David Serrano
Director of IMDEA Energy
Móstoles, August 2019
The major focus of the IMDEA Energy Institute is the development of efficient, cost-competitive and clean energy technologies for contributing to the transition towards a low-carbon energy system. The Scientific Program of IMDEA Energy addresses a number of topics of high relevance, such as energy storage materials and devices, solar energy, sustainable fuels, smart management of electricity demand, energy systems with enhanced efficiency, valorization of CO₂ emissions and techno-economic evaluation of energy systems.

Created by the Regional Government of “Comunidad de Madrid”, IMDEA Energy is an R&D center featured by having a modern and flexible management system. The headquarters of IMDEA Energy are located in a building of new construction in the Technological Park of Móstoles (Madrid), furnished with high efficiency energy systems. These facilities were awarded with the Gold LEED certificate, which is a highly reputed international recognition for buildings with a minimum environmental impact.

Scientific excellence, international visibility and cooperation with industry remain as the main key drivers of the IMDEA Energy activities. The availability of sophisticated lab equipment, as well as of singular pilot plant infrastructures, allows the research activities to be performed on a very high level of excellence and to attract prestigious scientists.

As described in this Annual Report, 2018 has been a highly successful year for IMDEA Energy. Thus, although the overall staff number remained basically stable, both the scientific productivity and the incomes from external sources reached the highest values since the creation of the Institute: 99 scientific indexed publications were contributed, whereas the external funding coming from competitive projects, contracts with companies and personnel grants reached 3.6 M€, which accounts for a self-funding ratio over 50%. Among the projects and contracts undertaken during 2018 (62 in total), 11 were international projects (mainly of the H2020 EU program) that have been awarded in very competitive calls, as it is the case of the two ERC grants active during 2018 at IMDEA Energy. In addition, 27 personnel grants, funded by third parties, were active along 2018.

Cooperation with industry is an essential element for our institute, aimed to establish solid alliances with companies and to promote innovation and technology transfer. In this way, 21 contracts with companies and 7 industrial projects have been active during 2018. Likewise, 1 new patent was applied and 2 patents were granted in 2018.

The scientific structure of IMDEA Energy comprises eight research units, which includes scientists and technicians with a great variety of backgrounds and specializations like mechanical, electrical, industrial, chemical and materials engineering, physics, biology, chemistry, biochemistry and environmental science, among others. This provides the Institute with a highly qualified and multidisciplinary team of researchers to undertake the study of complex energy systems. In addition to hosting 19 visiting researchers, about 55 B.Sc. and M.Sc. students have collaborated during 2018 in the different research topics of the Institute, whereas 32 PhD theses were under development and 4 were defended. These figures evidence the high relevance given by IMDEA Energy to training activities of young researchers.

These excellent results, together with those of previous years, have positioned IMDEA Energy as a world-class research institute. These achievements must be acknowledged to the IMDEA Energy staff by its outstanding effort, commitment and dedication, as well as to the Regional Government and the Assembly of “Comunidad de Madrid” by its valuable and highly appreciated support.

_words from the director..._
annual report

2018

editor
imdea energy institute

graphic design
base 12 diseño y comunicación

D.L.
M-26438-2019
The IMDEA Energy Institute is a research centre created 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 R&D energy themes by bringing together high quality researchers, providing them with excellent infrastructures and resources, and promoting their close collaboration with the industrial sector.

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 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.

The building and laboratories of IMDEA Energy Institute are located at the Technological Park of Mostoles, Madrid, on a land with 10,000 m².

The building has been recognized with the prestigious LEED Gold Certificate and the A Energy Efficiency Certificate.

Research topics

- Production of sustainable fuels
- Concentrated solar power
- Energy storage
- Smart management of electricity demand
- Energy systems with enhanced efficiency
- Valorization of CO₂ emissions
- Techno-economic evaluation of energy systems

8 scientific labs
2 pilot plants
office work areas and an auditorium
our structure

- Financial management and human resources.
- Project management.
- External relationships and technology transfer.
- Infrastructure and facilities management.
- Health and safety.
- Central research laboratories.
The highest decision-making body is responsible for government representation and administration, aiming to ensure the achievement of the established goals.

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President of the Foundation  
Professor of the Institute for Environmental Engineering and Energy Economics  
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Polytechnic University of Madrid, Spain

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Complutense University of Madrid, Spain  
(appointed by IMDEA Water)

Prof. Dr. Paula Sánchez  
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(appointed by IMDEA Materials)

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

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University of Zaragoza, Spain

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Head Scientist  
Institute of Catalysis and Petrochemistry, CSIC, Spain

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Spain

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Los Alamos National Laboratory, USA

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Professor of Chemical Engineering  
Santiago de Compostela University, Spain

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Research Coordinator  
National Laboratory of Energy and Geology, Portugal

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National Laboratory of Energy and Geology, Portugal

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Institute of Catalysis and Petrochemistry, CSIC, Spain
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 for the recruitment of scientists.

### Human Resources Evolution

<table>
<thead>
<tr>
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<tbody>
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<td>2017</td>
<td>97</td>
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<tr>
<td>2018</td>
<td>94</td>
</tr>
</tbody>
</table>

### Human Resources Distribution by the 31st of December of 2018

- 21 Researcher professors / Senior researchers / Senior assistant researchers (22%)
- 17 Postdoctoral researchers (18%)
- 33 Predoctoral researchers (35%)
- 11 Technicians (12%)
- 12 Management and administration (13%)

### 55 Students in Connection with the IMDEA Energy Institute in 2018

- 25 Internships (46%)
- 16 Master projects (29%)
- 14 Bachelor projects (25%)

### Mobility Actions in 2018

- 9 Secondments of Imdea Energy researchers
- 19 visiting researchers

### Publications in Indexed Scientific Journals

<table>
<thead>
<tr>
<th>Year</th>
<th>Publications</th>
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<td>2017</td>
<td>90</td>
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<tr>
<td>2018</td>
<td>99</td>
</tr>
</tbody>
</table>

### R&D Results

#### 2018

- 70 conference communications, 11 invited conferences and 26 poster communications.
- 1 new patent applied and 2 patents granted.
The portfolio of the Institute research projects is characterized by its diversity in terms of funding source, being remarkable the high degree of collaboration with industries and research institutions of the energy sector.

Along the year 2018 the Institute was hosting two Consolidator Grants awarded by the European Research Council with a total budget of 4.5 M€.
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 with industry in R&D projects is one of the key objectives of the IMDEA Energy Institute. Because of that, the Institute has maintained an intense activity with the aim to promote agreements with industrial partners and a strong presence in networks and international platforms with participation of companies.

COOPERATION WITH COMPANIES 2018
During the year 2018, it should be highlighted the celebration of 96 meetings with companies related with the energy sector, covering a wide range of sizes and business areas with an active presence has been maintained, attending events of Associations (Club de la Energía, Madri+d, Madrid Network, enerTIC, AEC, Gasnam, CEOE, Madrid Foro Empresarial, AEBIG), technological platforms (Futured, PTE-EE, M2F, PTFE, PTF4LS, ETIP SNET, FCH-JU, EERAs), seminars, fairs, infodays, conferences, congresses and brokerage events, national and international (Genera and Conama).
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 also a means of increasing the external visibility of IMDEA Energy Institute, 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.
The following lists summarizes the main associations in which IMDEA Energy Institute has participated as a member in 2018:

NATIONAL

INTERNATIONAL
research lines

Energy storage coupled to renewable energy and transport

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 super-capacitors.

**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 thermo-clines and moving bed exchangers.
- Development of thermochemical storage systems making use of high temperature redox reactions.

Production of sustainable fuels

Biofuels, alternative fuels and bioproducts aiming at the 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.
- Valorization of plastic wastes.

Concentrated solar power

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

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

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.

Valorization of CO$_2$ emissions

CO$_2$ valorization routes by its transformation into high-demand valuable products.

- CO$_2$ photoreduction for energy storage and fuels production.
- Development of multifunctional materials and solar reactors for photoactivated processes.
- Thermo-catalytic routes for CO$_2$ 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.
Instrumental Techniques

- Near-ambient pressure (NAP) XPS which allows the in-situ characterisation of photocatalytic processes under illumination at different gas atmospheres and pressures up to 25 mbar.

- Chemical characterization techniques: mass spectrometry, gas/mass chromatography, elemental analysis ICP-OES and CHONS.

- Thermogravimetric analysis (TG-DTA) in oxidising (air), inert (Ar) or reductive (10% H2/Ar) atmospheres.

- 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.

Pilot Plants Facilities


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.

Solar field consisting of 169 heliostats, 3 m² each, with an experimental platform located on top of a 18 m height tower. This facility allows testing receivers, reactors and materials up to 250 kW thermal power under irradiances above 2500 kW/m².
research units

Thermochemical Processes Unit

High Temperature Processes Unit

Electrochemical 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. Juan Miguel Moreno
Senior Researcher

Dr. Patricia Pizarro
Associated Senior Researcher
R&D Objectives

- Development of materials, mainly catalysts, and thermochemical processes for: biomass, CO₂, and wastes valorization to fuels and energy storage.

Research lines

- Production of advanced fuels and chemical products of new generation by thermochemical conversion (pyrolysis and hydrotreatments) of biomass and plastic wastes.
- Redox materials for the production of solar fuels through decomposition of CO₂ and H₂O and by Chemical Looping Reforming with methane and CO₂.
- Redox materials for thermochemical heat storage.
Relevant projects and networking

After the successful completion of CASCATBEL project [FP7-NMP-2013-LARGE-7 (Topic: NMP.2013.1.1-1)] in 2017, coordinated by IMDEA Energy, the research activities of TCPU in 2018 have been mostly developed through the projects CATPLASBIO, RESTOENE2, SOLARKITE, BILIGWASTE and PICASSO, which are financially supported by diverse organisations of either national, regional or private nature. The main objective of that projects is the development of more efficient catalysts for the production of advanced biofuels by pyrolysis and Hydrodeoxygenation. CATPLASBIO, RESTOENE2, and SOLARKITE projects were completed in 2018. BILIGWASTE and Picasso are still active in 2019.

In addition, the Thermochemical Processes Unit (TCPU) participates in associations such as the European Energy Research Alliance (EERA) of Bioenergy, the Biobased Industries Joint Undertaken (BBIJU) and the Spanish Platform of Sustainable Chemistry (SUSCHEM). Likewise, the TCPU keeps contact with several universities and research centres in Spain, Europe, South Africa and USA.
Facilities

Raw Materials conditioning
- Biomass milling and sieving.
- Oven for biomass drying.

Synthesis and characterization of catalysts
- Lab equipment for catalysts and materials preparation by different routes such as sol-gel, hydrothermal and co-precipitation.
- Methods for dispersing active phases on porous supports.
- Tubular muffle furnace for thermal treatment under controlled atmosphere.
- Characterization techniques available in IMDEA Energy (gases physisorption, ICP-OES, elemental analysis, TPD-TPR, thermogravimetry, XRD, SEM, Raman, FTIR, among others). Access to techniques at Rey Juan Carlos University (TEM, FEG-SEM, NMR, XRF).

Lab scale reactors for testing catalytic activity
- Stirred tank high pressure batch reactors ($P_{\text{max}}$ 150 bar).
- High pressure continuous fixed-bed reactor ($P_{\text{max}}$ 50 bar).
- High temperature continuous fixed-bed reactor for testing redox materials ($T_{\text{max}}$ 1500 °C).
- Downdraft fixed-bed pyrolysis reactors.
- Continuous feeding pyrolysis reactor.

Pilot scale reactor
- Continuous feeding fluidized bed pyrolysis reactor (max. 1.5 kg/h).
- Fixed bed continuous flow high pressure reactor ($P_{\text{max}}$ 50 bar).
- Possibility to operate with both fluidized bed and fixed bed reactors connected in series or in independent modes.

Analysis of raw materials and reactions products
- Elemental CHNS-O analysis, Karl Fischer titration, potentiometric titration for carbonyl determination in bio oils.
- Chromatographic analysis: GC-MS, 2 GC (FID, TCD), 2 μGC.
- Metal analysis by ICP-OES.
- Thermogravimetric analysis.
- Spectroscopic techniques (FTIR, XRD).
Scientific activities and results

Production of advanced fuels and chemical products of new generation by thermochemical conversion (pyrolysis and hydrotreatments) of biomass and plastic wastes

- In the field of catalytic co-pyrolysis of plastic and lignocellulosic wastes, bio-oil* yields have been maximized (> 40 wt.%), as well as non-oxygenated aromatics (> wt. 70%), by optimization of both the operating conditions and catalyst properties.
- A variety of catalysts and the effect of operating conditions have been evaluated in reactions for the selective synthesis of valuable products (apocynin and cyclohexyl-phenol) using compounds from pyrolysis bio-oils as starting materials.
- Regarding the valorization of lignin wastes by ex-situ catalytic pyrolysis, a variety of operating conditions and pre-treatments have been assessed in the thermal pyrolysis step. Catalysts tested were based on HZSM-5 Zeolite. It is remarkable the high yield of char and the necessity to operate at higher temperatures in the thermal zone when compared with lignocellulose as feedstock. Catalytic bio-oils were very heterogeneous, with less guaiacols but higher amounts of other compound families, such as alkyl-phenols and metoxi-benzenes.
- The experimental work on pressurized pyrolysis (1-10 bar) has been started. It is necessary to implement modifications for better controlling the operation variables (mainly P).
- Experiments on fluidization for the future design of a new reaction system have been performed. This new facility will allow carrying out reactions of ex-situ catalytic pyrolysis and HDO with continuous regeneration of catalysts at lab-intermediate scale.
Redox materials for the production of solar fuels through decomposition of CO$_2$ and H$_2$O and by Chemical Looping Reforming with methane and CO$_2$

- New compositions of perovskites have been evaluated for the CO + H$_2$ production by cycles of reduction with CH$_4$ and oxidation with CO$_2$.
- La$_{0.9}$Sr$_{0.1}$FeO$_3$ shows a remarkable activity and stability during successive redox cycles. Using this material, the syngas yield has been significantly increased by supporting it onto YSZ or by incorporating Ni into its composition.

Redox materials for thermochemical heat storage

- Different materials for thermochemical heat storage based on spinels of Mn, MMn$_2$O$_4$ (M=Cu, Li) have been produced and characterized, in collaboration with Western Cape University (Cape Town, South Africa).
High Temperature Processes Unit

Dr. Manuel Romero
Research Professor
Head of the Unit

Dr. José González-Aguilar
Senior Researcher
Co-head of the Unit

Salvador Luque
Senior Assistant Researcher
R&D Objectives

- Modular, efficient, dispatchable and cost-effective high temperature solar concentrating technologies for power generation, industrial process heat and production of solar fuels and chemicals.

Research lines

- Modular schemes for solar thermal facilities, with high efficiency and dispatchability, and urban integration.
- Solar receivers and reactors (volumetric and particle).
- High-T thermal energy storage (PCM, chemical), materials, modelling and test bed for characterization.
- Solar fuels and chemicals production using metal oxides.
- Power conversion unit integration, heat recovery & environmental impact (advanced cycles, water, glint, glare).
Relevant projects and networking

The High Temperature Processes Unit (HTPU) focuses its research on solar thermal technologies with special emphasis on applications involving high temperature and very high concentrated solar flux. In 2018, the HTPU develops its R&D&I activities at local, national and international level. It leads this topic in the Comunidad de Madrid by the regional project ALCCONES (2014-2018) and it is actively contributing to the most recent developments on production of solar fuels (EU H2020 Sun-to-Liquid project), new heat transfer fluids and solar receivers (EU H2020 NEXT-CSP and ES Retos ARROPAR-CEX projects), and solar thermal industrial process heat (EU H2020 INSHIP), 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. Unique HTPU’s facilities allow supporting industrial developments on component for applications in concentrated solar energy.

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 and Task II on solar thermochemistry as well as in 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, automatic siever, Chantillon gauge, pHmeters).
- 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 micro-chromatograph.

Singular facilities 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 and two testing platforms.

Specific test rigs

- Aerothermal characterization of volumetric absorbers.
- Thermal storage in packed and fluidized beds.
- Outdoor test rig for small heliostats qualification.

Computational design lab for high temperature processes

- Workstations.
- Specific software for computer-aided design, computational fluid dynamic modelling, illumination design & optical analysis, data treatment and process control and monitoring, chemical process and power plant design.
Scientific activities and results

Innovative modular concepts with minimum environmental impact

- Carried out a detailed optical characterisation of heliostats by deflectometry of a 250 kW central receiver solar facility for its use in testing at high temperature and very high concentrated solar flux (>2,000 kW/m²).
- Developed a customised software for fast optical analysis of heliostats incorporating experimental optical errors.

Solar receivers & new heat transfer fluid

- Successfully determined the volumetric effects in novel additively manufactured open solar receivers (Selected Laser melting) at kW-scale in the 7kWe-high flux solar simulator.
Energy storage & solar thermo-chemistry

- The operation of a fully integrated 50kW Solar-Thermochemical process for Liquid Hydrocarbon Fuels synthesis under realistic conditions has been achieved.
- Realized the macroencapsulation of sodium chloride and sodium nitrate as phase change materials for thermal energy storage based on sol-gel method.
- Determined the operational conditions in a directly-irradiated solar reactor for solar-driven thermochemical water-splitting by Cerium Oxide.
- Elaborated methodologies for physico-chemical characterization of redox materials for Thermochemical Heat Storage. An international round robin test on enthalpies of perovskites for thermochemical heat storage has been coordinated.
- The synthesis and materials characterization of ceria foams from porous material of vegetable origin has been tested in a high-flux solar simulator.

