Annual Academic Report
Academic year 2013 - 2014

Institute for Research in Technology

Instituto de Investigación Tecnológica
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6.1.1 EES-U ETP partners

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7. Data about IIT
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, which turned thirty years during the past academic year.

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 and commitment.

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

Efraim Centeno Hernández
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:

- Innovative engineering equipment design and advanced computer applications (usually developed to customer specifications) used in many different companies.

- 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 2013 - 2014, from the September 2, 2013 to August 31, 2014.
2. Organization

2.1 Management

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

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

2.2 Council

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

- **Centeno Hernández, Efraim.** Director
- **Frias Marín, Pablo.** Reseacher representative
- **González Sotres, Luis.** IEF representative
- **Latorre Canteli, Jesús María.** Reseacher representative
- **Paz Jiménez, Eva.** IEF representative (since September 2013)
- **Ramos Galán, Andrés.** Reseacher representative
- **Reneses Guillén, Javier.** Reseacher representative
- **Rivier Abbad, Michel.** Reseacher representative
- **Rodríguez-Morcillo García, Carlos.** Secretary
- **Saiz Marín, Elena.** IEF representative (until September 2013)
- **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.** Assistant Researcher
  Ph.D. in Industrial Engineering (Comillas)
  Electrical Engineer (Comillas)
  Areas of interest: Economics and regulation of the electricity industry. Modelling of electricity markets.

- **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 Associate  
  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.

- **Cucala García, Asunción Paloma.** Assistant 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.

- **Dueñas Martínez, Pablo.** Research Associate  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  
  Areas of interest: Analysis of gas markets regulation and performance, and their interaction with electric power markets.

- **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.** Assistant Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electronics Engineer (Comillas)  
  Areas of interest: System modeling and control. Power system stability.

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

- **Fernández Martínez, Cesáreo.** Assistant 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.
• Frías Marín, Pablo. Assistant 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. Assistant 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. Assistant 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.** Associate 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.

• **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)

• **Muñoz San Roque, Antonio.** Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electrical Engineer (Comillas)

• **Nieto Fuentes, Francisco.** Assistant 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)

• **Pagola y de las Heras, Francisco Luis.** Professor
  Ph.D. in Industrial Engineering (UPM)
  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.

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

• **Rodríguez Mondéjar, José Antonio.** Assistant 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.** Assistant 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.** Assistant 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.** Assistant Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electronics Engineer (Comillas)  
• **Sánchez Úbeda, Eugenio Francisco.** Assistant 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 Associate  
  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.** Lecturer
  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.** Assistant 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)

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

- **Fernández Bernal, Fidel.** Associate Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electrical Engineer (Comillas)
  Areas of interest: Dynamics of electrical systems. Motor control and applications on electric vehicles. Power electronics.
• **Giannetti, Romano.** Associate Professor  
  Ph.D. in Electronics and Computing Engineering (University of Padua, Italy)  
  Electronics Engineer (University of Pisa, Italy)  

• **Jiménez Octavio, Jesús.** Lecturer  
  Ph.D. in Industrial Engineering (Comillas)  
  Mechanical Engineer (Comillas)  
  Areas of interest: Railway systems. Design and optimization. Computational mechanics.

• **Laloux Dallemagne, Damián.** Assistant 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.** Assistant Professor  
  Ph.D. in Mathematics Science (UCM)  
  Mathematics Science degree (UCM), Economic Science diploma (UCM)  

• **Meseguer Velasco, Claudia.** Assistant Professor  
  Ph.D. in Industrial Engineer  
  Mechanical Engineer (UPM)  
  Areas of interest: Regulation, economics, operation and planning of electric power systems.

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

• **Muñoz Frías, José Daniel.** Assistant Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electronics Engineer (Comillas)  
- Ortiz Marcos, Susana. Assistant 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. Assistant 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.

- Zamora Macho, Juan Luis. Assistant Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electronics Engineer (Comillas)  
  Areas of interest: Drive control. System identification. Signal processing.
2.5 Research assistants

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

- **Alonso Rivas, Eduardo.** Electronics Engineer (Comillas), M.Sc. in Automatics and Electronics (Comillas)
- **Andrade Vieira, Rodrigo José.** Mechanical Engineer (Federal University of Pará - UFPA, Belém, Brazil), M.Sc. in Mechanical Engineering (Federal University of Pará - UFPA, Belém, Brazil)
- **Ayala Santamaría, Pablo.** Mechanical Engineer (Comillas)
- **Báñez Chicharro, Fernando.** Electronics Engineer (Comillas)
- **Bello Morales, Antonio.** Mechanical Engineer (Comillas)
- **Boal Martín-Larrauri, Jaime.** Ph.D. in Industrial Engineering (Comillas) Electronics 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)
- **Cervilla Mateu, Carles.** Energetic Engineer (UPV), Specialist in wind Energy (UNED), M.Sc. in Electric Power Industry (Comillas)
- **Chaves Ávila, José Pablo.** 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)
- **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)
- **Díez Maroto, Luis.** Electrical Engineer (Comillas)
- **Fernández Rodríguez, Adrián.** Electrical Engineer (UPM)
- **Fitiwi, Desta Zahlay.** Electrical and Computer Engineer (Addis Ababa University, Ethiopia), M.Sc. in Electrical Engineering (PETRONAS University of Technology, Malaysia)
- **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)
- **González García, Andrés.** Electronics Engineer (Comillas), M.Sc. in Power Systems (Comillas)
- **González Sotres, Luis.** Electronics Engineer (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)
• **Juárez Montojo, Javier.** Electronics Engineer (Comillas)
• **Khan, Zarrar.** M.Sc. in Civil Engineering (Cornell University, Ithaca, NY, United States of America)
  M.Sc. in Project Management (COMSATS Institute of Information Technology - CIIT, Islamabad, Pakistan)
  Environmental Engineer (Dartmouth College, Hanover, N H, United Sta
• **López Lópeze, Álvaro Jesús.** Electronics degree (Comillas), M.Sc. in Automatics and Electronics (Comillas)
• **Lumbreras Sancho, Sara.** Ph.D. in Industrial Engineering (Comillas)
  Electrical Engineer (Comillas)
• **Marcos Peirotén, Rodrigo Alejandro de.** Electronics Engineer (Comillas)
• **Martín Martínez, Francisco.** Electrical Engineer (Comillas)
• **Martín Sastre, Carlos.** Agronomist Engineer (UPM)
• **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)
• **Momber, Ilan.** Industrial Engineer (Karlsruhe Institute of Technology - KIT, Germany)
• **Morales España, Germán Andrés.** Electrical Engineer (Industrial University of Santander - UIS, Bucaramanga, Colombia), M.Sc. in Electricity Sector (Comillas), M.Sc. in Engineering and Policy Analysis (Delft University of Technology - TU Delft, The Netherlands)
• **Mosácula Atienza, Celia.** M.Sc. in Renewable Energies (CEU San Pablo University)
  Chemistry Engineer (UPV/EHU)
• **Nogales Gómez, Adelaida.** Electrical Engineer (University of Extremadura)
• **Ochoa Giménez, Miguel.** Electronics degree (Comillas), M.Sc. in Automatics and Electronics (Comillas)
• **Paz Jiménez, Eva.** Industrial Technical Engineering in Industrial Chemistry (UPM), M.Sc. in Production Engineering (UPM)
• **Pinczynski, Marcin.** Computer Science degree (Adam Mickiewicz University in Poznan, Poland), Engineer Diploma in the field of Construction (Gdansk University of Technology, Poland), Postgraduate studies in Real Property Management (Poznan University of Economics, Poland), M.S
• **Portela González, José.** Electronics Engineer (Comillas)
Research assistants

- **Renedo Anglada, Francisco Javier.** Electrical Engineer (Comillas)
- **Rodríguez Calvo, Andrea.** Electronics Engineer (Comillas)
- **Roldán Pérez, Javier.** Electronics Engineer (Comillas), M.Sc. in Automatics and Electronics (Comillas)
- **Romero Mora, José Carlos.** M.Sc. in Research in Engineering Systems Modeling (Comillas) Electrical and Power Systems Engineer (University of Malaga)
- **Saboya Bautista, Inmaculada.** Electrical Engineer (Comillas)
- **Saiz Marín, Elena.** Electrical Engineer (Comillas)
- **Sánchez González, Guillermo.** Electronics Engineer (Comillas)
- **Sánchez Rebollo, Cristina.** Mechanical Engineer (Comillas)
- **Valle Díez, Aurora del.** Energy Techniques Engineer (UPM)
- **Vallés Rodríguez, Mercedes.** Electrical Engineer (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.upcomillas.es/organizacion/mac.php.en

3.1.1.2 Smart and Green Networks Area (Redes)

This area is focused on the analysis and development of models for the simulation and optimization of future electricity networks.

Coordinator: Pablo Frías Marín
Web page: http://www.iit.upcomillas.es/organizacion/redes.php.en
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.).

Coordinator: Michel Rivier Abbad
Web page: http://www.iit.upcomillas.es/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.upcomillas.es/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.upcomillas.es/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.upcomillas.es/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.upcomillas.es/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.upcomillas.es/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

- **Dynamic excitation module technology**
  Alstom. April 2010 - April 2014. (Luis Rouco Rodríguez, Luis Díez Maroto, Fidel Fernández Bernal)

  Alstom has developed a dynamic excitation module technology. This module is added to static excitation systems fed from generator terminals to improve the generator stability in case of network faults. This project will include the development of a reduced-scale test bank and will provide support to Alstom in the simulation of the machine behaviour. It will also study the large disturbance stability mechanisms of synchronous machines and the design of advanced control schemes of the dynamic excitation module.
• **Future scenarios and global sustainability indicators for a sustainable and self-sufficient biocity (BIOCAS)**
  Iberdrola Ingeniería y Construcción. January 2011 - December 2013. (Pedro Linares Llamas, Yolanda González Arechavala, Ana María Santos Montes, Carlos Martín Sastre, José Carlos Romero Mora)

  The objectives of the project are twofold, although very much related. On the one hand, we define future scenarios to make them compatible with the structural scenarios assumed for biocities, and to assess the behavior of the biocity for each of them. We also assess the contribution of algi to biocities and to the general environment of the scenarios proposed. On the other hand, we propose a set of global sustainability indicators for biocities, considering energy and environmental sustainability indicators, and also introducing economic, social or human capital indicators.

• **Pre-feasibility analysis on power highways for the Europe-MENA region integration in the framework of the Dii Rollout Plan 2050**
  CESI. April 2012 - April 2014. (Michel Rivier Abbad, Andrés Ramos Galán, Luis Olmos Camacho, Fernando Báñez Chicharro)

  The integration of the power systems of the MENA region with the European interconnected pool (ENTSO-E) is a key requirement to enable a massive power exchange between the two areas, which is the mission of Desertec Industrial Initiatives (Dii). This project evaluates the grid transmission reinforcements required to meet such an integration, for several medium and long horizons and different scenarios set by Dii.

