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Towards the H_2 economy in Spain

H_2 storage in carbon-based materials

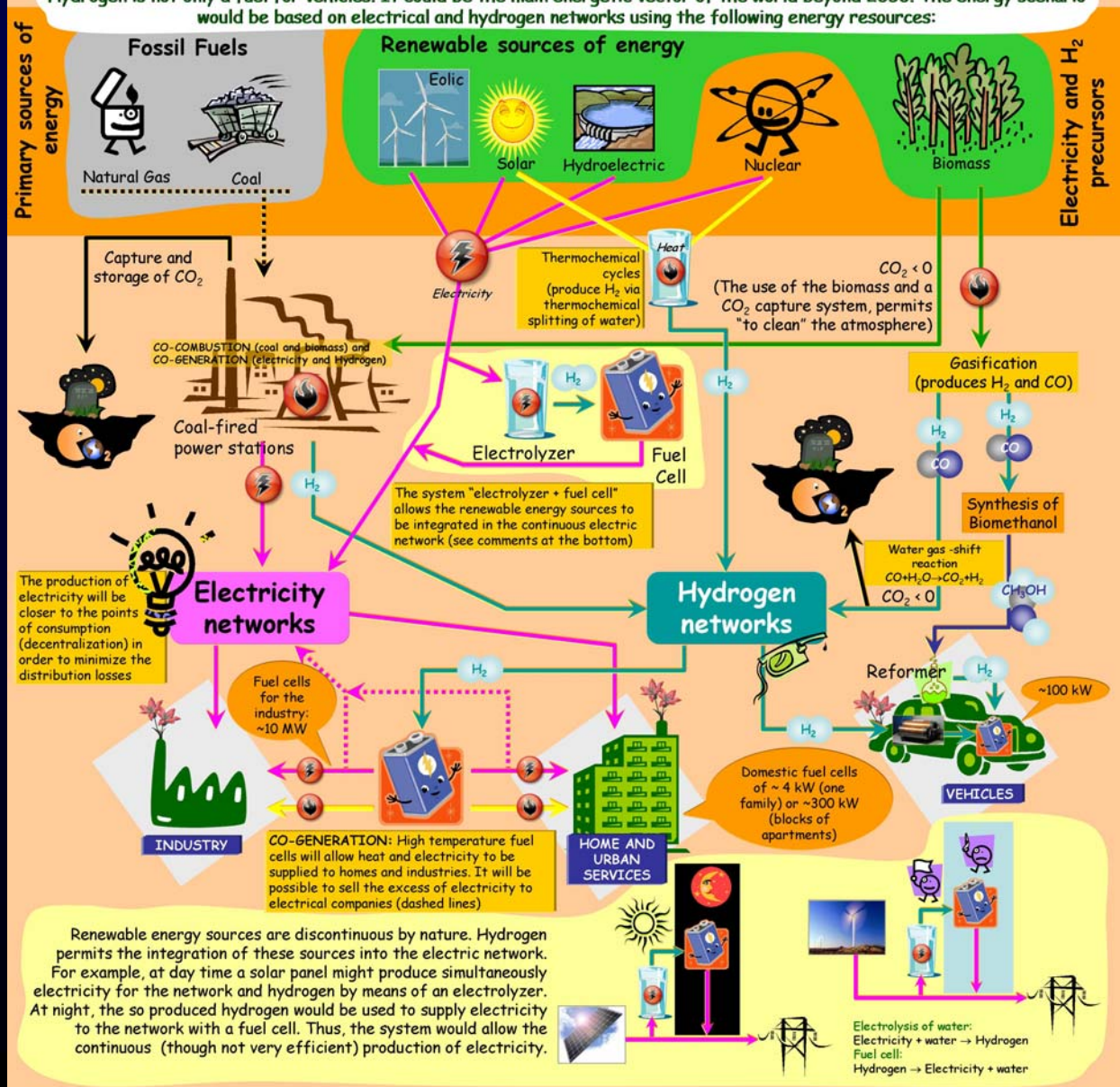
Instituto Nacional del Carbón - INCAR

Consejo Superior de Investigaciones Científicas

The "Hydrogen Economy"

An attainable goal?

Hydrogen is not only a fuel for vehicles. It could be the main energetic vector of the world beyond 2050. The energy scenario would be based on electrical and hydrogen networks using the following energy resources:



