Annual Academic Report
Academic year 2014 - 2015

Institute for Research in Technology

Instituto de Investigación Tecnológica
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Dear Friend,

Another year, it is with much pleasure and satisfaction that I present the annual report of the work carried out in the Institute for Research in Technology (IIT) of the ICAI School of Engineering at the Comillas Pontifical University.

This document - a record of a year of effort and dedication on the part of our research staff - is proof indeed of the position we have been able to consolidate, both nationally and internationally, in our chosen areas of research. It describes a situation which attests both to the strength of the institute’s research teams, who also make an important contribution to our ambitious and internationally-oriented doctoral programs, and to the continuing success of our collaboration with the industrial sector, and that is the result of more than thirty years of hard work.

All of the activity described in this report would not have been possible without the work and commitment of all the professionals in the institute: teachers, 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.

Our goal now is to build on our success and advance further in our areas of expertise. This we hope to achieve though our continuing commitment and our professionalism, a professionalism which will enable us to continue to enjoy the confidence of those national and international companies and organizations with whom we collaborate, in particular the ICAI School of Engineering itself, the Comillas Pontifical University, and ICAI Engineers Association, for whose valuable support we would like to express our gratitude. We wish to continue to earn 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 global economic situation, especially in the energy sector, we face it with enthusiasm, commitment and moderate optimism, as the tendency of the economy seems to be changing. 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.

Efraim Centeno Hernáez
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, usually with scholarships from the IIT and dedicated to the Institute. 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 2014 - 2015, from the September 1, 2014 to September 1, 2015.
2. Organization

2.1 Management

The management of the Institute for Research in Technology has been formed by the following teachers:

- **Centeno Hernáez, Efraim.** Director
- **Villar Collado, José.** Deputy Director

2.2 Council

Members of the Council of the Institute for Research in Technology were:

- **Centeno Hernáez, Efraim.** Director
- **Frias Marín, Pablo.** Researcher representative
- **Gómez San Román, Tomás.** Researcher representative (since September 2014)
- **González Sotres, Luis.** IEF representative (until September 2014)
- **Latorre Canteli, Jesús María.** Researcher representative (until September 2014)
- **Paz Jiménez, Eva.** IEF representative
- **Ramos Galán, Andrés.** Researcher representative
- **Reneses Guillén, Javier.** Researcher representative (until September 2014)
- **Rivier Abbad, Michel.** Researcher representative
- **Rodríguez Calvo, Andrea.** IEF representative (since September 2014)
- **Rodríguez-Morcillo García, Carlos.** Secretary
- **Rouco Rodríguez, Luis.** Researcher representative (since September 2014)
- **Villar Collado, José.** Deputy Director
2.3 Academic staff

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

• **Alexandres Fernández, Sadot.** Associate Professor  
  Ph.D. in Telecommunications Engineering (UPM)  
  Telecommunications Engineer (UPM)  

• **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)  

• **Batlle López, Carlos.** Associate Researcher  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  
  Areas of interest: Economics and regulation of the electricity industry. Modelling of electricity markets.

• **Boal Martín-Larrauri, Jaime.** Lecturer  
  Ph.D. in Industrial Engineering (Comillas)  
  Electronics Engineer (Comillas)  
  Areas of interest: Home automation and energy efficiency · Autonomous mobile robots, computer vision, topological modeling of the environment · Analog and digital electronics, wireless communications

• **Campos Fernández, Francisco Alberto.** Research Assistant  
  Ph.D. in Industrial Engineering (Comillas)  
  Mathematics Science degree (UCM)  

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

• **Cerisola López de Haro, Santiago.** Research Affiliate  
  Ph.D. in Industrial Engineering (Comillas)  
  Mathematics Science degree (UCM)

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

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

• **Cuadra García, Fernando de.** Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electrical Engineer (Comillas)

• **Cucala García, Asunción Paloma.** 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.** Research Assistant
  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.** Associate Professor
  Ph.D. in Industrial Engineering (Comillas)
  Physics Science degree (UCM)

- **Frias 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. Optimisation techniques. Integration of distributed generation in power systems. Advanced electric machines.

- **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.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (UPC)  
  Areas of interest: Economy and optimization of electric power systems.

- **García González, Pablo.** 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)  

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

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

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

• **Lumbreras Sancho, Sara.** Lecturer  
Ph.D. in Industrial Engineering (Comillas)  
Electrical Engineer (Comillas)  

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

• **Mateo Domingo, Carlos.** Research Assistant  
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)

- **Nieto Fuentes, Francisco.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Mechanical Engineer (Comillas)  
  Areas of interest: Robotics. Reliability and safety. Mechanical design.

- **Olmos Camacho, Luis.** Assistant Researcher  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  

- **Palacios Hielscher, Rafael.** 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.

- **Ramos Galán, Andrés.** Professor  
  Ph.D. in Industrial Engineering (UPM)  
  Electrical Engineer (Comillas)  
• **Reneses Guillén, Javier.** Assistant 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.** Research Assistant  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  

• **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.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electronics Engineer (Comillas)  
  Areas of interest: Control systems. Railway electrification. Thermoelectricity.

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

• **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 Martín, Pedro.** 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.** 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)  

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

• **Sigrist, Lukas.** Research Assistant  
  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.** Associate 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.

• **Villar Collado, José.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electronics Engineer (Comillas)

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


### 2.4 Associated academic staff

Collaborated with IIT, as Associate Researchers:

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

- **Cantizano González, Alexis.** Lecturer
  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)

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

- **Castro Ponce, Mario.** Associate Professor
  Ph.D. in Physics Science (UCM)
  Physics Science degree (UCM)
• **Fernández Bernal, Fidel.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  
  Areas of interest: Dynamics of electrical systems. Motor control. Renewable energies integration.

• **Fernández Martínez, Cesáreo.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (UPM)  
  Areas of interest: Software for real-time control. Parallel architectures in control. HV line protection. Control in electric power substations.

• **Giannetti, Romano.** Associate Professor  
  Ph.D. in Electronics and Computing Engineering (University of Padua, Italy)  
  Electronics Engineer (University of Pisa, Italy)  

• **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.

• **Maté Jiménez, Carlos.** Associate Professor  
  Ph.D. in Mathematics Science (UCM)  
  Mathematics Science degree (UCM), Economic Science diploma (UCM)  

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

• **Ortiz Marcos, Susana.** Associate Professor  
  Ph.D. in Industrial Engineering (UPM)  
  Industrial Engineer (UPM)  

• **Porras Galán, José.** Lecturer  
  Ph.D. in Industrial Engineering (Comillas)  
  Mechanical Engineer (Comillas)  

• **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. Nanomaterials: preparation, characterization and simulation of nanomaterials.

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

• **Santos Montes, Ana María.** 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.
2.5 Research assistants

The group of Research Assistants at the IIT consisted of the following graduates in this course:

- **Abdelmotteleb, Ibtihal.** Electrical and Control Engineer (Arab Academy for Science, Technology and Maritime Transport, Cairo, Egypt), Máster en Electrical and Control Engineering (Arab Academy for Science, Technology and Maritime Transport, Cairo, Egypt)
- **Alonso Rivas, Eduardo.** Electronics Engineer (Comillas), Automatics and Electronics degree (Comillas), M.Sc. in Research in Engineering Systems Modeling (Comillas)
- **Bañez Chicharro, Fernando.** Electronics Engineer (Comillas), M.Sc. in Power Systems (Comillas)
- **Bello Morales, Antonio.** Mechanical Engineer (Comillas), M.Sc. in Power Systems (Comillas)
- **Calvillo Muñoz, Christian Francisco.** Mechatronic Engineer (Instituto de Estudios Superiores de Monterrey - IITESM, Mexico), M.Sc. in Electronic Systems Modeling (Instituto de Estudios Superiores de Monterrey - IITESM, Mexico)
- **Cañeque Simón, María Peñahora.** Electrical Engineer (Comillas)
- **Carvajal Carreño, William.** Electrical Engineer (Industrial University of Santander - UIS, Bucaramanga, Colombia), M.Sc. in Electrical Engineer (Industrial University of Santander - UIS, Bucaramanga, Colombia)
- **Chaves Ávila, José Pablo.** 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)
- **Ciller Cutillas, Pedro.** Electronics Engineer (Comillas), Mathematics (UCM)
- **Conchado Rodríguez, Adela.** Electrical Engineer (Comillas), M.Sc. in Power Systems (Comillas), M.Sc. in Business and Community (University of Bath, United Kingdom)
- **Danesin, Alessandro.** Economics and Management of Complex Systems degree (Ca’Foscari University of Venice, Italy), M.Sc. in Models and Methods of Quantitative Economics (Universidad Autónoma de Barcelona - UAB and Université Paris 1 Panthéon - Sorbonne, France)
- **Fernández Rodríguez, Adrián.** Electrical Engineer (UPM)
• **Formozo Fernandes, Camila.** Economics Science degree (Federal University of Rio de Janeiro - UFRJ, Brazil), M.Sc. in Electric Power Industry (Comillas), M.Sc. in Economics, Technology and Territory (University Paris-Sud 11, France)

• **Gil Medina, María.** Electrical Engineer (Comillas), M.Sc. in Power Systems (Comillas)

• **González García, Andrés.** Electronics Engineer (Comillas), M.Sc. in Power Systems (Comillas)

• **González Sotres, Luis.** Electronics Engineer (Comillas), M.Sc. in Power Systems (Comillas)

• **Herrero Gallego, Ignacio.** Electronics Engineer (Comillas)

• **Izadkhast, Seyedmahdi.** Electrical Engineer (University of Tehran, Iran), M.Sc. in Power Electronics and Electrical Machines (Sharif University of Technology, Tehran, Iran)

• **Jovanovic, Nenad.** Master Engineer of Electrical Engineering and Computer Science (University of Niš, Republic of Serbia)

• **Khan, Zarrar.** Environmental Engineer (Dartmouth College, Hanover, NH, United States of America), M.Sc. in Civil and Environmental Engineering (Cornell University, Ithaca, NY, United States of America), M.Sc. in Project Management (COMSATS Institute of Information Technology - CIIT, Islamabad, Pakistan)

• **López López, Álvaro Jesús.** Electronics degree (Comillas), M.Sc. in Automatics and Electronics (Comillas), M.Sc. in Research in Engineering Systems Modeling (Comillas)

• **Marcos Peirotén, Rodrigo Alejandro de.** Electronics Engineer (Comillas)

• **Martín Lopo, Miguel.** Electronics Engineer (Comillas)

• **Martín Martínez, Francisco.** Electrical Engineer (Comillas)

• **Mastropietro, Paolo.** Environmental Engineer (University of Rome Tor Vergata, Italy), M.Sc. in Environmental Engineering (University of Rome Tor Vergata, Italy)

• **Mazidi, Peyman.** M.Tech. in Electrical Engineering (Jawaharlal Nehru Technological University, Hyderabad, India) Electrical Engineer (Islamic Azad University, Aliabad, Golestan, Iran)

• **Melese, Yeshambel.** Chemical Engineering (Addis Ababa University, Ethiopia), M.Sc. in Sustainable Energy Engineering (Royal Institute of Technology - KTH, Stockholm, Sweden)

• **Moreno Carbonell, Santiago.** Electronics Engineer (Comillas)

• **Mosácula Atienza, Celia.** Chemistry Engineer (UPV/EHU), M.Sc. in Renewable Energies (CEU San Pablo University)

• **Ochoa Giménez, Miguel.** Electronics degree (Comillas), M.Sc. in Automatics and Electronics (Comillas), M.Sc. in Research in Engineering Systems Modeling (Comillas)

• **Orgaz Gil, Alberto.** Electronics Engineer (Comillas)
Research assistants

- **Paz Jiménez, Eva.** Industrial Technical Engineering in Industrial Chemistry (UPM), M.Sc. in Production Engineering (UPM)
- **Ploussard, Quentin.** Electrical Engineer (Ecole Supérieure d’Électricité - SUPELEC, Paris, France), M.Sc. in Network Economics and Regulations (Paris Dauphine University, Paris, France)
- **Portela González, José.** Electronics Engineer (Comillas), M.Sc. in Research in Engineering Systems Modeling (Comillas)
- **Renedo Anglada, Francisco Javier.** Electrical Engineer (Comillas), M.Sc. in Mathematical Engineering (UC3M)
- **Rigaud Gálvez, Mario.** Mechanical Engineer (Comillas)
- **Rodríguez Calvo, Andrea.** Electronics Engineer (Comillas), M.Sc. in Power Systems (Comillas)
- **Romero Mora, José Carlos.** Electrical and Power Systems Engineer (University of Malaga), M.Sc. in Research in Engineering Systems Modeling (Comillas)
- **Saboya Bautista, Inmaculada.** Electrical Engineer (Comillas), M.Sc. in Power Systems (Comillas)
- **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)
- **Usera Rodés, Inés.** Electrical Engineer (UPM)
- **Valle Díez, Aurora del.** Energy Techniques Engineer (UPM)
- **Vallés Rodríguez, Mercedes.** Electrical Engineer (Comillas), M.Sc. in Power Systems (Comillas)
- **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)

2.6 Services staff

2.6.1 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

2.6.2 Administrative staff

The staff that manage the documentation, the general and technical secretariat and the trips consist of:
• **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 two main areas of research:

3.1.1 Power Systems (SE)

That is mainly aimed at subjects related to the electricity and energy sector and in particular to the generation, transportation, and distribution of electrical energy. It is subdivided into four areas:

3.1.1.1 Modelling, Analysis and Control of the Electric Power Systems Area (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: http://www.iit.comillas.edu/organizacion/mac.php.en

3.1.1.2 Smart and Green Networks Area (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.
3.1.1.3 Regulation and Economics of the Electric Sector Area (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.).

Coordinators: Michel Rivier Abbad (until January 2015) and Pablo Rodilla Rodríguez (since February 2015)
Web page: http://www.iit.comillas.edu/organizacion/rye.php.en

3.1.1.4 Decision Support Systems in the Energy Sector Area (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: http://www.iit.comillas.edu/organizacion/sadse.php.en

3.1.2 Industrial Systems (SI)

This area is focused on activities in other technical sectors, and it is divided into four different technical areas.

3.1.2.1 Engineering Design Area (ADI)

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: Francisco Nieto Fuentes
Web page: http://www.iit.comillas.edu/organizacion/adi.php.en

3.1.2.2 Railway Systems Area (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: http://www.iit.comillas.edu/organizacion/asf.php.en

3.1.2.3 Intelligent Systems Area (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: http://www.iit.comillas.edu/organizacion/asi.php.en

3.1.2.4 Electronics and Automatic Group (GEA)

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: http://www.iit.comillas.edu/organizacion/gea.php.en

3.2 Research projects

Research projects in which they have worked during this academic year are collected here, grouped by area and type of funding, along with a brief description of them. It also indicates the collaborating institution, dates of beginning and end, and the researchers involved.

3.2.1 Power Systems Areas

3.2.1.1 Research and develop projects

3.2.1.1.1 Private funding

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

  This project represents an integrated research and educational program for graduate and undergraduate students and faculty from Johns Hopkins U., Texas Tech U., Smith College, U. of Puerto Rico, and their international partners 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
Comillas Pontifical U. in Spain.
The partnership will address pressing research questions concerning the addition of multiple wind sources to the power system, such as physical sources of fluctuations; statistical characterization and propagation of variability; and the economic and social implications for design and operation of a sustainable power supply. With hundreds of billions of dollars to be invested in renewable power and associated infrastructure over the next several years, developing tools to manage variability is crucial to making effective use of sustainable but intermittent power sources. Research will be tightly integrated with a student training program that includes carefully designed international experiences. Comillas cooperates in the education of students in research topics of integration of wind generation in electricity markets.

