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Dear reader,

This report summarizes the work carried out at the Institute for Research in Technology (IIT) of the ICAI School of Engineering at the Comillas Pontifical University during the last academic year.

The overview presented in the annual report underlines the position we have been able to consolidate, both nationally and internationally, in our chosen areas of research. It showcases the strength of the research teams, who also make an important contribution to our internationally-oriented doctoral programs, and the continuing success of our collaboration with the industrial sector for more than thirty years.

All of the activity described in this report would not have been possible without the work and commitment of all the professionals at the institute: professors, researchers, administrative staff, post-graduate students and representatives of the industrial sector. If the work of the IIT has become an international benchmark in its areas of research, it is without doubt entirely their achievement.

The goal is to build on our success and advance further in our areas of expertise thanks to our continuing commitment and our professionalism. We are convinced that this professionalism will enable us to continue enjoying the confidence of the national and international companies and organizations we collaborate with as well as the ICAI School of Engineering itself, the Comillas Pontifical University, and ICAI Engineers Association. We highly appreciate their valuable support.

We wish to continue earning this confidence by dint of our efforts to produce qualified professionals who are highly sought after by companies in the industrial sector, to encourage applied research which adds to the engineering knowledge base, and to pass on this knowledge so that it may be of use to society.

We are conscious that this is a difficult challenge in the current globalized and interdependent economy with faster and deeper technology change, especially in the energy, transport and telecommunication sectors. We face this challenge with enthusiasm, commitment and optimism. Technology is to play a crucial role in
the history of humanity over the upcoming decades and we want to be part of this adventure.

I cordially invite you to get to know us better by reading these pages.

Tomás Gómez San Román
1. Introduction

The Institute for Research in Technology (IIT) is a University Research Institute that belongs to the ICAI School of Engineering of Comillas Pontifical University. Its primary objective is to promote research and postgraduate training in various technological fields through the participation in specific projects of interest for the industry and the administration. It is a nonprofit institute that seeks to be flexible and pragmatic in the way it works. Its funding mainly comes from projects contracted with companies; therefore, IIT responds to a social demand.

The results of this research are specified in the following products:

- Advanced computer applications, usually developed to customer specifications and used in many different companies, and innovative engineering equipment design.

- Analysis, consulting and technical, statistical, regulatory and econometric studies developed for companies and institutions in various countries.

- Doctoral theses defended at the University and publications in conferences and international journals.

The research staff of the IIT is composed of professors of the school of engineering ICAI who develop their research activities at IIT together with IIT full-time research scientists. They supervise the research conducted by the research assistants who are enrolled in different engineering PhD programs of Comillas.

This report covers the period for the academic year 2018 - 2019, from September 1, 2018 to August 31, 2019.
2. Organizational structure

2.1 Management

The management of the IIT during the course 2018 - 2019 has been carried out by the following Professors and Researchers:

- **Frias Marín, Pablo.** Deputy Director for Internal Affairs (until September 2018)
- **García González, Javier.** Deputy Director for Academic and Economic affairs
- **Gómez San Román, Tomás.** Director
- **Sigrist, Lukas.** Deputy Director for Institutional Relationships

2.2 Council

The members of the council of the IIT during the course 2018 - 2019 were the following ones:

- **Cossent Arín, Rafael.** Researcher Representative
- **Frias Marín, Pablo.** Deputy Director for Internal Affairs (until September 2018)
- **García González, Javier.** Deputy Director for Academic and Economic affairs
- **Gómez San Román, Tomás.** Director
- **López López, Álvaro Jesús.** Researcher Representative
- **Otaola Arca, Pedro de.** IEF Representative
- **Ramos Galán, Andrés.** Researcher Representative
- **Rivier Abbad, Michel.** Researcher Representative
- **Roch Dupré, David.** IEF Representative
- **Rodilla Rodríguez, Pablo.** Researcher Representative
- **Sigrist, Lukas.** Secretary General
- **Sigrist, Lukas.** Deputy Director for Institutional Relationships
2.3 Area coordinators

IIT’s research activities are divided into eight research areas. The coordinators of the eight research areas during the course 2018 - 2019 were the following ones:

• Cantizano González, Alexis. PCI Coordinator
• Cossent Arín, Rafael. REDES Coordinator
• Cucala García, Asunción Paloma. ASF Coordinator
• Ramos Galán, Andrés. SADSE Coordinator
• Rodilla Rodríguez, Pablo. RYE Coordinator
• Rodríguez-Morcillo García, Carlos. BIO Coordinator
• Rouco Rodríguez, Luis. MAC Coordinator
• Sánchez Miralles, Álvaro. ASI Coordinator

2.4 Scientific advisory board

The members of the scientific advisory board (SAB) are the following ones:

• Andersson, Göran (Chairman), ETH Zurich, Switzerland
• Miranda, Vladimiro (Vice chairman), INESC TEC, Univ. of Porto, Portugal
• Hobbs, Benjamin F. (Member), Johns Hopkins University, USA
• Miyatake, Masafumi (Member), Sophia University, Japan
• Neuhoff, Karsten (Member), DIW Berlin, Technical Univ. Berlin, Germany
• Wehenkel, Louis (Member), University of Liège, Belgium

2.5 Academic staff

The permanent staff of the IIT consisted of the following professors and research scientists:

• Bello Morales, Antonio. Research Assistant Professor
  Ph.D. in Industrial Engineering (Comillas), M.Sc. in Power Systems (Comillas), Mechanical Engineer (Comillas),
  Areas of interest: Risk management support, energy forecasting, energy market modelling, planning of electricity and gas markets, artificial intelligence.

• Boal Martín-Larrauri, Jaime. Assistant Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electronics Engineer (Comillas)
  Areas of interest: Home automation and energy efficiency · Analog and digital electronics, wireless communications · Deep learning · Autonomous mobile robots, computer vision, topological modeling of the environment
• **Campos Fernández, Francisco Alberto.** Research Associate Professor  
Ph.D. in Industrial Engineering (Comillas)  
Mathematics Science degree (UCM)  

• **Centeno Hernáez, Efraim.** Professor  
Ph.D. in Industrial Engineering (Comillas)  
Electronics Engineer (Comillas)  

• **Chaves Ávila, José Pablo.** Research Assistant Professor  
Ph.D. in Electrical Engineering (Comillas), Ph.D. in Electrical Engineering (Delft University of Technology - TU Delft, The Netherlands), Ph.D. in Electrical Engineering (Royal Institute of Technology - KTH, Stockholm, Sweden), Economics (University of Costa Rica), M.Sc. in Electric Power Industry (Comillas), M.Sc. in Network Industries and Digital Economics (University Paris-Sud 11, France)  
Areas of interest: Energy economics, integration of renewable resources and distributed energy resources in the electricity sector, smart grids and regulation of the electricity and gas sectors.

• **Contreras Bárcena, David.** Associate Professor  
Ph.D. in Industrial Engineering (Comillas)  
Computing Engineer (Comillas), Postgraduate in Management Information Systems (Comillas)  

• **Cossent Arín, Rafael.** Research Assistant Professor  
Ph.D. in Industrial Engineering (Comillas)  
Electrical Engineer (Comillas)  
Areas of interest: Power system economics and regulation. Regulation of electricity distribution activity, integration of renewable and distributed generation, demand response and smart distribution grids.

• **Cuadra García, Fernando de.** Professor  
Ph.D. in Industrial Engineering (Comillas)  
Electrical Engineer (Comillas)  
• **Cucala García, Asunción Paloma.** Senior Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electronics Engineer (Comillas)  
  Areas of interest: Modelling, simulation, design, management and control of railway systems, and their optimisation

• **Echavarren Cerezo, Francisco Miguel.** Research Assistant Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  
  Areas of interest: Modeling, analysis and simulation of power systems.

• **Egido Cortés, Ignacio.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electronics Engineer (Comillas)  
  Areas of interest: Load-frequency control and voltage control. System modeling and control. Power system stability.

• **Fernández Cardador, Antonio.** Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Physics Science degree (UCM)  

• **Fernández Rodríguez, Adrián.** Research Assistant Professor  
  Ph.D. in Engineering (Comillas)  
  Electrical Engineer (UPM)  
  Master's Degree in Research in Engineering Systems Modeling (Comillas)  
  Areas of interest: Train simulation, energy efficiency in railway operation and nature inspired optimisation.

• **Frías Marín, Pablo.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  
  Areas of interest: Operation and planning of electric power systems. Power economics. Integration of distributed generation in power systems. Advanced electric machines. Electric Vehicles and Sustainable Mobility.

• **García Cerrada, Aurelio.** Professor  
  Ph.D. in Electrical and Electronics Engineering (University of Birmingham, U.K.)  
  Electrical Engineer (UPM)  
  Areas of interest: Power electronics. Control of electrical drives. FACTS. System identification and control.
• **García González, Javier.** Senior Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (UPC)  
  Areas of interest: Economy and optimization of electric power systems.

• **García González, Pablo.** Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  
  Areas of interest: Control. Power electronics. Power electronics applied to the electric power systems (FACTS devices, active filters, HVDC, etc.). Electric power systems stability and control.

• **Gómez San Román, Tomás.** Professor  
  Ph.D. in Industrial Engineering (UPM)  
  Electrical Engineer (Comillas)  

• **Latorre Canteli, Jesús María.** Research Assistant Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electronics Engineer (Comillas)  

• **Linares Llamas, Pedro.** Professor  
  Ph.D. in Agricultural Economics (UPM)  
  Agricultural Engineering degree (UPM)  

• **Lobato Miguélez, Enrique.** Senior Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  
  Areas of interest: Analysis, planning, operation and economics in electric power systems.

• **López López, Álvaro Jesús.** Research Assistant Professor  
  PhD in Engineering (Comillas)  
  Electronics degree (Comillas), M.Sc. in Automatics and Electronics (Comillas)  
  M.Sc. in Research in Engineering Systems Modeling (Comillas)  
• **López López, Gregorio.** Assistant Professor  
PhD in Telecommunications Engineering. Universidad Carlos III de Madrid.  
Areas of interest: Optimization of M2M communications networks based on analysis and simulation, cybersecurity and data analytics for the IoT, and the use of technology and the Internet.

• **Lumbreras Sancho, Sara.** Associate Professor  
Ph.D. in Industrial Engineering (Comillas)  
Electrical Engineer (Comillas)  
Areas of interest: Decision methods applied to complex problems. ---Techniques:--- decision under uncertainty, stochastic optimization, Benders’ decomposition, risk analysis, heuristics, metaheuristics, genetic algorithms, ordinal optimization. ---Areas of application:--- power systems, planning, network design, transmission expansion planning, wind energy, offshore windfarm design, finance, risk analysis, derivatives.

• **Martín Martínez, Francisco.** Research Assistant Professor  
Electrical Engineer (Comillas)  
Master’s degree in Research in Engineering Systems Modeling (Comillas)  
Ph.D. in Industrial Engineering (Comillas)  
Areas of interest: Microgrids. Distributed generation and energy efficiency. Digital electronics systems.

• **Mastropietro, Paolo.** Research Assistant Professor  
Ph.D. in Electrical Engineering (Comillas), Ph.D. in Electrical Engineering (Delft University of Technology - TU Delft, The Netherlands), Ph.D. in Electrical Engineering (Royal Institute of Technology - KTH, Stockholm, Sweden), M.Sc. in Environmental Engineering (University of Rome Tor Vergata, Italy), Environmental Engineer (University of Rome Tor Vergata, Italy)  
Areas of interest: Power sector regulation; Security of supply; Capacity remuneration mechanisms; regional markets; tariff design and subsidies.

• **Matanza Domingo, Javier.** Assistant Professor  
Ph.D. in Industrial Engineering (Comillas)  
Telecommunications Engineer (Technical University of Valencia)  

• **Mateo Domingo, Carlos.** Research Assistant Professor  
Ph.D. in Industrial Engineering (Comillas)  
Electronics Engineer (Comillas), Computer Systems Engineer (UNED)  
Areas of interest: Models of electricity distribution networks. Integration of distributed energy resources.
• **Muñoz San Roque, Antonio.** Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  

• **Nobrega Barroso, Luiz Augusto.** Research Affiliate  
  Ph.D. in Power Engineering and Operations Research (Federal University of Rio de Janeiro - UFRJ, Brazil)  
  Mathematics Science degree (Universidade Federal do Rio de Janeiro - UFRJ, Brasil)  

• **Olmos Camacho, Luis.** Research Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  

• **Palacios Hielscher, Rafael.** Senior Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Mechanical Engineer (Comillas)  
  Areas of interest: Advanced data analysis (including vibration analysis, optical handwritten character recognition, image processing, artificial intelligence and data mining). Parallel processing. Thermoelectric applications. Failure detection and maintenance. Aviation safety.

• **Pérez Arriaga, José Ignacio.** Lecturer  
  Ph.D. and M.Sc. in Electrical Engineering (Massachusetts Institute of Technology - MIT, U.S.A.), Ph.D. in Industrial Engineering (UPM)  
  Electrical Engineer (Comillas)  
  Areas of interest: Regulation, economics, planning, operation and control of electric power systems. Sustainability of the energy model. Electricity access in developing countries.

• **Portela González, José.** Assistant Professor  
  PhD in Engineering (Comillas), Electronics Engineer (Comillas), M.Sc. in Research in Engineering Systems Modeling (Comillas)  
  Areas of interest: Functional Data Analysis, Neural Networks, time series models

• **Ramos Galán, Andrés.** Professor  
  Ph.D. in Industrial Engineering (UPM)  
  Electrical Engineer (Comillas)
Academic staff


• **Renedo Anglada, Francisco Javier.** Research Assistant Professor  
  PhD in Engineering (Comillas)  
  Electrical Engineer (Comillas)  
  M.Sc. in Mathematical Engineering (UC3M)  
  Areas of interest: VSC-HVDC multi-terminal systems, power system stability

• **Reneses Guillén, Javier.** Research Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas), Mathematics Science degree (UNED)  
  Areas of interest: Operation, regulation and planning of power and natural gas systems. Tariff design.

• **Rivier Abbad, Michel.** Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  
  Areas of interest: Electric power systems analysis, optimisation, regulation economic, operation and planning. Optimisation techniques.

• **Rodilla Rodríguez, Pablo.** Research Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  
  Areas of interest: Fundamental and quantitative electricity market modeling. Market design and regulation for wholesale electricity markets. Competition and strategic behavior analysis. Security of supply mechanisms in competitive power systems. Regulatory mechanisms focused on environmental policies

• **Rodríguez Mondéjar, José Antonio.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electronics Engineer (Comillas)  
  Areas of interest: Communication and control in electric power systems and railway systems.
• **Rodríguez Pecharromán, Ramón.** Senior Associate Professor  
Ph.D. in Industrial Engineering (Comillas)  
Electronics Engineer (Comillas)  
Areas of interest: Control systems. Railway electrification. Thermoelectricity.

• **Rodríguez-Morcillo García, Carlos.** Research Assistant Professor  
Ph.D. in Industrial Engineering (Comillas)  
Electronics Engineer (Comillas), M.Sc. in Communication Technologies and Systmes (UPM)  

• **Romero Mora, José Carlos.** Research Assistant Professor  
PhD in Engineering (Comillas)  
Electrical and Power Systems Engineer (University of Malaga), M.Sc. in Research in Engineering Systems Modeling (Comillas)  
Areas of interest: Energy Sustainability; Fuel Poverty; Energy Transition

• **Rouco Rodríguez, Luis.** Professor  
Ph.D. in Industrial Engineering (UPM)  
Electrical Engineer (UPM)  
Areas of interest: Electric power systems stability and control. System identification. Simulation of electromagnetic transients.

• **Sánchez Fornié, Miguel Ángel.** Research Affiliate  
Electromechanical Engineer de ICAI (Comillas)  
Nuclear Security Diploma (MIT)  
Power systems asset management. Smart grids. Telecommunications systems and operations. Telecommunications for power systems. Cybersecurity, Big data analysis and artificial intelligence on power systems.

• **Sánchez Martín, Pedro.** Senior Associate Professor  
Ph.D. in Industrial Engineering (Comillas)  
Industrial Engineer (Comillas)  
Areas of interest: Transmission and generation electric system modeling. Industrial process planning and scheduling. Work system design. Manufacturing and logistics simulation

• **Sánchez Miralles, Álvaro.** Senior Associate Professor  
Ph.D. in Industrial Engineering (Comillas)  
Electronics Engineer (Comillas)  
Areas of interest: Smart grids. Smart cities. Security systems. Mobile robotics.
Academic staff

• **Sánchez Úbeda, Eugenio Francisco.** Associate Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electronics Engineer (Comillas)
  Areas of interest: Machine learning – Forecasting – Data analysis and visualization - Non-linear statistical modeling - Deep learning

• **Sanz Bobi, Miguel Ángel.** Professor
  Ph.D. in Industrial Engineering (UPM)
  Electrical Engineer (UPM)

• **Sigrist, Lukas.** Research Assistant Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electrical and Electronics Engineer (École Polytechnique Fédérale de Lausanne - EPFL, Switzerland)

• **Ventosa Rodríguez, Mariano.** Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electronics Engineer (Comillas)
  Areas of interest: Operations, planning and economy of electric energy systems. Application of operations research in electric energy markets.

• **Wogrin, Sonja.** Associate Professor
  Ph.D. in Industrial Engineering (Comillas)
  Technical Mathematics degree (Graz University of Technology, Austria), M.Sc. in Computation for Design and Optimization (Massachusetts Institute of Technology - MIT, U.S.A.)

2.6 Associated academic staff

The following professors have collaborated with the IIT as associate researchers:

• **Arenas Pinilla, Eva María.** Assistant Professor
  Ph.D. in Industrial Engineering (Comillas)
  Mechanical Engineer (Comillas)
  MSc Thermal Power and Fluids Engineering (University of Manchester. Institute of Science and Technology)
Areas of interest: S-CO2 turbomachinery, hydro-powered pumping, hydraulic turbomachinery, energy poverty

• Ayala Santamaría, Pablo. Assistant Professor
  Ph.D. in Industrial Engineering (Comillas), Mechanical Engineer (Comillas), Master’s degree in Research in Engineering Systems Modeling (Comillas)
  Areas of interest: CFD, fire modelling, fire protection installation, smoke movement

• Ballesteros Iglesias, Yolanda. Associate Professor
  Ph.D. in Chemistry Science (UAM)
  Chemistry Science degree (UAM)

• Cantizano González, Alexis. Associate Professor
  Ph.D. in Industrial Engineering (Comillas)
  Mechanical Engineer (Comillas), M.Sc. in Thermal Power and Fluids Engineering (University of Manchester Institute of Science and Technology - UMIST, U.K.), Psychology degree (UNED)
  Areas of interest: Fire Protection Engineering, Fire Dynamics, Computational Fluid Dynamics (CFD), Hydraulic and Thermal Turbomachines

• Carnicero López, Alberto. Associate Professor
  Ph.D. in Industrial Engineering (Comillas)
  Mechanical Engineer (Comillas)

• Castro Ponce, Mario. Senior Associate Professor
  Ph.D. in Physics Science (UCM)
  Physics Science degree (UCM)

• Fernández Bernal, Fidel. Senior Associate Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electrical Engineer (Comillas)
  Areas of interest: Dynamics of electrical systems. Motor control. Renewable energies integration.

• Giannetti, Romano. Professor
  Ph.D. in Electronics and Computing Engineering (University of Padua, Italy)
  Electronics Engineer (University of Pisa, Italy)
• **González Arechavala, Yolanda.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Computing Engineer (UPV-EHU)  
  Areas of interest: Software engineering: software development process, programming paradigms, software quality assurance and control, CASE tools. RAMS: standards and analysis. Safety critical and real time systems. Railway systems. Sustainability assessment of energy generation from biomass using LCA.

• **Herraiz Martínez, Francisco Javier.** Assistant Professor  
  Engineer and Ph.D. degrees in Telecommunications, Carlos III University of Madrid (Spain)  

• **Jiménez Octavio, Jesús.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Mechanical Engineer (Comillas)  
  Areas of interest: Computational mechanics

• **Laloux Dallemagne, Damián.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  
  Areas of interest: Modelling, analysis and control of electric power systems. Sustainable development.

