ANNUAL ACADEMIC REPORT

Academic Year

2020-2021

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 2020 - 2021, from September 1, 2020 to August 31, 2021.

2. Organizational structure

2.1 Management

The management of the IIT during the course 2020 - 2021 has been carried out by the following Professors and Researchers:

- **Chaves Ávila, José Pablo**. Deputy Director for Research Development
- **García González, Javier**. Deputy Director for Economic Affairs
- **Lumbreras Sancho, Sara**. Deputy Director for Research Results
- **Ramos Galán, Andrés**. Director

2.2 Council

The members of the Council of IIT during the course 2020 - 2021 were the following ones:

- **Calvo Báscones, Pablo**. IEF Representative
- **Chaves Ávila, José Pablo**. Deputy Director for Research Development
- **Cossent Arín, Rafael**. Reseacher Representative
- **García González, Javier**. Deputy Director for Economic Affairs
- **Gerres, Timo**. IEF Representative
- **Gómez San Román, Tomás**. Reseacher Representative
- **López López, Álvaro Jesús**. Reseacher Representative
- **Ramos Galán, Andrés**. Director
- **Rivier Abbad, Michel**. Reseacher Representative
- **Rodilla Rodríguez, Pablo**. Reseacher Representative
- **Sigrist, Lukas**. Secretary General

2.3 Area coordinators

The coordinators of the eight research areas that group the different activities carried out in the IIT during the course 2020 - 2021 are the following ones:

- **Aracil Fernández, Elisa María**. SMS Coordinator
- **Cantizano González, Alexis**. PCI Coordinator
- **Cossent Arín, Rafael**. REDES Coordinator
- **Cucala García, Asunción Paloma**. ASF Coordinator
- **Portela González, José**. ASI Coordinator
- **Reneses Guillén, Javier**. SADSE Coordinator
- **Rodilla Rodríguez, Pablo**. RYE Coordinator
- **Rodríguez-Morcillo García, Carlos**. BIO Coordinator
- **Rouco Rodríguez, Luis**. MAC 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:

- **Aracil Fernández, Elisa María**. Assistant Professor
  Ph.D. in Sustainable Banking. Universidad Rey Juan Carlos de Madrid.
  Degree in Law. Universidad Nacional de Educación a Distancia (UNED).
  Degree in Business Administration. Universidad Complutense de Madrid.
  Areas of interest: Corporate strategy, sustainability, innovation and digitalization, development economics, savings and investment products, sustainable finance, financial markets, stakeholder capitalism.

- **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 Engineering Systems Modeling (Comillas ICAI)
  M.Sc. in Research in Engineering Systems Modeling (Comillas ICAI)
  Electronics Engineer (Comillas ICAI)
  Areas of interest: Energy efficiency and flexibility · Internet of Things (IoT) · Deep learning · Computer vision · Autonomous mobile robots · Topological modeling of the environment · Industry 4.0

- **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.

- **Castro Ponce, Mario**. Professor
  Ph.D. in Physics Science (UCM)
  Physics Science degree (UCM)
  Areas of interest: Statistical Mechanics, Nonlinear Physics, Theoretical Biology, Bayesian Statistics and Epidemiology, Forest fires.

- **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, energy transition, integration of renewable and distributed generation, smart grids, hydrogen and decarbonization.

- **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: Decision support models in the electric power industry

- **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, 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.

- **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 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

- **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: My research focuses on demand flexibility, energy usages, optimization models, and specifically on aggregation and microgrids issues. I am developing studies in electrical systems and the impact of different energy resources. I am also working with digital electronics systems for the control and monitoring of residential consumption.

- **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**. Associate 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**. 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, Machine Learning, Neural Networks, time series models

- **Ramos Galán, Andrés**. Professor
  Ph.D. in Industrial Engineering (Universidad Politécnica de Madrid)
  Electrical Engineer (Universidad Pontificia 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, application of power electronics to power systems, power systems with large amounts of renewable energy sources

- **Reneses Guillén, Javier**. Senior 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.

- **Roch Dupré, David**. Assistant Professor
  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)
  Areas of interest: Sustainability. Modelling, simulation and optimization. Energy efficiency in electrified railway systems.

- **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: Modelling, simulation, simulation, control and identification of electric power systems

- **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 Associate 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.

- **Valor Martínez, Carmen**. Senior Associate Professor
  Ph.D. in Information Sciences. Universidad Complutense de Madrid.
  Master in Business Administration (MBA). Universidad Carlos III de Madrid.
  MSc Business and Community. University of Bath.
  Areas of interest: Sustainable Consumption. Sustainable brands. Innovation for sustainability. Collaborative consumption. Social Change.

- **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.

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

- **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

- **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: Electric Machines and Electric Drives, Electrical Generation, Renewable Generation, Wind Generation.

- **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.

- **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.

- **Morales Polo, Carlos**. Assistant Professor
  Industrial Engineer.Comillas Pontifical University.
  PhD. Industrial Engineer. Comillas Pontifical University
  Areas of interest: Waste management and treatment. Water technologies. Energy use. Environmental Impact Study through Life Cycle Assesment.

- **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 2020 - 2021 were the following ones:

- **Akullo, Grace**. Bachelors in Entrepreneurship and Small Business Management (Makerere University)
  Masters degree in Management and Promotion of Local Development (University of Valencia)
  Masters in Intercultural Communication and Public Service Translation and Interpretation (University of Alcalá de Henares)
- **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).
- **Arias Blanco, Víctor**. Master in Smart Grid. Universidad Pontificia Comillas (ICAI) University of Strathclyde
  Master in Industrial Engineering, Universidad Pontificia Comillas (ICAI)
  Degree in Electromechanical Engineering. Comillas Pontifical University (ICAI)
- **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.

- **Barba Suárez, Luis Ismael de la**. Master in Industrial Engineering, Universidad Pontificia Comillas, ICAI
  Master in the Electric Power Industry, Universidad Pontificia Comillas, ICAI
  Degree in Electromecanical Engineer (Electrical cathegory), Universidad Pontificia Comillas, ICAI
- **Barrella, Roberto**. Master's Degree Energy Engineering, Renewable Energy. Faculty of Civil and Industrial Engineering, Università degli Studi di Roma La Sapienza
  Bachelor's Degree Energy Engineering. Faculty of Civil and Industrial Engineering, Università degli Studi di Roma La Sapienza
- **Benítez Domínguez, Álvaro**. Master in Aerospace Engineering. Universidad Carlos III de Madrid.
  Máster de Energías Renovables y Medio Ambiente. Universidad Politécnica de Madrid.
- **Blanco Castillo, Manuel**. Bachelor's Degree in Mechanical Engineering. University of Jaén.
  Master's Degree in Industrial Engineering. University of Málaga.
- **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)
- **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)
- **De Rosa, Luca**. 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.
- **Díaz Pastor, Santos José**. Industrial Engineering. Polytechnic University of Madrid and the Karlsruher Institut für Technologie (KIT.
  Master's Degree in Industrial Engineering and the Master's Degree in the Power Sector. Universidad Pontificia Comillas.
- **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 Comillas
  Máster in Industrial Engineering. Universidad Pontificia 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)
- **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)
- **González Sánchez, Alberto**. Graduate in Industrial Technologies Engineering (Polytechnic University of Madrid)
  Master's Degree in Industrial Engineering (Polytechnic University of Madrid)
- **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.
- **Loras Gimeno, Diego**. B.Sc. in Economics. University of Valencia.
  M.Sc. in Economics and Finance. Barcelona Graduate School of Economics.
  M.A. in Ethics and Democracy. University of Valencia.
- **Manjón Rodríguez, María José**. Grade in Law. University of Granada.
  Executive MBA. Instituto de Empresa.
  Master in International Business ESCP-EAP School of Management (Paris and Bangkok)
  Master in Sustainability and Corporate Responsibility (UNED.)
- **Marulanda García, Geovanny Alberto**. Electrical Engineer, Universidad Tecnológica de Pereira (Colombia)
  Master in Electrical Engineering, Universidad Tecnológica de Pereira (Colombia)

- **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.
- **Monteagudo Honrubia, Miguel**. Bachelor Degree in Biomedical Engineering (Universitat Politècnica de València)
  MSc in Biomedical Engineering (University of Twente)
- **Montero Guirao, Luis Manuel**. Bachellor's degree in Chemical Engineering from the Universidad de Granada.
  Master's degree in Chemical Engineering from the 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.
- **Moreno Brieva, Fernando Javier**. Master's degree in Economics and Innovation Management (Autonomous University of Madrid, Complutense University of Madrid and Polytechnic University of Madrid)
  Master's degree in Business Administration (Andres Bello University of Chile).
  Bachelor's degree in Business Administration (UCINF University of Chile)
  Bachelor's degree in Tourist Administration (Metropolitan Technological University of Chile)
- **Nemati, Hadi**. B.Sc. degree in Electrical Engineering (Shiraz University)
  M.Sc. degrees in Electrical Engineering (Isfahan University of Technology)

- **Oladimeji, Oluwaseun Enoch**. BSc. Electrical and Electronics Engineering (University of Ibadan)
  MSc. Energy Systems (Skolkovo Institute of Science and Technology)
- **Ortega Manjavacas, Álvaro**. Ph.D. in Electrical Engineering. University College Dublin, Ireland.
  Industrial Engineering, Itinerary of Electrical, Electronic and Automation. University of Castilla-La Mancha, Spain.
- **Otaola Arca, Pedro de**. Bachelor's degree in Electromechanical Engineering (major in Electronics)(Comillas)
  Master's degree in Industrial Engineering (Comillas)
- **Paolis Robles, Carlo de**. Bachelor's Degree in Electromechanical Engineering. Comillas Pontifical University.
  Master's Degree in Industrial Engineering. Comillas Pontifical University.
- **Pérez Bravo, Manuel**. Graduado en Ingeniería de Tecnologías Industriales. Universidad de Sevilla
  Máster Universitario en Ingeniería Industrial. Universidad de Sevilla
- **Pérez Sánchez, Jaime**. Degree in Telecommunication Technologies and Services Engineering, by the Universidad Politécnica de Madrid (2013-2018)
  Master's Degree in Telecommunications Engineering, by the Universidad Politécnica de Madrid (2018-2020)

- **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.
- **Rajora, Gopal Lal**. Master's in applied Telecommunication & Engineering Management. Polytechnic University of Catalonia
  Master of Science in Finance. University of Siena.
  Bachelor of Technology in Electronics Instrumentation & Control. Rajasthan Technical University.
- **Rodrigo Tobías, Ignacio de**. Bachelor´s Degree in Electromechanical Engineering (Comillas Pontifical University)
  Official Master´s Degree in Industrial Engineering (Comillas Pontifical University)
  Master of Engineering in Mobility and Safety (Comillas Pontifical University)
- **Rodríguez Matas, Antonio Francisco**. Degree in Industrial Engineering (University of Seville)
  Master's Degree in Economics (Complutense University of Madrid)
  Master's Degree in Energy Management (Repsol)
- **Rodríguez Pérez, Néstor**. Universitary Master's Degree in Industrial Engineering - Pontifical University of Comillas, ICAI (2020)
  Master in Smart Grids - Pontifical University of Comillas, ICAI (2020)
  MSc in Smart Grids - University of Strathclyde (2020)
  Bachelor's Degree in Electromechanical Engineering - Pontifical University of Comillas, ICAI (2018)
- **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.
- **Tomás Martín, Andrés**. University Degree in Communications Electronic Engineering. Complutense University of Madrid.
  Master's Degree in Energy. Complutense University of Madrid.
- **Troncia, Matteo**. Ph.D. in Industrial Engineering (University of Cagliari), M.Sc. in Electrical Engineering (University of Cagliari), B.Sc. in Electrical Engineering (University of Cagliari)
- **Urosa Sánchez, Pablo**. Bachelor degree in Electromechanical Engineering.
  Masters degree in Industrial Engineering.
- **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 Vírseda, 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.
- **Villegas Galaviz, Carolina**. M. A. in Organizational Governance and Culture. University of Navarra.
  B. A. in Philosophy & B. A. in Communications, Journalism. University of Navarra.

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)
- **Porfido, Alessandra**. Degree in Economics and Management (Universitá degli Studi di Trento)
  Master's degree in Economics (Universitá di Bologna)
  Master's degree in International Business Management (Universidad Carlos III de Madrid)
- **Ruiz González-Mateo, Cristina**. Law and Legal Advisor Companies degree (Comillas)
- **Sánchez Alfayate, María Belén**. Social Education Diploma (Universidad Complutense de Madrid)
- **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 nine research areas.

3.1.1 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

3.1.2 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

3.1.3 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

3.1.4 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: Javier Reneses Guillén
Web page: https://www.iit.comillas.edu/research-area/sadse

3.1.5 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

3.1.6 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

3.1.7 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: José Portela González
Web page: https://www.iit.comillas.edu/research-area/asi

3.1.8 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

3.1.9 Smart Management for Sustainability (SMS)

Area aimed at building and promoting firms' competitive advantages. Its research focuses on the two main strategic challenges faced by companies: transitions to sustainability under the framework of the Sustainable Development Goals (SDG), and Environmental, Social and Governance (ESG) management.

Coordinator: Elisa María Aracil Fernández
Web page: https://www.iit.comillas.edu/research-area/sms

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 Research and development projects

3.2.1.1 Private funding

- **Voltage control system of the transmission grid with renewable generation**
  Red Eléctrica de España, S.A. April 2018 - June 2021. (Luis Rouco Rodríguez, Enrique Lobato Miguélez, Ignacio Egido Cortés, Álvaro Benítez Domínguez)

  This project will perform simulations of a voltage control system of the transmission grid with renewable generation.

- **Predictive models in healthcare**
  Medsavana S.L. June 2018 - December 2021. (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.

- **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.

- **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 2021. (Michel Rivier Abbad, Tomás Gómez San Román, Álvaro Sánchez Miralles, Francisco Martín Martínez, José Pablo Chaves Ávila, Teresa Freire Barceló, Timo Gerres, Andrés Ramos Galán, Sébastien Huclin)

  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 2021. (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 under different possible scenarios, and to develop proposals to facilitate the decarbonisation objectives to be achieved in the most efficient possible way.

- **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.

- **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.

- **CEVESA: A long term planning model for investment decisions in electricity generation and transportation**
  Institute for Systems and Computer Engineering, Technology and Science (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.

- **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.

- **Assistance and maintenance of Middle Office models**
  Enel Iberoamérica 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 Medios y Sistemas S.L. January 2020 - December 2020. (Efraim Centeno Hernáez, Luis Alberto Herrero Rozas, José Carlos Romero Mora)

  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.

- **VALSA-EXPANDE integration and unification of algorithms, single interface and preparation for migration to the cloud**
  Enel Iberoamérica 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**
  Endesa Medios y Sistemas S.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**
  Endesa Medios y Sistemas S.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, Gonzalo Sánchez Contreras, Manuel Blanco Castillo)

  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.

- **Development of an integrated execution environment for the VALORE-HEPLASE tool in a MIBEL and European framework**
  Enel Iberoamérica 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.

- **Fitting and backtesting of the tool VALORE-SEIE**
  Enel Iberoamérica 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.

- **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.

- **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.

- **Advanced generator of stochastic scenarios**
  Iberdrola Generación España, S.A.U. April 2020 - March 2023. (Andrés Ramos Galán, Jesús María Latorre Canteli, Jesús David Gómez Pérez)
  In this project a series of stochastic scenarios is obtained, adapted to the Iberian electric system, linked stochastically. Those scenarios allow the generation optimization in the medium term in an uncertain framework, especially by the variability of natural hydro inflows.
  Besides, we model the Portuguese electric system, new hybrid hydro power plants, and new energy storage systems.

- **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.

- **Evaluation of the impact of hybrid energy storage systems on the island power system of Tenerife**
  Endesa Generación S.A. 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.

- **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.

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

- **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, José Ignacio Linares Hurtado)

  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.

- **Hydraulic design of integral turbine-pump devices**
  JOGOSA Obras y Servicios. June 2020 - November 2021. (Eva María Arenas Pinilla, Alexis Cantizano González, Reza Valizadeh)

  The project is part of the SHIFT! project ("Save water, Save energy, Save costs, Sustainable irrigation with integral turbine pump") and is financed by the European Eurostars programme. JOGOSA Obras y Servicios is a partner of the consortium created for the development of this project, the rest of the members of the consortium being the Dutch company aQysta Holding BV and TU Delft University.
  The objective is to develop several versions of the Integral Pump-Turbine (BTI), adapted to the initial specifications. A BTI is a set of pump and turbine, compact, which takes energy from a channel of water to pump a part of it, and thus be able to irrigate or provide drinking water.
  It is, therefore, an equipment that does not need external energy, such as electricity or fossil fuels (or others). This allows it to be independent of the electricity grid, and reduce operating costs, with a minimum impact on greenhouse gas emissions.

- **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.

- **The new role of consumers in a power sector in transition**
  PSR Soluçoes e Consultoria em Energia Ltda. 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.

- **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.

- **EXCOM-EXLA: Development of the stochastic model, consideration technical constraints market, and improvements in the hydro model**
  Endesa Medios y Sistemas S.L. September 2020 - November 2020. (Javier García González, Pedro de Otaola Arca, Ignacio Candela Ripoll)

  This project is part of the development of the EXCOM and EXLA decision support tools. The first objective of this project is to develop the stochastic optimization module to obtain the optimal operation of the reservoirs taking as input data a scenario tree of natural inflows. The second objective is to improve the modeling of the technical constraint market.

- **The impact of Covid-19 on the Spanish electricity sector: implications for energy poverty and decarbonisation goals**
  Fundación Iberdrola España. September 2020 - May 2021. (Paolo Mastropietro)

  The Covid-19 pandemic and the measures implemented by the Government to tackle it had a significant impact on the Spanish electricity sector. This research project analyses this impact in two specific areas: i) the exacerbation of energy poverty issues and the policies that have been introduced to avoid it, and ii) the

fulfilment of decarbonisation objectives for the power sector, which could be affected by the economic crisis caused by the pandemic. The goal of this research project is to advance recommendations for the Spanish context, based also on a review of the regulatory responses in other jurisdictions in similar conditions.

- **Calculation of gas price sensitivities to risk variables**
  Endesa Medios y Sistemas S.L. September 2020 - October 2020. (Antonio Bello Morales, Javier Reneses Guillén, Paulo Brito Pereira)

  This proposal focuses on implementing a methodology in OMEGA Monte Carlo tool that enables the calculation of gas price sensitivities with respect to different risk variables.