• **The future role of solar PV in US electric power systems**
  MIT (Massachusetts Institute of Technology). May 2012 - October 2013. (Carlos Batlle López, Pablo Rodilla Rodríguez, Andrea Veiga Santiago, Pablo Frías Marín, Carlos Mateo Domingo)

  In the context of the MIT «Future of solar energy» study, it was determined to support the findings and the recommendations of the scoping paper with some quantitative modeling analyses. Research activities are focused on two complementary lines: «Integration of solar generation in wholesale electricity markets» and «Integration of solar PV at distribution network level».

  In the first task, the framing questions to be discussed are:
  - How much will solar generation affect the operation of the electric power system?
  - How much will solar affect the long-term adequacy requirements?
  - Which are the existing synergies and incompatibilities between solar and other technologies (nuclear, coal, wind, hydro, storage, etc.)?
  - How much will increasing penetration of solar affect market prices?

  On the distribution networks side, the objective is to understand the impact that different future penetration levels of PV would have in the required additional CAPEX and OPEX. Of special interest is to study the influence of the:
  - Characteristics of the existing network: remaining capacity, geographic dispersion and local engineering practices;
  - Spatial concentration of the new PV generation;
- Load profiles of existing customers;
- Radiation level.

- **Technical assistance in the use of the tools EXLA and SIROCO**
  The aim of this project is the technical assistance in the use of the tools EXLA and SIROCO, both developed for ENDESA. The model EXLA is a model for optimal operation and planning of hydropower units and reservoirs in the medium and short term. The SIROCO system consists of a set of tools for monitoring and forecasting the Spanish secondary reserve market.

- **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.

- **Assessing and forecasting on the iberian electricity market**
  This project is framed into the on-going cooperation line followed by Endesa and IIT since 1998 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 extreme prices in the market, improvements in the use of system states and improving the interaction with the operation model of the gas system.

- **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 adapting the tool VALORE for medium-term operation to a European context (MIBEL and CWE). The tasks envisaged include acquisition and processing of data from CWE and neighboring countries, as well as the use of system states and the generalization of the market splitting model.

- **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 integrating an equivalent model of CWE market for MIBEL forecasts, improving executions with system states and modeling mechanisms subsequent to day-ahead market.

- **Smarter electricity distribution grids to integrate distributed energy resources**  
  MIT (Massachusetts Institute of Technology). January 2013 - December 2014. (Carlos Batlle López, Álvaro Sánchez Miralles)  
  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.

• **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. Specifically, it focuses on the one hand, on improving the modeling, in order to include some aspects that are not yet considered in the gas operation forecasting, such as the LNG carrier fleet and the future gas market. On the other hand, it aims to add value to the forecasts, efficiently using the results provided by the model and including uncertainty in the forecasts.

• **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**  
  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.

• **New developments for market forecasts in the short-term**  
  Endesa. January 2013 - December 2013. (Javier García González, Miguel Ángel Fernández Sánchez, Antonio Muñoz San Roque, José Portela González, Eugenio Francisco Sánchez Úbeda)  
  The model EXCOM is decision support tool that allows to obtain optimal operating decisions in the short term for a generation company operating in the Spanish electricity market. The objectives of this project are to expand the time horizon up to three weeks with hourly periods, to improve the modeling of the thermal and hydraulic generation units, and to perform an analysis of residual demand curves to generate scenarios that consider the effect of the minimum income condition.
• **Capacity studies under a new generation and demand structure framework**


Joint work of IIT and Endesa about Strategic Analysis of Generation Capacity Expansion. The main objective is about analysis and improvement of the algorithms and study methods used by Endesa in order to elaborate its yearly expansion plan and other studies associated to it. The results of this work are two tools: EXPANDE (capacity expansion) and a tool (MERCO2) to estimate the price of CO2 emission allowances. This year the objectives include the adaptation to a new demand structure with high penetration of renewable generation plants, introduce the new Spanish generation tax and the improvement of the interface.

• **MORSE: regulatory analysis and tariffs design, ancillary services assessment and European market equilibrium**


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 design and implementation of new tools and models for regulatory analysis and tariffs design, ancillary services assessment and the application of Morse to the European electricity market.

• **The utility of the future study**

Enel. February 2013 - October 2013. (Carlos Batlle López, Pablo Frías Marín, Michel Rivier Abbad, Álvaro Sánchez Miralles, Javier Reneses Guillén, Claudio Ricardo Vergara Ramírez, Pablo Rodilla Rodríguez)

The objective of the Comillas team is to contribute to frame some of the aspects addressed in the study: Regulation of DSOs, network operators (transmission and distribution) interaction, tariff design, innovative business models, new technical solutions for distribution grids, vision of the communication systems for distribution grids.

• **Short- Medium-term Risk Management Model**

Endesa. September 2013 - December 2013. (Javier Reneses Guillén, Efraim Centeno Hernández, Antonio Bello Morales, Rodrigo Alejandro de Marcos Peiroton)

The aim of this project is to carry out conceptual and operational developments in the current short-term risk management tool used by Endesa, as well as assisting in the use of the model and the interpretation of results. Additionally, the calculation of implied volatilities is addressed and the outputs of the electricity market forecasting tool (VALORE) are being adapted to improve the data used in the risk model.
• **Natural gas risk management model**
  The objective of this project between IIT and Endesa is to perform a first phase to provide Endesa with a tool able to meet the needs and requirements for the risk decision-making process in the natural gas business. This first stage is to carry out the conceptual development and define the architecture of the tool.

• **Short-medium-term risk management model**
  The objective of this project between IIT and Endesa is to perform a first phase to provide Endesa with a tool able to meet the needs and requirements for the risk decision-making process in the long term (more than three years). This first stage is to carry out the conceptual development and define the architecture of the tool.

• **Impact of renewable energy in electricity markets in Latin America and the Caribbean: from dispatch to long term integration**
  InterAmerican Development Bank. October 2013 - November 2013. (Carlos Batlle López, Pablo Rodilla Rodríguez)
  This work briefly reviews the challenges associated with the integration of variable energy sources, like wind or solar, into Latin American energy systems, expose solutions and technological improvements for short term planning and analyze modeling options for seizing their benefits in an integrated long term approach.

• **Analysis of incentives for investment in generation in the context of massive penetration of renewable energy sources**
  Iberdrola. November 2013 - June 2014. (Carlos Batlle López, Pablo Rodilla Rodríguez, Samuel Vázquez Martínez, Ignacio Herrero Gallego)
  The project consists of three stages:
  • Assessment of the long-term evolution of the electricity systems in a context of high penetration renewable sources.
  • Analysis of investment incentives perceived by generation in a market context.
  • Critical analysis of the current market design.

• **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 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.

• **Update of the analysis of the impact of a European electricity market on the Iberian market: 2020 scenarios**  
The main objective of this project is to update the qualitative and quantitative assessment of the impact of the future implementation of a European electricity market on the Iberian electricity market (MIBEL), focused on the year 2020. The impact on electricity prices, generated energy, generation margin, as well as on other parameters, such as saturation and spread in interconnections will be quantified.
Research projects

• 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 focuses 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.

• The Utility of the Future
  MIT (Massachusetts Institute of Technology). February 2014 - January 2015. (Tomás Gómez San Román, José Pablo Chaves Ávila)

  This Project in partnership with MIT applies existing analytical tools and reviews relevant literature, and where needed to develop new models to understand how the electricity system will change over the coming decade.

• High frequency modeling of shell type transformers
  ABB. March 2014 - July 2014. (Luis Rouco Rodríguez)

  The project is aimed at analyzing and improving the ABB computer code for high frequency modeling of shell type transformers.

• Analysis of electrification scenarios for the Spanish energy system
  REE (Red Eléctrica de España). April 2014 - October 2014. (Pedro Linares Llamas, Michel Rivier Abbad, Jesús María Latorre Canteli)

  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.

• Analysis of KAPSARC energy model
  KAPSARC. June 2014 - July 2014. (Sonja Wogrin)

  Collaboration with KAPSARC’s energy systems modeling team on the development of the KAPSARC Energy Model. This involves providing assistance and suggestions on various modeling issues, like the incorporation of intermittent sources of energy or the formulation of MPEC/EPEC problems.
• **Impact assessment of the connection of gas based micro-cogeneration in electric distribution networks**
ENI. July 2014 - December 2015. (Pablo Frías Marín, Carlos Mateo Domingo)
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.

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.

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.

• **Design and impact of a harmonised policy for renewable electricity in Europe**  

The work will comprise a detailed elaboration of feasible policy approaches for a harmonisation of RES support in Europe, involving five different policy paths - i.e. uniform quota, quota with technology banding, fixed feed-in tariff, feed-in premium, no further dedicated RES support besides the ETS. A thorough impact assessment will be undertaken to assess and contrast different instruments as well as corresponding design elements. This involves a quantitative model-based analysis of future RES deployment and corresponding cost and expenditures based on the Green-X model and a detailed qualitative analysis, focussing on strategic impacts as well as political practicability and guidelines for juridical implementation. Aspects of policy design will be assessed in a
broader context by deriving prerequisites for and trade-offs with the future European electricity market. The overall assessment will focus on the period beyond 2020, however also a closer look on the transition phase before 2020 will be taken.

The final outcome will be a fine-tailored policy package, offering a concise representation of key outcomes, a detailed comparison of pros and cons of each policy pathway and roadmaps for practical implementation. The project will be embedded in an intense and interactive dissemination framework consisting of regional and topical workshops, stakeholder consultation and a final conference.

• **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.

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


  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.
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Project funded by Ministerio de Economía y Competitividad.

- **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)
  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.

- **PV GRID: Reducing barriers hampering large-scale integration of PV electricity into the distribution GRID**
  The overall goal of the PV GRID project is to contribute to overcoming the barriers hampering the large-scale integration of Photovoltaic (PV) power into the electricity Distribution Systems (DS). This goal will be pursued through an analysis of barriers and solutions and the formulation of regulatory and normative recommendations.

- **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.

**ADVANCED: Active Demand Value and Consumer Experience Discovery**


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 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:

![European Union](image)

![Seventh Framework Programme](image)

**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

Project funded by European Union, within Seventh Framework Programme:

- **Impact on power generation technologies of the availability of water in climate change scenarios**
  This project assesses the relationship between water and energy in one direction, the impact on power generation technologies of changes in the availability of water induced by climate change scenarios

- **Assessment of capacity reliability mechanisms alternatives for the German electricity market**
  Assessment of capacity reliability mechanisms alternatives for the German electricity market

- **Forecasting and Optimization of Wind Generation in Energy Markets 2**
  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.
Research projects

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.

• Estimating costs of renewable energies compared to conventional energy
  sources up to 2030 and beyond
Fraunhofer. March 2014 - June 2015. (Luis Olmos Camacho, Andrés Ramos
Galán, Michel Rivier Abbad)
We aim to make a quantitative estimate of the impact of the set of RES
generation deployment strategies on transmission network development and
operation costs at European level. The geographical scope of the analysis is the
EU-28 system, while the time scope is the year 2030. Thus, the expansion of
the European transmission system and the system operation in the year 2030
shall be jointly optimized. We will focus on identifying optimal main
transmission network corridors to reinforce and the extent of reinforcements
needed in them, though we will also compute the performance of the resulting
network architectures with respect to main operation variables affected by the
existence of the grid, like investment cost of grid additions, network losses
incurred, CO₂ emissions produced, and overall production by technology and fuel production costs.