• **López Valdés, Francisco José.** Assistant Professor  
  Mechanical Engineering, Mechanics Universidad de Valladolid (Spain)  
  PhD. Mechanical and Aerospace Engineering. University of Virginia (USA)  
  Areas of interest: Biomechanics, Injury prevention, biological tissue characterization, injury thresholds, automotive safety

• **Mochón Castro, Luis Manuel.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Mechanical Engineer (Comillas)  

• **Muñoz Frías, José Daniel.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electronics Engineer (Comillas)  
• **Paz Jiménez, Eva.** Assistant Professor  
PhD in Engineering (Comillas)  
Industrial Technical Engineering in Industrial Chemistry (UPM), M.Sc. in Production Engineering (UPM)  
Areas of interest: Biomaterials, Bone cements, Composite materials, Nanocomposites, Carbon based nanomaterials, Mechanical Characterisation.

• **Real Romero, Juan Carlos del.** Senior Associate Professor  
Ph.D. in Industrial Engineering (Comillas)  
Industrial Engineer (Comillas)  
Areas of interest: Adhesive bonding: adhesives suitable for each application; mechanical characterization of adhesive bonding; durability studies and failure modes; surface treatments to improve durability of the adhesive joints. Composites: preparation of polymer matrix composites reinforced by micro and nanoparticles; mechanical characterization; thermal analysis; applications as coatings; biomedical applications. Carbon based nanomaterials. Nanocomposites.

• **Sáenz Nuño, María Ana.** Assistant Professor  
Ph.D. in Industrial Engineering (Comillas)  
Physics Science degree (UCM)  
Areas of interest: Dimensional metrology.

• **Santos Montes, Ana María.** Senior Associate Professor  
Ph.D. in Chemistry Science (UCM)  
Chemistry Science degree (UAM)  
Areas of interest: Development, optimization and validation of chromatographic analytical methods for high-performance liquid chromatography (HPLC) to determine steroids, diuretics and contaminants in urine samples, feed and water. Analysis of the life cycle of crops for biofuels.

• **Zamora Macho, Juan Luis.** Associate Professor  
Ph.D. in Industrial Engineering (Comillas)  
Electronics Engineer (Comillas)  
Areas of interest: Drive control. System identification. Signal processing.

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### 2.7 Research assistants

The Research Assistants (PhD students) that developed their activity at the IIT during the academic course 2018 - 2019 were the following ones:
Research assistants

- **Barrella, Roberto.** Bachelor's Degree in Energy Engineering (Università degli Studi di Roma La Sapienza)  
Master's degree in Energy Engineering (Università degli Studi di Roma La Sapienza)
- **Calvo Báscones, Pablo.** Electromechanical Engineer (Comillas). M.Sc. in Industrial Engineering (Comillas)
- **Candela Ripoll, Ignacio.** Degree in Energy Engineer, Polytechnic University of Valencia (UPV).  
Master of Science in Sustainable Energy Engineer, Technical University of Denmark (DTU).
- **Ciller Cutillas, Pedro.** Electronics Engineer (Comillas), Mathematics (UCM)
- **Correa Ramírez, Mauricio.** Electrical Engineer (National University of Colombia)  
Specialist in Electronics and Informatics (University of Antioquia)  
MBA in Corporate Finance (University of Viña del Mar)
- **Cunillera Pérez, Alejandro.** Bachelor’s Degree in Mathematics and Physics, Universidad Complutense de Madrid.  
Master’s Degree in Physics of Complex Systems, Universidad de las Islas Baleares.
- **Doenges, Kai.** Master of Science in Industrial Engineering, Technical University of Dortmund (TU Dortmund)
- **Doménech Martínez, Salvador.** Mechanical Engineer (Comillas)
- **Domínguez Barbero, David.** Bachelor’s Degree in Computer Engineering, Universidad de Castilla – La Mancha.  
Master’s Degree in Artificial Intelligence Research, Menendez Pelayo International University.
- **García Aguilar, Javier.** Master’s Degree in Industrial Engineering. Universidad P. Comillas
- **Gerres, Timo.** B.Sc. in Business Administration and Engineering (Universität Paderborn) (DE)  
M.Sc. in Systems Engineering, Policy Analysis & Management (Technische Universität Delft) (NL)
- **González Romero, Isaac Camilo.** B.Sc. in Economics and Mathematics (Colombian School of Engineering «Julio Garavito»)  
Master’s degree in the Electric Power Industry (Comillas Pontifical University)  
Master in the Network Industries and Digital Economy (Paris Sud University -France)
- **Huclin, Sébastien.** Master’s degree in Physics (University of Paris-Sud)
- **Jiménez Serrano, Clara.** Bachelor's Degree in Electromechanical Engineering. Universidad Pontificia Comillas.  
Master's Degree in Industrial Engineering. Universidad Pontificia Comillas.
- **Lind, Leandro.** B.Sc. in Economics. Federal University of Santa Catarina (Brasil)  
Master in the Electric Power Industry. University Pontificia Comillas (Spain)  
Master in Digital Economics and Network Industries. University Paris-Sud 11 (France)
• Marcos Peirotén, Rodrigo Alejandro de. Electronics Engineer (Comillas)
• Martín Lopo, Miguel. Electronics Engineer (Comillas)
• Marulanda García, Geovanny Alberto. Electrical Engineer, Universidad Tecnológica de Pereira (Colombia)
  Master in Electrical Engineering, Universidad Tecnológica de Pereira (Colombia)
• Mestre Marcos, Guillermo. Bachelor’s Degree in Mathematics (Universidad de Alicante)
  Master’s Degree in Advanced Mathematics (Universidad Complutense de Madrid)
• Montero Guirao, Luis Manuel. Degree in Chemical Engineering, Universidad de Granada.
  Master’s degree in Chemical Engineering, Universidad de Salamanca.
• Morell Dameto, Nicolás Mariano. Bachelor’s Degree in Industrial Engineering,
  Universidad Politécnica de Madrid.
  Master’s Degree in Industrial Engineering, Universidad Politécnica de Madrid.
  Master in Electricity Markets, Illinois Institute of Technology, USA.
• Mosácula Atienza, Celia. Chemistry Engineer (UPV/EHU), M.Sc. in Renewable Energies (CEU San Pablo University)
• Orgaz Gil, Alberto. Electronics Engineer (Comillas). Master's Degree in Research in Engineering Systems Modeling (Comillas)
• Otaola Arca, Pedro de. Bachelor’s degree in Electromechanical Engineering
  (major in Electronics)(Comillas)
  Master’s degree in Industrial Engineering (Comillas)
• Pérez-Andújar Carretié, Clara. Electromechanical Engineering specialized in electronics. Universidad P. Comillas.
  Master’s Degree in Industrial Engineering. Universidad P. Comillas.
• Postigo Marcos, Fernando Emilio. Electromechanical Engineer (Comillas)
  M.Sc. in Industrial Engineering (Comillas)
• Roch Dupré, David. Electromechanical Engineer (Comillas)
  M.Sc. in Industrial Engineering (Comillas)
  Official Master’s Degree in Research in Engineering Systems Modeling (MRE)
• Rodríguez Gallego, Alejandro. Industrial Engineer (ICAI). Universidad Pontificia Comillas
  Executive MBA. IE Business School
  Master’s degree in Stock Markets & Financial Derivatives. UNED
  Master’s degree in Business Intelligence & Big Data. EOI
• Rosso Mateo, Ángel. Industrial Engineering (Comillas)
  MPhil in Electrical Engineering (University of Manchester)
• Utrilla Bustamante, María Candelaria. Double Degree in Electromechanical Engineering. Universidad Pontificia Comillas - CentraleSupélec.
  Official Master’s Degree in Industrial Engineering. Universidad Pontificia Comillas.
Research assistants

- **Vásquez del Solar, Mónica.** Food industry engineer. (Universidad Nacional Agraria La Molina)
  Master in Economic and Innovation Management. (Universidad Autónoma de Madrid)

2.8 Services staff

2.8.1 Systems administrator staff

System administrator staff covers the management of networks and computer systems, and the development of web-tools. System administrator staff consists of:

- **Lázaro Martín, Marco Antonio.** Technical Engineer in Management Computing
- **Martín Tena, Julián.** Computer Expert

2.8.2 Administrative staff

Administrative staff covers the general and the technical secretariat, the management of databases and of the documentation used or generated at IIT (like books, papers, working papers, reports, CV, etc), and the management of communication, dissemination and of international relations. The administrative staff consists of:

- **García Lecuona, Paula.** Degree in Hispanic Philology (Universidad Complutense de Madrid)
- **Ruiz González-Mateo, Cristina.** Law and Legal Advisor Companies degree (Comillas)
- **Sánchez Ortega, María Isabel.** Librarianship and Information Science Diploma (University of Granada)
- **Tamudo González, Isabel.** Criminology degree (UEM), Criminology diploma (UCM)
3. Research

3.1 Research areas

The IIT is divided into eight research areas that can be grouped into two major categories: Energy systems and Industrial systems.

3.1.1 Energy systems

The following four areas mainly focus on the energy sector, and in particular, on the generation, transmission and distribution of electrical energy:

3.1.1.1 Electric Power Systems (MAC)

Area dedicated to the development of computer tools for electrical studies related to such aspects as load flows, stability, transients, frequency-power control, power plant regulators, voltage control, design of systems of electric feeding, protection, harmonics, and the impact of the distributed generation.

Coordinator: Luis Rouco Rodríguez
Web page: https://www.iit.comillas.edu/research-area/mac

3.1.1.2 Smart and Sustainable Grids (REDES)

The Smartgrids and RES integration Group investigates the challenges of future power systems from a technical, economic and regulatory perspectives. On the one hand, it covers the techno-economic evaluation of the impact of distributed energy resources in distribution networks (such as distributed generation, demand management, electric vehicles and storage). Based on the cost & benefit and scalability & replicability analysis different proposals for standards and regulation are presented. On the other hand, the research in this area also covers the impact of high levels of renewable energy penetration in power systems, and new market and ancillary services designs for their optimal integration.
Coordinator: Rafael Cossent Arín
Web page: https://www.iit.comillas.edu/research-area/redes

3.1.1.3 Energy Economics and Regulation (RYE)

Area centred on research into the organization, remuneration and regulation of the power systems (sector structure, market models, economic signals, tariffs and quality of service, etc.).

Coordinator: Pablo Rodilla Rodríguez
Web page: https://www.iit.comillas.edu/research-area/rye

3.1.1.4 Energy Systems Models (SADSE)

Area which goal is to provide assistance in the taking of decisions and in the technical-economic analysis of the generation, transport and distribution systems in the energy sector.

Coordinator: Andrés Ramos Galán
Web page: https://www.iit.comillas.edu/research-area/sadse

3.1.2 Industrial systems

The following four areas mainly focus on technical fields different from but increasingly related to the energy sector:

3.1.2.1 Fire Safety, Thermal and Fluids Engineering (PCI)

This area is dedicated to mechanical elements design and to running complex simulations using a computer, specially for general mechanical purposes as well as electromagnetism, wind grounds, etc.

Coordinator: Alexis Cantizano González
Web page: https://www.iit.comillas.edu/research-area/adi

3.1.2.2 Railway Systems (ASF)

This area aims to develop models and other custom-made software tools, safety analysis and quality control, related with different topics of railway systems. These topics include the infrastructure design and management, the power systems planification and operation, as well as the railway traffic planification and operation.

Coordinator: Asunción Paloma Cucala García
Web page: https://www.iit.comillas.edu/research-area/asf
3.1.2.3 Intelligent Systems (ASI)

This area deals with the monitoring, diagnosis, reliability and maintenance of industrial processes, and modelling and prediction of industrial and economic systems.

Coordinator: Álvaro Sánchez Miralles
Web page: https://www.iit.comillas.edu/research-area/asi

3.1.2.4 Bioengineering (BIO)

This group works to develop electronic instrumentation and microprocessors, power electronics, control engineering applications, signal analysis, electronic design, automatization and digital communications.

Coordinator: Carlos Rodríguez-Morcillo García
Web page: https://www.iit.comillas.edu/research-area/geac

3.2 Research projects

This section includes all the research projects developed at IIT during this academic year grouped by the category of areas and type of funding. A brief description of them and the most relevant data (collaborating institution, dates, staff involved) are also included.

3.2.1 Energy systems

3.2.1.1 Research and development projects

3.2.1.1.1 Private funding

• Technologies and strategies for the optimal participation of renewable energies in electricity markets
  Gas Natural Fenosa Engineering, SL. January 2017 - December 2019. (Enrique Lobato Miguélez, Ignacio Egido Cortés, Kai Doenges, Lukas Sigrist)
  SILILIA project develops a set of tools and optimal strategies for the efficient participation of renewables energies in the Spanish electricity markets.

• Tools and methodologies for energy planning under uncertainty
  XM Compañía de Expertos en Mercados, SA. November 2017 - December 2018. (Andrés Ramos Galán, Jesús María Latorre Canteli)
  In this project we are going to introduce improvements in the two medium- and long-term energy planning models for the Colombian system. Both are integrated in a single tool sharing input data and output results and the piece of code that is suitable. The forecasted improvements are the following ones:
Introduction of a variable production function of hydro plants of relevant reservoirs
Optimal representation of the uncertainty for variables like hydro inflows, wind and solar power by means of scenario trees for being used in the energy planning model
Development of a simulation module of deterministic scenarios after the stochastic optimization solution
Development of a synthetic multivariate series generator for hydro, solar and wind generation to be used in the energy planning model

- **Long-term risk analysis in the electricity markets. Maintenance of the ARIES tool**
The aim of this collaboration between IIT and Endesa is the maintenance of the ARIES tool for long-term risk management in the Iberian electricity market.

- **Forecasts and analysis of the short- and medium-term operation in the Spanish extrapeninsular power systems**
The objective of this collaboration is the improvement of the VALORE tool so that it can be used in the short- and medium-term operation of the insular and extra-peninsular Spanish electrical systems.

- **The energy company of the future electrification in developing countries**
The objective of the project is to define a viable large-scale business model, to be deployed in one or more developing countries, which would accelerate energy access and be attractive for corporate investment.

- **Short- and medium-term risk analysis in electricity markets. Improvements in the asset representation**
The aim of this project is to continue with the developments of the ACUARIO tool. In particular, the improvement in the representation of the different assets modeled in ACUARIO is addressed. Continued support is also being given on the use of the tool and the interpretation of the results.

- **Medium and long term gas portfolio risk modeling**
The aim of this collaboration is to continue with the developments in the AURIGA mid-term risk-management tool for the natural gas market. During 2018 the project focuses on obtaining a better representation of the valuation of the portfolio and improving the management of correlation, such as considering the correlation between the different time horizons of the markets.

• **Medium- and long-term planning in the Iberian electricity market. Integration of hourly executions**
  This project between IIT and Endesa focuses on the medium and long-term planning of the Iberian electricity market (MIBEL). Specifically, in addition to the continuous assistance to users, the integration of the hourly executions and its associated tools is addressed, as well as the flexibilization of the BIP executions.

• **Operation and planning of the Iberian natural gas market: hub representation and Monte Carlo executions**
  This project, which is included in the framework of a continuous research between Endesa and the IIT, is focused on the operation and forecasting in the context of the Iberian natural gas market. The objective of this new phase of the development of OMEGA is to improve the computation process of the OMEGA MonteCarlo tool and the outputs it provides, as well as the enhancement of the modelling of the hub balance market.

• **Support in forecasting and optimizing the operation in electricity markets**
  This project is framed into the on-going cooperation line followed by Endesa and IIT in the framework of medium-term operation and planning in the context of the Iberian electricity market. The collaboration is focused on the integration of France in the LPM simulations, as well as on redesigning the internal structure of the tool for Monte Carlo executions.

• **Simulation and sizing of hybrid systems based on energy storage systems**
  Gas Natural SDG, S.A. January 2018 - March 2019. (Enrique Lobato Miguélez, Lukas Sigrist, José María Fernández de Bobadilla Navarrete)
  Optimal Simulation and sizing of hybrid systems based on batteries for different business models.
• **VALSA-EXPANDE integration and developments for the long-term analysis**

Enel Iberoamerica S.R.L. January 2018 - December 2018. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

VALSA is an expansion model for generation investment and complementary service analyses of the Spanish electricity system in the long-term. The objectives of this collaboration include the follow-up of the strategic reflection that begun in the previous collaboration, to know what elements are currently determining the system behaviour and what is the best way to address them. Another objectives are to guarantee the adaptation of VALSA to the system changes expected in the next few years (as for example the changes in the generation or consumption structure) and also the continued assistance in the use of VALSA.

• **Simulation of the global gas market in the medium term**


The aim of this collaboration between IIT and Enel is to develop a simulation tool able to accurately represent the global natural gas market in the medium term.

• **Predictive models in healthcare**

Medsavana, S.L. June 2018 - October 2020. (Sara Lumbreras Sancho)

The widespread adoption of the electronic medical record (Electronic Health Records, EHR) opens the way to evidence-based medicine, based on the history of large numbers of real patients rather than limited clinical trials. This can be used to create custom risk profiles or predictive models to anticipate the effect of specific treatment lines. Although a substantial amount of work has been done in this field in recent years, there are still unresolved limitations. One of the main ones is the use of unstructured text data, which contains most of the relevant information. This text is considerably difficult to use, given the complexity of medical terminology. The second limitation is the large number of variables that can be explained or used in the models.

Savana is an EHR manager that provides innovative solutions for the extraction of knowledge of these data and support for the decision-making in research, clinic and management. It owns the SAVANA MANAGER, SAVANA CONSULTA, SAVANA RESEARCH and SAVANA PREDICT platforms, as well as the EHREAD and ENTROPIA technology, which are computer tools capable of reading and interpreting the information contained in the electronic clinical records. In addition, it is able to associate each medical term with the concepts related to it, linking them to the standard medical oncology SnoMed. Savana has access to one of the largest EHR databases internationally, with several hundred million stories.

This proposal describes the future collaboration between the Technological Research Institute and Savana, which has the fundamental objective of accelerating the development of predictive models as well as the dissemination of research results.
• Development of scenarios of Spanish island power systems
Gas y Electricidad Generación S.A. July 2018 - December 2018. (Lukas Sigrist, Luis Rouco Rodríguez, Clara Jiménez Serrano)
The aim of the project is to determine the characteristics of a battery storage system to reduce reserve requirements and improve frequency stability of the island power system of Menorca. The project will also show how the battery storage system associated to a conventional generator contributes to the fulfilments of the connection requirements of this generator. The project will finally show how the hybrid generator fits into the operational procedure and the economic regulation of the Spanish isolated systems.

• Non conventional electrification solutions
Iberdrola Distribución Eléctrica S.A.U. October 2018 - December 2018. (Carlos Mateo Domingo, Lukas Sigrist, Rafael Cossent Arín, Pablo Frías Martín, Fernando Emilio Postigo Marcos)
The objective of this project is designing and simulating non-conventional electrification solutions to improve supply in a distribution network when there are faults in the power lines. In the project, alternatives based on micro-grids are proposed to improve reliability and use renewable sources. The main components are photovoltaics, storage and diesel power units. The solutions are found with an exhaustive search, being this approach feasible for small scale networks.

• Frequency and transient stability of isolated power systems
The objective of the project is to evaluate the impact of large PV plants on the stability of the Spanish mainland power system. Frequency and transient stability will be studied.

• Tuning power system stabilizers for damping very low frequency oscillations
Redes Energéticas Nacionais, SGPS, S.A. December 2018 - December 2019. (Luis Rouco Rodríguez, Francisco Javier Renedo Anglada)
The project objective is the review of the tuning of the PSSs of the proposed set power plants. If the review of the tuning of the PSSs reveals poor performance in a wide frequency range, new settings will be proposed.