- **DATA-COVID: Development of a triage and psychological care app to overcome COVID-19**
  Universidad Pontificia Comillas. September 2020 - August 2022. (Carlos Rodríguez-Morcillo García, Lucía Halty Barrutieta, Álvaro Taboada López, Virginia Cagigal de Gregorio, Rocío Rodríguez Rey, Mª Jesús Martínez Beltrán)

  After the medical crisis produced in the Spanish health system due to the COVID-19 pandemic, a collapse of mental health problems is looming as a result of the psychological impact that the pandemic has generated in Spanish society. Sources from the General Council of Psychology, the MIT Technology Review magazine, or the director of the WHO Mental Health Area herself, warn of the possible collapse of the mental health and primary care system. It is estimated that 10 million Spaniards are at risk of presenting psychological problems derived from COVID-19. The psychological affectation will be deep and prolonged in time. In previous investigations of SARS suffered in 2003, post-traumatic symptoms were observed in affected people after 3 years of the disease (Brooks et al., 2020). Taking into account the harshness with which this crisis has occurred, we have to be prepared to attend to many people affected directly (health workers, sick people, relatives of the deceased, people who have lost their jobs) and indirectly (confined people, reorganization of the social system…).
  Given these data, it is necessary to prepare and offer the population resources, as personalized as possible, to meet two objectives. In the first place, offer psychological help to all those who may need it and, secondly, protect the health system, which has been so depleted.
  In order to meet both objectives, it is necessary to provide mental health and primary care professionals with technological tools that allow serving a significant number of people. The application developed in this project will allow professionals to carry out psychological triage in real time. In this way, many people can be cared for and those with the greatest psychological risk referred to the healthcare service, avoiding the collapse of the system. The flow of derivations generated by the application would be as follows. The person who needs it accesses the application, fills in a series of screening questions and through decision trees and underlying algorithms, the person can be classified as “risk” or “no risk”. If it is classified as "risk", it is referred to a healthcare service of the corresponding health center; but if it is classified as

"no risk", the application is capable of offering a series of guidelines that help the person to better cope with the situation for which they have requested the use of the tool; in this way, the application supports and serves a significant volume of people who are not at risk. From the previous experience with iCygnus, this volume of people who could be served through the application would be 75%, while the remaining 25% would be referred to "risk". With these data we can say that the collapse of the health system would be avoided.

- **Support Endesa Red on FutuRed tasks on flexibility markets**

  Endesa RED S.A. September 2020 - May 2021. (José Pablo Chaves Ávila, Tomás Gómez San Román, Mauricio Correa Ramírez)

  FutuRed is the Spanish Electricity Grids Platform that was created with the mission of promoting the technological evolution of Spanish electricity transmission and distribution grids. Its objectives include:

  1. To collaborate with companies in the Spanish electricity sector so that they can develop new products and services based on technology and innovation for the new energy supply scenario.
  2. To strengthen R&D cooperation between electricity companies and their suppliers of goods and services, especially SMEs, research centres and universities.

  In this area of collaboration, Endesa Red is leading a working group on flexibility markets with the participation of various stakeholders, including electricity companies, suppliers, research centres, etc.

  The objectives project are the following:

  1. Definition of new mechanisms for resilience markets adapted to real-time operation, congestion management, voltage regulation, island control, among others.
  2. Define guidelines for Sandbox for flexibility in DSO networks: describes how DSOs should act in an optimal way to buy and activate network services, in a reliable and efficient way, in a controlled environment where active consumers can participate.
  3. Define the optimal coordination schemes between agents. Defining the conditions for cooperation between all actors, including the detection of barriers to consumer participation and their adaptation in new flexible markets.

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

  Fundación Iberdrola España. September 2020 - August 2021. (Carlos Mateo Domingo, Tomás Gómez San Román, Fernando Emilio Postigo Marcos)

  In this research project it is developed a stochastic model to improve the resiliency of large-scale distribution networks using micro-grids, while minimizing the cost of the installations. A multi-objective optimization is implemented. The investment candates are power line undergrounding, photovoltaics, batteries and smart switches. Stochasticity enables to enhance the model in order to prevent harmful events, and their consequences, such as multiple simultaneous failures.

- **Design of reactive power compensation means in wind farms and PV plants**
  Iberdrola Renovables Energía, S.A.U. September 2020 - December 2020. (Luis Rouco Rodríguez)

  The aim of this work is to develop mathematical models for the design reactive power compensation means in wind farms and PV plants.

- **Generation-grid models**
  Iberdrola Renovables Energía, S.A.U. September 2020 - December 2020. (Luis Rouco Rodríguez)

  Theaim of this work is to develop generation-grid models for simulation and analysis. Wind generator based on DFIG and MSG and solar PV inverters models will be developed.

- **The economic viability of storage technologies in the power sector of the future: an economic and environmental analysis**
  Fundación Iberdrola España. September 2020 - August 2021. (Sonja Wogrin, José Pablo Chaves Ávila, Juan José Valentín Vírseda)

  Energy storage technologies (and especially batteries) are bound to play a fundamental role in the transition to a decarbonized power system. It will be a key ingredient to integrate a high penetration of renewables and to provide flexibility and services to power and distribution system operators. Among these services is the provision of operating reserves or congestion management. However, under the current regulatory scheme the economic viability of these services is by no means guaranteed in the power system of the future.
  The main objective of this project is: first, to quantify the social and environmental welfare generated by storage technologies in highly decarbonized power systems; second, to analyze which of the services are economically viable in a liberalized electricity sector; and finally, establish which are the regulatory measures most adequate to guarantee the economic viability of storage technologies thereby closing the gap between the technically possible and the economically viable.

- **Improvements in the representation of the LNG market in virtual balance tank**
  Endesa Medios y Sistemas S.L. October 2020 - November 2020. (Antonio Bello Morales, Javier Reneses Guillén)

  This proposal focuses on improving the representation of the LNG market placed in a virtual balance tank, once the developments related to new gas tolls and the calculation of the price of LNG have already been consolidated.

- **Migration of the executions to EKS**
  Endesa Medios y Sistemas S.L. October 2020 - October 2020. (Antonio Bello Morales, Javier Reneses Guillén, Alberto Orgaz Gil)

  This project between IIT and Endesa focuses on carrying out the migration of the execution of the Hydraulic Feasibility Model and the execution of the VALORE LPM Model to EKS.

- **Analysis of irrigation in endodontics**
  Clínica Gaizka Loroño - Endodoncia Exclusiva. October 2020 - April 2021. (Jesús Jiménez Octavio)

  The global objective of this collaboration is focused on the analysis of cracks and the structural weakening of premolars caused by the opening and internal machining process of root canals. Endodontic treatment includes this among its main phases as a previous step to the irrigation of the root canals. Along with the risk of hypochlorite extrusion in the apical area, vertical cracking of the tooth constitutes the most significant risk in this clinical application.
  The specific goal of the analysis will be the computational modeling of a premolar tooth obtained by micro-CT and the analysis of the stress concentration resulting from different case studies. A review of the state of the art will be carried out and, based on this, the contour conditions and loads applied to a premolar in the different phases of opening and machining typical of endodontic treatment will be defined.

- **Development of a boxing movement recognition module using deep learning techniques for its integration into a home training system**
  Brooklyn Fitboxing International S.L. October 2020 - January 2021. (Jaime Boal Martín-Larrauri, Eugenio Francisco Sánchez Úbeda)

  Taking as input the images obtained from an RGB-D camera, boxing movement detection algorithms are trained using deep learning techniques. Once the model is adjusted, it is implemented in an electronic board equipped with an artificial intelligence acceleration module. The objective is to determine, in real time, if the movement executed by the user corresponds in time and form to the one expected in the exercise.

- **Energy simulation and efficient speed profile optimisation in High Speed lines in Germany**
  Patentes Talgo S.L.U. October 2020 - May 2021. (Antonio Fernández Cardador, Asunción Paloma Cucala García, Adrián Fernández Rodríguez, Manuel Blanco Castillo)

  In this project the energy optimal speed profile is design for a Talgo train running in high speed lines in Germany, 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.

- **New 100% renewable, flexible and robust energy system for the integration of new generation, grid and demand-side technologies- Network Planning and reconfiguration**
  i-DE Redes Eléctricas Inteligentes, S.A.U. October 2020 - December 2023. (José Pablo Chaves Ávila, Fernando Emilio Postigo Marcos, Tomás Gómez San Román, Orlando Mauricio Valarezo Rivera, Carlos Mateo Domingo)

  The main objective of the FLEXENER project is to research new technologies and simulation models in the field of renewable generation, storage systems and flexible demand management and distribution grid operation. The aim is to

achieve a 100% renewable and decarbonised energy mix, effectively integrated into the electricity system of the future in a flexible, efficient and safe manner.
This project supports the FLEXENER project by focusing on the challenges of distribution networks. The specific objective is to develop a series of tasks identified within the FLEXENER project:
- Distribution grid flexibility solutions.
- Analysis of requirements and simulations of future scenarios and their impact on the grid in the Iberian Peninsula.
- Technological research into new markets, flexibility services and system regulation to achieve a 100% renewable energy mix with safe, efficient and clean energy.

- **FLEXENER: New 100% renewable, flexible and robust energy system for the integration of new technologies in generation, networks and demand - Scenarios**
  Iberdrola Generación España, S.A.U. October 2020 - December 2023. (Michel Rivier Abbad, Tomás Gómez San Román, Álvaro Sánchez Miralles, Francisco Martín Martínez, Andrés Ramos Galán, José Pablo Chaves Ávila, Stefanía Gómez Sánchez)

  This project is part of the FLEXENER project. It corresponds to one of the activities of said project. The main objective of the FLEXENER project is to investigate new technologies and simulation models in the field of renewable generation, storage systems and flexible demand management and operation of the distribution network. A 100% renewable and decarbonised energy mix is ??sought, effectively integrated into the electrical system of the future in a flexible, efficient and safe way.
  In this context, this project or activity has been in charge of building future scenarios for 2030 that, based on the resources and technological equipment available at that time, determine an optimal mix of renewable generation technologies, storage systems and energy management. the demand that allows covering the demand for electricity with sufficient guarantees of supply reliability.
  These scenarios have served to feed other activities of the FLEXENER Project that analyze aspects of the detailed electrotechnical behavior of the electrical networks in these conditions to investigate the technical feasibility of the system and explore possible solutions to the technical problems they present.

- **New 100% renewable, flexible and robust energy system for the integration of new generation, grid and demand-side technologies- Technical studies of networks**
  Iberdrola Generación España, S.A.U. October 2020 - December 2023. (Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo, Enrique Lobato Miguélez, Carlo de Paolis Robles)

  This project is part of the FLEXENER project. The main objective of the FLEXENER project is to investigate new technologies and simulation models in the field of renewable generation, storage systems and flexible demand management and operation of the distribution network. A 100% renewable and decarbonised energy mix is sought, effectively integrated into the electrical

system of the future in a flexible, efficient and safe way. In this context, this project has been in charge of the assessment of the contribution to the stability of the Spanish mainlad system of the solutions developed in activities A2, A3 and A4.

- **FLEXENER: New 100% renewable, flexible and robust energy system for the integration of new technologies in generation, networks and demand - Market design**

  Iberdrola Generación España, S.A.U. October 2020 - December 2023. (Michel Rivier Abbad, José Pablo Chaves Ávila, Pablo Rodilla Rodríguez)

  This project is part of the FLEXENER project. It corresponds to one of the activities of said project. The main objective of the FLEXENER project is to investigate new technologies and simulation models in the field of renewable generation, storage systems and flexible demand management and operation of the distribution network. A 100% renewable and decarbonised energy mix is ??sought, effectively integrated into the electrical system of the future in a flexible, efficient and safe way.

  In this context, this project or activity has been in charge of designing configuration options for the electricity market that are adapted to the existence of a 100% renewable electricity system. The general configuration of the market has been analyzed (types of markets involved, their sequence, role of agents, type of agents), focusing in particular on capacity markets and balancing markets. The different options have been analyzed, identifying the advantages and disadvantages for a 100% renewable electricity system.

- **New 100% renewable, flexible and robust energy system for the integration of new generation, grid and demand-side technologies-Technical studies of networks**

  I-DE Redes Eléctricas Inteligentes, S.A. October 2020 - December 2023. (Luis Rouco Rodríguez, Lukas Sigrist)

  This project is part of the FLEXENER project. The main objective of the FLEXENER project is to investigate new technologies and simulation models in the field of renewable generation, storage systems and flexible demand management and operation of the distribution network. A 100% renewable and decarbonised energy mix is sought, effectively integrated into the electrical system of the future in a flexible, efficient and safe way. In this context, this project has been in charge of the assessment of the contribution to the distribution grid to the system stability.

- **Optimal identification of secondary regulation hydraulic resources for SIROCO-Diario by using the EXCOM-EXLA model**

  Endesa Medios y Sistemas S.L. October 2020 - December 2020. (Francisco Alberto Campos Fernández, Javier García González, Antonio Muñoz San Roque)

  The objective of this project is the optimal identification of hydraulic resources for SIROCO-Diario, taking as a starting point the experience acquired in the previous collaboration, which was entitled «Concept solution: Analysis of the

feasibility of using the hydraulic model of EXCOM-EXLA », Where the feasibility of integrating the constraints and objective function of SIROCO-Semanal in the EXCOM-EXLA model was analyzed. In this collaboration, it was possible to take advantage of the detailed modeling of the hydraulic equipment used in EXCOM-EXLA to identify and optimally manage the secondary reserve resources of the hydro groups in a multi-week horizon, with encouraging results in several of the cases analyzed.

- **VALORE HEPLASE in a grid computing environment**
  Endesa Medios y Sistemas S.L. October 2020 - February 2021. (Antonio Bello Morales, Javier Reneses Guillén)

  This project focuses on carrying out the necessary developments to execute VALORE HEPLASE in a grid computing environment, with the same design and scope as that currently used by VALORE-LPM users for the execution of Montecarlo and deterministic cases.

- **Voltage control system of the transmission grid with renewable generation**
  Iberdrola Generación España, S.A.U. October 2020 - December 2021. (Luis Rouco Rodríguez, Enrique Lobato Miguélez, Ignacio Egido Cortés, Álvaro Benítez Domínguez)

  This project will develop a voltage control system of the transmission grid with renewable generation.

- **Design of the battery-recharge system of an autonomous robot**
  Picaro Surf S.L.U. October 2020 - January 2021. (Álvaro Jesús López López, Juan Luis Zamora Macho, Jaime Boal Martín-Larrauri, Lucía Güitta López)

  Design of the positioning system to recharge the battery of an autonomous robot

- **A methodology to measure the silver economy**
  Fundación Mapfre. October 2020 - June 2021. (Elisa María Aracil Fernández, David Roch Dupré)

  The silver economy measurement methodology is a project led by the IIT for the Ageingnomics Research Center, within the MAPFRE Foundation. This center aims to lead a global strategy to disseminate the economic and social benefits associated with longevity, as well as contribute positively to economic activity related to population aging.

- **Incorporation of scenarios of gas contracts availability**
  Endesa Medios y Sistemas S.L. November 2020 - January 2021. (Antonio Bello Morales, Javier Reneses Guillén)

  This proposal focuses on incorporating scenarios of gas contracts availability in the Monte Carlo executions.

- **CEVESA: A long term planning model for investment decisions in electricity generation and transportation**
  Institute for Systems and Computer Engineering, Technology and Science (INESC TEC). November 2020 - November 2022. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

  CEVESA is a dynamic model with hourly chronology for planning the expansion of electricity generation in the Spanish and Portuguese electricity systems that considers both the investments made by customers in distributed energy resources from generation and storage (DER) and by generators in conventional plants of thermal generation, renewable and centralized storage (CR). It also represents the Spanish transport sector by including investment decisions in electric vehicles (PEV) and internal combustion motor vehicles (ICEV), taking into account the deployment of infrastructure, fuel and the social and environmental costs of both transport technologies. In turn, CEVESA models investments and hourly operation of hydrogen (H2) production plants in Spain to cover a daily demand for H2 that allows representing a penetration scenario of vehicles powered by H2 (H2EV) or a satisfied H2 demand by renewable generation for other industrial uses. It is also a multizonal model that considers marketsplitting to represent interzonal flows.

- **Research on the optimal spinal angle to maximize the safety of pediatric occupants using child restraint systems**
  Karwala Spótka z Ograniczona Odpowiedzialnoscia Spótka Komandytowa. November 2020 - May 2021. (Francisco José López Valdés)

  The goal of the project is to investigate on the optimal seatback angle for infant carriers to be carried out by Universidad Pontificia Comillas (from hereafter, Comillas) in collaboration with Karwala Spótka z Ograniczona Odpowiedzialnoscia Spótka Komandytowa (from hereafter, Karwala).
  The objective of the research proposal is to understand the range of spine angles that are biomechanically more favorable in the event of an impact when a child (age to be specified by Karwala) is using a child restraint system (CRS) in a passenger car.
  Due to the impossibility of performing this study using human surrogates, most of the research is based on computational simulations, that would be partially validated by experimental data whenever possible.

- **Calculation of density and distribution functions in OMEGA**
  Endesa Medios y Sistemas S.L. November 2020 - December 2020. (Antonio Bello Morales, Javier Reneses Guillén, Luis Manuel Montero Guirao, Cristina Casillas Clot)

  The objective of this project is the implementation of the calculation of density and distribution functions in OMEGA's Monte Carlo execution.

- **EXCOM-EXLA: Initial phase for the computation of the water value curves**
  Endesa Medios y Sistemas S.L. November 2020 - December 2020. (Javier García González, Pedro de Otaola Arca, Ignacio Candela Ripoll)

This project is part of the development of the EXCOM and EXLA decision support tools. The objective of this project is to study the algorithm to build the the water value curves for each hydro power plant.

