ANNUAL ACADEMIC REPORT

Academic Year

2019-2020

IIT
INSTITUTO DE INVESTIGACIÓN TECNOLÓGICA

Index

Director's greeting

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 an 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.

Andrés Ramos Galán

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 participation in specific projects of interest to the industry and the administration. It is a nonprofit institute that seeks to be flexible and pragmatic in the way they work. Its funding comes mainly from projects contracted with companies and, therefore, meet the social demand proven.

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 core of IIT is composed of a group of Professors and Researchers. This group is supplemented by postgraduate researchers as Research Assistants, dedicated to the Institute exclusively. Work teams are formed between both groups for the development of research projects, some of which are made dissertations.

This report covers the period for the academic year 2019 - 2020, from September 1, 2019 to August 31, 2020.

2. Organizational structure

2.1 Management

The management of the IIT during the course 2019 - 2020 has been carried out by the following Professors and Researchers:

- **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 IIT during the course 2019 - 2020 were the following ones:

- **Calvo Báscones, Pablo**. IEF Representative
- **Cossent Arín, Rafael**. Reseacher Representative
- **García González, Javier**. Deputy Director for Academic and Economic affairs
- **Gerres, Timo**. IEF Representative
- **Gómez San Román, Tomás**. Director
- **López López, Álvaro Jesús**. Reseacher Representative
- **Ramos Galán, Andrés**. Reseacher Representative
- **Rivier Abbad, Michel**. Reseacher Representative
- **Rodilla Rodríguez, Pablo**. Reseacher Representative
- **Sigrist, Lukas**. Secretary General
- **Sigrist, Lukas**. Deputy Director for Institutional Relationships

2.3 Area coordinators

The coordinators of the eight research areas that group the different activities carried out in the IIT during the course 2019 - 2020 are 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 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 IIT consisted of the following Professors and Researchers:

- **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)
  Areas of interest: Nash equilibriums. Possibility theory. Optimization under uncertainty. Electricity markets. Cryptanalysis.

- **Centeno Hernáez, Efraim**. Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electronics Engineer (Comillas)
  Areas of interest: Electric power system operation models. Hydrothermal coordination. Electric power markets.

- **Cerisola López de Haro, Santiago**. Research Affiliate
  Ph.D. in Industrial Engineering (Comillas)
  Mathematics Science degree (UCM)
  Areas of interest: Pure and applied mathematics. Optimization. Stochastic optimization. Decomposition techniques.

- **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)
  Areas of interest: Wireless Networks. Bluetooth architecture. Information Retrieval Systems. Software development. IoT, Cloud and Big Data. Blockchain.

- **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)

Areas of interest: Large-scale modelling, simulation and optimisation problems. Knowledge engineering. Intelligent CAD. Control theory. Power systems. Railways systems. Software engineering and graphical languages for the specification of digital systems.

- **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 Associate 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)
  Areas of interest: Systems modelling, analysis and simulation. Simulation techniques for optimisation and control problems. Design, management and control of railway systems.

- **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**. Senior 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 aplied 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)
  Areas of interest: Economics and regulation of the energy sector. Planning and operation of transmission and distribution electricity networks. Integration of renewable and distributed energy resources in power systems. Power quality standards and regulation. Electric vehicles. Smart grids.

- **Herraiz Martínez, Francisco Javier**. Assistant Professor
  Engineer and Ph.D. degrees in Telecommunications. Carlos III University of Madrid (Spain)
  Areas of interest: Passive sensors and RFID systems. Electromagnetic metamaterials. Antennas. Microwave circuits.

- **Latorre Canteli, Jesús María**. Research Assistant Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electronics Engineer (Comillas)
  Areas of interest: Operations research and modeling. Stochastic programming. Parallel and distributed computing. Algorithms and numerical methods.

- **Linares Llamas, Pedro**. Professor
  Ph.D. in Agricultural Economics (UPM)
  Agricultural Engineering degree (UPM)
  Areas of interest: Energy economics. Energy planning models. Integration of renewable energies. Environmental economics. Environmental policy instruments. Multiple criteria decision making.

- **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, 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.

- **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)
  Areas of interest: Industry 4.0, Machine Learning, IoT, Railway Power Systems, Railway System Simulation, Dynamic System Control.

- **Lumbreras Sancho, Sara**. Associate Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electrical Engineer (Comillas)
  Areas of interest: Decision methods applied to complex problems. ---Tecniques:--- 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)

Areas of interest: Signal processing. Communication systems. Power Line Communication. Wireless communications.

- **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)
  Areas of interest: Time series forecasting. Data mining. Application of artificial intelligence techniques to the monitoring and diagnosis of industrial processes. Analog electronics and digital signal processing.

- **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)
  Areas of interest: Power system economics. Stochastic optimization. Game theory. Energy policy.

- **Olmos Camacho, Luis**. Research Associate Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electrical Engineer (Comillas)
  Areas of interest: Regulation of the energy sector. Transmission of electricity. Power economics. System identification.

- **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)
  Areas of interest: Development of new algorithms and computer implementation. Modeling of complex systems. Mathematical techniques of operations research and their application to large-scale problems. Large-scale optimization techniques. Stochastic optimization. Benders decomposition. Planning and operation of electric energy systems -models for generation and transmission network planning, generation operation models-. Economy of the electric sector. Computational techniques and analytical methods for planning, operations, and control. Economics, market organization, cost structures, pricing, and risk management. Reliability, uncertainty, and probability and stochastic system applications. Emerging methods for restructured systems. Generation system resource planning. Transmission system planning. Industry restructuring planning and policy issues.

- **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)
  Areas of interest: Embedded systems. Digital systems. Autonomous systems (batteries). HW design. PCB design. PCB manufacturing. Digital communications (wired and wireless). Communication protocols. Programmable logic. Microcontrollers programming.

- **Romero Mora, José Carlos**. 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)
  Areas of interest: Power engineering. Power systems regulation. Power systems planning and operation.
  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.

- **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)
  Areas of interest: Monitoring and analysis of industrial processes. Modelling and simulation of industrial components performance. Expert systems. Neural networks. Fuzzy logic. Genetic algorithms. Failure detection techniques. Reliability. Predictive maintenance. Image and voice processing.

- **Sigrist, Lukas**. Research Assistant Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electrical and Electronics Engineer (École Plytechnique Fédérale de Lausanne - EPFL, Switzerland)
  Areas of interest: Modeling, analysis and control of electric power systems. Energy Systems Models.

- **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.)
  Areas of interest: Optimization. Bilevel programming. Generation expansion planning. Energy storage.

2.6 Associated academic staff

The following professors have collaborated with IIT as Associate Researchers:

- **Alfaya Sánchez, David**. Assistant Professor
  PhD in Mathematics . Universidad Autónoma de Madrid (UAM)
  Bachelor Degree in Mathematics. Universidad Autónoma de Madrid (UAM)
  Education, Culture and Sports).
  Computer Science Engineer. Universidad Autónoma de Madrid (UAM)
  Master in Mathematics and Applications . Universidad Autónoma de Madrid (UAM)
  Master in Research and Innovation in Communications and Information Technologies. Universidad Autónoma de Madrid (UAM)

  Areas of interest: Pure and applied mathematics.
  Study of the geometry of moduli spaces (specially moduli of decorated bundles including, among others, Higgs bundles, connections and parabolic structures). Information Retrieval, Information Geometry, Blockchain technologies and interactions between Artificial Intelligence and Mathematics.

- **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)

  Areas of interest: Materials. Environment.

- **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

Associated academic staff

- **Carnicero López, Alberto**. Senior Associate Professor
  Ph.D. in Industrial Engineering (Comillas)
  Mechanical Engineer (Comillas)
  Areas of interest: Numerical methods in engineering. Railway Catenary. Catenary-pantograph dynamic interaction

- **Castro Ponce, Mario**. Senior Associate Professor
  Ph.D. in Physics Science (UCM)
  Physics Science degree (UCM)
  Areas of interest: Fluid mechanics. Statistical mechanics. Communication networks. Nonlinear physics. Nanomaterials. Biophysics.

- **Cledera Castro, Mª del Mar**. Assistant Professor
  Industrial Engineer. Universidad Politécnica de Madrid.
  Ph.D. in Industrial Engineering. Universidad Pontificia Comillas.
  Areas of interest: Energy and Environment. Materials.

- **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)
  Areas of interest: Measurement instrumentation and methodology. Biomedical instrumentation. Noise measurements.

- **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.

- **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)
  Areas of interest: Computacional fluid dynamic. Fluid control. Hydraulic energy. Heat transfer. Olehidraulic systems.

- **Morales Contreras, Manuel Francisco**. Assistant Professor
  Industrial Engineer ICAI, master in Mechanics
  PhD Economics and Business Administration ICADE
  Areas of interest: Sustainability and global supply chain management; lean and efficient operations; process innovation; hospitality and healthcare sectors.

- **Muñoz Frías, José Daniel**. Associate Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electronics Engineer (Comillas)
  Areas of interest: Digital systems design. Computer architecture. Motor drives control. Design of embbedded systems for automatic control applications.

- **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.

- **Sánchez Merchante, Luis Francisco**. Assistant Professor
  Telecommunications Engineer (Universidad Politécnica de Madrid)
  Master's degree in Multimedia and Communications (Universidad Carlos III de Madrid)
  PhD in Information Technology (Universidad Tecnológica de Compiègne)
  Areas of interest: Advanced analytics on Big Data platforms
  Machine Learning
  Smart cities

- **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.

2.7 Research assistants

The Research Assistants (PhD students) that developed their activity at the IIT during the academic course 2019 - 2020 were the following ones:

- **Álvarez Quispe, Erik Francisco**. Bachelor's Degree in Mechanical and Electrical Engineering. National University of Engineering (Peru).
  Master's Degree in Electrical Engineering. State University of Campinas (Brazil).

- **Ávila Martínez, Régulo Enrique**. Bachelor Degree in Electrical Engineering. University of Oriente (UDO), Venezuela.
  Master degree in Renewable Energies in Electrical Systems. Carlos III University of Madrid (UC3M), Spain.
- **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)
- **Brito Pereira, Paulo**. Degree in Electrical Engineering and Masters Degree in Industrial Engineering (University of Las Palmas of Gran Canaria). Masters Degree in the Electric Power Industry (Comillas Pontifical University).
- **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).
- **Casillas Clot, Cristina**. Bachelor's degree in Industrial Engineering. Politechnic University of Madrid.
  Master's degree in Industrial Engineering. Politechnic University of Madrid.
- **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)
- **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.
- **Freire Barceló, Teresa**. Degree in Industrial Engineering. Universidad Pontificia de Comillas
  Máster in Industrial Engineering. Universidad Pontificia de Comillas
- **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 Universiteit Delft) (NL)
- **Gholami Mayani, Mahdieh**. B.S. from Shahrood University of Technology and M.S. degree in electrical engineering from Shahid Beheshti University of Tehran.
- **Gómez Pérez, Jesús David**. Electrical engineer and M.Sc. in electrical engineering. Universidad Tecnológica de Pereira (Colombia)

- **Gómez Sánchez, Stefanía**. Degree in Industrial Engineering. (Escuela Colombiana de Ingeniería Julio Garavito, Colombia)
  Master's Degree in Optimization. (Universidad Autónoma Metropolitana, México)
- **Güitta López, Lucía**. Degree in Electromechanical Engineer (Comillas)
  Master's Degree in Industrial Engineering (Comillas)
  Master in Smart Industry (Comillas)
- **Herding, Leslie**. Bachelor of Engineering. Technische Hochschule Köln (Germany).
  Master in Research in Energy Efficiency and Sustainability in Industry, Transport, Construction and Town Planning. UPV/EHU (Bilbao).
- **Herrero Rozas, Luis Alberto**. Degree in Chemical Engineering. Universidad de Cantabria.
  Master's degree in Chemical Engineering. (Universidad de Cantabria (UC) and Universidad del País Vasco (UPV/EHU)
- **Huclin, Sébastien**. Master's degree in Physics (University of Paris-Sud)
- **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)
- **López de Armentia Hernández, Sara**. Bachelor Degree in Industrial Technology Engineering. Universidad Politécnica de Madrid.
  Master Degree in Materials Science and Engineering. Universidad Carlos III de Madrid.
- **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)
- **Mohammed Nour, Morsy Abdelkader Morsy**.
  Bachelor's degree in Electrical Engineering. Aswan University, Aswan, Egypt.
  Master's degree in Electrical Engineering. Budapest university of Technology and Economics, Budapest, Hungary.
- **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 Intitute of Technology, USA.
- **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)
- **Pizarroso Gonzalo, Jaime**. Electromechanical Engineer. Universidad Pontificia Comillas.
  Master's Degree in Industrial Engineering (MII) and Master's Degree in Smart Industry (MIC). Universidad Pontificia Comillas.
- **Postigo Marcos, Fernando Emilio**. Electromechanical Engineer (Comillas)
  M.Sc. in Industrial Engineering (Comillas)
- **Rajabdorri, Mohammad**. Bachelor's degree of Electrical Power Engineering. Shiraz University, Iran.
  Master's in Electrical Power Systems. Shiraz University of Technology, Iran.
- **Roch Dupré, David**. Ph.D. (with International Mention) in Engineering Systems Modeling.(Comillas)
  Electromechanical Engineer. (Comillas)
  M.Sc. in Industrial Engineering. (Comillas)
  Official Master's Degree in Research in Engineering Systems Modeling (MRE) (Comillas)
- **Rosa, Luca de**. Bachelor Degree in Energy Engineering. Politecnico of Milan.
  Msc in Sustainable Energy Engineering. KTH Stockholm.
  Msc in Energy Engineering and Management. Instituto Superior Tecnico Lisbon.
- **Sánchez Contreras, Gonzalo**. Degree in Electromechanical Engineering. Comillas Pontifical University.
  Master's Degree in Industrial Engineering. Comillas Pontifical University.
- **Sidelkivska, Valerya**. Bachelor's Degree in Psychology and Communications. Saint Louis University, Madrid. Master's Degree in Brain and Cognition. University of Pompeu Fabra, Barcelona.
  Master's Degree in Pharmacological Research, specialization in Neuropsychopharamcology. Autonomous University of Madrid.
- **Valarezo Rivera, Orlando Mauricio**. Bachelor's degree in Electrical Engineering (Escuela Superior Politécnica del Litoral - ESPOL)
  Master's degree in Power System and its Automation (Shandong University)
  Master's degree in Computational Engineering and Mathematics (Universitat Rovira i Virgili)
- **Valdano, Manuel**. Mechanical Engineering. Universidad Nacional de Rio Cuarto (Argentina).
- **Valentín Virseda, Juan José**. Bachelor's Degree in Energy Enginnering. Universidad Politécnica de Madrid (UPM)
  Master of Science in Sustainable Energy. Technical University of Denmark (DTU)
- **Valizadeh, Reza**. Bachelor's degree in Aerospace Engineering. Polytechnic of Tehran.
  MS.c. in aerodynamics. Sharif University of Technology.

- **Ziegler, David Ulrich**. B.Eng. in Energy Management. Reinhold-Wuerth-Hochschule (Germany)
  M.Eng. in Energy Engineering. Universidad Politécnica de Cataluña (Barcelona)-
  M.Sc. in Electrical Engineering as part of the European master program from EIT (European Institute of Innovation and Technology)

2.8 Services staff

2.8.1 Systems administrator staff

The staff responsible for managing networks and computer systems consists of:

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

2.8.2 Administrative staff

The staff that manage the documentation, the general and technical secretariat and the trips consist 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 are mainly focused 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

This area is focused on technical fields different from the energy sector, and it is divided into four different technical areas:

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 area 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 estrategies 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)

  SILILA project develops a set of tools and optimal estrategies for the efficient participation of renewables energies in the Spanish electricity markets.

- **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.

- **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 objetive 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 performace in a wide frequency range, new settings will be proposed.

- **Assistance and maintenance of Middle Office models**
  Enel Iberoamerica S.R.L. January 2019 - December 2019. (Javier Reneses Guillén, Antonio Bello Morales, Alberto Orgaz Gil, Geovanny Alberto Marulanda García, Luis Manuel Montero Guirao, Celia Mosácula Atienza, Ángel Rosso Mateo, Rodrigo Alejandro de Marcos Peirotén)

  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 OMEGA model, consideration of gas demand in Monte Carlo executions, and daily simulations**
  Enel Iberoamerica S.R.L. January 2019 - December 2019. (Javier Reneses Guillén, Antonio Bello Morales, Ángel Rosso Mateo, Luis Manuel Montero Guirao)

  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**
  Enel Iberoamerica S.R.L. January 2019 - November 2019. (Javier Reneses Guillén, Antonio Bello Morales, Alberto Orgaz Gil, Geovanny Alberto Marulanda García, Luis Manuel Montero Guirao, Daniel López Rodríguez)

  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**
  Enel Iberoamerica S.R.L. January 2019 - September 2019. (Antonio Bello Morales, Javier Reneses Guillén, Alberto Orgaz Gil, Geovanny Alberto Marulanda García, Luis Manuel Montero Guirao)

  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.

- **Integration of Expande and Valsa models. Codex**
  Endesa Medios y Sistemas S.L. January 2019 - December 2019. (Efraim Centeno Hernáez, Diego Alejandro Tejada Arango, Francisco Alberto Campos Fernández)

  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.

- **Analysis of the expansion and operation of the Spanish electricity system for a 2030-2050 time horizon**
  Iberdrola España S.A.U. January 2019 - December 2020. (Michel Rivier Abbad, Tomás Gómez San Román, Álvaro Sánchez Miralles, Francisco Martín Martínez, José Pablo Chaves Ávila, Teresa Freire Barceló, Timo Gerres)

  The main objective of this line of research is to model and analyze possible scenarios of investment and operation of energy resources for the Spanish electricity system in the 2030-2050 horizon. More specifically, the objective is to evaluate the potential and role that each generation, storage and consumption technology can play in the future mix of the electricity system, identifying the factors and scenarios that are most critical for each one of them.

- **Modeling and assessment of electrical networks´ requirements for the energy transition in Spain**
  Iberdrola España S.A.U. January 2019 - December 2020. (Michel Rivier Abbad, Tomás Gómez San Román, Rafael Cossent Arín, José Pablo Chaves Ávila, Leslie Herding, Andrés Ramos Galán, Sara Lumbreras Sancho)

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**
  Enel Iberoamerica S.R.L. January 2019 - December 2019. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

  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.

- **Further developments to the hydrothermal scheduling model MHE**
  Iberdrola Generación España, S.A.U. February 2019 - December 2019. (Andrés Ramos Galán, Jesús María Latorre Canteli)

  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.

- **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 Hernáez)

  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.

- **Obtaining a feasible unit commitment of thermal groups using Machine Learning techniques from the results of VALORE**
  Enel Iberoamerica S.R.L. July 2019 - December 2019. (Javier Reneses Guillén, Antonio Bello Morales, Alberto Orgaz Gil, Geovanny Alberto Marulanda García, Luis Manuel Montero Guirao)
  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.

- **Development of the Excom-Exla Minimum Viable Product and improvements in the modeling of hydraulics**
  Endesa Medios y Sistemas S.L. August 2019 - December 2019. (Javier García González, Pedro de Otaola Arca, Ignacio Candela Ripoll)
  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.

- **Power system economic scheduling modeling tools for the GCC interconnector**
  Massachusetts Institute of Technology (MIT). September 2019 - June 2020. (Pablo Rodilla Rodríguez, Paolo Mastropietro)
  Unit-commitment and regional market simulation models for the analysis of future scenarios of flexibility needs and market designs in the GCC interconnector context.

- **VALORE in a grid and cloud computing environment using Linux. Consolidation of basic functionalities for the LPM**
  Enel Iberoamerica S.R.L. September 2019 - December 2019. (Antonio Bello Morales, Javier Reneses Guillén)
  This project focuses on consolidating a version of VALORE`s deterministic and Montecarlo executions in a cloud and grid computing environment that works in Linux.

- **Tools for the analysis of security and quatility of Asturias transmission grid**
  Energias de Portugal, S.A. (EDP). September 2019 - July 2020. (Luis Rouco Rodríguez, Enrique Lobato Miguélez, Lukas Sigrist, Kai Doenges)
  The aim of this research project is to develop computer tools for the analysis of security and quality of Asturias transmission grid.

- **Computational model to analyse the response of consumers to prices and charges in an environment of decarbonisation, decentralization and digitalization of electrical systems**

  Fundación Iberdrola España. September 2019 - July 2020. (José Pablo Chaves Ávila, Nicolás Mariano Morell Dameto, Tomás Gómez San Román)

  The electrical system is evolving towards a low-emission system and, at the same time, developing technological changes which allow a more active participation of consumers in the electrical system, through local generation, electric vehicles or demand management solutions, among others.
  The active participation of consumers in the system is conditioned by the price signals they receive. This research project aims to model the reaction of these consumers, so that simulating market prices and the different tariff options for network charges and other regulated charges, this model can determine their consumption patterns changes when they incorporate the technologies listed above. In addition, it is intended to analyse the impact of these changes on the total costs of the system. As a result of these analyses, tariff options that promote efficiency and also consider equity concerns for the cost allocation among different types of consumers may be recommended.

