

research for a **sustainable**
energy development

imdea **energy** institute

annual report

2016

www.energy.imdea.org

institute
iMdea
energy

annual report

2016

www.energy.imdea.org



David Serrano

Director of IMDEA Energy
Móstoles, September 2017

I have the pleasure of introducing the Annual Report of the IMDEA Energy Institute corresponding to 2016. IMDEA Energy is an R&D institution with the legal form of Public Foundation, promoted by the Regional Government of "Comunidad de Madrid". Its principal goal is to contribute to the transition towards a low-carbon energy system, in which sustainability issues and economic feasibility can be combined. Scientific excellence, international impact and cooperation with industry are the key drivers of the IMDEA Energy activities.

The research areas addressed by IMDEA Energy present high scientific, industrial and social relevance, being well aligned with the national and international programs on energy and environment. The main topics studied at IMDEA Energy are as follows: concentrating solar thermal power; production of sustainable fuels; energy storage materials and devices; smart management of electricity demand; energy systems with enhanced efficiency and valorization of CO₂ emissions.

The headquarters of IMDEA Energy are located in the Technological Park of Móstoles (Madrid), having been awarded with the Gold LEED certificate, which is a highly reputed international recognition for buildings with a minimum environmental impact. The research activities of the Institute are strongly supported by the availability of sophisticated scientific equipment and singular pilot plant infrastructures.

The personnel of IMDEA Energy consist of a highly qualified and multidisciplinary team of researchers, from

a variety of backgrounds, specializations and countries. By the end of 2016, a total of 78 persons were working in IMDEA Energy, having also the collaboration of 51 B.Sc. and M.Sc. students in the different research topics.

The external funding executed by the institute in 2016 reached 2.93 M€ which represents a 38% increase compared to 2015. Those funds came from 42 ongoing research projects granted by public administrations, 12 contracts with private institutions and 20 personnel grants. In this way, international projects contributed to about 50% of the overall external incomes. These figures have allowed the IMDEA Energy Institute to reach in 2016 a self-funding ratio of 56% regarding its total budget.

On the other hand, remarkable results were obtained also in 2016 in terms of scientific indicators: 79 scientific works published in indexed journals, 85 communications presented in scientific congresses, 10 of them as invited conferences, 5 PhD Thesis defended and 1 patent filed. Moreover, 6 IMDEA Energy scientists have performed stays in international research groups, whereas the Institute has hosted a total of 17 visiting researchers along 2016.

Finally, I would like to express my gratitude to all the IMDEA Energy staff by its strong effort and commitment during 2016, which have made possible the excellent results herewith summarized, as well as to the continuous support received from the Regional Government of "Comunidad de Madrid".

words from the director...

annual report 2016 www.energy.imdea.org

editor

imdea energy institute

graphic design

base 12 diseño y comunicación

D.L.

M-28265-2017

contents

| | | |
|----------------|---------------------------------------|-----|
| | about us | 6 |
| our structure | | 8 |
| | in figures | 10 |
| cooperation | | 12 |
| | networking | 14 |
| research lines | | 16 |
| | scientific facilities | 18 |
| research units | | 20 |
| | annex | 70 |
| | R&D projects, contracts and grants | 71 |
| | scientific results | 87 |
| | training and dissemination activities | 106 |

about us



The IMDEA Energy Institute is a research centre established by the Regional Government of Comunidad de Madrid in the year 2006 that operates as a non-profit foundation. The Scientific Programme of the IMDEA Energy Institute aims at contributing to the future establishment of a sustainable energy system.

The IMDEA Energy Institute is committed with having a significant impact on the R&D activities on energy themes by bringing together high quality researchers, providing them with excellent infrastructures and resources, and promoting their close collaboration with the industrial sector.



Research topics

Sustainable fuels

Solar termal concentration

Energy storage

Smart grids

Development of
high-energy efficiency
devices

Valorization of CO₂

about us



The building and laboratories of IMDEA Energy Institute are located at the Technological Park of Mostoles, Madrid, on a land with 12,500 m².

The building has been recognized with the prestigious **Certificate LEED Gold** and the **A certificate of energy efficiency**. The different spaces of the building are used to hold numerous events, conferences, workshops and scientific meetings.

10,500 m²

7 scientific labs

2 pilot plants

experimental solar field

office work areas and
an auditorium for 130 people



The strategic framework guiding the R&D priorities of IMDEA Energy is based on goals and priorities established by energy plans and research programmes at regional, national and European levels; such as the new European Strategic Energy Technology (SET) Plan with selected targets for 2020 and 2050; the European Research Framework HORIZON 2020; technology roadmaps of recognized international institutions and associations and implementation agreements of the International Energy Agency.

The excellent R&D capabilities and the first class research facilities make IMDEA Energy a great partner for companies, research centres and universities



our structure



Responsible of managing and dealing with the main business administration and scientific activities of the Institute.

RESEARCH UNITS

THERMOCHEMICAL PROCESSES UNIT

ELECTROCHEMICAL PROCESSES UNIT

BIOTECHNOLOGICAL PROCESSES UNIT

HIGH TEMPERATURE PROCESSES UNIT

ELECTRICAL SYSTEMS UNIT

PHOTOACTIVATED PROCESSES UNIT

SYSTEM ANALYSIS UNIT

ADVANCED POROUS MATERIALS UNIT

MANAGEMENT, ADMINISTRATION AND TECHNICAL SUPPORT UNIT

- Financial management and human resources.
- Project management.
- External relationships and technology transfer.
- Infrastructure and facilities management.
- Health and safety.
- Central research laboratories with scientific equipment of general use by the researchers.

BOARD OF TRUSTEES

The highest decision-making body responsible of the government, representation and administration, aiming to ensure the achievement of the established goals.

Prof. Dr. Martin Kaltschmitt

President of the Foundation
Director of the Institute for Environmental Engineering and Energy Economics
Technical University of Hamburg, Germany

Mr. Rafael van Grieken

Vice-president of the Foundation
Regional Minister of Education, Youth and Sport
Comunidad de Madrid, Spain

REGIONAL ADMINISTRATION REPRESENTATIVES

Mr. José Manuel Torralba

General Director of Universities and Research
Comunidad de Madrid, Spain

Mr. Rafael García

Deputy General Director for Research
Comunidad de Madrid, Spain

Mr. José de la Sota

Scientific and Technical Coordinator
Fundación para el conocimiento madri+d
Comunidad de Madrid, Spain

INSTITUTIONAL TRUSTEES

Prof. Dr. Juan Antonio Melero

Vice-Rector for Innovation, Quality and Scientific Research Infrastructures
Rey Juan Carlos University, Spain

Prof. Dr. Cayetano López

General Director
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, CIEMAT, Spain

Prof. Dr. Máximo León

Professor of Applied Physics
Autónoma University of Madrid, Spain

Prof. Dr. Carlos del Cañizo

Director of the Solar Energy Institute
Polytechnic University of Madrid, Spain

SCIENTIFIC TRUSTEES

Prof. Dr. Nazim Muradov

Research Professor
Florida Solar Energy Center, University of Central Florida, USA

Prof. Dr. Adriano García-Loygorri

Polytechnic University of Madrid, Spain

Prof. Dr. Antonio Monzón

Director of the Chemical Engineering and Environmental Technologies Department,
University of Zaragoza, Spain

Dr. Iacovos Vasalos

Emeritus Professor
Chemical Process Engineering Research Institute (CPERI), Greece

Prof. Dr. Francesc Castells

Emeritus Professor
Rovira and Virgili University, Spain

EXPERT TRUSTEES

Mr. José Jacinto Monge

Rey Juan Carlos University
Móstoles, Spain

Mr. Íñigo Sabater

Vice President of Global Business Development, VESTAS
Madrid, Spain

COMPANIES TRUSTEES

Mr. Valentín Ruiz

Repsol, S.A.
Director of New Energy Technology
Móstoles, Spain

Pending to be appointed

Iberdrola España, S.A.U.
Madrid, Spain

SECRETARY

Mr. Alejandro Blázquez

Consultalia

SCIENTIFIC COUNCIL

Advisory body responsible of the elaboration of the scientific programme and of the establishment of the goals to be achieved by periods of four years as well as of the assessment of the annual performance.

Prof. Dr. Martin Kaltschmitt

Director of the Institute for Environmental Engineering and Energy Economics
Technical University of Hamburg, Germany

Prof. Dr. Nazim Muradov

Research Professor
Florida Solar Energy Center, University of Central Florida, USA

Prof. Dr. Antonio Monzón

Director of the Chemical Engineering and Environmental Technologies Department, University of Zaragoza, Spain

Dr. Carmen M. Rangel

Research Coordinator
National Laboratory of Energy and Geology, LNEG, Portugal

Prof. Dr. Aldo Steinfeld

Professor of Renewable Energy Carriers at the ETH Zurich and Head of the Solar Technology Laboratory at the Paul Scherrer Institute, Switzerland

Prof. Dr. Iacovos Vasalos

Emeritus Research Professor
Chemical Process Engineering Research Institute (CPERI), Greece

Prof. Dr. Adriano García-Loygorri

Polytechnic University of Madrid, Spain

Dr. Francisco Girio

Coordinator of the Bioenergy Unit
National Laboratory of Energy and Geology, LNEG, Portugal

Prof. Dr. Francesc Castells

Emeritus Professor
University Rovira and Virgili, Spain

Prof. Dr. Manuel Berenguel

Research Professor
Computer Science Department
University of Almería, Spain

Prof. Dr. Michael Froeba

Professor
Department of Applied Inorganic Chemistry
University of Hamburg, Germany

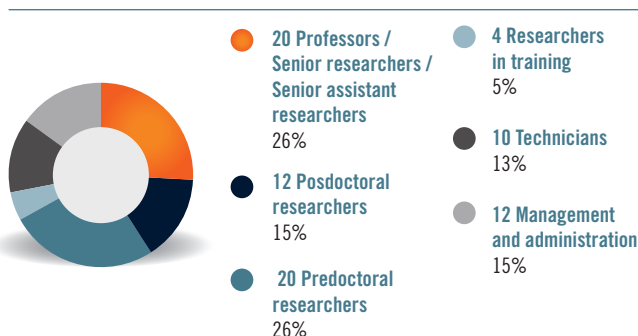
in figures

IMDEA Energy is firmly committed to the objective of providing the Institute with a world-class staff and prestigious researchers. Accordingly, the Institute is developing from the beginning a selective process of recruitment of scientists.

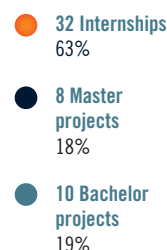
human resources



Human resources distribution by the 31st of December of 2016



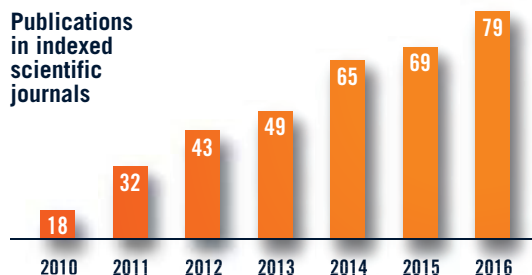
51 students in connection with the IMDEA Energy Institute in 2016



Mobility actions in 2016

6 Secondments of Imdea Energy researchers
17 visiting researchers

Publications in indexed scientific journals



2016

47 congresses communications,
10 invited conferences
and 28 poster communications.

24 Ph.D. thesis under development
and 5 Ph. D. thesis defended.

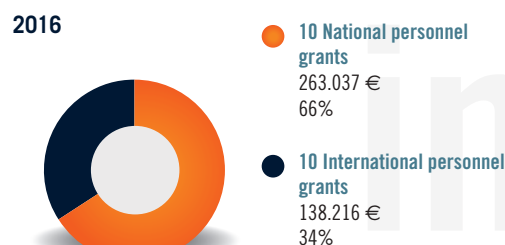
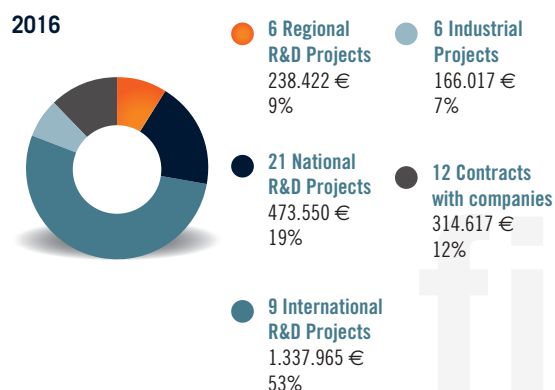
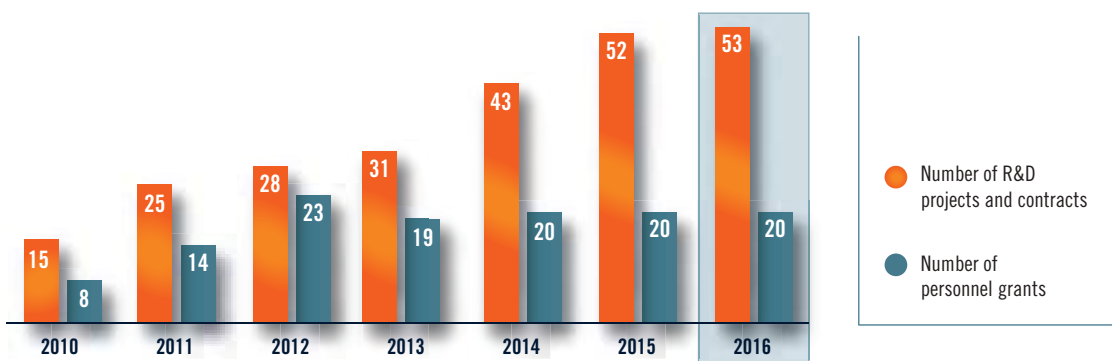
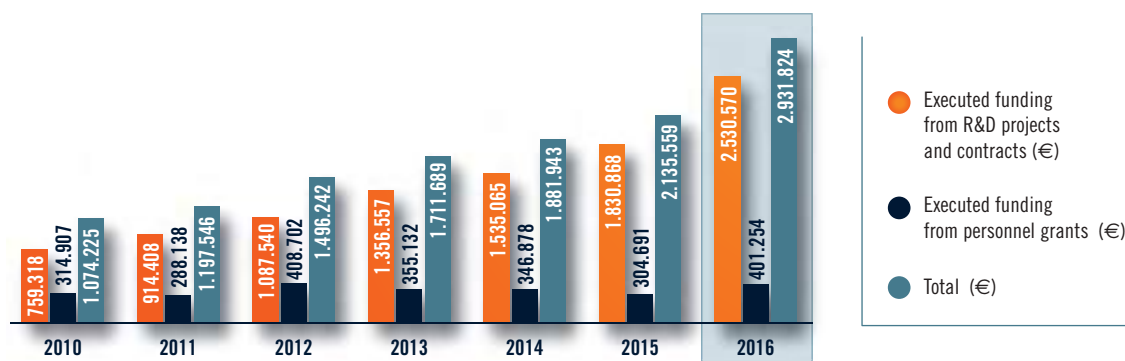
8 patents. During 2016 one new patent was applied.

R&D results

external funding

The portfolio of the research projects developed at IMDEA Energy is characterized by its diversity in terms of funding programs source, being remarkable the high degree of participation of industries and research institutions of the energy sector. During the year 2016 the Institute was hosting two Consolidator Grants awarded by the European Research Council with a total budget of 4.5 M€, and it was coordinating an European Project of more than 17 partners and a total budget over 9 M€.

Personnel grants in 2016 were supported by the Marie Curie Cofund Program of the European Union and by the Spanish Ministry of Economy and Competitiveness under the Ramón y Cajal program, the predoctoral researchers program and the incorporation of doctors program.



cooperation

IMDEA Energy collaborates with universities and research centres worldwide, both within the framework of research projects and for the development of educational programs.

Cooperation in R&D&i with companies is one of the main objectives of the IMDEA Energy Institute. In 2016, IMDEA

Energy has promoted a wide number of meetings with companies and was actively involved in the organization and participation in business events. More than 90 companies were contacted during the year 2016 and more than 26 new R&D proposals in collaboration with industries have been launched.

COOPERATION WITH COMPANIES 2016

ABENGOA



Outotec





COOPERATION WITH RESEARCH INSTITUTIONS AND FOUNDATIONS 2016

COOPERATION WITH UNIVERSITIES 2016



cooperation



networking



The IMDEA Energy Institute, since its creation, has considered as a relevant activity its participation in associations, technology platforms, expert groups and alliances of the energy sector. This is a means of increasing its external visibility, establishing new links with companies and research institutions and to gain updated information on the initiatives being planned and launched related to the different energy topics.



NATIONAL



INTERNATIONAL



SPANISH TECHNOLOGY PLATFORMS



networking

research lines

Energy storage coupled to renewable energy and transport



Development of technologies and systems for the storage of energy enabling the increased penetration of renewable energies and the distributed generation of electricity.

Electrochemical energy storage

- Nanostructured materials for electrochemical capacitors and advanced batteries.
- Electrochemical capacitors with high energy density.
- Low-cost redox flow batteries.
- Development of testing protocols for batteries and supercapacitors.

Thermal and thermochemical energy storage

- Development of phase change materials (PCM) with macro-encapsulated structures and storage systems for solar thermal power plants and industrial waste heat recovery.
- Thermal energy storage with gas/solid systems in thermoclines and moving bed exchangers.
- Development of thermochemical storage systems making use of high temperature redox reactions.

Production of sustainable fuels



Development of biofuels, alternative fuels and bioproducts aiming at the complete decarbonisation of the transport sector.

- Biofuels and bio-products from microalgae carbohydrates.
- Biofuels via fast pyrolysis or catalytic pyrolysis of lignocellulose biomass and residues.
- Upgrading of bio-oils by catalytic hydrodeoxygenation processes.
- Development of CO₂-free fuels by solar driven thermochemical cycles.
- Solar fuels production by artificial photosynthesis.

Concentrated solar power



Development of efficient and dispatchable solar concentrating technologies for power generation, industrial process heat and production of solar fuels and chemicals.

- Optical design of modular schemes for solar thermal power plants.
- Solar receivers and reactors for new heat transfer fluids.
- Solar technologies for fuels and chemicals production with CSP.
- Increasing solar-to-electricity conversion efficiency and dispatchability.

Smart management of electricity demand



To improve management, reliability and stability aspects of future electricity networks and new algorithms for demand management and renewable integration

- Demand forecasting and network management algorithms.
- Reliability of power systems with high penetration of renewables.
- Building and residential demand modelling.
- Distribution network applications and services.
- Power electronics and power interfaces.

Energy systems with enhanced efficiency



Development of technologies and strategies for efficient end-use of energy in buildings, industrial processes and environmental applications.

- Control systems and algorithms for energy efficiency in industrial applications.
- Capacitive deionization for energy efficient water treatment.
- Solar heat for medium and high temperature industrial processes.
- Integration of renewable energy technologies in buildings.

Confinement and valorization of CO₂ emissions



Development of CO₂ valorization routes by its transformation into high-demand valuable products.

- CO₂ photoreduction for energy storage and fuels production.
- Development of multifunctional materials and solar reactors for photoactivated processes.
- Thermo-catalytic routes for CO₂ transformation in industrial processes.

Techno-economic evaluation of energy systems



Sustainability assessment, optimisation of processes and modelling for energy planning.

- Process simulation and optimization.
- Life cycle management, sustainability and social aspects.
- System modelling and technology roadmapping.

research lines



scientific facilities

Instrumental Techniques

- Chemical characterization techniques: mass spectrometry, gas/mass chromatography, elemental analysis ICP - OES and CHONS.
- Thermogravimetric analysis (TG-DTA) in an oxidising (air), inert (Ar) or reductive (10% H₂/Ar) atmosphere.
- Properties of solids: textural and chemisorption.
- X-ray diffraction with structural PDF analysis and controlled atmosphere chamber up to 900 °C and 10 bar.
- Spectroscopy: IR (DRIFT, ATR and VEEMAX), UV-vis-NIR, raman and fluorescence.
- Thermal diffusivity determination.
- Microscopy: atomic force, SEM.
- Biotechnological characterisation techniques: GC, HPLC equipped with different columns and detectors (IR, MS, UVVIS, HPAEC-PAD). Electrophoresis instrumentation for recombinant DNA technology, protein purification and analysis.

Simulation and Modelling Tools

- Aspen Plus for chemical process analysis and optimization.
- EBSILON Professional for simulation of thermodynamic cycle processes and power plants.
- STEC/TRNSYS for dynamic simulation of solar thermal power plants.
- Simapro 7.2 Professional for life cycle assessment (LCA) and carbon footprinting.
- GaBi Professional and DEA-Solver Pro for sustainability analysis.
- LEAP software for energy planning and thermal fluid dynamics.
- Matlab-Simulink for process simulation and data processing.
- LabVIEW for data acquisition, process control and calorimetric loops.
- SolidWorks for 3D computer-aided design.
- COMSOL Multiphysics for CFD analysis.
- Tracepro for ray tracing simulation of solar systems.

scientific facilities



Pilot Plants Facilities

High-flux solar simulators of 7 and 42 kW. Surface treatment and synthesis of materials. Advanced solar concentration optics. Solar receivers and reactors. Thermal fluids for high temperature applications. Characterisation techniques for high radiation fluxes, high temperatures and simulation tools.

Smart energy integration lab. Real-time emulation of AC and DC power networks and microgrids. Development of optimal dispatch algorithms for energy resource management. Stability analysis, power quality and control strategies for microgrids and power electronics converters. Renewable and storage integration to power network.

Test installation for batteries and electrochemical capacitors with various assay protocols in DC and AC. Simulation of demand cycles in powers from 0.3 to 30 kW under controlled temperature and humidity.

Production and conversion of biomass in open and closed photobioreactors with versatile and flexible configuration. Pyrolysis (thermal or catalytic) on fluidised bed reactor and hydrodeoxygenation on fixed bed reactor. This may be operated in series or independently coupled to systems of volumetric and chromatographic analysis.

research units

**Thermochemical
Processes Unit**



**Electrochemical
Processes Unit**



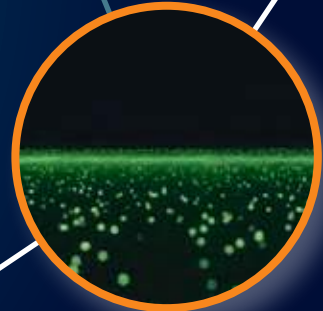
**High Temperature
Processes Unit**



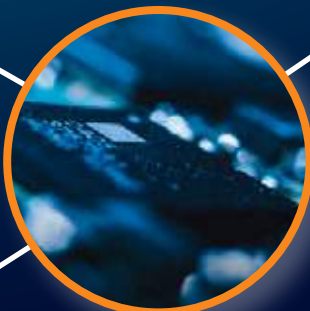
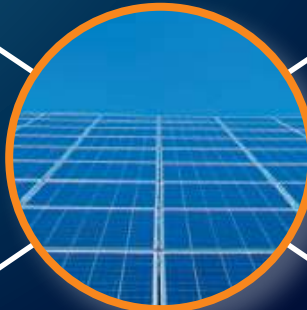
**System Analysis
Unit**



**Biotechnological
Processes Unit**



**Photoactivated
Processes Unit**



**Electrical Systems
Unit**



**Advanced Porous
Materials Unit**



Thermochemical Processes Unit



Prof. Dr. David P. Serrano
Research Professor
Head of the Unit



Dr. Juan M. Coronado
Senior Researcher



Dr. Patricia Pizarro
Senior Associated
Researcher



Dr. Juan Miguel Moreno
Senior Researcher

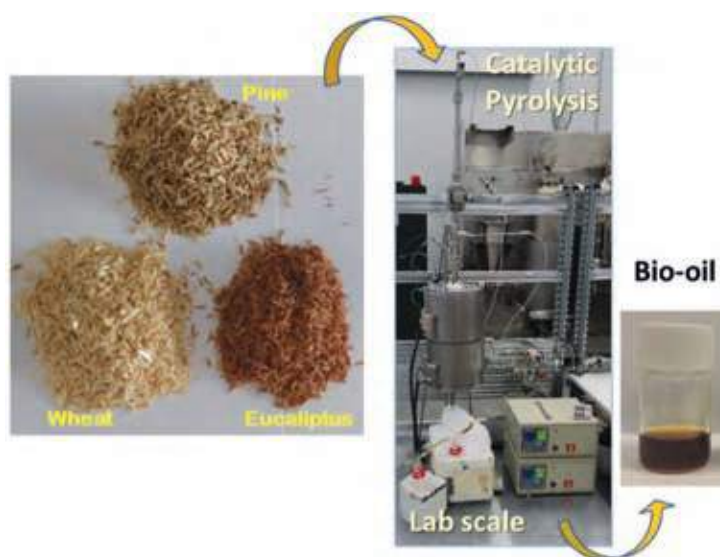


R&D Objectives

- Production of sustainable fuels: advanced biofuels & hydrogen
- Development of materials and processes for thermochemical energy storage

Research lines

- Advanced biofuels production from lignocellulosic biomass and other residues mainly by pyrolysis and subsequent upgrading of bio-oils via hydrodeoxygenation among other processes.
- Design of catalysts and optimization of operation conditions at lab and pilot plant scale reactors for the production of advanced biofuels.
- Development of redox materials for the thermochemical energy storage at medium and high temperatures.
- Production of solar fuels by H_2O and CO_2 splitting over redox materials.



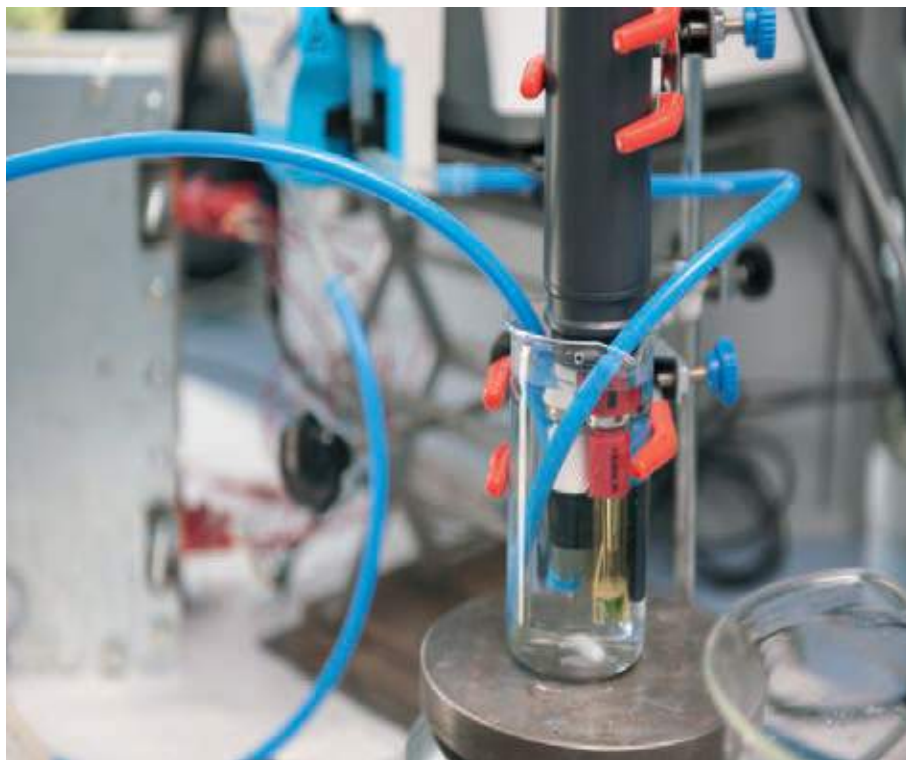


Relevant projects and networking

The Thermochemical Processes Unit (TCPU) is coordinating the project CAS-CATBEL of the call FP7-NMP-2013-LARGE-7 (Topic: NMP.2013.1.1-1), developed with the participation of 17 partners of both academic and industrial institutions, and aimed to design, optimize and scale-up a novel multi-step process for the production of second-generation liquid biofuels from lignocellulosic biomass. In the same research line, the TCPU also participates in the project CATPLASBIO of the Spanish Ministry of Economy and Competitiveness and RESTOENE2 of the Madrid Regional Government. The research activities related to thermochemical store

and the production of solar fuels have been funded by the project MULTISTOR of the Spanish Ministry of Economy and Competitiveness and SOLARKITE of the Ramon Areces Foundation. In addition, the Unit has been awarded with one research grant by the Iberdrola Foundation.

Besides TCPU participates at the European Energy Research Alliance (EERA) of Bioenergy and in the Spanish Platform of Sustainable Chemistry and Biofuels. In addition the unit is in contact with a number of universities and research centres in Spain, Europe, Africa (Algeria and South Africa), and USA.



Facilities

Synthesis and characterization of catalysts

- Lab equipment for catalyst and materials preparation by different routes such as sol-gel, hydrothermal and co-precipitation.
- Tubular muffle furnace for thermal treatment under controlled atmosphere.
- Characterization of textural (Ar and N₂ physisorption), chemical (ICP) and structural (XRD, TEM, Raman spectroscopy) properties.



Lab scale reactors for testing catalytic activity

- Stirred tank high pressure batch reactors.
- High pressure fixed bed continuous flow reactor.
- High temperature fixed bed continuous flow reactor for testing redox materials.
- Downdraft fixed-bed pyrolysis reactors.
- Continuous feeding pyrolysis reactor.

Pilot scale reactor

- Continuous feeding fluidized bed pyrolysis reactor.
- Continuous flow fixed bed high pressure reactor.