• **Smarter electricity distribution grids to integrate distributed energy resources**
  The objective of this project is to develop and demonstrate an electric energy management system based on aggregation of clients' behavior, which are located all over the distribution network, and to propose new business models that allow the efficiency improvement of the electric system. In this context, efficiency refers to the reduction of CO2 emissions, maximum usage of distributed renewable energy sources, and the increment of benefits for users, distributors and aggregators/retailers.
  To this purpose, the following sub-objectives are proposed:
  • To determine the benefits, in a detailed way, that result from the aggregation of clients' behavior in comparison to the non-aggregated demand approach.
  • To determine the requirements of systems and aggregation limits by running simulations that emulate the behaviour of real clients and markets.
  • To develop control algorithms for the optimal aggregation to make more efficient the electric system.
  • To optimize the resources that the clients should implement in order to get the maximum profit of the aggregation.

• **Comparative analysis of electric market regulatory systems in different Latin American countries**
  The aim of this project is to present an updated and complete regional analysis of the regulatory approaches adopted in the main countries of the Latin American region.
  Secondly, an attempt will be made to contribute to a prospective view of the direction that evolution may reasonably be expected to take, in light of
regulatory developments in the past years, as well as to propose innovative solutions that might help to increase the efficiency of the development of the business.

• **Low-cost energy technologies for universal access**  
  Endesa Foundation. January 2013 - August 2015. (Carlos Batlle López, José Ignacio Pérez Arriaga, Andrés González García)  
  The general objective of this study is to determine how to address the provision of universal access to modern energy services, as a contribution to the global energy model for the next decades.

• **Assessing and forecasting on the Iberian electricity market**  
  This project is framed into the on-going cooperation line followed by Endesa and IIT in the framework of operation and planning in the context of the Iberian electricity market. Specifically, it focuses on improving and updating the tool VALORE for medium term operation in electricity markets to changing needs of users and the structural and regulatory developments in the electricity sector. The tasks envisaged include forecasting hourly prices in the electricity market, the development of a tool to forecast hourly wind generation, and the optimization of the fuel mix of Endesa’s generation units.

• **Assessing and forecasting on the European electricity market**  
  This project is framed into the on-going cooperation line followed by Endesa and IIT in the framework of operation and planning in the context of the European electricity market. Specifically, it focuses on the use of the tool VALORE for medium-term operation in a European context (MIBEL and CWE). The tasks envisaged include the developments needed to model an environment of imperfect competition, and the forecast of hourly solar production.

• **Optimization tool for the short-term operation in the Spanish natural gas hub**  
  The main objective of this project is to maximize Endesa’s profit in the short term and to develop a model able to represent the operation in the future Spanish (or Iberian) hub which will be regulated in the next few months. In particular, the model support medium-term balancing decisions, that is, monthly decisions which are taken during the next two years with the objective of maximizing medium-term profits. Afterwards, the model is extended in order
Research projects

to include daily operation strategies able to maximize short-term profits, that is, during the next three months.

• **Medium- and long-term planning in the Iberian electricity market**  
  This project is framed into the on-going cooperation line followed by Endesa and IIT since in the framework of medium- and long-term planning in the context of the Iberian electricity market. In addition to assistance with the use of the model VALORE, the planned tasks include conducting a study to analyze the behavior of the agents in the market and developments in the executions with states.

• **Iberian natural gas market operation: operational and modeling improvements**  
  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. In particular, the model is extended in order to consider agents’ strategic behavior in a profit-maximizing context. Furthermore, a balancing hub which will be regulated during 2014 is included, as well as global gas markets are represented with detail. Finally, the interaction with the electricity market model is consolidated allowing to obtain synergies from the joint operation, and input variables uncertainty are incorporated.

• **Short- Medium-term risk management tool in electricity markets**  
  The aim of this project is to continue with the conceptual and operational developments in the current short- and medium-term risk management tool used by Endesa, as well as assisting in the use of the model and the interpretation of results. The main objective is to complete the integration of the different tools that are used currently (specifically, the portfolio assessment tool) and enable the use of the model by different users with different needs.

• **Development of a risk management model for the natural gas business**  
  The objective of this project between IIT and Endesa is to continue the development of a simulation tool which allows Endesa respond to the needs and requirements for the risk decision-making process in the natural gas business. In this second stage the implementation of the tool is started in order to have a preliminary version along the collaboration.
• Development of a long-term energy risk management model  
The objective of this project between IIT and Endesa is to continue the development of a tool which allows Endesa to meet the needs and requirements for the risk decision-making process in the long term (more than three years). In this second phase, the development of the simulation module of risk factors and the simulation module of the electricity market is carried out. Then, the results of both modules are used to perform a preliminary version of the profit calculation module.

• Generation capacity studies with high level of renewable energies penetration  
This project deals with the analysis and improvement of algorithms and methods used by Endesa for the preparation of its annual capacity plan and to other studies associated with it. During 2013 the model Expande has been extended to work with multiple scenarios considering some stochastic input variables.  
Project goals include continuous updating of the methods used to enhance and expand the capabilities of the models, adapt to ensure regulatory changes expected to be presented in the coming months and assistance for the use of the tools. This proposal raises on the one hand tasks oriented to stochastic modeling and on the other, tasks to refine the results obtained in the execution based of scenarios.

• MORSE: regulatory simulator, with investments and technology mix analysis  
MORSE is a model of the Spanish electricity sector, developed by the Institute for Research in Technology (Instituto de Investigación Tecnológica, IIT) in collaboration with Endesa. It is intended for strategic analysis of the evolution of this sector, especially when changes of the utilities structure, new regulations, or new generation technologies take place.  
This collaboration focus on providing the functionality needed to end up with a proper regulatory simulation tool, to analyze the impact of the decisions of the regulator on the investments, the operation, and the final sector balance. Some of the main tasks are the improvement of the representation of the incomes and costs of the electricity sector, and of the investments module to provide it with better chronological detail and account for the reserves requirements of the system.
• Distributed energy systems modeling analysis in the MIT Utility of the Future study
Massachusetts Institute of Technology (MIT). February 2014 - July 2016. (Tomás Gómez San Román, José Pablo Chaves Ávila, Carlos Batlle López)
The objective is to analyze how Distributed Energy Systems (DES) can change electric power systems over the coming decade. This involves the following tasks:
• Identification and classification of existing analytical tools and models including relevant literature that will allow to assess quantitative impacts of new business models on current incumbent activities.
• Development of new analytical models to allow for the evaluation of candidate technologies and business models
• Proposal and formulation of case studies that would illustrate how those new DES technologies and business models may impact incumbent activities.
The project also covers the potential implications that the development of DES can have on the proper design of end-user tariffs.

• Analysis of electrification scenarios for the Spanish energy system
Red Eléctrica de España (REE). April 2014 - October 2014. (Pedro Linares Llamas, Michel Rivier Abbad, Jesús María Latorre Canteli, José Carlos Romero Mora)
The goal of this research is to analyze the effects of an increase in the level of electrification of the Spanish economy, by substituting current demands of other energy sources in the different sectors. This way we identify quantitative and qualitative arguments that support this increase in electrification.
The effects will be measured in terms of primary energy demand, energy dependence ratios, energy intensity, adaptation costs and also costs of energy supply, level of penetration of renewable energy, and CO2 emission levels.

• Impact assessment of the connection of gas based micro-cogeneration in electric distribution networks
The aim of this project, developed in collaboration with MITEI, is to evaluate the impact of an increased penetration of natural gas-fueled distributed generation in the electrical distribution network. The results of this analysis will identify possible operation (technical) and planning (economical) barriers in the electrical distribution network to integrate a high level of distributed generation.

• Promoting long-term intrarregional agreements in the Central American regional electric market
The Central American Regional Electric Market («MER» for its initials in Spanish) is the supranational market in which the national power generation markets or systems can carry out intra-regional transactions. The main objective of the Central American Regional Electric Market («MER» for its initials in
Spanish) is to provide a clear and efficient legal and regulatory framework to promote the attraction of regional investments in generation and transmission infrastructure. The MER has encountered difficulties to promote intra-regional long-term power purchase agreements between countries, given the financial implications that any potential interruption of the power supply may have to the seller and/or the buyer. The objective of the project is to explore potential instruments that may mitigate this risk.

• **Pilot project for electrification of a village in Rwanda taking the local school as the anchor load**

  Advanced methods will be applied to the design of the micro-grid and for the expansion of the number of loads connected to it. Ad-hoc studies will comprise the early involvement of the community in the co-design process, the characterization of sustainable business models and the proposal of a suitable regulatory and enabling environment. Based on the experience gained with the pilot project, this proposal also includes a study to extend the concept to a large number of rural schools (potentially several thousand), either in Rwanda or in another country with similar characteristics.

• **Energy storage perspectives**
  Ente Nazionale Idrocarburi (ENI). September 2014 - April 2016. (Carlos Batlle López, Pablo Rodilla Rodríguez, Ignacio Herrero Gallego, Inés Usera Rodés)

  The aim of this project, developed in collaboration with MITEI, is to provide an engineering, economic and regulatory assessment of energy storage systems (EES).

• **Specification and development of medium and long term energy planning models**
  XM. October 2014 - October 2015. (Andrés Ramos Galán, Jesús María Latorre Canteli)

  In this project we are going to develop a medium and long term energy planning models for the Colombian system. The first one will represent the system operation with a scope of 1-2 years and the second one reaching 5-10 years. The results of the medium term model will be used as input by short term models. Both models will be integrated in a single software application sharing input data and presentation of the output results as well as the corresponding part of the code.

• **Regulatory review in the MIT Utility of the Future study**
  Massachusetts Institute of Technology (MIT). November 2014 - October 2016. (Carlos Batlle López, Pablo Rodilla Rodríguez, Ignacio Herrero Gallego, Paolo Mastropietro)

  Power systems regulatory review in face of the development of distributed energy services
This review mainly cover the following topics:
- Wholesale markets
- Distribution network remuneration
- Tariff design: network costs and other regulated activities & charges
- Clean energy support mechanisms
- Power sector organization: system operators and retail markets

• Wholesale markets redesign in the MIT Utility of the Future study
Massachusetts Institute of Technology (MIT). November 2014 - October 2016. (Pablo Rodilla Rodríguez, Ignacio Herrero Gallego, Carlos Batlle López)
The current wholesale market mechanisms need to be enhanced with new solutions that improve their role as providers of efficient market signals for all the system agents involved. This necessarily entails revisiting most of the design elements that currently define market processes (e.g. timing of markets, SO actions, pricing, etc.). An in-depth analysis of the relevant literature on market design and efficiency issues in the US and Europe is carried out to properly frame the problem. Then, the aim is to put forward new proposals for improvement at all levels.

• Short-medium-term risk management tool in electricity markets
The aim of this project is to continue with the conceptual and operational developments in the current short- and medium-term risk management tool used by Endesa, as well as assisting in the use of the model and the interpretation of results. The main objective is to complete the integration of the different tools that are used currently (specifically, the portfolio assessment tool) and enable the use of the model by different users with different needs.

• Long-term energy risk management: portfolio evaluation and optimization of strategies
The aim of this collaboration between IIT and Endesa is to continue the development of the ARIES tool for long-term risk management. Specifically, in this stage the adaptation of the tool to the user’s needs is addressed, as well as the implementation of improvements in the long-term time series module and in the electric market module.

• Gas portfolio risk management: optimization of strategies
The aim of this collaboration is to continue with the conceptual and operational developments in the AURIGA risk management tool for the natural gas market, as well as to assist users in using the tool and interpreting results.
The project is focused on the development of the three major modules in AURIGA: generating price paths, valuing portfolios and treatment of outcomes.

- **Strategic operation in the Iberian natural gas market**  
  The objective of this project is to continue the development of the short-term gas operation tool GAMMA. In particular, the optimization of Endesa’s logistic operations, as well as of infrastructure contracting. Additionally, the management of supply contracts and the possibility of participating in the natural gas market are dealt with. The goal is to help Endesa in strategic decision-making that allow to maximize the obtained profit and to define strategies in the natural gas market.

- **Support in medium- and long-term planning in the Iberian electricity market**  
  This project is framed into the on-going cooperation line followed by Endesa and IIT in the framework of medium- and long-term planning in the context of the Iberian electricity market. In addition to assistance with the use of the model VALORE, the planned tasks include estimating the conjectures of the agents in the long term, as well as the integration of a simplified modeling of the European market.

- **Operation optimization and modeling of the Iberian natural gas market**  
  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 is to consider the strategic decisions of the agents in the OMEGA model, including a new iterative algorithm. Thus, the maximization of Endesa’s profit and the definition of a joint strategy in markets natural gas and electricity are addressed.

- **Assessing and forecasting on the Iberian electricity market**  
  This project is framed into the on-going cooperation line followed by Endesa and IIT in the framework of operation and planning in the context of the Iberian electricity market. The first objective is to provide support in adapting and updating the medium-term operation tool VALORE to new user requirements and structural and regulatory changes of the electric sector. Additionally, it focuses on developing a forecasting hourly solar production tool and on the calculation of market equilibrium in a European context.
• **Dissemination workshop for e-Highway**  
Dissemination workshop for e-Highway

• **MORSE: regulatory decisions optimizer and analysis of its impact on the electricity sector**  
MORSE is a model of the Spanish electricity sector, developed by the Institute for Research in Technology (Instituto de Investigación Tecnológica, IIT) in collaboration with Endesa. It is intended for strategic analysis of the evolution of this sector, especially when changes of the utilities structure, new regulations, or new generation technologies take place.
This collaboration focuses on the development of a model for the optimization of regulatory decisions considering its impact on the power system, both in the new capacity investment decisions of the market participants and on the operation of the generation resources. The inclusion of active clients or prosumers, electric vehicle and distributed generation is also analyzed.

• **An analysis of energy scenarios: Enagas in 2040**  
The goal of this project is to analyze the situation of the energy sector in 2040 under different scenarios of the global evolution of energy supply and demand. In particular, the study assesses the role that natural gas may play in this scenarios, in order to contribute to the design of robust strategies for planning natural gas networks. The analysis will use Spain as a case study.

• **Optimization of the design of the medium voltage wind farm grids of Iberdrola Renovables in Spain**  
Iberdrola Renovables. July 2015 - February 2016. (Lukas Sigrist)
The project’s objective is to develop an optimization module of the design of medium voltage wind farm grids of Iberdrola Renovables in Spain and to incorporate it into the HAPER tool.

