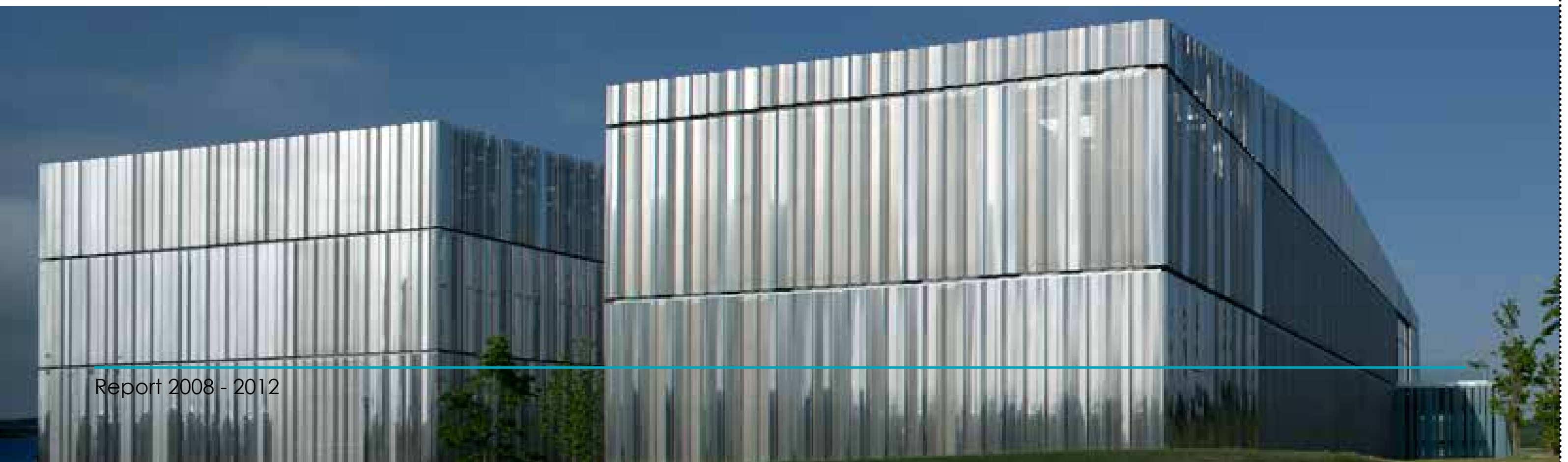
The centre strives to foster human relations and interactivity and support between study and research groups. Therefore, on each storey there is an area set aside for recreational use of the researchers, with work tables that are joined together without visual dividers which create a coordinated and group work atmosphere.

The defining of laboratory contents and structure is on demand, in accordance with the specifications that each of the area managers defines.
The overall effect is high-tech and innovative, in which nature is reflected and merged with the buildings.

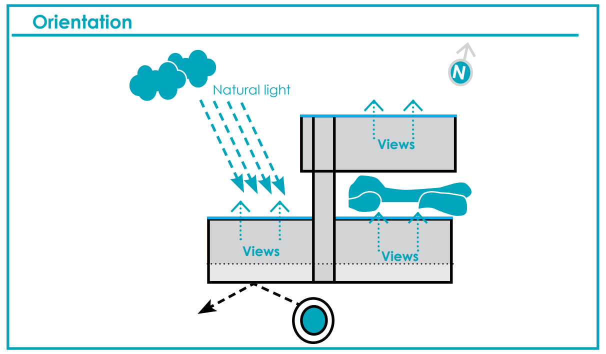
Principal characteristics

Modularity and flexibility for the centre's growth and for the arrangement of laboratories

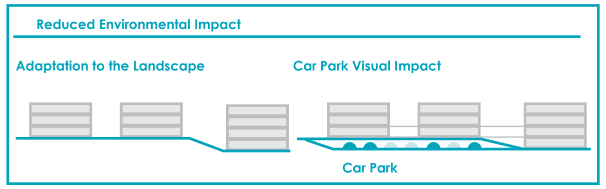




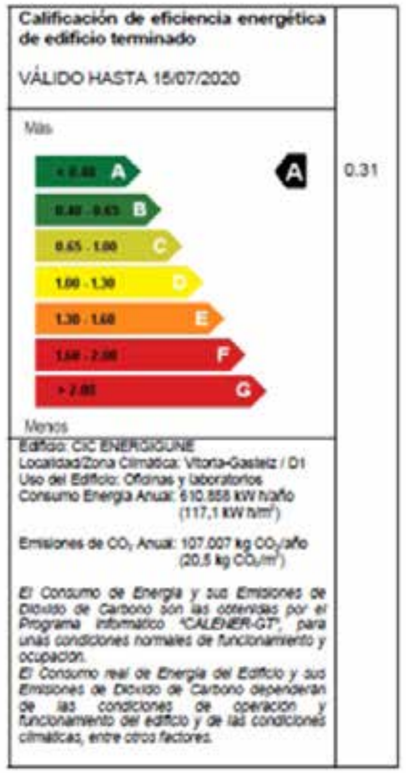
Comfortable work conditions



Minimal environmental and landscape impact



Energy efficiency and sustainability



CIC Energigune principal installations

CIC Energigune has premier infrastructures to serve the research areas. In addition, following on approach aimed at optimising the use of resources, the centre regards as fundamental the provision of access to their equipment by third parties.

The CIC Energigune general laboratories have been designed taking into account the logical sequence of research at the centre:

a) Design and synthesis of materials.
b) Characterisation to study their properties.
c) Integration into the batteries, supercaps or loop test systems.
d) Testing.

For this reason, they are distributed by area as follows:

EES:

Laboratories 1, 2 and 3 are devoted to the synthesis and assembly of battery cells and supercaps; number 4, and the platforms it houses, is for characterisation; in laboratory 5A and the dry room the integration and development of the system is carried out; and, finally, laboratory 5B is for electrochemical testing. Both in laboratory 2 and in the dry room operating and post mortem analysis are carried out.

The dry room, which will allow the scaling of the results of research to pre-industrial scales, is a benchmark infrastructure in Europe with the following main features:

- Possibility of five people working simultaneously in the room.
- Dew point in room: –65ºC
- Area 55 m^2.

TES:

The thermal energy storage area has a fully equipped laboratory for the synthesis of materials, with equipment such as fume cupboards, glove box and ovens that allow the measurement of thermal stability.

In addition, a thermal oil loop has been designed that enables the testing of materials during the processes of the loading and unloading of energy, at identical temperatures and with flow rates similar to those of real-world applications.

This facility provides CIC Energigune with the ability to perform experimental tests on laboratory scale prototypes and pilot projects, an essential requirement for pre-industrial demonstration at a later stage.

Technological platforms

Electron Microscopy

The electron microscopy platform is the centre for the microstructural characterisation of the materials studied at CIC Energigune. The highest spatial resolution, combined with the simultaneous acquisition of spectroscopic data, is used to guide the synthesis of new materials, as well as to monitor the structural developments induced by ex situ electromagnetic reactions at the atomic level. The objective is to understand the relationship between structure and electrochemical properties.

This service provides measurements by electron microscopy using a transmission electron microscope (TEM) and a scanning electron microscope (SEM), and is also supported by the preparation of relevant samples.

There is a laboratory dedicated specifically to the preparation of samples, which houses the equipment necessary to apply mechanical and ion-beam reduction, carbon and gold coating, and plasma cleaning .

Dr Vladimir Roddatis
Head of Platform

- Master's in Physics, 1995, Moscow State University (Russia).
- PhD in Physics, 1999, Crystallography Institute, Russian Academy of Sciences (Russia).
- Postdoctoral researcher, 2000-2001, Fritz-Haber Institute, Max Planck Society (Germany).

Equipment

FEI-TECNAI G2 F20 S-TWIN. The FEI Tecnai G2 is a TEM/STEM with a 200 kV high-resolution FEG that was installed at CIC Energigune in 2010. The equipment enables the addressing of a variety of challenges in materials science easily and quickly. This electron microscope excels in versatility and flexibility by providing high performance in all of the spectrum imaging modes: TEM, STEM and EDX.

FEI-QUANTA 200FEG. The Quanta 200 FEG is a scanning electron microscope that was installed at CIC Energigune in the winter of 2010. It is an environmental high-resolution microscope that can operate in three different modes: high vacuum, variable pressure and environmental mode; which means that it can handle all samples, including non-conductive samples without coating and wet samples that need to be above the vapour pressure of water. The combination of high output thermal field emission (>100 nA beam current) with a high sensitivity (18 mm) allows the achievement of a final resolution of up to 3-5 nm with low conductivities.

Surface analysis unit

The surface analysis platform at CIC Energigune is a laboratory equipped with the most modern facilities for working with surfaces and thin films of different materials.

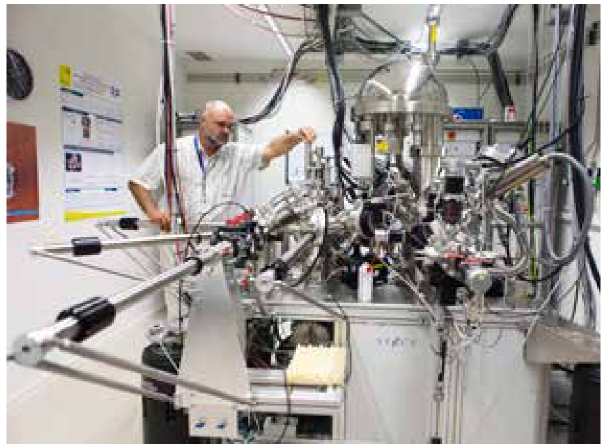
We can handle materials in a solid state, including powders and polymers, and in some cases even liquids. The composition of the surface, as well as its electronic and geometric structure, can be tested by combining several complementary spectroscopic and microscopic techniques: X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES), scanning Auger microscopy/ scanning electron microscopy (SAM/SEM), Raman spectroscopy, near-field scanning optical microscopy (NSOM), tip-enhanced Raman spectroscopy (TERS), tunnel-effect electron microscopy/atomic force microscopy in air or liquid.

