

ANNUAL ACADEMIC REPORT

Academic Year

2017-2018



IIT
INSTITUTO DE
INVESTIGACIÓN
TECNOLÓGICA

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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 institute's research teams, who also make an important contribution to our internationally-oriented doctoral programs, and the continuing success of our collaboration with the industrial sector for more than thirty years.

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

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


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

We are conscious that this is a difficult challenge in the current globalized and interdependent economy with faster and deeper technology change, especially in the energy, transport and telecommunication sectors. We face this challenge with

enthusiasm, commitment and optimism. Technology is to play a crucial role in the history of humanity over the upcoming decades and we want to be part of this

adventure.

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



Tomás Gómez San Román

1. Introduction

The Institute for Research in Technology (IIT) is a University Research Institute that belongs to the ICAI School of Engineering of Comillas Pontifical University. Its primary objective is to promote research and postgraduate training in various technological fields through 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 2017 - 2018, from September 1, 2017 to August 31, 2018.

2. Organizational structure

2.1 Management

The management of the IIT during the course 2017 - 2018 has been carried out by the following Professors and Researchers:

- **Frías Marín, Pablo.** Deputy Director
- **García González, Javier.** Deputy Academic Director
- **Gómez San Román, Tomás.** Director
- **Sigrist, Lukas.** Deputy Director for International Programs

2.2 Council

The members of the Council of IIT during the course 2017 - 2018 were the following ones:

- **Centeno Hernández, Efraim.** Researcher Representative
- **Espejo González, Rafael.** IEF Representative
- **Frías Marín, Pablo.** Deputy Director
- **García González, Javier.** Secretary General
- **García González, Javier.** Deputy Academic Director
- **Gómez San Román, Tomás.** Director
- **Ramos Galán, Andrés.** Researcher Representative
- **Rivier Abbad, Michel.** Researcher Representative
- **Roch Dupré, David.** IEF Representative
- **Rodilla Rodríguez, Pablo.** Researcher Representative
- **Rouco Rodríguez, Luis.** Researcher Representative

2.3 Area coordinators

The coordinators of the eight research areas that group the different activities carried out in the IIT during the course 2017 - 2018 are the following ones:

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

2.4 Scientific Advisory Board

The members of the SAB are the following ones:

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

2.5 Academic staff

The permanent staff of IIT consisted of the following Professors and Researchers:

- **Bello Morales, Antonio.** Assistant Researcher
Ph.D. in Industrial Engineering (Comillas), M.Sc. in Power Systems (Comillas),
Mechanical Engineer (Comillas),
Areas of interest: Risk management support, energy forecasting, energy market modelling, planning of electricity and gas markets, artificial intelligence.
- **Boal Martín-Larrauri, Jaime.** Assistant Professor
Ph.D. in Industrial Engineering (Comillas)
Electronics Engineer (Comillas)
Areas of interest: Home automation and energy efficiency · Analog and digital electronics, wireless communications · Deep learning · Autonomous mobile robots, computer vision, topological modeling of the environment

- **Campos Fernández, Francisco Alberto.** Assistant Researcher
Ph.D. in Industrial Engineering (Comillas)
Mathematics Science degree (UCM)
Areas of interest: Nash equilibriums. Possibility theory. Optimization under uncertainty. Electricity markets. Cryptanalysis.
- **Centeno Hernández, 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.** Assistant Researcher
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.
- **Cossent Arín, Rafael.** Assistant Researcher
Ph.D. in Industrial Engineering (Comillas)
Electrical Engineer (Comillas)
Areas of interest: Power system economics and regulation. Regulation of electricity distribution activity, integration of renewable and distributed generation, demand response and smart distribution grids.
- **Cuadra García, Fernando de.** Professor
Ph.D. in Industrial Engineering (Comillas)
Electrical Engineer (Comillas)

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

- **Cucala García, Asunción Paloma.** Senior Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Electronics Engineer (Comillas)
Areas of interest: Modelling, simulation, design, management and control of railway systems, and their safety and quality analysis.
- **Echavarren Cerezo, Francisco Miguel.** Assistant Researcher
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.** Senior Associate 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.
- **Frías Marín, Pablo.** Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Electrical Engineer (Comillas)
Areas of interest: Operation and planning of electric power systems. Power economics. Integration of distributed generation in power systems. Advanced electric machines. Electric Vehicles and Sustainable Mobility.
- **García Cerrada, Aurelio.** Professor
Ph.D. in Electrical and Electronics Engineering (University of Birmingham, U.K.)
Electrical Engineer (UPM)
Areas of interest: Power electronics. Control of electrical drives. FACTS. System identification and control.
- **García González, Javier.** Senior Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Electrical Engineer (UPC)

Areas of interest: Economy and optimization of electric power systems.

- **García González, Pablo.** Senior Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Electrical Engineer (Comillas)

Areas of interest: Control. Power electronics. Power electronics applied to the electric power systems (FACTS devices, active filters, HVDC, etc.). Electric power systems stability and control.

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

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.

- **Latorre Canteli, Jesús María.** Assistant Researcher
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: Multiple criteria decision making. Energy economics. Energy planning models. Integration of renewable energies. Environmental economics. Environmental policy instruments.

- **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.** Assistant Researcher
Electronics degree (Comillas), M.Sc. in Automatics and Electronics (Comillas)
M.Sc. in Research in Engineering Systems Modeling (Comillas)

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

- **Lumbreras Sancho, Sara.** Assistant Professor
Ph.D. in Industrial Engineering (Comillas)
Electrical Engineer (Comillas)

Areas of interest: Decision methods applied to complex problems.
---Techniques:--- decision under uncertainty, stochastic optimization, Benders' decomposition, risk analysis, heuristics, metaheuristics, genetic algorithms, ordinal optimization. ---Areas of application:--- power systems, planning, network design, transmission expansion planning, wind energy, offshore windfarm design, finance, risk analysis, derivatives.

- **Marín Gracia, Ángel.** Research Affiliate
Aeronautical Engineer (Universidad Politécnica de Madrid)
PhD Aeronautical Engineer (Universidad Politécnica de Madrid)
Areas of interest: Design of urban transport networks and the railway freight transportation
- **Martín Martínez, Francisco.** Assistant Researcher
Electrical Engineer (Comillas)
Areas of interest: Microgrids. Distributed generation and energy efficiency. Digital electronics systems.
- **Mastropietro, Paolo.** Assistant Researcher
Ph.D. in Electrical Engineering (Comillas), Ph.D. in Electrical Engineering (Delft University of Technology - TU Delft, The Netherlands), Ph.D. in Electrical Engineering (Royal Institute of Technology - KTH, Stockholm, Sweden), M.Sc. in Environmental Engineering (University of Rome Tor Vergata, Italy), Environmental Engineer (University of Rome Tor Vergata, Italy)
Areas of interest: Power sector regulation; Security of supply; Capacity remuneration mechanisms; regional markets; tariff design and subsidies
- **Matanza Domingo, Javier.** Assistant Professor
Ph.D. in Industrial Engineering (Comillas)
Telecommunications Engineer (Technical University of Valencia)
Areas of interest: Signal processing. Communication systems. Power Line Communication. Wireless communications.
- **Mateo Domingo, Carlos.** Assistant Researcher
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.** Associate Researcher
Ph.D. in Industrial Engineering (Comillas)
Electrical Engineer (Comillas)
Areas of interest: Regulation of the energy sector. Transmission of electricity. Power economics. System identification.
- **Palacios Hielscher, Rafael.** Senior Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Mechanical Engineer (Comillas)
Areas of interest: Advanced data analysis (including vibration analysis, optical handwritten character recognition, image processing, artificial intelligence and data mining). Parallel processing. Thermoelectric applications. Failure detection and maintenance. Aviation safety.
- **Pérez Arriaga, José Ignacio.** Professor
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
Electronics Engineer (Comillas), M.Sc. in Research in Engineering Systems Modeling (Comillas)
Areas of interest: Functional Data Analysis, Neural Networks, time series models
- **Ramos Galán, Andrés.** Professor
Ph.D. in Industrial Engineering (UPM)
Electrical Engineer (Comillas)

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

- **Renado Anglada, Francisco Javier.** Assistant Researcher
Electrical Engineer (Comillas), M.Sc. in Mathematical Engineering (UC3M)
Areas of interest: VSC-HVDC multi-terminal systems, power system stability
- **Reneses Guillén, Javier.** Associate Researcher
Ph.D. in Industrial Engineering (Comillas)
Electrical Engineer (Comillas), Mathematics Science degree (UNED)
Areas of interest: Operation, regulation and planning of power and natural gas systems. Tariff design.
- **Rivier Abbad, Michel.** Professor
Ph.D. in Industrial Engineering (Comillas)
Electrical Engineer (Comillas)
Areas of interest: Electric power systems analysis, optimisation, regulation economic, operation and planning. Optimisation techniques.
- **Rodilla Rodríguez, Pablo.** Associate Researcher
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.** Assistant Researcher
Ph.D. in Industrial Engineering (Comillas)
Electronics Engineer (Comillas), M.Sc. in Communication Technologies and Systems (UPM)
Areas of interest: On board communications. Embedded systems. Wireless communications. Programmable logic. Digital systems.
- **Román Úbeda, Jaime.** Research Affiliate
Industrial Engineering (UPM)
Ph.D. y M.Sc. in Electrical Engineering (University of Manchester)
Areas of interest: Power economics. Optimisation techniques. Risk Management. Electric Vehicle.
- **Rouco Rodríguez, Luis.** Professor
Ph.D. in Industrial Engineering (UPM)
Electrical Engineer (UPM)
Areas of interest: Electric power systems stability and control. System identification. Simulation of electromagnetic transients.
- **Sánchez Fornié, Miguel Ángel.** Research Affiliate
Electromechanical Engineer de ICAI (Comillas)
Nuclear Security Diploma (MIT)
Areas of interest: Power engineering. Power systems regulation. Power systems planning and operation.
Power systems asset management. Smart grids. Telecommunications systems and operations. Telecommunications for power systems. Cybersecurity, Big data analysis and artificial intelligence on power systems.
- **Sánchez Martín, Pedro.** Senior Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Industrial Engineer (Comillas)
Areas of interest: Transmission and generation electric system modeling. Industrial process planning and scheduling. Work system design. Manufacturing and logistics simulation
- **Sánchez Miralles, Álvaro.** Senior Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Electronics Engineer (Comillas)
Areas of interest: Smart grids. Smart cities. Security systems. Mobile robotics.
- **Sánchez Úbeda, Eugenio Francisco.** Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Electronics Engineer (Comillas)

Areas of interest: Data mining. Artificial Intelligence (automatic learning, decision trees, neural networks, fuzzy logic, genetic algorithms, heuristic search). Biometrics (optical character, image and speech recognition). Electric energy systems (bidding in competitive markets, forecasting, dynamic security assessment, transmission and subtransmission planning). Multi-agent systems.

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

Areas of interest: Modeling, analysis and control of electric power systems.

- **Ventosa Rodríguez, Mariano.** Professor
Ph.D. in Industrial Engineering (Comillas)
Electronics Engineer (Comillas)

Areas of interest: Operations, planning and economy of electric energy systems. Application of operations research in electric energy markets.

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

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

2.6 Associated academic staff

The following professors have collaborated with IIT as Associate Researchers:

- **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.** Assistant 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: CFD. Hemodynamics. Blood rheological characterization. Multiphase fluid flow. Advanced thermal systems. New energy technologies. Peltier effect.
- **Carnicero López, Alberto.** Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Mechanical Engineer (Comillas)
Areas of interest: Numerical methods in engineering. Railway Catenary. Catenary-pantograph dynamic interaction
- **Castro Ponce, Mario.** Senior Associate Professor
Ph.D. in Physics Science (UCM)
Physics Science degree (UCM)
Areas of interest: Fluid mechanics. Statistical mechanics. Communication networks. Nonlinear physics. Nanomaterials. Biophysics.
- **Fernández Bernal, Fidel.** Senior Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Electrical Engineer (Comillas)
Areas of interest: Dynamics of electrical systems. Motor control. Renewable energies integration.
- **Giannetti, Romano.** Senior Associate 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.

- **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.
- **Jiménez Octavio, Jesús.** Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Mechanical Engineer (Comillas)
Areas of interest: Railway systems. Design and optimization. Computational mechanics.
- **Laloux Dallemagne, Damián.** Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Electrical Engineer (Comillas)
Areas of interest: Modelling, analysis and control of electric power systems. Sustainable development.
- **López Valdés, Francisco José.** Assistant Professor
Mechanical Engineering, Mechanics Universidad de Valladolid (Spain)
PhD. Mechanical and Aerospace Engineering. University of Virginia (USA)
Areas of interest: Biomechanics, Injury prevention, biological tissue characterization, injury thresholds, automotive safety
- **Mochón Castro, Luis Manuel.** Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Mechanical Engineer (Comillas)
Areas of interest: Computacional fluid dynamic. Fluid control. Hydraulic energy. Heat transfer. Olehidraulic systems.
- **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 embedded systems for automatic control applications.
- **Nieto Fuentes, Francisco.** Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Mechanical Engineer (Comillas)
Areas of interest: Robotics. Reliability and safety. Mechanical design.
- **Real Romero, Juan Carlos del.** Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Industrial Engineer (Comillas)

Areas of interest: Adhesive bonding: adhesives suitable for each application; mechanical characterization of adhesive bonding; durability studies and failure modes; surface treatments to improve durability of the adhesive joints. Composites: preparation of polymer matrix composites reinforced by micro and nanoparticles; mechanical characterization; thermal analysis; applications as coatings; biomedical applications. Carbon based nanomaterials. Nanocomposites

- **Sáenz Nuño, María Ana.** Assistant Professor
Ph.D. in Industrial Engineering (Comillas)
Physics Science degree (UCM)

Areas of interest: Dimensional metrology.

- **Santos Montes, Ana María.** Senior Associate Professor
Ph.D. in Chemistry Science (UCM)
Chemistry Science degree (UAM)

Areas of interest: Development, optimization and validation of chromatographic analytical methods for high-performance liquid chromatography (HPLC) to determine steroids, diuretics and contaminants in urine samples, feed and water. Analysis of the life cycle of crops for biofuels.

- **Zamora Macho, Juan Luis.** Associate Professor
Ph.D. in Industrial Engineering (Comillas)
Electronics Engineer (Comillas)

Areas of interest: Drive control. System identification. Signal processing.

2.7 Research Assistants

The Research Assistants (PhD students) that developed their activity at the IIT during the academic course 2017 - 2018 were the following ones:

- **Abdelmotteleb, Ibtihal.** Electrical and Control Engineer (Arab Academy for Science, Technology and Maritime Transport, Cairo, Egipt), Máster en Electrical and Control Engineering (Arab Academy for Science, Technology and Maritime Transport, Cairo, Egipt)
- **Alonso Rivas, Eduardo.** Electronics Engineer (Comillas), Automatics and Electronics degree (Comillas), M.Sc. in Research in Engineering Systems Modeling (Comillas)
- **Cabrera Azpilicueta, Leopoldo Javier.** Electromechanical Engineer (Comillas)
M.Sc. in Industrial Engineering (Comillas)
M.Sc. in Business Administration (Comillas)
- **Calvo Bascónes, Pablo.** Electromechanical Engineer (Comillas). M.Sc. in Industrial Engineering (Comillas)

- **Casado Fulgueiras, Laura.** Electromechanical Engineer (Comillas)
M.Sc. in Industrial Engineering (Comillas)
Official Master in Research in Engineering Systems Modeling (MRE)(Comillas)
- **Ciller Cutillas, Pedro.** Electronics Engineer (Comillas), Mathematics (UCM)
- **Doenges, Kai.** Master of Science in Industrial Engineering, Technical University of Dortmund (TU Dortmund)
- **Doménech Martínez, Salvador.** Mechanical Engineer (Comillas)
- **Espejo González, Rafael.** Industrial Technology Engineer (University of Seville), M.Sc. in Industrial Engineering (Comillas), M.Sc. in Business Administrations (Comillas)
- **Fernández de Bobadilla Navarrete, José María.** Electromechanical Engineer (Comillas). M.Sc. in Industrial Engineering (Comillas)
- **Fernández Rodríguez, Adrián.** Electrical Engineer (UPM)
- **Gerres, Timo.** B.Sc. in Business Administration and Engineering (Universität Paderborn) (DE)
M.Sc. in Systems Engineering, Policy Analysis & Management (Technische Universiteit Delft) (NL)
- **González García, Andrés .** Electronics Engineer (Comillas), M.Sc. in Power Systems (Comillas)
- **González Romero, Isaac Camilo.** B.Sc. in Economics and Mathematics (Colombian School of Engineering «Julio Garavito»)
Master's degree in the Electric Power Industry (Comillas Pontifical University)
Master in the Network Industries and Digital Economy (Paris Sud University -France)
- **Lind, Leandro.** B.Sc. in Economics. Federal University of Santa Catarina (Brasil)
Master in the Electric Power Industry. University Pontificia Comillas (Spain)
Master in Digital Economics and Network Industries. University Paris-Sud 11 (France)
- **Marcos Peirotén, Rodrigo Alejandro de.** Electronics Engineer (Comillas)
- **Martín Lopo, Miguel.** Electronics Engineer (Comillas)
- **Martínez Morales, Diego.** Degree in Industrial Engineering ICAI (Comillas)
- **Mestre Marcos, Guillermo.** Bachelor's Degree in Mathematics (Universidad de Alicante)
Master's Degree in Advanced Mathematics (Universidad Complutense de Madrid)
- **Mosácula Atienza, Celia.** Chemistry Engineer (UPV/EHU), M.Sc. in Renewable Energies (CEU San Pablo University)
- **Orgaz Gil, Alberto.** Electronics Engineer (Comillas). Master's Degree in Research in Engineering Systems Modeling (Comillas)
- **Otaola Arca, Pedro de.** Bachelor's degree in Electromechanical Engineering (major in Electronics)(Comillas)
Master's degree in Industrial Engineering (Comillas)
- **Postigo Marcos, Fernando Emilio.** Electromechanical Engineer (Comillas)
M.Sc. in Industrial Engineering (Comillas)

- **Roch Dupré, David.** Electromechanical Engineer (Comillas)
M.Sc. in Industrial Engineering (Comillas)
Official Master's Degree in Research in Engineering Systems Modeling (MRE)
- **Romero Mora, José Carlos.** Electrical and Power Systems Engineer (University of Malaga), M.Sc. in Research in Engineering Systems Modeling (Comillas)
- **Rosso Mateo, Ángel.** Industrial Engineering (Comillas)
MPhil in Electrical Engineering (University of Manchester)
- **Simons, Lorenzo August.** Bachelor and Master in Business Engineering (Handelsingenieur) (University of Leuven, Belgium)
Master in Fiscal Law (University of Ghent)
Erasmus Mundus Master in Economies and Management of Network Industries (Comillas)
- **Sun, Deniz.** Bachelor's degree in Industrial Engineering (Middle East Technical University, Turkey)
Minor degree in Industrial Economics (Middle East Technical University, Turkey)
Erasmus Mundus Joint Master in Economics and Management of Network Industries (Comillas Pontifical University, Spain)
Master's degree in the Electric Power Industry (Comillas Pontifical University, Spain)
Master's degree in Network Industries and Digital Economy (Paris Sud-11 University, France)
- **Tejada Arango, Diego Alejandro.** Electrical Engineer (National University of Colombia - UNAL, Medellin, Colombia), Specialis in Transmission and Distribution Power Systems (Pontifical Bolivarian University - UPB, Medellin, Colombia), M.Sc. in Electrical Engineering (University of Antioquia - UdeA, Medellin, Colombia)
- **Vázquez Blanco, Antonio.** Bachelor's degree in Electromechanical Engineering (major in Electronics)
Master's degree in Industrial Engineering
- **Zhao, Quanyu.** Honours Electrical (McGill University, Canada), M.Sc. in Numerical Economics and Network Industries (University Paris-Sud 11, France), M.Sc. in Electric Power Industry (Comillas)

2.8 Services staff

2.8.1 Systems administrator staff

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

- **Díaz Pérez, Marcos Mario.** Electronics and Automatics Engineer (University of Carabobo - UC, Valencia, Venezuela)
- **Martín Tena, Julián.** Computer Expert

2.8.2 Administrative staff

The staff that manage the documentation, the general and technical secretariat and the trips consist of:

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

3. Research

3.1 Research areas

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

3.1.1 Energy Systems

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

3.1.1.1 Electric Power Systems (MAC)

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

Coordinator: Luis Rouco Rodríguez

Web page: <https://www.iit.comillas.edu/research-area/mac>

3.1.1.2 Smart and Sustainable Grids (REDES)

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

Coordinator: Rafael Cossent Arín

Web page: <https://www.iit.comillas.edu/research-area/redes>

3.1.1.3 Energy Economics and Regulation (RYE)

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

Coordinator: Pablo Rodilla Rodríguez

Web page: <https://www.iit.comillas.edu/research-area/rye>

3.1.1.4 Energy Systems Models (SADSE)

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

Coordinator: Andrés Ramos Galán

Web page: <https://www.iit.comillas.edu/research-area/sadse>

3.1.2 Industrial Systems

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

3.1.2.1 Fire Safety, Thermal and Fluids Engineering (PCI)

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

Coordinator: Alexis Cantizano González

Web page: <https://www.iit.comillas.edu/research-area/adi>

3.1.2.2 Railway Systems (ASF)

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

Coordinator: Asunción Paloma Cucala García

Web page: <https://www.iit.comillas.edu/research-area/asf>

3.1.2.3 Smart Industry and Cities (ASI)

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

Coordinator: Álvaro Sánchez Miralles

Web page: <https://www.iit.comillas.edu/research-area/asi>

3.1.2.4 Bioengineering (BIO)

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

Coordinator: Carlos Rodríguez-Morcillo García

Web page: <https://www.iit.comillas.edu/research-area/geac>

3.2 Research projects

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

3.2.1 Energy Systems Areas

3.2.1.1 Research and development projects

3.2.1.1.1 Private funding

- **Wind energy intermittency: from wind farm turbulence to economic management**

Johns Hopkins University. November 2012 - October 2017. (Andrés Ramos Galán, Carlos Batlle López, Sonja Wogrin, Pablo Rodilla Rodríguez)

This project represents an integrated educational and research program for graduate and postgraduate students and professors at the Johns Hopkins U., Texas Tech U., Smith College, U. of Puerto Rico and their international collaborators at the Danish Technical U. (DTU) and the Risø Laboratory in Denmark, ECN in the Netherlands, EPFL in Switzerland, Katholieke U. Leuven in Belgium and Universidad Pontificia Comillas in Spain.