- **Micro-grids with renewables and storage to improve resiliency in future distribution networks**

  Fundación Iberdrola España. September 2019 - August 2020. (Carlos Mateo Domingo, Tomás Gómez San Román, Fernando Emilio Postigo Marcos)

  The digitalization of the power system is modifying how the system is planned. The transmission network is highly automated and digitized, but it covers only 3% of the kilometers of the European electricity networks. The remaining 97% is covered by the distribution networks, which are significantly less monitorized and mainly radial, making more difficult to restore the service.
  In this project it is developed a model to improve the resiliency of large-scale distribution networks, while minimizing the cost of the installations. A multi-objective optimization is implemented using meta-heuristics. The system is comprised of photovoltaics, batteries and smart switches, which are optimally located in the network and sized.

- **Assistance for the improvement of hydro management and for obtaining feasible simulated paths**

  Endesa Medios y Sistemas S.L. October 2019 - December 2019. (Antonio Bello Morales, Javier Reneses Guillén)

  This project focuses on the assistance to the Hydro Squad in order to successfully implement the simulation of hydro paths in VALORE, ensuring consistency in the representation of hydro management. In addition, this project focuses on the design of an automatic tool for guaranteeing the feasibility of the simulated scenarios.

- **CEVESA: A long term planning model for investment decisions in electricity generation and transportation**
  INESC TEC. October 2019 - November 2020. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

  CEVESA is a dynamic multizonal generation expansion planning model for the Spanish power system (assumed as a single-node), that considers both investments made by distributed customers in Distributed Energy Resources (DER: generation and storage) and by generation companies (GENCOs) in Centralized Resources (CR: conventional thermal generation plants, renewable generation and centralized storage). It is also connected with the transport sector by including investments decisions on Electric Vehicles (PEV) and Internal Combustion Engine Vehicles (CEV), considering infrastructure deployment, fuel, and social and environmental costs of both technologies. The model is based on a multizonal conjectural-variation equilibrium with price-response conjectures with hourly detail, energy and endogenous secondary reserve requirements, ramping constraints, and start-ups and shut-downs.

- **Improvements in the representation of the Collar in ACUARIO**
  Enel Iberoamerica S.R.L. December 2019 - December 2019. (Antonio Bello Morales, Javier Reneses Guillén)

  This project includes different developments to improve the representation of the Collar and the level of information of ACUARIO.

- **Evolutionary developments in the process of integrating VALORE-LPM outputs in Big Data**
  Enel Iberoamerica S.R.L. December 2019 - December 2019. (Antonio Bello Morales, Javier Reneses Guillén)

  The objective of this collaboration is to carry out different developments and improvements in the process of integration in the Big Data of the outputs of the VALORE-LPM executions for each one of the cases executed in the Montecarlo tool.

- **Outputs of VALORE-LPM in Big Data with Parquet format**
  Enel Iberoamerica S.R.L. December 2019 - December 2019. (Antonio Bello Morales, Javier Reneses Guillén)

  The objective of this collaboration is to carry out all the necessary developments to enable the outputs of the VALORE-LPM executions of each one of the cases executed in the Monte Carlo tool to be subsequently loaded in the Big Data using Parquet format.

- **Development of a tool to make feasible hydro generation scenarios**
  Enel Iberoamerica S.R.L. January 2020 - February 2020. (Antonio Bello Morales, Javier Reneses Guillén, Alberto Orgaz Gil)

  This project continues the work carried out in the previous collaboration to develop in a Cloud environment an automatic tool able to make feasible the simulated scenarios of hydro generation.

- **Assistance and maintenance of Middle Office models**
  Enel Iberoamerica S.R.L. January 2020 - December 2020. (Javier Reneses Guillén, Antonio Bello Morales, Alberto Orgaz Gil, Geovanny Alberto Marulanda García, Luis Manuel Montero Guirao, Cristina Casillas Clot)

  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-VEIMAO, AURIGA, and VALORE-CLOUD.

- **VALSA-EXPANDE integration and unification of algorithms,single interface and preparation for migration to the cloud**
  Endesa. January 2020 - December 2020. (Efraim Centeno Hernáez, Luis Alberto Herrero Rozas)

  The main objective of this project is to continue with the integration of EXPANDE (and MORSE) systems in CODEX. Specifically, this collaboration aims at addressing the representation of renewable generation and storage, as well as the generation of input scenarios and the preparation for integer and stochastic executions.

- **Modeling of the net head effect and time-delays in the tool EXCOM-EXLA, and refinement of the cost-revenue algorithm**
  Endesa Medios y Sistemas S.L. January 2020 - April 2020. (Javier García González, Pedro de Otaola Arca, Ignacio Candela Ripoll)

  The objective of this project is to introduce improvements in the modeling of the hydraulic system (effect of the net head effect, and the time delays). In addition, the algorithm used to ensure consistency between operating costs and market revenues will be updated.

- **VALSA-EXPANDE integration and unification of algorithms, single interface and preparation for migration to the cloud**
  Enel Iberoamerica S.R.L. January 2020 - December 2020. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

  The main objective of this project is to address the representation in CODEX of renewable generation and storage, as well as the generation of input scenarios and the preparation for integer and stochastic executions.

- **Adaptation of the OMEGA model to the new gas tariffs and calculation of gas prices in LNG tank**
  Enel Iberoamerica S.R.L. January 2020 - May 2020. (Javier Reneses Guillén, Antonio Bello Morales, Cristina Casillas Clot, Luis Manuel Montero Guirao)

  This collaboration focuses on the inclusion of the new gas tariffs implemented in the Iberian gas market, as well as on the calculation of the gas price in a virtual LNG tank.

- **Improvements of the tool VALORE-LPM**
  Enel Iberoamerica S.R.L. January 2020 - March 2020. (Antonio Bello Morales, Javier Reneses Guillén, Alberto Orgaz Gil)

This proposal focuses on the realization of different improvements that allow achieve a better decision-making process based on the forecasts made in VALORE-LPM.

- **Improvements in the modeling of renewable assets in ACUARIO and conceptual analysis of the model**
  Enel Iberoamerica S.R.L. February 2020 - July 2020. (Antonio Bello Morales, Javier Reneses Guillén, Rodrigo Alejandro de Marcos Peirotén, Geovanny Alberto Marulanda García)

  The objective of this project is twofold. On the one hand, the improvement of the modeling of renewable assets in ACUARIO. In particular, the project deals with representation of solar, wind and hydro generation assets.
  On the other, carry out a conceptual analysis on the possible improvements that must be implemented during the next years in ACUARIO in order to adapt the tool to the changing environment of the Iberian electricity market.

- **Development of an integrated execution environment for the VALORE-HEPLASE tool in a MIBEL and European framework**
  Enel Iberoamerica S.R.L. February 2020 - September 2020. (Javier Reneses Guillén, Antonio Bello Morales, Alberto Orgaz Gil, Geovanny Alberto Marulanda García, Luis Manuel Montero Guirao)

  This project focuses on improving the decision making process with the model through the comprehensive and flexible management of the executions of VALORE-HEPLASE that are carried out both for the Iberian and the European electricity market.

- **Developments to improve the reliability and the performance of the executions in the Cloud**
  Enel Iberoamerica S.R.L. February 2020 - May 2020. (Antonio Bello Morales, Javier Reneses Guillén)

  This project between IIT and Endesa focuses on strengthening the execution of the VALORE LPM in the Cloud, once the required developments to allow users to carry out executions in the Cloud with the same features as on local servers have been already completed.

- **Fitting and backtesting of the tool VALORE-SEIE**
  Enel Iberoamerica S.R.L. February 2020 - November 2020. (Antonio Bello Morales, Javier Reneses Guillén, Geovanny Alberto Marulanda García)

  This proposal focuses on backtesting and subsequent fitting of the VALORE-SEIE forecasting tool in each subsystem.

- **Implementation of the use of daily system states and gas units daily TPA contracting for VALORE-LPM**
  Enel Iberoamerica S.R.L. March 2020 - July 2020. (Antonio Bello Morales, Javier Reneses Guillén, Alberto Orgaz Gil, Luis Manuel Montero Guirao)

This proposal focuses on the adaptation of the use of daily system states, using clustering techniques for each month, so that a better representation of the gas units daily TPA contracting is achieved.

- **Proposal for the development of a regulatory sandbox in Spain for flexibility procurement by electricity distribution companies**
  EDISTRIBUCIÓN Redes Digitales, S.L. March 2020 - November 2020. (José Pablo Chaves Ávila, Mauricio Correa Ramírez, Tomás Gómez San Román)

  This project will develop a proposal to specificity of a regulatory sandbox conditions and deployment requirements that could be applied in Spain to procure flexibility services by DSOs. In a first step, the conditions for the sandbox will be highlighted and, in a second step, a proposal for a Sandbox demonstration will be specified.

- **Improvement of the execution time for VALORE-LPM: Phase 1**
  Enel Iberoamerica S.R.L. April 2020 - May 2020. (Antonio Bello Morales, Javier Reneses Guillén)

  This proposal focuses on the implementation of several improvements with the aim of reducing the execution time in VALORE, both in local servers and in the cloud.

- **Advanced generator of stochastic scenarios**
  Iberdrola Generación España, S.A.U. April 2020 - March 2021. (Andrés Ramos Galán, Jesús María Latorre Canteli, Jesús David Gómez Pérez)

  In this project a series of stochastic scenarios will be obtained, adapted to the Iberian electric system, linked stochastically. Those scenarios will allow the generation optimization in the medium term in an uncertain framework, especially by the variability of natural hydro inflows.

- **Modeling of hydraulic constraints and particularities of the Sil transfer and shared property of Salime**
  Endesa Medios y Sistemas S.L. April 2020 - July 2020. (Javier García González, Pedro de Otaola Arca, Ignacio Candela Ripoll)

  The objective of this project is to introduce improvements in the modeling of the particularities of the hydraulic system (gravitational water transfer in the Sil river basin, and shared ownership of the Salime power plant).

- **Evaluation of the impact of hybrid energy storage systems on the island power system of Tenerife**
  Endesa. May 2020 - September 2020. (Lukas Sigrist, Luis Rouco Rodríguez, Enrique Lobato Miguélez)

  The objective of the collaboration is to determine the economic benefits of the installation of a hybrid energy storage systems based on batteries and liquid air energy storage (LAES) in the island power system of Tenerif for the scenarios of 2025 and 2030.

- **Alternatives for providing inertia by the distribution system**
  I-DE Redes Eléctricas Inteligentes, S.A. May 2020 - December 2020. (Lukas Sigrist, Lukas Sigrist, Luis Rouco Rodríguez, Luis Rouco Rodríguez)

  The objective of this collaboration is to study the viability to provide inertia by distribution systems to guarantee frequency stability in low-inertia scenarios.

- **Implementation of an algorithm to calculate price sensitivities in Monte Carlo execution**
  Enel Iberoamerica S.R.L. June 2020 - July 2020. (Antonio Bello Morales, Javier Reneses Guillén)

  This proposal focuses on implementing a methodology in the VALORE Monte Carlo tool that allows to calculate price sensitivities with respect to different risk variables.

- **Modeling the theorethical electricity expenditure in Spanish households**
  Fundación Ecología y Desarrollo (ECODES). June 2020 - November 2020. (Eva María Arenas Pinilla, Roberto Barrella, José Carlos Romero Mora)

  The general objective of the project is to obtain a model that allows to calculate the theoretical expenditure that a Spanish household should have in order to cover its electrical energy needs, according to its most representative parameters
  The theoretical electricity expenditure is defined as the necessary expenditure on electricity to
  satisfy the minimum needs of a household derived from all the electrical appliances. Excluded from the study are heating/cooling or DHW production, even if they are electrical, because they are
  included in a previously developed thermal expenditure model. Therefore, appliances such as washing machines, dishwashers, ovens, refrigerators, kitchens, televisions, computers,etc... would be considered.

- **The new role of consumers in a power sector in transition**
  PSR. August 2020 - December 2020. (Paolo Mastropietro, Pablo Rodilla Rodríguez, Paulo Brito Pereira, Carlos Batlle López)

  The project aims at investigating the role that consumers will play in the power sector of the future. Currently, there is a significant gap between the top-down regulatory push towards consumer empowerment and the real behaviour of end-users, still very little engaged in the electricity market. The project analyses which models can result in a massive engagement of energy consumers (including aggregators, energy communities and CCAs) and characterises prosumers and prosumer preferences. Furthermore, it also studies the concept of willingness-to-engage, reviewing recent academic literature in search of surveys that allow to understand the current barriers to the activation of electricity demand.

3.2.1.1.2 Public funding

- **Open phase detection system for start-up transformers in nuclear generating stations (RTC-2016-5160-3)**
  Ministerio de Economía, Industria y Competitividad. March 2016 - December 2019. (Luis Rouco Rodríguez, Enrique Lobato Miguélez, Francisco Miguel Echavarren Cerezo, Kai Doenges)

  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 protopytes 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".

- **Smart-DS: synthetic models for advanced, realistic testing of distribution systems and scenarios**
  U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E). September 2016 - August 2021. (Tomás Gómez San Román, Carlos Mateo Domingo, Fernando de Cuadra García, Rafael Cossent Arín, Pedro Ciller Cutillas, Fernando Emilio Postigo Marcos)

  The National Renewable Energy Laboratory, with partners MIT-Comillas-IIT and Alstom Grid, develop combined distribution-transmission power grid models. Distribution models are created using a version of Comillas' Reference Network Model (RNM), adapted to U.S. utilities, and based on real data from a broad range of utility partners. The models are complemented by the development of customizable scenarios that can be used for accurate algorithm comparisons. These scenarios take into account unknown factors that affect the grid like future power generation technologies, including distributed energy resources,

such as residential solar and home energy storage, varying electrical load, disruptions due to weather events, solar and wind data, and repeatable contingency sequences.

Video here

More information at https://www.nrel.gov/grid/smart-ds.html

- **Value of pumping-storage in insulated electrical systems with strong wind penetration**
  Ministerio de Economía y Competitividad. December 2016 - December 2019. (Javier García González)
  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**
  Ministerio de Economía, Industria y Competitividad. December 2016 - December 2020. (Sonja Wogrin, Isaac Camilo González Romero, Tomás Gómez San Román, Efraim Centeno Hernáez, Diego Alejandro Tejada Arango, Juan José Valentín Vírseda)
  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. January 2017 - October 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, Tomás Gómez San Román, Carmen Valor Martínez)

  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 busines 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**
  FEDER, Ministerio de Ciencia, Innovación y Universidades – Agencia Estatal de Investigación, Proyecto _Proyecto RTC-2017-6074-3. January 2018 - December 2020. (Luis Rouco Rodríguez, Aurelio García Cerrada, Ignacio Egido Cortés, Lukas Sigrist, Javier García Aguilar, Juan Luis Zamora Macho)

  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"

- **EU Energy system: modelling, data collection and studies**
  Comisión Europea. June 2018 - August 2021. (Luis Olmos Camacho, Carlos Mateo Domingo, Stefanía Gómez Sánchez, Rafael Cossent Arín, Andrés Ramos Galán, Tomás Gómez San Román, Fernando Emilio Postigo Marcos, Sonja Wogrin)

  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**
  FEDER, Ministerio de Ciencia, Innovación y Universidades – Agencia Estatal de Investigación, Proyecto _Proyecto RTC-2017-6296-3. September 2018 - August 2020. (Luis Rouco Rodríguez, Pablo García González, José Daniel Muñoz Frías, Francisco Miguel Echavarren Cerezo, Francisco Javier Renedo Anglada, María Candelaria Utrilla Bustamante, Lukas Sigrist, Luis Ismael de la Barba Suárez)

  This project is aimed at developing control and protection systems for island opertion 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"

- **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, Enrique Lobato Miguélez, Orlando Mauricio Valarezo Rivera)

  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.

- **Modelling, technologies, control and operation for AC-DC hybrid electric grids with low-to-nil synchronous generation and strong penetration of renewable generation (RTI2018-098865-B-C31)**
Ministerio de Ciencia e Innovación (MCI), Agencia Estatal de Investigación (AEI), Fondo Europeo de Desarrollo Regional (FEDER). January 2019 - December 2021. (Aurelio García Cerrada, Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo, Francisco Javier Renedo Anglada, Pablo García González, Ignacio Egido Cortés)

  The future sustainability of the Worlds Energy System (WES) rests on a massive and distributed penetration of renewable energy sources and their substantial increase in the generation mix. This phenomenon is already taking place at an ever-increasing pace (that is bound to speed up in the future) thanks to facilitating technologies such as power electronics. Therefore, conventional synchronous technology will gradually move from its dominant position towards a situation in which coordination with other and newer technologies will be mandatory. In fact, a situation in which the whole electricity demand of certain regions is supplied by electronic converters from renewable energy sources, at least temporarily, is possible or is already occurring. In this new situation there exists the urgent need to rethink current paradigms regarding the control and operation of conventional electric energy systems in order to address future scenarios (lower system inertia, faster dynamics, controller

interactions, etc.). The main objective of this project is to provide the in-depth analysis of the control, operation and technology requirements for the newly created breed of electricity networks of low-to-nil conventional generation with increasing numbers of smart components (generators and loads, for example). This type of systems must include (a) alternating current (AC) sub-grids because of the large number of existing AC loads and the necessity of maintaining the compatibility with the conventional grid and (b) direct current (DC) sub-grids where most of the renewable-based generation can be more naturally integrated (see solar energy, for example), energy storage (batteries) can also be easily interfaced and some domestic and industrial loads can be connected (computers and electrical drives, for example). Currently, the operation of hybrid (DC/AC) electric grids is possible thanks to the use of electronic Voltage Source Converters (VSCs, abbreviated). This project will address the following specific topics:
(1) Modelling, analysis, control, and quality of electrical grids with low-to-nil conventional generation in order to improve their flexibility thanks to the use of power electronics while similar levels of voltage control, quality and reliability of supply to those already achieved with conventional systems can be reached.
(2) The detailed study of selected electronic power converters and related technologies as key tools for electrical grids like those under study. The project will focus on solid-state (electronic or intelligent) transformers, energy storage, distributed VSCs and virtual synchronous machines.
(3) Experimental demonstration and validation of the main theoretical contributions developed in points (1) and (2).

Project RTI2018-098865-B-C31 funded by Ministerio de Ciencia e Innovación (MCI), Agencia Estatal de Investigación (AEI) and Fondo Europeo de Desarrollo Regional (FEDER)

- **Programa Microrredes Inteligentes Comunidad de Madrid**
  Comunidad de Madrid, Fondo Social Europeo, Fondo Europeo de Desarrollo Regional. January 2019 - December 2020. (Aurelio García Cerrada, David Domínguez Barbero, Ramón Rodríguez Pecharromán, Carlos Rodríguez-Morcillo García, Pablo Frías Marín, Jaime Boal Martín-Larrauri, Javier Matanza Domingo, Álvaro Sánchez Miralles, Lukas Sigrist, Francisco Javier Renedo Anglada, Pablo García González, Asunción Paloma Cucala García, Antonio Fernández Cardador, Luis Rouco Rodríguez, Andrés Tomás Martín)

  PROMINT will investigate several aspects of the deployment of smart micro-grids in urban environments: generation, energy recovery, electric vehicles, peer-to-peer communications and machine learning applied to data collection and analysis. Specific objectives are:
  1. Design, simulation, communication architecture evaluation in distributed energy systems working as micro-grids.
  2. Study of hybrid AC-DC urban micro-grids.
  3. Energy recovery and recycling from urban railway systems in urban micro-grids.
  4. Generation management of micro-grids.
  5. Machine learning applied to micro-grids, electric vehicles and energy management.

- **Transport and policies for the transition to a low-carbon economy in Spain**
  Ministerio de Ciencia e Innovación (MCI), Agencia Estatal de Investigación (AEI), Fondo Europeo de Desarrollo Regional (FEDER). 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.

Project RTI2018-093692-B-I00 funded by Ministerio de Ciencia e Innovación (MCI), Agencia Estatal de Investigación (AEI) and Fondo Europeo de Desarrollo Regional (FEDER)

- **Implementation of EN 50463-4 Ed 2017 in the Spanish railway system**
  Adif. January 2019 - January 2020. (José Antonio Rodríguez Mondéjar, Yolanda González Arechavala)

  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.

- **IELECTRIX - Indian and European Local Energy CommuniTies for Renewable Integration and the Energy Transition**
  Comisión Europea. May 2019 - October 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**
  Comisión Europea. May 2019 - April 2023. (Luis Olmos Camacho, Sara Lumbreras Sancho, Andrés Ramos Galán, Michel Rivier Abbad, Erik Francisco Álvarez Quispe)

  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.

- **Technical support to the preparation of the strategy for the decarbonization of the economy in 2050**
  Ministerio para la Transición Ecológica. May 2019 - October 2019. (Pedro Linares Llamas, Timo Gerres, José Pablo Chaves Ávila)

  The goal of this project is to provide technical expertise about the Spanish industrial sector and its perspectives for evolution towards 2050 regarding greenhouse gas emissions. This will in turn allow for the preparation of the strategy for the decarbonization of the Spanish economy in 2050.

- **Outline for reliability spotlight for the WEO 2019**
  International Energy Agency (IEA). July 2019 - September 2019. (Fernando de Cuadra García, Andrés González García)

  The project consists in performing illustrative analyses about the relevance of reliability/quality modelling, in the context of electrification plans in developing countries, and the description of results in chapter format for the WEO (World Energy Outlook)

- **Island system operation with high degree of renewable energy resources**
  Ministerio de Ciencia e Innovación, Agencia Estatal de Investigación, Fondo Europeo de Desarrollo Regional (FEDER). September 2019 - August 2021. (Lukas Sigrist, Enrique Lobato Miguélez, Mohammad Rajabdorri, Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo)

  This projects jointly addresses the operation planing and frequency stability. Both problems are intimately related in island power systems and operation planing taking into account frequency stability and its associated dynamics can lead to stabler and more efficient operation. Real island systems will be used to validate the methods developed.