Recently created Ministry: Ministry of Science and Innovation

5 Strategic Research Lines (Health, Energy & Climate change, Nanoscience & Nanotechnology, TICs, Biotechnology)

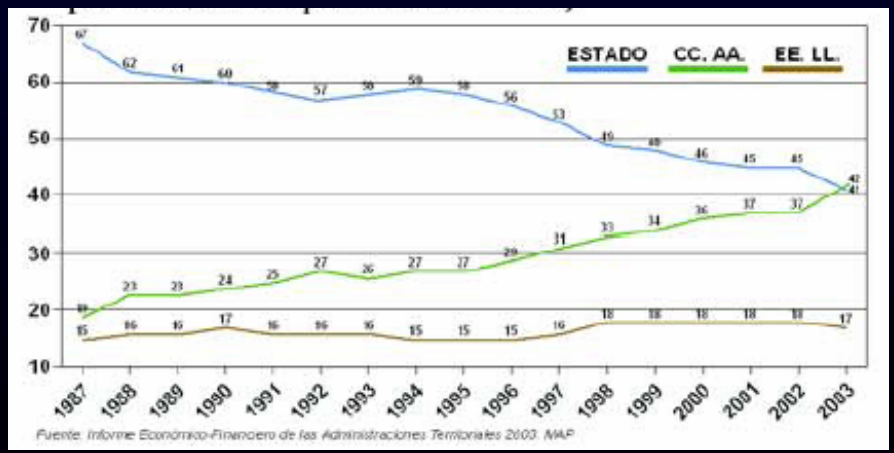
R&D and Innovation Projects
- ***Fundamental Research Projects***
- ***Applied Research Projects***
- ***Experimental Development Projects***
- ***Innovation Projects***

Strategic Action for Energy and Climate Change
- **Energy Efficiency, Renewable Energies and Technologies for Clean Coal Combustion**
- **R&D and Innovation Projects for Sustainable Mobility and Global Change**
- **Sustainable Building**
- **Non-energy mitigation of climate change, climate observation and adaptation to climate change**

Status of Regional Administration in Spain

Spain is one of the most decentralized countries in the world

- 17 Autonomous or ”Foral” Communities
- Mainly based on historic grounds, very diverse
- More **budget** on Regions than on the State
- One financial regime, except for Navarra and Euskadi



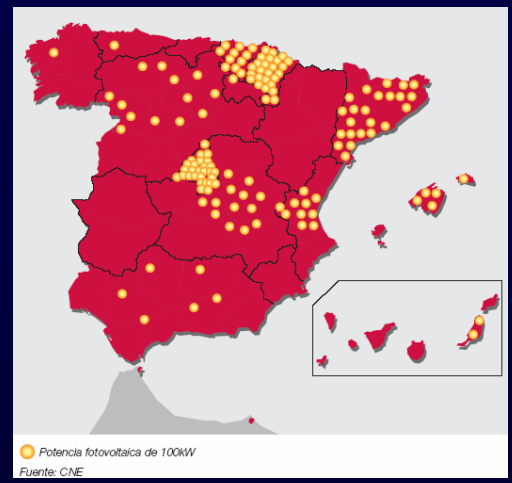
- Only 5 exclusive “competences” of the State
- Most of the **“competences” are shared**: education, research, environment, industry, energy, taxes…

Common issues and differences

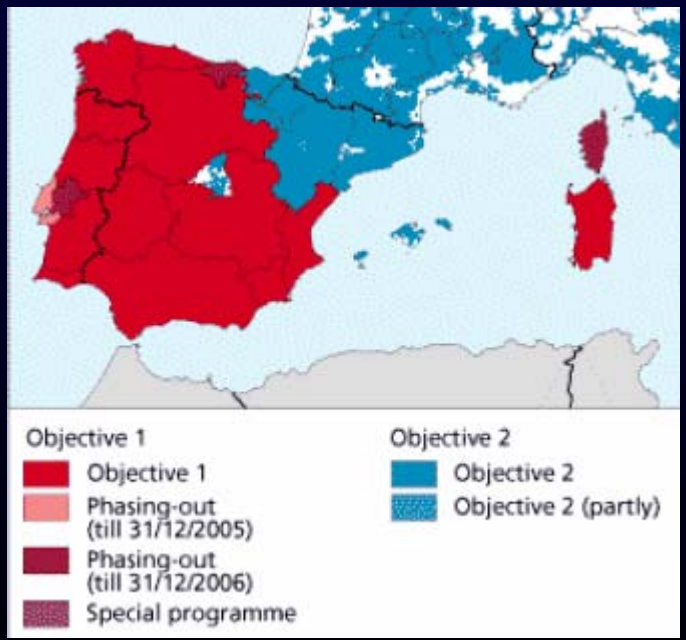
Common

•Same level of “competences”
•Interest on **Renewable Energy**: National and Regional Plans for Renewable Energy
•**Spanish Hydrogen Platform**: Working Group to coordinate regional/national

Installed wind power on 31st Dec 2004



100 kW PV facilities on 31st Dec 2004



Differences

•Diverse industrial and economic background
•Different approaches to Renewable Energy
•Very marked difference in accession to Structural Funds from the EU
•Many organisational models to support R&D

Spanish Hydrogen Platform: Working Group to coordinate regional/national

Working Groups:

- H2 Production from RES via electrolyses
- H2 Production from RES from different sources
- H2 Production from conventional energy & nuclear
- H2 storage and distribution
- H2 utilisation in transport
- Stationary uses
- Portable uses

- Reports
- Surveys
- Recommendations
- Links with other European Platforms
- Link to the *Joint Technology Iniciative on Fuel Cell and Hydrogen (JTI FCH)*
- *Activities inside the working groups (meetings, seminars, etc)*

Spanish Associations:

…to promote the technological development of the hydrogen energy and its use in industrial and commercial applications

…to promote scientific and technical development of Fuel Cell technology, and any actions that may be associated with their research and use

Promotion of internationalisation: Thematic Networks

- ARGENTINA
- BOLIVIA
- BRASIL
- CHILE
- COLOMBIA
- COSTA RICA
- CUBA
- ESPAÑA
- MÉXICO
- PORTUGAL
- VENEZUELA

Forum to collaborations, funded projects, meetings, conferences, seminars, etc.