Dr Alex Bondarchuk
Platform leader

- PhD in Surface Science, 1995, University of Kiev (Ukraine). Thesis: Extended Fine Structure in the Elastically Scattered Electron Spectra and Determination of the Short-Range Order Parameters for Disordered Solid Surfaces. Thesis director: Dr P. Melnik.
- Master's in radio and electronic physics, 1983, Taras Shevchenko National University of Kiev (Ukraine). Director: Dr P. Melnik.

Equipment

Multi Technique UHV Surface Analysis System for XPS, AES, SEM/SAM ISS and Depth Profiling. Multi-technique analysis system for ultra high vacuum surfaces for XPS, AES, SEM/SAM and depth profiling with high spatial and energy resolution on the different types of conductive and non-conductive samples, from single crystals to powders and polymers. The system features a unique combination of methods for the preparation and implementation of in situ tests, provided by four electron beam evaporation sources, and a high-pressure cell or electrochemical cell in the preparation chamber . The analytical part of the system is based on the PHOIBOS 150 hemispherical analyser (SPECS GmbH), the Al/Ag anode X-ray source with the FOCUS 500 monochromator (SPECS GmbH), fine focus electron gun with Schottky emitter for SEM/SAM (FEI), FG15/40 flood gun (SPECS GmbH) for charge compensation and an IQE 12/38 scannable small spot ion cannon (SPECS GmbH) for ion treatment and precise depth profiling.



Classic 500 SP Sputtering System (Pfeiffer). Cathode magnetron sputtering system for the deposition of thin films, both conductive and insulating. The main potential of this technique can be seen in its features: low temperature deposition (no need to heat the target); versatility to evaporate diverse types of material (metal conductors, ceramic insulators ...), including materials with a high melting point; removal of blends and alloys, while maintaining the composition of the target; good adhesion of the deposited film, since the arrival energy of atoms sprayed at the surface of the substrate can reach several units of eV; easy control of the target erosion rate, mainly through the power applied to the discharge.

AFM/STM Microscope Agilent 5500. Complete system for atomic force microscopy for samples of small and medium size. This equipment allows the initial characterisation of the materials studied, the observation of their interaction with other battery components, and the determination of the mechanisms of degradation of the electrodes during its lifetime.

AFM/RAMAN integrated system (Nanonics/ Renishaw). This equipment allows the chemical and physical characterisation of non-destructive optical nanostructures and interfaces in materials used in batteries and supercapacitors, so that advanced information can be obtained about chemical bonds and other molecule variables and their identification and characterization can be carried out. Raman spectroscopy is an important technique for the microscopic study of the ceramic and polymeric materials that are commonly used as electrodes and electrolytes in batteries and supercapacitors.

Nuclear magnetic resonance

The solid state nuclear magnetic resonance platform is a laboratory equipped with state-of-the-art spectrometers to help CIC Energigune scientists better understand the nature of energy storage materials by studying environments and the interactions between the different nuclei.

- A low magnetic field (200 MHz), combined with ultra-fast rotation (65 kHz), allows the study of paramagnetic materials.
- A higher magnetic field (500 MHz), combined with ultra-fast rotation, provides the desired increased resolution for more conventional systems. The aim is to complement the study of the structural changes occurring during thermal and electrochemical energy storage, currently the main research focuses at the CIC.

Dr Juan Miguel López del Amo

Platform leader

- PhD from the Free University of Berlin (Germany), in 2006, dedicated to the development and applications of solid state nuclear magnetic resonance for the structural and physicochemical characterisation of organic and organometallic solids.
- Postdoctoral researcher at the Leibniz Institute for Molecular Pharmacology (FMP, Berlin, Germany) in the group of Professor Bernd Reif (2007).
- He later joined the Helmholtz Centre for Environmental Health in Munich (Germany), to work on solid state nuclear magnetic resonance studies (2011).

Equipment

Bruker Avance III 200 MHz. The Avance III 200 MHz was installed at CIC in March 2012. It is a wide bore, low magnetic field magnet dedicated to the study of paramagnetic materials, which are a frequent component of battery and supercapacitor electrodes. Two probes are available: (1) 1H/19F-X DVT CPMAS 1.3 mm double resonance probe that can reach ultra-fast spinning speeds of up to 65 kHz; (2) 1H-X DVT CPMAS 4 mm double resonance probe, that can reach temperatures of up to 400ºC and rotational speeds of up to 20 kHz.

Bruker Avance III 500 MHz. The Avance III 500 MHz was installed at CIC in March 2012. It is a wide bore magnet especially suited to non-magnetic materials where high resolution is desired. Three probes are available: (1) 1H/19F-X DVT CPMAS 1.3 mm double resonance probe that can reach ultra-fast spinning speeds of up to 65 kHz; (2) 1H-X–Y, DVT CPMAS 2.5 mm triple resonance probe that can rotate up to 35kHz; and (3) H-X static wideline probe for in situ electrochemical studies.

X-ray platform

Equipment

D8 ADVANCE – XRD. The D8 ADVANCE is a multi-purpose X-ray analyser which can be configured for all applications of powder diffraction, including phase identification, quantitative analysis and phase analysis of microstructure and crystal structure. The system can also operate with parallel-beam geometry, such as the Bragg-Brentano configuration, and has a LYNXEYE detector. The LYNXEYE is a unidimensional "compound silicon strip" detector for diffraction measurements of ultrafast X-rays. Installing with a LYNXEYE, it is possible to obtain high quality diffraction information at an unprecedented speed, more than 150 times faster than with a conventional point detector system.

Nanostar – SAXS. The SAXS is a reliable, economical and non-destructive method for the analysis of nanostructured materials, producing information about particle size and distribution for sizes between 1 and 100 nm, including the shape and orientation of the distribution of the samples in liquid, powder etc. In fact, NANOSTAR analyses the properties of the pure samples, even in systems with non-isotropic samples. Also, you can take a real space image with a SAXS resolution in microns using Nanography.

The quantum design PPMS (physical properties measurement system) is intended for a wide variety of characterisations, both physical and chemical-physical, of solid masses, powders and thin films, from cryogenic temperatures up to 126ºC and inside a magnetic field.

The system consists of an environmental sample platform, allowing precise control of the temperature (1.9-400 K), the magnetic field (up to 9 T DC) and vacuum (up to 10^{4} mbar). This platform may be supplemented through different options, allowing the measurement of electronic conductivity (DC and AC), non-linear electronic conductivity (I-V), the Hall effect, thermal conductivity, the thermoelectric effect, the thermoelectric figure of merit (ZT), specific heat, DC magnetisation and AC magnetic susceptibility (down to 2.10^{-8} emu) .

Thermal analysis platform

The thermal analysis platform has as its objective the thermophysical characterisation of a large spectrum of (solid and liquid) samples.

The platform has cutting-edge technology instruments such as the simultaneous thermal analyser (STA), connected to a mass spectrometer and differential scanning calorimeter (DSC) for thermodynamic characterisation, a laser flash apparatus (LFA) and dilatometer for physical measurements.

4 Lines of research

Apart from the principal lines (EES and TES), the following lines of research are also carried out.

Electrical energy storage (batteries and supercapacitors)

Lithium-ion batteries

Purpose

To identify and develop alternative conversion electrode materials, with a significant improvement in performance (lower cost and increased energy density) on intercalation compounds currently available commercially.

Objectives

- To meet the market requirements in terms of energy density (250 Wh/kg), useful life and safety.
- To maintain the requirements regarding sustainability.
- To achieve attractive costs for practical applications (<500 $/kg).

Limitations and risks

- The possibility of not obtaining materials with the necessary electrochemical activity.

Results so far

- A presentation at an international congress.
- Two articles in journals with a high impact rating.
- A project with a company.

Collaborators

Solid electrolytes

Purpose

To develop solid electrolytes with high ionic conductivity that are safer and more reliable, by replacing the liquid organic solvents that are currently used.

Objectives

- Polymer electrolytes. Preparation of hybrid nanoparticles, grafted well with polymer supports or with a plasticiser (such as ionic liquid, organic compounds with a high dielectric constant etc.) aimed at achieving the following:
  - An increase in the stability of the electrolyte operating at high temperatures.
  - The elimination of the problem of dendrite formation.
- Ceramic electrolytes. Use of ceramic ionic conductors, to increase the security and chemical and electrochemical stability of the systems, with the advantage that ceramic materials can be obtained with a wide range of stoichiometries, crystal structures and microstructures leading to a controlled range of electrochemical properties that can be used in these devices.

Limitations and risks

- The range of materials to test is very wide.
- There are many study groups in the world working in this field.

Results so far

- A presentation in the ECS Prime 2012 Conference.
- An article in a journal with a high impact rating.
- A PCT patent application is being processed.

Collaborators

Lithium-air batteries

Purpose

To produce the components of a lithium-air battery with properties capable of overcoming the limitations of current lithium technology, with the idea of accelerating the development of functional prototypes in order to test, compare and contrast the theoretical properties of this type of battery in the laboratory.

Objectives

- To significantly increase the energy density of the batteries (>750 Wh/kg).
- To reduce the cost through reduced use of raw materials.
- To reduce the weight.

Limitations and risks

- Difficulty in finding an optimised design for a lithium-air cell.
- Electrolyte instability.
- Limitation of the specific capacity due to the loss of porosity in the air cathode during the cell cycles.

Results so far

- Presentations at four international conventions.
- Presentations for two more international conventions in progress.
- Two articles in preparation.

Collaborators

Sodium-ion batteries

Purpose

To achieve low-cost systems for applications of stationary storage, through the synthesis of new phases at the anode, the cathodes and the electrolytes with the appropriate sodium-ion chemistry.

Objectives

- To achieve a low cost (less than 200 $/kWh).
- To achieve improved safety.
- Robustness with a number of cycles greater than 5000.

Limitations and risks

- The range of materials to test is very wide.
- There are many study groups in the world working in this field.

