Annual Academic Report
Academic year 2012 - 2013

Institute for Research in Technology

Instituto de Investigación Tecnológica
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Director's greeting

Dear Friend,

Continuing with the healthy habit of writing down what you have done, 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 programmes, and to the continuing success of our collaboration with the industrial sector, which will turn thirty years during this 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 through 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 organisations 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 2012 - 2013, from the September 3, 2012 to September 1, 2013.
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
• **Dueñas Martínez, Pablo.** IEF representative (until September 2012)
• **Frías Marín, Pablo.** Researcher representative (since September 2012)
• **González Sotres, Luis.** IEF representative (since September 2012)
• **Latorre Canteli, Jesús María.** Researcher representative
• **Ramos Galán, Andrés.** Researcher representative
• **Reneses Guillén, Javier.** Researcher representative
• **Rivier Abbad, Michel.** Researcher representative
• **Rodríguez-Morcillo García, Carlos.** Secretary and Researcher representative (until September 2012)
• **Saiz Marín, Elena.** IEF representative
• **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)  

- **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)  

- **Cerísola López de Haro, Santiago.** Honorary Associate  
  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)  

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

- **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.

- **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.

- **Frias 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.

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

- **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.** Assistant Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electrical Engineer (Comillas)
Areas of interest: Analysis, planning, operation and economics in electric power systems.

- **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)
  Areas of interest: On board Communications. Embedded Systems. Wireless
  communications. Programmable logic. Digital systems.

• **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)
  Areas of interest: Smart grids. Electrical vehicles. Security systems. Mobile
  robotics.

• **Sánchez Úbeda, Eugenio Francisco.** Assistant Professor
  Ph.D. in Industrial Engineering (Comillas)
  Electronics Engineer (Comillas)
  Areas of interest: Data mining. Artificial Intelligence (automatic learning,
  decision trees, neural networks, fuzzy logic, genetic algorithms, heuristic
  search). Biometrics (optical character, image and speech recognition). Electric
  energy systems (bidding in competitive markets, forecasting, dynamic security
  assessment, transmission and subtransmission planning). Multi-agent systems.

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


- **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)

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)  
  Earthquake engineering. Wavelets.

• **Castro Ponce, Mario.** Associate Professor  
  Ph.D. in Physics Science (UCM)  
  Physics Science degree (UCM)  

• **Fernández Bernal, Fidel.** Associate Professor  
  Ph.D. in Industrial Engineering (Comillas)  
  Electrical Engineer (Comillas)  
  Areas of interest: Dynamics of electrical systems. Motor control and applications on electric vehicles. Power electronics.

• **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)  

• **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)
- **Alvar Miró, Manuel.** Electronics Engineer (Comillas), Arts and Manufactures Engineer (École Centrale Paris, France)
- **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.** Electronics Engineer (Comillas)
- **Calvillo Muñoz, Christian Francisco.** Mechatronic Engineer (Instituto de Estudios Superiores de Monterrey - ITESM, Mexico), M.Sc. in Electronic Systems (Instituto de Estudios Superiores de Monterrey - ITESM, Mexico)
- **Carvajal Carreño, William.** Electrical Engineer (Industrial University of Santander - UIS, Bucaramanga, Colombia), M.Sc. in Electrical Engineer (Industrial University of Santander - UIS, Bucaramanga, Colombia)
- **Castel Conesa, Carlos.** Electrical degree (UPV), M.Sc. in Materials and Sensors Systems for Environmental Technologies (Polytechnic University of Valencia - UPV and Kungliga Tekniska Högskolan - KTH, Stockholm, Sweden)
- **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)
- **Contreras Alfonso, Alejandro.** Electrical Engineer (Comillas)
- **Cossent Arín, Rafael.** Electrical Engineer (Comillas)
Research assistants