Engagement on H_2&FCs activities

Galicia
wind-to-hydrogen projects

Euskadi
Very active Technology and Research Centres

Aragon
•Foundation for Hydrogen in Aragon: comprising 38 stakeholders covering all the value chain. Dedicated to H2&FCs
•Ither project (wind-to-H2) and SMEs focused projects (2.5 M€ in 2006)
•Regional Research Plan

Asturias
•Regional Research Plan & Investment
•Research Centres: University & INCAR-CSIC
•Interest of companies from different sectors

Madrid & Barcelona
CUTE Project

Andalucía
•Regional Research and Demonstration Plan
•Hercules project: H2 from solar, storage, distribution (Hynergreen, Santana, Solucar…)

Canarias
RES2H2 project

Comunidad Valenciana
•Funding of Technology Institutes dealing with RES and H2 (2.4 M€ in 2006)
•Energy Infrastructures Plan and Starter Plan for RES target H2, as well as bus fleet in Valencia

Castilla-La Mancha
•Cornerstones: ELCOGAS IGCC plant and AJUSA (PEM manufacturer)
•Regional Research Plan (R&D&D)

Creation of specific Centres to promote H_2 and FC

CNETHPC

Home | The Centre | Governing Board | Newness | News | Contact | Españo

National Centre on Hydrogen and Fuel Cell Technology Experimentation

National Centre on Hydrogen and Fuel Cell Technology Experimentation

The Centre is a new Scientific Research and Technology Development facility, devoted to hydrogen and fuel cell technologies. The Centre has been created as a Consortium of the Spanish Ministry for Science and Innovation and the Castilla-La Mancha Regional Government, as part of the implementation of the Spanish Roadmap of Scientific and Technological Facilities. The Consortium established its headquarters in Puertollano (Ciudad Real).

More information at:

- The Centre
- Governing Board
- Newness
- News

News:

June/2008
Call for applications for the Managing Director of the Centre

25/January/2008
Call for applications for the Director position published in Science Magazine

24/January/2008
Call for applications for the Director of the Centre

24/January/2008
The CNETHPC participates in the 2nd Genery Assembly of the Spanish Hydrogen and Fuel Cell Technology Plataform.

24/Enero/2007
Call for applications for the Director position published in Nature Journal

21/December/2007
The Ministry of Education and Science and the Castilla-La Mancha Regional Government sign an agreement for the creation of a National Center for Hydrogen and Fuel Cell Technology Experimentation.

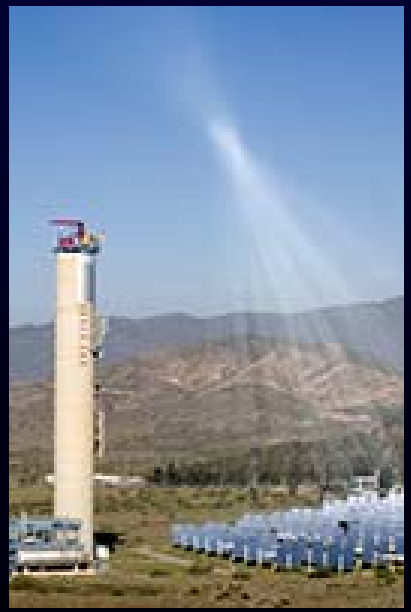
Main R+D Units

- H_2 Production
- H_2 Storage
- H_2 Distribution
- Related technologies (H_2 separation, purification)
- H_2 applications – Fuel Cells