- 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.

3.2.1.2 Consultancy and technological support

3.2.1.2.1 Private funding
- Feasibility studies for the western electricity trans-mediterranean corridor
  MEDGRID. December 2012 - December 2013. (Michel Rivier Abbad, Andrés Ramos Galán, Luis Olmos Camacho, Pedro Sánchez Martín, Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo)
  In the context of the Mediterranean Solar Plan, MEDGRID is interested in evaluating the feasibility of transporting large amounts of electrical energy from countries in North Africa to Europe. These trans-Mediterranean electricity exchanges have three potential complementary corridors, the Western one through the Iberian Peninsula, the Center one through Italy and the Eastern through Turkey. This project analyzes, using tools developed at IIT within their research projects, the network reinforcements required for the Western corridor to increase the South to North capacity of transmission in several GW. The initial reference network corresponds to the result of the TYNDP 2020.

- Maintenance and new capabilities of Eon Tools 2013 to 2014
  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 electrici market, GHIAN optimizes with an annual and weekely time scope the hydro power plants of Eon,
OFCctg 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.

- **Analysis of Central América regional electricity market mathematical algorithms**
  This project consists in reviewing and enhancing the algorithms that are currently used in the Central America regional electricity market in order to improve the representation both of the power plants technical constraints and of the different kinds of contracts considered by the market rules.

- **Study of induced voltages in two parallel 230 kV isolated cables**
  Cobra Instalaciones y Servicios S.A. January 2014 - January 2014. (Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo)
  The aim of the study is to compare the sheath to ground voltages in two insulated cables that are laid parallel without and with the effect of the other cable.

- **Consulting services dynamic studies OWF Wikinger**
  This collaboration is aimed at providing services to Iberdrola Ingeniería y Construcción on dynamic studies of the off-shore wind farm OWF Wikinger.

- **W2008-64 bits version of the AGC-IIT software installed in Cepsa control system**
  This work is aimed at supplying W2008-64 bits version of the AGC-IIT software installed in Cepsa control system.

- **Validation of the AECOM simulation program RailEST**
  AECOM. 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**
  EON 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, OFCcccgt, 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, OFCcccgt 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 and 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.

• **Updating and maintenance of the information system IDAT-MDB**
  Updating and maintenance of the information system IDAT-MDB.

• **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.

### 3.2.1.2.2 Public funding

- **A think tank hosting an interdisciplinary network to provide knowledge support to EU energy policy making**
Research projects

The three year coordinating action THINK will improve the knowledge support to policy making by the European Commission in the context of the Strategic Energy Technology Plan. THINK is organized around a multidisciplinary group of 24 experts covering five dimensions of energy policy: science and technology, market and network economics, regulation, law, and policy implementation. The Think Tank will respond to the European Commission’s evolving needs on a semester basis and produce 12 dossiers and a book.

• Support and Maintenance of ESLA System
REE (Red Eléctrica de España). February 2013 - December 2013. (Luis Rouco Rodríguez)
ESLA is a tool for building long term power system scenarios. Long term power system scenarios are used for a wide variety of studies by the Security of Supply Department of Red Electrica de España. This project is aimed at providing user support and corrective and evolutive maintenance.

• Study of electrical integration model between the countries of the Andean region
CENACE. October 2013 - March 2014. (Carlos Batlle López, Pablo Rodilla Rodríguez)
Study of electrical integration model between the countries of the Andean region.

• Evaluation of the inclusion of profit sharing for workers as part of operation and maintenance costs to be considered in setting the 2013-2017 RAB
Evaluation of the inclusion of profit sharing for workers as part of operation and maintenance costs to be considered in setting the 2013-2017 rate asset base from the regulatory approach.

• Post 2020 framework in a liberalised electricity market with large share of Renewable Energy Sources
European Commission. April 2014 - October 2016. (Luis Olmos Camacho, Pablo Frías Marín, Pablo Rodilla Rodríguez, Camila Formozo Fernandes)
Market 4RES 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.
3.2.1.3 Services and analysis projects

3.2.1.3.1 Private funding

  This project will contribute to the book «Technology, economics and regulation of the energy sector», promoted by the European Academy of Science and Arts. A chapter focused on the electrical infrastructures will be developed.

- **Building the European internal market for gas and electricity**
  Fundación de las Cajas de Ahorro (FUNCAS). January 2014 - June 2014. (Tomás Gómez San Román)
  The aim of this study is to write a report on «Building the European internal market for gas and electricity». This report will be published by FUNCAS in the considered most appropriate format.

- **Basic facts about electric energy**
  The goal of the collaboration is to write a book that is a collective publication for legal professionals where the main technical notions of power with an informative approach are presented.

- **Technical support related to AGC and assessment of AGC operation**
  BBE. June 2014 - September 2014. (Ignacio Egido Cortés)
  The main objective of this project it 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.
3.2.1.3.2 Public funding

- Validation of the Call for Proposals of the electric supply of the Malaga city council
  Ayuntamiento de Málaga. September 2013 - October 2013. (Álvaro Sánchez Miralles, Javier Reneses Guillén, Pablo Frias Marín)
  The aim of the project is to revise the Call for Proposals of the electric supply of the Malaga’s city council, which is used for supplying energy to all the buildings owned by the Malaga’s city council.

3.2.2 Engineering Design Area

3.2.2.1 Research and develop projects

3.2.2.1.1 Private funding

- Future scenarios and global sustainability indicators for a sustainable and self-sufficient biocity (BIOCAS)
  Iberdrola Ingeniería y Construcción. January 2011 - December 2013. (Pedro Linares Llamas, Yolanda González Arechavala, Ana María Santos Montes, Carlos Martín Sastre, José Carlos Romero Mora)
  The objectives of the project are twofold, although very much related. On the one hand, we define future scenarios to make them compatible with the structural scenarios assumed for biocities, and to assess the behavior of the biocity for each of them. We also assess the contribution of algi to biocities and to the general environment of the scenarios proposed. On the other hand, we propose a set of global sustainability indicators for biocities, considering energy and environmental sustainability indicators, and also introducing economic, social or human capital indicators.

- 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.

- Stability analysis of compact lines with horizontal vees
  The goal of the project is to have a further knowledge about the stability of the horizontal vees used in compact towers under wind action. It try to establish some criteria facing the design of this type of line.
3.2.2.1 Public funding

• **3D Simulation of the wind effect on the catenary-pantograph interaction for high speed trains**

This research project studies the effect of wind gusts on the interaction between catenary and pantograph by means of 3D simulation models. On the one hand, the aerodynamic effect of the wind on catenaries and pantographs of high speed trains is studied applying both new numerical models and the results measured with an aerodynamic channel, which were obtained within the previous project EVITAV. On the other hand, the project develops numerical 3D models catenaries and pantographs able to include the numerical and experimental aerodynamic information.

The main goal of this project is transcending the current catenary-pantograph simulation models by adding the effect of the wind over this dynamic interaction and the clear upgrade that 3D formulations entail. This study is tackled by comparing the numerical results obtained both with simplified models and complex models of catenaries and pantographs of high speed trains. It is specially valuable the benefits reported by the advanced 3D models against the classical 2D ones developed within previous projects.

The numerical study is carried out by the Institute of Research in Technology of Universidad Pontificia Comillas (IIT-COMILLAS). Besides its small size, this research group has reached important contributions to the catenary-pantograph simulation problem and has become one of the most internationally relevant groups of reference. This project widens the objectives of the research line opened within the last National Plan, moreover it generalizes and overcomes the limitations of the developed 2D models.

Project funded by Ministerio de Economía y Competitividad.

3.2.2.2 Consultancy and technological support

3.2.2.2.1 Private funding

• **Computation of droppers and cantilevers in railway catenaries**

The project develops a computer program to compute the droppers length and the cantilevers geometry in railway catenaries.
• **ANDASOL III Incidents Assessment**  
1. Possible relationship between the two claims (gearBox and blades of the low pressure turbine).  
2. Others incidents (broken pipes, etc.) have also affected the availability of the plant. Their contribution to the loss of profit should be quantified.  
3. Mean time to repair each type of damage including the time to manufacture a set of blades.  
4. In the period from July 19, 2012 to January 25, 2013, many actions has been taken over the Gear Box to keep the plant working. Some of these actions should be considered part of the repair and should be covered.

• **Study of thermal heat dissipation of a transponder CIT25-A**  
Study of thermal heat dissipation of a transponder CIT25-A

• **Assess possible causes of failure of bernuolli filters**  
1. Assess possible causes of failure of a number of self-cleaning filters F450 DN500 SAB brand, supplied by CUÑADO GROUP SA and installed in the plant ACWA power desalination plant in Oman.  
2. Computational Fluid Dynamics of the filter for the range (Flow rate and Differential pressure) specified by the manufacturer.

3.2.3 Railway Systems Area

3.2.3.1 Research and develop projects

3.2.3.1.1 Private funding

• **Regulation system for automatic driving of high speed trains**  
The goal of this project is the design and development of a regulation system for automatic driving of high speed trains, in order to fulfill the programmed schedule in an efficient way.

• **Modeling and computer implementation of the signal-lines network of the railway commuting lines of Madrid and Barcelona**  
KV Consultores. April 2013 - October 2013. (Ramón Rodríguez Pecharromán, Álvaro Jesús López López)  
The aim of the project is to analyze the current situation of the signal-lines of the commuting railway lines of Madrid and Barcelona, and to provide
proposals to improve them. The load for these lines is steadily increasing and new increments are expected associated to the installation of new devices ERTMS/GSM-R. The main aspects of the project are the following ones:
- Modeling of the signal lines and implementation of them in the application PowerFactory.
- Validation of the model with electrical measurements (not included in this project).
- Conclusions: identification of problems in the network and possible improvements.

• 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.

3.2.3.1.2 Public funding
• Smart management of regenerated energy in metro lines to charge electric cars

The purpose of this project is to develop an innovative system for the smart management of the direct current grid of the trains and of the associated systems and devices of Metro de Madrid (traction substations, fixed accumulators, possible inverters), by introducing power feed points for electric cars into the grid, in such a way as to maximise the harnessing of the energy regenerated by the trains during braking and the overall efficiency of the system.

Photo project achievements
For this purpose a Consortium has been formed, comprised by Metro de Madrid, the Universidad Pontificia de Comillas through its Technological Research Institute (ICAI), the company, Sistemas de Computación y Automática General (SICA), and the research centre, Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT), in order to address the objectives of the project and successfully undertake the relevant actions within a specified time limit.

The following specific targets have been set for the attainment of the objective described in the first paragraph:
- To develop configurable models and simulators making it possible to analyse the system overall (both the electricity grid as well as the traffic), and to
Research projects

investigate the strategies for the control of the energy regenerated in order to optimise its use. The models and simulators must consider the characteristics of the traction network, the operation and outputs of the various devices (accumulators, voltage transformation elements, etc.), the traction and braking characteristics of the trains and their auxiliary systems, traffic scenarios (peak and off-peak hours), and charging requirement of the electric cars (car fleet, connection points, charging cycles, power, business model, etc.).