Analysis of reactions products

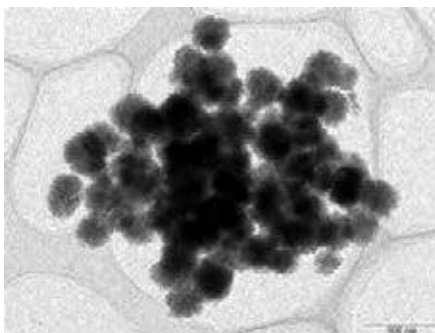
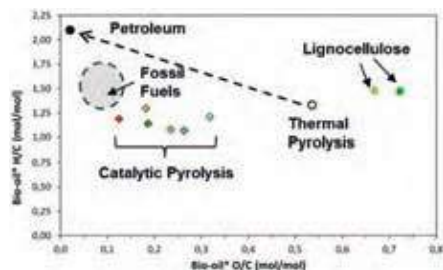
- Light elements (CHNS-O) determination, Karl Fischer titration, MS gas analysis.
- Chromatographic analysis: GC-MS, 2 GC (FID, TCD), 2 μ GC.



Scientific and technical results

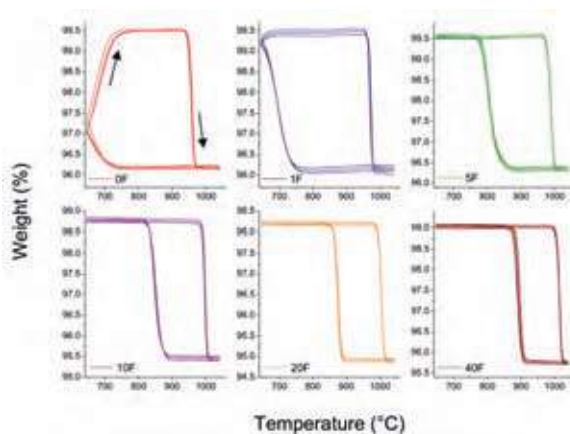
Advanced biofuels

- Optimization of the reactions conditions for pyrolysis reactions at both lab and pilot plant scales and using different lignocellulosic feedstocks.
- Development of highly effective multifunctional catalysts for pyrolysis based on zeolites, which allows a significant deoxygenation of bio-oils with good energy yields.
- Synergetic coupling of catalysts for effective upgrading of bio-oils.
- Enhanced quality bio-oils with high aromatic content obtained catalytically by co-feeding plastics and lignocellulosic biomass.
- Design of high performance bifunctional catalysts based on inexpensive metal phosphides and supports of moderate acidity for hydrodeoxygenation reactions.
- Deeper mechanistic understanding of the network reactions relevant in the different thermochemical processes for the production of biofuels.
- Fine tuning of catalysts synthesis methods to control the properties from nanoscale to the technical shaped formulations.
- Scaling up of the catalysts preparation procedures including agglomeration and shaping to obtain materials with technical grade.



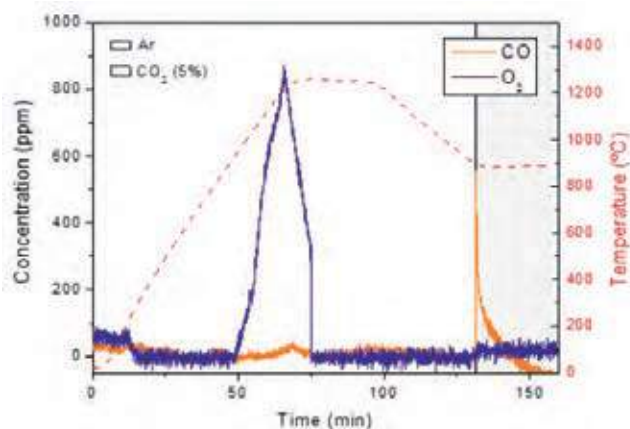
Thermochemical heat storage

- Modification of the $\text{Mn}_2\text{O}_3/\text{Mn}_3\text{O}_4$ couple by Fe-doping has proved to boost the stability and improve the performance of this material for the high temperature heat storage.
- Kinetic modelling of thermal storage and in situ structural characterization of redox materials.
- Study of the BaO_2/BaO redox pair as a promising system for thermochemical storage at high temperature.



Solar fuels production

- Development of alternative three steps thermochemical cycles of the $\text{MnO}_x\text{-Na}$ system for hydrogen production.
- Setting-up a dedicated lab scale reactor for testing thermochemical CO_2 and H_2O splitting at high temperature.
- Development of redox perovskites of complex composition with activity for CO_2 splitting.





High Temperature Processes Unit

annual report
2016



Dr. Manuel Romero
Research Professor
Head of the Unit



Dr. José González-Aguilar
Senior Researcher



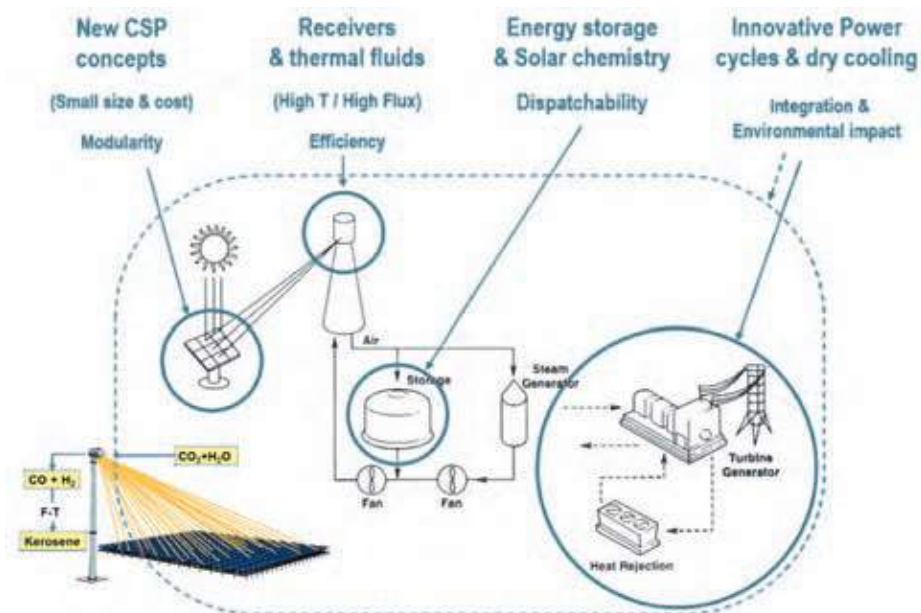
Salvador Luque
Senior Assistant
Researcher

R&D Objectives

- Modular, efficient and dispatchable solar concentrating technologies for power generation, industrial process heat and production of solar fuels and chemicals

Research lines

- New modular schemes for high-efficient and dispatchable solar thermal power plants and urban integration.
- Solar receivers and reactors: cavity, volumetric, rotary kiln, and particle receivers. Computational fluid dynamic simulation and experimental characterization.
- Thermal energy storage (latent heat, thermochemical) for STE/CSP plants. Modelling and CFD simulation and test rigs for materials and system characterization.
- Solar fuels and chemicals production using metal oxides.
- PCU Integration & Environmental impact (advanced cycles, water, glint, glare).

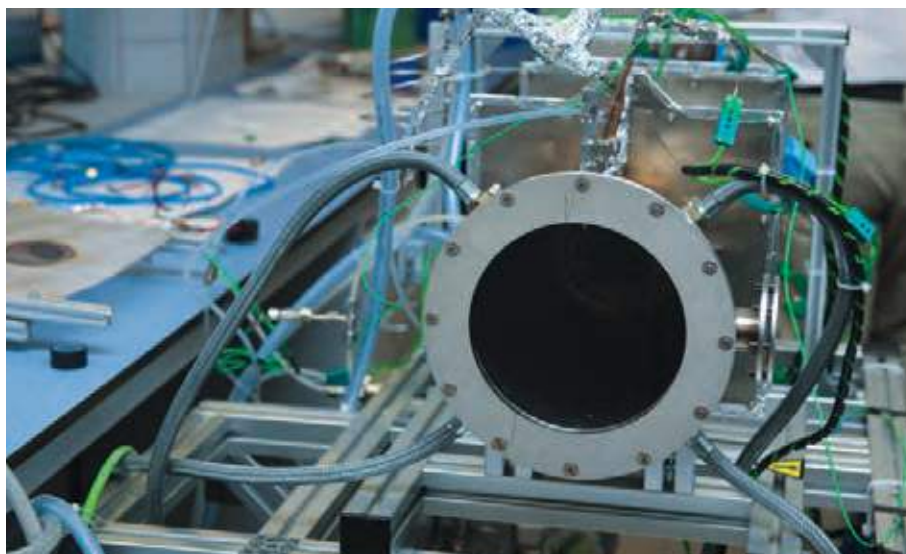


Relevant projects and networking

The High Temperature Processes Unit (HTPU) is an active agent in the research on solar thermal technologies covering collaborations at local, national and international level. Thus the HTPU coordinates the projects SOLGEMAC (2010-2013) and Alcones (2014-2018) addressing this topic in the Comunidad de Madrid and it is actively contributing to the most recent developments on new heat transfer fluids and solar receivers (EU H2020 NEXT-CSP and ES Retos ARROPAR-CEX projects), solar thermal industrial process heat (EU H2020 INSHIP), production of solar fuels (EU H2020 Sun-to-Liquid project) and it takes part of the Integrated Research Program STAGE-STE (Scientific and Technological Alliance for Guaranteeing the European Excellence in Concentrating Solar Thermal Energy) that gathers 42 members, all EU research institutions

partners of EERA JP-CSP plus a significant number of additional organizations, including those from non-EU countries.

Besides HTPU participates at the European Energy Research Alliance (EERA AISBL) within the Joint Programmes (JP) on Concentrated Solar Power (EERA JP-CSP) and on Energy Storage. In the national arena, HTPU is also involved in the Spanish technological platform on CSP (Solar Concentra) and the Working Group on Energy Storage (GIA), an initiative of the Spanish Ministry of Economy and Competitiveness, within Thermal Storage activities and participates in the IEA SolarPACES Task III within the Workgroup on Thermal Storage as well as national and international associations on Solar Energy (ISES).



Facilities



Laboratory for material synthesis and characterization in extreme conditions (high solar irradiance and/or temperature)

- Material synthesis by ball milling and wet-chemical routes.
- Material characterization (1600 °C sintering furnace, thermal diffusivity by laser flash technique).
- 7 kWe high-flux solar simulator equipped with three-axis positioning system.
- Specific instruments for temperature, radiation flux and gas composition measurements: infrared, CCD and CMOS cameras, radiometers, pyrometers, gas analyzers and microchromatograph.

Pilot plants for components and prototypes testing

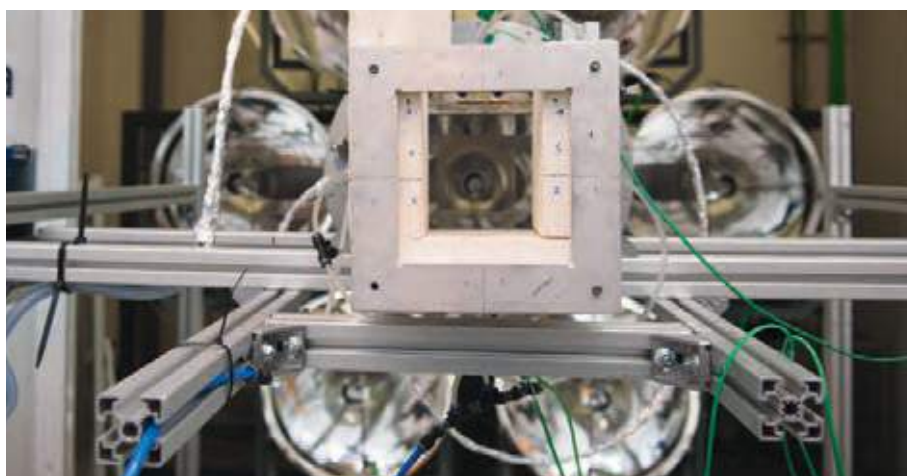
- 42 kWe high-flux solar simulator equipped with a three-axis positioning system with a static load capacity of 250 kg.
- 250 kW solar tower facility composed of 169 heliostats.

Specific test rigs

- Aerothermal characterization of volumetric absorbers.
- Thermal storage in packed and fluidized beds.

Tools for numerical analyses and data acquisition and monitoring

- Workstations.
- Specific software for computational fluid dynamic, lightning, data treatment and process control and monitoring, process engineering.



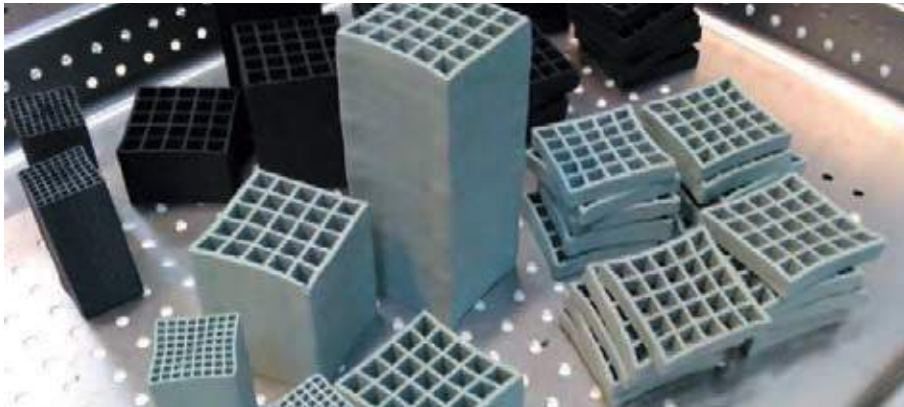
Scientific and technical results

Innovative modular concepts with minimum environmental impact

- Modules for solar field design for optical analysis using Montecarlo Ray Tracing software.
- Contribution to the design and construction and optical characterisation of small facets having short focal distances.
- Construction of a modular solar tower with 169 small heliostats able to achieve irradiance higher than 2000 kW/m^2 (commissioning carried out in 2017).

Solar receivers & new heat transfer fluid

- Design of a fully equipped test rig for experimental aerothermal characterization of absorber materials and receivers at 10kW scale.
- Patent filled on “Ricevitore volumetrico perfezionato” (102015000059704).
- Physico-chemical characterization of materials made of pure silicon carbide and ceria for production of volumetric absorber by extrusion.
- Design, construction and commissioning of 1 kW and 5 kW fluidised bed particle receivers.



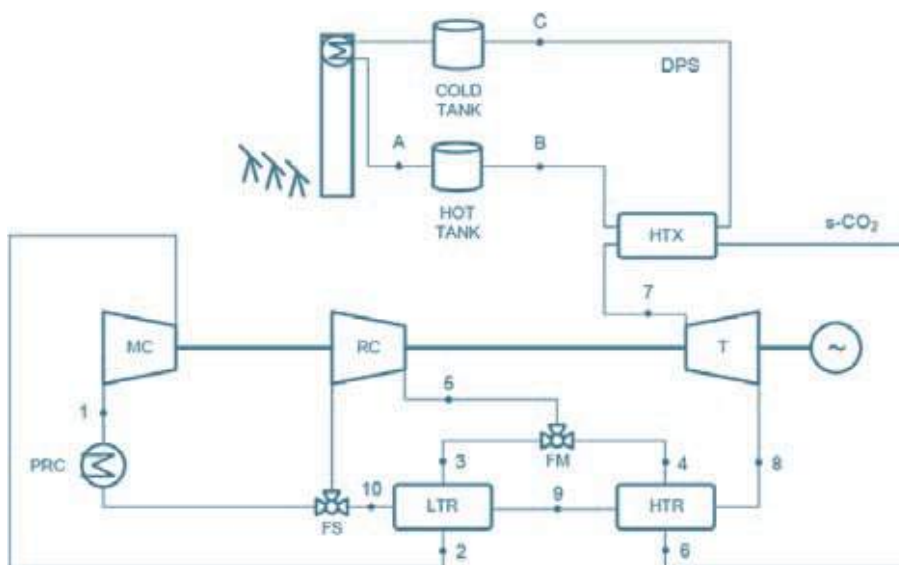


Energy storage & solar thermo-chemistry

- Fully equipped test bench for experimental characterization of kinetics in solar thermochemistry.
- Own designed 1 kWth rotary kiln for solar thermochemistry.
- Numerical models for simulations of components and thermal storage systems using PCM and thermochemical materials.
- Development of macro-encapsulated phase change materials for thermal storage systems.
- Analysis of solar-driven pyrolysis and gasification of low-grade carbonaceous materials from biomass (*Scenedesmus* algae and wheat straw) and waste treatment (sewage sludge).

High temperature processes integration & environmental impact

- Analysis on integration of new heat transfer fluids based on dense particle suspensions in central receiver solar thermal power plants.
- New models for solar receivers, heat exchangers and thermal storage systems based on particles applied to dynamic simulation of solar thermal power plants.
- Analysis on innovative solar thermal power plants concepts based on thermo-electrochemical conversion (Na/S batteries and carbon fuel cells).





Electrochemical Processes Unit



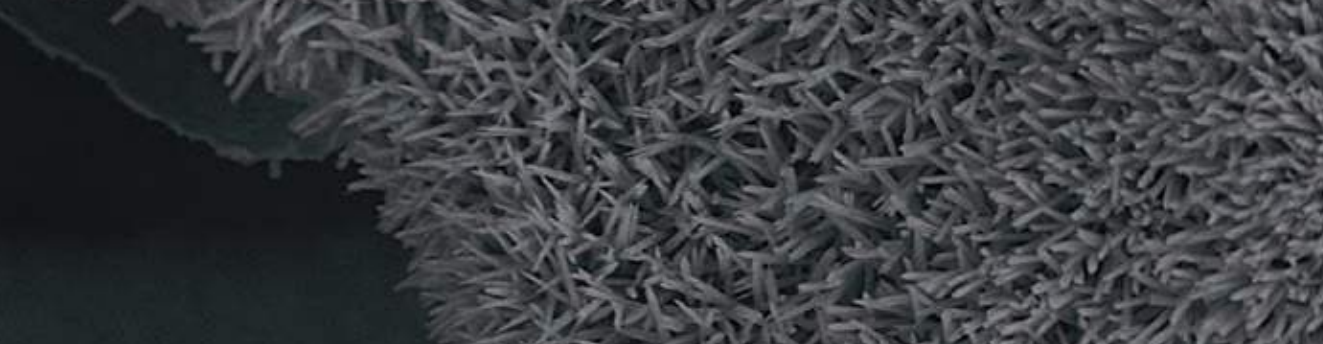
Prof. Dr. Marc A. Anderson
Research Professor
Head of the Unit



Dr. Jesús Palma
Senior Researcher
Co-head of the Unit



Dr. Rebeca Marcilla
Senior Researcher

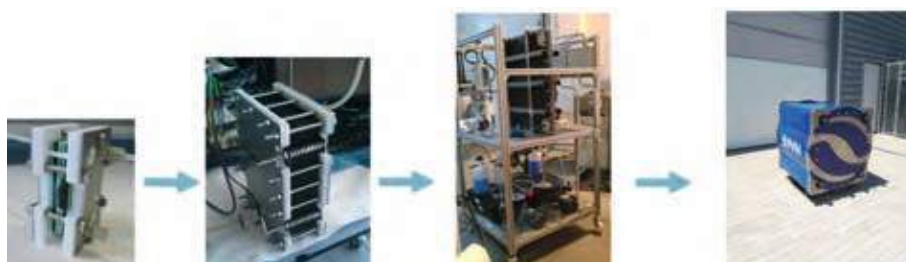


R&D Objectives

- Electrochemical energy storage to increase the dispatchability of renewable sources and for the electrification of transport
- Energy-efficient electrochemical devices for energy and environmental applications

Research lines

- Electrochemical capacitors: increase the energy density and development of multifunctional devices.
- Capacitive deionization: energy recovery and application to brine concentration in water desalination.
- Redox flow batteries: low-cost electrolytes with increased energy density and new membrane-free concepts.
- Metal-air batteries: low-cost high-performance electrodes and electrolytes and high reversibility of $\text{Me}_0/\text{Me}_{n+}$ y O_2/O_2^- reactions.
- Battery testing: performance and accelerated cycle life assessment, and non-conventional testing.





Relevant projects and networking

The Electrochemical Processes Unit (ECPU) is becoming a well-known agent on electrochemical energy storage in the Comunidad de Madrid. In 2016, it has participated in the regional project MAD2D (2014-2018). Regarding National funds, the ECPU has been involved in two fundamental research projects SUPERLION and MATCAP, and in three applied research projects LPT, DC-SOIAS and ALIENA. At European level, the ECPU has been involved in an Innovative Training Network and in a project funded by the Joint Undertaking on Fuel Cells and Hydrogen. One of the ECPU members has been recently awarded with a Consolidator Grant of the European Research Council (ERC). Regarding private funds, the ECPU has been involved in a project with B/E Aerospace, leading manufacturer of aircraft cabin interior products and services.

At European level, ECPU participates in the European Energy Research Alliance (EERA) as member of the Joint Programme on Energy Storage (EERA JP-ES). At national level, ECPU is involved in the Spanish Technological Platform on Smart Grids (Futured) and in the Working Group on Energy Storage (GIA) as coordinator of the Electrochemical Storage subgroup. Besides, the ECPU is a member of the Spanish network of excellence in Redox Flow Batteries (BAT-FLU).

The ECPU maintains collaboration agreements with several national and foreign universities to host students doing internships or Degree/Master theses. Like Massachusetts Institute of Technology and Fraunhofer Chile Research.





Facilities

Components preparation and characterization Laboratory

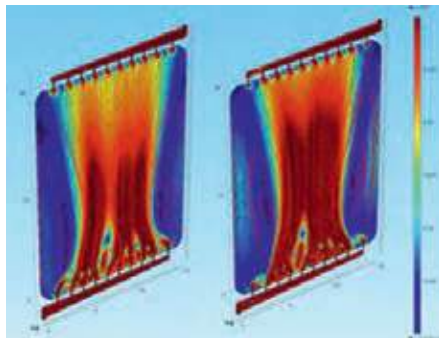
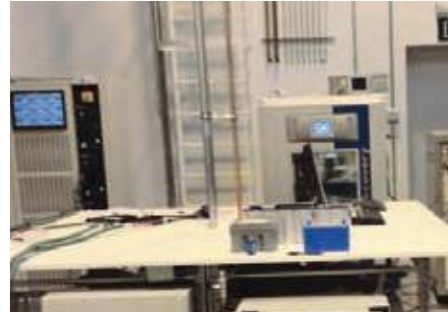
- Sol-gel, hydrothermal and ultrasonic synthesis.
- Particle size and Z-potential analysis
- Electrode preparation equipment: ink mixer, doctor blade, roll press.
- Electrode puncher, coin cell crimper, vacuum sealing machine.
- Potentiostats for electrochemical characterization (30 channels $\pm 10V / 0,5A$ to 10A); impedance spectroscopy.
- Rotating disk and rotating ring-disk electrodes.
- Inert glove box.

Modeling and design facilities

- 3D Design: Solidworks.
- 3D Printer.
- Computational chemistry: Spartan / Gaussian.
- Computer fluid dynamics: COMSOL Multiphysics.

Electrochemical devices testing Laboratory

- Battery cycler (3 x 300 W, 80 V - 50A max.)
- Battery cycler (3 x 8 kW, 120V - 200A max.)
- Climatic chamber (-40 to +180°C and 10 a 98%H).
- Gas supply (N_2 , H_2 , Air, O_2).
- Flow battery test bench with controlled Q, T, P, pH, ORP.
- Flow battery pilot tests from 5 kW to 35 kW.
- LabView programmable control system.



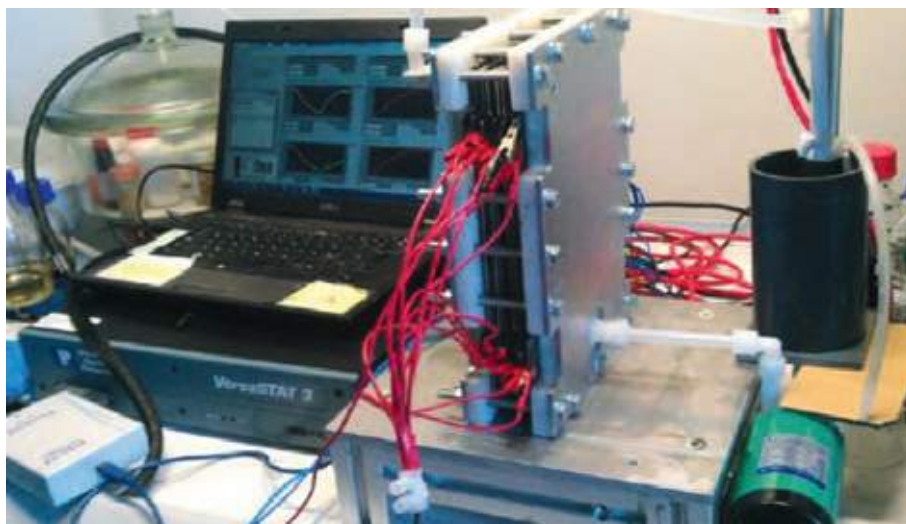
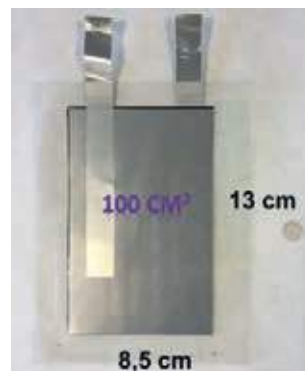
Scientific and technical results

Electrochemical capacitors

- Pseudocapacitive electrodes with composites carbon-based materials and nanostructured metal oxides.
- Polymer electrolytes based on ionic liquids.
- Solid state supercapacitors with improved mechanical properties for flexible or structural devices: 100 cm² prototypes.
- Hybrid supercapacitors combining redox organic molecules and ionic liquids.
- International patent filled “Composite comprising CNT fibres and an ionic conducting compound as part of an energy storage device” WO 2017/045715 A1.
- PhD thesis on “Application of ionic liquids, innovative polymer electrolytes and novel carbonaceous materials in supercapacitors” by Girum A. Tiruye.

Capacitive deionization

- Increase the deionization capacity by improving active materials and increasing mass loading.
- Adaptation of capacitive deionization to highly concentrated brackish water (over 10 g/L TDS).



Redox flow batteries

- Exploration of new concepts for membrane-free flow batteries.
- New electrolytes containing organic redox couples.
- Design and testing of modules based on vanadium electrolytes. Test benches of 5 to 35 kW.
- Spanish patent filled “Batería redox con electrolitos inmiscibles” P201630327.

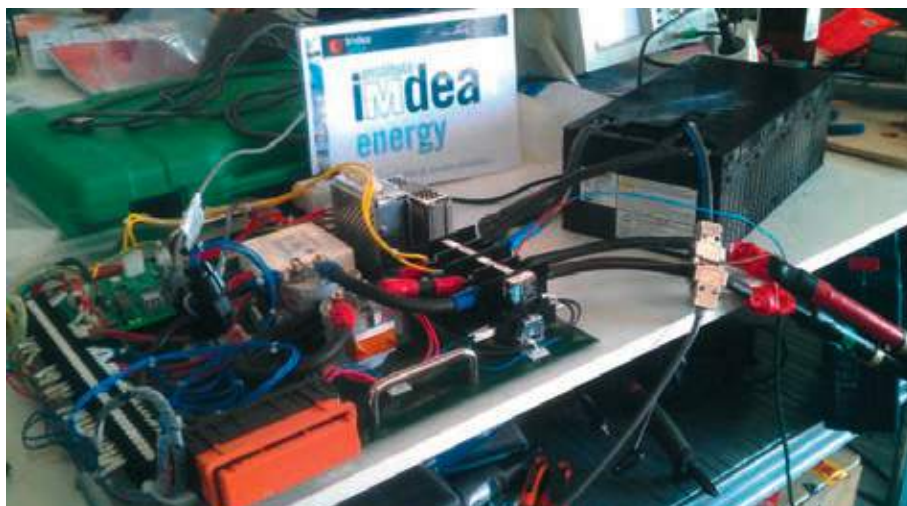
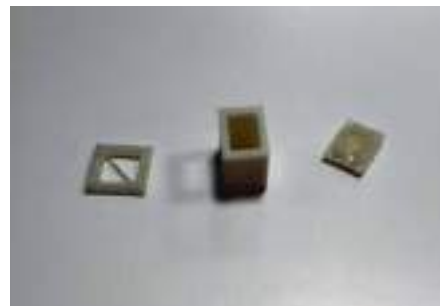
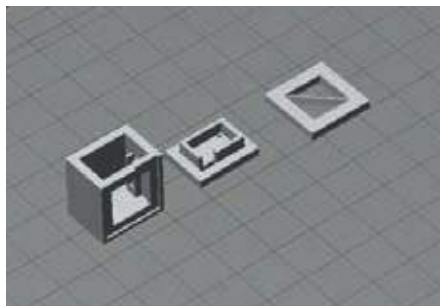


Metal-air batteries

- Ionic liquid electrolytes for reversible Al-air batteries.
- Metal oxides, graphene and conductive polymers as catalysts for oxygen reduction and oxygen evolution reactions.
- Increase discharge voltage of Zn-air batteries.

Battery testing

- Accelerated cycle life and ageing testing protocols based on differential impedances.
- Application to a 1.1 kWh LTO Li-ion battery.