• **Wind farm losses optimization by means of reactive power compensation**  
Wind farms must meet mandatory reactive power requirements at their point of common coupling to the transmission network. This can be done either by means of wind turbines reactive power, or installing capacitor banks. Reactive sharing among the different elements result in different power losses. A module to optimize the medium voltage network corresponding to the Iberdrola wind farms is developed in this research project. This module is incorporated to the HAPER tool, which allows calculating losses in wind farms harvesting networks.
3.2.1.1.2 Public funding

- **Power electronics for the integration of renewable energy in the grid**
  Ministerio de Ciencia e Innovación. May 2011 - December 2014. (Aurelio García Cerrada, Juan Luis Zamora Macho, Miguel Ochoa Giménez, Ramón Rodríguez Pecharromán, Francisco Javier Renedo Anglada)

This project will investigate the contribution of voltage source converters to the integration of renewable energy in the grid. It will look into optimal exploitation of existing grids, more flexible and efficient power flow control and better utilization of existing grids with the contribution of power electronics. For the purpose describe above, this project will have three specific actions:

1. A new strategy to control power flows will be developed and fully tested. It will take the form of a Static Synchronous Series Compensator (SSSC).
2. Studies will be promoted to improve the current knowledge of the use of FACTS and HVDC in the Spanish grid. Models and tools will be investigated.
3. The results obtained in the national and international arena

Project funded by Ministerio de Ciencia e Innovación, into Plan Nacional de Investigación Científica, Desarrollo e Innovación Tecnológica, 2008-11.

![Government of Spain](image)

Project funded by Ministerio de Economía y Competitividad.

- **PRICE-GDI: Joint Project of smart grids in the Corredor del Henares area: Distributed Generation management**

This project is part of the joint initiative for the deployment of smart grids in the Corredor del Henares area, carried out by the distribution utilities Iberdrola and Unión Fenosa, together with research institutes and manufacturers. Within this joint initiation, the objective of this project is focused on finding system solutions that helps the efficient integration of distributed energy resources in the distribution network, mainly distributed generation.

Project funded by Ministerio de Ciencia e Innovación, into Plan Nacional de Investigación Científica, Desarrollo e Innovación Tecnológica, 2008-11.

Project funded by Ministerio de Economía y Competitividad.

- **Grid+ (Supporting the development of the European electricity grids initiative)**
  European Commission (DG TREN). October 2011 - September 2014. (Luis Rouco Rodríguez, Lukas Sigrist)
  The present project provides the necessary support to the EEGI Team gathering, in a structured and organised way, a team of top level players (research centres, SMEs, universities, in close coordination with ENTSO-e and EDSO for SG) to design in a coordinated way with both TSOs and DSOs a set of accompanying activities to make sure that the EEGI will pass through the critical 2012-2014 period (preparation of FP8, initial operation of ACER, increased specification duties of the network operators) when dealing with the most complex electricity system in the world and to address the five remaining critical issues (costs, benefits, KPIs, knowledge sharing and financing) in involving all the stakeholders, to ensure the rational, fluid and stable EEGI workflow, as to reach safely the 2020 European goals. The main contribution of IIT team is the leadership of work package 4 on replication and scalability of the projects on smart grids.

Project funded by European Union, within Seventh Framework Programme:
• **Large-scale demonstration of smart electricity distribution networks with distributed generation and active customer participation**

European Commission. November 2011 - October 2015. (Pablo Frías Marín, Rafael Cossent Arín, Andrea Rodríguez Calvo, Pedro Linares Llamas, Michel Rivier Abbad, Javier Reneses Guillén, Efraim Centeno Hernández, Seyedmahdi Izadkhast)

GRID4EU is a collaborative project within the 7th framework program. The project will extend over 4 years, and involves 28 partners in 12 different EU countries. The goal of the GRID4EU project is to carry on demonstration pilots of Smart Grids solutions on a large scale basis. GRID4EU aims at testing in real size innovative system concepts and technologies in order to highlight and help to remove some of the barriers to the smart grids deployment and the achievement of the 2020 European goals.

More information at [http://www.grid4eu.eu](http://www.grid4eu.eu)

Project funded by European Union, within Seventh Framework Programme:

![European Union flag](image)

![Seventh Framework Programme](image)

• **Comprehensive solutions for power quality issues and power-flow control, using power electronics**

Ministerio de Ciencia e Innovación. January 2012 - March 2015. (Aurelio García Cerrada, Juan Luis Zamora Macho, Javier Roldán Pérez, Miguel Ochoa Giménez)

This project is devoted to:

1. A global analysis of series and shunt electronic converters to improve voltage and current quality in electric power systems.
2. A global analysis of series and shunt electronic converters to optimize power flows in power systems.
3. The promotion to multi-purpose and flexible series and shunt electronic converters to be used in power systems.
4. The integration of power electronic converters in the daily operation of electric power systems in order to study the advantages and disadvantages of this technology.
5. The analysis of power electronic devices in power systems with an important participation of renewable energy sources.

The above objectives are part of a coordinated project with Alcalá University. With this coordinated action, we intend:

(a) To contribute to the global analysis of the integration of renewable energy in the grid using power electronics.
(b) To contribute to the global analysis of the use of power electronic converters to improve voltage and current quality in electrical grids
(c) To contribute to the global analysis of the use of power electronic converters
to optimize power flows in electrical grids.
(d) To contribute to find new electronic devices to improve the operation of future electric grids (from micro-grids to HVDC super grids).
(e) To investigate multi-purpose devices to obtain more efficient solutions.
(f) To investigate the massive integration of power electronics converters in future electrical grids.

Project funded by Ministerio de Ciencia e Innovación, into Plan Nacional de Investigación Científica, Desarrollo e Innovación Tecnológica, 2008-11.

- **GridTech: impact assessment of new technologies to foster RES-electricity integration into the European transmission system**
  European Commission. May 2012 - April 2015. (Pablo Frías Marín, Luis Olmos Camacho, Camila Formozo Fernandes, Pablo Rodilla Rodríguez)
  The major objective of GridTech is to conduct a fully integrated impact assessment of the implementation of new technologies (RES-E generation, bulk storage, transmission network technologies) into the European electricity system necessary to exploit the full potential of future RES-E generation across Europe with lowest possible total electricity system cost.

Project funded by European Union, within Intelligent Energy Europe Programme:
• **Modular development plan of the pan-european transmission system 2050**

  The project is aimed at developing and applying a methodology for the long-term development of the Pan-European transmission network. It will deliver a top-down methodology to support the planning from 2020 to 2050. First, it implements a set of future power scenarios, including generation units, the possible use of electricity storage and demand-side management solutions: scenarios for power localization are proposed with assumptions on the energy mix in each of the connected clusters covering the ENTSO-E area. Network studies are performed to detect the weak points when implementing the scenarios for 2050. Grid architectures options and a modular development plan are then proposed, including electricity highways, on the basis of power flow calculations, network stability analysis, socio-economic, network governance considerations, and with remarks from the consultation of European stakeholders. In parallel, an advanced planning methodology is designed, developed and tested with academic laboratories to address a few critical aspects of the above planning methodology, which may impact the robustness of the resulting architectures. This enhanced approach takes into account the correlated uncertainties in renewable generation and consumption, potential voltage and stability issues, and black-out risks including the feasibility of defense plans to avoid uncontrolled cascading failures of the candidate architectures. It includes the use of non-linear detailed models of power grids and stochastic optimization techniques.

  Project funded by European Union, within Seventh Framework Programme:

![EU Flag](image)

![Seventh Framework Programme](image)

• **ADVANCED: Active Demand Value and Consumer Experience Discovery**
  European Commission. December 2012 - December 2014. (Pablo Frías Marín, Javier Reneses Guillén, Mercedes Vallés Rodríguez, Andrea Rodriguez Calvo, Rafael Cossent Arín, Carlos Mateo Domingo)

  The ADVANCED project develops actionable frameworks enabling residential, commercial/industrial consumers to participate in active demand, thus contributing to active demand mass deployment in Europe. The project is based on the investigation of four active demand pilot projects together with the analysis of a database including the most relevant project across Europe. IIT contributes in the definition of a conceptual model of active consumer participation to evaluate the aggregated impact of active demand under
Research projects

different scenarios. Moreover this model helps to analyze the replicability and scalability of the active demand alternatives.

Project funded by European Union, within Seventh Framework Programme:

• **SUSTAINABLE**: Smart distribution system operation for maximizing the integration of renewable generation
European Commission. January 2013 - December 2015. (Pablo Frías Marín, Carlos Mateo Domingo, Luis González Sotres, Rafael Cossent Arín, Carlos Rodríguez-Morcillo García)
The SUSTAINABLE project will develop and demonstrate a new operation paradigm, leveraging information from smart meters and short-term localized predictions to manage distribution systems in a more efficient and cost-effective way. This new paradigm will enable a large-scale deployment of variable distributed resources.
Within the project the IIT analyses the economic and regulatory implications of the SuSTAINABLE concept and makes proposals and recommendations that would pave the way for the adoption of smart grid technologies and strategies at distribution level. In addition the IIT is also responsible for the analysis of scalability, replicability and implementation conditions of the SUSTAINABLE concept. This analysis will result in a roadmap for large-scale replication will be developed.
More information at [http://www.sustainableproject.eu](http://www.sustainableproject.eu)

Project funded by European Union, within Seventh Framework Programme:

• **Forecasting and Optimization of wind Generation in Energy Markets 2 (MTM2013-48462-C2-2-R)**
The coordinated project «Forecasting and Optimization of Wind Generation in Energy Markets» (FOWGEM) aims at applying a global approach to the problem of the optimal integration of the wind-energy generation of a generation company in the wholesale electricity market through the combination of statistical forecasting models, mathematical programming models for electricity markets and optimization algorithms. In the framework of the Spanish Strategy for Science and Technology and Innovation 2013-2020 this project contributes fundamentally to challenge 3, «safe, sustainable and clean energy.» Indeed, the forecasting and optimization models and procedures that will be developed in this project are the necessary mechanisms to allow the competitive and safe integration of wind-energy generation in the multiple-markets based wholesale national energy production system.

The FOWGEM project adopts an original and global approach to this problem that combines advanced methodologies in the area of statistics, mathematical modeling of energy markets and theoretical and computational optimization that were developed in several previous projects of the «Plan Nacional» by the groups of the Universidad Politécnica de Catalunya and the Universidad Pontificia Comillas. The main objectives of the project are:

Objective 1: To develop predictive models for wind-energy generation and electricity prices for the spot and ancillary electricity markets as a base for the optimal planning of a generation company’s production.

Objective 2: To develop mathematical programming models for the optimal integration of wind-energy production of the generation companies in the wholesale spot and ancillary services electricity market based on the results of the forecasting models for the wind-energy generation and market prices.

Objective 3: To develop and implement efficient optimization algorithms for the large scale mixed linear and quadratic programming problems arising in real instances of the models for the integration of wind-energy production.

Regarding the social and economic impact of this project, the forecasting models for wind-energy generation and market prices together with the optimization models for the optimal integration of the wind-energy will indicate power companies how to optimally coordinate their dispatchable generation with the stochastic wind-energy generation. As a result, the expected cost of the total production will be minimized (which means less fossil fuel consumption with the consequent positive impact on the environment) and also the wind-energy spillage will be minimized.

From the point of view of scientific and technical impact, the main feature of this project is its global and multidisciplinary approach through a methodological cycle that combines statistical methods, mathematical modeling of electricity markets and optimization techniques to tackle with an actual problem concerning generation companies with real impacts on the national economy and environment. It is to mention the collaboration as EPO of two of the major Spanish generation companies, Gas Natural Fenosa and Iberdrola, together with the KIC InnoEnergy, a company promoting the research and development in energy systems, integrated into the European Institute of Innovation and Technology of the European Union and the Institute for Energy Research (IREC), the major research institution in Catalonia in the field of energy.
Research projects

Project funded by Ministerio de Economía y Competitividad.

• **Innomerics DOS - development of innovative modeling tools to increase the operating and economic efficiency of thermal generators**
  Ministerio de Economía y Competitividad. February 2014 - December 2016. (Sonja Wogrin, Andrés Ramos Galán)
  This project is a collaboration between the Universidad Pontificia Comillas, the Universidad de Cantabria and Innomerics under the RETOS program to develop innovative modeling tools to increase the operating and economic efficiency of thermal generators. Please see the Spanish description for further details.

Project funded by Ministerio de Economía y Competitividad.

• **Post 2020 framework in a liberalised electricity market with large share of Renewable Energy Sources**
  Market4RES is a project that focuses on electricity market design to support a more efficient integration of renewable energy (RES-E) into the pan-European electricity system, in line with the 2020 objectives - and the forthcoming 2030 targets.
  In particular, the project aims at answering the question of whether the current design of the liberalised European market for electricity, the so-called Target Model (TM) which is expected to be fully implemented by 2015, provides sufficient investment incentives for RES post 2020 and how these incentives can be further attracted.

Project funded by European Union, within Intelligent Energy Europe Programme:
• **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.

Project funded by European Union, within Seventh Framework Programme:

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


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

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

Project funded by Ministerio de Economía y Competitividad.
• **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 - December 2017. (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)**  
  (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)  
  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.

- **Innovative business models for market uptake of renewable electricity unlocking the potential for flexibility in the industrial electricity use**  
  European Commission. January 2015 - December 2017. (Pablo Frías Marín, Tomás Gómez San Román, Mercedes Vallés Rodríguez)  
  The flexibility of the industrial electricity demand has been identified as a potential that through innovative business models can facilitate further growth of variable renewable energy, while reducing the industrial electricity costs and contributing to the European energy policy goals. In this project the large industry is working with the renewable energy community to identify and implement business models for supplying variable renewable electricity to industrial users with flexibility in their demand, creating win-win situations. Several variations of the business models will be described covering different options like on and off-site renewable energy production. The business models will be adapted to 5 industrial sectors (chemicals, non-ferrous metals, cold storage, steel, and water treatment) and 6 target countries (Belgium, France, Germany, Italy, Spain and UK). Tools will be developed to facilitate adoption of the business models: Model contracts adapted to the target countries and the
Research projects

different business models and a methodology that assesses the flexibility in industrial units and its value within the business models. The methodology will be transferred to third parties and will be applied in 6 case studies covering all target sectors and countries. Recommendations for improvements in the regulatory and market framework will be formulated and promoted. A top-down and a bottom-up methodology will be used to quantify the potential for further cost-effective grid integration of variable renewable electricity by the exploitation of the industrial electricity demand flexibility.

Project funded by European Union, within Horizon 2020 Programme:

- **Empirics of intraday and real-time markets in Europe**  
  Empirics of intraday and real-time markets in Europe

- **Consequences of climate change on energy demand and supply in Spain**  
  Ministerio de Agricultura, Alimentación y Medio Ambiente. April 2015 - November 2015. (Pedro Linares Llamas, José Carlos Romero Mora)  
  The goal of this project is to analyze, with an exploratory and preliminary approach, the consequences of climate change for the Spanish energy system, and in particular its effects on energy demand and supply in Spain. The study identifies the analysis previously done, and compiles the existing knowledge on this issue, in particular its application to Spain, in order to identify the gaps that may exist.

- **Adapting policies and regulation to the changing ownership structure in the electricity generation sector**  
  International Renewable Energy Agency (IRENA). April 2015 - December 2015. (Rafael Cossent Arín, Pedro Linares Llamas, Tomás Gómez San Román, José Ignacio Pérez Arriaga)  
  The goal of this collaboration is to produce a report evaluating the adaptations in power sector policy and regulation required under different contexts in response to the changes in electricity generation ownership, primarily driven by the deployment of small renewable generation units. The main target group for the report is that of policy makers.
3.2.1.2 Consultancy and technological support

3.2.1.2.1 Private funding

- **Validation of the AECOM simulation program RailEST**
  AECOM INOCSA, S.L.U. April 2014 - December 2014. (Luis Rouco Rodríguez)
  The aim of this work is the validation of the AECOM simulation program RailEST. The validation is addressed by comparing RailEST output with IIT simulation program output.