- **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)
- **Delgadillo Vega, Andrés Ramiro.** Electrical Engineer (Universidad Nacional de Colombia, Bogota, Colombia), M.Sc. in Economy (Universidad Nacional de Colombia, Bogota, Colombia)
- **Dias Blesby Rodrigues, Renato.** Economics Science degree (Federal University of Rio de Janeiro - UFRJ, Brazil), M.Sc. in Economics of Industry and Technology. Stricto Sensu (Federal University of Rio de Janeiro - UFRJ, Brazil)
- **Díaz Durán, Cristian Andrés.** Electrical Engineer (Industrial University of Santander - UIS, Bucaramanga, Colombia)
- **Dietrich, Kristin.** Industrial Engineering and Management degree (Dresden University of Technology - TU Dresden, Germany)
- **Díez Maroto, Luis.** Electrical Engineer (Comillas)
- **Domínguez Gago, María.** Electrical Engineer (Comillas)
- **Dueñas Martínez, Pablo.** Electrical Engineer (Comillas)
- **Fernández Fernández, Ismael Jaime.** Electronics Engineer (Comillas)
- **Fernández Rodríguez, Adrián.** Electrical Engineer (UPM)
- **Fernández Sánchez, Miguel Ángel.** Electronics Engineer (Comillas)
- **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)
- **García Matos, Jesús Ángel.** Mechanical Engineer (Comillas)
- **Gascón González, Alberto.** Electronics Engineer (Comillas)
- **Gil Medina, María.** Electrical Engineer (Comillas)
- **González García, Andrés.** Electronics Engineer (Comillas), M.Sc. in Power Systems (Comillas)
- **González Gascón y Marín, Pablo.** Energy Techniques Engineer (UPM)
- **González Sotres, Luis.** 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)
- **López López, Álvaro Jesús.** Electronics degree (Comillas), M.Sc. in Automatics and Electronics (Comillas)
- **López-Peña Fernández, Álvaro.** Electrical Engineer (Comillas), Engineer (ICAM - Ecole d’ingénieurs généralistes, Toulouse, France)
• **Lumbreras Sancho, Sara.** 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)
• **Matanza Domingo, Javier.** Telecommunications Engineer (Technical University of Valencia)
• **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)
• **Moreno Barrado, Ana.** Physics Science degree (University of Seville)
• **Nasri, Amin.**
• **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)
• **Portela González, José.** Electronics Engineer (Comillas)
• **Renedo Anglada, Francisco Javier.** Electrical Engineer (Comillas)
• **Richstein, Joern Constantin.** Industrial Engineer (Karlsruhe Institute of Technology - KIT, Germany)
• **Rivero Puente, Enrique.** Electronics and Communications Engineer (Instituto de Estudios Superiores de Monterrey - ITESM, Mexico), M.Sc. in Electric Power Industry (Comillas), M.Sc. in Economics, Technology and Territory (University Paris-Sud 11, France)
• **Rodríguez Calvo, Andrea.** Electronics Engineer (Comillas)
• **Roldán Pérez, Javier.** Electronics Engineer (Comillas), M.Sc. in Automatics and Electronics (Comillas)
• **Saboya Bautista, Inmaculada.** Electrical Engineer (Comillas)
• **Saiz Marín, Elena.** Electrical Engineer (Comillas)
• **Sánchez Rebollo, Cristina.** Mechanical Engineer (Comillas)
• **Santodomingo Berry, Rafael.** Electrical Engineer (Comillas)
• **Vallés Rodríguez, Mercedes.** Electrical Engineer (Comillas)
• **Vázquez Martínez, Samuel.** Mining degree in Energetic Resources, Fuels & Explosives (University of Leon), Mining Engineer (UPM)
• **Veiga Santiago, Andrea.** Electrical Engineer (Comillas)
• **Wogrin, Sonja.** Technical Mathematics degree (Graz University of Technology, Austria), M.Sc. in Computation for Design and Optimization (Massachusetts Institute of Technology - MIT, U.S.A.)
2.6 Services staff

2.6.1 Systems administrator staff

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

- **Checa López, Francisco**. Senior Technical in Computer Systems Management, Senior Technical in Sales and Marketing Management
- **Martín Tena, Julián**. Computer Expert

2.6.2 Administrative staff

The staff that manage the documentation, the technical secretariat and the Ph.D. consist of:

- **Ignacio Pimentel, Almudena**. Senior Technical in Administration and Finance
- **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 diploma (UCM), Criminology degree (UEM)
3. Research

3.1 Research areas

The IIT is divided into two main areas of research:

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:

   • **Modelling, Analysis and Control of the Electric Power Systems Area (MAC)**, 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

   • **Smart and Green Networks Area (Redes)**, 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

   • **Regulation and Economics of the Electric Sector Area (RYE)**, 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

   • **Decision Support Systems in the Energy Sector Area (SADSE)**, 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
2) **Industrial Systems (SI)**, which is focused on activities in other technical sectors. This area is divided into four different technical areas:

- **Analysis and Design in Engineering Area (ADI)**, 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

- **Railway Systems Area (ASF)**, 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

- **Intelligent Systems Area (ASI)**, 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

- **Electronics and Control Group (GEA)**, works to develop electronic instrumentation and microprocessors, power electronics, control engineering applications, signal analysis, electronic design, automatization and digital communications.
  Coordinators: Sadot Alexandres Fernández (until October 2012) and Carlos Rodríguez-Morcillo García (since October 2012)
  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

- **SMARTCITY: alignment with the DENISE project**
  Endesa. October 2009 - March 2013. (Álvaro Sánchez Miralles, Álvaro Arranz Domingo, Miguel Ángel Sanz Bobi)
  The aim of the project is to determine what aspects of the DENISE project could be used in the SMARTCITY project, exploiting synergies between both projects. Besides, activity monitoring of the SMARTCITY will be done, in order to assure an efficient alignment with the DENISE project.