Results so far

- Two presentations at international conventions.
- Three articles published in journals with a high impact rating and two in progress.
- One of the ten most read articles on energy and environmental sciences during 2012.
- A patent application at the internal analysis stage.

Collaborators

Metal-air batteries

Purpose

To provide a high-energy hybrid system of batteries and high temperature batteries (SOFC) for applications in power generation, distribution, regulation of energy networks and transport.

Objectives

- Achieve high energy density (800 Wh/L and 70% efficiency).
- Improve safety: avoiding the formation of dendrites or flammable or unstable cathodes and electrolytes.
- To achieve a low cost (< 500 $/kWh).

Limitations and risks

- Completely new approach that requires a significant preliminary analysis to assess its feasibility.

Results so far

- A patent application (11 December 2011, in Europe; 12 February 2012, in the USA).
- A poster in the Power Your Future 2012 convention.

Collaborators

Supercapacitors

Purpose

To optimise the carbon materials and transition metal oxides/nitrides in relation to the high energy and power of the supercapacitors, in both gravimetric and volumetric terms.

Objective

- To optimise capacity by altering the conditions of synthesis of the carbon-based materials and controlling their microstructure.
- To provide a better understanding of adsorption and ion transport in the microporous electrodes of the supercapacitor through ex situ and in situ microstructural study.
- To propose new, cheap and pseudocapacitive systems based on transition metals oxides and nitrides.

Limitations and risk

- Limited progress with microporous carbon materials in recent years.
- Need for a sophisticated experimental set-up and important approximations in the interpretation of the data regarding structural studies and in situ.

Results so far

- An industrial collaboration.
- An article in preparation

Collaborators

Thermal energy storage

Metal alloys for phase change materials

Purpose

To develop new thermal energy storage systems based on phase change in eutectic metal alloys for their subsequent application in concentrated solar power (CSP) plants or heat recovery in industrial processes.

Objectives

- To identify new metallic materials for energy storage with improved thermo-physical properties.
- Optimisation of the properties, performance and efficiency of the storage systems based on these materials.

Limitations and risks

- Cost of alloys compared to other existing storage materials.

Results so far

- Two presentations in 2012: INNOSTOCK and ASME.
- Two publications in: Applied Energy and the Journal of Solar Energy Engineering.

Collaborators

Seasonal heat storage

Purpose

To develop new phase change materials based on sugars and alcohols for seasonal thermal energy storage applications at mid-range temperatures.

Objectives

- To develop molecular alloys of sugar and alcohols (MASA) with a melting point between 70 and 150ºC, and a high energy density (>200 kJ/m3).
- To achieve significant and stable subcooling.
- To obtain high crystallisation kinetics.

Limitations and risks

- Achieving a lower energy density than expected.
- Producing unstable MASA alloys.
- Failure to obtain metastability in phase change.

Results so far

- FP7 project (April 2012-April 2015).

Collaborators

European projects

FP7 projects

CIC Energigune began its activity in late 2011 and it was in this same year that the first proposal was submitted to an FP7 Cooperation programme in the field of energy: Sugar based Materials for Seasonal Storage (FP7-ENERGY 2011.4.1-3: SAM-SSA.), which was led by the CNRS, in whose consortium eight research agencies from six European countries participate.

During 2012 the activity in this field has intensified and the following proposals have been submitted to the FP7 programme:

1. FP7-ICT-2013-FET-F: Graphene Flagship.
2. FP7-ENERGY.2013.7.3.3: SIRBATT.
3. FP7-2013-GC-Materials: MAT4BATT.
4. FP7-ENERGY.2013.7.3.3: MINLICAP.
5. FP7-2013-GC-Materials: MATBALIA.
6. FP7-ENERGY-2013-IRP: EESTORIGA.

Of the proposals submitted, the following have been pre-approved and are at negotiation phase:

1. FP7-ICT-2013-FET-F: Graphene Flagship.
2. FP7-ENERGY.2013.7.3.3: SIRBATT.
3. FP7-2013-GC-Materials: MAT4BATT.
4. FP7-ENERGY-2013-IRP: EESTORIGA.

Also, it is worth noting that an FP7-PEOPLE-2012-IOF Marie Curie cooperation grant has been awarded to CIC Energigune jointly with the Massachusetts Institute of Technology.

Alliances

In late 2012, CIC Energigune joined the EERA (European Energy Research Alliance) consortium. The EERA is an alliance of leading organisations in the field of energy research, which aims to strengthen, expand and optimise the energy research capacities of the EU through the sharing of premier national facilities within Europe and the joint realisation of pan-European research programmes (EERA Joint Programmes) .

The main focus of the EERA is to accelerate the development of energy technologies to the point where they can be integrated into the research driven by the industry. To achieve this goal, the EERA streamlines and coordinates national and European R&D energy programmes.

The SET Plan for investment in energy research and innovation gives priority to the technologies most relevant to the 2020 climate and energy policy and will regulate the new EU Horizon 2020 programme.

In order to help achieve the objectives of the SET Plan and strengthen the research base in the EU, the EERA has the following objectives:

- To accelerate the development of new energy technologies by developing and implementing joint research programmes to support the priorities established in the SET Plan; to share and integrate activities and resources, combining national and Community funding sources; and to maximize complementarities and synergies, including international partners.
- To work in the long term, for the lasting integration of the excellent but dispersed research capabilities across the EU, by overcoming fragmentation, optimising the use of resources, creating additional research capacity and developing a wide range of world class, pan-European energy research infrastructures.
- To develop links and sustained alliances with industry to strengthen the interaction between research results and innovation.

Collaborations

First-class collaborations

The philosophy of CIC Energigune is to establish high-value collaborations with other research centres and universities in the area, as well as with the leading centres and universities at the international level.

In this regard, the principal collaborations established during this period have involved stays by our researchers at premier research centres, while the facilities of the CIC became operational, and the generation of networking, establishing the first collaborative projects.

Commitment to the development of talent

Euskampus campus of excellence

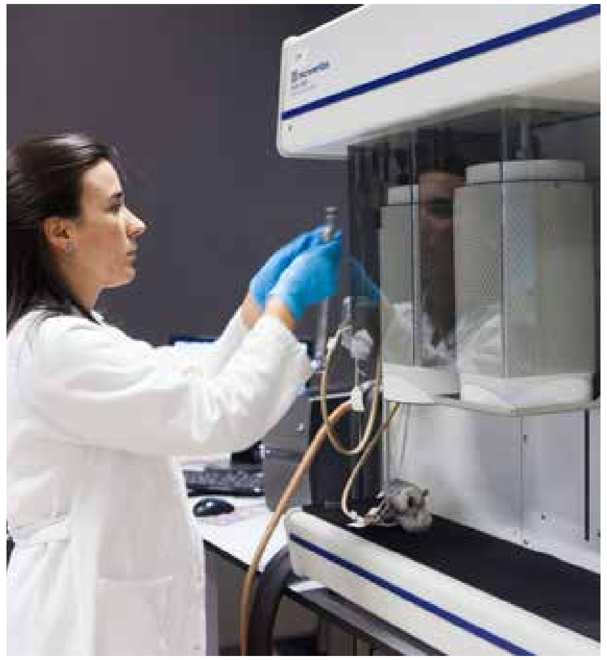
CIC Energigune has signed an agreement with Euskampus Fundazioa, which aims, among other things, to help build and consolidate a culture of science and innovation within its territory, supported by its partners and founding members. It attaches a special importance to the area of society and integration with the territory, and the activities that encourage awareness of science and bring science closer to the media and to business are supported by all of the founding members, who coordinate them jointly with a group of experienced agents.

Euskampus, thanks to the work of all of its partners and project friends, has obtained the accreditation of Scientific Culture and Communication Unit from the FECYT. In this way, it is connected to the most important national network of scientific outreach and makes further progress in its project of communication and promotion of science within society.

In this area, the Energigune CIC agreement is vital to strengthen the development of local talent and for the leveraging of synergies in the field of energy storage.

MESC

The CIC is actively participating in the Erasmus Mundus Materials for Energy Storage and Conversion master's degree.
This master's degree is designed to provide an educational programme of two years in Electrochemistry and Materials Science at five world renowned universities in three European countries: France (Marseilles, Toulouse, Amiens) , Spain (Córdoba) and Poland (Warsaw). Together with study at these universities, the programme also includes projects with major research laboratories in the field of materials related to energy, among which is CIC Energigune.
The MESC is funded by the European Commission as an Erasmus Mundus Master's. The Erasmus Mundus programme supports high-quality European Master's degrees, improving the visibility and attractiveness of European higher education in other countries.



First CIC Energigune doctoral programme

In July 2012 the first round of applications for scholarships for doctoral studies was held, in nine subject areas (eight in EES and one in TES); and six of these have already been awarded. There are six people currently doing their doctoral theses at CIC Energigune in the area of electrochemical energy storage and one in the area of thermal energy storage, in keeping with the philosophy of combining the development of local talent with the attraction of international talent in the following subjects:

- Development of ceramic lithium ion electrolytes for high performance batteries (ref. CerElec)

Doctoral student:
William Jr. Manalastas
CIC tutor:
Prof. John Kilner.