- **Design of protection settings and damping of low-frequency oscillations in power systems with high penetration of non-synchronous generation**
  Gas y Electricidad Generación S.A. December 2020 - December 2021. (Lukas Sigrist, Antonio Muñoz San Roque, Luis Rouco Rodríguez, José Portela González, Miguel Ángel Sanz Bobi, Miguel Ángel Durán Olivencia, Carlo de Paolis Robles)

  Scenarios of high penetration of RES involve a high penetration of non-synchronous, inverter-based generation. On the one hand, inverter response during faults es different from the response of synchronous generation. On the other hand, high penetration of RES affects the dispatch of conventional synchronous generators that are in charge today of damping low-frequency oscillations. RES generator could also contribute to the damping of low-frequency oscillations. The objective of this project is two-fold: design of protection settings by using machine learning techniques and tuning of PSS to damp low-frequency oscillations in a inverter-dominated power system.

- **Improvements in ACUARIO to use spot price simulations generated by Onerisk**
  Enel Iberoamérica S.R.L. January 2021 - April 2021. (Antonio Bello Morales, Javier Reneses Guillén, Pablo Rodilla Rodríguez, Paulo Brito Pereira)

  The objective of this project is twofold. On the one hand, the adaptation of the model ACUARIO to be able to use spot price simulations generated by Onerisk. On the other hand, and linked to the above, the planning of the first steps to improve the temporal representation used in ACUARIO.

- **Assistance and maintenance of Middle Office models**
  Enel Iberoamérica S.R.L. January 2021 - December 2021. (Antonio Bello Morales, Javier Reneses Guillén, 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.

- **New integrated model for strategic bidding and operation planning in the secondary reserve market**
  Endesa Medios y Sistemas S.L. January 2021 - December 2021. (Javier García González, Francisco Alberto Campos Fernández, Antonio Muñoz San Roque, Pedro de Otaola Arca)

  The objective of this project is to expand the SIROCO model to integrate it with the developments carried out recently in the tools EXCOM and EXLA to 1) facilitate digitization process, cloud computing and connection with Big-Data, and 2) take advantage of detailed modeling of hydro subsystems. This new integrated model will make it possible to submit quarter-hour offers to the

secondary reserve market, and to obtain the bi-monthly planning for this market.

- **Electricity storage: An assessment of technical, economic and regulatory issues**
  PSR Soluçoes e Consultoria em Energia Ltda. January 2021 - July 2021. (Paolo Mastropietro, Pablo Rodilla Rodríguez, Paulo Brito Pereira, Carlos Batlle López)

  The goal of this project is to analyse different storage technologies (mechanical, electrochemical, electrical, chemical, and thermal) from a technical (power, energy, discharge capability, response time, conversion rate) and an economic point of view (present costs and cost forecasts). After the techno-economic assessment, the study focuses on the most relevant regulatory aspects, reviewing international experiences, identifying the services that storage can provide to the system (among others, ancillary services, reliability and adequacy services, and grid services) and analysing the regulatory barriers that hamper storage participation in the market.

- **Consideration of solar production scenarios in Monte Carlo executions of the VALORE model**
  Enel Iberoamérica S.R.L. January 2021 - March 2021. (Antonio Bello Morales, Javier Reneses Guillén, Luis Manuel Montero Guirao)

  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 solar uncertainty is considered within Monte Carlo executions.

- **CODEX: Improvements in the representation of renewable energies and thermal subtechnologies of the fundamental model**
  Endesa Medios y Sistemas S.L. January 2021 - January 2021. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

  The main objective of this project is to improve the level of detail of representation of the different generation technologies, with special emphasis on France and on the countries that most significantly affect their prices, such as Germany, Italy, the United Kingdom, the Netherlands or Switzerland.

- **Modeling the meteorological behavior for medium-term forecasting using machine learning techniques**
  Endesa Medios y Sistemas S.L. January 2021 - December 2021. (Eugenio Francisco Sánchez Úbeda)

  The aim of this project is to model the behavior of the main meteorological variables, (such as wind, solar radiation or air temperature), in order to improve the medium-term forecasts for the medium-term operation and planning tools of the Iberian electricity market (MIBEL).

- **New functionalities, automation and maintenance DESI and DESIEXT Models 2021**
  Endesa Medios y Sistemas S.L. January 2021 - December 2021. (Enrique Lobato Miguélez)

  New functionalities, automation and maintenance DESI and DESIEXT models 2021

- **Flexible and efficient integration of CO2 generation technologies**
  Siemens Gamesa Renewable Energy Innovation & Technology S.L. January 2021 - December 2023. (Luis Rouco Rodríguez, Aurelio García Cerrada, Juan Luis Zamora Macho, Javier García Aguilar, Lukas Sigrist)

  This project will develop "fundamental models" for the design and analysis of wind-based generation technologies. Fundamental models are those derived from more detailed models that capture the most relevant dynamics of systems to be studied so that they can be included in the study of broader systems. These fundamental models will have various degrees of detail according to the purpose they will be intended for.

- **Development of advanced forecasting models for residual demand curves and group necesities in real time**
  Endesa Medios y Sistemas S.L. January 2021 - September 2021. (José Portela González, Antonio Muñoz San Roque, Alberto González Sánchez)

  The objective of the proposed collaboration is to improve the tools for forecasting residual demand curves in the electricity market.

- **Modeling and forecasting of the demand for natural gas and electricity in Spain, Portugal and France**
  Endesa Medios y Sistemas S.L. January 2021 - December 2021. (Eugenio Francisco Sánchez Úbeda, Víctor Arias Blanco, Eugenio Francisco Sánchez Úbeda)

  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.

- **Calculation of water value curves and feasible disaggregation of the cleared program among the physical units**
  Endesa Medios y Sistemas S.L. January 2021 - May 2021. (Javier García González, Pedro de Otaola Arca)

  This project is part of the development of the decision support tools EXCOM and EXLA. The first objective of this project is to put into production the module that allows the construction of water value curves for each hydro plant. The second objective is to develop a module that makes it possible to obtain the feasible disaggregation of the clared program among the physical units that belong to the bidding unit.

- **Development of aggregated and hierarchical forecasting models for forecasting offer curves in the Italian Electricity Market**
  Enel SpA. January 2021 - May 2021. (José Portela González, Antonio Muñoz San Roque)

  The objective of this project is to develop an advanced forecasting model for estimating offer curves by Production Units for each zone in the Italian electricity market. Hierarchical time series models and Machine Learning is applied to create a coherent forecast.

- **Improving freight representation in OMEGA**
  Endesa Medios y Sistemas S.L. February 2021 - April 2021. (Antonio Bello Morales, Javier Reneses Guillén, Cristina Casillas Clot)

  This project focuses on improving the representation of freight charges in the OMEGA model.

- **Improvements in the simulations of Extrapeninsular Systems**
  Enel Iberoamérica S.R.L. February 2021 - March 2021. (Antonio Bello Morales, Javier Reneses Guillén, Geovanny Alberto Marulanda García)

  This project focuses on improving the reporting in the Extrapeninsular System executions.

- **Short- medium-term risk management model**
  Endesa Medios y Sistemas S.L. February 2021 - March 2021. (Efraim Centeno Hernáez, Luis Alberto Herrero Rozas)

  The aim of this project is to carry out conceptual and operational developments in the current short-term risk management tool used by Endesa, as well as assisting in the use of the model and the interpretation of results. Additionally, the calculation of implied volatilities is addressed and the outputs of the electricity market forecasting tool (VALORE) are being adapted to improve the data used in the risk model.

- **CODEX: Implementation improvements to reduce execution times**
  Endesa Medios y Sistemas S.L. February 2021 - March 2021. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

  The main objective of this project is to reduce the CODEX execution time by improving both the definition and handling of variables and constraints as well as the management of files or other aspects that might be producing high execution times.

- **Improvements in Monte Carlo executions and in the resolution processes of the P48 and the extrapeninsular systems**
  Enel Iberoamérica S.R.L. March 2021 - October 2021. (Antonio Bello Morales, Javier Reneses Guillén, Alberto Orgaz Gil, Geovanny Alberto Marulanda García)

This project focuses on a redesign of the methodology currently used in Monte Carlo simulations, as well as in improving the representation of generation units in the extrapeninsular systems.

- **CODEX: Improvements in the generation of hourly profiles for synthetic weeks**
  Endesa Medios y Sistemas S.L. March 2021 - April 2021. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)
  The main objective of this project is to improve the processes for generating demand curves, solar and wind scenarios for all European CODEX countries, in the stochastic execution mode using synthetic periods, and which includes the integration and automation of the clusters' computation of the historical profiles of the variables referred to.

- **Improving Monte Carlo simulations in OMEGA**
  Endesa Medios y Sistemas S.L. April 2021 - October 2021. (Antonio Bello Morales, Javier Reneses Guillén, Cristina Casillas Clot, Luis Manuel Montero Guirao, Diana María Navarrete Cruz)
  This project focuses on improving the methodology used in Monte Carlo simulations.

- **Simulation of the global gas market in the medium term**
  Enel Global Trading S.P.A. April 2021 - October 2021. (Antonio Bello Morales, Javier Reneses Guillén, Pablo Rodilla Rodríguez, Paulo Brito Pereira)
  The aim of this collaboration between IIT and Enel is to develop different improvements in SIMGAS to enable a more realistic representation of the global natural gas market in the medium term.

- **Improvement in the generation of hourly profiles for synthetic weeks**
  Endesa Medios y Sistemas S.L. April 2021 - April 2021. (Efraim Centeno Hernáez)
  CODEX is a model for long-term MIBEL analysis that allows the representation either hourly either by states of the time horizon, the representation of generation resources by technologies or groups, the modeling of competition and the secondary reserve, as well as the treatment of uncertainty by characterizing the stochastic variables mentioned above. In this task, improvements were proposed in the representation of renewable energies using hourly profiles.

- **Improvements in the representation of renewable energies from the rest of the countries of the fundamental model**
  Endesa Medios y Sistemas S.L. April 2021 - April 2021. (Efraim Centeno Hernáez)
  CODEX is a model for long-term MIBEL analysis that allows the representation either hourly either by states of the time horizon, the representation of generation resources by technologies or groups, the modeling of competition

and the secondary reserve, as well as the treatment of uncertainty by characterizing the stochastic variables mentioned above. In this task, improvements were proposed in the representation of renewable energies for the European countries represented in the model.

- **CODEX: Improvements in the generation of hourly profiles for synthetic weeks**

  Endesa Medios y Sistemas S.L. April 2021 - May 2021. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

  The main objective of this project is to improve the representation of renewable energies (solar and wind profiles, hydro treatment and pumping) and thermal subtechnologies of the countries of CODEX-Fra.

- **AgroMaster: Automatic and autonomous support system for small primary farms based on IoT (internet of things) and edge computing with fully distributed autonomous data and power network**

  Universidad Ramón Llull, Universidad de Deusto. May 2021 - April 2022. (Carlos Rodríguez-Morcillo García, Javier Matanza Domingo, José Daniel Muñoz Frías, Francisco Javier Herraiz Martínez, Romano Giannetti, Gregorio López López)

  In this project, we want to build a small prototype that allows demonstrating that it is possible to improve the economic performance of various agricultural activities. To do this, it will focus on improving the efficiency of energy, water, and time spent. A solution especially suitable for areas of extensive irrigation, livestock and greenhouse crops, where communications have little or no coverage. That it covers from beginning to end the needs suffered by large areas of land, in poor areas from the economic point of view. A cheap solution, without fixed maintenance costs (such as a telephone communication may suppose), which makes it accessible to the small farmer or producer, on a personal basis. A solution that can serve multiple points scattered throughout a large area of ??land, avoiding the movement of people.
  The project, for the agricultural scenario, offers water and energy savings, by being able to irrigate in a controlled way thanks to the use of sensors, with the necessary water, in the lowest hours of energy cost, including obtaining energy in a renewable (solar or wind). Not forgetting that accurate and adequate irrigation affects the quantity and quality of production. In other scenarios, such as farms or greenhouses, the implementation of this system results in cost savings.
  To demonstrate the feasibility of improving economic performance, it is necessary to build a prototype consisting of three parts:
  1) The minimum elements to control, provided by INEA will be 1 solenoid valve, 1 irrigation motor, and 1 door. They provide knowledge about the operation of crops and farms, the management and supervision of the installed prototype, and the analysis of the collected data.
  2) The control and sensor electronics (temperature, humidity, pressure), which will be designed and built by ICAI, using low-cost components. It will be in charge of the assembly and tests in the laboratory and in the field.
  3) The totally autonomous electrical supply (solar panels and batteries) of the

previous parts, which will be designed and built by the URL-IQS electrotechnical laboratory. They will be in charge of the assembly and laboratory tests.

- **Technical viability of the connection of an offshore wind power plant in Tenerife island**

  Endesa Generación S.A. May 2021 - July 2021. (Enrique Lobato Miguélez, Luis Rouco Rodríguez, Lukas Sigrist)

  This project tackles the feasibility of connecting an offshore wind power plant on the island of Tenerife. The viability is analyzed according to the three criteria established in the new Circular 1/2021: (a) short-circuit power limit according to the WSCR index, (b) static security limit and (c) dynamic stability limit.

- **Optimal design of ATO driving parameters in the branches of Valles Line of FGC**

  Siemens Rail Automation S.A.U. May 2021 - December 2021. (Antonio Fernández Cardador, Asunción Paloma Cucala García, Adrián Fernández Rodríguez, Manuel Blanco Castillo)

  The objective of this project is the design and implementation of efficient ATO speed commands in FGC railway line in Tarrasa and Sabadell branches. These ATO speed commands are selected and sent to the train by the traffic regulation system in real-time. The new ATO speed commands must comply with technical, operational and comfort restrictions and will minimise the energy consumption.

- **Support to deployment of DRE solutions within the Rockefeller Foundation Call for Action and the Integrated Distribution Framework**

  MIT, Rockefeller Foundation. May 2021 - May 2022. (Fernando de Cuadra García, Carlos Mateo Domingo, Paolo Mastropietro, Santos José Díaz Pastor, José Ignacio Pérez Arriaga, Andrés González García)

  This project is a collaboration between the MITei research team (in which the Comillas-IIT is a relevant partner) and the Rockefeller Foundation (RF) regarding the ongoing collaboration around the Global Commission to End Energy Poverty (GCEEP), and the development of a globally applicable Integrated Distribution Framework (IDF)
  The main areas of action of the project are:
  - Advancing IDF implementation aligned with the Call Action Plan for massive deployment of
  Distributed Renewable Electrification (DRE) solutions
  - Index measuring the progress towards a fully electrified and decarbonized economy for all
  Some of the tasks included in the IIT contributions to the project are:
  - Definition and implementation of computer models to analyse optimal electrification along time, in specific areas (several demand clusters related to the same feeder). Solutions include grid and off-grid options, uncertainty and multiple scenarios.

- Analysis of the effects and promotion schemes for demand growth: C&I customers, electric cooking or electric vehicles
- Definition of dynamic scenarios for demand, regulation and business models.
- Analysis of business models, policies, tariffs and subsidies.

- **Simulation of distributed energy resources**
  Zola Electric. May 2021 - September 2021. (Carlos Mateo Domingo, Francisco Javier Renedo Anglada, Fernando Emilio Postigo Marcos)

  The objective of the project is to simulate the steady state of a microgrid with AC/DC power conversion units (PCUs), loads and delta-wye three-phase transformers. The model is based on a full three-phase model of a distribution network. The equations in the PCUs relate the frequency of and the voltage in their terminals to the power injected into the grid. The algorithm searches for the solution iteratively looking for a solution of the power flow that is coherent with the equations of the PCUs.

- **Development of a module to monitor functional training exercises with computer vision and deep learning**
  Brooklyn Fitboxing International S.L. May 2021 - October 2021. (Jaime Boal Martín-Larrauri, Eugenio Francisco Sánchez Úbeda)

  Using images captured with an RGB-D camera, the aim of the project is to detect the functional exercise (sit-ups, push-ups...) being performed by a person and to count the number of correct repetitions automatically. To identify the exercises, deep learning models are trained and quantized in order to deploy them on an electronic board equipped with an artificial intelligence acceleration module.

- **Training, innovation and development in Metrology**
  Universidad Nacional Educación a Distancia (UNED). May 2021 - July 2022. (María Ana Sáenz Nuño)

  Projects typically small in duration or budget on metrology, including training, design, innovation for companies, etc.

- **Improvement of the modeling of wind generation in a European context and from a probabilistic perspective**
  Enel Iberoamérica S.R.L. June 2021 - December 2021. (Antonio Bello Morales, Javier Reneses Guillén, Luis Manuel Montero Guirao, Geovanny Alberto Marulanda García)

  This project focuses on improving the decision-making process with the model through a better modeling of wind generation in a European context and from a probabilistic perspective.

- **Phase 1 of GAMS code reengineering**
  Endesa Medios y Sistemas S.L. June 2021 - October 2021. (Antonio Bello Morales, Javier Reneses Guillén, Alberto Orgaz Gil, Geovanny Alberto Marulanda García)

This project focuses on improving the resolution of SENP systems by means of structural changes in the optimization process.

- **Improvements in the temporal representation used in ACUARIO**
  Enel Iberoamérica S.R.L. June 2021 - December 2021. (Antonio Bello Morales, Javier Reneses Guillén, Pablo Rodilla Rodríguez, Paulo Brito Pereira)

  The objective of this project is to undertake a reengineering of ACUARIO to improve the temporal representation used in the model by making the current load blocks more flexible.

- **Analysis of impact factors in mechanical life cycle tests**
  Inesco Ingenieros S.L. June 2021 - September 2021. (José Portela González, Sonja Wogrin)

  The objective of the project is the analysis of data from different mechanical tests to determine the factors that significantly affect the useful life.

- **CODEX: Modeling of new trends**
  Endesa Medios y Sistemas S.L. June 2021 - September 2021. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

  The main objective of this project is the integration in CODEX of a model that allows to represent green hydrogen, without considering its storage or its use in reconditioned thermal power plants to generate electricity.

- **Improvements in the modeling of the Salime reservoir, in the technical constraints market module and in the module for the feasibility of cleared schedules**
  Endesa Medios y Sistemas S.L. August 2021 - September 2021. (Javier García González, Pedro de Otaola Arca)

  This project is part of the development of the decision support tools EXCOM and EXLA. The objective of this project is to improve the modeling of the Salime reservoir (shared power plant), as well as the technical constraints market, and the feasibility modules.

3.2.1.2 Public funding

- **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

- **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:

- **Metrology for smart energy management in electric railway systems**
  Comisión Europea. September 2017 - December 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.