Biotechnological Processes Unit



Dr. Mercedes Ballesteros
Principal Researcher
Head of the Unit



Dr. Cristina González
Senior Assistant
Researcher



Dr. María José Negro
Senior Associated
Researcher



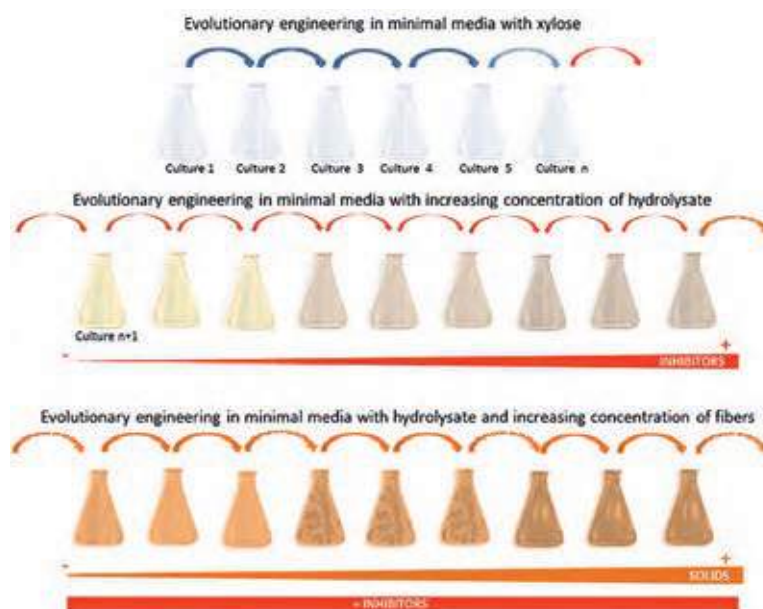
Dr. Ignacio Ballesteros
Senior Associated
Researcher

R&D Objectives

- Processes and technologies development to produce biofuels and bioproducts via biological processes using lignocellulosic and microalgal biomass

Research lines

- Microalgae in upstream processes: microalgae and aerobic bacteria consortia for wastewater treatment.
- Microalgae downstream processes: photosynthetic biomass anaerobic digestion.
- Lignocellulose based biofuels and bioproducts.
- Kluyveromyces marxianus*: a cell factory.





Relevant projects and networking

The Biotechnological Processes Unit (BTPU) leads national and international projects dealing with anaerobic digestion of microalgae biomass and the integration of this technology in wastewater treatment practices. In WWALGAS project (2014-2018) the strategies to optimize biogas production from microalgae are studied with special attention to the characteristics of the cell wall composition. IMDEA Energy is also involved in MICROALBAC (2015-2018), which aims to implement microalgae-bacteria consortia in small size wastewater treatment facilities. The unit of biotechnology is currently working in the development of tools to improve phototrophic biomass production with the participation in INSPIRA1 (project devoted to the production and commercial application of Spirulina (*Arthrospira platensis*)). More recently, the unit has been also awarded with two ERANET projects, namely WASTE2BIO (2017-2020, dealing with the anaerobic digestion of residues from the leftovers attained after ethanol production using municipal organic wastes)

and BIOGASMENA (2017-2020), addressing key technological challenges to foster the development of biogas technology in both the EU and the mediterranean region, with a particular focus on rural agrarian communities. BTPU is experienced in coordination of international microalgae projects. As a matter of fact, the COST Action EUALGAE (2015-2019) funded by the European Commission is led by BTPU. This project counts with more than 100 investigators from 25 countries. The main objective is the establishment of a European network devoted to create an economical feasible model for commercialization of algae-based products. BTPU is actively working in yeast culture for bioenergy production from lignocellulosic residues. In LIGNOYEAST (2015-2018), strains tolerant to mechanical stress are being tested for the production ethanol at high substrate loading while BIO_LIGWASTE (2016-2019) is devoted to valorize municipal solid waste through yeast based processes.





Facilities



Biotechnology and microbiology Lab

- Laminar flow hood, PCR cabinet.
- Orbital shakers.
- Cell counter.
- Anaerobic reactors, fermenters and photobioreactors.
- Oven, muffle and balances.

Chemical analytics Lab

- Gas and liquid chromatographs with different detectors (FID, TCD, DAD, RI).
- Ionic chromatography.
- Equipment for routine analysis; TS/VS, pH, TNK, COD.
- Spectrophotometers: microplate and cuvette type.

Molecular biology Lab

- Polymerase chain reaction: traditional and real-time.
- Electroporator.
- Denaturing gradient gel electrophoresis and agarose electrophoresis.

Pilot plants

- Steam explosion and screw extruder pretreatment plants for lignocellulosic material.
- Bioreactors.
- 3 modules of 4 bubbled columns each (1 m³ in total).
- 2 open raceways (1 m³ in total).





Scientific and technical results

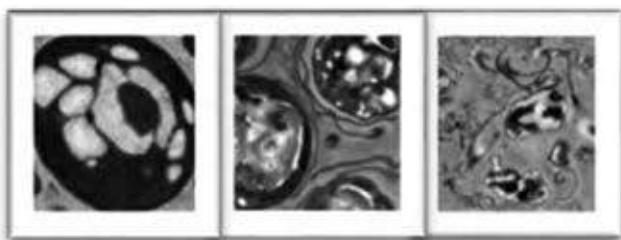
Microalgae in upstream processes: microalgae and aerobic bacteria consortia for wastewater treatment

- Determination of microalgae oxygenation potential and light dependence of the bio-process.
- Assessment of symbiotic interactions between microalgae and bacteria through calculation of oxygen mass balances.
- Evaluation of nutrients removal mechanisms and kinetics.
- Genetic identification of microalgae and bacteria consortia.
- Microalgae cultivation upscaling: from culture plate to raceways and bubbled columns photobioreactors.



Microalgae downstream processes: photosynthetic biomass anaerobic digestion

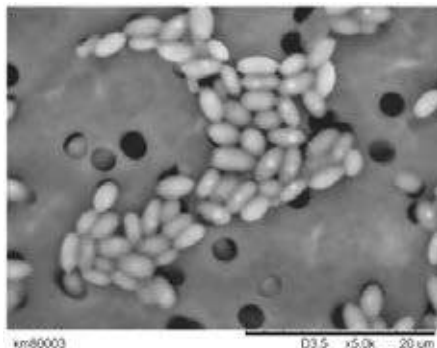
- Microalgae biomass characterization: macromolecular distribution.
- Alternative photosynthetic microorganisms for bioenergy production purposes; cyanobacteria and diatoms.
- Biomass pretreatments: enzymatic and thermal application at mild temperatures for biomethane production improvement.
- Biomethane potential assessment in batch and semicontinuous digestion mode.
- Anaerobic microbiome: microbial community's identification of biomethanization digesters.





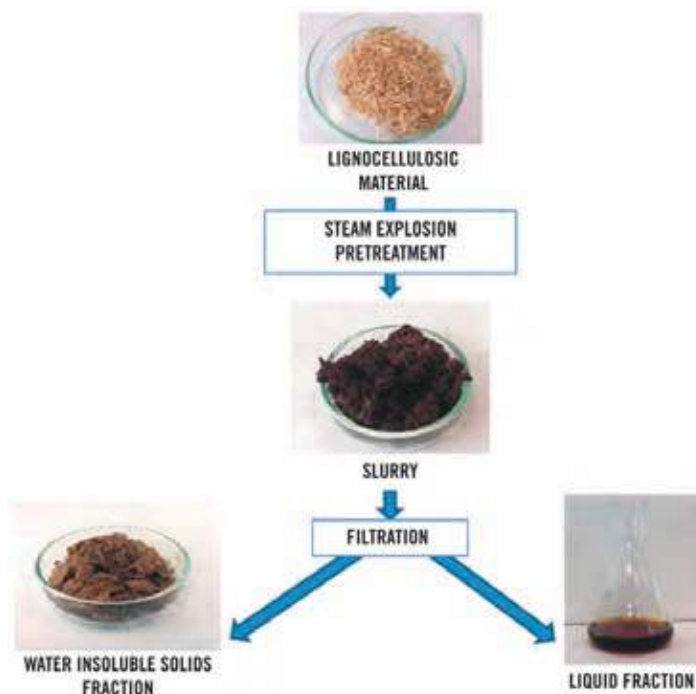
Kluyveromyces marxianus: a cell factory

- Use and application of non-conventional yeast.
- Evaluation of *K. marxianus* potential as a tool for tailored biotechnological production.



Lignocellulose based biofuels and bioproducts

- Biochemical conversion of lignocellulose: enzymatic hydrolysis and fermentation at high consistency (SHF, SSF, SScF).
- Biomass characterization: chemical composition of lignocellulosic feedstocks well as the solid, liquid, and slurry samples produced during conversion processes.
- Biomass pretreatments: steam explosion, liquid hot water, extrusion and ultramilling (< 1mm).
- Production of biofuels (bioethanol) and bioproducts (lactic acid) from residual lignocellulosic feedstocks.
- Development of new yeast strains with interesting fermentative traits.





Electrical Systems Unit

annual report
2016



Dr. Milan Prodanovic
Senior Researcher
Head of the Unit

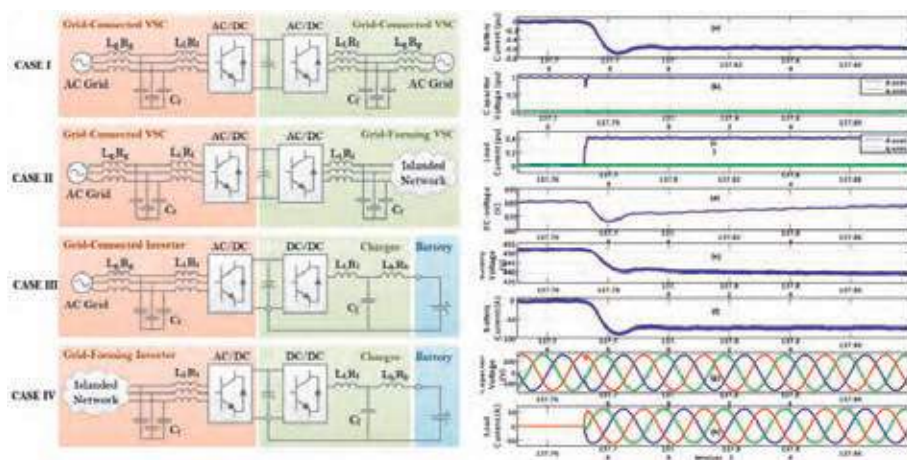


R&D Objectives

- To improve management, reliability and stability aspects of future electricity networks with high share of renewable and storage technologies, to propose optimisation based algorithms for demand management and renewable integration and to increase energy efficiency in industrial applications

Research lines

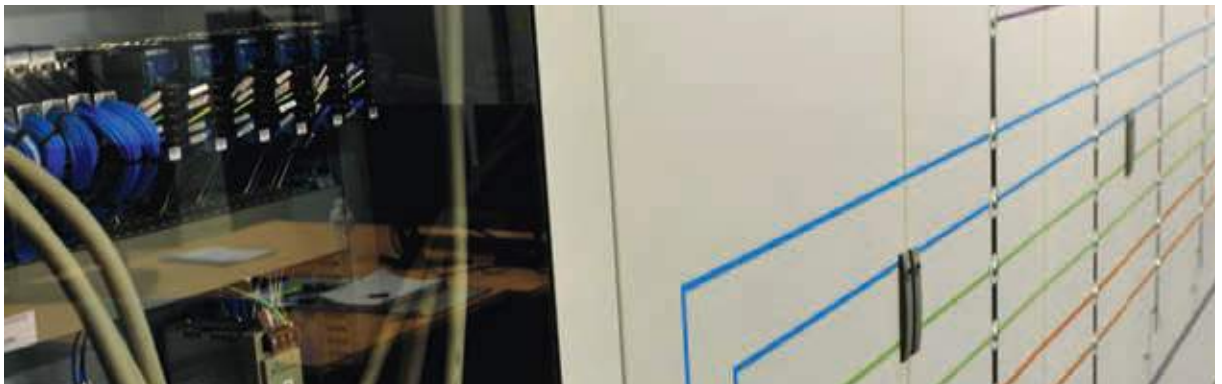
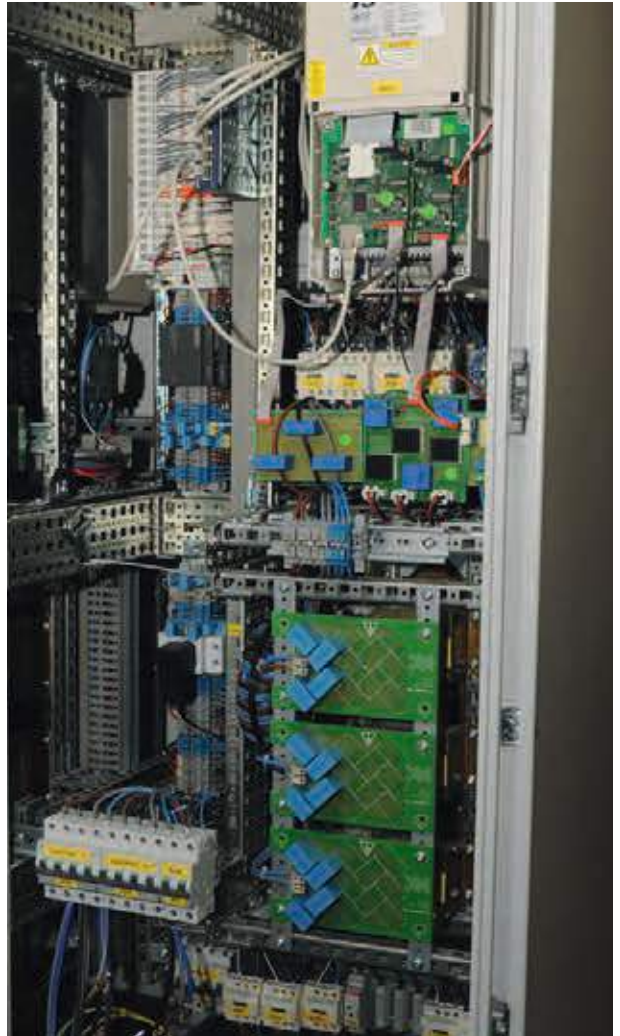
- Demand forecasting, network state estimation and active network management.
- Reliability and stability of power systems and networks with high penetration of renewables
- Building and residential demand modelling with demand flexibility.
- Optimization driven energy management and optimal sizing of energy supply mix.
- Energy efficiency in systems for vibration testing.
- Power electronics applications in distribution networks and microgrids.



Relevant projects and networking

The Electrical Systems Unit (ESU) actively participated in several research and development projects. Principal research activities were performed in national and regional projects RESmart (2014-2016) and PRICAM (2014-2018) as well as in ARGES project (2015-2016) funded by Foundation Iberdrola. These projects addressed the management algorithms, stability and reliability issues for renewable and storage integration to power networks and also power electronics applications. Regarding the industrial collaboration the main projects were LPT (2013-2018) addressing the energy storage integration to power networks, NGBTE (2014-2016) developing new battery test equipment technology and EEISVT (2011-) dealing with the development of energy efficient vibration test equipment.

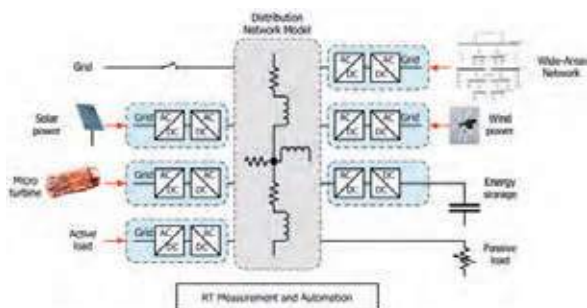
ESU actively contributed to the Spanish Platform for Power Networks (FUTURED) within two workgroups: Power Electronics and Energy Storage. Also, in 2016 ESU joined the Spanish Platform on ICT applications in Energy Efficiency (EnerTIC) as an associated member.



Facilities

Smart energy integration Lab (SEIL)

- 4 x 15 kVA and 2 x 75 kVA converters.
- 2 x 30 kW remotely controllable loads.
- 47.5 kWh battery system.
- 75 kW battery charger.
- Remotely configurable AC and DC network distribution panels.
- Configurable network impedances.
- Integrated measurement and control system.
- Flexible programming platform.



Smart buildings management Lab

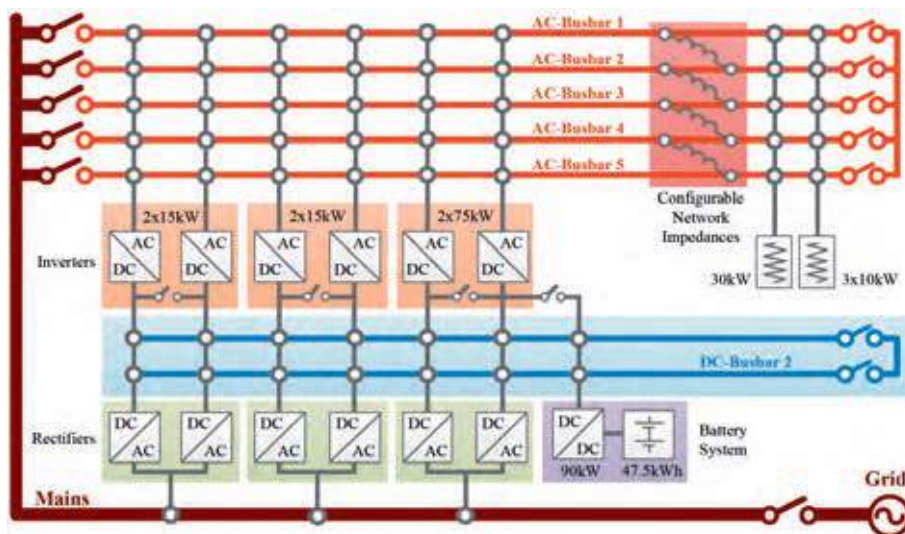
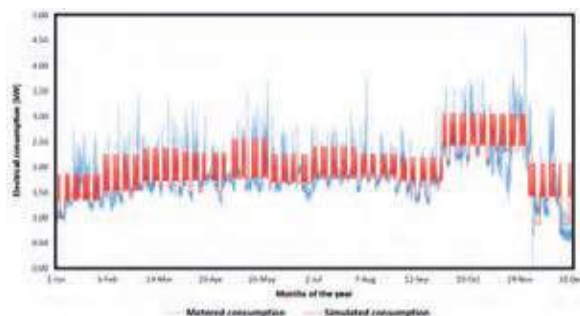
- KNX (Siemens) based technology.
- Sensors and actuators.

Modelling and simulation tools

- Matlab, PowerWorld, IPSA, PLECS.

Acquisition and control platforms

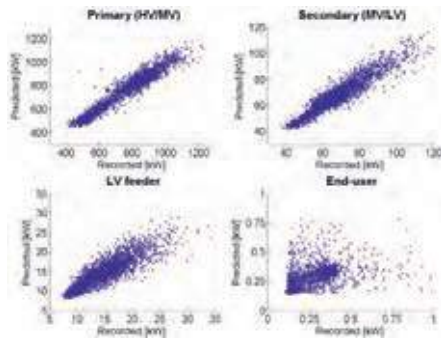
- LabView (NI), Beckhoff, Texas Instruments, etc.
- Oscilloscopes, bench power supplies, function generators, etc.



Scientific and technical results

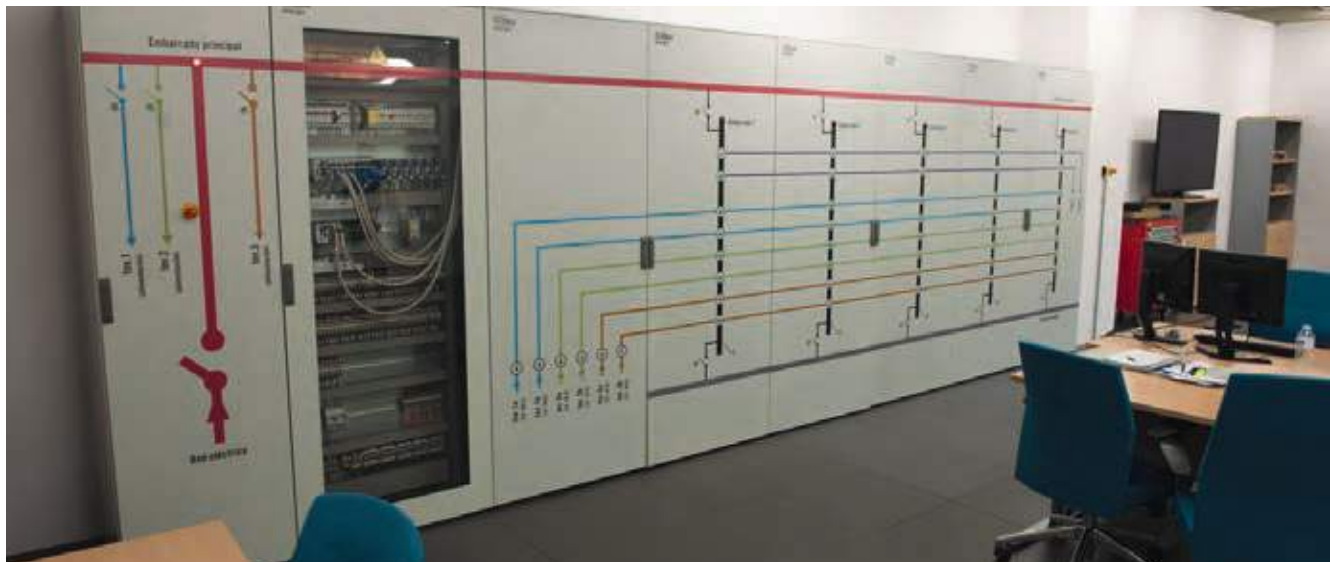
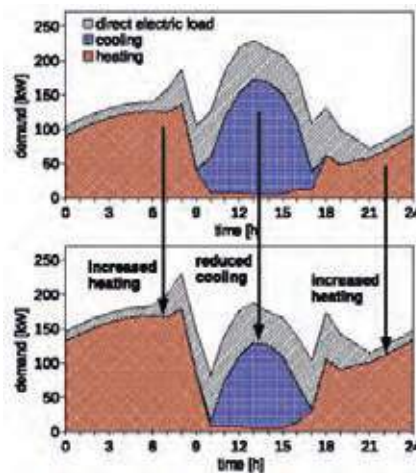
New services for distribution network operators

- Closed-loop state estimation tools for MV network monitoring and operation.
- Demand prediction methods using top-to-bottom and bottom-to-top approaches.
- Techno-economic analysis of demand response schemes based on individual pricing for residential users.
- Automatic detection of topology changes in distribution networks.



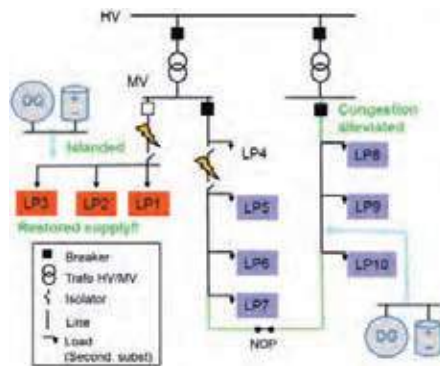
Demand modelling and demand flexibility

- High granularity modelling of building consumption for demand flexibility studies including the effects of user interaction.
- Estimation tools for building demand and cost sensitivity studies.
- Tools for optimal demand coverage design.
- Residential demand modelling for advanced demand response schemes.



Power network reliability studies

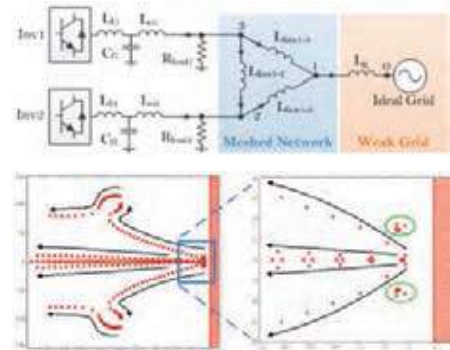
- Distribution generation and energy storage modelling for reliability studies.
- Novel analytic methods for reliability assessment of distribution networks with high penetration of renewables and energy storage technologies.
- Reliability assessment of SmartGrids technologies deployed in distribution networks.
- Sizing tools for renewable and energy storage installations taking into account quality of supply.



Stability and control of power electronics grid applications

- Development of an integrated small signal modelling for weak power networks.
- Stability analysis tools for power networks based on Singular Value Decomposition for identifying system resonances.
- New modelling approach to Back-to-Back converters allowing converter size and cost reduction and more control design flexibility.

- Battery power electronic interface for islanded and grid connected applications.
- Development of novel controller boards for power electronics converters.



Energy efficiency in systems for vibration testing

- Development of shaker thermal models for advanced energy management.
- Intelligent check-up tools for shaker system installation.
- Efficient power amplifiers for vibration systems.
- Development of a novel 20kW isolated, bidirectional power supply.
- New control algorithms for Intelligent Shaker Manager.





System Analysis Unit

annual report
2016



Dr. Javier Dufour
Senior Researcher
Head of the Unit



Dr. Diego Iribarren
Senior Assistant
Researcher

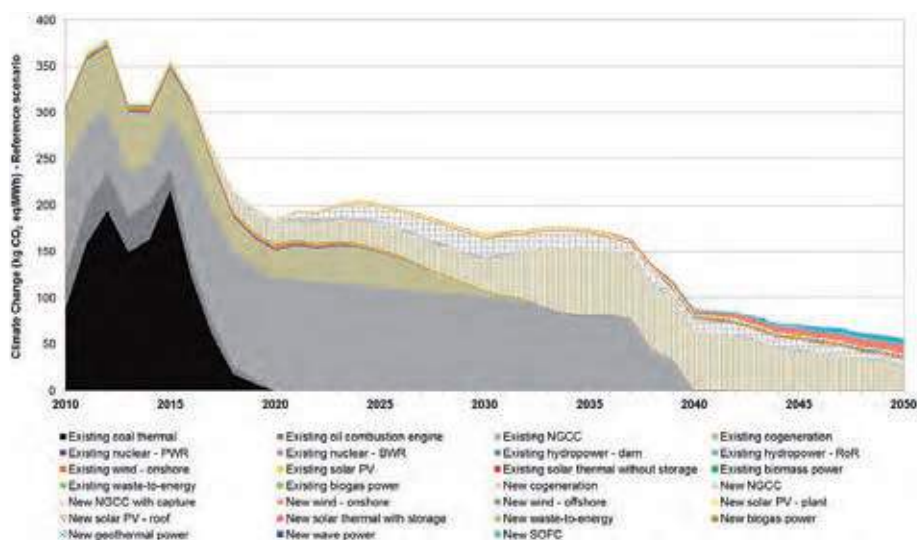


R&D Objectives

- Sustainability assessment of energy systems; process design, simulation and optimisation; and energy systems modelling for energy planning

Research lines

- Life Cycle Assessment of energy systems: environmental LCA, life cycle sustainability assessment, and multi-criteria decision analysis (LCA + DEA).
- Assessment of the feasibility of energy processes through simulation, thermodynamic analysis (energy and exergy balances), optimisation and economic/environmental evaluation.
- Prospective analysis of energy scenarios: development of energy system models; integration of sustainability indicators and geographic information systems.





Relevant projects and networking

The System Analysis Unit (SAU) participates in a wide range of research projects and contracts. For instance, at the European level, it is involved in the evaluation of energy systems for solar fuel production (EU H2020 Sun-to-Liquid project) as well as in the assessment of end-of-life strategies for fuel cells and hydrogen technologies (EU FCHJU HyTechCycling project). At the national level, this research unit is involved in the sustainability assessment and roadmapping of novel processes for biomass transformation (BIOSUSCAT project), also being recently awarded a project for planning the implementation of alternative fuels for a sustainable transport system in Spain (PICASO project). Finally, at the regional level, SAU is responsible for the evaluation and roadmapping of novel pathways for the production of clean transportation fuels from agro-forestry and oily waste (ResToEne-2 programme).

Moreover, SAU participates actively in international networks such as the IEA Hydrogen Implementing Agreement (oper-

ating agent for Task 36) and the European Energy Research Alliance (JP e3s). Furthermore, the Head of the Unit –Prof. Javier Dufour– is vice-chair for cross-cutting research activities of N.ERGHY and chairman of the Spanish Network for Life Cycle Assessment (esLCA).