- **Maintenance of Eon Tools 2014 to 2015**
  E.ON Generacion, S.L. April 2014 - March 2015. (Enrique Lobato Miguélez, Pedro Sánchez Martín, Elena Saiz Marín)
  The aim of this project consists of incorporating new capabilities identified by Eon that might be required due to the market evolution (regulatory and operational changes). The computer tools developed for Viesgo by IIT are GRIMEL, GRIMEL CORTO PLAZO, GHIAN, OFCccgt, PLAMER OFERTAS and PLAMER CASACION, KPITERM and KPIAGU. GRIMEL OFERTAS creates the bids that Eon submits into the different electricity markets, GHIAN optimizes with an annual and weekly time scope the hydro power plants of Eon, OFCccgt optimizes the start-up/shut-down cycling of CCGT plants of Eon, GRIMEL CORTO PLAZO plans the electricity production by Viesgo assess in a variable time scope (from one week to a month), PLAMER OFERTAS and PLAMER CASACION simulates the electricity market with an annual time scope, and finally, KPITERM anbd KPIAGU obtains key performance indexes (KPIs) of the management of thermal and pumping units in the market.

- **Development of new functions of a tool for computing electrical losses in power networks of wind farms**
  Iberdrola Renovables. May 2014 - December 2014. (Luis Rouco Rodríguez)
  The aim of the project is the development of new capabilities of a tool for computing electrical losses in power networks of wind farms. Both modeling and user interface new capabilities will be added.

- **Development of new functions of a tool for computing electrical losses in power networks of wind farms**
  Iberdrola Renovables. August 2014 - December 2014. (Luis Rouco Rodríguez)
  The aim of the project is the development of complementary capabilities of a tool for computing electrical losses in power networks of wind farms. Both modeling and user interface new capabilities will be added.

- **Development of a tool to determine the equivalent load factor of wind farms connected to a common infrastructure**
  Iberdrola Renovables. August 2014 - December 2014. (Luis Rouco Rodríguez)
  The aim of the project is the development of a tool to determine the equivalent load factor of wind farms connected to a common infrastructure.
• **Network codes for the transmission, system operation and market administration of the electricity market in Honduras**  
  Banco Atlántida. September 2014 - February 2015. (Tomás Gómez San Román, Javier Reneses Guillén, Rafael Cossent Arín)  
  The aim of this project is to develop the network codes for the transmission grid, the system operation, and the market administration of the electricity market in Honduras according to the provisions of the new Electricity Law.

• **Lincence extension of the AGC system for the energy management system of ALPIQ**  
  Nucleo. September 2014 - October 2014. (Luis Rouco Rodríguez, Ignacio Egido Cortés, Inmaculada Saboya Bautista)  
  IIT has developed an AGC zone regulator adapted for Spanish AGC system. This project comprises the extension of the licence of the AGC zone regulator integrated in the Nucleo SCADA system of ALPIQ.

• **Analysis of the sustainability of the power system in Colombia in the long-term**  
  As members of the international panel of experts Prof. Gomez and Ramos provide support for the project «Analysis of the sustainability of the power system in Colombia in the long-term» carried out by the consortium of CIDET-ECSIM-CO NosER for the Unit for Planning of mining and energy resources (UPME) of Colombia.

• **Task scheduling of metallic surface treatment**  
  The project consists of the optimization of the task scheduling of metal surface treatment of aeronautic parts. There is only one automatism to manipulate metal parts. There are resources with singular capacity although there are several resources that can do the same process.

• **Market report of wind and CSP assets in the Spanish electricity system**  
  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 revenues of 16 wind farms and CSP plants is carried out.

• **Capacity mechanisms experiences for the Vietnamese context**  
  PSR. January 2015 - March 2015. (Carlos Batlle López, Pablo Rodilla Rodríguez, Paolo Mastropietro)
Review of the capacity mechanism designs which could be of special interest for the reform process of the Vietnamese electric power system

- **Overall planning of generation capacity**
  In this project tasks to maximize the capabilities of the new estimation module renewable capacity were developed. Some parts of the algorithm that were heuristically computed, as the annual breakdown of the new investments are now more systematically. The new model also allows extensions to include performance criteria in calculating the expansion. Open tasks also are considered to adapt the model to the circumstances of the sector during 2015.

- **Ex-ante certification of research, development and innovation of a project of product life management and business product management in manufacturing companies with high level of reengineering with make-to-order products**
  Asociación Española de Normalización y Certificación (AENOR). January 2015 - February 2015. (Pedro Sánchez Martín)
  Ex-ante certification of research, development and innovation of a project of product life management and business product management in manufacturing companies with high level of reengineering with make-to-order products.

- **Design and reception test of a voltage regulator for low voltage networks**
  The objective of this project is the design of a voltage regulator for low voltage networks, using an auto-transformer with different windings. First, equipment specifications, control and electrical connections will be designed. Then, the control system for voltage regulation will be coded and implementen in a commercial PLC. Finally, a set of reception tests will be carried, off load and with different loading.

- **Forecasting Spanish market electricity prices in the 2015-2040 horizon**
  G-Advisory. February 2015 - March 2015. (Javier Reneses Guillén, Jesús María Latorre Canteli)
  This project consists of the collaboration of IIT in a report focused on the forecasting of the Spanish market electricity prices in the 2015-2040 horizon.

- **Study of changing the location of reactor number 2 in 33 kV feeders of La Meca-Medina high speed train line**
  Railways Infrastructures, Instalaciones y Servicios LLC. February 2015 - March 2015. (Luis Rouco Rodríguez, Ignacio Egido Cortés)
  This work has addressed the study of changing the location of reactor number 2 in 33 kV feeders of La Meca-Medina high speed train line.
• **Study of induced voltages in control and protection circuits in Barro Blanco hydro power station**
  Cobra Instalaciones y Servicios S.A. February 2015 - March 2015. (Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo)
  This study has determined the induced voltages in control and protection circuits due to power cables connecting generators to step-up transformer low voltage side in Barro Blanco hydro power station.

• **Market report of wind and PV assets in the Spanish electricity system**
  G-Advisory. March 2015 - March 2015. (Javier Reneses Guillén, Jesús María Latorre Canteli)
  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 revenues of 10 wind farms and PV plants is carried out.

• **Market report of wind assets in the Spanish electricity system**
  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 revenues of 14 wind farms is carried out.

• **Tuning of the power system stabilizer of gas turbine 7 of Ibiza power station**
  This work is aimed at tuning the power system stabilizer of generator driven by gas turbine 7 of Ibiza power station. Stabilizer of gas turbine 7 will damp out the local mode of generator driven by gas turbine 7 and will contribute to the global mode of Ibiza power station. The study will provide the gain and the time constants of the stabilizer which will be determined using eigenvalue sensitivities techniques as implemented in SMAS3 program package. Stabilizer tuning will be validated using small-disturbance (eigenvalues) and large-disturbance (time domain simulation) techniques.

• **Consulting on the implementation of smart grids with emphasis on distributed generation and power transmission and energy efficiency in buildings**
  Inter-American Development Bank (IADB). September 2015 - December 2015. (Carlos Batlle López, Paolo Mastropietro)
  Transmission of basic knowledge about the technical, economic and environmental aspects of smart grids and energy efficiency in buildings that may impact the 2015-2050 National Energy Plan developed by the Secretariat of Energy of Panama

• **Tuning of the power system stabilizer of gas turbine 7 of Ibiza power station**
  Endesa. September 2015 - December 2015. (Luis Rouco Rodríguez, Ignacio Egido Cortés)
This work is aimed at tuning the power system stabilizer of generator driven by gas turbine 7 of Ibiza power station. Stabilizer of gas turbine 7 will damp out the local mode of generator driven by gas turbine 7 and will contribute to the global mode of Ibiza power station. The study will provide the gain and the time constants of the stabilizer which will be determined using eigenvalue sensitivities techniques as implemented in SMAS3 program package. Stabilizer tuning will be validated using small-disturbance (eigenvalues) and large-disturbance (time domain simulation) techniques.

3.2.1.2.2 Public funding

- **Referee of research projects for The Research Council of Norway**
  Referee of research projects.

- **Support in the use of the reference network models for assisting in the regulation of the electricity distribution companies**
  Support to the Spanish Commission of Markets and Competence in the use of the reference network models for assisting in the regulation of the electricity distribution companies. Simulations of the models were carried out to estimate the cost efficiently incurred by the distribution companies, as support to estimate efficiency factors.
  The following tasks have been carried out to achieve this objective:
  1. Updating the cost of the equipments of the distribution companies, using the cost tipologies of the CNMC.
  2. Adapting the data input to use as starting point the latest data formats of the CNMC.
  3. Making simulations to evaluate the total investment costs of the companies, and in particular the low voltage installations.

- **ESLA: Long-Term scenarios builder**
  Red Eléctrica de España (REE). March 2015 - December 2015. (Francisco Miguel Echavarren Cerezo)
  ESA 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 Electrica de España. This project is aimed at providing user support, maintenance and extensions of several algorithms.
3.2.1.3 Services and analysis projects

3.2.1.3.1 Private funding

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

- **Technical support related to AGC and assessment of AGC operation**
  Bahía de Bizkaia Electricidad (BBE). June 2014 - September 2014. (Ignacio Egido Cortés)
  The main objective of this project is to address some questions posed by BBE related to the detailed real operation of AGC in certain circumstances. Additional objectives are also the initial evaluation of the power plant operation at its technical minimum, and of the economic results related to AGC regulation reserve.

- **Hydro plant energy production management’s brief and descriptive report**
  A report has been delivered with a summarized description of a hydro plant energy production management in a power system. It briefly presents concepts such as economic dispatch, optimal water management, marginal value of hydro resources, water spillages, as well as the role of uncertainty (hydro inflows, load, energy market prices, ...) in designing a proper hydro plant production management.

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

- **Expert report regarding the economic loss suffered by Ferroatlantica due to its generation under operating costs**
  Villar Mir Energía. February 2015 - April 2015. (Javier Reneses Guillén, Celia Mosácula Atienza)
  This project consists of an expert report regarding the economic loss suffered by Ferroatlántica due to the generation of its units in hours where the market price was below their operating costs.
• **Maintenance of Eon Tools 2015 to 2016**
  E.ON Generación S.L. April 2015 - March 2016. (Enrique Lobato Miguélez, Elena Saiz Marín, Pedro Sánchez Martín)

  The aim of this project consists of incorporating new capabilities identified by Eon that might be required due to the market evolution (regulatory and operational changes). The computer tools developed for Viesgo by IIT are GRIMEL, GRIMEL CORTO PLAZO, GHIAN, OFCccgt, PLAMER OFERTAS and PLAMER CASACION, KPITERM, KPIAGU and GAGAN. GRIMEL OFERTAS creates the bids that Eon submits into the different electricity markets, GHIAN optimizes with an annual and weekly time scope the hydro power plants of Eon, OFCccgt optimizes the start-up/shut-down cycling of CCGT plants of Eon, GRIMEL CORTO PLAZO plans the electricity production by Viesgo assess in a variable time scope (from one week to a month), PLAMER OFERTAS and PLAMER CASACION plans the electricity market with an annual time scope, and finally, KPITERM and KPIAGU obtains key performance indexes (KPIs) of the management of thermal and pumping units in the market. GAGAN optimizes with an annual and weekly time scope the pumping units of EON.

• **Steady-state thermal analysis of a set of MV cable installations**
  TYPSA. April 2015 - May 2015. (Francisco Miguel Echavarren Cerezo, Luis Rouco Rodriguez)

  IIT collaboration will be focused on the computation of core conductors and sheaths temperatures for a set of underground installations with different medium-voltage-cable configurations, to check if the cables disposition is acceptable. Equivalent thermal resistivities of soil will be also computed.

• **Electric energy security in Iceland**
  Massachusetts Institute of Technology (MIT), Landsvirkjun. September 2015 - September 2016. (Michel Rivier Abbad, Andrés Ramos Galán, Luis Olmos Camacho)

  This is a common project between MIT(Boston) and IIT for a consortium of electric companies and institutions in Iceland. The project models the functioning of the electric power system in Iceland in order to better understand how drought conditions impact the system, and the most efficient way to ensure a secure operation of the system in the target horizon, including the computation of the potential value of an interconnector between Iceland and the UK.

### 3.2.2 Engineering Design Area

#### 3.2.2.1 Research and develop projects

##### 3.2.2.1.1 Private funding

• **Safe evacuation of people in large volume spaces in case of fire**
Complete study of the evacuation of enclosed areas where the number of occupants is high. The project has a numerical-experimental nature, the results will be compared with existing norms and correlations, suggesting possible improvements in the present regulation.

3.2.2.2 Consultancy and technological support

3.2.2.2.1 Private funding

- **Dimensional metrology spanish standardization comittee**
  Asociación Española de Normalización y Certificación (AENOR). February 1999 - September 2016. (María Ana Sáenz Nuño)
  Management of the technical secretary of the dimensional metrology Spanish standardization comittee and the development of the technical expert delegation in the mirror ISO comittee.

- **Ausbildung in Koordinaten Messtechnik**
  Ausbildung Koordinatenmesstechnik e. V. (AUKOM). July 2009 - July 2016. (María Ana Sáenz Nuño)
  The objective of the «Ausbildung Koordinatenmesstechnik e. V. – AUKOM» is to ensure an up-to-date, comparable, controllable and certifiable training in coordinate metrology in accordance with its capabilities. The organisation promotes the basic, comprehensive and solid training in the area of industrial production metrology, in particular in the area of coordinate metrology. The organisation ensures the standard and comparability of the courses offered by the members of the organisation within the coordinate metrology training. It organizes events for promoting the exchange between manufacturers, users and science in the area of coordinate metrology training and publishes new findings and trends from this area. It develops, promotes and spreads the «good measurement practice» and furthers the Europeanisation of cooperation in coordinate metrology training. The IIT will control the training in Spanish.

- **Caracterization of a system for determining a thermal fatigue life of the nozzles in the vessel of nuclear power plants**
  Innomerics. September 2014 - September 2015. (Luis Manuel Mochón Castro)
  Experimental validation of a system for determining a thermal fatigue life of the nozzles in the vessel of nuclear power plants

- **Fluid dynamic characterization of oil filters for internal combustion engines of alternative heavy vehicle**
  Martinrea Honsel. September 2014 - October 2014. (Luis Manuel Mochón Castro)
  Fluid dynamic characterization of oil filters for internal combustion engines of alternative heavy vehicle.
• **Design and mechanical analysis of a waler beam for a cable tensioning**
  Design of a waler beam for a cable tensioning system in the field of civil engineering, whose technical and mechanical characteristics facilitate its repositioning with easy assembly and disassembly works. Consequently, the structural analysis such that the safety of tensioning system was guaranteed is also carried out.

• **CASIOPEA extension**
  Extension of the program CASIOPEA for new types of cantilevers and input data

• **Experimental validation of a system for measuring dynamic pressure oscillations**
  Innomerics. September 2015 - December 2015. (Luis Manuel Mochón Castro)
  Experimental validation of a system for measuring dynamic pressure oscillations.

### 3.2.3 Railway Systems Area

#### 3.2.3.1 Research and develop projects

##### 3.2.3.1.1 Private funding

• **Optimal design of ATO driving parameters for FGC**
  The objective of this project is the design of the efficient ATO speed commands in FGC railway line. These ATO speed commands will be 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.