- **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"

- **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 - December 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"

- **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 2021. (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, Aurelio García Cerrada)

  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, Shilpa Bindu, Álvaro Sánchez Miralles, Nicolás Mariano Morell Dameto, Javier Matanza Domingo, Gregorio López López, Enrique Lobato Miguélez, Orlando Mauricio Valarezo Rivera, Matteo Troncia)

  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)**
  MCIN/ AEI/10.13039/501100011033/ "FEDER Una manera de hacer Europa". January 2019 - June 2022. (Aurelio García Cerrada, Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo, Francisco Javier Renedo Anglada, Pablo García González, Ignacio Egido Cortés, Régulo Enrique Ávila Martínez)

  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).

Grant RTI2018-098865-B-C31 funded by MCIN/AEI/ 10.13039/501100011033 and by "ERDF A way of making Europe"

- **Programa Microrredes Inteligentes Comunidad de Madrid**
  Comunidad de Madrid, Fondo Social Europeo, Fondo Europeo de Desarrollo Regional. January 2019 - December 2022. (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, Javier García González)

  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.

Program of R&D activities among Research Groups of "Comunidad de Madrid" in Technology 2018, funding by Comunidad de Madrid and co-funding by European Social Fund and European Regional Development Fund, 2014-2020.

- **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 - September 2022. (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)

- **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.

- **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, Mauricio Correa Ramírez, Luca De Rosa, Francisco Javier Renedo Anglada, Lukas Sigrist)

  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.

- **Island system operation with high degree of renewable energy resources (RTI2018-100965-A-I00)**
  MCIN/ AEI/10.13039/501100011033/ "FEDER Una manera de hacer Europa". September 2019 - September 2022. (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.

Grant RTI2018-100965-A-I00 funded by MCIN/AEI/ 10.13039/501100011033 and by "ERDF A way of making Europe".

- **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, Matteo Troncia)

  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**
  National Renewable Energy Laboratory (NREL), U.S. Department of Energy. 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) is 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, Gopal Lal Rajora, 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.

- **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.

- **CR4ALL: Responsible consumption for all**
  Ministerio de Ciencia e Innovación (MCI), Agencia Estatal de Investigación (AEI). May 2020 - April 2023. (Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque, José Portela González, Ignacio Navas Pascual, Francisco Rodríguez Cuenca)

  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.

Project Retos- Colaboración RTC2019-007380-3 funded by Ministerio de Ciencia e Innovación (MCI) and Agencia Estatal de Investigación (AEI)

- **Biophysics of immune response: receptors, cells and populations**

  Ministerio de Ciencia e Innovación (MCIN), Agencia Estatal de Investigación (AEI), 10.13039/501100011033. June 2020 - May 2023. (Mario Castro Ponce, Angela Jiménez Casas, Alberto Carnicero López, Miguel García Sánchez)

  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.

Grant PID2019-106339GB-I00 funded by MCIN/AEI/10.13039/501100011033/

- **Development of movement behavior models of complex chronic patients**
  Ministerio de Ciencia e Innovación (MCI), Agencia Estatal de Investigación (AEI). 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.

Project Retos- Investigación PID2019-110747RB-C22/ AEI/10.13039/501100011033 funded by Ministerio de Ciencia e Innovación (MCI) and Agencia Estatal de Investigación (AEI)

- **Powering system flexibility in the future through RES (POSYTYF)**
  Comisión Europea. July 2020 - July 2023. (Lukas Sigrist, Luis Rouco Rodríguez, Enrique Lobato Miguélez, Álvaro Ortega Manjavacas, Oluwaseun Enoch Oladimeji, Hadi Nemati, Pedro Sánchez Martín)

  The main objective in the POSYTYF project is to group several RES into a systemic object called Virtual Power Plant (VPP). VPP is a way to aggregate RES sources to form a portfolio of dispatchable/non-dispatchable RES able to optimally internally redispatch resources in case of meteorological and system variations in order to provide sufficient flexibility, reliable power output and grid services.
  The POSYTYF project will provide TSOs, DSOs and generators with knowledge, models and tools for synthesis of VPP controls both for local (production) and grid (ancillary services) objectives. New analysis (stability assessement) and control (centralized vs decentralized concepts) methods will be particularly proposed. Solutions will be immediately implementable in the actual grid and regulatory situation. Realistic (large-scale grids and concrete RES technologies) cases will be treated and full validations – both in simulation and hardware in the loop along with the codes for regulator's implementation will be made available. Proposals for some main problems like stability will be formulated for next generation grids of massive RES penetration and low inertia systems.

- **Stability analysis of large power systems with 100% of non-synchronous generators**
  Ministerio de Ciencia e Innovación (MCI). September 2020 - August 2024. (Aurelio García Cerrada, Régulo Enrique Ávila Martínez, Luis Rouco Rodríguez, Francisco Javier Renedo Anglada)

  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:
"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."

This project is supported by the Spanish Government through the 2019 edition of its pre-doctoral contract programme with reference number PRE2019-088084

- **MODESC – Platform of innovative models for speeding the energy transition towards a decarbonized economy**
  Ministerio de Ciencia e Innovación (MCI), Agencia Estatal de Investigación (AEI). September 2020 - December 2023. (Tomás Gómez San Román, Michel Rivier Abbad, José Pablo Chaves Ávila, Andrés Ramos Galán, Pedro Linares Llamas, Leslie Herding, Teresa Freire Barceló)

  The aim of the project is the development of a global platform that integrates innovative energy simulation and impact assessment models that allow speeding the decarbonization of the electricity system including the electrification of the energy demand. Several scenarios in the horizon 2030-2050 are considered.

Project Retos- Colaboración RTC2019-007315-3 funded by Ministerio de Ciencia e Innovación (MCI) and Agencia Estatal de Investigación (AEI)

- **OneNet- One network for Europe**

  European Commission. October 2020 - September 2023. (José Pablo Chaves Ávila, Tomás Gómez San Román, Rafael Cossent Arín, Luis Olmos Camacho, Javier Matanza Domingo, Gregorio López López, Leandro Lind, Orlando Mauricio Valarezo Rivera, Matteo Troncia)

  OneNet addresses the growing needs of TSOs and DSOs to have real-time insight into the operation of
  their networks to work in a closely coordinated way, while unlocking and enabling new flexibility markets in a fair and open way. Goal is to enable a cost-effective, seamless and secure bidirectional power flow to and from network customers as active players while supporting grid operators in their system responsibilities.
  The challenges that OneNet addresses are:
  • The need to unlock markets of flexibility at every level to address all the possible needs of network operators
  • The need to effectively support both TSOs and DSOs system-level operation through providing flexibility for 'frequency balancing' and 'non-frequency' ancillary services among others
  • The need for TSOs and DSOs to secure power supplies in the context of ever-increasing RES penetration, decreasing network outages,
  • The need for TSOs and DSOs to gain near real-time insight into the operation of the networks and to can optimise them in near real-time, and
  • The need for improved efficiency of grid reinforcements and stabilization of future costs of grid connection.
  Comillas is leader of WP10– From OneNet demonstrators to EU wide implementation of coordinated
  market schemes and interoperable platforms for standardized system products.

- **Empowering and educating young people for the internet by playing**

  Comisión Europea. October 2020 - October 2023. (Gregorio López López, Nereida Bueno Guerra, Mario Castro Ponce, Álvaro Jesús López López, Javier Matanza Domingo, Sara Lumbreras Sancho, Yolanda González Arechavala, Carlos Rodríguez-Morcillo García, Rafael Palacios Hielscher, David Contreras Bárcena, Francisco Javier Herraiz Martínez, Jaime Pérez Sánchez, María Riberas Gutiérrez, María Reneses Botija)

  The RAYUELA project is a 3-years project beginning in October 2020 with a budget of 5M EUR. The consortium involves 17 partners from 9 countries and is co-ordinated by Universidad Pontificia Comillas. The project brings together experts from different areas of knowledge from all over Europe to develop an interactive story-like game that, on the one side, will allow minors to learn good practices on the use of the Internet and associated technology by playing, and, on the other side, will allow modelling, in a friendly and non-invasive manner, online habits and potential risk profiles related to cybersecurity and cybercriminality, providing Law Enforcement Agencies with scientifically sound foundations to define appropriate policies.

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

  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.

- **integRatEd Solutions for POsitive eNergy and reSilient CitiEs**
  Comisión Europea. October 2020 - September 2025. (Gregorio López López, Javier Matanza Domingo, Rafael Cossent Arín, José Pablo Chaves Ávila, Tomás Gómez San Román, Carlos Rodríguez-Morcillo García, Néstor Rodríguez Pérez)

  RESPONSE supports the Lighthouse cities of Dijon (FR) and Turku (FI) and their Fellow cities Brussels (BE), Zaragoza (ES), Botosani (RO), Ptolemaida (GR), Gabrovo (BU) and Severodonetsk (UA) to facilitate them deliver positive energy blocks and districts. Through RESPONSE ,the two LHs will achieve a local RES penetration of 11.2 GWh/y, energy savings of 3,090 MWh/y and an emission reduction of 9, 799 tons CO2eq/y within their districts. To achieve this goal, RESPONSE demonstrates 10 Integrated Solutions (ISs), comprising of 86 innovative elements (technologies, tools, methods), that are being monitored with specific impact metrics (KPIs). It attracts the interest of various stakeholders by generating innovative business models enabling the upscale and replication of the solutions forming a validated roadmap for sustainable cities across Europe and beyond. RESPONSE adopts an energy transition strategy, which includes 5 Transformation Axes (TAs), encompassing the 10 ISs. TA#1 focuses on transforming existing and new building stock into Energy Positive and Smart-ready. TA#2 focuses on the decarbonization of the electricity grid and the district heating/cooling systems, supporting fossil-based regions in transition and the development of energy communities. TA#3 proposes grid flexibility strategies and novel storage systems for optimizing energy flows, maximize self-consumption and reduce grid stress. TA#4 links existing CIPs with apps and other digital infrastructure to enable digitalisation of services and connected city ecosystems, integrating also smart e-Mobility to promote the decarbonisation of the mobility sector. TA#5 offers interdisciplinary citizen engagement and co-creation practices putting citizen at the forefront of shaping the cities they live in and towards the development of each city's 2050 own

bold city-vision. Special focus is given to creating resilient and safe cities increasing quality of life and lowering the impacts of climate change.

- **Graphene-enhanced 3D printed biodegradable scaffolds for bone regeneration (EIN2020-112443)**
  MCIN/AEI /10.13039/501100011033, Unión Europea NextGenerationEU/ PRTR. November 2020 - October 2022. (Eva Paz Jiménez)

  Grant for proposal preparation fot the Horizon Europe Call: ERC Grants (Pillar 1) - Starting Grants (StG).

Grant EIN2020-112443 funded by MCIN/AEI/ 10.13039/501100011033 and by the European Union NextGenerationEU/PRTR.

- **INTMOD: from the mathematical model to the human decision: positioning Spain as a leader in interpretable models**
  Agencia Estatal de Investigación (AEI). November 2020 - October 2022. (Sara Lumbreras Sancho)

  Granted awarded in the 2020 call for “Europe Research” Revitalization Actions for the preparation and presentation of the proposal addressed to the Horizon Europe call: ERC Aids (Pillar 1) - Starting Grants (StG).

Action EIN2020-112480 funded by Agencia Estatal de Investigación (AEI)

- **Building synthetic distribution networks in Canada**
  Ministère de l´Énergie et des Ressources naturelles. November 2020 - July 2021. (Carlos Mateo Domingo, Tomás Gómez San Román, Fernando de Cuadra García)

  In this project, synthetic electricity distribution networks in Canada are built. They are designed using a U.S. Reference Network Model (RNM-US), developed by IIT. This models is able to build a synthetic distribution network from scratch, taking into account information about the location and the demand of the consumers to be modelled. These synthetic networks are not

real, but very realistic, and take into account technical and geographical constraints. In particular, the layout of these networks respects the street map. Moreover, they are designed taking into account differential aspects of distribution networks in North America, such as the use of single- and three-phase feeders.

- **Implementing network codes**
  Research Council of Norway (RCN), Statkraft, Statnett, Ministry of Petroleum and Energy, Nord Pool. January 2021 - December 2024. (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?

- **Assessment of the storage needs for the Spanish electric system in a horizon 2020-2050 with large share of renewables**
  Instituto para la Diversificación y Ahorro de la Energía (IDAE). January 2021 - March 2022. (Andrés Ramos Galán, Pedro Linares Llamas, José Pablo Chaves Ávila, Javier García González, Sonja Wogrin, Juan José Valentín Vírseda)

  This project assesses, from a technical and economic point of view, the daily, weekly and seasonal storage needs for the Spanish electricity system in the 2020-2050 horizon, considering the different storage technologies, as well as keys such as the flexibility of demand or hydroelectric availability.

- **Methodology for allocation of social funds Comunidad Madrid**
  Comunidad de Madrid. February 2021 - March 2021. (Elisa María Aracil Fernández, David Roch Dupré, Rosalía Mota López, Gonzalo Gómez Bengoechea, Elena María Díaz Aguiluz)

  The General Directorate of Social Services and Social Innovation of the Department of Social Policies, Families, Equality and Natality of the Community of Madrid sends us the need to review the current system of indicators for the allocation of funds dedicated to social benefits intended 54 city councils with more than 20,000 inhabitants -except for the Madrid City Council- and 16 mancomunidades. The current system, under the figure of a single agreement, dates from 2018, distributing the funds according to three main items: poverty and exclusion (60%), child poverty (20%) and prevention of dependency (20%). This system of distribution indicators takes into account aspects related to population and per capita income. The General Directorate of Social Services and Social Innovation requests the technical review of the current system, its weighting, and the proposal of additional indicators that reflect the social and economic reality of the affected groups, in order to

improve the transparency and social impact of the funds. intended for social services.

- **Harnessing the potential of demand response in emerging economies to boost the energy transition**
  World Bank. March 2021 - June 2021. (Paolo Mastropietro, Pablo Rodilla Rodríguez, Carlos Batlle López)

  Demand response can provide a broad range of services to the power system, which are very beneficial today and whose need will grow constantly as the electricity sector moves towards decarbonisation. This is especially relevant for emerging economies, where the largest untapped potential for demand-side management can be found. This project analyses demand response in the wider framework of power sector regulation from a theoretical point of view, it reviews the implementation of DR schemes in emerging economies, and it presents a high-level blueprint for the deployment of demand response in developing countries.

- **European Climate and Energy Modellling Forum**
  Comisión Europea. May 2021 - December 2024. (Sara Lumbreras Sancho, Andrés Ramos Galán, Luis Olmos Camacho, Carlos Mateo Domingo)

  The aim of ECEMF is to provide the knowledge to inform the development of future energy and climate policies at national and European levels. In support of this aim, ECEMF proposes a range of activities to achieve five objectives and meet the four challenges set out in the call text.
  ECEMF's programme of events and novel IT-based communications channel will enable researchers to identify and co-develop the most pressing policy-relevant research questions with a range of stakeholders to meet ambitious European energy and climate policy goals, in particular the European Green Deal and the transformation to a climate neutral society.
  Answers will be provided by the first inclusive and open full-scale model comparison exercise on achieving climate neutrality in Europe, including from the outset over 20 models and 15 top research groups, to produce a coherent and relevant evidence-base for energy and climate policy impact assessment.
  ECEMF's evidence-base will support the development of policy-relevant insights which will be communicated to and discussed with the key decision makers via a range of novel methods, including interactive embeddable visualisation blocks, policy briefs, workshops and high-profile events.
  This loop of knowledge co-production stands on two pillars.
  First, ECEMF will advance the state-of-the-art of energy and climate modelling by enabling sharing of: input data using open standards, methods for model comparison building on the vast experience of the consortium, scientific software tools such as the IIASA scenario explorer and hands-on training for researchers.
  Second, ECEMF will be established as a long-term, open and welcoming European focal-point for researchers and policy makers with unparalleled international connections to the EMF, JMIP, IAMC and IPCC. Through extensive links to ongoing H2020 projects, research and policy communities & networks

ECEMF will reduce fragmentation of the European energy and climate research landscape.

3.2.2 Consultancy and technological support

3.2.2.1 Private funding

- **Studies of dynamic models of cogeneration plants**
  Invesyde S.L. January 2019 - December 2020. (Pablo Frías Marín)

  The objective of the collaboration is to study the adjustments of the dynamic models that simulate the electro-mechanical behavior of the generation units of industrial cogeneration plants.

- **Electrical studies of integration to the electrical grid of photovoltaic generation facilities with storage**
  Invesyde S.L. January 2019 - December 2020. (Pablo Frías Marín)

  The objective of the collaboration is to carry out a study on the impact on radial distribution networks due to the connection of photovoltaic plants with storage.

- **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 - December 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.

- **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, Stefanía Gómez Sánchez)

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

- **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.

- **New functionalities, automation and maintenance DESI Model 2020**
  Endesa Medios y Sistemas S.L. 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.

- **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, Francisco Martín Martínez, Fernando Emilio Postigo Marcos, Luca De Rosa)

  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

- **Development of the universal access to electricity strategy in Ecuador, based on a georreferenced electricity access plan**
  Inter-American Development Bank (IADB). June 2020 - June 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.

- **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.

- **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.

- **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.

- **Support in the development of electricity market models and in market studies in the Iberian market**
  Invesyde S.L. September 2020 - June 2021. (Javier Reneses Guillén, Antonio Bello Morales)

The objective of this collaboration is twofold. On the one hand, it focuses on advising on the development of electricity market models within the Iberian market (MIBEL) in the long term. On the other, the IIT supports Invesyde in long-term market studies carried out with the model.

- **Application of machine learning techniques for the study of customer and employee experience**
  Lukkap Consultants S.L. October 2020 - September 2021. (José Portela González, Antonio Muñoz San Roque)

  The objective of the proposed collaboration is the application of machine learning models to extract useful knowledge from customer experience or employee experience data.
  Different modeling strategies and different models that can be used to automatically extract the desired useful information will be identified.

- **Electricity prices in Spain: price formation and comparison with other countries**
  Fundación Naturgy. November 2020 - April 2021. (Tomás Gómez San Román, José Pablo Chaves Ávila, Nicolás Mariano Morell Dameto)

  The objective of this study is a report published by Fundación Naturgy where the electricity sector in Spain is described, the sector cost breakdown and the allocation of these costs to electricity consumers. Finally, a comparison with other European countries is included.