Capabilities

Sustainability assessment of energy systems

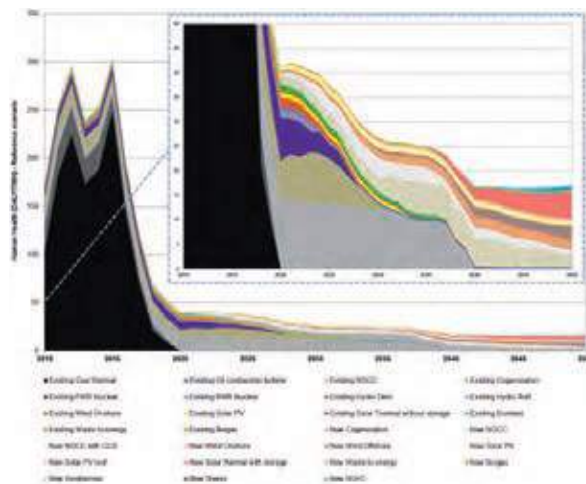
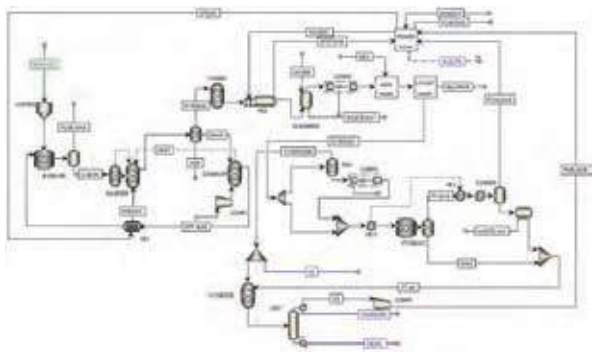
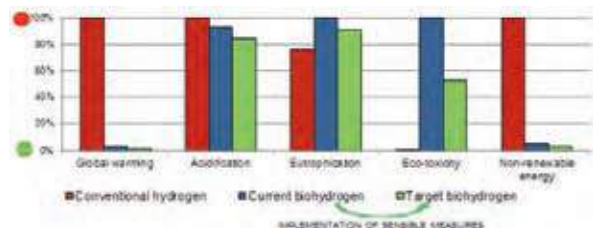
- Environmental LCA, carbon footprinting and ecodesign.
- Combined application of LCA and Data Envelopment Analysis for multi-criteria decision analysis.
- Harmonised LCA and life cycle sustainability assessment.

Feasibility of energy processes

- Process design, simulation and optimisation (Aspen Plus®, EBSILON® Professional, SuperPro Designer, etc.).
- Energy, exergy and emergy analysis.
- Conventional economic analysis and externalities.

Energy planning

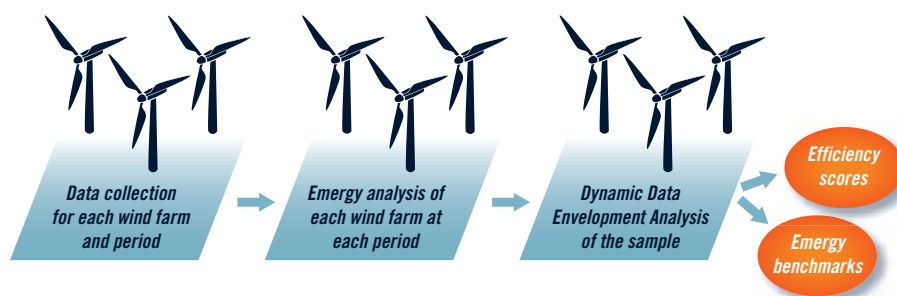
- Development of national and regional energy models (Spain, Region of Madrid, cities).
- Evolution of techno-economic and sustainability indicators in prospective energy scenarios, and demand projection.
- Integration of geographic information systems.



Scientific and technical results

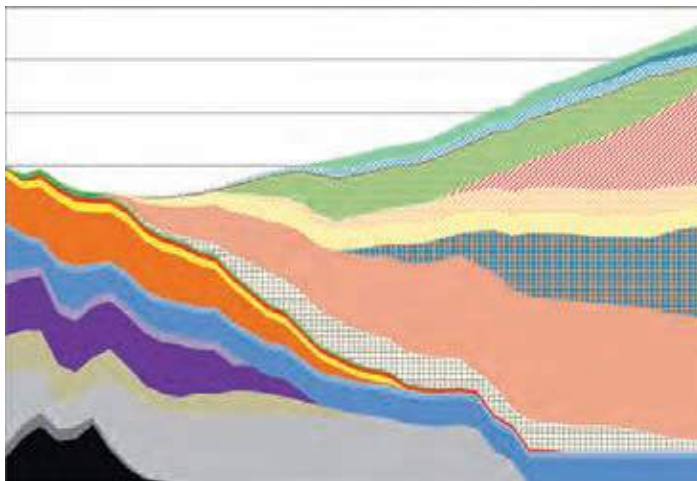
Sustainability assessment methodology

- LCA + DEA methodology for sustainability assessment of energy systems: application to fossil and renewable energy systems; dynamic eco-centric assessment of wind farms; multi-criteria prioritisation of energy scenarios.
- Hydrogen energy systems: LCA harmonisation protocols; identification and definition of end-of-life technologies.
- Evolution of life-cycle indicators in prospective power generation scenarios.



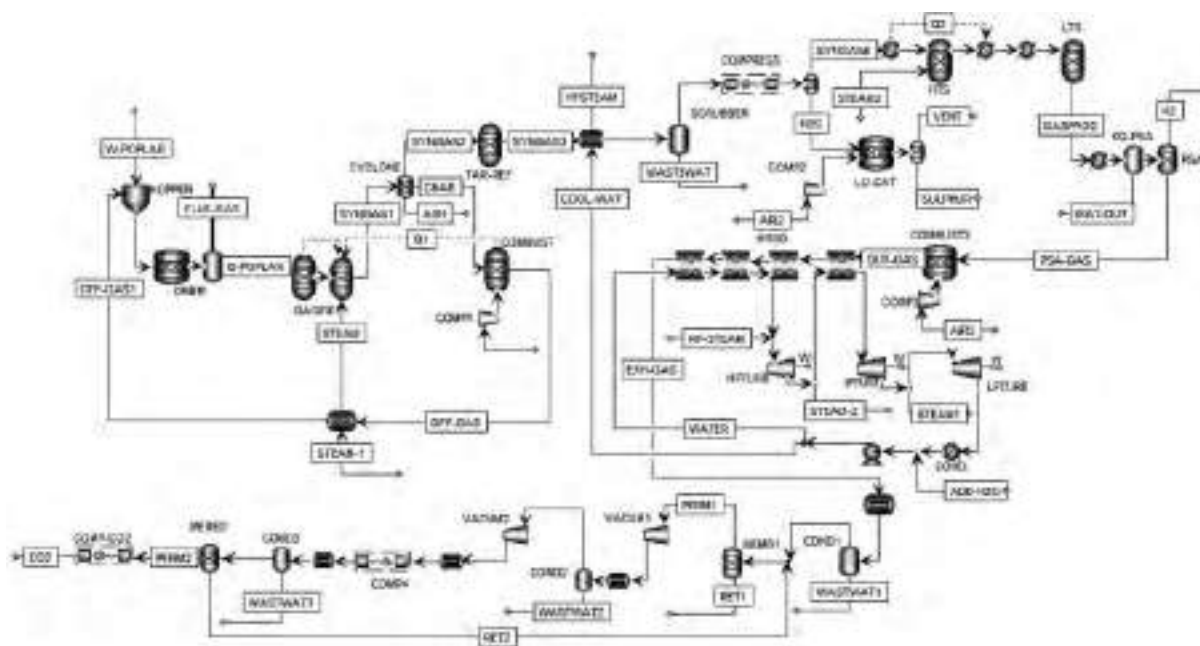
Energy systems modelling

- Energy model for the Region of Madrid and prospective energy scenarios.
- Power generation model for Spain and prospective energy scenarios.
- Endogenous integration of sustainability and energy security indicators for power generation in Spain.
- Regionalisation of the Madrid energy model and integration of geographic information systems.



Feasibility of energy processes

- Biorefinery: predictive model and economic/environmental analysis of catalytic pyrolysis.
- Biomass integration in oil refineries: predictive model of the co-processing of hydrodeoxygenated biomass pyrolysis oil (HDO-oil) with atmospheric and vacuum gas oils (AGO, VGO) in fluid catalytic cracking (FCC) units; predictive model of the co-processing of HDO-oil with VGO in hydrocracking units.
- Biofuels: simulation and exergy analysis of the coproduction of synthetic fuels and electricity via biomass gasification, Fischer-Tropsch synthesis and a combined-cycle scheme; predictive model and economic/environmental analysis of biogas dry reforming; predictive model and economic/environmental analysis of the Fischer-Tropsch synthesis for the production of jet fuels; simulation and economic/environmental analysis of novel microalgal systems; predictive model and environmental analysis of biohydrogen with/without CO₂ capture.





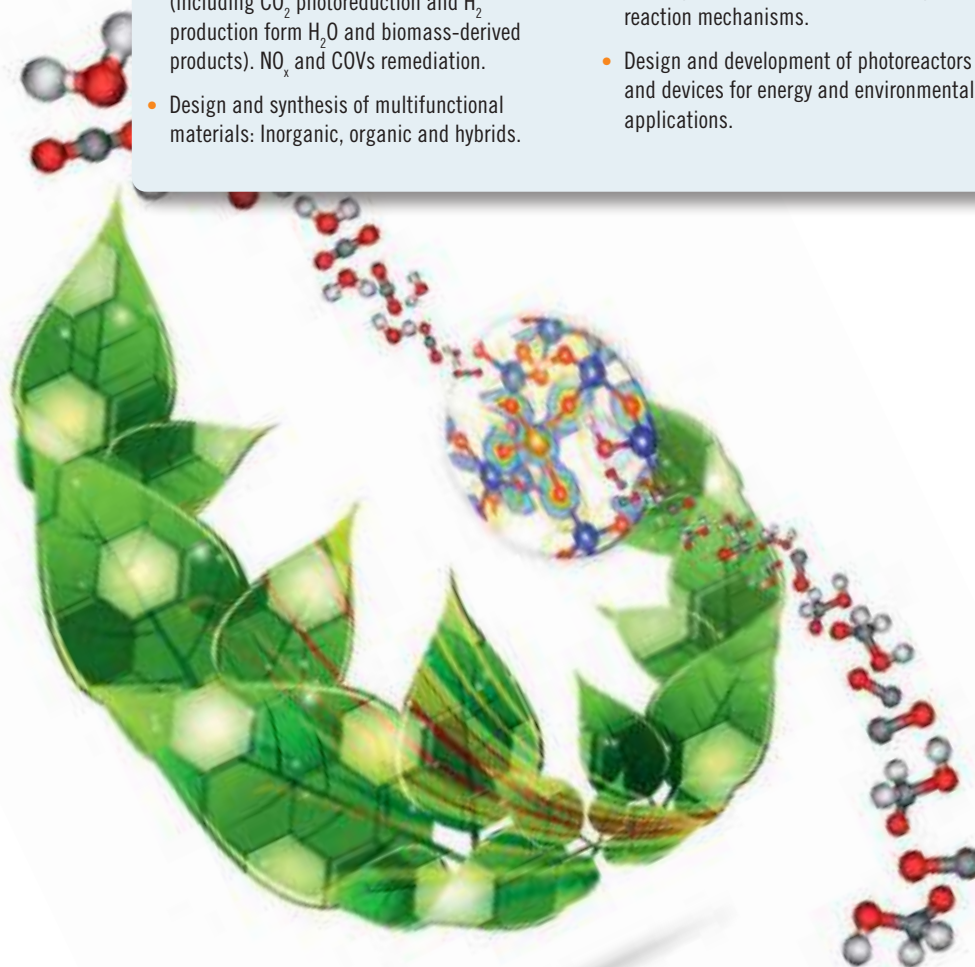
Photoactivated Processes Unit

annual report
2016



Dr. Victor A. de la Peña
Senior Researcher
Head of the Unit

photoactivated



R&D Objectives

- Covering the processes and technologies that allow a smart and efficient light harvesting to drive photon-activated processes for energy and environmental applications

Research lines

- Development of energy and environmental photoactivated processes: Solar fuels production by artificial photosynthesis (including CO_2 photoreduction and H_2 production from H_2O and biomass-derived products). NO_x and COVs remediation.
- Design and synthesis of multifunctional materials: Inorganic, organic and hybrids.
- Full-spectrum light harvesting technologies for electron transfer processes.
- Gaining fundamental understanding of the reaction mechanisms.
- Design and development of photoreactors and devices for energy and environmental applications.

Relevant projects and networking

The Photoactivated Processes Unit (PhPU) has the support of a European project corresponding to the call ERC-2014-CoG (Topic ERC-CoG-2014 - ERC Consolidator Grant) of the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme. At a national level, PhPU is funded through several projects such as Ra-PHUEL (2017-2019) and SolarFuel (2015-2017) as well as a project of the Ramon y Cajal Programme (2015 call), all of them related with the design and synthesis of new materials (inorganic semiconductors and organic-inorganic hybrids) as heterogeneous photocatalyst for artificial photosynthesis. In the regional framework, the unit is participating into the MAD2D program (Fundamental Properties and Applications of Graphene and other two-dimensional Materials) and the unit has been awarded with a *Programa de Atracción de Talento* contract (model 1).

Besides, PhPU is coordinating the national Excellence Network FOTOFUEL, which promotes the synergies and networking of international top research groups devoted to the development of materials and devices

for efficient solar fuels production. In addition, PhPU participates at the Spanish CO₂ technological platform (PTCO2) where act as the coordinator of CO₂ uses working group.



Facilities

Synthesis of materials

- Equipment for organic and polymer synthesis.
- Thermal and microwave ovens and autoclaves for hydrothermal synthesis.
- Tools for chemical synthesis under controlled atmosphere.



Materials characterization facilities

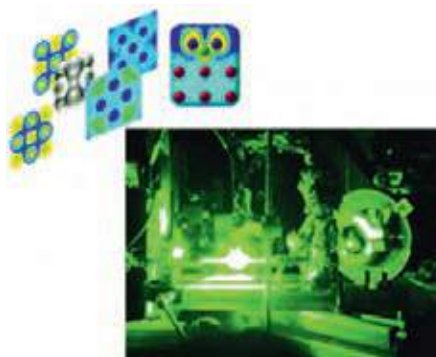
- Single-crystal X ray diffraction equipment with Cu μ -focus source.
- Transient absorption spectrophotometer provided with an i-CCD camera and a tuneable laser radiation source (Nd:YAG plus OPO and extended UV).
- In situ and operando cells for spectroscopic measurements including synchrotron radiation.
- Electro and photoelectrochemical characterization in three-electrode cell configuration. Cyclic voltammetry, photovoltage, photocurrent and electrochemical impedance spectroscopy by potentiostatic measurements.

Reactors

- Gas phase reactors and microreactors for photocatalytic reduction of CO_2 provided with gas chromatography for product analysis.
- Reactors for photocatalytic H_2 production coupled to in-line gas chromatography for product analysis.
- Photoelectrochemical cells for solar fuels production by water splitting and CO_2 reduction, coupled to potentiostatic measurements and in-line gas chromatography.

Theoretical calculations and modelling

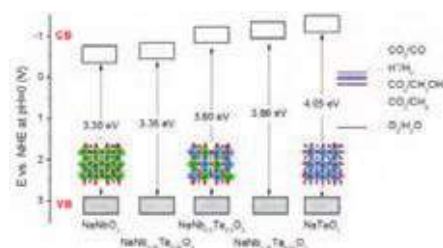
- Work stations.
- Software for chemical modelling.
- Tools for computational fluid dynamics, data treatment and process engineering.



Scientific and technical results

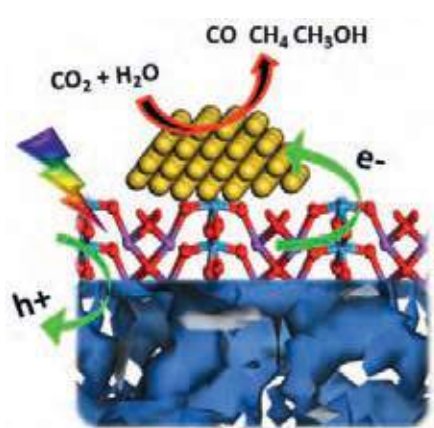
Development of novel inorganic photocatalysts

- Band-Gap engineering synthesis of UV- and visible-light-absorbing metallates based on group-5 metals and cations with outer shell s-electrons.
- Preparation of novel oxide-oxide hetero-junctions with improved photocatalytic activity and extended absorption spectrum.
- Controlled deposition of metal nanoparticles as co-catalysts on metal oxides and metallates.



Design and synthesis of conjugated porous polymers and its hybrids

- Design and synthesis of new building blocks: monomers and ligands.
- Synthesis and design of conjugated polymers (linear and hyper-branched) based on DTT and BOPHY.
- Post-functionalization of conjugated polymers.
- Preparation and characterization of hybrid materials from conjugated porous polymers and inorganic semiconductor.



MOFS

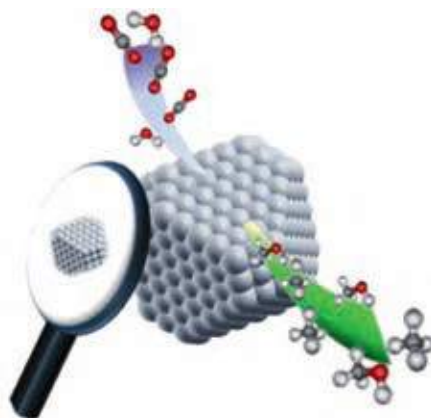
- Design and synthesis of novel UV- and visible-light-absorbing building blocks as organic MOFs linker.
- Design and synthesis of Metal Organic Frameworks (MOFs) based on group-5 metals.
- Postfunctionalization including metal nanoparticles, redox coordination compounds and organic polymers.





Gaining fundamental understanding of the reaction mechanisms

- Determination of structural, textural and morphological properties of properties of multifunctional materials.
- Optoelectronic characterization by time-resolved optical techniques to correlate these intrinsic properties with the efficiency of the devices for light-driven technologies.
- *In-situ* characterization under working condition using vibrational and optical spectroscopies both laboratory and synchrotron radiation based techniques.
- *Ab-initio* and QM theoretical calculation.



Process evaluation and scale-up

- Synergistic improvement of solar fuels production using hybrid photocatalysts.
- Tunable selectivity of CO₂ photoreduction with metal nanoparticle co-catalysts.
- H₂ production from biomass derivatives in real matrices.
- Scalability studies for CO₂ photoreduction catalysts.
- Design of a solar reactor for photocatalytic CO₂ reduction and hydrogen production.





Advanced Porous Materials Unit



Dr. Patricia Horcajada
Senior Researcher
Head of the Unit

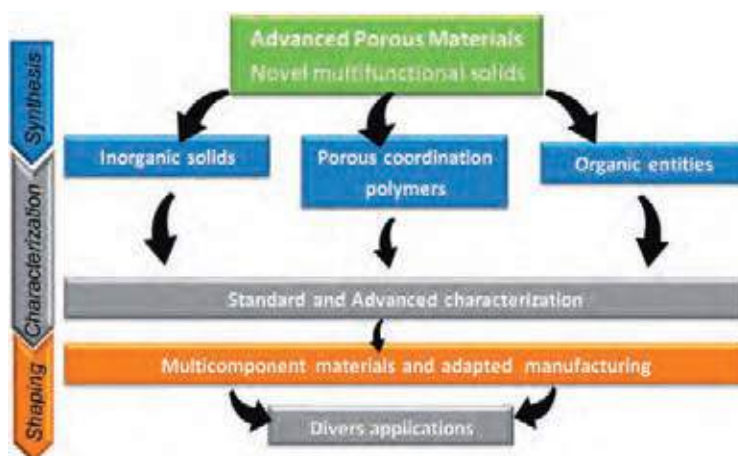


R&D Objectives

- Development of innovative multifunctional solids.
- Full understanding of the structural features for improving and/or adapting the materials properties to specific applications
- Adapted devices for their final applications (scale-up and shaping)

Research lines

- Synthesis of new multifunctional materials like porous coordination polymers; inorganic solids with regular and/or hierarchical porosity and organic entities as building units of hybrid solids and/or 3D materials.
- Tuning physicochemical properties of materials through the control of their chemical nature and textural properties.
- Improvement of the material performances from the characterization of their physicochemical properties.
- Multicomponent materials and manufacturing: control of particle size, morphology, thin films, membranes, columns, pellets and monoliths, among others.





Relevant projects and networking

The Advanced Porous Materials Unit (APMU) was created in february 2016 and is involved in a national project funded by MINECO (2016-2019, Raphuel) focused on the development of new multifunctional materials for CO₂ photoconversion. APMU has been also awarded with three personal fellowships in 2016 (Ramon y Cajal, Marie Curie European Program and Predoctoral fellows from the region Comunidad de Madrid).

APMU possesses a large frame of collaborations at the national (UCM, Universidad Carlos III Madrid, Universidad de Navarra, USC, U. Vigo, ITQ, Universidad de Granada, ICMAB), European (Université Aix-Marseille, Institut de Matériaux de Nantes, Institut Lavoisier Versailles, Institut Charles Gerhardt Montpellier, CEA Fontenay-aux-Roses, Institut NEEL, University of Poland, Instituto Superior Tecnico of Lisbon, Synchrotron Soleil) and international level (UNAM and CINVESTAV-Mexico, U. Sfax-Tunisia, U. Isfahan-Iran). APMU is also involved in the MATERPLAT platform,

promoting innovation in advanced materials Spanish system.

APMU is also in contact with different industrial companies (Bertin Pharma, nanoscale Biomagnetics, Reig Joffre, FIST).



Facilities

Synthesis

- Best practice organic/inorganic laboratory tools: Schlenk line, ovens, rotatory evaporator, (ultra) centrifuge.
- Traditional inorganic synthetic methods: two-layer diffusion, evaporation, high temperature.
- Conventional solvothermal, microwave-assisted, ultrasound, mechanical methods.
- High-through put solvothermal reactors.

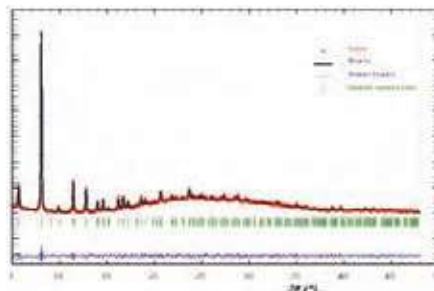


Manufacturing

- Supercritical CO₂ extraction system (material purification, adsorption, shaping).
- Spin and/or dip-coating (thin films, membranes).

Characterization

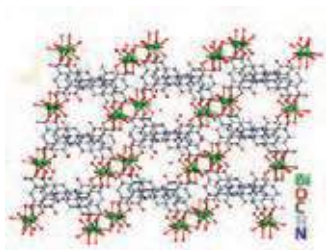
- Standard techniques: physi- and chemisorption, XRD, IR, Raman, UV-Vis, EDX-SEM, TGA, DLS, elemental analysis, ICP, AFM.
- High-through put filtration system coupled with multi-sample XRPD.
- In situ structural characterization (XRD, IR) as a function of temperature, adsorbate and pressure.
- Experimental crystalline structure determination and refinement.
- Chemical, structural, mechanical and colloidal stability tests.
- Computer simulation of crystalline structures from the first principles and atomistic modelling.



Scientific and technical results

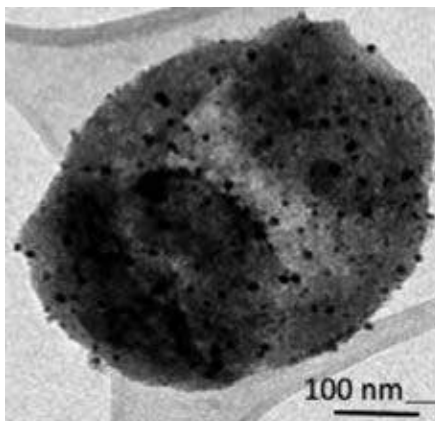
Novel porous metal-organic frameworks (MOFs)

- Fully equipped laboratory for solvothermal synthesis (microwave-assisted, high-throughput and low and medium scale solvothermal reactions).
- “Green” multigram-scale synthesis of a new 3D MOF structure based on the colorless and highly polarizable bismuth and a photoactive azobenzene derivative. This material, exhibiting permanent porosity, labile protons and a high chemical, mechanical and thermal stability, is a promising candidate for CO₂ capture, photocatalysis and proton conductivity.
- Environmentally-friendly and fast synthesis of a novel highly robust magnesium MOF based on a photoactive azobenzene derivative.
- New MOFs based on environmentally-friendly cations (Ag, Na, K, Ca, Mg, Zn, Cu, Zr) and therapeutically/photo active linkers.



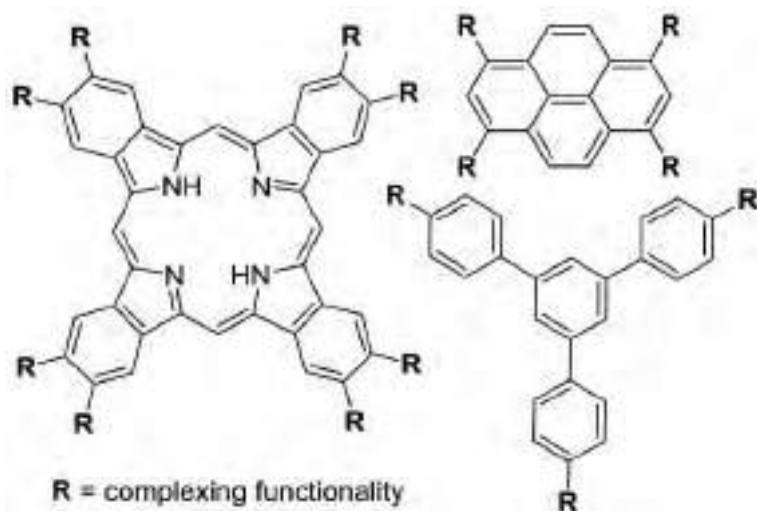
Inorganic solids

- Design and synthesis of porous composite micro- and nanostructured inorganic main group metal halides for optical applications.
- Synthesis and characterization of new sustainable light halide and oxide absorbers with 3D and reduced structural dimensionality.
- Association of metal nanoparticles (Au, Ag) into porous substrates (*e.g.* photoactive MOFs) by (1) *in situ* synthesis within their porosity, (2) *in situ* synthesis within their structure and (3) seed for MOF growth (core-shell). Enhancement of their optical properties with the objective of obtaining suitable photocatalysts for energy storage (*e.g.* Li/air batteries, artificial photosynthesis).
- Controlled pyrolysis of porous MOFs to form porous metal oxides/nitrides with improved electrochemical properties under acidic and basic conditions.
- Highly porous carbon materials (electrochemically active) obtained from demetalization of porous MOFs.



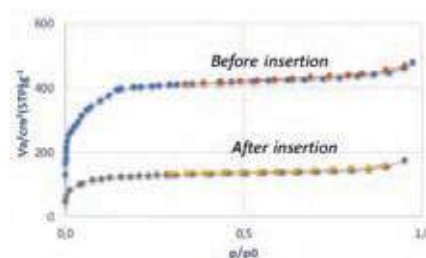
Organic entities

- Fully equipped laboratory for organic synthesis (microwave, Schlenk line, rotatory evaporator, etc).
- Development of multigram-scale synthetic procedures for the preparation of multipodal organic linkers (complexing functionalities) with potential photo-, electro- and proton conductivity.
- Template-based nanostructuring of high ordered organic polymers with improved electron conductivity.



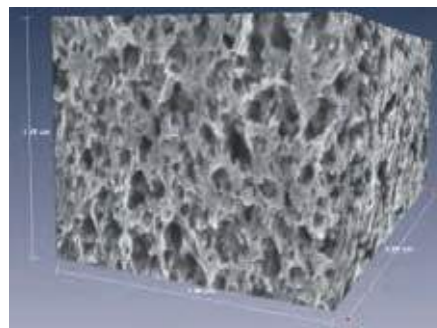
Multicomponent materials

- Composite materials based on the in situ polymerization of highly conducting polymers within the porosity of stable MOFs.
- Insertion of therapeutically- and/or photo-active organic molecules and inorganic complexes within the MOF porosity.
- Adsorption of proton-carrier species within the MOF porosity.