• **Railway traffic planning and management system for the new Mexico-Toluca line**
  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)
3.2.3.2 Consultancy and technological support

3.2.3.2.1 Private funding

- **Validation of the AECOM simulation program RailEST**  
  AECOM INOCSA, S.L.U. April 2014 - December 2014. (Luis Rouco Rodríguez)  
  The aim of this work is the validation of the AECOM simulation program RailEST. The validation is addressed by comparing RailEST output with IIT simulation program output.

- **Implementation of ATO speed commands in Metro de Bilbao**  
  The objective of this project is the design, implementation and energy measurement of ATO speed commands in Metro de Bilbao lines. These ATO speed commands will be selected and sent to the train by the traffic regulation system in real-time. For each inter-station a set of 3 speed commands are designed, the flat out command and 2 regulation commands. The new ATO speed commands must comply with technical, operational and comfort restrictions and will minimise the energy consumption.

3.2.3.2.2 Public funding

- **Adoption of the protocol for transmitting the on onboard energy measurement as a European standard protocol**  
  Adif Alta Velocidad. December 2014 - June 2015. (José Antonio Rodríguez Mondéjar)  
  The objective of this project is that the communication protocol designed by IIT for ADIF for the transmission of onboard energy measurement be adopted as an international standard.

3.2.4 Intelligent Systems Area

3.2.4.1 Research and develop projects

3.2.4.1.1 Private funding

- **Integration of forecasting tools at Enagas. Application to the medium-term forecasting tool for conventional demand**  
  Indra. June 2011 - September 2014. (Eugenio Francisco Sánchez Úbeda, Alberto Gascón González)  
  Enagas, the technical operator of the Spanish natural gas system, is in charge of ensuring the continuity and quality of natural gas supply at any point in Spain. Enagas uses specific forecasting tools developed for that purpose. The aim of this project is to develop an integrated forecasting system able to provide a coordinated view of the different forecasting time scales (short,
medium and long term horizons). This process will start with the integration of PATRONES, the medium-term forecasting tool of Enagas for the conventional demand.

- **Smarter electricity distribution grids to integrate distributed energy resources**
  The objective of this project is to develop and demonstrate an electric energy management system based on aggregation of clients' behavior, which are located all over the distribution network, and to propose new business models that allow the efficiency improvement of the electric system. In this context, efficiency refers to the reduction of CO2 emissions, maximum usage of distributed renewable energy sources, and the increment of benefits for users, distributors and aggregators/retailers.
  To this purpose, the following sub-objectives are proposed:
  - To determine the benefits, in a detailed way, that result from the aggregation of clients' behavior in comparison to the non-aggregated demand approach.
  - To determine the requirements of systems and aggregation limits by running simulations that emulate the behaviour of real clients and markets.
  - To develop control algorithms for the optimal aggregation to make more efficient the electric system.
  - To optimize the resources that the clients should implement in order to get the maximum profit of the aggregation.

- **MORSE: regulatory simulator, with investments and technology mix analysis**
  MORSE is a model of the Spanish electricity sector, developed by the Institute for Research in Technology (Instituto de Investigación Tecnológica, IIT) in collaboration with Endesa. It is intended for strategic analysis of the evolution of this sector, especially when changes of the utilities structure, new regulations, or new generation technologies take place.
  This collaboration focus on providing the functionality needed to end up with a proper regulatory simulation tool, to analyze the impact of the decisions of the regulator on the investments, the operation, and the final sector balance. Some of the main tasks are the improvement of the representation of the incomes and costs of the electricity sector, and of the investments module to provide it with better chronological detail and account for the reserves requirements of the system.

- **Modelling the strategic bidding behaviour in the Spanish electricity market**
  The primary aim of this project is the improvement of the information system and the methodology implemented for the analysis of the Spanish electricity 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.

• **Forecasting residual demand curves of the day-ahead Spanish electricity market**
  Endesa. September 2014 - December 2014. (Antonio Muñoz San Roque, José Portela González)
  The objective of this project is to develop a new information system for processing the input data required for the generation of residual demand scenarios of the day-ahead and secondary reserve electricity markets. These residual demand curves are used as inputs for the optimization of the operating decisions of Endesa in the short term.

• **Smart labels for locating losed objects and helping disabled people in smart cities**
  EASYSTEM. December 2014 - June 2015. (Álvaro Sánchez Miralles, Miguel Martín Lopo)
  The aim of the project is to develop an intelligent system based on beacons to localize losed objects in households or in small environments. Moreover, these beacons will be deployed in some important places spread throughout cities in order to help disabled people finding those places; for example, cash machines, bins, benches,...

• **MORSE: regulatory decisions optimizer and analisis of its impact on the electricity sector**
  MORSE is a model of the Spanish electricity sector, developed by the Institute for Research in Technology (Instituto de Investigación Tecnológica, IIT) in collaboration with Endesa. It is intended for strategic analysis of the evolution of this sector, especially when changes of the utilities structure, new regulations, or new generation technologies take place.
  This collaboration focus on the development of a model for the optimization of regulatory decisions considering its impact on the power system, both in the new capacity investment decisions of the market participants and on the operation of the generation resources. The inclusion of active clients or prosumers, electric vehicle and distributed generation is also analyzed.

• **Modelling the strategic bidding behaviour in the Spanish electricity market**
  Endesa. January 2015 - December 2015. (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.

- **Application of advanced data analysis techniques to the long and medium term prediction of the Spanish electricity market**


  The objective of this project is the application of advanced data analysis techniques to the long and medium term prediction of the Spanish electricity market.

3.2.4.1.2 Public funding

- **New systems, technologies and operation models based on ICTs for the management of energy positive and proactive neighbourhoods**

  European Commission. November 2012 - April 2016. (Álvaro Sánchez Miralles)

  E+ aims to develop, implement and demonstrate a new energy management operation and business model based on ICTs, able to increase the energy efficiency at neighbourhood level, while achieving near zero emissions neighbourhoods. The new control system (E+) will be prepared to manage and control energy sources, stationary storage devices, street lighting, electric vehicles charging infrastructure, buildings loads, etc. Both, electrical and thermal (including geothermal) energy sources and consumption are considered in E+. Two demonstration sites are committed with E+: Málaga, in the South of Spain, and Mons, in Belgium. The results and conclusions coming from the demonstration activities will provide the basis for the elaboration of recommendations for energy positive urban planning.

  Project funded by European Union, within Seventh Framework Programme:  

  ![EU Flag](image)

  ![Seventh Framework Programme](image)

- **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 - December 2017. (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.

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


  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:
3.2.4.3 Services and analysis projects

3.2.4.3.1 Private funding

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

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

3.2.5 Electronics and Automatic Group

3.2.5.1 Research and develop projects

3.2.5.1.1 Private funding

- **Development of a system for intraoperative neurological monitoring. Phase I: development of a neurological signs hub and integration in an intraoperative monitoring system**
  Soluciones Integrales de Desinfección SL (SOINDE SL). October 2014 - March 2015. (Carlos Rodríguez-Morcillo García, Sadot Alexandres Fernández, José Daniel Muñoz Frías, Romano Giannetti, Javier Matanza Domingo, Eduardo Alonso Rivas)
  The objective of this project is to design and develop a high reliability, high accuracy, low cost and small size hub of neurological signs. This collaboration includes the development of the electronics required for the integration of the hub with intraoperative monitoring equipment being used at present, which will be connected via cable.

3.2.5.1.2 Public funding

- **Power electronics for the integration of renewable energy in the grid**
  Ministerio de Ciencia e Innovación. May 2011 - December 2014. (Aurelio García Cerrada, Juan Luis Zamora Macho, Miguel Ochoa Giménez, Ramón Rodríguez Pecharromán, Francisco Javier Renedo Anglada)
  This project will investigate the contribution of voltage source converters to the integration of renewable energy in the grid. It will look into optimal exploitation of existing grids, more flexible and efficient power flow control and
better utilization of existing grids with the contribution of power electronics. For the purpose described above, this project will have three specific actions:

1. A new strategy to control power flows will be developed and fully tested. It will take the form of a Static Synchronous Series Compensator (SSSC).
2. Studies will be promoted to improve the current knowledge of the use of FACTS and HVDC in the Spanish grid. Models and tools will be investigated.
3. The results obtained in the national and international arena.

Project funded by Ministerio de Ciencia e Innovación, into Plan Nacional de Investigación Científica, Desarrollo e Innovación Tecnológica, 2008-11.

• Comprehensive solutions for power quality issues and power-flow control, using power electronics

Ministerio de Ciencia e Innovación. January 2012 - March 2015. (Aurelio García Cerrada, Juan Luis Zamora Macho, Javier Roldán Pérez, Miguel Ochoa Giménez)

This project is devoted to:
1. A global analysis of series and shunt electronic converters to improve voltage and current quality in electric power systems.
2. A global analysis of series and shunt electronic converters to optimize power flows in power systems.
3. The promotion to multi-purpose and flexible series and shunt electronic converters to be used in power systems.
4. The integration of power electronic converters in the daily operation of electric power systems in order to study the advantages and disadvantages of this technology.
5. The analysis of power electronic devices in power systems with an important participation of renewable energy sources.

The above objectives are part of a coordinated project with Alcalá University. With this coordinated action, we intend:
(a) To contribute to the global analysis of the integration of renewable energy in the grid using power electronics.
(b) To contribute to the global analysis of the use of power electronic converters to improve voltage and current quality in electrical grids.
(c) To contribute to the global analysis of the use of power electronic converters to optimize power flows in electrical grids.
(d) To contribute to find new electronic devices to improve the operation of future electric grids (from micro-grids to HVDC super grids).
(e) To investigate multi-purpose devices to obtain more efficient solutions.
(f) To investigate the massive integration of power electronics converters in future electrical grids.

Project funded by Ministerio de Ciencia e Innovación, into Plan Nacional de Investigación Científica, Desarrollo e Innovación Tecnológica, 2008-11.

• **Research programme on smart grids in Madrid**
Comunidad de Madrid. October 2014 - September 2016. (Aurelio García Cerrada, Juan Luis Zamora Macho)
This project will look into the application of smart grid technologies in Madrid. The analysis will be spelled out as follows.
(1) Devices and infrastructure: Application of power electronics devices to improve the present infrastructure.
(3) Management level: Application of computational intelligence (CI) to the prediction of the generation from renewable sources. Implementation of CI techniques in big data platforms to model the energy consumption from data collected by smart meters and sensors deployed in the system. Investigation on variable-pricing scenarios.
(4) Decision level: Medium-term improvement of safety and service. Optimization of electricity consumption based on better activity schedules.
(5) Finally, a transversal study on the communications network for information exchange between agents and devices will be carried out, with focus on low
and medium voltage networks and their problems concerning latency and bandwidth.

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

Project funded by European Union, into European Social Fund.

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

  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.
• **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:

3.2.5.2 Consultancy and technological support

3.2.5.2.1 Private funding

• **Implementation of a DFIG controller for wind-based generation**  
  EDIBON. June 2014 - March 2015. (Aurelio García Cerrada, Juan Luis Zamora Macho, Javier Roldán Pérez)  
  This project will tackle the implementation of the control system for a doubly-fed induction generator using two electronic converters (one connected to the rotor and one connected to the grid). The prototype will be used in a demonstrator for teaching purposes.

• **Certification of research, development and innovation of a project of product life management and business product management in manufacturing companies with high level of reengineering with make-to-order products**  
  Asociación Española de Normalización y Certificación (AENOR). October 2014 - December 2014. (Pedro Sánchez Martín)  
  Certification of research, development and innovation of a project of product life management and business product management in manufacturing companies with high level of reengineering with make-to-order products
3.2.5.2.2 Public funding

- Adoption of the protocol for transmitting the onboard energy measurement as a European standard protocol
  Adif Alta Velocidad. December 2014 - June 2015. (José Antonio Rodríguez Mondéjar)
  The objective of this project is that the communication protocol designed by IIT for ADIF for the transmission of onboard energy measurement be adopted as an international standard.

3.3 Publications

3.3.1 Books


3.3.2 Chapters in books


3.3.3 Publications in journals


### 3.3.4 Presentations in congress


### 3.3.5 IIT technical documents

Here are collected, the reports submitted to both companies at their request, within the framework of research projects listed above (usually confidential), as possible articles or research papers not yet published.


- A. Rodríguez, R. Cossent, P. Frías, "Understanding the impacts of smart grid solutions: a methodology proposal to perform a scalability and replicability analysis (SRA)". March 2015. Ref: IIT-14-111A.


### 3.3.6 Other publications

  Proyecto: 2013 Universal Access / WP17

  Proyecto: GridTech_IEE / WP5

  Proyecto: ADVANCED / WP6 - T6.5

  Proyecto: GridTech_IEE / WP5

  Proyecto: GridTech_IEE / WP5


**Publications**

  Proyecto: ESPLIDER / Hito 2. Tarea 2.3.B

  Proyecto: ESPLIDER / Hito 4. Tarea 4.1

  Proyecto: IndustRE / WP2-T2.2

  Proyecto: ADVANCED / WP6 – T6.3

### 3.4 Software products

- **Electric generation system reliability model (FLOP Model)**
  (http://www.iit.upcomillas.es/aramos/flop.htm)
  The model calculates the Expected Energy Non Served (EENS) and the Loss Of Load Probability (LOLP) for a prespecified set of periods in which the year is divided. It uses discrete convolution method.
  The input data for the model are: demand in each period, modelled as a chronological or load-duration curve, and generating units in each period: effective output in peak hours and availability rate. Generators are dispatched to supply demand in increasing merit order given a price ladder (although this order is irrelevant for reliability purposes). Price has only informative effects while a reserve bid system isn't available.
  The results given by the model: for each period value of EENS, LOLP and price (only for the clearing process of power reserve bids), graphs of EENS and LOLP evolution along the time, and graph of resulting price in each period.

- **Bulk production cost model (StarNet Model)**
  (http://www.iit.upcomillas.es/aramos/starnet.htm)
A bulk production cost model determines the system operation variables that minimize variable costs for a defined time scope. The model determines the unit commitment binary variables and furthermore the unit output and power flow through the network. It is a short and medium term model. In the short term demand is modeled chronologically, while in the medium term it considered as a load-duration curve. It can also be considered as a medium term Bulk Production Cost Model (BCPM) to obtain economic and unit operation forecasts.

- **Reliability and Operation Model for renewable energy sources (ROM Model)**
  (http://www.iit.upcomillas.es/aramos/ROM.htm)
  The model objective is to determine technical and economic impact of intermittent generation (IG) and other types of emerging technologies (active demand response, electric vehicles, concentrated solar power, solar photovoltaic) into the medium-term system operation including reliability assessment. Results include generation output including IG surplus, pumped storage and storage hydro usage, and adequacy reliability measures. The benefits of improving IG predictions can also be determined by changing forecasting error distributions and re-running the model.

  A daily stochastic optimization model followed by a sequential hourly simulation. Detailed operation constraints such as minimum load, ramp-rate, minimum up-time and downtime of thermal units and power reserve provision are included into the daily stochastic unit commitment model. The hourly simulation is run for the same day to account for IG production errors and unit failure and therefore revising the previous schedule. This system modeling in two phases reproduces the usual decision mechanism of the system operator.

  A chronological approach to sequentially evaluate every day of a year. Decisions above this scope as the weekly scheduling of pumped storage hydro plants are done internally in the model by heuristic criteria. Yearly hydro scheduling of storage hydro plants is done by higher hierarchy models, as for example, a hydrothermal coordination model.

  Monte Carlo simulation of many yearly scenarios that deal with IG stochasticity.