- **Supply of the AGC-IIT and commissioning in the Acciona SCADA system**
  Nexus energía S.A. November 2020 - September 2021. (Ignacio Egido Cortés, Luis Rouco Rodríguez)

  Nexus will participate in the secondary regulation in the Spanish power system. In order to do that, Nexus needs to include an AGC regulator in its SCADA system. This project consists in the supply to Nexus of the AGC-IIT, and the assistance to both Nexus and the SCADA provider in its integration in the system.

- **Analysis, parameter adjustment, validation and commissioning of the AGC system of Ence**
  Ence Energía y Celulosa S.A. November 2020 - May 2021. (Ignacio Egido Cortés)

  Ence uses AGC-IIT as its AGC regulator to participate in the secondary regulation in the Spanish power system. This project is focused on the increase of AGC-IIT capabilities by adding the calculation of the reserves that is done by REE

- **Position on ancillary services of Endesa in Iberia**
  Endesa Generación S.A. November 2020 - December 2020. (Luis Rouco Rodríguez, Lukas Sigrist)

This work is aimet at investigating the position on ancillary services of Endesa in Iberia in 2030.

- **4D Certification of hydrogen generation onboard systems**
  OCA Instituto de Certificación S.L.U. December 2020 - December 2020. (Pedro Sánchez Martín)

  Perform a 4D certification to determine the type of R&D&I of a project of hydrogen generation onboard systems.

- **CODEX: Renewable technologies representation improvement**
  Endesa Medios y Sistemas S.L. January 2021 - January 2021. (Efraim Centeno Hernáez, Luis Alberto Herrero Rozas)

  CODEX is a model to analyze lont-term trends in MIBEL. It allows a representation of both a hourly or states-based representation of the study horizon, a flexible representation of generation plants, includes agents competitive behaviour, secondary reserve and uncertainty of these variables. This task objective was to improve renewable energies modelling.

- **Simulation-based study to evaluate the effects of E-mobility smart charging strategies in India**
  Fraunhofer Institute for Energy Economics and Energy System Technology. January 2021 - December 2021. (Pablo Frías Marín, Tomás Gómez San Román, Manuel Pérez Bravo, Morsy Abdelkader Morsy Mohammed Nour)

  This project will conduct a detailed study based on critical global review on EV charging infrastructure, smart charging strategies, and simulation studies on selected Distribution networks in India with the main thrust on the following focus points:
  -A detailed and comprehensive global review on different smart charging strategies for EVs;
  -Structured framework for desired data collection from selected DISCOM and other relevant
  sources along with data filtering and quality check;
  -Performing concrete simulations on smart charging strategies for EVs while considering
  different scenarios/use cases with the grid data provided by the DISCOM;
  -Preparation of comprehensive and concrete guidelines for smart EV charging in India;
  -Conducting a detailed literature review on charging infrastructure and consumer response;
  -Providing a framework for short term pool of experts for ad hoc support.

- **Assistance and maintenance of tools CODEX, SIROCO and DESI**
  Endesa Medios y Sistemas S.L. January 2021 - December 2021. (Efraim Centeno Hernáez, Francisco Alberto Campos Fernández, Salvador Doménech Martínez, Enrique Lobato Miguélez)

  Assistance and maintenance of tools developed by IIT for Endesa

- **Support for the development of the CERES commercial integrated planning model**
  Pharoes Advisory S.L. January 2021 - January 2022. (Sara Lumbreras Sancho, Andrés Ramos Galán)

  PHAROES requests COMILLAS a collaboration through the provision of support services
  mathematical / computational for the development of the CERES model.

- **4D Certification of hydrogen generation onboard systems**
  OCA Instituto de Certificación S.L.U. April 2021 - May 2021. (Pedro Sánchez Martín)

  Performing a 4D certification to determine the type of R&D&I of a project of a prototype of a machine for cutting, dosifying, rolling and calibrating of sponge biscuit processed in a continuous manufacturing system.

- **Roadmap for the national strategy for the production and use of hydrogen in Colombia**
  Banco Interamericano de Desarrollo (BID). April 2021 - September 2021. (Pablo Rodilla Rodríguez, Pedro Linares Llamas, José Pablo Chaves Ávila, Timo Gerres, Sonja Wogrin, Juan José Valentín Vírseda, Paolo Mastropietro, Carlos Batlle López)

  The objective of the project is to develop the roadmap for the implementation of hydrogen in Colombia. Among other tasks, it is necessary to evaluate the competitiveness of hydrogen in Colombia, calculate the internal demand and evaluate the regulatory enablers.

- **Assessment of energy losses incentives**
  EDISTRIBUCIÓN Redes Digitales S.L. May 2021 - October 2021. (Tomás Gómez San Román, Rafael Cossent Arín, Nicolás Mariano Morell Dameto, Mauricio Correa Ramírez)

  The aim of this project is to analyze the energy losses incentive proposed in Spain in Circular 6/2019. Some improvements are proposed in the conceptual formulation and in how to apply the incentive taking into account zonal differences between distribution companies.

- **Jerusalem Citypass tram brake aignal analysis**
  Construcciones Auxiliares del Ferrocarril S.A. May 2021 - May 2021. (Carlos Rodríguez-Morcillo García)

  The objective of the project is to make a digital map of the tram control system from the emergency brake signal to the traction signal

- **Migration of the Theoretical Thermal Expenditure calculation model to a web-based software tool**
  Fundación Ecología y Desarrollo (ECODES). May 2021 - December 2021. (Eva María Arenas Pinilla, Efraim Centeno Hernáez, José Carlos Romero Mora, Roberto Barrella)

In the study "Characterization of the energy situation and behavior in the sample of households of the program «Not a single household without energy»", a computer application (DIAGNOSTIC) implemented using a local high-level language was used to determine the so-called Theoretical Thermal Expenditure, which represents the sum of the expenditure required to meet the thermal demand for heating and for the preparation of domestic hot water (DHW). This project migrates this DIAGNOSTIC application to a web platform, so that it can be used remotely, in particular by vulnerable households, volunteers and energy audit technicians. Specifically, it is integrated into the Enersoc application of the NGO ECODES and the freely accessible website of the "Not a single household without energy" project.

- **Colombia sustainable integrated electrification planning. Grid and off-grid strategies assessment**
  Massachusetts Institute of Technology (MIT), Rockefeller Foundation. July 2021 - June 2022. (Fernando de Cuadra García, Andrés González García, Rafael Palacios Hielscher, Carlos Mateo Domingo, Clara Pérez-Andújar Carretié, Santos José Díaz Pastor, José Ignacio Pérez Arriaga)

  This project is a collaboration between the MITei research team (in which the Comillas-IIT is a relevant partner) and the Rockefeller Foundation (RF) regarding the ongoing collaboration around the Global Commission to End Energy Poverty (GCEEP), and the development of a globally applicable Integrated Distribution Framework (IDF).
  The project aims to extend the electrification planning effort to the whole national territory of Colombia, providing the grounds for the Government to launch an integrated (comprising grid, mini?grids and individual standalone systems) electrification effort that will lead to the achievement of the Universal Access goal by 2030, including the communities in most isolated areas of the country. This planning strategy will also aim at assessing the main components of an integrated (grid and off?grid) sustainable framework for power supply which will allow the attraction of the necessary investments, the governance of the business?model stakeholders ecosystem, and the regulatory and energy policy provisions which will allow for the long?term supply and its future sustainable evolution.

- **4D Certification of hydrogen generation onboard systems**
  OCA Instituto de Certificación S.L.U. July 2021 - July 2021. (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 design of new hybrid rotomolding prototypes for outdoor lighting

3.2.2.2 Public funding

- **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 - November 2022. (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, Pablo Urosa Sánchez, Manuel Blanco Castillo)

  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.

- **Scaling Mini-Grid: PPP model development, technical support, data and tender management platform**

  International Finance Corporation (IFC). July 2020 - December 2020. (Rafael Palacios Hielscher, José Ignacio Pérez Arriaga, Andrés González García, Santos José Díaz Pastor)

  Objective of the assignment: develop a programmatic, replicable, partnership-driven structuring solutions to scale-up high impact, nascent mini grid markets in sub-Saharan Africa, where:
  * Programmatic: design a full IFC program, which should cover pre-development activities, making projects bankable, and IFC and other donor investment package
  * Replicable: some parts of the package should be standardized to be replicated (60-80% of the package), while some will need to be tailored to each country.
  From a country perspective:
  *Cost: if countries want in, they should agree to the package as is.
  *Benefit: reduces transaction cost for each project and increases speed of mini grid scale up,
  *Partnership-driven: allowing various stakeholders to participate in the implementation of the solution, by means of two things:
  1) Involve stakeholders in designing the solution (developers, other MDBs) to ensure that the package proposed will be financeable and that developers will want to bid on it
  2) From a PPP angle: leverage private financing for MGs while using public sector to de-risk the project and crowd-in private finance (in line with MFD approach)
  Structuring solutions : turnkey solutions /all-encompassing for the Governments to develop a mini grid program (not turnkey solutions to develop mini grids)
  *PPP model that includes:
  – Regulatory framework (set of rules on tariffs, entry, grid encroachment, etc…, which will be standard although the way of implementing them will vary)
  – Allocation of responsibilities and risks (defining where in the PPP spectrum to allocate design, construction, financing, operations and ownership)
  – Risk mitigation tools (with special focus on demand, regulatory and currency risk)
  – Financing structure: grants/concessional financing, and IFC financing
  *Procurement model / bid award criteria
  *Standardized approach to define sites/packages of sites to be electrified by mini grids
  – High-impact and nascent markets: IFC will start implementing this in markets they have identified as ready to pick up MG development
  – Africa: region with the largest potential given current electrification rates. Potential to replicate program to other regions in the future.

- **Improving energy system modelling tools and capacity**

  Comisión Europea. October 2020 - June 2022. (Sara Lumbreras Sancho, Andrés Ramos Galán, Pedro Linares Llamas, Manuel Pérez Bravo, Antonio Francisco Rodríguez Matas, José Carlos Romero Mora, Rodrigo Camarillo Ramos)

The project improve the description of the Spanish energy system in model TIMES-SINERGIA, from the technologies consiered or a higher time resolution to the detailed modeling of the power sector, such as the inclusion of transmission constraints.

- **Mechanical characterization of composite superconducting wires**
  Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT). October 2020 - October 2020. (Juan Carlos del Real Romero)
  Mechanical characterization of composite superconducting wires

- **Protecting children in crashes through the investigation of the material and structural properties of developing tissue (EIN2020-112448)**
  MCIN/AEI /10.13039/501100011033 y por la Unión Europea NextGenerationEU/ PRTR. November 2020 - October 2022. (Francisco José López Valdés)
  PROCHILD is a proposal submitted to the EUROPA INVESTIGACION 2020 of the PROGRAMA ESTATAL DE I+D+I ORIENTADA A LOS RETOS SOCIALES. The goal of the proposal is to obtain funding to establish a collaborative network with several Spanish and international institutions to prepare a successful proposal to the European Research Council Consolidator Grants (ERC CoG) call for projects of the program HORIZON EUROPE.
  The ERC CoG proposal will address the global problem of infant injuries due to motor vehicle (MV) crashes. Unintentional injuries, and particularly motor vehicle injuries, are the leading cause of death, serious injury and acquired disability for children and youth between 1 and 14 years of age. In addition, for every fatality, around 18 children are hospitalized and over 400 hundred receive medical treatment. The ultimate goal of the ERC CoG proposal is to eliminate fatal, severe and severely incapacitating injuries caused by road traffic to children and adolescents worldwide. To that end, the specific objective of the proposal is to investigate on the most appropriate constitutive models of developing human musculoskeletal tissue so that detailed finite element models of children are biofidelic and can predict tissue failure. Then, the project will also seek how to implement these models into testing standards and regulations that can be easily adopted by low- and middle- income countries. Indeed, the cost of testing equipment and large testing facilities is a barrier for these countries to implement effective programs to assess the safety of vehicles and vehicle components. But thinking only in the so-called passive safety of children would be to look at one piece of the picture, especially with the advent of more automated cars. This international projection of the results to be obtained within the ERC CoG project is why we consider a need to meet with international experts working on the field of automated vehicles to identify how these features can also help not only in well-established high-income countries, but also in others that are struggling to have a safe and sustainable transport system and cannot afford the toll on young human lives that suboptimal vehicles may impose in their populations. To this end, the current proposal will dedicate funds to establish meetings with those responsible of international testing and regulatory programs such as EuroNCAP and the United Nations.

As for the scientific contribution of the proposal, the approach of the ERC CoG project to the prevention of pediatric injury is novel because it presents a comprehensive research methodology to analyze changes of tissue mechanical properties with age by linking age to microstructural tissue changes and it is the first robust attempt of developing probabilistic tissue injury criteria based on strain predictions of human FE models. In addition, the proposal will advance existing knowledge on pediatric injuries by approaching them from a multidimensional perspective including not only risk to life but also aspects of disability and treatment costs.
Thus, PROCHILD also seeks to establish close collaborations with relevant national research groups such as the School of Medicine of the Universidad San Pablo CEU and the IQS at Universidad Ramon Llull, both well known for their expertise in biomechanical and post-mortem studies and in material testing and characterization.

Grant EIN2020-112448 funded by MCIN/AEI/ 10.13039/501100011033 and by the European Union NextGenerationEU/PRTR.

- **White Paper supporting the institutional and regulatory modernization of the Peruvian sector. Pillar 3- innovation in distribution and retail**
  World Bank. January 2021 - June 2021. (Pablo Rodilla Rodríguez, Tomás Gómez San Román, Rafael Cossent Arín, Paolo Mastropietro)

  Innovation in distribution and retail in Peru. The challenges posed by the incorporation of renewable energies and other distributed resources, the improvement of service quality and the expansion of coverage make it necessary to identify and develop a new model of economic regulation for electricity distribution, as well as the redesign of the Peruvian retail market, the independent development of the commercialization (supply) activity, and the potential active role of costumers/consumers as prosumers.

- **Elaboration of a technical annex for a law on the use of biometric systems for public security**
  Gobierno del Principado de Andorra. February 2021 - May 2021. (Jaime Boal Martín-Larrauri, Rafael Palacios Hielscher)

  Development of a technical document that establishes the quality, resolution, and usage requirements that a biometric system must meet in order to be used for authentication, identification, and automatic detection of people. The study includes fingerprint reading, iris recognition, and facial recognition systems.

- **Least cost electrification study and mini-grid portfolio readiness assessment for Pakistan**

  World Bank. June 2021 - March 2022. (Rafael Palacios Hielscher, Andrés González García, José Ignacio Pérez Arriaga, Santos José Díaz Pastor, Genérico Proyectista Ief)

  The Government of Pakistan adopted sustainable development goals (SDGs) in February 2016. As a part of SDGs, the government has targeted universal energy access by 2030. This project aims to analyze both grid extension and off-grid systems as a potential solution for providing energy access to unelectrified population, allowing to electrify 32 million households.

  The World Bank (WB) is supporting Pakistan's energy sector through "Pakistan Sustainable Energy Program" which includes this project to assist the Government in identifying solutions to achieve universal energy access in Pakistan.

  The organizations involved in this project will use the Reference Electrification Model (REM) and the Village Data Analytics (VIDA) for the LCES and mini-grid portfolio assessment respectively. The chosen model and analytical tool have been successfully used for similar activities worldwide.

  The Least-Cost Electrification Study (LCES) shall include:

  (i) Geospatial analysis (grid and off-grid) - The detailed geospatial analysis will consider, based on good practice and international experience, possible least-cost options for electrification, provide a sound strategic basis to implement systematically staged grid extensions and the deployment of off-grid technologies (mini-grids and standalone systems) powered by cost-effective renewable energy solutions where appropriate.

  (ii) Recommendations for implementation – Recommendations on policies, actions and investments needed to achieve the goal of universal electricity access by 2030, including proposed intermediate targets, corresponding investment financing frameworks, an action plan to address the enabling policy and institutional framework, and capacity strengthening initiatives for key sector institutions and agencies involved.

  The Mini-Grid Portfolio Assessment shall support mini-grid pipeline development to assist the World Bank in conducting its due diligence on a potential mini-grid investment operation and provide useful evidence and data to sector agencies and stakeholders.

- **Studies on the design options for the electricity market in Mexico**

  Agence Française de Développement (AFD). July 2021 - December 2021. (Pablo Rodilla Rodríguez, Carlos Batlle López, Paolo Mastropietro)

  The objective of this project is to carry out a diagnosis of the electricity market design in Mexico and propose improvements to enhance its efficiency. The proposed design should focus on minimizing the costs of integrating renewable energies.

3.2.3 Services and analysis projects

3.2.3.1 Private funding

- **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, 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, HADES and MODEM developed by IIT.

- **Support in the process of creating closed distribution networks in large industrial sites**
  Asociación Empresarial Química de Tarragona (AEQT). October 2020 - December 2020. (Rafael Cossent Arín, Pablo Rodilla Rodríguez, Paulo Brito Pereira, Tomás Gómez San Román)

  The objective of the proposed collaboration is to support the process of creating closed distribution networks in the industrial sites AEQT.
  The report will describe the current configuration of the networks and the consumption of the different participants, as well as the corresponding payments for network and other regulated electricity charges.

- **Technical support for the tools DECA, HADES and MODEM**
  Endesa Medios y Sistemas S.L. January 2021 - December 2021. (Eugenio Francisco Sánchez Úbeda, José Portela González)

  The objective of this project is to provide ENDESA with technical support and maintenance of the tools DECA, HADES and MODEM developed by IIT.

- **Analysis of how undergrounding the electric line of a wind farm impacts on its profitability**
  Villar Mir Energía. April 2021 - April 2021. (Javier Reneses Guillén)

  The objective of this project is to carry out an analysis of how undergrounding the electric line of a wind farm impacts on the profitability and viability of the project.

- **Suplementary report about the hydro power plant management in an electric system**
  Iberdrola Clientes España S.A.U. June 2021 - June 2021. (Andrés Ramos Galán)

  Summarized and descriptive suplementary report about the hydro power plant management in an electric system and, specifically, the impact of the uncertainty in its natural inflows' management decisions.

3.2.3.2 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, María Belén Sánchez Alfayate)

  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.