The collaboration is aimed at analyzing research issues such as the introduction of multiple wind generators in the electrical system, origins of fluctuations, statistical characterization and propagation of variability and the economic and social implications of the design and operation of a source of sustainable

generation. With hundreds of billions of dollars invested in renewable generation and the associated structure in the coming years, it is crucial to develop tools to manage the variability to make effective and sustainable but intermittent use of these resources. The research is coupled with a student training program that includes carefully designed international experiences. Comillas collaborates in the training of students in research topics of integration of wind generation, and in particular developing different research projects focused on the integration of wind generation in electricity markets, from the analysis of short and long market rules term to the study of the expansion of the networks in markets of regional scope, in order to evaluate how to take advantage of the complementarities of the different technologies in a supranational (supra-state) scope.

- **RNM- KSA as an energy exporter: the future of electricity networks**

Massachusetts Institute of Technology (MIT). November 2015 - November 2017. (Fernando de Cuadra García, Pedro Ciller Cutillas)

Support in the development of a new generation/transmission expansion planning model and use for the case of the Kingdom of Saudi Arabia. use of RNM model in the context of the REM initiative as supporting tool of the previous development and to execute the most complex cases.

- **TEPES - KSA as an energy exporter: the future of electricity networks**

Massachusetts Institute of Technology (MIT). November 2015 - September 2017. (Andrés Ramos Galán)

Support in the development of a new transmission expansion planning model and use for the case of the Kingdom of Saudi Arabia.

use of TEPES model as supporting tool of the previous development and to execute the most complex cases.

- **Advanced system of off-grid energy generation: plug-and-play and 100% renewables**

Norvento Energía Distribuida, S.L. January 2016 - January 2018. (Lukas Sigrist, Luis Rouco Rodríguez, Kai Doenges)

OG+ is a complete system for isolated grids. OG+ should operate in a fully integrated manner, by optimizing the available resources to generate energy in a secure, stable and highly reliable way and at minimum costs. Secure operation of the grid is assured by the primary frequency and voltage regulators. Minimum costs are obtained by dispatching the available energy resources of the grid optimally.

- **Energy scenario assessment in a context of cost reductions of distributed energy resources**

Gas Natural SDG, S.A. December 2016 - December 2017. (Tomás Gómez San Román, José Pablo Chaves Ávila, Michel Rivier Abbad, Álvaro Sánchez Miralles, Francisco Martín Martínez, Timo Gerres)

The aim of this project is the quantitative assessment of future energy scenarios in a context of cost reductions for distributed energy resources. This analysis is

focused on the countries of interest of Gas Natural Fenosa, in particular Spain, Chile, Panama and Mexico. The analysis is intended to support strategic decisions of Gas Natural Fenosa.

- **Short- and medium-term risk analysis in electricity markets. Financial asset simulation and improving input data**

Enel Iberoamerica S.R.L. January 2017 - December 2017. (Antonio Bello Morales, Javier Reneses Guillén, Sara Lumbreras Sancho, Rodrigo Alejandro de Marcos Peirotén)

The aim of this project is to continue with the developments of the ACUARIO tool once it is in production phase at Endesa. In particular, the integration of the financial asset simulation tool is continued, new conceptual and practical developments are addressed, and the input data used by the model are analyzed from a theoretical and practical point of view. Continued support is also being given on the use of the tool and the interpretation of the results.

- **Long-term risk analysis in the electricity markets and theoretical developments in the context of risk management**

Enel Iberoamerica S.R.L. January 2017 - December 2017. (Antonio Bello Morales, Javier Reneses Guillén)

The aim of this collaboration between IIT and Endesa is twofold. On the one hand, to continue the development of the ARIES tool for long-term risk management in electricity markets. On the other hand, the objective is to carry out theoretical developments that serve as support in different strategic risk management decision-making processes.

- **Simulation and optimization of the gas portfolio risk management**

Enel Iberoamerica S.R.L. January 2017 - December 2017. (Jesús María Latorre Canteli, Sara Lumbreras Sancho, Javier Reneses Guillén, Celia Mosácula Atienza)

The aim of the project is to continue with the developments within the framework of the AURIGA tool. In 2017 the objective is to implement improvements in the price simulation process and to consider contracts with optionality within the optimization model, in addition to opening the possibility of carrying out additional studies on aspects that can improve the results obtained.

- **Medium- and long-term planning in the Iberian electricity market. Consideration of uncertainty in the forecasts**

Enel Iberoamerica S.R.L. January 2017 - December 2017. (Javier Reneses Guillén, Antonio Bello Morales, Jesús María Latorre Canteli, Alberto Orgaz Gil, Leopoldo Javier Cabrera Azpilicueta)

This project continues with previous collaborations between IIT and Endesa on medium and long-term planning of the Iberian electric energy market (MIBEL). The expected tasks include the improvement of medium- and long-term forecasts, especially with regard to the characterization of the uncertainty of multiple risk variables and the widespread use of Montecarlo simulations and

hourly executions. It also addresses the improvement of the TPA modeling, as well as a training course for new users of VALORE.

- **Modeling the operation of the Iberian natural gas market. Consideration of uncertainty and daily detail**

Enel Iberoamerica S.R.L. January 2017 - December 2017. (Jesús María Latorre Canteli, Rocío Zamorano Onieva, Antonio Bello Morales, Ángel Rosso Mateo, Javier Reneses Guillén, Aurora del Valle Díez, Diego Martínez Morales)

This project is included in the framework of a continuous research between Endesa and the IIT focused on the operation and forecasting in the Iberian natural gas market. The objective is to consolidate a version able to model the hub and include a daily representation for part of the time scope. Finally, the project addresses the use of Monte Carlo sampling techniques to consider various scenarios of demand, gas supply costs and other variables subject to uncertainty.

- **Support for medium-term planning and forecasting in the European and Iberian electric markets**

Enel Iberoamerica S.R.L. January 2017 - December 2017. (Javier Reneses Guillén, Antonio Bello Morales, Alberto Orgaz Gil, Leopoldo Javier Cabrera Azpilicueta, Francisco Alberto Campos Fernández)

This project is framed into the on-going cooperation line followed by Endesa and IIT in the framework of medium-term operation and planning in the context of the Iberian electricity market. The collaboration is focused, in the first place, on finalizing some developments already initiated, such as the consolidation of the interaction with the OMEGA tool at a deterministic level. On the other hand, there are some significant developments, especially within the context of European forecasts, such as the generalized use of wind and solar production scenario generators, and the increase of the number of variables subject to uncertainty in the European market. The collaboration also addresses the improvement of hourly and daily price forecasting at a probabilistic level, using a hybrid fundamental-econometric scheme.

- **Forecasts and analysis of the short- and medium-term operation in the Spanish Extrapeninsular power systems**

Enel Iberoamerica S.R.L. January 2017 - December 2017. (Javier Reneses Guillén, Francisco Alberto Campos Fernández, Antonio Bello Morales, Alberto Orgaz Gil)

The main objective of this collaboration is the adequacy of the tool VALORE so that it can be used for modeling the the short- and medium-term operation of the Spanish islands and extrapeninsular power systems. On the other hand, this collaboration also focuses on the generation of demand scenarios with advanced statistical techniques and the training of future users of VALORE SEIE.

- **Technologies and strategies for the optimal participation of renewable energies in electricity markets**

Gas Natural Fenosa. January 2017 - December 2019. (Enrique Lobato Miguélez, Ignacio Egido Cortés, Kai Doenges, Lukas Sigríst)

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

- **VALSA-EXPANDE integration and developments for the long-term analysis (influence of renewable generation, distributed, electric vehicle, etc.)**

Enel Iberoamerica S.R.L. January 2017 - December 2017. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

Valsa is a model for the long term assessment of the ancillary services of the Spanish system, as part of Morse model, developed by the Institute for Research in Technology (Instituto de Investigación Tecnológica, IIT) in collaboration with Endesa for strategic analysis of the evolution of this sector, especially when changes of the utilities structure, new regulations, or new generation technologies take place. The objective of this collaboration is the integration of platforms Valsa and Expande as well as the implementation and validation of procedures for the calculation of endogenous reserves and their use, which were discussed during the previous collaboration. Studies will also be carried out to analyze the influence of renewable and distributed generations, the electric vehicle, etc., in the long term.

- **Analysis of different technology based scenarios in power systems for the 2040 horizon**

Iberdrola S.A. February 2017 - December 2017. (Michel Rivier Abbad, Tomás Gómez San Román, José Pablo Chaves Ávila, Álvaro Sánchez Miralles, Francisco Martín Martínez, Timo Gerres, Rafael Cossent Arín, Andrés Ramos Galán, Pedro Linares Llamas)

The project analyses and investigates several different possible technology based scenarios in Power Systems for the 2040 horizon. The factors and issues that may have a more relevant impact in future Power Systems configuration from a technological point of view are identified and analysed. Then a quantitative assessment of the impact of such factors is performed for different scenarios, using computer models available at IIT.

- **Adding value to thermal generation in island systems under scenarios of high penetration of renewables**

Enel SpA. March 2017 - October 2017. (Lukas Sigríst, Luis Rouco Rodríguez, Enrique Lobato Miguélez, José María Fernández de Bobadilla Navarrete)

The objective of the project is investigating on how to add value to islands electric power systems under scenarios of high penetration of renewable through the integration of ESS in conventional generation plants.

- **Investigation of the use of fault records in condition monitoring of power apparatus**

Unión Fenosa Distribución, S.A. April 2017 - September 2017. (Luis Rouco Rodríguez)

This work investigates of the use of fault records in condition monitoring of power apparatus.

- **Impact of the energy transition on the security and quality of electric power system**

Energías de Portugal (EDP). June 2017 - December 2017. (Luis Rouco Rodríguez, Aurelio García Cerrada, Andrés Ramos Galán, Lukas Sigríst, Javier García González)

The aim of this research project is to assess the impact of the energy transition on the security and the quality of the electric power system and the contribution of EDP's thermal generation in Asturias region.

- **State of the art of unit commitment models**

XM. June 2017 - June 2018. (Andrés Ramos Galán, Pedro Sánchez Martín, Sonja Wogrin, Sara Lumbreras Sancho)

In this project we review the state of the art of short-term operation models with two complementary focuses: i) the first one emphasizing the representation of the transmission network and ii) the second one the thermal units. The latest objective of this review is to allow the development of a single model for supporting the short-term operation including both perspectives.

The state of the art review will include not only an academic point of view but also the mathematical specification and the computer implementation in models suitable for being used in the daily operation of the Colombian system done by the Dispatch.

- **Modeling at EXCOM of renewable generation assets, adjustment markets and integrated management of gas consumption**

Endesa Medios y Sistemas. July 2017 - June 2018. (Javier García González, Pedro de Otaola Arca)

The objective of this project is to incorporate in the model EXCOM the renewable generation assets, to conduct a joint management of the gas consumption, as well as to include the adjustment markets in the decision process.

- **Modelling of solid-state (or electronic) transformers for power system analysis**

Fundación Iberdrola España. September 2017 - August 2018. (Aurelio García Cerrada, Luis Rouco Rodríguez, Laura Casado Fulgueiras)

This project will investigate the application of solid-state transformers (SST) in the future electric power systems with a large penetration of generation based on power electronics. The project will:

(1) Develop a detailed model of a SST in SIMULINK+SimPowerSys in order to study the behaviour of all its elements in detail (electronic converters and high-frequency transformer).

(2) Develop a simplified model for the average variables of the converter (no switching) in order to represent those aspects of interest in a system-wide analysis.

(3) Build a software tool to carry out small-signal analysis of electrical grids with electronic power converters. This tool will deal with many types of distributed generators with contribution of electronic converters and with the SST model developed previously.

(4) Study various control possibilities for a SST in a power system with a large penetration of electronic generation.

(5) Study the design of stabilisers for power converters in a power system with a large penetration of electronic generation. The study will consider local and global measurements.

The study must be applicable to a medium-size grid, avoiding micro-grids explicitly.

- **Tools and methodologies for energy planning under uncertainty**

XM. November 2017 - December 2018. (Andrés Ramos Galán, Jesús María Latorre Canteli)

In this project we are going to introduce improvements in the two medium- and long-term energy planning models for the Colombian system. Both are integrated in a single tool sharing input data and output results and the piece of code that is suitable. The forecasted improvements are the following ones:

Introduction of a variable production function of hydro plants of relevant reservoirs

Optimal representation of the uncertainty for variables like hydro inflows, wind and solar power by means of scenario trees for being used in the energy planning model

Development of a simulation module of deterministic scenarios after the stochastic optimization solution

Development of a synthetic multivariate series generator for hydro, solar and wind generation to be used in the energy planning model

- **Short- and medium-term risk analysis in electricity markets. Improvements in the asset representation**

Enel Iberoamerica S.R.L. January 2018 - December 2018. (Antonio Bello Morales, Javier Reneses Guillén, Rodrigo Alejandro de Marcos Peirotén, Geovanny Alberto Marulanda García)

The aim of this project is to continue with the developments of the ACUARIO tool. In particular, the improvement in the representation of the different assets modeled in ACUARIO is addressed. Continued support is also being given on the use of the tool and the interpretation of the results.

- **Long-term risk analysis in the electricity markets. Maintenance of the ARIES tool**

Enel Iberoamerica S.R.L. January 2018 - December 2018. (Antonio Bello Morales, Javier Reneses Guillén, Rodrigo Alejandro de Marcos Peirotén)

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

- **Medium and long term gas portfolio risk modeling**

Enel Iberoamerica S.R.L. January 2018 - December 2018. (Jesús María Latorre Canteli, Javier Reneses Guillén, Antonio Bello Morales, Celia Mosácula Atienza)

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

- **Medium- and long-term planning in the Iberian electricity market. Integration of hourly executions**

Enel Iberoamerica S.R.L. January 2018 - December 2018. (Antonio Bello Morales, Javier Reneses Guillén, Daniel López Rodríguez, Alberto Orgaz Gil, Leopoldo Javier Cabrera Azpilicueta)

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

- **Operation and planning of the Iberian natural gas market: hub representation and Monte Carlo executions**

Enel Iberoamerica S.R.L. January 2018 - December 2018. (Jesús María Latorre Canteli, Javier Reneses Guillén, Antonio Bello Morales, Ángel Rosso Mateo, Diego Martínez Morales, Aurora del Valle Díez)

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

- **Support in forecasting and optimizing the operation in electricity markets**

Enel Iberoamerica S.R.L. January 2018 - December 2018. (Javier Reneses Guillén, Antonio Bello Morales, Alberto Orgaz Gil, Leopoldo Javier Cabrera Azpilicueta, Geovanny Alberto Marulanda García)

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

- **Forecasts and analysis of the short- and medium-term operation in the Spanish extrapeninsular power systems**

Enel Iberoamerica S.R.L. January 2018 - December 2018. (Antonio Bello Morales, Javier Reneses Guillén, Daniel López Rodríguez)

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

- **The energy company of the future electrification in developing countries**

Shell Foundation. January 2018 - December 2018. (José Ignacio Pérez Arriaga, Fernando de Cuadra García, Carlos Mateo Domingo, Andrés González García, Pedro Ciller Cutillas)

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

- **Simulation and sizing of hybrid systems based on energy storage systems**

Gas Natural Fenosa. January 2018 - March 2019. (Enrique Lobato Miguélez, Lukas Sigrist, José María Fernández de Bobadilla Navarrete)

Optimal Simulation and sizing of hybrid systems based on batteries for different business models.

- **Expande. Integration with Valsa and developments for long-term analysis**

Endesa S.A. January 2018 - July 2018. (Efraim Centeno Hernáez, Diego Alejandro Tejada Arango)

Improvement of methods and tools used by Endesa for long-term studies. Special attention was paid to investment in renewable energy plants and adequate representation of storage.

- **VALSA-EXPANDE integration and developments for the long-term analysis**

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

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

- **VALUE in a grid and cloud computing environment**

Enel Iberoamerica S.R.L. March 2018 - June 2018. (Javier Reneses Guillén, Antonio Bello Morales, Alberto Orgaz Gil)

This project addresses the digitalization of VALORE with its integration in a cloud and grid computing environment, which will give great value to this tool in Endesa's decision-making process, both in terms of execution times and in regarding the volume of data that may be generated in the forecast and its visibility.

- **Predictive models in healthcare**

Medsavana, S.L. June 2018 - June 2019. (Sara Lumbreras Sancho)

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

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

This proposal describes the future collaboration between the Technological Research Institute and Savana, which has the fundamental objective of accelerating the development of predictive models as well as the dissemination of research results.

- **Development of scenarios of Spanish island power systems**

Endesa Generación, S.A. July 2018 - December 2018. (Lukas Sigrist, Luis Rouco Rodríguez, Clara Jiménez Serrano)

The aim of the project is to determine the characteristics of a battery storage system to reduce reserve requirements and improve frequency stability of the island power system of Menorca. The project will also show how the battery storage system associated to a conventional generator contributes to the fulfilments of the connection requirements of this generator. The project will finally show how the hybrid generator fits into the operational procedure and the economic regulation of the Spanish isolated systems.

3.2.1.1.2 Public funding

- **Economics of energy efficiency in the residential and transport sectors in Spain**

Ministerio de Economía y Competitividad. January 2014 - December 2017.
(Pedro Linares Llamas)

The project is divided into four lines of work, that are related but relatively independent, in whose development "interested entities" that participate in this project will be essential. The first deals with the demand for electricity and the importance of information to introduce EE measures, through the use of field experiments. A second line deals with the effectiveness of EE certificates of housing, with a hedonic approach and/or with the use of choice experiments. The third line refers to the calculation of the price elasticity of demand for energy-efficient vehicles in Spain. Finally, the project will incorporate distributional analyses, as energy poverty has become an important issue that is obviously related to energy demand and policies to promote EE.

Project funded by Ministerio de Economía y Competitividad.



- **Beyond state-of-the-art technologies for re-powering ac corridors & multi-terminal hvdc systems**

European Commission. September 2014 - September 2018. (Javier García González, Michel Rivier Abbad, Quanyu Zhao)

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

Video [here](#)

Video [here](#)

Video [here](#)

Video [here](#)

Video [here](#)

Project funded by European Union, within Seventh Framework Programme:



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

Ministerio de Economía y Competitividad. January 2015 - December 2018.
(Andrés Ramos Galán, Sara Lumbreras Sancho, Rafael Espejo González)

This task is divided in two:

- Micrositing, i.e., location of the wind turbines in a farm area

The effect of the separation of the wind turbines are introduced in a wind farm layout design model, considering the power output results obtained from CFD models for many possible separation steps. The ultimate objective is to define the optimal micrositing of the wind turbines.

- Transmission network impact of wind farms.

In a second step, an advanced optimization model capable to represent the complexity of the transmission network is developed.

Project funded by Ministerio de Economía y Competitividad.



- **Challenges of Universal Access to modern energy, and their impact on climate change. Models to support decision-making**

Ministerio de Economía y Competitividad. January 2015 - March 2018. (Rafael Palacios Hielscher, José Ignacio Pérez Arriaga, Andrés González García)

AUNE is a tool-kit that facilitates that electrification agencies and governments of developing countries interact with private companies to define viable business models to provide universal energy access.

To build strategies for universal access to energy services that are clean, reliable and affordable for cooking, heating, lighting, health, communications and productive uses requires tools that allow a careful assessment, centered in the

diverse present and future needs of the beneficiaries and in their capacities, bringing together suitable innovative technologies, business initiatives, frontier financing and regulatory mechanisms according to the country strengths, to make use of the limited resources in an efficient manner.