High temperature processes integration & environmental impact

- Assessed the performance of concentrated solar power plants based on carbon and hydrogen fuel cells.
- Designed flowsheets of central receiver solar thermal power plants based on dense particle suspensions and supercritical fluids as heat transfer fluids.
### 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

<table>
<thead>
<tr>
<th>Electrochemical capacitors</th>
<th>Increase energy density of aqueous RFBs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Increase energy density by designing new electrodes and formulating advanced electrolytes.</td>
<td>• Membrane-free concepts: immiscible electrolytes and micro-RFBs.</td>
</tr>
<tr>
<td>• Multifunctional devices combining structural and storage capacities.</td>
<td>• Metal-air / metal-ion batteries (Zn-air, Al-ion and Li-ion)</td>
</tr>
<tr>
<td>Capacitive deionization</td>
<td>• Electrodes and electrolytes for lower cost and increased performance primary Zn-air batteries.</td>
</tr>
<tr>
<td>• Energy efficiency in water deionization.</td>
<td>• Promote the reversibility of reactions in secondary Al-ion batteries.</td>
</tr>
<tr>
<td>• Enhanced water recovery, reduction of effluents, brine concentration, ion separation.</td>
<td>• Structural Li-ion batteries based on reinforced electrodes and solid electrolytes.</td>
</tr>
<tr>
<td>Redox flow batteries</td>
<td>Battery testing</td>
</tr>
<tr>
<td>• Improving vanadium-based redox flow batteries.</td>
<td>• Accelerated non-conventional testing.</td>
</tr>
<tr>
<td>• Organic-based electrolytes for low-cost and sustainable RFBs.</td>
<td>• Performance evaluation, aging and life cycle assessments.</td>
</tr>
</tbody>
</table>
Relevant projects and networking

In 2018 the Electrochemical Processes Unit (ECPU) has participated in 15 research projects ranging from fundamental to industrial research. The regional government of Comunidad de Madrid supports one of them with the R&D collaboration program; two with talent attraction grants; and one more with the industrial doctorates programme. The Spanish Research Agency (AEI) supports three projects that belong to the applied research programme identified as “Retos Colaboracion” and one that belongs to the fundamental research programme, identified as “Retos Investigacion”. The European Research Council is funding one Consolidator Grant awarded to Dr. Rebeca Marcilla, senior researcher of the ECPU. Finally, the Unit has been involved in 6 research contracts funded directly by private companies.

The ECPU has expanded its network in 2018, resulting in a greater involvement in Spanish and European organizations. ECPU acted as deputy coordinator of the Electrochemical Energy Storage subprogramme in the Joint Programme on Energy Storage of the European Energy Research Alliance (EERA). In addition, it is member of the Working Group on Energy Storage of the European Technology and Innovation Platform on Smart Networks for Energy Transition (ETIP-SNET); coordinator of the Electrochemical Storage subgroup of the Working Group on Energy Storage (GIA), created by several Spanish Technological Platforms; coordinator of the working group on New Technologies of the Spanish Association of Batteries and Energy Storage (AEPibal) and member of the Spanish network of excellence in Energy and Environmental Applications of Electrochemical Technologies (E3TECH).

In 2018, the ECPU has maintained cooperation agreements for training and mobility actions with foreign universities and research organizations such as Max Planck in Germany; University of Salerno in Italy and University of Malaysia Sarawak.

Facilities

Synthesis and characterization of electroactive materials
- Light scattering for particle size and Z-potential analysis.
- 1 Glove box for synthesis in controlled atmosphere.
- Slenck line for polymer synthesis.
- Pressurized reactors for hydrothermal synthesis.
- Probes for ultrasonic synthesis.
- Reactors and dialyzers for sol-gel synthesis.
Components fabrication and characterization
- Ink mixing: 1 ball mill, 1 vacuum and 3 high-shear mixers.
- Ink coating: 2 doctor blade coaters, 2 vacuum driers.
- Ink printing: 1 inkjet printer for micro-electrodes.
- Electrode consolidation: 1 roll press and 2 uniaxial presses.
- Coin cells: 1 puncher and 2 crimpers.
- Pouch sealing: 1 vacuum and 1 heat sealing machine.
- Chemical characterization: ion chromatography and semiautomatic titration.
- Physicochemical characterization: viscosity, density, conductivity, pH and ORP meters.
- Electrochemical characterization: multipotentiostats (50 channels ±10V – 0.5A); channel boosters 2 x 4A and 1 x 10A; impedance spectroscopy; rotating disk and rotating ring-disk electrodes.
- 1 Glove box for testing in controlled atmosphere.

Modelling
- Computational chemistry: electronic structure calculations (density functional theory, wave function theory, molecular dynamics), GAUSSIAN ® and VASP ®.
- Computer fluid dynamics: COMSOL Multiphysics ®.
- Matlab-simulink ® for dynamic modelling of batteries.

Prototyping
- 3D design: SolidWorks.
- 3D printers: fused deposition modeling (1 x 4 Litres + 1 x 600 litres) stereo-lithography (1 x 1,2 litres).
- CNC micro-milling machine.
- Cell prototypes: coin cells up to 2 cm²; pouch cells from 10 to 100 cm² electrodes; flow cells (10, 25, 300, 1200 and 2400 cm² electrodes) and flow modules up to 20 cells; micro-flow cells; injectable cells.

Electrochemical devices testing
- Battery cycler: 3 channels x 8 kW, 120V – 200A max.
- Battery cycler: 4 channels x 300 W, 80V – 50A max.
- Cell cyclers: 24 channels x 30 W, 5V – 6A max.
- Cell cyclers: 88 channels x 0,05 W, 5V – 10mA max.
- 5 climatic chambers (20, 100, 220, 250 and 4800 L) from -40 to +180ºC and 10 to 98%H.
- Flow reactor test bed with controlled flow, temperature, pressure and measurement of pH, ORP and conductivity.
- LabView ® programmable control system.
Scientific activities and results

**Electrochemical capacitors**

- Investigated some flexible and structural electrochemical double layer capacitors based on carbon nanotube fibers and solid electrolytes.
- Research has been carried out on pseudocapacitors made of mixed metal oxides, metal sulfides and their composites with graphene.
- Designed and fabricated several pouch cell prototypes of hybrid supercapacitors with 12 cm² electrodes.

**Capacitive deionization (CDI)**

- Development of high deionization capacity electrodes using carbon felts mixed with activated carbons.
- Fabrication of flexible and structural deionization electrodes with carbon nanotube fibers.
- Application of capacitive deionization to treat brines produced as permeates from desalination plants with reverse osmosis. Design, construction and testing of a pilot plan for full size capacitive deionization reactors. The reactor prototype tested involved a stack of 10 cells of 2400 cm² electrodes with active mass loadings of 40 mg/cm².

**Redox flow batteries (RFB)**

- Explored new and immiscible aqueous electrolytes for membrane-free redox flow batteries.
- Applied microfluidic concepts to produce membrane less redox flow batteries working under ideal laminar flow regime.
- Formulated new electrolytes with organic redox couples in aqueous solvents to reduce the cost and toxicity of the electrolytes, and to build redox flow batteries free of critical materials.
- Studied the possible hybridization of flow and static batteries to increase the energy density of vanadium-free redox flow batteries.

• Synthesized and characterized redox-active polymers with potential use as low-cost cathodes for lithium-ion batteries.

• Realized proof of concept of injectable lithium-ion batteries using semi-solid mixtures of electrolytes and electrode active materials. Fabrication and testing of laboratory prototypes.

Battery testing

• Development of new test protocols based on differential impedance measurements to determine the state of health of lithium-ion secondary batteries.

Metal-air batteries / Metal-ion batteries (Me-air / Me-ion)

• Development of new anode materials for rechargeable aluminum batteries. Design and testing of laboratory prototypes manufactured with 3D printing techniques.

• Research carried out on new concepts to make flexible and rechargeable zinc-air batteries. Fabrication and testing of laboratory prototypes.

• Development of software tools and protocols for accelerated testing and early failure prediction of primary batteries such as zinc-manganese and lithium-manganese.
Biotechnological Processes Unit

Dr. Mercedes Ballesteros
Researcher Professor
Head of the Unit

Dr. Cristina González
Senior Assistant Researcher

Dr. Elia Tomás
Senior Assistant Researcher

Dr. María José Negro
Associated Senior Researcher

Dr. Ignacio Ballesteros
Associated Senior Researcher
R&D Objectives

- Development of technologies to produce biofuels and bioproducts via biological processes using biogenic residues and wastes as feedstock.

Research lines

- Microalgae downstream processes: photosynthetic biomass anaerobic fermentation.
- Microbial oil production from the carboxylic platform (volatile fatty acids).
- Lignocellulose based biofuels and bioproducts.
- Anaerobic fermentation of waste streams for carboxylate and biogas production.
Relevant projects and networking

The Biotechnological Processes Unit (BTPU) participates in several national and international projects related with the use of photosynthetic microorganisms for wastewater treatment and microalgae biomass valorization by anaerobic digestion. In this sense, BTPU leads the European project EUALGAE (2015-2019), supported COST Action of H2020, which involves more than 180 investigators from 27 countries. Also within the microalgae research field, BTPU leads the national project WWAL-GAS (2014-2018) and is involved in MICROALBAC (2015-2018) which is conducted in collaboration with industry. Under WWAL-GAS, the anaerobic microbiome of the sludge used for microalgae digestion has been investigated. Likewise, this biomass has been also studied for the production of alternative bioproducts (volatile fatty acids). Furthermore, the Biotechnology Processes Unit is currently working in the development of tools to improve phototrophic biomass production through the participation in INSPIRA1 project (2014-2018) to determine the feasibility of using Spirulina biomass for anaerobic digestion. The unit is also actively involved in BIOGASMENA (2017-2020) (ERANET MED), addressing key technological challenges to foster the development of biogas technology in both the EU and the Mediterranean region.

BTPU is also very active in the valorization of lignocellulosic biomass. In this sense, BTPU is working in yeast and bacteria culture for bioenergy and bioproducts production from lignocellulosic residues. The unit works in LIGNOYEAST (2015-2018) and BIO_LIGWASTE (2016-2019) projects related with the production of bioethanol at high substrate loading and lactic acid from lignocellulosic streams.

With regard to alternative waste streams, other than microalgae and lignocellulosic material, in 2018 BTPU has started leading the national project ACMIBIO_AD (2017-2021) with the objective to produce microbial oils VFAs obtained by anaerobic digestion of agricultural and food residues. Likewise, the unit works with organic matter from urban wastes for biogas production purposes in the framework of WASTE2BIO (2017-2020) (ERANET+ BESTF3).

As a result of the participation in the mentioned projects, BTPU actively collaborates with leading research groups and companies along Europe. Besides, UBTP is member of EERA-Bioenergy, the Biobased Industries Consortia (BIC) and BIOPLAT.
Facilities

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

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.
- RNA-ase free cabinet.
- Denaturing gradient gel electrophoresis.
- Agarose electrophoresis.

Pilot plants
- Bioreactors.
- 3 modules of 4 bubbled columns each (1 m³ in total).
- 2 open raceways (1 m³ in total).
**Scientific activities and results**

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

- Developed the microbial activity of an algal-bacterial consortium during wastewater treatment based on oxygen evolution.
- Observed that a significant amount of oxygen is consumed by the microalgae itself through endogenous respiration and photorespiration.
- Concluded that the reactor configuration might help overcoming limited efficiency of microalgae-bacteria consortia for wastewater bioremediation technology.

![Graph showing oxygen evolution over time](image)

**Microalgae downstream processes: photosynthetic biomass anaerobic fermentation**

- Generation of alternative bioproducts (VFAs) as a chemical platform.
- Established the temperature as a determining factor in the anaerobic digestion of photosynthetic biomass.
- Analyzed the effect of anaerobic sludge inoculum on the digestion of microalgae biomass.
- Conducted research on proteins as a key macromolecule for an efficient anaerobic digestion of microalgae biomass.
- Batch and semicontinuous fermentation comparison in terms of VFA production yields and profile.
- Identification of microbial communities in anaerobic microbiome of biodigesters operated to produce VFAs.

![Bar chart showing microbial communities](image)
Anaerobic fermentation of waste streams for carboxylate and biogas production

- Observed that selective residues provided higher methane potentials than non-selective residues.
- Determined that the digestions of a fermented fraction for ethanol production provided at least the same methane production than raw residues.

Lignocellulose based biofuels and bioproducts

- Lactic acid production from lignocellulosic hydrolysates with lactic acid bacteria.
- Enzymatic hydrolysis tests to release monomeric sugars from lignocellulosic hydrolysates.
- Development of an evolutionary engineering approach to obtain lactic acid bacteria highly tolerant to low pH and with improved xylose conversion capacity.
- Bioethanol production from cellulosic fraction of gardening residues.

Microbial oil production from the carboxylic platform (volatile fatty acids)

- Screening and selection of different oleaginous yeasts for producing high concentrations of lipids.
- Evaluation of oleaginous yeast growth on different concentrations of VFAs: comparison of synthetic mixtures and real digestates.
- Extraction and determination of lipids produced by oleaginous yeasts.
Dr. Milan Prodanovic
Senior Researcher
Head of the Unit
R&D Objectives

- Improved management, reliability and stability aspects of future electricity networks with high share of renewable and storage technologies. Application of optimisation based algorithms for demand management and renewable integration. Increased energy efficiency in industrial applications.

Research lines

- Renewable and energy storage integration.
- Stability of power networks with high penetration of renewables.
- Reliability of power systems with high share of distributed generation and storage.
- Control of power converters for applications in electricity networks.
- Energy efficiency in systems for vibration testing.
Relevant projects and networking

In 2018, Electrical Systems Unit (ESU) actively participated in several research and development projects. Principal research activities were performed within the framework of regional project PRICAM (2014-2018) and also within projects EnRed and SinCortes funded by Foundation Iberdrola (2017-2018 and 2018-2019). These projects addressed stability and reliability aspects of renewable and storage integration to power networks as well as control of power electronics interfaces for grid applications. With respect to industrial collaborations, the main projects were LPT (2015-2018) with PVH addressing energy storage integration to power networks, Microgrid-On-Chip (2018-2021) with NORVENTO developing control of battery interfaces for microgrids and EEISVT (2011-) with IMV improving the efficiency of vibration test equipment. Research project RITSE (Reduced Inertia Transient Stability Enhancement, 2019-2020) started in December in collaboration with SuperGrid Institute, Lyon, as the result of a successful application to the competitive research call Grid 2030 funded by Red Eléctrica de España.

ESU participated in activities of the Spanish Platform for Power Networks (FUTURED) within two workgroups: Power Electronics and Energy Storage. In 2018 ESU continued its role in 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 programmable loads.
- 47.5 kWh battery system.
- 75 kW bidirectional battery interface.
- Remotely configurable distribution panels for AC and DC networks.
- Configurable network impedances.
- Integrated measurement and SCADA 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 activities and results

Renewable and energy storage integration

- Development of advanced converter control techniques for energy storage interfaces for power systems and microgrids.
- Coordinated management of distributed storage applications.
- Applied battery storage integration to railway systems.
- Evaluation of battery technologies for PV grid applications (Li-Ion and flow-batteries).

Control of power converters for applications in electricity networks

- Analysed advanced control of railway power supply systems.
- Developed novel differential and common power concepts for control of Back-to-Back converters.
- Obtained primary, secondary and tertiary control algorithms for power converters in AC and DC microgrids.
- Improved the power quality in weak power networks.
- Power converter design and control improvements for grid applications (improved noise filtering, damping etc.).

Energy efficiency in systems for vibration testing

- Development of control boards for switching power amplifiers in vibration system applications.
- Research carried out on control system improvement of switching amplifiers.
- Development and testing of a 20 kW bidirectional isolated industrial power supply.
- Improved management algorithms for Intelligent Shaker Manager.
Stability of power networks with high penetration of renewables

- Modelled the small-signal of AC, DC and hybrid power networks.
- Analysis of transient stability for power networks based on Singular Value Decomposition.
- Assessment of the impact of power converter grid connection on grid stability.
- Development of control of multi-terminal DC networks in power transmission and distribution applications.
- Generation of virtual inertia in HVDC and distribution networks.

Reliability of power systems with high share of distributed generation and storage

- Development of analytic methods for reliability assessment of distribution networks and islanded microgrids with high share of renewable and energy storage technologies.
- Reliability assessment of SmartGrids technologies deployed in distribution networks (SNOP, OLTC, DLC, etc.).
- Developed optimisation based sizing tools for renewable and energy storage installations for improving continuity of supply in power networks.
- Estimated the economic benefits produced by operating networks in both grid-connected and islanded modes.
System Analysis Unit

Dr. Javier Dufour
Researcher Professor
Head of the Unit

Dr. Diego Iribarren
Senior Assistant
Researcher

Dr. José Luis Gálvez
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 costing, social life cycle assessment, 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 techno-economic and environmental evaluation.
- Prospective analysis of energy scenarios: development of energy system models; integration of sustainability indicators and geographic information systems.
Relevant projects and networking

In 2018, the Systems Analysis Unit (SAU) has continued its participation in three European projects related to solar fuels (EU H2020 Sun-to-Liquid project), end-of-life strategies for fuel cells and hydrogen technologies (EU FCHJU HyTechCycling project) and the deployment of compressed and liquid natural gas infrastructure for transportation (EU CEF Eco-Gate project). At domestic level, SAU finished the BIOSUSCAT project, developing scalability criteria and the techno-economic assessment of “building block” compounds obtained from lignocellulosic biomass, and continued working on the PICASO project where the Spanish alternative mobility model is being developed. At the regional level, SAU collaborated in the ResToEne-2 programme, continuing with the roadmapping and sustainability assessment of new processes for the manufacturing of clean transportation fuels from agro-forestry and oily waste. Moreover, SAU has developed nine research contracts with several institutions dealing with process simulation (3), feasibility studies (3), life cycle assessment (2), and energy modelling (1).