- **Renewal of the methodology for the network charges and tariff system**

  Elektroinštitut Milan Vidmar inštitut za elektrogospodarstvo in Elektroindustrijo (EIMV). January 2021 - August 2021. (José Pablo Chaves Ávila, Tomás Gómez San Román, Nicolás Mariano Morell Dameto)

  This project intends to improve and completely overhaul the electricity tariff system in the Republic of Slovenia. The proposed tariffs must take into account the new active role of the customer to increase the efficiency of the billing methodology.
  The new tariff system must weight regulatory principles and other key aspects such as investment deferral, effective customer responsiveness, the gradual implementation of the proposed solutions and identification of the side effects of tariff elements. The tariffs must consider the normative requirements national strategy documents and other strategies and guidelines, such as the Slovenian Energy Act, the Clean Energy for All Europeans (CEP) and the Network Charge Act. This project analyses the best practices in the EU with an assessment of CEP compliance and applicability in Slovenia. The project quantifies the proposes tariffs including the formulation of data requests, the acquisition of data and their processing.

3.3 Publications

3.3.1 Books

- T. Gómez, *"El sector eléctrico, pieza clave en la transición energética. Lección inaugural del curso académico 2020/2021".* Publisher: Universidad Pontificia Comillas. ISBN: 978-84-8468-846-4. October 2020.

- A. Sendín, J. Matanza, R. Ferrús, *"Smart grid telecommunications".* Publisher: Wiley-IEEE Press. ISBN: 978-1-119-75537-1. August 2021.

3.3.2 Chapters in books

- F.M. Echavarren, L. Sigrist, *"Stability considerations for transmission system planning".* Chapter in the book "Transmission expansion planning: the network challenges of the energy transition". Editors: Lumbreras Sancho, Sara; Abdi, Hamdi; Ramos Galán, Andrés. Publisher: Springer. Pp. 201-248. ISBN: 978-3-030-49427-8. November 2020.

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- P. Frías, C. Miguel Perales, *"Environmental aspects of the electric vehicle".* Chapter in the book "The role of the electric vehicle in the energy transition. A multidimensional approach. Green Energy and Technology". Editors: Arcos-Vargas, A. Publisher: Springer. Pp. 93-108. ISBN: 978-3-030-50632-2. September 2020.

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- A. Ortega, F. Milano, *"Frequency definition and estimation in modern power systems".* Chapter in the book "Converter-based dynamics and control of modern power systems". Publisher: Academic Press. Pp. 125-147. ISBN: 978-0-12-818491-2. October 2020.

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3.3.3 Publications in journals

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3.3.5 IIT technical documents

This section includes both technical reports prepared for companies and institutions in the framework of research projects that are usually confidential documents, as well as working papers that have been registered.

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- I.J. Pérez-Arriaga, R.J. Stoner, *"Abuja electric's proposed sub-franchising model: DESSA".* December 2020. Ref: IIT-20-175A.

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- T. Gerres, J. Lehne, G. Mete, S. Schenk, C. Swalec, *"Green steel production: how G7 countries can help change the global landscape".* Technical report in European Climate Foundation (ECF). June 2021.

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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

- *Aplicación de técnicas de procesamiento de imágenes y deep learning para la extracción automática de información de planos de ingeniería*
  García Torres, Alejandro Alberto. Supervised by José Portela González.

- *Optimización con material de impresión 3D de un sensor dieléctrico para la caracterización de líquidos con aplicación en la biomedicina*
  Martínez Valledor, Lara. Supervised by Javier Matanza Domingo.

- *Sensitivity analysis of the CNN learning process using synthetic images*
  España Novillo, Irene. Supervised by Jaime Boal Martín-Larrauri.

4.1.2 Bachelor's Degree in Engineering for Industrial Technologies

- *A cleaner and more sustainable alternative for cooking in developing countries*
  Rigardo de la Dehesa, Adrián. Supervised by Pablo Ayala Santamaría.

- *Análisis de la importancia de la estimación del límite superior de potencia de la generación eólica para su participación en el servicio de regulación secundaria*
  Doménech Patón, Jorge. Supervised by Ignacio Egido Cortés, Kai Niclas Doenges .

- *Análisis del potencial para la participación de la generación eólica en el servicio de regulación secundaria*
  Valcarce Barbosa, Alejandro. Supervised by Ignacio Egido Cortés, Kai Niclas Doenges .

- *Analysis of the economic dispatch of island electricity systems with safety and operational stability criteria*
  Fuente Pascual, Delia. Supervised by Lukas Sigrist .

- *Desarrollo de un sistema de seguridad por control de velocidad y separación de un robot industrial basado en LiDAR*
  Pascual Rubio, Ana. Supervised by Jaime Boal Martín-Larrauri.

- *Descarbonización del sistema eléctrico de Melilla mediante generación solar fotovoltaica*
  Arcos Presedo, María Eugenia. Supervised by Pablo Frías Marín.

- *Despacho económico en sistemas eléctricos insulares*
  Guasch Albareda, Jordi. Supervised by Lukas Sigrist .

- *Ecodiseño de una pala de pádel para reducir su impacto ambiental*
  Serrano Quiñones, Millán. Supervised by Eva Paz Jiménez.

- *Energy-environmental impact assessment of food loss and food waste in Spain*
  González Felipe, Raquel. Supervised by José Carlos Romero Mora.

- *Fabricación de ecofilamento con lignina para impresión 3D*
  Álvarez Fernández, Jaime. Supervised by Eva Paz Jiménez, Sara López de Armentia Hernández.

- *Impacto de la economía del hidrógeno en el sector eléctrico*
  Barceló Álvarez, Alejandra María. Supervised by Francisco Alberto Campos Fernández, Salvador Doménech Martínez.

- *Modelado de predictores no lineales en la detección del punto de colapso de tensiones mediante técnicas de continuación*
  Sánchez Montiel, Eva María. Supervised by Francisco Echavarren Cerezo.

- *Modelado del comportamiento de un agregador de demanda en la toma de decisiones de inversión en generación distribuida mediante teoría de juegos cooperativos*
  García Blanco, Javier. Supervised by Francisco Alberto Campos Fernández, Salvador Doménech Martínez.

- *Modelo de optimización de la operación de los almacenes del Banco de Alimentos de Madrid*
  Cerezo de Osma, Guillermo. Supervised by Francisco Alberto Campos Fernández, Salvador Doménech Martínez.

- *Modelo matemático de tarifas eléctricas para recuperación de costes de red: comparativa entre el planteamiento binivel y mononivel*
  Aranguren Alonso, Alejandra. Supervised by Francisco Alberto Campos Fernández, Salvador Doménech Martínez.

- *Módulo para el análisis de la rentabilidad de las tecnologías de generación para el modelo de mercado CEVESA*
  Guerrero Rodríguez, Juncal. Supervised by Francisco Alberto Campos Fernández, Salvador Doménech Martínez.

- *Optimización bajo incertidumbre de la red eléctrica de tracción ferroviaria*
  Domínguez Larre, Teresa. Supervised by David Roch Dupré.

- *Simulación de incendios con modelos multicapa-zonal*
  Manrique Bautista, Íñigo. Supervised by Pablo Ayala Santamaría.

- *Sistema de picking de palés para un robot industrial equipado con una cámara RGB-D*
  Güitta López, Lionel. Supervised by Jaime Boal Martín-Larrauri.

4.1.3 Bachelor's Degree in Engineering in Telecommunications Technologies

- *Análisis y evaluación del circuito generador de números aleatorios LAMPERT CIRCUIT*
  Rodríguez García, Alejandro. Supervised by Javier Matanza Domingo.

- *Implementación de técnicas mejoradas de comunicaciones digitales aplicadas a docencia*
  Novales Peleato, Lucas Francisco. 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, Sonja Wogrin

- *Internship*
  Luis Olmos Camacho

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

- *Master's thesis*
  Luis Olmos Camacho

- *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

- *Control, supervisión y digitalización*
  José Antonio Rodríguez Mondéjar

- *Diseño de la operación del tráfico*
  Asunción Paloma Cucala García, Antonio Fernández Cardador, Adrián Fernández Rodríguez

- *Electrificación*
  Luis Rouco Rodríguez

- *Normativa ERTMS Y RAMS*
  Adrián Fernández Rodríguez

- *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 MBA in the Global Energy Industry

Director: Andrés Ramos

- *Análisis de Datos*
  Andrés Ramos Galán

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, Sonja Wogrin

- *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

- *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)

- *Fundamentals of Power Systems*
  Ignacio Egido Cortés

- *Internship and Master Thesis*
  Javier Matanza Domingo

- *Master Thesis*
  Javier Matanza Domingo

- *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, Rafael Cossent Arín, Francisco Miguel Echavarren Cerezo, Javier Matanza Domingo, Carlos Mateo Domingo, Francisco Javier Renedo Anglada, Lukas Sigrist

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

- *Regulación y Nuevos Modelos de Negocio*
  Paolo Mastropietro, Pablo Rodilla Rodríguez

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

- *Telecommunications for Smart Grids*
  Javier Matanza Domingo

4.2.1.7 Master in smart agricultural industry and sustainability

More information at
https://inea.edu.es/formacion/master-en-agroindustria-conectada-y-sostenibilidad/

- *Automation and IoT: sensors, communication, and robotics*
  Carlos Rodríguez-Morcillo García

4.2.2 Graduate theses supervised at IIT

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

- *Análisis de imágenes RGB-D por Visión Artificial para el agarre de piezas industriales*
  Horcajo de la Cruz, Daniel. Supervised by Álvaro Jesús López López, Ignacio de Rodrigo Tobías.

- *ANÁLISIS DE LA INFLUENCIA DE LOS FACTORES CLIMÁTICOS EN EL CONSUMO DE ENERGÍA Y EL TIEMPO DE RECORRIDO DE UN TREN DE ALTA VELOCIDAD*
  Pallarés Fernández-Bujarrabal, Antonio Andrés. Supervised by Adrián Fernández Rodríguez.

- *Análisis de la ruta de descarbonización del sector servicios en España en 2030 y 2050*
  Cualladó Diges, Juan. Supervised by José Carlos Romero Mora.

- *Análisis de redes en finanzas*
  Sagaz Spottorno, Íñigo. Supervised by Sara Lumbreras Sancho.

- *Análisis de viabilidad técnico-económica de la bomba de calor aerotérmica accionada mediante gas natural para viviendas en bloque como medida activa contra la pobreza energética*
  Izaguirre de Benito, Álvaro Josu. Supervised by Roberto Barrella .

- *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.

- *Analysis and implementation of Optimal Power Flow (OPF) tool for grid operation and planning under future potential flexibility scenarios- Application to i-DE network.*
  Noreña Alcalá-Galiano, Ricardo. Supervised by Jose Pablo Chaves Ávila.

- *Analysis of the deployment of PRIME 1.4 meters in an interoperable field environment for 15,000 meters*
  Villasante Martín, Borja. Supervised by Javier Matanza Domingo.

- *AUTOMATIZACIÓN DE LAS REDES INTELIGENTES*
  Martín Langa, Guillermo. Supervised by Rafael Cossent Arín.

- *Caracterización de la pobreza energética oculta en España mediante la implementación de un novedoso indicador basado en el gasto energético teórico de los hogares*
  Asín Portell, María. Supervised by José Carlos Romero Mora, Roberto Barrella .

- *Caravaca II: Islands with energy storage: Inrush Current*
  Tejero Calvo, Gonzalo. Supervised by Lukas Sigrist .

- *Control de convertidores VSC grid forming para aplicaciones en microrredes*
  Morillo-Velarde Moraleda, Alejandro. Supervised by Francisco Javier Renedo Anglada.

- *DISEÑO DE UNA INSTALACIÓN DE AUTOCONSUMO COLECTIVO SOLAR EN UNA COMUNIDAD DE VECINOS EN MADRID*
  Arredondo Bonilla, Dionisio. Supervised by Jose Pablo Chaves Ávila.

- *Ergodicidad en la valoración de activos de capital*
  Herranz Ramos, Juan Carlos. Supervised by Sara Lumbreras Sancho.

- *Estrategia de electrificación para una flota de vehículos de transporte de dinero en efectivo*
  Laguna Núñez, Javier. Supervised by Pablo Frías Marín.

- *Estudio de composites basados en grafeno aplicados a la biotecnología*
  Martínez Cruz, Roberto. Supervised by Eva Paz Jiménez.

- *Evaluación de la sostenibilidad de mixes de generación eléctrica de diferentes países mediante análisis de ciclo de vida*
  Goas Martín, Jorge. Supervised by Carlos Martín Sastre.

- *Fabricación bajo demanda por extrusión de filamento a medida para impresión 3D por FDM de componentes mecánicos de alta resistencia*
  Guerrero Duque, Jaime. Supervised by Eva Paz Jiménez.

- *Fabricación de estructuras reforzadas con grafeno mediante impresión 3D para aplicaciones biomédicas.*
  Hernández Blanco, Sergio. Supervised by Eva Paz Jiménez, Sara López de Armentia Hernández.

- *Formulación del despacho económico como un control predictivo (MPC) para un sistema insular con alta penetración renovable*
  Cuartero García, Arturo. Supervised by Lukas Sigrist .

- *Generación de escenarios de energía solar en mercados eléctricos considerando dependencias espacio temporales*
  Benito Adrados, Diego. Supervised by Antonio Bello Morales, Geovanny Alberto Marulanda García.

- *Identificación de acciones en formato vídeo con un modelo de red Convolucional 2D + LSTM*
  Navarro Velasco, Luis. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Identificación de acciones en formato video con un modelo de redes convolucionales 3D (3DCNN)*
  Castillo Rodríguez, Alberto. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Implantación de una solución de pick and place en un robot industrial utilizando un sistema de visión artificial basado en redes convolucionales*
  Sánchez de Pedro Rada, Daniel. Supervised by Jaime Boal Martín-Larrauri.

- *Implementation of a Balancing Platform in Spain using Electric Vehicles and managed through a digital platform developed with Blockchain technology*
  García-Mina Peñaranda, Julio Canuto. Supervised by Jose Pablo Chaves Ávila.

- *Implementation of a RPA making use of artificial intelligence within the STG Web flow chart*
  Burgos Rastoll, Angel. Supervised by Javier Matanza Domingo.

- *Mejora de sistemas de alarma y video vigilancia mediante la incorporación de análisis de audio*
  Menéndez Ruiz de Azúa, Alberto. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *MODELADO DE LA MARCHA Y DEL CONSUMO DE TRENES METROPOLITANOS DE CONDUCCIÓN AUTOMÁTICA MEDIANTE TÉCNICAS DE MACHINE LEARNING*
  Rodríguez Pita, Sofía. Supervised by Adrián Fernández Rodríguez.

- *Modelado del equilibrio en un mercado P2P local de energía*
  Lorenzo García, Cristina de. Supervised by Francisco Alberto Campos Fernández, Salvador Doménech Martínez.

- *Monitorización inteligente y análisis de aprendizaje no supervisado aplicados sobre variables de la red eléctrica*
  García Domínguez, Andrés. Supervised by Álvaro Jesús López López.

- *Plataforma Industria 4.0 a Escala para los Fondos Next Generation*
  Navarro Villacieros, Aurora. Supervised by Álvaro Jesús López López.

- *Simulación en tiempo real de actuación de protecciones de línea en sistemaseléctricos con elevada penetración de generación conectada a través de inversores*
  Yusta Fernández, Cristina. Supervised by Álvaro Ortega Manjavacas.

- *The future costs of offshore wind: an estimation based on auction results.*
  Rubio Domingo, María Gabriela. Supervised by Pedro Linares Llamas.

- *Unit Committment Interpretable*
  Elechiguerra Batlle, Daniel. Supervised by Sara Lumbreras Sancho.

- *What will be the role of hydrogen in the Spanish energy mix? A modelling approach for the 2050 horizon.*
  Galdós Ispizua, Marta. Supervised by José Carlos Romero Mora, Timo Gerres .

- *Wikicai?s Business Case and Study of the Digital Note-sharing Spanish Market*
  Dueñas Llera, Francisco. Supervised by Álvaro Jesús López López.

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

- *Aplicación de técnicas de procesamiento de imágenes y deep learning para la extracción automática de información de planos de ingeniería*
  García Torres, Alejandro Alberto. Supervised by José Portela González.

- *Desarrollo y análisis de ingeniería para la migración de una herramienta software de red en una empresa internacional*
  Panasik Grishin, Daniil. Supervised by Javier Matanza Domingo.

- *Monitorización de la distancia interpersonal mediante visión artificial y aprendizaje profundo*
  López de Toledo Soler, Rodrigo. Supervised by Álvaro Jesús López López, Jaime Boal Martín-Larrauri.

- *Optimización con material de impresión 3D de un sensor dieléctrico para la caracterización de líquidos con aplicación en la biomedicina*
  Martínez Valledor, Lara. Supervised by Javier Matanza Domingo.

- *Sensitivity analysis of the CNN learning process using synthetic images*
  España Novillo, Irene. Supervised by Jaime Boal Martín-Larrauri.

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

- *Assesing the value of energy storage in future energy grids: a techno-economic study*
  Niño Serrano, Marta. Supervised by Sonja Wogrin .

- *Electrification of Rural Communities in the Department of Yoro - Honduras*
  Hernández Yanguas, Carmen. Supervised by Andrés González García.

- *Evaluation of distribution network charges designs in the Context of Decarbonization, Digitalization, and Decentralization*
  Miguel Peña, David de. Supervised by Jose Pablo Chaves Ávila, Nicolás Morell Dameto.

- *Impact of the new access and connection to distribution networks regulation in the Spanish electricity system*
  Cuenca García, Héctor. Supervised by Rafael Cossent Arín.

- *Taking advantage of Artificial Neural Networks for the Unit Commitment problem resolution*
  Florez Montes, Manuel. Supervised by Pedro de Otaola Arca.

4.2.2.4 Master in Railway Systems

- *Modelado borroso de la incertidumbre en la intensidad del viento y su influencia en la conducción de un tren de alta velocidad*
  Pallarés Fernández-Bujarrabal, Antonio Andrés. Supervised by Adrián Fernández Rodríguez.

4.2.2.5 Master's Degree in Smart Industry (MIC)

- *Análisis de imágenes RGB-D por Visión Artificial para el agarre de piezas industriales*
  Horcajo de la Cruz, Daniel. Supervised by Álvaro Jesús López López, Ignacio de Rodrigo Tobías.