- **ENERGOS: models and systems for generation management in microgrids**
  Indra. December 2009 - December 2012. (Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo, Alezeia González García, Lukas Sigrist)
  This project is a part of the CENIT Energos project leaded by Gas Natural Fenosa on smart grids. Within the framework of the task «Models and systems for generation management in microgrids», IIT team will undertake two sub-tasks: voltage control and reactive power management and load-frequency control in microgrids.

- **STORE: demostration project on energy storage technologies**
  STORE is a demonstration project supported by Fondo Tecnologico of CDTI and led by Endesa. The project will comprise the installation of energy storage systems based on BrZn and NaS batteries and ultracapacitors in power systems of the Canary islands. IIT will contribute in a number of tasks of the technical and economic feasibility studies and experimental analysis.

- **Project ENERGOS: technologies for automated and intelligent management of energy distribution networks of the future**
  Sistemas Avanzados de Control. January 2010 - December 2012. (Sadot Alexandres Fernández, Carlos Rodríguez-Morcillo García, José Daniel Muñoz Frías, Ainhoa Cabetas Azcoitia, David Contreras Bárcena, Javier Juárez Montojo)
  The goal of Project ENERGOS «Technologies for automated and intelligent management of energy distribution networks of the future» is the development of knowledge and technologies that advance the deployment of Intelligent Networks.
  The main technological challenges of Intelligent Networks, are tackled in different lines of work of the Project. In the area of Business Management, includes the development of technologies for the creation of new environments Operation of the Network (including tools for simulation and estimation of states), the active demand management and the Planning and Optimizing.
Research projects

In the Area of Platform Integration and Communication, will work on the processes of acquiring and processing information in real time (with the difficulties of the large volume of information being generated and the criticality of its availability), the infrastructure necessary for the management and recharging of electric vehicles and the requirements of supervision and control of micro.

Smart Network Devices, new techniques include signal acquisition, the development of intelligent devices and energy recording equipment Automation Network.

The consortium, led by natural gas - Unión Fenosa Distribución, has the presence of a leader in technologies such as Indra and prestigious companies in the electricity sector as ZIV, AIA, Ormazabal, SAC, Diagnostiq and the technology sector information as Visual Tools, Brainstorm, Prodevelop, and Indra Answear Software Labs.

**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.

**ENERGOS: technologies for the automatic and intelligent management of future distribution networks**

The main objective of the ENERGOS Project is to develop knowledge and technologies to move towards the implementation of Smartgrids. The ENERGOS project is within the CENIT Program 2009. Gas Natural and Union Fenosa are the leaders of the Project, and many leading Spanish electricity companies integrate the Project consortium. The IIT will collaborate with Unión Fenosa in different tasks. Firstly, barriers for the implementation of Smartgrids and its economic assessment will be analyzed. Then, the economic involvement and barriers for the integration of micro-generation in active demand management will be studied. Finally, an economic and regulatory analysis on the metering of different end-user services using the electricity network will be performed.
• 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 algii 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.

• Development of a decision support model to optimize the scheduling of the generating units of Endesa in the short term
Endesa. November 2011 - October 2012. (Javier García González, Miguel Ángel Fernández Sánchez, Eugenio Francisco Sánchez Úbeda)
The objective of this collaboration is to develop a decision support tool (EXCOM-2012) to obtain the optimal hourly scheduling of all the generating units (thermal and hydro) that belong to Endesa in the short term (10 days or 1 week), with a chronological representation of time with hourly intervals.

• Assessing and forecasting on the Iberian Electricity Market. Modeling operational states
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, AGM 2012 is focused on the modeling of operational states that will substitute the traditional load levels used in mid-term models. Besides, the project will cope with the forecast of abnormal low prices in the day-ahead market, as well as the adaptation of the methodology to the forecasting of abnormal high prices. Finally, the interaction with a natural gas operation model and the joint optimization of different markets will be addressed in the project.

• Planning of generation Iberian Electricity market. New developments
This project is developed in the framework of a continuous research for the Energy Planning Division of Endesa. It is aimed in the development of models for medium- and long- term planning for generation power systems. More specifically, the research is focused on: modeling the mechanism and markets
subsequent to day-ahead market and development of hourly chronological executions.