Regarding networking, Javier Dufour, head of SAU, has been the Vice-chair of Cross-cutting Research Activities of Hydrogen Europe Research. Likewise, the Unit has been actively involved in the chairmanship 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.
- Social life cycle assessment, life cycle costing.
- Harmonised LCA and life cycle sustainability assessment.

Feasibility of energy processes
- Process design, simulation and optimization.
- Circular economy energy modelling.
- Energy and exergy analyses.
- 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 activities and results

Sustainability assessment methodology

- Elaborated LC + DEA methods as multi-criteria decision analysis tools in the field of energy systems analysis.
- Development of conventional and harmonised LCA of microalgal-based systems for biofuels production.
- Defined end-of-life strategies for FCH products.
- Assessed the sustainability of several hydrogen production routes.
- Prospective assessment of life-cycle indicators for power generation.

Feasibility of energy processes

- Carried out scalability analysis of “platform molecules” production processes from biomass.
- Development of hydrothermal treatments models for municipal solid waste, gardening waste, food waste and generic waste.
- Performed the model and simulation of a biomass-oil co-processing refinery.
- Development of the model for the calculation and analysis of life cycle inventories of regional waste management systems.
- Techno-economic assessment of CO₂ capture and utilization alternatives.

**Energy systems modelling**

- Realized the roadmapping for new lignocellulosic biofuels.
- Techno-economic assessment of high-value bio-based products.
- Validation and enhancement of the energy systems models of several European cities.
- Carried out the evaluation of energy scenarios in Spain: coal extension; externalities internalisation; and energy security.
- Developed a methodological assessment of the energy-economy decoupling.
Photoactivated Processes Unit

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

Dr. Marta Liras
Senior Assistant Researcher

Dr. Fernando Fresno
Senior Assistant Researcher

Dr. Raúl Pérez
Senior Assistant Researcher
R&D Objectives

• Covering the materials, 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 photoactivated processes for energy and environment: Solar fuels production by artificial photosynthesis (including CO₂ photoreduction and H₂ production from H₂O and biomass-derived products), NOx and VOCs remediation.

• Design and synthesis of multifunctional materials: inorganic, organic and hybrid thereof.

• Full-spectrum light harvesting technologies for electron transfer processes.

• Combination of advanced characterisation and theoretical calculation for fundamental studies of reaction mechanisms.

• Photoreactors and devices (photocatalytic and photoelectrocatalytic) for energy and environmental applications.

• Smart window devices based on electrochromic materials and semiconductor nanocrystals with Localised Surface Plasmon Resonance (LSPR).
Relevant projects and networking

In 2018 the Photoactivated Processes Unit (PAPU) has participated in 6 research project funded at regional, national and European levels. Dr. Victor A. de la Peña O’Shea, senior researcher and head of the PAPU, 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 national level, PAPU is funded and supported through several projects such as Ra-PHUEL (2017-2019) and SOL-PAC (2018-2020) as well as by a Ramon y Cajal Programme project (2015 call) and a Juan de la Cierva Formacion grant (2017 call), all of them related with the design and synthesis of new materials (inorganic semiconductors, conductive polymers and organic-inorganic hybrids) as heterogeneous photocatalysts and photoelectrodes 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). Also, at industrial level PAPU holds a project with Mercedes Company. Besides, PAPU is coordinating the national Excellence Network FOTOFUEL, which promotes synergies and networking of national top research groups devoted to the development of materials and devices for efficient solar fuels production. In addition, PAPU participates in the Spanish CO₂ technological platform (PTECO2) where the head of the Unit coordinates the CO₂ uses working group.

Along 2018 PAPU has been awarded new projects from several research calls such as ART-LEAF, funded by Fundación Ramon Areces, and FOTOART project (Tecnologías 2018 call) funded by regional government of Comunidad de Madrid. These projects are a guarantee to maintain the R&D activity in forthcoming years.
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.
- Ball milling.
- Spin coating.

Materials characterization facilities
- Single-crystal and powder 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).
- Time resolve fluorescence spectrometer.
- Electro- and photoelectrochemical characterization in three and two electrode cell configuration. Cyclic voltammetry, photovoltage, photocurrent and electrochemical impedance spectroscopy (EIS) by potentiostatic and galvanostatic measurements.
- In situ and operando cells for spectroscopic measurements such as FTIR, Raman, XPS, NEXAFS, at laboratory and synchrotron set ups.
- Near-ambient pressure (NAP) XPS which allows the in-situ characterisation of photocatalytic processes under illumination at different gas atmospheres and pressures up to 25 mbar.

Reactors
- Gas phase reactors and micro-reactors for photocatalytic reduction of CO₂ provided with gas chromatography for product analysis.
- Reactors for photocatlytic H₂ production coupled to in-line gas chromatography for product analysis.
- Photoelectrochemical cells for solar fuels production by water splitting and CO₂ reduction, coupled to potentiostatic measurements and in-line gas chromatography.
- Gas-phase compound parabolic collector solar reactor for CO₂ reduction and H₂ production with solar radiation measurement and chromatographic gas analysis.
- Spectroelectrochemical cells for spectral response and electrochromic response measures.

Theoretical calculations and modelling
- Workstations.
- Software for chemical modelling.
- Tools for computational fluid dynamics, data treatment and process engineering.
Scientific activities and 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.
- Controlled deposition of metal nanoparticles as co-catalysts in mono- and bimetallic catalytic systems.

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, hyper-branched and porous networks) based on DTT, Benzodithiophenes and BOPHY moieties.

Synthesis of conjugated porous polymer nanostructures by miniemulsion and electropolymerization techniques.

MOFS

- Design and synthesis of novel UV- and visible-light-absorbing building blocks as organic MOF linkers.
- Design and synthesis of MOFs based on group-5 metals.
- Post-functionalization including metal nanoparticles, redox coordination compounds and organic polymers.
Fundamental studies of reaction mechanisms

- Determined the structural, textural and morphological 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 conditions using vibrational and optical spectroscopies with 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.
- Implemented tunable selectivity of CO₂ photoreduction with metal nanoparticle co-catalysts.
- H₂ production from biomass derivatives in real matrices.
- Performed scalability studies for CO₂ photoreduction catalysts.
- Preparation of thin films of all the new synthesised materials and evaluation as photoelectrodes in photoelectrochemical cells.
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

- Proton conducting materials: Fuel cells.
- Semiconducting materials: Photovoltaics.
- Electroactive materials: Energy storage and production.
- Adsorbent and catalytic materials.
Relevant projects and networking

During 2018 the Advanced Porous Materials Unit (APMU) has been involved in 3 national projects. The project Raphuel (2016-2019), funded by MINECO, focused on the development of new multifunctional materials for CO$_2$ photoconversion. The project funded by BBVA Leonardo call (2017-2019, PolyMOF) is dedicated to the preparation of new conducting polymer@MOF composites for energy storage. The project funded by Iberdrola Foundation (2017-2018) was aiming to develop electroactive metal@MOF composites for different applications (energy storage, sensing, biomedicine).

Two additional projects have been accepted for starting in 2019. A regional project Madrid-PV2-CM (2019-2022) dealing with the investigation of materials, devices and technologies for the development of the photovoltaic industry and a Ramón Areces project (2019-2022), which aims to develop fuel cells based on novel composite MOFs. In addition, APMU has been awarded with 5 personal fellowships: 1 national “Ramon y Cajal” and 4 regional grants (2 Junior Postdoctoral Talento, Predoctoral and Technician fellows).

APMU possesses a large frame of collaborations at the national, European and international level that has enhanced mobility actions and collaborative projects. APMU is also involved in the MATERPLAT platform, promoting innovation in advanced materials Spanish system.
Facilities

Synthesis
- Best practice organic/inorganic laboratory tools: Schlenk lines, ovens, rotatory evaporator, (ultra)centrifuge, climate chamber, thin-layer chromatography (TLC), UV lamp, Soxhlet, glove bag.
- Traditional inorganic synthetic methods: two-layer diffusion, evaporation, high temperature...
- Conventional solvothermal, microwave-assisted, sonochemical and mechano-chemical methods, syringe pump techniques.
- High-through put solvothermal reactors.

Manufacturing
- Supercritical CO₂ extraction system (material purification, adsorption, shaping).
- Press-molding and monoliths.
- Spin-coating (thin films, membranes).

Characterization
- Standard techniques available at IMDEA Energy (physi- and chemi-sorption, XRD, IR, Raman, UV-Vis, EDX-SEM, TGA, DLS, elemental analysis, ICP, AFM, etc.) and URJC (TEM, FEG-SEM, NMR, etc.).
- 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.
- Computation of properties of periodic structures using state-of-art density functional theory methods (ORCA, Dmol3, CASTEP, VASP codes) and atomistic modelling.
- High performance liquid chromatography (HPLC) coupled with a photodiode array (PDA) detector.
- Permeation chambers.
Scientific activities and results

Proton conducting materials: Fuel cells

• Design and synthesis of a robust proton conducting MOF based on bismuth and a photoactive azobenzene derivative, exhibiting permanent porosity.
• Design and synthesis of new multifunctional MOFs based on the phosphonate ligands. In particular, 2 new porous structures were prepared based on a pyrene derivative and Cu$^{2+}$ cations, exhibiting proton conductivity and promising optical properties. Other promising novel structures based on tri (Bi) and tetravalent (Zr) cations have been isolated.
• Insertion of proton conductive species into the porosity of aqueous stable MOFs. A novel lysine@MOF composites has been prepared with proton conductivity and structural stability higher than the starting material.
• Five new MOFs based on environmentally friendly cations (Na, K, Ca) and a dicarboxylate ligand with reversible structural changes upon moisture exposure.

Semiconducting materials: Photovoltaics

• Design and synthesis of lead-free organic-inorganic materials for mesoporous dye-sensitized solar cells. A series of materials based on organic cations and complex inorganic bismuth-based [Bi$_m$I$_n$] anions of controlled of dimensionality has been prepared, reaching visible light absorbers with $E_g = 1.8$-2.2 eV.
• Application of crystallographic indicators for evaluation of anion-cation interactions. Computationally assessment of microscopic parameters, supported by experimental evaluation of bulk and micro/nanoscale textural properties of the new developed materials.
Adsorbent and catalytic materials

- Development of new heterogeneous catalysts like Cu-imidazolate porous coordination polymers with controlled particle size with a remarkable catalytic activity in the reduction of methylene blue.
- Preparation of shape-tunable centimetric MOF-based monoliths with hierarchical porosity and mechanical robustness.
- Incorporation of active ingredients (AI) in porous MOFs. An in deep-understanding study of the MOF sorption abilities has concluded that MOF/drug hydrophobic/hydrophilic balance together with the structural parameters of the framework strongly affect the adsorption and delivery from MOFs. In addition, a robust MOF has been proposed for the first time as an efficient oral detoxifying agent.
- Development of antimicrobial surfaces for several applications (heat exchange, biocorrosion, medical devices, food industry, transport). Highly antibacterial activity of gentamicin Fe-MOF vector.

Electroactive materials: Energy storage and production

- Use of a bimetallic (i.e., Co and Fe) MOF as precursor for the preparation of N-doped porous carbons electrocatalysts for rechargeable Zn-air batteries.
- Conducted research on efficient and recyclable production of biodiesel from soybean oil using a lipase@ZIF-67 nanobio-reactor, as an alternative for green energy production via biodiesel transesterification using enzyme-immobilized MOFs.
- Carried out macromolecules nanostructuration using porous electroactive materials based on conducting polymer/MOF composites that exhibit a reversible and cyclable electrochromic switching.
- Obtained the integration of inorganic species into porous materials.
<table>
<thead>
<tr>
<th>R&amp;D projects, contracts and grants</th>
<th>71</th>
</tr>
</thead>
<tbody>
<tr>
<td>scientific results</td>
<td>90</td>
</tr>
<tr>
<td>training and dissemination activities</td>
<td>113</td>
</tr>
</tbody>
</table>
1. R&D projects, contracts and grants

1.1. Regional R&D projects

1. 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 €

2. Title/Acronym: Use of agro-forest and oily residues to produce clean transportation fuels/RESTOENE2
   Partners: ICP-CSIC (Coordinator); CIEMAT; Rey Juan Carlos University; IMDEA Energy Institute; Autonomous University; 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 €

3. 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; Autonomous University; 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: 140,511 €

4. Title/Acronym: Smart grids for the Comunidad de Madrid/PRICAM
   Partners: Alcalá University (Coordinator); Rey Juan Carlos University; Carlos III University; Pontificia Comillas University; Laboratory-IMDEA Energy; Iberdrola; Indra; Real Academia de Ingeniería; Fuenlabrada University Hospital
   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 €
5. **Title/Acronym:** Industrial applications of spirulina/INSPIRA1  
**Partners:** CIB-CSIC (Coordinator); ICP-CSIC; ICV-CSIC; UAM; UCM; URJC; Laboratory-IMDEA Energy; Biodesma; Micro algae Solutions; Laboratorios Actafarma; Isolux Corsán; Canal de Isabel II; UPM  
**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 €

6. **Title/Acronym:** Design and optimization of a continuous reactor for the catalytic pyrolysis of biomass and the production of high quality bio-oils.  
**Partners:** Process Integral Development & Tech; IMDEA Energy Institute  
**Period:** 2018-2020  
**Funding Institution/Program:** Comunidad de Madrid/ Industrial Doctorates 2017  
**IMDEA Energy Institute external funding:** 76,000 €

7. **Title/Acronym:** Research and study of flow microbatteries for application in photovoltaic microinverters.  
**Partners:** Micro Electrochemical Technologies; IMDEA Energy Institute  
**Period:** 2018-2020  
**Funding Institution/Program:** Comunidad de Madrid/ Industrial Doctorates 2017  
**IMDEA Energy Institute external funding:** 78,000 €

### 1.2. National R&D projects

1. **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:** 2014-2018  
**Funding Institution/Program:** Ministry of Economy and Competitiveness/Research, Development and Innovation Oriented Challenges of the Society. Research Challenges 2013  
**IMDEA Energy Institute external funding:** 127,050 €

2. **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 €
3. 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: 2015-2018
Funding Institution/Program: Ministry of Economy and Competitiveness/Research, Development and Innovation Oriented Challenges of the Society. Research Challenges 2014
IMDEA Energy Institute external funding: 174,240 €

4. Title/Acronym: Innovative storage for stationary applications based on aluminum/ALIENA
Partners: Albufera Energy Storage (Coordinator); ALEASTUR; GFM; ITMA; IMDEA Energy Institute
Period: 2015-2019
Funding Institution/Program: Ministry of Economy and Competitiveness/Research, Development and Innovation Oriented Challenges of the Society. Collaboration Challenges 2015
IMDEA Energy Institute external funding: 128,088 €

5. 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/Research, Development and Innovation Oriented Challenges of the Society. Collaboration Challenges 2015
IMDEA Energy Institute external funding: 162,480 €

6. 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
Period: 2015-2019
Funding Institution/Program: Ministry of Economy and Competitiveness/Research, Development and Innovation Oriented Challenges of the Society. Collaboration Challenges 2015
IMDEA Energy Institute external funding: 416,900 €
7. **Title/Acronym:** New strategies for the integration of microalgae-bacteria consortium in small size urban wastewater treatment plants/MICROALBAC  
**Partners:** FACSA (Coordinator); IMDEA Energy Institute; CSIC  
**Period:** 2015-2019  
**Funding Institution/Program:** Ministry of Economy and Competitiveness/Research, Development and Innovation Oriented Challenges of the Society. *Collaboration Challenges 2015*  
**IMDEA Energy Institute external funding:** 160,926 €

8. **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:** 2016-2019  
**Funding Institution/Program:** Ministry of Economy and Competitiveness/Research, Development and Innovation Oriented Challenges of the Society. *Research Challenges 2015*  
**IMDEA Energy Institute external funding:** 189,970 €

9. **Title/Acronym:** Innovative materials for application in advanced supercapacitor/MATCAP  
**Partners:** IMDEA Energy Institute (Coordinator); CIC Energune; Repsol; Solvionic; AVANZARE Innovacion Tecnologica  
**Period:** 2016-2019  
**Funding Institution/Program:** Ministry of Economy and Competitiveness/Research, Development and Innovation Oriented Challenges of the Society. *Research Challenges 2015*  
**IMDEA Energy Institute external funding:** 145,200 €

10. **Title/Acronym:** New biorefinery concept based on the production of bioethanol and other by-products from pruning waste and gardening residues/BIO_LIGWASTE  
**Partners:** TETma (Coordinator); IMDEA Energy Institute; Centre VERD; CIEMAT  
**Period:** 2016-2019  
**Funding Institution/Program:** Ministry of Economy, Industry and Competitiveness/Research, Development and Innovation Oriented Challenges of the Society. *Collaboration Challenges 2016*  
**IMDEA Energy Institute external funding:** 102,132 €
11. **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 Institute of Chemical Technology  
**Period:** 2016-2019  
**Funding Institution/Program:** Ministry of Economy, Industry and Competitiveness/Research, Development and Innovation Oriented Challenges of the Society. *Research Challenges 2016*  
**IMDEA Energy Institute external funding:** 223.850 €

12. **Title/Acronym:** Planning the implementation of alternative fuels in the Spanish energy sector towards a sustainable transport system/PICASO  
**Partners:** IMDEA Energy Institute  
**Period:** 2017-2019  
**Funding Institution/Program:** Ministry of Economy, Industry and Competitiveness/Research, Development and Innovation Oriented Challenges of the Society. *Modality young researchers 2015*  
**IMDEA Energy Institute external funding:** 203.280 €