- *Identificación de acciones en formato vídeo con un modelo de red Convolucional 2D + LSTM*
  Navarro Velasco, Luis. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Identificación de acciones en formato video con un modelo de redes convolucionales 3D (3DCNN)*
  Castillo Rodríguez, Alberto. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Mejora de sistemas de alarma y video vigilancia mediante la incorporación de análisis de audio*
  Menéndez Ruiz de Azúa, Alberto. Supervised by Álvaro Jesús López López, Lucía Güitta López.

- *Monitorización inteligente y análisis de aprendizaje no supervisado aplicados sobre variables de la red eléctrica*
  García Domínguez, Andrés. Supervised by Álvaro Jesús López López.

- *Wikicai?s Business Case and Study of the Digital Note-sharing Spanish Market*
  Dueñas Llera, Francisco. Supervised by Álvaro Jesús López López.

4.2.2.6 Master's Degree in Smart Grids (MSG)

- *Analysis and implementation of Optimal Power Flow (OPF) tool for grid operation and planning under future potential flexibility scenarios- Application to i-DE network*
  Noreña Alcalá-Galiano, Ricardo. Supervised by Jose Pablo Chaves Ávila.

- *Analysis and preparation of the deployment of PRIME 1.4 smart meters in an interoperable field environments for 15,000 meters*
  Villasante Martín, Borja. Supervised by Javier Matanza Domingo.

- *Assessment and Proposal of the Evolution of Operational Information Structures for Telecommunications Physical and Logical Networks and Services*
  Encinas del Río, Daniel. Supervised by Javier Matanza Domingo.

- *Caravaca II: Islands with energy storage: Synchronization and Inrush Current*
  Tejero Calvo, Gonzalo. Supervised by Lukas Sigrist .

- *Implementation of a RPA making use of artificial intelligence within the STG Web flow chart.*
  Burgos Rastoll, Angel. Supervised by Javier Matanza Domingo.

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.

- *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: *Contributions to the improvement of capacity in urban railway lines*
  Author: Luis Miguel Navarro Rodríguez
  Supervisors: Antonio Fernández Cardador and Asunción Paloma Cucala García
  Date: September 04, 2020

- Title: *Short -term forecasting of electricit y prices: a hybrid methodolog y based on fundamental and statistical analysis*
  Author: Rodrigo Alejandro de Marcos Peirotén
  Supervisors: Javier Reneses Guillén and Antonio Bello Morales
  Date: October 02, 2020

- Title: *Steady-state analysis of multiterminal VSC AC/DC power systems*
  Author: José Carlos Fernández Pérez
  Supervisors: Francisco Miguel Echavarren Cerezo and Luis Rouco Rodríguez
  Date: March 05, 2021

- Title: *The rural electrification planning problem: strategies and solutions*
  Author: Pedro Ciller Cutillas
  Supervisors: Sara Lumbreras Sancho and José Ignacio Pérez Arriaga
  Date: April 07, 2021

- Title: *Pro-environmental behavior: the role of mindfulness in socioemotional and volitional competences*
  Author: Ana Gómez Olmedo
  Supervisors: Isabel Carrero Bosch and Carmen Valor Martínez
  Date: July 08, 2021

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: *Building synthetic distribution networks in US and EU: Algorithms and applications to new planning approaches*
  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 Description texts of protocol Behaviour*
  Author: Sonia León del Rosario
  Supervisor: José Antonio Rodríguez Mondéjar

- Title: *Market aproach to esg?*
  Author: Paraskevas Paraskevas Kamforidou
  Supervisors: Isabel Catalina Figuerola-Ferreti Garrigues and Sara Lumbreras Sancho

- Title: *Multi-area electricity market modeling using Intelligent data Techiniques and an Advanced Temporal Framework*
  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: *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: *Multi-region probabilistic electric load forecasting using coherent temperature scenarios*
  Author: Santiago Moreno Carbonell
  Supervisors: Eugenio Francisco Sánchez Úbeda and Antonio Muñoz San Roque

- 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
  Supervisor: Antonio Bello Morales

- Title: *Modelling and Optimizing the behavior of distributed agents in decentralized power systems by Reinforcement Learming techniques*
  Author: David Domínguez Barbero
  Supervisors: Javier García González and Miguel Ángel Sanz Bobi

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

- Title: *Research status report: The intentionality in impact funds: how to measure it and effects on impact perfomance*
  Author: Olga de Bergé Pineo
  Supervisors: José Luis Fernández Fernández and Elisa María Aracil Fernández

- Title: *THE FACTORS FOR SUSTAINABLE BRAND EXTENSION SUCCESS*
  Author: María Luisa Hernández Olalla
  Supervisor: Carmen Valor Martínez

- Title: *Highly sensitive Metamaterial-Inspired Microwave Sensors for Liquid Dielectric Characterization*
  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: *Novel approaches for condition monitoring and dimensioning of high-voltage insulators*
  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 Machanisms to provide DSO flexibility services*
  Author: Fernando David Martín Utrilla
  Supervisors: Rafael Cossent Arín and José Pablo Chaves Ávila

- Title: *Dealing with Uncertainty in Energy Planning: Robust Optimization for Energy Models*
  Author: Antonio Francisco Rodríguez Matas
  Supervisors: Pedro Linares Llamas and José Carlos Romero Mora

- Title: *Mejoras en el control secundario de microrredes con sistemas de batería*
  Author: Diana Patricia Morán Río
  Supervisor: Aurelio García Cerrada

- Title: *A bilevel model for the long-term evolution of the power sector considering optimal*
  Author: Salvador Doménech Martínez
  Supervisor: Francisco Alberto Campos Fernández

- Title: *Operación de sistemas insulares con alta penetración de energías Renovables*
  Author: Mohammad Rajabdorri
  Supervisors: Enrique Lobato Miguélez and Lukas Sigrist

- Title: *Influence of Education on East African Women`s Entrepreneurial Innovation Practices*
  Author: Grace Akullo
  Supervisor: Elisa María Aracil Fernández

- Title: *The adoption of new circular business models by SMEs: the role of the management team in Spanish SMEs*
  Author: Nuria Fernandez Muñiz
  Supervisor: Elisa María Aracil Fernández

- Title: *Access Based Services Customer misbehaviour and value co-creation in carshaning explained through the lens of academic theories in social sciences. Evidence from the data*
  Author: Andres Camacho Donézar
  Supervisors: Carmen Valor Martínez and José Portela González

- Title: *Are you sustainable product? Consumer´s and practitioner´s categorization of sustainable products*
  Author: María Aranzazu Larrañaga Muguerza
  Supervisor: Carmen Valor Martínez

- Title: *Dideño de tarifas eléctricas en un entorno de descarbonización, descentralización y digitalización de los sistemas eléctricos*
  Author: Nicolás Mariano Morell Dameto
  Supervisors: Tomás Gómez San Román and José Pablo Chaves Ávila

- Title: *Interaction between DSO and third-party flexibility resources in the operation of distribution grids*
  Author: Orlando Mauricio Valarezo Rivera
  Supervisors: Tomás Gómez San Román and José Pablo Chaves Ávila

- Title: *Development of Nanomaterial based Scaffolds for Bone Tissue Regeneration*
  Author: Sara López de Armentia Hernández
  Supervisor: Eva Paz Jiménez

- Title: *Risk assessment and modeling of human behavior through games and AI*
  Author: Jaime Pérez Sánchez
  Supervisors: Gregorio Ignacio López López and Mario Castro Ponce

- Title: *El comportamiento, los conflictos de tráfico y los factores asociados con la accidentalidad de los motociclistas en las intersecciones de las vías de Cartagena*
  Author: Holman Ospina Mateus
  Supervisor: Francisco José López Valdés

- Title: *Robust control of electric power systems with important share of electronic generation*
  Author: Javier García Aguilar
  Supervisors: Juan Luis Zamora Macho and Aurelio García Cerrada

- Title: *The impact of explicit demand flexibility for generation investment planning and operationof the future electric system*
  Author: Teresa Freire Barceló
  Supervisors: Álvaro Sánchez Miralles and Francisco Martín Martínez

- Title: *Improving medium-term models to deal with the low-carbon reality of modern power systems*
  Author: Luis Manuel Montero Guirao
  Supervisors: Juan Miguel Ferrer Grenesche and Antonio Bello Morales

- Title: *Planning and assessment of the impact of distribution networks interconnection in urban districts with high deployment of flexible distributed energy resources.*
  Author: Luca de Rosa
  Supervisors: Tomás Gómez San Román and Carlos Mateo Domingo

- Title: *Detección de Ciberataques mediante algoritmos de aprendizaje y clasificación en al matriz de MITRE ATT&CK*
  Author: Antonio Pérez Sánchez
  Supervisor: Rafael Palacios Hielscher

- Title: *Cryogenic Supply System with Magnetic Refrigeration Stage*
  Author: Carlos José Hernando López de Toledo
  Supervisor: Juan Carlos del Real Romero

- Title: *Improving the representation of the transport sector within energy models*
  Author: Manuel Pérez Bravo
  Supervisors: Pedro Linares Llamas and Pablo Frías Marín

- Title: *Regulation of Flexibility in Electricity Distribution Networks*
  Author: Mauricio Correa Ramirez
  Supervisors: Tomás Gómez San Román and Rafael Cossent Arín

- Title: *Coordination between Generation and Transission expasion planning in a liberalized electricoty context, and the use os fte of FTRs as a coordination tool*
  Author: Stefania Gómez Sánchez
  Supervisor: Luis Olmos Camacho

- Title: *DC segmentation of power system*
  Author: Mathieu Guillaume Robin
  Supervisors: Francisco Javier Renedo Anglada and Aurelio García Cerrada

- Title: *Desarrollo y aplicación real de un indicador de degradación de un sistema BESS operando en regulación*
  Author: Jose Ignacio Alvarez-Monteserin Garcia
  Supervisor: Miguel Ángel Sanz Bobi

- Title: *Explainable Machine Learning applied to predictive Maintenance*
  Author: Jaime Pizarroso Gonzalo
  Supervisors: José Portela González and Antonio Muñoz San Roque

- Title: *Multi-agent secondary control of microgrids*
  Author: Andrés Tomás Martín
  Supervisors: Aurelio García Cerrada and Lukas Sigrist

- Title: *The impact of bike-sharing systems in urban mobility : the BiciMad casa*
  Author: Carlos Miguel Vallez Fernández
  Supervisors: Mario Castro Ponce and David Contreras Bárcena

- Title: *Injury risk assessment through the combination of metdmodels and baseline human body models*
  Author: Manuel Valdano
  Supervisor: Francisco José López Valdés

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

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

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

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

- Title: *A Blockchain Proof-of-Concept for managing medical records of refugees*
  Author: Sara Noureldin
  Supervisors: Mercedes Fernández García and David Contreras Bárcena

5.4.3 Submitted theses in other universities

- Title: *Investment planning for flexibility sources and transmission lines in the presence of renewable generation.*
  Author: Dina Khastieva
  Supervisors: Mikael Amelin and Lennart Söder
  Kungliga Tekniska Högskolan. Stockholm (Sweden).
  Date: September 07, 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

6.2 Visiting professors

- Jenny Alexandra Cifuentes Quintero, from Santander Big Data Institute, Universidad Carlos III , Madrid (España). September 2020-July 2021.

6.3 Visiting students

- Jan Marc Schwidtal, from Department: Industrial Engineering, University of Padua, Padua (Italy). October 2020.

6.4 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.

- José Pablo Chaves Ávila, Matteo Troncia, *"ISGAN Academy webinars".* International Smart Grid Action Network (ISGAN). Italy. on-line.

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

- 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.

- José Portela González, *"Technical assistance for the development of a training course on applications of artificial intelligence in the air transport sector".* INARI Learning & Technology S.L. Italy. on-line.

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

- María Ana Sáenz Nuño, *"Calibration of instruments".* Asociación de Empresarios del Henares (AEDHE). Italy. Madrid.

- José Antonio Rodríguez Mondéjar, *"course on distributed power system modeling using CIM".* I-DE Redes Eléctricas Inteligentes, S.A. Italy. on-line.

- Luis Olmos Camacho, Luis Rouco Rodríguez, Rafael Palacios Hielscher, *"Coordination of the course committee of the EES-UETP network during the year 2021".* Electric Energy Systems - University Enterprise Training Partnership Association (EES-UETP). Italy. Madrid.

- Javier García González, Andrés Ramos Galán, *"Computational modeling for promoting low-carbon electricity".* Massachusetts Institute of Technology (MIT). Italy. on-line.

- Luis Olmos Camacho, *"ERERA course on electricity transmission regulation".* Tony Blair Institute (TBI). Italy. on-line.

- Luis Rouco Rodríguez, Lukas Sigrist, *"Course on grid integration of renewable generation".* Acciona, S.A. Italy. on-line.

- José Antonio Rodríguez Mondéjar, *"Course on distributed power system modeling using CIM for developers".* Núcleo de Comunicaciones y Control, S.L.U. Italy. on-line.

- Pablo Rodilla Rodríguez, Paolo Mastropietro, *"FSR e-learning course on regulation of energy utilities".* European University Institute (EUI), Florence School of Regulation. Italy. on-line.

- Eugenio Francisco Sánchez Úbeda, José Portela González, *"Preparation of materials to disseminate information on machine learning and artificial intelligence techniques".* Endesa Energía, S.A.U. Italy. Madrid.

6.5 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.

- Elisa María Aracil Fernández, *"Ageingnomics. The economics of aging".* Foro de Fundaciones y sociedad civil Demos 2020. Asociación Española de Fundaciones para el desarrollo de la sociedad civil (AEF).

- Elisa María Aracil Fernández, David Roch Dupré, *"The silver economy tracker, an interdisciplinary approach".* Measuring the silver economy: impact and metrics an interdisciplinary approach to ageing societies. Universidad Pontificia Comillas; Centro de investigación Ageingnomics - Fundación MAPFRE.

- Eva María Arenas Pinilla, *"Presentation of the project: "Development of a model for calculating theoretical electricity consumption in Spanish homes"".* VI Sesión del Seminario Interdisciplinar. Cátedra de Energía y Pobreza.. Cátedra de Energía y Pobreza. Universidad Pontificia Comillas.

- Régulo Enrique Ávila Martínez, *"Fast voltage boosters to improve transient stability of power systems with 100% of grid-forming VSC-based generation".* 16th Workshop on Industrial Systems and Energy Technologies - JOSITE'2021. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Yolanda Ballesteros Iglesias, *"Show us the way".* Noroto SAU.

- Roberto Barrella, *"Impact of energy refurbishment strategies on domestic energy services affordability: the Spanish case".* Making the Carbonisation Fair conference. Fuel Poverty Research Network, Defesa do consumidor (DECO); Center for Environmental and Sustainability Research (CENSE -FCT NOVA); y ENGAGER-COST Action.

- Roberto Barrella, *"The Spanish national strategy against energy poverty 2019-2024: policy and research perspectives".* ENGAGER Training School 2: Mainstreaming Innovative Energy Poverty Metrics. ENGAGER COST Action.

- Roberto Barrella, *"The Spanish national strategy against energy poverty 2019-2024: policy and research perspectives".* 9th Engager Café. ENGAGER COST Action.

- Roberto Barrella, Eva María Arenas Pinilla, José Carlos Romero Mora, Efraim Centeno Hernáez, *"Modeling and analysis of electricity consumption in Spanish vulnerable households. Technical session: Energy transition".* 14th IEEE PowerTech Conference 2021. Institute of Electrical and Electronics Engineers Power and Energy Society (IEEE PES); y Universidad Pontificia Comillas.

- Mario Castro Ponce, *"Agenda 2030: Environmental and health law in the post-covid era".* XX Semana de la Ciencia y la Innovación 2020.. Fundación para el conocimiento madri+d; y Comunidad de Madrid.

- Mario Castro Ponce, *"Can we predict when the next pandemic will be?".* XX Semana de la Ciencia y la Innovación 2020.. Fundación para el conocimiento madri+d; y Comunidad de Madrid.

- José Pablo Chaves Ávila, *"Electricity network tariffs in a context of decarbonization, digitalization, and decentralization".* SynErgie Workshop on electricity market design: designing markets for large shares of renewables. ZEW; Technical University of Munich; Research Center Finanz- & Informationsmanagement; y Fraunhofer Institute for Applied Information Technology (FIT);.

- José Pablo Chaves Ávila, *"OneNet market designs for the procurement of system services by DSOs and TSOs".* SynErgie Workshop on electricity market design: designing markets for large shares of renewables. ZEW; Technical University of Munich; Research Center Finanz- & Informationsmanagement; y Fraunhofer Institute for Applied Information Technology (FIT);.

- José Pablo Chaves Ávila, Orlando Mauricio Valarezo Rivera, *"Local market designs for maximizing social benefits (survey results)".* ISGAN Annex 6 workshop “Capturing Flexibility in Local Energy Systems". International Smart Grid Action Network (ISGAN).

- Adrián Fernández Rodríguez, *"Efficient operation of interoperable traffic: ATO over ERTMS".* Jornadas "Innovación en gestión energética: contribución del ferrocarril a la movilidad sostenible". Plataforma Tecnológica Ferroviaria Española (PTFE); Fundacion de los Ferrocarriles Españoles; y ADIF.

- Pablo Frías Marín, *"EV charging infrastructure-global experience".* Transport and Climate Change Week Webinar. GIZ India; IIT-Bombay.

- Pablo Frías Marín, *"Electric mobility: trends and challenges".* Presente y futuro de la movilidad eléctrica. IBM.

- Pablo Frías Marín, *"Regulatory barriers and gaps for e-mobility".* Digitalization of the user-centric Energy System: the use case of electric mobility. Interconnect Project.

- Timo Gerres, *"Carbon Contracts for Difference (CCfD) and product carbon requirements".* Mistra Carbon Exit Webinar. MISTRA.

- Tomás Gómez San Román, *"Analysis of new market models in Europe".* The Energy Transition. Towards a decarbonized economy. 3º Webinar. IEEE PES ESPAÑA.

- Tomás Gómez San Román, *"Non-conventional renewable energies. Vision in the EU.".* XVIII Curso de regulación energética "Planes Nacionales de Energía y Clima". Asociación Iberoamericana de Entidades Reguladoras de la Energía (ARIAE).

- Yolanda González Arechavala, *"The future of women's employability through STEM training: FP, the great alternative".* Cátedra para la promoción de la Mujer en vocaciones STEM en la Formación Profesional para la Movilidad Sostenible.