A problem of this magnitude cannot be seriously approached without private capital and, most likely, with the serious involvement of major energy companies. However, decentralized approaches either transitory or not cannot be ruled out and they are already taking place. This will happen only if an attractive and sustainable business model can be defined with the participation of the concerned communities. This project proposes to create a suite of computer models and methodologies that support global and local decision-making of governments, companies and practitioners, and that contribute meaningfully to the achievement of universal access to modern energy services, considering altogether the impacts over climate change and other energy policies.

Project funded by Ministerio de Economía y Competitividad.



- **Tools for the analysis and simulation of hybrid power systems HVDC-VSC multiterminal + HVAC (ENE2014-57760-C2-1-R)**

Ministerio de Economía y Competitividad. January 2015 - March 2018. (Aurelio García Cerrada, Luis Rouco Rodríguez, Juan Luis Zamora Macho, Ignacio Egido Cortés, Pablo García González, Lukas Sigrist, Miguel Ochoa Giménez, Francisco Javier Renedo Anglada, Laura Casado Fulgueiras)

This project is part of a bigger one in collaboration with Universidad de Alcalá de Henares: «Contributions to the architecture, modelling and control of HVDC grids and their integration with existing HVAC systems. A key challenge for a sustainable future of power systems» where IIT will be responsible for the following tasks/objectives:

Ob1: Development of tools for the simulation of hybrid (HVDC-VSC/HVAC) power systems with various detail levels.

Ob2: Investigation of control and operation alternatives for hybrid (HVDC-VSC/HVAC) power systems.

Ob3: Development of tools for the analysis of power quality in hybrid (HVDC-VSC/HVAC) power systems.

Ob4: Stability-related analysis of hybrid (HVDC-VSC/HVAC) power systems (transient stability and small-signal stability).

Ob5: Investigation of algorithms for detection and protection of faults in DC networks.

Project funded by Ministerio de Economía y Competitividad.



- **Obligations and penalties in capacity mechanisms to maximize security of supply in a context of a large penetration of intermittent generation**

Ministerio de Economía y Competitividad. October 2015 - December 2017. (Pablo Rodilla Rodríguez, Carlos Batlle López, Inés Usera Rodés, Ignacio Herrero Gallego)

This task, involved in the taskforce "Modeling design for the development of new methodologies to allow for an efficient integration of renewable energy resources in electric power networks and markets" developed by the IIT in the context of the WINDINSPIRE project, aims at developing economic models to support the analysis of the most efficient design elements of capacity market mechanisms, in a context of increasing variability and intermittency.

It is split in two subtasks:

- Analysis of the suitability of including long-term fuel contract obligations in capacity markets.
- Analysis on the impact of explicit penalty schemes in capacity mechanisms.

Project funded by Ministerio de Economía y Competitividad.



- **Short-term market mechanisms and pricing rules to enhance incentives for intermittent resources to improve forecasting and generation management tools**

Ministerio de Economía y Competitividad. October 2015 - December 2017. (Pablo Rodilla Rodríguez, Carlos Batlle López, Ignacio Herrero Gallego)

The main objective of this task is the development of a simulation model to allow to evaluate and to make recommendations on the most efficient way to calculate and determine short to very short-term schedules and prices in both the US and EU market contexts.

Project funded by Ministerio de Economía y Competitividad.



• **Overcoming technological, economic, and regulatory barriers to the development of HVDC supergrids (ENE2015-67048-C4-2-R)**

Ministerio Economía y Competitividad - ENE2015-67048-C4-2-R (MINECO/FEDER), Fondo Europeo de Desarrollo Regional (FEDER) - ENE2015-67048-C4-2-R (MINECO/FEDER). January 2016 - December 2018. (Luis Olmos Camacho, Michel Rivier Abbad, Javier García González, Francisco Miguel Echavarren Cerezo, Quanyu Zhao, Deniz Sun)

This project aims at facilitating the development and operation of HVDC grids in a market context through several interrelated research lines:

- Definition of benefit (and cost) allocation schemes for HVDC infrastructures
- The design of market developments to be implemented to facilitate the integration of RES generation in the system and the grid
- The modeling of the operation of HVDC grids in a market context (considering them accurately enough in the system dispatch and operation planning problems).

Project funded by Ministerio de Economía y Competitividad.



Project funded by Fondo Europeo de Desarrollo Regional (FEDER).



- **Open phase detection system for start-up transformers in nuclear generating stations (RTC-2016-5160-3)**

Ministerio de Economía, Industria y Competitividad. March 2016 - December 2019. (Luis Rouco Rodríguez, Enrique Lobato Miguélez, Francisco Miguel Echavarren Cerezo, Kai Doenges)

The aim of this project is the development of a detection system of open phase conditions in the start-up transformers of nuclear generating stations. The challenge comes from the fact that start-up transformers are at no load. The project involves simulation studies, development of small-scale laboratory prototypes and the implementation of a full scale prototype in Cofrentes nuclear generating station.

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



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de Desarrollo Regional
"Una manera de hacer Europa"



- **Navigating the roadmap for clean, secure and efficient energy innovation**

European Commission. April 2016 - April 2019. (Sara Lumbreras Sancho, Andrés Ramos Galán, Luis Olmos Camacho, Quentin Ploussard)

The overarching goal of SET-Nav is to support strategic decision making in Europe's energy sector, enhancing innovation towards a clean, secure and efficient energy system. It prescribes a wide range of analyses in order to better understand the complex links, interactions and interdependencies between the different actors, the available technologies and the impact of the different interventions in the energy system. To meaningfully contribute to the call objectives requires a large modelling portfolio. To ensure focus on the most important aspects and policy relevance, industry partners and stakeholders with varying perspectives should be involved from start to finish.

This leads up to the three key objectives of SET-Nav:

1) Enhance modelling capacities to increase understanding of interactions and interdependencies between actors, technologies and policy interventions in

Europe's energy system.

- 2) Provide model-based decision support for enhancing energy innovation towards a clean, secure and efficient energy system – through strategic policy analyses tackling relevant technology and policy options, complemented by detailed comparative assessments of energy transformation pathways.
- 3) Ensure a proper research orientation and a high impact through a continuous and in-depth stakeholder involvement and dialogue.

Project funded by European Union, within Horizon 2020 Programme:



- **Promotion of mini-grids for rural electrification**

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. September 2016 - December 2017. (José Ignacio Pérez Arriaga, Fernando de Cuadra García, Andrés González García, Pedro Ciller Cutillas)

Uganda's low electrification rate of around 15% is one of the major challenges for economic development and poverty reduction, with business, education, health and communication services suffering. With 70% of the population living outside the cities, the on-grid projects foreseen nationally leave vast areas of the country and a huge section of the population without access to electricity. The promotion of Mini-Grids for Rural Electrification (Pro Mini-Grids) project addresses the biggest gap in Uganda's electrification agenda, this being the very poor rate of progress in rural electrification, from an estimated 1% in 2001 to around 7% in 2013. In response to this issue, government and development partners have sought to find ways to accelerate access to electricity in order to meet the needs of the rural population.

- **Strategic network and generation expansion planning under uncertainty in the electricity market**

Ministerio de Economía, Industria y Competitividad. December 2016 - December 2019. (Sonja Wogrin, Isaac Camilo González Romero, Tomás Gómez San Román, Efraim Centeno Hernández, Diego Alejandro Tejada Arango)

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**

European Commission. December 2016 - May 2020. (Rafael Cossent Arín, Pablo Frías Marín, José Pablo Chaves Ávila, Leandro Lind, Lorenzo August Simons, Michel Rivier Abbad)

The InteGrid project intends to bridge the gap between citizens and technology in the area of smart distribution grids. The main objectives are:

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

In order to achieve these goals, three large demonstration sites have been selected to be part of InteGrid: 1) «From smart grid to disruptive business models» (Lisbon district, Portugal), «Consumer engagement towards sustainability» (Stockholm, Sweden), «Self-sustainability facilitation» (Ljubljana, Slovenia).

Video [here](#)

Project funded by European Union, within Horizon 2020 Programme:



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.

- **Damping of inter-area oscillations**

Red Eléctrica de España (REE). October 2017 - March 2018. (Luis Rouco Rodríguez, Lukas Sigrist, Francisco Javier Renedo Anglada)

The aim of this project is to review and to improve the stabilizing means of the mainland Spain power plants to contribute to the damping of the low frequency oscillations (0.15 Hz) of the Continental Europe power system.

- **Mozambique geospatial options analysis towards universal electrification**

World Bank. May 2018 - December 2018. (Carlos Mateo Domingo, Andrés González García, José Ignacio Pérez Arriaga, Fernando de Cuadra García, Pedro Ciller Cutillas)

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

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

- **EU Energy system: modelling, data collection and studies**

European Commission. June 2018 - May 2020. (Luis Olmos Camacho, Carlos Mateo Domingo, Andrés Ramos Galán, Tomás Gómez San Román, Rafael Cossent Arín)

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

the future evolution and operation of the system and draw conclusions on these analyses.

3.2.1.2 Consultancy and technological support

3.2.1.2.1 Private funding

- **Mid- to long-term model for prospective analysis of the electric market**

Gas Natural Fenosa. July 2016 - December 2017. (Pablo Rodilla Rodríguez, Carlos Batlle López, Ignacio Herrero Gallego, Paolo Mastropietro)

Mid- to long-term model for prospective analysis of the electric market.

- **Design of a tool to support mid-term analysis of the Mexican electricity market**

Iberdrola S.A, Iberdrola Generación España, S.A.U. September 2016 - December 2017. (Michel Rivier Abbad, Andrés Ramos Galán, Luis Olmos Camacho, Marta Irene Fera Cerrada)

The project addresses the design and development of a tool devoted to the medium-term analysis of the Mexican electricity market. The model focuses on the annual operation simulation of the Mexican electricity system. The model includes those aspects that better characterize that system and the factors that explain the most the market price behavior. The project consist of a first phase to design, develop and validate the tool, and a second phase to prepare case studies and to analyze, qualitatively and quantitatively, the results obtained.

- **Analysis, parameter adjustment, validation and commissioning of the AGC system of Axpo Iberia**

Invesyde S.L. December 2016 - September 2017. (Ignacio Egido Cortés, Fidel Fernández Bernal)

After an analysis of the AGC system in Axpo Iberia, Axpo Iberia has decided not to use its own AGC but to implement the ACG-IIT through the purchase of a license for its control zone. This project includes the integration of the AGC-IIT in the control system of Axpo Iberia and the necessary FAT and SAT tests to verify its correct integration and operation.

- **Development of scenarios of Spanish island power systems**

Endesa Generación, S.A. December 2016 - September 2017. (Luis Rouco Rodríguez, Lukas Sigrist, Laura Casado Fulgueiras)

The aim of this project is the development of scenarios of the Spanish island power systems. Power flow and short circuit models corresponding to present (2017) and future (2020) scenarios will be developed. Dynamic models will be updated and validated comparing simulations with actual responses.

- **Generation expansion and renewable technologies**

Enel Iberoamerica S.R.L. January 2017 - December 2017. (Efraim Centeno Hernández, Sonja Wogrin, Diego Alejandro Tejada Arango)

The objectives of the project include a strategic analysis in order to consider which factors among those that currently determine the Spanish and Portuguese electric system are the most relevant for generation expansion as well as the best way to address them, the continuous update of the methods that are currently used and the assistance in the usage of the models and tools that are active nowadays.

- **Maintenance of HAPER tool**

Iberdrola Renovables Energías, S.A. April 2017 - December 2017. (Lukas Sigrist, Ignacio Egido Cortés)

The aim of the project is the maintenance of the HAPER tool during 2017. HAPER is a tool for losses analysis in wind farms connected to a common infrastructure.

- **The role of natural gas in the Spanish energy sector in 2030**

Enagás S.A. May 2017 - September 2017. (Pedro Linares Llamas, José Pablo Chaves Ávila, José Carlos Romero Mora)

The goal of this consultancy is to assess the contribution of natural gas to the different scenarios that may arise in the Spanish energy sector in 2030, and considering the uncertainty related to different parameters.

- **Consulting services for network studies within mediterranean master plan of interconnections**

Mediterranean Transmission System Operators (Med-TSO). May 2017 - February 2018. (Francisco Miguel Echavarren Cerezo, Luis Rouco Rodríguez, Andrés Ramos Galán)

The objective of this collaboration is to evaluate the capacity of the network among Mediterranean countries to deal with future South to North energy transfers in the 2030 horizon, and also to assess about potential reinforcements. To achieve that, some processes have to be accomplished.

A set of long term scenarios has to be defined and built. Those scenarios require a reference network of the Mediterranean Power System. Countries involved are Algeria, France, Italy, Morocco, Portugal, Spain, Tunisia, Albania, Cyprus, Egypt, Greece, Israel, Jordan, Libya, Lebanon, Montenegro, Palestine, Slovenia, Syria and Turkey. A clustering criteria to split it into electrical regions has to be agreed. Also, different snapshots have to be considered, attending to different profiles of load, generation and energy transfer through interconnections.

The selected scenarios are analyzed. Power flow considering N and N x situations are run to identify potential overloaded regions and to compute sensitivities and participation factors. Considering the results, potential reinforcements are analyzed considering both technical and economic criteria. The final product is the "Mediterranean Master Plan of Interconnections".

- **Market design for a large share of variable renewable energy in the Chilean national electricity system**

Generadoras de Chile AG. June 2017 - September 2017. (Pablo Rodilla Rodríguez, Paolo Mastropietro, Ignacio Herrero Gallego, Tomás Gómez San Román, Carlos Batlle López)

The study contains four sections:

1. A detailed literature review of the various international experiences regarding how high levels of VRE penetration into different electric energy markets has been addressed.
2. Identification of market failures that prevent efficient investment in VRE, conventional energy and storage capacity.
3. Identification of best practices of solutions to high penetration of variable and intermittent energies such as the creation of ancillary services or other markets.
4. The report must propose, based on efficient economic criteria and market foundations that currently govern the Chilean electric energy generation sector, a policy that complement and/or modify Chile's current regulations as well as the sequence and time frames necessary to implement them.

- **Energy access: scoping the energy company of the future**

Shell Foundation. July 2017 - October 2018. (Fernando de Cuadra García, Pedro Ciller Cutillas, Andrés González García)

The objective of the Comillas team is to contribute to frame some of the aspects that will need to be addressed, specifically focused on the in-depth analysis of the relevant literature and the utilization of analytical tools, and where needed the development of new models to understand how the electric power sector in least developed countries will face the challenge of Universal Access to Electricity in the coming decade.

- **Prospective analysis of the sources of value of a solar farm plus storage system in the contexts of CAISO and ERCOT**

Iberdrola Renovables Energía, S.A.U. September 2017 - September 2017. (Carlos Batlle López, Pablo Rodilla Rodríguez, Ignacio Herrero Gallego)

The purpose of this project is to develop an analysis on the potential sources of value of a storage system in the context of CAISO and ERCOT markets. In particular, the study focuses on conducting a first exploration of the potential synergies and added values that the battery could bring in conjunction with a solar PV installation.

- **Prospective analysis of the sources of value of a solar plant system plus storage in the contexts of CAISO and ERCOT**

Iberdrola. September 2017 - October 2017. (Pablo Rodilla Rodríguez, Ignacio Herrero Gallego, Carlos Batlle López)

Prospective analysis of the sources of value of a solar plant system plus storage in the contexts of CAISO and ERCOT

- **Support in the development of an electricity market model and in market studies in the Iberian Market**

Invesyde S.L. September 2017 - March 2018. (Javier Reneses Guillén)

This project consists of the collaboration of IIT in a market report focused on a series of renewable assets in Spain. In particular, a forecast of future electricity prices and revenues for 10 wind farms is carried out.

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

- **Individual control of hydro units within the Endesa AGC control**

Endesa. October 2017 - October 2018. (Ignacio Egidio Cortés, Luis Rouco Rodríguez, Kai Doenges, Lukas Sigríst)

Endesa has a primary EMS in Madrid and secondary EMSs in Montearenas, Lérida and Sevilla. The AGC control in the primary EMS sends control signal to each individual thermal units and to the secondary EMSs. Each secondary EMS then distributes the received signal among the individual hydro units. This research project analyses the possibility of sending control signal from the primary EMS to each individual hydro unit and studies the due changes to allow this control.

- **Technical assistance for the integration and commissioning of the AGC-IIT in the Scada of Alpiq**

ALPIQ. December 2017 - September 2018. (Ignacio Egidio Cortés, Luis Rouco Rodríguez)

Alpiq already has a licence of the AGC-IIT software integrated in the SCADA from Nucleo. Alpiq has changed its Scada provided, so AGC-IIT needs to be commissioned in the new SCADA. In this project the services of integration and commissioning of AGC-IIT in the new SCADA are provided.

- **Maintenance of HAPER tool**

Iberdrola Renovables Energías, S.A.U. December 2017 - December 2017. (Lukas Sigríst, Ignacio Egidio Cortés)

The aim of the project is to extend the functionalities of the HAPER tool during 2018. HAPER is a tool for losses analysis in wind farms connected to a common infrastructure.

- **The future of the Spanish electricity sector**

Iberdrola. April 2018 - September 2018. (Tomás Gómez San Román, Pedro Linares Llamas, Pablo Rodilla Rodríguez, Michel Rivier Abbad, Pablo Frías Marín, Álvaro Sánchez Miralles, Rafael Cossent Arín, Luis Olmos Camacho, Andrés Ramos Galán, Luis Rouco Rodríguez)

Report that summarizes the main challenges and policies for guiding the transition to a more decarbonized electricity system in general, and in particular including the peculiarities of the Spanish system.

- **Analysis of the Spanish nuclear power plants' lifespan extension, from the plant owners perspective**

Iberdrola S.A. May 2018 - December 2018. (Michel Rivier Abbad, Tomás Gómez San Román, José Pablo Chaves Ávila, Francisco Martín Martínez, Timo Gerres)

The objective of the project is to analyze the profitability of the extending the lifespan of the Spanish nuclear power plants, from the perspective of the owners of such plants. First, for a set of future scenarios, expected market revenues for those plants are computed for the lifespan extension period, in a high renewable generation penetration environment due first to the expected reduction of their investment costs, and second to the renewable production quotas set by the European Commission. It follows an evaluation of the costs to be faced by those power plants during the lifespan extension period, including the costs they must face to be able to extend the lifespan of those plants. Finally, based on the revenues and costs estimations, the profitability, for the owners of such plants, of extending their lifespan is assessed.

- **Study of the electrical interconnection between Bolivia and Peru**

Banco Interamericano Desarrollo (BID). June 2018 - February 2019. (Andrés Ramos Galán, Luis Olmos Camacho, Michel Rivier Abbad, Jesús María Latorre Canteli)

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

3.2.1.2.2 Public funding

- **ESLA: long-term scenarios builder**

Red Eléctrica de España (REE). January 2017 - December 2017. (Francisco Miguel Echavarren Cerezo)

ESLA is a tool for building long term power system scenarios. Long term power system scenarios are used for a wide variety of studies by the Security of Supply Department of Red Eléctrica de España. This project is aimed at providing user support, maintenance and extensions of several algorithms.

- **Consultancy services grid integration technical study to support deployment of distributed solar PV in Viti Levu - Fiji**

International Renewable Energy Agency (IRENA). September 2017 - December 2017. (Lukas Sigrist, Luis Rouco Rodríguez, Ignacio Egido Cortés, Francisco Javier Renedo Anglada)

The objective of the project is to determine the maximum amount of PV generation that can be installed in the island system of Viti Levu. The study starts by determining the maximum amount at zonal level in distribution grids before analyzing the impact at system level.

- **Re-design of the methodology for the firm capacity calculation of non-conventional renewable resources**

Supervisor de la Inversión en Energía y Minería (OSINERGMIN). October 2017 - May 2018. (Paolo Mastropietro, Pablo Rodilla Rodríguez)

The goal of a capacity mechanism is to complement the energy market, by remunerating the supposed contribution of each resource to the security of supply in the medium and long term. In order to achieve this objective, the regulation must define a metric that allow estimating such contribution. This metric, in capacity-constrained systems, is defined as firm capacity.

The design of a methodology for the calculation of the firm capacity has been complicated by the penetration of high shares of renewable technologies. The objective of this project is to support the Peruvian regulator in the elaboration of a methodology to define the firm capacity of non-conventional renewable resources.

3.2.1.3 Services and analysis projects

3.2.1.3.1 Private funding

- **Report about the impact of the new hydrological plans on the remuneration of a hydroelectric power plant IBG**

Iberdrola Generación España, S.A. May 2016 - July 2018. (Andrés Ramos Galán)

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

- **Technical support for the tools EXCOM, EXLA, GEDEX AND SIROCO**

Enel Iberoamérica S.R.L. January 2017 - December 2017. (Javier García González, Francisco Alberto Campos Fernández, José Portela González, Antonio Muñoz San Roque)

The objective of this project is to provide ENDESA with technical support and maintenance of the tools EXCOM, EXLA, GEDEX and SIROCO developed by IIT.