Project RTI2018-100965-A-I00 funded by Ministerio de Ciencia e Innovación, Agencia Estatal de Investigación and Fondo Europeo de Desarrollo Regional (FEDER)

- **Definition of new reliability metrics and de-rating methodologies for the Colombian electricity market**
  Comisión de Regulación de Energía y Gas (CREG). October 2019 - January 2020. (Paolo Mastropietro, Pablo Rodilla Rodríguez, Paulo Brito Pereira, Luiz Augusto Nobrega Barroso, Carlos Batlle López)

  The objective of this project is to present an integral approach to the reliability problem for the Colombian electricity market and to define new de-rating metodologies that allow to calculate the real contribution of each technology to the security of electricity supply. The project also presents some simplifications of the integral approach and focuses on six specific technologies: i) large-scale self-generators, ii) cogeneration, iii) generation from solid waste, iv) self-dispatched plants, v) intermittent and variable energy sources, and vi) battery storage.

- **Expansion planning scenarios of a real distribution network**
  Empresas públicas de Medellín E.S.P. October 2019 - December 2019. (Carlos Mateo Domingo, Fernando de Cuadra García, Tomás Gómez San Román, Fernando Emilio Postigo Marcos)

The objective of the project is to use a reference network model to analyze a real network of Empresas Públicas de Medellín (EPM). First, the data about the network is loaded, and then the distribution network is analyzed technically in terms of power flows and reinforcements. The reinforcements are determined for demand growth scenarios, and the expansion of the network is planned to accommodate additional consumers. Besides, a sensitivity is carried out to analyze the impact of reliability targets.

- **Thematic Network of Energy Modeling for a Sustainable Energy Transition**
  Ministerio de Ciencia, Innovación y Universidades. January 2020 - December 2021. (Pedro Linares Llamas)

  The fight against climate change involves undertaking an energy transition, at global and at national level, to a new energy system with low greenhouse gas emissions. The political and technological decisions adopted by our country in the next decades will build the future energy system and they will have impacts on the economy, the environment and the society. To inform the strategic decision-making process, a wide range of appropriate tools adapted to the actual energy situation of our country is required. There are several tools available, but few of them have been applied on regular basis to energy planning so far. These tools need to be able to assess the economic, environmental and social repercussions of the energy transition. The models developed by the groups of these network show their multidisciplinary character, from multiregional input-output models, dynamics, or with environmental and social extensions and with social accounting matrices, models of computable general equilibrium, of productivity and efficiency frontier analysis and Data Envelopment Analysis, demand forecasting, simulation models, to models of energy optimization. The goal of the network is to contact these national research groups that, from different perspectives and methodological approaches, are working on energy modelling to develop synergies and complementarities, to align priorities adapted to and able to respond to the needs and threats pose by the energy transition, to set up a group of reference at national and international level in energy modelling able to support agents in their process of decision-making, promote the improving the skills on energy modelling, participate on R&D projects together and convey the network research and results to society.

- **EUniversal - Market enabling interface to unlock flexibility solutions for cost-effective management of smarter distribution grids**
  Comisión Europea. February 2020 - July 2023. (Rafael Cossent Arín, Tomás Gómez San Román, José Pablo Chaves Ávila, Mauricio Correa Ramírez, Nicolás Mariano Morell Dameto, Leslie Herding, Orlando Mauricio Valarezo Rivera, David Ulrich Ziegler)

  The present context shows the potential of electricity grids to lead the energy system transition as long as new solutions deal with the challenges related to flexibility solutions, grid observability and controllability, market mechanisms and interoperability in a holistic way. The new solutions need to cover the technological aspects by linking smart and integrated services and tools for distribution grid with market mechanisms. This architecture will guarantee a

significant impact on the environment and society.
The project consortium accepted this challenge and will develop "EUniversal Project" which will enable the transformation of the electricity grid by resolving existing limitations in the energy system through the introduction of a Universal Market Enabling Interface (UMEI). Through this concept, grids will become capable of accommodating all future scenarios through the active use of grid services, acting as an extensive toolbox of flexibility solutions and innovate market mechanisms.
The primary goal of EUniversal is to enable the transformation of the energy system into a new multi-energy and multi-consumer concept guaranteeing a sustainable, secure and stable manner of electricity supply by bringing forward an universal, adaptable and modular approach
through a Universal Market Enabling Interface (UMEI) to interlink active system management with electricity markets and the provision of flexibility services, taking also into consideration the activation needs and the coordination requirements with both commercial parties and TSOs. To do so, EUniversal will define, develop and validate a set of market-oriented flexibility management services from DER in a real environment, under a large RES integration and high electrification scenario.
In order to demonstrate the services generated in the development phase of the project, 3 different DEMO sites (located in Portugal (PT), Germany (DE) and Poland (PL)) will be run to validate the project solutions.

- **Distribution network design of U.S. districts in the URBANopt platform**
  U.S. Department of Energy, National Renewable Energy Laboratory (NREL). February 2020 - September 2021. (Carlos Mateo Domingo, Tomás Gómez San Román, Luca de Rosa)

  The objetive of the URBANopt Grid-Interactive Efficient Building (GEB) Modeling Toolkit, is to model efficient, connected and smart building with a portfolio of interoperable technologies that can adjust demand up or down and shift, store, or dispatch electric load in response to grid and building needs. In this project the U.S. Reference Network Model (RNM-US) will be integrated into the URBANopt platform in order to design the distribution network of districts, to be able to analyze the interaction between the buildings and the distribution network, taking into account distributed energy resources.

- **Advanced Tools Towards cost-efficient decarbonisation of future reliable Energy SysTems**
  Comisión Europea. March 2020 - February 2023. (Miguel Ángel Sanz Bobi, Carlos Mateo Domingo, Pablo Calvo Báscones, Rafael Palacios Hielscher, Rafael Cossent Arín, Eugenio Francisco Sánchez Úbeda, José Portela González)

  The objective of the ATTEST project is to develop and operationalize a modular open source toolbox comprising a suite of innovative tools to
  support TSOs / DSOs operating, maintaining and planning the energy systems of 2030 and beyond in an optimised and coordinated manner,
  considering technical, economic and environmental aspects. The consortium, from six EU countries, that has been assembled to deliver ATTEST
  consists of five highly experienced research organisations in the energy systems

area, two utilities that manage and operate the transmission system and the distribution system in Croatia, and two industry partners that specialise in the development of advanced ICT solutions and SCADA systems. The development of this broad spectrum of energy-related ICT tools and the utilization of next generation algorithms, demonstrated in a real world environment has not been attempted before. The outputs from the ATTEST project will enable accelerated dissemination, by a wide range of research institutions, within and outside of the project consortium, of the tools that will help TSOs and DSOs to better manage their networks. The demonstration of the results of the project will be valuable for the scientific community and EU energy industry and attest to the relevance of the solutions developed. The ATTEST's ambition is to enable a wide range of users to utilize and test the tools developed in the project, thereby contributing to spread knowledge and experience in the energy systems community in the EU and on a global scale. This will contribute significantly to addressing not only the specific challenges of the call and the Horizon 2020 Energy Work Program, but also those of the EU's Energy Union strategy and the 2020 Climate & Energy package.

- **Implementing network codes**
  Research Council of Norway (RCN), Statkraft, Statnett, Ministry of Petroleum and Energy, Nord Pool. May 2020 - July 2023. (Paolo Mastropietro)

  The project investigates the implementation of European Network Codes and Guidelines'. These are detailed rules on electricity trade intended to improve and harmonize the EU internal energy market. They could have far-reaching consequences for how we use our electricity network, but so far, they have largely escaped scholarly attention. This project asks several fundamental questions: i) how have network codes and guidelines been designed and outlined at the general level? ii) how have they been further specified in various 'terms, conditions and methods' (TCMs) across Europe? iii) how have they actually worked in practice? iv) have they been able to deliver on the fundamental goal of increasing the efficiency of electricity trade within Europe?

- **Recommendations to enhance the competition in the wholesale electricity market of Peru: Phase 2**
  World Bank. May 2020 - September 2020. (Paolo Mastropietro, Pablo Rodilla Rodríguez, Paulo Brito Pereira, Carlos Batlle López)

  The goal of this project is to advance legal and regulatory recommendations to reinfornce the role of the wholesale electricity market in Peru, in order to guarantee the efficiency of both the operation of the system in the short term and its expansion in the long term. The project focuses on the format of long-term contracts for gas supply and the declaration of gas prices for the electricity market clearing.

- **Alternatives to promote competition in the wholesale electricity market in Peru: Phase 1**
  World Bank. May 2020 - December 2020. (Pablo Rodilla Rodríguez, Paolo Mastropietro, Paulo Brito Pereira, Carlos Batlle López)

  The goal of this project is to advance legal and regulatory recommendations to reinfornce the role of the wholesale electricity market in Peru, in order to guarantee the efficiency of both the operation of the system in the short term and its expansion in the long term. The project focuses on the format of long-term contracts for gas supply and the declaration of gas prices for the electricity market clearing.

3.2.1.2 Consultancy and technological support

3.2.1.2.1 Private funding

- **Study of the electrical interconnection between Bolivia and Peru**
  Banco Interamericano Desarrollo (BID). June 2018 - December 2019. (Andrés Ramos Galán, Luis Olmos Camacho, Michel Rivier Abbad, Jesús María Latorre Canteli)

  Technical and economical assessment of an HVDC cross-border line between Bolivia and Peru.

- **Study of the electrical interconnection between Bolivia and Brasil**
  Banco Interamericano Desarrollo (BID), Empresa Nacional de Electricidad (ENDE) - Bolivia, Centrales Eléctricas Brasileñas (ELETROBRAS). June 2019 - June 2021. (Luis Olmos Camacho, Andrés Ramos Galán, Michel Rivier Abbad, Jesús María Latorre Canteli, Francisco Miguel Echavarren Cerezo, Francisco Javier Renedo Anglada, Stefanía Gómez Sánchez)

  Technical and economical assessment of the elecrical interconnection between Bolivia and Brasil.

- **Test bench and tests of a brushless DC machine**
  ALTRAN INNOVACION SL. September 2019 - November 2019. (Lukas Sigrist, Fidel Fernández Bernal, Pablo Frías Marín)

  The objective is to build a test bench to test a brushless DC machine in order to determine its steady state characteristic. The steady state characteristic refers to the torque-speed curve without exceeding a given temperature of the coils of the stator (i.e., without exceeding a certain current limit).

- **Technical support related to AGC and assessment of AGC operation**
  Bahía de Bizkaia Electricidad (BBE). September 2019 - April 2020. (Ignacio Egido Cortés)

  REE has modified the P.O. 7.2 that stablishes the rules for the secondary regulacion in the Spanish power system. This proyect analyses how these changes affect the operation of BBE in this ancillary service, and also studies if BBE has to modify its AGC to comply with the new requirements.

- **Study of the electrical interconnection between Bolivia and Brasil**
  Banco Interamericano Desarrollo (BID). September 2019 - October 2020. (Luis Olmos Camacho, Andrés Ramos Galán, Michel Rivier Abbad, Jesús María Latorre Canteli, Luis Olmos Camacho, Stefanía Gómez Sánchez)

  Technical, economic, and environmental assessment of the construction of the 2nd circuit of the SIEPAC line across Central America.

- **Analysis, parameter adjustment, validation and commissioning of the AGC system of Ence**
  Invesyde S.L. September 2019 - April 2020. (Ignacio Egido Cortés, Fidel Fernández Bernal)

  Ence will participate in the secondary regulation in the Spanish Power System. In order to do that it need an AGC control. This project includes the integration of the AGC-IIT in the control system of Ence and the necessary FAT and SAT tests to verify its correct integration and operation.

- **Study of frequency stability and optimal sizing of batteries for Haiti electrical system that supplies electricity to Caracol Industrial Park**
  Inter-American Development Bank (IADB). September 2019 - February 2020. (Ignacio Egido Cortés, Lukas Sigrist, Francisco Javier Renedo Anglada, Damián Laloux Dallemagne, Clara Jiménez Serrano)

  The IADB is currently in a preliminary stage of a project in Haiti, which consists on the installation of a solar photovoltaic (PV) plant and a battery bank. The aim of the battery bank is to tackle short-term power fluctuations and contribute to primary frequency support. This project studies the frequency stability of the system and the optimal sizing of the battery bank. Technical recommendations related to the PV plants and the battery bank are also given.

- **Climate Friendly Materials Platform**
  European Climate Foundation (ECF). October 2019 - December 2020. (Pedro Linares Llamas, José Pablo Chaves Ávila, Timo Gerres)

  The Climate Friendly Materials Platform (CFMP) proposes a comprehensive project to help catalyse transformational change across the EU basic materials sector - to net climate neutrality by 2050. The platform will facilitate effective exchange between leading policy analysts, policy makers, industry leaders and other relevant stakeholders, within members states and across Europe. By simultaneously and iteratively linking multiple existing dialogues, the platform will facilitate knowledge exchange and build capacity on policy instrument design and suitability, synergies in the policy mix, the structure of policy packages and their governance.

- **Seminars and publications on resiliency of power networks and gas tariffs**
  Fundación Naturgy. October 2019 - December 2019. (Luis Rouco Rodríguez, José Pablo Chaves Ávila, Celia Mosácula Atienza, Tomás Gómez San Román, Lukas Sigrist, Rafael Cossent Arín)

  The aim of this work is contributing to Seminars and publications on resiliency of power networks and gas tariffs.

- **Supply of the AGC-IIT and commissioning in the Acciona SCADA system**
  Acciona Energía S.A. November 2019 - July 2020. (Ignacio Egido Cortés, Luis Rouco Rodríguez)

  Acciona participates in the secondary regulation in the Spanish power system. Acciona updates its SCADA system and also its AGC regulator. This project consists in the supply to Acciona of the AGC-IIT and the assistance to both Acciona and the SCADA provider in its integration in the system.

- **Performance of 400/132 kV transformer at Rodela substation during phase confirmation tests**
  Cobra Gestión de Infraestructuras S.A.U. November 2019 - December 2019. (Luis Rouco Rodríguez)

  The aim of the study is to investigate the performance of 400/132 kV transformer at Rodela substation during phase confirmation tests.

- **Electrical losses calculation in Oitis (Brazil) wind farm**
  Iberdrola Renovables Energía SAU. November 2019 - December 2019. (Luis Rouco Rodríguez)

  The aim of the study is the electrical losses calculation in Oitis (Brazil) wind farm.

- **Impact of wind generation on the damping of low frequency electromechanical oscillations**
  Iberdrola Renovables Energía SAU. December 2019 - December 2019. (Luis Rouco Rodríguez, Francisco Javier Renedo Anglada)

  The aim of the study is to study the impact of wind generation on the damping of low frequency electromechanical oscillations.

- **Technical support for the development of user-defined models for dynamic simulation of power systems**
  Supergrid Institute SAS. January 2020 - January 2020. (Francisco Javier Renedo Anglada)

  Technical support on:
  * Dynamic simulation of power systems with PSS/E
  * Scripting with Python for dynamic simulation of power systems in PSS/E
  * Development of user-defined models for dynamic simulation of power systems in Fortran + PSS/E

- **Regulation of the electricity sector in Spain: assessment of scenarios in the new PNIEC context**
  Repsol Technology Lab. February 2020 - June 2020. (Pablo Rodilla Rodríguez, Paolo Mastropietro, Paulo Brito Pereira, Álvaro Sánchez Miralles, Carlos Batlle López)

  Analysis of the regulation of the electricity sector in Spain in the next decade. In particular, the focus is on the forthcoming regulatory changes in the context of the new PNIEC.

- **New functionalities, automation and maintenance DESI Model 2020**
  Endesa. February 2020 - December 2020. (Enrique Lobato Miguélez)

  New functionalities, automation and maintenance of DESI Model (Economic Dispatch of Island Power Systems) 2020

- **Techno-economic analysis of decarbonized alternatives to natural gas**
  Enagás S.A. February 2020 - November 2020. (Pedro Linares Llamas, Timo Gerres, José Pablo Chaves Ávila)

  The goal of this collaboration is to assess, from a techno-economic point of view, the different alternatives available for the decarbonization of heavy transport and industry in the horizon 2030-2050. This analysis is done along two lines: one in which the different energy vectors are assessed; and another in which the implications for infrastructures are considered.

- **Technical workshops on integration and regulation of energy storage devices**
  Naturgy. May 2020 - June 2020. (Enrique Lobato Miguélez, Tomás Gómez San Román, José Pablo Chaves Ávila, Lukas Sigrist)

  Workshops on integration and regulation of energy storage devices

- **Guidelines for energy infrastructures in an urban district located in Madrid North**
  IDOM Consulting, Engineering and Architecture S.A.U. May 2020 - October 2020. (Tomás Gómez San Román, Álvaro Sánchez Miralles, Rafael Cossent Arín, Carlos Mateo Domingo, Pablo Rodilla Rodríguez)

  In the context of the project Guidelines for energy infrastructures in an urban district located in Madrid North developed by IDOM for Distrito Castellana Norte, IIT is carrying out the following studies:
  - Evolution of electric vehicles and charging points
  - Electricity distribution infrastructure
  - Global energy model
  - Governance model

- **Agregated models of solar photovoltaic inverters**
  Iberdrola Renovables Energía, S.A.U. June 2020 - July 2020. (Luis Rouco Rodríguez, Francisco Javier Renedo Anglada)

  The aim of this work is the development of agregated models of solar photovoltaic inverters.

- **Update of AGC-IIT running in BBE**
  Bahía Bizkaia Electricidad, S.L. June 2020 - December 2020. (Ignacio Egido Cortés)

  The current version of AGC-IIT running in BBE Scada was commissioned in 2008. REE has recently updated P.O.7.2 about secondary regulation. AGC-IIT running in BBE is updated to version 2.4, which complies with the regulation requirements after the REE update. AGC-IIT parameter's that control zone and unit behavior are also updated.

- **Transient phenomena in gas insulated substations and solutions**
  Intradel S.L. June 2020 - June 2020. (Luis Rouco Rodríguez)

  The aim of the study is to ellaborate a report about transient phenomena in gas insulated substations and solutions. It will also include data requirements to conduct simulations.

- **Assessment of new market models in Europe**
  GRUPO OMI. July 2020 - October 2020. (Tomás Gómez San Román, José Pablo Chaves Ávila, Leandro Lind, Mauricio Correa Ramírez, Orlando Mauricio Valarezo Rivera, Morsy Abdelkader Morsy Mohammed Nour, David Ulrich Ziegler)

  In this project, new market models proposed and recently implemented in Europe are assessed. In the review two developments are considered. On one hand, commercial platforms that allow energy trading among distributed resources and also the provision of services by those resources. On the other hand, research and demonstration European projects focused on the provision of flexibility to system operators and network operators are reviewed.

- **Computation of grid access capacity**
  Iberenova Promociones S.A.U. July 2020 - December 2020. (Luis Rouco Rodríguez, Enrique Lobato Miguélez)

  The aim of this project is the development of a compute tool for computing the grid acces capacity according to the WSCR criteria.

3.2.1.2.2 Public funding

- **Geospatial workshop for the National Universal Electrification Plan of Bolivia**
  Banco Interamericano de Desarrollo (BID). September 2019 - October 2019. (José Ignacio Pérez Arriaga)

  The InterAmerican Development Bank - IADB develops in La Paz, Bolivia, a high level technical meeting with the government, regulator and the national power industrie: "The use of Referenced Geospatial Information for the development of a Rural Electrification Expansion Plan for Bolivia", to be celebrated form September 30th to October 3rd 2019.
  The main objective is the discussion of electrification grid and off-grid alternatives, and the least-cost planning methodologies in the international context, sharing international good practices and exchanging knowledge on rural electrification.

- **Mission for energy matrix transition and modernization of the power sector in Colombia - 3rd Pillar**
  World Bank. September 2019 - June 2020. (Pablo Rodilla Rodríguez, Paolo Mastropietro, Carlos Batlle López)

  Digitalization, decentralization and demand management in the context of the «Mission for energy matrix transition and modernization of the power sector in Colombia»

- **Consulting service for the study of energy storage in the Peruvian electrical system**

  Organismo Supervisor de la Inversión en Energía y Minería (OSINERGMIN). January 2020 - April 2020. (Pablo Rodilla Rodríguez)

  Consulting service for the study of energy storage in the Peruvian electrical system:
  Market design
  Storage as a network asset
  Tariffs

- **Grid integration technical study to support implementation of renewable energy in the power system of the Republic of Mozambique**

  International Renewable Energy Agency (IRENA). February 2020 - October 2020. (Lukas Sigrist, Luis Rouco Rodríguez, Ignacio Egido Cortés, Francisco Javier Renedo Anglada, Carlo de Paolis Robles)

  The objective of the proposed grid integration study is the assessment of the impacts and constraints, from the technical prospective, of the integration of large amounts of hydro and variable solar and wind generation on the secure and reliable operation of the electricity network in Mozambique.

