



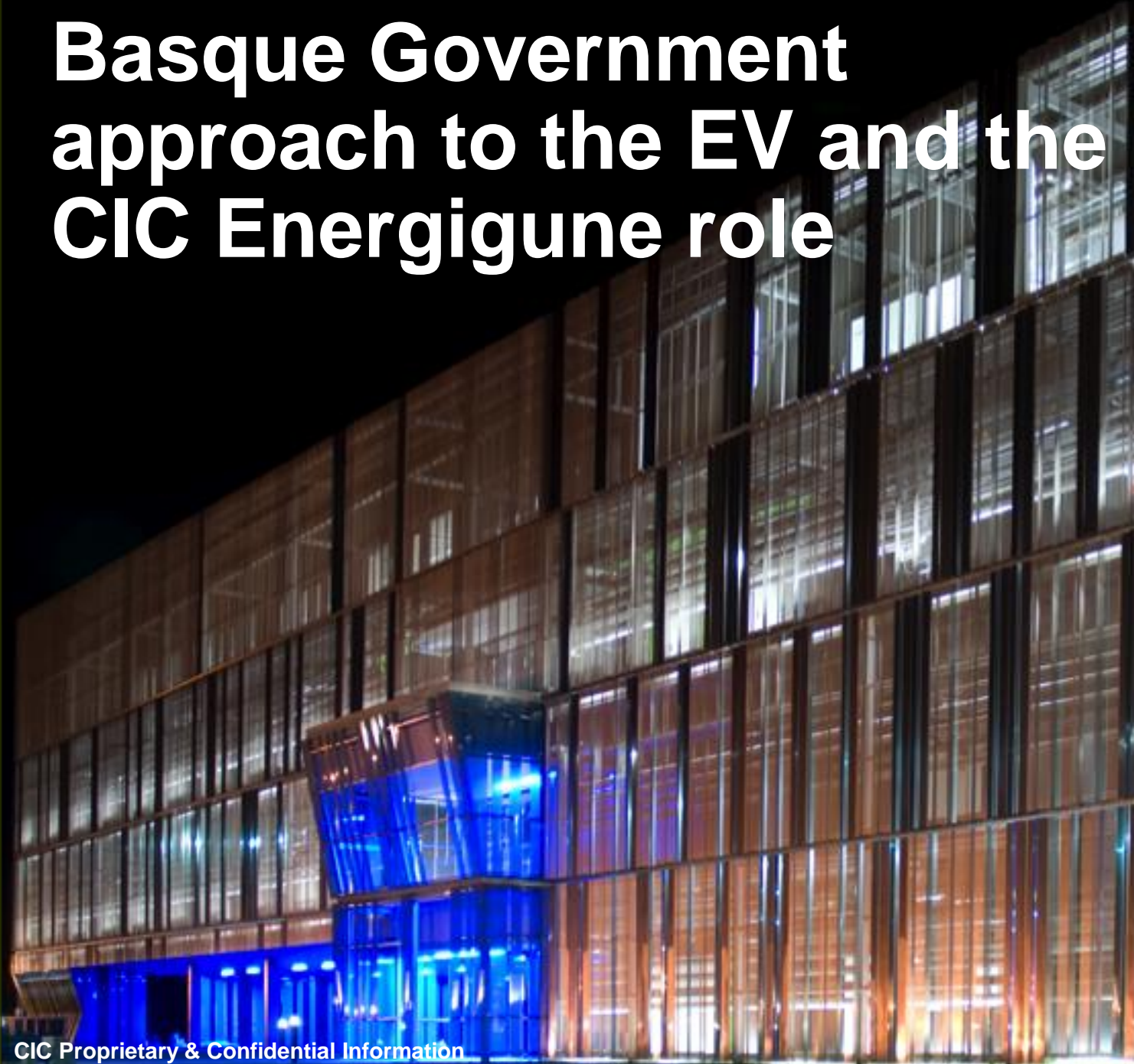
CIC
energi
GUNE

energy cooperative
research centre

2013

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Basque Government approach to the EV and the CIC Energigune role





a) Basque Government Strategy for the development of EV

Basque Government approach to EV

Collaboration with industry

Agreement between Basque Government and Mercedes Benz



- **Development and production project for the EV at the Mercedes-Benz plant in Vitoria** (contracting the RVCTI Technology Centre)
- **Pilot project for the use of electric vehicles (E-Vito and E-Smart) in Basque Country fleets, including the monitoring and assessment of results** (in collaboration with EVE)
- **Project to generate knowledge and joint development between Mercedes Benz and the Basque automotive industry, R&D and innovation related to EV projects** (in collaboration with AIC and Basque companies in the automotive sector)



Basque Government approach to EV

Collaboration with industry

Development of infrastructure of charging points

EVE and REPSOL have created a joint venture for the construction and operation of a network of recharging electric vehicles in the Basque Country

IBIL: example of public-private partnership

IBIL is a charge manager

50%



13/10/10



Gestor de carg

IBIL supplies its customers 100% renewable energy

Stakeholders:

- Electric and electronic equipment industrial sector
- Technology/research centres
- City Halls
- Energy Cluster of the Basque Country
- Automotive manufacturers
- Supplier companies

Support of the Basque Government to promote the research and development of charging elements.