• Inception phase of the EXCOM-EXLA CLOUD project and Epic execution 1
The EXCOM model is the tool developed by the IIT in collaboration with Endesa that allows 1) to determine the strategic self unit-commitment as well as its hourly schedule, 2) determine the optimal management of water resources, and 3) obtain estimates of the daily market prices taking into account ENDESA’s full portfolio of purchases and sales, as well as estimates of the competitors behavior. The EXLA model allows the planning in the medium term and in the short term of all the hydroelectric resources belonging to Endesa.
The result of the model is the optimal management of the reservoirs over the following months until the end of the next hydrological year, as well as the optimal policy hydro production with all the generation units. This project covers the development of the first "epic" (Agile methodology) oriented to connect with the Big Data of Endesa all the data set and results of the EXCOM model, as well as to run a simplified version of the model in Amazon Web Services.

• **Black start of wind farms**  
  Iberdrola Renovables Energías, S.A. December 2018 - December 2018. (Luis Rouco Rodríguez, Lukas Sigrist)  
  This project is aimed at investigating black start of wind farms. The project will develop control schemes of wind generators to make possible the provision of the black start ancillary service.

• **Improvements of the risk management tools ACUARIO and AURIGA**  
  The objective of this collaboration is carry out improvements in the risk management tools in the electricity market (ACUARIO) and in the natural gas market (AURIGA).

• **Assistance and evolutionary maintenance of the risk management tool AURIGA**  
  The objective of this collaboration is to assist the users of the gas portfolio risk management tool AURIGA with its use, as well as perform an evolutionary maintenance of the tool.

• **Assistance and maintenance of Middle Office models**  
  This project between IIT and Endesa focuses on the assistance and maintenance of Middle Office tools VALORE (with its three users LPM, HEPLASE, and SEIE), OMEGA, ACUARIO, AURIGA and VEIMAO.

• **New developments of the VALORE tool**  
This project includes different developments, adaptations and improvements of the VALORE tool to respond to new market situations and new needs of LPM and HEPLASE users.

• **Representation of the European electricity market in the VALORE-HEPLASE model**
  This project between IIT and Endesa focuses on the medium and long-term planning of the Iberian electricity market (MIBEL). Specifically, this proposal addresses the improvement in the fundamental representation of the European electricity market in VALORE-HEPLASE.

• **New developments of the OMEGA model, consideration of gas demand in Monte Carlo executions, and daily simulations**
  This project between IIT and Endesa focuses on the operation and forecasting in the context of the Iberian natural gas market. Specifically, this proposal addresses three tasks. First, the implementation of new functionalities for the OMEGA tool. Second, the improvements so that gas demand is considered within Monte Carlo executions. Finally, the developments in the model in order to include daily detail during the first months of the simulations.

• **Consideration of demand, hydro and wind production scenarios in Monte Carlo executions of the VALORE model**
  This project between IIT and Endesa focuses on the medium-term operation and planning of the Iberian electricity market (MIBEL). Specifically, this proposal addresses the improvement in the way demand, hydro and wind uncertainty is considered within Monte Carlo executions.

• **New hourly outputs for the VALORE-SEIE model and new demand horizon**
  This project between IIT and Endesa focuses on the short- and medium-term planning of the insular and extra-peninsular electrical systems. Specifically, this proposal addresses two tasks. First, the generation of new hourly outputs within the framework of executions with different time scopes. Second, the consideration of a longer time horizon for demand forecasting.
Research projects

• Integration of Expande and Valsa models. Codex
On the one hand, the project address the update of some modeling details of the tool Expande, mainly to improve de renewable generation modelling. On the other hand, a new model development is started, integrating the characteristics of the two models that are currently used for long-term analysis of the electric system.

• Modeling and assessment of electrical networks’ needs for the energy transition in Spain
The main objective of the research is to analyze the impact on electricity networks of the connection of new renewable plants on the 2030 horizon in Spain under different possible scenarios, and to develop proposals to facilitate the decarbonisation objectives to be achieved in the most efficient possible way.

• VALSA-EXPANDE integration and unification algorithms, unique interface and preparation for migration to the cloud: initial phase
The main objective of the collaboration is the integration of the EXPANDE and MORSE systems in a single system called CODEX that integrates the best capabilities of both systems, among which stand out the time representation of the time horizon, the modeling of the competition and of the secondary reserve as well as the treatment of the uncertainty by characterizing the stochastic variables mentioned above. In addition, it includes extending the data entry interface shared so far by EXPANDE and MORSE, guaranteeing the consistency of the data used by both systems, in order to become the interface of the future CODEX integrated system. Regarding the market model, in this phase only the hydrothermal part of the electricity generation resources is developed.

• Identification of appropriate sites for mini-grids, and development of adequate regulatory approach for integration in selected states in India
Massachusetts Institute of Technology (MIT). January 2019 - June 2019. (Rafael Palacios Hielscher, José Ignacio Pérez Arriaga, Clara Pérez-Andújar Carretié, Andrés González García)
This project focuses on the identification of appropriate sites for the deployment of a large number of mini-grids in the preselected number of Indian states, including preliminary design features of these mini-grids.
The project is developed by the Universal Energy Access Lab, partnership between Comillas-IIT and MITei (Massachusetts Institute of Technology - Energy Initiative).
IIT also participates in developing the most adequate regulatory approach to integrate the presence of this large number of mini-grids into the existing
activity of the distribution companies in the corresponding territories, looking for the maximum short-term energy access while considering also a long-term efficient outcome. This required working with the incumbent distribution companies and with the relevant central and state governmental bodies to define workable deployment paths with both a short-, medium- and long-term views, to establish adequate collaboration and to identify and implement any necessary policy reforms.

• **Proof of concept of the use of VALORE in a grid and cloud computing environment**
  In this project, a practical demonstration of the use of VALORE in a cloud and grid computing environment is carried out.

• **Further developments to the hydrothermal scheduling model MHE**
  In this project we have introduced a set of developments that allow to speed up the model runs for numerous and varied hydro scenarios, and at the same time being accurate enough in representing the system operation under the current conditions. Among them they are: i) run time reduction, ii) change from week to moon month, iii) peaking of hydro production, iv) adaptation of MHE results to simulador, v) exchanges with France.

• **Connection of large PV power plants to the transmission grid**
  Iberenova Promociones, S.A. March 2019 - October 2019. (Luis Rouco Rodríguez, Lukas Sigrist)
  The objective of the project is to evaluate the connection of large PV plants to the Spanish transmission grid. Power flow and short circuito analysis are performed.

• **VALORE in a grid and cloud computing environment using Linux**
  This project focuses on launching a version of VALORE in a cloud and grid computing environment that works in Linux.

• **Modeling of the thermal plants, increase of the time horizon, treatment of scenarios, and consideration of hydro generation**
  The objective of this project is to introduce improvements in the modeling of the thermal groups in the EXCOM tool, to extend the tool’s temporal scope and
Research projects

to improve the treatment of the scenarios in order to allow their parallel execution in the cloud. In addition, a first version of the EXLA tool, focused on hydro generation, will be developed.

• Analysis of the «Ni un hogar sin energía» program dataset
  Fundación Ecología y Desarrollo (ECODES). May 2019 - October 2019. (Eva María Arenas Pinilla, José Carlos Romero Mora, José Ignacio Linares Hurtado, Roberto Barrella, Efraim Centeno Hernández)
  The project consisted in the analysis of the dataset collected by ECODES in the "Ni un hogar sin energía" program and covered basically two points. First, the characterization of the vulnerable families served by "Ni un hogar sin energía" was carried out, following the methodologies proposed at national and European level and, secondly, an energy demand prediction model (thermal and electrical) for Spanish households was developed.

• Outputs of VALORE-LPM in Big Data
  The objective of this collaboration is to carry out all the necessary developments to enable the outputs of the executions of VALORE-LPM of each one of the cases executed in the Montecarlo tool to be loaded later in the Big Data in a structured way.

• Obtaining a feasible unit commitment of thermal groups using Machine Learning techniques from the results of VALORE
  This project between IIT and Endesa focuses on obtaining a feasible unit commitment for Endesa thermal groups using the results obtained in a VALORE execution (either deterministic or Monte Carlo), using machine learning techniques.

• New developments of the risk management tool ACUARIO and the price simulation algorithm
  This project includes different developments, adaptations and improvements of the risk management tool in the electricity market (ACUARIO) to respond to new market situations and new needs of end users.

• Development of the Excom-Exla Minimum Viable Product and improvements in the modeling of hydraulics
The objective of this proposal is to develop the Minimum Viable Product so that it can be put into production in December 2019 as well as to introduce improvements in the modeling of the hydroelectric system.
3.2.1.1.2 Public funding

- **Beyond state-of-the-art technologies for re-powering ac corridors & multi-terminal hvdc systems**
  Comisión Europea. September 2014 - September 2018. (Javier García González, Michel Rivier Abbad, Quanyu Zhao)

A group of eight transmission system operators with a generator company, manufacturers and research organizations, propose 5 demonstration projects to remove several barriers which prevent large-scale penetration of renewable electricity production in the European transmission network. The full large scale demonstrations led by industry aim at proving the benefits of novel technologies coupled with innovative system integration approaches: HVDC links, HVDC-VSC multi-terminal control, innovative components and architectures, AC overhead corridors, and DC superconducting links within an AC meshed network. The experimental results will be integrated into European impact analyses to show the scalability of the solutions.

Video [here](#)
Video [here](#)
Video [here](#)
Video [here](#)
Video [here](#)

Project funded by European Union, within Seventh Framework Programme:

![EU Logo](#)

![7FP Logo](#)

- **Micrositing of wind farms and transmission network impact**

This task is divided in two:
- Micrositing, i.e., location of the wind turbines in a farm area
  The effect of the separation of the wind turbines are introduced in a wind farm layout design model, considering the power output results obtained from CFD models for many possible separation steps. The ultimate objective is to define the optimal micrositing of the wind turbines.
- Transmission network impact of wind farms.
  In a second step, an advanced optimization model capable to represent the
complexity of the transmission network is developed.

Project funded by Ministerio de Economía y Competitividad.

- Overcoming technological, economic, and regulatory barriers to the development of HVDC supergrids (ENE2015-67048-C4-2-R)
  This project aims at facilitating the development and operation of HVDC grids in a market context through several interrelated research lines:
  - Definition of benefit (and cost) allocation schemes for HVDC infrastructures
  - The design of market developments to be implemented to facilitate the integration of RES generation in the system and the grid
  - The modeling of the operation of HVDC grids in a market context (considering them accurately enough in the system dispatch and operation planning problems).

Project funded by Ministerio de Economía y Competitividad.

Project funded by Fondo Europeo de Desarrollo Regional (FEDER).
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• **Open phase detection system for start-up transformers in nuclear generating stations (RTC-2016-5160-3)**
  The aim of this project is the development of a detection system of open phase conditions in the start-up transformers of nuclear generating stations. The challenge comes from the fact that start-up transformers are at no load. The project involves simulation studies, development of small-scale laboratory prototypes and the implementation of a full scale prototype in Cofrentes nuclear generating station.

  Project cofunded by the Ministerio de Economía, Industria y Competitividad, and by EDRF funds, under the thematic objective “Strengthening research, technological development and innovation”.

• **Navigating the roadmap for clean, secure and efficient energy innovation**
  Comisión Europea. April 2016 - April 2019. (Sara Lumbreras Sancho, Andrés Ramos Galán, Luis Olmos Camacho, Quentin Ploussard)
  The overarching goal of SET-Nav is to support strategic decision making in Europe’s energy sector, enhancing innovation towards a clean, secure and efficient energy system. It prescribes a wide range of analyses in order to better understand the complex links, interactions and interdependencies between the different actors, the available technologies and the impact of the different interventions in the energy system. To meaningfully contribute to the call objectives requires a large modelling portfolio. To ensure focus on the most important aspects and policy relevance, industry partners and stakeholders with varying perspectives should be involved from start to finish.
  This leads up to the three key objectives of SET-Nav:
1) Enhance modelling capacities to increase understanding of interactions and interdependencies between actors, technologies and policy interventions in Europe’s energy system.

2) Provide model-based decision support for enhancing energy innovation towards a clean, secure and efficient energy system - through strategic policy analyses tackling relevant technology and policy options, complemented by detailed comparative assessments of energy transformation pathways.

3) Ensure a proper research orientation and a high impact through a continuous and in-depth stakeholder involvement and dialogue.

Project funded by European Union, within Horizon 2020 Programme:

- **Value of pumping-storage in insulated electrical systems with strong wind penetration**
  The main objective of the project is to estimate the value of storage by pumping (AB) in isolated electrical systems with strong wind penetration.
  For this, it is planned to use the electrical systems of four Spanish islands as case studies. In those where the installation of AB is not foreseen, the project team (EP) will define the main parameters of these facilities according to their experience.
  Various optimization models will be developed for the assignment of groups (Unit Commitment, UC) and the optimal dispatch of power (Power Dispatch, PD).

- **Strategic network and generation expansion planning under uncertainty in the electricity market**
  In an effort to mitigate climate change and to achieve a sustainable supply of energy, the Programa Estatal de Investigación, Desarrollo e Innovación Orientada a los Retos de la Sociedad - and in particular the Plan Estatal de Investigación Científica y Técnica y de Innovación 2013-2016 - seeks to promote research and development (R&D) of renewable energy (RE) technologies and to foster their adoption by the market. The challenge to obtain “safe, efficient and clean energy”, declared by the Estrategia Española de Ciencia y Tecnología y de Innovación, is also in line with the the EU’s Strategic
Energy Technology Plan (SET-Plan). Indeed, given the deregulation of energy sectors, i.e., both electricity and natural gas, in most EU member states, power companies would adopt RE technologies only if they contributed to their profit-maximising incentives. Furthermore, since RE technologies like wind and solar power are typically intermittent and uncertain in their output and geographically dispersed, their viability will depend on integration with the existing transmission network. However, grid-expansion decisions are taken by separate entities with differing and even conflicting objectives, i.e., welfare-maximising regulated transmission system operators (TSOs). Most policy-enabling models of the EU energy system overlook these intricacies and are based on assumptions of either perfect competition or perfect foresight, which do not adequately reflect the current paradigm and, thus, may lead to flawed market designs. Consequently, in order for the Spanish Plan Estatal’s objectives to be achieved, policymakers and market participants alike will require an enhanced understanding of how market fundamentals and strategic behaviour interact. Towards that end, STEXEM will develop completely new models that will be better suited for the research challenge of uncovering the impact of policy measures and market designs on investment and operational decisions in deregulated industries. Moreover, STEXEM will carry out state-of-the-art analyses based on stochastic optimisation and game theory in order to provide insights on efficient market design, the sustainable integration of RE and storage technologies, and the transmission investment necessary to maintain system security.

- Integrid - Demonstration of intelligent grid technologies for renewables integration and interactive consumer participation enabling interoperable market solutions and interconnected stakeholders

Comisión Europea. December 2016 - May 2020. (Rafael Cossent Arín, Pablo Frías Marín, José Pablo Chaves Ávila, Leandro Lind, Lorenzo August Simons, Mauricio Correa Ramírez, Michel Rivier Abbad, Pedro Linares Llamas, Paolo Mastropietro, Pablo Rodilla Rodríguez, Timo Gerres, Javier Matanza Domingo, Gregorio López López)

The InteGrid project intends to bridge the gap between citizens and technology in the area of smart distribution grids. The main objectives are:
- To demonstrate how distribution system operators (DSOs) may enable the different stakeholders to actively participate in the energy market and to develop and implement new business models, making use of new data management and consumer involvement approaches, and
- To demonstrate scalable and replicable solutions in an integrated environment that enable DSOs to plan and operate the network with a high share of distributed renewable energy sources (DRES) in a stable, secure and economic way, using flexibility inherently offered by specific technologies and interaction with different stakeholders.

In order to achieve these goals, three large demonstration sites have been selected to be part of InteGrid: 1) «From smart grid to disruptive business models» (Lisbon district, Portugal), «Consumer engagement towards sustainability» (Stockholm, Sweden), «Self-sustainability facilitation» (Ljubljana, Slovenia).
Comillas University is leading the Work Package dealing with cost-benefit analyses, regulation and business models definition. Additionally, Comillas actively contributes to the assessment of stakeholder engagement and perspectives as well as the scalability and replicability potential of tested smart grid solution.

Video [here](#)

Project funded by European Union, within Horizon 2020 Programme:

- **Solutions to improve the performance of wind generators connected to weak grids**
  This project is aimed at developing control control systems aimed at improving the performance of doubly fed induction generators connected to weak grids.

Project funded by FEDER/Ministerio de Ciencia, Innovación y Universidades – Agencia Estatal de Investigación/ Proyecto Proyecto RTC-2017-6074-3

"To promote technological development, innovation and quality research"
• Mozambique geospatial options analysis towards universal electrification

Since the end of Mozambique's civil war in 1992, the country has had strong and sustainable economic growth, averaging 7.4 percent annually. However, GDP per capita is low (US$600 in 2016), and approximately, 50 percent of the population still live below the poverty line. Moreover, most of the population lives in rural areas, and only 26 percent of people were connected to the electricity grid in 2016.

The objective is to prepare a geospatial analysis and present the options for electrification – encompassing grid and off-grid access delivery modalities and technology choices - with an overall target of universal access by 2030 in Mozambique. The analysis provides detailed estimation of investment and operating cost requirements for the various options.

• EU Energy system: modelling, data collection and studies

The objective of this project is upgrading the operation model of the European electricity system METIS to include the electricity transmission and distribution grids. Then, this model will be applied to analyse several case studies related to the future evolution and operation of the system and draw conclusions on these analyses.

• Control and protection systems for island operation of distribution feeders

This project is aimed at developing control and protection systems for island operation of distribution feeders to improve the quality and continuity of electricity supply taking advantage of distributed energy resources.

Project funded by FEDER/Ministerio de Ciencia, Innovación y Universidades – Agencia Estatal de Investigación/ Proyecto Proyecto RTC-2017-6296-3

"To promote technological development, innovation and quality research"
• **Climate friendly materials platform: supporting transition in Central and Southern Europe**

The project initiates a networks of policy makers, industry, practitioners, industrial and applied researchers to facilitate mutual understanding of successfully transforming and the decarbonisation of basic materials sector into a climate friendly materials sector.

Through the network, facilitated by the project’s provision of suitable “knowledge material” and embedded in the national and EU level policy discourses, the project starts to elaborate a portfolio of key incentives (and corresponding instruments) for the large-scale use of climate friendly options for selected materials sectors. The project contributes first to inform appropriate structures and the effective coordination of innovation funding for the transformation of the basic material sector.

• **Large scale campaigns to demonstrate how TSO-DSO shall act in a coordinated manner to procure grid services in the most reliable and efficient way**
  Comisión Europea. January 2019 - June 2022. (José Pablo Chaves Ávila, Rafael Cossent Arín, Tomás Gómez San Román, Leandro Lind, Timo Gerres, Luis Olmos Camacho, Miguel Ángel Sánchez Fornié, Álvaro Sánchez Miralles, Nicolás Mariano Morell Dameto, Javier Matanza Domingo, Gregorio López López)

The CoordiNet project aims at demonstrating how DSOs and TSOs shall act in a coordinated manner to procure and activate grid services in the most reliable and efficient way through the implementation of three “TSO-DSO-Consumer” demonstrations at large scale, in cooperation with market participants (and consumers). The consortium defines and adapts, demonstrates and promotes future standardized products for grid services and related market platforms to contribute to the seamless pan-European electricity market.

The project covers not only typical market situations but also advanced and futuristic scenarios, such as P2P markets, to paint the most flexible and advanced vision of how a cooperative service platform may look in the future European energy system.

In a nutshell the innovation introduced by CoordiNet can be captured in the following points:
- Creation of the appropriate conditions of cooperation among all the actors including the customers removing barriers;
- Complete analysis and definition of flexibility in the grid at every voltage level
encompassing TSO and DSO domain and including consumer participation;
- Definition of new mechanisms more suitable for real time operations;
- Implementation of large-scale field-tests able to comprehend all the voltage
  level and to trigger the participation of all the actors including the small
  players;
- Definition of the requirements for a standard unified European platform to be
  exploited beyond the limit of the project.
Three large-scale demonstration projects are foreseen, implemented by both
DSOs and TSOs for the networks covered within the respective demonstration
areas in Spain, Sweden and Greece.
Each demonstration assesses the application of selected coordination schemes
and prototype market platforms and test a complete set of products for grid
services. Demonstration areas are selected based on existing and future needs
for additional / adapted grid services for the network operator and the
availability of flexibility from energy consumers, storage and or small-scale
(RES) generation connected to the network. The demonstration regions provide
versatility in terms of geographical location, market maturity and their load /
generation profile. Finally, the results of these demonstrators are extrapolated to
other European countries to pave the way towards a pan-European platform.