- **Criteria and methods for distributed generation charges in Costa Rica**

  Autoridad Reguladora de los Servicios Públicos (ARESEP). March 2020 - October 2020. (José Pablo Chaves Ávila, Tomás Gómez San Román, Rafael Cossent Arín, Nicolás Mariano Morell Dameto, Leslie Herding)

  The objective of this project is to determine the technical criteria and possible methods to define the charges to the producer-consumer to connect to the distribution network and the limits for the integration of the distributed generation into the Costa Rican electricity system.
  Once the diagnosis of the sector and the synthesis of the review of international experiences have been prepared, a workshop will be held in order to identify relevant aspects for the design of a strategy for implementing actions for the integration of distributed generation in the electrical system national.
  From the diagnosis, the analysis of the international experiences and the results of the workshop will be elaborated: (i) a proposal for the calculation method for determining of the distribution network availability rate and its technical justification, (ii) a proposal of calculation method for the determination distribution network access charges and its technical justification, (iii) a proposal of technical criteria to calculate the limits for connection of systems and energy injected in the network.

- **A method for the settlement of the complementary service of supplying electricity to trains in the ADIF and ADIF high-speed railway systems**

  Administrador de Infraestructuras Ferroviarias (ADIF). June 2020 - August 2021. (Tomás Gómez San Román, José Antonio Rodríguez Mondéjar, Asunción Paloma Cucala García, Antonio Fernández Cardador, Ramón Rodríguez Pecharromán, Álvaro Jesús López López, Adrián Fernández Rodríguez, Carlos Mateo Domingo, Rafael Cossent Arín, Yolanda González Arechavala)

The aim of the project is to set the regulatory conditions and operational procedures for the settlement of electricity supply to trains belonging to different mobility operators under a context of liberalization of train operators, implementation of on-board energy measurement equipment, and providing energy efficiency signals to the train operators. In addition, the project proposes a remuneration regime for ADIF that acknowledges the efficient incurred costs, providing financial sustainability and economic efficiency signals together with keeping quality of service standards for ADIF as an energy supplier and an infrastructure operator.

- **Development of the universal access to electricity strategy in Ecuador, based on a georreferenced electricity access plan**
  Inter-American Development Bank (IADB). June 2020 - March 2021. (José Ignacio Pérez Arriaga, Andrés González García, Rafael Palacios Hielscher, Santos José Díaz Pastor)

  The objective of this project is the development of the Universal Access to Electricity Strategy of Ecuador, based on a Georreferenced Electricity Access Plan, which will lead the country to supply sustainable, reliable, affordable, and universal access to power services in 2030. The high-level geospatial universal electrification access plan (PAUNE) will provide a sound strategic foundation for the detailed design and systematic incremental implementation of grid extension and connection to the national power system, integrated with the corresponding execution of isolated off-grid supply systems (mini-grids and standalone systems) for a variety of residential, community and productive customers, at the least possible cost, using the Reference Electrification Model REM. PAUNE will be implemented in the whole country from 2020 to 2030. The strategy will also identify the necessary investment plan to achieve this target, based on a sustainable financial framework for the implementation period.

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 theremuneration of a hydroelectric power plant IBG**
  Iberdrola Generación España, S.A. May 2016 - December 2019. (Andrés Ramos Galán)

  Writting of a brief report que assess and explains the impact of new hydrological plan on the remuneration of a hydroelectric power plant.

- **Report about the impact of the new hydrological plans on the remuneration of a hydroelectric power plant IBR**
  Iberdrola Renovables Energías, S.A. June 2016 - December 2019. (Andrés Ramos Galán)

  Writting of a brief report que assess and explains the impact of new hydrological plan on the remuneration of a hydroelectric power plant.

- **Assistance and maintenance of tools for back office and reserve areas**
  Endesa Medios y Sistemas S.L. January 2019 - December 2019. (Efraim Centeno Hernáez, Francisco Alberto Campos Fernández, Salvador Doménech Martínez)
  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**
  Endesa Medios y Sistemas S.L. January 2019 - December 2019. (Eugenio Francisco Sánchez Úbeda, Javier García González, Antonio Muñoz San Roque, José Portela González)
  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**
  Enel Iberoamérica S.R.L. January 2019 - December 2019. (Francisco Alberto Campos Fernández, José Portela González)
  The objective of this project is to provide ENDESA with developing maintenance of the tool SIROCO developed by IIT.

- **Technical support for the tool SIROCO**
  Enel Iberoamérica S.R.L. January 2019 - December 2019. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)
  The objective of this project is to provide ENEL with technical developing maintenance of the tool VALSA developed by IIT.

- **Update of the LRMC computation**
  MRC Consultants and Transaction Advisers S.L.U. September 2019 - December 2019. (Andrés Ramos Galán, Jesús María Latorre Canteli, Rafael Cossent Arín)
  Update of the computation of LRMC for the Jamaican system for the new investment expansion plan.

- **Assistance and maintenance of tools for back office and reserve areas**
  Endesa Medios y Sistemas S.L. January 2020 - December 2020. (Francisco Alberto Campos Fernández, Efraim Centeno Hernáez, Salvador Doménech Martínez, Luis Alberto Herrero Rozas)
  Assistance and maintenance of tools developed by IIT for Endesa for back office and reserve areas.

- **Technical support for the tools DECA, EXLA, HADES and MODEM**
  Endesa Medios y Sistemas S.L. January 2020 - December 2020. (Eugenio Francisco Sánchez Úbeda, Javier García González, Antonio Muñoz San Roque, José Portela González)
  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.

- **Analysis the income of a pumping unit in the Iberian electricity market for the 2025-2045 horizon**
  Villar Mir Energía. January 2020 - February 2020. (Javier Reneses Guillén, Antonio Bello Morales)

  The objective of this project is to carry out a forecast of the income obtained by a pumping unit in the Iberian electricity market, under different designs and different scenarios. In particular, the revenues in the day-ahead market are estimated for different reservoir capacities. On the other hand, revenues in the balancing markets are forecasted depending on whether the plant has the capacity to regulate when operating in pumping mode.

- **Capacity studies for the hashfela corridor of the Israel railway electrification project - 3**
  Sociedad Española de Montajes Industriales (SEMI). July 2020 - August 2020. (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 unaccepoatable, SEMI will propose an alternative configuration.
  Computation of core conductor temperatures will be carreid out using a modified version of a three-phase model for ampacity computation.

3.2.1.3.2 Public funding

- **EDucation for DIgitalisation of Energy. Sector Skills Alliances for implementing a new strategic approach ("Blueprint") to sectoral cooperation on skills**
  Education, Audiovisual and Culture Executive Agency. January 2020 - December 2023. (Fernando de Cuadra García, Carlos Mateo Domingo, Miguel Ángel Sánchez Fornié, Álvaro Jesús López López, Juan Carlos del Real Romero, Pablo García González)

  The EDDIE project aims at creating a Sector Skills Alliance (SSA) by bringing together all the relevant stakeholders in the energy value chain such as industry, education
  and training providers, European organisations, recruiters, social partners and public authorities. The main objective of this SSA is to develop a long-driven Blueprint for the
  digitalisation of the European energy sector to enable the matching between the current and future demand of skills necessary for the digitalisation of the energy sector and
  the supply of improved Vocational Education and Training (VET) systems and beyond.

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,

- **Tool of optimal design and simulation of high speed trains**
  Patentes Talgo S.L.U. December 2018 - December 2020. (Antonio Fernández Cardador, Asunción Paloma Cucala García, Adrián Fernández Rodríguez)

  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-EXPANDE integration and unification algorithms, unique interface and preparation for migration to the cloud: initial phase**
  Enel Iberoamerica S.R.L. January 2019 - December 2019. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

  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.

- **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**
  Enel Iberoamerica S.R.L. January 2019 - December 2019. (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, Portugal and France. A probabilistic approach is used to fulfill this objective.

- **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.

- **Optimal design of ATO driving parameters for Metro de Barcelona to Line 1**
  Bombardier European Investments, S.L.U. July 2019 - December 2020. (Antonio Fernández Cardador, Asunción Paloma Cucala García, Adrián Fernández Rodríguez)

  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.

- **The role of the final consumers in the energy transition**
  REPSOL. September 2019 - February 2020. (Álvaro Sánchez Miralles, Carlos Mateo Domingo)

  The objective is to study the final consumer and the distribute energy. Both can play a key role in the energy transition, towards a more renewable system, participating in the energy efficiency, reducing the total cost of the electricity system.

- **Analysis of the generation mix in 2030 under different demand and generation management scenarios**
  REPSOL. September 2019 - October 2019. (Francisco Martín Martínez, Álvaro Sánchez Miralles)

  Determine how different scenarios of demand management and distributed generation influence the future generation mix until 2030, complying with European emission restrictions and the Spanish plan (PNIEC). The SPLODER SYSTEM model is used in the project. This model allows regulatory analysis and support strategic decisions for electric companies. It also optimizes investments in a system with both centralized and distributed resources, taking into account, as input data exogenous to the model.

- **A radiofrequency sensor system demonstrator for biomedical applications**
  Instituto de Investigación Tecnológica. September 2019 - December 2020. (Francisco Javier Herraiz Martínez, Romano Giannetti, Javier Matanza Domingo, Gregorio López López, Carlos Rodríguez-Morcillo García)

  During the last years, the Bioengineering research team of the IIT has been working on radiofrequency (RF) sensors. These sensors have several advantages as their low cost, their reduced dimensions and they are easy to integrate with antennas to develop wireless devices. The systems based on this kind of sensors are composed of two elements: the sensors and the reader (an electronic device to interrogate the sensors). The aim of this project is to develop a functional demonstrator of the whole system. This will be used to show the feasibility of the proposed technology. Moreover, this demonstrator will be used in the future to develop biosensors for health applications as the continuation of this research line.

- **Feasibility study of a capnometry system for the improvement and optimization of outpatient practice**
  IIT. September 2019 - December 2020. (Carlos Rodríguez-Morcillo García, Alexis Cantizano González, Romano Giannetti, José Daniel Muñoz Frías, Javier Matanza Domingo, Francisco Javier Herraiz Martínez, Gregorio López López, Pablo Ayala Santamaría)

  In some of the emergencies attended by the SUMMA 112 service, if the patient has a respiratory illness or deficiency, it is necessary to connect him to an automatic respirator that helps him, to a greater or lesser extent, to perform the breathing process in a way optimal In addition, depending on the severity of the patient, it may be necessary to perform a tracheal intubation, which involves inserting a flexible plastic tube through the mouth to the trachea through the throat, if the patient is unable to breathe on his own and is unconscious; or simply use a plastic mask, which is placed on the patient's face covering the nose and mouth, non-invasively, when the patient is conscious and can perform the breathing process by himself, even if it is difficult.
  It is necessary to measure the exhaled CO2 (called capnometry) of the patients they attend during an emergency and they must be connected to a respirator, because the retention and accumulation of CO2 in the body can have fatal consequences for the patient.

In addition to capnometry, it is necessary to know the way in which the patient exhales the CO2, which is represented by a curve (called capnography), whose form provides very valuable information to the healthcare staff about the patient's breathing quality. This may indicate an acute respiratory insufficiency, or a decompensation between inspiration and expiration, as well as helping to focus the diagnostic criterion of respiratory failure, among other characteristics.
Depending on the quality of breathing and the amount of CO2 exhaled by the patient, it may be necessary to increase the oxygen pressure (O2) sent to the patient, which allows him to improve the exchange of O2 and CO2 in the lungs. However, increasing the O2 pressure in the automatic breathing system, when a non-invasive mask is used, causes the capnometry and capnography to be altered in such a way that they become totally erroneous data, so they cannot be used to assess the patient's condition.
Because of this, there is a need to develop a capnometer (which includes capnography) that is capable of adequately measuring exhaled CO2, under the condition of high O2 pressure. For this, a feasibility study must be carried out in two complementary aspects: on the one hand, the form of the non-invasive mask used must be analyzed and the modifications made to it must be determined so that the capnographic measure is not altered by pressure of O2. And on the other hand, we must analyze the CO2 sensors on the market and study the feasibility of building a capnograph, small in size, that can be attached to the previous mask (so it has to be small, light weight and electrically autonomous), and connect with a mobile device (smartphone or tablet type) where to display the patient's capnographic information. Furthermore, we also want to analyze the design of a radiofrequency (RF) sensor, based on metamaterials, which allows the measurement of exhaled CO2 with a completely new technique in the market.

- **System for automatic control of street lighting by motion detection (Phase I)**
  EIXIMENIS. September 2019 - November 2019. (Carlos Rodríguez-Morcillo García, Javier Matanza Domingo, Jesús María Latorre Canteli, David Contreras Bárcena)

  The objective of the collaboration is to develop the prototype of an electronic system capable of controlling the lighting power of a set of one-way street lamps, based on the detection of the presence of vehicles and / or people in said section of track.

- **CEVESA: A long term planning model for investment decisions in electricity generation and transportation**
  INESC TEC. October 2019 - November 2020. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

  CEVESA is a dynamic multizonal generation expansion planning model for the Spanish power system (assumed as a single-node), that considers both investments made by distributed customers in Distributed Energy Resources (DER: generation and storage) and by generation companies (GENCOs) in Centralized Resources (CR: conventional thermal generation plants, renewable generation and centralized storage). It is also connected with the transport sector by including investments decisions on Electric Vehicles (PEV) and

Internal Combustion Engine Vehicles (CEV), considering infrastructure deployment, fuel, and social and environmental costs of both technologies. The model is based on a multizonal conjectural-variation equilibrium with price-response conjectures with hourly detail, energy and endogenous secondary reserve requirements, ramping constraints, and start-ups and shut-downs.

- **Energy simulation and efficient speed profile optimisation in High Speed line Madrid-Barcelona**
  Patentes Talgo S.L.U. October 2019 - November 2020. (Adrián Fernández Rodríguez, Antonio Fernández Cardador, Asunción Paloma Cucala García)
  In this project the energy optimal speed profile is design for a Talgo train running in Madrid-Barcelona stretch, subject to objective running time and comfort requirements. The design is based on detailed simulation of the train dynamics and energy consumption, including regenerated energy during braking processes.

- **Radio frequency system to detect micro wires. Phase II**
  INPROTEC Robótica Industrial, S.L. October 2019 - May 2020. (Álvaro Sánchez Miralles, Jaime Boal Martín-Larrauri, Miguel Martín Lopo, Carlos Rodríguez-Morcillo García, Javier Matanza Domingo, Francisco Javier Herraiz Martínez)
  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.

- **Analysis of influential factors and correction strategies for dynamic energy consumption tests of Talgo High Speed trains**
  Patentes Talgo S.L.U. November 2019 - December 2020. (Adrián Fernández Rodríguez, Antonio Fernández Cardador, Asunción Paloma Cucala García)
  This project analyses the possible influential factors and the corresponding correction strategies for the energy consumption dynamic tests of Talgo High Speed trains. The conditions of the actual tests to which high-speed trains undergo are different from those proposed as a simulation hypothesis at the time of the offers. For this reason, the project deals with the proposal of acceptance criteria for the field tests, for which the sensitivity to external factors that may affect the energy consumption of the train will be studied. In addition, hypotheses and models will be developed to allow estimating corrections in the results of running time and energy consumption of the measures obtained during the actual tests.

- **Development of a rapid blood sepsis detection system**
  Instituto de Investigación Biomédica de Bellvitge (IDIBELL), Fundacio Institut d´Investigacio Biomedica de Bellvitge (IDIBELL). November 2019 - July 2020. (Carlos Rodríguez-Morcillo García, Romano Giannetti, José Daniel Muñoz Frías, Javier Matanza Domingo, Francisco Javier Herraiz Martínez, Gregorio López López)

  Design and development of a system capable of detecting blood sepsis infection, in a much shorter period than the laboratory cultures currently take.

- **Eco-driving design for the Stockholm, Malmö and Göteborg railway lines**
  Patentes Talgo. November 2019 - December 2019. (Adrián Fernández Rodríguez, Antonio Fernández Cardador, Asunción Paloma Cucala García)

  In this project the energy optimal speed profile is design for a Talgo train running in Stockholm - Malmö, Göteborg - Malmö and Stockholm - Göteborg stretches, subject to objective running time and comfort requirements. The design is based on detailed simulation of the train dynamics and energy consumption, including regenerated energy during braking processes.

- **Microgas network measurement system in natural gas**
  PLUVIA RISKS. November 2019 - December 2019. (Luis Manuel Mochón Castro)

  Microgas network measurement system in natural gas

- **VALSA-EXPANDE integration and unification of algorithms, single interface and preparation for migration to the cloud**
  Enel Iberoamerica S.R.L. January 2020 - December 2020. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

  The main objective of this project is to address the representation in CODEX of renewable generation and storage, as well as the generation of input scenarios and the preparation for integer and stochastic executions.

- **Generation of coherent scenarios for medium-term forecasting using machine learning techniques**
  Enel Iberoamerica S.R.L. January 2020 - December 2020. (Eugenio Francisco Sánchez Úbeda)

  The aim of this project is the development of probabilistic generators of coherent scenarios 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, Portugal and France**
  Enel Iberoamerica S.R.L. January 2020 - December 2020. (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, Portugal and France. A probabilistic approach is used to fulfill this objective.

- **New interoperable CBTC system for the future urban transport**
  CAF SIGNALLING, SL. January 2020 - December 2021. (Asunción Paloma Cucala García, Antonio Fernández Cardador, Adrián Fernández Rodríguez)

  In this project, new models are developed for the calculation of transport capacity in railways urban networks equipped with CBTC or ERTMS signalling system. These models obtain the maximum capacity in complex nodes of the network: terminal stations, intermediate turn-back stations, yards and switches. In addition, an optimization model is developed for the design of the signaling system to fulfill a target headway between trains.
  This project is in the framework of the CIEN program (2018) of CDTI.

- **Connection of the HaDes analysis and prediction tool to Big Data information system**
  Endesa S.L. January 2020 - July 2020. (José Portela González, Antonio Muñoz San Roque, Jaime Pizarroso Gonzalo)

  The objective of the proposed collaboration is to connect Endesa's BigData system with the tool for monitoring and recalibration of predictive models (HaDes). This allows to develop advanced predictive models using the new information stored in the system.

- **System for automatic control of street lighting by motion detection (Phase II)**
  EIXIMENIS. February 2020 - January 2021. (Carlos Rodríguez-Morcillo García, Javier Matanza Domingo, Jesús María Latorre Canteli, David Contreras Bárcena)

  The objective of the collaboration is to develop the prototype of an electronic system capable of controlling the lighting power of a set of one-way street lamps, based on the detection of the presence of vehicles and / or people in said section of track.

- **Optimal design of ATO driving parameters for Metro de Barcelona to Line 1 for new trains**
  Bombardier European Investments, S.L.U. April 2020 - December 2021. (Antonio Fernández Cardador, Asunción Paloma Cucala García, Adrián Fernández Rodríguez)

  The objective of this project is the design and implementation of ATO speed commands in Line 1 of Metro de Barcelona to minimise the energy consumption of new trains in this line. 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.

- **Optimal design of ATO driving parameters for Metro de Barcelona to Line 1 for new trains**
  Bombardier European Investments, S.L.U. April 2020 - December 2021. (Antonio Fernández Cardador, Asunción Paloma Cucala García, Adrián Fernández Rodríguez)

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 of new trains in this line. 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.

- **New developments and models for forecasting offer curves in the Italian Electricity Market**
  Enel SpA. May 2020 - October 2020. (José Portela González, Antonio Muñoz San Roque, Guillermo Mestre Marcos)

  The objective of this project is to develop a new short-term forecasting model for estimating the competitors' offer curves for each zone in the Italian Electricity Market.

- **Development of an tool to optimize the filling of containers and trucks**
  Pladur Gypsum S.A. June 2020 - July 2020. (Álvaro Jesús López López, Fernando de Cuadra García, Lucía Güitta López)

  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.

- **Dry rail dispersion factors Kdry calculation for the on-board ERTMS system configuration**
  Patentes Talgo S.L.U. June 2020 - October 2020. (Adrián Fernández Rodríguez, Antonio Fernández Cardador, Asunción Paloma Cucala García)

  In this project a new software tool is developed for the calculation of the dry rail dispersion factors (Kdry) to be configured in the on-board ERTMS systems. The tool uses Montecarlo method to obtain the variability in the braking curve as a function of the uncertainty in the application of the different train braking systems.

- **Generation of coherent scenarios for medium-term forecasting using machine learning techniques**
  Inter-American Development Bank (IDB). August 2020 - December 2020. (Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque, José Portela González, Jaime Pizarroso Gonzalo)

  The COVID 19 Pandemic crisis have obliged governments around the world to take robust measures to stop the contact between people. The measures are different between countries, but it is expected important effects in the economy, in the social behaviors and as a result in the energy demand.
  The aim of this project is to implement a model to explain the electricity demand in a set of Latin America and the Caribbean (LAC) countries in order to evaluate the impact of COVID 19 pandemic crisis in the demand. Those

models are used to establish, for each LAC country, possible medium-term recovery energy demand scenarios.

3.2.2.1.2 Public funding

- **Metrology for smart energy management in electric railway systems**
  Comisión Europea. September 2017 - September 2020. (Asunción Paloma Cucala García, Antonio Fernández Cardador, Adrián Fernández Rodríguez)

  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.