- **Maintenance of Viesgo tools and consultancy**

Viesgo. April 2017 - March 2018. (Enrique Lobato Miguélez, Ignacio Egidio Cortés, Kai Doenges)

Maintenance of Viesgo tools and consultancy 2017-2018

- **Development of European energy market under the context of global energy interconnection**

Global Energy Interconnection Research Institute Europe GmbH. July 2017 - November 2017. (Luis Olmos Camacho, Michel Rivier Abbad)

The objectives of this collaboration are identifying the main drivers and obstacles to the integration of the several electricity markets belonging to different regions and, considering these, analysing the integration, or

coordination, of the energy markets and systems in the Internal Electricity Market of the European Union and a neighboring region. This problem is analysed from a conceptual point of view.

- **Technical support to the study of the impact of electrical supply system of Quito Metro Line 1 on Petroecuador pipelines**

EPRail Research and Consulting. September 2017 - August 2018. (Luis Rouco Rodríguez)

The aim of this project is to provide EPRail technical support to the study of the impact of electrical supply system of Quito Metro Line 1 on Petroecuador pipelines.

- **Jamaica - Tariffs**

MRC Consultores. September 2017 - June 2018. (Rafael Cossent Arín, Tomás Gómez San Román, Andrés Ramos Galán, José Pablo Chaves Ávila, Ibtihal Abdelmotteleb, Marta Irene Feria Cerrada, Carlos Mateo Domingo, Fernando Emilio Postigo Marcos)

The objectives of this project are to:

i) Assist JPS in formulating a position on the regulatory framework for power wheeling

and auxiliary connections inclusive of requirements to be included in the national grid codes.

ii) Set wheeling charges and electricity tariffs based on a long run marginal cost of

service study to promote open access by third parties to transmission and distribution

networks, economic efficiency of production and consumption and ensure financial

viability of the electricity sector, while taking into account social and equity considerations. Efficient wheeling charges are a necessary condition for open access to

the networks and for enhancing competition.

iii) Develop the institutional capacity within the tariff unit to design economically

efficient tariffs based on marginal cost principles.

- **Computation of induced voltages in isolated cables**

Gas Natural Fenosa Generación. October 2017 - December 2017. (Francisco Miguel Echavarren Cerezo, Luis Rouco Rodríguez)

Current flow through a cable may induce voltages along other cables placed in parallel. Technical staff of CCC Aceca are interested in the computation of the aforementioned induced voltages, in order to take decisions about the need of using individual protection equipment when maintenance works in cables are done close to energized cables.

Objective of the project is to compute those induced currents for a set of cable configurations.

- **Regulatory analysis of the Brazilian energy sector with a focus on natural gas distribution and reserve energy auctions for electricity**

KPMG S.A. December 2017 - January 2018. (Paolo Mastropietro, Pablo Rodilla Rodríguez)

The project provides a review of the Brazilian energy regulation. The two main topics covered by the review are as follows:

- i) Regulation of the natural gas sector (evolution of the regulatory framework), with a focus on the distribution segment and the tariff review processes in different states.
- ii) Regulation of the power sector (organisation of the market), with a focus on the design of long-term energy auctions.

- **Technical support for the tool SIROCO**

Enel Iberoamérica S.R.L. January 2018 - December 2018. (Francisco Alberto Campos Fernández, José Portela González)

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

- **Ampacity studies for the Hashfela corridor of the Israel railway electrification project**

Sociedad Española de Montajes Industriales (SEMI). March 2018 - May 2018. (Francisco Miguel Echavarren Cerezo, Luis Rouco Rodríguez)

The study will consist of determining the temperature of the cables according with some current profile among the installation. If temperatures would be unacceptable, SEMI will propose an alternative configuration.

Computation of core conductor temperatures will be carried out using a modified version of a three-phase model for ampacity computation, adapted to deal with one-phase railway feeders.

- **Impact studies of wind farms in Soria and Zaragoza**

Capital Energy S.A. July 2018 - July 2018. (Lukas Sigríst)

The objective is to analyze the capacity of the grid to evacuate wind farm generation in steady state under normal and N-1 operating conditions.

- **Disruptive technologies in the electricity sector**

Banco Interamericano de Desarrollo. August 2018 - November 2018. (José Pablo Chaves Ávila, Pablo Dueñas Martínez, José Pablo Chaves Ávila)

This project consists in describing the disruptive technologies in the electricity sector considering the following aspects:

- 1) A quick introduction showing the key disruptive technologies.
- 2) The reason why these technologies are disruptive or how they could dramatically change the industry.
- 3) The advances pointing out the future for these technologies and what are the technical barriers that need to be surpassed to be actual implemented.

3.2.1.3.2 Public funding

- **Power supply with renewable sources for isolated rural communities in the Napo river area (Amazonia, Perú)**

Agencia Española de Cooperación Internacional para el Desarrollo (AECID). June 2017 - December 2017. (Fernando de Cuadra García, Pedro Ciller Cutillas)

Joint initiative with the support of the Spanish Cooperation and Development Agency (AECID) for the basic supply of electricity to isolated rural communities in the area of the river Napo basin (Amazonia, Perú)

- **Introducing a multi-nodal pricing system in Colombia: assessing the options, conditions, benefits and transitional arrangements**

World Bank. February 2018 - June 2018. (Pablo Rodilla Rodríguez, Paolo Mastropietro)

The main objective of the project is to assess the pros and cons derived from establishing a multi-nodal pricing system in the Colombian wholesale market.

- **Designing binding day ahead and intraday markets in the Colombian electricity system**

Comisión de Regulación de Energía y Gas (CREG). June 2018 - November 2018. (Pablo Rodilla Rodríguez, Paolo Mastropietro, Luiz Augusto Nobrega Barroso)

The study contains four sections:

- 1.-Study the CREG proposal CREG 004B of 2016, as well as the proposal by the market operator XM S.A.S.P., and other studies conducted in this area by the sector. Review of the international experience that has been carried out in these studies on the design of the spot energy market.
2. Complete revision of Resolutions CREG 024 and 025 of 1995, as well as all those that modify them. Likewise, the agreements of the CNO that have some relation to the subject under study must be reviewed.
3. Development of a normative proposal aimed at the implementation of a binding dispatch, intraday markets, and balance mechanisms.
4. Development of a regulatory proposal regarding the commercial treatment of constraints and their settlement in the presence of a binding dispatch, intraday markets and balancing mechanisms.

3.2.2 Industrial Systems Area

3.2.2.1 Research and development projects

3.2.2.1.1 Private funding

- **Railway traffic planning and management system for the new Mexico-Toluca line**

CAF Signalling. March 2015 - December 2017. (Asunción Paloma Cucala García, Antonio Fernández Cardador, Adrián Fernández Rodríguez)

The objective of this research project is the specification of the functionality of the railway traffic planning and management system for the new Mexico-Toluca line as well as its validation. This line is equipped with ERTMS and the specification of the system takes into account the requirements associated with the new ATO over ERTMS (ATOoERTMS)

- **Monitor X**

Energi Norge. October 2015 - September 2019. (Miguel Ángel Sanz Bobi)

The aim of the MonitorX-project is to develop a model and corresponding software prototypes for optimal lifetime utilization of hydropower components based on monitoring of technical condition and risk. The model integrate advanced systems for condition monitoring and fault diagnosis based on machine learning and artificial intelligence. This project is supported by the Research Council of Norway and there are an important number of partners cooperating.

IIT assist the project in developing advanced condition monitoring algorithms and integration of these algorithms with models for maintenance planning and optimization. IIT contribute with scientific advisory and consultancy in model developing. Furthermore, IIT is a partner for student exchange,

- **RNM- KSA as an energy exporter: the future of electricity networks**

Massachusetts Institute of Technology (MIT). November 2015 - November 2017. (Fernando de Cuadra García, Pedro Ciller Cutillas)

Support in the development of a new generation/transmission expansion planning model and use for the case of the Kingdom of Saudi Arabia. use of RNM model in the context of the REM initiative as supporting tool of the previous development and to execute the most complex cases.

- **Renewable generation with storage and intelligent prosumers for optimal operation of microgrids with selfconsumption**

Endesa Energía S.A. December 2015 - December 2017. (Álvaro Sánchez Miralles, Miguel Martín Lopo)

The goal of the project is to develop a technology for the high penetration of PV panels in households in the Graciosa island. This technology must be able to optimize the operation of the several microgrids, taking into account an active participation of the distributor, retailers and prosumers in the improvement of the energy efficiency of the energy system.

- **Local market place to provide ancillary services at distribution grid level: GRACIOSA project**

Endesa Distribución Eléctrica S.L. January 2016 - December 2017. (Álvaro Sánchez Miralles)

The objectives of the collaboration are:

O1: Designing a local market to provide ancillary services in the Graciosa island, out of the current regulatory context.

O2: Implementing this local market satisfying the basic needs of the distributor: active and reactive power constraints in real time.

O3: Publishing customer consumption (after a customer agreement) to the distributor.

- **Development of an explanatory model for the electricity energy demand of Spain and Portugal**

Enel Iberoamerica S.R.L. September 2016 - September 2017. (Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque, Guillermo Mestre Marcos)

The objective of this project is the development of an explanatory model for the electricity energy demand of Spain and Portugal. The model is aimed to quantify the individual effects of explanatory variables such as temperature and calendar.

- **VALSA-EXPANDE integration and developments for the long-term analysis (influence of renewable generation, distributed, electric vehicle, etc.)**

Enel Iberoamerica S.R.L. January 2017 - December 2017. (Francisco Alberto Campos Fernández, Salvador Doménech Martínez)

Valsa is a model for the long term assessment of the ancillary services of the Spanish system, as part of Morse model, developed by the Institute for Research in Technology (Instituto de Investigación Tecnológica, IIT) in collaboration with Endesa for strategic analysis of the evolution of this sector, especially when changes of the utilities structure, new regulations, or new generation technologies take place. The objective of this collaboration is the integration of platforms Valsa and Expande as well as the implementation and validation of procedures for the calculation of endogenous reserves and their use, which were discussed during the previous collaboration. Studies will also be carried out to analyze the influence of renewable and distributed generations, the electric vehicle, etc., in the long term.

- **Applying big data techniques to monitor and analysis of the strategic bidding behaviour in the Iberian electricity market**

Enel Iberoamerica S.R.L. January 2017 - December 2017. (Eugenio Francisco Sánchez Úbeda, Santiago Moreno Carbonell)

The primary aim of this project is the improvement of the information system and the methodology implemented for the analysis of the Iberian market operation and the characterization of participants bidding strategies.

Taking as input the information published by the Market and System Operators, the proposed methodology establish the most appropriate mechanisms of data mining for its treatment, with the purpose of analyzing the bidding behaviour of firms and their pricing of the different generation technologies.

- **Development of tools for medium and long-term analysis and prediction of the Spanish ancillary services markets**

Endesa Medios y Sistemas. January 2017 - December 2017. (Antonio Muñoz San Roque, José Portela González, Guillermo Mestre Marcos)

The main objectives of this collaboration are the development of a tool for the analysis and characterization of the behavior of the agents in the ancillary

services markets and the development of a recalibration tool for the long-term forecasting models.

- **Logistics management system for the bananas farm in Canarias**

EASYTEM SISTEAM S.L. June 2017 - January 2018. (Álvaro Sánchez Miralles, Carlos Rodríguez-Morcillo García, Javier Matanza Domingo, Miguel Martín Lopo, Eduardo Alonso Rivas)

The aim of the project is to make a commercial system based on smart labels to improve the traceability of the spanish bananas in Canary islands.

- **Cloud-connected distributed energy-efficiency system for dwellings with high penetration of renewables and storage. Impact analysis getting the most of heat pumps**

Endesa Energía, S.A.U. July 2017 - January 2018. (Álvaro Sánchez Miralles, Jaime Boal Martín-Larrauri, Francisco Martín Martínez, Antonio Vázquez Blanco, Miguel Martín Lopo)

After one year with real demonstrations (24x7) of the energy efficiency system STEMY+SPLODER (www.stemyenergy.com y www.sploder.es), this project will carry out an impact analysis (social, economic and environmental). Besides, an special analysis of the use of that last generation of heat pumps (air-water and water water) will be made. Finally, some user experience improvements will be introduced using the know-how obtained in the last year, for example, voice control.

- **Optimal design of ATO driving parameters for FGC**

Siemens Rail Automation S.A.U. July 2017 - February 2018. (Antonio Fernández Cardador, Asunción Paloma Cucala García, Adrián Fernández Rodríguez)

The objective of this project is the design and implementation of the efficient ATO speed commands in FGC railway line from Plaza de Cataluña to Sant Cugat. 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.

- **Short-term forecasting of competitors' offer curves in the Italian electricity market**

Enel SpA. September 2017 - February 2018. (Antonio Muñoz San Roque, Guillermo Mestre Marcos, José Portela González)

The main objective of the collaboration proposal is to develop and implement an integrated tool for the monitoring and recalibration of the short-term forecasting models of the zonal aggregated offer curves in the Italian Electricity Market.

- **Modelling of solid-state (or electronic) transformers for power system analysis**

Fundación Iberdrola España. September 2017 - August 2018. (Aurelio García Cerrada, Luis Rouco Rodríguez, Laura Casado Fulgueiras)

This project will investigate the application of solid-state transformers (SST) in the future electric power systems with a large penetration of generation based on power electronics. The project will:

- (1) Develop a detailed model of a SST in SIMULINK+SimPowerSys in order to study the behaviour of all its elements in detail (electronic converters and high-frequency transformer).
- (2) Develop a simplified model for the average variables of the converter (no switching) in order to represent those aspects of interest in a system-wide analysis.
- (3) Build a software tool to carry out small-signal analysis of electrical grids with electronic power converters. This tool will deal with many types of distributed generators with contribution of electronic converters and with the SST model developed previously.
- (4) Study various control possibilities for a SST in a power system with a large penetration of electronic generation.
- (5) Study the design of stabilisers for power converters in a power system with a large penetration of electronic generation. The study will consider local and global measurements.

The study must be applicable to a medium-size grid, avoiding micro-grids explicitly.

- **Modeling and forecasting of the demand for natural gas and electricity in Spain and Portugal**

Enel Iberoamerica S.R.L. October 2017 - December 2018. (Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque, Guillermo Mestre Marcos)

The objective of this project is modeling and forecasting of the demand for natural gas and electricity in Spain and Portugal.

- **Development of a pricing model and bonuses for an integrated waste management system**

Piedmont Asesoramiento de Negocio y Dirección S.L. October 2017 - May 2018. (Francisco Alberto Campos Fernández)

The objective of this collaboration is the development of a pricing model that allows a company that manage recyclable containers to analyze its incomes by carrying out impact studies on the cartons tariffs taking into account different market scenarios. In addition, the model will also guide the design of the containers through sensitivity analysis on the model, in certain parameters that subsidize/penalize specific elements of the containers.

- **Design and simulation of a micro-strip structure for delay line tuned at 60GHz**

KCode LLC. November 2017 - December 2017. (Francisco Javier Herraiz Martínez, Javier Matanza Domingo, Carlos Rodríguez-Morcillo García)

The objective of the collaboration is the design and simulation of a wireless tag to be used as a proof of concept for a future chipless RFID technology, that is being developed by KCODE company.

More specifically, the objective is to design a micro-strip structure, formed by a

delay line or group of delay lines (depending on simulation results), tuned at 60GHz.

- **Design of a multiband feeder with autoracking**

Prodetel S.A. December 2017 - May 2018. (Francisco Javier Herraiz Martínez, Javier Matanza Domingo, Carlos Rodríguez-Morcillo García)

The main objective of this project is the design of a multiband feeder (S and C frequency bands) with autotracking capability for aeronautic telemetry applications.

- **VALSA-EXPANDE integration and developments for the long-term analysis**

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

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

- **Applying data analysis and forecasting techniques to monitor and analysis of the strategic bidding behaviour in the Iberian electricity market**

Enel Iberoamerica S.R.L. January 2018 - December 2018. (Eugenio Francisco Sánchez Úbeda, Santiago Moreno Carbonell)

The primary aim of this project is the improvement of the information system and the methodology implemented for the analysis of the Iberian market operation and the characterization of participants bidding strategies.

Taking as input the information published by the market and system operators, the proposed methodology establish the most appropriate mechanisms of data mining for its treatment, with the purpose of analyzing the bidding behaviour of firms and their pricing of the different generation technologies.

- **Analysis of the use of battery and improvements in turbine-pump technologies for secondary reserve assesment**

Enel Iberoamerica S.R.L. January 2018 - June 2018. (Francisco Alberto Campos Fernández, José Portela González)

The purpose of the proposed project is to analyze and model in SIROCO the use of batteries as well as to improve the representation of the pumping-turbine technology taking into account its daily cycles, for secondary reserve generation and assesment.

- **Predictive diagnosis and preventive (on condition) maintenance of power train subsystems and components: ATS Subsystem and AdBlue Filter**

SATE, S.r.l. - Systems & Advanced Technologies Engineering. January 2018 - December 2018. (Miguel Ángel Sanz Bobi, Álvaro Sánchez Miralles, Pablo Calvo Báscones)

This project develops a predictive diagnostic algorithm and the corresponding software in Matlab for the After Treatment System (ATS) of the gases in a vehicle. Also the project develops a predictive diagnostic algorithm and the corresponding software in Matlab for the AdBlue filter component of a vehicle engine to be integrated in the Client off-board infrastructure that allows its condition-based maintenance.

- **Development of the data analytics tool HADES**

Endesa Medios y Sistemas. March 2018 - December 2018. (Antonio Muñoz San Roque, José Portela González)

The main objectives of this collaboration are the development of advanced forecasting models, the automation of the training and evaluation of the predictive models and the integration of IAMEX and IAM in HADES.

- **Modeling and forecasting of the demand for natural gas and electricity in Spain and Portugal**

Enel Iberoamerica S.R.L. June 2018 - December 2018. (Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque, Guillermo Mestre Marcos)

The objective of this project is modeling and forecasting of the demand for natural gas and electricity in Spain and Portugal. A probabilistic approach is used to fulfill this objective.

3.2.2.1.2 Public funding

- **Research programme on smart grids in Madrid**

Comunidad de Madrid. October 2014 - December 2018. (Aurelio García Cerrada, Juan Luis Zamora Macho)

This project will look into the application of smart grid technologies in Madrid. The analysis will be spelled out as follows.

(1) Devices and infrastructure: Application of power electronics devices to improve the present infrastructure.

(2) Operation level: Power-frequency control. Integration of renewable resources in micro-grids. Optimal energy dispatch. Management of energy storage.

(3) Management level: Application of computational intelligence (CI) to the prediction of the generation from renewable sources. Implementation of CI techniques in big data platforms to model the energy consumption from data collected by smart meters and sensors deployed in the system. Investigation on variable-pricing scenarios.

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

(5) Finally, a transversal study on the communications network for information

exchange between agents and devices will be carried out, with focus on low and medium voltage networks and their problems concerning latency and bandwidth.

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



Project funded by European Union, into European Social Fund.



- **Challenges of Universal Access to modern energy, and their impact on climate change. Models to support decision-making**

Ministerio de Economía y Competitividad. January 2015 - March 2018. (Rafael Palacios Hielscher, José Ignacio Pérez Arriaga, Andrés González García)

AUNE is a tool-kit that facilitates that electrification agencies and governments of developing countries interact with private companies to define viable business models to provide universal energy access.

To build strategies for universal access to energy services that are clean, reliable and affordable for cooking, heating, lighting, health, communications and productive uses requires tools that allow a careful assessment, centered in the diverse present and future needs of the beneficiaries and in their capacities, bringing together suitable innovative technologies, business initiatives, frontier financing and regulatory mechanisms according to the country strengths, to make use of the limited resources in an efficient manner.

A problem of this magnitude cannot be seriously approached without private capital and, most likely, with the serious involvement of major energy companies. However, decentralized approaches either transitory or not cannot be ruled out and they are already taking place. This will happen only if an attractive and sustainable business model can be defined with the participation of the concerned communities. This project proposes to create a suite of

computer models and methodologies that support global and local decision-making of governments, companies and practitioners, and that contribute meaningfully to the achievement of universal access to modern energy services, considering altogether the impacts over climate change and other energy policies.

Project funded by Ministerio de Economía y Competitividad.



- **Tools for the analysis and simulation of hybrid power systems HVDC-VSC multiterminal + HVAC (ENE2014-57760-C2-1-R)**

Ministerio de Economía y Competitividad. January 2015 - March 2018. (Aurelio García Cerrada, Luis Rouco Rodríguez, Juan Luis Zamora Macho, Ignacio Egido Cortés, Pablo García González, Lukas Sigrist, Miguel Ochoa Giménez, Francisco Javier Renedo Anglada, Laura Casado Fulgueiras)

This project is part of a bigger one in collaboration with Universidad de Alcalá de Henares: «Contributions to the architecture, modelling and control of HVDC grids and their integration with existing HVAC systems. A key challenge for a sustainable future of power systems» where IIT will be responsible for the following tasks/objectives:

Ob1: Development of tools for the simulation of hybrid (HVDC-VSC/HVAC) power systems with various detail levels.