Manufacturing

- Monolithic MOF aerogels with hierarchical porosity (>55% micro-, meso- and macro-porosity) by a sol-gel approach combined by supercritical CO₂ drying.
- Manufacturing highly porous 3D pieces of CeO₂ via an easy template method based on abundant and low cost natural products.
- Microspheres based on nanoscaled MOFs and biocompatible polymers prepared by a continuous spray-drying technique.



annex

R&D projects,
contracts and grants

71

scientific results

87

training and
dissemination activities

106

annex

1. R&D projects, contracts and grants

1.1. Regional R&D projects

Title/Acronym: Storage and conversion of concentrated solar power/ALCCONES

Partners: IMDEA Energy Institute (Coordinator); URJC; CIEMAT; CSIC; Abengoa Research; SENER Ingeniería y Sistemas; Empresarios Agrupados

Period: 2014-2018

Funding Institution/Program: Comunidad de Madrid/ Program of R&D activities between research groups in Technology

IMDEA Energy Institute external funding: 232.921 €

Title/Acronym: Use of agro-forest and oily residues to produce clean transportation fuels/ RESTOENE2

Partners: ICP-CSIC (Coordinator); CIEMAT; GIQA-URJC; IMDEA Energy Institute; UAM; Laboratorio-URJC; Abengoa Bioenergía; Repsol; Exide Technologies; Soluciones Catalíticas Ibercat

Period: 2014-2018

Funding Institution/Program: Comunidad de Madrid/ Program of R&D activities between research groups in Technology

IMDEA Energy Institute external funding: 143.399 €

Title/Acronym: Fundamental properties and application of graphene and other 2D materials/MAD2D

Partners: ICMM-CSIC (Coordinator); IMDEA Energy Institute; IMDEA Nanoscience Institute; IMDEA Materials Institute; Autonoma University of Madrid; Laboratory-IMDEA Materials; Laboratory-IMDEA Nanoscience; Laboratory-IMDEA Energy; Airbus Operations; Repsol; Bruker; Albufera Energy Storage; Nanoinnova Technologies

Period: 2014-2018

Funding Institution/Program: Comunidad de Madrid/ Program of R&D activities between research groups in Technology

IMDEA Energy Institute external funding: 140.373 €

Title/Acronym: Smart grids for the Community of Madrid/PRICAM

Partners: Alcalá University (Coordinator); Rey Juan Carlos University; Carlos III University; Pontificia Comillas University of Madrid; Laboratory-IMDEA Energy; Iberdrola; Indra; Real Academia de Ingeniería; Hospital Universitario de Fuenlabrada

Period: 2014-2018

Funding Institution/Program: Comunidad de Madrid/ Program of R&D activities between research groups in Technology

IMDEA Energy Institute external funding: 148.500 €

Title/Acronym: Industrial applications of spirulina/INSPIRA1

Partners: CIB-CSIC (Coordinator); ICP-CSIC; ICV-CSIC; UAM; UCM; URJC; Laboratory-IMDEA Energy; Bidesma; Micro algae Solutions; Laboratorios Actafarma; Isolux Corsán; Canal de Isabel II; UPM (Dr. Diego García de Jalón)

Period: 2014-2018

Funding Institution/Program: Comunidad de Madrid/ Program of R&D activities between research groups in Technology

IMDEA Energy Institute external funding: 80.000 €

1.2. National R&D projects

Title/Acronym: Development of high performance supercapacitors by using novel ionic liquid-based electrolytes/SUPERLION

Partners: IMDEA Energy Institute (Coordinator); Repsol; Solvionic

Period: 2013-2016

Funding Institution/Program: Ministry of Economy and Competitiveness/ Subprogram of Fundamental non-oriented research

IMDEA Energy Institute external funding: 174.330 €

Title/Acronym: Design of multifunctional redox systems based on mesoporous transition metal oxides for thermochemical energy storage/MULTISTOR

Partners: IMDEA Energy Institute (Coordinator); Repsol; Abengoa Hidrógeno

Period: 2013-2016

Funding Institution/Program: Ministry of Economy and Competitiveness/ Subprogram of Fundamental non-oriented research

IMDEA Energy Institute external funding: 140.400 €





Title/Acronym: Integration of renewable energy in the smart grid/RESmart

Partners: Carlos III University (Coordinator); IMDEA Energy Institute; Unión Fenosa Distribución

Period: 2014-2016

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Research Challenges 2013

IMDEA Energy Institute external funding: 65.340 €

Title/Acronym: Algal biogas from wastewater bioremediation: seeking for insights on population dynamics and cell wall characteristics/WWAL-GAS

Partners: IMDEA Energy Institute (Coordinator); Explotación Agropecuaria Jose Mario Anton Andrés; Bodega Valdehermoso; Aqualia

Period: 2014-2017

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Research Challenges 2013

IMDEA Energy Institute external funding: 127.050 €

Title/Acronym: European projects office Madrimasd-IMDEA/OPE MADRIMASD-IMDEA

Partners: Fundación madrimasd para el conocimiento (Coordinator); IMDEA Energy Institute; IMDEA Water Institute; IMDEA Food Institute; IMDEA Materials Institute; IMDEA Nanoscience Institute; IMDEA Networks Institute; IMDEA Software Institute

Period: 2014-2017

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Acciones de dinamización “Europa Redes y Gestores”

Title/Acronym: New challenges in the production of solar fuels/FOTOFUEL

Partners: IMDEA Energy Institute (Coordinator); ICP-CSIC; ICIQ; UPV-CSIC; IMDEA Materials Institute; ALBA-CELLS; University of Barcelona; Universitat Jaume I de Castello; Plataforma Solar de Almería; MATGAS

Period: 2014-2016

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program for Promotion of Scientific and Technical Research Excellence. Acciones de dinamización “Redes de excelencia”

IMDEA Energy Institute external funding: 9.259 €

Title/Acronym: Efficient production of solar fuels through the development of new perovskites with redox capacity for thermochemical splitting of CO₂ and H₂O/SOLARKITE

Partners: IMDEA Energy Institute

Period: 2015-2018

Funding Institution/Program: Ramón Areces Foundation/ XVII Concurso Nacional para la adjudicación de ayudas a la Investigación en Ciencias de la Vida y de la Materia 2014

IMDEA Energy Institute external funding: 126.849 €

Title/Acronym: Lignocellulosic bioethanol production at high substrate loading: developing yeast tolerant to mechanical stress/LignoYeast

Partners: IMDEA Energy Institute (Coordinator); Abengoa Bioenergía; Neol Biosolution; Biopolis

Period: 2015-2017

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Research Challenges 2014

IMDEA Energy Institute external funding: 174.240 €

Title/Acronym: Catalytic co-processing of waste plastics and lignocellulosic residues for the preparation of advanced fuels/CATPLASBIO

Partners: Rey Juan Carlos University (Coordinator); IMDEA Energy Institute; Abengoa Research; Urbaser, CLH

Period: 2015-2017

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Research Challenges 2014

Title/Acronym: Advanced catalytic systems for the sustainable valorization of cellulosic biomass towards high-value biobased products/BIOSUSCAT

Partners: Rey Juan Carlos University (Coordinator); IMDEA Energy Institute; Abengoa Research

Period: 2015-2017

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Research Challenges 2014

Project: Solar fuels by artificial photosynthesis with multifunctional hybrid catalysts/SolarFuel

Partners: IMDEA Energy Institute

Period: 2015-2017

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Modality young researchers 2014

IMDEA Energy Institute external funding: 170.610 €

Title/Acronym: Production of second generation biofuels from lignocellulosic biomass
Partners: IMDEA Energy Institute
Funding Institution/Program: IBERDROLA Foundation/ Call for research funding in energy and environment 2015-2016
Period: 2015-2016
IMDEA Energy Institute external funding: 20.000 €

Title/Acronym: Multifunctional materials for chemical energy storage by photocatalytic processes
Partners: IMDEA Energy Institute
Funding Institution/Program: IBERDROLA Foundation/ Call for research funding in energy and environment 2015-2016
Period: 2015-2016
IMDEA Energy Institute external funding: 20.000 €

Title/Acronym: Stability and control in weak grids/ARGES
Funding Institution/Program: IBERDROLA Foundation/ Call for research funding in energy and environment 2015-2016
Period: 2015-2016
IMDEA Energy Institute external funding: 20.000 €

Title/Acronym: Innovative Storage for Stationary Applications Based on Aluminum/ ALIENA
Partners: Albufera Energy Storage (Coordinator); ALEASTUR; GFM; ITMA; IMDEA Energy Institute
Period: 2015-2018
Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Collaboration Challenges 2015
IMDEA Energy Institute external funding: 128.538 €

Title/Acronym: Capacitive Deionization of Brines Coming from Brackish Water Reverse Osmosis Plants/DC-SÓIAS
Partners: GS-INIMA (Coordinator); PROINGESA; IMDEA Energy Institute
Period: 2015-2018
Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Collaboration Challenges 2015
IMDEA Energy Institute external funding: 162.480 €

Title/Acronym: The Total Photovoltaic Platform – LPT. Project to equip the photovoltaic plants with a platform that allows their maximum level of energy management/LPT

Partners: Ingenia Solar Energy (Coordinator); PV Hardware Solutions; Grupo Gransolar; IMDEA Energy Institute; Carlos III University of Madrid

Period: 2015-2019

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Collaboration Challenges 2015

IMDEA Energy Institute external funding: 416.900 €

Title/Acronym: New strategies for the integration of microalgae-bacteria consortium in small size urban wastewater treatment plants/ MICROALBAC

Partners: FACSÁ (Coordinator); IMDEA Energy Institute; CSIC

Period: 2015-2018

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Collaboration Challenges 2015

IMDEA Energy Institute external funding: 160.926 €

Title/Acronym: Flow batteries for electrical energy storage/BAT-FLU

Partners: IREC (Coordinator); Fundació Institut Català de Nanociència i Nanotecnologia; Castilla La-Mancha University; Cidetec Foundation; Tecnalia Research & Innovation Foundation; CSIC; Tekniker Foundation; IMDEA Energy Institute

Period: 2015-2017

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program for Promotion of Scientific and Technical Research Excellence. Acciones de dinamización “Redes de excelencia” 2015



Title/Acronym: Production of clean transportation biofuels from lignocellulosic biomass/ SUGTOBIO

Partners: URJC (Coordinator); ICP-CSIC; IMDEA Enegy Institute; Autónoma University of Madrid; CIEMAT **Period:** 2015-2017

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program for Promotion of Scientific and Technical Research Excellence. Acciones de dinamización “Redes de excelencia” 2015

Title/Acronym: Multidisciplinary analysis of indirectly-heated particles receivers/reactors for solar applications in extreme conditions/ARROPAR-CEX

Partners: IMDEA Energy Institute (Coordinator); CIEMAT; Nanoker Research; Abengoa Research

Period: 2016-2018

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Research Challenges 2015

IMDEA Energy Institute external funding: 189.970 €.

Title/Acronym: Innovative materials for application in advanced supercapacitor/MATCAP

Partners: IMDEA Energy Institute (Coordinator); CIC Energune; Repsol; Solvionic; AVAN-ZARE Innovacion Tecnologica

Period: 2016-2018

Funding Institution/Program: Ministry of Economy and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Research Challenges 2015

IMDEA Energy Institute external funding: 145.200 €.

Title/Acronym: State of the art revision in Flow Batteries for energy storage in stationary applications

Funding Institution/Program: IBERDROLA Foundation/ Call for research funding in energy and environment 2016-2017

Period: 2016-2017

IMDEA Energy Institute external funding: 20.000 €

Title/Acronym: Decoupled turbomachinery for small solar applications

Funding Institution/Program: IBERDROLA Foundation/ Call for research funding in energy and environment 2016-2017

Period: 2016-2017

IMDEA Energy Institute external funding: 20.000 €

Title/Acronym: Sistemas avanzados de almacenamiento de energía renovable y gestionable/TERMOSTOK

Partners: Abengoa Research (Coordinator); IMDEA Energy Institute

Period: 2016-2019

Funding Institution/Program: Ministry of Economy, Industry and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Collaboration Challenges 2016

IMDEA Energy Institute external funding: 345.934 €

Title/Acronym: Nuevo concepto de biorrefinería multifuncional basado en la producción de bioetanol lignocelulósico y otros bioproductos a partir de residuos de poda y limpieza de jardines/BIO_LIGWASTE

Partners: TETma (Coordinator); IMDEA Energy Institute; Centre VERD; CIEMAT

Period: 2016-2019

Funding Institution/Program: Ministry of Economy, Industry and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Collaboration Challenges 2016

IMDEA Energy Institute external funding: 102.159 €

Title/Acronym: CO₂ photoconversion to solar fuels using multifunctional materials/Ra-Phuel

Partners: IMDEA Energy Institute (Coordinator); Repsol; Plataforma Tecnológica del CO₂; Gas Natural Fenosa; Korea Research Institut of Chemical Technology

Period: 2016-2019

Funding Institution/Program: Ministry of Economy, Industry and Competitiveness/ State Program of Research, Development and Innovation Oriented Challenges of the Society. Research Challenges 2016

IMDEA Energy Institute external funding: 223.850 €

1.3. International R&D projects

Title/Acronym: Training network in innovative polyelectrolytes for energy and environment/RENAISSANCE

Partners: University of the basque country (Coordinator); CNRS-University of Bordeaux I; Max Planck Institute of Colloids and Interfaces; Linköping University; University of Liege; IMDEA Energy Institute; Kitozyme; Procter & Gamble Italy; Procter & Gamble Services Company

Period: 2012-2016

Funding Institution/Program: European Union/ FP7-People Program. Call identifier FP7-PEOPLE-2011-ITN

IMDEA Energy Institute external funding: 223.481 €





Title/Acronym: CAScade deoxygenation process using tailored nanoCATalysts for the production of BiofuELs from lignocellulosic biomass/CASCATBEL

Partners: IMDEA Energy Institute (Coordinator); ENCE; Universita' degli studi di milano-bicocca; Charles University in Prague; Institute of Physical Chemistry; Universiteit Utrecht; Aston University; Abengoa Research; ETH Zürich; Max Planck Institut fuer Kohlenforschung; MAST Carbon International; Silkem; Nanologica; Center for Research and Technology Hellas/Chemical Process and Energy Research Institute; ENI; Hamburg University of Technology; OUTOTEC

Period: 2013-2017

Funding Institution/Program: European Union/ FP7-Cooperation. Call identifier: FP7-NMP-2013-LARGE-7

IMDEA Energy Institute external funding: 1.127.422 €

Title/Acronym: Scientific and Technological Alliance for Guaranteeing the European Excellence in Concentrating Solar/STAGE-STE

Partners: CIEMAT (Coordinator); more than 40 partners, companies, universities, research centres, associations, from all over the world

Period: 2014-2018

Funding Institution/Program: European Union/ FP7-Cooperation. Call identifier: FP7-ENERGY-2013-IRP

IMDEA Energy Institute external funding: 472.102 €

Title/Acronym: European network for algal-bioproducts/EUALGAE

Partners: IMDEA Energy Institute (Coordinator); Wageningen University; Istituto per lo Studio degli Ecosistemi; Institute National de la Recherche Agronomique; Biefeld University; Laboratorio Nacional de Energia e Geologia; Katholieke Universiteit Leuven; Agricultural University of Athens; Bioforsk; Ege University

Period: 2015-2019

Funding Institution/Program: European Union/ COST actions

IMDEA Energy Institute external funding: 35.324 € (estimated GP2 and GP3)

Title/Acronym: Hybrid Materials for Artificial Photosynthesis/HyMap

Partners: IMDEA Energy Institute

Period: 2015-2020

Funding Institution/Program: European Union/ ERC-Consolidator Grants

IMDEA Energy Institute external funding: 2.506.738 €

Title/Acronym: Integrated solar-thermochemical synthesis of liquid hydrocarbon fuels/ SUN-TO-LIQUID

Partners: Bauhaus Luftfahrt (Coordinator); Eidgenoessische Technische Hochschule Zuerich; Deutsches Zentrum für Luft- und Raumfahrt e. V.; IMDEA Energy Institute; HyGear Technology and services; Abengoa Research; ARTTIC

Period: 2016-2019

Funding Institution/Program: European Union/ H2020-LCE-2015-1-two-stage (LCE-11-2015)

IMDEA Energy Institute external funding: 936.525 €

Title/Acronym: New technologies and strategies for fuel cells and hydrogen technologies in the phase of recycling and dismantling/HYTECHCYCLING

Partners: Fundacion para el desarrollo de nuevas tecnologías del hidrógeno en Aragón (Coordinator); Univerza V Ljubljani; IMDEA Energy Institute; Industrias López Soriano; Parco Scientifico e Tecnologico per l'ambiente - Environment Park spa

Period: 2016-2019

Funding Institution/Program: European Union/ H2020-JTI-FCH-2015-1 (FCH-04.1-2015)

IMDEA Energy Institute external funding: 89.292 €

Title/Acronym: High Temperature concentrated solar thermal power plant with particle receiver and direct thermal storage/NEXT-CSP

Partners: CNRS (Coordinator); Électricité de France; Sbp Sonne; IMDEA Energy Institute; Comessa; Whittaker Engineering; European Powder and Process Technology; Katholieke Universiteit Leuven; Institut National polytechnique de Toulouse; Euronovia

Period: 2016-2020

Funding Institution/Program: European Union/ H2020-JTI-FCH-2015-1 (FCH-04.1-2015)

IMDEA Energy Institute external funding: 199.791 €

Title/Acronym: Valorization of urban WASTEs to new generation of BIOethanol/WASTE2BIO

Partners: Imecal (Coordinator); Ciemat; Exergy; IMDEA Energy Institute

Period: 2016-2019

Funding Institution/Program: Ministry of Economy, Industry and Competitiveness/ Cofund ERA-NET BESTF3 joint call/ APCIN 2016

IMDEA Energy Institute external funding: 42.000 €

1.4. Contracts with companies and organizations

Title/Acronym: Energy efficiency in systems for vibration testing

Company: IMV Corporation (Japan)

Period: 2010-2017

IMDEA Energy Institute external funding: 202.498 €

Title/Acronym: Next generation battery testing equipment/NGBTE

Company: IMV Corporation (Japan)

Period: 2014-2016

IMDEA Energy Institute external funding: 271.347 €

Title/Acronym: Development of new structural materials for energy harvesting and storage/DESMAN

Institution: IMDEA Materials Institute (Spain)

Period: 2014-2017

IMDEA Energy Institute external funding: 151.600 €

Title/Acronym: Organic flow battery for ultrafast charge of electric vehicles in conventional petrol pumps /BAFO

Period: 2015-2016

Company: Repsol (Spain)

IMDEA Energy Institute external funding: 234.494 €

Title/Acronym: Simulation of PERSEO process/SIMPER

Company: KIC Innoenergy Iberia/IMECAL (Spain)

Period: 2015-2016

IMDEA Energy Institute external funding: 11.250 €

Title/Acronym: Energy storage with flow batteries in photovoltaic plants

Company: Ingenia Solar Energy (Spain)

Period: 2015-2017

IMDEA Energy Institute external funding: 108.161 €

Title/Acronym: Development of cathode materials for primary zinc air batteries

Company: CEGASA PORTABLE ENERGY (Spain)

Period: 2015-2016

IMDEA Energy Institute external funding: 31.082 €



Title/Acronym: Inventory of shocking actions and minimization measures for the PERSEO process/INVAC

Company: IMECAL (Spain)

Period: 2016

IMDEA Energy Institute external funding: 6.210 €

Title/Acronym: Preparation of vanadium electrolyte from V2O5/ELECTROVAN

Company: PV HARDWARE SOLUTIONS (Spain)

Period: 2016-2017

IMDEA Energy Institute external funding: 19.008 €

Title/Acronym: Installation and operation of a 100kW vanadium flow battery demonstrator /DEMOVAN

Company: PV HARDWARE SOLUTIONS (Spain)

Period: 2016-2017

IMDEA Energy Institute external funding: 40.522 €

Title/Acronym: Characterization and study of materials derived from graphene for energy applications

Company: GNANOMAT (Spain)

Period: 2016-2017

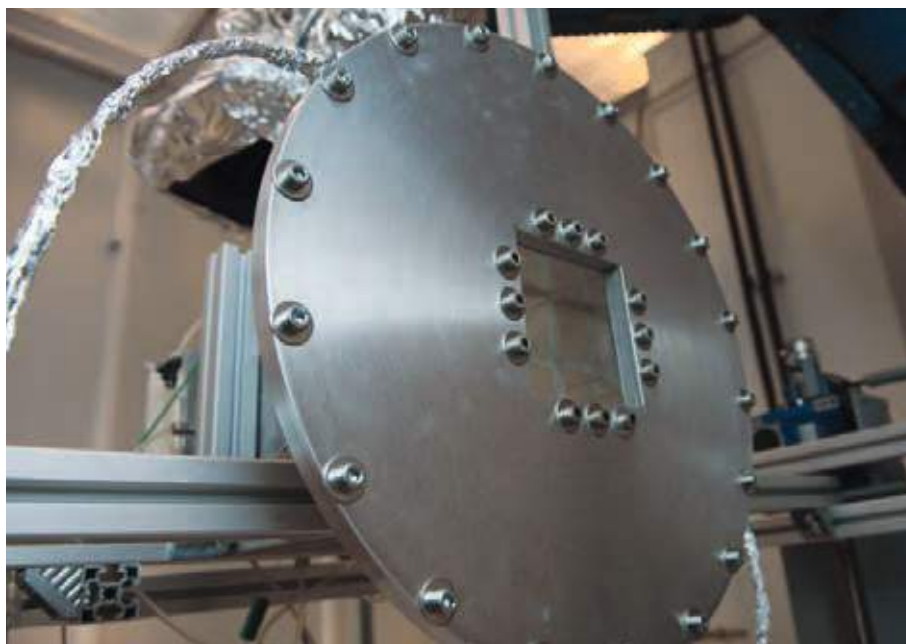
IMDEA Energy Institute external funding: 13.750 €

Title/Acronym: Research in electrochemical energy storage technologies/ITAE

Company: Inversiones Financieras Perseo (Spain)

Period: 2016-2017

IMDEA Energy Institute external funding: 15.000 €



1.5. Researchers grants

Program: Ramón y Cajal 2011

Project: Intelligent power interfaces for real-time management of future power networks

Period: 2012-2016

Funding Institution: Ministry of Economy and Competitiveness

IMDEA Energy Institute external funding: 168.600 €

Dr. Milan Prodanovic

Program: Ramón y Cajal 2011

Project: Application of ionic liquid-based materials in high performance supercapacitor

Period: 2012-2016

Funding Institution: Ministry of Economy and Competitiveness

IMDEA Energy Institute external funding: 168.600 €

Dr. Rebeca Marcilla

Program: Fellowship of Ministry of Higher Education

Project: Characterization and development of indigenous microalgae for biofuels production

Period: 2012-2016

Funding Institution: Ministry of Higher Education

IMDEA Energy Institute external funding: 108.000 €

Mr. Ahmed Abdel-Mohsen Mahdy

Program: "Marie Curie" AMAROUT Europe II. FP7-People Program. Call identifier FP7-PEOPLE-2011-COFUND

Period: 2013-2016

Funding Institution: European Union

IMDEA Energy Institute external funding: 54.727 €

Dr. Barry Hayes

Program: "Marie Curie" AMAROUT Europe II. FP7-People Program. Call identifier FP7-PEOPLE-2011-COFUND

Period: 2013-2016

Funding Institution: European Union

IMDEA Energy Institute external funding: 55.087 €

Dr. Sankaranayanan Thangaraju

Program: Predoctoral Research Grant (FPI)

Project/Acronym: Development of novel catalytic systems for the production of 2nd-Generation Biofuels by deoxygenation of lignocellulosic biomass processes/LIGCATUP

Period: 2013-2017

Funding Institution: Ministry of Economy and Competitiveness

IMDEA Energy Institute external funding: 97.000 €

Mr. Antonio M. Berenguer

Program: Contract FPI

Project/Acronym: Development of high performance supercapacitors by using novel ionic liquid-based electrolytes/SUPERLION

Period: 2014-2017

Funding Institution: Ministry of Economy and Competitiveness

IMDEA Energy Institute external funding: 82.400 €

Ms. Paula Navalpotro

Program: “Marie Curie” AMAROUT Europe II. FP7-People Program. Call identifier FP7-PEOPLE-2011-COFUND Period: 2014-2017

Funding Institution: European Union

IMDEA Energy Institute external funding: 49.276 €

Dr. Elia Tomás

Program: “Marie Curie” AMAROUT Europe II. FP7-People Program. Call identifier FP7-PEOPLE-2011-COFUND Period: 2014-2016

Funding Institution: European Union

IMDEA Energy Institute external funding: 34.158 €

Dr. Puiki Leung

Program: “Marie Curie” AMAROUT Europe II. FP7-People Program. Call identifier FP7-PEOPLE-2011-COFUND Period: 2014-2016

Funding Institution: European Union

IMDEA Energy Institute external funding: 38.507 €

Dr. Afshin Pendashteh

Program: “Marie Curie” AMAROUT Europe II. FP7-People Program. Call identifier FP7-PEOPLE-2011-COFUND

Period: 2015-2017

Funding Institution: European Union

IMDEA Energy Institute external funding: 46.119 €

Dr. Fernando Fresno

Program: “Marie Curie” AMAROUT Europe II. FP7-People Program. Call identifier FP7-PEOPLE-2011-COFUND

Period: 2015-2017

Funding Institution: European Union

IMDEA Energy Institute external funding: 42.026 €

Dr. Salvador Luque

Program: “Marie Curie” AMAROUT Europe II. FP7-People Program. Call identifier FP7-PEOPLE-2011-COFUND

Period: 2015-2016

Funding Institution: European Union

IMDEA Energy Institute external funding: 9.860 €

Dr. Beatriz Molinuevo

Program: “Marie Curie” AMAROUT Europe II. FP7-People Program. Call identifier FP7-PEOPLE-2011-COFUND

Period: 2015-2016

Funding Institution: European Union

IMDEA Energy Institute external funding: 14.886 €

Dr. Michael Epstein

Program: Contract FPU

Project/Acronym: Particle reactors for applications in the solar thermochemical

Period: 2015-2019

Funding Institution: Ministry of Education, Culture and Sports

IMDEA Energy Institute external funding: 76.204 €

Ms. Lucía Arribas

Program: Ramón y Cajal 2014

Project: Linking wastewater bioremediation by means of microalgae cultivation and energy production out of this biomass

Period: 2016-2020

Funding Institution: Ministry of Economy and Competitiveness

IMDEA Energy Institute external funding: 168.600 €

Dr. Cristina González

Program: Ramón y Cajal 2014

Project: Bioapplications of porous materials

Period: 2016-2021

Funding Institution: Ministry of Economy and Competitiveness

IMDEA Energy Institute external funding: 168.600 €

Dr. Patricia Horcajada



Program: “Marie Curie” AMAROUT Europe II. FP7-People Program. Call identifier FP7-PEOPLE-2011-COFUND

Period: 2016-2017

Funding Institution: European Union

IMDEA Energy Institute external funding: 59.385 €

Dr. Patricia Horcajada

Program: IED 2016

Period: 2016-2018

Funding Institution: Ministry of Economy, Industry and Competitiveness

IMDEA Energy Institute external funding: 98.684 €

Dr. Rebeca Marcilla

Program: IED 2016

Period: 2016-2018

Funding Institution: Ministry of Economy, Industry and Competitiveness

IMDEA Energy Institute external funding: 98.684 €

Dr. Victor A. de la Peña



2. Scientific Results

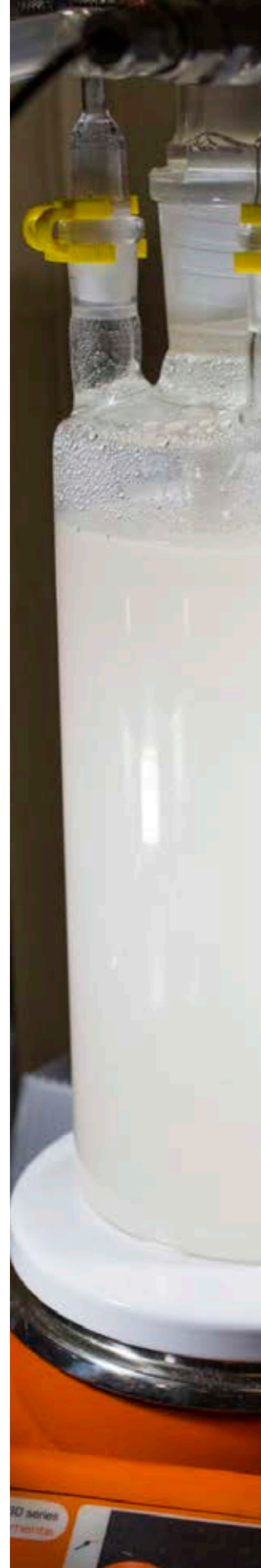
2.1. Scientific publications

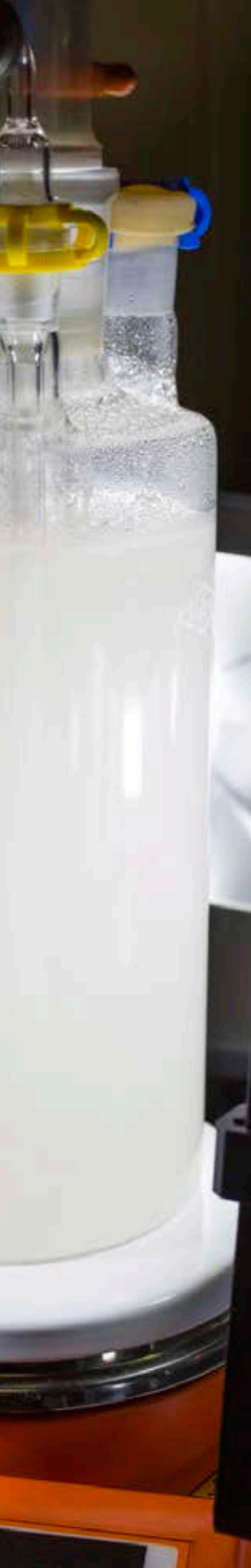
1. Bayón, A.; de la Peña O'Shea, V.A.; Coronado, J.M.; Serrano, D.P. "Role of the physicochemical properties of hausmannite on the hydrogen production via the Mn_2O_3 -NaOH thermochemical cycle". *International Journal of Hydrogen Energy*, **2016**, *41*, 113-122.
2. Berenguer, A.; Sankaranarayanan, T.M.; Gómez, G.; Moreno, I.; Coronado, J.M.; Pizarro, P.; Serrano, D.P. "Evaluation of transition metal phosphides supported on ordered mesoporous materials as catalysts for phenol hydrodeoxygenation". *Green Chemistry*, **2016**, *18*, 1938-1951.
3. Blandez, J.F.; Santiago-Portillo, A.; Navalón, S.; Giménez-Marqués, M.; Álvaro, M.; Horcajada, P.; García, H. "Influence of functionalization of terephthalate linker on the catalytic activity of UiO-66 for epoxide ring opening". *Journal of Molecular Catalysis A: Chemical*, **2016**, *425*, 332-339.
4. Carrillo, A.J.; Sastre, D.; Serrano, D.P.; Pizarro, P.; Coronado, J.M. "Revisiting the BaO_2/BaO redox cycle for solar thermochemical energy storage". *Physical Chemistry Chemical Physics*, **2016**, *18* (11), 8039-8048.
5. Carrillo, A.J.; Serrano, D.P.; Pizarro, P.; Coronado, J.M. "Manganese oxide-based thermochemical energy storage: modulating temperatures of redox cycles by Fe-Cu co-doping". *Journal of Energy Storage*, **2016**, *5*, 169-176.
6. Carrillo, A.J.; Serrano, D.P.; Pizarro, P.; Coronado, J.M. "Understanding Redox Kinetics of Iron-Doped Manganese Oxides for High Temperature Thermochemical Energy Storage". *Journal of Physical Chemical C*, **2016**, *120* (49), 27800-27812.
7. Carrillo, A.J.; Serrano, D.P.; Coronado, J.M.; Pizarro, P. "Hydrogen production by methane decomposition over MnO_x/YSZ catalysts". *International Journal of Hydrogen Energy*, **2016**, *41* (42), 19382-19389.
8. Castillo-Blas, C.; Snecko, N.; de la Peña O'Shea, V.A.; Gallardo, J.; Gutierrez-Puebla, E.; Monge, M.A.; Gandara, F. "Crystal phase competition by addition of a second metal cation in solid solution metal-organic frameworks". *Dalton Transactions*, **2016**, *45* (10), 4327-4337.
9. Cejka, J.; Morris, R.E.; Serrano, D.P. "Catalysis on Zeolites-Catalysis Science & Technology". *Catalysis Science & Technology*, **2016**, *6* (8), 2465-2466.
10. Faraldos, M.; Kropp, R.; Anderson, M.A.; Sobolev, K. "Photocatalytic hydrophobic concrete coatings to combat air pollution". *Catalysis Today*, **2016**, *259*, 228-236.
11. Feroso, J.; Hernando, H.; Jana, P.; Moreno, I.; Přeč, J.; Ochoa-Hernández, C.; Pizarro, P.; Coronado, J.M.; Čejka, J.; Serrano, D.P. "Lamellar and pillared ZSM-5 zeolites modified with MgO and ZnO for catalytic fast-pyrolysis of eucalyptus woodchips". *Catalysis Today*, **2016**, *277*, 171-181.
12. Figueiredo, A.L.; Araujo, A.S.; Linares, M.; Peral, A.; Garcia, R.A.; Serrano, D.P.; Fernandes, V.J. "Catalytic cracking of LDPE over nanocrystalline HZSM-5 zeolite prepared by seed-assisted synthesis from an organic-template-free system". *Journal of Analytical and Applied Pyrolysis*, **2016**, *117*, 132-140.
13. Francés-Soriano, L.; Liras, M.; Kowalczyk, A.; Bednarkiewicz, A.; González-Béjar, M.; Pérez-Prieto, J. "Energy transfer in diiodoBodipy-grafted upconversion nanohybrids". *Nanoscale*, **2016**, *8* (1), 204-208.