- **Software tools for the design of high capacity railway lines [TOOLTRAIN]**
  FEDER, Ministerio de Ciencia, Innovación y Universidades – Agencia Estatal de Investigación, Proyecto _Proyecto RTC-2017-6506-4. June 2018 - May 2020. (Asunción Paloma Cucala García, Antonio Fernández Cardador, Adrián Fernández Rodríguez, Alejandro Cunillera Pérez, Gonzalo Sánchez Contreras)

  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"

- **Wear analysis of the rotary instruments used in endodontics**
  Universidad Complutense de Madrid. November 2018 - November 2019. (Jesús Jiménez Octavio, Juan Carlos del Real Romero)

  The overall objective of this collaboration focuses on the experimental analysis of the wear of rotary instruments, commonly called files, applied to the machining of dental canals. The endodontic treatment includes among its main phases the aforementioned perforation of the dentine, necessary for the subsequent irrigation of the pulp canals of teeth infected with sodium hypochlorite in low concentration to clean bacteria and other detritus inside such pieces.
  The goal of the analysis will be to evaluate the resistance to cyclic fatigue and the wear caused in different rotary instruments, as well as the influence of the working temperatures reached in the machining process. For this purpose, experimental measurements of three-dimensional profilometry, differential scanning calorimetry and X-ray crystallography among others will be used. This study will require the use of the own equipment of the Chemistry and Materials Laboratories, as well as the subcontracting of other measurements to specialized research centers. Thus, conclusions can be obtained concerning the typology and materials used in the design of the machining instruments as well as possible indicators for their optimal redesign.

- **Programa Microrredes Inteligentes Comunidad de Madrid**
  Comunidad de Madrid, Fondo Social Europeo, Fondo Europeo de Desarrollo Regional. January 2019 - December 2020. (Aurelio García Cerrada, David Domínguez Barbero, Ramón Rodríguez Pecharromán, Carlos Rodríguez-Morcillo García, Pablo Frías Marín, Jaime Boal Martín-Larrauri, Javier Matanza Domingo, Álvaro Sánchez Miralles, Lukas Sigrist, Francisco Javier Renedo Anglada, Pablo García González, Asunción Paloma Cucala García, Antonio Fernández Cardador, Luis Rouco Rodríguez, Andrés Tomás Martín)

  PROMINT will investigate several aspects of the deployment of smart micro-grids in urban environments: generation, energy recovery, electric vehicles, peer-to-peer communications and machine learning applied to data collection and analysis. Specific objectives are:
  1. Design, simulation, communication architecture evaluation in distributed energy systems working as micro-grids.
  2. Study of hybrid AC-DC urban micro-grids.
  3. Energy recovery and recycling from urban railway systems in urban micro-grids.
  4. Generation management of micro-grids.
  5. Machine learning applied to micro-grids, electric vehicles and energy management.

- **Implementation of EN 50463-4 Ed 2017 in the Spanish railway system**
  Adif. January 2019 - January 2020. (José Antonio Rodríguez Mondéjar, Yolanda González Arechavala)

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**
  State Key Lab of Rail Traffic Control and Safety (Beijing Jiaotong University). February 2019 - February 2021. (Asunción Paloma Cucala García, Antonio Fernández Cardador, Adrián Fernández Rodríguez)

  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.

- **Advanced Tools Towards cost-efficient decarbonisation of future reliable Energy SysTems**
  Comisión Europea. March 2020 - February 2023. (Miguel Ángel Sanz Bobi, Carlos Mateo Domingo, Pablo Calvo Báscones, Rafael Palacios Hielscher, Rafael Cossent Arín, Eugenio Francisco Sánchez Úbeda, José Portela González)

  The objective of the ATTEST project is to develop and operationalize a modular open source toolbox comprising a suite of innovative tools to
  support TSOs / DSOs operating, maintaining and planning the energy systems of 2030 and beyond in an optimised and coordinated manner,
  considering technical, economic and environmental aspects. The consortium, from six EU countries, that has been assembled to deliver ATTEST
  consists of five highly experienced research organisations in the energy systems area, two utilities that manage and operate the transmission
  system and the distribution system in Croatia, and two industry partners that specialise in the development of advanced ICT solutions and SCADA
  systems. The development of this broad spectrum of energy-related ICT tools and the utilization of next generation algorithms, demonstrated in a
  real world environment has not been attempted before. The outputs from the ATTEST project will enable accelerated dissemination, by a wide
  range of research institutions, within and outside of the project consortium, of the tools that will help TSOs and DSOs to better manage their
  networks. The demonstration of the results of the project will be valuable for the scientific community and EU energy industry and attest to the
  relevance of the solutions developed. The ATTEST's ambition is to enable a wide range of users to utilize and test the tools developed in the
  project, thereby contributing to spread knowledge and experience in the energy systems community in the EU and on a global scale. This will
  contribute significantly to addressing not only the specific challenges of the call and the Horizon 2020 Energy Work Program, but also those of the
  EU's Energy Union strategy and the 2020 Climate & Energy package.

- **Analysis of an auditable random number generation circuit**
  University of Kent. April 2020 - September 2020. (Javier Matanza Domingo, Gregorio López López, Álvaro Jesús López López, Carlos Rodríguez-Morcillo García)

  The objective of the project is to run a performance analysis of the the robust, low-cost and auditable random number generation for embedded system security published in https://github.com/lampertb/LampertCircuitRNG.
  In order to perform this analysis, a set of devices will be fabricated in order to run a serires of performance tests. Based on the obtained results, an analysis will be carried out to compute the the security of the circuit against a series of side-channel attacks including voltage peaks, extreme temperatures, fault injection, etc.

- **CR4ALL: Responsible Consumption for All**
  Ministerio de Ciencia e Innovación. May 2020 - April 2023. (Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque, José Portela González)

  The main objective of the CR4ALL project (Responsible Consumption for All) is to develop a system that, based on the specific information on consumption per device of a relatively small number of representative customers and complementing it with information from external sources, is capable of generating personalized recommendations that improve the efficiency of consumption for the entire customer base of the company. Machine Learning and Big Data techniques will be used.

- **Biophysics of immune response: receptors, cells and populations**
  Ministerio de Ciencia e Innovación. June 2020 - May 2023. (Mario Castro Ponce)

  The immune response involves multiple stages operating at different spatial and temporal scales. In recent years there has been increasing recognition of the role of physical processes in the effectiveness of the response, starting with the region of physical contact between cells (the so-called immunological synapse). In general, it is not possible to speak of the immune response at a scale but an interaction between scales. On the other hand, although the exact molecular structure of the T cell receptor was discovered in August 2019, this knowledge does not fully determine the immune response as it is a dynamic process out of equilibrium, which requires the use of the traditional tools of statistical physics.
  The central objective of the project is to quantify through modeling, simulation, and data analysis the role of the biophysical aspects of the immune response operating at different scales, always focusing on the explanation of experimental data, discrimination between alternative theories and the generation of new hypotheses. To achieve this objective, a study is proposed separating these scales and choosing the methodology that best adapts to their characteristics (large/small concentrations, fluctuations, spatial properties versus well-mixed, etc...) and the available experimental data.
  At the molecular level, we will model the cooperation of T-cell receptors (TCR) to determine the dominant mechanism in the amplification of sensitivity by TCR nanoclusters. Combining stochastic models, image analysis and Bayesian

inference, we will quantify the dynamics and function of these nanoclusters. This approach will extend to cytokine-activated competition processes.
At the cellular level, we propose the quantitative study of cell deformation at the synapse. In the first phase, we will use an experimental model of a collaborating group (hydrothermal carbon) to validate simulation models based on finite elements and generate effective models of this deformation. In the second phase, we will model the cell membrane using the phase-field method. Finally, we will extend classical models of statistical physics (Smoluchowski model) to study the intracellular dynamics of organelles in viral infections.
At the population level, we will introduce compartmental models that allow us to contrast hypotheses on the maturation dynamics of T lymphocytes in the thymus, with special emphasis on symmetry/asymmetry in the selection of double negative cells, and we will use the models to extract the most parsimonious mechanism from the analysis of experimental data. Following the compartmental models, we will study the role of latency in the severity of HIV infection. The model will be contrasted with experimental data where the role of drugs reversing latency will be analyzed. At all levels, exhaustive use of statistical inference methods will be made, for which the transversal problem of the models' identifiability and new measures of sensitivity and synergy of the models' parameters will be analyzed.
The research team is multidisciplinary (Physics, Mathematics, and Mechanical engineering) and will have a work team made up of biologists, mathematicians and physicists and experimental collaborators who will provide us with empirical data to validate the models.

- **Development of movement behavior models of complex chronic patients**
  Ministerio de Ciencia e Innovación. June 2020 - May 2023. (Eugenio Francisco Sánchez Úbeda, Rafael Palacios Hielscher, Antonio Muñoz San Roque, José Portela González, Carlos Rodríguez-Morcillo García)

  The aim of this project, coordinated with Virgen del Rocío University Hospital (HUVR), is to investigate how the deterioration of mobility may reflect changes in the patient's clinical condition, and its degeneration in the domain of integrated care of complex chronic patient.
  To fulfill this objective, an IoT infrastructure and information system is developed. Based on the collected data on patients mobility, machine learning techniques are applied to create patterns capable of modeling and characterizing movement in the patients in order to explain aspects of the clinical evolution of patients.

- **Real consumer engagement through a new user-centric ecosystem development for end-users´assets in a multi-market scenario**
  Comisión Europea. July 2020 - October 2023. (Álvaro Sánchez Miralles, Francisco Martín Martínez, Miguel Ángel Sanz Bobi, Carmen Valor Martínez, Álvaro Erdozain Vila, Alessandra Porfido)

  This project not only enables the effective participation of the consumers/prosumers in the energy market, but also drives a profound change turning traditional company’s value chain into value generation chain, based on a revolutionary Service Dominant Logic paradigm. The main objective of

the REDREAM project is to effectively move the consumer (as a residential, industrial and tertiary consumer) participation to the centre of the energy market through an open and co-creative ecosystem where all stakeholders will actively interact. This ambitious challenge will require the collection of demand response tools and services (energy and non-energy) capable of enabling the capacity for the consumers of participating in the energy market through an improvement of predictability of consumption patterns and consumer behaviour.

3.2.2.2 Consultancy and technological support

3.2.2.2.1 Private funding

- **Application of machine learning models for developing an intelligent inertial position system**
  Airbus Defence and Space S.A.U. September 2019 - December 2019. (José Portela González, Antonio Muñoz San Roque, Eugenio Francisco Sánchez Úbeda, Guillermo Mestre Marcos, Jaime Pizarroso Gonzalo)
  The objective of this project is the application of machine learning models to improve the accuracy of an inertial position system.

- **4D Certification of hydrogen generation onboard systems**
  OCA INSTITUTO DE CERTIFICACION, S.L.U. October 2019 - November 2019. (Pedro Sánchez Martín)
  Perform of a 4D certification to determine the characteristics of the expert and the report quality to evaluate from the point of R&D&I view the project of hydrogen generation onboard systems.

- **Guidelines for energy infrastructures in an urban district located in Madrid North**
  IDOM Consulting, Engineering and Architecture S.A.U. May 2020 - October 2020. (Tomás Gómez San Román, Álvaro Sánchez Miralles, Rafael Cossent Arín, Carlos Mateo Domingo, Pablo Rodilla Rodríguez)
  In the context of the project Guidelines for energy infrastructures in an urban district located in Madrid North developed by IDOM for Distrito Castellana Norte, IIT is carrying out the following studies:
  - Evolution of electric vehicles and charging points
  - Electricity distribution infrastructure
  - Global energy model
  - Governance model

- **Technological consulting for the development of disruptive models using artificial intelligence techniques**
  Insurance Manager, S.L. July 2020 - December 2021. (David Contreras Bárcena, Álvaro Jesús López López)

This project develops the consulting and coordination of the tasks to be carried out for the subsequent development of an intelligent risk management system for the IMEUREKA company within the framework of the awarded NEOTEC project.
The definition of artificial intelligence techniques, methods, and algorithms proposed by the IIT will be developed by the IMEUREKA IT team.

3.2.2.2.2 Public funding

- **Support for the review of design of roadside safety features**
  World Bank. June 2019 - January 2020. (Francisco José López Valdés)

  In collaboration with the World Bank and the Secretariat of Mobility of Bogota (SDM), the goal of the project is to design a new crash barrier system, which is likely to include elements currently not widely used on Colombian roads, such as energy absorbing barrier terminals and motorcycle friendly guardrails. SDM is also working on expanding the use of guardrails where appropriate in other parts of the city.

- **A method for the settlement of the complementary service of supplying electricity to trains in the ADIF and ADIF high-speed railway systems**
  Administrador de Infraestructuras Ferroviarias (ADIF). June 2020 - August 2021. (Tomás Gómez San Román, José Antonio Rodríguez Mondéjar, Asunción Paloma Cucala García, Antonio Fernández Cardador, Ramón Rodríguez Pecharromán, Álvaro Jesús López López, Adrián Fernández Rodríguez, Carlos Mateo Domingo, Rafael Cossent Arín, Yolanda González Arechavala)

  The aim of the project is to set the regulatory conditions and operational procedures for the settlement of electricity supply to trains belonging to different mobility operators under a context of liberalization of train operators, implementation of on-board energy measurement equipment, and providing energy efficiency signals to the train operators. In addition, the project proposes a remuneration regime for ADIF that acknowledges the efficient incurred costs, providing financial sustainability and economic efficiency signals together with keeping quality of service standards for ADIF as an energy supplier and an infrastructure operator.

3.2.2.3 Services and analysis projects

3.2.2.3.1 Private funding

- **Technical support for the tools EXCOM, EXLA AND SIROCO**
  Endesa Medios y Sistemas S.L. January 2019 - December 2019. (Eugenio Francisco Sánchez Úbeda, Javier García González, Antonio Muñoz San Roque, José Portela González)

  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**
  Enel Iberoamérica S.R.L. January 2019 - December 2019. (Francisco Alberto Campos Fernández, José Portela González)

  The objective of this project is to provide ENDESA with developing maintenance of the tool SIROCO developed by IIT.

- **Technical support for the tool SIROCO**
  Enel Iberoamérica S.R.L. January 2019 - December 2019. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

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

- **Technical support for the tools DECA, EXLA, HADES and MODEM**
  Endesa Medios y Sistemas S.L. January 2020 - December 2020. (Eugenio Francisco Sánchez Úbeda, Javier García González, Antonio Muñoz San Roque, José Portela González)

  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.

- **GAUDETE: model of prediction, decision-making and transfer to society against the expansion of the coronavirus COVID-19**
  Universidad Pontificia Comillas. March 2020 - May 2020. (Carlos Rodríguez-Morcillo García, Álvaro Taboada López, David Roch Dupré, Julio César de la Torre Montero, José Antonio Pozas Álvarez, Miguel Ángel Sanz Bobi, Elena Gismero González, María Prieto Ursua, Luis Garvía Vega, María Ana Sáenz Nuño, Federico de Montalvo Jaaskelainen, Javier Matanza Domingo, Jesús María Latorre Canteli, Francisco Javier Renedo Anglada, Francisco José López Valdés, Lucía Güitta López, Pablo Calvo Báscones, David Contreras Bárcena, Laura Bermejo Toro, Lucía Halty Barrutieta, Angustias Roldán Franco, Virginia Cagigal de Gregorio, Mª Jesús Martínez Beltrán, Rafael Jódar Anchía, Macarena Sánchez-Izquierdo Alonso, Calixto Plumed Moreno, José Ángel Ceballos-Amandi, Pablo Sanz Bayón, Jesús Labrador Fernández, Daniel Fernández Robles, Borja Sánchez Barroso)

  The project consists of the development of an algorithm that allows to know, with greater accuracy, the situation of the pandemic, to predict its evolution and to identify enhancing factors and limiting measures of its expansion. Assist in the decision-making of the competent entities and try to provide answers for society.
  It is not only an algorithm, it is a tool through which, with an interdisciplinary approach, a triple objective is sought:
  1. Give hope to society.
  2. Give meaning to the individual and collective effort that is being made.
  3. Serve as a support in the decision-making process. GAUDETE: model of prediction, decision-making and transfer to society against the expansion of the coronavirus COVID-19
  Web page: proyectogaudete.com

3.3 Publications

3.3.1 Books

- S. Lumbreras, *"Respuestas al transhumanismo. Cuerpo, autenticidad y sentido. Argumentos para el s. XXI.".* Publisher: Digital Reasons, CB.. ISBN: 978-84-120888-9-2. January 2020.

- C. Mosacula, J.P. Chaves, *"La tarifa del gas. De los costes al precio final".* Publisher: Fundación Naturgy. ISBN: 978-84-09-12943-0. November 2019.

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- D. Contreras, J.L. Gahete, I. Alonso, D. Alfaya, *"Validation and governance in an Alastrian testnet node".* Chapter in the book "Alastria mission and vision. A multidisciplinary research". Editors: Ibáñez Jiménez. J.W. (Coord). Publisher: Editorial Reus S.A.. Pp. 280. ISBN: 978-84-290-2312-1. July 2020.

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- D. Roch Dupré, T. Gonsalves, *"Increasing energy efficiency by optimizing the electrical infrastructure of a railway line using fireworks algorithm".* Chapter in the book "Handbook of research on fireworks algorithms and swarm intelligence". Editors: Tan, Ying. Publisher: Business Science Reference. Pp. 400. ISBN: 9781799816591. February 2020.

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3.3.2 Publications in journals

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- E. Alonso, R. Giannetti, C. Rodríguez-Morcillo, J. Matanza, J.D. Muñoz Frías, *"A novel passive method for the assessment of skin- electrode contact impedance in intraoperative neurophysiological monitoring systems",* Scientific Reports, vol. 10, nº. 2819, pp. 1-11. ISSN: 2045-2322. February 2020.

- E. F. Álvarez, M. Paredes Quiñones, M.J. Rider, *"Semidefinite relaxation and generalised benders decomposition to solve the transmission expansion network and reactive power planning",* IET Generation Transmission & Distribution, vol. 14, nº. 11, pp. 2160-2168. ISSN: 1751-8687. February 2020/June 2020.

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3.3.4 IIT technical documents

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- S. Lumbreras, *"El coronavirus podría estar debilitándose".* Electronic press in Tendencias 21. Madrid (Spain). June 2020.
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- S. Lumbreras, *"¿Se está debilitando el coronavirus?".* Electronic press in Diario ABC, S.L. Madrid (Spain). June 2020.
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- S. Lumbreras, *"¿Seremos superhumanos?".* Electronic press in La voz de Galicia, S.L. Corunna (Spain). June 2020.
  La voz de Galicia. Opinión. Junio 2020. https://bit.ly/2NVpCxq

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- S. Lumbreras, *"¿Puede debilitarse el COVID-19?".* Electronic press in Diario ABC, S.L. Madrid (Spain). July 2020.
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- S. Lumbreras, *"Por qué beber con pajita puede ser clave para frenar los contagios".* Electronic press in The Conversation Media Group Ltd. Madrid (Spain). July 2020.
  The Conversation. Julio 2020. https://bit.ly/34APTdQ

- S. Lumbreras, *"Por qué el miedo no va a ayudarnos a superar la pandemia".* Electronic press in Diario ABC, S.L. Madrid (Spain). August 2020.
  ABC. Opinión. Agosto 2020. https://bit.ly/2G2hnPv

- P. Mastropietro, *"Measures to tackle the Covid-19 outbreak impact on energy poverty: preliminary analysis based on the Italian and Spanish experiences".* Electronic press in Florence School of Regulation (FSR). Florence (Italy). April 2020.
  https://bit.ly/3cEwf1j

- K. Neuhoff, O. Chiappinelli, T. Gerres, M. Haussner, R. Ismer, N. May, A. Pirlot, J.C. Richstein, *"Building blocks for a climate-neutral European industrial sector".* Technical report in Ministerio de la Transición Ecológica. Madrid (Spain). October 2019.
  Proyecto: Estrategia2050

- K. Neuhoff, F. Lettow, O. Chiappinelli, T. Gerres, E. Joltreau, P. Linares, A. Sniegocki, *"Investments in climate-friendly materials to strengthen the recovery package".* Technical report in European Climate Foundation (ECF). Madrid (Spain). June 2020.
  Proyecto: CFMP_ECF_2019

- I.J. Pérez-Arriaga, R.J. Stoner, D. Nagpal, G. Jacquot, *"The Global Commission to end energy poverty. Inception report".* Technical report in Massachusetts Institute of Technology (MIT). Madrid (Spain). September 2019.

- SEI Platform, I.J. Pérez-Arriaga, *"Scaling-up energy investments in Africa for inclusive and sustainable growth".* Technical report in European Union. Madrid (Spain). November 2019.

4. Teaching

The experience that the IIT holds in various technological fields is a valuable input for the different Bachelor's and Master's degrees offered by the ICAI School of Engineering

This section presents the Bachelor and Master Theses that have been supervised by IIT staff during the last academic year, and the list of Master courses where IIT Researchers have participated as lecturers.

4.1 Supervised undergraduate theses at IIT

4.1.1 Telematics Engineering

- *Standardizing Evaluation of Neural Network Pruning*
  González Ortiz, José Javier. Supervised by Javier Matanza Domingo.

4.1.2 Bachelor's Degree in Engineering for Industrial Technologies

- *Análisis en perfiles de conducción mediante aprendizaje automático*
  Abad Arboiro, Ana. Supervised by Álvaro Jesús López López.

- *Análisis numérico de la propagación de incendios en barrios con infravivienda*
  Ortega Torremocha, Jorge. Supervised by Pablo Ayala Santamaría.

- *Aplicación de técnicas de Machine Learning para mejorar la seguridad en entornos industriales.*
  Moraga Gómez-Olea, Valentín Manuel. Supervised by Álvaro Jesús López López.

- *Desarrollo de algoritmos de control para la navegación de un robot móvil en interiores.*
  Castellote López, Belén. Supervised by Jaime Boal Martín-Larrauri, Javier García Aguilar.