Basque Government approach to EV

Opportunities for industry

EV: opportunities for Basque companies in new products

- Design and construction of charging facilities
- Manufacture of specific equipment and components for charging stations
- Control and management systems for the charging network and communication with vehicles
- **Optimization of batteries**

Grants: Etorgai, Eortek, Gaitek

Basque companies, in consortiums, are taking part in innovative projects in the framework of R&D grants.

Through these projects, companies share knowledge, in many cases, from technology/research centres.

Special interest group of companies from Energy Cluster

- The aim of this group, coordinated by the Basque Energy Board, is to create a cooperation framework to identify opportunities and **innovative projects** in collaborations among stakeholders regarding the electro-mobility field.
- Some innovative projects are being developed as a result of this interest group work.



b) About CIC



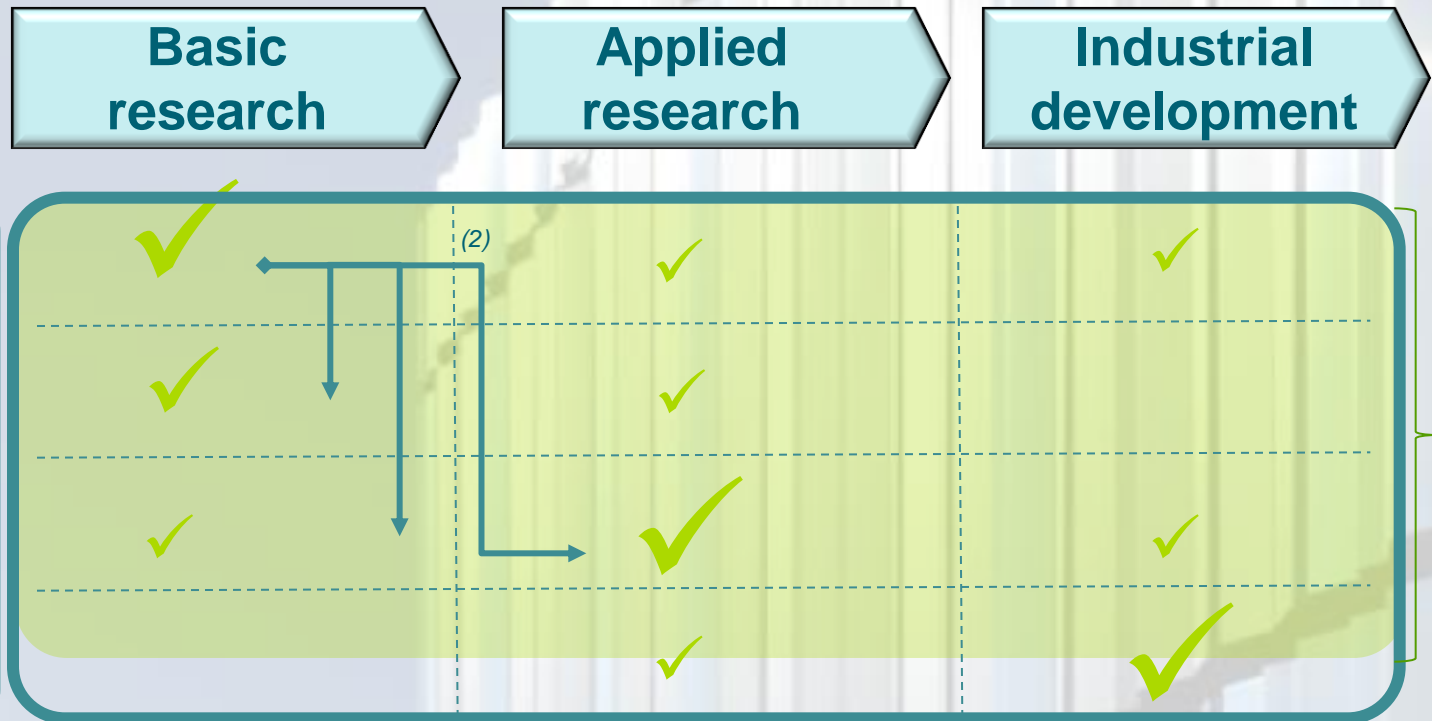
1. CIC profile

CIC Profile: the CIC concept

- CIC energigUNE is a **new Cooperative Energy Research Centre**, located in Euskadi (the Basque Country). It was founded in 2007.
 - It focuses on **basic oriented research on energy related technologies**, aimed at storage systems focused on renewables and power applications.
 - It is intended to play a leading role on the international stage, and contribute to the industrial competitiveness of Basque businesses.
- CIC energigUNE will **complement skills** and resources in the energy related industry and services already existing in the region.