- Andrés González García, *"A business vision on Development Goal 7. Opportunities for the energy sector of the universal access to energy in Africa, Asia and Latin America".* Webinar Diálogo entre Foros EJE&CON. Foro de Energía y Materias Primas y el Foro de Sostenibilidad de la Asociación de Ejecutiv@s y Consejer@s (EJE&CON).

- Sébastien Huclin, *"Exploring the competition and complementary of batteries and hydro storage technologies in an electricity system with high shares of renewable energy. Insights from the Spanish system in 2030".* 16th Workshop on Industrial Systems and Energy Technologies - JOSITE'2021. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Pedro Linares Llamas, *"Conversations on climate change and international positions".* Webinar. Fundación Naturgy; y Club de Roma.

- Pedro Linares Llamas, *"Towards a new sustainable model".* Diálogos UNIA: seminarios virtuales sobre el cambio social tras el coronavirus. Universidad Internacional de Andalucía.

- Pedro Linares Llamas, *"Challenges and opportunities of the energy transition in a post-covid future".* Jornada de presentación del Observatorio de la Transición Energética y la Acción Climática (OTEA). Basque Centre for Climate Change (BC3).

- Álvaro Jesús López López, *"Business digitization and European funds".* Quinta sesión del Ciclo de Jornadas sobre Nuevas Tecnologías y su Impacto Económico y Social. Fundación de Estudios de Economía Aplicada (FEDEA); y Círculo de Empresarios.

- Gregorio López López, *"Analysis of security and privacy in internet of things devices used by young people".* VI Jornadas Nacionales de Investigación en Ciberseguridad. Universidad de Castilla La Mancha.

- Gregorio López López, *"Welcome, brief overview of the RAYUELA project, and speakers' introduction".* Technology and cybercrime. Different perspectives. RAYUELA H2020 Project.

- Gregorio López López, Mario Castro Ponce, *"The H2020 project RAYUELA: a fun way to fight cybercrime".* VI Jornadas Nacionales de Investigación en Ciberseguridad. Universidad de Castilla La Mancha.

- Gregorio López López, Alejandro Rodríguez García, Javier Matanza Domingo, Carlos Rodríguez-Morcillo García, Álvaro Jesús López López, *"Analysis and experimental evaluation of the random number generator circuit Lampert Circuit".* VI Jornadas Nacionales de Investigación en Ciberseguridad. Universidad de Castilla La Mancha.

- Francisco José López Valdés, *"Injury prevention".* Curso de Seguridad Vial Infantil. Fundación Gonzalo Rodríguez; Agencia Nacional de Seguridad Vial; y Ministerio de Transporte de la Nación Argentina.

- Sara Lumbreras Sancho, *"International day of the future: transhumanist visions".* Ateneo de Madrid.

- Sara Lumbreras Sancho, *"The future of the humanity. Transhumanism and artificial intelligence.".* Fundación Cultural Ángel Herrera Oria.

- Sara Lumbreras Sancho, *"Transhumanism and our confrontation with finitude".* Jornadas ciencia y religión ante la pandemia del Covid-19. Cátedra Francisco José Ayala de Ciencia, Tecnología y Religión.

- Sara Lumbreras Sancho, *"Data exploitation and scientific truth".* Seminario Permanente «La huella digital». Fundación Pablo VI.

- Sara Lumbreras Sancho, *"Optimal network planning: from transmission expansion to offshore grid design".* Online workshop "The future of renewable energy in Scotland and Spain". University of Edinburgh.

- Sara Lumbreras Sancho, *"Transversal Workshop: The keys to science that we need".* Asociación Celera.

- Sara Lumbreras Sancho, *"What AI is missing".* The Structure of Creditions Congress 2020. Universität Graz.

- Sara Lumbreras Sancho, *"What is transhumanism? Humanism, transhumanism and beyond".* Madrid Singularity.

- Javier Matanza Domingo, Gregorio López López, *"Pilot project-learning experience among signal theory subjects In the Telecommunication Engineering degree of ICAI".* XI Congreso Iberoamericano de Docencia Universitaria. Asociación Iberoamericana de Docencia Universitaria (AIDU).

- Holman Ospina Mateus, *"Behavior, traffic conflicts and factors associated with road accidents of motorcyclists at access point in Cartagena".* 16th Workshop on Industrial Systems and Energy Technologies - JOSITE'2021. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- José Ignacio Pérez Arriaga, *"Achieving universal access to electricity. Panel 1: Decentralized energy systems for clean electricity access".* Ministerial Thematic Forums: High-level dialogue on energy. United Nations.

- José Ignacio Pérez Arriaga, *"Investing in grids to meet the needs of rapidly urbanizing countries".* Grids4Africa launch event. Challenges and opportunities for African electricity grids.. RES4Africa Foundation.

- José Ignacio Pérez Arriaga, *"Regulation for electricity access in emerging market & developing economies".* Summer school on the regulation of energy utilities. European University Institute. Florence School of Regulation (FSR).

- José Ignacio Pérez Arriaga, *"Report valoration «ODS 7 en Iberoamérica. Alcanzar la última milla. Energía asequible, segura, sostenible y moderna para todas las personas»ods".* Seminario Virtual «ODS 7 en Iberoamérica. La última milla». Secretaría General Iberoamericana (SEGIB), la Asociación Iberoamericana de Entidades Reguladoras de la Energía (ARIAE) y la Mesa para el Acceso Universal de la Energía (MAUE).

- Jaime Pérez Sánchez, *"Data augmentation through multivariate scenario forecasting in data centers using generative adversarial networks".* 16th Workshop on Industrial Systems and Energy Technologies - JOSITE'2021. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Andrés Ramos Galán, *"IIT developing models in its late thirties. Plenary session: Power system models for real life problems".* 14th IEEE PowerTech Conference 2021. Institute of Electrical and Electronics Engineers Power and Energy Society (IEEE PES); y Universidad Pontificia Comillas.

- Andrés Ramos Galán, *"Implementation of an efficient unit commitment model".* 2º Ciclo de Conferencias de Postgrado en Ingeniería de Sistemas 2021. Universidad Autónoma de Nuevo León.

- Andrés Ramos Galán, *"Decomposition methods in integer programming: Benders decomposition".* Ciclos de Conferencias del IMI-DSC. Instituto de Matemática Interdisciplinar. Universidad Complutense de Madrid.

- Mathieu Robin, *"DC segmentation: a potential solution to improve angle stability of stressed power systems".* 16th Workshop on Industrial Systems and Energy Technologies - JOSITE'2021. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- David Roch Dupré, *"Green energy and sustainable investment: EGMX composite energy mix efficiency indicator Webcast".* 360 Smart Vision.. Universidad Pontificia Comillas; Deloite.

- Néstor Rodríguez Pérez, *"Analysis of an edge-computing-based solution for local data processing at secondary substations".* 16th Workshop on Industrial Systems and Energy Technologies - JOSITE'2021. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Néstor Rodríguez Pérez, *"Implementation of an edge-computing-based solution for local data processing at secondary substations".* SmartTalks. Universidad Pontificia Comillas; y University of Strathclyde.

- Miguel Ángel Sánchez Fornié, *"Education in digital within the energy sector: the EDDIE project. Session 8: Education in the digital era for digitalization".* 3rd IEEE International Forum on Smart Grids for Smart Cities - ISG4SC 2021. IEEE Smart Grid; y RWTH Aachen University.

- Lukas Sigrist, *"System protection in island power systems with high renewable penetration. Special session: Challenges and solutions for islands with large-scale integration of renewables".* 14th IEEE PowerTech Conference 2021. Institute of Electrical and Electronics Engineers Power and Energy Society (IEEE PES); y Universidad Pontificia Comillas.

- Reza Valizadeh, *"Design and optimization of a new low head integrated turbine pump system for eco-friendly and sustainable water supply".* 16th Workshop on Industrial Systems and Energy Technologies - JOSITE'2021. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

- Carlos Miguel Vallez Fernández, *"Dock-based bike-sharing rebalancing: challenges, opportunities and pitfalls".* 16th Workshop on Industrial Systems and Energy Technologies - JOSITE'2021. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.

6.6 Organization of congresses, seminars and workshops

- Mario Castro Ponce, *"9th International Conference on Complex Networks and their Applications".* Grupo de Sistemas Complejos -GSC- (Universidad Politécnica de Madrid). Madrid (Spain) Online. December 2020.

- Alberto Carnicero López, *"Future Urban Mobility Challenge 2".* Universidad Pontificia Comillas; y Ferrovial. Madrid (Spain). February 2021.

- Roberto Barrella, Efraim Centeno Hernáez, José Carlos Romero Mora, *"VI Sesión del Seminario Interdisciplinar. El Suministro Mínimo Vital (SMV): una herramienta crucial en la lucha contra la pobreza energética".* Cátedra de Energía y Pobreza. Universidad Pontificia Comillas. Madrid (Spain). April 2021.

- Antonio Francisco Rodríguez Matas, *"YES Europe Spain Webinars".* Young Leaders in Energy and Sustainability (YES) - Europe. Geneva (Switzerland). April 2021.

- Efraim Centeno Hernáez, José Carlos Romero Mora, Roberto Barrella, *"Una nueva factura eléctrica el 1 de junio".* Cátedra de Energía y Pobreza. Universidad Pontificia Comillas. Madrid (Spain). May 2021.

- Sara Lumbreras Sancho, *"ESSSAT 2021.XVIIIth European Conference on Science and Theology: Creative Pluralism?".* European Society for the Study of Science and Theology / Cátedra F. J. Ayala de Ciencia, Tecnología y Religión. Madrid (Spain). June 2021.

- Tomás Gómez San Román, Luis Rouco Rodríguez, Pablo Frías Marín, Luis Rouco Rodríguez, Javier García González, Sonja Wogrin, Pedro Linares Llamas, Michel Rivier Abbad, José Pablo Chaves Ávila, Carlos Rodríguez-Morcillo García, Jesús María Latorre Canteli, , *"14th IEEE PowerTech Conference 2021".* Institute of Electrical and Electronics Engineers Power and Energy Society (IEEE PES); y Universidad Pontificia Comillas. Madrid (Spain). June-July 2021.

- Eva María Arenas Pinilla, *"XIII Jornada Anual de la Cátedra Rafael Mariño de Nuevas Tecnologías Energéticas".* Cátedra Rafael Mariño de Nuevas Tecnologías Energéticas - Universidad Pontificia Comillas. Online. June 2021.

- Elisa María Aracil Fernández, David Roch Dupré, *"Measuring the silver economy: impact and metrics an interdisciplinary approach to ageing societies".* Universidad Pontificia Comillas; Centro de investigación Ageingnomics - Fundación MAPFRE. Madrid (Spain). June 2021.

- Sara Lumbreras Sancho, *"16th Workshop on Industrial Systems and Energy Technologies - JOSITE'2021".* Instituto de Investigación Tecnológica. Universidad Pontificia Comillas. Madrid (Spain). July 2021.

6.7 Organization and management of other academic activities

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

- Efraim Centeno Hernáez, *"Chairman in Session 1. Presentation of the project: "Development of a model for calculating theoretical electricity consumption in Spanish homes" in «VI Sesión del Seminario Interdisciplinar. El Suministro Mínimo Vital (SMV): una herramienta crucial en la".* Cátedra de Energía y Pobreza. Universidad Pontificia Comillas. Madrid (Spain). April 2021.

- Efraim Centeno Hernáez, *"Chairman in Seminar «A new electric bill on June 1».".* Cátedra de Energía y Pobreza. Universidad Pontificia Comillas. Madrid (Spain). May 2021.

- Francisco Miguel Echavarren Cerezo y Sonja Wogrin, *"Member of the Scientific Committee of International Advisory Committee of the 14th IEEE PowerTech Conference 2021".* Institute of Electrical and Electronics Engineers Power and Energy Society (IEEE PES); y Universidad Pontificia Comillas. Madrid (Spain). June-July 2021.

- Pablo Frías Marín, *"Chairman in Round table «Challenges of mobility for all» in «Ciclo Encuentros de Innovación para la Sostenibilidad».".* Casa de Mexico en España; y Fundación Iberdrola España. Madrid (Spain). May 2021.

- 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, *"Editor of Journal of Modern Power Systems and Clean Energy".* Nanjing NARI Electric Power Information Co., Ltd. ; e Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). March 2020- Today.

- 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.

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7. Data about IIT

The relevant numbers of the academic year 2020 - 2021 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:

7,25 M€ Turnover

80 Professors and researchers

59 Research assistants

139 Research projects

42 Consultancy projects

9 Services and analisys projects

2 Books and 16 Chapters in books

84 Papers published in JCR journals

10 Papers published in other journals

52 Papers presented at conferences

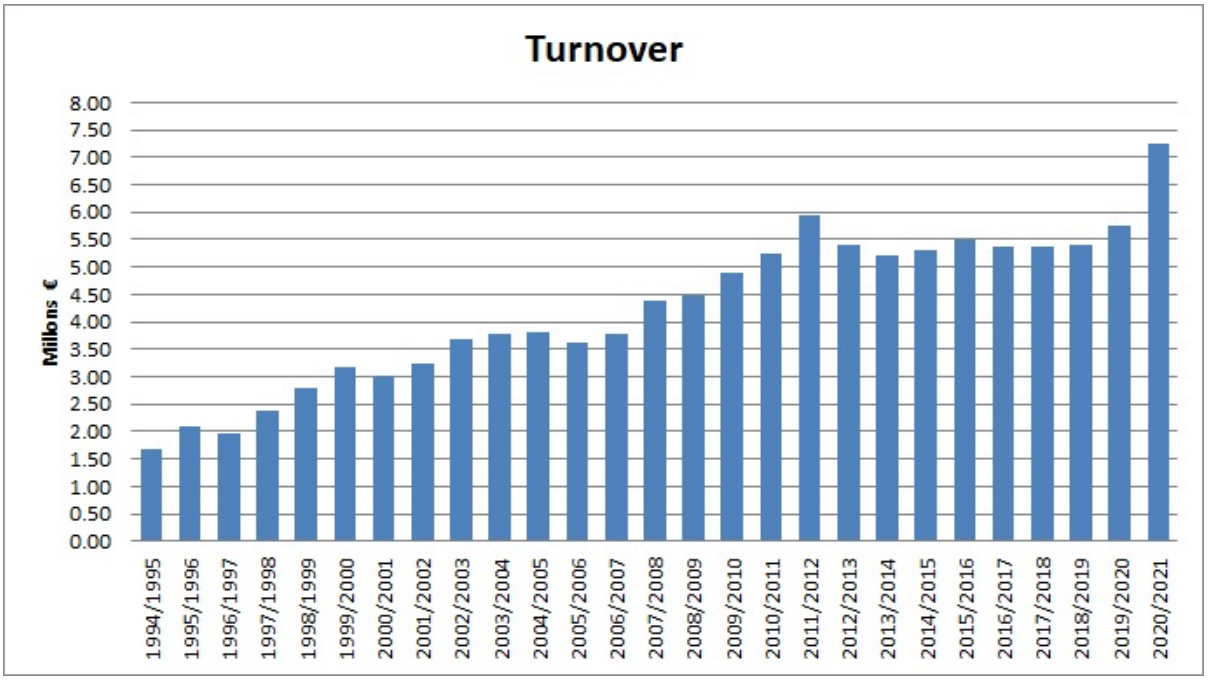
25 Technical reports and 26 Working papers

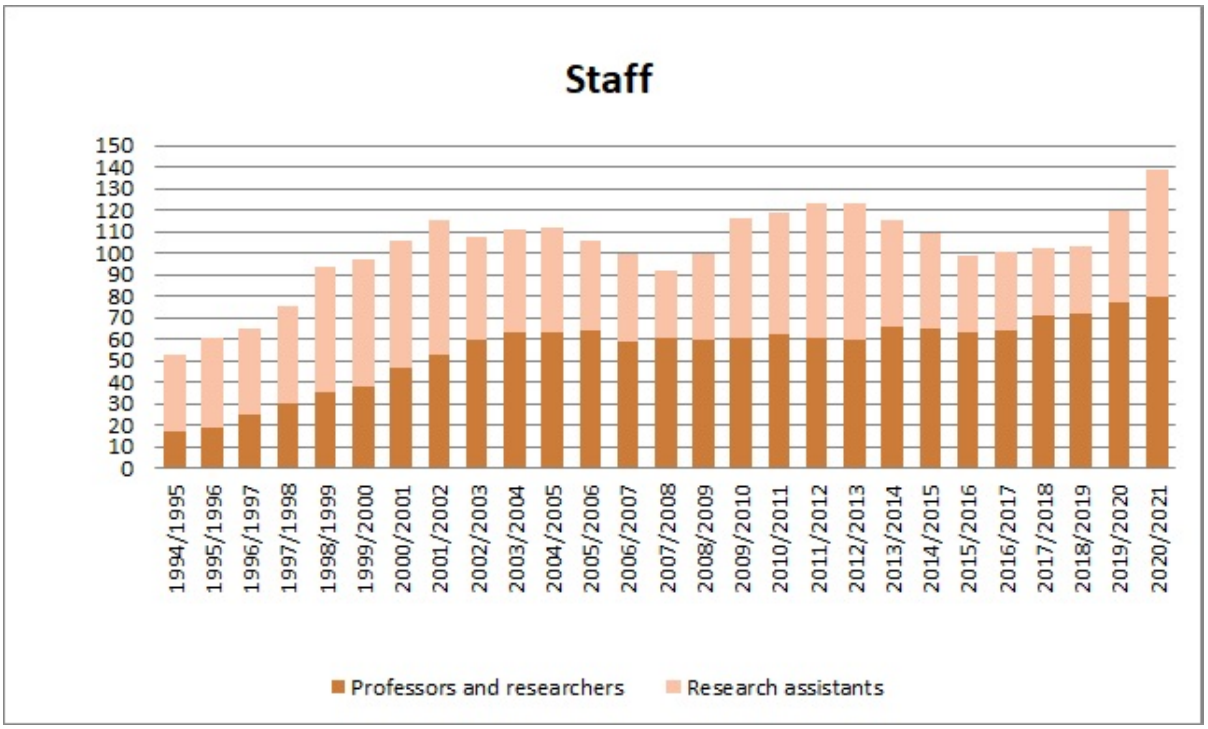
5 Submitted theses

63 Ongoing theses

15 Courses offered to external entities

Data about IIT





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