13. **Title/Acronym:** New challenges in the production of solar fuels/FOTOFUEL-2  
**Partners:** IMDEA Energy Institute (Coordinator); ICP-CSIC; Polytechnic University of Valencia; IMDEA Materials Institute; Consorci per a la Construccio, Equipament i Explo-tacio del Laboratori de llum de Sincroto; Barcelona University; Jaume I University; Fundacio Institut de Recerca de l Energia de Catalunya; ICIQ; PSA  
**Period:** 2017-2019  
**Funding Institution/Program:** Ministry of Economy, Industry and Competitiveness/Promotion of Scientific and Technical Research Excellence. *Dinamization actions Networks of Excellence 2016*  
**IMDEA Energy Institute external funding:** 19.000 €

14. **Title/Acronym:** Impact of the high penetration of the storage, renewable and other technologies to the stability of distribution networks/EnRed  
**Partners:** IMDEA Energy Institute  
**Period:** 2017-2018  
**Funding Institution/Program:** Fundación Iberdrola España/Call for research funding in energy and environment 2017-2018  
**IMDEA Energy Institute external funding:** 20.000 €
<table>
<thead>
<tr>
<th></th>
<th>Title/Acronym</th>
<th>Partners</th>
<th>Period</th>
<th>Funding Institution/Program</th>
<th>IMDEA Energy Institute external funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.</td>
<td>Nano-metallic electroactive objects associated to porous organic metal networks for the chemical storage of energy</td>
<td>IMDEA Energy Institute</td>
<td>2017-2018</td>
<td>Fundación Iberdrola España/Call for energy and environment 2017-2018</td>
<td>20,000 €</td>
</tr>
<tr>
<td>19.</td>
<td>Advanced tools for smart distribution network planning to guarantee optimal continuity of supply/SinCortes</td>
<td>IMDEA Energy Institute</td>
<td>2018-2019</td>
<td>Fundación Iberdrola España/Call for energy and environment 2018-2019</td>
<td>20,000 €</td>
</tr>
</tbody>
</table>
20. **Title/Acronym:** Circular economy perspectives for the management of electric car batteries at their end-of-life/BATTMAN  
**Period:** 2018-2019  
**Funding Institution/Program:** Fundación Iberdrola España/Call for energy and environment 2018-2019  
**IMDEA Energy Institute external funding:** 20,000 €

21. **Title/Acronym:** Environmental and energy applications of electrochemical technology/Red E3Tech  
**Partners:** Castilla-La Mancha University (Coordinator); Barcelona University; Cantabria University; Alicante University; Polytechnic University of Valencia; Vigo University; Polytechnic University of Cartagena; Valencia University; IMDEA Energy Institute  
**Period:**  
**Funding Institution/Program:** Ministry of Economy, Industry and Competitiveness/Promotion of Scientific and Technical Reseach Excellence. *Dinamization actions Networks of Excellence 2017*

22. **Title/Acronym:** Hybridization of geothermal energy and flow batteries for heating and cooling of zero-energy tertiary use buildings/GeoBATT  
**Partners:** Sacyr Industrial (Coordinator); PVH Energy Storage; IMDEA Energy Institute; Polytechnic University of Madrid; Carlos III University  
**Period:** 2018-2021  
**Funding Institution/Program:** Ministry of Science, Innovation and Universities/Research, Development and Innovation Oriented Challenges of the Society. *Collaboration Challenges 2017*  
**IMDEA Energy Institute external funding:** 255,476 €
### 23. Title/Acronym: Battery inverter with integrated controls of power converter and microgrid/ MICROGRID-ON-CHIP

**Partners:** Norvento Energía Distribuida (Coordinator); IMDEA Energy Institute; Alcalá University.

**Period:** 2018-2021

**Funding Institution/Program:** Ministry of Science, Innovation and Universities/Research, Development and Innovation Oriented Challenges of the Society. *Collaboration Challenges 2017*

**IMDEA Energy Institute external funding:** 92,310 €

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### 1.3. International R&D projects

1. **Title/Acronym:** Scientific and technological alliance for guaranteeing the European excellence in concentrating solar thermal energy/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. Call identifier: FP7-ENERGY-2013-IRP

**IMDEA Energy Institute external funding:** 472,102 €

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2. **Title/Acronym:** European network for algal-bioproducts/EUALGAE

**Partners:** IMDEA Energy Institute (Coordinator); more than 180 researchers of 113 companies, universities, research centres, associations, from all over the world

**Period:** 2015-2019

**Funding Institution/Program:** European Union/COST actions

**IMDEA Energy Institute external funding:** 62,134 € (estimated)

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3. **Title/Acronym:** Hybrid materials for artificial photosynthesis/HyMap

**Partners:** IMDEA Energy Institute

**Period:** 2015-2020

**Funding Institution/Program:** European Union/ERC-2014-CoG

**IMDEA Energy Institute external funding:** 2,506,738 €
### 4. Title/Acronym: SUNlight-to-LIQUID: 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; IMDEA Energy Institute; HyGear Technology and Services; Abengoa Research; ARTTIC  
**Period:** 2016-2019  
**Funding Institution/Program:** European Union/H2020. Call H2020-LCE-2015-1  
**IMDEA Energy Institute external funding:** 936,525 €

### 5. 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  
**Period:** 2016-2019  
**Funding Institution/Program:** European Union/H2020. Call H2020-JTI-FCH-2015-1  
**IMDEA Energy Institute external funding:** 89,292 €

### 6. 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. Call H2020-JTI-FCH-2015-1  
**IMDEA Energy Institute external funding:** 199,791 €

### 7. Title/Acronym: Valorization of urban wastes to new generation of bioethanol/WASTE-2BIO
**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 €
8. Title/Acronym: Integrating national research agendas on solar heat for industrial processes/INSHIP
Partners: Fraunhofer (Coordinator); Ciemat; Aee Intec; Fondazione Bruno Kessler; Universidade de Evora; The Cyprus Institute; Centre for renewable energy sources and saving; ETH Zürich; CEA; Middle East Technical University; EERA Aisbl; CNRS; DLR; ENEA; CNR; Universita degli Studi di Palermo, Universita degli Studi di Napoli Federico II; Universita degli Studi di Firenze; Lneg; Associacao do Instituto Superior Tecnico para a Investigacao e Desenvolvimento; Cener-Ciemat; IMDEA Energy Institute; Centro Tecnológico Avanzado de Energías Renovables de Andalucía; Tecnalia; Ik4-tekniker; Seville University; Cic Energigune; Cranfield University
Period: 2017-2020
Funding Institution/Program: European Union/H2020. Call H2020-LCE-2016-ERA
IMDEA Energy Institute external funding: 10,000 €

9. Title/Acronym: Membrane-free redox flow batteries/MFreeB
Partners: IMDEA Energy Institute
Period: 2017-2022
Funding Institution/Program: European Union/ ERC-2016-CoG
IMDEA Energy Institute external funding: 1,998,407 €

10. Title/Acronym: European corridors for natural gas transport efficiency/ECO-GATE
Partners: Gas Natural; CETIL Dispensing technology; Fundacion Cidaut; IMDEA Energy; GASNAM; Inversora Melofe; Port Authority of Huelva; SOLTEL IT Solutions; Santiago of Compostela University; Port Authority of Gijon; Sociedad Estatal de Correos y Telégrafos; SOULMAN Insightful Thinking; ENAGAS Transporte; ENDESA Energía; MOLGAS Energía; EVARM Innovación; Mantenimiento de instalaciones de gas y servicios auxiliares; REP-SOL; Dourogás Natural- medição e exploração de sistema de gás; GALP Gas Natural; Universidade De tras-os-montes e alto douro; Gas Natural Europe; Ghenova Ingeniería; AUDIGNA; San-José López
Period: 2017-2019
Funding Institution/Program: European Union/ H2020. Call CEF-Transport-2016-MAP General
IMDEA Energy Institute external funding: 20,654 €
11. **Title/Acronym:** Demonstration of dry fermentation and optimization of biogas technology for rural communities in the MENA region/BIOGASMENA  
**Partners:** Hohenheim University (Coordinador); Verona University; Agricultural University of Athens (AUA), Nireas-IWRC (University of Cyprus), EGE University, Université des Sciences et Technologies d’Oran (USTO), Laboratoire de Biotechnologie de L’Environnement (LBE of INRA), IMDEA Energy, Centre de Biotechnologie de Sfax (CBS), Cairo University, Nenufar, ERM, Talos, Euromarket, FnBB e.V.  
**Period:** 2017-2020  
**Funding Institution/Program:** Ministry of Economy, Industry and Competitiveness/ERANETMED 2nd joint call / APCIN 2017  
**IMDEA Energy Institute external funding:** 99,865 €

### 1.4. Contracts with companies and other organizations

| 1. **Title/Acronym:** Energy efficiency in systems for vibration testing  
Company: IMV Corporation (Japan)  
**Period:** 2010-2019  
**IMDEA Energy Institute external funding:** 245,021 € |
|---|
| 2. **Title/Acronym:** Development of an organic flow drum based on redox pairs for electric vehicles and stationary storage/BAFO2  
Company: PV Hardware Solutions/Repsol (Spain)  
**Period:** 2017-2018  
**IMDEA Energy Institute external funding:** 346,682 € |
| 3. **Title/Acronym:** Testing and evaluation of reflective mirror under concentrating solar light exposure  
Company: XXENTRIA Technology Materials (Taiwan)  
**Period:** 2017-2018  
**IMDEA Energy Institute external funding:** 17,500 € |
| 4. **Title/Acronym:** LCA critical review  
Company: Solinnen (France)  
**Period:** 2017-2018  
**IMDEA Energy Institute external funding:** 2,300 € |
| 5. **Title/Acronym:** Validation and numerical analysis of components of a desalination device by humidification/dehumidification  
Company: Seenso Renoval (Spain)  
**Period:** 2017-2018  
**IMDEA Energy Institute external funding:** 5,760 € |
6. **Title/Acronym:** Modeling and simulation of the fucus vesiculosus and sugarbeet pulp filter for the treatment of wastewater from galvanizing and zinc-plating processes  
**Company:** Hidrolab (Spain)  
**Period:** 2017-2018  
**IMDEA Energy Institute external funding:** 2,000 €

7. **Title/Acronym:** Modeling and simulation of different technologies for the wastewater treatment of São Domingos mine  
**Company:** LCW Consult (Portugal)  
**Period:** 2017-2018  
**IMDEA Energy Institute external funding:** 3,500 €

8. **Title/Acronym:** Characterization of materials and determination of their electrochemical properties  
**Company:** GNANOMAT (Spain)  
**Period:** 2017-2018  
**IMDEA Energy Institute external funding:** 37,022 €

9. **Title/Acronym:** Testing and validation of a system of HDH-Al beds for desalination  
**Company:** Seenso Renoval (Spain)  
**Period:** 2018  
**IMDEA Energy Institute external funding:** 26,117 €

10. **Title/Acronym:** Technical advice for the determination of polluting substances in a paint application process  
**Company:** Mercedes Benz España (Spain)  
**Period:** 2018-present  
**IMDEA Energy Institute external funding:** 10,850 €
<table>
<thead>
<tr>
<th></th>
<th>Title/Acronym</th>
<th>Company</th>
<th>Period</th>
<th>IMDEA Energy Institute external funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.</td>
<td>Analysis of hydrogen production technologies/ANHYPRO</td>
<td>WorleyParsons España (Spain)</td>
<td>2018</td>
<td>2.500 €</td>
</tr>
<tr>
<td>13.</td>
<td>In-situ measurement system of concentrated solar flux in solar towers/EFFECTO</td>
<td>Cobra Instalaciones y Servicios (Spain)</td>
<td>2018-2019</td>
<td>50.000 €</td>
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<tr>
<td>14.</td>
<td>In-situ measurement system of concentrated solar flux in solar towers/EFFECTO</td>
<td>Egatel (Spain)</td>
<td>2018-2019</td>
<td>50.000 €</td>
</tr>
<tr>
<td>15.</td>
<td>Research on electrochemical technologies for seasonal energy storage/AE3</td>
<td>Inversiones Financieras Perseo (Spain)</td>
<td>2018-2019</td>
<td>15.000 €</td>
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<tr>
<td>16.</td>
<td>Process simulation with professional software licenses/EcoSim</td>
<td>Rey Juan Carlos University (Spain)</td>
<td>2018</td>
<td>4.500 €</td>
</tr>
<tr>
<td>17.</td>
<td>Collaboration in the development of energy models of European towns/MySmartLife</td>
<td>Fundación Tecnalia Research &amp; Innovation (Spain)</td>
<td>2018</td>
<td>11.950 €</td>
</tr>
</tbody>
</table>
18. Title/Acronym: LCA study/WINPOLCA  
Company: SeoBird/Life (Spain)  
Period: 2018  
IMDEA Energy Institute external funding: 3,000 €

19. Title/Acronym: Development and integration of flexible Li-ion batteries into vehicle’s components/BATFLEX  
Institution: IMDEA Materials Institute and private company (Spain)  
Period: 2018-2019  
IMDEA Energy Institute external funding: 38,500 €

20. Title/Acronym: Testing of primary batteries for wireless devices/TEBAWI  
Company: Securitas Direct España (Spain)  
Period: 2018-2019  
IMDEA Energy Institute external funding: 26,900 €

21. Title/Acronym: Techno-economic and environmental assessment of alkaline-based carbon capture and utilization/TEECCU  
Company: EWL-Ecological World for Life España (Spain)  
Period: 2018-2019  
IMDEA Energy Institute external funding: 11,500 €

1.5. Researcher grants

1. Program: Contract FPU2014  
Project/Acronym: Particle reactors for applications in the solar thermochemical  
Period: 2015-2018  
Funding Institution: Ministry of Education, Culture and Sports  
IMDEA Energy Institute external funding: 57,109 €  
Ms. Lucía Arribas

2. 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
3. Program: Ramón y Cajal 2014  
Project: Bioaplications of porous materials  
Period: 2016-2021  
Funding Institution: Ministry of Economy and Competitiveness  
IMDEA Energy Institute external funding: 168,600 €  
Dr. Patricia Horcajada

Period: 2016-2018  
Funding Institution: Ministry of Economy, Industry and Competitiveness  
IMDEA Energy Institute external funding: 98,684 €  
Dr. Rebeca Marcilla

5. 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

6. Program: Ramón y Cajal 2015  
Project: Design and Synthesis of Hybrid Materials for Advances Applications: Solar Fuels Generation  
Period: 2017-2021  
Funding Institution: Ministry of Economy, Industry and Competitiveness  
IMDEA Energy Institute external funding: 168,600 €  
Dr. Marta Liras

7. Program: Recruitment of young doctors 2016 (Modality 2)  
Period: 2017-2021  
Funding Institution: Comunidad de Madrid  
IMDEA Energy Institute external funding: 80,000 €  
Dr. Julio Lado

8. Program: Recruitment of experienced doctors 2016 (Modality 1)  
Project/Acronym: Application of photon up-conversion in photoredox catalysis/APUPCAT  
Period: 2017-2021  
Funding Institution: Comunidad de Madrid  
IMDEA Energy Institute external funding: 85,557 €  
Dr. Raúl Pérez
9. Program: Recruitment of research assistants and laboratory technicians 2016
Period: 2017-2019
Funding Institution: Comunidad de Madrid
IMDEA Energy Institute external funding: 45,000 €
Mr. Carlos Lirio

10. Program: Recruitment of research assistants and laboratory technicians 2016
Period: 2017-2019
Funding Institution: Comunidad de Madrid
IMDEA Energy Institute external funding: 38,000 €
Ms. Eva Álvarez

11. Program: Recruitment of research assistants and laboratory technicians 2016
Period: 2017-2019
Funding Institution: Comunidad de Madrid
IMDEA Energy Institute external funding: 38,000 €
Mr. Alejandro Aguilar