• Transport and policies for the transition to a low-carbon economy in Spain

Ministerio de Ciencia, Innovación y Universidades. January 2019 - December
2021. (Pedro Linares Llamas)
The transport sector has become one of the fundamental sectors in fighting
against climate change. The great importance of emissions in this sector
(responsible for 14% of global greenhouse gas emissions as well as significant
emissions of local pollutants) makes it paramount to accelerate the energy
transition process. This requires transforming existing mobility policies, among
other things, by facilitating the transition from combustion to electric vehicles.
This transformation process must begin both at a local level with new strategies
for environmental sustainability and urban mobility as well as at the state and
regional level to penalize the use of polluting vehicles, subsidize the
acquisition of clean vehicles and implement tax reforms incorporating
environmental criteria. These new policies must be approached from different
perspectives. Reforms are required to keep pace with the long and short-term
transition in the private vehicle market. It is equally important to establish
compensatory mechanisms to avoid the distribution of a disproportionately
large share of the costs of these policies to certain population groups.
Within this context, this project aims to study the policies required to deal with
this transition in Spain in the short-term, both by reforming fuel and vehicle
registration taxes as well as promoting energy efficient vehicles. This project is
therefore structured in three lines of work that are interrelated but also relatively
independent. The first of them, based on the analysis of the current situation of
private residential transport in Spain, will analyze the environmental, tax and
distributive impacts on Spanish households of the tax reform on fuel and
vehicle registration; it will study the impact of modifying tax rates and consider
different recycling alternatives of additional income/revenue that could/might
compensate the possible regressive effects of the reforms. The second line of
work aims to develop a homogeneous database on mobility in Spain that could expand the current energy-environmental models to include the transport sector at a level of detail that would allow us to identify the most efficient policies in the area within the context of a broad energy transition. Last but not least, the third line of work will analyze the capacity of various public policies to promote energy-efficient cars in the Spanish market. The results of the above-mentioned lines of work may contribute to an informed design and evaluation of foreseeable reforms in public transport policies in Spain, to be undertaken in the coming years, in line with the objectives and proposals put forward by the EU.

• **IELECTRIX - Indian and European Local Energy CommuniTies for Renewable Integration and the Energy Transition**
  Comisión Europea. March 2019 - August 2022. (Rafael Cossent Arín, Pablo Frías Marín, Carlos Mateo Domingo, Fernando Emilio Postigo Marcos, Nicolás Mariano Morell Dameto)

An increasing role is foreseen in Europe for local energy communities (LECs) to speed up the grid integration of RES. Today, the enabling role of DSOs in support of LECs is hampered by a lack of flexibility when planning cost-efficient LEC connections to their network at MV level, and by a lack of digitalization of the LV networks to make LEC’s smart prosumers benefit economically when serving the DSO flexibility needs. Four European DSOs (E.ON, ENEDIS, E.DIS, Güssing Stadtwerke) and an Indian DSO (TATA) have joined with IT-based, innovative product and solution providers, and technology and research centers, to demonstrate the combined roles of innovative functionalities serving the MV and LV networks, when implemented in 5 different regulatory regimes (Austria, France, Hungary, Germany, India- state of Delhi-).

The joint work of DSOS aims at accelerating scaling up and replication tested by HEDNO (Greece) and E.ON (Sweden). Dissemination towards players of the energy value chain recommends business models, possible regulatory adjustments and deployment roadmaps of the most promising use cases, in support of the implementation of the Clean Energy Package.

• **Open energy transition analyses for a low-carbon economy**

The primary objective of Open ENTRANCE is to contribute to an improved and robust understanding of the transition to a low carbon energy system in Europe by developing, demonstrating and using an Open platform. The platform will be populated with a suite of open 1) integrated modelling tools and a common database including all necessary data for conducting among other scenario building exercises and macro-economic analyses of pathways to a low-carbon energy system at regional, national and pan-European level.

• **Disruption in the electricity sectors of the MENA region**
Research projects

The MENA (Middle East and North Africa) region is facing a convergence of disruptive energy technology change and long overdue structural reform needs. This project aims to produce an Approach Paper that provides direction for MENA as a region on how disruptive technologies would impact Consumers, SOEs and the electricity sector in general. Supported by the "MENA Tech" initiative in the World Bank, this project is part of the "MENA Energy Program on Disruptive Transformation".

3.2.1.2 Consultancy and technological support

3.2.1.2.1 Private funding

- Energy access: scoping the energy company of the future
  Shell Foundation. July 2017 - October 2018. (Fernando de Cuadra García, Pedro Ciller Cutillas, Andrés González García)
  The objective of the Comillas team is to contribute to frame some of the aspects that will need to be addressed, specifically focused on the in-depth analysis of the relevant literature and the utilization of analytical tools, and where needed the development of new models to understand how the electric power sector in least developed countries will face the challenge of Universal Access to Electricity in the coming decade.

- Individual control of hydro units within the Endesa AGC control
  Endesa Medios y Sistemas S.L. October 2017 - October 2018. (Ignacio Egido Cortés, Luis Rouco Rodríguez, Kai Doenges, Lukas Sigrist)
  Endesa has a primary EMS in Madrid and secondary EMSs in Montearenas, Lérida and Sevilla. The AGC control in the primary EMS sends control signal to each individual thermal units a to the secondary EMSs. Each secondary EMS then distributes the received signal among the individual hydro units. This research project analyses the possibility of sending control signal from the primary EMS to each individual hydro unit and studies the due changes to allow this control.

- Technical assistance for the integration an commissioning of the AGC-IIT in the Scada of Alpiq
  Alpiq Energía España S A U. December 2017 - September 2018. (Ignacio Egido Cortés, Luis Rouco Rodríguez)
  Alpiq already has a licence of the AGC-IIT software integrated in the SCADA from Nucleo. Alpiq has changed its Scada provided, so AGC-IIT needs to be commissioned in the new SCADA. In this project the services of integration and commissioning of AGC-IIT in the new SCADA are provided.
• **The future of the Spanish electricity sector**
  Iberdrola S.A. April 2018 - September 2018. (Tomás Gómez San Román, Pedro Linares Llamas, Pablo Rodilla Rodríguez, Michel Rivier Abbad, Pablo Frías Marín, Álvaro Sánchez Miralles, Rafael Cossent Arín, Luis Olmos Camacho, Andrés Ramos Galán, Luis Rouco Rodríguez, José Pablo Chaves Ávila, Timo Gerres, Francisco Martín Martínez)
  Report that summarizes the main challenges and policies for guiding the transition to a more decarbonized electricity system in general, and in particular including the peculiarities of the Spanish system.

• **Analysis of the Spanish nuclear power plants’ lifespan extension, from the plant owners perspective**
  Iberdrola S.A. May 2018 - December 2018. (Michel Rivier Abbad, Tomás Gómez San Román, José Pablo Chaves Ávila, Francisco Martín Martínez, Timo Gerres)
  The objective of the project is to analyze the profitability of the extending the lifespan of the Spanish nuclear power plants, from the perspective of the owners of such plants. First, for a set of future scenarios, expected market revenues for those plants are computed for the lifespan extension period, in a high renewable generation penetration environment due first to the expected reduction of their investment costs, and second to the renewable production quotas set by the European Commission. It follows an evaluation of the costs to be faced by those power plants during the lifespan extension period, including the costs they must face to be able to extend the lifespan of those plants. Finally, based on the revenues and costs estimations, the profitability, for the owners of such plants, of extending their lifespan is assessed.

• **Study of the electrical interconnection between Bolivia and Peru**
  Technical and economical assessment of an HVDC cross-border line between Bolivia and Peru.

• **Market report of two wind farms in the Spanish electricity system**
  This project consists of the collaboration of IIT in a market report focused on two wind farms in Spain. In particular, a forecast of future revenues during twenty years is carried out, as well as a number of alternative scenarios.

• **Study on the European grid code compliance of generating unit projects**
  Endesa Generación S.A. September 2018 - November 2018. (Luis Rouco Rodríguez, Lukas Sigrist)
  This work is aimed at studying the European grid code compliance of generating unit projects. Two candidate suppliers of diesel engines for Los Guinchos power plant (La Palma) and three candidate suppliers of gas turbines for Candelaria power plant (Tenerife) are evaluated.
**Research projects**

- **Technical support for the EXCOM tool**  
  The objective of the EXCOM model, developed by the IIT in collaboration with Endesa, is to help the planning of the operation of the entire Endesa generation portfolio. The objective of this project is to provide technical advice on the use of the tool to Endesa personnel as well as perform maintenance tasks.

- **Technical support for the EXLA tool**  
  The model EXLA, developed by the Institute for Research in Technology (IIT) in collaboration with Endesa, aims at helping the planning of the hydroulectric generation resources of Endesa. The objective of this project is to provide technical advice on the use of the tool to Endesa personnel as well as perform maintenance tasks.

- **Advising of German electricity balancing market**  
  AlphaSights Ltd. September 2018 - October 2018. (José Pablo Chaves Ávila)  
  This project advises a Japanese electricity company about the balancing market in Germany, including the procurement of balancing services and the imbalance settlement.

- **Development of scenarios of Spanish island power systems**  
  Endesa Generación S.A. October 2018 - December 2018. (Lukas Sigrist, Luis Rouco Rodríguez, Clara Jiménez Serrano)  
  The aim of the project is to determine the influence of a battery storage system on the frequency stability of Melilla and in particular, of the avoided amount of shed load.

- **Grimel tool update**  
  Viesgo Generación S.L. October 2018 - November 2018. (Enrique Lobato Miguélez)  
  Update of Grimel tool for generation groups BRR1 and PNN3

- **New outputs for VALORE Montecarlo**  
  This project focuses on the creation of new outputs for the execution of the LPM using the VALORE Montecarlo tool.

- **Support in the development of an electricity market model and in market studies in the Iberian Market**  
  Invesyde S.L. November 2018 - June 2019. (Javier Reneses Guillén)  
  This project consists of the collaboration of IIT in a market report focused on a series of renewable assets in Spain. In particular, a forecast of future electricity
prices and revenues for 10 wind farms is carried out. The objective of this collaboration is twofold. On the one hand, it focuses on advising on the development of an electricity market model that represents the Iberian market (MIBEL) in the long term. On the other, the IIT supports Inveside in market studies carried out with the model.

- **Power evacuation study of solar thermal power plants in the Spanish transport network**
  Invesyde S.L. November 2018 - December 2018. (Pablo Frías Marín)
  The objective of the collaboration is to carry out a study to calculate the hosting capacity at the Villanueva del Rey substation, in the 220kV Spanish transmission network. Different scenarios of generation, demand and configuration of the transmission network will be studied.

- **Assessment of Spanish secondary regulation market**
  The project will explore if the amount of band cleared in the secondary regulation market influences a set of fundamental variables related to the economic performance of that market. In the case of finding significant correlations, quantitative functions of these relationships will be sought to allow these parameters to be included in the process of building the offer to submit to the secondary regulation market. On the other hand, this influence will be checked by simulating real-time operation of the Spanish AGC. The AGC power assignment to the most efficient regulatory units from a technical-economic point of view will be explored.

- **Least-cost electrification plan of Maluku-Papua region of Indonesia**
  The Government of Indonesia has the objective of providing near full electrification access by 2020. Despite the progress made so far, this objective will be particularly difficult to meet in the easternmost regions of the country, which presently have the lowest electrification rates.
  An electrification plan is needed to estimate the investment required to achieve the established objectives and to guide and coordinate the activities of the state electricity company PLN as well as of other stakeholders.
  A former electrification plan for the four provinces of Papua, Papua Barat, Maluku and Maluku Utara (in what follows Papua and Maluku) was developed for the Government of Indonesia and the Asian Development Bank (ADB) in December 2017 by Castlerock Consulting.
  The objective of this new plan is to assess, complement and develop in more detail the aforementioned plan using the Reference Electrification Model (REM) developed jointly by the Universal Energy Access Lab of IIT-Comillas and MIT. We will test diverse hypothetical scenarios to reflect the uncertainty of main input variables to the plan and the degrees of freedom of the planner: demand growth, priorities in the deployment of electrification, existence and treatment
of embedded generation, and reliability of the main grid. The proposed study will also focus on Maluku and Papua. If successful, the software and methodology could be applied to more regions in Indonesia, in particular to remote non-electrified islands. This project is developed jointly with the Massachusetts Institute of Technology (MIT).

• Maintenance of HAPER tool
Iberdrola Renovables Energías, S.A.U. December 2018 - December 2018. (Lukas Sigrist)
The aim of the project is to extend the functionalities of the HAPER tool during 2018. HAPER is a tool for losses analysis in wind farms connected to a common infrastructure.

• Market report of hydro assets in the Spanish electricity system
This project consists of the collaboration of IIT in a market report focused on hydro assets in Spain. In particular, a forecast of future revenues during twenty-five years is carried out, as well as a number of alternative scenarios.

• Study of the electrical interconnection between Bolivia and Brasil
Technical and economical assessment of the electrical interconnection between Bolivia and Brasil.

3.2.1.2.2 Public funding
• Grid integration technical study to assess the expansion of assessment of impacts of high shares of variable renewable energy in the operation of the power system of the Dominican Republic
The Dominican Republic has set a national target to reduce its greenhouse emissions by 25% (compared to 2010 levels) by 2030. To achieve this goal, the Dominican Republic is planning the integration of large amounts of variable renewable energy technologies (VRE's) into its power system, mainly wind and solar PV energy.
The objective of this grid integration study is the assessment of the impact and constraints of the integration of large amounts of VRE's into the Dominican Republic’s power system on technical operation (contingency analysis, transient stability and frequency stability). Consistent recommendations will be provided to guarantee the security of the system, based on the findings and conclusions of the study.
Findings of the study will aim to support the development and implementation of policies, regulation and operation practices to allow the operability of a future power system in the Dominican Republic with high shares of renewable energy.

- **Analysis of energy and economic plans and policies**
  Isdefe, S.A. November 2018 - January 2019. (Pedro Linares Llamas, José Pablo Chaves Ávila, José Carlos Romero Mora, Timo Gerres)
  Support to Isdefe, in collaboration with BC3, towards the elaboration of the national integrated energy and climate plan.

- **Assessment and proposal for modification of the electricity regional transmission charges in Central America**
  Consejo Director del Mercado Eléctrico Regional de América Central (CDMER), Consejo de Electrificación de América Central (CEAC). January 2019 - July 2019. (Luis Olmos Camacho, Michel Rivier Abbad)
  The electricity regional transmission charges applied in the Central American regional electricity market must be assessed. Based on this assessment, and a review of the best international practices, changes to the design and implementation of these charges must be proposed.

### 3.2.1.3 Services and analysis projects

#### 3.2.1.3.1 Private funding

- **Report about the impact of the new hydrological plans on the remuneration of a hydropower power plant IBR**
  Writing of a brief report that assesses and explains the impact of new hydrological plans on the remuneration of a hydropower power plant.

- **Technical support for the tool SIROCO**
  Enel Iberoamérica S.R.L. January 2018 - December 2018. (Francisco Alberto Campos Fernández, José Portela González)
  The objective of this project is to provide ENDESA with technical support and maintenance of the tool SIROCO developed by IIT.

- **Disruptive technologies in the electricity sector**
  Banco Interamericano Desarrollo (BID). August 2018 - November 2018. (José Pablo Chaves Ávila)
  This project consists in describing the disruptive technologies in the electricity sector considering the following aspects:
  1) A quick introduction showing the key disruptive technologies.
  2) The reason why these technologies are disruptive or how they could dramatically change the industry.
3) The advances pointing out the future for these technologies and what are the technical barriers that need to be surpassed to be actual implemented.

- **Regulatory analysis on electricity tariff reform in power systems with distributed energy resources**
  The project studies, from a theoretical point of view and through a review of international experiences, which aspects of electricity tariff design have to be reformed when distributed energy resources enter the power system.

- **Impact studies of wind farms in Soria and Zaragoza**
  Capital Energy S.A. October 2018 - December 2018. (Lukas Sigrist)

- **Power flow analysis of the Manzanares corridor**
  Aries Solar Termoeléctrica S.L. November 2018 - December 2018. (Francisco Miguel Echavarren Cerezo, Luis Rouco Rodríguez)
  Power flow analysis of the Manzanares corridor using an actual scenario of the Spanish electric power system. Next hypothesis will be considered:
  * Arenas de San Juan 220: 319 MW
  * Las Carroyuelas 220: 304 MW
  * Manzanares 220: 435 MW
  * La Paloma 220: 309 MW
  * Madridejos 220: 123 MW
  This study will check the fulfillment of the P.O. 1.1 in base case and under N-1.

- **Ampacity studies for the Hashfela corridor of the Israel railway electrification project**
  Sociedad Española de Montajes Industriales (SEMI). November 2018 - December 2018. (Francisco Miguel Echavarren Cerezo, Luis Rouco Rodríguez)
  Continuation of the SEMIcables project.
  The study will consist of determining the temperature of the cables according with some current profile among the installation. It temperatures would be unacceptable, SEMI will propose an alternative configuration.
  Computation of core conductor temperatures will be carried out using a modified version of a three-phase model for ampacity computation, adapted to deal with one-phase railway feeders.

- **Assistance and maintenance of tools for back office and reserve areas.**
  Assistance and maintenance of tools developed by IIT for Endesa for back office and reserve areas.
• **Technical support for the tools EXCOM, EXLA AND SIROCO**  
  The objective of this project is to provide ENDESA with technical support and maintenance of the tools DECA, EXLA, HADES and MODEM developed by IIT.

• **Evolutive maintenance for the long-term market analysis Expande tool**  
  Evolutive maintenance for the long-term market analysis Expande tool.

• **Technical support for the tool SIROCO**  
  The objective of this project is to provide ENDESA with developing maintenance of the tool SIROCO developed by IIT.

• **Technical support for the tool VALSA**  
  The objective of this project is to provide ENEL with technical developing maintenance of the tool VALSA developed by IIT.

### 3.2.1.3.2 Public funding

• **Designing binding day ahead and intraday markets in the Colombian electricity system**  
  Comisión de Regulación de Energía y Gas (CREG). June 2018 - November 2018. (Pablo Rodilla Rodríguez, Paolo Mastropietro, Luiz Augusto Nobrega Barroso, Paulo Brito Pereira)  
  The study contains four sections:  
  1. Study the CREG proposal CREG 004B of 2016, as well as the proposal by the market operator XM S.A.S.P., and other studies conducted in this area by the sector. Review of the international experience that has been carried out in these studies on the design of the spot energy market.  
  2. Complete revision of Resolutions CREG 024 and 025 of 1995, as well as all those that modify them. Likewise, the agreements of the CNO that have some relation to the subject under study must be reviewed.  
  3. Development of a normative proposal aimed at the implementation of a binding dispatch, intraday markets, and balance mechanisms.  
  4. Development of a regulatory proposal regarding the commercial treatment of constraints and their settlement in the presence of a binding dispatch, intraday markets and balancing mechanisms.
- **Modernization of electricity tariff structure for Costa Rica**
  Instituto Costarricense de Electricidad. January 2019 - April 2019. (José Pablo Chaves Ávila)
  The objective of this project is to support Grupo Mercados Energéticos Consultores to identify the criteria and long-term methodologies for the definition of electricity tariffs for Costa Rica. In order to reach this objective, different aspects are analyzed:
  - structure of the Costa Rican electricity system
  - consumption patterns for the different kind of consumers,
  - separation for the different activities and division of costs,
  - technological challenges that the sector is experiencing such as the distributed generation, in self-generation mode as well as owned by distribution companies,
  - definition of tariff groups and exemptions of consumers groups
  - tariffs components and new possibilities that smart meters provide, among other aspects

3.2.2 Industrial systems

3.2.2.1 Research and development projects

3.2.2.1.1 Private funding

- **Monitor X**
  Energi Norge. October 2015 - September 2019. (Miguel Ángel Sanz Bobi)
  The aim of the MonitorX-project is to develop a model and corresponding software prototypes for optimal lifetime utilization of hydropower components based on monitoring of technical condition and risk. The model integrate advanced systems for condition monitoring and fault diagnosis based on machine learning and artificial intelligence. This project is supported by the Research Council of Norway and there are an important number of partners cooperating.
  IIT assist the project in developing advanced condition monitoring algorithms and integration of these algorithms with models for maintenance planning and optimization. IIT contribute with scientific advisory and consultancy in model developing. Furthermore, IIT is a partner for student exchange,

- **Modeling and forecasting of the demand for natural gas and electricity in Spain and Portugal**
  Enel Iberoamerica S.R.L. October 2017 - December 2018. (Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque, Guillermo Mestre Marcos)
  The objective of this project is modeling and forecasting of the demand for natural gas and electricity in Spain and Portugal.