CIC Profile:

role of CIC energigUNE on the energy R&D value chain
covering the gap between universities and technological centres



(1) NATIONAL AND INTERNATIONAL CENTRES OF EXCELLENCE
(2) Relationship / coordination model

Knowledge transfer = KEY FACTOR

CIC Profile:

important energy cluster within the Basque Country backing the CIC

Companies

356

Global billing in the energy sector

44.206M€

Global workers in the energy sector

68.625

... in the Basque Country

15.469M€

35%

... in the Basque Country

24.378

36%

Scientific – technological agents

7

Global expenditure in R&D for the energy sector

324M€

Global R&D workers in the energy sector

2.948

Industrial R&D units

10

... in the Basque Country

188M€

58%

... in the Basque Country

1.905

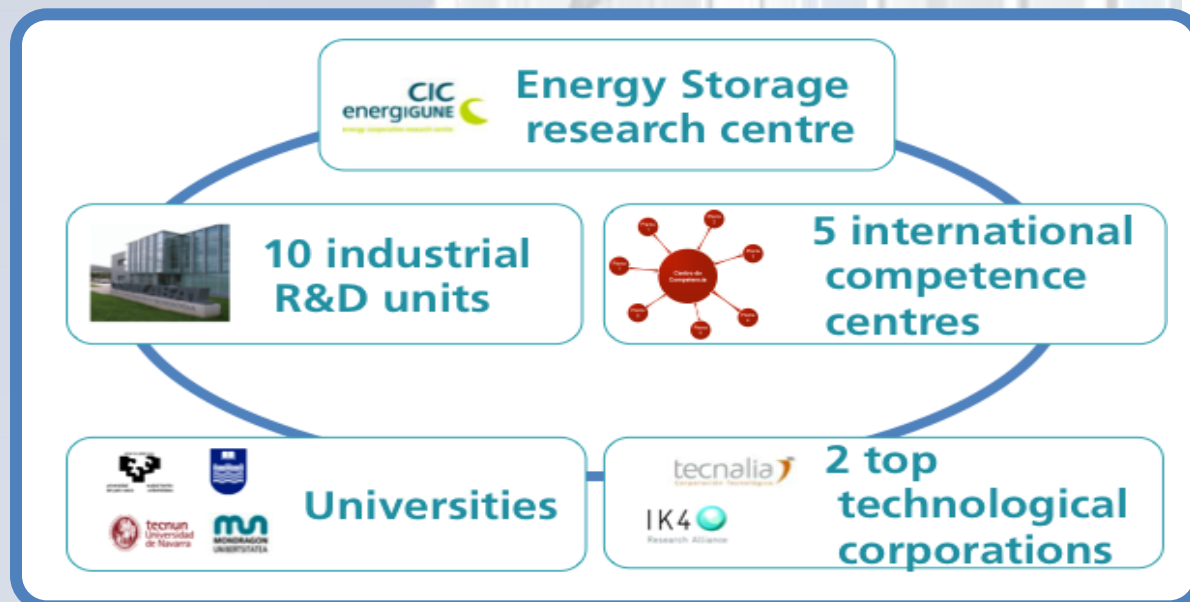
65%

*data from 2010

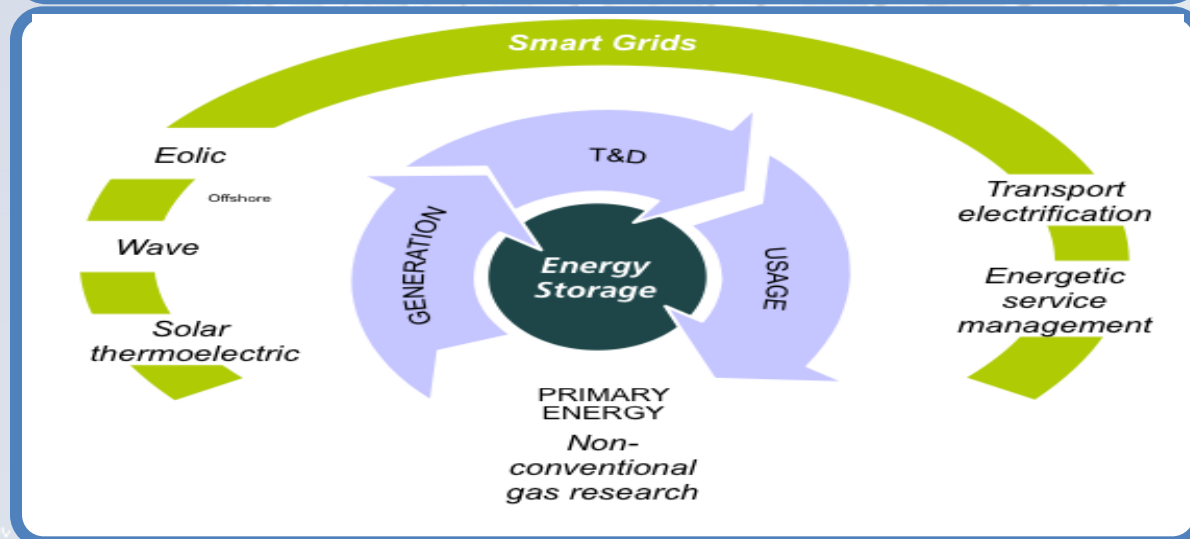
CIC Profile:

CIC and energy storage play a critical role in the Basque Gov.'s energy strategy

Basque
energy
environment



Basque
energy
strategy
critical areas



CIC Mission & Vision:

to become a top 5 Research Centre in Europe, focused on basic research in energy related materials oriented to storage

MISSION



Play a **leading role** on the international scientific stage focused on **basic research** in **energy** related **materials** oriented to storage applications, contributing to industrial competitiveness of Basque businesses, through:

- Excellent and breakthrough research
- Transfer of technology and knowledge to local industry
- Coordination of Basque technology and research efforts (in energy storage)



2016 VISION:

Become a **top 5 research centre in Europe** in CIC focus areas (EES, TES) and the leader of collective energy storage R&D effort in the Basque Country, generating measurable impact for Industry

EES: POWER STORAGE; BATTERIES AND SUPERCAPS
TES: THERMAL ENERGY STORAGE

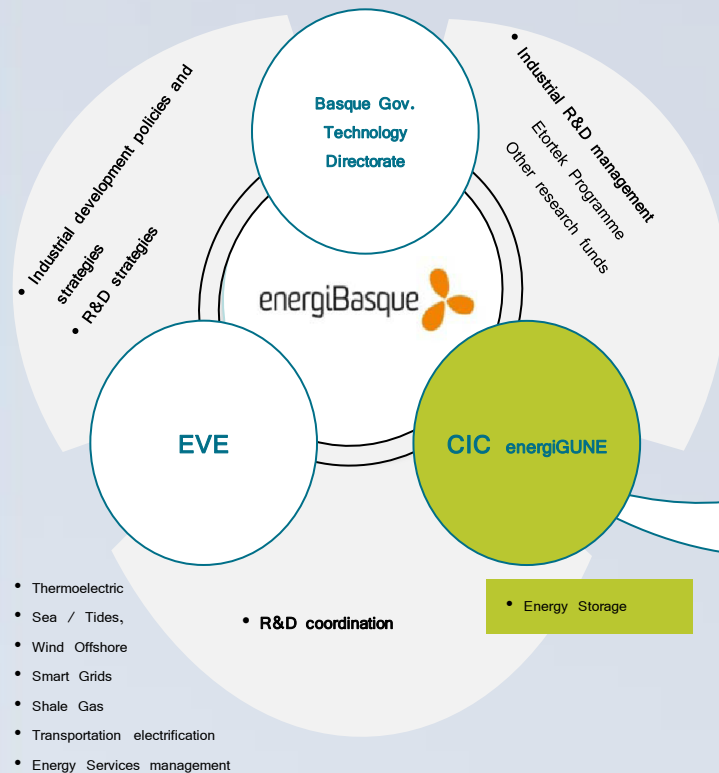
CIC Board Members: a non-profit private foundation