- **AGC software for the Spanish power system v2.0.1**
  AGC software adapted to the Spanish Power System that outperforms other current commercial alternatives. The software can be easily integrated in any complete SCADA system.

- **IDAT** is an intelligent information processing tool that includes technologies of processing and visualization of information, as well as advanced analysis and data mining by means of statistical models and Artificial Intelligence techniques. IDAT has been developed at the IIT and is being used as analytical tool for diverse projects.

- **iMetro: subway best route calculator**
  (http://www.iit.upcomillas.es/imetro/)
  Finds the best routes between two stations in a subway (metro) network (several cities implemented)
There are three versions of this application: iMetro WebApp (web access, Javascript algorithm), iMetro PHP (web access, PHP interface), and iMetro Multi-city (iOS application).
- If possible, it finds three different solutions:
  - **Fastest Route**: based on minimum time estimation.
  - **Minimum Connections**: it is useful if you have luggage, or just prefer an easier route.
  - **Handicap accessible**: makes all connections at stations with handicap access.
4. Teaching

4.1 Graduate Teaching

4.1.1 Final Projects, Dissertations and Degree Thesis

4.1.1.1 Electric Engineering
- Gestión óptima recursos energéticos en edificios
  Daniel de la Hera López. Supervised by Tomás Gómez San Román y José Pablo Chaves Ávila.

4.1.1.2 Electronic Engineering
- A tutorial of the knapsack cryptosystem
  Íñigo García de Mata. Supervised by Jesús María Latorre Canteli y Francisco Alberto Campos Fernández.

- Ordenación de objetos mediante robot y técnicas de visión artificial (versión IIND)
  Gabriel García Garrido. Supervised by José Antonio Rodríguez Mondéjar.

- Diseño de una unidad de punto flotante

4.1.1.3 Mechanical Engineering
- Intercomparación 3D en el sector hospitalario
  Natividad Bermejo Herrero. Supervised by María Ana Sáenz Nuño.

- Ingeniería inversa para la caracterización dimensional y geométrica de una pieza mecánica
  Ignacio Ramírez Ramón-Borja. Supervised by María Ana Sáenz Nuño.
4.1.1.4 Electric Engineering

- Evaluación de ahorros de energía en España mediante la Directiva Europea de Eficiencia Energética
  Rafael Arranz Martín. Supervised by Pedro Linares Llamas.

- Cuantificación del impacto de los recursos distribuidos en la operación del sistema eléctrico
  Vasco Benito Simoes-Coelho. Supervised by Tomás Gómez San Román y José Pablo Chaves Ávila.

- Diseño y construcción de un equipo de sincronización automático para máquinas síncronas
  Rafael Buenadicha Avilés. Supervised by Pablo Frías Marín.

- Evaluación del impacto de recursos energéticos distribuidos en el sistema energético
  María Cuadrado Quintana. Supervised by Tomás Gómez San Román y José Pablo Chaves Ávila.

- Diseño y construcción de un equipo de sincronización manual para máquinas síncronas
  Fernando Díaz González. Supervised by Pablo Frías Marín.

- Evaluación del impacto de recursos energéticos distribuidos en el sistema eléctrico
  Jaime Domínguez de Pablo. Supervised by Tomás Gómez San Román y José Pablo Chaves Ávila.

- Diseño y construcción de un equipo de medida de energía eléctrica de bajo coste
  David Egido Nieto. Supervised by Ignacio Egido Cortés y Pablo Frías Marín.

- Analyzing the role of energy storage systems in the future functioning and evolution of electric power wholesale markets
  Carlos Fernández del Valle. Supervised by Carlos Batlle López, Pablo Rodilla Rodríguez, José Agustín Moliner de Palacio y Ignacio Herrero Gallego.

- Estimación de la expansión de generación distribuida a nivel nacional
  Juan Fernández-Daza de Flórez. Supervised by José Villar Collado, Francisco Alberto Campos Fernández y Carles Cervilla Mateu.

- Analysis of switching potential of backup generators to distributed generation
  Jaime Gorjón Piquer. Supervised by Pablo Frías Marín.
- **Análisis de la expansión combinada de generación intermitente y vehículo eléctrico**  
  Diego Martínez Morales. Supervised by José Villar Collado y Francisco Alberto Campos Fernández.

- **Study of the bidding strategy of a wind power producer in electricity markets**  
  Eduardo Ramos Rodríguez. Supervised by Pablo Frías Marín y Camila Formozo Fernandes.

- **Análisis y evaluación del uso de almacenamiento como soporte a la generación fotovoltaica en sistemas aislados**  
  Eduardo Rodríguez Montero. Supervised by Pablo Frías Marín y Carlos Mateo Domingo.

- **Diseño y construcción de un regulador automático de tensión de máquina síncrona**  
  Francisco de Asís Salas Igea. Supervised by Pablo Frías Marín.

### 4.1.1.5 **Electronic Engineering**

- **Diseño del sistema de control de nivel para una planta con cuatro tanques interconectados**  
  Juan Pablo Dehesa Golding. Supervised by Juan Luis Zamora Macho y Ramón Rodríguez Pecharromán.

- **Coordinación de recursos energéticos distribuidos en distritos inteligentes**  
  Enrique Fernandez-Castaño Ruiz. Supervised by Álvaro Sánchez Miralles, Jaime Boal Martín-Larrauri y Francisco Martín Martínez.

- **Medida de potencia para sistemas de gestión de energía en hogares**  
  Jorge García-Morales Merino. Supervised by Álvaro Sánchez Miralles, Jaime Boal Martín-Larrauri y Francisco Martín Martínez.

- **Diseño del sistema de control de un UAV de ala fija para vuelo autónomo en exteriores**  
  Miguel González López. Supervised by Juan Luis Zamora Macho y José Porras Galán.

- **Diseño de una tarjeta de adquisición de datos de 16 canales simultáneos para bus PC/104**  
  Pablo González-Palencia Soria. Supervised by José Daniel Muñoz Frías.

- **Sistema "ABX" para realizar pruebas de audio a ciegas**  
  Esteban Hidalgo Sancho. Supervised by José Daniel Muñoz Frías.
Graduate Teaching

- Diseño del sistema de control de una motocicleta accionada por un cuadrirrotor
  Sonia León Vázquez. Supervised by Juan Luis Zamora Macho y José Porras Galán.

- Control de un cuadricóptero para vuelos autónomos en interiores
  Juan Martínez Olondo. Supervised by Juan Luis Zamora Macho y José Porras Galán.

- Diseño de un sistema de suspensión activa para esquivar la colisión con badenes
  Pablo Martínez Rodríguez. Supervised by Juan Luis Zamora Macho y José Porras Galán.

- Control de un cuadricóptero para vuelos autónomos en exteriores
  Diego Menéndez Botella. Supervised by Juan Luis Zamora Macho y José Porras Galán.

- Automatización de una línea de montaje
  Antonio Luis Molero Senosiain. Supervised by José Antonio Rodríguez Mondéjar.

- Etiquetas inteligentes para la localización de objetivos
  Belen Núñez Oliva. Supervised by Álvaro Sánchez Miralles, Jaime Boal Martín-Larrauri y Francisco Martín Martínez.

- Ordenación de objetos mediante robot y técnicas de visión artificial (versión grado)
  Carlota Prado López de Carrizosa. Supervised by José Antonio Rodríguez Mondéjar.

- Diseño de un microprocesador multicore y un compilador
  Antonio Vazquez Blanco. Supervised by Sadot Alexandres Fernández y José Daniel Muñoz Frías.

- Prototipo a escala de electrificación ferroviaria
  Jesús Vecino Prieto. Supervised by Ramón Rodríguez Pecharromán, Aurelio García Cerrada y Álvaro Jesús López López.

4.1.1.6 Mechanical Engineering

- Fabricación y caracterización de materiales compuestos de base polimérica reforzados con nanopartículas
  Javier Belda González. Supervised by Yolanda Ballesteros Iglesias.
- Aplicación de adhesivos en cirugía de reconstrucción facial
  Elena Díaz Olivares. Supervised by Juan Carlos del Real Romero y Jesús Jiménez Octavio.

- Design, simulation and optimization of a retractor’s frame riveting process
  Íñigo Erhardt López-Perea. Supervised by Jesús Jiménez Octavio y Peter Blome.

- Vehículo con motor neumático y frenada regenerativa
  Óscar García Amorós. Supervised by Luis Manuel Mochón Castro.

- Compresor rotativo de paletas desmodrómicas para aplicaciones en automoción

- Análisis modal de una catenaria ferroviaria y la infraestructura de sustentación
  Alberto Luis Mariscal Rivas. Supervised by Alberto Carnicero López y Jesús Jiménez Octavio.

- Light-wind effects on the resonance of overhead catenary line R3MIX
  Víctor Martín Palacios. Supervised by Alberto Carnicero López y Jesús Jiménez Octavio.

- Osteometría trazable sin contacto y modelado CAE del sistema óseo humano
  David Muñoz Gordo. Supervised by María Ana Sáenz Nuño.

- Diseño óptimo de una cocina biodigestora
  Miriam Pons Matilla. Supervised by Pedro Linares Llamas.

- Prototipado y ensayo de un modelo a escala de bomba-turbina integral
  Cayetana Urbina Soguero. Supervised by José Porras Galán, Alexis Cantizano González y Eva Arenas Pinilla.

4.1.1.7 Telematics Engineering
- Desarrollo de una plataforma para la definición natural de comportamientos en
  un sistema domótico
  Marta Garrido Oriol. Supervised by Álvaro Sánchez Miralles, Jaime Boal Martín-Larrauri y Francisco Martín Martínez.

4.1.1.8 Industrial Engineering
- Implantación de tecnología Rolling para la fabricación de anillos de rodamiento
  Yago Varela Augé. Supervised by Susana Ortiz Marcos.
4.2 Postgraduate teaching

The IIT has, in teaching, the research orientation complement within the university setting in which it enrolls. This teaching activity takes the form of master courses in collaboration with departments of Comillas ICAI. Additionally, the IIT encourages participation of its researchers in activities of teaching.

Other academic activities include doctoral courses and teaching courses in other schools.

4.2.1 Master courses

In various master's programs organized by Comillas ICAI are addressed technical and management problems.

You can find detailed information of the masters in the respective prospectuses of Comillas and through the University website.

The following are the courses taught by IIT staff in different masters in which the Institute participates.

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

Director: Juan Carlos del Real Romero

- Financial and cost analysis
  Sara Lumbreras Sancho

- Automation and advanced control
  Jaime Boal Martín-Larrauri, Álvaro Jesús López López, José Antonio Rodríguez Mondéjar, Juan Luis Zamora Macho, Ramón Rodríguez Pecharromán

- Electric power systems control
  Francisco Miguel Echavarren Cerezo, Ignacio Egido Cortés, Enrique Lobato Miguélez, Elena Saiz Marín,

- Operation of electric power systems
  Javier García González, Michel Rivier Abbad

- Quantitative decision methods
  Andrés Ramos Galán, Pedro Sánchez Martín, Eugenio Francisco Sánchez Úbeda

- Production and manufacturing systems
  Sara Lumbreras Sancho, Susana Ortiz Marcos, Pedro Sánchez Martín
- Electronic systems
  Jaime Boal Martín-Larrauri, Romano Giannetti, José Daniel Muñoz Frías, Álvaro Sánchez Miralles

- Machine technology
  Yolanda Ballesteros Iglesias, José Porras Galán, Juan Carlos del Real Romero, María Ana Sáenz Nuño

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

Director: Rafael Palacios Hielscher

- Financial and cost analysis
  Sara Lumbreras Sancho

- Architecture of network services
  David Contreras Bárcena

- Optical communications
  Javier Matanza Domingo

- Communication electronics
  Romano Giannetti

- Electronic instrumentation
  Romano Giannetti

- Business intelligence
  Miguel Ángel Sanz Bobi

- Quantitative decision methods
  Andrés Ramos Galán, Pedro Sánchez Martín, Eugenio Francisco Sánchez Úbeda

- Communications systems I
  Javier Matanza Domingo

- Communications systems II
  Sadot Alexandres Fernández
4.2.1.3 Master in Railway Systems

Director: Antonio Fernández Cardador

- Electrification
  Luis Rouco Rodríguez

- Catenary mechanics
  Alberto Carnicero López, Jesús Jiménez Octavio

- ERTMS and RAMS
  Yolanda González Arechavala

- Professional practice
  Asunción Paloma Cucala García, Antonio Fernández Cardador

- Design and traffic control advanced systems
  Asunción Paloma Cucala García, Antonio Fernández Cardador

- Control and supervision systems
  Sadot Alexandres Fernández, José Antonio Rodríguez Mondéjar

- Master thesis
  Asunción Paloma Cucala García, Antonio Fernández Cardador

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

Director: Javier García González (until November 2014) and Luis Olmos Camacho (since December 2014)

- Decision support models in the electric power industry
  Efraim Centeno Hernáez, 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
  Pablo Frías Marín, Javier García González, Damián Laloux Dallemagne, Andrés Ramos Galán, Javier Reneses Guillén, Michel Rivier Abbad

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

- Master's thesis and internships monitoring
  Javier García González

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

- Regulation of the electric power industry
  Carlos Batlle López, Tomás Gómez San Román, José Ignacio Pérez Arriaga, Michel Rivier Abbad, Pablo Rodilla Rodríguez

- Wholesale and retail electricity markets
  Carlos Batlle López, Pablo Rodilla Rodríguez

4.2.1.5 Master in Electricity Generation. Promotion, Technology and Operation (Online)

Director: Pablo Frías Marín

- Economic operation of electricity generation. Electricity markets.
  Pablo Rodilla Rodríguez

- Power plant electrical system
  Luis Rouco Rodríguez

4.2.1.6 Master in Fire Protection Engineering

Director: Alexis Cantizano González
More information at http://www.icai.upcomillas.es/es/master-propio/mpci

- Exploitation and operation of systems
  Alexis Cantizano González
- Fundamentals
  Pablo Ayala Santamaría

- Introduction to the PBD (Performance Based Design)
  Pablo Ayala Santamaría

- Fire protection in industry
  Alexis Cantizano González

- Fire protection in transport systems
  Alexis Cantizano González

- Fire protection in buildings
  Alexis Cantizano González

- Water systems for fire protection
  Pablo Ayala Santamaría

- Active fire protection systems
  Pablo Ayala Santamaría

- Passive fire protection systems
  Pablo Ayala Santamaría

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

Director: Fernando de Cuadra García

More information at

- Maintenance management of high voltage power lines
  Miguel Ángel Sanz Bobi

- Maintenance management of high voltage power lines: models and strategies of maintenance: predictive, preventive, corrective, RCM and TPM.
  Miguel Ángel Sanz Bobi

- Transmission Lines
  Luis Rouco Rodríguez

- Power lines parameters computation
  Francisco Miguel Echavarren Cerezo
- Projects of high voltage infrastructures: design parameters of high voltage installations
  Luis Rouco Rodríguez

- Electric high voltage infrastructure projects: electric infrastructure policy in Spain
  Michel Rivier Abbad

4.2.1.8 MBA in the Global Energy Industry

Director: Andrés Ramos Galán
More information at

- Operations management
  Javier García González, Michel Rivier Abbad, Tomás Gómez San Román

4.2.2 Comillas master theses

4.2.2.1 Erasmus Mundus International Master in Economics and Management of Network Industries (EMIN)
- Impact of wind generation on electricity prices
  Thi Kim Lien Nguyen. Supervised by Benjamin F. Hobbs and Javier García González.