Ob2: Investigation of control and operation alternatives for hybrid (HVDC-VSC/HVAC) power systems.

Ob3: Development of tools for the analysis of power quality in hybrid (HVDC-VSC/HVAC) power systems.

Ob4: Stability-related analysis of hybrid (HVDC-VSC/HVAC) power systems (transient stability and small-signal stability).

Ob5: Investigation of algorithms for detection and protection of faults in DC networks.

Project funded by Ministerio de Economía y Competitividad.



- **Real proven solutions to enable active demand and distributed generation flexible integration through a fully controllable LV and MV distribution grid**

European Commission. January 2015 - December 2017. (Álvaro Sánchez Miralles, Miguel Ángel Sanz Bobi, Peyman Mazidi, Miguel Martín Lopo, Christian Francisco Calvillo Muñoz)

The main objectives of this project are: to improve the observability and controllability for LV/ MV networks, increase networks flexibility to RES, EV and storage integration, mitigate the costs of network reinforcements by optimising the utilization of existing infrastructure, perform Life Cycle Assessment and cost-benefit analysis, provide benefits by cost efficiency and energy savings and involve users/consumers in Active Demand scenarios and actions.

Project funded by European Union, within Horizon 2020 Programme:



- **CIM as the reference data model of the project**

European Commission. January 2015 - December 2017. (José Antonio Rodríguez Mondéjar)

The aim is to use the CIM model (IEC 61970, IEC 61968 and IEC 62325 standard series) as the reference data model of the European project UPGRID (call H2020 LOW CARBON ENERGY) to ensure interoperability, replicability and scalability.

Project funded by European Union, within Horizon 2020 Programme:



- **Development of concentrates of thermosetting resins with graphite nanoplatelets for industry (RTC-2016-5138-4)**

Ministerio de Economía, Industria y Competitividad. March 2016 - June 2018. (Juan Carlos del Real Romero, Yolanda Ballesteros Iglesias, Eva Paz Jiménez, Javier Cañas Jiménez)

The aim of the project is the development and commercialization of concentrates epoxy resins based on graphite nanoplatelets (GRAPHENIT) developed by Nanoinnova Technologies SL to be used on composite materials

reinforced with fibers (fiberglass, carbon fiber, natural fibers) epoxy resins for industrial and transport sector.

The project has been developed by the following research group: Juan Carlos del Real-Romero, Yolanda Ballesteros, Eva Paz, Raquel Caro and Javier Jiménez.

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



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

European Commission. September 2017 - September 2020. (Asunción Paloma Cucala García, Antonio Fernández Cardador, Adrián Fernández Rodríguez)

The project aims to develop the metrological infrastructure for accurate measurement of energy exchange and for reliable system monitoring, which underpins the implementation of an energy efficient management of the European DC and AC railway and DC subway system. The project also focuses on the characterisation of the railway subsystem as a producer-consumer, with a view to its integration in a wide smart grid as well as on the assessment of eco-driving performances.

- **Scientific and technical innovations for safer Powered Two Wheelers (PTW)**

European Cooperation in Science and Technology (COST). June 2018 - February 2019. (Francisco José López Valdés)

Enhancing traffic safety is an on-going quest. Traffic accidents cause human suffering and huge economic losses. In the period 2000-2012, the riders killed per 10,000 Powered Two Wheelers (PTW) registered has more than halved, passing from 2.68 to 1.32. Nevertheless, PTW riders are still among the most vulnerable road users and other efforts are necessary toward a vision zero (accident) concept. On the other end, the use of PTW is currently increasing worldwide, especially in urban environments, since PTW offer many benefits

for personal mobility: less congestion, time gain, energy savings, easier parking. These beneficial opportunities can only be capitalised if PTW safety is further prioritised. As prior initiatives to improve PTW safety have concentrated on single aspects, a truly holistic and integrated approach towards PTW safety is still lacking. This COST Action addresses this gap, by bringing together PTW safety experts to i) acquire, unify and coordinate PTW safety research, and ii) ensure broad dissemination towards PTW users, industry and public authorities.

3.2.2.2 Consultancy and technological support

3.2.2.2.1 Private funding

- **Dimensional metrology Spanish standardization committee**

Asociación Española de Normalización y Certificación (AENOR). February 1999 - September 2017. (María Ana Sáenz Nuño)

Management of the technical secretary of the dimensional and clinical metrology Spanish standardization committee and the development of the technical expert delegation in the mirror ISO committee.

- **Microtubes heat exchanger**

Innomerics S.L. June 2016 - December 2017. (Luis Manuel Mochón Castro)

Development of a model and optimization of its software for the design of microtube heat exchangers.

- **Running times and train speed profiles analysis to improve the transport capacity in Metros Ligeros de Madrid ML1**

Metros Ligeros de Madrid S.A. June 2017 - November 2017. (Antonio Fernández Cardador, Asunción Paloma Cucala García, Adrián Fernández Rodríguez)

The main objective of this study is to analyse running times in Metros Ligeros de Madrid ML1, using train data recorded onboard. The target is to reduce these running times improving the transport capacity. The possible actions to be taken could be related to: bottleneck detection, driving issues, terminal stations management, operative, capacity or signalling issues.

- **4D certification of the development of a pilot manufacturing plant for vehicle axles**

OCA Cert. November 2017 - December 2017. (Pedro Sánchez Martín)

4D follow up certification is performed to determine the characteristics of the expert to evaluate the development of a pilot manufacturing plant for vehicle axles and afterwards the quality of the performed evaluation by the expert based on the certification company requirements.

- **Validation of a flow measurement system by ultrasonic Doppler effect**

Innomerics S.L. January 2018 - March 2018. (Luis Manuel Mochón Castro)

Validation of a flow measurement system by ultrasonic Doppler effect.

3.2.2.2.2 Public funding

- **Elderly volunteer and PMHS crash data analysis**

Universidad de Zaragoza. February 2018 - March 2018. (Francisco José López Valdés)

Analysis of experimental data from impact tests with elderly human volunteers and Post Mortem Human Surrogates (PMHS). The goal is to investigate whether the dynamic response of the occupant during an impact depends on the age of the occupant.

3.2.2.3 Services and analysis projects

3.2.2.3.1 Private funding

- **Technical support for the tools EXCOM, EXLA, GEDEX AND SIROCO**

Enel Iberoamérica S.R.L. January 2017 - December 2017. (Javier García González, Francisco Alberto Campos Fernández, José Portela González, Antonio Muñoz San Roque)

The objective of this project is to provide ENDESA with technical support and maintenance of the tools EXCOM, EXLA, GEDEX and SIROCO developed by IIT.

- **Technical analysis of a fire alarm switch**

Reciclados Sostenibles S.L. (RECSO). November 2017 - December 2017. (Carlos Rodríguez-Morcillo García)

The purpose of the proposed collaboration is to carry out a technical analysis of a fire alarm button, in order to arrive at the conclusion of whether it could be the cause of the fire of an industrial building, assuming that the installation of the electronic fire detection system of the premises was in correct operation at the time of the events.

- **Technical support for the tool SIROCO**

Enel Iberoamérica S.R.L. January 2018 - December 2018. (Francisco Alberto Campos Fernández, José Portela González)

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

3.3 Publications

3.3.1 Books

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3.3.2 Chapters in books

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- M. Castro, G. Lythe, C. Molina-Paris, "*The T cells in an ageing virtual mouse*". Chapter in the book "Stochastic processes, multiscale modeling, and numerical methods for computational cellular biology". Editors: Holcman, David. Publisher: Springer International Publishing AG. Pp. 127-140. ISBN: 978-3-319-62626-0. October 2017.
- S. Lumbreras, "*Strong artificial intelligence and imago hominis: the risks of a reductionist definition of human nature*". Chapter in the book "Issues in science and theology: are we special? Human uniqueness in science and theology". Editors: Fuller, Michael [et al.]. Publisher: Springer International Publishing. Pp. 157-168. ISBN: 978-3319621234. September 2017.
- S. Lumbreras, "*La ingeniería ante la tecnocracia*". Chapter in the book "La tecnocracia". Editors: Caamaño, J.M. Publisher: Editorial SaITerrae. Pp. 61-76. ISBN: 978-84-293-2716-8. January 2018.
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3.3.3 Publications in journals

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- J.P. Bastos, G. Cunha, L.A. Barroso, T. Aquino, *"Reliability mechanism design: an economic approach to enhance adequate remuneration and enable efficient expansion"*, Energy, vol. 158, pp. 1150-1159. ISSN: 0360-5442. May 2018.
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- I.C. González-Romero, S. Wogrin, T. Gómez, *"Proactive bi-level geptep with storage considerations"*, Communication in 24th Young Energy Economists and Engineers Seminar - YEEES 2018. Delft (Netherlands). 12-13 April 2018.
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- A.J. López López, R.R. Pecharromán, A. Fernández-Cardador, A.P. Cucala, *"Improvement of a DC electrical railway simulator using artificial intelligence"*, Communication in 8th International Power Electronics Conference -ECCE Asia - IPEC-Niigata 2018 -ECCE Asia. Niigata (Japan). 20-24 May 2018.
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- P. Martín-Escudero, F. Miguel-Tobal, M.L. Dotor, S.M. López-Silva, R. Giannetti, M. Galindo, *"Oxygen saturation through pulse oximetry in sportswomen"*, Communication in 23rd Annual Congress of the European College of Sport Science - ECSS Dublin 2018. Dublin (Ireland). 04-07 July 2018.
- J. Roldán-Pérez, A. Rodríguez-Cabero, M. Ochoa, A. García-Cerrada, J. Zamora, *"Diseño de reguladores resonantes en tiempo discreto para un restaurador dinámico de tensión"*, Communication in 25º Seminario Anual de Automática, Electrónica industrial e Instrumentación - SAAEI'18. Barcelona (Spain). 04-06 July 2018.

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- S. Wogrin, D.A. Tejada, D. Yacar, *"Optimizing storage allocation and investment for transmission constrained networks considering losses and high renewable penetration"*, Communication in 29th European Conference on Operational Research - EURO 2018. Valencia (Spain). 08-11 July 2018.
- R. Lorente-Pedreille, M.A. Sebastián, M. Sáenz, N. Medina, *"La trazabilidad de la medición del par en la generación de energía eólica"*, Communication in 22nd International Congress on Project Management and Engineering - ICPME 2018. Madrid (Spain). 11-13 July 2018.
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- K. Doenges, I. Egido, E. Lobato, L. Sigrist, *"Introduction of wind power into the Spanish automatic generation control (AGC)"*, Communication in 47 CIGRE Session - CIGRE 2018. Paris (France). 26-31 August 2018.
- X.M. López-Fernández, L. Rouco, C. Álvarez-Mariño, H. Gago, C. Vila, *"A high frequency power transformers model for network studies and tdsf monitoring"*, Communication in 47 CIGRE Session - CIGRE 2018. Paris (France). 26-31 August 2018.
- X.M. López-Fernández, L. Rouco, C. Álvarez-Mariño, H. Gago, C. Vila, *"A high frequency power transformers model for network studies and tdsf monitoring"*, Communication in 47 CIGRE Session - CIGRE 2018. Paris (France). 26-31 August 2018.
- J. Roldán-Pérez, A. García-Cerrada, A. Rodríguez-Cabero, M. Prodanovic, *"Phase-matched frequency adaptive repetitive controller for a grid-supporting STATCOM"*, Communication in 18th International Conference on Power Electronics and Motion Control - IEEE-PEMC 2018. Budapest (Hungary). 26-30 August 2018.

- L. Rouco, F. Perán, *"Reactive power capability of large hydro generators and the European grid code requirements with respect to voltage stability"*, Communication in 47 CIGRE Session - CIGRE 2018. Paris (France). 26-31 August 2018.
- L. Sigrist, I. Egido, L. Rouco, A. Rodríguez, C. Castro, J. Rupérez, S. Marín, *"A tool for simulation, analysis and design of underfrequency load-shedding (UFLS) schemes of isolated power systems"*, Communication in 47 CIGRE Session - CIGRE 2018. Paris (France). 26-31 August 2018.
- G. Mestre, J. Portela, A. Muñoz, E. Alonso, *"White noise testing for functional time series. Application to model identification and diagnosis"*, Communication in 2nd Satellite CRONoS Workshop on Functional Data Analysis - CRONoS FDA 2018. Iasi (Romania). 31 August - 02 September 2018.

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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- J. Barquín, P. Rodilla, R. Cossent, C. Batlle, *"Obtaining best value for money in RES auctions: a capacity-based with an embedded menu of contracts approach"*. November 2017. Ref: IIT-17-177A.
- P. Bhagwat, L. Lind, *"Towards a more investment friendly economic incentive regime for offshore infrastructure projects"*. February 2018. Ref: IIT-18-009A.
- S. Burger, J. D. Jenkins, C. Batlle, I.J. Pérez-Arriaga, *"Restructuring revisited: competition and coordination in electricity distribution systems"*. April 2018. Ref: IIT-18-033A.
- P. Ciller, S. Lumbreras, *"The rural electrification problem: an assessment of methods and tools"*. September 2017. Ref: IIT-17-141A.
- S. Doménech, F.A. Campos, J. Villar, M. Rivier, *"An equilibrium approach for modeling centralized and distributed generation expansion planning"*. February 2018. Ref: IIT-18-018A.

- S. Doménech, F.A. Campos, J. Villar, M. Rivier, *"Joint energy and capacity equilibrium for centralized and distributed generation"*. May 2018. Ref: IIT-18-053A.
- I. Egido, A. García-Cerrada, L. Rouco, L. Sigrist, *"Control of wind turbines. Introduction & power ramp-up and ramp-down rate limits and power curtailment for frequency control in wind farms"*. November 2017. Ref: IIT-17-178I.
- J.M. Fernández de Bobadilla Navarrete, E. Lobato, L. Sigrist, A. González, *"A tool for optimal operation and design of batteries and its applications to self-consumption"*. April 2018. Ref: IIT-18-038A.
- M. Madaleno, M. Robaina, J. Villar, *"The contribution of renewable energy to European decarbonization"*. September 2017. Ref: IIT-17-148A.
- P. Mastropietro, P. Rodilla, C. Batlle, *"De-rating of wind and solar resources in capacity mechanisms: a review of international experiences"*. April 2018. Ref: IIT-18-043A.
- G. Mestre, J. Portela, G. Rice, A. Muñoz, E. Alonso, *"Functional time series identification and diagnosis by means of autocorrelation analysis"*. August 2018. Ref: IIT-18-102A.
- I.J. Pérez-Arriaga, R.J. Stoner, R. Rahnama, S.J. Lee, G. Jacquot, E. Protzer, A. González-García, R. Amatya, M. Brusnahan, P. Dueñas, *"A utility approach to accelerate universal electricity access in less developed countries: a regulatory proposal"*. February 2018. Ref: IIT-18-010A.
- J. Renedo, A. García-Cerrada, L. Rouco, Q. Zhao, J. García-González, A.A. Ibrahim, B. Kazemtabrizi, *"A simplified algorithm to solve optimal power flows in hybrid VSC-based AC/DC systems"*. October 2017. Ref: IIT-17-165A.
- J. Roldán-Pérez, M. Prodanovic, A. Rodriguez-Cabero, J.M. Guerrero, A. García-Cerrada, *"Finite-gain repetitive controller for harmonic sharing improvement in a VSM microgrid"*. August 2018. Ref: IIT-18-100A.
- F.J. Santos, P. Linares, *"Combining participatory tools and multi-criteria decision methods for selecting appropriate technologies for rural electrification: an application to Rwanda."*. April 2018. Ref: IIT-18-036A.
- L. Sigrist, J. Renedo, F.M. Echavarren, L. Rouco, *"Modeling of steady state fault current contribution of inverter-connected generation"*. March 2018. Ref: IIT-18-027A.

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- A. Valle, S. Wogrin, J. Reneses, *"Multi-objective bi-level optimization problem for the investment in new gas infrastructures"*. January 2018. Ref: IIT-18-008A.

3.3.6 Other publications

- Y. Ballesteros, J.C. del Real-Romero, E. Paz, *"Bone cement with microencapsulated antimicrobial"*. Patent in Universidad Pontificia Comillas; INESCOP. Madrid (Spain). October 2017.
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- E. Centeno, *"Comillas ICAI-ICADE crea la Cátedra de Energía y Pobreza"*. Electronic press in STRONG ELEMENT S.L. Galapagar (Spain). March 2018.
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- J.P. Chaves, P. Linares, A. Ramos, J.C. Romero, *"Escenarios para el sector energético en España 2030-2050"*. Technical Report in Economics for Energy. Vigo (Spain). December 2017.
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- R. Cossent, P. Linares, I.J. Pérez-Arriaga, J.C. Romero, *"Observatorio BP de Energía y Sostenibilidad en España. Informe año 2017"*. Technical Report in Cátedra BP de Energía y Sostenibilidad. Universidad Pontificia Comillas. Madrid (Spain). April 2018.
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Proyecto: InteGrid / WP1
- P. Frías, *"Siete coches eléctricos para comprar en 2018 con descuentos"*. Electronic press in EDICIONES EL PAIS, S.L. Madrid (Spain). January 2018.
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- P. Frías, *"Más que incentivos económicos, hace falta una estrategia de país para cambiar nuestro concepto de movilidad"*. Electronic press in Diario El Correo, S.A. Bilbao (Spain). February 2018.
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- R. Giannetti, A. Sánchez, *"Sensor, dispositivo, sistema y método no invasivo para determinar parámetros de entrenamiento durante la realización de un ejercicio físico"*. Patent in Consejo Superior de Investigaciones Científicas (CSIC); Universidad Pontificia Comillas; y Universidad Complutense de Madrid. Madrid (Spain). August 2018.
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- P. Linares, *"Comisión de Expertos de Transición Energética. Análisis y propuestas para la descarbonización"*. Technical Report in Ministerio de Energía, Turismo y Agenda Digital. Madrid (Spain). April 2018.
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- P. Linares, J.P. Chaves, F. Postigo, *"Estudio técnico de viabilidad de escenarios de generación eléctrica en el medio plazo en España"*. Technical report in Greenpeace España. Madrid (Spain). March 2018.
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- P. Linares, et al., *"Comisión de Expertos de Transición Energética. Análisis y propuestas para la descarbonización"*. Technical report in Ministerio de Energía, Turismo y Agenda Digital. Madrid (Spain). April 2018.
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- S. Lumbreras, *"Mujeres y ciencia se imponen en la nueva promoción de la aceleradora de talentos Celera"*. Electronic press in Periódico El Mundo. Madrid (Spain). February 2018.
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- C. Mateo, *"La Universidad de Comillas participa en un proyecto de Grid Data"*. Electronic press in Interempresas Media, S.L.U. Barcelona (Spain). January 2018.
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- J. Renedo, A. García-Cerrada, L. Rouco, L. Sigrist, J. Zamora, I. Egido, P. García-González, M. Ochoa, R. Marcos, *"Protecciones en sistemas HVDC-VSC multi-terminal"*. Technical report in Ministerio de Economía, Industria y Competitividad. Madrid (Spain). January 2018.
Proyecto: HVDC-VSC-HVAC / WP5

- M. Rivier, T. Gómez, J.P. Chaves, R. Cossent, A. Sánchez, F. Martín, T. Gerres, *"Análisis de escenarios futuros para el sector eléctrico en España para el período 2025-2050"*. Technical report in Iberdrola S.A. Madrid (Spain). March 2018.
Proyecto: IBD ESCENARIOS /

- L. Rouco, "*Sistema y método para detectar una condición de fase abierta en la alimentación a un transformador trifásico de arranque*". Patent in Iberdrola Generación Nuclear, S.A.U. Madrid (Spain). October 2017.
Número de Solicitud: 201630369; Número de publicación: 2635132;
Inventores: Archilla Martín-Sanz, Jacobo; Rouco Rodríguez, Luis; Gavilán Moreno, Carlos Julián.
- L. Simons, T. Gómez, P. Frías, "*Innovative business models for market uptake of renewable electricity unlocking the potential for flexibility in the industrial electricity use. Policy recommendations*". Technical report in Comisión Europea. Madrid (Spain). September 2017.
Proyecto: IndustRE / WP5-T5.3

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 Bachelor Theses at IIT

4.1.1 Electrical, Electronics, and Mechanical Engineering

- *Diseño y fabricación de las manguetas del vehículo Formula SAE ICAI*
Ignacio Granell Heredero. Supervised by Alberto Carnicero López.
- *Adhesivos reforzados con nanopartículas base carbono para mejorar las propiedades mecánicas*
Gema Lara Vegazo. Supervised by Juan Carlos del Real Romero.
- *Análisis de una bomba turbina integral mediante CFD*
Ignacio Asenjo Pedraza. Supervised by Alexis Cantizano González.
- *Análisis del reparto de carga entre subestaciones de una red metropolitana ferroviaria*
Manuel Angel Benedito Pallarés. Supervised by Álvaro Jesús López López and Ramón Rodríguez Pecharromán.
- *Análisis y mejora de las propiedades de uncemento óseo acrílico mediante la adicción de microcápsulas de antibióticos*
Alba Pérez Sánchez. Supervised by Eva Paz Jiménez.
- *Captación y suministro sostenible de agua potable en una aldea de Perú*
Laura Laguña García. Supervised by Andrés González García.