14. García-Bosch, N.; Liras, M.; Quijada-Garrido, I.; García, O. "Multiamino polymeric capping of fluorescent silver nanodots as an effective protective, amphiphilic and pH/thermo-responsive coating". *RSC Advances*, **2016**, 6 (72), 67643-67650.
15. García-Gusano, D.; Espegren, K.; Lind, A.; Kirkengen, M. "The role of the discount rates in energy systems optimization models". *Renewable and Sustainable Energy Reviews*, **2016**, 59, 56-72.
16. García-Gusano, D.; Iribarren, D.; Martín-Gamboa, M.; Dufour, J.; Espegren, K.; Lind, A. "Integration of life-cycle indicators into energy optimisation models: the case study of power generation in Norway". *Journal of Cleaner Production*, **2016**, 112, 2693-2696.
17. García-Gusano, D.; Martín-Gamboa, M.; Iribarren, D.; Dufour, J. "Prospective analysis of life-cycle indicators through endogenous integration into a national power generation model". *Resources*, **2016**, 5 (4), 39-55.
18. García-Márquez, A.; Hidalgo, T.; Cunha, D.; Lana, H.; Bellido, E.; Álvarez, C.; Boissiere, C.; Sánchez, C.; Serre, C.; Blanco-Prieto, M.J.; Horcajada, P. "Biocompatible polymer-MIL-100(Fe) composite patches for the cutaneous administration of active molecules". *Journal of Materials Chemistry B*, **2016**, 4, 7031-7040.
19. García-Quismondo, E.; Santos, C.; Palma, J.; Anderson, M.A. "On the challenge of developing wastewater treatment processes: capacitive deionization". *Desalination and Water Treatment*, **2016**, 57 (5), 2315-2324.
20. García-Quismondo, E.; Santos, C.; Soria, J.; Palma, J.; Anderson, M.A. "New Operational Modes to Increase Energy Efficiency in Capacitive Deionization Systems". *Environmental Science and Technology*, **2016**, 50 (11), 6053-6060.
21. Gil, M.V.; Feroso, J.; Pevida, C.; Chen, D.; Rubiera, F. "Production of fuel-cell grade H₂ by sorption enhanced steam reforming of acetic acid as a model compound of biomass-derived bio-oil". *Applied Catalysis B: Environmental*, **2016**, 184, 64-76.
22. Gómez, G.; Botas, J.A.; Serrano, D.P.; Pizarro, P. "Hydrogen production by methane decomposition over pure silica SBA-15 materials". *Catalysis Today*, **2016**, 277, 152-160.
23. Gómez-García, F.; González-Aguilar, J.; Olalde, G.; Romero, M. "Thermal and hydrodynamic behavior of ceramic volumetric absorbers for central receiver solar power plants: A review". *Renewable and Sustainable Energy Reviews*, **2016**, 57, 648-658.
24. González-Fernández, C.; Mahdy, A.; Ballesteros, I.; Ballesteros, M. "Impact of temperature and photoperiod on anaerobic biodegradability of microalgae grown in urban wastewater". *International Biodeterioration & Biodegradation*, **2016**, 106, 16-23.
25. Hayes, B.P.; Wilson, A.; Webster, R.; Djokic, S. "Comparison of two energy storage options for optimum balancing of wind farm power outputs". *IET Generation Transmission and Distribution*, **2016**, 10 (3), 832-839.
26. Hayes, B.P.; Prodanovic, M. "State forecasting and operational planning for distributed energy management systems". *IEEE Transactions on Smart Grid*, **2016**, 7 (2), 1002-1011.
27. Hernando, H.; Jiménez-Sánchez, S.; Feroso, J.; Pizarro, P.; Coronado, J.M.; Serrano, D.P. "Assessing biomass catalytic pyrolysis in terms of deoxygenation pathways and energy yields for the efficient production of advanced biofuels". *Catalysis Science & Technology*, **2016**, 6, 2829-2843.

28. Huerta, F.; Gruber, J.K.; Prodanovic, M.; Matatagui, P. "Power-hardware-in-the-loop test beds: evaluation tools for grid integration of distributed energy resources". *IEEE Industry Applications Magazine*, **2016**, *22* (2), 18-26.
29. Hunns, J.A.; Arroyo, M.; Lee, A.F.; Escola, J.M.; Serrano, D.P.; Wilson, K. "Hierarchical mesoporous Pd/ZSM-5 for the selective catalytic hydrodeoxygenation of m-cresol to methylcyclohexane". *Catalysis Science & Technology*, **2016**, *6* (8), 2560-2564.
30. Iribarren, D.; Martín-Gamboa, M.; O'Mahony, T.; Dufour, J. "Screening of socio-economic indicators for sustainability assessment: A combined Life Cycle Assessment and Data Envelopment Analysis approach". *The International Journal of Life Cycle Assessment*, **2016**, *21* (2), 202-214.
31. Iribarren, D.; Martín-Gamboa, M.; Manzano, J.; Dufour, J. "Assessing the social acceptance of hydrogen for transportation in Spain: An unintentional focus on target population for a potential hydrogen economy". *International Journal of Hydrogen Energy*, **2016**, *41* (10), 5203-5208.
32. Jana, P.; de la Peña O'Shea, V.A.; Mata Montero, C.; Pizarro, P.; Coronado, J.M.; Fresno, F.; Serrano, D.P. "Factors influencing the photocatalytic activity of alkali Nb[sbnd]Ta perovskites for hydrogen production from aqueous methanol solutions". *International Journal of Hydrogen Energy*, **2016**, *41* (44), 19921-19928.
33. Kakvand, P.; Rahmanifar, M.S.; El-Kady, M.F.; Pendashteh, A.; Kiani, M.A.; Hashami, M.; Najafi, M.; Abbasi, A.; Mousavi, M.F.; Kaner, R.B. "Synthesis of NiMnO₃/C nano-composite electrode materials for electrochemical capacitors". *Nanotechnology*, **2016**, *27* (31), 315401.
34. Khor, A.C.; Mohamed, M.R.; Sulaimen, M.H.; Daniyal, H.; Razali, A.R.; Oumer, A.N.; Leung, P.K. "Numerical investigation on serpentine flow field and rhombus electrolyte compartment of vanadium redox flow battery (V-RFB)". *ARPN Journal of Engineering and Applied Sciences*, **2016**, *11* (10), 6715-6720.
35. Khaldoun, B.; Coronado, J.M.; Boudjemaa, A.; Oualid, T. "Porous Materials: Synthesis, Characterizations and Applications". *Journal of Chemistry*, **2016**, Article ID 5028795, 1 page.
36. Lado, J.J.; Zornitta, R.L.; Calvi, F.A.; Tejedor-Tejedor, M.I.; Anderson, M.A.; Ruotolo, L.A.M. "Study of sugar cane bagasse fly ash as electrode material for capacitive deionization". *Journal of Analytical and Applied Pyrolysis*, **2016**, *120*, 389-398.
37. Leung, P.; Palma, J.; Garcia-Quismondo, E.; Sanz, L.; Mohamed, M.R.; Anderson, M. "Evaluation of electrode materials for all-copper hybrid flow batteries". *Journal of Power Sources*, **2016**, *310*, 1-11.
38. Leung, P.; Martina, T.; Shah, A.A.; Anderson, M.A.; Palma, J. "Membrane-less organic-inorganic aqueous flow batteries with improved cell potential". *Chemical Communications*, **2016**, *52*, 14270-14273.
39. Liras, M.; Iglesias, M.; Sánchez, F. "Conjugated Microporous Polymers Incorporating BODIPY Moieties as Light-Emitting Materials and Recyclable Visible-Light Photocatalysts". *Macromolecules*, **2016**, *5*, 1666-1673.
40. Liras, M.; Simoncelli, S.; Rivas-Aravena, A. et al. "Nitroxide amide-BODIPY probe behavior in fibroblasts analyzed by advanced fluorescence microscopy". *Organic & Biomolecular Chemistry*, **2016**, *14*, 4023-4026.

41. Liras, M.; Pintado-Sierra, M.; Iglesias, M.; Sánchez, F. "A deprotection strategy of a BODIPY conjugated porous polymer to obtain a heterogeneous (dipyrrin)(bipyridine)ruthenium(II) visible light photocatalyst". *Journal of Materials Chemistry A*, **2016**, 4 (44), 17274-17278.
42. Luque, S.; Jones, T.V.; Povey, T. "Theory for the scaling of metal temperatures in cooled compressible flows". *International Journal of Heat and Mass Transfer*, **2016**, 102, 331-340.
43. Mahdy, A.; Ballesteros, M.; González-Fernández, C. "Enzymatic pretreatment of *Chlorella vulgaris* for biogas production: Influence of urban wastewater as a sole nutrient source on macromolecular profile and biocatalyst efficiency". *Bioresource Technology*, **2016**, 199, 319-325.
44. Mahdy, A.; Méndez, L.; Tomás-Pejó, E.; Morales, M.M.; Ballesteros, M.; González-Fernández, C. "Influence of enzymatic hydrolysis on the biochemical methane potential of *Chlorella vulgaris* and *Scenedesmus* sp". *Journal of Chemical Technology and Biotechnology*, **2016**, 91 (5), 1299-1305.
45. Márquez, A.G.; Hidalgo, T.; Lana, H.; Cunha, D.; Blanco-Prieto, M.J.; Álvarez-Lorenzo, C.; Boissière, C.; Sánchez, C.; Serre, C.; Horcajada, P. "Biocompatible polymer-metal-organic framework composite patches for cutaneous administration of cosmetic molecules". *Journal of Materials Chemistry B*, **2016**, 4 (43), 7031-7040.
46. Martín-Gamboa, M.; Iribarren, D. "Dynamic ecocentric assessment combining energy and data envelopment analysis: Application to wind farms". *Resources*, **2016**, 5 (1), 8-19.
47. Martín-Gamboa, M.; Iribarren, D.; Susmozas, A.; Dufour, J. "Delving into sensible measures to enhance the environmental performance of biohydrogen: A quantitative approach based on process simulation, life cycle assessment and data envelopment analysis". *Bioresource Technology*, **2016**, 214, 376-385.
48. Méndez, L.; Sialve, B.; Tomás-Pejó, E.; Ballesteros, M.; Steyer, J.P.; González-Fernández, C. "Comparison of *Chlorella vulgaris* and cyanobacterial biomass: cultivation in urban wastewater and methane production". *Bioprocess and Biosystems Engineering*, **2016**, 39 (5), 703-712.
49. Moreno, A.D.; Ibarra, D.; Alvira, P.; Tomás-Pejó, E.; Ballesteros, M. "Exploring laccase and mediators behavior during saccharification and fermentation of steam-exploded wheat straw for bioethanol production". *Journal of Chemical Technology and Biotechnology*, **2016**, 91 (6), 1816-1825.
50. Moreno, A.D.; Ibarra, D.; Mialon, A.; Ballesteros, M. "A bacterial laccase for enhancing saccharification and ethanol fermentation of steam-pretreated biomass". *Fermentation*, **2016**, 2 (2), 11-25.
51. Molinuevo, B.; Mahdy, A.; Ballesteros, M.; González-Fernández, C. "From piggery wastewater nutrients to biogas: Microalgae biomass revalorization through anaerobic digestion". *Renewable Energy*, **2016**, 96, 1103-1110.
52. Narayanan, S.; Vijaya, J.J.; Sivasanker, S.; Ragupathi, C.; Sankaranarayanan, T.M.; Kennedy, L.J. "Hierarchical ZSM-5 catalytic performance evaluated in the selective oxidation of styrene to benzaldehyde using TBHP". *Journal of Porous Materials*, **2016**, 23 (3), 741-752.
53. Navalpotro, P.; Palma, J.; Anderson, M.; Marcilla, R. "High performance hybrid supercapacitors by using para-Benzoquinone ionic liquid redox electrolyte". *Journal of Power Sources*, **2016**, 306, 711-717.





54. Núñez, J.; Fresno, F.; Collado, L.; Jana, P.; Coronado, J.M.; Serrano, D.P.; de la Peña O'Shea, V.A. "Photocatalytic H₂ production from aqueous methanol solutions using metal-co-catalysed Zn₂SnO₄ nanostructures". *Applied Catalysis B: Environmental*, **2016**, *191*, 106-115.
55. Núñez, J.; Fresno, F.; Platero-Prats, A.E.; Jana, P.; Fierro, J.L.G.; Coronado, J.M.; Serrano, D.P.; de la Peña O'Shea, V.A. "Ga-Promoted Photocatalytic H₂ Production over Pt/ZnO Nanostructures". *ACS Applied Materials & Interfaces*, **2016**, *8* (36), 23729-23738.
56. Oliva-Taravilla, A.; Tomás-Pejó, E.; Demuez, M.; González-Fernández, C.; Ballesteros, M. "Phenols and lignin: Key players in reducing enzymatic hydrolysis yields of steam-pretreated biomass in presence of laccase". *Journal of Biotechnology*, **2016**, *218*, 94-101.
57. Oliva-Taravilla, A.; Tomás-Pejó, E.; Demuez, M.; González-Fernández, C.; Ballesteros, M. "Optimization of the laccase detoxification step in hybrid hydrolysis and fermentation processes". *Bioethanol*, **2016**, *2*, 126-133.
58. Oliva-Taravilla, A.; Tomás-Pejó, E.; Demuez, M.; González-Fernández, C.; Ballesteros, M. "Effect of laccase dosage on enzymatic hydrolysis and fermentation of steam-exploded wheat straw". *Journal Cellulose Chemistry and Technology in a Special Issue of Biorefinery of Lignocellulosic Materials*, **2016**, *50* (3-4), 391-395.
59. Pendashteh, A.; Palma, J.; Anderson, M.; Marcilla, R. "Facile Synthesis of NiCoMnO₄ Nanoparticles as Novel Electrode Materials for High-Performance Asymmetric Energy Storage Devices". *RSC Advances*, **2016**, *6*, 28970-28980.
60. Peral, A.; Escola, J.M.; Serrano, D.P.; Přech, J.; Ochoa-Hernández, C.; Čejka, J. "Bidimensional ZSM-5 zeolites probed as catalysts for polyethylene cracking". *Catalysis Science & Technology*, **2016**, *6* (8), 2754-2765.
61. Petrakopoulou, F.; Sanz-Bermejo, J.; Dufour, J.; Romero, M. "Exergetic analysis of hybrid power plants with biomass and photovoltaics coupled with a solid-oxide electrolysis system". *Energy*, **2016**, *94*, 304-315.
62. Recalde, I.; Estebanez, N.; Francés-Soriano, L.; Liras, M.; González-Béjar, M.; Pérez-Prieto, J. "Upconversion Nanoparticles with a strong acid-resistant capping". *Nanoscale*, **2016**, *8*, 7588-7594.
63. Reñones, P.; Moya, A.; Fresno, F.; Collado, L.; Vilatela, J.J.; de la Peña-O'Shea, V.A. "Hierarchical TiO₂ nanofibres as photocatalyst for CO₂ reduction: Influence of morphology and phase composition on catalytic activity". *Journal of CO₂ Utilization*, **2016**, *15*, 24-31.
64. Reyes-Belmonte, M.A.; Sebastián, A.; Romero, M.; González-Aguilar, J. "Optimization of a recompression supercritical carbon dioxide cycle for an innovative central receiver solar power plant". *Energy*, **2016**, *112*, 17-27.
65. Roch, C.; Hidalgo, T.; Banh, H.; Fischer, R.A.; Horcajada, P. "A promising catalytic and theranostic agent obtained by in situ synthesis of Au nanoparticles by reduced POM incorporated within the mesoporous MIL-101 material". *European Journal of Inorganic Chemistry*, **2016**, *27*, 4387-4394.
66. Romero, M.; González-Aguilar, J. "High-flux/high-temperature solar thermal conversion: technology development and advanced applications". *Renewable Energy and Environmental Sustainability*, **2016**, *1* (26), 1-6.
67. Senokos, E.; Reguero, V.; Palma, J.; Vilatela, J.J.; Marcilla, R. "Macroscopic fibres of CNTs as electrodes for multifunctional electric double layer capacitors: from quantum capacitance to device performance". *Nanoscale*, **2016**, *8*, 3620-3628.

68. Serrano, D.P.; Escola, J.M.; Sanz, R.; Garcia, R.A.; Peral, A.; Moreno, I.; Linares, M. "Hierarchical ZSM-5 zeolite with uniform mesopores and improved catalytic properties". *New Journal of Chemistry*, **2016**, 40 (5), 4206-4216.
69. Simon-Yarza, T.; Baati, T.; Neffati, F.; Njim, L.; Couvreur, P.; Serre, C.; Gref, R.; Najjar, M.F.; Zakhama, A.; Horcajada, P. "In vivo behavior of MIL-100 nanoparticles at early times after intravenous administration". *International Journal of Pharmaceutics*, **2016**, 511 (2), 1042-1047.
70. Song, J.; Zhu, Y.; Tong, K.; Yang, Y.; Reyes-Belmonte, M.A. "A note on the optic characteristics of daylighting system via PMMA fibers". *Solar Energy*, **2016**, 136, 32-34.
71. Susmozas, A.; Iribarren, D.; Zapp, P.; Linen, J.; Dufour, J. "Life-cycle performance of hydrogen production via indirect biomass gasification with CO₂ capture". *International Journal of Hydrogen Energy*, **2016**, 41, 19484-19491.
72. Tagliaferri, F.; Hayes, B.P.; Viola, I.M.; Djokić, S.Z. "Wind modelling with nested Markov chains". *Journal of Wind Engineering and Industrial Aerodynamics*, **2016**, 157, 118-124.
73. Tiruye, G.A.; Muñoz-Torrero, D.; Palma, J.; Anderson, M.; Marcilla, R. "Performance of solid state supercapacitors based on polymer electrolytes containing different ionic liquids". *Journal of Power Sources*, **2016**, 326, 560-568.
74. Wang, Y.; Tejedor-Tejedor, M.I.; Tan, W.; Anderson, M.A. "Influence of solution chemistry on the dielectric properties of TiO₂ thin-film porous electrodes". *Journal of Physical Chemistry C*, **2016**, 120 (38), 21543-21551.
75. Wang, Y.; Tejedor-Tejedor, M.I.; Tan, W.; Anderson, M.A. "Importance of Protons and Specifically Adsorbing Ions on Changing Capacitance, Space Charge Potential Inside the Solid, and the Interfacial Potential at the TiO₂ Aqueous Solution Interface". *Electrochimica Acta*, **2016**, 219, 577-587.
76. Wouters, J.J.; Tejedor-Tejedor, M.I.; Lado, J.J.; Pérez-Roa, R.; Anderson, M.A. "Influence of metal oxide coatings on the microstructural and electrochemical properties of different carbon materials". *Journal of the Electrochemical Society*, **2016**, 163 (13), A2733-A2744.
77. Yang, Y.; Ochoa-Hernández, C.; Pizarro, P.; de la Peña O'Shea, V.A.; Coronado, J.M.; Serrano, D.P. "Ce-promoted Ni/SBA-15 catalysts for anisole hydrotreating under mild conditions". *Applied Catalysis B: Environmental*, **2016**, 197, 206-213.
78. Zhang, J.; Dumur, F.; Horcajada, P.; Livage, C.; Xiao, P.; Fouassier, J.P.; Gigmes, D.; Lalevée, J. "Iron-Based Metal-Organic Frameworks (MOF) as Photocatalysts for Radical and Cationic Polymerizations under Near UV and Visible LEDs". *Macromolecular Chemistry and Physics*, **2016**, 217 (22), 2534-2540.
79. Zornitta, R.L.; Lado, J.J.; Anderson, M.A.; Ruotolo, L.A.M. "Effect of electrode properties and operational parameters on capacitive deionization using low-cost commercial carbons". *Separation and Purification Technology*, **2016**, 158, 39-52.



2.2. Patents

1. Application number: P201630327, Title: “Batería redox con electrolitos inmiscibles”. Date of application: 21/03/2016 (OEPM). Holders: Fundación IMDEA Energía. Inventors: Navalpotro, P.; Anderson, M.A.; Palma, J.; Marcilla, R.

2.3. Books/chapters of books

1. Iribarren, D.; Peters, J.F.; Susmozas, A.; Cruz, P.L.; Dufour, J. **2016**. Chapter: “Carbon footprints and greenhouse gas emission savings of alternative synthetic biofuels”. Book: “The Carbon Footprint Handbook”, CRC Press, Boca Raton (USA). ISBN: 978-1-4822-6222-3 [hardcover]; ISBN: 978-1-4822-6222-0 [ebook].

2. Romero, M.; González-Aguilar, J. **2016**. Chapter 7: “Next generation of liquid metal and other high-performance receiver designs for concentrating solar thermal (CST) central tower systems”. Book: “Advances in Concentrating Solar Thermal Research and Technology-1st edition”. Editors: Blanco, M.; Ramirez, L. Ed.: Elsevier. ISBN: 9780081005163.

2.4. Articles in general journals

1. Alberti, F.; Santiago, S.; Roccabruna, M.; Luque, S.; González-Aguilar, J.; Crema, L.; Romero, M. “Numerical analysis of radiation propagation in innovative volumetric receivers based on selective laser melting techniques”. SolarPACES 2015. AIP Conference Proceedings, vol.1734, pp. 030001-1/8, doi: 10.1063/1.4949053, June 2016.

2. Article in Innovaspain: “IMDEA Energía aboga por la innovación tecnológica sostenible”. 10 March 2016.

3. Marín, F.; Prodanovic, M. “Hacia un futuro inteligente”. Journal: AGENDA DE LA EMPRESA, nº 210, pp. 92, March 2016.

4. Guédez, R.; Topel, M.; Conde-Buezas, I.; Ferragut, F.; Callaba, I.; Spelling, J.; Hassar, Z.; Pérez-Segarra, C.D.; Laumert, B. “A methodology for determining optimum solar tower plant configurations and operating strategies to maximize profits based on hourly electricity market prices and tariffs”. Proceedings of ASME Power & Energy 2016. Journal of Solar Energy Engineering, vol. 138 (2), pp. 021006-1/12. Paper No: SOL-15-1226, April 2016.

5. Palma, J. 2016. Informe “Almacenamiento-Estado de las tecnologías”. Grupo Interplataformas de Almacenamiento Electroquímico.

6. Sizmann, A.; Batteiger, V.; Steinfeld, A.; Furler, P.; Koepf, E.; Marxer, D.; Brendelberger, S.; Le Clercq, P.; Roeb, M.; Romero, M.; González-Aguilar, J.; Dufour, J.; De Wit, E.; Lieftink, D.; Prieto, C.; Serrano, J.C. “SUNlight-to-LIQUID Project: Producing sustainable fuels for aviation with concentrated solar energy”. Revista Energética XXI, nº158, June/July 2016, pp. 48-49.



7. Álvarez de Miguel, S.; Bellan, S.; García de María, J.M.; González-Aguilar, J.; Romero, M. "Numerical modelling of a 100-Wh lab-scale thermochemical heat storage system for concentrating solar power plants". SolarPACES 2015. AIP Conference Proceedings, vol.1734, pp 050005-1/8, doi: 10.1063/1.4949103, June 2016.

8. Carrillo, A.J.; Serrano, D.P.; Pizarro, P.; Coronado, J.M. "Design of Efficient Mn-based Redox Materials for Thermochemical Heat Storage at High Temperatures". SolarPACES 2015. AIP Conference Proceedings, vol. 1734, pp 050009-1/8, doi: 10.1063/1.4949107. June 2016.

9. Gómez-García, F.; Santiago, S.; Luque, S.; Romero, M.; González-Aguilar, J. "A new laboratory-scale experimental facility for detailed aerothermal characterizations of volumetric absorbers". AIP Conference Proceedings, vol.1734, pp 030018-1/9, doi: 10.1063/1.4949070, June 2016.

10. Serrano, E.; Hernández, A.; Oraá, B.; Sánchez, A.; Miroslavov, V.; García-Quismondo, E.; Palma, J. "Large scale vanadium redox flow battery: fast-tracking development". Conference Proceedings, Congress: The International Flow Battery Forum (IFBF2016), Karlsruhe, Germany, 7-9 June 2016.

11. Prodanovic, M. "Visión Tendencias 2017". Journal enerTIC. September 2016.

12. Gruber, J.K.; Prodanovic, M.; Marín, F. "Herramientas de estimación de consumo y sensibilidad de costes energéticos en edificios". Journal SEE Sostenibilidad y Eficiencia Energética, vol. 532, pp. 22-24. September-October 2016.

13. "Documento de posicionamiento Gestión energética sostenible e inteligente en el ámbito ferroviario". PTFE. November 2016.

2.5. PhD thesis

1. Title: *Análisis de sistemas energéticos basados en gasificación de biomasa*

Author: Ana Isabel Susmozas Torres

Director: Dr. Javier Dufour and Dr. Diego Iribarren

Venue: Rey Juan Carlos University, Madrid, Spain

Date: 5 February 2016

2. Title: *Development of efficient Mn-based redox materials for thermochemical heat storage in concentrated solar power plants*

Author: Alfonso Carrillo del Teso

Director: Dr. Juan Coronado and Dr. Patricia Pizarro

Venue: Rey Juan Carlos University, Madrid, Spain

Date: 21 April 2016

3. Title: *Application of Ionic Liquids, Innovative Polymer Electrolytes and Novel Carbonaceous Materials in Supercapacitors*

Author: Girum Ayalneh Tiruye

Director: Dr. Rebeca Marcilla

Venue: Autónoma University of Madrid, Spain

Date: 23 May 2016

4. Title: *Integración de enzimas lacasas en el proceso de producción de etanol de lignocelulosa: efecto sobre la hidrólisis enzimática y la fermentación*

Author: Alfredo Oliva Taravilla

Director: Dr. Elia Tomás

Co-director: Dr. Marie Demuez

Venue: Complutense University of Madrid, Spain

Date: 1 July 2016

5. Title: *Biological tools to improve biogas production from microalgae biomass*

Author: Ahmed Mahdy

Director: Dr. Cristina González and Dr. Mercedes Ballesteros

Venue: Rey Juan Carlos University, Madrid, Spain

Date: 24 October 2016

2.6. Congress communications

2.6.1. Invited lectures

1. Title: *Metal Organic Frameworks for bioapplications*

Author: Horcajada, P. (Keynote)

Congress: Simposio Química Inorgánica: desde un enfoque multidisciplinario

Venue: UNAM, Mexico

Date: 3-4 March 2016

Organizer: UNAM

2. Title: *Introduction to the CASCATBEL project*

Author: Serrano, D.P. (Keynote)

Congress: Workshop Thermochemical Lignocellulose Conversion Technologies

Venue: Porto Carras, Chalkidiki, Greece

Date: 18-20 May 2016

Organizer: CERTH/CPERI; TUHH

3. Title: *Building a Better Environment by Doing Things Porely*

Author: Anderson, M.A. (Keynote)

Congress: Glass & Optical Materials Division (GOMD 2016)

Venue: Madison, USA

Date: 22-26 May 2016

Organizer: The American Ceramic Society

4. Title: *Enhancing Catalyst Performance for Bioethanol Photo-Reforming*

Author: Coronado, J.M. (Keynote)

Congress: First International Conference on New Photocatalytic Materials for Environment, Energy and Sustainability (NPM-1)

Venue: Göttingen, Germany

Date: 7-10 June 2016

Organizer: NPM

5. Title: *Design of zeolitic catalysts for the production of fuels and/or chemicals from waste plastics*

Author: Serrano, D.P. (Keynote)

Congress: Pre-Conference School on Zeolites

Venue: São Paulo, Brazil

Date: 17-18 June 2016

Organizer: IZC

6. Title: *High performance hybrid supercapacitors by using para-Benzoquinone ionic liquid redox electrolyte*

Author: Navalpotro, P.; Palma, J.; Anderson, M.; Marcilla, R. (Keynote)

Congress: 5th international Symposium on Energy Challenges & Mechanics-working on small scales (ECM5)

Venue: Inverness, Scotland, UK

Date: 10-14 July 2016

Organizer: North Sea Conference & Journal

7. Title: *Progress towards structural energy management using CNT fibre capacitive electrodes*

Author: Vilatela, J.J.; Senokos, E.; Reguero, V.; Palma, J.; Marcilla, R. (Keynote)

Congress: The 67th Annual Meeting of the International Society of Electrochemistry

Venue: The Hague, The Netherlands

Date: 21-26 August 2016

Organizer: ISE

8. Title: *Bioenergía a partir de microalgas*

Author: Ballesteros, M.