12. Program: Recruitment of research assistants and laboratory technicians 2016
Period: 2017-2019
Funding Institution: Comunidad de Madrid
IMDEA Energy Institute external funding: 37,167 €
Mr. Álvaro Pérez
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<th></th>
<th>Program: Call for Predoctoral and Postdoctoral Researchers 2016</th>
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<tr>
<td>13.</td>
<td>Period: 2017-2019</td>
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<td></td>
<td>Funding Institution: Comunidad de Madrid</td>
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<td></td>
<td>IMDEA Energy Institute external funding: 25,000 €</td>
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<td>Ms. Ana Arenas</td>
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<th>Program: Call for Predoctoral and Postdoctoral Researchers 2016</th>
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<td>Funding Institution: Comunidad de Madrid</td>
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<td>IMDEA Energy Institute external funding: 25,000 €</td>
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<td>Mr. Antonio Molina</td>
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<th>Program: Contract FPU2016</th>
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<tr>
<td>15.</td>
<td>Project/Acronym: Integración de sistemas de conversión termo-electro-química en centrales termosolares</td>
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<td>Period: 2017-2018</td>
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<tr>
<td></td>
<td>Funding Institution: Ministry of Education, Culture and Sports</td>
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<td></td>
<td>IMDEA Energy Institute external funding: 13,288 €</td>
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<td>Ms. Elena Díaz</td>
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<th>Program: H2020-MSCA-IF-2016</th>
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<td>16.</td>
<td>Project/Acronym: Solar Energy Storage PERovskites/SESPer</td>
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<td>Period: 2017-2018</td>
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<td></td>
<td>Funding Institution: European Union</td>
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<td></td>
<td>IMDEA Energy Institute external funding: 67,585 €</td>
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<td>Dr. Emanuela Mastronardo</td>
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<th>Program: Contract FPI2016</th>
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<tr>
<td>17.</td>
<td>Project/Acronym: Multidisciplinary analysis of indirectly-heated particles receivers/reactors for solar applications in extreme conditions/ARROPAR-CEX</td>
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<tr>
<td></td>
<td>Period: 2017-2021</td>
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<tr>
<td></td>
<td>Funding Institution: Ministry of Economy, Industry and Competitiviness</td>
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<td></td>
<td>IMDEA Energy Institute external funding: 82,000 €</td>
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<td>Mr. Mario Sánchez</td>
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<th>Program: H2020-MSCA-IF-2017</th>
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<td>18.</td>
<td>Project/Acronym: Sustainability assessment of advanced energy systems: towards new methodological approaches/ SUSADES</td>
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<td>Period: 2018-2019</td>
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<td></td>
<td>Funding Institution: European Union</td>
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<td></td>
<td>IMDEA Energy Institute external funding: 106,326 €</td>
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<td>Dr. Anna Skorek-Osikowska</td>
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<td>Program</td>
<td>Project/Acronym</td>
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<tr>
<td>Recruitment of experienced doctors 2017 (Modality 1)</td>
<td>Batteries based on semi-solid fluids/BASS</td>
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<tr>
<td>Recruitment of experienced doctors 2017 (Modality 1)</td>
<td>Computer-aided design of functional nanomaterials for energy storage applications/CADFUNES</td>
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<tr>
<td>Juan de la Cierva-Formación 2016</td>
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<tr>
<td>Recruitment of young doctors 2017 (Modality 2)</td>
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<td>Call for Predoctoral and Postdoctoral Researchers 2017</td>
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<td>Call for Predoctoral and Postdoctoral Researchers 2017</td>
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</table>
25. Program: Call for Predoctoral and Postdoctoral Researchers 2017  
Period: 2018-2020  
Funding Institution: Comunidad de Madrid  
IMDEA Energy Institute external funding: 539 €  
Mr. Domingo Olivares

26. Program: Contract FPI2017  
Project/Acronym: CO₂ photoconversion to solar fuels using multifunctional materials/ Ra-Phuel  
Period: 2018-2022  
Funding Institution: Ministry of Science, Innovation and Universities  
IMDEA Energy Institute external funding: 82.000 €  
Mr. Giacomo Armani

27. Program: Recruitment of research assistants and laboratory technicians 2017  
Period: 2018-2020  
Funding Institution: Comunidad de Madrid  
IMDEA Energy Institute external funding: 38.000 €  
Ms. Miriam Bravo
2. Scientific Results

2.1. Publications in journals with impact index


47. Navalpotro, P.; Sierra, N.; Trujillo, C.; Montes, I.; Palma, J.; Marcilla, R. “Exploring the versatility of membrane-free battery concept using different combinations of immiscible redox electrolytes”. ACS Materials & Interfaces, 2018, 10 (48), 41246-41256.


57. Piperopoulos, E.; Fazio, M.; Mastronardos, E. “Synthesis of me doped Mg(OH)2 materials for thermochemical heat storage”. Nanomaterials, 2018, 8 (8), art. no. 573.


84. Wouters, J.J.; Tejedor-Tejedor, M.I.; Anderson, M.A., Noguera, D.R. “Performance of SiO₂, ZrO₂, TiO₂, Al₂O₃ or Fe₃O₄ coatings on Ti electrodes for arsenic (V) detection utilizing electrochemical impedance spectroscopy”. Journal of the Electrochemical Society, 2018, 165 (2), B34-B47.


2.2. Patents

2.2.1. Granted patents


2.2.2. Submitted patents


2.3. Books/Chapters of books


2.4. Non indexed publications


2.5. PhD Thesis

1. **Title:** Desarrollo de electrolitos redox para su aplicación en nuevos dispositivos electroquímicos de almacenamiento de energía  
**Author:** Paula Navalpotro Molina  
**Director:** Dr. Rebeca Marcilla and Dr. Jesús Palma  
**Venue:** Autonoma University of Madrid, Spain  
**Date:** 22 June 2018

2. **Title:** Development of multifunctional flexible and structural supercapacitors based on CNT fibers  
**Author:** Evgeny Senokos  
**Director:** Dr. Juan José Vilatela (IMDEA Materials) and Dr. Rebeca Marcilla  
**Venue:** Polytechnic University of Madrid, Spain  
**Date:** 7 September 2018

3. **Title:** Particle reactors for solar thermochemical applications  
**Author:** Lucía Arribas Dávila  
**Director:** Dr. Manuel Romero  
**Venue:** Rey Juan Carlos University, Madrid  
**Date:** 16 October 2018

4. **Title:** Modelling, simulation and analysis of the coprocessing of biomass-based feedstocks in crude oil refineries  
**Author:** Pedro Luis Cruz Prieto  
**Director:** Dr. Javier Dufour  
**Venue:** Rey Juan Carlos University, Madrid  
**Date:** 30 October 2018

2.6. Congress communications

2.6.1. Invited lectures

1. **Title:** Engineered-surface metal-organic frameworks (MOFs) as drug nanocarriers for drug nanocarriers  
**Author:** Horcajada, P.  
**Congress:** 1st Nanomed workshop: novel nanoporous materials for biomedical applications  
**Venue:** Alicante, Spain  
**Date:** 21-22 March 2018  
**Organizer:** NanoMed Project

2. **Title:** Drug vectorization using engineered-surface metal-organic frameworks  
**Author:** Horcajada, P.  
**Congress:** UK MOF symposium  
**Venue:** Southampton, UK  
**Date:** 9-10 April 2018  
**Organizer:** University of Southampton

3. **Title:** Critical materials and recycling strategies for fuel cells and hydrogen technologies  
**Author:** Férriz, A.M.; Zarzuela, M.; Bernad, A.; Fiorot, S.; Dufour, J.; Iribarren, D.; Mori, M.  
**Congress:** 22nd World hydrogen energy conference (WHEC2018)  
**Venue:** Rio de Janeiro, Brazil  
**Date:** 17-22 June 2018  
**Organizer:**

4. **Title:** Membrane-free battery: a paradigm shift in energy storage  
**Author:** Marcilla, R.; Navalpotro, P.; Anderson, M.A.; Palma, J.  
**Congress:** XXXIX Reunión del grupo de electroquímica de la real sociedad española de química y III simposio E3 del Mediterráneo (XXXIX GERSEQ & 3rd E3-MS)  
**Venue:** Madrid, Spain  
**Date:** 2-5 July 2018  
**Organizer:** Specialized Group in Electrochemistry
5. **Title:** Importance of anodic reaction in reversible aluminium batteries  
**Author:** Muñoz-Torrero, D.; García-Quismondo, E.; Ventosa, E.; Anderson, M.A.  
**Congress:** XXXIX Reunión del grupo de electroquímica de la real sociedad española de química y III simposio E3 del Mediterráneo (XXXIX GESEQ & 3rd E3-MS)  
**Venue:** Madrid, Spain  
**Date:** 2-5 July 2018  
**Organizer:** Specialized Group in Electrochemistry

6. **Title:** Engineered-surface metal-organic frameworks as drug nanocarriers  
**Author:** Horcajada, P.  
**Congress:** XXVII International materials research congress (IMRC 2018)  
**Venue:** Cancún, Mexico  
**Date:** 19-24 August 2018  
**Organizer:** The Sociedad Mexicana de Materiales (SMM) and the Materials Research Society® (MRS)

7. **Title:** Redes metal-orgánicas porosas en medicina  
**Author:** Horcajada, P. (Plenary)  
**Congress:** III QuimBioQuim  
**Venue:** Albacete, Spain  
**Date:** 3-5 October 2018  
**Organizer:** University of Castilla La Mancha

8. **Title:** Metal organic frameworks in medicine  
**Author:** Horcajada, P. (Plenary)  
**Congress:** XVII Encuentro de química inorgánica  
**Venue:** Los Andes, Chile  
**Date:** 21-24 October 2018  
**Organizer:** Sociedad Chilena de Química

9. **Title:** Challenges in biomass pyrolysis and catalytic bio-oil upgrading for the production of advanced biofuels  
**Author:** Serrano, D.P.  
**Congress:** 4th Iberoamerican congress on biorefineries (4-CIAB)  
**Venue:** Jaén, Spain  
**Date:** 24-26 October 2018  
**Organizer:** University of Jaén

10. **Title:** Solar-driven thermochemical processes  
**Author:** Romero, M.  
**Congress:** The Decarbonisation of the energy sector in the mediterranean region and middle east - the role of CSP (CSP4Climate 2018 International Conference)  
**Venue:** Nicosia, Cyprus  
**Date:** 29 November-1 December 2018  
**Organizer:** The Cyprus Institute

11. **Title:** Metal-organic frameworks as novel detoxifying agents  
**Author:** Horcajada, P.  
**Congress:** 6th International conference on metal organic frameworks & open framework compounds (MOF2018)  
**Venue:** Auckland, New Zealand  
**Date:** 9-13 December 2018  
**Organizer:** The University of Auckland

**2.6.2. Oral communications**

1. **Title:** Volatile fatty acids production via anaerobic digestion from enzymatically pretreated microalgae  
**Author:** Magdalena, J.A.; Colzi, A.; Llamas, M.; Ballesteros, M.; González-Fernández, C.  
**Congress:** 2nd Workshop early career investigators  
**Venue:** Thessaloniki, Greece  
**Date:** 6 March 2018  
**Organizer:** EUALGAE project

2. **Title:** End-of-life of FCH products: a review of the current situation  
**Author:** Férriz, A.M.; Dufour, J.; Iribarren, D.; Mori, M.; Fiorot, S.  
**Congress:** European hydrogen energy conference 2018 (EHEC2018)  
**Venue:** Málaga, Spain  
**Date:** 14-16 March 2018  
**Organizer:** AeH₂
3. Title: Results from “New recycling technologies applied to FCH products”  
Author: Valente, A.  
Congress: HyTechCycling dissemination workshop  
Venue: Móstoles, Madrid, Spain  
Date: 20 March 2018  
Organizer: HyTechCycling project

4. Title: Real-time operation of a centralized energy management system for an islanded microgrid  
Author: Peña-Asensio, A.; Arnalte, S.; Rodríguez-Amendo, J.L.; García-Plaza, M.; Prodanovic, M.  
Congress: International Conference on Renewable Energies and Power Quality (ICREPQ’18)  
Venue: Salamanca, Spain  
Date: 21-23 March 2018  
Organizer: Escola Técnica Superior de Enxeñaría

5. Title: Antifouling photo-bactericidal combined effect of a Ag@nanoMOF  
Author: Arenas, A.; Amariei, G.; Aguado, S.; Rosal, R.; Horcajada, P.  
Congress: 34th International congress of the groupe français de zeolites (GFZ2018)  
Venue: Cabourg, Normandie, France  
Date: 26-29 March 2018  
Organizer: The French Group of Zeolites

6. Title: Parallel current-controlled synchronverters for voltage and frequency regulation in weak grids  
Author: Roldán-Pérez, J.; Rodríguez-Cabero, A.; Prodanovic, M.  
Congress: The 9th International conference on power electronics, machines and drives (PEMD2018)  
Venue: Liverpool, UK  
Date: 17-19 April 2018  
Organizer: IET

7. Title: Antifouling photo-bactericidal Combined effect of a Ag@nanoMOF  
Author: Arenas, A.; Amariei, G.; Aguado, S.; Rosal, R.; Horcajada, P.  
Congress: 1st European doctoral symposium on metal-organic frameworks (docMOF 2018)  
Venue: Raitenhaslach, Germany  
Date: 29 April-2 May 2018  
Organizer: DEFect NETwork

8. Title: Nanometric MIL-125-NH₂ metal–organic framework as nerve agent antidote carrier  
Author: Salcedo, P.; Vilela, S.M.F.; Colinet, I.; Salles, F.; de Koning, M.C.; Joosen, M.J.A.; Serre, C.; Horcajada, P.  
Congress: 1st European doctoral symposium on metal-organic frameworks (docMOF 2018)  
Venue: Raitenhaslach, Germany  
Date: 29 April-2 May 2018  
Organizer: DEFect NETwork

9. Title: Novel proton conducting bismuth-based metal-organic framework  
Author: Vilela, S.M.F.; Devic, T.; Várez, A.; Horcajada, P.  
Congress: 2018 3rd International conference on energy materials and applications (ICEMA 2018)  
Venue: Salamanca, Spain  
Date: 9-11 May 2018  
Organizer: ICEMA Committees

10. Title: Finite-gain-current repetitive controller for synchronverters with harmonic-sharing capabilities  
Author: Roldán J.; Prodanovic, M.; Rodríguez, A.; Guerrero, J.M.; García, A.  
Congress: ICHQP 2018  
Venue: Ljubliana, Slovenia  
Date: 13-16 May 2018  
Organizer: IEEE

11. Title: Volatile fatty acids production from microalgae biomass via semi-continuous anaerobic digestion  
Author: Magdalena, J.A.; Colzi, A.; Llamas, M.; Ballesteros, M.; González-Fernández, C.  
Congress: Young algaeneers symposium (YAS 2018)
12. Title: Supporting metal phosphides on hierarchical zeolites: structural impact and its correlation with HDO performance  
Author: Berenguer, A.M.; Ochoa-Hernández, C.; Linares, M.; Moreno, I.; Coronado, J.M.; Serrano, D.P.; Pizarro, P.  
Congress: Advances in zeolites chemistry and catalysis 2018  
Venue: Český Krumlov, Czech Republic  
Date: 21-25 May 2018  
Organizer: Jiří Čejka

13. Title: Enhanced liquid biofuels and aromatics production via catalytic co-pyrolysis of lignocellulose and plastic wastes over hierarchical ZSM-5  
Author: Jiménez, S.; Peral, A.; Moreno, J.M.; Coronado, J.M.; Pizarro, P.; Serrano, D.P.  
Congress: Advances in zeolites chemistry and catalysis 2018  
Venue: Český Krumlov, Czech Republic  
Date: 21-25 May 2018  
Organizer: Jiří Čejka

14. Title: A novel bismuth-tetracarboxylate MOF as a proton conductor  
Author: Vilela, S.M.F.; Devic, T.; Várez, A.; Sales, F.; Horcajada, P.  
Congress: 2nd Meeting on porous molecular solids (2nd PoMoS)  
Venue: Vietri sul Mare, Italy  
Date: 6-8 June 2018  
Organizer: University of Salerno

15. Title: Valorización de residuos urbanos para la producción de bioetanol y biogás  
Author: Magdalena, J.A.; Colzi, A.; Ballesteros, M.; González-Fernández, C.  
Congress: Jornadas de biometanización de RSU 2018  
Venue: Barcelona, Spain  
Date: 18-19 June 2018  
Organizer: University of Barcelona

16. Title: Caracterización óptico-energética de heliostatos de pequeñas dimensiones para sistemas solares de muy alta concentración  
Author: Martínez-Hernández A.; Sánchez M.; Luque S.; González-Aguilar J.; Romero M.  
Congress: XVI Congreso Ibérico y XII Congreso Iberoamericano de Energía Solar (CIES2018)  
Venue: Madrid, Spain  
Date: 20-22 June 2018  
Organizer: AEDES, UPM/ETSIDI, UIB

17. Title: Determinación de estrategias de apunte en un simulador solar de alto flujo  
Author: Sánchez, M.; González-Aguilar J.; Romero M.  
Congress: XVI Congreso ibérico y XII congreso iberoamericano de energía solar (CIES2018)  
Venue: Madrid, Spain  
Date: 20-22 June 2018  
Organizer: AEDES, UPM/ETSIDI, UIB

18. Title: Producción solar de H₂ con Ni₂FeO₄ en un lecho fluidizado directamente irradiado  
Author: Arribas, L.; González-Aguilar J.; Romero M.  
Congress: XVI Congreso ibérico y XII congreso iberoamericano de energía solar (CIES2018)  
Venue: Madrid, Spain  
Date: 20-22 June 2018  
Organizer: AEDES, UPM/ETSIDI, UIB

19. Title: Strategies to design organic moieties as building block for photocatalytic hybrid materials based on conjugated porous polymers  
Author: Liras, M.; García, C.; García-Sánchez, A.; Reñones, P.; Barawi, M.; Fresno, F.; de la Peña O’Shea, V.A.  
Congress: XXVII Reunión bienal de química orgánica (BIQOS2018)  
Venue: Santiago de Compostela, Spain  
Date: 20-22 June 2018  
Organizer: GEQOR
20. Title: Synchronized biphotonic processes triggering catalytic reactions
Author: García, C.; Liras, M.; de la Peña-O’Shea, V.A.; Pérez-Ruíz, R.
Congress: XXVII Reunión Bienal de Química Orgánica (BIQOS2018)
Venue: Santiago de Compostela, Spain
Date: 20-22 June 2018
Organizer: GEQOR

21. Title: Assessing biomass catalytic pyrolysis for the efficient production of advanced biofuels
Congress: III Encuentro de jóvenes investigadores de la SECAT
Venue: Valencia, Spain
Date: 25-27 June 2018
Organizer: SECAT

22. Title: A Comparison of the renewable distributed generation models used in reliability assessment
Author: Escalera, A.; Prodanovic, M.; Castronuovo, E.D.
Congress: PMAPS 2018
Venue: Boise, USA
Date: 25-28 June 2018
Organizer: IEEE PES Boise Chapter, Idaho Power, the University of Idaho, Boise State University.