- Investigations of New Anode Materials for Sodium Ion Batteries (ref. ElecNa)

Doctoral student:
María José Piernas
CIC tutor:
Dr Elizabeth Castillo/ Prof. Téófilo Rojo

- Na or Li salt-polymer hybrid nanoparticles as electrolytes for solid-state batteries. (ref. Polym)

Doctoral student:
Nerea Lago
CIC tutor:
Dr Oihane García/Prof. Teófilo Rojo

- Positive electrode materials for aqueous Na-ion batteries (ref. AquoNa)

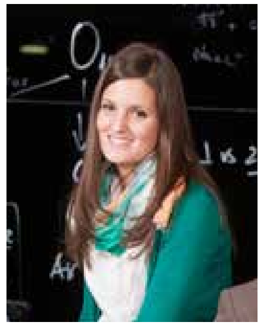
Doctoral student:
Antonio Fernández
CIC tutor:
Dr Montserrat Casas-Cabanas/Dr Miguel Ángel Muñoz

- Regime-selected morphological patterns during the electrodeposition of catalytic nanoparticles (ref. CatNano)

Doctoral student:
Marya Baloch
CIC tutor: Dr Carmen López/Dr Sofía Pérez

- Hybrid Organic - Inorganic Materials for advanced power storage systems

Doctoral student:
Paula Sánchez *
CIC tutor: Dr Carmen López



- Hybrid Organic - Inorganic Materials for advanced power storage systems

Doctoral student:
Elena Risueño
CIC tutor: Dr Stefania Doppiu

(*) Student at UPV-EHU

5 Key Performance Indicators

Communications

For the team working at CIC Energigune, the exchange of information is essential. Hence the importance that is given to communications. So, sharing of knowledge and learning from the experiences of others through collaborations or attending conventions and events is a key part of the job. Below, in a number of tables, is a list of all of the communications that the CIC has participated, from articles published in high impact scientific journals to posters presented at seminars …

Seminars and conventions

Seminars and conventions organised by CIC Energigune

2011

Workshop on Thermal Energy Storage
16/06/2011

EGNATION Meetings
4-6/07/2011

All batteries great and small
09/09/2011

Structural, Electrical and Magnetic Properties of CoFe2O4 and BaTiO3 Layered Nanostructures
21/11/2011

2012

Metal-air Project (by Lide Rodríguez, Ikerlan)
10/01/2012

Synthesis, Characterization and Applications of Nanoporous Materials
31/01/2012

Combining (electro)chemistry with XPS. Surface modifications at the Solid-liquid interface (by Thomas Stempel)
17/02/2012

Delving into the Depths of Solution Structure… Developing Tools for Lithium Battery Electrolyte Characterization (by Wesley Henderson)
08/03/2012

Power our future
20-21/03/2012

Applications of accelerated molecular dynamics in materials science (by Blas Uberuaga)
03/04/2012

Thermochemical energy storage for concentrated solar power plants
17/04/2012

Seminar on solid state NMR and applications (by Juan Miguel López del Amo)
18/04/2012

Solid state NMR and its applications (by Pieter Magusin)
24/04/2012

Can carbon monolithes be suitable electrodes in supercapacitator cells? (by Francisco del Monte)
8/05/2012

I. Industrial Seminar, Trainelec
29/05/2012

II. Industrial Seminar, Ingeteam
28/09/2012

Materials characterization by secondary ion mass spectrometry (by Dr Alexander Tolstoguzov)
17/10/2012

Of surfaces, ions, lipids, and platelets:interactions of biological model systems with inorganic oxides (by Dr Ilya Reviakin)
19/10/2012

III. Industrial Seminar, Graphenea
22/10/2012

IV. Industrial Seminar, Ormazabal
26/11/2012

In situ surface analytical characterization of electronic devices: Ion Lithium Batteries (by Dr Andreas Thißen)
28/11/2012

Workshop: Present and Future Perspectives on Li-air Battery Research
13/12/2012

Seminars and conventions with CIC Energigune participation

2010

Nanoscale Devices for Environmental and Energy Applications (NDEEA 10)
San Sebastián, Spain
26/04/2010

IMLB 2010 - 15th International Meeting on Lithium Batteries
Montreal, Canada
27/06/2010

Workshops and Experts Meeting on Compact Thermal Energy Storage
Bordeaux, France
07/07/2010

Solar PACES 2010
Perpignan, France
21/09/2010

International Conference on Solar Heating, Cooling and Buildings (EuroSun 2010)
Graz, Austria
28/09/2010

2010 MRS Fall Meeting
Boston, Massachusetts, USA
29/11/2010

20th International Seminar on Double Layer Capacitors & Hybrid Energy Storage Devices
South Florida, USA
05/12/2010

2011

International Conference for Sustainable Energy Storage 2011
Belfast, UK
21/02/2011

Concentrating Solar Thermal Power
Scottsdale, Arizona, USA
23/02/2011

International Conference On Thermal Energy Storage and Environment INCOTEE - 2011
Tamil Nadu, India
24/03/2011

Materials Research Society
San Francisco, CA, USA
25/04/2011

The Electrochemical Society
Montreal, Canada
01/05/2011

62nd Annual Meeting of the International Society of Electrochemistry
Turku, Finland
08/05/2011

ASES National Solar Conference, SOLAR 2011
Raleigh, North Carolina, USA
17/05/2011

16th International symposium on intercalation compounds
Sec-Ustupky, Czech Republic
22/05/2011

ICMAT 2011
Suntec, Singapore
26/06/2011

CSP today USA 2011
Las Vegas, USA
29/06/2011

Lithium batteries discussion LIBD
Arcachon, France
01/07/2011

18th International Conference on Solid State Ionics
Warsaw, Poland
03/07/2011

NEUTRONS AND MATERIALS FOR ENERGY
Complutense University of Madrid, Madrid, Spain
11/07/2011

2011 Energy Sustainability Conference and Fuel Cell Conference
Grand Hyatt, Washington, USA
07/08/2011

ISES Solar World Congress 2011
Kassel, Germany
28/08/2011

62nd Annual Meeting of the International Society of Electrochemistry
Niigata, Japan
11/09/2011

Solar Paces 2011
Granada, Spain
20/09/2011

Battery Power 2011
Nashville, TN, USA
20/09/2011

Batteries 2011
Cannes-Mandelieu, France
28/09/2011

The Electrochemical Society
Boston, Massachusetts, USA
9/10/2011

The Battery Show
Detroit, Michigan, USA
25/10/2011

Lithium Battery Power 2011
Paris Las Vegas Hotel & Casino, Las Vegas, USA
07/11/2011

Mobile Power Technology 2011
Paris Las Vegas Hotel & Casino, Las Vegas, USA
09/11/2011

Battery Safety 2011
Paris Las Vegas Hotel & Casino, Las Vegas, USA
09/11/2011

2012

Gordon Research Conferences: Electrochemistry
Four Points Sheraton/Holiday Inn Express, Ventura, CA, USA
08/01/2012

Linz Winter Workshop
Linz, Austria
02/02/2012

Knowledge Exposed: Large Scale Solar Power
Long Beach Convention Center, CA, USA
14/02/2012

Arpa energy innovation summit
Washington DC, USA
27/02/2012

Gordon Research Conferences: Batteries
Four Points Sheraton/Holiday Inn Express, Ventura, CA, USA
04/03/2012

2nd ToF-SIMS LEIS Workshop
Imperial College, London, UK
19/04/2012

Titan User Club 2012 Meeting
Eindhoven, Netherlands
25/04/2012

Innostock
Lleida, Spain
15/05/2012

16th International Meeting on Lithium Batteries
Jeju, South Korea
17/06/2012

Electrical Energy Storage Workshop
Mondragón University, Mondragón, Spain
22/06/2012

International Flow Battery Forum
Munich, Germany
25/06/2012

Energy Research Information/ Partnering Day – 2013 calls
Brussels, Belgium
30/07/2012

ASME Conference
San Diego, CA, USA
23/07/2012

XIII International Symposium on Polymer Electrolytes
Selfoss, Iceland
26/08/2012

Solar paces 2012
Marrakesh, Morocco
11/09/2012

Electrochemistry 2012
Munich, Germany
17/09/2012

Neutrons for Energy
Delft, Netherlands
17/09/2012

IBero-American NMR
Aveiro, Portugal
24/09/2012

Graphel Conference
Mykonos, Greece
30/09/2012

Green Cars 2012: Business Challenges and Global Opportunities
Vitoria, Spain
03/10/2012

PRIME
Honolulu, Hawaii, USA
08/10/2012

The Eighth Experts Meeting
Petten, Netherlands
18/10/2012

SAM SSA
Eindhoven, Netherlands
22/10/2012

Scientific lives
San Sebastián, Spain
12/11/2012

MRS 2012 Fall Meeting & Exhibit
Boston, USA
25/11/2012

2012 EMN Fall Meeting
Las Vegas, USA
29/11/2012

Lithium Battery Power
Las Vegas, USA
04/12/2012

Crystal Chemistry and Magnetic New materials for Energy Storage Scientific Research Authorization
University of Pierre and Marie Curie, Paris, France
07/12/2012

Publications

In the area of publications, it should be noted that an article written by researchers at CIC Energigune, "Na-ion batteries, recent advances and present challenges to become low cost energy storage systems", has been among the ten most read articles on energy and environmental sciences since its publication in February 2012. Details of articles published in high impact journals:

2011

Near Heterosite Li0.1FePO4 Phase Formation as Atmospheric Aging Product of LiFePO4/C Composite. Electrochemical, Magnetic and EPR Study
Journal of the Electrochemical Society, 158 (9) A1042-A1047 (2011)
Electrical energy storage
21/07/2011
2,59
V. Palomares, A. Goñi, I. Gil de Muro, L. Lezama, I. de Meatza, M. Bengoechea, I. Boyano, T. Rojo

Recycled Material for Sensible Heat Based Thermal Energy Storage to be Used in Concentrated Solar Thermal Power Plants
Journal of Solar Energy Engineering-Transactions of the Asme Volume: 133 Issue: 3; DOI: 10.1115/1.4004267
Thermal Energy Storage
22/08/2011
0,846
X. Py, N. Calvet, R. Olives, A. Meffre, P. Echegut, C. Bessada, E. Veron, S. Ory

A Phosphite Oxoanion-Based Compound with Lithium Exchange Capability and Spin-Glass Magnetic Behavior
Chemistry of Materials, 2011, 23 (19), pp 4317–4330
DOI: 10.1021/cm201337g
Power storage; Batteries and Supercaps
15/09/2011
7,286
U-Ch. Chung, J. L. Mesa, J. L. Pizarro, I. de Meatz a, M. Bengoechea, J. Rodríguez Fernandez, M. I. Arriortua, T. Rojo