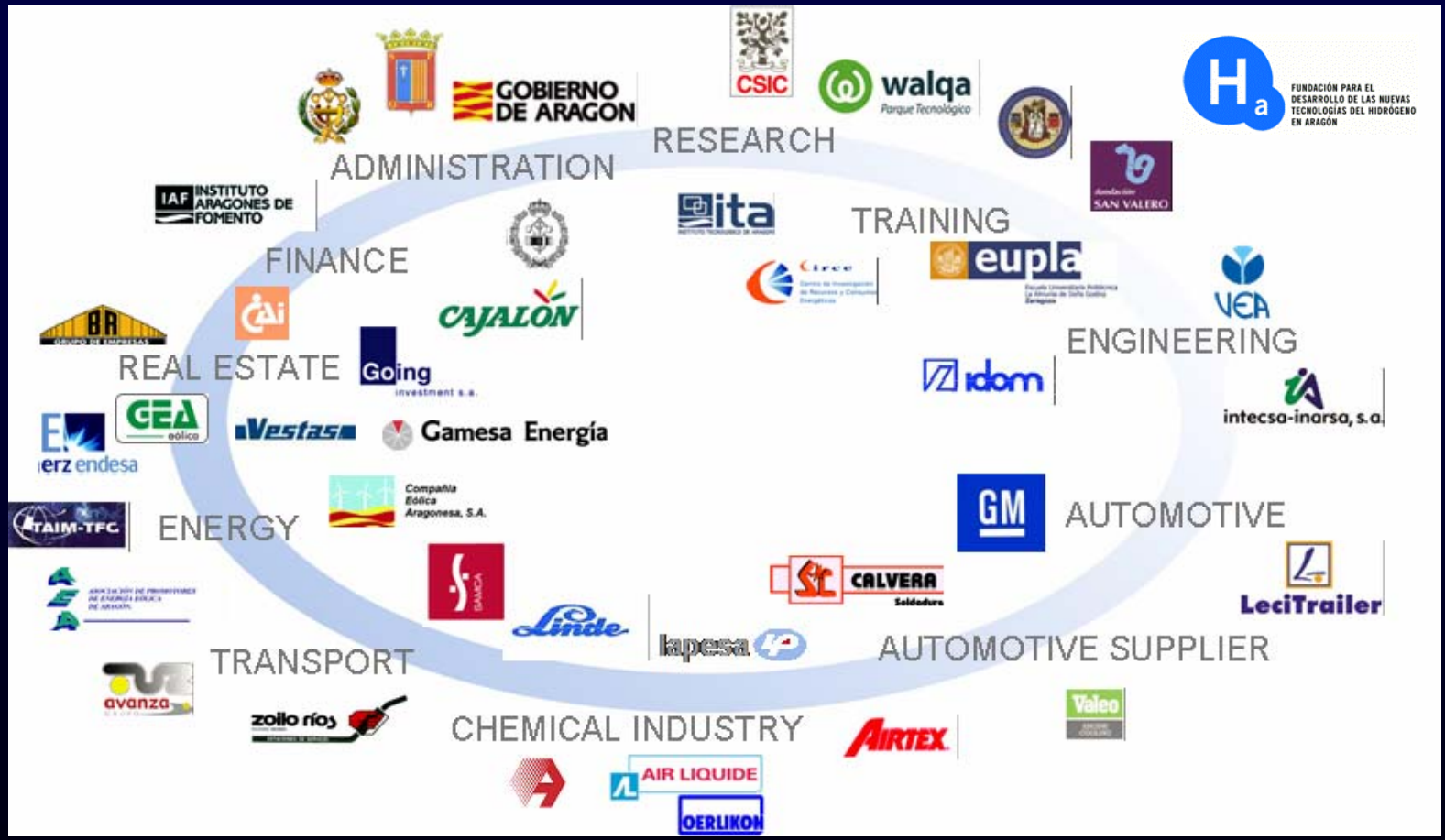
CNETHPC - C/ Juan Bravo, 22 - 13500 - Puertollano (Ciudad Real) - SPAIN -
Tel: +34.926.117.211 - Fax: +34.926.670.507 - E-mail: info@cnethpc.es

Creation of specific Centres to promote H_2 and FC

The Plataforma Solar de Almería (PSA), a dependency of the Center for Energy, Environment and Technological Research (CIEMAT), is the largest center for research, development and testing of concentrating solar technologies in Europe. PSA activities form an integral part of the CIEMAT Department of Renewable Energies as one of its lines of R&D

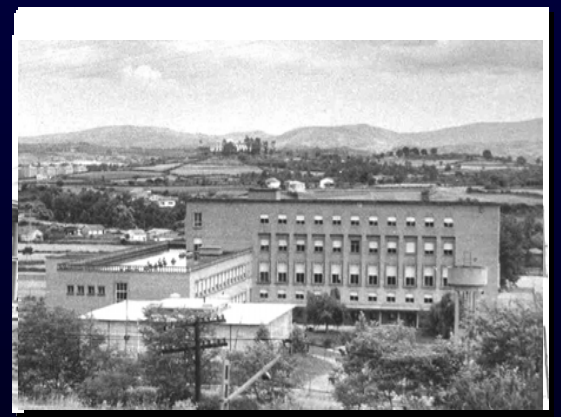


Spanish case: Common diversity



Presentation

- CSIC area: Chemistry and Chemical Technology
  - Headquarters in Oviedo (Asturias)