- *Desarrollo de un sistema de navegación para un robot móvil usando aprendizaje por refuerzo*
  Luque Bayón, Emmanuel. Supervised by Álvaro Jesús López López, Jaime Boal Martín-Larrauri.

- *Despacho económico basado en reglas*
  Olmo Muñoz, Silvia del. Supervised by Lukas Sigrist .

- *Diseño de un marco de referencia para el consumo de energía de un brazo robótico industrial.*
  Jiménez Berazaluce, Gonzalo. Supervised by Álvaro Jesús López López.

- *Diseño de un predictor parabólico para el cálculo de máxima capacidad de transferencia entre sistemas interconectados*
  Urretavizcaya Tato, Marta. Supervised by Francisco Echavarren Cerezo.

- *Diseño y fabricación de un fondo plano para un coche fórmula student*
  Nadal Estivill, Jordi. Supervised by Pablo Ayala Santamaría.

- *Explorando la aplicación de blockchain para la provisión de servicios de balance mediante VEs*
  Araque Pineda, Francisco José. Supervised by Jose Pablo Chaves Ávila.

- *Mejora del sistema de seguridad por control de velocidad y separación de un robot industrial basado en visión artificial*
  Fernández Blázquez, Álvaro Luis. Supervised by Jaime Boal Martín-Larrauri.

- *Modelado numérico multiescala para simulación de incendios en túneles*
  Álvarez Coedo, Diego. Supervised by Pablo Ayala Santamaría.

- *Modelos electromecánicos de convertidores VSC en Matlab + Simulink + SimPowerSystems*
  Medina Lage, Rodrigo. Supervised by Francisco Javier Renedo Anglada, Lukas Sigrist .

- *Nexus agua-energía: representación de una desaladora en el despacho económico*
  Benavente Martínez, Eduardo. Supervised by Lukas Sigrist .

- *Optimización del sistema de visión artificial de un robot industrial para una aplicación de pick and place*
  Ortiz de Zúñiga Mingot, Ignacio. Supervised by Jaime Boal Martín-Larrauri.

- *Parametrización y optimización de una red neuronal recurrente aplicada a la generación de texto*
  García Muñoz, Venancio. Supervised by Álvaro Jesús López López.

- *Predicción de la demanda y estudio de las características de los consumidores en comercios online*
  Pérez de Vargas Belmonte, Javier. Supervised by Álvaro Jesús López López.

- *Quantitative analysis of energy consumption andpollutant emissions coming from the passenger car fleet in Madrid, based on variousmobility scenarios*
  Moreno Marín, Javier María. Supervised by Pablo Frías Marín.

- *Robot poeta. Optimización de la estructura del modelo de representación y del método de muestreo.*
  Geûens Álvarez, Carlos. Supervised by Álvaro Jesús López López.

- *Simulación numérica y verificación experimental de la propagación de incendios entre viviendas aisladas*
  Plata Martínez, María. Supervised by Pablo Ayala Santamaría.

- *Telemetría de un coche tipo fórmula*
  Blázquez Patino, Pablo. Supervised by Carlos Rodríguez-Morcillo García.

- *Análisis del nivel de contaminación atmosférica en Madrid utilizando técnicas de machine learning*
  Manuel Sainz de Baranda Portela. Supervised by Eugenio Francisco Sánchez Úbeda.

- *Extracción de conocimiento de puntos de interés georreferenciados de una ciudad utilizando técnicas de aprendizaje automático.*
  Ignacio Serrano Jiménez. Supervised by Eugenio Francisco Sánchez Úbeda.

4.1.3 Bachelor's Degree in Engineering in Telecommunications Technologies

- *Aplicación móvil para gestión de eventos grupales con tomas de decisión*
  Benito Cháfer, Juan Sebastián de. Supervised by Miguel Manuel Martín Lopo.

- *Implantación de algoritmos de SLAM en el entorno de simulación V-REP usando ROS 2*
  Ampuero González, Ignacio. Supervised by Jaime Boal Martín-Larrauri.

- *Music Detecting Light System*
  Sánchez Sánchez, Alfredo. Supervised by Javier Matanza Domingo.

4.2 Postgraduate teaching

4.2.1 Graduate courses

On the University website, as well as in the corresponding information brochures, you can find detailed information on the different master programs available. The master courses given by IIT staff in which they participate as lecturers are listed hereafter.

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

Director: Luis Olmos Camacho
This master can also be taken in the context of the Erasmus Mundus *Master in Economics and Management of Network Industries* (EMIN). More information at http://www.icai.upcomillas.es/en/master/mepi-en

- *Decision support models in the electric power industry*
  Antonio Bello Morales, Javier García González, Tomás Gómez San Román, Sara Lumbreras Sancho, Andrés Ramos Galán

- *Economy of the electric power industry*
  José Pablo Chaves Ávila

- *Electric power systems*
  Michel Rivier Abbad, Luis Rouco Rodríguez

- *Environmental and renewable energy policy*
  Pedro Linares Llamas

- *Fundamentals on electrical engineering and optimization techniques*
  Francisco Alberto Campos Fernández, Javier García González, Michel Rivier Abbad, Sonja Wogrin

- *Internship*
  Luis Olmos Camacho

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

- *Master's thesis*
  José Pablo Chaves Ávila, Tomás Gómez San Román, Pedro Linares Llamas, Paolo Mastropietro, Carlos Mateo Domingo, Luis Olmos Camacho, Andrés Ramos Galán, Pablo Rodilla Rodríguez, José Carlos Romero Mora, Luis Rouco Rodríguez

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

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

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

4.2.1.2 Master in Railway Systems

Director: Antonio Fernández Cardador
More information at http://www.icai.upcomillas.es/en/master/msf-en

- *Ampliación del Trabajo Fin de Máster*
  Asunción Paloma Cucala García, Antonio Fernández Cardador

- *Electrificación*
  Luis Rouco Rodríguez

- *Práctica profesional*
  Asunción Paloma Cucala García

- *Sistemas Avanzados de Diseño y Control de Tráfico*
  Asunción Paloma Cucala García, Antonio Fernández Cardador, Adrián Fernández Rodríguez

- *Sistemas de Control y Supervisión*
  José Antonio Rodríguez Mondéjar

- *Trabajo Fin de Máster*
  Asunción Paloma Cucala García, Antonio Fernández Cardador

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

Director: Fernando de Cuadra García
More information at
http://www.structuralia.com/es/cursos/item/249-master-en-proyecto-construccion-y-mantenimiento-de-infraestructuras-electricas-de-alta-tension&ORIG=dina&CAMP=buscador&TCAMP=WEB&term=M%C3%A1ster%20en%20Proyecto,%20Construcci

- *Transmission Lines*
  Francisco Miguel Echavarren Cerezo

4.2.1.4 Master's Degree in Smart Industry (MIC)

Director: Bernardo Villazán
More information at
https://www.comillas.edu/en/masters/master-degree-in-smart-industry

- *IIoT-Cloud Communications +OC*
  Gregorio López López

- *Machine Learning +OC*
  Guillermo Mestre Marcos, José Portela González

- *Master Thesis*
  Álvaro Jesús López López

- *Smart Systems Applied to Industry +OC*
  Álvaro Sánchez Miralles

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

More information at
https://www.comillas.edu/en/masters/master-degree-in-big-data-technologies-and-advanced-analytics

- *Fundamentos Matemáticos del Análisis de Datos +OC*
  José Portela González

- *Machine Learning I*
  José Portela González, Sonja Wogrin

- *Machine Learning II +OC*
  Eugenio Francisco Sánchez Úbeda, Miguel Ángel Sanz Bobi

4.2.1.6 Master's Degree in Smart Grids (MSG)

- *Internship and Master Thesis*
  Javier Matanza Domingo, Miguel Ángel Sanz Bobi

- *Operación y Planificación de las Futuras Redes de Distribución*
  José Pablo Chaves Ávila, Rafael Cossent Arín, Francisco Miguel Echavarren Cerezo, Carlos Mateo Domingo, Francisco Javier Renedo Anglada, Lukas Sigrist

- *Operation and Planning of Future Distribution Networks*
  José Pablo Chaves Ávila, Carlos Mateo Domingo, Lukas Sigrist

- *Operation and Planning of Future Distribution Networks Laboratory*
  Francisco Miguel Echavarren Cerezo, Francisco Javier Renedo Anglada, Lukas Sigrist

- *Regulation and New Business Models*
  Paolo Mastropietro, Pablo Rodilla Rodríguez

- *Telecommunications for Smart Grids*
  Javier Matanza Domingo

4.2.2 Graduate theses supervised at IIT

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

- *Accuracy improvement of Deep Neural Networks through preprocessing and neural structure tuning techniques. An approach to time-series models.*
  López-Tafall Criado, Mónica. Supervised by Jaime Pizarroso Gonzalo, José Portela González.

- *Advanced Models for Computer Vision*
  Huertas Collado, Miguel. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Advanced Neural Networks Architectures Research - Forecasting Recommendations*
  Rilo Sánchez, Santiago. Supervised by Jaime Pizarroso Gonzalo, José Portela González.

- *Análisis comparativo de algoritmos de localización de robots móviles basados en filtros de partículas*
  Labora Gómez, Julio. Supervised by Jaime Boal Martín-Larrauri.

- *Análisis de ciclo de vida de posibles escenarios de mix de generación eléctrica en España en 2030*
  Quintero Bermejo, Guillermo. Supervised by Carlos Martín Sastre.

- *Análisis de conglomerados industriales en España*
  Fraile López, Juan. Supervised by Jose Pablo Chaves Ávila, Timo Gerres .

- *Análisis de las emisiones de CO2 embebidas en los flujos de comercio internacional*
  Gómez Gómez, Jacobo. Supervised by Pedro Linares Llamas.

- *Análisis de las implicaciones de inclusión de la red de distribución de calor en un despacho económico termoeléctrico.*
  Miguel Peña, David de. Supervised by Lukas Sigrist .

- *Análisis de los objetivos estratégicos del PNIEC español relacionados con el sector eléctrico*
  Llorca Ortolá, Juan Ramón. Supervised by Francisco Alberto Campos Fernández, Salvador Doménech Martínez.

- *Análisis de viabilidad técnico-económica de la bomba de calor aerotérmica accionada eléctricamente para viviendas en bloque como medida activa contra la pobreza energética*
  Priego Peña, Irene. Supervised by Roberto Barrella .

- *Análisis del impacto en la población vulnerable a la pobreza energética de diferentes escenarios de demanda térmica en los sectores residencial y servicios a 2030 y 2050*
  Sánchez Villamor, Pablo. Supervised by José Carlos Romero Mora.

- *Analyzing the impact of spot and reserve price uncertainty in optimization models for Combined Cycle Gas Turbines considering thermal fatigue*
  Escribano Delgado, Carlos. Supervised by Sonja Wogrin .

- *Aplicación de los avances de aprendizaje automático para inversión en mercados financieros*
  Olazabal Bernaldo de Quirós, Borja de. Supervised by José Portela González.

- *Aplicaciones del control de convertidores tipo fuente de tensión en sistemas eléctricos de baja inercia*
  Urosa Sánchez, Pablo. Supervised by Francisco Javier Renedo Anglada, Javier Roldan Pérez.

- *Application of smart meter phase connectivity to voltage unbalance in low voltage networks*
  Garcerán Sánchez, Andrés. Supervised by Javier Matanza Domingo.

- *Caso estudio de hibridación de renovables con baterías para la participación en la regulación frecuencia-potencia*
  Tapiador Ferrero, Laura María. Supervised by Luis Díez Maroto.

- *Control de convertidores tipo fuente de tensión conectados a una red de baja inercia*
  Sánchez Bas, Pedro. Supervised by Francisco Javier Renedo Anglada.

- *Control de convertidores tipo fuente de tensión controlados en tensión y frecuencia para aplicaciones de microrredes*
  Morillo-Velarde Moraleda, Alejandro. Supervised by Francisco Javier Renedo Anglada.

- *Desarrollo de plataforma para la interconexión de donantes de alimentos con bancos de alimentos*
  Ripoll Ramzi, Carlos. Supervised by Álvaro Jesús López López.

- *Desarrollo de un entorno virtual en Unity orientado a optimizar la carga de contenedores en la industria*
  Soria Soto, José. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Desarrollo de una aplicación para análisis modal de sistemas eléctricos de potencia*
  Corral Vila, Pablo. Supervised by Javier García Aguilar.

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

- *Diseño de mesa interactiva para análisis de movilidad y modelado de escenarios urbanos*
  Rodrigo Tobías, Ignacio de. Supervised by Jaime Boal Martín-Larrauri.

- *Diseño de un modelo de aprendizaje profundo para realizar operaciones de compraventa de activos financieros*
  Díaz García, Lucía. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Estudio acerca de la transformación digital en las empresas y su aplicación a 2P Projects*
  Quintanilla Pastor, Fernando. Supervised by Álvaro Jesús López López.

- *Estudio de la implementación de la tecnología blockchain en un sistema de low voltage distribution loop*
  Plata Rodilla, Diego. Supervised by Antonio Vázquez Blanco, Miguel Manuel Martín Lopo.

- *Estudio de la transición a un sistema de transporte de viajeros más sostenible desde una perspectiva de ciclo de vida.*
  González Halcón, Carmen. Supervised by Carlos Martín Sastre.

- *Estudio de las posibles mejoras en la gestión de carteras de valores mediante la aplicación de técnicas de aprendizaje por refuerzo*
  Oriol Dolz de Espejo, José. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Evaluación de fiabilidad en sistemas con microrredes*
  Basanta Vázquez, Iria. Supervised by Carlos Mateo Domingo, Fernando Emilio Postigo Marcos.

- *Evaluación medioambiental de diferentes tipos de dietas de alimentación humana en función del origen, animal o vegetal, de los nutrientes.*
  Ortega Torremocha, Ángel. Supervised by Carlos Martín Sastre.

- *Faltas en redes de distribución en isla: respuesta ante fallos desequilibrados y generación de corrientes de secuencia inversa y homopolar mediante inversores*
  Barba Suárez, Luis Ismael de la. Supervised by Lukas Sigrist .

- *Financial Applications of Forecasting Models for Functional Time Series*
  Sanjuán Ruiz, Carlos. Supervised by Guillermo Mestre Marcos.

- *Impacto del acceso a la energía en el desarrollo humano*
  Lara Vegazo, Gema. Supervised by Pedro Linares Llamas.

- *Impacto del consumidor en la transición energética*
  Clavaguera López-Puigcerver, José Manuel. Supervised by Pedro Linares Llamas.

- *Impacto social de la 4ª Revolución Industrial*
  Bravo Lázaro, Marta. Supervised by Álvaro Jesús López López.

- *Integración y aplicación de técnicas de aprendizaje por refuerzo al robot IRB120 en el entorno virtual de MuJoCo*
  Dong, Lixiang. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Lane Detection Model using Deep Learning Algorithms*
  Tello del Rosal, Juan Antolín. Supervised by Álvaro Jesús López López.

- *Las energías renovables en la España Vaciada*
  Cabanzón Labat, Jacobo. Supervised by Carlos Martín Sastre.

- *NB-PLC Frequency Bands (151-471 kHz) Feasibility Study for PRIME v1.4 Protocol*
  Arias Blanco, Víctor. Supervised by Javier Matanza Domingo.

- *Optimización de recursos en el Banco de Alimentos de Madrid: Abordando las necesidades de compras y aprovisionamiento*
  Castañón Naseiro, Rosendo Daniel. Supervised by Álvaro Jesús López López, Francisco Alberto Campos Fernández, Salvador Doménech Martínez.

- *Optimización del flujo de carga de una planta industrial y automatización de su inventario*
  Alonso Álvarez, Raimundo. Supervised by Álvaro Jesús López López.

- *Predicción de demanda convencional de gas natural a nivel nacional a medio y largo plazo*
  Loring Castillo, Jaime. Supervised by Álvaro Jesús López López.

- *Respuesta de elementos grid forming ante grande perturbaciones*
  Benedito Pallarés, Manuel Ángel. Supervised by Lukas Sigrist .

- *Spare parts demand forecasting*
  Atienza Lama, Gonzalo. Supervised by Álvaro Jesús López López.

- *Transición del sistema eléctrico español a un sistema fundamentalmente renovable. Análisis técnico-económico*
  González Vázquez, Álvaro. Supervised by Francisco Alberto Campos Fernández, Salvador Doménech Martínez.

4.2.2.2 Official Master's Degree in Telecommunications Engineering (MIT)

- *Standardizing Evaluation of Neural Network Pruning*
  González Ortiz, José Javier. Supervised by Javier Matanza Domingo.

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

- *Análisis de políticas óptimas globales contra el cambio climático*
  Pretel Parejo-Merino, Carlos Jesús. Supervised by Pedro Linares Llamas.

- *Estimating the impact of industrial decarbonization on the Spanish energy demand*
  Martínez Sendin, Esperanza Macarena. Supervised by José Carlos Romero Mora, Timo Gerres .

- *Evaluation of tariff designs the Context of Decarbonization, Digitalization, and Decentralization*
  Miguel Peña, David de. Supervised by Jose Pablo Chaves Ávila.

- *Modelos Organizativos Teal para Startups Sociales. Caso WAYVOLUTION*
  Díaz Pastor, Santos-José. Supervised by Andrés González García.

- *Integrating distribution networks in market models for distributed energy resources dispatch*
  Alberto de Andrés Romañach. Supervised by Carlos Mateo Domingo and Tomás Gómez San Román.

4.2.2.4 Master in Railway Systems

- *Validación del software de simulación ?OlgaNG? considerando la nueva normativa CENELEC*
  Galende López, Jesús. Supervised by Eduardo Pilo de la Fuente.

4.2.2.5 Master's Degree in Smart Industry (MIC)

- *Accuracy improvement of Deep Neural Networks through preprocessing and neural structure tuning techniques. An approach to time-series models.*
  López-Tafall Criado, Mónica. Supervised by Jaime Pizarroso Gonzalo, José Portela González.

- *Advanced Models for Computer Vision*
  Huertas Collado, Miguel. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Análisis comparativo de algoritmos de localización de robots móviles basados en filtros de partículas*
  Labora Gómez, Julio. Supervised by Jaime Boal Martín-Larrauri.

- *Análisis y Diseño de Arquitecturas de Redes Neuronales aplicadas a Predicción de Series Temporales*
  Rilo Sánchez, Santiago. Supervised by Jaime Pizarroso Gonzalo, José Portela González.

- *Desarrollo de plataforma para la interconexión de donantes de alimentos con bancos de alimentos*
  Ripoll Ramzi, Carlos. Supervised by Álvaro Jesús López López.

- *Desarrollo de un entorno virtual en Unity orientado a optimizar la carga de contenedores en la industria*
  Soria Soto, José. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Diseño de un modelo de aprendizaje profundo para realizar operaciones de compraventa de activos financieros*
  Díaz García, Lucía. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Estudio de las posibles mejoras en la gestión de carteras de valores mediante la aplicación de técnicas de aprendizaje por refuerzo*
  Oriol Dolz de Espejo, José. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Financial Applications of Forecasting Models for Functional Time Series*
  Sanjuán Ruiz, Carlos. Supervised by Guillermo Mestre Marcos.

- *Impacto social de la 4ª Revolución Industrial*
  Bravo Lázaro, Marta. Supervised by Álvaro Jesús López López.

- *Integración y aplicación de técnicas de aprendizaje por refuerzo al robot IRB120 en el entorno virtual de MuJoCo*
  Dong, Lixiang. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Optimización de recursos en el Banco de Alimentos de Madrid: Abordando las necesidades de compras y aprovisionamiento*
  Castañón Naseiro, Rosendo Daniel. Supervised by Álvaro Jesús López López, Francisco Alberto Campos Fernández, Salvador Doménech Martínez.

- *Optimización del flujo de carga de una planta industrial y automatización de su inventario*
  Alonso Álvarez, Raimundo. Supervised by Álvaro Jesús López López.

- *Predicción de demanda convencional de gas natural a nivel nacional a medio y largo plazo*
  Loring Castillo, Jaime. Supervised by Álvaro Jesús López López.

4.2.2.6 Master's Degree in Smart Grids (MSG)

- *Application of smart meter phase connectivity to voltage unbalance in low voltage networks*
  Garcerán Sánchez, Andrés. Supervised by Javier Matanza Domingo.

- *Automatización de las Redes Inteligentes*
  Martín Langa, Guillermo. Supervised by Rafael Cossent Arín.

- *NB-PLC Frequency Bands (151-471 kHz) Feasibility Study for PRIME V1.4 Protocol*
  Arias Blanco, Víctor. Supervised by Javier Matanza Domingo.

- *Use of current and energy reports to manage grid capacity and flexibility*
  Gallego Fernández, Pablo. Supervised by Javier Matanza Domingo.

4.2.2.7 Master in Mobility and Safety Engineering (MMS)

- *Diseño de mesa interactiva para análisis de movilidad y modelado de escenarios urbanos*
  Rodrigo Tobías, Ignacio de. Supervised by Jaime Boal Martín-Larrauri.

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 Pedro Ciller 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.

- *Métodos de Investigación I: Introducción, Fuentes de Información y Métodos de Investigación Cuantitativa*
  Carmen Valor Martínez

- *Métodos de Investigación II: Epistemología de la Ciencia, Métodos de Investigación Cualitativa y Redacción de Textos Científicos*
  Carmen Valor Martínez

- *Optimization techniques*
  Andrés Ramos Galán, Sonja Wogrin

- *Preliminary research project*
  Andrés Ramos Galán

- *Publicación de resultados de investigación / 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.