Preparation and Characterization of Monodisperse Fe3O4 Nanoparticles: An Electron Magnetic Resonance Study
Chemistry of Materials, 2011, 23 (11), pp 2879–2885
DOI: 10.1021/cm200253k
Power storage; Batteries and Supercaps
04/11/2011
7,286
J. Salado, M. Insausti, L. Lezama, I. Gil de Muro, E. Goikolea, T. Rojo

Novel Pr0.6Sr0.4Fe0.8Co0.2O3:Ce0.8Sm 0.2O2 composite nanotubes for energy conversion and storage
Journal of Power Sources 201 (2012) 332-339
DOI: 10.1016/j.jpowsour.2011.10.089
Power storage; Batteries and Supercaps
15/12/2011
4,951
R. Pinedo, I. Ruiz de Larramendi, N. Ortiz-Vitoriano, I. Gil de Muro, T. Rojo

Photoinduced Optical Transparency in Dye-Sensitized Solar Cells Containing Graphene Nanoribbons
Journal of Physical Chemistry C, 2011, 115 (50), pp 25125–25131
DOI: 10.1021/jp2069946
Electrical energy storage
26/12/2011
4,805
J. A. Velten, J. Carretero-Gonzalez, E. Castillo-Martínez, J. Bykova, A. Cook, R. Baughman, A. Zakhidov

2012

Thermal storage material from inertized wastes: Evolution of structural and radiative properties with temperature
Solar Energy, Volume 86, Issue 1, January 2012, Pages 139–146
Thermal Energy Storage
01/012012
2,475
A. Faik, S. Guillot, J. Lambert, E. Ve´ron, S. Ory, C. Bessada, P. Echegut, X. Py

Enhanced performances of macro-encapsulated phase change materials by intensification of the internal effective thermal conductivity
Journal of Heat and Mass Transfer
Thermal Energy Storage
submitted 01/01/2012
N. Calvet, X. Py, R. Olivès, J.P. Bedecarrats, J.P. Dumas, F. Jay

Structural, magnetic and electrochemical study of a new active phase obtained by oxidation of a LiFePO4/C composite†
Journal of Materials Chemistry
DOI: 10.1039/c2jm14462j
Electrical energy storage
30/01/2012
5,968
Ver onica Palomares, Aintzane Goni, Amaia Iturrondobeitia, Luis Lezama,a Iratxe de Meatza, Miguel Bengoecheab and Teofilo Rojo

Na-ion batteries, recent advances and present challenges to become low cost energy storage systems
Energy & Environmentai Science DOI: 10.1039/c2ee02781j
Power storage; Batteries and Supercaps
07/02/2012
9,61
V. Palomares, P. Serras, I. Villaluenga, K. B. Hueso, J. Carretero-Gonzalez, T. Rojo

Molten ternary nitrate salts mixture for use in an active direct thermal energy storage system in parabolic trough plants
Journal of Solar Energy Engineering
Thermal Energy Storage
submitted 1/3/2012
J. Gomez, N. Calvet, A. Starace, G. Glatzmaier

Structural Changes upon Lithium Insertion in Ni0.5TiOPO4
Journal of Alloys and Compounds
http://dx.doi.org/10.1016/j.jallcom.2012.03.103
Thermal Energy Storage
11/04/2012
2,289
R. Essehli, B.E. Bali, A. Faik, S. Benmokhtar, B. Manoun, Y. Zhang, X.J. Zhang, Z. Zhou, H. Fuess

A study of the crystal structure and the phase transitions of the double perovskites A2ScSbO6 (A= Sr, Ca) by neutron and X-ray powder diffraction.
JOURNAL OF SOLID STATE CHEMISTRY Volume: 192 Pages: 273-283
http://dx.doi.org/10.1016/j.jssc.2012.04.019
Thermal Energy Storage
12/04/2012
2,159
A. Faik, J. M. Igartua, D. Orobengoa, J. M. Perez-Mato and M. I. Aroyo

Effect of doping LiMn2O4 spinel with a tetravalent species such as Si(IV) versus with a trivalent species such as Ga(III). Electrochemical, magnetic and ESR study
Journal of power Sources 216 (2012) 482 488
http://dx.doi.org/10.1016/j.jpowsour.2012.06.031
Electrical energy storage
19/06/2012
4,951
A. Iturrondobeitia a, A. Goñi a, V. Palomares a, I. Gil de Muro a, L. Lezama a, Teofilo Rojo

Infrared normal spectral emissivity of Ti–6Al–4V alloy in the 500–1150 K temperature range
Journal of Alloys and Compounds
http://dx.doi.org/10.1016/j.jallcom.2012.06.117
Thermal Energy Storage
29/06/2012
2,289
L. González-Fernández , E. Risueño R.B. Pérez-Sáez M.J. Tello

Improving thermochemical storage behavior by inserting additives
Submitted to Applied Energy
Thermal Energy Storage
04/07/2012
Ch.Rosskopf,A.Faik.M.Linder,A.Worner

Compatibility of a post-industrial ceramic with nitrate molten salts, for use as filler materials in a thermocline storage system
Applied Energy
http://dx.doi.org/10.1016/j.apenergy.2012.12.078
Thermal Energy Storage
16/07/2012
5,106
N. Calvet, J.C. Gomez, A. Faik, V. Roddatis, A.K. Starace, A. Meffre, G.C. Glatzmaier, S. Doppiu, and X. Py

Role of Surface Contamination in Titanium PM
Key Engineering Materials Vol. 520 (2012) pp 121-132
DOI: 10.4028/www.scientific.net/KEM.520.121
Platforms
24/08/2012
Orest M. Ivasishina,, Dmytro G. Savvakinb, Mykola M. Gumenyakc,Oleksandr Bondarchuk

Composition-Structure Relationships in the Li-Ion Battery Electrode Material LiNi0.5Mn1.5O4
Chemistry of Materials
Chem. Mater., 2012, 24 (15), pp 2952–2964
DOI: 10.1021/cm301148d
Power storage; Batteries and Supercaps
30/08/2012
7,286
Jordi Cabana, Montserrat Casas-Cabanas, Fredrick.Omenya,Natasha A. Chernova, Dongli Zeng, M. Stanley Whittingham, and Clare P. Grey

Crystal structures and high-temperature phase-transitions in SrNdMRuO6 (M=Zn,Co,Mg,Ni) new double perovskites studied by symmetry-mode analysis
Journal of solid state chemistry
http://dx.doi.org/10.1016/j.jssc.2012.09.007
Thermal Energy Storage
04/09/2012
2,159
E. Iturbe-Zabaloa,b, J.M. Igartuab, A. Faik, A. Larra˜nagad, M. Hoelzele,G. Cuelloa

High voltage cathode materials for Na-ion batteries of general formula Na3V2O2x(PO4)2F3 2x
Journal of material chemistry
J. Mater. Chem., 2012,22, 22301-22308
DOI: 10.1039/C2JM35293A
Power storage; Batteries and Supercaps
07/09/2012
5,968
Paula Serras, Veronica Palomares, Aintzane Goñi, Izaskun Gil de Muro, Pierre Kubiak, Luis Lezama and Teofilo Rojo

Reconstruction of the polar interface between hexagonal LuFeO3 and intergrown Fe3O4 nanolayers
Scientific Reports
doi: 10.1038/srep00672
Electrical energy storage
19/09/2012
N/A yet
A. R. Akbashev, V. V. Roddatis. L. Vasiliev, S. Lopatin, V. A. Amelichev & A. R. Kaul

Tensile Lattice Distortion Does Not Affect Oxygen Transport in Yttria-Stabilized Zirconia (YSZ)–CeO2 Hetero-Interfaces
ACS Nano
DOI: 10.1021/nn302812m
Electrical energy storage
29/10/2012
11,421
Daniele Pergolesi , Emiliana Fabbri, Stuart N. Cook ,Vladimir Roddatis , Enrico Traversa , and John A. Kilner

Kinetics of Coupled Double Proton and Deuteron Transfer in Hydrogen-Bonded Ribbons of Crystalline Pyrazole-4-carboxylic Acid
Z. Phys. Chem.
doi: 10.1524/zpch.2012.0305
Platforms
29/10/2012
1,568
Veronica Torres, Juan-Miguel Lopez,Uwe Langer Gerd Buntkowsky Hans-Martin Vieth4, Jose Elguero, and Hans-Heinrich Limbach

2013

High temperature sodium batteries: status, challenges and future trends
Royal Society of Chemistry
Energy Environ. Sci., 2013,6, 734-749
DOI: 10.1039/C3EE24086J
Electrical energy storage
14/01/2013
9,61
Karina B. Hueso, Michel Armand, and Teófilo Rojo

Comprehensive Insights into the Structural and Chemical Changes in Mixed-Anion FeOF Electrodes by Using Operando PDF and NMR
JACKS, J. Am. Chem. Soc., 2013, 135 (10), pp 4070–4078
DOI: 10.1021/ja400229
Electrical energy storage
22/02/2013
9,907
Kamila M. Wiaderek, Olaf J. Borkiewicz, Elizabeth Castillo-Martínez, Rosa Robert Nathalie Pereira, Glenn G. Amatucci, Clare P. Grey Peter J. Chupas,and Karena W. Chapman Nathalie Pereira, Glenn G. Amatucci Clare P. Grey, Peter J. Chupas,and Karena W. Chapman

New hydrophobic ionic liquids based on (fluorosulfonyl)(polyfluorooxaalkanesulfonyl) imides with various oniums
Electrochimica Acta, Volume 99, 1 June 2013, Pages 262–272
http://dx.doi.org/10.1016/j.electacta.2013.02.095
Electrical energy storage
25/03/2013
3,832
Chengyong Liu, Fei Xu, Shaowei Feng, Liping Zhen, Heng Zhang, Wenfang Fenga, Xuejie Huang, Michel Armand, Jin Nie, , Zhibin Zhou,