• To simulate and design a regenerated energy control system that will implement smart management strategies of the grid and that will make it possible to provide power to the fleet of electric cars for each operation scenario. This design includes the selection and the dimensioning of the devices comprising the system (accumulators, voltage transformers, etc.), their connections and the design of the energy controller which, in the end, will have to manage the flow of energy between the catenary and the cars.

• To develop a prototype of the smart grid in METRO DE MADRID which will enable the testing and validation of the strategies developed, making use of the fleet of electric cars used by METRO DE MADRID for its security personnel.

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

![Government of Spain and Ministry of Science and Innovation](image)

Project funded by Ministerio de Economía y Competitividad.

3.2.3.2 Consultancy and technological support

3.2.3.2.1 Private funding

• Optimal design of ATO driving parameters for Metro Barcelona
  Dimetronic S.A. September 2011 - December 2013. (Antonio Fernández Cardador, Asunción Paloma Cucala García)
  The objective of this project is the design and implementation of ATO speed commands in Metro de Barcelona 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 4 speed commands are designed, the flat out
command and 3 commands parameterised by coast/re-motor speed or by the regulation speed, as well as the brake deceleration. The new ATO speed commands must comply with technical, operational and comfort restrictions and will minimise the energy consumption.

**• Validation of the AECOM simulation program RailEST**

AECOM. 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.

**• Capacity analysis of Line 1 of Metro Bilbao**


A capacity analysis of Metro Bilbao is carried out focused on the extension of Line 1 from Etxebarri to Galdakao

### 3.2.3.3 Services and analysis projects

#### 3.2.3.3.1 Private funding

**• Capacity analysis of Metro de Bogotá**


The main goal is the calculation of the minimum headway in Metro de Bogotá provided by the CBTC signalling system. The fulfillment for transport capacity requirements and possible improvements will be assessed.

### 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.

- **Technical assistance in the use of the tools EXLA and SIROCO**
  The aim of this project is the technical assistance in the use of the tools EXLA and SIROCO, both developed for ENDESA. The model EXLA is a model for optimal operation and planning of hydropower units and reservoirs in the medium and short term. The SIROCO system consists of a set of tools for monitoring and forecasting the Spanish secondary reserve market.

- **Virtual Traffic Solver: Representation and simulation tool for road accidents**
  ARSINTON DIGITAL S.L. December 2012 - December 2013. (David Contreras Bárcena, Carlos Mateo Domingo)
  The aim of this project is to deploy a tool named Virtual Traffic Solver. It will be focused on the design of traffic accident sketches and plans. The potential users of this tool will be policemen and technical people who will write down the most important field data observed in the place of the accident. Later, they will insert them into the tool to get the technical calculations about the accident.

- **Smarter electricity distribution grids to integrate distributed energy resources**
  MIT (Massachusetts Institute of Technology). January 2013 - December 2014. (Carlos Batlle López, Álvaro Sánchez Miralles)
  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.

- **New developments for market forecasts in the short-term**
  Endesa. January 2013 - December 2013. (Javier García González, Miguel Ángel Fernández Sánchez, Antonio Muñoz San Roque, José Portela González, Eugenio Francisco Sánchez Úbeda)
The model EXCOM is decision support tool that allows to obtain optimal operating decisions in the short term for a generation company operating in the Spanish electricity market. The objectives of this project are to expand the time horizon up to three weeks with hourly periods, to improve the modeling of the thermal and hydraulic generation units, and to perform an analysis of residual demand curves to generate scenarios that consider the effect of the minimum income condition.

- **MORSE: regulatory analysis and tariffs design, ancillary services assessment and European market equilibrium**

  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 design and implementation of new tools and models for regulatory analysis and tariffs design, ancillary services assessment and the application of Morse to the European electricity market.

- **Application of data mining techniques for the monitoring and analysis of 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.

- **Development of an intelligent small-scale building demonstrator**
  IBM. September 2013 - October 2013. (Álvaro Sánchez Miralles)

  The objective of this project is to develop a small-scale demonstrative building that permits to show the goodnesses of the energy management algorithms and the underlying ICT architecture. This demonstrator would incorporate real renewable energy sources (solar and wind) and storage (based on batteries). Grid connection would be able to transmit real-time prices. It would connect with a computer which could have IBM IOC installed. The main control areas would be: illumination, energy, watering, security and conditioning.

- **Design of an automatic shop. The commerce of the future**
This aim of this Project is to develop an automatic shop with a view to replacing classic stores with shop assistants. This type of shops will be a breakthrough in the commerce of the future, since they occupy very little space and they don’t need shop assistants during 24h.

- **Identification of medium-term models for forecasting conventional gas demand**
  The objective is to identify and adjust the forecasting models for the 400 series of conventional gas demand of ENAGAS. These models are used to obtain the consumption patterns for the period 2014-2016. The models have been fitted using the MoCAP tool, developed by IIT for ENAGAS.

- **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.

- **“Virtual Traffic Solver” version 1.15 Tool**
  Arsinton Digital S.L. February 2014 - April 2014. (David Contreras Bárscena, Carlos Mateo Domingo)
  New funcionality and improvements of Virtual Traffic Solver tool.
• **Forecasting residual demand curves of the day-ahead Spanish electricity market**
  The objective of this project is to develop a tool for monitoring and updating the forecasting models used for the generation of residual demand scenarios of the day-ahead electricity market. These residual demand curves are used as inputs for the optimization of the operating decisions of a generation company in the short term.

• **New developments and improvements in the SGO analysis tool of the Spanish electricity market**
  Endesa. May 2014 - June 2014. (Eugenio Francisco Sánchez Úbeda, Jesús María Latorre Canteli)
  This project is devoted to the development of new features and improvements in the SGO analysis tool of Endesa, previously developed by IIT.

### 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**
  Comisión Europea. 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.

### 3.2.4.2 Consultancy and technological support

#### 3.2.4.2.1 Private funding

• **Method for characterising the health condition of a wind turbine by monitoring of its basic parameters of power generation**
  Olivento. April 2013 - September 2013. (Miguel Ángel Sanz Bobi, Rodrigo José Andrade Vieira)
  The project objective is to characterize the health condition of a wind turbine using information available about generated power and some environmental conditions such as wind speed and ambient temperature. In particular, this project will develop a method for analysis of possible observed changes in the
power curve of a wind turbine over a long period of its time life. These changes can alert about possible anomalies that could evolve to catastrophic faults or non justified loss of the generation capability due to several causes.

- **Short term electricity and secondary reserve price forecasting**  
  ALPIQ. September 2013 - November 2013. (Antonio Muñoz San Roque)  
  The main objective of this project is the development of a short term (24 to 168 hours) forecasting model for the Spanish secondary reserve market prices.

- **Updating and maintenance of the information system IDAT-MDB**  
  Updating and maintenance of the information system IDAT-MDB.

### 3.2.5 Electronics and Automatic Group

#### 3.2.5.1 Research and develop projects

- **Private funding**

  - **Virtual Traffic Solver: Representation and simulation tool for road accidents**  
    ARSINTON DIGITAL S.L. December 2012 - December 2013. (David Contreras Bárzina, Carlos Mateo Domingo)  
    The aim of this project is to deploy a tool named Virtual Traffic Solver. It will be focused on the design of traffic accident sketches and plans. The potential users of this tool will be policemen and technical people who will write down the most important field data observed in the place of the accident. Later, they will insert them into the tool to get the technical calculations about the accident.

  - **Feasibility study of communications systems for the improvement and optimization of clinical practice and surgical**  
    The objective of the proposed collaboration is to carry out a feasibility study on each of these three lines of work:  
    - To develop, without wires, of instrumentation associated with the electrodes and accessories needed for recording and stimulation in Intraoperative Monitoring.  
    - To develop of a communication system for remote monitoring and management of various surgical activities simultaneously.  
    - To develop of a software for Neurophysiology devices that enables greater and better accessibility to the needs of the specialist.
These feasibility studies will enable future decisions on development or not any of the above three lines.

- **Virtual Traffic Solver** version 1.15 Tool
  Arsinton Digital S.L. February 2014 - April 2014. (David Contreras Bárcena, Carlos Mateo Domingo)
  New functionality and improvements of Virtual Traffic Solver tool.

### 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.

- Project funded by Ministerio de Economía y Competitividad.
• **Comprehensive solutions for power quality issues and power-flow control, using power electronics**


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.

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Project funded by Ministerio de Economía y Competitividad.
3.2.5.2 Consultancy and technological support

3.2.5.2.1 Private funding

- Technical advice on «No + Vello IPL System» hair removal equipments
  No Más Vello S.L. October 2013 - January 2014. (Carlos Rodríguez-Morcillo García)
  The goal of the collaboration is to technically assist No Más Vello S.L. on Intense Pulsed Light hair removal equipment (IPL system) model «No + Vello IPL System» and testing to verify compliance with the European Directives 2004/108/EC and 2006/95/EC and UNE-EN 55014-1, UNE-EN 55014-2, EN 61000-3-2, EN 61000-3-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, UNE-EN 61000-4-5, EN 61000-4-6, EN 61000-4-11, EN 60335-1 and EN 60335-2-27.

- Technical advice on «No + Vello IPL System» hair removal equipments of Campanillas (Málaga)
  No Más Vello S.L. December 2013 - January 2014. (Carlos Rodríguez-Morcillo García)
  The goal of the collaboration is to technically assist No Más Vello S.L. on Intense Pulsed Light hair removal equipment (IPL system) model «No + Vello IPL System» of Campanillas (Málaga) and testing to verify compliance with the European Directives 2004/108/EC and 2006/95/EC and UNE-EN 55014-1, UNE-EN 55014-2, EN 61000-3-2, EN 61000-3-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, UNE-EN 61000-4-5, EN 61000-4-6, EN 61000-4-11, EN 60335-1 and EN 60335-2-27.

- Technical advice on «No + Vello IPL System» hair removal equipments of Loja (Granada)
  No Más Vello S.L. December 2013 - February 2014. (Carlos Rodríguez-Morcillo García)
  The goal of the collaboration is to technically assist No Más Vello S.L. on Intense Pulsed Light hair removal equipment (IPL system) model «No + Vello IPL System» of Loja (Granada) and testing to verify compliance with the European Directives 2004/108/EC and 2006/95/EC and UNE-EN 55014-1, UNE-EN 55014-2, EN 61000-3-2, EN 61000-3-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, UNE-EN 61000-4-5, EN 61000-4-6, EN 61000-4-11, EN 60335-1 and EN 60335-2-27.