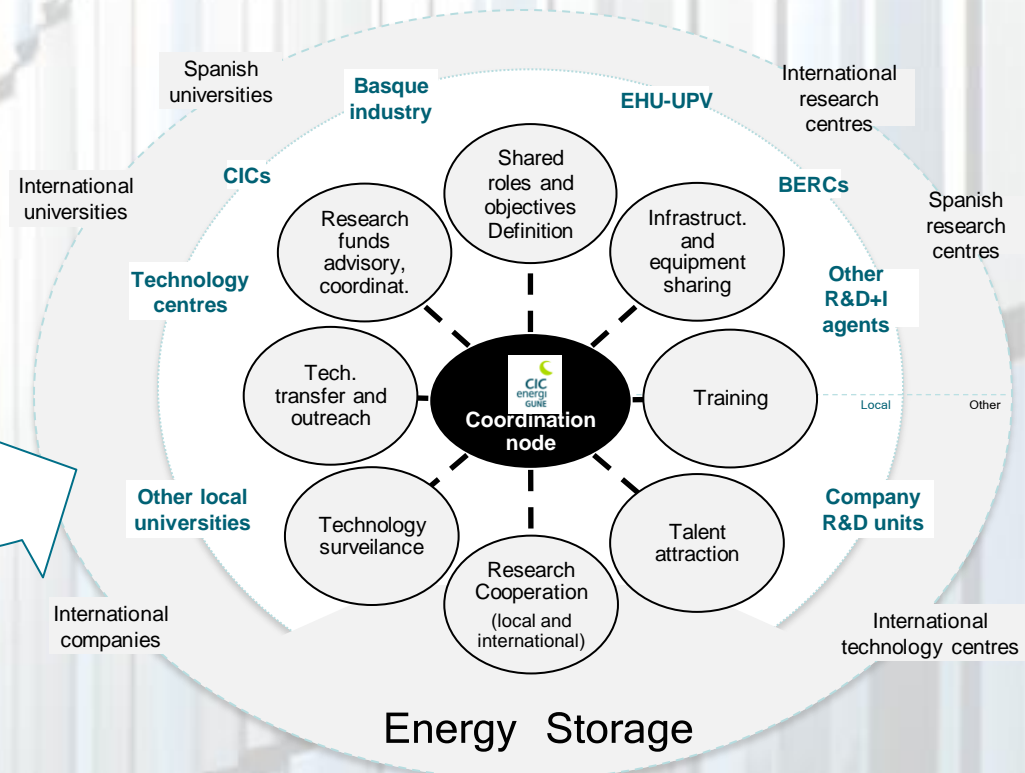
Extended CIC: gathering Basque efforts in Energy Storage research

CIC energiGUNE is responsible for the coordination of Energy Storage research activities in the Basque Country

energiBasque research management responsibilities



Extended CIC agents and activities



CIC Collaborators:

Industry - CIC works in close relationship with industry to improve competitiveness in the international marketplace

- CIC's counts with 6 reknown companies as board members
- CIC's is actively establishing contact and collaborating with industry



CEGASA
GROUP

Gamesa

REPSOL
YPF



AEG

Power Solutions



GRAPHENEA
NANOMATERIALS

 **naturgas energia**
grupo edp



IBERDROLA



GrupoGuascor

Ingeteam



Orona



ORMAZABAL

CIC Collaborators: Research Centers at Universities & Research centers shared projects & research agreements with key





2. CIC's Research Focus

CIC's Research Focus

Main Goals

Near Term (1-3 years)

- Identify key research directions
- Build a world class research team
- Set up a cutting-edge facility
- Start research lines and develop key battery and capacitor components

Medium Term (4-7 years)

- Establish a strong IP portfolio (patents) in key areas
- Commercialize a technology through licensing or joint venture
- Establish CIC's position in ES research with high quality publications

Long Term (8-15 years)

- Lead breakthroughs in advanced energy storage technologies
- Become a center with integrated science and engineering capabilities

CIC's Key Research Directions

100% on Electrochemical & Thermal Energy Storage

Energy Storage Types:

- **Electrochemical Storage**
- **Thermal Storage**
- Mechanical Storage
- Chemical Storage
- Superconducting Magnetic ES



EES:
POWER
STORAGE;
BATTERIES and
SUPERCAPS



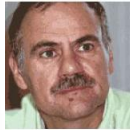











TES:
THERMAL
ENERGY
STORAGE



CIC's Leading Scientists

a skilled multidisciplinary world class research team

 <p>Dr T Rojo</p> <ul style="list-style-type: none"> • EES Scientific Director at CIC energiGUNE • Professor of Inorganic Chemistry (UPV) • Over 30 years experience on the research of materials for batteries. • More than 350 papers 	 <p>Dr J Kilner</p> <ul style="list-style-type: none"> • Professor of Materials Science (Imperial College London) • European Editor for Solid State Ionics Journal • Over 30 years experience on the research of conducting ceramics • Over 250 papers & several patents 	 <p>Dr M Armand</p> <ul style="list-style-type: none"> • Honorary Research Director at CNRS-LRCS • Professor Université de Picardie • Over 30 years involvement on the research of materials for batteries. • Over 70 papers and about 80 patents.
 <p>Dr C Lopez</p> <ul style="list-style-type: none"> • EES Group Leader at CIC energiGUNE • Li-based research group specialist • Over 10 years research experience 	 <p>Dr M Casas-Cabanas</p> <ul style="list-style-type: none"> • EES Group Leader at CIC energiGUNE • Structure Surface & Analysis research group specialist • Over 10 years research experience. 	 <p>Dr R Mysyk</p> <ul style="list-style-type: none"> • EES Associate Researcher at CIC energiGUNE • Supercapacitors research line specialist • Over 10 years research experience
 <p>Dr MA Munoz</p> <ul style="list-style-type: none"> • EES Researcher at CIC energiGUNE • Li-ion research line specialist • Over 10 years research experience. 	 <p>Dr P Kubiak</p> <ul style="list-style-type: none"> • EES Associate Researcher at CIC energiGUNE • Na-ion research line specialist • Over 10 years research experience 	 <p>Dr D Saurel</p> <ul style="list-style-type: none"> • EES Associate Researcher at CIC energiGUNE • Na-ion & supercapacitors research lines specialist • Over 10 years research experience.
 <p>Dr M Tello</p> <ul style="list-style-type: none"> • Cathedratric Professor of Physics (UPV) • Xabier María de Munibe award (1995) • Over 30 years experience on the research for TES. • Over 150 papers. 	 <p>Dr S Doppiu</p> <ul style="list-style-type: none"> • TES Group Leader at CIC energiGUNE • Materials for TES research group specialist • Over 10 years research experience. 	 <p>Dr N Calvet</p> <ul style="list-style-type: none"> • TES Researcher at CIC energiGUNE • Latent and sensible heat storage research lines specialist • Over 5 years research experience