Single lithium-ion conducting polymer electrolytes based onpoly[(4styrenesulfonyl)(trifluoromethanesulfonyl)imide] anions
Electrochimica Acta
http://dx.doi.org/10.1016/j.electacta.2013.01.119
Electrical energy storage
30/03/2013
3,832
Shaowei Feng, Dongyang Shi, Fang Liu, Liping Zheng, Jin Nie, Wengfang Feng, Xuejie Huang, Michel Armand, Zhibin Zhou

Optimizing solid oxide fuel cell cathode processing route for intermediate temperature operation
Applied Energy
http://dx.doi.org/10.1016/j.apenergy.2012.12.003
Electrical energy storage
01/04/2013
5,106
N. Ortiz-Vitoriano, C. Bernuy-López, I. Ruiz de Larramendi, R. Knibbe, K. Thydén, A. Hauch, P. Holtappels, T. Rojo

Electrochemical performance of mixed valence Na3V2O2x(PO4)2F3-2x/C as cathode for sodium-ion batteries
Journal of Power Sources
http://dx.doi.org/10.1016/j.jpowsour.2013.04.094
Electrical energy storage
19/04/2013
4,951
Paula Serras, Verónica Palomares, Aintzane Goñi, Pierre Kubiak, Teófilo Rojo

The Formation of Performance Enhancing Pseudo-Composites in the Highly Active La 1– x Ca x Fe 0.8 Ni 0.2 O 3 System for IT-SOFC Application
Advanced Functional Materials
DOI: 10.1002/adfm.201300481
Electrical energy storage
30/04/2013
10,179
Nagore Ortiz-Vitoriano , Idoia Ruiz de Larramendi , Stuart N. Cook , Mónica Burriel ,Ainara Aguadero , John A. Kilner , and Teófilo Rojo

Electrochemical characterization of La0.6Ca0.4Fe0.8Ni0.2O3-δ perovskite cathode for IT-SOFC
Journal of Power Sources
http://dx.doi.org/10.1016/j.jpowsour.2013.03.121
Electrical energy storage
01/10/2013
4,951
N. Ortiz-Vitoriano, A. Hauch, I. Ruiz de Larramendi, C. Bernuy-López, R. Knibbe, T. Rojo.

Otras publicaciones

2011

Near Heterosite Li0.1FePO4 Phase Formation as Atmospheric Aging Product of LiFePO4/C Composite. Electrochemical, Magnetic and EPR Study
Journal of the Electrochemical Society, 158 (9) A1042-A1047 (2011)
Electrical energy storage
21/07/2011
V. Palomares, A. Goñi, I. Gil de Muro, L. Lezama, I. de Meatza, M. Bengoechea, I. Boyano, T. Rojo

Recycled Material for Sensible Heat Based Thermal Energy Storage to be Used in Concentrated Solar Thermal Power Plants
Journal of Solar Energy Engineering-Transactions of the Asme Volume: 133 Issue: 3; DOI: 10.1115/1.4004267
Thermal Energy Storage
22/08/2011
X. Py, N. Calvet, R. Olives, A. Meffre, P. Echegut, C. Bessada, E. Veron, S. Ory

A Phosphite Oxoanion-Based Compound with Lithium Exchange Capability and Spin-Glass Magnetic Behavior
Chemistry of Materials, 2011, 23 (19), pp 4317–4330
DOI: 10.1021/cm201337g
Power storage; Batteries and Supercaps
15/09/2011
U-Ch. Chung, J. L. Mesa, J. L. Pizarro, I. de Meatza, M. Bengoechea, J. Rodríguez Fernandez, M. I. Arriortua, T. Rojo

Preparation and Characterization of Monodisperse Fe3O4 Nanoparticles: An Electron Magnetic Resonance Study
Chemistry of Materials, 2011, 23 (11), pp 2879–2885
DOI: 10.1021/cm200253k
Power storage; Batteries and Supercaps
04/11/2011
J. Salado, M. Insausti, L. Lezama, I. Gil de Muro, E. Goikolea, T. Rojo

Novel Pr0.6Sr0.4Fe0.8Co0.2O3:Ce0.8Sm 0.2O2 composite nanotubes for energy conversion and storage
Journal of Power Sources 201 (2012) 332-339
DOI: 10.1016/j.jpowsour.2011.10.089
Power storage; Batteries and Supercaps
15/12/2011
R. Pinedo, I. Ruiz de Larramendi, N. Ortiz-Vitoriano, I. Gil de Muro, T. Rojo

Photoinduced Optical Transparency in Dye-Sensitized Solar Cells Containing Graphene Nanoribbons
Journal of Physical Chemistry C, 2011, 115 (50), pp 25125–25131
DOI: 10.1021/jp2069946
Electrical energy storage
26/12/2011
J. A. Velten, J. Carretero-Gonzalez, E. Castillo-Martínez, J. Bykova, A. Cook, R. Baughman, A. Zakhidov

2012

Thermal storage material from inertized wastes: Evolution of structural and radiative properties with temperature
Solar Energy, Volume 86, Issue 1, January 2012, Pages 139–146
Thermal Energy Storage
01/01/2012
A. Faik, S. Guillot, J. Lambert, E. Ve´ron, S. Ory, C. Bessada, P. Echegut, X. Py

Enhanced performances of macro-encapsulated phase change materials by intensification of the internal effective thermal conductivity
Journal of Heat and Mass Transfer
Thermal Energy Storage
submitted 01/01/2012
N. Calvet, X. Py, R. Olivès, J.P. Bedecarrats, J.P. Dumas, F. Jay

Structural, magnetic and electrochemical study of a new active phase obtained by oxidation of a LiFePO4/C composite†
Journal of Materials Chemistry
DOI: 10.1039/c2jm14462j
Electrical energy storage
30/01/2012
Veronica Palomares, Aintzane Goni, Amaia Iturrondobeitia, Luis Lezama,a Iratxe de Meatza, Miguel Bengoecheab and Teofilo Rojo

Na-ion batteries, recent advances and present challenges to become low cost energy storage systems
Energy & Environmentai Science DOI: 10.1039/c2ee02781j
Power storage; Batteries and Supercaps
07/02/2012
V. Palomares, P. Serras, I. Villaluenga, K. B. Hueso, J. Carretero-Gonzalez, T. Rojo

Molten ternary nitrate salts mixture for use in an active direct thermal energy storage system in parabolic trough plants
Journal of Solar Energy Engineering
Thermal Energy Storage
submitted 1/3/2012
J. Gomez, N. Calvet, A. Starace, G. Glatzmaier

Structural Changes upon Lithium Insertion in Ni0.5TiOPO4
Journal of Alloys and Compounds
http://dx.doi.org/10.1016/j.jallcom.2012.03.103
Thermal Energy Storage
11/04/2012
R. Essehli, B.E. Bali, A. Faik, S. Benmokhtar, B. Manoun, Y. Zhang, X.J. Zhang, Z. Zhou, H. Fuess

A study of the crystal structure and the phase transitions of the double perovskites A2ScSbO6 (A= Sr, Ca) by neutron and X-ray powder diffraction.
JOURNAL OF SOLID STATE CHEMISTRY Volume: 192 Pages: 273-283
http://dx.doi.org/10.1016/j.jssc.2012.04.019
Thermal Energy Storage
12/04/2012
A. Faik, J. M. Igartua, D. Orobengoa, J. M. Perez-Mato and M. I. Aroyo

Effect of doping LiMn2O4 spinel with a tetravalent species such as Si(IV) versus with a trivalent species such as Ga(III). Electrochemical, magnetic and ESR study
Journal of power Sources 216 (2012) 482 488
http://dx.doi.org/10.1016/j.jpowsour.2012.06.031
Electrical energy storage
19/06/2012
A. Iturrondobeitia a, A. Goñi a, V. Palomares a, I. Gil de Muro a, L. Lezama a, Teofilo Rojo

Infrared normal spectral emissivity of Ti–6Al–4V alloy in the 500–1150 K temperature range
Journal of Alloys and Compounds
http://dx.doi.org/10.1016/j.jallcom.2012.06.117
Thermal Energy Storage
29/06/2012
L. González-Fernández , E. Risueño R.B. Pérez-Sáez M.J. Tello

Improving thermochemical storage behavior by inserting additives
Submitted to Applied Energy
Thermal Energy Storage
04/07/2012
Ch.Rosskopf,A.Faik.M.Linder,A.Worner

Compatibility of a post-industrial ceramic with nitrate molten salts, for use as filler materials in a thermocline storage system
Applied Energy
http://dx.doi.org/10.1016/j.apenergy.2012.12.078
Thermal Energy Storage
16/07/2012
N. Calvet, J.C. Gomez, A. Faik, V. Roddatis, A.K. Starace, A. Meffre, G.C. Glatzmaier, S. Doppiu, and X. Py

Role of Surface Contamination in Titanium PM
Key Engineering Materials Vol. 520 (2012) pp 121-132
DOI: 10.4028/www.scientific.net/KEM.520.121
Platforms
24/08/2012
Orest M. Ivasishina,, Dmytro G. Savvakinb, Mykola M. Gumenyakc,Oleksandr Bondarchuk

Composition-Structure Relationships in the Li-Ion Battery Electrode Material LiNi0.5Mn1.5O4
Chemistry of Materials
Chem. Mater., 2012, 24 (15), pp 2952–2964
DOI: 10.1021/cm301148d
Power storage; Batteries and Supercaps
30/08/2012
Jordi Cabana, Montserrat Casas-Cabanas, Fredrick.Omenya,Natasha A. Chernova, Dongli Zeng, M. Stanley Whittingham, and Clare P. Grey

Crystal structures and high-temperature phase-transitions in $SrNdMRuO_6$ (M=Zn,Co,Mg,Ni) new double perovskites studied by symmetry-mode analysis
Journal of solid state chemistry
http://dx.doi.org/10.1016/j.jssc.2012.09.007
Thermal Energy Storage
04/09/2012
E. Iturbe-Zabaloa,b, J.M. Igartuab, A. Faik, A. Larra˜nagad, M. Hoelzele,G. Cuelloa