- Founded in 1947 to assist the local mining and steel industry

Human Resources

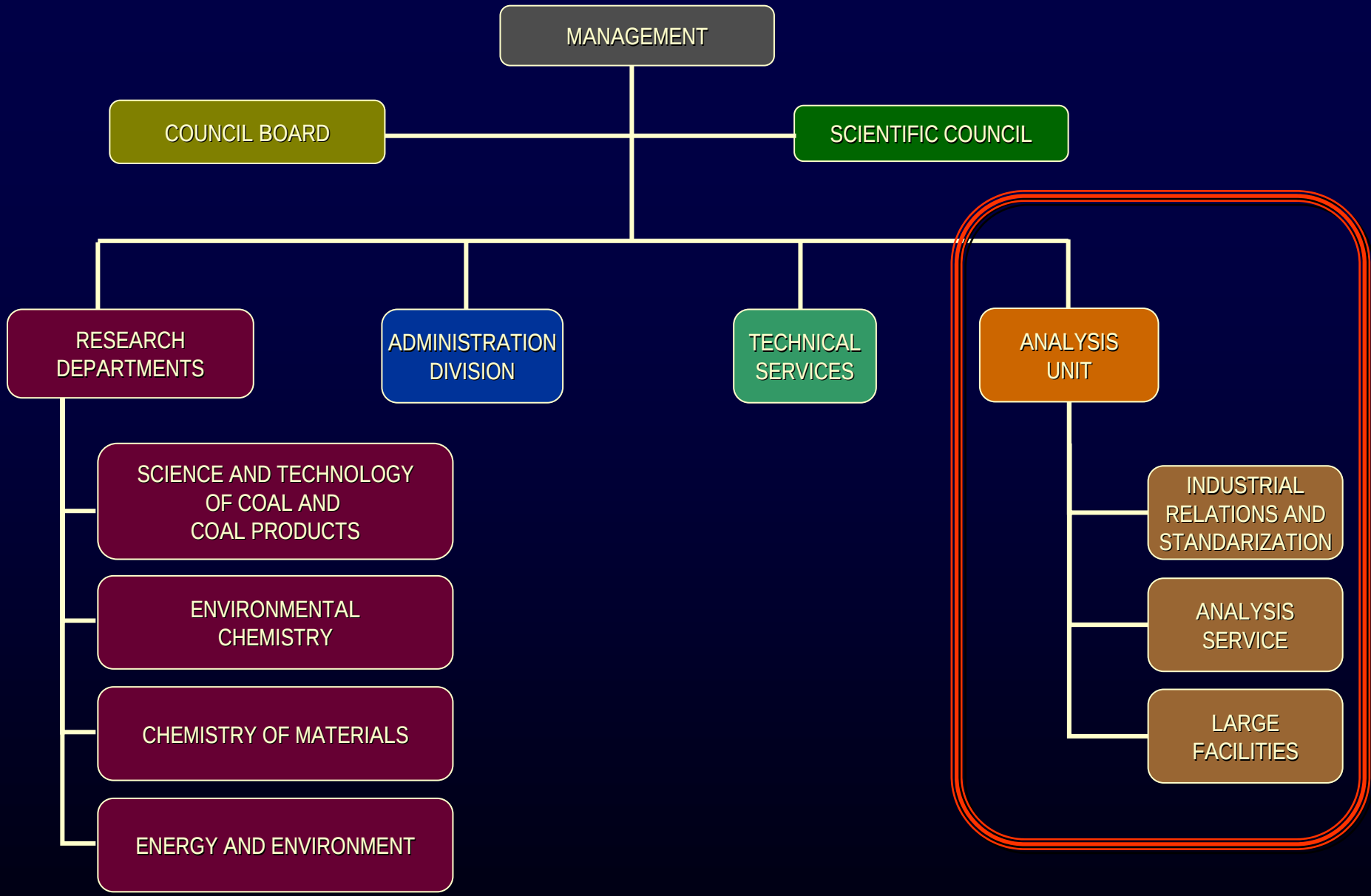
Situation in 2007

- 62 permanent staff
  - 32 scientists
  - 24 technicians
  - 6 administrative support

TOTAL 127

- temporary staff and research students
  - Doctors
  - Graduates under contract
  - Technicians under contract
  - Predoctoral students

} 65


MANAGEMENT
COUNCIL BOARD
SCIENTIFIC COUNCIL
RESEARCH DEPARTMENTS
ADMINISTRATION DIVISION
TECHNICAL SERVICES
ANALYSIS UNIT
SCIENCE AND TECHNOLOGY OF COAL AND COAL PRODUCTS
ENVIRONMENTAL CHEMISTRY
CHEMISTRY OF MATERIALS
ENERGY AND ENVIRONMENT
INDUSTRIAL RELATIONS AND STANDARIZATION
ANALYSIS SERVICE
LARGE FACILITIES

General Resources

ANALYSIS LAB

SEM-EDX

RAMAN

FTIR

XPS

XRD

ICP-MS

Microscopy

...