CIC Core Facilities: Cutting edge Laboratories and Infrastructures Jan.2013



LABS 1,2,3



LAB 4 & Platforms



LAB 5a, Dry Room



LAB 5b

Synthesis & cell
assembly

Characterisation
lab

System
integration &
development

Testing

LABS 2 & 5b

In operando and postmortem
analysis



Tech.
Platforms

Thermal Analysis Platform

EM Platform

X-Ray Platform

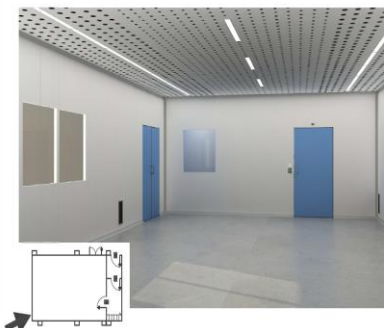
Surface analysis unit

NMR Platform

PPMS

General Analysis Techniques

DRY ROOM

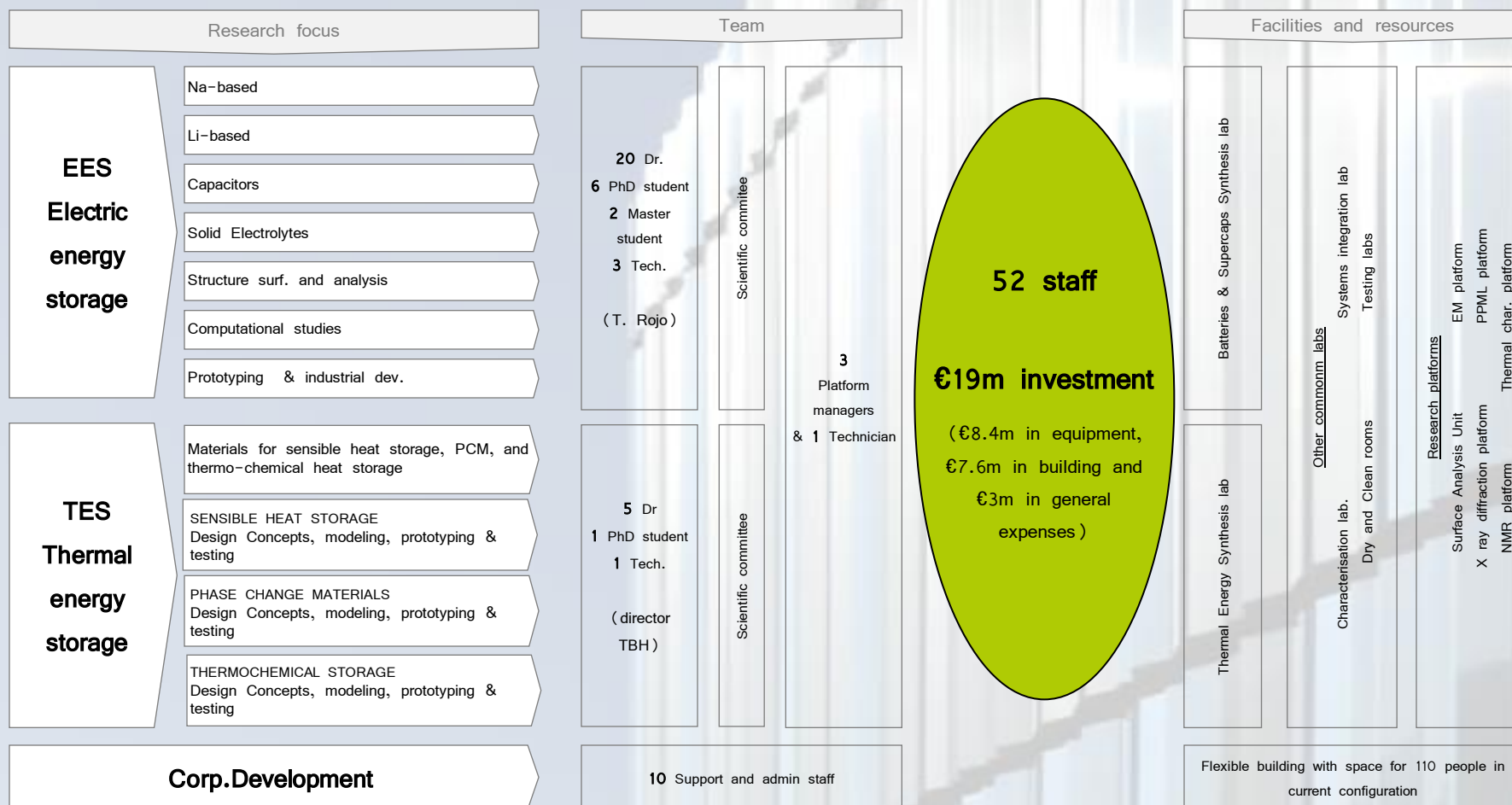


55m², 5 people,
-65 °C Dew Point

CIC's Research Focus Overview

... ambitious approach and relevant resources

CIC energigUNE 2013 research focus areas, team and resources (current)

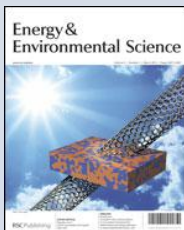


Flexible building with space for 110 people in current configuration

CIC's Research Output

CIC has a high level output at events, journals, patents...

Publications: 27 (EES: 15 / TES: 12) with a Impact Factor >4.0



Energy Environ. Sci., 2012, **5**, 5884-5901

"Na-ion batteries, recent advances and present challenges to become low cost energy storage systems"

V Palomares, P Serras, **I Villaluenga**, K B. Hueso, **J Carretero** and **T Rojo**

Amongst **TOP 10 most-read** RCS article on a monthly basis since publication in Feb12



Organisation of events:16

Seminars

Workshops

Conferences

Participation on Conferences: 56

7
2010



29
2011



21+
2012

Patents: 5 (EES: 2 / TES: 2)

in progress for approval



2. Final goal of CIC Energigune

Final goal of CIC Energigune:

■ Creation of economic activity

- Industrial development
- Possible spin-offs
- Job creation
- Attraction of talent
- Involve university & private

■ CIC ready for IP Creation

- Sharing of IP rights
- Encouraging innovation
- Specific programmes of the Basque Country
- Difficult field

■ Difficulties & opportunities

- Only one company manufacturing
- Commercialization requires a community
- Our community are users
- Need to attract seed capital

■ Lack of entrepreneurial culture

- CIC arrive to pre-prototype
- Difficulties towards investment
- CIC wants more than IP revenues
- Mechanisms: this isn't USA!
- Economic Development Agencies
- Political Risk
- Need of Private Investment




Annex: CIC Research Lines