- Addendum to the report of technical advice on «No + Vello IPL System» hair removal equipments
  No Más Vello S.L. March 2014 - May 2014. (Carlos Rodríguez-Morcillo García)
  The goal of the collaboration is to technically assist No Más Vello S.L. on one Intense Pulsed Light hair removal equipment (IPL system) model «No + Vello IPL System»; testing it to verify compliance with the European Directives 2004/108/EC and 2006/95/EC and UNE-EN 55014-1, UNE-EN 55014-2, EN 61000-3-2, EN 61000-3-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4,
UNE-EN 61000-4-5, EN 61000-4-6, EN 61000-4-11, EN 60335-1 and EN 60335-2-27; and writing an addendum of a report done before.

- **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.

### 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.


- M. Ochoa, "Efficient multiple-reference-frame controller for harmonic suppression in active power filters". February 2014. Ref: IIT-14-007A.


- P. Rodilla, C. Batlle, A. Veiga, M. Hagerty, "Modeling the role of existing hydro resources in the capacity expansion problem in face of a significant penetration of solar PV". June 2014. Ref: IIT-14-060A.


3.3.6 Other publications


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 is 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:
  o Fastest Route: based on minimum time estimation.
  o Minimum Connections: it is useful if you have luggage, or just prefer an
easier route.
  o 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

- Optimización del rendimiento de un motor eléctrico por introducción de un ferrofluido en su entrehierro
  Juan Alcaraz García. Supervised by Santiago Cano Casanova y Mario Castro Ponce.

- Evaluación de la fiabilidad en redes eléctricas de distribución en las que hay una gran participación de sistemas de energía renovable
  Fernando Astorga Serrano. Supervised by Miguel Ángel Sanz Bobi.

- Redes de comunicaciones para smart grids
  Cristina Cordón Peralta. Supervised by Carlos Mateo Domingo y Luis González Sotres.

- Modelado y simulación de transformadores acorazados ante onda tipo rayo
  Alfredo Del Río Muñoz. Supervised by Luis Rouco Rodríguez.

- Transmission and expansion planning with a genetic algorithm

- Intermittent Res-E, spot prices and generation investment incentives: the role of pricing rules
  Ignacio Herrero Gallego. Supervised by Carlos Batlle López y Pablo Rodilla Rodríguez.

- Diseño de un esquema de protección por frecuencia del sistema eléctrico aislado de La Palma
  David López Larrosa. Supervised by Lukas Sigrist.
- Impacto de diferentes mecanismos de retribución para la energía solar fotovoltaica
  Carlos Reina Lebrón. Supervised by Pablo Frías Marín y Rafael Cossent Arín.

- Diseño y desarrollo de un dispositivo de campos electromagnéticos pulsantes (PEMF)
  Lucía Romero Tejera. Supervised by Fernando de Cuadra García.

- Optimizing long-term service agreements in a context of increasing penetration of variable resources
  Miguel Sánchez González. Supervised by Carlos Batlle Lópe y Pablo Rodilla Rodríguez.

- Diseño del regulador para el AGC de un parque eólico

- Aplicación de técnicas de Inteligencia Artificial para la mejora de un algoritmo de Arranque-Rápido para el AGC
  Ana Vázquez Rodríguez. Supervised by Ignacio Egido Cortés y Inmaculada Saboya Bautista.

### 4.1.1.2 Electronic Engineering
- Sistema para diseño, simulación e implantación de sistemas de control basado en Scilab y Scicos
  Fernando Alonso Real. Supervised by José Daniel Muñoz Frías.

- Control domótico de una casa a escala
  Guillermo Álvarez Ramírez. Supervised by Álvaro Sánchez Miralles.

- Control de un sistema domótico mediante un iPhone
  Ignacio Bautista Enciso. Supervised by Álvaro Sánchez Miralles, Jaime Boal Martín-Larrauri y Francisco Martín Martínez.

- Modelado y control de una motocicleta accionada por un cuadrirotor
  José Antonio Fernández Ramírez. Supervised by Juan Luis Zamora Macho, José Porras Galán y Cesáreo Fernández Martínez.

- Control de un sistema domótico mediante un smartphone Android
  Miguel Manuel Martín Lopo. Supervised by Álvaro Sánchez Miralles, Jaime Boal Martín-Larrauri y Francisco Martín Martínez.

- Interfaz para el control de un entorno doméstico mediante la voz
  Santiago Moreno Carbonell. Supervised by José Antonio Rodríguez Mondéjar.
- Integración de energías renovables y sistemas de almacenamiento en una casa inteligente
  Juan Ignacio Ortueta Olartecoech. Supervised by Álvaro Sánchez Miralles, Jaime Boal Martín-Larrauri y Christian Francisco Calvillo Muñoz.

- Desarrollo de una aplicación móvil para una dieta por intercambios
  Antonio Peral Pereira. Supervised by Rafael Palacios Hielscher y Antonio Prieto.

- Modelado y control de un cuadricóptero
  Luis Sevilla Fernández. Supervised by Juan Luis Zamora Macho, José Porras Galán y Cesáreo Fernández Martínez.

4.1.1.3 Mechanical Engineering
- Determinación de factores que influyen en el modelo de tasa de fallos de un aerogenerador de un parque eólico según su historia de incidencias y mantenimiento
  Manuel Blanco Madrazo. Supervised by Miguel Ángel Sanz Bobi y Rodrigo José Andrade Vieira.

- Proyecto técnico de diseño, fabricación y ensayo de sistemas adhesivos mediante cintas PSA
  Agustín Carreño Echanove. Supervised by Yolanda Ballesteros Iglesias.

- Compactadora de chatarra de alto tonelaje
  José Andrés García Álvarez. Supervised by Luis Manuel Mochón Castro.

- Efecto de la adición de antibióticos en elevadas dosis en la actividad atibacteriana y en las propiedades mecánicas de un cemento óseo
  Paula Gea Sánchez. Supervised by Juan Carlos del Real Romero.

- Análisis de políticas de eficiencia energética para España
  María Jacob Jareño. Supervised by José Ignacio Pérez Arriaga, Adela Conchado Rodríguez, Álvaro López-Peña Fernández y Andrés González García.

- Optimización de las curvas de elevación del hilo de contacto en el seccionamiento de catenarias para obtener la mejor interacción de pantógrafo-catenaria en la zona de frotamiento común
  Gonzalo Limones Pradas. Supervised by Alberto Camicero López.

- Adaptación del modelo MASTER.SO de optimización de políticas energéticas sostenibles al análisis de acceso universal a la electricidad. Caso de estudio Kenia
- Análisis estático y dinámico del efecto de las fuerzas aeroelásticas sobre líneas de alta tensión
  Alejandro Quiroga Agudo. Supervised by Alberto Carnicero López y Jesús Jiménez Octavio.

- Almacenamiento de aire comprimido en formaciones geológicas subterráneas
  Mario Rigaud Gálvez. Supervised by Luis Manuel Mochón Castro.

- Caracterización mecánica de un adhesivo óseo biodegradable y osteoconductivo
  Víctor Manuel Villapún Puzas. Supervised by Juan Carlos del Real Romero.

4.1.1.4 Industrial Engineering
- Herramientas de predicción de valores del IBEX-35 a través de Twitter
  Gonzalo Casajus Rey. Supervised by Eugenio Francisco Sánchez Úbeda y Alberto Gascón González.

- Las nuevas tecnologías y las Smart Cities en España. Comparación y sostenibilidad de las ciudades
  Roberto Espina Ezcurdia. Supervised by Susana Ortiz Marcos, Mercedes Fernández García y Raquel Caro Carretero.

- Análisis del sector textil: evaluación de la competitividad, causas de la deslocalización y eficiencia económica
  Diego Ezquerra Fuster. Supervised by Susana Ortiz Marcos, Mercedes Fernández García y Raquel Caro Carretero.

- Aplicación móvil para organizar partidos de golf entre usuarios compatibles
  Fernando Fraile Romero. Supervised by Rafael Palacios Hielscher.

- UMIT Testing Methodology
  Gonzalo García Ballesteros. Supervised by Susana Ortiz Marcos.

- Sistema de ayuda al conocimiento de estado del vehículo

- Aplicación de técnicas de Lean Manufacturing en el sector servicios
  Belén Molina del Campo. Supervised by Susana Ortiz Marcos, Mercedes Fernández García y Raquel Caro Carretero.

- Despacho competitivo de trenes usando modelos de equilibrio
- Herramienta informática de análisis de series temporales financieras  
  Ignacio Vidri Salgado. Supervised by Alberto Gascón González.

4.1.1.5 Computer Engineering (communications branch)
- Solución de marketing de precisión basada en bluetooth low energy  
  Miguel Álvarez de Espejo Montiel. Supervised by David Contreras Bárcena.

4.1.1.6 Computer Engineering (IT management and software engineering branch)
- Herramienta de evaluación y modelado del tiempo de resolución de incidencias dentro del área de Mejora Continua en una empresa del sector de distribución  
  Teresa Alicia Sarmiento García. Supervised by David Contreras Bárcena y Raquel Caro Carretero.

4.1.1.7 Computer Engineering (Internet and new information technologies branch)
- Desarrollo y plan de negocio de un videojuego multiplataforma para dispositivos móviles  
  Eduardo Cuadrado. Supervised by David Contreras Bárcena.

- Business development and prototyping of a social payments platform  
  Íñigo Beitia Arévalo. Supervised by David Contreras Bárcena.

- Desarrollo de una aplicación para personas con trastornos en la comunicación  
  Alejandro Carretero García. Supervised by Claudia Meseguer Velasco y Miguel Ángel Sanz Bobi.

- Red social web con sistema inteligente de creación y recomendación de conjuntos, prendas y usuarios similares  
  Isabel López Baeza-Rojano. Supervised by David Contreras Bárcena.

- Estudio, análisis y evaluación del Framework Hadoop  
  Raquel Rubio Echevarría. Supervised by David Contreras Bárcena.

- Análisis de las preferencias de los consumidores de compra online: estudio sobre una tienda online de moda en un entorno Big Data  
  Adrián Tung Lu. Supervised by Eugenio Francisco Sánchez Úbeda y Francisco Lucena Alcalde.
4.1.1.8 Computer Engineering (intelligent systems branch)
- Adaptación de un sistema a las necesidades de personas discapacitadas  
  Javier Castellano Ruiz. Supervised by David Contreras Bárcena y Miguel Ángel  
  Sanz Bobi.

- Análisis de IBM InfoSphere BigInsights configuración e implementación de casos  
  prácticos  
  Pablo Liste García. Supervised by David Contreras Bárcena y Luis Reina Juliá.

- Optimización de la cadena de suministro utilizando sistemas multiagentes  
  Jacobo Liste García. Supervised by Claudia Meseguer Velasco y Miguel Ángel  
  Sanz Bobi.

- Sistema inteligente de previsión de la evolución de la fiabilidad de un  
  aerogenerador de un parque eólico en función de la vida observada y del  
  mantenimiento aplicado  
  Jorge Luque Carrasco. Supervised by Miguel Ángel Sanz Bobi y Rodrigo José  
  Andrade Vieira.

- Reconocimiento de expresiones faciales mediante imágenes adquiridas con  
  cámara Kinect  
  Rodrigo Ruiz Martín. Supervised by Antonio Muñoz San Roque y Rafael  
  Palacios Hielscher.