4.2.2.2 Official Master's Degree in the Electric Power Industry (MEPI)
- Influences of energy efficiency measures on electricity demand
  David Declercq. Supervised by Pedro Linares Llamas.

  - Market equilibrium in natural gas systems: analysis of the implementation of a hub
    Aurora del Valle Díez. Supervised by Javier Reneses Guillén and Pablo Dueñas Martínez.

  - mothballing mechanisms in the Spanish power system: economic and operational assessment
    Irene Campos Blanco. Supervised by Javier García González.

  - Pricing models in the energy markets: a quantitative and qualitative approach
    Santiago Blanes Cabanes. Supervised by Antonio Bello Morales.
Postgraduate teaching

- PV Distributed generation and storage in the Spanish electricity system. Economic analysis for a regulatory proposal
  Sebastián Feinblatt Wechsler. Supervised by Pablo Frías Marín.

- What is the economic value of aggregation in the balancing market?
  Pierre-Emmanuel Peslier. Supervised by Tomás Gómez San Román and José Pablo Chaves Ávila.

4.3 Other academic activities

4.3.1 Master courses


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 funds a portion of a doctoral thesis developed at the IIT every year. During this academic year, the thesis funded was "Mejora de la infraestructura eléctrica de un sistema ferroviario electrificado en CC para optimizar el aprovechamiento del frenado regenerativo", developed by Álvaro Jesús López López, and supervised by Antonio Fernández Cardador and Ramón Rodríguez Pecharromán.

Moreover, the IIT has agreed to publish some or their research at the Associations' official journal, "Anales de Mecánica y Electricidad".

5.2 Doctoral courses

The courses that comprise the Official Master's Degree in Research in Engineering Systems Modeling (MRE), of Comillas ICAI, relevant technical and managerial problems to which the industry currently faces are described rigorously, and are proposed approaches and methods for analysis and solution based on the latest research. These courses are conducted in collaboration with the Departments of Comillas ICAI.

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

Director: Miguel Ángel Sanz Bobi

- Advanced computing tools for applied research
  Rafael Palacios Hielscher, Jaime Boal Martín-Larrauri
Doctoral courses

- Artificial intelligence
  Francisco Alberto Campos Fernández, Miguel Ángel Sanz Bobi, José Villar Collado

- Decision methods
  Pedro Linares Llamas, Sara Lumbreras Sancho

- Deterministic optimization
  Andrés Ramos Galán

- Intelligent data analysis
  Carlos Maté Jiménez, Eugenio Francisco Sánchez Úbeda

- International experiences in the energy sector I
  Luis Olmos Camacho

- International experiences in the energy sector II
  Luis Olmos Camacho

- Preliminary research project
  Andrés Ramos Galán

- Publishing research results
  Aurelio García Cerrada

- Seminars and workshops
  Mario Castro Ponce, Eugenio Francisco Sánchez Úbeda

- Simulation methods
  Pedro Sánchez Martín

- Stochastic optimization
  Andrés Ramos Galán

- Strategies in energy markets under Game Theory approach
  Javier García González

5.3 Doctoral seminars

The aim of the doctoral seminars is to provide students with basic information about various research techniques. With that, it is intended that students will be able to assess the potential usefulness of these techniques to determine a deepening in them or their possible application in projects and research.
- Cloud-based and parallel multi-stage stochastic optimization  
  Luiz Augusto Nobrega Barroso

- Energy efficiency in railways  
  Asunción Paloma Cucala García

### 5.4 Research sufficiency degree

The following doctoral students, whose tutor is a researcher at IIT, have obtained the Master Degree, through public defense of the Final Project:

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

- Design of robust and energy efficient ATO speed profiles of metropolitan lines considering train load variations and delays  

- New primary force standard machine at CEM  
  Raquel María Lorente Pedreille. Supervised by María Ana Sáenz Nuño.

- Optimization of PLC networks  
  Eduardo Alonso Rivas. Supervised by Carlos Rodríguez-Morcillo García.

- Prosumers’ optimal DER investments and DR usage in isolated microgrids  
  Francisco Martín Martínez. Supervised by Álvaro Sánchez Miralles and Michel Rivier Abbád.

- The influence of the design in the catenary-pantograph dynamic interaction  
  María Victoria Calleja Duro. Supervised by Alberto Carnicero López and Jesús Jiménez Octavio.

### 5.5 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.
5.5.1 Comillas submitted theses

- Title: Unit commitment: computational performance, system representation and wind uncertainty management
  Author: Germán Andrés Morales España
  Supervisors: Andrés Ramos Galán and Javier García González
  Date: October 08, 2014

- Title: Analysis of the impact of subsequent markets and mechanisms used to resolve technical constraints on wholesale electricity
  Author: Andrés Ramiro Delgadillo Vega
  Supervisor: Javier Reneses Guillén
  Date: October 28, 2014

- Title: Implicaciones de la continuidad de suministro en el diseño de la tarifa de red de distribución
  Author: Alezeia González García
  Supervisors: Tomás Gómez San Román and Francisco Miguel Echavarren Cerezo
  Date: November 24, 2014

- Title: Demand response in electric systems: its contribution to regulation reserves and its role in aggregating distributed
  Author: Kristin Dietrich
  Supervisors: Luis Olmos Camacho and Jesús María Latorre Canteli
  Date: December 17, 2014

- Title: Application and control of series active conditioners in electrical distribution systems
  Author: Javier Roldán Pérez
  Supervisors: Aurelio García Cerrada and Juan Luis Zamora Macho
  Date: January 29, 2015

- Title: Behavior detection models using computer vision applied to security systems
  Author: Manuel Alvar Miró
  Supervisor: Álvaro Sánchez Miralles
  Date: March 05, 2015

- Title: Wind effects on the dynamic interaction between pantograph and overhead contact lines
  Author: Cristina Sánchez Rebollo
  Supervisor: Alberto Carniceró López
  Date: July 03, 2015
- **Title:** Optimal security-constrained model for the integrated power and natural-gas system  
  **Author:** Carlos M. Correa-Posada  
  **Supervisor:** Pedro Sánchez Martín  
  **Date:** July 22, 2015

- **Title:** An experimental and numerical study on the smoke layer growth and movement within large-volume spaces: atrium fires  
  **Author:** Pablo Ayala Santamaría  
  **Supervisors:** Alexis Cantizano González and Cándido Gutiérrez Montes  
  **Date:** July 23, 2015

### 5.5.2 Submitted Theses in other universities

- **Title:** European short-term electricity market designs under high penetration of wind power  
  **Author:** José Pablo Chaves Ávila  
  **Supervisors:** Margot P.C. Weijnen and Rudi A. Hakvoort  
  **Delft University of Technology. Delft (Netherlands).**  
  **Date:** September 11, 2014

- **Title:** Optimal decision-making under uncertainty for portfolio owners of natural gas power plants  
  **Author:** Tommy Leung  
  **Supervisor:** José Ignacio Pérez Arriaga  
  **Massachusetts Institute of Technology. Cambridge, MA (U.S.A.).**  
  **Date:** April 29, 2015

- **Title:** Engineering future power systems: the role of renewable electricity generation in transitioning to a low-carbon economy  
  **Author:** Claudia Octaviano Villasana  
  **Supervisors:** José Ignacio Pérez Arriaga and John Reilly  
  **Massachusetts Institute of Technology. Cambridge, MA (U.S.A.).**  
  **Date:** May 12, 2015

### 5.5.3 Comillas ongoing theses

- **Title:** HYBRID MODELING FOR ELECTRICITY POLICY ASSESSMENTS.  
  **Author:** Renato Dias Bleasby Rodrigues  
  **Supervisor:** Pedro Linares Llamas

- **Title:** Stress induced hydrodynamic by ion beam sputtering (IBS) in amortyzable materials: molecular dynamics and theory.  
  **Author:** Ana Moreno Barrado  
  **Supervisor:** Mario Castro Ponce
- Title: Modelling and assessment of sustainability in transport policies  
  Author: Alessandro Danesin  
  Supervisor: Pedro Linares Llamas

- Title: Improving the integration of systems in Smart Homes using semantic techniques  
  Author: Javier Juárez Montojo  
  Supervisor: José Antonio Rodríguez Mondéjar

- Title: A regulatory framework for an active participation of intermittent generators in electricity markets  
  Author: Camila Formozo Fernandes  
  Supervisors: Pablo Frías Marín and Javier Reneses Guillén

- Title: Mejora de la infraestructura eléctrica de un sistema ferroviario electrificado en CC para optimizar el aprovechamiento del frenado regenerativo  
  Author: Álvaro Jesús López López  
  Supervisors: Antonio Fernández Cardador and Ramón Rodríguez Pecharromán

- Title: Medium-term forecasting of electricity prices: a hybrid methodology based on fundamental and technical analysis.  
  Author: Antonio Bello Morales  
  Supervisors: Antonio Muñoz San Roque and Javier Reneses Guillén

- Title: Ultracapacitor-based supplementary excitation module for improvement of generator transient stability.  
  Author: Luis Díez Maroto  
  Supervisors: Luis Rouco Rodríguez and Fidel Fernández Bernal

- Title: Technical, economic and regulatory assessment of information and communication technologies for smart grids.  
  Author: Luis González Sotres  
  Supervisors: Carlos Mateo Domingo and Pablo Frías Marín

- Title: Operación de unidades de arranque rápido para la regulación secundaria frecuencia-potencia.  
  Author: Inmaculada Saboya Bautista  
  Supervisors: Ignacio Egido Cortés and Enrique Lobato Miguélez

- Title: Scalability and replicability of the impact of smart grid solutions in distribution systems.  
  Author: Andrea Rodríguez Calvo  
  Supervisors: Pablo Frías Marín and Rafael Cossent Arín
- Title: ENERGY INNOVATION POLICY: Mapping its potential benefits and identifying best strategies for small- and medium-size countries.  
  Author: Adela Conchado Rodríguez  
  Supervisor: Pedro Linares Llamas

- Title: Análisis del impacto de las políticas climáticas europeas en la competitividad de la economía española.  
  Author: Pablo Pintos Touriño  
  Supervisor: Pedro Linares Llamas

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

- Title: General methodology for the optimum design of closed wind tunnels.  
  Author: Isaac Prada y Nogueira  
  Supervisors: Fernando de Cuadra García and Álvaro Sánchez Miralles

- Title: Modeling and forecasting residual demand curves in electricity markets with functional time series models.  
  Author: José Portela González  
  Supervisor: Antonio Muñoz San Roque

- Title: Demand response in electric power systems: consumer responsiveness and design of tariffs and incentives.  
  Author: Mercedes Vallés Rodríguez  
  Supervisors: Javier Reneses Guillén and Pablo Frías Marín

- Title: Evaluación medioambiental y económica de la producción de energía a partir de biomasa agrícola en España mediante análisis de ciclo de vida.  
  Author: Carlos Martín Sastre  
  Supervisor: Yolanda González Arechavala

- Title: Cementos óseos reforzados con nanomateriales basados en el carbono.  
  Author: Eva Paz Jiménez  
  Supervisor: Juan Carlos del Real Romero

- Title: Methodology for benefit analysis of transmission expansion projects.  
  Author: Fernando Báñez Chicharro  
  Supervisors: Jesús María Latorre Canteli and Luis Olmos Camacho
6. Other activities

6.1 EES-UETP

Web page: http://www.ees-uetp.com/

The Electric Energy Systems - University Enterprise Training Partnership (EES-UETP) is a consortium of 3 companies and 23 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).

The main objective of the EES-UETP is to increase the competitiveness and profitability of the electricity 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.

The main activities of the ESS-UETP are financed through contributions from its industrial partners.

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
  - ENEL
  - Université degli Studi di Bologna
  - Université degli Studi di Cagliari
  - Université 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-U ETP:
- Chairman of the Executive Board: Mr. Luis Rouco Rodríguez
- Coordinating Secretary: Mr. Luis Olmos Camacho

6.1.2 Teached courses
- Demand Response in Deregulated Electricity markets: Trends and Opportunities
  Universidad Politécnica de Valencia, Valencia, Spain

- HVDC Technology and Applications
  University of Strathclyde, Glasgow, UK

- Building-to-Smart-Grid Integration
  Universidad de Sevilla, Seville, España
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:


- Luis Díez Maroto, in Smart Transmission Systems Laboratory (SmarTSLab), KTH Royal Institute of Technology, Stockholm (Sweden). August-December 2014.


- Sara Lumbreras Sancho, Santa Fe Institute, Santa Fe (United States of America). June-July 2015.


- Andrea Rodríguez Calvo, in Institute for Energy and Transport (IET), Joint Research Centre (JRC) - European Commission, Petten (Netherlands). March-April 2015.

- Elena Saiz Marín, in Electricity Research Center (ERC), University College Dublin (UCD), Dublin (Ireland). April-June 2015.

- Mercedes Vallés Rodríguez, in Department of Statistical Science, University College London (UCL), London (United Kingdom). August-November 2014.


6.3 Visitting professors

- Pablo Dueñas Martínez, from Engineering Systems Division, Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). March 2015.

- Pablo Dueñas Martínez, from Engineering Systems Division, Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). May-June 2015.

- Pablo Dueñas Martínez, from Engineering Systems Division, Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). June-July 2015.

- Pablo Dueñas Martínez, from Engineering Systems Division, Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). July 2015.

- Dennice F. Gayme, from Department of Mechanical Engineering, Johns Hopkins University, Baltimore (USA). May 2015.


- Sauro José Yagüe Yagüe, from Insituto Químico de Sarriá, Universitat Ramon Llull, Barcelona (Spain). June-July 2015.

6.4 Visitting students


- Michael Birk, from Engineering Systems Division, Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). June-July 2015.


- Francesca Ciralli, Delft University of Technology, Delft (The Netherlands). September 2014.

- Kai Doenges, from Institute of energy systems, energy efficiency and energy economics, TU Dortmund, Dortmund (Germany). January-May 2015.


- Carlos Andrés García Montoya, from Facultad de Ingeniería, Universidad de Antioquia (UdeA), Medellín (Colombia). August 2015-February 2016.

- Michele Gaspari, from Economics Department, University of Venice, Venice (Italy). February-July 2015.


- Roderick Go, from Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore (USA). January 2015.


- Samuel Huntington, from Engineering Systems Division, Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). June-July 2015.


- Bahadir Karaca, Gazi University, Ankara (Turkey). August-September 2015.


- Vivian Li, from Engineering Systems Division, Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). June-July 2015.

- Shujie Liu, Huazhong University of Science and Technology, Wuhan, Hubei (China). March-April 2015.


- Ilan Momber, KIT - Karlsruhe Institute for Technology (Germany), Karlsruhe (Germany). September 2010-September 2014.
Visiting students

- Lien Nguyen, Korea Advanced Institute of Science and Technology, Daejeon (South Korea). February-March 2015.


- Yong Kai Saw, from Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore (USA). June-July 2015.

- Andrea Vasekova, from Computer Systems and Communications, Masaryk University, Brno (Czech Republic). September- November 2014.

- Phoebe Yeo, from Matemáticas aplicadas, Johns Hopkins University, Baltimore (USA). June-July 2015.

- Li Zhao, from Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore (USA). January 2015.

### 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:

- Luis Olmos Camacho, Luis Rouco Rodríguez, Rafael Palacios Hielscher, "Coordination of the course committee during the year 2014". EES-UETP Association. USA. Madrid.