23. Title: Multifunctional hybrid materials based on conjugated porous polymer for solar fuel production
Author: García-Sánchez, A.; García, C.; Liras, M.; de la Peña-O’Shea, V.A.
Congress: Spotlight POLYMAT
Venue: San Sebastián, Spain
Date: 26-29 June 2018
Organizer: POLYMAT and the University of the Basque Country

24. Title: In situ x-ray diffraction studies within an operating electrochemical cell: from structural controlled modifications to ion’s
Author: Santos, C.; Vilatela, J.J.; Marcilla, R.; Pendashteh, A.; Senokos, E.
Congress: CARBON 2018
Venue: Madrid, Spain
Date: 1-6 July 2018
Organizer: Spanish Carbon Group

25. Title: CNT fibers as multifunctional electrode material for flexible supercapacitors: electrochemical properties, functionalization and application
Congress: CARBON 2018
Venue: Madrid, Spain
Date: 1-6 July 2018
Organizer: Spanish Carbon Group

26. Title: Injectable Li-ion batteries
Author: Ventosa, E.; Escudero, M.J.; Pérez, D.; Palma, J.
Congress: XXXIX Reunión del Grupo de Electroquímica de la Real Sociedad Española de Química y III Simposio E3 del Mediterráneo (XXXIX GE-RSEQ & 3rd E3-MS)
Venue: Madrid, Spain
Date: 2-5 July 2018
Organizer: Specialized Group in Electrochemistry

27. Title: Control system design for a virtual synchronous machine connected to a weak grid
Author: Roldán-Pérez, J.; Rodríguez-Cabero, A.; Prodanovic, M.
Congress: Seminario anual de automática, electrónica industrial e instrumentación (SAAEI 2018)
Venue: Barcelona, Spain
Date: 4-6 July 2018
Organizer: Grupo E3PACS-Universitat Politècnica de Catalunya
28. **Title:** Discrete-time resonant controllers design for a dynamic voltage restorer  
**Author:** Roldán-Pérez, J.; Rodríguez-Cabero, A.; Ochoa-Giménez, M.; García-Cerrada, A.; Zamora-Macho, J.L.  
**Congress:** Seminario anual de automática, electrónica industrial e instrumentación (SAAEI 2018)  
**Venue:** Barcelona, Spain  
**Date:** 4-6 July 2018  
**Organizer:** Grupo E3PACS-Universitat Politècnica de Catalunya

29. **Title:** Stability analysis for weak meshed networks with power electronics based distributed generation  
**Author:** Rodríguez-Cabero, A.; Prodanovic, M.  
**Congress:** Seminario anual de automática, electrónica industrial e instrumentación (SAAEI 2018)  
**Venue:** Barcelona, Spain  
**Date:** 4-6 July 2018  
**Organizer:** Grupo E3PACS-Universitat Politècnica de Catalunya

30. **Title:** Challenges of the photocatalytic reforming of lignocellulosic bioethanol  
**Author:** Fresno, F.; Lirio, C.; Justicia, J.; Tomás, E.; de la Peña-O’Shea, V.A.; Serrano, D.P.; Coronado, J.M.  
**Congress:** 4th International symposium on catalysis for clean energy and sustainable chemistry (CCESC2018)  
**Venue:** Bilbao, Spain  
**Date:** 9-11 July 2018  
**Organizer:** Hydrogen Europe Research

31. **Title:** Organic-inorganic hybrid materials based on conjugated porous polymers and their use in artificial photosynthesis  
**Author:** Liras, M.; López-Calixto-C.G.; García-Sánchez, A.; Reñones, P.; Alfonso-González, E.; Barawi, M.; Villar, I.J.; Pérez-Ruiz, R.; Fresno, F.; de la Peña-O’Shea, V.A.  
**Congress:** 27th PhotolUPAC  
**Venue:** Dublín, Ireland  
**Date:** 8-13 July 2018  
**Organizer:** University College Dublin/UCLA

32. **Title:** Photocatalyzed C-C coupling reactions by vis-to-uv upconversion technology  
**Author:** Pérez-Ruiz, R.; López-Calixto-C.G.; Liras, M.; de la Peña-O’Shea, V.A.  
**Congress:** 27th PhotolUPAC  
**Venue:** Dublín, Ireland  
**Date:** 8-13 July 2018  
**Organizer:** University College Dublin/UCLA

33. **Title:** Life cycle sustainability assessment of hydrogen from biomass gasification: a comparison with conventional hydrogen  
**Author:** Valente, A.; Iribarren, D.; Dufour, J.  
**Congress:** HYPOTHESIS XIII  
**Venue:** Singapore  
**Date:** 24-27 July 2018  
**Organizer:** NTU Singapore

34. **Title:** Novel end-of-life technologies for fuel cells and hydrogen products  
**Author:** Valente, A.; Iribarren, D.; Dufour, J.  
**Congress:** HYPOTHESIS XIII  
**Venue:** Singapore  
**Date:** 24-27 July 2018  
**Organizer:** NTU Singapore

35. **Title:** End of life of fuel cells and hydrogen products: from technologies to strategies  
**Author:** Valente, A.; Iribarren, D.; Dufour, J.  
**Congress:** HYPOTHESIS XIII  
**Venue:** Singapore  
**Date:** 24-27 July 2018  
**Organizer:** NTU Singapore

36. **Title:** Phase-matched frequency adaptive repetitive controller for a grid-supporting STATCOM  
**Author:** Roldán-Pérez, J.; García-Cerrada, A.; Rodríguez-Cabero, A.; Prodanovic, M.  
**Congress:** 18th International conference on power electronics and motion control (IEEE-PEMC 2018)  
**Venue:** Budapest, Hungary  
**Date:** 26-30 August 2018  
**Organizer:** IEEE
37. Title: 3,6-bis-(3,5-diamino-triazolyl-1-yl)-1,2,4,5-tetrazine high dielectric molecular semiconductor for excitonic solar cells  
Author: Babaryk, A.; Khaynokava, O.A.; Horcajada, P.  
Congress: 7th EuCheMS Chemistry Congress  
Venue: Liverpool, UK  
Date: 26-30 August 2018  
Organizer: EuCheMS

38. Title: Defect/doping engineering of CNT fibers as self-standing air cathodes for rechargeable Zn-Air Batteries  
Author: Pendashteh, A.; Palma, P.; Anderson, M.; Vilatela, J.J.; Marcilla, R.  
Congress: 69th Annual meeting of the international society of electrochemistry  
Venue: Bologna, Italy  
Date: 2-7 September 2018  
Organizer: ISE

39. Title: Highly conductive Nanostructured PEDOT polymer confined into the mesoporous MIL-100(Fe)  
Author: Salcedo-Abraira, P.; Navalón, S.; Atienzar, P.; Bordet, P.; Salles, F.; Guillou, N.; Garcia, H.; Horcajada, P.  
Congress: 1er Congreso sobre materiales multifuncionales para jóvenes (MultiMat)  
Venue: Granada, Spain  
Date: 3-4 September 2018  
Organizer: University of Granada

40. Title: Drug vectorization using engineered-surface metal-organic frameworks  
Congress: 1er Congreso sobre materiales multifuncionales para jóvenes (MultiMat)  
Venue: Granada, Spain  
Date: 3-4 September 2018  
Organizer: University of Granada

41. Title: Mathematical modelling of a membraneless redox flow battery  
Author: Ruiz-Martin, D.; Moreno-Boza, D.; Vera, M.; Marcilla, R.; Sánchez-Sanz, M.  
Congress: 12th European fluid mechanics conference (EFMC12)  
Venue: Vienna, Austria  
Date: 9-13 September 2018  
Organizer: Fundació Scito

42. Title: Diaminotriazolium halobismuthates as one-dimensional lead free photovoltaic materials  
Author: Babaryk, A.; Cuesta, J.; Horcajada, P.  
Congress: 7th International Workshop of Layered Materials  
Venue: Krakow-Tomaszowice, Poland  
Date: 9-13 September 2018  
Organizer: Polish Zeolite Association

43. Title: Encapsulation of inorganic phase change materials by sol-gel method for thermal energy storage  
Author: González-Aguilar, J.; Lucio, B.  
Congress: EuroSun 2018  
Venue: Rapperswil, Switzerland  
Date: 10-13 September 2018  
Organizer: HSR; ISES

44. Title: Understanding charge storage mechanism of mixed metal sulfides in alkaline media: NiCoMnS2 nano-needles case study  
Author: Sánchez, J.; Pendashteh, A.; Palma, J.; Anderson, M.; Marcilla, R.  
Congress: 2018 E-MRS fall meeting  
Venue: Warsaw, Poland  
Date: 17-20 September 2018  
Organizer: E-MRS

45. Title: Small-Signal modelling and control design of VSCs in multi-terminal railway applications  
Author: Rodríguez-Cabero, A.; Roldan-Perez, J.; Prodanovic, M.  
Congress: The 10th Annual IEEE energy conversion congress and exposition (ECCE2018)  
Venue: Portland, Oregón, USA  
Date: 23-27 September 2018  
Organizer: IEEE
46. Title: A membrane-free redox flow battery with two immiscible electrolytes  
Author: Navalpotro, P.; Palma, J.; Anderson, M.A.; Marcilla, R.  
Congress: ECS and SMEQ joint international meeting (AIMES 2018)  
Venue: Cancún, Mexico  
Date: 30 September-4 October 2018  
Organizer: ECS

47. Title: Biowaste-derived carbon electrodes for capacitive deionization  
Author: Lado, J.J.; Ruotolo, L.A.M.; Zornitta, R.L.  
Congress: ECS and SMEQ joint international meeting (AIMES 2018)  
Venue: Cancún, Mexico  
Date: 30 September-4 October 2018  
Organizer: ECS

48. Title: Application of un-fired closed Brayton cycle with mass flow regulation and particles based thermal energy storage systems for CSP  
Author: Rovense, F.; Reyes-Belmonte, M.A.; González-Aguilar, J.; Amelio, M.; Bova, S.; Romero, M.  
Congress: SolarPACES 2018  
Venue: Casablanca, Morocco  
Date: 2-5 October 2018  
Organizer: SolarPACES

49. Title: Pre-Commercial scale liquid fuels from concentrated sunlight: an overview on development of a 50 kW solar thermochemical reactor for the SUN-to-LIQUID Project  
Congress: SolarPACES 2018  
Venue: Casablanca, Morocco  
Date: 2-5 October 2018  
Organizer: SolarPACES

50. Title: SUN-to-LIQUID: solar fuels from H₂O, CO₂ and concentrated sunlight  
Congress: SolarPACES 2018  
Venue: Casablanca, Morocco  
Date: 2-5 October 2018  
Organizer: SolarPACES

51. Title: Polímeros de coordinación porosos como agentes detoxificantes  
Author: Rojas, S.; Navarro, J.A.R.; Horcajada, P.  
Congress: III QuimBioQuim  
Venue: Albacete, Spain  
Date: 3-5 October 2018  
Organizer: University of Castilla La Mancha

52. Title: Caracterización fluidodinámica de un receptor de partículas en régimen de lecho fluidizado  
Author: Sánchez, M.; González-Aguilar, J.; Romero, M.  
Congress: I Jornada de jóvenes investigadores en ciencia y tecnología químicas de la Universidad de Salamanca  
Venue: Salamanca, Spain  
Date: 4-5 October 2018  
Organizer: University of Salamanca

53. Title: Towards laminated lithium-ion batteries with high flexibility and toughness  
Congress: 55th edition of the annual technical meeting of the society of engineering science (SES 2018)  
Venue: Madrid, Spain  
Date: 10-12 October 2018  
Organizer: SES
54. **Title:** Antifouling photo-bactericidal combined effect of AgNP@nanoMIL-125(Ti)NH2  
**Author:** Arenas, A.; Horcajada, P.  
**Congress:** Brain Wars: the future is in your hands  
**Venue:** Madrid, Spain  
**Date:** 19 October 2018  
**Organizer:** ECS Student Chapter-UCM

55. **Title:** Virtual synchronous machine control of VSC HVDC for power system oscillation damping  
**Author:** Roldán-Pérez, J.; Are Suul, J.; D’Arco, S.; Rodríguez-Cabero, A.; Prodanovic, M.  
**Congress:** 44th Annual conference of IEEE industrial electronics society (IECON2018)  
**Venue:** Washington DC, USA  
**Date:** 21-23 October 2018  
**Organizer:** IEEE Industrial Electronics Society

56. **Title:** LTCL-filter active-damping design considerations for low-switching-frequency grid-tied VSCs  
**Author:** Roldán-Perez, J.; Ávila-Martínez, R.; Rodríguez-Cabero, R.; Prodanovic, M.  
**Congress:** 44th Annual conference of IEEE industrial electronics society (IECON2018)  
**Venue:** Washington DC, USA  
**Date:** 21-23 October 2018  
**Organizer:** IEEE Industrial Electronics Society

57. **Title:** An analysis of the energy storage for improving the reliability of distribution networks  
**Author:** Escalera, A.; Prodanovic, M.; Castronuovo, E.D.  
**Congress:** 8th IEEE PES innovative smart grid technologies conference Europe 2018 (2018 IEEE PES ISGT)  
**Venue:** Sarajevo, Bosnia and Herzegovina  
**Date:** 21-25 October 2018  
**Organizer:** IEEE

58. **Title:** Design and development of a multilayer photoelectrode composed of TiO$_2$ nanocrystals and a new nanostructured conjugate porous polymer with advanced photoelectrochemical properties  
**Author:** Barawi, M.; González, A.; Alfonso, E.; García, A.; López-Calixto, C.; Liras, M.; de la Peña-O’Shea, V.A.
**Congress:** nanoGe Fall Meeting 2018  
**Venue:** Torremolinos, Spain  
**Date:** 22-26 October 2018  
**Organizer:** Fundació Scito

59. **Title:** Solar fuels productions by artificial photosynthesis: from inorganic semiconductors to hybrid multifunctional materials  
**Author:** García, A.; Reñones, P.; García, C.; Alfonso, E.; Collado, L.; Perez-Ruiz, R.; Barawi, M.; Villar, I.; Liras, M.; Fresno, F.; de la Peña O’Shea, V.A.  
**Congress:** nanoGe Fall Meeting 2018  
**Venue:** Torremolinos, Spain  
**Date:** 22-26 October 2018  
**Organizer:** Fundació Scito

60. **Title:** Characterization of Cu$_{2-x}$Te nanocrystals for photoelectrochemical cells  
**Author:** Alonso, E.; Wang, M.; Barawi, M.; De Trizio, L.; Manna, L.; de la Peña-O’Shea, V.A.  
**Congress:** nanoGe Fall Meeting 2018  
**Venue:** Torremolinos, Spain  
**Date:** 22-26 October 2018  
**Organizer:** Fundació Scito

61. **Title:** Recuperación de salmueras con la tecnología de desionización capacitiva  
**Author:** Ordóñez, A.; Gutiérrez, B.; Huertas, F.; Palma, J.; Lado, J.J.; García-Quismondo, E.; de Miguel, A.  
**Congress:** XII Congreso de la asociación española de desalación y reutilización (AEDyR)  
**Venue:** Toledo, Spain  
**Date:** 23-25 October 2018  
**Organizer:** AEDyR

62. **Title:** Lactic acid production from hemicellulosic hydrolysates by Lactobacillus pentosus CECT 4023T in a biorefinery context  
**Author:** Cubas-Cano, E.; Ballesteros, M.; González-Fernández, C.; Tomás-Pejó, E.  
**Congress:** 4th Iberoamerican congress on biorefineries (4-CIAB)
63. Title: Semicontinuous anaerobic digestion of protease pretreated Chlorella vulgaris for the production of volatile fatty acids
Author: Magdalena, J.A.; Colzi, A.; Llamas, M.; González-Fernández, C.
Congress: 4th Iberoamerican congress on biorefineries (4-CIAB)
Venue: Jaén, Spain
Date: 24-26 October 2018
Organizer: University of Jaén

64. Title: Yarrowia lipolytica as a promising candidate for the sustainable production of fatty acid-based biofuels from anaerobic digestion effluents
Author: Llamas, M.; Tomás-Pejó, E.; González-Fernández, C.
Congress: 4th Iberoamerican congress on biorefineries (4-CIAB)
Venue: Jaén, Spain
Date: 24-26 October 2018
Organizer: University of Jaén

65. Title: Ex-situ fast co-pyrolysis of eucalyptus woodchips and low density polyethylene with zeolite and mesoporous
Author: Jiménez, S.; Peral, A.; Pizarro, P.; Serrano, D.P.
Congress: 4th Iberoamerican congress on biorefineries (4-CIAB)
Venue: Jaén, Spain
Date: 24-26 October 2018
Organizer: University of Jaén

66. Title: Fine chemicals synthesis from bio-oils using zsm-5 zeolites
Author: Gutiérrez-Rubio, S.; Moreno, I.; Coronado, J.M.; Serrano, D.P.
Congress: 4th Iberoamerican congress on biorefineries (4-CIAB)
Venue: Jaén, Spain
Date: 24-26 October 2018
Organizer: University of Jaén

67. Title: Modelling and assessing the use of biomass feedstock in conventional refineries: a comparative life-cycle study
Author: Cruz, P.L.; Iribarren, D.; Dufour, J.
Congress: 4th Iberoamerican congress on biorefineries (4-CIAB)
Venue: Jaén, Spain
Date: 24-26 October 2018
Organizer: University of Jaén

68. Title: Parallel statistical model checking for safety verification in smart grids
Author: Mancini, T.; Mari, F.; Melatti, I.; Salvo, I.; Tronci, E.; Gruber, J.; Hayes, B.; Prodanovic, M.; Elmegaard, L.
Congress: SmartGridComm, IEEE International conference on communications, control, and computing technologies for smart grids
Venue: Aalborg, Denmark
Date: 29-31 October 2018
Organizer: Universidad de Aalborg