4.1.1.9 Electric Engineering
- Comparative study of domestic low voltage DC and AC distribution systems  
  Leopoldo Cabrera Azpilicueta. Supervised by Pablo Frías Marín y Tomás Gómez  
  San Román.

- Instalación solar fotovoltaica destinada al autoconsumo de una vivienda  
  Álvaro Guerrero Plasencia. Supervised by Fernando de Cuadra García.

- Design of a FACTS device to improve the importing capacity from Morocco  
  Antonio Malpica Morales. Supervised by Pablo Frías Marín.

- Controlador de motor Brushless para Arduino  
  Luis Martínez-Brocal Contreras. Supervised by Fidel Fernández Bernal.

- Diseño de una placa de control para un regulador tensión de flujo luminoso  
  Jorge Nieto Gavilán. Supervised by Pablo Frias Marín.

- Relight- Turbina eólica para la iluminación de las rutas  
  Cecilia Ollero Merello. Supervised by Fernando de Cuadra García.
- Impacto de las restricciones de red en la estrategia de los generadores del mercado de electricidad
  Álvaro Ortiz Gil. Supervised by José Villar Collado, Cristian Andrés Díaz Durán y Pablo González Gascón y Marín.

- Estudio del impacto de la pérdida de una fase en los sistemas de alimentación exterior de una central nuclear
  Alfonso Pontes Jiménez. Supervised by Luis Rouco Rodríguez.

- Impacto de un eclipse sobre la producción fotovoltaica
  Fernando Sainz de Rozas Lafita. Supervised by Fernando de Cuadra García.

- Diseño y construcción de un regulador de velocidad de máquinas de corriente continua de excitación independiente
  Enrique Salas Díaz. Supervised by Pablo Frías Marín.

- Diseño de una placa de control para un estabilizador regulador de tensión doméstico
  Alejandro San Felipe García. Supervised by Pablo Frías Marín.

- Impacto de mecanismos de predicción de generación fotovoltaica en el sistema eléctrico
  Javier Sterling Barba. Supervised by Pablo Frías Marín, Carlos Mateo Domingo y Luis González Sotres.

- Análisis y coordinación de una microred

4.1.1.10 Electronic Engineering

- Control inalámbrico de equipos en un edificio inteligente
  Jaime Adroher Molins. Supervised by Álvaro Sánchez Miralles, Jaime Boal Martín-Larrauri y Francisco Martín Martínez.

- Aplicación web basada en HTML 5 para interfaz con un sistema domótico X10
  Alberto Arce Arroyo. Supervised by Juan Luis Zamora Macho y José Daniel Muñoz Frías.

- Desarrollo de un prototipo de ordenador para bicicleta de montaña
  Íñigo Fernández de Araoz. Supervised by Antonio Muñoz San Roque y José Villar Collado.

- Diseño de un sistema "motion load" para un simulador de vuelo
  José María Fernández de Bobadilla Navarrete. Supervised by Sadot Alexndres Fernández, José Daniel Muñoz Frías y Carlos Pérez Ramírez.
Graduate Teaching

- Sistema de RFID para control automático de palets
  Antonio Ferreiro González. Supervised by José Antonio Rodríguez Mondéjar.

- HAPTIC interface
  Ángela María García-Cano. Supervised by Álvaro Sánchez Miralles.

- Desarrollo de un controlador domótico X10
  Roberto González Celma. Supervised by Juan Luis Zamora Macho y José Daniel Muñoz Frías.

- Centro de montaje robotizado
  Eduardo Gutiérrez Fernández. Supervised by José Antonio Rodríguez Mondéjar.

- Mandos de vuelo para simulador de helicóptero
  Luis J. Isasi Guerrero. Supervised by Sadot Alexandres Fernández, José Daniel Muñoz Frías y Carlos Pérez Ramírez.

- Instrumentación y programación de un banco de ensayos de sistemas de propulsión para cuadricópteros
  Guillermo Izard Taillefer. Supervised by Juan Luis Zamora Macho y José Porras Galán.

- Diseño de un sistema de control para la plataforma de un simulador de vuelo
  Juan Lopis Bernat. Supervised by Sadot Alexandres Fernández, Ramón Rodríguez Pecharromán, José Daniel Muñoz Frías y Carlos Pérez Ramírez.

- Diseño y construcción de un regulador de tensión de máquinas síncronas
  Ignacio Marchena González. Supervised by Pablo Frías Marín.

- Dimensionamiento de una subestación de tracción ferroviaria metropolitana teniendo en cuenta el ruido en el tiempo de parada de los trenes
  David Roch Dupré. Supervised by Ramón Rodríguez Pecharromán y Álvaro Jesús López López.

- Comparación metrológica de termómetros clínicos infrarrojos
  Estanislao Rolandi. Supervised by José Daniel Muñoz Frías.

- Diseño y construcción de una impresora 3D de tecnología de deposición por hilo fundido
  Martín Romero Sánchez. Supervised by José Porras Galán y Silvia Fernández Villamarín.

- Diseño de un sistema de control predictivo de temperatura para una vivienda
  Juan Antonio Sainz Ruiz. Supervised by Juan Luis Zamora Macho.
- Desarrollo de un sistema de comunicación en grupo para bicicleta de montaña
  Marina Veloso Pereira. Supervised by Antonio Muñoz San Roque y José Villar Collado.

- Robotización en sistemas de producción
  Roberto Zumárraga Lizundia. Supervised by Álvaro Sánchez Miralles.

4.1.1.11 Mechanical Engineering
- Estudio de evacuación en caso de incendio de un edificio
  Fernando Adell Pijuán. Supervised by Alexis Cantizano González y Pablo Ayala Santamaría.

- Diseño de un vehículo aéreo no tripulado para el transporte de pequeñas cargas
  Rodrigo Álvarez Hernández. Supervised by Juan Luis Zamora Macho y José Porras Galán.

- Diseño de tren MacPherson y de su triángulo de suspensión
  Juan Azcoitia Revuelta. Supervised by Jesús Jiménez Octavio.

- Multi-objective optimization method for structures in fire
  Pablo Cosío de los Arcos. Supervised by Jesús Jiménez Octavio y Alexis Cantizano González.

- Calificación cualitativa del estado de salud de un aerogenerador de un parque eólico a través de técnicas neuro-fuzzy
  Francisco de Asís Marín Gómez. Supervised by Miguel Ángel Sanz Bobi.

- Analysis of the porosity of wood

- Análisis del diseño de un pantógrafo para alta velocidad ferroviaria
  Carmen de Pablos Alfar. Supervised by Jesús Jiménez Octavio y Cristina Sánchez Rebollo.

- Modelización y diseño mecánico de equipos electrónicos
  José Enrique Pallarés Carrasco. Supervised by Jesús Jiménez Octavio y Jesús Vállega Tejero.

- Aplicación de un sistema de frenado regenerativo oleohidráulico para vehículos de transporte público
Generación y cálculo de ménsulas tubulares para infraestructura ferroviaria
Julen Vega Apezetxea. Supervised by Alberto Carnicero López y Cristina
Sánchez Rebollo.

4.1.1.12 Telematics Engineering
- Herramienta proactiva de seguridad para redes WAN
  Francisco Blanco Torrente. Supervised by Rafael Palacios Hilscher y Javier
  Jarauta Sánchez.

- Plataforma de comunicaciones Ethernet-OFDM: etapa temporal
  Juan Cruz Sánchez. Supervised by Carlos Rodríguez-Morcillo García y Javier
  Matanza Domingo.

- Etapa de frecuencia en pasarela
  de comunicaciones Gigabit Ethernet – OFDM
  de aplicación en vehículos ferroviarios
  Alejandro Pascual Laguna. Supervised by Carlos Rodríguez-Morcillo García y
  Javier Matanza Domingo.

4.1.1.13 Industrial Engineering
- La predicción del precio del petróleo. Una aproximación basada en el análisis
  de series temporales de intervalos (STI)
  Sergio Álvarez Sánchez. Supervised by Carlos Maté Jiménez.

- Evaluación de la flexibilidad de la minifábrica ICAI
  Alfonso Arroyo Hernández. Supervised by José Antonio Rodríguez Mondéjar y
  Pedro Sánchez Martín.

- Desarrollo de una aplicación para personas con transtornos de comunicación
  Alejandro Carretero García. Supervised by Claudia Meseguer Velasco y Miguel
  Ángel Sanz Bobi.

- Metodología del plan de transformación de municipios a Smart City
  Ignacio Castro López. Supervised by Susana Ortiz Marcos y David Contreras
  Bárcena.

- Plan de negocio y desarrollo de un videojuego multiplataforma para dispositivos
  móviles
  Eduardo Cuadrado. Supervised by David Contreras Bárcena.

- Análisis técnico-económico de la viabilidad de un compresor de doble etapa
  rotativo para aplicación en diferentes sectores industriales
  Óscar García Cantón. Supervised by Susana Ortiz Marcos y Eduardo García
  Sánchez.
- Desarrollo de herramientas de planificación integrada de extensión de redes y electrificación off-grid mediante GIS
  Antonio Gómez Herrero. Supervised by José Ignacio Pérez Arriaga y Andrés González García.

- Sistema de predicción de la demanda de electricidad. Un enfoque basado en el análisis de intervalos
  Luis Eduardo Llorente Zaballos. Supervised by Carlos Maté Jiménez.

- Análisis del sector de la construcción: evaluación de la competitividad y situación actual

- Análisis económico de viabilidad de una plataforma eólica marina flotante
  Aniela Pérez Garcia. Supervised by Javier Reneses Guillén.

- Desarrollo de un taller Lean
  Claudio Rascón San Martín. Supervised by Susana Ortiz Marcos.

- Predicción de las preferencias de los consumidores de compra online: Aplicación a una tienda online de moda en un entorno Big Data
  Adrián Tung Lu. Supervised by Eugenio Francisco Sánchez Úbeda y Francisco Lucena Alcalde.

### 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 Master in Railway Systems

Director: Antonio Fernández Cardador

- Electrification
  Luis Rouco Rodríguez

- 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

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

Director: Fernando de Cuadra García
More information at http://www.structuralia.com/mat

- 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 infraestructure projects: electric infraestructure policy in Spain
  Michel Rivier Abbad

4.2.1.3 Official Master's Degree in the Electric Power Industry (MEPI)
- Decision support models in the electric power industry
  Efraim Centeno Hernández, Javier García González, Antonio Muñoz San Roque, Andrés Ramos Galán, Javier Reneses Guillén

- 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

- Internship
  Javier García González

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

- Regulation of the electric power industry
  Carlos Batlle López, Javier Reneses Guillén, Michel Rivier Abbad, Pablo Rodilla Rodríguez

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

4.2.1.4 Master's Degree in International Industrial Project Management
- Quality management and control
  Sara Lumbreras Sancho
4.2.1.5 **MBA in the Global Energy Industry**
- Analytical support for decision making
  Javier García González, Andrés Ramos Galán

- Marketing management
  Javier García González, Michel Rivier Abbad

- Regulation in the electricity market
  Michel Rivier Abbad

4.2.2 **Comillas master theses**

4.2.2.1 **Erasmus Mundus International Master in Economics and Management of Network Industries (EMIN)**
- Electrification of rural areas: optimal microgrid energy management
  Irene George Wadie Barsoum. Supervised by Claudio Ricardo Vergara Ramírez and Javier García González.