- Carlos Batlle López, "Wholesale markets design in the Skoltech «Power markets and regulation»". Skolkovo Institute of Science and Technology (Skoltech). USA. Skolkovo, Moscow (Russia).

- Yolanda González Arechavala, "Coordination of ICAI Tech Camp". Universidad Pontificia Comillas. USA. Madrid.
- Carlos Batlle López, Javier Reneses Guillén, Pablo Rodilla Rodríguez, Michel Rivier Abbad, Rafael Cossent Arín, "FSR e-learning course on regulation of energy utilities (10th Edition)". European University Institute, Florence School of Regulation. USA. Florence (Italy).

- Yolanda González Arechavala, Miguel Ángel Sanz Bobi, Rodrigo José Andrade Vieira, "Basic course of maintenance and dependability". Ineco. USA. Madrid.

- Luis Olmos Camacho, Luis Rouco Rodríguez, Rafael Palacios Hielscher, "Coordination of the course committee during the year 2015". EES-UETP Association. USA. Madrid.


- Juan Carlos del Real Romero, "Technical advice on adhesive joints". Fundación Tecnalia Research & Innovation. USA. San Sebastián de los Reyes, Madrid.


**6.6 Seminars**

Members of the IIT offered dissemination seminars throughout the year, which can present results of research carried out or simply refer to current issues. The seminars that have taken place in this academic year are:

- Fernando Báñez Chicharro, Sara Lumbreras Sancho, "Grid expansion at nodal level". Stakeholder workshop «Enhanced pan-European transmission planning methodology». Universidad Pontificia Comillas y RTE.

- Fernando Báñez Chicharro, Sara Lumbreras Sancho, "Network reduction according to critical branches". Stakeholder workshop «Enhanced pan-European transmission planning methodology». Universidad Pontificia Comillas y RTE.

- Carlos Batlle López, "Session II: «Market rules for an efficient integration of DES»". Workshop «Distributed Energy Systems (DES) and the future of electricity systems regulation: new markets and networks regulatory design to deal efficiently with the new agents». Universidad Pontificia Comillas.

- Mario Castro Ponce, "Células troncales y medicina regenerativa: presente y futuro". Conferencia Tecnooptimismo ¿Única esperanza?. Cátedra de Ciencia, Tecnología y Religión de la Universidad Pontificia Comillas.
- Mario Castro Ponce, José Ignacio Pérez Arriaga, "Energía y sostenibilidad económica". Ciclo de Conferencias «Desafíos del ecologismo actual». Cátedra de Ciencia, Tecnología y Religión de la Universidad Pontificia Comillas.

- Efraim Centeno Hernáez, "Saludo y presentación". Workshop «Robots de bajo coste y discapacidad». Campus Aristos Mundus 2015. Universidad Pontificia Comillas.


- José Pablo Chaves Ávila, "Economics, regulation and business models". Smart Grids: New Challenges. École polytechnique - Université Paris Saclay.


- Tomás Gómez San Román, "Electricity markets". XXIX Jornadas de Economía Industrial. Graduate School of Economics.


- Tomás Gómez San Román, "Recursos energéticos distribuidos: generación distribuida y consumidores activos". VIII Asamblea General de Futured. Plataforma Tecnológica Española de Redes Eléctricas FUTURED.
- Tomás Gómez San Román, "Regulation and the future role of DSOs. A perspective from Comillas University". 7th DSO Committee Meeting. Eurelectric.

- Tomás Gómez San Román, "The utility of the future". ETH Zúrich.

- Andrés González García, "Challenges of universal access to modern energy, and their impact on energy and climate change policies: models to support decision-making". 10th Workshop on Industrial Systems and Energy Technologies - JOSITE’2015. Universidad Pontificia Comillas.

- Andrés González García, Pedro Linares Llamas, "Objetivo del milenio 7: garantizar la sostenibilidad del medio ambiente (ODM7)". Objetivos de Desarrollo del Milenio. Universidad Pontificia Comillas.


- Benjamin F. Hobbs, "Large-scale stochastic programming to co-optimize networks and generation in the face of long-run uncertainties: what lines should we build now?". Aula de Investigación. Universidad Pontificia Comillas.


- Pedro Linares Llamas, "La carrera profesional del Doctor". Doctorado e Investigación Científica en Comillas. Universidad Pontificia Comillas.


- Pedro Linares Llamas, "Presentación". La reindustrialización de España. Universidad Pontificia Comillas.


- Sara Lumbreras Sancho, "El tecnooptimismo de Ray Kurzweil. ¿Está cerca la singularidad?". Conferencia Tecnooptimismo ¿Única esperanza?. Cátedra de Ciencia, Tecnología y Religión de la Universidad Pontificia Comillas.


- Paolo Mastropietro, "National capacity mechanisms in the European IEM: opening the doors to neighbours". 10th Workshop on Industrial Systems and Energy Technologies - JOSITE'2015. Universidad Pontificia Comillas.

- José Daniel Muñoz Frías, "Actualiza tu propio PC". XIV Semana de la Ciencia. Universidad Pontificia Comillas; Fundación madri+d y Comunidad de Madrid.


- José Ignacio Pérez Arriaga, "Acceso universal a la energía: retos y soluciones desde la cooperación al desarrollo, la empresa eléctrica y la investigación". Aula de Solidaridad.


- José Ignacio Pérez Arriaga, "Electric systems and the growth of renewable generation". Renewable energy and innovation towards sustainable energy for all. World Access to Modern Energy (WAME).
- José Ignacio Pérez Arriaga, "Enabling strategies and integrated policies for supporting resource integration". Energy and the integrated management of resources: system thinking for technicians and policy makers. Politecnico di Milano; Enel Foundation y Edison.

- José Ignacio Pérez Arriaga, "Ensuring fair access to energy for all". Conference «A fair energy transition. A challenge for Europe». Research and Social Action Center (CERAS).

- José Ignacio Pérez Arriaga, "Instrumentos para alcanzar los objetivos". La propuesta de la Comisión Europea sobre Energía y Clima a 2030: un análisis económico. Fundación Ramón Areces.

- José Ignacio Pérez Arriaga, "Notes on some proposals regarding electricity market design in India". Central Electricity Regulatory Commission (CERC).


- José Ignacio Pérez Arriaga, "Session III: «Network and end-user tariffs regulation»". Workshop «Distributed Energy Systems (DES) and the future of electricity systems regulation: new markets and networks regulatory design to deal efficiently with the new agents». Universidad Pontificia Comillas.

- José Ignacio Pérez Arriaga, "Should energy and climate policy go together and why?". Online live debate. Florence School of Regulation.

- José Ignacio Pérez Arriaga, "¿El sistema marginalista de fijación de precios es compatible con las energías renovables?". I Foro Solar Español. Los desafíos de la energía fotovoltaica en la era post primas. Unión Española Fotovoltaica (UNEF).


- Luis Rouco Rodríguez, "Robustness of the grid". Stakeholder workshop «Enhanced pan-European transmission planning methodology». Universidad Pontificia Comillas y RTE.

- María Ana Sáenz Nuño, "Mesa redonda y debate sobre aplicaciones e implicaciones de la nanotecnología". Nanotecnología - un campo profesional con futuro. Colegio Oficial de Físicos.

- María Ana Sáenz Nuño, "Taller de iniciación a la biomecánica". XIV Semana de la Ciencia. Universidad Pontificia Comillas; Fundación madri+d y Comunidad de Madrid.

- Elena Saiz Marín, "¿Existe distanciamiento entre la industria y la universidad? ¿Hasta qué punto deben acercarse ambos mundos?". 2014 Jornadas Técnicas del Comité Nacional de CIGRE. Comité Nacional de España de CIGRE.

- Álvaro Sánchez Miralles, "Uso de robots de bajo coste para rehabilitación neuropsicológica". Workshop « Robots de bajo coste y discapacidad». Campus Arístos Mundus 2015. Universidad Pontificia Comillas.

- Diego Alejandro Tejada Arango, "Challenges of the Colombian electricity system in the electrical and energy planning". Aula de Investigación. Universidad Pontificia Comillas.


### 6.7 Congress, seminars and journals organization

- Pablo Frías Marín, Mercedes Vallés Rodríguez, "3rd SAB Workshop ADVANCED «Demand response: relevance for the electricity system & barriers and enablers from the consumers perspective»". Universidad Pontificia Comillas. Madrid (Spain). September 2014.


### 6.8 Other academic activities organization


- Sadot Alexandres Fernández, "Permanent member of Frontiers in Education Conference". Institute of Electrical and Electronics Engineers (IEEE). January 2002- Today.

- Sadot Alexandres Fernández, "Permanent member of revisors of Conference on Design of Circuits and Integrated Systems - DCIS". Universidad Politécnica de Madrid; Universidad Politécnica de Sevilla; Universidad Politécnica de Cataluña; Universidad Politécnica de Cantabria; Laboratoire d’Informatique, de Robotique et de Microélectronique de Montpellier (LIRMM); Universidade do Por. January 1992- Today.


- Pedro Linares Llamas, "Chairman in Roundtable · Water and energy nexus in the context of isolated electric and hydraulic systems". Universidad de La Laguna. Tenerife (Spain). February 2015.

- José Ignacio Pérez Arriaga, "Chairman in 5th OMIE International Workshop Electricity Wholesale Markets & Demand-Side Resources. Session: Challenges and opportunities to the old order from demand-side resources". OMIE. Madrid (Spain). November 2014.


- José Ignacio Pérez Arriaga, "Editor of Fifth Assessment Report (AR5)". Intergovernmental Panel on Climate Change (IPCC). Geneva (Switzerland). October 2010-December 2014.


- Juan Carlos del Real Romero, "Member of XV Congress of Adhesion and Adhesives". Instituto Tecnológico de Aragón y Universidad Carlos III de Madrid. Zaragoza (Spain). September 2014.

- Luis Rouco Rodríguez, "Chairman in Is there estrangement between industry and universities? To what extent should approach both worlds?". Comité Nacional de España de CIGRE. Madrid (Spain). November 2014.

- Mariano Ventosa Rodríguez, "Chairman in The re-industrialization of Spain". Universidad Pontificia Comillas. Madrid (Spain). April 2015.


6.9 Other activities


- Yolanda Ballesteros Iglesias, Supervision of the research work "Hybrid PSA adhesive joints". University of Illinois at Urbana-Champaign. Champaign (United States of America). May-June 2015.


- Julián Barquín Gil, Carlos Batlle López, Rafael Cossent Arín, Pablo Dueñas Martínez, Tomás Gómez San Román, Damián Laloux Dallemagne, Pedro Linares Llamas, Luis Olmos Camacho, José Ignacio Pérez Arriaga, Javier Reneses Guillén, Michel Rivier Abbad, Pablo Rodilla Rodríguez, Course "On-line Course on Regulation of the Power Sector". Florence School of Regulation y Universidad Pontificia Comillas. February-July 2015.


- Alexis Cantizano González, Director del Máster en Ingeniería de Protección Contra Incendios in Universidad Pontificia Comillas. Madrid (Spain). November 2010- Today.


- Adela Conchado Rodríguez, Reviewer of "Infrastructure Complexity". Springer-Verlag, GmbH. Heidelberg (Germany). February 2015.


- Fernando de Cuadra García, Vocal de la Junta de Gobierno in Asociación/Colegio Nacional de Ingenieros del ICAI. Madrid (Spain). June 2010- Today.

- Fernando de Cuadra García, Patrono in Fundación Universidad Loyola Andalucía. Seville (Spain). June 2010- Today.

- Fernando de Cuadra García, Director del Máster en Proyecto, Construcción y Mantenimiento de Infraestructuras Eléctricas de Alta Tensión (Online) in Universidad Pontificia Comillas y Structuralia. Madrid (Spain). September 2010- Today.


- Luis Díez Maroto, Vocal de la Junta de Gobierno in Asociación/Colegio Nacional de Ingenieros del ICAI. Madrid (Spain). June 2012-April 2015.


- María Gil Medina, Aurora del Valle Díez, Attendance to "Specialised Training on Regulation of Gas Markets Course". Florence School of Regulation. Florence (Italy). March 2015.

- Tomás Gómez San Román, Course "Regulatory and market design issues". Universidad de Sevilla y EES-U ETP. Seville (Spain). June 2015.


- Carlos Maté Jiménez, Reviewer of "Advances in Data Analysis and Classification". Springer. Heidelberg (Germany). April 2010- Today.


- Carlos Maté Jiménez, Reviewer of "IEEE Transactions on Neural Networks and Learning Systems". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (United States of America). February 2013- Today.


- Ana Moreno Barrado, Grant awards "Beca predoctoral del subprograma de Formación de Personal Investigador (FPI)". Ministerio de Economía y Competitividad. Madrid (Spain). September 2010- Today.


- Luis Olmos Camacho, Director del Erasmus Mundus Joint Master in Economics and Management of Network Industries (EMIN) in Universidad Pontificia Comillas; Delft University of Technology; Paris-Sud 11 University; Florence School of Regulation; y Catholic University of Leuven. Madrid (Spain). January 2015- Today.

Other activities


- Rafael Palacios Hielscher, Director del Máster Universitario en Ingeniería de Telecomunicación (MIT) in Universidad Pontificia Comillas. Madrid (Spain). September 2014- Today.


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


- José Ignacio Pérez Arriaga, Moderador del Scientific Advisory Board del «Next Infrastructures Program» in January 2010- Today.


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

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


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


- Andrea Rodríguez Calvo, Grant awards "Beca Erasmus «Personal Docente/Investigador» de formación". Joint Research Centre (JRC) - European Commission. Petten (Netherlands). March 2015.


- José Antonio Rodríguez Mondéjar, Vocal del Comité Técnico de Normalización 207 SC 13 «Aparatos de medida de la energía eléctrica y del control de cargas» in AENOR. Madrid (Spain). December 2011- Today.


- José Antonio Rodríguez Mondéjar, Experto del Comité Técnico IEC/TC 57/WG 21 «System interfaces and communication protocol profiles relevant for systems connected to the Smart Grid» in AENOR. Madrid (Spain). December 2011- Today.


Other activities


- Luis Rouco Rodríguez, Presidente del Capítulo Español de la Power Engineering Society in Institute of Electrical and Electronic Engineers (IEEE). Seville (Spain). July 2009- Today.


- Mariano Ventosa Rodríguez, Miembro del Consejo de Redacción de la revista «Anales de Mecánica y Electricidad» in Asociación de Ingenieros del ICAI. Madrid (Spain). September 2006- Today.

- Mariano Ventosa Rodríguez, Miembro del Comité de la Energía y la Ingeniería de Arbitraje y Mediación in Asociación Europea de Arbitraje (AEADE). Madrid (Spain). December 2010- Today.

- Sonja Wogrin, Grant awards "Beca de movilidad para investigadores «NILS Ciencia y Sostenibilidad»". Universidad Complutense de Madrid. Trondheim (Norway). February-March 2015.

7. Data about IIT

The relevant numbers of the academic year 2014 - 2015 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:

- 5,32 M€ Turnover
- 65 Professors and researchers
- 44 Research assistants
- 79 Research projects
- 38 Consultancy projects
- 10 Services and analysis projects
- 1 Book and 9 Chapters in books
- 63 Papers published in JCR journals
- 11 Papers published in other journals
- 74 Papers presented at conferences
- 17 Technical reports
- 9 Submitted theses
- 21 Ongoing theses
- 8 Visiting professors and 28 students
- 10 International exchanges
- 8 Courses offered to external entities