- *Doctorado ICAI: Advanced Excel for research (10h)*
  Javier García González, Jesús María Latorre Canteli

- *Doctorado ICAI: Advanced GAMS for applied research (10h)*
  Andrés Ramos Galán

- *Doctorado ICAI: Advanced Matlab for applied research (10h)*
  Eugenio Francisco Sánchez Úbeda

- *Doctorado ICAI: Advanced VBA-Excel for applied research (10h)*
  Francisco Alberto Campos Fernández, Jesús María Latorre Canteli

- *Doctorado ICAI: Data analysis (10h)*
  Eugenio Francisco Sánchez Úbeda

- *Doctorado ICAI: Data Management (10h)*
  Jesús María Latorre Canteli, Eugenio Francisco Sánchez Úbeda

- *Doctorado ICAI: Forecasting techniques (10h)*
  José Portela González

- *Doctorado ICAI: Oral presentation of research results (10h)*
  Efraim Centeno Hernáez

- *Programa oficial de doctorado CETIS 99/2011: Doctorado e Investigación Científica en Comillas (8h)*
  Carmen Valor Martínez

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: *A complex-network approach to support transmission expansion planning*
  Author: Rafael Espejo González
  Supervisors: Andrés Ramos Galán and Sara Lumbreras Sancho
  Date: October 28, 2019

- Title: *Electricity markets operation planning with risk-averse agents: stochastic decomposition and equilibrium*
  Author: Nenad Jovanovic
  Supervisors: Javier García González and Julián Barquín Gil
  Date: November 05, 2019

- Title: *Development of a novel concept of efficient superconducting magnet for radioisotope production cyclotron*
  Author: Javier Munilla López
  Supervisors: Mario Castro Ponce and Fernando Toral Fernández
  Date: January 21, 2020

- Title: *Improving the electrical infrastructure of dc-electrified railway systems to increase energy efficiency, taking into account complex topologies and representative traffic scenarios*
  Author: David Roch Dupré
  Supervisors: Asunción Paloma Cucala García and Ramón Rodríguez Pecharromán
  Date: July 02, 2020

5.4.2 Comillas ongoing theses

- Title: *Development of a wireless brain computer interface system*
  Author: Eduardo Alonso Rivas
  Supervisors: Carlos Rodríguez-Morcillo García and Romano Giannetti

- 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: *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: *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: *Contribuciones al análisis y la previsión de los precios del petróleo*
  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: *Contibuciones 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 comunication 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*
  Author: Bernardo Villazán Gil
  Supervisors: Laura Fernández Méndez and Sara Lumbreras Sancho

- Title: *Volatility premiums as a proxy for ESG scores?*
  Author: Paraskevas Paraskevas Kamforidou
  Supervisors: Isabel Catalina Figuerola-Ferreti Garrigues and Sara Lumbreras 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 techeniques*
  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: *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: *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 Bárcena

- Title: *Incroporación de un nuevo factor sostenibilidad al modelo de valoración de activos de Fama-French*
  Author: Alejandro Rodríguez Gallego
  Supervisors: Isabel Catalina Figuerola-Ferreti 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

- Title: *Analysis of policy strategies for renewable energy integration in multi-area electricity markets*
  Author: Geovanny Alberto Marulanda García
  Supervisors: Antonio Bello Morales and Javier Reneses Guillén

- Title: *Modelling and optimising a microgrid system by reinforcement learning techniques*
  Author: David Domínguez Barbero
  Supervisors: Javier García González and Miguel Ángel Sanz Bobi

- Title: *Comparing centralized vs. decentralized medium-term hydrothermal operation considering storage with different timeframes*
  Author: Sébastien Huclin
  Supervisors: Andrés Ramos Galán and José Pablo Chaves Ávila

- Title: *Desing, analyze and fabrication of highly-sensitive sensors for bio-sanitary applications*
  Author: Mahdieh GholamiMayani
  Supervisors: Romano Giannetti and Javier Matanza Domingo

- Title: *Optimal power grid design for a low carbon emisson future*
  Author: Erik Francisco Alvarez Quispe
  Supervisors: Andrés Ramos Galán and Luis Olmos Camacho

- Title: *Assessment of electricity network requierements for the energy transition*
  Author: Leslie Lara Herding
  Supervisors: Michel Rivier Abbad and Rafael Cossent Arín

- Title: *Modelado de aisladores de vidrio con recubrimiento de silicona para líneas de alta tensión en condiciones de contaminación ambiental severa*
  Author: Héctor de Santos Yubero
  Supervisor: Miguel Ángel Sanz Bobi

- Title: *Flexible charging of electric vehicles using distributed technologies such as blockchain*
  Author: Morsy Abdelkader Morsy Mohammed Nour
  Supervisors: Álvaro Sánchez Miralles and José Pablo Chaves Ávila

- Title: *Stability analysis of large power systems with 100% of non-synchronous generation*
  Author: Regulo Enrique Avila Martinez
  Supervisor: Luis Rouco Rodríguez

- Title: *Medium-term hydrothermal scheduling considering short-term uncertainty*
  Author: Jesús David Gómez Pérez
  Supervisors: Andrés Ramos Galán and Jesús María Latorre Canteli

- Title: *Exploring the design of local market-based mechanisms to provide DSO flexibility services*
  Author: Fernando David Martín Utrilla
  Supervisors: Rafael Cossent Arín and José Pablo Chaves Ávila

5.4.3 Submitted theses in other universities

- Title: *Rate design for the 21st century: improving economic efficiency and distributional equity in electricity rate design*
  Author: Scott Burger
  Supervisor: José Ignacio Pérez Arriaga
  Massachussets Institute of Technology. Cambridge, MA (U.S.A.).
  Date: September 01, 2019

- Title: *Diseño e implementación de sistemas de etiquetas pasivas basadas en líneas magneto-inductivas*
  Author: José Juan Martínez Martínez
  Supervisor: Francisco Javier Herraiz Martínez
  Universidad Carlos III de Madrid. Madrid (Spain).
  Date: September 26, 2019

- Title: *Diseño e implementación de sensores y lectores IoT para la caracterización dieléctrica y la detección de espesores*
  Author: Gabriel Galindo Romera
  Supervisor: Francisco Javier Herraiz Martínez
  Universidad Carlos III de Madrid. Madrid (Spain).
  Date: September 27, 2019

- Title: *Análisis computacional de dinámica de fluidos con sistemas de presión positiva y negativa en anatomías reales de conductos ovales con ramificaciones apicales*
  Author: Gaizka Loroño Goikoetxea
  Supervisors: Rafael Cisneros Cabello, Ana María Arias Paniagua and Jesús Jiménez Octavio
  Universidad Europea de Madrid. Madrid (Spain).
  Date: June 12, 2020

- Title: *Fluid dynamics of smoke from enclosure fires*
  Author: Gabriele Vigne
  Supervisors: Cándido Gutiérrez Montes and Alexis Cantizano González
  Universidad de Jaén. Jaén (Spain).
  Date: July 30, 2020

6. Other activities

6.1 EES-UETP

The Electric Energy Systems - University Enterprise Training Partnership (EES-UETP) is a consortium of 3 companies and 22 universities and research centers in 15 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.

More information at http://www.ees-uetp.com.

6.1.1 EES-UETP partners

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

- **Austria**
  - Graz University of Technology
- **Belgium**
  - Katholieke Universiteit Leuven (KU Leuven)
- **Croatia**
  - Energy Institute Hrvoje Požar
  - University of Osijek
- **Denmark**
  - Danmarks Tekniske Universitet
- **Finland**
  - Graduate School in Electrical Energy Engineering (GSEEE)
- **France**
  - École Supérieure d´Electricité (SUPELEC)

- Gestionnaire du Réseau de Transport d'Electricité (RTE)
- **Germany**
  - Technische Universität Dortmund
- **Greece**
  - National Technical University of Athens
- **Italy**
  - Universitá degli Studi di Bologna
  - Universitá degli Studi di Cagliari
  - Universitá degli Studi di Genova
- **Latvia**
  - Riga Technical University
- **Portugal**
  - Institute for Systems and Computer Engineering of Porto (INESC Porto)
- **Spain**
  - Catalonia Institute for Research in Technology (IREC)
  - Iberdrola, S.A.
  - Universidad de Sevilla
  - Universidad Politécnica Valencia
  - Universidad Pontificia Comillas
- **Sweden**
  - KTH Royal Institute of Technology
- **Switzerland**
  - École Polytechnique Fédérale de Lausanne (EPFL)
  - ETH Zürich
- **United Kingdom**
  - University of Manchester
  - University of Strathclyde

Besides being an active member of the network, the Comillas Pontifical University covers the following positions in the EES-UETP:
- Chairman of the Executive Board: Mr. Luis Rouco Rodríguez
- Coordinating Secretary: Mr. Luis Olmos Camacho

6.1.2 Teached courses

- *Integration of Electric Vehicles in Power Systems*
  TU Dortmund University, Dortmund, Germany

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 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:

- Isaac Camilo González Romero, in Center for System Science and Engineering. Department of Civil Engineering, Johns Hopkins University, Baltimore (United States of America). September-December 2019.

- Sonja Wogrin, in Information and Decision Systems (LIDS), Massachusetts Institute of Technology (MIT), Cambridge (United States of America). February-July 2020.

6.3 Visiting professors

- Jenny Alexandra Cifuentes Quintero, from Santander Big Data Institute, Universidad Carlos III , Madrid (España). September 2019-July 2020.

- Carlos Andrés García Montoya, from Dirección Planeación Transmisión y Distribución, Empresas Públicas de Medellín, Medellín (Colombia). October-November 2019.

- Andrés González García, September 2019-August 2020.

- Pablo Magliarella, from Ingenieria Industrial, Universidad Tecnológica Nacional FRBA, Buenos Aires (Argentina). September 2019-July 2020.

- Carlos Morales Polo, December 2019-December 2020.

- Francisco José Pérez Thoden Van Velzen, September 2019-August 2020.

- Pedro Manuel Soares Moura, from Dep. of Electrical and Computer Engineering, University of Coimbra, Coimbra (Portugal). March-June 2020.

- Diego Alejandro Tejada Arango, Universidad Pontificia Comillas, Madrid (Spain). July 2019-July 2020.

6.4 Visiting students

- Aladdin Attieh, from Engineering Department, Saint Joseph University of Beirut, Beirut (LIBANO). September-October 2019.

- Farah Bou Said, from Engineering Department, Saint Joseph University of Beirut, Beirut (LIBANO). September-October 2019.

- Alejandro Parrado Duque, from Dpto. Ingeniería Eléctrica, Universidad Industrial de Santander, Bucaramanga (Bucaramanga). September 2019-February 2020.

- Juan Andrés Pérez Rúa, from Wind Energy, Technical University of Denmark (DTU), Roskilde (Roskilde). September-December 2019.

- Andrew Thompson, Université Paris-Sud, Orsay (France). September-December 2019.

- Matteo Troncia, from Department of Electrical and Electronic Engineering, University of Cagliari, Cagliary (Italy). October 2019-January 2020.

6.5 Courses offered and coordinated to external companies and institutions

The courses offered to companies and consultancy activities are frequently related to research projects. There have been as follows:

- 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.

- José Pablo Chaves Ávila, Matteo Troncia, ISGAN. Italy.

- Pablo Rodilla Rodríguez, *"FSR Summer school on regulation of energy utilities".* Florence School of Regulation (FSR). Italy. Florence, Florence (Italy).

- 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.

- 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.

- Pablo Rodilla Rodríguez, Paolo Mastropietro, *"Course on wholesale market design".* XM Compañía de Expertos en Mercados, SA. Italy. Medellin, Antioquia (Colombia).

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

- Sara Lumbreras Sancho, *"Invited lecture «From analytics to decision making»".* Generali Global Corporate. Italy. Segovia, Segovia.

- Juan Carlos del Real Romero, *"Technical advice on adhesive joints".* Fundación Tecnalia Research & Innovation. Italy. San Sebastian, Guipuzcoa.

- Pablo Rodilla Rodríguez, Javier Reneses Guillén, Paolo Mastropietro, Michel Rivier Abbad, *"FSR Annual Training on the Regulation of Energy Utilities (15th edition)".* European University Institute (EUI), Florence School of Regulation (FSR). Italy. Florence, Florence (Italy).

- Juan Carlos del Real Romero, *"Training European Adhesive Bonder (QC / Durability)".* Sika, S.A.U. Italy. Alcobendas, Madrid.

- Juan Carlos del Real Romero, Yolanda Ballesteros Iglesias, Eva Paz Jiménez, Sara López de Armentia Hernández, *"Training European Adhesive Specialist (Surface treatment)".* Asociación Española de Soldadura y Tecnologías de Unión (CESOL). Italy. Madrid.

- Francisco Javier Herraiz Martínez, *"Invited lecture «Radiofrequency biosensors based on metamaterial resonators»".* FUNDECYT-PCTEX. Italy. Merida, Yucatan (Mexico).

- Juan Carlos del Real Romero, Sara López de Armentia Hernández, *"Training European Adhesive Bonder (Design-Quality control-Durability)".* Asociación Española de Soldadura y Tecnologías de Unión (CESOL). Italy. Madrid.

- Francisco Javier Renedo Anglada, Ignacio Egido Cortés, Lukas Sigrist, *"Grid Integration workshop on Advanced Modelling for Renewables in PSS/E for Power System Studies".* International Renewable Energy Agency (IRENA). Italy. San Salvador (El Salvador).

- Juan Carlos del Real Romero, Eva Paz Jiménez, Yolanda Ballesteros Iglesias, Sara López de Armentia Hernández, *"Training European Adhesive Specialist (Durability-Mechanical testing adhesive joints)".* Asociación Española de Soldadura y Tecnologías de Unión (CESOL). Italy. Madrid.

- Juan Carlos del Real Romero, *"Technical advice on adhesive joints".* Fundación Tecnalia Research & Innovation. Italy. San Sebastian, Guipuzcoa.

- Juan Carlos del Real Romero, *"Technical advice on adhesive joints".* Fundación Tecnalia Research & Innovation. Italy. San Sebastian, Guipuzcoa.

- Juan Carlos del Real Romero, Eva Paz Jiménez, Sara López de Armentia Hernández, *"Training European Adhesive Specialist (Standardization-Mechanical properties)".* Asociación Española de Soldadura y Tecnologías de Unión (CESOL). Italy. Madrid.

- Luis Olmos Camacho, Luis Rouco Rodríguez, Rafael Palacios Hielscher, *"Coordination of the course committee of the EES-UETP network during the year 2020".* Electric Energy Systems - University Enterprise Training Partnership Association (EES-UETP). Italy. Madrid.

- Andrés Ramos Galán, Javier García González, *"Computational modeling for promoting low-carbon electricity".* Massachusetts Institute of Technology (MIT). Italy. Cambridge, MA (United States of America).

- Francisco José López Valdés, *"EuroNCAP testing protocols".* Inscripciones asistentes. Italy. Madrid.

- Francisco José López Valdés, *"Child restraint system expert course".* Inscripciones asistentes. Italy. Madrid.

- Juan Carlos del Real Romero, Eva Paz Jiménez, Yolanda Ballesteros Iglesias, Sara López de Armentia Hernández, *"European adhesive bonder training".* Asociación Española de Soldadura y Tecnologías de Unión (CESOL). Italy. Alcobendas, Madrid.

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 member or guest speakers coming from other institutions. The seminars that have taken place in this course are the following ones.

- Erik Francisco Álvarez Quispe, *"Semidefinite relaxation and generalised Benders decomposition to solve the transmission expansion network and reactive power planning".* 15th Workshop on Industrial Systems and Energy Technologies - JOSITE'2020. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Elisa María Aracil Fernández, *"Impact of COVID on Latin America".* COVID-19 Webinar. Geneva Centre for Security Policy.

- Eva María Arenas Pinilla, *"Analysis of the results of the Project "Not a home without energy"".* IV Sesión del Seminario Interdisciplinar. Cátedra de Energía y Pobreza.. Cátedra de Energía y Pobreza. Universidad Pontificia Comillas.

- Régulo Enrique Ávila Martínez, *"Impact of PLL control on small?signal stability of wind DFIGs connnected to a weak grid".* 15th Workshop on Industrial Systems and Energy Technologies - JOSITE'2020. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Roberto Barrella, *"Climate change and energy poverty".* ENGAGER WG1/WG4 Meeting. European Cooperation in Science and Technology (COST).

- Roberto Barrella, *"Energy Poverty. Who is left behind by energy transition?".* MEPI Conference. Cátedra de Energía y Pobreza. Universidad Pontificia Comillas.

- Alexis Cantizano González, *"New scenario of associated legal responsibilities".* I Taller de aplicación de ingeniería del fuego. Sector logístico: nuevas soluciones para nuevos desafíos. El diseño de la protección contra incendios ante los nuevos riesgos asociados a la robotización de la logística.. Quanture fire; Ashes-fire; Victaulic.

- Alexis Cantizano González, *"Fire propagation simulation in vulnerable urban environments.".* 10º Congreso Internacional de Ingeniería de Seguridad Contra Incendios. Asociación de Profesionales de Ingeniería de Protección Contra Incendios (APICI); Universidad Pontificia Comillas; y Fundación Mapfre.

- Efraim Centeno Hernáez, José Carlos Romero Mora, *"Energy Poverty. Who is left behind by energy transition?".* Cátedra de Energía y Pobreza. Universidad Pontificia Comillas.

- José Pablo Chaves Ávila, Rafael Cossent Arín, *"New services that industrial demand can provide to network operators. Practical cases of the InteGrid and CoordiNet European Projects.".* Jornada Técnica IIT-AEGE. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas; y Asociación de Empresas con Gran Consumo Energético (AEGE).

- Mauricio Correa Ramírez, *"How to implement flexibility mechanisms in the planning of electricity distribution networks?".* 15th Workshop on Industrial Systems and Energy Technologies - JOSITE'2020. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Rafael Cossent Arín, *"New business models for distribution grid stakeholders under high penetration of DER".* Webinar. European Copper Institute.

- David Domínguez Barbero, *"Optimising a microgrid system by deep reinforcement learning techniques".* 15th Workshop on Industrial Systems and Energy Technologies - JOSITE'2020. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Pablo Frías Marín, *"Charging Up India's Electric Vehicles – a charging infrastructure and power system perspective".* FSR Global Hub Launch. Florence School of Regulation.

- Pablo Frías Marín, *"EV revolution: a power sector view on coupling with mobility".* Evento online. Florence School of Regulation (FSR).

- Pablo Frías Marín, *"Regulation of electricity generation distributed in Spain. Comparison with other countries".* Seminario «Generación eléctrica distribuida: impactos e implementación». Fundación Naturgy.

- Timo Gerres, *"The role of CAUC technologies in the Spanish trategy for reducing emissions by 2050".* Asamblea General 2019. Plataforma Tecnológica Española del CO2.

- Timo Gerres, *"The role of the industry in the decarbonization process".* Jornada Técnica IIT-AEGE. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas; y Asociación de Empresas con Gran Consumo Energético (AEGE).

- Timo Gerres, *"Phasing out emission intensive basic materials: product carbon requirements as a building block for a European industrial policy".* International Winter School 2020 «Impact Assessment of European Climate Policy». Technische Universität Bergakademie Freiberg.

- Mahdieh Gholami Mayani, *"Highly-sensitive dielectric resonator sensor for liquid characterization".* 15th Workshop on Industrial Systems and Energy Technologies - JOSITE'2020. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Tomás Gómez San Román, *"Academic point of view on the major possible models of development".* Future challenges for network operators in changing times for the European Union. Robert Schuman Center for Advanced Studies - European University Institute - Florence School of Regulation (FSR).

- Tomás Gómez San Román, *"Iberia regulation and flexibility markets".* Workshop Nacional de Flexibilidad. Endesa.

- Andrés González García, *"Integrated models of power supply".* V Aniversario Mesa de Acceso Universal a la Energía «Trabajando juntos por el acceso universal a la energía». Mesa de Acceso Universal a la Energía (MAUE).

- Isaac Camilo González Romero, *"Considering market feedback in transmission expansion planning with storage and renewable technologies".* 12th Trans-Atlantic Infraday Conference -TAI 2019. University of Mariland.

- Francisco Javier Herraiz Martínez, *"Intelligent sensorization in health".* Foro Innova 2019. Junta de Extremadura.

- Sonia León del Rosario, *"Inconsistency detection on data communication standards using information extraction techniques: the ABP case".* 15th Workshop on Industrial Systems and Energy Technologies - JOSITE'2020. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Pedro Linares Llamas, *"Decarbonization of the industry".* XV Congreso de la Asociación Española para la Economía Energética. "La descarbonización energética: de las palabras a los hechos". Asociación Española para la Economía Energética (AEEE).

- Pedro Linares Llamas, *"Energy and climate change".* Prioridades ambientales y social-ecológicas para el día después de la pandemia. Universidad Internacional Menéndez Pelayo.

- Pedro Linares Llamas, *"The elements for a Spanish law on climate change and energy transition".* Escuela Técnica Superior de Ingeniería (Comillas ICAI).

- Pedro Linares Llamas, *"Energy transition".* Conferencia de las Partes (COP25Madrid). Fundación Imagen de Chile.

- Pedro Linares Llamas, *"A global challenge".* Foro de Fundaciones y sociedad civil. Demos 2019. Asociación Española de Fundaciones.

- Pedro Linares Llamas, *"Will a new government stimulate Spain's energy transition? Latest political developments".* Spanish Energy Day. Montel.