- **VALSA-EXPANDE integration and developments for the long-term analysis**
  Enel Iberoamerica S.R.L. January 2018 - December 2018. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)
VALSA is an expansion model for generation investment and complementary service analyses of the Spanish electricity system in the long-term. The objectives of this collaboration include the follow-up of the strategic reflection that begun in the previous collaboration, to know what elements are currently determining the system behaviour and what is the best way to address them. Another objectives are to guarantee the adaptation of VALSA to the system changes expected in the next few years (as for example the changes in the generation or consumption structure) and also the continued assistance in the use of VALSA.

- **Applying data analysis and forecasting techniques to monitor and analysis of the strategic bidding behaviour in the Iberian electricity market**
  Enel Iberoamerica S.R.L. January 2018 - December 2018. (Eugenio Francisco Sánchez Úbeda, Santiago Moreno Carbonell)
  The primary aim of this project is the improvement of the information system and the methodology implemented for the analysis of the Iberian market operation and the characterization of participants bidding strategies. Taking as input the information published by the market and system operators, the proposed methodology establish the most appropriate mechanisms of data mining for its treatment, with the purpose of analyzing the bidding behaviour of firms and their pricing of the different generation technologies.

- **Predictive diagnosis and preventive (on condition) maintenance of power train subsystems and components: ATS Subsystem and AdBlue Filter**
  This project develops a predictive diagnostic algorithm and the corresponding software in Matlab for the After Treatment System (ATS) of the gases in a vehicle. Also the project developes a predictive diagnostic algorithm and the corresponding software in Matlab for the AdBlue filter component of a vehicle engine to be integrated in the Client off-board infrastructure that allows its condition-based maintenance.

- **Development of the data analytics tool HADES**
  Endesa Medios y Sistemas S.L. March 2018 - December 2018. (Antonio Muñoz San Roque, José Portela González)
  The main objectives of this collaboration are the development of advanced forecasting models, the automation of the training and evaluation of the predictive models ans the integration of IAM EX and IAM in HADES.

- **Modeling and forecasting of the demand for natural gas and electricity in Spain and Portugal**
  Enel Iberoamerica S.R.L. June 2018 - December 2018. (Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque, Guillermo Mestre Marcos)
The objective of this project is modeling and forecasting of the demand for natural gas and electricity in Spain and Portugal. A probabilistic approach is used to fulfill this objective.

• **Radio frequency system to detect micro wires**
  Inprotec Robótica Industrial, S.L. November 2018 - April 2019. (Álvaro Sánchez Miralles, Javier Matanza Domingo, Francisco Javier Herraiz Martínez, Carlos Rodríguez-Morcillo García, Jaime Boal Martín-Larrauri, Miguel Martín Lopo)
  The aim of the project is to develop a functional system which able to detect micro wires. This is a disruptive concept that is going to be a breakthrough in the security of shops. This system is based on putting a micro wire, undetectable by sight, in the products of a shop, which are going to replace the traditional security tags.

• **Tool of optimal design and simulation of high speed trains**
  In this project a new software tool is developed to design the driving of high speed trains based on detailed simulation of train dynamics and energy consumption. The tool includes eco-driving optimisation algorithms that minimise the energy consumption for a target running time. Simulated drivings will be compared with real measurements registered at Talgo trains in order to validate the tool.

• **VALSA-EXPANE integration and unification algorithms, unique interface and preparation for migration to the cloud: initial phase**
  The main objective of the collaboration is the integration of the EXPANE and MORSE systems in a single system called CODEX that integrates the best capabilities of both systems, among which stand out the time representation of the time horizon, the modeling of the competition and of the secondary reserve as well as the treatment of the uncertainty by characterizing the stochastic variables mentioned above. In addition, it includes extending the data entry interface shared so far by EXPANE and MORSE, guaranteeing the consistency of the data used by both systems, in order to become the interface of the future CODEX integrated system. Regarding the market model, in this phase only the hydrothermal part of the electricity generation resources is developed.

• **Scenario generation for medium-term forecasting using automatic learning techniques**
  Enel Iberoamerica S.R.L. January 2019 - December 2019. (Eugenio Francisco Sánchez Úbeda)
  The aim of this project is the development of probabilistic scenario generators for the medium-term operation and planning tools of the Iberian electricity market (MIBEL).
• **Modeling and forecasting of the demand for natural gas and electricity in Spain and Portugal**
  The objective of this project is modeling and forecasting of the demand for natural gas and electricity in Spain, Portugal and France. A probabilistic approach is used to fulfill this objective.

• **Identification of appropriate sites for mini-grids, and development of adequate regulatory approach for integration in selected states in India**
  Massachusetts Institute of Technology (MIT). January 2019 - June 2019. (Rafael Palacios Hielscher, José Ignacio Pérez Arriaga, Clara Pérez-Andújar Carretié, Andrés González García)
  This project focuses on the identification of appropriate sites for the deployment of a large number of mini-grids in the preselected number of Indian states, including preliminary design features of these mini-grids.
  The project is developed by the Universal Energy Access Lab, partnership between Comillas-IIT and MITei (Massachusetts Institute of Technology - Energy Initiative).
  IIT also participates in developing the most adequate regulatory approach to integrate the presence of this large number of mini-grids into the existing activity of the distribution companies in the corresponding territories, looking for the maximum short-term energy access while considering also a long-term efficient outcome. This required working with the incumbent distribution companies and with the relevant central and state governmental bodies to define workable deployment paths with both a short-, medium- and long-term views, to establish adequate collaboration and to identify and implement any necessary policy reforms.

• **Modeling a distributed processing network using distributed ledger technology (DLT)**
  DAINWARE S.L. January 2019 - May 2020. (David Contreras Bárcena, David Alfaya Sánchez, José Luis Gahete Díaz, Israel Alonso Martínez, Alejandro García San Luis)
  This project aims to model a distributed processing network based on DLT for the transaction log. In addition to the definition of the model, the technologies used in current DLT and Blockchain systems should be evaluated from the point of robustness, proof of work, consensus, etc. The final model defined must be validated mathematically.

• **Eco-driving design for the British railway lines H2S and CRN London-Birmingham-Glasgow**
  In this project eco-driving will be designed for two British railway lines, minimising the energy consumption for a target running time: the high speed line HS2 from London Euston to Birmingham Curzon Street, and CRN line from
Handsacre Junction to Glasgow. Eco-driving in HS2 will consider the new ATO over ERTMS system.

- **Predictive diagnosis and preventive (on condition) maintenance of power train subsystems and components: ATS Subsystem and AdBlue Filter-Extension of a previous project**
  This project is an extension of a previous cooperation focussed on the research around the development of a predictive diagnostic algorithm and the corresponding software in Matlab for the After Treatment System (ATS) of the gases in a vehicle. Also the project develops a predictive diagnostic algorithm and the corresponding software in Matlab for the AdBlue filter component of a vehicle engine to be integrated in the Client off-board infrastructure that allows its condition-based maintenance.

- **Development of an tool to optimize the filling of containers and trucks**
  This project is aimed at improving productivity in Pladur operations. Specifically, we develop an tool to optimize the filling of containers and trucks that will allow the reduction of time and costs, the exploration of diverse and more ambitious solutions, and materialize the knowledge of the company in a stable tool, beyond of dependence on expert employees.

- **Optimal design of ATO driving parameters for Metro de Barcelona to Line 1**
  The objective of this project is the design and implementation of ATO speed commands in Line 3 of Metro de Barcelona to minimise the energy consumption. These ATO speed commands are selected and sent to the train by the traffic regulation system in real-time. For each inter-station a set of 4 speed commands are designed, the flat out command and 3 commands parameterized basically by a coast point and a regulation speed.

### 3.2.2.1.2 Public funding

- **Research programme on smart grids in Madrid**
  Comunidad de Madrid. October 2014 - December 2018. (Aurelio García Cerrada, Juan Luis Zamora Macho)
  This project will look into the application of smart grid technologies in Madrid. The analysis will be spelled out as follows.
  (1) Devices and infrastructure: Application of power electronics devices to improve the present infrastructure.
(3) Management level: Application of computational intelligence (CI) to the prediction of the generation from renewable sources. Implementation of CI techniques in big data platforms to model the energy consumption from data collected by smart meters and sensors deployed in the system. Investigation on variable-pricing scenarios.

(4) Decision level: Medium-term improvement of safety and service. Optimization of electricity consumption based on better activity schedules.

(5) Finally, a transversal study on the communications network for information exchange between agents and devices will be carried out, with focus on low and medium voltage networks and their problems concerning latency and bandwidth.

Project funded by Comunidad de Madrid, into Programa de Actividades de I+D entre Grupos de Investigación en Tecnologías 2013.

Project funded by European Union, into European Social Fund.

**Metrology for smart energy management in electric railway systems**

The project aims to develop the metrological infrastructure for accurate measurement of energy exchange and for reliable system monitoring, which underpins the implementation of an energy efficient management of the European DC and AC railway and DC subway system. The project also focuses on the characterisation of the railway subsystem as a producer-consumer, with a view to its integration in a wide smart grid as well as on the assessment of eco-driving performances.
• **Scientific and technical innovations for safer Powered Two Wheelers (PTW)**  
  European Cooperation in Science and Technology (COST). June 2018 - February 2019. (Francisco José López Valdés)  
  Enhancing traffic safety is an ongoing quest. Traffic accidents cause human suffering and huge economic losses. In the period 2000-2012, the riders killed per 10,000 Powered Two Wheelers (PTW) registered has more than halved, passing from 2.68 to 1.32. Nevertheless, PTW riders are still among the most vulnerable road users and other efforts are necessary toward a vision zero (accident) concept. On the other hand, the use of PTW is currently increasing worldwide, especially in urban environments, since PTW offer many benefits for personal mobility: less congestion, time gain, energy savings, easier parking. These beneficial opportunities can only be capitalised if PTW safety is further prioritised. As prior initiatives to improve PTW safety have concentrated on single aspects, a truly holistic and integrated approach towards PTW safety is still lacking. This COST Action addresses this gap, by bringing together PTW safety experts to i) acquire, unify and coordinate PTW safety research, and ii) ensure broad dissemination towards PTW users, industry and public authorities.

• **Software tools for the design of high capacity railway lines [TOOLTRAIN]**  
  The objective of the TOOLTRAIN project is the research and development of new software tools for the design of high capacity railway lines, equipped with the latest signalling systems: CBTC and ERTMS level 2. This way, the transport capacity is increased and trains can be operated safely with a shorter interval between consecutive trains providing flexibility to railway traffic control. Therefore, safety, reliability, punctuality and frequency can be improved.

Project funded by FEDER/Ministerio de Ciencia, Innovación y Universidades – Agencia Estatal de Investigación/ _Proyecto _Proyecto RTC-2017-6506-4

"To promote technological development, innovation and quality research"
• **Implementation of EN 50463-4 Ed 2017 in the Spanish railway system**
  EN 50463-4 defines the communications protocol between energy meters on trains (EMS) and ground. This project deals with their use and the improvements to be made for their application in the Spanish railway system.

• **Multi-objective optimization of railway operation. Collaboration with Beijing Jiaotong University-China**
  This project is a collaboration between Comillas University and the State Key Lab of Rail Traffic Control and Safety (Beijing Jiaotong University-China). It aims to tackle the optimal operation of trains in a railway system. Optimal operation can be achieved by means of a two level optimization problem. These levels optimize not only the train speed profiles but also the timetable. The tasks of this project produce methods to assist the designing process of efficient operation in a railway line applying multi-objective optimization techniques and Pareto analysis.

### 3.2.2.2 Consultancy and technological support

#### 3.2.2.2.1 Private funding

• **4D certification of a project development to automatize the ink making process**
  OCA Instituto de Certificación, S.L.U. October 2018 - January 2019. (Pedro Sánchez Martín)
  Perform of a 4D certification control to determine the characteristics of the expert to evaluate a project development to automatize the ink making process and afterwards the quality of the performed evaluation by the expert based on the certification company requirements.

• **Adapt output files form GEDEX forecasting module to Big Data**
  Enel Iberoamérica S.R.L. April 2019 - April 2019. (José Portela González)
  The goal is to adapt the output files from GEDEX forecasting module to Endesa's Big Data implementation
3.2.2.3 Services and analysis projects

3.2.2.3.1 Private funding

- **Technical support for the tool SIROCO**  
  Enel Iberoamérica S.R.L. January 2018 - December 2018. (Francisco Alberto Campos Fernández, José Portela González)  
  The objective of this project is to provide ENDESA with technical support and maintenance of the tool SIROCO developed by IIT.

- **Technical support for the tools EXCOM, EXLA AND SIROCO**  
  The objective of this project is to provide ENDESA with technical support and maintenance of the tools DECA, EXLA, HADES and MODEM developed by IIT.

- **Technical support for the tool SIROCO**  
  The objective of this project is to provide ENDESA with developing maintenance of the tool SIROCO developed by IIT.

- **Technical support for the tool VALSA**  
  The objective of this project is to provide ENEL with technical developing maintenance of the tool VALSA developed by IIT.

3.3 Publications

3.3.1 Chapters in books


3.3.2 Publications in journals


### 3.3.3 Conference presentations


3.3.4 IIT technical documents

This section includes both technical reports prepared for companies and institutions as well as working papers that have been registered.


- S. Lumbreras, "As a leader, you need to set your value agenda. Here’s why.". April 2019. Ref: IIT-19-037A.


- N. Morell, R. Cossent, J.P. Chaves, P. Rodilla, T. Gómez, "Respuesta a la Consulta pública previa a la elaboración del Real Decreto por el que se establece las metodologías de cálculo de los cargos del sistema eléctrico del Ministerio para la Transición Ecológica.". June 2019. Ref: IIT-19-063A.


3.3.5 Other publications


4. Teaching

The experience that the IIT holds in various technological fields is a valuable input for the different undergraduate and graduate degrees offered by the school of engineering ICAI.

This section presents the undergraduate and graduate theses that have been supervised by IIT staff during the last academic year, and the list of graduate courses led by members of the IIT or they have participated as lecturers.

4.1 Supervised undergraduate theses at IIT

4.1.1 Electrical, Electronics, and Mechanical Engineering
- Control de tensión y/o corriente de salida en convertidores electrónicos fuente de tensión modulares y multinivel (MMC) para su conexión a la red eléctrica

- Control de un sistema de suspensión activa para un vehículo a escala
  José Esteban Rivero Ríos. Supervised by Juan Luis Zamora Macho.

- Desarrollo de patrones de calibración en defectos de forma
  Álvaro Valdés Gómez. Supervised by María Ana Sáenz Nuño.

- Desarrollo de una prótesis low cost destinada a países en conflicto o en vía de desarrollo
  Beatriz Quiralte Moreno. Supervised by María Ana Sáenz Nuño.

- Detección de anomalías de un aerogenerador a través de sus curvas de estado
  Ramón Conejero Guillén. Supervised by Miguel Ángel Sanz Bobi.

- Diseño de la suspensión trasera de una moto de competición
  Tomás Manuel Bañegil Collado. Supervised by Pablo Ayala Santamaría.
- Diseño e integración de un control predictivo de temperatura en un sistema domótico  
  Sara Puente Iglesias. Supervised by Juan Luis Zamora Macho.

- Estudio y diseño de un hidroala y posibles aplicaciones en el sector marítimo y de recreo  

- Integration of interurban delivery vehicles in the grid and optimization of the charging process  
  Marta García-Borregón Castañeda. Supervised by Pablo Frías Marín.

- Modularización de tareas en la minifábrica ICAI  
  Aurora Valdés Zafra. Supervised by José Antonio Rodríguez Mondéjar.

4.1.2 Telematics Engineering
- Desarrollo de una plataforma IoT para conocer el mapa sonoro ambiental de un entorno exterior  
  María de la Concepción Martín Velázquez-Gaztelu. Supervised by Miguel Ángel Sanz Bobi.

- Implementación de una solución distribuida IoT mediante la tecnología Blockchain  
  José María Moyano Suárez. Supervised by David Contreras Bárcena.

4.1.3 Bachelor's Degree in Engineering for Industrial Technologies
- Análisis de alternativas de coberturas de riesgos para inversiones en generación transfronteriza en la región latinoamericana  
  Alberto Pascual Virué. Supervised by José Pablo Chaves Ávila.

- Análisis de estrategias de inversión basadas en aprendizaje no supervisado  
  Marta Martínez Esteban. Supervised by Juan Luis Zamora Macho.

- Análisis de estrategias de inversión basadas en aprendizaje supervisado  
  Gonzalo Sierra Calero. Supervised by Juan Luis Zamora Macho.

- Análisis del despliegue de puntos de recarga interurbanos para vehículos eléctricos  
  Pablo Mendoza Caballero. Supervised by Pablo Frías Marín.

- Aplicación de la realidad virtual a la programación de robots  
  Francisco Javier Domínguez Sánchez-Girón. Supervised by José Antonio Rodríguez Mondéjar.
- Aplicación de la realidad virtual a la programación de robots industriales de grandes dimensiones
Mario Serrano Rodríguez. Supervised by José Antonio Rodríguez Mondéjar.

- Aplicación de un filtro de Kalman a la gestión óptima de una cartera de valores
Javier Maguregui Ortiz. Supervised by Juan Luis Zamora Macho.

- Asistente electrónico de entrenamientos de natación
Jorge Zumarraga Martínez. Supervised by Álvaro Sánchez Miralles.

- Automatización de una línea de acabado de planchas de acero inoxidable
Gonzalo Valencia Torralbo. Supervised by José Antonio Rodríguez Mondéjar.

- Blockchain-based carbon credit solution
Álvaro Nicolás Gemperle Sánchez del Corral. Supervised by José Pablo Chaves Ávila.

- Cálculo y diseño para un sistema integrado de almacenamiento de energía eléctrica en subestación de media/alta tensión para la optimización de generación de energía renovable
Laura Cansado Romera. Supervised by Pablo Frías Marín.

- Comparación de dos métodos de ajuste de estabilizadores de oscilaciones subsíncronas de aerogeneradores basados en generadores de inducción doblemente alimentados
Paloma López Díaz. Supervised by Luis Rouco Rodríguez.

- Comparativa de la sostenibilidad de los mixes energéticos de distintos países bajo la perspectiva del análisis de ciclo de vida
Antonio Andrés Rebollar Juárez. Supervised by Yolanda González Arechavala.

- Comparativa de la sostenibilidad de los mixes energéticos de distintos países europeos bajo la perspectiva del análisis de ciclo de vida
Diego Benito Adrados. Supervised by Ana María Santos Montes.

- Comparative analysis of international offshore wind sector
María Gabriela Rubio Domingo. Supervised by Jesús Jiménez Octavio.

- Comportamiento a fractura y fatiga de cementos óseos reforzados con grafeno

- Comportamiento de un adhesivo de construcción frente al aumento de temperatura generada en un incendio
Pablo Lozano Gil. Supervised by Yolanda Ballesteros Iglesias and Pablo Ayala Santamaría.
- Construcción de un equipo de equilibrado de una esfera sobre plataforma móvil para docencia
  Enrique Alonso Álvarez. Supervised by Juan Luis Zamora Macho.