High voltage cathode materials for Na-ion batteries of general formula $Na_3V_2O_{2x}(PO_4)_2F_{3-2x}$
Journal of material chemistry
J. Mater. Chem., 2012,22, 22301-22308
DOI: 10.1039/C2JM35293A
Power storage; Batteries and Supercaps
07/09/2012
Paula Serras, Veronica Palomares, Aintzane Goñi, Izaskun Gil de Muro, Pierre Kubiak, Luis Lezama and Teofilo Rojo

Reconstruction of the polar interface between hexagonal $LuFeO_3$ and intergrown Fe_3O_4 nanolayers
Scientific Reports
doi: 10.1038/srep00672
Electrical energy storage
19/09/2012
A. R. Akbashev, V. V. Roddatis. L. Vasiliev, S. Lopatin, V. A. Amelichev & A. R. Kaul

Tensile Lattice Distortion Does Not Affect Oxygen Transport in Yttria-Stabilized Zirconia (YSZ)–CeO_2 Hetero-Interfaces
ACS Nano
DOI: 10.1021/nn302812m
Electrical energy storage
29/10/2012
Daniele Pergolesi , Emiliana Fabbri , Stuart N. Cook ,Vladimir Roddatis , Enrico Traversa , and John A. Kilner

Kinetics of Coupled Double Proton and Deuteron Transfer in Hydrogen-Bonded Ribbons of Crystalline Pyrazole-4-carboxylic Acid
Z. Phys. Chem.
doi: 10.1524/zpch.2012.0305
Platforms
29/10/2012
Veronica Torres, Juan-Miguel Lopez,Uwe Langer Gerd Buntkowsky Hans-Martin Vieth4, Jose Elguero, and Hans-Heinrich Limbach

2013

High temperature sodium batteries: status, challenges and future trends

Royal Society of Chemistry
Energy Environ. Sci., 2013,6, 734-749
DOI: 10.1039/C3EE24086J
Electrical energy storage
14/01/2013
Karina B. Hueso, Michel Armand, and Teófilo Rojo

Comprehensive Insights into the Structural and Chemical Changes in Mixed-Anion FeOF Electrodes by Using Operando PDF and NMR
JACKS
J. Am. Chem. Soc., 2013, 135 (10), pp 4070–4078
DOI: 10.1021/ja400229
Electrical energy storage
22/02/2013
Kamila M. Wiaderek, Olaf J. Borkiewicz, Elizabeth Castillo-Martínez, Rosa Robert Nathalie Pereira, Glenn G. Amatucci, Clare P. Grey Peter J. Chupas,and Karena W. Chapman Nathalie Pereira, Glenn G. Amatucci Clare P. Grey, Peter J. Chupas,and Karena W. Chapman

New hydrophobic ionic liquids based on (fluorosulfonyl)(polyfluorooxaalkanesulfonyl) imides with various oniums
Electrochimica Acta, Volume 99, 1 June 2013, Pages 262–272
http://dx.doi.org/10.1016/j.electacta.2013.02.095
Electrical energy storage
25/03/2013
Chengyong Liu, Fei Xu, Shaowei Feng, Liping Zhen, Heng Zhang, Wenfang Fenga, Xuejie Huang, Michel Armand, Jin Nie, , Zhibin Zhou,

Single lithium-ion conducting polymer electrolytes based onpoly[(4styrenesulfonyl)(trifluoromethanesulfonyl)imide] anions
Electrochimica Acta
http://dx.doi.org/10.1016/j.electacta.2013.01.119
Electrical energy storage
30/03/2013
Shaowei Feng, Dongyang Shi, Fang Liu, Liping Zheng, Jin Nie, Wengfang Feng, Xuejie Huang, Michel Armand, Zhibin Zhou

Optimizing solid oxide fuel cell cathode processing route for intermediate temperature operation
Applied Energy
http://dx.doi.org/10.1016/j.apenergy.2012.12.003
Electrical energy storage
01/04/2013
N. Ortiz-Vitoriano, C. Bernuy-López, I. Ruiz de Larramendi, R. Knibbe, K. Thydén, A. Hauch, P. Holtappels, T. Rojo

Electrochemical performance of mixed valence $Na_3V_2O_{2x}(PO_4)_2F_{3-2x}$/C as cathode for sodium-ion batteries
Journal of Power Sources
http://dx.doi.org/10.1016/j.jpowsour.2013.04.094
Electrical energy storage
19/04/2013
Paula Serras, Verónica Palomares, Aintzane Goñi, Pierre Kubiak, Teófilo Rojo

The Formation of Performance Enhancing Pseudo-Composites in the Highly Active $La_{1-x}Ca_xFe_{0.8}Ni_{0.2}O_3$ System for IT-SOFC Application
Advanced Functional Materials
DOI: 10.1002/adfm.201300481
Electrical energy storage
30/04/2013
Nagore Ortiz-Vitoriano , Idoia Ruiz de Larramendi , Stuart N. Cook , Mónica Burriel ,Ainara Aguadero , John A. Kilner , and Teófilo Rojo

Electrochemical characterization of $La_{0.6}Ca_{0.4}Fe_{0.8}Ni_{0.2}O_{3-\delta}$ perovskite cathode for IT-SOFC
Journal of Power Sources
http://dx.doi.org/10.1016/j.jpowsour.2013.03.121
Electrical energy storage
01/10/2013
N. Ortiz-Vitoriano, A. Hauch, I. Ruiz de Larramendi, C. Bernuy-López, R. Knibbe, T. Rojo.

2011

Conclusions reached by the scientific committee responsible for the area of electrical energy storage
Independent publication
Scientific committee

Conclusions from the Scientific Committee for thermal energy storage
Independent publication
Scientific committee

Near Heterosite $Li_{0.1}FePO_4$ Phase Formation as Atmospheric Aging Product of $LiFePO_4$/C Composite. Electrochemical, Magnetic and EPR Study
Journal of the Electrochemical Society, 158 (9) A1042-A1047 (2011)
V. Palomares, A. Goñi, I. Gil de Muro, L. Lezama, I. de Meatza, M. Bengoechea, I. Boyano, T. Rojo

Recycled Material for Sensible Heat Based Thermal Energy Storage to be Used in Concentrated Solar Thermal Power Plants
Journal of Solar Energy Engineering-Transactions of the Asme Volume: 133 Issue: 3; DOI: 10.1115/1.4004267
X. Py, N. Calvet, R. Olives, A. Meffre, P. Echegut, C. Bessada, E. Veron, S. Ory

Recycling of industrial waste as applied to thermal energy storage American Chemistry Society, August 28th–September 1st, 2011, Denver, USA.
N. Calvet, X. Py, R. Olivès, C. Bessada, P. Echegut

Enhancement of effective thermal conductivity in macro-encapsulate PCMs
American Chemistry Society, August 28th–September 1st, 2011, Denver, USA.
N. Calvet, X. Py, R. Olivès, J.P. Bedecarrats, J.P. Dumas

High temperature thermal energy storage material from vitried fly-ashes
Solar Paces 2011 International conference, Granada
A. Meffre, X. Py, R. Olives, A. Faik, C. Bessada, P. Echegut, U. Michon

A Phosphite Oxoanion-Based Compound with Lithium Exchange Capability and Spin-Glass Magnetic Behavior
Chemistry of Materials, 2011, 23 (19), pp. 4317–4330
DOI: 10.1021/cm201337g
U-Ch. Chung, J. L. Mesa, J. L. Pizarro, I. de Meatza, M. Bengoechea, J. Rodríguez Fernandez, M. I. Arriortua, T. Rojo

Preparation and Characterization of Monodisperse Fe_3O_4 Nanoparticles: An Electron Magnetic Resonance Study
Chemistry of Materials, 2011, 23 (11), pp. 2879-2885
DOI: 10.1021/cm200253k
J. Salado, M. Insausti, L. Lezama, I. Gil de Muro, E. Goikolea, T. Rojo

Novel $Pr_{0.6}Sr_{0.4}Fe_{0.8}Co_{0.2}O_3$:$Ce_{0.8}Sm_{0.2}O_2$ composite nanotubes for energy conversion and storage
Journal of Power Sources 201 (2012) 332-339
R. Pinedo, I. Ruiz de Larramendi, N. Ortiz-Vitoriano, I. Gil de Muro, T. Rojo

Photoinduced Optical Transparency in Dye-Sensitized Solar Cells Containing Graphene Nanoribbons
Journal of Physical Chemistry C, 2011, 115 (50), pp. 25125–25131
DOI: 10.1021/jp2069946
J. A. Velten, J. Carretero-Gonzalez, E. Castillo-Martínez, J. Bykova, A. Cook, R. Baughman, A. Zakhidov

2012

Thermal storage material from inertized wastes: Evolution of structural and radiative properties with temperature
Solar Energy, Volume 86, Issue 1, January 2012, Pages 139–146
A. Faik, S. Guillot, J. Lambert, E. Ve´ron, S. Ory, C. Bessada, P. Echegut, X. Py

Enhanced performances of macro-encapsulated phase change materials by intensification of the internal effective thermal conductivity
Journal of Heat and Mass Transfer
N. Calvet, X. Py, R. Olivès, J.P. Bedecarrats, J.P. Dumas, F. Jay

Structural, magnetic and electrochemical study of a new active phase obtained by oxidation of a $LiFePO_4$/C composite†
Journal of Materials Chemistry. DOI: 10.1039/c2jm14462j
Verónica Palomares, Aintzane Goni, Amaia Iturrondobeitia, Luis Lezama, Iratxe de Meatza, Miguel Bengoechea, Teófilo Rojo

Na-ion batteries, recent advances and present challenges to become low cost energy storage systems
Energy & Environmental Science DOI: 10.1039/c2ee02781j
V. Palomares, P. Serras, I. Villaluenga, K. B. Hueso, J. Carretero-Gonzalez, T. Rojo