Congress: VI Congress de microbiología industrial y biotecnología microbiana

Venue: León, Spain

Date: 12-14 September 2016

Organizer: University of León

9. Title: *Challenges of the photocatalytic reforming of bioethanol*

Author: Rodríguez, A.; Fresno, F.; Jana, P.; Pizarro, P.; Serrano, D.P.; de la Peña-O'Shea, V.A.; Coronado, J.M. (Keynote)

Congress: 1st FOTOFUEL School & Conference: Current Challenges in Solar Fuels Production

Venue: Almería, Spain

Date: 25-27 October 2016

Organizer: Fotofuel Excellence Network

10. Title: *Current challenges in solar fuels production*

Author: de la Peña-O'Shea, V.A. (Keynote)

Congress: 1st FOTOFUEL School & Conference: Current Challenges in Solar Fuels Production

Venue: Almería, Spain

Date: 25-27 October 2016

Organizer: Fotofuel Excellence Network

2.6.2. Oral communications

1. Title: *Are Cyanobacteria comparable to microalgae in terms of wastewater treatment and biogas production?*

Author: Méndez, L.

Congress: Young Algaeneers Symposium 2016

Venue: Qawra, Saint Paul's Bay, Malta

Date: 23-25 April 2016

Organizer: PHOTO.COMM; AccliPhot

2. Title: *Feasibility Study for the Installation of On-Site Energy Resources in a Public Building*

Author: Gruber, J.K.; Favero, M.; Prodanovic, M.

Congress: 12th REHVA World Congress (CLIMA 2016)

Venue: Aalborg, Denmark

Date: 22-25 May 2015

Organizer: DANVAK; Aalborg University; REHVA

3. Title: *Revalorization of lipid extracted spirulina sp. biomass via anaerobic digestion: the effect of extraction solvents*

Author: Méndez, L.

Congress: 6th International Conference on Engineering for Waste and Biomass Valorisation (WasteEng'16)

Venue: Albi, France

Date: 23-26 May 2016

Organizer: WasteEng; MINES Albi-Carmaux



4. Title: *Laccase as versatile enzymes: from reducing glucose yields to enhancing ethanol production*

Author: Tomás-Pejó, E.; Oliva, A.; Moreno, A.D.; González-Fernández, C.; Ballesteros, M.

Congress: 12th International conference on Renewable Resources and Biorefineries (RRB-12)

Venue: Ghent, Belgium

Date: 30 May-1 June 2016

Organizer: University of Ghent

5. Title: *Performance of hierarchical ZSM in catalytic fast-pyrolysis of deashed wheat straw*

Author: Hernando, H.

Congress: 1st Workshop biomass resources for renewable energy production

Venue: Móstoles, Madrid, Spain

Date: 2-3 June 2016

Organizer: URJC; IMDEA Energy

6. Title: *Revalorization of microalgae biomass via anaerobic digestion*

Author: Méndez, L.

Congress: 1st Workshop biomass resources for renewable energy production

Venue: Móstoles, Madrid, Spain

Date: 2-3 June 2016

Organizer: URJC; IMDEA Energy

7. Title: *High-efficiency CSP plants based on thermos-electro-chemical conversion devices*

Autor/es: Díaz, E.; Martín, L.; Epstein, M.; González-Aguilar, J.; Romero, M.

Congress: 12th SOLLAB Doctoral Colloquium

Venue: Rodalquilar, Spain

Date: 6-8 June 2016

Organizer: Plataforma Solar de Almería (PSA)

8. Title: *Large scale vanadium redox flow battery: fast-tracking development*

Autor/es: Serrano, E.; Hernández, A.; Oraá, B.; Sánchez, A.; Miroslavov, V.; García-Quismondo, E.; Palma, J.

Congress: The International Flow Battery Forum (IFBF2016)

Venue: Karlsruhe, Germany

Date: 7-9 June 2016

Organizer: IFBF

9. Title: *Solar-driven pyrolysis and gasification of low-grade carbonaceous materials*

Autor/es: Arribas, L.; Arconada, N.; González-Fernández, C.; González-Aguilar, J.; Löhr, C.; Kaltschmitt, M.; Romero, M.

Congress: 21st World Hydrogen Energy Conference 2016 (WHEC2016)

Venue: Zaragoza, Spain

Date: 13-16 June 2016

Organizer: AEH2

10. Title: *Comparative life cycle assessment of a fuel cell electric vehicle replacing a battery electric vehicle for golf courses*

Author: Iribarren, D.; Martín, M.; Ramos, C.; Dufour, J.

Congress: 21st World Hydrogen Energy Conference (WHEC2016)

Venue: Zaragoza, Spain

Date: 13-16 June 2016

Organizer: AEH2

11. Title: *Techno-economic and environmental assessment of hydrogen production through indirect biomass gasification*

Author: Susmozas, A.; Iribarren, D.; Dufour, J.

Congress: 21st World Hydrogen Energy Conference (WHEC2016)

Venue: Zaragoza, Spain

Date: 13-16 June 2016

Organizer: AEH2

12. Title: *Harmonised life-cycle impacts of renewable hydrogen*

Author: Valente, A.; Iribarren, D.; Dufour, J.

Congress: 21st World Hydrogen Energy Conference (WHEC2016)

Venue: Zaragoza, Spain

Date: 13-16 June 2016

Organizer: AEH2

13. Title: *Study of synthesis of catalysts for high temperature WGS reaction by nanocasting using SBA-16 as hard template*

Author: Dufour, J.; Martos, C.; Ruiz, A.; Lameiro, A.

Congress: 21st World Hydrogen Energy Conference (WHEC2016)

Venue: Zaragoza, Spain

Date: 13-16 June 2016

Organizer: AEH2

14. Title: *Boosting photocatalytic CO₂ reduction: from inorganic semiconductors to hybrid multifunctional materials*

Author: Reñones, P.; Fresno, F.; Collado, L.; Liras, M.; García-Sánchez, A.; de la Peña-O'Shea, V.A.

Congress: 9th European meeting on Solar Chemistry and Photocatalysis: Environmental Applications (SPEA9)

Venue: Strasbourg, France

Date: 13-17 June 2016

Organizer: University of Strasbourg; CNRS

15. Title: *Phenol hydrodeoxygenation for bio-oil upgrading over metal phosphides supported on hierarchical zeolites*

Author: Berenguer, A.; Moreno, I.; Sankaranarayanan, T.M.; Linares, M.; Ochoa-Hernández, C.; Coronado, J.M.; Pizarro, P.; Serrano, D.P.

Congress: 18th International Zeolite Conference (IZC18)

Venue: Rio de Janeiro, Brazil

Date: 15-25 June 2016

Organizer: IZC

16. Title: *Metal oxides-containing pillared ZSM-5 for upgrading of bio-oil from lignocellulose fast-pyrolysis*

Author: Ochoa-Hernández, C.; Přecha, J.; Čejka, J.; Feroso, J.; Hernando, H.; Moreno, I.; Pizarro, P.; Coronado, J.M.; Serrano D.P.

Congress: 18th International Zeolite Conference (IZC18)

Venue: Rio de Janeiro, Brazil

Date: 15-25 June 2016

Organizer: IZC

17. Title: *Biofuel production by hydroprocessing of oleic acid over zeolitic Ni/catalysts: influence of the support*

Author: Botas, J.A.; Escola, J.M.; Serrano, D.P.; Paredes, B.; López-Domínguez, M.

Congress: 18th International Zeolite Conference (IZC18)

Venue: Rio de Janeiro, Brazil

Date: 15-25 June 2016

Organizer: IZC

18. Title: *Solar thermochemical heat storage based on redox cycles of BaO₂/BaO: Re-evaluating an old concept*

Author: Carrillo, A.J.; Sastre, D.; Serrano, D.P.; Pizarro, P.; Coronado, J.M.

Congress: ASME Energy Sustainability Conference

Venue: Charlotte, USA

Date: 27-30 June 2016

Organizer: ASME



19. Title: *Development of rechargeable aluminium batteries*

Author: Muñoz-Torrero, D.; Palma, P.; Marcilla, R.

Congress: XXXVII Reunión del Grupo de Electroquímica de la Real Sociedad Española de Química

Venue: Alicante, Spain

Date: 17-20 July 2016

Organizer: RSEQ

20. Title: *State Forecasting and Operational Planning for Distribution Network Energy Management Systems*

Author: Hayes, B.; Prodanovic, M.

Congress: 2016 IEEE Power & Energy Society General Meeting

Venue: Boston, USA

Date: 17-21 July 2016

Organizer: IEEE

21. Title: *New insight into solar fuels production by artificial photosynthesis*

Author: Collado, L.; Reñones, P.; García-Sánchez, A.; Liras, M.; Fresno, F.; de la Peña-O'Shea, V.A.

Congress: 21st International Conference on Photochemical Conversion and Storage of Solar Energy (IPS-21)

Venue: St. Petersburg, Russia

Date: 25-29 July 2016

Organizer: St. Petersburg State University

22. Title: *Polymer electrolytes based on ionic liquids and their combination with multifunctional electrodes in electric double layer capacitors*

Author: Senokos, E.; Tiruye, G.A.; Palma, J.; Vilatela, J.J.; Marcilla, R.

Congress: XV International Symposium on Polymer Electrolytes (ISPE-XV)

Venue: Uppsala, Sweden

Date: 15-19 August 2016

Organizer: Uppsala University; Chalmers University of Technology

23. Title: *Operational experience of 5 kW All-Vanadium flow battery in photovoltaic grid applications*

Author: García- Quismondo, E.; Almonacid, I.; Miroslavov, V.; Palma, J.; Anderson, M.; Serrano, E.; Hernández, A.; Oraá, B.

Congress: The 67th Annual Meeting of the International Society of Electrochemistry

Venue: The Hague, The Netherlands

Date: 21-26 August 2016

Organizer: ISE

24. Title: *Development of multifunctional EDLC based on macroscopic fibres of CNTs*

Author: Senokos, E.; Reguero, V.; Palma, J.; Vilatela, J.J.; Marcilla, R.

Congress: The 67th Annual Meeting of the International Society of Electrochemistry

Venue: The Hague, The Netherlands

Date: 21-26 August 2016

Organizer: ISE

25. Title: *Hydrodeoxygenation of bio-oil model compounds over Ni_2P supported on 2D ZSM-5 zeolites*

Author: Gutiérrez S.; Moreno I.; Berenguer A.; Přeč J.; Ochoa-Hernández C.; Pizarro P.; Coronado J.M.; Čejka, J.; Serrano D.P.

Congress: V International Workshop on Layered Materials

Venue: Kutná Hora, Czech Republic

Date: 5-9 September 2016

Organizer: Jiří Čejka

26. Title: *Catalytic fast pyrolysis of lignocellulosic biomass over 2D ZSM-5 pillared with different metal oxides*

Author: Hernando H.; Ochoa-Hernández C.; Přeč J.; Fermoşo J.; Pizarro P.; Coronado J.M.; Serrano D.P.; Čejka J.

Congress: V International Workshop on Layered Materials

Venue: Kutná Hora, Czech Republic

Date: 5-9 September 2016

Organizer: Jiří Čejka

27. Title: *Solar Fuels Production from H_2O and CO_2 Splitting by Thermochemical Redox Cycles with Perovskites*

Author: Sastre, D.; Carrillo, A.; Serrano, D.P.; Pizarro, P.; Coronado, J.M.

Congress: 3rd International Symposium on Catalysis for Clean Energy and Sustainable Chemistry (CCESC 2016)

Venue: Madrid, Spain

Date: 7-9 September 2016

Organizer: CSIC; AEH2; EQS

28. Title: *Photoreduction of CO_2 using hybrid heterojunction photocatalysts*

Author: Reñones, P.; Fresno, F.; Collado, L.; García-Sánchez, A.; Liras, M.; de la Peña-O'Shea, V.A.

Congress: 3rd International Symposium on Catalysis for Clean Energy and Sustainable Chemistry (CCESC 2016)

Venue: Madrid, Spain

Date: 7-9 September 2016

Organizer: CSIC; AEH2; EQS

29. Title: *Conjugated microporous polymer based on dithienothiophene moieties and TiO_2 hybrid materials as CO_2 photoreduction catalyst*

Author: Liras, M.; García, A.; Reñones, P.; Fresno, F.; de la Peña-O'Shea, V.A.

Congress: Vth Spanish-Portuguese Photochemistry Conference

Venue: Toledo, Spain

Date: 7-10 September 2016

Organizer: University of Castilla La Mancha

30. Title: *New insight in Artificial Photosynthesis: from inorganic semiconductors to hybrid multifunctional materials*

Author: Liras, M.; García, A.; Reñones, P.; Fresno, F.; de la Peña-O'Shea, V.A.

Congress: 6th EUCHEMS Chemistry Congress

Venue: Seville, Spain

Date: 11-15 September 2016

Organizer: EuCheMS; Anque

31. Title: *Conjugated microporous polymer based on dithienothiophene moieties and TiO_2 hybrid materials as CO_2 photoreduction catalyst*

Author: Liras, M.; García, A.; Reñones, P.; Fresno, F.; de la Peña O'Shea, V.A.

Congress: 6th EUCHEMS Chemistry Congress

Venue: Seville, Spain

Date: 11-15 September 2016

Organizer: EuCheMS; Anque

32. Title: *Zinc pyrazolate MOF nanoparticles for the delivery of anticancer drugs*

Author: Rojas, S.; Horcajada, P.; Serre, C.; Carmona, J.; Maldonado, C.R.; Rodríguez-Navarro, J.A.; Barea, E.

Congress: 6th EuCheMS Chemistry Congress

Venue: Seville, Spain

Date: 11-15 September 2016

Organizer: EuCheMS; Anque

33. Title: *A Unified Control of Back-to-Back Converter*

Author: Rodríguez-Cabero, A.; Huerta, F.; Prodanovic, M.

Congress: IEEE Energy Conversion Congress & Expo (ECCE)

Venue: Milwaukee, USA

Date: 18-22 September 2016

Organizer: IEEE

34. Title: *Efecto del estrés mecánico sobre *Kluyveromyces marxianus* y *Saccharomyces cerevisiae* en procesos de producción de bioetanol*

Author: Salor, J.M.; Ballesteros, M.; Tomás-Pejó, E.

Congress: XVIII Reunión de la Red Lignocell

Venue: Jaén, Spain

Date: 6-7 October 2016

Organizer: Red Lignocell

35. Title: *Event-triggered Topology Identification for State Estimation in Active Distribution Networks*

Author: Prodanovic, M.; Hayes, B; Escalera, A.

Congress: Innovative Smart Grids Technologies 2016 (ISGT2016)

Venue: Ljubljana, Slovenia

Date: 9-12 October 2016

Organizer: IEEE

36. Title: *Performance comparison of different thermodynamic cycles for an innovative central receiver solar power plant*

Author: Reyes-Belmonte, M.A.; Sebastián, A.; González-Aguilar, J.; Romero, M.

Congress: SolarPACES 2016

Venue: Abu Dhabi, UAE

Date: 11-14 October 2016

Organizer: SOLARPACES

37. Title: *Heat exchanger modelling in central receiver solar power plant using dense particle suspension*

Author: Reyes-Belmonte, M.A.; Gómez-García, F.; González-Aguilar, J.; Romero, M.; Benoit, H.; Flamant, G.

Congress: SolarPACES 2016

Venue: Abu Dhabi, UAE

Date: 11-14 October 2016

Organizer: SOLARPACES

38. Title: *A parametric experimental study of aerothermal performance and efficiency in monolithic volumetric absorbers*

Author: Luque, S.; Bai, F.; González-Aguilar, J.; Wang, Z.; Romero, M.

Congress: SolarPACES 2016

Venue: Abu Dhabi, UAE

Date: 11-14 October 2016

Organizer: SOLARPACES

39. Title: *Ultra-Modular 500m² heliostat field for high flux/high temperature solar-driven processes*

Author: Romero, M.; González-Aguilar, J.; Luque, S.

Congress: SolarPACES 2016

Venue: Abu Dhabi, UAE

Date: 11-14 October 2016

Organizer: SOLARPACES

40. Title: *Macro-encapsulation of inorganic salts as phase change materials for thermal energy storage*

Author: Arconada, N.; González-Aguilar, J.; Romero, M.

Congress: ISES International Conference on Solar Energy for Buildings and Industry

Venue: Palma de Mallorca, Spain

Date: 12-14 October 2016

Organizer: ISES

41. Title: *Impacto de la integración de recursos energéticos distribuidos en la mejora de la continuidad del suministro eléctrico de las Smart Grids*

Author: Escalera, A.; Hayes, B.; Prodanovic, M.

Congress: III Congreso Smart Grids

Venue: Madrid, Spain

Date: 18-19 October 2016

Organizer: GRUPOTECMARED

42. Title: *Stability Analysis for Weak Grids with Power Electronics Interfaces*

Author: Rodríguez-Cabero, A.; Prodanovic, M.

Congress: 42nd Annual Conference of IEEE Industrial Electronics Society (IECON)

Venue: Florence, Italy

Date: 24-27 October 2016

Organizer: IEEE

43. Title: *Hybrid photocatalysts applied to the reduction of CO₂*

Author: Reñones, P.; Fresno, F.; Collado, L.; García-Sánchez, A.; Liras, M.; de la Peña-O'Shea, V.A.

Congress: 1st FOTOFUEL School & Conference: Current Challenges in Solar Fuels Production

Venue: Almería, Spain

Date: 25-27 October 2016

Organizer: Fotofuel Excellence Network

44. Title: *FOTOFUEL: A network facing the new challenges in Solar Fuels Production*

Author: Fresno, F.

Congress: 1st FOTOFUEL School & Conference: Current Challenges in Solar Fuels Production

Venue: Almería, Spain

Date: 25-27 October 2016

Organizer: Fotofuel Excellence Network

45. Title: *ALGAEUROPE*

Author: González-Fernández, C.; Gouveia, L.; Muñoz-Torre, R.; Torzillo, G.; Muylaert, K.; Hayes, M.; Vidovic, S.; Kleinegris, D.; Klemenčič, M.; Refardt, D.

Congress: COST Action ES1408: European Network for Algal-Bioproductions

Venue: Móstoles, Madrid, Spain

Date: 5-7 December 2016

Organizer: COST action

46. Title: *Towards a robust life cycle assessment of end-of-life strategies for fuel cells and hydrogen technologies*

Author: Valente, A.; Martín-Gamboa, M.; Iribarren, D.; Dufour, J.

Congress: III Simposio de la Red Española de ACV

Venue: Valencia, Spain

Date: 4 November 2016

Organizer: Red Española de ACV

47. Title: *Evolution of life-cycle indicators through energy systems modelling: A focus on power generation*

Author: García-Gusano, D.; Martín-Gamboa, M.; Iribarren, D.; Dufour, J.

Congress: III Simposio de la Red Española de ACV

Venue: Valencia, Spain

Date: 4 November 2016

Organizer: Red Española de ACV

2.6.3. Poster communications

1. Title: *Boosting energy storage performance of commercial Fe_3O_4 nanoparticles by facile anchoring on rGO nanosheets*

Author: Sánchez, J.; Pendashteh, A.; Palma, J.; Anderson, M.; Marcilla, R.

Congress: Graphene 2016

Venue: Genoa, Italy

Date: 19-22 April 2016

Organizer: Phantoms foundation; ICN2; UCL; IIT

2. Title: *Lessons from the endogenous integration of life-cycle indicators into national energy models*

Author: García, D.; Iribarren, D.; Martín, M.; Lind, A.; Espregren, K.; Dufour, J.

Congress: SETAC Europe 26th Annual Meeting

Venue: Nantes, France

Date: 22-26 May 2016

Organizer: SETAC Europe

3. Title: *Prospective performance indicators of electricity production in Spain*

Author: García, D.; Garraín, D.; Iribarren, D.; Cabal, H.; Dufour, J.

Congress: SETAC Europe 26th Annual Meeting

Venue: Nantes, France

Date: 22-26 May 2016

Organizer: SETAC Europe

4. Title: *Screening of sustainability indicators for conventional renewable energy systems (Poster spotlight)*

Author: Garraín, D.; Iribarren, D.; Fuss, M.; Cao, F.; Poganietz, W-R.; Dufour, J.; Lechón, Y.

Congress: SETAC Europe 26th Annual Meeting

Venue: Nantes, France

Date: 22-26 May 2016

Organizer: SETAC Europe



5. Title: *Novel tools and methodological advances in modelling and analysing the sustainability of future energy systems: Outcomes of the SuReTool project*

Author: García, D.; Iribarren, D.; Martín, M.; Lind, A.; Espegren, K.; Dufour, J.

Congress: International Outreach and Closure Event of the NILS Science and Sustainability Programme

Venue: Madrid, Spain

Date: 26 May 2016

Organizer: NILS project

6. Title: *Simulation of bio-oil production through catalytic fast pyrolysis of lignocellulosic biomass*

Author: Montero, E.; Iribarren, D.; Dufour, J.

Congress: 1st Workshop biomass resources for renewable energy production

Venue: Móstoles, Madrid, Spain

Date: 2-3 June 2016

Organizer: URJC; IMDEA Energy

7. Title: *CFD thermal model validation of a lab-scale solar reactor*

Author: Tapia, E.; Bellan, S.; Iranzo, A.; González-Aguilar, J.; Pino, F.J.; Rosa, F.; Salva, J.A.

Congress: 21st World Hydrogen Energy Conference 2016 (WHEC2016)

Venue: Zaragoza, Spain

Date: 13-16 June 2016

Organizer: AEH2

8. Title: *FOTOFUEL: An excellence network facing the new challenges in artificial photosynthesis*

Author: de la Peña-O'Shea, V.A.; Fresno, F.; Fierro, J.L.G.; Llobet, A.; García, H.; Vilatela, J.J.; García-Aranda, M.A.; Illas, F.; Giménez, S.; Malato, S.

Congress: 9th European meeting on Solar Chemistry and Photocatalysis: Environmental Applications (SPEA9)

Venue: Strasbourg, France

Date: 13-17 June 2016

Organizer: Universidad de Strasbourg; CNRS

9. Title: *Reliability assessment of active distribution networks considering distributed energy resources and operational limits*

Author: Escalera, A.; Hayes, B.; Prodanovic, M.

Congress: CIRED 2016

Venue: Helsinki, Finland

Date: 14-15 June 2016

Organizer: The IET

10. Title: *Híbrid hydrolysis and fermentation: implementing laccase detoxification in the ethanol process*

Author: Oliva-Taravilla, A.; Tomás-Pejó, E.; Demuez, M.; González-Fernández, C.; Ballesteros, M.

Congress: 4th Symposium on Biotechnology applied to Lignocelluloses

Venue: Madrid, Spain

Date: 19-22 June 2016

Organizer: CSIC

11. Title: *SiC-based monolithic receivers for concentrating solar power plants*

Author: Portela, R.; González-Aguilar, J.; Ávila, P.; Romero, M.

Congress: 5th International Conference on Structured Catalysts and Reactors (ICOSCAR5)

Venue: Donostia-San Sebastián, Spain

Date: 21-24 June 2016

Organizer: Public University of Navarra; University of the Basque Country; University of Seville

12. Title: *Biomass Catalytic Fast-Pyrolysis over MgO and ZnO Supported on Hierarchical Zeolites*

Author: Feroso, J.; Hernando, H.; Jiménez, S.; Moreno, I.; Jana, P.; Pizarro, P.; Coronado, J.M.; Serrano, D.P.

Congress: 18th International Zeolite Conference (IZC18)

Venue: Rio de Janeiro, Brazil

Date: 15-25 June 2016

Organizer: IZC

13. Title: *Hybrid hydrolysis and fermentation: implementing laccase detoxification in the ethanol process*

Author: Tomás Pejó, E.

Congress: 4th Symposium on Biotechnology applied to Lignocelluloses (LignoBiotech2016)

Venue: Madrid, Spain

Date: 19-22 June 2016

Organizer: CSIC

14. Title: *Fotorreducción de CO₂ por medio de catalizadores híbridos*

Author: Reñones, P.; Fresno, F.; García-Sánchez, A.; Liras, M.; Collado, L.; de la Peña-O'Shea, V.A.

Congress: II Encuentro Jóvenes Investigadores de la SECAT

Venue: Ciudad Real, Spain

Date: 27-29 June 2016

Organizer: SECAT

15. Title: *Synthesis of multifunctional hybrid materials: in the way to artificial photosynthesis*

Author: García-Sánchez, A.; Reñones, P.; Fresno, F.; Liras, M.; de la Peña-O'Shea, V.A.

Congress: Valorización química sostenible de CO₂

Venue: Santander, Spain

Date: 27-30 June 2016

Organizer: University of Cantabria

16. Title: *Optimización de electrolitos poliméricos basados en líquidos iónicos para supercondensadores*

Author: Muñoz-Torrero, D.; Tiruye, G.A.; Palma, J.; Anderson, M.; Marcilla, R.

Congress: XXXVII Reunión del Grupo de Electroquímica de la Real Sociedad Española de Química

Venue: Alicante, Spain

Date: 17-20 July 2016

Organizer: RSEQ

17. Title: *FOTOFUEL: An excellence network facing the new challenges in artificial photosynthesis*

Authors: de la Peña O'Shea, V.A.; Fresno, F.; Fierro, J.L.G.; Llobet, A.; García, H.; Vilatela, J.J.; García-Aranda, M.; Illas, F.; Giménez, S.; Malato, S.

Congress: 21st International Conference on Photochemical Conversion and Storage of Solar Energy (IPS-21)

Venue: St. Petersburg, Russia

Date: 25-29 July 2016

Organizer: St. Petersburg State University

18. Title: *Hydrodeoxygenation of guaiacol and propionic acid blends as bio-oil model over Ni-supported catalysts*

Author: Sankaranarayanan, T.M.; Kreider, M.; Berenguer, A.; Moreno, I.; Pizarro, P.; Coronado, J.M.; Serrano, D.P.

Congress: 3rd International Symposium on Catalysis for Clean Energy and Sustainable Chemistry (CCESC 2016)

Venue: Madrid, Spain

Date: 7-9 September 2016

Organizer: CSIC; AEH2; EQS

19. Title: *Soluciones alternativas al control predictivo basado en modelo de Volterra*

Author: Gruber, J.K.; Peñarrocha, I.

Congress: XXXVII Jornadas de Automática

Venue: Madrid, Spain

Date: 7-9 September 2016

Organizer: UCM, UNED, UPM, UC3M, CSIC

20. Title: *Conjugated microporous polymer based on dithienothiophene moieties and TiO₂ hybrid materials as CO₂ photoreduction catalyst*

Author: Liras, M.; García, A.; Reñones, P.; Fresno, F.; de la Peña-O'Shea, V.A.

Congress: Vth Spanish-Portuguese Photochemistry Conference

Venue: Toledo, Spain

Date: 7-10 September 2016

Organizer: Universidad Castilla La Mancha

21. Title: *Zinc pyrazolate MOF nanoparticles for the delivery of anticancer drugs*

Author: Rojas, S.; Horcajada, P.; Serre, C.; Carmona, J.; Maldonado, C.R.; Rodríguez-Navarro, J.A.; Barea, E.

Congress: 6th EuCheMS Chemistry Congress

Venue: Seville, Spain

Date: 11-15 September 2016

Organizer: EuCheMS; Anque

22. Title: *Efecto del estrés mecánico sobre Kluyveromyces marxianus y Saccharomyces cerevisiae en procesos de producción de bioetanol*

Author: Salor, J.M.

Congress: VI congreso de microbiología industrial y biotecnología microbiana

Venue: León, Spain

Date: 12-14 September 2016

Organizer: University of León

23. Title: *Round robin test on the measurement of the specific heat of solar salt*

Author: Muñoz-Sánchez, B.; Nieto-Maestre, J.; González-Aguilar, J.; Julia, J.E.; Navarrete, N.; Faik, A.; Bauer, T.; Bonk, A.; Navarro, M.E.; Ding, Y.; Uranga, N.; Veca, E.; Sau, S.; Giménez, P.; García, P.; Burgaleta, J.I.