69. Title: Combined NAP XPS and NAP Core hole clock studies of polymer/TiO₂ hybrids for artificial photosynthesis
Congress: 5th Ambient Pressure XPS workshop
Venue: Berlin, Germany
Date: 12-14 December 2018
Organizer: University of Jaén

70. Title: Modelado de la Economía Circular para el análisis y la gestión ambiental: residuos sólidos urbanos en Madrid
Author: Dufour, J.; Gálvez-Martos, J.L.
Congress: FENERCOM. Jornada sobre economía circular
Venue: Madrid, Spain
Date: 19 December 2018
Organizer: Fundación de la Energía de la Comunidad de Madrid
2.6.3. Poster communications

1. Title: CO₂ reduction over bare and silver-modified niobium-tantalum perovskite photocatalysts  
   Congress: 10th European meeting on solar chemistry and photocatalysis: environmental applications (SPEA10)  
   Venue: Almería, Spain  
   Date: 4-8 June 2018  
   Organizer: University of Almería, PSA

2. Title: Influence of post-synthesis modifications of Ti₁₋ₓZrₓO₂ nanocrystallites on the photocatalytic performance for VOC's removal  
   Author: Hernández-Alonso, M.D.; Fresno, F.; de la Peña-O’Shea, V.A.; Soria, J.; Coronado, J.M.  
   Congress: 10th European meeting on solar chemistry and photocatalysis: environmental applications (SPEA10)  
   Venue: Almería, Spain  
   Date: 4-8 June 2018  
   Organizer: University of Almería, PSA

3. Title: Avances en la producción fotocatalítica de combustibles solares: de los semiconductores inorgánicos a los catalizadores híbridos  
   Congress: 10th European meeting on solar chemistry and photocatalysis: environmental applications (SPEA10)  
   Venue: Almería, Spain  
   Date: 4-8 June 2018  
   Organizer: University of Almería, PSA

4. Title: Reliability evaluation of grid-connected microgrids with high penetration of renewable distributed energy resources  
   Author: Escalera, A.; Prodanovic, M.; Castronovo, E.D.  
   Congress: CIRED 2018  
   Venue: Ljubliana, Slovenia  
   Date: 7-8 June 2018  
   Organizer: AIM

5. Title: Decarboxylation of stearic acid to long-chain hydrocarbons over Pd/Al-SBA-15 and Pd/H-ZSM-5 catalysts  
   Author: Serrano, D.P.; Escola, J.M.; Briones, L.; Arroyo, M.  
   Congress: XXII Zeolite Forum
6. Title: Catalytic co-pyrolysis of Eucalyptus woodchips and LDPE over nanocrystalline and hierarchical ZSM-5 zeolites  
Author: Jiménez-Sánchez, S.; Peral, A.; Pizarro, P.; Serrano, D.P.  
Congress: XXII Zeolite Forum  
Venue: Niepołomice, Poland  
Date: 19-23 June 2018  
Organizer: Polish Zeolite Association

7. Title: Energía solar de concentración para todas las edades  
Author: Díaz, E.; Arribas, L.; Luque S.; Reyes-Belmonte, M.A.; Lucio, B.; Sánchez, M.; Martínez, A.; Romero, M.; González-Aguilar, J.  
Congress: XVI Congreso ibérico y XII congreso iberoamericano de energía solar (CIES2018)  
Venue: Madrid, Spain  
Date: 20-22 June 2018  
Organizer: AEDES, UPM/ETSIDI, UIB

8. Title: Simulación numérica del funcionamiento y control de un campo de helióstato para aplicaciones termosolares  
Congress: XVI Congreso ibérico y XII congreso iberoamericano de energía solar (CIES2018)  
Venue: Madrid, Spain  
Date: 20-22 June 2018  
Organizer: AEDES, UPM/ETSIDI, UIB

9. Title: Design and synthesis of conjugated porous polymers based on BOPHY dye for solar fuels production  
Author: García, C.; Liras, M.; Fresno, F.; de la Peña-O’Shea, V.A.  
Congress: XXVII Reunión bienal de química orgánica (BIGQS2018)  
Venue: Santiago de Compostela, Spain  
Date: 20-22 June 2018  
Organizer: GEQOR

10. Title: Estudio comparativo del efecto del gas reductor en la producción de gas de síntesis mediante ciclos termoquímicos redox utilizando perovskitas LSMA  
Author: Sastre, D.; Serrano, D.P.; Pizarro, P.; Coronado, J.M.  
Congress: III Encuentro de jóvenes investigadores de la SECAT  
Venue: Valencia, Spain  
Date: 25-27 June 2018  
Organizer: SECAT

11. Title: Influencia de las interacciones moleculares en la hidrodesoxigenación de mezclas de guayacol y ácido acético sobre Ni2P/ZSM-5  
Author: Gutiérrez-Rubio, S.; Moreno, I.; Pizarro, P.; Coronado, J.M.; Serrano, D.P.  
Congress: III Encuentro de jóvenes investigadores de la SECAT  
Venue: Valencia, Spain  
Date: 25-27 June 2018  
Organizer: SECAT
12. Title: Performance of K-ZSM-5 zeolites in lignocellulose catalytic pyrolysis  
Author: López-Renau, L.M.; Gómez-Pozuelo, G.; Hernando, H.; Botas, J.A.; Serrano, D.P.  
Congress: EFCATS SCHOOL on CATALYSIS 2018  
Venue: Liblice, Czech Republic  
Date: 25-29 June 2018  
Organizer: Jiří Čejka

13. Title: Hybrid materials composed of nanos-structured Conjugated Porous Polymers and TiO_2 for Enhanced hydrogen evolution in Photoelectrochemical Cells  
Author: Barawi, M.; González, A.; Alfonso, E.; García, A.; López-Calixto, C.G.; Liras, M.; de la Peña-O'Shea, V.A.  
Congress: XXXIX Reunión del grupo de electroquímica de la real sociedad española de química y III simposio E3 del Mediterráneo (XXXIX GERSEQ & 3rd E3-MS)  
Venue: Madrid, Spain  
Date: 2-5 July 2018  
Organizer: Specialized Group in Electrochemistry

14. Title: Modelo comportamental de bajo coste de la impedancia de entrada de inversores trifásicos para el análisis de estabilidad de sistemas de distribución en corriente continua  
Congress: Seminario anual de automática, electrónica industrial e instrumentación (SAAEI 2018)  
Venue: Barcelona, Spain  
Date: 4-6 July 2018  
Organizer: Grupo E3PACS-Universitat Politècnica de Catalunya

15. Title: Design and synthesis of tunable conjugated porous polymers and behavior as photocatalysts in hydrogen production  
Author: López-Calixto, C.G.; Liras, M.; Fresno, F.; de la Peña-O'Shea, V.A.  
Congress: 27th PhotolUPAC

16. Title: Feasibility of one-pot Transformation routes of biomass-derived hexoses into chemicals  
Author: Gálvez, J.L.; Lirio, C.; Dufour, J.  
Congress: 4th International symposium on catalysis for clean energy and sustainable chemistry (CCESC2018)  
Venue: Bilbao, Spain  
Date: 9-11 July 2018  
Organizer: Hydrogen Europe Research

17. Title: Antifouling photo-bactericidal combined effect of a Ag@nanoMOF  
Author: Arenas-Vivo, A.; Amariei, G.; Aguado, S.; Rosal, R.; Horcajada, P.  
Congress: XXVII International materials research congress (IMRC 2018)  
Venue: Cancún, Mexico  
Date: 19-24 August 2018  
Organizer: The Sociedad Mexicana de Materiales (SMM) and the Materials Research Society® (MRS)

18. Title: Nanometric MIL-125-NH_2 metal-organic framework as nerve agent antidote carrier  
Author: Vilela, S.M.F.; Salcedo-Abaira, P.; Colinet, I.; Salles, F.; de Koning, M.C.; Joosen, M.J.A.; Serre, C.; Horcajada, P.  
Congress: XXVII International materials research congress (IMRC 2018)  
Venue: Cancún, Mexico  
Date: 19-24 August 2018  
Organizer: The Sociedad Mexicana de Materiales (SMM) and the Materials Research Society® (MRS)

19. Title: Sulfur polyconjugated organic ligands as building blocks in photoactive Metal-Organic Frameworks  
Author: García-Sánchez, A.; Liras, M.; Barawi, M.; Fresno, F.; Gutiérrez-Puebla, E.; Monge, A.; Gándala, F.; de la Peña-O'Shea, V.A.
Consortium: 31st European crystallographic meeting (ECM31 2018)
Venue: Oviedo, Spain
Date: 22-27 August 2018
Organizer: European Crystallographic Association

20. Title: MnO₂ on CNT fibers for high-performance ionic liquid-based supercapacitors
Author: Pendashteh, A.; Senokos, E.; Palma, J.; Anderson, M.; Vilatela, J.J.; Marcilla, R.
Congress: 69th Annual Meeting of the International Society of Electrochemistry
Venue: Bologne, Italy
Date: 2-7 September 2018
Organizer: ISE

21. Title: Metal-organic frameworks as detoxifying agents
Author: Rojas, S.; Guillou, N.; Navarro, J.A.R.; Horcajada, P.
Congress: 1er Congreso sobre materiales multifuncionales para jóvenes (MultiMat)
Venue: Granada, Spain
Date: 3-4 September 2018
Organizer: University of Granada

22. Title: Photocatalyzed reactions by photon upconversion based on triplet-triplet annihilation
Author: Pérez-Ruiz, R.; López-Calixto, C.G.; Liras, M.; de la Peña-O'Shea, V.A.
Congress: VI Brazil-Spain workshop on organic chemistry (BSWOC 2018)
Venue: Oviedo, Spain
Date: 1-3 October 2018
Organizer: University of Oviedo

23. Title: Round robin test on enthalpies of redox materials for thermochemical heat storage: perovskites
Congress: SolarPACES 2018
Venue: Casablanca, Morocco
Date: 2-5 October 2018
Organizer: SolarPACES

24. Title: Development of small low-cost heliostats for ultra-modular high flux solar fields
Author: Luque, S.; Martínez, A.; González-Aguilar, J.; Romero, M.
Congress: SolarPACES 2018
Venue: Casablanca, Morocco
Date: 2-5 October 2018
Organizer: SolarPACES

25. Title: Technoeconomic assessment of sustainable transformation routes of lignocellulose
Author: Gálvez, J.L.; Lirio, C.; Dufour, J.
Congress: 4th Iberoamerican congress on biorefineries (4-CIAB)
Venue: Jaén, Spain
Date: 24-26 October 2018
Organizer: University of Jaén

26. Title: Metal-organic frameworks based on polyconjugated organic ligands for photocatalytic applications
Author: de la Peña-O’Shea, V.A.
Congress: 6th International conference on metal organic frameworks & open framework compounds (MOF2018)
Venue: Auckland, New Zealand
Date: 9-13 December 2018
Organizer: The University of Auckland
### 3. Training and dissemination activities

#### 3.1. Mobility actions

**IMDEA Energy researchers**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>2. Raúl Pérez</td>
<td>Stay at: Politechnic University of Valencia, Spain</td>
<td>Period: 4 months, 2018</td>
<td>Funding Institution: IMDEA Energy Institute</td>
</tr>
<tr>
<td>3. Héctor Hernando</td>
<td>Stay at: Utrecht University - Utrecht, Netherlands</td>
<td>Period: 3 months, 2018</td>
<td>Funding Institution: IMDEA Energy Institute and Rey Juan Carlos University</td>
</tr>
<tr>
<td>5. Mercedes Llamas</td>
<td>Stay at: Patras University - Patras, Greece</td>
<td>Period: 3 months, 2018</td>
<td>Funding Institution: COST Association (EUALGAE project)</td>
</tr>
</tbody>
</table>
### 6. José A. Magdalena
Stay at: Delf University - Delf, Netherlands  
Period: 3 months, 2018  
Funding Institution: COST Association (EUALGAE project)

### 7. Sergio Vilela
Stay at: Centre Nacional de la Recherche Scientifique-CNRS-ICGM-Motpellier, France  
Period: 3 months, 2018  
Funding Institution: Ministry of Education, Culture and Sports

### 8. Patricia Reñones
Stay at: Heriot Watt University-Edimburg, United Kingdom  
Period: 3 months, 2018  
Funding Institution: IMDEA Energy Institute

### 9. Jaime Sánchez
Stay at: Max Plank-Fritz Haber Institute- Berlin, Germany.  
Period: 3 months, 2018  
Funding Institution: IMDEA Energy Institute

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### Visiting Researchers

<table>
<thead>
<tr>
<th>Visiting Researchers</th>
<th>Details</th>
</tr>
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</table>
| **1. Marzia Scolastico**, ERASMUS Student | Origin institution: University of Naples Federico II, Italy  
Host Unit: High Temperature Processes Unit  
Period: 5 months, 2018 |
| **2. Vincenzo Senatore**, ERASMUS Student | Origin institution: University of Salerno, Italy  
Host Unit: Electrochemical Processes Unit  
Period: 5 months, 2018 |
| **3. Adlane Tahar** | Origin institution: Research Centre in Analytical Chemistry and Physics (CRAPC), Algeria  
Host Unit: Photoactivated Processes Unit  
Period: 2 months, 2018 |
| **3. Luis Miguel López** | Origin institution: Rey Juan Carlos University, Madrid  
Host Unit: Thermochemical Processes Unit  
Period: 12 months, 2018 |
5. Sara Rojas  
**Origin institution:** Institute Lavoisier, France  
**Host Unit:** Advanced Porous Materials Unit  
**Period:** 8 months, 2018

6. Silvia Quaresma  
**Origin institution:** High Technical Institute of Lisbon, Portugal  
**Host Unit:** Advanced Porous Materials Unit  
**Period:** 1 month, 2018

7. Seyed Dariush Teherzade  
**Origin institution:** University of Teherán, Iran  
**Host Unit:** Advanced Porous Materials Unit  
**Period:** 9 months, 2018

8. Nidia Libia Torres García  
**Origin institution:** Michoacan University of San Nicolás Hidalgo, México  
**Host Unit:** Photoactivated Processes Unit  
**Period:** 11 months, 2018

9. Clara López Aguado  
**Origin institution:** Rey Juan Carlos University, Madrid  
**Host Unit:** Systems Analysis Unit  
**Period:** 1 month, 2018

10. Miguel García Casas  
**Origin institution:** Rey Juan Carlos University, Madrid  
**Host Unit:** Systems Analysis Unit  
**Period:** 7 months, 2018

11. Guadalupe Diocelina Toledo  
**Origin institution:** Autonoma University of the State of Morelos, México  
**Host Unit:** Systems Analysis Unit  
**Period:** 3 months, 2018

12. Vanesa Celis Arias  
**Origin institution:** Autónoma Metropolitan University of Azcapotzalco, México  
**Host Unit:** Advanced Porous Materials Unit  
**Period:** 3 months, 2018
<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Origin institution</th>
<th>Host Unit</th>
<th>Period</th>
</tr>
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<tbody>
<tr>
<td>13</td>
<td>Marco Smeltink</td>
<td>Hygear Technology and Services, BV, Belgium</td>
<td>High Temperature Processes Unit</td>
<td>18 months, 2018</td>
</tr>
<tr>
<td>14</td>
<td>Dick Lieftink</td>
<td>Hygear Technology and Services, BV, Belgium</td>
<td>High Temperature Processes Unit</td>
<td>18 months, 2018</td>
</tr>
<tr>
<td>15</td>
<td>Claudia Miyiseth Valverde</td>
<td>Rey Juan Carlos University, Madrid</td>
<td>Thermochemical Processes Unit</td>
<td>6 months, 2018</td>
</tr>
<tr>
<td>16</td>
<td>Laura García Pina</td>
<td>Rey Juan Carlos University, Madrid</td>
<td>Thermochemical Processes Unit</td>
<td>6 months, 2018</td>
</tr>
<tr>
<td>17</td>
<td>Tim Schlichting</td>
<td>Deutches Zentrum für Luft und Raumfahrt, Germany</td>
<td>High Temperature Processes Unit</td>
<td>5 days, 2018</td>
</tr>
</tbody>
</table>
18. Moussa Dicko  
**Origin institution:** Université Paris 13, France  
**Host Unit:** Systems Analysis Unit  
**Period:** 12 days, 2018

19. Alberto Quintero  
**Origin institution:** B5tec, Spain  
**Host Unit:** Electrochemical Processes Unit  
**Period:** 15 months (3 months, 2018 and 12 months 2019)

### 3.2. Organization of scientific events

1. **EXILUM 2018** Keys to the success of public lighting  
**Venue:** IMDEA Energy Institute, Madrid, Spain  
**Date:** 15 February 2018  
**Organizer:** Federación de Municipios de Madrid/City Council of Móstoles/IMDEA Energy

2. **HyTechCycling dissemination Workshop**  
**Venue:** IMDEA Energy Institute, Madrid, Spain  
**Date:** 20 March 2018  
**Organizer:** HyTechCycling project

3. **Workshop:** Uses and transformation of CO₂: from the laboratory to the company  
**Venue:** IMDEA Energy Institute, Madrid, Spain  
**Date:** 25 June 2018  
**Organizer:** URJC/IMDEA Energy/PTECO₂

4. **Workshop:** SUN-to-LIQUID: Production of solar fuels for road transport, aviation and shipping: technology development and market uptake  
**Venue:** IMDEA Energy Institute, Madrid, Spain  
**Date:** 10-11 October 2018  
**Organizer:** Sun-to-Liquid consortium