a. Electrochemical Storage:

“Li-ion batteries; Supercaps & Others”



Title:	Structural and surface studies of conversion electrodes for Li-ion batteries		
Goal:	To identify and develop alternative electrode materials which combine a lower cost with higher energy density and power compare to the commercial ones.		
Objectives:	<p>To tackle the current limitations of conversion reactions namely, polarization, reversibility and first cycle capacity retention.</p> <p>(a) Investigation of new conversion electrodes and electrolyte additives and optimization of existing ones.</p> <p>(b) Elucidation of reaction mechanisms through physicochemical characterization of the electrode bulk and surface regions.</p> <p>(c) Correlation of materials properties with the electrochemical performance so as to gather a complete picture of the systems under study.</p>		
Results:	<ul style="list-style-type: none"> • Papers: 2 submitted • Conferences: 1 presentations 	Collaborators:	

Title:	Development of Viable Li-air Battery Technology
Goal:	<p>To develop a working prototype for a rechargeable Li-air battery with the following figures of merit:</p> <ul style="list-style-type: none"> - cycle life ≥ 5000 cycles at 80-90% DoD, - specific energy density 4000 Wh/kg, - operating temperature range -25 to 60 °C.
Objectives:	<p>(a) development of a reliable cell baseline, including cell embodiment, electrolyte and electrode formulation,</p> <p>(b) synthesis, characterization and electrochemical testing of alternative anode materials,</p> <p>(c) synthesis, characterization and electrochemical testing of nanostructured cathode materials including carbonaceous cathode supports (carbon nanotubes (CNTs)), and electrocatalysts for the oxygen evolution reaction (OER) and for the oxygen reduction reaction (ORR).</p>
Results:	<div> <ul style="list-style-type: none"> • 1 patent requested (EU Dec 11 / USA Feb 12) • Papers: 2 under preparation • Conferences: 4 presentations, 1 poster </div> <div>Collaborators:</div> <div>     </div>

Title: Advanced materials and new technologies for Li-S batteries

Goal: To develop a working prototype Li-S battery with the following target :




- specific energy density > 600 Wh/kg,
- driving autonomy >400km,
- cost < 150 \$/kWh.