• **Iberian natural gas market operation. Supply optimization**
  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, it is expected the optimization of the natural gas supply on behalf of the natural gas companies considering the exercise of their natural gas contracts and the management (reception, diversion, loading) of the LNG carriers. Additionally, a module for the efficient contracting of the natural gas infrastructure will be developed. Afterwards, conventional demand (households, industry, CHP) will be segmented. During the project, the interaction with the electricity market model will deepen and a support for carrying out multiple simulations will be provided. Finally, uncertainty of relevant parameters, such as the demands or the prices, will be incorporated.

• **Updating of the decision support tool EXLA and development of the water value curves module**
  The objectives of this project are mostly related to improvements in the user-interface module, and EXLA information system, and also the development of the module that calculates the water value curves at each reservoir of the hydro basins.

• **Models for strategic analysis**
  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 new tool (MERCO2) to estimate the price of CO2 emission allowances in under development. The objectives of the project include maintenance of the first model and the enhancement of the representation on non-electrical sectors in the second one.

• **HUMAP**
  Smoke movement study in large volume spaces, with full-scale experiments and numerical simulations.
• **MORSE: energy and reserve market, network constraints and investments signals**  

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 improving the hourly equilibrium model (with endogenous conjecture computation) for providing energy and reserve prices, on applying the equilibrium model with network constraints and endogenous conjecture computation to the European market, and on including investments signals in the core tools to be able to make feasible extreme forecast scenarios, such as those with massive interruptible generation.

• **Optimal bidding strategies for the secondary reserve market**  
Endesa. February 2012 - September 2012. (Antonio Muñoz San Roque, Eugenio Francisco Sánchez Úbeda, Francisco Alberto Campos Fernández, José Portela González)

The primary aim of this project is the development of a set of tools for monitoring and forecasting the Spanish secondary reserve market.

• **Analysis of innovation in energy in Spain**  

The goal of this research is to collaborate in the annual report of Economics for Energy, about innovation in energy in Spain. IIT has assessed the current and past situation regarding innovation in energy in Spain, and has taken part in the formulation of proposals and recommendations for its improvement.

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

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.
• **Maintenance and new capabilities of Eon Tools 2012 to 2013. Economic assessment of Eon AGC (automatic generation control) system**
  E.ON Generacion, S. L. April 2012 - March 2013. (Enrique Lobato Miguélez, Pedro Sánchez Martín, Francisco Alberto Campos Fernández, Ignacio Egido Cortés, Elena Saiz Marín)

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

  In addition, an economic assessment of Eon automatic generation control system (AGC) will be tackled.

• **The future role of solar PV in US electric power systems**
  MIT. 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.

• **Impact of a European electricity market on the Iberian market. Analysis of 2020 scenarios**
  Endesa. July 2012 - December 2012. (Javier Reneses Guillén, Luis González Sotres, Mercedes Vallés Rodríguez, Pablo Dueñas Martínez)
The main objective of this project is to adapt the tool VALORE in order to carry out medium- and long-term forecasts in a European-wide scope, especially in the CWE market (that, currently, includes France, Germany/Austria, Netherlands, Luxemburg and Belgium). The collaboration will also be focused on the management of the data needed by the model and the treatment of the results obtained.

• **Analysis tools for the Iberian Electricity Market**  
Gas Natural Fenosa. September 2012 - September 2013. (Carlos Batlle López, Pablo Rodilla Rodríguez, Samuel Vázquez Martínez)

In the last decade there have been significant changes in both present and expected configuration of the generating. From the point of view of the generating function the changes that the high penetration wind and solar is provoking on the production regimes of conventional thermal power (more starts, fewer hours of operation, etc.) are particularly important. All this leads to the conclusion that some details of short-term modeling which have traditionally been neglected in models of medium and long term are more relevant now than before.

The aim of the project is to further develop the planning model previously developed by IIT for Gas Natural Fenosa, oriented to allow for a proper representation of the impact of a significant intermittent generation penetration.

• **Grid Integration of Compressed Air Energy Storage systems (CAES)**  

The integration of large amounts of wind and solar energy requires the use of energy storage systems. The energy storage systems with greater capacity traditionally used are based on reversible hydro (pump/turbin facilities). However, the best sites have already been exploited and the prospects of bringing new sites are limited.

Among the most promising alternatives for energy storage is the geological storage of high pressure air. This energy storage use compressive energy contained in a mass of pressurized air stored in geological cavities. Energy storage is done compressing air during valley hours. During peak hours, the compressed air is used to produce energy, expanding through Bryton cycle gas turbines with relatively high efficiency.