- *Construcción y control de un vehículo equilibrista basado en una raspberry pi*
María del Carmen Ladrón de Guevara Tapia. Supervised by Juan Luis Zamora Macho.
- *Control de convertidores electrónicos fuente de tensión para el soporte de la red eléctrica*
Iñigo Cervigón Núñez-Lagos. Supervised by Aurelio García Cerrada.
- *Control de un brazo robótico para emulación de los movimientos de una mano*
Carlos Ripoll Ramzi. Supervised by Juan Luis Zamora Macho.
- *Control de un cuadricóptero mediante gestos*
Javier del Río López-Corona. Supervised by Juan Luis Zamora Macho.
- *Control de un robot humanoide*
Alejandro Morillo-Velarde Moraleta. Supervised by Juan Luis Zamora Macho.
- *Control de un vehículo autónomo en un entorno limitado*
Julio Labora Gómez. Supervised by Juan Luis Zamora Macho.
- *Desarrollo de indicadores para prognosis de la condición de componentes de un aerogenerador*
Guillermo Lázaro Martínez. Supervised by Miguel Ángel Sanz Bobi.
- *Desarrollo de un modelo de simulación del comportamiento de un aerogenerador*
Miguel González López. Supervised by Miguel Ángel Sanz Bobi.
- *Desarrollo e integración de un centro de control domótico*
Carlos Javier Cabrera Criado. Supervised by Juan Luis Zamora Macho.
- *Design of a two bladed wind turbine*
Carlos Ignacio Laiz Quereda. Supervised by Luis Manuel Mochón Castro.
- *Diseño de válvula inteligente de radiador para controlar la temperatura de una habitación*
Daniel Goicoechea Artero. Supervised by Francisco Martín Martínez and Álvaro Sánchez Miralles.
- *Diseño e implantación de un control 3D para un cubo mediante volantes de inercia*
Víctor Arias Blanco. Supervised by Juan Luis Zamora Macho.
- *Diseño e implementación de una sonda diferencial para osciloscopio*
Francisco de Asís Palá Barangán. Supervised by Romano Giannetti.

- *Diseño y construcción de un levitador magnético*
Pedro Sánchez Bas. Supervised by Juan Luis Zamora Macho.
- *Diseño y desarrollo del control de una caldera de gas Vaillant ecoTEC Plus mediante protocolo eBus*
Hugo García Tovar. Supervised by Francisco Martín Martínez and Álvaro Sánchez Miralles.
- *Diseño y fabricación de elementos aerodinámicos Fórmula Student*
Jose Antonio Fernández Gascón. Supervised by Jesús Jiménez Octavio.
- *Diseño y fabricación de un basculante para motocicleta de competición*
Daniel San Román López. Supervised by Jesús Jiménez Octavio.
- *Diseño, construcción y simulación de un accionamiento para vehículos eléctricos*
Luis Ismael de la Barba Suárez. Supervised by Lukas Sigríst.
- *Estabilidad de frecuencia de un sistema interconectado con alta penetración de generación renovable*
Jacobo Gómez Gómez. Supervised by Luis Rouco Rodríguez and Lukas Sigríst.
- *Evaluación de algoritmos de clasificación para el diagnóstico de cáncer a partir de imágenes*
Ricardo Moreno Alonso. Supervised by Jaime Boal Martín-Larrauri and Santiago Moreno Carbonell.
- *Funcionamiento en isla de redes de distribución*
Ernesto Calmarza Lozano. Supervised by Luis Rouco Rodríguez and Lukas Sigríst.
- *Impacto ambiental y económico del Vehículo Eléctrico (VE)*
José González Pérez. Supervised by Fidel Fernández Bernal.
- *Integración de visión artificial en un robot industrial*
Lucía Díaz García. Supervised by Jaime Boal Martín-Larrauri and José Antonio Rodríguez Mondéjar.
- *Modelo de inversión en el sector eléctrico y del transporte*
Rosendo Daniel Castañón Naseiro. Supervised by Francisco Alberto Campos Fernández and Salvador Doménech Martínez.
- *Modelo del despacho económico incluyendo restricciones de red*
Juan Fraile López. Supervised by Lukas Sigríst.

- *Navegación autónoma de drones en interiores mediante balizas de infrarrojos*
Carlos Sanjuán Ruiz. Supervised by Juan Luis Zamora Macho.
- *Navegación autónoma de un cuadricóptero en exteriores*
Jaime Loring Castillo. Supervised by Juan Luis Zamora Macho.
- *Predicción del campo de temperaturas en un incendio de un edificio tipo atrio*
Gabriela María Meliá García. Supervised by Pablo Ayala Santamaría and Jaime Boal Martín-Larrauri.
- *Prueba de protecciones con registros oscilograficos obtenidos con simulación con ATP*
Sergio Rodríguez Ballesteros. Supervised by Luis Rouco Rodríguez.
- *Simulación del efecto del viento en líneas de alta tensión con crucetas aislantes pivotantes*
Daniel Andrés Arcones. Supervised by Alberto Carnicero López and Jesús Jiménez Octavio.
- *Sistema de detección de obstáculos para apoyo a invidentes en la práctica de la hípica*
Miguel Angel Sánchez Sánchez. Supervised by José Daniel Muñoz Frías.
- *Sistema domótico de notificación de alarmas por SMS*
Inés Arnaiz Lázaro-Carrasco. Supervised by Juan Luis Zamora Macho.
- *Sistemas de musicoterapia aplicados a la epilepsia*
María Eugenia Montesino Sarmiento. Supervised by Romano Giannetti.
- *Study of improvements in the aerodynamics of a tourism*
Rodrigo Sánchez de Rojas Lozano. Supervised by Luis Manuel Mochón Castro.

4.1.2 Telematics Engineering

- *Desarrollo de un controlador para motocicleta eléctrica*
Víctor Antonio Guizien Martín. Supervised by Aurelio García Cerrada and José Daniel Muñoz Frías.
- *Evaluación de la tecnología de comunicaciones inalámbrica BLE mediante entornos simulados y experimentales*
Alvaro Bartolomé Ucero. Supervised by David Contreras Bárcena.
- *Identificación de patrones de comportamiento de consumo en el mercado eléctrico en entornos Big Data*
Beatriz Torreiro Mosquera. Supervised by David Contreras Bárcena.

- *Implementación de un driver para medida de temperatura con radiofrecuencia*
Carlos Arranz Herrero. Supervised by Javier Matanza Domingo.
- *Implementación y despliegue de una solución de gamificación en la empresa sobre redes públicas y privadas Blockchain*
María Pilar Hernández Bas. Supervised by David Contreras Bárcena.
- *Improving the security of IoT devices by implementing a location-based access control*
Iciar Ortega Oria de Rueda. Supervised by Rafael Palacios Hielscher.
- *Plataforma en Tiempo Real Big Data de procesamiento de sensores IoT para la predicción de la demanda de una franquicia de restauración*
José María Rodríguez Cano de Santayana. Supervised by David Contreras Bárcena.
- *Reconocimiento de emociones a través de la voz*
Marta Castañeda Albillos. Supervised by Miguel Ángel Sanz Bobi.
- *Sistema de inventariado para drones usando visión artificial*
Irene España Novillo. Supervised by Jaime Boal Martín-Larrauri and Miguel Martín Lopo.

4.2 Postgraduate teaching

4.2.1 Master 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 Research in Engineering Systems Modeling (MRE)

Director: Miguel Ángel Sanz Bobi

More information at <http://www.icaui.upcomillas.es/en/master/mre-en>

- *Preliminary research project*
Andrés Ramos Galán
- *Forecasting techniques*
Antonio Muñoz San Roque

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

Director: Luis Olmos Camacho

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.icae.upcomillas.es/en/master/mepi-en>

- *Decision support models in the electric power industry*
Efraim Centeno Hernández, Javier García González, Tomás Gómez San Román, Antonio Muñoz San Roque, Andrés Ramos Galán
- *Economy of the electric power industry*
Pablo Rodilla Rodríguez
- *Electric power systems*
Damián Laloux Dallemagne, 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, Pablo Frías Marín, Javier García González, Damián Laloux Dallemagne, Michel Rivier Abbad, 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, Luis Olmos Camacho, Pablo Frías Marín, Tomás Gómez San Román, Michel Rivier Abbad, Miguel Ángel Sánchez Fornié
- *Regulation of the electric power industry*
Carlos Batlle López, Pablo Rodilla Rodríguez, Tomás Gómez San Román
- *Wholesale and retail electricity markets*
Carlos Batlle López, Pablo Rodilla Rodríguez

4.2.1.3 Master in Railway Systems

Director: Antonio Fernández Cardador

More information at <http://www.icaei.upcomillas.es/en/master/msf-en>

- *Electrification*

Luis Rouco Rodríguez

- *Catenary mechanics*

Alberto Carnicero López, Jesús Jiménez Octavio

- *ERTMS and RAMS*

Yolanda González Arechavala

- *Professional practice*

Asunción Paloma Cucala García

- *Design and traffic control advanced systems*

Asunción Paloma Cucala García, Antonio Fernández Cardador

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

Director: Fernando de Cuadra García

More information at

<http://www.structuralia.com/es/cursos/item/249-master-en-proyecto-construccion-y-mantenimiento-de-infraestructuras-electricas-de-alta-tension&ORIG=dina&CAMPA=buscador&TCAMP=WEB&term=M%C3%A1ster%20en%20Proyecto,%20Constucci>

- *Maintenance management of high voltage power lines*

Miguel Ángel Sanz Bobi

- *Transmission lines*

Francisco Miguel Echavarren Cerezo

- *Transmission Lines*

Francisco Miguel Echavarren Cerezo

- *Projects of high voltage infrastructures*

Luis Rouco Rodríguez, Michel Rivier Abbad

4.2.1.5 Master's Degree in International Industrial Project Management

More information at

<https://www.comillas.edu/postgrado/master-en-direccion-internacional-de-proyectos-industriales>

- *Control and quality management*
Pedro Sánchez Martín
- *Design and operations management*
Pedro Sánchez Martín

4.2.1.6 MBA in the Global Energy Industry

Director: Andrés Ramos

- *Data analysis for the decision group I*
Javier García González, Andrés Ramos Galán
- *Operations management*
Javier García González, Tomás Gómez San Román, Michel Rivier Abbad
- *Energy and sustainability*
Pedro Linares Llamas
- *Policies and regulation in the electricity market*
Carlos Batlle López, Tomás Gómez San Román, Michel Rivier Abbad

4.2.1.7 Master's Degree in Smart Industry (MIC)

Director: Bernardo Villazán

More information at

<https://www.comillas.edu/en/masters/master-degree-in-smart-industry>

- *Connected Industry and Intelligent Systems*
Álvaro Sánchez Miralles
- *Machine Learning*
Antonio Muñoz San Roque
- *Machine Learning (Practice I)*
José Portela González
- *Machine Learning (Practice II)*
Guillermo Mestre Marcos

- *Cyberphysical Systems and Robotics*
Jaime Boal Martín-Larrauri

4.2.1.8 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>

- *Big Data Architecture*
David Contreras Bárcena
- *Mathematical Fundamentals of data analysis*
Mario Castro Ponce
- *Machine learning I*
Antonio Muñoz San Roque, José Portela González
- *Machine learning II*
Eugenio Francisco Sánchez Úbeda

4.2.1.9 Master's Degree in Management Solutions

More information at

<https://www.comillas.edu/en/masters/master-in-international-industrial-project-management>

- *Energy: energy business management*
Carlos Batlle López

4.2.2 Master Theses supervised at IIT

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

- *Analysis of the European cross-border physical flows applying machine learning techniques*
Laura Estévez Cabello. Supervised by Santiago Moreno Carbonell and Eugenio Francisco Sánchez Úbeda.
- *Análisis de la rentabilidad de los recursos de generación eléctrica en España ante la penetración de tecnologías limpias (renovable, VE y baterías) y el cierre de tecnologías contaminantes*
Francisco de Paula Martínez Rubio. Supervised by Francisco Alberto Campos Fernández and Salvador Doménech Martínez.

- *Análisis de las opciones de reducción de emisiones del sector de cemento en España hasta el horizonte 2030*
Luis Angel Pé-Ferrer Carpintero. Supervised by José Pablo Chaves Ávila and Timo Gerres.
- *Análisis de los flujos energéticos, económicos y medioambientales en el sector del transporte*
Roberto Puente Aranda. Supervised by Pedro Linares Llamas.
- *Análisis de viabilidad económica y futuro del car sharing eléctrico*
Aldara Bernárdez Cordeiro. Supervised by Pablo Frías Marín.
- *Análisis de viabilidad económica y futuro del car sharing eléctrico en Francia*
Johan Marcel Jérôme Argentier. Supervised by Pablo Frías Marín.
- *Análisis del impacto de la crisis económica en la intensidad energética española y las emisiones de gases de efecto invernadero*
Mario Ginel Pérez. Supervised by Pedro Linares Llamas.
- *Análisis económico de la generación distribuida y centralizada con paneles fotovoltaicos*
Zhiyin Lou. Supervised by Francisco Martín Martínez and Álvaro Sánchez Miralles.
- *Análisis forense de un dataset industrial y propuesta de un estándar gráfico para los registros en la ciberseguridad*
Jorge Buil García. Supervised by Álvaro Jesús López López.
- *Análisis técnico de la tecnología blockchain*
Diego Plata Rodilla. Supervised by Miguel Martín Lopo and Antonio Vázquez Blanco.
- *Análisis y definición del algoritmo de mantenimiento predictivo de transformadores e interruptores*
Ana Carrasco Fonseca. Supervised by Álvaro Jesús López López.
- *Aplicación de técnicas de análisis de datos a la gestión óptima de una cartera de valores*
Antonio Luis Molero Senosiain. Supervised by Juan Luis Zamora Macho.
- *Automatización avanzada de un sistema de riego por pivotes*
Jose M^a Cabrera Millán. Supervised by José Antonio Rodríguez Mondéjar.
- *Back-end development of a Profinet-based data collector application and final deployment*
Germán Ferreira Peña. Supervised by José Daniel Muñoz Frías.

- *Blockchain technology application to energy communities*
Enrique Gómez Limia. Supervised by José Pablo Chaves Ávila.
- *Creación de Start-up: Aplicación basada en economía colaborativa de comida casera*
Francisco Salvador Alamar. Supervised by David Contreras Bárcena.
- *Culture vs. financial performance: an assessment using web-scraped data*
Jaime Domínguez de Pablo. Supervised by Sara Lumbreras Sancho.
- *Desarrollo de entorno motivacional para el aprendizaje*
Ana Ruiz García. Supervised by Álvaro Sánchez Miralles.
- *Desarrollo de sistemas de navegación autónoma en interiores para un UAV*
Javier García Aguilar. Supervised by Juan Luis Zamora Macho.
- *Design of an axial turbine and compressor for an SC-CO₂ power cycle*
Javier Parrondo Navarro. Supervised by Alexis Cantizano González.
- *Diseño pedagógico de prácticas de implantación de técnicas Lean en procesos industriales*
Iñigo Agustín Franco Arbiza. Supervised by Pedro Sánchez Martín.
- *Estimación de indicadores de sostenibilidad en España para años medios*
Eva M^a González Isla. Supervised by Pedro Linares Llamas.
- *Estudio de mercado y planificación del suministro energético sostenible en la Amazonía peruana*
Clara Pérez-Andújar Carretié. Supervised by Andrés González García.
- *Estudio de sostenibilidad sobre el acceso universal a energía y agua potable en el Amazonas*
Belén Rabadán Travesí,. Supervised by José Carlos Romero Mora.
- *Estudio del entrehierro en generadores síncronos de turbinas eólicas Siemens Gamesa*
Daniel Conesa Escolar. Supervised by Luis Rouco Rodríguez.
- *Estudio técnico-económico de la implantación de una batería en un parque eólico*
María de la Candelaria Utrilla Bustamante. Supervised by Luis Rouco Rodríguez.
- *Estudio y propuesta de conversión del modelo de acondicionamiento de una vivienda*
Bruno Rodríguez Esteban. Supervised by Luis Manuel Mochón Castro.

- *Evaluation of nuclear flexibility in the operation for future scenarios of Spanish power system*
Alvaro Ramírez Sánchez. Supervised by José Pablo Chaves Ávila and Tomás Gómez San Román.
- *Expansión de la red de transporte en España a largo plazo*
Manuel Buitrón Prats. Supervised by Rafael Espejo González and Andrés Ramos Galán.
- *Huella de Carbono actual de la Universidad Pontificia Comillas y recomendaciones para reducirla*
Rafael Arranz Martín. Supervised by Pedro Linares Llamas.
- *Modelado y control de la planta AERO de Quanser*
Juan Pablo Dehesa Golding. Supervised by Juan Luis Zamora Macho.
- *Modelos de negocio asociados a las infraestructuras de recarga de vehículos eléctricos*
Sara Rodríguez-Portugal Dobarro. Supervised by Pablo Frías Marín.
- *Optimización de la formulación de un cemento óseo acrílico cargado con microcápsulas de rifampicina*
Ariana Marco Foruny. Supervised by Eva Paz Jiménez.
- *Potencial de la tecnología Blockchain en el sector eléctrico*
Daniel García Guzmán. Supervised by Ignacio Herrero Gallego and Francisco Martín Martínez.
- *Propuesta de norma técnica para la gestión metrológica en el sector sanitario español.*
David Palancar Martínez. Supervised by María Ana Sáenz Nuño.
- *Sistema de ayuda al diagnóstico del cáncer de mama*
Antonio Alonso Cristellys. Supervised by Jaime Boal Martín-Larrauri and Santiago Moreno Carbonell.
- *Sistema de control de tracción gestión de la batería de un VE para países en vías de desarrollo*
Carla Lamadrid Orús. Supervised by Álvaro Sánchez Miralles.
- *Sistema de localización de huesos mediante ultrasonidos de alta frecuencia*
Francisco de Borja Jiménez Valverde. Supervised by Romano Giannetti.
- *Sistema de medida de tensión arterial en dedos con fotoplethysmografía: sistema PPG*
Felipe Gil Borralló. Supervised by Romano Giannetti.

- *Sistema de medida de tensión arterial en dedos con fotopletimografía: sistema de oclusión*
Carlos Martín Parages. Supervised by Romano Giannetti.
- *Sistema único de seguridad, punto de venta y asistente personal para la tienda de ropa del futuro*
Ramón Rodríguez Riesco. Supervised by José Daniel Muñoz Frías.
- *Study of the energy consumptions in Spain for the energy poverty analysis*
Javier Cortizas Arnosó. Supervised by Pablo Frías Marín.
- *Techno-economics of CHP and HVAC technologies at consumer level*
María Luisa Orozco Moyá. Supervised by José Pablo Chaves Ávila.
- *Techno-economics of PV solar and electric storage at consumer level*
Asier Díez de Ulzurrun Mutilva. Supervised by José Pablo Chaves Ávila.
- *Timón aerodinámico para automoción*
Israel Humbrias Moracia. Supervised by Jesús Jiménez Octavio.
- *Uso de la realidad virtual para el entrenamiento del personal de operación y mantenimiento: aplicación a la minifábrica ICAI*
Carlos Álvarez Vereterra. Supervised by José Antonio Rodríguez Mondéjar.
- *Validación y análisis de medidas de redes complejas aplicado a redes eléctricas de países europeos*
Luis Cuadrado Granda. Supervised by Rafael Espejo González and Andrés Ramos Galán.

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

- *Análisis comparativo de las principales tecnologías para transmisión de datos en PLC de banda estrecha*
Margarita Sanz del Río. Supervised by Javier Matanza Domingo.
- *Desarrollo de indicadores anomalías y prognosis de la condición de componentes de una central eléctrica hidráulica*
Beatriz García Alejo. Supervised by Miguel Ángel Sanz Bobi.
- *Determinación de perfiles de consumo de energía eléctrica en una muestra de clientes del sector no residencial en España*
Jaime Fernández Sánchez. Supervised by Miguel Ángel Sanz Bobi.

- *Diseño e implementación de un sistema de comunicaciones con tasas de muestreo sub-Nyquist empleando técnicas de muestreo compresivo*
Rodrigo Serna Pérez. Supervised by Javier Matanza Domingo.
- *Gestión de una minifábrica mediante realidad aumentada*
Alvaro Bolinches Tejedor. Supervised by José Antonio Rodríguez Mondéjar.
- *Sistema de detección de patrones basado en técnicas de Machine Learning sobre una plataforma Big Data en un escenario IoT*
Luis Miguel Calzada Lorente. Supervised by David Contreras Bárcena.