- Control de navegación autónoma de un cuadricóptero en interiores
  Jorge Jacobo Bennasar Vázquez. Supervised by Juan Luis Zamora Macho.

- Control de un coche teledirigido mediante reconocimiento de gestos
  Marcos Ventosa Pontes. Supervised by Álvaro Sánchez Miralles.

- Control de un levitador magnético
  Patricia García de Castro Iribas. Supervised by Juan Luis Zamora Macho and Aurelio García Cerrada.

- Control de un vehículo equilibrista mediante una raspberry pi
  Carmen Jiménez Cortés. Supervised by Juan Luis Zamora Macho.

- Desarrollo de un modelo simplificado para la simulación de la dinámica corporal en un impacto
  Federico Gil Fernández. Supervised by Alberto Carnicero López.

- Desarrollo de una app de reconocimiento facial con técnicas de inteligencia artificial
  Alberto Menéndez Ruiz de Azúa. Supervised by Álvaro Jesús López López.

- Desarrollo de una plataforma IoT para conocer la calidad medioambiental
  Jorge Suárez Porras. Supervised by Miguel Ángel Sanz Bobi.

- Desarrollo y fabricación de un sistema de iluminación automático de pasos de cebra
  Francisco Gregorio Lacruz Sisamón. Supervised by Alberto Carnicero López.

- Design of a self-supplied sensor for an industrial vibrating machine
  Alfonso Vijande Fernández. Supervised by Alberto Carnicero López.

- Diseño de sistema de control de un péndulo invertido accionado mediante volante de inercia
  Ignacio Martín-Bustamante González-Iglesias. Supervised by Juan Luis Zamora Macho.

- Diseño de un control por realimentación del espacio de estado de un aerogenerador basado en un generador de inducción doblemente alimentado
  Aurora Navarro Villacieros. Supervised by Luis Rouco Rodríguez.

- Diseño del control de navegación para un dron parrot mambo
  Marcos Roa Escobar. Supervised by Juan Luis Zamora Macho.
- Diseño personalizado del cuadro de una bicicleta btt
  Santiago Sanz Ruiz. Supervised by Francisco José López Valdés.

- Diseño y construcción de un dron de apoyo a personas con discapacidad visual
  Miguel Rodríguez de Robles Pozo. Supervised by Juan Luis Zamora Macho and
  María Ana Sáenz Nuño.

- Diseño y fabricación del carenado para Formula Student
  Sergio Hernández Blanco. Supervised by Jesús Jiménez Octavio.

- Diseño y fabricación del fondo plano para Formula Student
  Nuria González Ochoa. Supervised by Jesús Jiménez Octavio.

- Diseño y optimización de los bujes delanteros y traseros para Fórmula Student
  Pablo Borreguero Aláez. Supervised by Alberto Carnicero López.

- Diseño, fabricación y ensayo de un rodete axial de 6 álabes para una turbina
  Kaplan rápida
  Rodrigo Basante Moreno. Supervised by Eva María Arenas Pinilla.

- Diseño, fabricación y ensayo de un rodete de 4 álabes para una turbina Kaplan
  rápida
  Ana Manzano García. Supervised by Eva María Arenas Pinilla.

- Diseño, fabricación y ensayo de un rodete para una turbina Kaplan
  Miguel Cabello Reyes. Supervised by Eva María Arenas Pinilla.

- Economía experimental en el análisis del comportamiento de los consumidores
  en la toma de decisiones de inversión en generación distribuida
  Gonzalo Suáriz Álvarez del Manzano. Supervised by Salvador Doménech
  Martínez and Francisco Alberto Campos Fernández.

- Enchufes inteligentes y vehículo eléctrico
  José Cubelos Ordás. Supervised by José Pablo Chaves Ávila.

- Entrenador del personal de mantenimiento de la minifábrica ICAI basado en
  realidad virtual
  Borja Rojo González. Supervised by José Antonio Rodríguez Mondéjar.

- Estrategias de control en sistemas VSC-HVDC multi-terminal para la mejora de la
  estabilidad transitoria
  Cristina Yusta Fernández. Supervised by Aurelio García Cerrada and Francisco
  Javier Renedo Anglada.
- Estrategias para el control primario de frecuencia entre áreas asíncronas interconectadas por sistemas VSC-HVDC multi-terminal

- Estrategias para el modelado y análisis computacional en la resolución de problemas de programación matemática binivel para la caracterización de las decisiones regulador-agente del sector eléctrico

- Estudio de envejecimiento in vitro de cementos óseos enriquecidos con antibióticos

- Estudio de estabilidad de un sistema eléctrico con generación 100% eólica
  Ricardo Noreña Alcalá-Galiano. Supervised by Luis Rouco Rodríguez.

- Hacia la securización de los sistemas de industriales. El caso de las infraestructuras críticas
  Isabel Rivera Ruiz. Supervised by Álvaro Jesús López López.

- Hacia la securización de los sistemas de control industriales. El caso de la industria manufacturera
  Carlos Redondo Alamillos. Supervised by Álvaro Jesús López López.

- Interpretación y análisis de sensibilidad de CNN mediante imágenes sintéticas
  Gabriela Martín Carballo. Supervised by Jaime Boal Martín-Larrauri and Eugenio Francisco Sánchez Úbeda.

- Modelado y control de un brazo robótico SCARA
  Erik Martín Vik Espárrago. Supervised by Juan Luis Zamora Macho.

- Navegación autónoma en interiores basada en un LIDAR
  Javier González del Campo Artesero. Supervised by Juan Luis Zamora Macho.

- Navegación externalizada de robots móviles en un almacén
  Nerea Zabala Orive. Supervised by Álvaro Sánchez Miralles.

- Optimización del encendido-apagado de subestaciones en una red ferroviaria metropolitana
  Carlos Moro García. Supervised by Ramón Rodríguez Pecharromán and Álvaro Jesús López López.
- Prepagos de contadores de energía utilizando tecnología Blockchain
  Julio Canuto García-Mina Peñaranda. Supervised by José Pablo Chaves Ávila.

- Primary frequency control quality under high RES scenarios: role of conventional generation
  Jaime Fernández-Kelly Rodríguez-Marqués. Supervised by Luis Rouco Rodríguez and Lukas Sigrist.

- Sensitivity analysis of impact of clusterization methods in medium-term power system models
  Marta Niño Serrano. Supervised by Sonja Wogrin and Diego Alejandro Tejada Arango.

- Simulación detallada de la etapa intermedia de un transformador electrónico
  Manuel Florez Montes. Supervised by Aurelio García Cerrada.

- Simulación y ajuste del conjunto inversor+motor para un vehículo ligero eléctrico de competición
  Juan Fernando Soriano Botella. Supervised by Fidel Fernández Bernal.

- Sistema de control de cuadricópteros para navegación en exteriores
  Diego Gil de Antuñano Durán. Supervised by Juan Luis Zamora Macho.

- Sistema de gestión de una cartera bursátil mundial basado en la influencia de algunas variables del análisis fundamental
  Marcos Dhanwani Díaz. Supervised by Juan Luis Zamora Macho.

- Sistema domótico para el control remoto del acceso a una vivienda
  Eduardo Martínez Jiménez. Supervised by Juan Luis Zamora Macho.

### 4.1.4 Bachelor’s Degree in Engineering in Telecommunications Technologies

- Actualización del sistema de detección de obstáculos para apoyo a invidentes en la práctica de la hípica
  Francisco José Aranda Serrano. Supervised by José Daniel Muñoz Frías.

- Algoritmo de predicción de los mercados a través de múltiples criterios como el análisis de redes sociales entre otros
  Luis Puyol Lombos. Supervised by Rafael Palacios Hielscher.

- Algoritmos de clasificación y clustering para identificar la demanda de una compañía eléctrica y predecirla
  Pedro Murcia Morilla. Supervised by Miguel Ángel Sanz Bobi and David Contreras Bárbara.
- Análisis de electrocardiogramas mediante técnicas de ingeniería para la detección de enfermedades cardíacas
  Juan Quer Martínez. Supervised by Carlos Mateo Domingo.

- Análisis de la sensibilidad a la temperatura de un resonador de radio frecuencia
  Daniil Panasik. Supervised by Javier Matanza Domingo.

- Aplicación de la visión artificial a la seguridad de un robot
  Concepción Góngora Luque. Supervised by Jaime Boal Martín-Larrauri and José Antonio Rodríguez Mondéjar.

- Desarrollo de un interfaz de visualización en una infraestructura Big Data para una solución de procesamiento de datos masivos
  Cayetano Valero Amores. Supervised by David Contreras Bárca.

- Desarrollo de un sistema de procesamiento de datos en un proyecto Big Data
  Pablo Mena Gómez de Merodio. Supervised by David Contreras Bárca.

- Despliegue de una solución IoT sobre una infraestructura real Blockchain
  Esther Vázquez Rodríguez. Supervised by David Contreras Bárca.

- Entorno de desarrollo basado en técnicas de aprendizaje profundo por refuerzo
  Jaime Fúster De la Fuente. Supervised by Miguel Ángel Sanz Bobi.

- Ingesta de datos en un proyecto Big Data
  Beltrán Rodríguez-Mon Barrera. Supervised by David Contreras Bárca.

- Integración de un sistema de visión artificial en la mano de un robot industrial
  Ana Berjón Valles. Supervised by Jaime Boal Martín-Larrauri and José Antonio Rodríguez Mondéjar.

- Plataforma interactiva de análisis de imágenes de microscopio con aplicaciones en medicina
  Gonzalo José Echanove Puig. Supervised by Mario Castro Ponce and David Contreras Bárca.

- Sensor de radiofrecuencia para la clasificación de líquidos
  Jorge Rivera Rueda. Supervised by Francisco Javier Herraiz Martínez.

- Sistema de procesamiento de análisis clínicos masivos mediante Herramientas open source
  Ignacio Cabrera Lama. Supervised by David Contreras Bárca.

- Tecnología Blockchain aplicada a competencias en juegos de habilidad
  Mauricio David Muñoz López. Supervised by Rafael Palacios Hielscher.
- Visualización descriptiva mediante geolocalización del análisis de consumos eléctricos por una compañía eléctrica
  Javier Caminos Colmenarejo. Supervised by Miguel Ángel Sanz Bobi and David Contreras Bárcena.

4.2 Postgraduate teaching

4.2.1 Graduate courses

The graduate courses led by members of the IIT or where they participate as lecturers are listed hereafter.

4.2.1.1 Official Master's Degree in Research in Engineering Systems Modeling (MRE)

Director: Miguel Ángel Sanz Bobi

- Preliminary research project
  Andrés Ramos Galán

- Forecasting techniques
  Antonio Muñoz San Roque

4.2.1.2 Official Master's Degree in the Electric Power Industry (MEPI)

Director: Luis Olmos Camacho


- Decision support models in the electric power industry
  Antonio Bello Morales, Andrés Ramos Galán, Efraim Centeno Hernáez, Javier García González, Tomás Gómez San Román

- Economy of the electric power industry
  José Pablo Chaves Ávila

- Electric power systems
  Damián Laloux Dallemagne, Michel Rivier Abbad, Luis Rouco Rodríguez

- Environmental and renewable energy policy
  Pedro Linares Llamas
Postgraduate teaching

- Fundamentals on electrical engineering and optimization techniques
  Francisco Alberto Campos Fernández, Sonja Wogrin, Damián Laloux Dallemagne

- Internship
  Luis Olmos Camacho

- Law and legislation of the power industry
  Tomás Gómez San Román

- Master's thesis
  José Pablo Chaves Ávila, Carlos Mateo Domingo, Luis Olmos Camacho, Lukas Sigrist, Pedro Linares Llamas, Javier García González, Tomás Gómez San Román

- Network business: transmission, distribution and smart grids
  José Pablo Chaves Ávila, Rafael Cossent Arín, Luis Olmos Camacho, Pablo Frías Marín, Tomás Gómez San Román, Michel Rivier Abbad

- Regulation of the electric power industry
  Paolo Mastropietro, Pablo Rodilla Rodríguez, Tomás Gómez San Román

- Wholesale and retail electricity markets
  Paolo Mastropietro, Pablo Rodilla Rodríguez

4.2.1.3 Master in Railway Systems

Director: Antonio Fernández Cardador

- Electrification
  Luis Rouco Rodríguez

- Catenary mechanics
  Alberto Carnicero López, Jesús Jiménez Octavio

- ERTMS and RAMS
  Yolanda González Arechavala

- Professional practice
  Asunción Paloma Cucala García

- Design and traffic control advanced systems
  Antonio Fernández Cardador, Asunción Paloma Cucala García
- Control and Supervision Systems
  José Antonio Rodríguez Mondéjar

- Master thesis
  Antonio Fernández Cardador, Asunción Paloma Cucala García

**4.2.1.4 Master in Project, Construction and Maintenance of High Voltage Electrical Transmission (On-line)**

Director: Fernando de Cuadra García
More information at https://www.structuralia.com/formacion/master-en-proyecto-construccion-y-mantenimiento-de-infraestructuras-electricas-de-alta-tension

- Transmission Lines
  Francisco Miguel Echavarren Cerezo

**4.2.1.5 Master's Degree in International Industrial Project Management**

More information at https://www.comillas.edu/postgrado/master-en-direccion-internacional-de-proyectos-industriales

- Internship and final project report
  Pedro Sánchez Martín

- Operations management
  Pedro Sánchez Martín

**4.2.1.6 Official Master's Degree in Biomechanics and Sports Physiotherapy**

Director: Ricardo Blanco Méndez
https://www.comillas.edu/postgrado/master-universitario-en-biomecanica-y-fisioterapia-deportiva

- Assessment and objective diagnosis of advanced sports physiotherapy techniques
  María Ana Sáenz Nuño
4.2.1.7 MBA in the Global Energy Industry

Director: Andrés Ramos
- Marketing management
  Pablo Rodilla Rodríguez

4.2.1.8 Master's Degree in Smart Industry (MIC)

Director: Bernardo Villazán
More information at https://www.comillas.edu/en/masters/master-degree-in-smart-industry
- Cyber-physical Systems and Robotics
  Jaime Boal Martín-Larrauri
- Smart Systems Applied to Industry
  Álvaro Sánchez Miralles

4.2.1.9 Master's Degree in Big Data Technologies and Advanced Analytics (MBD)

Responsible: Carlos Morrás Ruiz-Falcó, Cristina Sánchez Rebollo, David Contreras Bárcena, Antonio Muñoz San Roque
- Big Data Architecture
  David Contreras Bárcena
- Machine Learning I
  Antonio Muñoz San Roque, José Portela González
- Machine Learning II
  Jaime Boal Martín-Larrauri, Eugenio Francisco Sánchez Úbeda, Miguel Ángel Sanz Bobi

4.2.1.10 Master's Degree in Smart Grids (MSG)

Director: Miguel Ángel Sánchez Fornié
- Operation and Planning of Future Distribution Networks
  Rafael Cossent Arín, Francisco Miguel Echavarren Cerezo, Francisco Javier Renedo Anglada, Lukas Sigrist, Pablo Frias Marín
- Telecommunications for Smart Grids
  Javier Matanza Domingo

4.2.1.11 Master in Mobility and Safety Engineering (MMS)

Director: Alberto Carnicero
https://www.comillas.edu/postgrado/master-en-ingenieria-para-la-movilidad-y-la-seguridad

- Vehicle dynamics
  Alberto Carnicero López

- 19/5000 Light structures
  Alberto Carnicero López, Jesús Jiménez Octavio

- Advanced materials and joining techniques
  Juan Carlos del Real Romero, Eva Paz Jiménez

4.2.2 Graduate theses supervised at IIT

4.2.2.1 Official Master’s Degree in Industrial Engineering (MII)

- Análisis de la curva de oferta de biomasa en España para diferentes sectores industriales
  Jaime Alonso-Cortés Vivancos. Supervised by José Pablo Chaves Ávila and Timo Gerres.

- Análisis del modelo de negocio de la infraestructura de recarga rápida para vehículos eléctricos
  Javier Zumárraga Martínez. Supervised by Pablo Frías Marín.

- Análisis y mejora de la calidad del agua potable en el distrito de los Morochucos, en Ayacucho, Perú
  Juan Manzanares Estrada. Supervised by Yolanda Ballesteros Iglesias.

- Análisis y propuestas de nuevos indicadores de pobreza energética
  Juan Torres Sánchez. Supervised by José Carlos Romero Mora and Roberto Barrella.

- Aplicación de técnicas de Big Data Analytics para la detección de fugas de combustible en aviones
  Jaime Pizarroso Gonzalo. Supervised by Antonio Muñoz San Roque and José Portela González.

- Arranque en negro de parques eólicos
  Ignacio Sanz Soriano. Supervised by Luis Rouco Rodríguez.
- Blockchain Application to enable the financing of solar power plants
  Patricia Oliveros Rubio. Supervised by José Pablo Chaves Ávila.

- Comparativa medioambiental de diferentes tipos de transporte de viajeros
  utilizando una perspectiva de análisis de ciclo de vida
  Inmaculada Caballero Ruiz. Supervised by Yolanda González Arechavala.

- Construction of set-up for the evaluation of non-linear behavior of
  supercapacitors
  Simone Guidi. Supervised by Romano Giannetti.

- Creación de herramientas de mejora continua en la planificación logística
  industrial
  Juan Francisco Aguilera Funes. Supervised by Pedro Sánchez Martín.

- Desarrollo de un sistema flexible para personalizar el comportamiento de una
  vivienda inteligente
  Ignacio García Vera. Supervised by Jaime Boal Martín-Larrauri and Miguel
  Martín Lopo.

- Design of quantitative models for developing automatic trading strategies in
  energy markets
  Carlos Jesús Pretel Parejo-Merino. Supervised by Javier Reneses Guillén and
  Antonio Bello Morales.

- Despacho económico de sistemas eléctricos insulares incluyendo plantas
  desaladoras
  José Luis González Pizarro. Supervised by Enrique Lobato Miguélez and Lukas
  Sigrist.

- Diseño de una vivienda de bajo coste para las aldeas de Quiché (Guatemala)

- Diseño y desarrollo de un pedal de efectos para la guitarra eléctrica
  Luis Cobas Aranguren. Supervised by Javier García González and José Daniel
  Muñoz Frías.

- Diseño y evaluación de estructuras porosas (scaffolds) reforzadas con grafeno y
  obtenidas mediante fabricación aditiva para mejorar la regeneración ósea

- Estudio de la implementación de la tecnología blockchain en un sistema de low
  voltage distribution Loop
  Diego Plata Rodilla. Supervised by Antonio Vázquez Blanco and Miguel Martín
  Lopo.
- Estudio de viabilidad de la participación de los gestores de carga en los mercados de ajuste
  José María Pérez Cruz. Supervised by José Pablo Chaves Ávila and Pablo Rodilla Rodríguez.

- Estudio sobre riesgos de incendios en infraviviendas
  Fernando José Lozano Zurita. Supervised by Alexis Cantizano González.

- Estudio y redimensionamiento de la instalación de bombeo de la escuela secundaria Ignacio de Loyola en Mozambique
  Blanca Sáez Jaén. Supervised by Alexis Cantizano González.

- Formulación de un algoritmo de flujo de cargas parabólico
  Alejandro Ruiz Berciano. Supervised by Francisco Miguel Echavarren Cerezo.

- Identification method of consumer phase connection in distribution networks
  Juan Víctor Camarena Parada. Supervised by Carlos Mateo Domingo and Fernando Emilio Postigo Marcos.

- Impacto de la reducción de la generación síncrona en la estabilidad del sistema eléctrico continental europeo
  Eduardo Campillos García. Supervised by Luis Rouco Rodríguez.

- Impacto técnico-económico de una red HVDC para distintos escenarios de penetración de energía eólica y solar en el sistema eléctrico español
  Pablo Collado Ruiz. Supervised by Javier García González.

- Implantación de técnicas de mejora continua en el proceso de elaboración artesanal de cerveza
  Jaime Royo Coll. Supervised by Pedro Sánchez Martín.

- La descarbonización en España: el caso del sector agrícola
  Ernesto García Cantarero. Supervised by José Pablo Chaves Ávila and Timo Gerres.