5. **ETIP SNET Western Region Workshop**  
**Venue:** IMDEA Energy Institute, Madrid, Spain  
**Date:** 22-23 November 2018  
**Organizer:** ETIP SNET, Futured, Circe, IMDEA Energy

6. **7th Annual Workshop of Young Researchers of IMDEA Energy Institute**  
**Venue:** IMDEA Energy Institute, Madrid, Spain  
**Date:** 13-14 December 2018  
**Organizer:** IMDEA Energy

### 3.3. Internal seminars

1. **Oral Presentation:** Energy management strategies for smart buildings  
**Speaker:** Dr. Milan Prodanovic (IMDEA Energy)  
**Date:** 26 January 2018

2. **Oral Presentation:** Water-energy nexus: The role of emerging technologies in sustainable development  
**Speaker:** Dr. July Lado (IMDEA Energy)  
**Date:** 26 January 2018

3. **Oral Presentation:** Contributions to steel industry, nanocomposites and aerospace applications  
**Speaker:** Dr. Beatriz Lucio (IMDEA Energy)  
**Date:** 23 February 2018
4. **Oral Presentation**: Decoupling energy and power in non-flowable batteries  
   **Speaker**: Teresa Páez (IMDEA Energy)  
   **Date**: 23 February 2018

5. **Lecture**: Molecular processes in intercalation and redox flow batteries  
   **Speaker**: Prof. Ulrich Stimming (Newcastle University, UK)  
   **Date**: 6 March 2018

6. **Oral Presentation**: How computational modeling can rationalise and guide experiments  
   **Speaker**: Dr. Andreas Mavrantonakis (IMDEA Energy)  
   **Date**: 23 March 2018

7. **Oral Presentation**: Photoelectrochemical study of semiconductor thin films for artificial photosynthesis  
   **Speaker**: Elena Alfonso (IMDEA Energy)  
   **Date**: 23 March 2018

8. **Lecture**: Procesos relacionados con la conversión electrocatalítica de la energía investigados in situ mediante espectroscopía de rayos X blandos generados por radiación de sincrotrón  
   **Speaker**: Dr. Juan J. Velasco Vélez (Fritz-Haber-Institute of the Max-Planck-Society, Berlin, Germany)  
   **Date**: 20 April 2018

9. **Oral Presentation**: Integrated approach of anaerobic digestion process towards producing biogas and biobased chemical building blocks with zero waste  
   **Speaker**: Dr. Alexandre Colzi (IMDEA Energy)  
   **Date**: 27 April 2018

10. **Oral Presentation**: Association of active species to Metal-Organic Frameworks  
    **Speaker**: Ana Arenas (IMDEA Energy)  
    **Date**: 27 April 2018

11. **Oral Presentation**: New materials for lithium batteries  
    **Speaker**: Dr. Nicola Boaretto (IMDEA Energy)  
    **Date**: 25 May 2018

12. **Oral Presentation**: Planning a sustainable road transport system for Spain  
    **Speaker**: Zaira Navas (IMDEA Energy)  
    **Date**: 25 May 2018

13. **Oral Presentation**: Environmental assessment of strategies for the circular economy  
    **Speaker**: Dr. Jose Luis Gálvez (IMDEA Energy)  
    **Date**: 22 June 2018

14. **Oral Presentation**: Electroactive porous multifunctional materials  
    **Speaker**: Pablo Salcedo (IMDEA Energy)  
    **Date**: 22 June 2018

15. **Lecture**: Low-cost materials for energy storage and conversion  
    **Speaker**: Dr. Ana Belén Jorge Sobrido (Queen Mary University of London)  
    **Date**: 5 July 2018

16. **Oral Presentation**: Redox active polymers for sustainable energy storage  
    **Speaker**: Dr. Nagaraj Patil (IMDEA Energy)  
    **Date**: 21 September 2018

17. **Oral Presentation**: Bioplastics from residues: Improving lactic acid production from hemicellulose by process optimization and experimental evolution  
    **Speaker**: Enrique Cubas (IMDEA Energy)  
    **Date**: 21 September 2018

18. **Oral Presentation**: Metal-Organic Frameworks in biomedical and environmental applications  
    **Speaker**: Dr. Sara Rojas (IMDEA Energy)  
    **Date**: 26 October 2018

19. **Oral Presentation**: Volatile fatty acids production from microalgae biomass  
    **Speaker**: José A. Magdalena (IMDEA Energy)  
    **Date**: 26 October 2018

20. **Oral Presentation**: Conjugated Microporous Polymer (CMP) for energy storage  
    **Speaker**: Antonio Molina (IMDEA Energy)  
    **Date**: 29 November 2018
3.4. Participation in science dissemination activities

1. Open day in the IMDEA Institutes led by female scientists
   Participants: Rebeca Marcilla, Elia Tomás, Marta Liras
   Activity: Guided tour in IMDEA Energy
   Venue: IMDEA Energy Institute, Madrid, Spain
   Date: 7 February 2018
   Organizer: Madri+d Foundation

2. Meeting between women scientists and high school students of educational centers in Madrid
   Participants: Patricia Horcajada
   Activity: Guided tour in IMDEA Energy
   Venue: IMDEA Energy Institute, Madrid, Spain
   Date: 8 February 2018
   Organizer: Madri+d Foundation

3. Jornadas con Ciencia en la Escuela
   Participants: Elena Díaz, Antonio Valente, Carmen García, David Muñoz
   Activity: “Motor Stirling: ¿Te atreves a hacer funcionar un motor sin combustible?” y “Baterías y medios conductores: Cómo un electrón y un limón pueden iluminar un hogar”
   Venue: Círculo de Bellas Artes de Madrid, Spain
   Date: 6-7 March 2018
   Organizer: El Círculo de Bellas Artes, FUHEM, FECYT, SM, Fundación José Ramón Otero and Consejería de Educación e Investigación

4. GENERA 2018
   Brokerage Event
   Speaker: Marín, F.
   Venue: IFEMA, Madrid, Spain
   Date: 13 June 2018
   Organizer: Madri+d Foundation

5. European researchers’ night 2018
   Activity: ¡Energizing the future!
   Venue: IMDEA Energy Institute, Madrid, Spain
   Date: 28 September 2018
   Organizer: IMDEA Energy

   Activity: Sustainability for the world of energy
   Venue: IMDEA Energy Institute, Madrid, Spain
   Date: 12-15 November 2018
   Organizer: IMDEA Energy

3.5. Training activities

1. Lucero, Sandra
   BSc in Chemical Engineering, Rey Juan Carlos University
   Internship work: Support activities for the advanced biofuel production line.
   Supervisor: Dr. Juan Miguel Moreno, TCPU
   Period: January-March 2018

2. Viggiano, Donato
   BSc in Chemical Engineering, Rey Juan Carlos University
   Internship work: Chemical recycling of plastics from electronic equipment (WEEE: Waste Electrical and Electronic Equipment) by thermochemical processes.
   Supervisor: Dr. Juan Miguel Moreno, TCPU
   Period: March-August 2018

3. Escudero, María Jesús
   BSc in Civil Engineering, Polytechnic University of Madrid
   Internship work: Development and improvement of aluminum ion batteries.
   Supervisor: Dr. Edgar Ventosa, ECPU
   Period: March-May 2018

4. Paradelo, Ainoa
   BSc in Chemical Engineering, Rey Juan Carlos University
   Internship work: Development of rechargeable batteries based on aluminum.
   Supervisor: David Muñoz-Torrero, ECPU
   Period: March-June 2018
5. González, Cristina  
BSc in Chemical Engineering, Rey Juan Carlos University  
*Internship work:* Identification of substances susceptible to contaminate the process of applying automotive painting using spectroscopic techniques and chromatographies.  
*Supervisor:* Dr. Fernando Fresno, PAPU  
*Period:* April-June 2018

6. González, Carlos  
BSc in Chemical Engineering, Rey Juan Carlos University  
*Internship work:* Numerical modeling of solar concentration optical systems by simulation tools by ray tracing. Technical support in the assembly and commissioning of experimental devices and in hydrogen production tests using thermochemical cycles.  
*Supervisor:* Dr. José González, HTPU  
*Period:* July-August 2018

7. García, Elena  
BSc in Chemical Engineering, Rey Juan Carlos University  
*Internship work:* Experimental research work on the thermocatalytic residue recovery line through pyrolysis processes.  
*Supervisor:* Dr. Juan Miguel Moreno, TCPU  
*Period:* September-October 2018

8. San Segundo, Noelia  
MSc in Chemical Engineering, Rey Juan Carlos University  
*Internship work:* Experimental research work on the thermocatalytic residue recovery line through pyrolysis processes.  
*Supervisor:* Dr. Juan Miguel Moreno, TCPU  
*Period:* November 2018-February 2019

9. García, Laura  
MSc in Engineering, Complutense University of Madrid  
*Internship work:* Develop “next-generation” high-performance organic batteries-based on redox-active polymers (RAPs), by following four key criteria: safe, sustainable, smart and stable (4S).  
*Supervisor:* Dr. Nagaraj Patil, ECPU  
*Period:* November 2018-February 2019

10. Torres, María José  
MSc in Engineering, Complutense University of Madrid  
*Internship work:* Development and optimization of electrochemical energy storage devices based on aluminum; specifically, injectable aluminum-ion batteries.  
*Supervisor:* David Muñoz-Torrero/ Dr. Edgar Ventosa, ECPU  
*Period:* November 2018-January 2019

11. Paredes, Guillermo  
Professional Training, IES- Salesianos de Atocha  
*Internship work:* Support tasks in the High Temperature Processes Unit  
*Supervisor:* Dr. José González, HTPU  
*Period:* April-June 2018

12. Martínez, Iñigo  
Professional Training, IES- Salesianos de Atocha  
*Internship work:* Support tasks in the Photoactivated Processes Unit  
*Supervisor:* Dr. Víctor de la Peña, PAPU  
*Period:* April-June 2018

13. Menéndez, Stalin Leonardo  
Professional Training, IES-Benjamin Rúa  
*Internship work:* Support tasks in the Electrical Systems Unit  
*Supervisor:* Adriana Torres, UELSU  
*Period:* March-June 2018

14. Castilla, Roberto  
Professional Training, IES- Palomeras Vallecñas  
*Internship work:* Support tasks in the Electrochemical Processes Unit  
*Supervisor:* Guzman García, ECPU  
*Period:* March-June 2018

15. Berlanas, Ismael  
Professional Training, IES- Lope de Vega
Internship work: Support tasks in the Electro-chemical Processes Unit  
Supervisor: Ignacio Almonacid, ECPU  
Period: April-June 2018

16. Rodriguez, Ariadna  
Professional Training, IES- Lope de Vega  
Internship work: Support tasks in the Thermo-chemical Processes Unit  
Supervisor: Ignacio Almonacid, ECPU  
Period: April-June 2018

17. Carrascosa, Guillermo  
Professional Training, IES- Lope de Vega  
Internship work: Support tasks in the Thermo-chemical Processes Unit  
Supervisor: Guzman Garcia, ECPU  
Period: September-December 2018

18. Navarrete, Sandra  
Professional Training, IES- Lope de Vega  
Internship work: Support tasks in the Thermo-chemical Processes Unit  
Supervisor: Ignacio Almonacid, ECPU  
Period: September-December 2018

19. Vázquez, Inés  
BSc in Chemical Engineering – Industrial Organization Engineering, Rey Juan Carlos University  
Project title: Análisis de la escalabilidad de alternativas de producción de biocombustibles a partir de cultivos microalgas (Industrial Organization Engineering). Análisis tecnoeconómico de procesos de producción de biocombustibles a partir de microalgas (Chemical Engineering).  
Supervisor: Dr. Javier Dufour, SAU  
Date of defense: February and March 2018

20. Suárez, Jasson  
BSc in Industrial Organization Engineering, Rey Juan Carlos University  
Project title: Estudio prospectivo del parque automovilístico español.  
Supervisor: Dr. Diego García, SAU  
Date of defense: March 2018

21. Martín, María Isabel  
BSc in Chemical Engineering and Environmental Engineering, Rey Juan Carlos University  
Project title: Integración del proceso Sabatier en una planta de obtención de biogás  
Supervisor: Dr. Javier Dufour, SAU  
Date of defense: July 2018

22. Ayuso, Lucas  
BSc in Electromechanical Engineering-Electro- nical Itinerary, Pontificia de Comillas University  
Project title: Estudio de la estrategia de control df/dt para convertidores conectados a la red eléctrica  
Supervisor: Dr. Javier Roldán, ELSU  
Date of defense: September 2018

23. Hornillos, Gonzalo  
BSc in Electrical Engineering, Pontificia of Comillas University  
Project title: Optimización de redes de media tensión con SNOP  
Supervisor: Dr. Alberto Escalera Blasco/ D. Alberto Rodriguez Cabero, ELSU  
Date of defense: August 2018

24. Escudero, María Jesús  
BSc in Civil Engineering, Politechnical University of Madrid  
Project title: Estudio y desarrollo de baterías inyectables para almacenamiento estacionario.  
Supervisor: Dr. Edgar Ventosa, ECPU  
Date of defense: July 2018

25. Almenara, Jesús  
BSc in Mechanical Engineering, Carlos III University of Madrid  
Project title: Mechanical and electrochemical characterization of an LFP-CNT deformable composite electrode  
Supervisor: Dr. Nicola Boaretto, ECPU  
Date of defense: October 2018
26. Martinez, Mathias  
MSc in Environmental Engineering and Sustainable Energy, Universidad Rovira y Virgili  
Project title: Carbon footprint and economic analysis of Calcium Sulfoaluminate clinkers  
Supervisor: Dr. José Luis Gálvez, SAU  
Date of defense: January 2018

27. González, Adrián  
MSc in Electronic and Application Systems, Carlos III University of Madrid  
Project title: Diseño y análisis de una máquina síncrona virtual controlada en corriente para redes débiles  
Supervisor: Dr. Javier Roldan, ELSU  
Date of defense: September 2018

28. Rodríguez, Pablo  
MSc in Electronic and Application Systems, Carlos III University of Madrid  
Project title: Almacenamiento de energía como herramienta fundamental para estabilizar redes eléctricas  
Supervisor: Dr. Milan Prodanovic, ELSU  
Date of defense: September 2018

29. Romero, Lucas  
MSc in Renewable Energies in Electrical Systems, Carlos III University of Madrid  
Project title: Estabilidad transitoria en redes eléctricas con alta penetración de fuentes renovables y poca inercia del sistema  
Supervisor: Dr. Milan Prodanovic, ELSU  
Date of defense: September 2018

30. Nizamian, Dustin  
MSc in Energy Science and Technology, ETHZ  
Project title: On-Sun commissioning of a 50 kW solar reactor for thermochemical H2O & CO2 splitting  
Supervisor: Dr. Manuel Romero, HTPU  
Date of defense: December 2018

31. Molinero, Javier  
MSc in Renewable and Environmental Energies, Polytechnic University of Madrid-ETSIDI  
Project title: Desarrollo y puesta en marcha de una técnica de caracterización de superficies especulares para sistemas de concentración solar  
Supervisor: Dr. José González, HTPU  
Date of defense: September 2018

32. Fernández, Alejandro  
MSc in Renewable Energies in Electrical Systems, Carlos III University of Madrid  
Project title: Nuevos modelos de almacenamiento de energía para la operación óptima de redes de distribución  
Supervisor: D. Alberto Escalera, ELSU  
Date of defense: September 2018

33. Segovia, Rodrigo  
MSc in Renewable Energies in Electrical Systems, Carlos III University of Madrid  
Project title: Continuidad del suministro en redes de distribución inteligentes con generación distribuida controlable y gestión Activa de la demanda  
Supervisor: D. Alberto Escalera, ELSU  
Date of defense: September 2018

34. Justicia, Jessica  
MSc in Chemical Engineering, Rey Juan Carlos University  
Project title: Producción de hidrógeno mediante procesos de fotorreformado  
Supervisor: Dr. Fernando Fresno, PAPU  
Date of defense: December 2018

35. Iglesias, Sirma  
MSc in Energy and Fuels for the Future, Autónoma University of Madrid  
Project title: Desarrollo de nuevos sistemas redox basados en óxidos mixtos de manganesos y metales alcalinos para procesos de almacenamiento termoquímico de energía  
Supervisor: Dr. Juan Coronado, TCPU  
Date of defense: June 2018
36. Sánz, Hector
  MSc in Microbiology and Parasitology, Complutense University of Madrid
  Project title: Ingeniería evolutiva como estrategia de mejora del proceso de producción de ácido láctico a partir de lignocelulosa con Lactobacillus pentosus CECT 4023T
  Supervisor: Dra. Elia Tomás, BTPU
  Date of defense: July 2018

37. González, Alberto
  MSc in Energy and Fuels for the Future, Autónoma University of Madrid
  Project title: Nuevos fotoelectrodos híbridos basados en TiO2 y polímeros porosos conjugados nanoestructurados para la producción de combustibles solares
  Supervisors: Drs. Marta Liras and Mariam Barawi, PAPU
  Date of defense: June 2018

38. González, Miguel
  MSc in Energy and Fuels for the Future, Autónoma University of Madrid
  Project title: Estudio de espectroscopía fotoeléctrica de fotocatalizadores híbridos para fotosíntesis artificial
  Supervisor: Dr. Ignacio Villar, PAPU
  Date of defense: June 2018

39. Guachamin, José Rafael
  MSc in Energy and Fuels for the Future, Autónoma University of Madrid
  Project title: Water-Energy Nexus: Effect of water composition in the energy efficiency of capacitive deionization
  Supervisors: Drs. Jesus Palma and Julio Lado, ECPU
  Date of defense: September 2018