4.2.2.3 Official Master's Degree in Engineering Research (MIMSI)

- *Diseño de una vivienda prefabricada sostenible para las aldeas del Quiché, Guatemala.*
Gonzalo García-Monsalve Olábarri. Supervised by Jesús Jiménez Octavio.

5. Doctorate

5.1 ICAI Engineers' Association

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

5.2 Training complements

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

- *Optimization techniques*
Andrés Ramos Galán, Sonja Wogrin
- *Preliminary research project*
Andrés Ramos Galán
- *Publishing research results*
Aurelio García Cerrada

5.3 Training activities

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

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

- *Advanced GAMS for applied research*
Andrés Ramos Galán
- *Advanced Matlab for applied research*
Eugenio Francisco Sánchez Úbeda
- *Advanced VBA-Excel for applied research*
Francisco Alberto Campos Fernández, Jesús María Latorre Canteli
- *Data Analysis*
Eugenio Francisco Sánchez Úbeda
- *Data management*
Álvaro Sánchez Miralles, Eugenio Francisco Sánchez Úbeda
- *Forecasting techniques*
Antonio Muñoz San Roque
- *Oral presentation of research results*
Efraim Centeno Hernández

5.4 Doctoral theses

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

5.4.1 Comillas submitted theses

- Title: *Análisis del impacto de las políticas climáticas europeas en la competitividad de la economía española*
Author: Pablo Pintos Touriño
Supervisors: Pedro Linares Llamas and Xavier Labandeira Villot
Date: September 08, 2017
- Title: *Energy management in smart cities*
Author: Christian Francisco Calvillo Muñoz
Supervisors: Álvaro Sánchez Miralles and José Villar Collado
Date: November 24, 2017

- Title: *Integrating water and energy systems for long-term resource management*
 Author: Zarrar Khan
 Supervisors: Pedro Linares Llamas and Javier García González
 Date: December 19, 2017
- Title: *Control of VSC-HVDC multi-terminal systems to improve angle stability in hybrid HVAC/HVDC electrical transmission systems*
 Author: Francisco Javier Renedo Anglada
 Supervisors: Aurelio García Cerrada and Luis Rouco Rodríguez
 Date: March 05, 2018
- Title: *From condition monitoring to maintenance management in electric power system generation with focus on wind turbines*
 Author: Peyman Mazidi
 Supervisor: Miguel Ángel Sanz Bobi
 Date: March 23, 2018
- Title: *Market mechanisms and pricing rules to enhance low-carbon electricity markets efficiency*
 Author: Ignacio Herrero Gallego
 Supervisors: Pablo Rodilla Rodríguez and Carlos Batlle López
 Date: July 06, 2018

5.4.2 Comillas ongoing theses

- Title: *Improving the integration of systems in smart homes using semantic techniques*
 Author: Javier Juárez Montojo
 Supervisor: José Antonio Rodríguez Mondejar
- Title: *Multi-agent simulation for long-term electricity market planning*
 Author: Jorge Arenillas Gay
 Supervisors: Javier Reneses Guillén and David Soler Soneira
- Title: *Regulation and competition: analysis of the strategic behaviour of shippers in natural gas markets*
 Author: María Gil Medina
 Supervisor: Javier Reneses Guillén
- Title: *Mejora de la capacidad de líneas ferroviarias urbanas mediante indicadores dinámicos*
 Author: Luis Miguel Navarro Rodríguez
 Supervisors: Antonio Fernández Cardador and María Asunción Cucala García

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

- Title: *Electricity markets medium term equilibrium considering risk averse agents with mixed renewable-thermal generation portfolio*
Author: Nenad Jovanovic
Supervisor: Javier García González

- Title: *Designing electricity distribution network charges for an efficient integration of distributed energy resources and customer Response*
Author: Ibtiha! Abdelmottaleb
Supervisors: Tomás Gómez San Román and Javier Reneses Guillén

- Title: *Impact of renewables on the transmission expansion planning of large-scale electric systems*
Author: Quentin Ploussard
Supervisors: Luis Olmos Camacho and Andrés Ramos Galán

- Title: *Desarrollo de un nuevo concepto de imán superconductor de alta eficiencia para un ciclotrón de producción de radioisótopos.*
Author: Javier Munilla López
Supervisor: Mario Castro Ponce

- Title: *Economic and technical impact of the deployment of a VSC-MTDC SUPERGRID with large-scale penetration of offshore wind*
Author: Quanyu Zhao
Supervisor: Javier García González

- Title: *Customer engagement desde la perspectiva de service-dominant logic: nuevas oportunidades para las smart Grids*
Author: Silvia Sievers Fernández
Supervisors: Carmen Valor Martínez and Alvaro Sánchez Miralles

- Title: *Total transfer capability computation in AC/DC electric power systems with VSC-HVDC*
Author: José Carlos Fernández Pérez
Supervisors: Luis Rouco Rodríguez and Francisco Miguel Echavarren Cerezo

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

- Title: *Adapting energy markets in Europe to integrate industrial demand response*
 Author: Lorenzo August Simons
 Supervisors: Pablo Frías Marín and Rafael Cossent Arín

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

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

- Title: *Modelling, analysis and design of the contribution of power electronics to electrical grids with high penetration of electronic generation.*
 Author: Laura Casado Fulgueiras
 Supervisors: Luis Rouco Rodríguez and Aurelio García Cerrada

- Title: *A model-based analysis on the impact of European measures for the creation of the single gas market under a market-equilibrium perspective.*
 Author: Aurora del Valle Díez
 Supervisors: Javier Reneses Guillén and Sonja Wogrin

- Title: *A regulatory mechanism to coordinate generation and transmission expansion planning in deregulated electricity markets*
 Author: Marta Irene Fera Cerrada
 Supervisors: Michel Luis Rivier Abbad and Andrés Ramos Galán

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

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

- 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 Ibarquén
 Supervisors: Pedro Sánchez Martín and Sara Lumbreras Sancho

- Title: *Gestión de reserva de operaciones en sistemas eléctricos insulares.*
Author: José María Fernández de Bobadilla Navarrete
Supervisors: Enrique Lobato Miguélez and Lukas Sigrist
- Title: *A Comprehensive approach to deal with uncertainty in medium-term analysis of electricity markets*
Author: Leopoldo Javier Cabrera Azpilicueta
Supervisors: Javier Reneses Guillén and Antonio Bello Morales
- 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 Cháves Avila
- Title: *Contribuciones al uso óptimo de los protocolos de comunicación en entornos específicos de ámbito industrial y ferroviario.*
Author: Juan Manuel Cerezo Sánchez
Supervisor: José Antonio Rodríguez Mondejar
- Title: *Contributions to automatic detection of inconsistencies on digital communication standards*
Author: Sonia León del Rosario
Supervisor: José Antonio Rodríguez Mondejar
- Title: *Towards a flexible energy-oriented meta-simulator: From virtual to real*
Author: Miguel Manuel Martín Lopo
Supervisors: Alvaro Sánchez Miralles and Jaime Boal Martín-Larrauri
- Title: *La actitud crítica de los consejeros independientes, en los procesos de toma de decisiones*
Author: Bernardo José Villazán Gil
Supervisors: Laura Fernández Méndez and Sara Lumbreras Sancho
- Title: *Analysis of grid-level energy storage integration in a context of high variable renewable energy*
Author: Diego Alejandro Tejada Arango
Supervisors: Efraim Centeno Hernández and Sonja Wogrin
- Title: *Volatility premiums as a proxy for ESG scores*
Author: Paraskevas Paraskevas Kamforidou
Supervisors: Isabel Catalina Figuerola-Ferreti Garrigues and Sara Lumbreras Sancho

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

- Title: *Measuring energy sustainability: a new operative framework based on weak and strong indicators*
 Author: José Carlos Romero Mora
 Supervisor: Pedro Linares Llamas

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

- Title: *Strategic generation and transmission expansion planning under uncertainty*
 Author: Isaac Camilo González Romero
 Supervisors: Sonja Wogrin and Tomás Gómez San Román

- Title: *DSO-TSO Coordination in the European context*
 Author: Leandro Lind
 Supervisors: Rafael Cossent Arín and Pablo Frías Marín

- Title: *Desarrollo de un modelo de mantenimiento colaborativo inteligente basado en indicaciones de salud y algoritmos adaptativos*
 Author: Pablo Calvo Báscones
 Supervisors: Miguel Angel Sanz Bobi and Álvaro Jesús López López

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

- Title: *Resilient internet of things for buildings*
 Author: Antonio Vázquez Blanco
 Supervisors: Alvaro Sánchez Miralles and Jaime Boal Martín-Larrauri

- Title: *The rural electrification planning problem: strategies and solutions*
 Author: Pedro Ciller Cutillas
 Supervisor: Sara Lumbreras Sancho

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

- Title: *Addressing the provision of universal access to modern energy services in developing countries: A comprehensive decision support framework*
Author: Andrés González García
Supervisor: José Ignacio Pérez Arriaga
- Title: *Modeling the particularities of the natural gas sector for a better representation of the strategic short-term optimal generation scheduling*
Author: Pedro de Otaola Arca
Supervisors: Javier García González and Pablo Frías Marín
- Title: *Contribution of gas to the decarbonisation objectives of Europe. Modelling and regulatory framework*
Author: Ángel Rosso Mateo
Supervisors: Javier Reneses Guillén and Jesús María Latorre Canteli
- Title: *Application of machine learning techniques for the characterization of the European electricity market*
Author: Santiago Moreno Carbonell
Supervisors: Eugenio Francisco Sánchez Ubeda and Antonio Muñoz San Roque
- Title: *A blockchain proof-of-concept for managing medical records of refugees*
Author: Sara Noureldin
Supervisors: M. Mercedes Fernández García and David Contreras Bárcena

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**
 - Università degli Studi di Bologna
 - Università degli Studi di Cagliari
 - Università degli Studi di Genova
- **Latvia**
 - Riga Technical University
- **Portugal**
 - Institute for Systems and Computer Engineering of Porto (INESC Porto)
- **Spain**
 - Catalonia Institute for Research in Technology (IREC)
 - Iberdrola, S.A.
 - Universidad de Sevilla
 - Universidad Politécnica Valencia
 - Universidad Pontificia Comillas
- **Sweden**
 - KTH Royal Institute of Technology
- **Switzerland**
 - École Polytechnique Fédérale de Lausanne (EPFL)
 - ETH Zürich
- **United Kingdom**
 - University of Manchester
 - University of Strathclyde

Besides being an active member of the network, the Comillas Pontifical University covers the following positions in the EES-UETP:

- Chairman of the Executive Board: Mr. Luis Rouco Rodríguez
- Coordinating Secretary: Mr. Luis Olmos Camacho

6.1.2 Taught courses

- *Risk Management in Power Systems: from Theory to Practice*
INESC Technology and Science (INESC TEC), Porto, Portugal
- *Uncertainty in Electricity Markets and System Operation*
Technical University of Denmark (DTU), Lyngby, Denmark

6.2 International exchanges

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

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

- Mario Castro Ponce, in Theoretical Biology and Biophysics Department, Los Alamos National Laboratory, Los Alamos (United States of America). July-August 2018.
- Efraim Centeno Hernáez, in Department of Industrial Engineering and Operations Research, University of California, Berkeley (United States of America). June 2018.
- Adrián Fernández Rodríguez, in Dipartimento di Ingegneria Astronautica, Elettrica ed Energetica (DIAEE), Sapienza Università di Roma, Rome (Italy). July-August 2018.
- Carlos Mateo Domingo, in Power System Design and Studies, National Energy Renewable Laboratory (NREL), Golden (United States of America). September-October 2017.
- Carlos Mateo Domingo, in MIT Energy Initiative, Massachusetts Institute of Technology (MIT), Cambridge (United States of America). October-November 2017.
- Rafael Palacios Hielscher, in MIT Energy Initiative (MITEI) y MIT TATA Center for Technology and Design, Massachusetts Institute of Technology (MIT), Cambridge (United States of America). August 2017-August 2018.
- Javier Reneses Guillén, in Energy Technologies Area. Electricity Markets and Policy Group., Lawrence Berkeley National Laboratory (LBNL), Berkeley (United States of America). August 2017-July 2018.
- Javier Reneses Guillén, in Energy Technologies Area. Electricity Markets and Policy Group., Lawrence Berkeley National Laboratory (LBNL), Berkeley (United States of America). August 2018-July 2019.

6.3 Visitting professors

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

- Göran Andersson, from Dept. of Information Technology and Electrical Engineering, ETH Zurich, Zurich (Switzerland). January 2017-December 2019.
- Carlos Batlle López, Massachusetts Institute of Technology (MIT), Boston (USA). October 2017-August 2018.
- Vladimiro Miranda, from Departamento de Engenharia Eletrotécnica e de Computadores, INESC TEC Porto, Porto (Portugal). January 2017-December 2019.
- Masafumi Miyatake, from Dept. of Engineering and Applied Sciences, Sophia University, Tokio (Japan). January 2017-December 2019.
- Karsten Neuhoff, from Department of Climate Policy, TU Berlin, Berlin (Germany). January 2017-December 2019.
- Eva Paz Jiménez, from Bioingeniería, Universidad Pontificia Comillas, Madrid (Spain). September 2017-August 2018.
- Néstor Pérez Mallada, Universidad Pontificia Comillas, Madrid (Spain). May 2018-May 2019.
- Francisco José Pérez Thoden Van Velzen, April-August 2018.
- Guillermo Rein Soto-Yarritu, from Mechanical Engineering, Imperial College London, London (United Kingdom). February 2018.
- Louis Wehenkel, from Department of Electrical Engineering and Computer Science, University of Liège, Liège (Belgium). January 2017-December 2019.

6.4 Visitting students

- Marc F. Barbar, from EECS, Massachusetts Institute of Technology (MIT), Cambridge (USA). June-July 2018.
- Frida Betto, from Industrial Engineering, Università degli studi di Padova, Padua (Italy). November 2017-March 2018.
- Colin Bowen, from Department of Environ. Health & Engineering, Johns Hopkins University, Baltimore (USA). June-July 2018.
- Weldon Carlos Elías Teixeira, from Instituto de Tecnologia ITEC/Ingeniería Eléctrica, Universidad Federal de Pará, Marabá-Pará (Brasil). May 2017-April 2018.

- Claire Galvin, from Department Engineering, University Saint Vicent College, Latrobe (USA). May-July 2018.
- Filippo Guiducci, from Department of Industrial Engineering, University of Padova, Padova (Italy). October 2017-March 2018.
- Charles Gulian, from Applied Mathematics & statistics, Johns Hopkins University, Baltimore (USA). June-July 2018.
- Nenad Jovanovic, from Power Engineering Department, University of Nis, Nis (Serbia). October 2016-April 2018.
- Taito Manabe, from Maruta Laboratory, Nagasaki University, Nagasaki (Japan). November 2017.
- Olamide Oladeji, from Technology and Policy Program, Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). January 2018.
- María Pérez de la Llave, from Engineering, Cornell University, Ithaca, NY (USA). May-August 2018.
- Jessica Quezada, from Urban Studies and Planning, Massachusetts Institute of Technology (MIT), Cambridge (USA). June-July 2018.
- Katherine Wilkins Sergeant, from Department Engineering, Clarkson University, Postdam (USA). May-July 2018.
- Masashi Taguchi, from Maruta Laboratory, Nagasaki University, Nagasaki (Japan). November 2017.

6.5 Courses offered and coordinated to external companies and institutions

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

- Tomás Gómez San Román, José Ignacio Pérez Arriaga, Carlos Batlle López, Michel Rivier Abbad, Pedro Linares Llamas, Pablo Rodilla Rodríguez, Rafael Cossent Arín, Javier Reneses Guillén, Luis Olmos Camacho, Damián Laloux Dallemagne, *"The regulation of the power sector"*. Florence School of Regulation (FSR). Japan. on-line.
- Pablo Frías Marín, José Pablo Chaves Ávila, *"ISGAN Academy webinars"*. International Smart Grid Action Network (ISGAN). Japan.

- Luis Olmos Camacho, Tomás Gómez San Román, Pablo Rodilla Rodríguez, Rafael Cossent Arín, Pablo Frías Marín, Jesús María Latorre Canteli, Paolo Mastropietro, *"Regulation of the Electric Power Industry"*. Instituto Global de Altos Estudios en Ciencias Sociales. Japan. Santo Domingo (Dominican Republic).
- Pablo Rodilla Rodríguez, *"FSR Summer school on regulation of energy utilities"*. Florence School of Regulation. Japan. Florence, Florence (Italy).
- Luis Olmos Camacho, Luis Rouco Rodríguez, Rafael Palacios Hielscher, *"Coordination of the course committee during the year 2017"*. Electric Energy Systems - University Enterprise Training Partnership Association (EES-UETP). Japan. Madrid.
- José Ignacio Pérez Arriaga, Andrés González García, *"Off-grid renewable energy systems: towards affordable, reliable and sustainable electricity for all"*. Escuela de Organización Industrial. Japan. on-line.
- Juan Carlos del Real Romero, *"Technical advice on adhesive joints"*. Fundación Tecnia Research & Innovation. Japan. San Sebastian, Guipuzcoa.
- Rafael Cossent Arín, Pablo Rodilla Rodríguez, Michel Rivier Abbad, Javier Reneses Guillén, *"FSR e-learning course on regulation of energy utilities (13th Edition)"*. European University Institute (EUI), Florence School of Regulation. Japan. Florence, Florence (Italy).
- Tomás Gómez San Román, Rafael Cossent Arín, Pablo Rodilla Rodríguez, José Pablo Chaves Ávila, *"Training on electricity markets"*. Empresa Nacional de Energía Eléctrica (ENEE). Japan. Tegucigalpa (Honduras).
- Juan Carlos del Real Romero, Eva Paz Jiménez, *"Technical advice on adhesive joints"*. Fundación Tecnia Research & Innovation. Japan. San Sebastian, Guipuzcoa.
- Juan Carlos del Real Romero, Eva Paz Jiménez, *"Technical advice on adhesive joints"*. Fundación Tecnia Research & Innovation. Japan. San Sebastian, Guipuzcoa.
- Luis Olmos Camacho, Luis Rouco Rodríguez, Rafael Palacios Hielscher, *"Coordination of the course committee of the EES-UETP network during the year 2018"*. Electric Energy Systems - University Enterprise Training Partnership Association (EES-UETP). Japan. Madrid.
- Andrés Ramos Galán, Javier García González, *"Electric power system modeling for a low carbon economy"*. Massachusetts Institute of Technology (MIT). Japan. Cambridge, MA (United States of America).

- Juan Carlos del Real Romero, *"Technical advice on adhesive joints"*. Fundación Tecnalia Research & Innovation. Japan. San Sebastian, Guipuzcoa.
- Luis Rouco Rodríguez, *"Course on small-signal stability of power systems"*. REE (Red Eléctrica de España). Japan. Tres Cantos, Madrid.
- Juan Carlos del Real Romero, Eva Paz Jiménez, *"European adhesive bonder training"*. Sika, S.A.U. Japan. Alcobendas, Madrid.
- Juan Carlos del Real Romero, Eva Paz Jiménez, *"Technical advice on adhesive joints"*. Fundación Tecnalia Research & Innovation. Japan. San Sebastian, Guipuzcoa.
- Rafael Cossent Arín, *"CEER Specialised training on network tariffs for transmission and distribution 2018"*. CEER - Council of European Energy Regulators. Japan. Brussels (Belgium).
- Juan Carlos del Real Romero, Eva Paz Jiménez, *"Course of adhesive joints durability for the training program of the European Engineer of Adhesives (EAE)"*. Asociación Española de Soldadura y Tecnologías de Unión (CESOL). Japan. Madrid.
- Juan Carlos del Real Romero, Yolanda Ballesteros Iglesias, Eva Paz Jiménez, *"Practical course of surface treatments for adhesive joints for the European Adhesive Engineer (EAE)"*. Asociación Española de Soldadura y Tecnologías de Unión (CESOL). Japan. Madrid.

6.6 Seminars

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

- Ibtihal Abdelmotteleb, *"A framework for electricity distribution-level coordination through local flexibility mechanisms"*. 13th Workshop on Industrial Systems and Energy Technologies - JOSITE'2018. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.
- Carlos Batlle López, José Pablo Chaves Ávila, José Ignacio Pérez Arriaga, *"The value of aggregators in electricity systems"*. 5th Armand Peugeot Chair International Conference - Electromobility: Challenging Issues. Governance and Regulation; y Vedecom Institute.