- Logística certificada en blockchain
  Ainhoa García Echeverría. Supervised by Francisco Martín Martínez.

- Mechanical Verification methods for satellites considering flight transients
  Marcos Feria Cerrada. Supervised by Alberto Carnicero López.

- Mejora de la eficiencia en el procesamiento de muestras en laboratorios clínicos
  Francisco Javier Caballero Fedriani. Supervised by Pedro Sánchez Martín.
- **Metodología de asignación de fases en redes de distribución**
  Alberto Maté Piñero. Supervised by Carlos Mateo Domingo and Fernando Emilio Postigo Marcos.

- **Modelado del comportamiento cooperativo de los consumidores en la toma de decisiones de inversión en generación distribuida mediante teoría de juegos cooperativos**

- **Modelado y control de la planta AERO de Quanser**
  Juan Pablo Dehesa Golding. Supervised by Juan Luis Zamora Macho.

- **Modelo de despacho de energía eléctrica con restricciones de red en potencia activa y reactiva**
  Francisco Javier Gibello Rael. Supervised by Lukas Sigrist.

- **Obtención de modelo antropométrico parametrizado de pelvis**
  Carlos de León Ortiz. Supervised by Jesús Jiménez Octavio and Francisco José López Valdés.

- **Rediseño de un transformador baja tensión/baja tensión monofásico para compensación de caída de tensión en líneas largas**
  Fernanda Zamora Hernández. Supervised by Luis Rouco Rodríguez.

- **Reserve deployment of RES in island power systems**
  Servando López Martínez. Supervised by Lukas Sigrist.

- **Simulación detallada de un transformador electrónico**
  Jorge López Rodríguez-Roselló. Supervised by Aurelio García Cerrada.

- **Sistema de regulación del alumbrado en vías públicas y gestión remota punto a punto**
  Lucía Güitta López. Supervised by Álvaro Jesús López López.

- **Spalling behaviour of concrete in fire: effect of different fibers**
  Marta Tena Briceño. Supervised by Alberto Carnicero López and Alexis Cantizano González.

- **Techno-economic analysis of gas and electricity technologies to supply energy services to commercial consumers**
  Jaime Dilla Piñero. Supervised by José Pablo Chaves Ávila.

- **Techno-economic feasibility analysis of Brayton supercritical CO2 power cycles as power conversion system for fusion reactors based on HCPB blanket**
  Mar Carmona Sanz. Supervised by Eva María Arenas Pinilla.
4.2.2.2 Official Master's Degree in Telecommunications Engineering (MIT)
- Aplicación de la realidad aumentada a la minifábrica ICAI
  Carlo Alonso Calleja. Supervised by José Antonio Rodríguez Mondéjar.
- Gestión de una minifábrica mediante realidad aumentada
  Álvaro Bolinches Tejedor. Supervised by José Antonio Rodríguez Mondéjar.
- Implementación de un sniffer de PRIME con BitScope
  Javier de la Paz Garcillán. Supervised by Javier Matanza Domingo.

4.2.2.3 Official Master's Degree in the Electric Power Industry (MEPI)
- Analysis of the carbon footprint evolution in Spain: economic and international trade drivers
  Mar Carmona Sanz. Supervised by Pedro Linares Llamas.
- Comparison of different modelling approaches of combined cycle gas turbines and regulatory revision of Thrid Party Access to the gas network
  Ignacio García Vera. Supervised by Javier García González.
- Distribution network archetypes for simulating flexibility provided by distributed energy resources
  Diego García Cuenca. Supervised by Tomás Gómez San Román and Carlos Mateo Domingo.
- Flexible operation of nuclear power plants
  Santiago Cortezo Nieto. Supervised by Tomás Gómez San Román and José Pablo Chaves Ávila.
- Learning curves analysis for solar PV
  Lucas Prado Sendagorta. Supervised by Pedro Linares Llamas.
- Spinning reserve provided by renewable energy sources
  Carmen Prats Soriano. Supervised by Lukas Sigrist.

4.2.2.4 Master's Degree in Smart Industry (MIC)
- Aplicación de técnicas de big data analytics para la detección de fugas de combustible en aviones
  Jaime Pizarroso Gonzalo. Supervised by José Portela González and Antonio Muñoz San Roque.
4.2.2.5 Master's Degree in Big Data Technologies and Advanced Analytics (MBD)

- Aplicación de técnicas de big data analytics para la detección de fugas de combustible en aviones
  Jaime Pizarroso Gonzalo. Supervised by José Portela González and Antonio Muñoz San Roque.
5. Doctorate

5.1 ICAI Engineers' Association

The IIT maintains a close relationship with the ICAI Engineers' Association in several aspects. On the one hand, the Association partially funds one of the IIT doctoral theses. During this academic year, the thesis developed by Eduardo Alonso Rivas has benefited from such financial support. On the other hand, the IIT collaborates with the Association sending some of its research for publication to its official journal Anales de Mecánica y Electricidad.

5.2 Training complements

Training complements typically correspond to Master courses that complement the training of the student in those aspects relevant for the doctoral thesis and that have not been tackled in the academic or professional career.

- Optimization techniques
  Andrés Ramos Galán

- Preliminary research project
  Andrés Ramos Galán

- Publishing research results
  Aurelio García Cerrada

5.3 Training activities

Training activities have to be carried out by all students. These activities provide the students with basic information about various research techniques.

- Advanced Excel for research
  Jesús María Latorre Canteli, Javier García González
Training activities

- Advanced GAMS for applied research
  Andrés Ramos Galán

- Advanced Matlab for applied research
  Eugenio Francisco Sánchez Úbeda

- Advanced VBA-Excel for applied research
  Francisco Alberto Campos Fernández, Jesús María Latorre Canteli

- Data Analysis
  Eugenio Francisco Sánchez Úbeda

- Data management
  Jesús María Latorre Canteli, Eugenio Francisco Sánchez Úbeda

- Forecasting techniques
  Antonio Muñoz San Roque

- Oral presentation of research results
  Efraim Centeno Hernández

5.4 Doctoral theses

The following doctoral theses defended in this academic year or currently in development are or have been conducted and led by researchers at the IIT. Usually, these theses are developed in conjunction or in close relationship with some of the research projects mentioned above.

5.4.1 Comillas submitted theses

- Title: Train eco-driving optimisation based on simulation models
  Author: Adrián Fernández Rodríguez
  Supervisors: Antonio Fernández Cardador and Asunción Paloma Cucala García
  Date: November 20, 2018

- Title: Designing electricity distribution network charges for an efficient integration of distributed energy resources and customer response
  Author: Ibthail Abdelmotteleb
  Supervisors: Tomás Gómez San Román and Javier Reneses Guillén
  Date: December 17, 2018
- Title: Technical and economic impact of the deployment of a VSC-MTDC supergrid with large-scale penetration of offshore wind  
  Author: Quanyu Zhao  
  Supervisor: Javier García González  
  Date: February 15, 2019

- Title: Measuring energy sustainability: a new operational framework based on weak and strong indicators  
  Author: José Carlos Romero Mora  
  Supervisor: Pedro Linares Llamas  
  Date: April 26, 2019

- Title: Efficient reduction techniques for a large-scale transmission expansion planning problem  
  Author: Quentin Ploussard  
  Supervisors: Luis Olmos Camacho and Andrés Ramos Galán  
  Date: May 28, 2019

- Title: Co-optimization of energy storage technologies in tactical and strategic planning models  
  Author: Diego Alejandro Tejada Arango  
  Supervisors: Efraim Centeno Hernáez and Sonja Wogrin  
  Date: July 03, 2019

- Title: A model-based approach for the analysis of the European internal natural gas market  
  Author: Aurora del Valle Díez  
  Supervisors: Javier Reneses Guillén and Sonja Wogrin  
  Date: July 18, 2019

**5.4.2 Comillas ongoing theses**

- Title: Mejora de la capacidad de líneas ferroviarias urbanas mediante indicadores dinámicos  
  Author: Luis Miguel Navarro Rodríguez  
  Supervisors: Antonio Fernández Cardador and Asunción Paloma Cucala García

- Title: Development of a wireless Brain-Computer-Interface system.  
  Author: Eduardo Alonso Rivas  
  Supervisors: Carlos Rodríguez-Morcillo García and Romano Giannetti

- Title: Desarrollo de un nuevo concepto de imán superconductor de alta eficiencia para un ciclotrón de producción de radioisótopos  
  Author: Javier Munilla López  
  Supervisor: Mario Castro Ponce
- Title: Total transfer capability computation in AC/DC electric power systems with VSC-HVDC.
  Author: José Carlos Fernández Pérez
  Supervisors: Luis Rouco Rodríguez and Francisco Miguel Echavarren Cerezo

- Title: Mejora de la infraestructura eléctrica de un sistema ferroviario electrificado en cc para incrementar su eficiencia energética, teniendo en cuenta topologías complejas y tráfico representativo
  Author: David Roch Dupré
  Supervisors: Asunción Paloma Cucala García and Ramón Rodríguez Pecharromán

- Title: Adapting Energy Markets in Europe to Integrate Industrial Demand Response.
  Author: Lorenzo August Simons
  Supervisors: Pablo Frías Marín and Rafael Cossent Arín

- Title: Building synthetic distribution networks in US and EU: Algorithms and applications to distributed energy resources integration studies.
  Author: Fernando Emilio Postigo Marcos
  Supervisors: Tomás Gómez San Román and Carlos Mateo Domingo

- Title: Contributions to the assessment of benefits of transmission investment projects: treatment of local environmental benefits and counterfactual problem
  Author: Deniz Sun
  Supervisors: Michel Rivier Abbad and Luis Olmos Camacho

- Title: Short-term forecasting of electricity prices: a hybrid methodology based on fundamental and statistical analysis
  Author: Rodrigo Alejandro de Marcos Peirotén
  Supervisors: Javier Reneses Guillén and Antonio Bello Morales

- Title: Natural gas tariff design: a comprehensive framework for analyzing economic efficiency.
  Author: Celia Mosácula Atienza
  Supervisors: Javier Reneses Guillén and José Pablo Chaves Ávila

- Title: Modelado y optimización de valoración de una empresa con métodos estocásticos usando el descuento de flujos de caja combinado con el Financing Feedback. Aplicación a sector eléctrico
  Author: Cristóbal Cantos Sánchez de Ibarguen
  Supervisors: Pedro Sánchez Martín and Sara Lumbreras Sancho

- Title: Contribuciones al Análisis y la Previsión de los Precios del Petroleo
  Author: Pedro Moreno Alonso
  Supervisor: Antonio Muñoz San Roque
- Title: Evaluating the Impact of Industrial Decarbonisation on the Energy System with Special Emphasis on the Electricity Sector  
  Author: Timo Gerres  
  Supervisors: Tomás Gómez San Román and José Pablo Chaves Ávila

- Title: Contribuciones al uso óptimo de los protocolos de comunicación en entornos específicos de ámbito industrial y ferroviario  
  Author: Juan Manuel Cerezo Sánchez  
  Supervisor: José Antonio Rodríguez Mondéjar

- Title: Contributions to automatic detection of inconsistencies on Digital Communication Standards.  
  Author: Sonia León del Rosario  
  Supervisor: José Antonio Rodríguez Mondéjar

- Title: "Towards a flexible energy-oriented meta-simulator: From virtual to real"  
  Author: Miguel Martín Lopo  
  Supervisors: Álvaro Sánchez Miralles and Jaime Boal Martín-Larrauri

- Title: "Avoiding The" Lazy Director" Effect: Measures to Reduce Social Loafing in Boards. An Analysis in the Spanish Context"  
  Author: Bernardo Villazán Gil  
  Supervisors: Laura Fernández Méndez and Sara Lumbrañas Sancho

- Title: Volatility premiums as a proxy for ESG scores  
  Author: Paraskevas Paraskevas Kamforidou  
  Supervisors: Isabel Catalina Figuerola-Ferretti Garrigues and Sara Lumbrañas Sancho

- Title: Integration of unconventional power sources in the automatic generation control (AGC)  
  Author: Kai Doenges  
  Supervisors: Lukas Sigrist and Ignacio Egido Cortés

- Title: Multi-area electricity market modeling using Monte Carlo simulation and intelligent data techniques  
  Author: Alberto Orgaz Gil  
  Supervisors: Javier Reneses Guillén and Antonio Bello Morales

- Title: Strategic Generation and Transmission Expansion Planning under Uncertainty  
  Author: Isaac Camilo González Romero  
  Supervisors: Sonja Wogrin and Tomás Gómez San Román

- Title: DSO-TSO Coordination in the European context  
  Author: Leandro Lind  
  Supervisors: Rafael Cossent Arín and Pablo Frías Marín
- Title: Desarrollo de un modelo de mantenimiento colaborativo inteligente basado en indicaciones de salud y algoritmos adaptativos
  Author: Pablo Calvo Báscones
  Supervisors: Miguel Ángel Sanz Bobi and Álvaro Jesús López López

- Title: Functional time series forecasting: a probabilistic approach
  Author: Guillermo Mestre Marcos
  Supervisor: Antonio Muñoz San Roque

- Title: The rural Electrification Planning problem: strategies and solutions
  Author: Pedro Ciller Cutillas
  Supervisor: Sara Lumbreras Sancho

- Title: Addressing the provision of Universal Access to Modern Energy Services in developing countries: A comprehensive decision support framework
  Author: Andrés González García
  Supervisor: Sara Lumbreras Sancho

- Title: Modeling the particularties of the natural gas sector for a better representation of the strategic short-tern optimal generation scheduling
  Author: Pedro de Otaola Arca
  Supervisor: Javier García González

- Title: Contribution of gas to the descarbonisation objetives of Europe. Modelling and regulatory framework
  Author: Ángel Rosso Mateo
  Supervisors: Javier Reneses Guillén and Jesús María Latorre Canteli

- Title: Application of machine learning techniques for the characterization of the European Electricity Market
  Author: Santiago Moreno Carbonell
  Supervisors: Eugenio Francisco Sánchez Úbeda and Antonio Muñoz San Roque

- Title: A Blockchain Proof-of-Concept for Managing Medical Records of Refugees
  Author: Sara Noureldin
  Supervisors: Mercedes Fernández García and David Contreras Bárzona

- Title: Incorporación de un nuevo factor sostenibilidad al modelo de valoración de activos de Fama-French
  Author: Alejandro Rodríguez Gallego
  Supervisors: Isabel Catalina Figuerola-Ferretti Garrigues and Sara Lumbreras Sancho

- Title: Characterisation of energy poor households in Spain proposal of feasible technical and policy solutions
  Author: Roberto Barrella
  Supervisors: José Ignacio Linares Hurtado and José Carlos Romero Mora
5.4.3 Submitted theses in other universities

- Title: Expansion governance of the integrated North Seas offshore grid
  Author: João Gorenstein Dedecca
  Supervisors: Paulien M. Herder and Rudi A. Hakvoort
  Delft University of Technology. Delft (The Netherlands).
  Date: November 30, 2018
6. Other activities

6.1 EES-UETP

The Electric Energy Systems - University Enterprise Training Partnership (EES-UETP) is a consortium of 1 companies and 12 universities and research centers in 10 European countries. They started operations in July 1992 under the program COMETT (COMmunity program for Education and Training in Technology). Since its origin, the IIT has participated very actively in the management and maintenance of this Association.

The main objective of the EES-UETP is to increase the competitiveness of the electric power industry sector through technology training. In this sense, the main activities of the EES-UETP are the organization of advanced courses in electric power systems and exchanges of students and researchers.


6.1.1 EES-UETP partners

Currently, the partners of the ESS-UETP are as detailed below, classified by country:

- **Belgium**
  - Katholieke Universiteit Leuven (KU Leuven)
- **Cyprus**
  - University of Cyprus
- **Denmark**
  - Danmarks Tekniske Universitet
- **France**
  - École Centrale de Nantes
- **Germany**
  - Technische Universität Dortmund
- **Italy**
  - Università degli Studi di Cagliari
- **Portugal**
Besides being an active member of the network, the Comillas Pontifical University covers the following positions in the EES-U ETP:
- Chairman of the Executive Board: Mr. Luis Rouco Rodríguez
- Coordinating Secretary: Mr. Luis Olmos Camacho

### 6.1.2 Teached courses

- **Advanced Data Analytics for Energy Systems**
  INESC Technology and Science (INESC TEC), Porto, Portugal

- **Low Inertia Power Systems**
  Universidad Pontificia Comillas, Madrid, Spain

- **Advanced controls for power systems with high penetration of renewables**
  Ecole Centrale de Nantes

- **Data-Driven Analytics and Optimization for Energy Systems**
  Technical University of Denmark, Denmark

### 6.2 International exchanges

It is an IIT policy to encourage and finance, to the extent possible, that its members expand their education and research experience abroad.

Some members of the IIT have spent some time at foreign universities and agencies, as visiting scientists or engineers, working on specific projects and expand its expertise in research problems. During this academic year, the stays are:


- David Roch Dupré, in Faculty of Science and Technology. Department of Information and Communication Sciences, Sophia University, Tokyo (Japan). March-June 2019.

- Diego Alejandro Tejada Arango, in Energy Transition Studies, ECN part of TNO, Amsterdam (Netherlands). October-December 2018.


6.3 Visiting professors

- Tayeb Allaoui, from L2GEGI Laboratory, Université Ibn Khaldoun Tiaret, Tiaret (Algeria). September 2018.

- Tayeb Allaoui, from L2GEGI Laboratory, Université Ibn Khaldoun Tiaret, Tiaret (Algeria). June 2019.

- Tayeb Allaoui, from L2GEGI Laboratory, Université Ibn Khaldoun Tiaret, Tiaret (Algeria). June-July 2019.

- Jenny Alexandra Cifuentes Quintero, from Program of Electrical Engineering, La Salle University, Bogotá (Colombia). November 2018-July 2019.

Visiting professors

- Paulo Sergio Franco Barbosa, from Water, Energy and Environmental Resources, School of Civil Engineering, Architecture and Urban Design, University of Campinas, Campinas (Brazil). September-October 2018.


6.4 Visiting students

- Ibtihal Abdelmotteleb, from Electrical and Control Engineering, Arab Academy for Science, Technology and Maritime, Cairo (Egypt). September-December 2018.

- Manuel Alejandro Álvarez Pérez, from Department of Engineering Sciences and Mathematics, Lulea University of Technology, Skelleftea (Sweden). October 2018.


- Anna Evans, from Institute for Data, Systems and Society, Massachusetts Institute of Technology, Cambridge, MA (USA). January-February 2019.

- Juan Carlo Intríago Zambrano, from Water Resources Management, Delft University of Technology, Delft (The Netherlands). September 2018.

- Alan Kaduvathookil Sabu, from Loyola-ICAM, LICET, Tamil Nadu (India). May-July 2019.

- Giovanni Micheli, from Department of Management, information and production engineering, University of Bergamo, Bergamo (Italy). November-December 2018.

- Giovanni Micheli, from Department of Management, information and production engineering, University of Bergamo, Bergamo (Italy). April-June 2019.

- Fabian Neumann, from Department of Informatics, Karlsruhe Institute of Technology, Karlsruhe (Germany). July 2019.

- José David Peñaloza Pérez, from Energetic Systems, Universidad Nacional Autónoma de México, Mexico City (Mexico). February-May 2019.


- Matteo Troncia, from Department of Electrical and Electronic Engineering, University of Cagliari, Cagliari (Italy). March-July 2019.

### 6.5 Courses offered and coordinated to external companies and institutions

The courses offered to companies are frequently related to research projects. The following courses have been given:

- Tomás Gómez San Román, José Ignacio Pérez Arriaga, Carlos Batlle López, Michel Rivier Abbad, Pedro Linares Llamas, Pablo Rodilla Rodríguez, Rafael Cossent Arín, Javier Reneses Guillén, Luis Olmos Camacho, Damián Laloux Dallemagne, "The regulation of the power sector". Florence School of Regulation (FSR). Italy. on-line.

- Pablo Frías Marín, José Pablo Chaves Ávila, "ISGAN Academy webinars". International Smart Grid Action Network (ISGAN). Italy.