Structural, magnetic and electrochemical study of a new active phase obtained by oxidation of a $LiFePO_4$/C composite
Journal of Materials Chemistry DOI: 10.1039/c2jm14462j
V. Palomares, A. Goñi, A. Iturrondobeitia, L. Lezama, I. de Meatza, M. Bengoechea, T. Rojo

Molten ternary nitrate salts mixture for use in an active direct thermal energy storage system in parabolic trough plants
Journal of Solar Energy Engineering
J. Gómez, N. Calvet, A. Starace, G. Glatzmaier

De la cerámica a la energía pasando por la catálisis, los polímeros y la nanotecnología.
Jornadas de Vidas Científicas Donosti 2012
J. Carretero

In situ FTIR microscopy vs. conventional in situ FTIR spectroscopy: Impact of VC on the SEI film in Li-ion batteries
Power our future 2012
S. Pérez-Villar, H. Schneider, P. Novák

Electrochemical Investigation of Nanosized Rutile TiO2 as Negative Electrode for Safer Li-ion Batteries
Power our future 2012
P. Kubiak, M. Pfanzelt, M. Marinaro, M. Wohlfahrt-Mehrens

Biscrolling nanotube sheets and functional guests into yarns for energy storage applications
Power our future 2012
J. Carretero-González, E. Castillo-Martínez, M. D. Lima, X. Lepro, R. H. Baughman

Crystal Structure, Energetics and electrochemistry of Li2FeSiO4 polymorphs from First Principles Calculations
Power our future 2012
A.Saracibar, A. Van der Ven, M. E. Arroyo-de Dompablo

Ni-Mn order and the local structure of LiNi0.5Mn1.5O4 cathode material during delithiation-lithiation studied by 6Li solid state NMR
Power our future 2012
E. Castillo-Martínez, M. Leskes, Ch. Kim, D. S. Middlemiss, J. Cabana, C. P. Grey.

Preparation of 3D Fe3O4@Cu electrodes for microbatteries
Power our future 2012
E. Goikolea, B. Daffos, P. L. Taberna, P. Simon

Structural Changes upon Lithium Insertion in Ni0.5TiOPO4
Journal of Alloys and Compounds (http://dx.doi.org/10.1016/j.jallcom.2012.03.103)
R. Essehli, B.E. Bali, A. Faik, S. Benmokhtar, B. Manoun, Y. Zhang, X.J. Zhang, Z. Zhou, H. Fuess

A study of the crystal structure and the phase transitions of the double perovskites A2ScSbO6 (A= Sr, Ca) by neutron and X-ray powder diffraction
Journal of solid state chemistry
A. Faik, J. M. Igartua, D. Orobengoa, J. M. Pérez-Mato and M. I. Arroyo

High temperature thermal energy storage material thermomechanical characterization and assessment of their resistance to thermal shock
INNOSTOCK, Lleida, Spain
N. Calvet, J. C. Gómez, A. K. Starace, A. Meffre, G. C. Glatzmaier, S. Doppiu, X. Py

Effect of doping LiMn2O4 with trivalent and tetravalent species on electrochemical performance
IMLB Conference, Jeju, South Korea
A. Iturrondobeitia, A. Goñi, V. Palomares, L. Lezama, I. Gil de Muro, T. Rojo

State of the art electrodes for Na-ion batteries. A materials view
IMLB Conference, Jeju, South Korea
V. Palomares, P. Serras, J. Carretero-González, T. Rojo

Synthesis and Characterization of Hybrid Organic-Inorganic Composite Electrodes for Li-ion and Li-air Batteries
IMLB Conference, Jeju, South Korea
C. M. López, P. Sánchez-Fontecoba, S. Pérez-Villar, T. Rojo

Effect of doping LiMn2O4 spinel with a tetravalent species such as Si(IV) versus with a trivalent species such as Ga(III). Electrochemical, magnetic and ESR study
Journal of power Sources 216 (2012) 482-488
A. Iturrondobeitia, A. Goñi, V. Palomares, I. Gil de Muro, L. Lezama, T. Rojo

Infrared normal spectral emissivity of Ti–6Al–4V alloy in the 500–1150 K temperature range
Journal of Alloys and Compounds
L. González-Fernández, E. Risueño, R. B. Pérez-Sáez, M .J. Tello

Improving thermochemical storage behavior by inserting additives
Applied energy (submitted)
C. Rosskopf, A. Faik, M. Linder, A. Worner

Sistemas de almacenamiento de energía para el vehículo eléctrico
Acto de clausura máster en química avanzada, Universidad de Córdoba
Téofilo Rojo

Compatibility of a post-industrial ceramic with nitrate molten salts, for use as filler materials in a thermocline storage system
N. Calvet, J. C. Gómez, A. Faik, V. Roddatis, A. K. Starace, A. Meffre, G. C. Glatzmaier, S. Doppiu, X. Py

Role of Surface Contamination in Titanium PM
Key Engineering Materials Vol. 520 (2012) pp. 121-132
Orest M. Ivasishina,, Dmytro G. Savvakinb, Mykola M. Gumenyakc, Oleksandr Bondarchuk

Composition-Structure Relationships in the Li-Ion Battery Electrode Material LiNi0.5Mn1.5O4
Chemistry of Materials
Jordi Cabana, Montserrat Casas-Cabanas, Fredrick.Omenya, Natasha A. Chernova, Dongli Zeng, M. Stanley Whittingham, Clare P. Grey

Crystal structures and high-temperature phase-transitions in SrNdMRuO6 (M=Zn,Co,Mg,Ni) new double perovskites studied by symmetry-mode analysis
Journal of solid state chemistry
E. Iturbe-Zabaloa, J.M. Igartuab, A. Faik, A. Larra˜nagad, M. Hoelzele,G. Cuelloa

Eutectic metal alloys as phase change material for thermal energy storage in concentrated solar power
Solar Paces, Marrakesh
P. Blanco Rodríguez, J. Rodríguez-Aseguinolaza, A. Faik, N. Calvet, K. Man, M. J. Tello, S. Doppiu

Conductive PCM composite materials applied to the dry cooling of CSP plants
Solar Paces, Marrakesh
S. Pincemin, D. Haillot, N. Calvet, R. Olivès, X. Py

Electrochemical behaviour of olivine FePO4 cathode material for Na-ion batteries
Prime, Honolulu
P. Kubiak, M. Casas-Cabanas, V. Roddatis, J. Carretero-González, D. Saurel, T. Rojo

In-plane ionic conductivity of Li(3x) La(2/3-x)TiO3 thin films deposited on perovskite substrates
Prime, Honolulu
Frederic Aguesse, Teófilo Rojo, John Kilner

Synthesis and Characterization of Hybrid Organic-Inorganic Composite Electrodes for Li-ion and Li-air Batteries
Prime, Honolulu
Carmen M. López, Paula Sánchez-Fontecoba, Sofía Pérez-Villar, Vladimir Roddatis, Teófilo Rojo

Reconstruction of the polar interface between hexagonal LuFeO3 and intergrown Fe3O4 nanolayers
Scientific Reports
A. R. Akbashev, V. V. Roddatis. L. Vasiliev, S. Lopatin, V. A. Amelichev & A. R. Kaul

Hybrid organic-inorganic materials for advanced power storage systems
UPV
Carmen M. López, Paula Sánchez-Fontecoba

Hybrid polymer electrolites based in nanomaterials for sodium ion batteries applications
UPV
Teófilo Rojo, Irune Villaluenga, Mónica Encinas

Tensile Lattice Distortion Does Not Affect Oxygen Transport in Yttria-Stabilized Zirconia (YSZ)–CeO2 Hetero-Interfaces
ACS Nano
Daniele Pergolesi, Emiliana Fabbri, Stuart N. Cook, Vladimir Roddatis, Enrico Traversa, John A. Kilner

Kinetics of Coupled Double Proton and Deuteron Transfer in Hydrogen-Bonded Ribbons of Crystalline Pyrazole-4-carboxylic Acid
Z. Phys. Chem.
Verónica Torres, Juan Miguel López, Uwe Langer, Gerd Buntkowsky, Hans-Martin Vieth, Jose Elguero, Hans-Heinrich Limbach

Crystallochemical aspects of Na insertion into FePO4
Boston, USA
M. Casas-Cabanas, V. Roddatis, D. Saurel, P, Kubiak, B. Acebedo, J. Carretero, T. Rojo

Patents

At this time there are four requests for patents pending resolution, two in the area of electric energy storage and two in thermal energy storage.

Electrochemical Energy Storage Device. Metal-air battery with a very high energy density and long operating life.
22/12/2011
European patent application
American patent application
CIC Energigune

Verfahren zur Verbesserung de Reaktions – und Flie verhaltens von Gasund Festoffreaktionen
22/02/2012
European patent application
CIC Energigune DLR

Hybrid Electrolyte: Preparación de electrolitos de nanopartícula -compuesto orgánico para baterías de litio y sodio.
17/08/2012
European patent application
American patent application
CIC Energigune

Process for the preparation of hierarchically meso and Macroporous structured materials
18/10/2012
European patent application
CIC Energigune

Economic Information

Executive Summary
CIC Energigune 2008-2012

	Accumulated (2012)
INDICATORS	
Total Corporate Development team	6
Total research team	38
Total CIC team	44
Competitive research projects	5
Projects with industry	7
Financial mix	95 % / 3 % / 2 % (% Basque Govt. / other public / private)
EXPENDITURE & INVESTMENT	
Expenditure	
Personnel costs	€4 020 690
General expenses	€3 386 930
Investment	
Total business as common investments	€8 589 886
Building	€8 100 000
	€24,097,506
SUMMATION OF INCOME	
Etortek programme	€8 565 345
CIC programme	€7 075 143
Other funds from Basque Govt. (support for conferences)	€15 000
Income from other public administrations for direct and competitive funding	€165 000
EVE (building)	€8 100 000
Contributions from industry (board + projects)	€239 483
	€24,157,971

The fact that the CIC has been fully operational since October 2011 should be taken into account.

Location

Parque Tecnológico de Álava
Albert Einstein, 48
Edificio CIC
01510 Miñano, Alava
Spain