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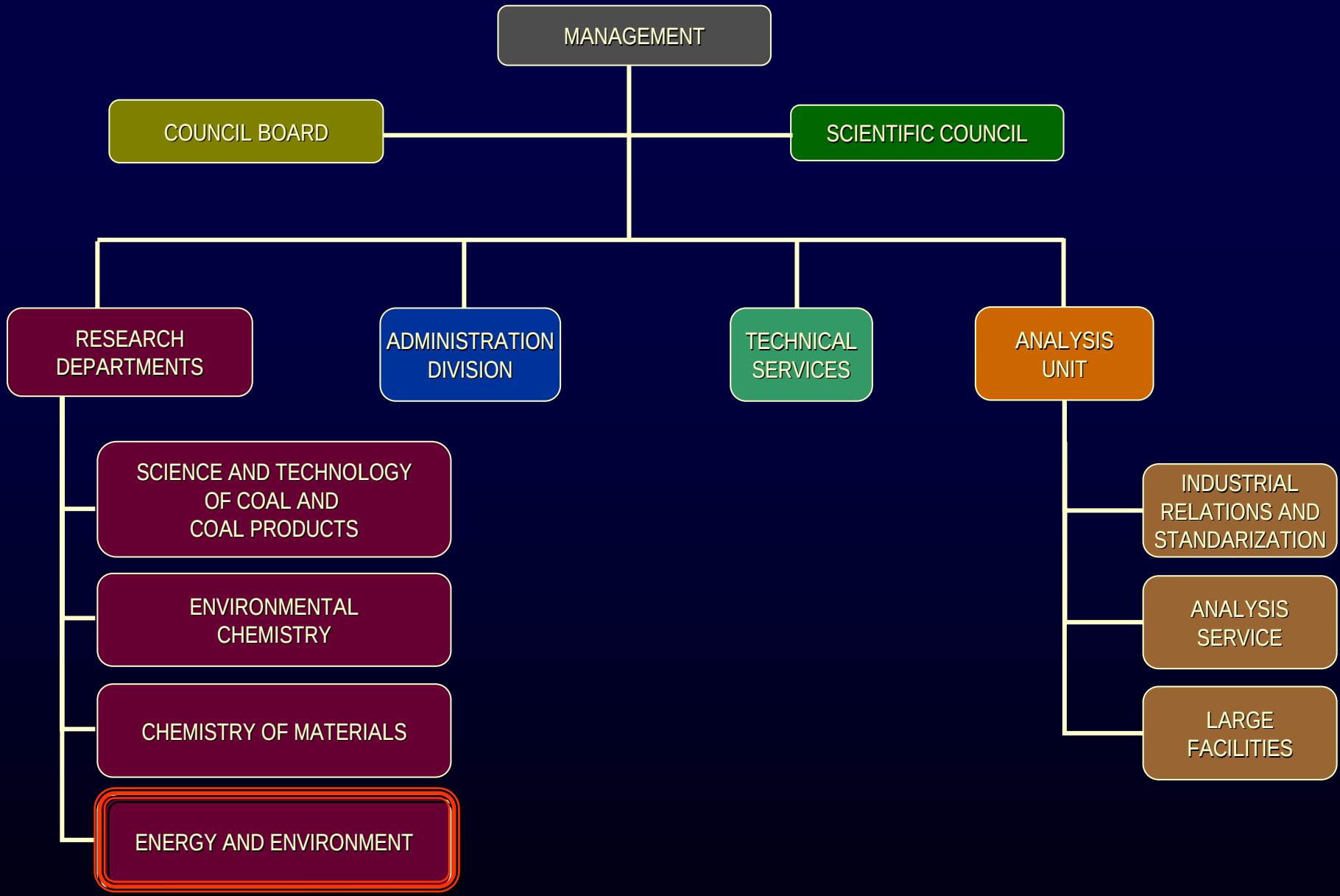
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ENERGY AND ENVIRONMENT
INDUSTRIAL RELATIONS AND STANDARIZATION
ANALYSIS SERVICE
LARGE FACILITIES

Research Topics

RESEARCH DEPARTMENTS

- ENERGY AND ENVIRONMENT
- SCIENCE AND TECHNOLOGY OF COAL AND COAL PRODUCTS
- ENVIRONMENTAL CHEMISTRY
- CHEMISTRY OF MATERIALS

Development of new materials for the generation, purification, storage and utilization of hydrogen as an energy carrier

Novel carbon materials for hydrogen storage

Catalytic heterogeneous reaction assisted by microwaves: hydrogen production (pyrolysis of biomass, methane decomposition, dry reforming, biogas to hydrogen, glycerol to hydrogen)

Carbon xerogels for their use in supercapacitors

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Research Line:

MATERIALS FOR ADVANCING TOWARDS THE HYDROGEN ECONOMY

The line comprises research in all stages involving materials and processes (both conventional and new) from hydrogen synthesis to utilisation; (1) centralised/decentralised hydrogen production from biomass, or fossil sources that can be associated to CCS (CO2 capture and storage) systems (i.e. catalysts and new processes for methane reforming), (2) onboard hydrogen production from clean sources (i.e. biofuel reforming catalysts for onboard hydrogen synthesis and purification), (3) onboard hydrogen storage (i.e. carbon-based sorbents), and (4) materials (catalysts for FCs) and supporting systems (supercapacitors) for onboard conversion of hydrogen into electricity. The research groups at INCAR working in this sub-line develop basic research in the materials and processes described above, with the long term goal to overcome the many scientific challenges that are on the way and help innovative and efficient designs for hydrogen production, storage and utilisation to be delivered in society

http://www.incar.csic.es/tecnologia/mcat/ingles.htm

CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

CSIC

INSTITUTO NACIONAL DEL CARBÓN

Es tiempo de investigación, es tiempo de vida, es tiempo CSIC

MCAT

Group of
Carbon Materials for Technological Applications

Energy and Environment Department

RESEARCH LINES

SCIENTIFIC PRODUCTION

- Papers
- Book chapters
- Patents

PROJECTS

- Research Projects

COLLABORATION

- International collaboration with other research groups

FORMATION

- Thesis
- Research works
- Students at MCAT

PICTURES AND VIDEOS

- Equipment
- Events

DIVULGATION

FOREWORD

The group of Carbon Materials for Technological Applications (MCAT) belongs to the Energy and Environment department of the Instituto Nacional del Carbón (INCAR) from the Spanish Scientific Council (CSIC). The research activity of the group focus on carbon materials for environmental and energy applications. At the present the group is composed by the following people: Dr. J. Ángel Menéndez (Research Scientist of the CSIC), Dr. Ana Arenillas (Tenured Scientist of the CSIC), Yolanda Fernández, Beatriz Fidalgo, Leire Zubizarreta (PhD of the CSIC).