- Impact of large scale wind power integration on operating reserves in Spain
  Metín Inan. Supervised by Pablo Frías Marín.

- Ramp-based scheduling vs. Energy-block scheduling in day ahead market (DAM)
  Quanyu Zhao. Supervised by Ross Baldick and Javier García González.

4.2.2.2 **Master in Railway Systems**
- Análisis automático de la interoperabilidad catenariapantógrafo

- Sistema independiente de ayuda a la conducción
  Felipe Rodríguez da Silva. Supervised by José Antonio Rodríguez Mondéjar.

4.2.2.3 **Official Master's Degree in the Electric Power Industry (MEPI)**
- Los HUBs gasistas. Análisis y modelado del HUB Ibérico
  Antonio López Martínez. Supervised by Pablo Dueñas Martínez.
4.3 Other academic activities

4.3.1 Master courses
- José Ignacio Pérez Arriaga, "Engineering, economics and regulation of the electric power sector", MIT OpenCourseWare. Organized by Massachusetts Institute of Technology (MIT). Cambridge, MA (USA).

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)

- Decision methods
  Pedro Linares Llamas, Sara Lumbreras Sancho

- Deterministic optimization
  Andrés Ramos Galán

- Forecasting methods and applications
  Antonio Muñoz San Roque
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.

- Complex networks
  Mario Castro Ponce

- Doctoral research in Comillas
  Pedro Linares Llamas

- Doing science today: from choosing the right journal to measuring your scientific impact
  Mario Castro Ponce

- Energy efficiency in railways
  Asunción Paloma Cucala García

- Graphic visualization with Matlab
  Eugenio Francisco Sánchez Úbeda

- Parallel computation
  Jesús María Latorre Canteli

- Quick guide to financial markets
  Sara Lumbreras Sancho
- Scientific computing with Matlab
  Rafael Palacios Hielscher

- Smart grids, business models and future scenarios
  Tomás Gómez San Román

- Visual basic for applications
  Jesús María Latorre Canteli

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 Master in Research in Engineering Systems Modelling
- Standardization in Additive Manufacturing. An initial study focused on obtaining a chart proposal of tolerances and fits for FDM parts and assemblies Silvia Fernández Villamarín. Supervised by José Porras Galán.

- Stenosis growth prediction based on geometry factors José María Menéndez Sánchez. Supervised by Mario Castro Ponce and Alexis Cantizano González.

- Use of the additive manufacturing technique - fused deposition modeling- to obtain drag reduction
  Alberto Sánchez Ramírez. Supervised by Mariano Jiménez Calzado and José Porras Galán.

5.4.2 Master in Power Systems


- Modelling and simulation of VSC-HVDC multi-terminal systems using PSS/E: static and dynamic regimes
  Javier Renedo Anglada. Supervised by Aurelio García Cerrada.

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: Analysis of oligopolistic electricity markets with network constraints
  Author: Cristian Andrés Díaz Durán
  Supervisors: Francisco Alberto Campos Fernández and José Villar Collado
  Date: September 24, 2013

- Title: Contribuciones a la predicción a corto plazo del precio de la electricidad mediante modelos de series temporales
  Author: Alberto Miguel Cruz García
  Supervisor: Antonio Muñoz San Roque
  Date: September 27, 2013

- Title: Improvements in the PLC systems for smart grids environments
  Author: Javier Matanza Domingo
  Supervisors: Sadot Alexandres Fernández and Carlos Rodríguez-Morcillo García
  Date: October 25, 2013

- Title: Analysis of the operation and contract management in downstream natural gas markets
  Author: Pablo Dueñas Martínez
  Supervisors: Javier Reneses Guillén and Julián Barquín Gil
  Date: November 15, 2013

- Title: Evaluation and design of sustainable energy policies: an application to the case of Spain
  Author: Álvaro López-Peña Fernández
  Supervisors: José Ignacio Pérez Arriaga and Pedro Linares Llamas
  Date: May 21, 2014
5.5.2 Submitted Theses in other universities

- Title: Design of wide-area electric transmission networks under uncertainty: methods for dimensionality reduction
  Author: Pearl Elizabeth Donohoo
  Supervisors: M. Webster and José Ignacio Pérez Arriaga
  Massachussets Institute of Technology. Cambridge (U.S.A.).
  Date: December 11, 2013

- Title: Designing market rules for electric power systems with renewables
  Author: Fernando de Sisternes Jiménez
  Supervisors: M. Webster and José Ignacio Pérez Arriaga
  Massachussets Institute of Technology. Cambridge (U.S.A.).
  Date: June 06, 2014

- Title: Análisis del tratamiento superficial del aluminio y su influencia en el proceso de la adhesión: evaluación de la topografía y su relación con la energía superficial del sustrato
  Author: Julián José Narbón Prieto
  Supervisors: Jose Manuel Arenas Reina and Juan Carlos del Real Romero
  Universidad Politécnica de Madrid. Madrid (Spain).
  Date: June 25, 2014

5.5.3 Comillas ongoing theses

- 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

- Title: Hybrid modeling for electricity policy assessments
  Author: Renato Dias Bleasby Rodrigues
  Supervisors: Pedro Linares Llamas and Antonio Gómez Gómez-Plana
- Title: Behaviour detection models using computer vision applied to security systems  
  Author: Manuel Alvar Miró  
  Supervisor: Álvaro Sánchez Miralles

- Title: Life-Centered maintenance management (LCMM). Gestión del mantenimiento centrada en la vida.  
  Author: Rodrigo José Andrade Vieira  
  Supervisor: Miguel Ángel Sanz Bobi

- Title: Analysis of the impact of subsequent markets and mechanisms used to resolve technical constraints on wholesale electricity markets  
  Author: Andrés Ramiro Delgadillo Vega  
  Supervisors: Javier Reneses Guillén and Julián Barquín Gil

- Title: Demand side management and its contribution to regulation reserves in electric systems  
  Author: Kristin Dietrich  
  Supervisors: Luis Olmos Camacho and Jesús María Latorre Canteli

- Title: Navegación de un robot móvil autónomo mediante SLAM métrico utilizando únicamente visión por computador  
  Author: Álvaro Arranz Domingo  
  Supervisors: Álvaro Sánchez Miralles and Arturo de la Escalera Hueso

- 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:** Aplicaciones en sistemas eléctricos de compensadores serie basados en convertidores electrónicos fuente de tensión  
  **Author:** Javier Roldán Pérez  
  **Supervisors:** Aurelio García Cerrada and Juan Luis Zamora Macho

- **Title:** Diseño del control de tensión en redes de evacuación de energía eólica  
  **Author:** Elena Saiz Marín  
  **Supervisors:** Enrique Lobato Miguélez and Ignacio Egido Cortés

- **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 Gutierrez Montes

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

- **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 grids solutions in distribution systems  
  **Author:** Andrea Rodríguez Calvo  
  **Supervisors:** Pablo Frías Marín and Rafael Cossent Arín

- **Title:** Efficient application of multiple-reference-frame controllers or power quality improvement with power electronics devices in electric distribution systems  
  **Author:** Miguel Ochoa Giménez  
  **Supervisors:** Aurelio García Cerrada and Juan Luis Zamora Macho
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 4 companies and 24 universities and research centers in 16 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**
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
  École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland; ETH Zürich, Zürich, Switzerland

- Microgrids - the building block of a smarter grid
  Institute for Systems and Computer Engineering of Porto (INESC Porto), Porto, Portugal
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:


- Jaime Boal Martín-Larrauri, in Autonomous Systems Laboratory, ETH Zürich, Zurich (Switzerland). June-September 2013.

- Mario Castro Ponce, in Department of Applied Mathematicas, University of Leeds, Leeds (United Kingdom). February 2014.


- Mario Castro Ponce, in Laboratory of Computational Immunology, Massachussets Institute of Technology (MIT), Cambridge, MA (U.S.A.). August 2014.

- Andrés Ramiro Delgadillo Vega, in Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, Maryland (USA). July-October 2013.

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


- Enrique Lobato Miguélez, in ERC (Electricity Research Centre), University College Dublin, Dublin (Ireland). October 2013.


- Carlos Rodríguez-Morcillo García, in Grid Integration Group (GIG). Environmental Energy Technologies Division (EETD), Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA (U.S.A.). June-August 2014. Estancia financiada por el programa Erasmus Mundus de la Comunidad Europea.


- Elena Saiz Marín, in Electricity Research Center (ERC), University College Dublin (UCD), Dublin (Ireland). September-December 2013.

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

- Sonja Wogrin, King Abdullah Petroleum Studies and Research Center (KAPSARC), Riyadh (Saudi Arabia). June-July 2014.

### 6.3 Visiting professors


- Ross Baldick, from Electrical and Computer Engineering, University of Texas (Austin), Austin, TX (USA). May 2014.
- Marius Bonhage, from Institute of Dynamics and Vibration Research, Leibniz Universität Hannover, Hannover (Germany). September 2013.


- Piotr Lukaszewicz, AF, Solna (Sweden). April-May 2014.


6.4 Visiting students

- Benedikt Dollinger, from Agricultural Engineering, University of Hohenheim, Stuttgart (Germany). April-September 2013.


- André Ortner, from Institute of energy systems and electric drives-Energy Economics Group, Vienna University of Technology, Vienna (Austria). October-December 2013.

- Suguru Sagara, from Advanced Engineering, Nagasaki University, Nagasaki (Japan). October-November 2013.

- Andrea Redwing Castillo, from Geography and Environmental Engineering, Johns Hopkins University, Baltimore (USA). December 2013.

- Cynthia Bothwell, from Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore (USA). January 2014.

- Irene George Wadie, German University in Cairo, New Cairo (Egypt). March-July 2014.


- Nuno Bento, from DINAMIA'CET, ISCTE-IHL (Instituto universitario de Lisboa), Lisbon (Portugal). May 2014.
- Quanyu Zhao, from Electrical and Computer Engineering, McGill University, Montreal (Canada). May-July 2014.


- Roderick Go, from Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore (USA). June-July 2014.


- Nigel Cleland, from Chemical and Materials Engineering, University of Auckland, Auckland (New Zealand). June 2014.

- Ashwini Bharatkumar, from Engineering Systems Division, Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). June-July 2014.


- Scott Burger, from Engineering Systems Division, Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). June-July 2014.


- Michael Davidson, from Engineering Systems Division, Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). June-July 2014.


### 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:

- Carlos Batlle López, "FSR Summer school on regulation of energy utilities". Florence School of Regulation. April 2012-July 2020.


- Carlos Batlle López, Javier Reneses Guillén, Pablo Rodilla Rodríguez, Michel Rivier Abbad, Rafael Cossent Arín, "FSR e-learning course on regulation of energy utilities (9th Edition)". European University Institute, Florence School of Regulation. November 2013-June 2014.