- Mario Castro Ponce, *"Artificial intelligence in industry and society"*. Conversaciones 4.0. Cátedra de Industria Conectada - Universidad Pontificia Comillas.
- José Pablo Chaves Ávila, *"Approaches for DSO-TSO-PX coordination"*. 1st Workshop Meeting on TSO-DSO-Px Cooperation. Future Power market Platform. Deutsches Institut für Wirtschaftsforschung (DIW Berlín).
- José Pablo Chaves Ávila, *"New energy companies (2). The new role of large energy utilities. Presentation of the study Comillas/MIT"*. Dimensiones económicas del nuevo modelo energético en España. Gobierno de Navarra; y Fundación Gas Natural Fenosa.
- José Pablo Chaves Ávila, *"Presentation of the report: Utility of the Future"*. Instituto Costarricense de Electricidad (ICE).
- José Pablo Chaves Ávila, *"Utility of the Future: electricity sector in transition"*. Escuela de Economía. Universidad de Costa Rica.
- Rafael Cossent Arín, Pablo Frías Marín, *"Integration of PV and EVs in unbalanced residential LV networks and implications for the smart grid and advanced metering infrastructure deployment"*. 5th Armand Peugeot Chair International Conference - Electromobility: Challenging Issues. Governance and Regulation; y Vedecom Institute.
- Kai Doenges, *"Control algorithm for the introduction of a Battery Energy Storage System (BESS) into the Spanish automatic generation control (AGC)"*. 10th Seminar for Next Generation of Researchers in Power Systems. University of Manchester.
- Salvador Doménech Martínez, *"Joint centralized and distributed electricity generation expansion in a decarbonized scenario"*. 13th Workshop on Industrial Systems and Energy Technologies - JOSITE'2018. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.
- José María Fernández de Bobadilla Navarrete, *"A tool for optimal operation and design of batteries and its applications to self-consumption"*. 13th Workshop on Industrial Systems and Energy Technologies - JOSITE'2018. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.
- Pablo Frías Marín, *"Future energy challenges at Comillas IIT/ICAI"*. IAIES Conference. Universidad de Deusto.
- Pablo Frías Marín, *"Business models for large industrial electricity users and necessary policy improvements"*. European workshop «Enabling PV integration by delivering flexibility to the energy market». European Commission.

- Pablo Frías Marín, *"Electro mobility: current state and challenges"*. YES 2018 -Europe Europe Annual Conference. Universidad Politécnica de Madrid.
- Pablo Frías Marín, *"Electro-mobility: local vs. regional policy integration?"*. YES 2018 -Europe Europe Annual Conference. Universidad Politécnica de Madrid.
- Pablo Frías Marín, *"New business models enabled by smart grids technology"*. From intelligent energy solutions to disruptive business models. InescTec; y edp distribuiÇao.
- Javier García González, *"The review of Special Drought Plans (PES)"*. Jornada «La gestión de la sequía a debate: Planes Especiales de Sequía y Planes de Emergencia para abastecimiento urbano» . Observatorio del Agua de la Fundación Botín .
- Timo Gerres, *"A review of cross-sector decarbonisation potentials in the European energy intensive industry"*. 13th Workshop on Industrial Systems and Energy Technologies - JOSITE'2018. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.
- Tomás Gómez San Román, *"Digitalization: transformation and challenges"*. 15 Encuentro del sector energético. Propulsores de cambio en el sistema energético global. IESE Business School; y Deloitte.
- Tomás Gómez San Román, *"The transition to a decarbonised electric sector."*. IX Simposio Internacional de Calidad de la Energía - SICEL 2017. Universidad Industrial de Santander.
- Tomás Gómez San Román, *"New business models for activating industrial demand response"*. 26th BBH Energy Conference. Renewable Energies & Flexible Industrial Consumption. Becker Büttner Held (bbh).
- Tomás Gómez San Román, *"Placing consumers at the centre: How will more flexible markets and pricing affect consumers' needs?"*. High Level European Electricity Regulation Conference. European Commission.
- Tomás Gómez San Román, *"Success story of RES integration in Spain. IIT research projects"*. Success story of RES integration in Spain - lo que el viento nos trajo. Capítulo Español del IEEE PES.
- Tomás Gómez San Román, *"The way forward for a fully digitalised distribution grid in the European Utilities of the future: Beyond UPGRID solutions"*. UPGRID Project Final Event Agenda. Iberdrola.

- Andrés González García, *"Universal access to energy. A goal of sustainable development at our disposal."*. 43 Reunión Anual Sociedad Nuclear Española. Sociedad Nuclear Española (SNE).
- Isaac Camilo González Romero, *"Proactive bi-level GEPTP with storage considerations"*. 13th Workshop on Industrial Systems and Energy Technologies - JOSITE'2018. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.
- Carlos Henggeler Antunes, *"Introduction to multiobjective linear and integer programming"*. Universidad Pontificia Comillas.
- Pedro Linares Llamas, *"Discernment vs. decision theory"*. Seminario «Toma de decisiones discernida». Cátedra de Liderazgo e Internacionalización. Universidad Pontificia Comillas.
- Pedro Linares Llamas, *"Renewable generation and electricity prices"*. International Spring School «European Energy System Transformation and Climate Policy – Heterogeneous Perspectives Ranging from Global via European to Local». Technische Universität Bergakademie Freiberg.
- Pedro Linares Llamas, *"Welcome and introduction"*. Workshop Developments in Energy Economics. Fundación Ramón Areces; Economics for Energy; y Spanish Association of Energy Economics (AEEE).
- Sara Lumbreras Sancho, *"Discernment vs. decision theory"*. Seminario «Toma de decisiones discernidas». Cátedra de Liderazgo e Internacionalización. Universidad Pontificia Comillas.
- Rodrigo Alejandro de Marcos Peiróten, *"Hybridisation of fundamental and composite econometric modelling for short-term electricity price forecasting"*. 13th Workshop on Industrial Systems and Energy Technologies - JOSITE'2018. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.
- Guillermo Mestre Marcos, *"Functional time series identification and diagnosis by means of autocorrelation analysis"*. 13th Workshop on Industrial Systems and Energy Technologies - JOSITE'2018. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.
- José Ignacio Pérez Arriaga, *"Benefits, constraints and challenges for the development of an open and competitive regional market: identifying best practices"*. Sixth Regional Electricity Regulatory Forum. ECOWAS Regional Electricity Regulatory Authority (ERERA).

- José Ignacio Pérez Arriaga, *"Closing remarks and final greetings"*. National Study Day on Mini Grids for Urban, Rural and Industrial Development. Associazione Italiana per le Macchine a Fluido e per i Sistemi per l'Energia e l'Ambiente (AIMSEA) ; y Università di Roma.
- José Ignacio Pérez Arriaga, *"Distributed generation and consumers: what is the impact on market and regulation?"*. VII World Forum on Energy Regulation -WFER 2018. Comisión Reguladora de Energía (CRE).
- José Ignacio Pérez Arriaga, *"Electricity industry structures: competition and regulation"*. VII World Forum on Energy Regulation -WFER 2018. Comisión Reguladora de Energía (CRE).
- José Ignacio Pérez Arriaga, *"Electrifying the developing world"*. 2017 MITEI Fall Colloquium and External Advisory Board Meeting. MIT Energy Initiative.
- José Ignacio Pérez Arriaga, *"Energy and Sustainability"*. El profesional en la sociedad frente a la ética, la innovación y los retos de la sostenibilidad. Universidad Industrial de Santander.
- José Ignacio Pérez Arriaga, *"Parallel workshops on settlements, electrification, and infrastructure. Session 2: Ideal designs and experience"*. MIT Conference on the Resilient Reconstruction of the Caribbean. MIT Energy Initiative.
- José Ignacio Pérez Arriaga, *"Public presentation of the summary of internal sessions of BP Forum on Energy and Sustainability 2017"*. Movilidad sostenible. Cátedra BP de Energía y Sostenibilidad de la Universidad Pontificia Comillas.
- José Ignacio Pérez Arriaga, *"Energy regulation. Passion, mission and challenges"*. Inauguración de la Escuela Iberoamericana de Regulación Eléctrica. Asociación Iberoamericana de Entidades Reguladoras de la Energía (ARIAE); y Escuela de Ingeniería de la Pontificia Universidad Católica de Chile.
- José Ignacio Pérez Arriaga, *"Session IV: Electricity Transmission Challenges"*. 2nd Spain-India Forum 2017. Fundación Consejo España-India; y Confederation of Indian Industry (CII).
- José Ignacio Pérez Arriaga, *"Testimonials from International Research Groups"*. National Study Day on Mini Grids for Urban, Rural and Industrial Development. Associazione Italiana per le Macchine a Fluido e per i Sistemi per l'Energia e l'Ambiente (AIMSEA) ; y Università di Roma.
- José Ignacio Pérez Arriaga, *"The integrated distribution company of the future. Session 5: Evolving electricity markets and technological innovations"*. RERA Annual Conference. Regional Electricity Regulators Association of Southern Africa (RERA).

- José Ignacio Pérez Arriaga, *"The Utility of the Future Study"*. University of Cape Town.
- José Ignacio Pérez Arriaga, *"The way forward"*. Annual Conference RES4MED&Africa « A call for Africa: enabling sustainable projects». Renewable Energy Solutions for the Mediterranean (RES4MED); Renewable Energy Solutions for Africa (RES4AFRICA); Y Enel Green Power.
- Quentin Ploussard, *"An efficient network reduction method for transmission expansion planning using multicut problem and Kron reduction"*. 13th Workshop on Industrial Systems and Energy Technologies - JOSITE'2018. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.
- Andrés Ramos Galán, *"Design Thinking"*. Fundación Universidad-Empresa.
- Javier Reneses Guillén, *"Distribution cost recovery: how do cost drivers change at different levels of the system and how should geographically diverse time-varying costs be recovered with uniform tariffs?"*. Two-Day Electric Rate Forum 2017. California Public Utilities Commission (CPUC).
- Javier Reneses Guillén, *"Experience with advanced dynamic rates in other jurisdictions"*. Two-Day Electric Rate Forum 2017. California Public Utilities Commission (CPUC).
- David Roch Dupré, *"Evaluation of the impact that the traffic model used in railway electrical simulation has on the assessment of the installation of a reversible substation"*. 13th Workshop on Industrial Systems and Energy Technologies - JOSITE'2018. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas.
- Carlos Rodríguez-Morcillo García, *"WIONM: wireless technology at the service of doctors and patients"*. XVII Semana de la Ciencia. Instituto de Investigación Tecnológica. Universidad Pontificia Comillas; Fundación para el conocimiento madri+d; y Comunidad de Madrid.
- Álvaro Sánchez Miralles, *"Buildings 2030: energetically flexible buildings, real case"*. IV Congreso Edificios Inteligentes. Grupo Tecma Red S.L..
- Álvaro Sánchez Miralles, *"Impact of UPGRID solutions in energy markets, business framework and consumer engagement : Monitoring and impact assessment of project demonstrators"*. UPGRID Project Final Event Agenda. Iberdrola.

6.7 Congress, seminars and journals organization

- Pablo Ayala Santamaría, Alexis Cantizano González, *"IX Congreso Internacional de Ingeniería de Seguridad contra Incendios"*. Asociación de Profesionales de Ingeniería de Protección Contra Incendios (APICI); y Universidad Pontificia Comillas. Madrid (Spain). October 2017.
- Javier García González, *"13th Workshop on Industrial Systems and Energy Technologies - JOSITE'2018"*. Universidad Pontificia Comillas. Madrid (Spain). May 2018.

6.8 Other academic activities organization

- Mario Castro Ponce, *"Permanent member of Congress of Statistical Physics - FISES"*. RSEF / GEFENOL. April 2014- Today.
- Pablo Frías Marín, *"Member of the Scientific Committee of 7th IEEE PES International Conference on Innovative Smart Grid Technologies (ISGT Europe 2017)"*. IEEE PES. Turin (Italy). September 2017.
- 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.
- Aurelio García Cerrada, *"Chairman in 25º Seminario Anual de Automática, Electrónica industrial e Instrumentación - SAAEI'18. Session: IENE2. Energy Engineering"*. Universitat Politècnica de Catalunya. Barcelona (Spain). July 2018.
- 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. Amsterdam (Netherlands). June 2014- 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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- Andrés Ramos Galán, *"Member of the Scientific Committee of International Conference on Renewable Energy Research and Applications (ICRERA)"*. International Journal of Renewable Energy Research - IJRER. September 2012- Today.
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6.9 Other activities

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- Yolanda Ballesteros Iglesias, Honorary professor in Universidad Autónoma de Madrid. Madrid (Spain). September 2014- Today.
- Yolanda Ballesteros Iglesias, Reviewer of *"The Journal of Adhesion"*. Taylor & Francis Ltd.. Philadelphia (United States of America). November 2013- Today.
- Carlos Batlle López, Co-Director of Energy Training in European University Institute. Florence School of Regulation (FSR). Florence (Italy). January 2008-October 2017.
- Carlos Batlle López, Director of Summer School on Regulation of Energy Utilities in European University Institute. Florence School of Regulation (FSR). Florence (Italy). June 2008-October 2017.
- Francisco Alberto Campos Fernández, Member of Cost Action Management Committee TD1207 in European Cooperation in Science and Technology (COST). Brussels (Belgium). December 2013- Today.
- Laura Casado Fulgueiras, Grant awards in *"Iberdrola Scholarship to research in energy and the environment"*. Iberdrola. Madrid (Spain). December 2017.

- Mario Castro Ponce, Project evaluator. Agencia Nacional de Evaluación y Prospectiva (ANEP), Ministerio de Ciencia e Innovación. Madrid (Spain). January 2007- Today.
- Efraim Centeno Hernández, Dissertation committee of *Khan, Z. «Integrating water and energy systems for long-term resource management»*. Universidad Pontificia Comillas. Madrid (Spain). December 2017.
- José Pablo Chaves Ávila, Leader of Annex 8 of the International Smart Grid Action Network (ISGAN) in International Smart Grid Action Network (ISGAN). New Delhi (India). October 2016- Today.
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- Rafael Cossent Arín, Reviewer of *"Sustainable Energy, Grids and Networks"*. Elsevier. Amsterdam (Netherlands). December 2015- Today.
- Fernando de Cuadra García, Member of the Governing Board in Asociación/Colegio Nacional de Ingenieros del ICAI. Madrid (Spain). June 2010- Today.
- Fernando de Cuadra García, Member of Patronage in Fundación Universidad Loyola Andalucía. Seville (Spain). June 2010- Today.
- Asunción Paloma Cucala García, Member of Spanish Railway Technology Platform in Fundación de los Ferrocarriles Españoles. Madrid (Spain). January 2006- Today.
- Francisco Miguel Echavarren Cerezo, Dissertation committee of *Renado Anglada, F.J. «Control of VSC-HVDC multi-terminal systems to improve angle stability in hybrid HVAC/HVDC electrical transmission systems»*. Universidad Pontificia Comillas. Madrid (Spain). March 2018.
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- Tomás Gómez San Román, Member of Council in Power Systems Computation Conference (PSCC). Zurich (Switzerland). August 2014-June 2018.
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- Pedro Linares Llamas, Member in International Society on Multiple Criteria Decision Making (MCDM). Ankara (Turkey). January 2000- Today.
- Pedro Linares Llamas, Co-Director in Economics for Energy. Vigo (Spain). July 2010- Today.
- Pedro Linares Llamas, Member of the Committee of experts on energy transition scenarios in Ministerio de Energía Turismo y Agenda Digital. Madrid (Spain). July 2017- Today.
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- José Ignacio Pérez Arriaga, Director of Energy Training in European University Institute. Florence School of Regulation (FSR). Florence (Italy). March 2001- Today.
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- José Ignacio Pérez Arriaga, Active member in Real Academia Española de Ingeniería. Madrid (Spain). October 2003- Today.
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7. Data about IIT

The relevant numbers of the academic year 2017 - 2018 are shown below, as well as the historical evolution of the turnover of the Institute and of its staff, separated into academic staff and research assistants:

5,36 M€ Turnover

71 Professors and researchers

31 Research assistants

84 Research projects

28 Consultancy projects

18 Services and analysis projects

1 Books and 6 Chapters in books

59 Papers published in JCR journals

18 Papers published in other journals

49 Papers presented at conferences

19 Technical reports

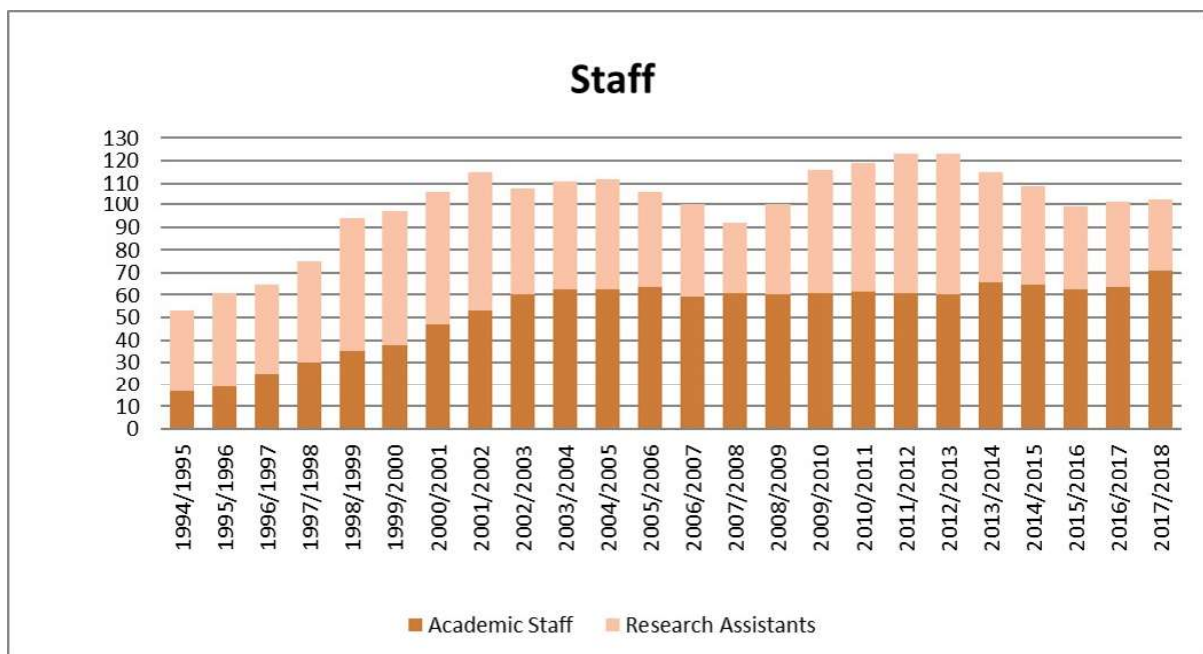
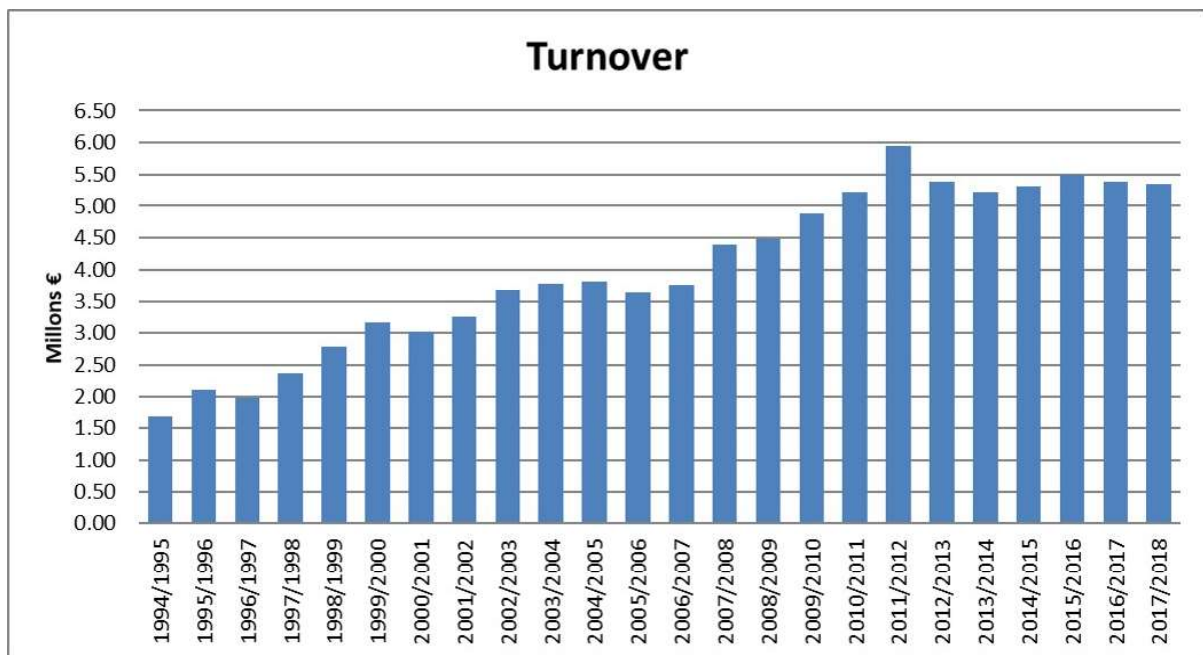
6 Submitted theses

47 Ongoing theses

12 Visiting professors and 14 students

8 International exchanges

20 Courses offered to external entities





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