J. Ángel Menéndez


Ana Arenillas


Leire Zubizarreta


Yolanda Fernández


Beatriz Fidalgo

Contact
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A. Arenillas: aapuente (at) incar.csic.es

Conventional Technologies

liquid H2

compressed H2

Solid materials

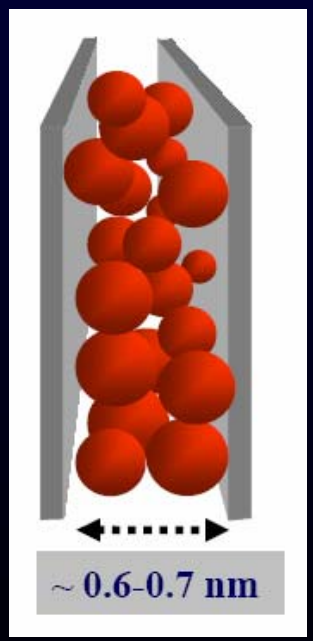
hydrides

DOE objectives	2010	2015
Gravimetric capacity	6 wt%	9 wt%
Volumetric capacity	45 kg/m^3	81 kg/m^3

+

Energy consumed	<5%	
Refuelling time	<5 min	
Life time	(80% capacity)	280 000 km

Novel carbon-based materials



Not necessary cryogenic temperatures

Not necessary very high pressures (security)

Light weight of carbon materials

Reversibility

High packing density

Keys:

porous structure

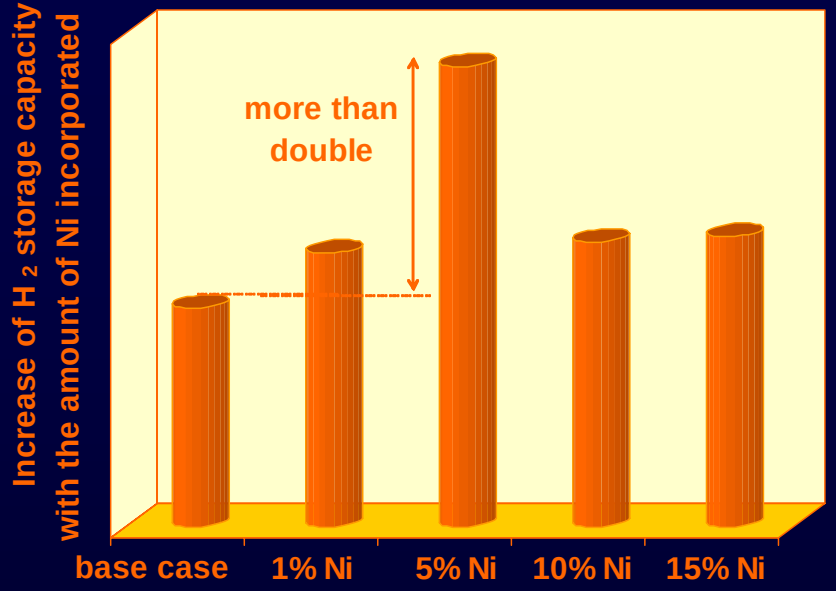
doping particules

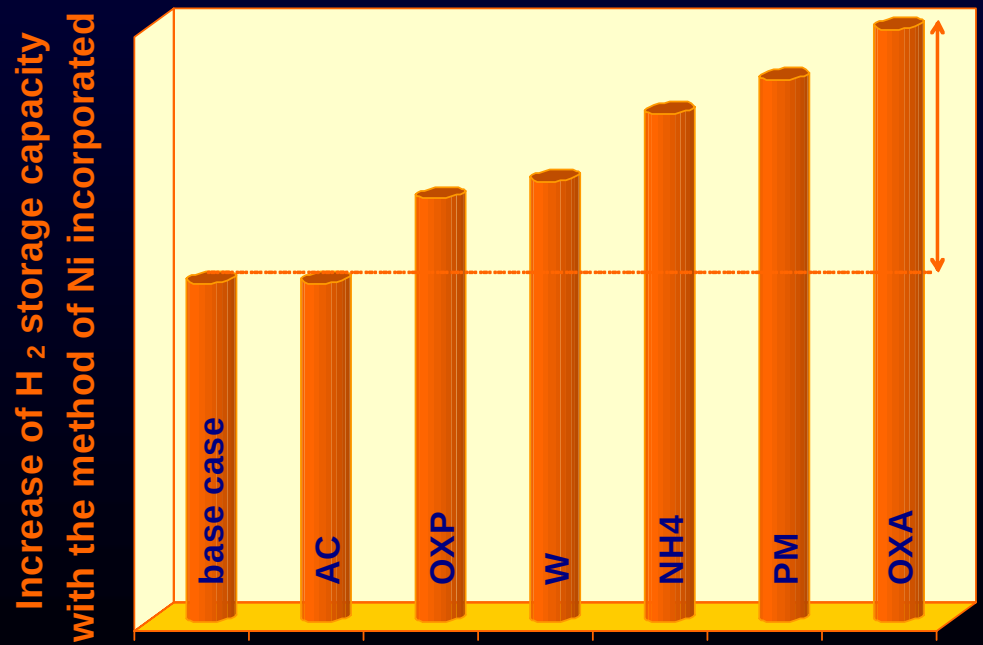
INCAR-CSIC

INCAR-CSIC

Experiments of H_2 storage capacity of non optimised material at

25 ºC and 90 bar





Increase of 75%

INCAR-CSIC

Group Resources

Complete Texture Lab
adsorption isotherms
porosimetry
He picnometry

Different furnaces devices
temperature treatments
different atmospheres
MWs

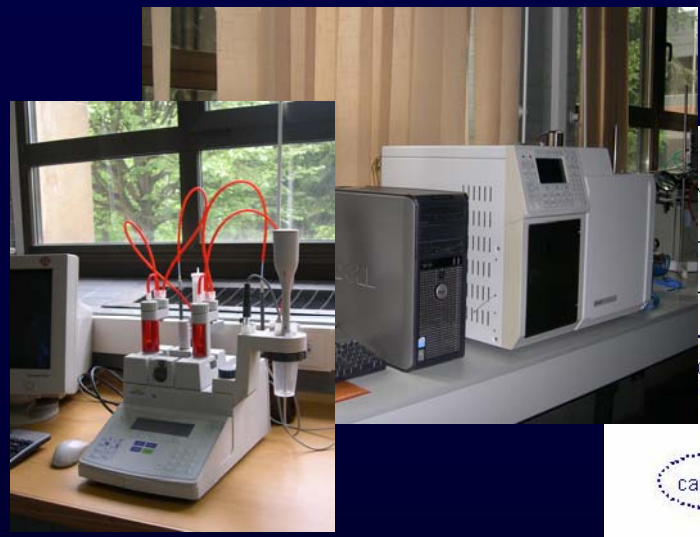
INCAR-CSIC

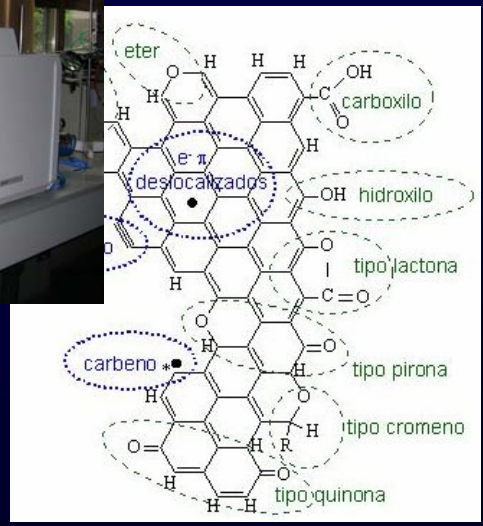
Group Resources

Surface chemistry characterisation

TPD

pH_{PZC}





H_2 storage capacity

TPD

Volumetric methods

Gravimetric methods

Electrochemical methods

INCAR-CSIC

Group Colaborations

USA

Italy
United Kingdom
Portugal
Belgium

Argentina

China

Bilateral cooperations
Researchers exchange
R+D Projects
R+D Contracts

Industries, Universities & Research Centers

Novel carbon materials for hydrogen storage

FP7 Cooperation Work Programme: Energy

Topic ENERGY.2007.1.2.4: Novel nanostructured materials for hydrogen storage

Content/scope: Research should focus on novel nanostructured materials for hydrogen-storage which are not currently under investigation in EU funded projects and/or existing independent initiatives in Member States. Emphasis should be on the fundamental understanding of the chemical and structural interactions governing the energetics, thermodynamics and kinetics of the hydrogen uptake and release characteristics of these novel materials. The nanostructures could be based on novel light metal hydrides, porous materials or other 'non-traditional' approaches and also on potential hybrids of these classes. Activities should include synthesis, characterisation, modelling and investigation of the associated production processes and consequences for scale up. A laboratory prototype tank for on-board vehicle storage applications should be also an expected outcome of this research.

Funding scheme: Collaborative Project (small or medium scale focused project), with a predominant R&D component.

*Expected impact: C*ost-effective breakthrough materials with demonstrable potential for incorporation into safe, conformable systems having in the order of 8wt% storage capacity. Opportunity for innovative SMEs.

Other information: Consortia will typically comprise universities, research centres and, specialised chemical companies with expertise in relevant process technology. Participation of qualified partners from IPHE countries is strongly encouraged.

Open in call: FP7-ENERGY-2007-1-RTD

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Thank you!

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