- Javier Reneses Guillén, Pablo Frías Marín, Rafael Cossent Arín, "Curso de formación sobre el negocio de distribución eléctrica: aspectos técnicos y regulatorios". CIDÉ. January-July 2014.


- Luis Rouco Rodríguez, Luis Díez Maroto, "EES-UETP In House Course para Iberdrola en temas avanzados de máquinas eléctricas". EES-UETP. January 2014.


- Tomás Gómez San Román, "Curso ERRA-MEDREG Economic and technical aspects of the deployment of renewable energy sources (RES)". ERRA-MEDREG. March 2014.


### 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:
- José Ignacio Pérez Arriaga, "Introduction". e4Dev Inaugural Launch Event. Massachusetts Institute of Technology (MIT).


- Rajeev J. Ram, "Ad hoc electricity grids for the developing world". Aula de investigación. Universidad Pontificia Comillas.


- Pedro Linares Llamas, "Análisis de los resultados preliminares. Limitaciones y líneas de trabajo siguientes". Seminario sobre nuevas tecnologías de generación eléctrica a partir de la disponibilidad de recursos hídricos en escenarios de cambio climático. Fundación Canal de Isabel II; Universidad Pontificia Comillas.

- Mariano Ventosa Rodríguez, "Apertura de la Jornada Técnica". Tecnología SIN Zanja, eje estratégico para el desarrollo sostenible de las ciudades. Asociación Ibérica de Tecnología SIN Zanja; Universidad Pontificia Comillas.

- Luiz Augusto Barroso, "Assessing the security of electricity supply in Brazil via decision making under uncertainty methods: will the lights go out in 2014?". Aula de investigación. Universidad Pontificia Comillas.

- Mariano Ventosa Rodríguez, "Bienvenida". Perspectivas sobre los hidrocarburos y la sostenibilidad del refino de petróleo en Europa. Cátedra BP de Energía y Sostenibilidad de la Universidad Pontificia Comillas.

- Michael Davidson, "China's power sector regulation and wind integration challenges". Aula de investigación. Universidad Pontificia Comillas.


- Ilan Momber, Sonja Wogrin, "Complementary models, stochasticity and their application to energy markets". UCL Statistical Science seminar. UCL.
- Pedro Linares Llamas, "Consecuencias del cambio climático en la oferta y demanda de energía". Consecuencias del calentamiento global en la disponibilidad de agua, suelo litoral y energía en España. Real Academia de Ingeniería (RAI).

- Pablo Frías Marín, "Consumo bajo demanda en smart grids". II Workshop Smart Grids. Grupo Tecma Red.


- Tomás Gómez San Román, "Distribution system operators: what are they for?". EU Energy Retail Market Workshop. Florence School of Regulation.


- Pedro Linares Llamas, "Environmental research at Comillas Pontifical University". Healing Earth Chicago Workshop II. Retreat & Ecology Center. Loyola University Chicago.


- Tomás Gómez San Román, "Future utility models". EPRG & CEEPR European Energy Policy Conference. CEEPR.

- José Pablo Chaves Ávila, "IIT models seminar". Seminario divulgativo. Universidad Pontificia Comillas.


- Lars Abrahamsson, "Improved railway power supply by the use of converters". Aula de investigación. Universidad Pontificia Comillas.

- Efraim Centeno Hernáez, "Investigación vs aplicación, cómo conectar universidades y empresas". V Congreso Internacional de Investigadores Audiovisuales: Tecnología y Contenidos Digitales Aplicados.. ESNE (Escuela Universitaria de Diseño e Innovación); ICONO14.

- José Ignacio Pérez Arriaga, "La línea de investigación en el MIT. Relaciones y beneficio mutuo". Seminario sobre nuevas tecnologías de generación eléctrica a partir de la disponibilidad de recursos hídricos en escenarios de cambio climático. Fundación Canal de Isabel II; Universidad Pontificia Comillas.

- José Ignacio Pérez Arriaga, "Las energías renovables como parte de la agenda social internacional". Jornada sobre «Las renovables en el acceso universal a la energía». Universidad Politécnica de Madrid; Energía y Sociedad.

- Pedro Linares Llamas, "Metodología del estudio: modelos, datos, escenarios futuros". Seminario sobre nuevas tecnologías de generación eléctrica a partir de la disponibilidad de recursos hídricos en escenarios de cambio climático. Fundación Canal de Isabel II; Universidad Pontificia Comillas.


- Andrés González García, "Modelos de negocio y emprendimiento social en el acceso universal a la energía". Conferencia GREDS «Modelos de negocio y emprendimiento social en el acceso universal a la energía». Catedra BP de Energía y Sostenibilidad de la Universidad Pontificia Comillas.

- Pedro Linares Llamas, "Potencial y costes de reducción de la demanda de energía en España". Cursos y Seminarios. Fundación para la Eficiencia Energética.


- José Ignacio Pérez Arriaga, "Presentación pública del resumen de las sesiones internas del Foro BP de Energía y Sostenibilidad". Perspectivas sobre los hidrocarburos y la sostenibilidad del refino de petróleo en Europa. Cátedra BP de Energía y Sostenibilidad de la Universidad Pontificia Comillas.


- José Ignacio Pérez Arriaga, "Regulators and the construction of the EIM. How did the objectives and practises of regulators evolve while the EIM progressed?". 10th Anniversary of the Florence School of Regulation. European University Institute.. Florence School of Regulation (FSR).


- José Ignacio Pérez Arriaga, "Retrospect next generation infrastructures". Infratrends Congres. Next Generation Infrastructures.

- Germán Andrés Morales España, "Robust reserve modeling for wind power integration in day-ahead unit commitment". KERMIT Users Summit. Dnv GI.

- Steven Lanzisera, "Sensors and systems for grid integration of small resources". Aula de investigación. Universidad Pontificia Comillas.


- Nigel Cleland, "The practical effects of reserve constraints in co-optimised electricity markets - case studies from the New Zealand electricity market". Seminario divulgativo. Universidad Pontificia Comillas.


- José Ignacio Pérez Arriaga, "The utility of the future... Why is this a suitable topic for a chair on «Energy & Sustainability»?". La «utility» del futuro. Conferencias GREDS. Cátedra BP de Energía y Sostenibilidad de la Universidad Pontificia Comillas.

- José Ignacio Pérez Arriaga, "The value of distributed generation". Fall 2013 CEEPR Workshop. MIT CEEPR.

- José Ignacio Pérez Arriaga, "Transformation of the energy and industry systems". WBCSD 2014 Liaison Delegates Meeting. WBCSD.

- Marius Bonhage, "Transient vibration of turbine blades". Aula de investigación. Universidad Pontificia Comillas.

- José Ignacio Pérez Arriaga, "Tsingua - MIT China energy and climate project". Third Annual Stakeholders Meeting. Tsingua University; MIT.

- Pablo Frías Marín, "Un análisis coste-beneficio de las alternativas de reducción de las emisiones «difusas» en España". Seminario de Gestión Ambiental. La reducción de emisiones «difusas»: alternativas energéticas. Fundación Gas Natural Fenosa.

- José Ignacio Pérez Arriaga, "Universalization of electricity supply". EPRG & CEEPR European Energy Policy Conference. CEEPR.

- Cherrelle Eid, "Workshop presentation skills for PhD’s (1st day)". Aula de investigación. Universidad Pontificia Comillas.

- Cherrelle Eid, "Workshop presentation skills for PhD’s (2nd day)". Aula de investigación. Universidad Pontificia Comillas.

- Alexis Cantizano González, "Formación universitaria de posgrado» dentro del espacio dedicado a la «Formación en ingeniería de seguridad contra incendios»". Feria SICUR 2014. IFEMA.

- José Ignacio Pérez Arriaga, "Sostenibilidad medioambiental de nuestro modelo de desarrollo: la perspectiva energética". Ciclo de conferencias «La evolución calculada». Cátedra de Ciencia, Tecnología y Religión de la Universidad Pontificia Comillas.

### 6.7 Congress, seminars and journals organization


### 6.8 Other academic activities organization


- Pablo Frías Marín; Aurelio García Cerrada; Tomás Gómez San Román; Yolanda González Arechavala; Pedro Linares Llamas; Antonio Muñoz San Roque; Rafael Palacios Hielscher; Michel Rivier Abbad; Luis Rouco Rodríguez; Álvaro Sánchez Miralles; Mariano Ventosa Rodríguez y Juan Luis Zamora Macho, "Chair / Moderator at Conference: 2nd International Conference on Renewable Energy Research and Applications -ICRERA 2013". Universidad Pontificia Comillas; International Journal of Renewable Energy Research - IJRER. Madrid (Spain). October 2013.


- José Ignacio Pérez Arriaga, "Chair / Moderator at Conference: 10th Anniversary of the Florence School of Regulation. European University Institute. Session: What has the Florence School done since 2004 and what will it do tomorrow?". Florence School of Regulation (FSR). Florence (Italy). July 2014.


- José Ignacio Pérez Arriaga, "Director and main instructor of the MIT one-week course «Regulation of the electric power sector»". Saudi Aramco. Dhahran (Saudi Arabia). December 2013.


- José Ignacio Pérez Arriaga, "Rethinking the regulation of electricity distribution system operators". Florence School of Regulation. Florence (Italy). March 2014.


- María Ana Sáenz Nuño, "Chair / Moderator at Conference: " . CEM; AEC. Madrid (Spain). May 2014.

- Miguel Ángel Sanz Bobí, "Scientific publishing editor: Use, operation and maintenance of renewable energy systems: experiences and future approaches (Green energy and technology)". Springer. Berlin (Germany). May 2014.


6.9 Other activities


- José Ignacio Pérez Arriaga, Miembro in Institute of Electrical and Electronic Engineers (IEEE). Piscataway (USA). March 1998- Today.


- José Ignacio Pérez Arriaga, Member and Chairman (since 2010) of the Scientific Advisory Board of the «Next Infrastructures Program» in Delft University. Delft (Netherlands). June 2006- Today.


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


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


- 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.


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


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


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


- Yolanda Ballesteros Iglesias, Supervision of research work "Modification of Structural Adhesives by Carbon-based Nanomaterials". University of Illinois at Urbana-Champaign. Champaign, IL (USA). May-June 2014.


- Eugenio Francisco Sánchez Úbeda, Miguel Ángel Sanz Bobi, Dissertation committee to Comillas in «Contribuciones a la predicción a corto plazo del precio de la electricidad mediante modelos de series temporales» por Alberto Miguel Cruz García. Universidad Pontificia Comillas. Madrid (Spain). September 2013.


7. Data about IIT

The relevant numbers of the academic year 2013 - 2014 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:

- 5,22 M€ Turnover
- 66 Professors and researchers
- 49 Research assistants
- 76 Research projects
- 33 Consultancy projects
- 6 Services and analysis projects
- 1 Book and 10 Chapters in books
- 64 Papers published in JCR journals
- 15 Papers published in other journals
- 62 Papers presented at conferences
- 18 Technical reports
- 10 Submitted theses
- 20 Ongoing theses
- 28 Visiting professors and students
- 19 International exchanges
- 11 Courses offered to external entities