Congress: SolarPACES 2016

Venue: Abu Dhabi, UAE

Date: 11-14 October 2016

Organizer: SOLARPACES

24. Title: *Round robin test on enthalpies of redox materials for thermochemical heat storage*

Author: González-Aguilar, J.; Coronado, J.M.; Nieto-Maestre, J.; Cabeza, L.F.; Lanchi, M.; Sau, S.; Navarro, H.; Ding, Y.; Prieto, C.; Seneca, O.; Tregambi, C.; Wokon, M.

Congress: SolarPACES 2016

Venue: Abu Dhabi, UAE

Date: 11-14 October 2016

Organizer: SOLARPACES

25. Title: *Nuevas estrategias de integración de consorcios microalga-bacteria en plantas de tratamiento de aguas residuales urbanas de pequeño tamaño. "MICROALBAC"*

Author: Tormos, I.; Miguel, D.; Chacón, L.; Berlanga, J.G.; Ballesteros, M.; González-Fernández, C.; García, C.; Hernández, M.T.

Congress: XI Congreso Internacional de la Asociación Española de Desalación y Reutilización (AEDyR)

Venue: Valencia, Spain

Date: 19-21 October 2016

Organizer: AEDyR

26. Title: *Niobium and tantalum perovskites as photocatalysts for CO₂ reduction*

Author: Fresno, F.; Jana, P.; Reñones, P.; Coronado, J.M.; Serrano, D.P.; de la Peña-O'Shea, V.A.

Congress: 1st FOTOFUEL School & Conference: Current Challenges in Solar Fuels Production

Venue: Almería, Spain

Date: 25-27 October 2016

Organizer: Fotofuel Excellence Network

27. Title: *Conjugated microporous polymer based on Dithienothiophene moiety and TiO₂ hybrid materials as artificial photosynthesis catalyst*

Author: García-Sánchez, A.; Liras, M.; Reñones, P.; Fresno, F.; de la Peña-O'Shea, V.A.

Congress: 1st FOTOFUEL School & Conference: Current Challenges in Solar Fuels Production

Venue: Almería, Spain

Date: 25-27 October 2016

Organizer: Fotofuel Excellence Network

28. Title: *Design and synthesis of conjugated microporous polymer based on BOPHY moieties: looking for new organic photocatalyst*

Author: García, C.; Liras, M.; de la Peña-O'Shea, V.A.

Congress: 1st FOTOFUEL School & Conference: Current Challenges in Solar Fuels Production

Venue: Almería, Spain

Date: 25-27 October 2016

Organizer: Fotofuel Excellence Network

3. Training and dissemination activities

3.1. Mobility actions

IMDEA Energy researchers

Stay at DLR Cologne, Germany

Period: 3 months, 2016

Funding Institution: European Union (STAGE-STE project)

Ms. Sandra Álvarez

Stay at University of Tennessee, Knoxville, USA

Period: 3 months, 2016

Funding Institution: Ministry of Education, Culture and Sports

Dr. Barry Hayes

Stay at UK Biochar Research Center, University of Edinburgh, United Kingdom

Period: 3 months, 2016

Funding Institution: Iberdrola Foundation

Dr. Javier Feroso

Stay at University of Aston, United Kingdom

Period: 3 months, 2016

Funding Institution: Ministry of Economy and Competitiveness

Mr. Antonio Berenguer

Stay at LEPABE-FEUP, University of Porto, Portugal

Period: 3 months, 2016

Funding Institution: Rey Juan Carlos University

Mr. Pedro Cruz

Stay at ESRF synchrotron, Grenoble, France

Period: 1 month, 2016

Funding Institution: IMDEA Energy Institute

Dr. Patricia Horcajada

Visiting researchers

Mr. Hadrien Benoit

Origin Institution: PROMES-CNRS, France

Host Unit: High Temperature Processes Unit

Period: 3 months, 2016

Activity: Development of a simplified model for an up-scaled solar receiver with air charged in particles as heat transfer fluid

Mr. Adlane Tahar, PhD Student

Origin Institution: Center of Research in Physical and Chemical Analysis (CRAPC), Algeria

Host Unit: Thermochemical Processes Unit

Period: 1 month, 2016

Activity: Testing photocatalysts samples prepared in CRAPC for CO₂ and water splitting

Mr. Mohammed Kebir, PhD Student

Origin Institution: Center of Research in Physical and Chemical Analysis (CRAPC), Algeria

Host Unit: Thermochemical Processes Unit

Period: 2 months, 2016

Activity: Testing photocatalysts samples prepared in CRAPC for CO₂ and water splitting

Ms. Martina di Palma, ERASMUS+ Student

Origin Institution: University of Cassino and Southern Lazio, Italy

Host Unit: Systems Analysis Unit

Period: 7 months, 2016

Activity: Life cycle assessment of hydrogen energy systems

Ms. Tania Hidalgo

Origin Institution: Institut Lavoisier, France

Host Unit: Advanced Porous Materials Unit

Period: 4,5 months, 2016

Activity: Characterization of porous metal-organic frameworks

Ms. Minoo Tasbihi

Origin Institution: Technische Universitat Berlin, Germany

Host Unit: Photoactivated Processes Unit

Period: 1 week, 2016

Activity: Comparative experiments of CO₂ photocatalytic reduction

Mr. Jan Engelhardt, PhD. Student

Origin Institution: Max Planck Institut Fur Kohlenforschung, Germany

Host Unit: Thermochemical Processes Unit

Period: 3 weeks, 2016

Activity: Perform reactions of catalytic hydrogeoxygenation of real bio-oils in the continuous fixed bed reactor (Microactivity), within the framework of CASCATBEL project

Mr. Pascual Márquez, PhD. Student

Origin Institution: Massachusetts Institute of Technology, USA

Host Unit: Photoactivated Processes Unit

Period: 5 weeks, 2016

Activity: Photoelectrochemical measures of hybrid catalysts

Ms. Reva Butensky, PhD. Student

Origin Institution: Massachusetts Institute of Technology, USA

Host Unit: Electrochemical Processes Unit

Period: 2 months, 2016

Activity: Lithium-ion battery testing

Mr. Juan Jaramillo, PhD. Student

Origin Institution: Massachusetts Institute of Technology, USA

Host Unit: Thermochemical Processes Unit

Period: 3 weeks, 2016

Activity: Production of advanced biofuels

Ms. Cristina Fernández, PhD. Student

Origin Institution: University of Santiago de Compostela, Spain

Host Unit: Advanced Porous Materials Unit

Period: 2 weeks, 2016

Activity: Synthesis and characterization of nanoparticulate porous hybrid solids

Mr. Aurélien Bodin, PhD. Student

Origin Institution: ERDF/ ITII Pays de la Loire, France

Host Unit: High Temperature Processes Unit

Period: 2 months, 2016

Activity: Design, maintenance and operation of high-flux solar simulators

Mr. Qing Li, PhD. Student

Origin Institution: Institute of Electrical Engineering, Chinese Academy of Sciences

Host Unit: High Temperature Processes Unit

Period: 1 month, 2016

Activity: Numerical analysis on atmospheric volumetric receivers

Ms. Olalla Iglesias

Origin Institution: University of Cantabria, Spain

Host Unit: Photoactivated Processes Unit

Period: 3 months, 2016

Activity: Water splitting+CO₂ reduction using composites

Mr. Andrés Peña, PhD. Student

Origin Institution: Carlos III University of Madrid, Spain

Host Unit: Electrical Systems Unit

Period: 2 months, 2016

Activity: Protocols testing the battery with the inverter, integrating the battery into the micro-grid and developing an EMS for micro-grid management

Mr. Ntuthuku Wonderboy, PhD. Student

Origin Institution: University of Western Cape, South Africa

Host Unit: Thermochemical Processes Unit

Period: 6 months, 2016

Activity: Preparation of materials for thermo-chemical and electrochemical storage

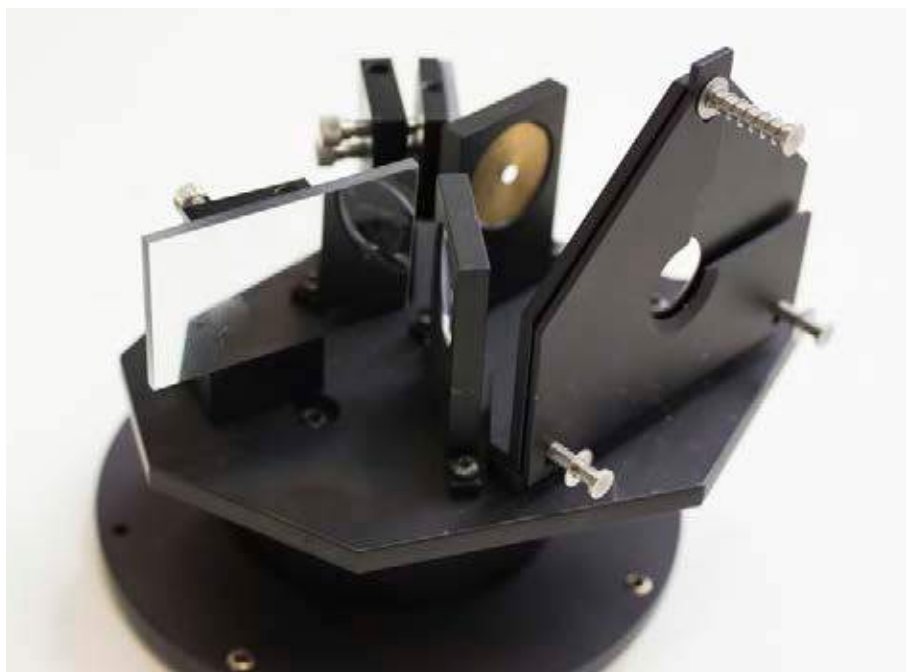
Mr. Mohammed Amouri, PhD. Student

Origin Institution: Centre Developpement des Energies Renouvelable, Algeria

Host Unit: Systems Analysis Unit

Period: 9 months, 2016

Activity: Development a biodiesel supply chain in Algeria using Decision-making tolos contribution



3.2. Organization of dissemination activities

1. 13ª Reunión plenaria de la Comunidad AEC Innovación. "Instrumentos de financiación de la innovación"

Author: Serrano, D.P.; Romero, M.; Marcilla, R.; Cachola, M.

Venue: IMDEA Energy Institute, Móstoles, Madrid, Spain

Date: 9 February 2016

Organizer: AEC; IMDEA Energy

2. 1st EUALGAE Workshop of algae bioproducts for early career investigators

Author: Jóvenes investigadores de la red

Venue: Valladolid, Spain

Date: 4 April 2016

Organizer: University of Valladolid; IMDEA Energy

3. International workshop rapid prototyping for smartgrids

Venue: IMDEA Energy Institute, Madrid, Spain

Date: 26 April 2016

Organizer: Triphase; IMDEA Energy

4. Workshop: Space applications focused to energy sector

Venue: IMDEA Energy Institute, Móstoles, Madrid, Spain

Date: 12 May 2016

Organizer: Madrid Aerospace; Madrid Network; IMDEA Energy

5. 1st Workshop biomass resources for renewable energy production

Venue: IMDEA Energy Institute, Móstoles, Madrid, Spain

Date: 2-3 June 2016

Organizer: URJC; IMDEA Energy

6. Workshop ALCCONES/STAGE-STE: Thermal storage for solar thermal concentrating plants

Venue: IMDEA Energy Institute, Móstoles, Madrid, Spain

Date: 14 September 2016

Organizer: CIEMAT; IMDEA Energy

7. Meeting Carlos III University-IMDEA Energy

Venue: IMDEA Energy Institute, Móstoles, Madrid, Spain

Date: 19 October 2016

Organizer: IMDEA Energy

8. Meeting Rey Juan Carlos University-IMDEA Energy

Venue: IMDEA Energy Institute, Móstoles, Madrid, Spain

Date: 25 October 2016

Organizer: IMDEA Energy

9. 1st FOTOFUEL Summer School and Conference: Current Challenges in Solar Fuels Production

Venue: Almería, Spain

Date: 25-27 October 2016

Organizer: IMDEA Energy

10. 5th Annual Workshop of Young Researchers of IMDEA Energy Institute

Venue: IMDEA Energy Institute, Móstoles, Madrid, Spain

Date: 16 December 2016

Organizer: IMDEA Energy



3.3. Organization of internal training activities

1. Oral presentation: Reliability assessment of distribution networks

Speaker: Alberto Escalera (IMDEA Energy)

Date: 29/01/2016

2. Oral presentation: How did I become an energy systems modeller. From my scientific background to the numbers I defend

Speaker: Dr. Diego García (IMDEA Energy)

Date: 29/01/2016

3. Lecture: Solar thermo-chemical charging of batteries for energy storage and conversion to electricity

Speaker: Dr. Michael Epstein (IMDEA Energy)

Date: 12/02/2016

4. Oral presentation: Biorefinery concept: biomass to high value products

Speaker: Esperanza Montero (IMDEA Energy)

Date: 26/02/2016

5. Oral presentation: Photoactive polymers

Speaker: Dr. Marta Liras (IMDEA Energy)

Date: 26/02/2016

6. Lecture: Energy Storage: Challenges and Opportunities in an Evolving Lithium Economy

Speaker: Michael M. Thackeray (Illionis, USA)

Date: 07/03/2016

7. Oral presentation: Turbomachinery: From automotive point of view to power generation on CSP plants

Speaker: Dr. Miguel A. Reyes (IMDEA Energy)

Date: 18/03/2016

8. Oral presentation: Fuels production by artificial photosynthesis

Speaker: Patricia Reñones (IMDEA Energy)

Date: 18/03/2016

9. Oral presentation: Materials overview from chemistry of surfaces

Speaker: Dr. Noemí Arconada (IMDEA Energy)

Date: 22/04/2016

10. Oral presentation: Aluminium: a real alternative

Speaker: David Muñoz-Torrero (IMDEA Energy)

Date: 22/04/2016

11. Lecture: Raman spectroscopy, a versatile instrument for in situ and real time operando studies of catalytic materials and reactions

Speaker: Dr. Miguel A. Bañares (ICP-CSIC)

Date: 13/05/2016

12. Oral presentation: Metal organic frameworks: from synthesis to applications

Speaker: Dr. Patricia Horcajada (IMDEA Energy)

Date: 20/05/2016

13. Oral presentation: Solar fuels production via H_2O & CO_2 splitting with perovskites

Speaker: Daniel Sastre (IMDEA Energy)

Date: 20/05/2016

14. Lecture: The design, construction and research possibilities of the University of Sheffield's 2MW/1MWh grid connected LTO battery

Speaker: Prof. Peter Hall (University of Sheffield, United Kingdom)

Date: 24/05/2016

15. Lecture: Multifunctional Lanthanide-Organic Frameworks based on phosphonate organic linkers

Speaker: Dr. Sergio Vilela (IMDEA Energy)

Date: 24/06/2016

16. Lecture: Graphene-based materials for hybrid energy storage devices

Speaker: Jaime Sánchez (IMDEA Energy)

Date: 24/06/2016

17. Lecture: Porous Coordination Polymers (PCPS / MOFs): what can be done with the organic part

Speaker: Dr. Thomas Devic (Institut Lavoisier, France)

Date: 01/07/2016

18. Lecture: Hidrógeno y Pilas de Combustible para un Desarrollo Sostenible

Speaker: Dr. Antonio González García-Conde (INTA)

Date: 15/07/2016

19. Lecture: Microalgae technology for energy production and environmental management

Speaker: Dr. Ignacio de Godos (IMDEA Energy)

Date: 21/07/2016

20. Lecture: Catalytic fast-pyrolysis of lignocellulosic biomass for the production of bio-fuels

Speaker: Sergio Jiménez (IMDEA Energy)

Date: 21/07/2016

21. Lecture: Batteries: Frequently Asked Questions

Speaker: Dr. Jesús Palma (IMDEA Energy)

Date: 23/09/2016

22. Lecture: New strategies for integration of microalgae-bacteria consortia in wastewater treatment plants

Speaker: Santiago Barreiro (IMDEA Energy)

Date: 23/09/2016

23. Lecture: Temperature measurements in gas turbines

Speaker: Dr. Salvador Luque (IMDEA Energy)

Date: 21/10/2016

24. Lecture: Stability Analysis for Weak Grids with Power Electronics Interfaces

Speaker: Alberto Rodríguez (IMDEA Energy)

Date: 21/10/2016

25. Lecture: Li-ion batteries; high energy density at all costs?

Speaker: Dr. Edgar Ventosa (Analytical Chemistry-Center for Electrochemical Sciences (CES), Ruhr-Universität Bochum, Germany)

Date: 04/11/2016

3.4. Participation in science and dissemination activities

1. GENERA 2016

a) Technical workshop: Avances y retos en Tecnología y despliegue comercial de Centrales Solares Termoeléctricas.

Speaker: Romero, M.

b) Science and technology forums

Conference: SUNlight-to-LIQUID Project: Integrated solar-thermochemical synthesis of liquid hydrocarbon.

Speaker: Romero, M.

Venue: IFEMA, Madrid, Spain

Date: 16 June 2016

Organizer: Madri+d Foundation

2. European researchers' night 2016

Activity: The energy game

Venue: IMDEA Energy Institute, Móstoles, Madrid, Spain

Date: 30 September 2016

Organizer: IMDEA Energy

3. Science Week of Comunidad de Madrid (2016)

Activity: Energy for a sustainable world

Venue: IMDEA Energy Institute, Móstoles, Madrid, Spain

Date: 7-10 November 2016

Organizer: IMDEA Energy



3.5. Training activities

1. Aguirre, Natalia

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Support tasks at Central Research Laboratories

Supervisor: Silvia Mateo, ADM

Period: February-April 2016

2. Alonso, Eduardo

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Efficient production of solar fuels through the development of new perovskites with redox capacity for thermochemical dissociation of CO₂ and H₂O

Supervisor: Dr. Juan Coronado, TCPU

Period: March-August 2016

3. Alumbrosos, Sara

B. Sc. in Energy Engineering, Rey Juan Carlos University

Internship work: Energy modelling of the introduction of biofuels in the Comunidad de Madrid

Supervisor: Dr. Diego García, SAU

Period: October 2016–February 2017

4. Álvarez, Eva

Profesional Training, IES-Lope de Vega

Internship work: Support tasks in the Thermochemical Processes Unit

Supervisor: Dr. Juan Coronado, TCPU

Period: April-June 2016

5. Asensio, Juan

M Sc. in Renewable Energy in Power Systems, Carlos III University of Madrid

Project title: Efecto de incertidumbre en el suministro eléctrico y posibles medidas

Supervisor: Dr. Jorn K. Gruber, ELSU

Date of defense: June 2016

6. Asiaín, Rubén

B. Sc. in Chemical Engineering and Energy Engineering, Rey Juan Carlos University

Internship work: Support tasks in the biofuel production line

Supervisor: Dr. Juan Coronado, TCPU

Period: June-August 2016

7. Ávila, Ignacio

Profesional Training, IES-Lope de Vega

Internship work: Support Tasks in the High Temperature Process Unit

Supervisor: Dr. José González, HTPU

Period: April-June 2016

8. Barrios, Víctor

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Support tasks in the biofuel production line

Supervisor: Dr. Juan Coronado, TCPU

Period: October 2016–January 2017

**9. Bonilla, Raquel**

B. Sc. in Physical Science, Complutense University of Madrid

Internship work: Optical analysis of solar concentration systems

Supervisor: Dr. José González, HTPU

Period: Julio 2016

10. De Fez, Mabel

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Production of solar fuels

Supervisor: Dr. Fernando Fresno, PAPU

Period: June-December 2016

11. De Paz, Ricardo

M Sc. in Renewable Energy in Power Systems, Carlos III University of Madrid

Project title: Electricity Load Forecast Formula for the Local Aggregation Level

Supervisor: Dr. Barry Hayes, ELSU

Date of defense: September 2016

12. Delgado, Laura Carmen

B. Sc. in Environmental Engineering, Rey Juan Carlos University

Project title: Análisis del ciclo de vida de bioqueroseno

Supervisor: Dr. Javier. Dufour, Dr. Diego Iribarren, SAU

Date of defense: December 2016

13. Encinas, Ignacio

B. Sc. in Energy Engineering, Rey Juan Carlos University

Internship work: Support in the development of life cycle analysis studies for energy production from lignocellulosic biomass and microalgae

Supervisor: Dr. Diego Iribarren, SAU

Period: February-July 2016

14. Encinas, Sergio

Professional Training, IES-Salesianos de Atocha

Internship work: Support tasks in the High Temperature Process Unit

Supervisors: Dr. Salvador Luque, HTPU

Period: April-June 2016

15. Esperanza, Paula

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Analytical characterization of catalytic pyrolysis products within the biofuel production line

Supervisor: Dr. Javier Feroso, TCPU

Period: December 2015-May 2016

16. Galdón, Sandra

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Photocatalytic reduction tests of CO₂ in gas phase

Supervisor: Dr. Fernando Fresno, PAPU

Period: December 2016-January 2017

17. Gómez, Gabriel

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Support tasks in biofuel pilot plant

Supervisor: Javier Marcos, TCPU

Period: November 2015-April 2016

18. Joon Jeon, Hyun

B. Sc. in Energy Engineering, Rey Juan Carlos University

Internship work: Development of social indicators for hydrogen production systems

Supervisor: Dr. Javier Dufour, SAU

Period: June -July 2016

19. Llamas, Mercedes

B. Sc. in Industrial and Environmental Biology, Complutense University of Madrid

Internship work: Elimination of nutrients (COD, N and P) from microalgae bacteria consortia in photobioreactors operated in continuous mode

Supervisor: Dr. Cristina González, BTPU

Period: October 2016-February 2017

20. Llordén, Marta

B. Sc. in Chemical Engineering and Energy Engineering, Rey Juan Carlos University

Internship work: Development of supercapacitors prototypes based on carbon nanotube fibers

Supervisor: Dr. Rebeca Marcilla, ECPU

Period: March-June 2016

21. López, Abel

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Project title: Modelización del co-procesado de bio-oil de pirólisis y crudo de petróleo en unidades de FCC

Supervisor: Dr. Javier. Dufour, Pedro L. Cruz, SAU

Date of defense: Julio 2016

22. Manzano, Francisco Javier

M Sc. in Renewable Energies, Fuel Cells and Hydrogen, UIMP/CSIC

Project title: Análisis exergético y económico de la producción y uso de hidrógeno en una planta hidroeléctrica

Supervisor: Dr. Diego Iribarren, SAU

Date of defense: June 2016

23. Marduck, Alejandro

Professional Training, IES-Benjamín Rua

Internship work: Support tasks in the Electrical Systems Unit

Supervisor: Dr. Jorn K. Gruber, ELSU

Period: March-June 2016

24. Martín, Laura

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Process engineering applied to the analysis of thermo-electrochemical solar systems

Supervisor: Dr. José González, HTPU

Period: October 2015-January 2016

25. Martín, Tania

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Electrochemical characterization of different positive organic molecules under different working conditions

Supervisor: Dr. Jesús Palma, ECPU

Period: March-April 2016

26. Martín, Tania

M Sc. in Chemical Engineering, Rey Juan Carlos University

Project title: Organic Redox Couple as the Half-cell Electrode Reaction of a Novel Redox Flow Battery

Supervisor: Dr. Jesús Palma, ECPU

Date of defense: March 2016

27. Mellina, Sara

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Cultivation of microalgae consortia in urban wastewater applying different growing conditions

Supervisor: Dr. Beatriz Molinuevo, BTPU

Period: January-March 2016

28. Mellina, Sara

M Sc. in Chemical Engineering, Rey Juan Carlos University

Project title: Estudio de la producción de biogás a partir de las biomásas residuales obtenidas en la producción de biodiésel a partir de microalgas

Supervisor: Dr. Cristina González, BTPU

Date of defense: June 2016

29. Navas, Zaira

B. Sc. in Energy Engineering, Rey Juan Carlos University

Project title: Diseño y simulación del reformado seco de biogás para la obtención de biocombustibles

Supervisor: Dr. Javier. Dufour, Pedro L. Cruz, SAU

Date of defense: Julio 2016

30. Navas, Zaira

B. Sc. in Environmental Engineering, Rey Juan Carlos University

Project title: Análisis del ciclo de vida de la obtención de biocombustibles a partir de biogás

Supervisor: Dr. Javier. Dufour, Dr. Diego Iribarren, SAU

Date of defense: Julio 2016

31. Navas, Zaira

B. Sc. in Energy Engineering and Environmental Engineering, Rey Juan Carlos University

Internship work: Support for process simulation and techno-economic and environmental analysis of alternative energy systems

Supervisor: Dr. Diego Iribarren, SAU

Period: October 2016–November 2016

32. Obando, Valentina

Profesional Training, IES-Lope de Vega

Internship work: Support tasks in the Electrochemical Processes Unit

Supervisor: Dr. Jesús Palma, ECPU

Period: April-June 2016

33. Palomares, Silvia

Profesional Training, IES-Lope de Vega

Internship work: Support tasks in the Biotechnological Processes Unit

Supervisor: Dr. Elia Tomás, BTPU

Period: April-June 2016

34. Pérez, Gemma

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Support tasks in the biofuel production line

Supervisor: Dr. Juan Coronado, TCPU

Period: September 2016–March 2017

35. Pérez, Ignacio

Profesional Training, IES-Benjamín Rúa

Internship work: Support tasks in the Electrical Systems Unit

Supervisor: Dr. Jorn K. Gruber, ELSU

Period: March-June 2016

36. Pérez, Lidia

B. Sc. in Environmental Engineering, Rey Juan Carlos University

Project title: Diseño de una planta de codigestión anaerobia a partir de microalgas y fangos de EDAR

Supervisor: Dr. Elia Tomás, BTPU

Date of defense: November 2016

37. Pérez, Luis

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Design and development of chemical reactors and test bench for solar thermal applications

Supervisor: Dr. Noemí Arconada, HTPU

Period: April-June 2016

38. Pérez, Luis

M Sc. in Chemical Engineering, Rey Juan Carlos University

Project title: Análisis de centrales termosolares basadas en pilas de combustible a alta temperatura

Supervisor: Elena Díaz, HTPU

Date of defense: December 2016

39. Rodríguez, Alberto

M Sc. in Modeling of Energy Systems, Pontificia University of Comillas

Project title: Unified Control of Back-to-Back Converter

Supervisor: Dr. Milan Prodanovic, ELSU

Date of defense: June, 2016

40. Sánchez, Gabriel

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Synthesis of different porous hybrid structures of known structure using the hydro-solvothermal pathway

Supervisor: Dr. Patricia Horcajada, APMU

Period: May-August 2016

41. Santos, María Luisa

M Sc. in Chemical Engineering, University of Castilla la Mancha

Project title: Evaluación de fibras de nanotubos de carbono para su aplicación en Desionización Capacitiva

Supervisor: Dr. Jesús Palma, ECPU

Date of defense: Julio 2016

42. Sanz, Daniel

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Modelling of an electrochemical flow reactor for environmental applications

Supervisor: Dr. Enrique García-Quismondo, ECPU

Period: May-Julio 2016

43. Segovia, Rodrigo

B. Sc. in Electrical Engineering, Politécnica University of Madrid

Internship work: State of the art, modelling and prototyping of inductive and resistive impedances to simulate the distribution network of the SEIL laboratory

Supervisor: Pablo Matatagui, ELSU

Period: March-June 2016

44. Sierra, Noemí

B. Sc. in Energy Engineering, Rey Juan Carlos University

Internship work: Electrochemical characterization of different organic redox pairs in electrolytes of different nature

Supervisor: Dr. Rebeca Marcilla, ECPU

Period: October 2015-March 2016

45. Suárez, Jasson

B. Sc. in Energy Engineering, Rey Juan Carlos University

Internship work: Assist in the development of energy models available in the SAU

Supervisor: Dr. Diego García, SAU

Period: February-Julio 2016

46. Torán, María del Rocío

M Sc. in Renewable Energy in Power Systems, Carlos III University of Madrid

Project title: Estudio de Flexibilidad en la Demanda y sus Oportunidades

Supervisor: Dr. Jorn K. Gruber, ELSU

Date of defense: Julio 2016

47. Toquero, Kevin

B. Sc. in Audiovisual Systems Engineering, Carlos III University of Madrid

Internship work: Design and implementation of a Web application for the management of a database related to materials and processes associated with Artificial Photosynthesis

Supervisor: Dr. Víctor de la Peña, PAPU

Period: May 2015-February 2017

48. Urruchi Quintano, Pablo

B. Sc. in Chemical Engineering, Rey Juan Carlos University

Internship work: Design and 3D manufacturing of an electrochemical flow cell prototype

Supervisor: Dr. Rebeca Marcilla, ECPU

Period: April-June 2016

49. Vara, Alicia

Profesional Training Dual IES-Gredos San Diego

Internship work: Support to laboratory tasks of the Biotechnological Processes Unit

Supervisor: Dr. Elia Tomás, BTPU

Period: April-June 2016

50. Vázquez, Inés

B. Sc. in Chemical Engineering and Industrial Organization Engineering, Rey Juan Carlos University

Internship work: Testing of electrochemical reactors for water treatment

Supervisor: Dr. Jesús Palma, ECPU

Period: March-December 2016

51. Watson, Conrado

B. Sc. in Electrical Engineering, Automated Electronics and Applied Physics, Politécnica University of Madrid

Internship work: Characterization of solar concentration systems

Supervisor: Dr. José González, HTPU

Period: March 2016



inidea
energia