- Pedro Linares Llamas, Timo Gerres, *"What about stuff? Policy frameworks to decarbonize the materials industry".* Conferencia de las Partes (COP25Madrid). Fundación Imagen de Chile.

- Leandro Lind, *"InteGrid scalability and replicability results & replication roadmap".* Webinar. Integrid.

- Sara López de Armentia Hernández, *"3D printed graphene scaffolds for bone regeneration: a preliminary study".* 15th Workshop on Industrial Systems and Energy Technologies - JOSITE'2020. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Álvaro Jesús López López, *"Industry 4.0: "Myth or reality". The importance of communication in the Fourth Industrial Revolution".* Cátedra Industria Conectada. Universidad Pontificia Comillas.

- Álvaro Jesús López López, *"Practical recommendations in the preparation of a winning proposal. The perspective of the evaluator and the coordinator".* Jornada Informativa Programa Marco de la Unión Europea Horizonte 2020. Convocatoria 2020 de Sociedades Seguras.. Centro para el Desarrollo Tecnológico Industrial (CDTI).

- Francisco José López Valdés, *"Cars and «accidents»: always joined?".* X Noche Europea de los Investigadores de Madrid. Universidad Pontificia Comillas.

- Sara Lumbreras Sancho, *"The challenge of the transhumanism. Body, authenticity and meaning.".* Facultad de Teología SEUT.

- Sara Lumbreras Sancho, *"Getting inspiration from artificial intelligence: understanding credition from an engineering perspective".* The Structure of Creditions 2019. Universität Graz.

- Sara Lumbreras Sancho, *"Artificial Intelligence : Where does it leave humanity?".* Ciclo de Conferencias 2020 Diálogo Ciencia-Religión. Centro Pignatelli.

- Sara Lumbreras Sancho, *"Artificial Intelligence vs. Human Intelligence".* European Leadership Programme (ELP). Jesuit European Social Centre (JESC).

- Sara Lumbreras Sancho, *"Science is not objective".* V Seminario Interdisciplinar de Ciencia, Tecnología y Religión. La universalidad de la razón.. Cátedra de Ciencia, Tecnología y Religión. Universidad Pontificia Comillas..

- Sara Lumbreras Sancho, *"Career opportunities".* Universidad Pontificia Comillas.

- Sara Lumbreras Sancho, *"The EU innovation landscape".* Innovation, Entrepreneurship & Talent. German Marshall Fund of the United States (GMF).

- Sara Lumbreras Sancho, *"Three key concepts to understand transhumanism".* 8th International Congress on Human Sciences - GKA HUMAN 2019. Global Knowledge Academy; y Universidad Autónoma de Madrid.

- Nicolás Mariano Morell Dameto, *"Energy smart meters for energy poverty assessment".* III Sesión del Seminario Interdisciplinar. Cátedra de Energía y Pobreza.. Cátedra de Energía y Pobreza. Universidad Pontificia Comillas.

- Nicolás Mariano Morell Dameto, *"Revisiting electricity network tariffs in a context of decarbonization, digitalization, and decentralization".* 15th Workshop on Industrial Systems and Energy Technologies - JOSITE'2020. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Rafael Palacios Hielscher, *" Quantum computing".* Eventos CIC 2019. Quantum Computing. Universidad Pontificia Comillas. Cátedra de Industria Conectada.

- José Ignacio Pérez Arriaga, *"Universal access to energy and agenda 2030".* V Aniversario Mesa de Acceso Universal a la Energía «Trabajando juntos por el acceso universal a la energía». Mesa de Acceso Universal a la Energía (MAUE).

- José Ignacio Pérez Arriaga, *"Alliances for universal access to energy and climate crisis".* Conferencia de las Partes (COP25Madrid). Energías sin fronteras.

- José Ignacio Pérez Arriaga, *"Expanding access to electricity in a carbon-constrained world".* Climate Action Symposia. MIT.

- José Ignacio Pérez Arriaga, *"Improvements in the enabling environment - what are the minimum requirements?".* 9th Annual Windaba. South African Wind Energy Association(SAWEA); y Global Wind Energy Council (GWEC).

- José Ignacio Pérez Arriaga, *"Just transition for all".* World Energy for Universities - WE4U. Enel Foundation.

- José Ignacio Pérez Arriaga, *"Moderator in Acceleration Workshop Africa GreenCo".* Africa GreenCo.

- José Ignacio Pérez Arriaga, *"The US and EU experience. Session 1: Key principles for regional electricity trade institutions and regulations".* The Pan-Arab Energy Trade Conference. League of Arab States (LAS); World Bank Group; y Arab Fund for Economic and Social Development (AFESD).

- José Portela González, *"Machine Learning and its application in the insurance sector".* 3º Hackathon Big ideas Línea Directa. Línea Directa Aseguradora, S.A..

- Alejandro Rodríguez Gallego, *"Talking about ESG matters".* 15th Workshop on Industrial Systems and Energy Technologies - JOSITE'2020. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Luis Rouco Rodríguez, *"Impact of PLL control on small-signal stability of wind DFIGs".* University College Dublin (UCD).

- Lukas Sigrist, *"As grids get greener with more wind and PV, what new requirements will emerge and how might CSP + TES meet those needs?. Session 6: Grid needs in the future".* The role of concentrating solar power in the evolving energy market in the Western U.S.. ata renewables.

- Carmen Valor Martínez, *"Meditation in action: the power of mindfulness".* XIX Semana de la Ciencia y la Innovación 2019. Fundación para el conocimiento madri+d; y Comunidad de Madrid.

- Mariano Ventosa Rodríguez, Alberto Carnicero López, Pablo García González, Francisco José López Valdés, *"The role of Engineering in post COVID-19 society".* Universidad Pontificia Comillas.

- Sonja Wogrin, *"Modeling energy storage technologies in long-term planning problems".* Center for Energy. Austrian Institute of Technology.

6.7 Organization of congresses, seminars and workshops

- Alexis Cantizano González, *"X Congreso Internacional de Ingeniería de Seguridad contra Incendios".* Asociación de Profesionales de Ingeniería de Protección Contra Incendios (APICI); y Universidad Pontificia Comillas. Madrid (Spain). September 2019.

- Rafael Cossent Arín, José Pablo Chaves Ávila, *"Jornada Técnica IIT-AEGE".* Instituto de Investigación Tecnológica. Universidad Pontificia Comillas; y Asociación de Empresas con Gran Consumo Energético (AEGE). Madrid (Spain). September 2019.

- Francisco José López Valdés, Jesús Jiménez Octavio, *"63rd AAAM's Annual Conference - Safety Without Borders".* Association for the Advancement of Automotive Medicine (AAAM); y Universidad Pontificia Comillas. Madrid (Spain). October 2019.

- Roberto Barrella, Efraim Centeno Hernáez, José Carlos Romero Mora, *"III Sesión del Seminario Interdisciplinar. Propuestas innovadoras para la lucha contra la pobreza energética".* Fundación Naturgy. Madrid (Spain). January 2020.

- Roberto Barrella, Efraim Centeno Hernáez, José Carlos Romero Mora, *"IV Sesión del Seminario Interdisciplinar. Presente y futuro de las situaciones de vulnerabilidad energética en España en el contexto de la emergencia del COVID-19".* Cátedra de Energía y Pobreza. Universidad Pontificia Comillas. Madrid (Spain). May 2020.

- Javier García González, *"15th Workshop on Industrial Systems and Energy Technologies - JOSITE'2020".* Instituto de Investigación Tecnológica. Universidad Pontificia Comillas. Madrid (Spain). July 2020.

6.8 Organization and management of other academic activities

- Mario Castro Ponce, *"Permanent member of Congress of Statistical Physics - FISES".* RSEF / GEFENOL. April 2014- Today.

- José Pablo Chaves Ávila y Tomás Gómez San Román, *"Editor of Guest Editorial. Energies. Special Issue "Integration of Renewable and Distributed Energy Resources in Power Systems".".* MDPI AG. Basel (Switzerland). November 2019-July 2020.

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

- Aurelio García Cerrada, *"Editor of IET Power Electronics".* Institute for Engineering and Technology (IET). Stevenage (United Kingdom). October 2007- Today.

- Javier García González, *"Permanent member of Power Systems Computation Conference - PSCC".* January 2001- Today.

- Tomás Gómez San Román, *"Editor of Sustainable Energy, Grids and Networks".* Elsevier Science BV.. Amsterdam (Netherlands). June 2014- Today.

- Tomás Gómez San Román, *"Chairman in Moderator in CEER Specialised Training on Network Tariffs for Transmission and Distribution. Group work: specific new challenges from a regulatory perspective faceb by DSOs on the issues discussed in the previous session".* Council of European Energy Regulators (CEER). Brussels (Belgium). February 2020.

- Yolanda González Arechavala, *"Organization/Direction of the course «Technology Campus of ICAI 2019»".* Universidad Pontificia Comillas y Fundación Salvador Soler. Madrid (Spain). February-July 2020.

- Isaac Camilo González Romero, *"Chairman in Moderator in 22nd Conference of the International Federation of Operational Research Societies - IFORS 2020. Session: Advances in Electricity System Modelling".* International Federation of Operational Research Societies (IFORS). Seoul (South Korea). June 2020.

- Pedro Linares Llamas, *"Editor of Papeles de Energía".* FUNCAS. Madrid (Spain). June 2015- Today.

- Pedro Linares Llamas, *"Editor of Energy Transitions".* Springer. Riyadh (Saudi Arabia). June 2017- Today.

- Gregorio López López, *"Member of the Scientific Committee of Technical Program Committee «2020 IEEE International Symposium on Power Line Communications and its Applications - IEEE ISPLC 2020»".* Institute of Electrical and Electronic Engineers (IEEE). Malaga (Spain). March-April 2020.

- Francisco José López Valdés, *"Editor of Journal of Healthcare Engineering".* Hindawi Ltd.. London (United Kingdom). January 2016- Today.

- Francisco José López Valdés, *"Editor of Frontiers in Bioengineering and Biotechnology. Biomechanics".* Frontiers Editorial. Lausanne (Switzerland). November 2014- Today.

- Francisco José López Valdés, *"Organization/Direction of the course «1st Edition Advanced technical course in child retention systems»".* Universidad Pontificia Comillas. Madrid (Spain). March-May 2020.

- Sara Lumbreras Sancho, *"Editor of Micro espacios de investigación. Revista científica e interdisciplinar".* Asociación UBUNTU. Madrid (Spain). January 2016- Today.

- Luiz Augusto Nobrega Barroso, *"Editor of IEEE Power & Energy Magazine".* IEEE Power & Energy Society (IEEE PES). Piscataway (United States of America). January 2017- Today.

- Luiz Augusto Nobrega Barroso, *"Editor of IEEE Open Access Journal of Power and Energy".* IEEE Power & Energy Society (IEEE PES). Piscataway (United States of America). January 2020- Today.

- Luis Olmos Camacho y Luis Rouco Rodríguez, *"Permanent member of Power Systems Computation Conference - PSCC".* June 2017- Today.

- Luis Olmos Camacho y Luis Rouco Rodríguez, *"Member of the Scientific Committee of Technical Program Committee «XXI Power Systems Computation Conference- PSCC 2020»".* Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência (INESC TEC). Porto (Portugal). June-July 2020.

- Rafael Palacios Hielscher, *"Chairman in Moderator in III Session of the Interdisciplinary Seminar. Session n.1. Energy smart meters for energy poverty assessment".* Cátedra de Energía y Pobreza. Universidad Pontificia Comillas. Madrid (Spain). January 2020.

- José Ignacio Pérez Arriaga, *"Editor of European Review of Energy Markets".* European Energy Institute. June 2015- Today.

- José Ignacio Pérez Arriaga, *"Organization/Direction of the course «Annual training on the regulation of energy utilities»".* European University Institute. Florence School of Regulation (FSR). Florence (Italy). September 2019-June 2020.

- José Ignacio Pérez Arriaga, *"Chairman in Moderator in FSR Global Hub Launch. Panel Discussion: Regulatory innovation for our shared future".* Florence School of Regulation. New Delhi (India). November 2019.

- José Ignacio Pérez Arriaga, *"Chairman in Moderator in V Anniversary MAUE «Working together for the universal access to energy» Session 2: Integrated models of power supply".* Mesa de Acceso Universal a la Energía (MAUE). Madrid (Spain). February 2020.

- Andrés Ramos Galán, *"Editor of Computational Management Science".* Springer. Heidelberg (Germany). October 2011- Today.

- Andrés Ramos Galán, *"Member of the Scientific Committee of International Conference on Renewable Energy Research and Applications (ICRERA)".* International Journal of Renewable Energy Research - IJRER. September 2012- Today.

- Juan Carlos del Real Romero, *"Member of the Scientific Committee of 1st International Conference on Industrial Applications of Adhesives 2020 - IAA 2020".* Universidade do Porto. Madeira (Portugal). March 2020.

- Juan Carlos del Real Romero, *"Permanent member of Congress of Adhesion and Adhesives".* Grupo Español de Adhesión y Adhesivos (GEAA). Zaragoza (Spain). January 2000- Today.

- Juan Carlos del Real Romero, *"Permanent member of International Conference on Structural Adhesive Bonding".* Porto (Portugal). January 2011- Today.

- Juan Carlos del Real Romero, *"Permanent member of International Conference on Advanced Joining Processes - AJP".* January 2019- Today.

- Juan Carlos del Real Romero, *"Permanent member of International Conference on Industrial Applications of Adhesives".* January 2020- Today.

- Juan Carlos del Real Romero, *"Member of the Scientific Committee of 4th International Congress on welding and joining technologies".* CESOL. Seville (Spain). January 2019-May 2020.

- Juan Carlos del Real Romero, *"Permanent member of International Conference on Science and Technology Education".* January 2020- Today.

- Juan Carlos del Real Romero, *"Chairman in Moderator in 1st International Conference on Advanced Joining Processes - AJP 2019. Session 1C. Adhesive bonding I".* Universidade do Porto. Ponta Delgada (Portugal). October 2019.

- José Carlos Romero Mora, *"Chairman in Moderator in COP25Madrid. The role of religions in the face of climate change".* Fundación Imagen de Chile. Madrid (Spain). December 2019.

- Luis Rouco Rodríguez, *"Editor of Electric Power Systems Research".* Elsevier Science Ltd.. Lausanne (Switzerland). January 2000- Today.

- Luis Rouco Rodríguez, *"Editor of IET Generation, Transmission and Distribution".* The Institution of Engineering and Technology (IET). Hertford (United Kingdom). April 2016- Today.

- Luis Rouco Rodríguez, *"Editor of IEEE Transactions on Power Systems".* Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). January 2017- Today.

- Luis Rouco Rodríguez, *"Chairman in Moderador in XXI Power Systems Computation Conference- PSCC 2020. Session: Transient stability".* Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência (INESC TEC). Porto (Portugal). June-July 2020.

- Lukas Sigrist, *"Editor of IET Generation,Transmission and Distribution".* Institute for Engineering and Technology (IET). Quebec (Canada). August 2017- Today.

- Carmen Valor Martínez, *"Editor of International Journal of Consumer Studies".* Wiley. Hoboken (United States of America). May 2020- Today.

- Mariano Ventosa Rodríguez, *"Chairman in Moderator in «Encuentro abierto online: Hacer visible lo invisible»".* Cátedra de Industria Conectada. Universidad Pontificia Comillas. Madrid (Spain). July 2020.

7. Data about IIT

The relevant numbers of the academic year 2019 - 2020 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:

5,76 M€ Turnover

77 Professors and researchers

43 Research assistants

112 Research projects

36 Consultancy projects

15 Services and analisys projects

2 Books and 6 Chapters in books

77 Papers published in JCR journals

9 Papers published in other journals

28 Papers presented at conferences

14 Technical reports and 19 Working papers

4 Submitted theses

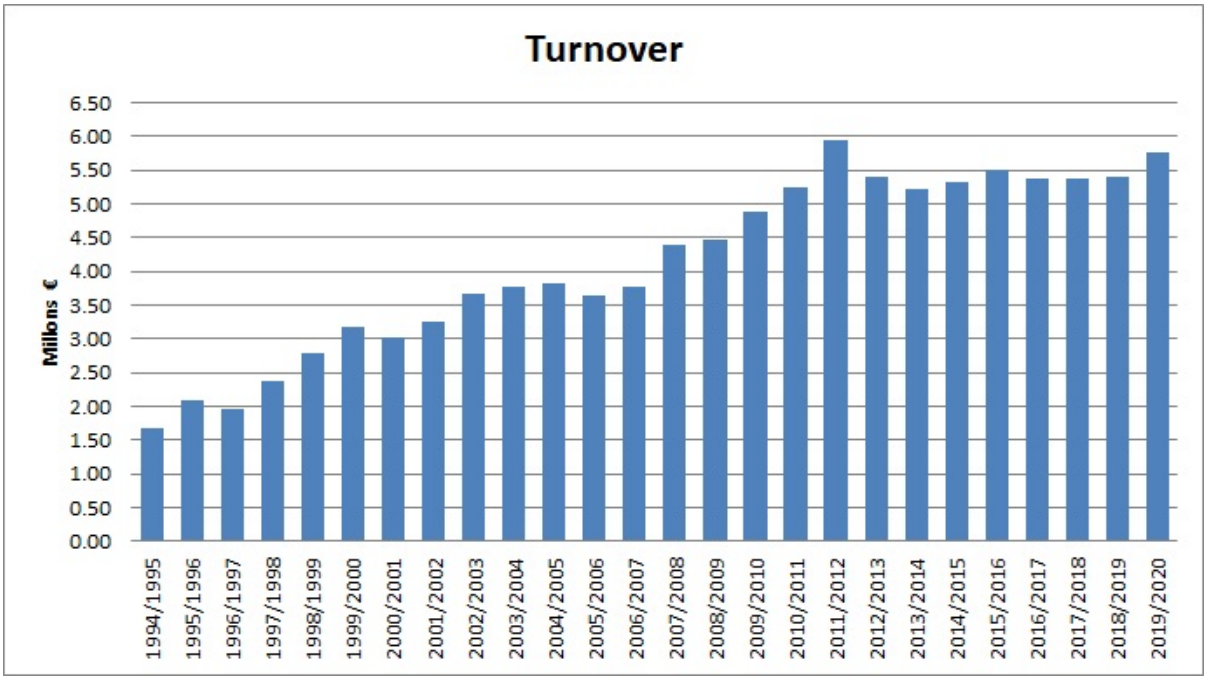
34 Ongoing theses

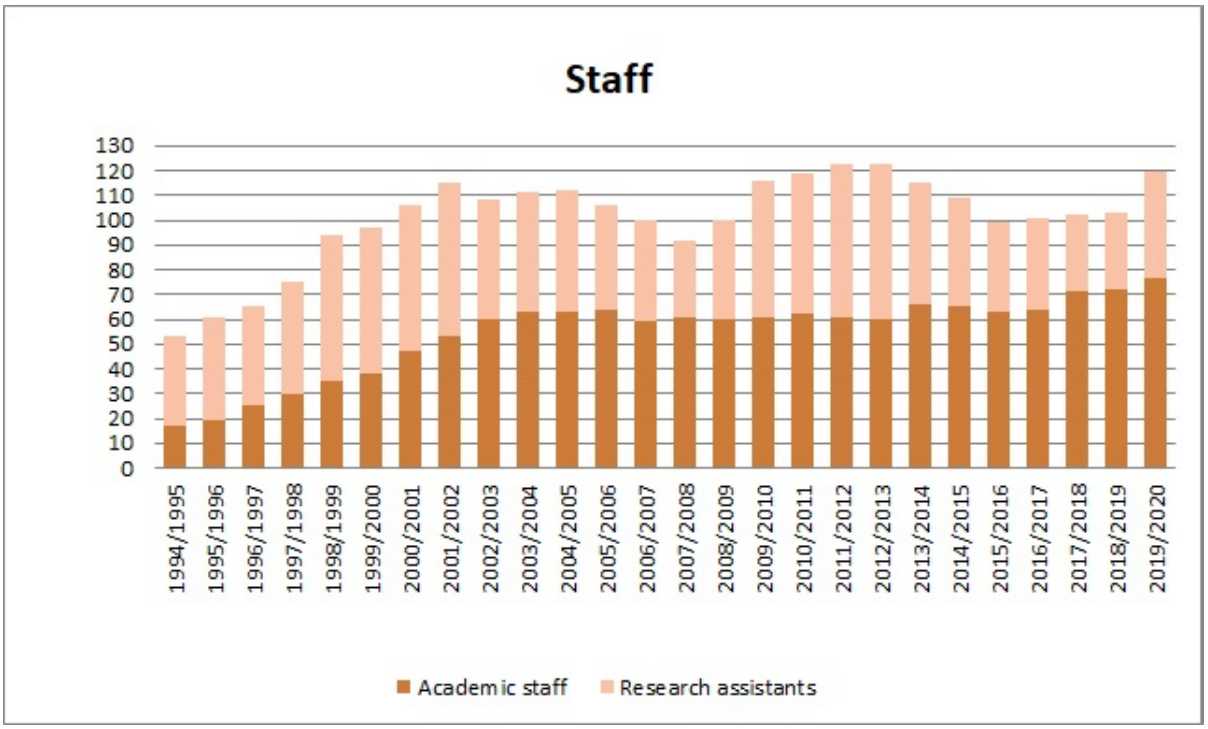
8 Visiting professors and 6 students

2 International exchanges

26 Courses offered to external entities

Data about IIT





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