Objectives:




- Research of **anodic materials** focused on avoiding dendrite formation in the Li negative electrode, or replacing it by an alloy with higher chemical stability towards sulfides.
- Study of **cathodic materials** based on redox polymers with disulfide (S-S) bonds to eliminate capacity fading associated with solubility of polysulfide species.
- Substitution of liquid electrolytes with **polymer electrolytes** in order to minimize the dissolution of polysulfides.
- **Simulation techniques** to complement the interpretation of the experimental studies, to investigate atomic-scale features and to predict the improvements of materials.

Results: New Project

Collaborators: Agreement with industry to be drawn

Title:	Development of Viable Na-ion Battery Technology	
Goal:	<p>Development of a low cost high energy sodium ion battery for stationary storage applications with target values of:</p> <ul style="list-style-type: none"> - cycle life ≥ 2000 cycles at 85% capacity retention, - specific energy density >130 KWh/kg (current Li technology), 	
Objectives:	<p>To produce a complete battery based on the intercalation of Na ions at room and close to room temperature. Composed of:</p> <ul style="list-style-type: none"> -high voltage cathode ($>3.5V$ vs. Na) -medium voltage anode ($<1.5V$) which should show high stability. <p>Electrolyte formulations will be developed in parallel for the chosen electrode materials.</p> <p>Once we have both candidates, we will perform nanostructuration of the active materials on both electrodes for improved electrochemical performance.</p>	
Results:	<ul style="list-style-type: none"> • Patent: 1 requested • Papers: 3published + 2 submitted • Review: Top Ten most-read (May '12) • Conferences: 2 presentations 	<p>Collaborators:</p> <div>    </div>



Title:	Solid Electrolytes for Na & Li batteries		
Goal:	To develop more secure and reliable solid electrolytes with high ionic conductivity, through the replacement of currently used liquid organic solvents.		
Objectives:	<p>Polymer Electrolytes -Preparation hybrid nanoparticles grafted either with polymer stands or/and plasticizer (such as ionic liquid, organic compounds with high dielectric constant, etc.).</p> <p>Ceramic Electrolytes -Use of ceramic ionic conductors to increase the safety and chemical and electrochemical stability of the systems with the advantage that ceramic materials can be obtained with a wide variety of stoichiometries, crystal structures and microstructures which lead to a controlled range of electrochemical properties with applicability in these devices.</p>		
Results:	<ul style="list-style-type: none"> • Papers: 1 under preparation • Conferences: 1 presentations 	Collaborators:	

Title:	Development of Capacitors	
Goal:	To optimise the synthesis of carbon materials and transitional metals oxide/nitrides to obtain high energy and power of supercapacitors in both gravimetric and volumetric terms.	
Objectives:	<p>Synthesis of novel electrode materials for electrochemical capacitor application with easier production and less costly than the best electrochemical capacitor electrode materials known to date.</p> <ul style="list-style-type: none"> -Optimised synthesis of nanoporous carbons from different precursors. -Exploration of pseudocapacitive materials based on the oxides/nitrides of transitional metals. 	
Results:	<ul style="list-style-type: none"> • Industrial collaboration • Papers: 1 under preparation 	<p>Collaborators:</p> <div>    </div>



b. Thermal Energy Storage



Title:	Metal alloys as PCM	
Goal:	To develop latent heat thermal energy storage materials based on solid-liquid phase transitions, focusing on eutectic metal alloys , for CSP technologies using Direct Steam Generation (DSG).	
Objectives:	<ul style="list-style-type: none">- To improve the power of TES systems,- To reduce the size of heat exchanger.	
Results:	<ul style="list-style-type: none">• Conferences: 2 presentations	Collaborators: <div></div>

Title:	Sugar Alcohol based Materials for Seasonal Storage Applications
Goal:	To develop new phase change materials for thermal energy seasonal storage applications in the range of medium temperatures.
Objectives:	<ul style="list-style-type: none"> - Development of efficient methods for increasing the thermal conductivity of MASA and testing and characterization of carbon foils, carbon foams and carbon/MASA materials. - Responsible for organising a workshop at the end of the project.
Results:	<ul style="list-style-type: none"> • Conferences: 1 presentation

Collaborators:





Questions?

Thank you for your attention!



energy cooperative
research centre

Jesús Goiri

General Director

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