- Pablo Rodilla Rodríguez, "FSR Summer school on regulation of energy utilities". Florence School of Regulation (FSR). Italy. Florence, Florence (Italy).
Courses offered and coordinated to external companies and institutions

- Luis Olmos Camacho, Luis Rouco Rodríguez, Rafael Palacios Hielscher, "Coordination of the course committee of the EES-U ETP network during the year 2018". Electric Energy Systems - University Enterprise Training Partnership Association (EES-U ETP). Italy. Madrid.


- Yolanda Ballesteros Iglesias, Eva Paz Jiménez, Juan Carlos del Real Romero, "Course on testing and analysis of adhesive joints for the training program of the European Engineer of Adhesives (EAE)". Asociación Española de Soldadura y Tecnologías de Unión (CESOL). Italy. Madrid.

- Rafael Cossent Arín, Pablo Rodilla Rodríguez, Michel Rivier Abbad, Javier Reneses Guillén, "FSR Annual Training on the Regulation of Energy Utilities (14th Edition)". European University Institute (EUI), Florence School of Regulation (FSR). Italy. Florence, Florence (Italy).


- José Antonio Rodríguez Mondéjar, Carlos Mateo Domingo, "Course on power system modeling using CIM". Crezer. Italy. Montevideo (Uruguay).

- Ignacio Egido Cortés, "Course on secondary regulation, RCP and AGC-IIT". Axpo Iberia SL. Italy. Madrid.

- Francisco José López Valdés, Jesús Jiménez Octavio, "63rd Association for the Advancement of Automotive Medicine Conference". Association for the Advancement of Automotive Medicine (AAAM). Italy. Madrid.
- Luis Olmos Camacho, Luis Rouco Rodríguez, Rafael Palacios Hielscher, "Coordination of the course committee of the EES-UETP network during the year 2019". Electric Energy Systems - University Enterprise Training Partnership Association (EES-UETP). Italy. Madrid.

- Francisco José López Valdés, "7th Advanced course on injury biomechanics". Inscripciones participantes. Italy. Madrid.


- Javier García González, "Practical course on the theoretical foundations of the EXLA tool and introduction to GAMS". Endesa Medios y Sistemas S.L. Italy. Madrid.

- Luis Rouco Rodríguez, Lukas Sigrist, Francisco Javier Renedo Anglada, "EES-UETP Course on low inertia power systems". EES-UETP. Italy. Madrid.


- Antonio Muñoz San Roque, Eugenio Francisco Sánchez Úbeda, José Portela González, Miguel Ángel Sanz Bobi, "Machine Learning Course for Endesa". Endesa S.A. Italy. Madrid.

- Luis Rouco Rodríguez, "Contribution to the ECN-EES-UETP Course on advanced controls for power systems with high penetration of renewables". Ecole Centrale de Nantes. Italy. Nantes (France).

- Pablo Rodilla Rodríguez, Paolo Mastropietro, "Course on wholesale market design". XM. Italy.

### 6.6 Seminars

Dissemination seminars are organized throughout the year at IIT facilities to present final or preliminary results of the ongoing research lines, as well as to discuss hot topics of general interest. The speakers of these seminars are either IIT
members or guest speakers coming from other institutions. The seminars that have taken place in this course are the following ones.


- Efraim Centeno Hernáez, "Lesson study: Researching about how we teach to improve how they learn". Reunión del GRID (Grupo de Reflexión sobre Innovación Docente). Universidad Pontificia Comillas.

- José Pablo Chaves Ávila, "Planning, taxes and state of the industry". Energías Renovables: Valores sociales y ambientales para la descarbonización. CONAMA 2018.. Fundación CONAMA.

- José Pablo Chaves Ávila, "Research activities within the Energy Sector in IIT-COMILLAS". ETIP SNET WG4. European Technology and Innovation Plattform (ETIP); Smart Networks for Energy Transition (SNET); Universidad Pontificia Comillas.


- Timo Gerres, "The role of nuclear power plants in electricity systems with high RES share". 14th Workshop on Industrial Systems and Energy Technologies - JOSITE’2019. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Tomás Gómez San Román, "Distribution grids: what are the new business models?". FSR Workshop: New business models in the electricity sector and developments behind the meter. Robert Schuman Center for Advanced Studies - European University Institute - Florence School of Regulation.

- Tomás Gómez San Román, "How to recover network and policy costs in the energy transition?". Transition énergétique: Consommateurs et réseaux. Liège Université.

- Tomás Gómez San Román, "How to recover the long term fixed costs of network infrastructure with declining use, more self-generation, local energy initiatives, etc.". CEER Workshop on Emerging issues in Network Tariffs. CEER-CRE-FSR.


- Tomás Gómez San Román, "How the energy market should be reformed so that it adapts to the characteristics of photovoltaic energy?". Unión Española Fotovoltaica - UNEF.

- Andrés González García, "Integrated grid and off-grid energy supply models: regulation, planning, innovation and governance for universal access to energy". International Conference on Solar Technologies & Hybrid Mini Grids to improve energy access. Universitat de Les Illes Balears.

- Andrés González García, "How electrification planning can help". 14º Foro BP de Energía y Sostenibilidad. Cátedra BP de Energía y Sostenibilidad de la Universidad Pontificia Comillas.
- Pedro Linares Llamas, "Viable business models for the access to electricity". Acceso universal a la energía eléctrica: retos regulatorios y empresariales. Cátedra BP de Energía y Sostenibilidad de la Universidad Pontificia Comillas.

- Pedro Linares Llamas, "Three critical crossroads: nuclear closure, transport taxation and decarbonization of the industry". 16º Encuentro del sector energético del IESE. IESE.


- Francisco José López Valdés, "Main guidelines of I+D+I". Reunión anual de la Plataforma de la Movilidad Conectada. ITS.


- Sara Lumbreras Sancho, "Cyber-ethic". Esto No Es una Charla; y Celera.

- Sara Lumbreras Sancho, "The challenge of transhumanism". Universidad Menéndez Pelayo.

- Sara Lumbreras Sancho, "Life from an avatar". FITUR 2019. FITUR.


- Luiz Augusto Nobrega Barroso, "Harmonizing energy planning and market mechanisms to ensure supply adequacy in electricity markets". Electricity systems of the future: incentives, regulation and analysis for efficient investment - MESW 02. Isaac Newton Institute for Mathematical Sciences.


- José Ignacio Pérez Arriaga, "Energy access". The power of Knowledge for a clean energy future. Enel Foundation.


- José Ignacio Pérez Arriaga, "Removing barriers to massive electrification business models". FSR Global Forum World Energy Transition. Florence School of Regulation (FSR).

- José Ignacio Pérez Arriaga, "Topics in electricity policy". Analysis and management of energy and environmental policy. Harvard University; Enel Foundation.

- José Ignacio Pérez Arriaga, "Utilities of the future, regulatory challenges and innovative tools". Regulatory challenges and tools to the introduction of new technologies. Inter-American Development Bank - IDB.

- María Ana Sáenz Nuño, "Review of the SI for the 21st century: the rules of nature create the rules of measurements". XVIII Semana de la Ciencia. Universidad Pontificia Comillas; Fundación para el conocimiento madri+d; y Comunidad de Madrid.

- Lukas Sigrist, "Electrification". The power of Knowledge for a clean energy future. Enel Foundation.


### 6.7 Organization of congresses, seminars and workshops

- Roberto Barrella, José Carlos Romero Mora, Efraim Centeno Hernández, "1ª Sesión Seminario Interdisciplinar. ¿Cómo garantizar el suministro de los hogares vulnerables?". Endesa. Madrid (Spain). November 2018.


6.8 Organization and management of other academic activities


- Aurelio García Cerrada, "Permanent member of Seminario Anual de Automática, Electrónica Industrial e Instrumentación - SAAEI". September 1999-Today.


6.9 Other activities


- José Pablo Chaves Ávila, Tomás Gómez San Román, Ibtihal Abdelmotteleb, Best Poster Award of the 8th International Conference on Integration of Renewable and Distributed Energy Resources - IRED 2018. «Simultaneous ascending auction: a local flexibility mechanism tool». Federal Ministry of Transport, Innovation and Technology (BMVIT); Austrian Institute of Technology (AIT); y International Smart Grid Action Network (ISGAN). Vienna (Austria). October 2018.

- Rafael Cossent Arín, Member of BRIDGE Working Group in representation of Integrid project in European Commission. Brussels (Belgium). April 2017- Today.


- Rafael Cossent Arín, Reviewer of "IEEE Transactions on Power Systems". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). April 2010- Today.

- Rafael Cossent Arín, Reviewer of "IET Generation, Transmission and Distribution". The Institution of Engineering and Technology (IET). Hertford (United Kingdom). April 2010- Today.

- Rafael Cossent Arín, Reviewer of "IEEE transactions on Smart Grid". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). March 2011- Today.


- Fernando de Cuadra García, Member of the Governing Board in Asociación/Colegio Nacional de Ingenieros del ICAI. Madrid (Spain). June 2010- Today.
- Fernando de Cuadra García, Member of Patronage in Fundación Universidad Loyola Andalucía. Seville (Spain). June 2010- Today.

- Asunción Paloma Cucala García, Member of Spanish Railway Technology Platform in Fundación de los Ferrocarriles Españoles. Madrid (Spain). January 2006- Today.

- Asunción Paloma Cucala García, Member of ICAITREN Committee in Asociación de Ingenieros de ICAI. Madrid (Spain). January 2017- Today.


- Pablo Frías Marín, Member of the Executive Committee of the International Smart Grid Action Network (ISGAN) in International Smart Grid Action Network (ISGAN). New Delhi (India). October 2015- Today.

- Pablo Frías Marín, Interview "Lights and shadows of the electric vehicle" in Cadena Ser. Madrid (Spain). February 2019.

- Aurelio García Cerrada, Member in Institute of Electrical and Electronic Engineers (IEEE). Piscataway (United States of America). January 1987- Today.


- Aurelio García Cerrada, Member of the Board of the Spanish Chapter of the IEEE Power Electronics, Industrial Electronics in Institute of Electrical and Electronic Engineers (IEEE). Piscataway (United States of America). July 2013- Today.

- Aurelio García Cerrada, Senior Member in Institute of Electrical and Electronic Engineers (IEEE). Piscataway (United States of America). February 2015- Today.


- Romano Giannetti, Member of the Working Group Metrology and Health in Asociación Española para la Calidad (AEC). Madrid (Spain). September 2012- Today.

- Romano Giannetti, Reviewer of "Physiological Measurement". IOP Publishing Ltd.. Bristol (United Kingdom). January 2006- Today.

- Romano Giannetti, Reviewer of "IEEE Transactions on Biomedical Engineering". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). January 2006- Today.

- Romano Giannetti, Reviewer of "Journal of Medical and Biomedical Engineering". Springer. Heidelberg (Germany). January 2006- Today.


- Tomás Gómez San Román, Member in Institute of Electrical and Electronic Engineers (IEEE). Piscataway (United States of America). January 1988- Today.


- Tomás Gómez San Román, Senior Member in Institute of Electrical and Electronic Engineers (IEEE). Piscataway (United States of America). January 2010- Today.

- Tomás Gómez San Román, Member of the International Scientific Reference Group of the SweGRIDS Program in Royal Institute of Technology (KTH). Stockholm (Sweden). January 2013- Today.

- Tomás Gómez San Román, Member of the Training Academy Advisory Board in Council of European Energy Regulators (CEER). Brussels (Belgium). March 2016- Today.
Other activities


- Tomás Gómez San Román, Course "How to design network charges in a context of high penetration of distributed resources, prosumers, on-site distributed generation an Local Energy Communities". Council of European Energy Regulators (CEER). Brussels (Belgium). March 2019.


- Francisco Javier Herraiz Martínez, Reviewer of "IEEE Transactions on Antennas and Propagation". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). January 2010- Today.


- Pedro Linares Llamas, Member of the Committee of experts on energy transition scenarios in Ministerio de Energía Turismo y Agenda Digital. Madrid (Spain). July 2017- Today.


- Gregorio López López, Member of IEEE Communications Society in Institute of Electrical and Electronic Engineers (IEEE). Piscataway (United States of America). July 2016- Today.


- Francisco José López Valdés, Member of Editorial Board of the journal «Injury Epidemiology» in Springer. London (United Kingdom). August 2013- Today.

- Francisco José López Valdés, Member of AAAM Scientific Program Committee in Association for the Advancement of Automotive Medicine (AAAM). Chicago (United States of America). October 2013-October 2019.

- Francisco José López Valdés, Member of IRCOBI Council in International Research council on Biomechanics of Injury (IRCOBI). Zurich (Switzerland). September 2014- Today.

- Francisco José López Valdés, Member of the Board of Directors of AAAM in Association for the Advancement of Automotive Medicine (AAAM). Chicago (United States of America). September 2015- Today.

- Francisco José López Valdés, Member of Cost Action Management Committee TU1407 in European Cooperation in Science and Technology (COST). Brussels (Belgium). January 2016- Today.

- Francisco José López Valdés, Member at large, Executive Committee, Board of Directors of AAAM in Association for the Advancement of Automotive Medicine (AAAM). Chicago (United States of America). September 2017- Today.


- Francisco José López Valdés, Reviewer of "Journal of Medical and Biological Engineering". Springer-Verlag, GmbH. Heidelberg (Germany). January 2014- Today.


- Francisco José López Valdés, Reviewer of "IEEE Transactions on Intelligent Transportation Systems". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). January 2017- Today.


- Sara Lumbreras Sancho, Member of the Management Committee of the Interdisciplinary Association José de Acosta (ASINJA) in Asociación Interdisciplinar José de Acosta (ASINJA). Madrid (Spain). September 2014-Today.

- Sara Lumbreras Sancho, co-Director of "Celeratón, marathon of interdisciplinary research" in Asociación Celera; Fundación Rafael del Pino; y Universidad Pontificia Comillas. Madrid (Spain). January 2017-Today.


- Francisco Martín Martínez, Reviewer of "Energies". MDPI AG. Basel (Switzerland). January 2018- Today.


- Francisco Martín Martínez, Reviewer of "Electric Power Systems Research". Elsevier Science Ltd.. Lausanne (Switzerland). November 2018- Today.


- José Ignacio Pérez Arriaga, Member of the Scientific Advisory Board of the «Next Infrastructures Program» in Delft University. Delft (Netherlands). June 2006- Today.

- José Ignacio Pérez Arriaga, Member of the Scientific Committee of IEFE in Bocconi University. Milano (Italy). September 2007- Today.

- José Ignacio Pérez Arriaga, Member of Scientific Committee in Economics for Energy. Vigo (Spain). July 2010- Today.


- José Ignacio Pérez Arriaga, Member of Editorial Board of the journal «Economics of Energy and Environmental Policy». Editorial Board. in International Association for Energy Economics (IAEE). Stockholm (Sweden). May 2011- Today.

- José Ignacio Pérez Arriaga, Member of the Board of Appeal in Agency for the Coordination of Energy Regulators (ACER). Ljubljana (Slovenia). October 2011- Today.

- José Ignacio Pérez Arriaga, Member of the International Scientific Committee in Enel Fundación. Rome (Italy). November 2011- Today.

- José Ignacio Pérez Arriaga, Member of the Advisory Board in ONGAWA. Madrid (Spain). July 2013- Today.

- José Ignacio Pérez Arriaga, Member of the Scientific Advisory Board in WAME & EXPO 2015. Milano (Italy). July 2013- Today.

- José Ignacio Pérez Arriaga, Director of the On-line Course on Regulation of the Power Sector in Florence School of Regulation; Universidad Pontificia Comillas. February 2015- Today.


- José Ignacio Pérez Arriaga, Tomás Gómez San Román, Member of Editorial Board of the journal «Papeles de Energía» in FUNCAS. Madrid (Spain). June 2015- Today.

- Fernando Emilio Postigo Marcos, Nicolás Mariano Morell Dameto, Grant awards "Iberdrola Scholarship to research in energy and the environment". Iberdrola. Madrid (Spain). June 2019.


- Andrés Ramos Galán, Research proposal evaluator in "Université Libre de Bruxelles (ULB)". Université Libre de Bruxelles (ULB). Madrid (Spain). January 2019.


Other activities

- Andrés Ramos Galán, Reviewer of "IEEE Transactions on Smart Grid". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). September 2012- Today.


- Juan Carlos del Real Romero, Member of Editorial Advisory Board of the journal «Journal of Adhesion» in Taylor & Francis Ltd.. Philadelphia (United States of America). September 2012- Today.

- Juan Carlos del Real Romero, Member of Editorial Board of the journal «Applied Adhesion Science» in Springer. Heidelberg (Germany). July 2013- Today.


- Juan Carlos del Real Romero, Reviewer of "Biomimetics". MDPI AG. Basel (Switzerland). January 2017- Today.


- Ramón Rodríguez Pecharromán, Reviewer of "IEEE Transactions on Vehicular Technology". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). January 2015- Today.


- Luis Rouco Rodríguez, Member in Institute of Electrical and Electronic Engineers (IEEE). Piscataway (United States of America). January 1989- Today.

- Luis Rouco Rodríguez, Member of the Executive Committee of the National Committee of Spain in International Council on Large Electric Systems (CIGRE). Paris (France). January 2000- Today.


- Luis Rouco Rodríguez, President of the Spanish Chapter of the Power Engineering Society in Institute of Electrical and Electronic Engineers (IEEE). Seville (Spain). July 2009- Today.


- María Ana Sáenz Nuño, Member of the Forum on University Education on Standardization (EUE Forum) in AENOR. Madrid (Spain). September 2015- Today.


- María Ana Sáenz Nuño, Coordinator of the forum on Metrology Clinical on AEC in Asociación Española para la Calidad (AEC). Madrid (Spain). July 2016-Today.

- María Ana Sáenz Nuño, Néstor Pérez Mallada, Director of awarded final project in "Une Awards. Director del TFM «Propuesta de norma técnica para la gestión metrológica en el sector sanitario español » por David Palancar Martínez.". Asociación Española de Normalización - U N E. Madrid (Spain). October 2018.


- Lukas Sigrist, Reviewer of "IEEE Transactions on Power Systems". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). December 2010- Today.


- Lukas Sigrist, Reviewer of "IEEE Transactions on Smart Grid". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). September 2012- Today.


- Lukas Sigrist, Reviewer of "Energies". MDPI AG. Basel (Switzerland). August 2016- Today.


- Mariano Ventosa Rodríguez, Member of the Editorial Board of the journal «Anales de Mecánica y Electricidad» in Asociación de Ingenieros del ICAI. Madrid (Spain). September 2006- Today.

- Mariano Ventosa Rodríguez, Member of the Committee on Energy and Engineering Arbitration and Mediation in Asociación Europea de Arbitraje (AEADE). Madrid (Spain). December 2010- Today.

- Mariano Ventosa Rodríguez, Member of the Working Group on Digital Transformation in Círculo de Empresarios. Madrid (Spain). November 2017- Today.

- Mariano Ventosa Rodríguez, Antonio Muñoz San Roque, Interview "Two engineers and one destination" in Universidad Pontificia Comillas. Madrid (Spain). December 2018.


- Sonja Wogrin, Member in Institute of Electrical and Electronic Engineers (IEEE). Piscataway (United States of America). January 2014- Today.


- Sonja Wogrin, Reviewer of "IEEE Transactions on Smart Grid". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). January 2012- Today.


- Sonja Wogrin, Reviewer of "IEEE Transactions on Sustainable Energy". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). January 2017- Today.

7. Data about IIT

The relevant numbers of the academic year 2018 - 2019 are shown below, as well as the historical evolution of the turnover of the Institute and of its staff, separated into academic staff and research assistants:

5.4 M€ Turnover
72 Professors and researchers
31 Research assistants
87 Research projects
30 Consultancy projects
17 Services and analysis projects
5 Chapters in books
58 Papers published in JCR journals
13 Papers published in other journals
42 Papers presented at conferences
14 Technical reports
7 Submitted theses
32 Ongoing theses
10 Visiting professors and 15 visiting students
9 International exchanges
25 Courses offered to external entities