This project addresses a technical and economic study of grid integration of energy storage plants compressed air.

• **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 modelo 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.

• **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 a 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**  
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

3.2.1.1.2 Public funding  
• **Active distribution networks with full integration of demand and distributed energy resources**  
European Commission. June 2008 - May 2013. (Pedro Linares Llamas, Pablo García González, José Antonio Rodríguez Mondéjar, Carlos Batlle López, Renato Dias Bleasby Rodríguez, Sadot Alexandra Fernández, Rafael Santodomingo Berry, Michel Rivier Abbad, Eugenio Francisco Sánchez Úbeda, Rafael Cossent Arín, Adela Conchado Rodríguez, Óscar Lago Vázquez, Javier Juárez Montojo)  
ADDRESS will research, develop and deploy technologies and processes to increase usage of distributed Generation and Renewable Energy Resources thereby engaging in a new relationship between customers, generators and network operators. ADDRESS aims to develop new innovative architectures for Active Distribution Networks (ADN) able to balance in real time power generation and demand allowing network operators, consumers, retailers and stakeholders to benefit from the increased flexibility of the entire system. Innovative use of communications, automation and household technologies will be combined with new trading mechanisms and algorithms providing ADN with low cost and reliable solutions. Customers will be encouraged into active participation enabling them to change their consumption habits, adopting a smarter use of energy and saving money. A cost/benefit analysis of different solutions will be developed: the most promising will be tested in three sites with different geographic, demographic and generation characteristics.

• **CENIT-VERDE: characterization, operation modes and grid impact of electric vehicles**  
REE (Red Eléctrica de España). December 2009 - December 2012. (Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo, Alezeia González García)  
The aim of REE-IIT collaboration is the development of tasks 6.1 and 6.2 of Activity 6 of the CENIT-VERDE project untitled "Integration of electric vehicle loading in the power system: infrastructures, network and services". Precisely, task 6.1 will address the characterization and operating modes of PHEVs and EVs, and task 6.2 will address the impact on the grid of the massive development of PHEVs and EVs.
• **Business models and regulatory challenges towards an efficient penetration of electric vehicles in power systems**

REE (Red Eléctrica de España), Iberdrola. January 2010 - December 2012. (Carlos Batlle López, Michel Rivier Abbad)

This project belongs to a larger research macroproject supported by the research program CENIT of the Spanish Ministry of Economy and Competitivity. This project focuses on the analysis of business models and regulatory frameworks required to support an efficient integration of Electrical vehicles in Power Systems. The role of existing and new agents, their interaction, the identification of regulatory barriers are part of the issues addressed in the project, always from the perspective of the relationship of the VE with the electrical grid.

• **Climate change and post-2012 regulatory regime**

Ministerio de Ciencia e Innovación. January 2010 - December 2012. (Pedro Linares Llamas)

A new regulatory regime of greenhouse gas emissions, to replace the Kyoto Protocol, will be born in 2012. This project is interested, in a context of regulatory prospective and from an economic approximation, in several key issues for the definition, analysis and evaluation of Spanish climate change policies. In particular, the project will deal with the interactions and preferences of climate change instruments, the influence of climate change impacts in the conformation of policies, and the economic and distributional assessment of climate change policies in Spain. First of all, this project will offer a review of the economic literature on international environmental agreements. Although the major objective will be to yield a group of plausible post-2012 policy scenarios, during this phase some research gaps will be identified. In this sense, the project intends to yield advances in the field of game theory applied to climate negotiations between states and blocks. Nevertheless, the main output of this part will be the foundation and specification of simulations (in families of hypothetical scenarios) to be used in subsequent phases. The simulations will consider the main climate architectures under discussion and the existing (EU) regulatory scenarios. A second objective is related to the selection, application and preferences for different instruments that are part of climate change policies. As the problem has a considerable magnitude and extent, being caused by almost every agent, the instruments should be powerful and diverse (including environmental, energy or fiscal tools). However, an accumulation of instruments can be counterproductive in terms of effectiveness and economic efficiency. Therefore, the subproject will deal with the interactions amongst different instruments, both from positive and normative point of views. A third objective is to contemplate the role of inter-temporal preferences and discount rates, of preference assessment with respect to prevention and mitigation policies, as well as of other environmental impacts not previously studied, in the conformation of climate change policies and their modeling strategies. Finally, this project has as an objective the scenario-based study of the environmental, economic and distributional effects from the application of different policies of climate change in Spain. With that in mind, the project integrates different methodologies and data. As a central core, a
dynamic applied general equilibrium model for Spain will provide the main macroeconomic effects, although other models will be used to solve the problems related to the scarce data given to some key sectors or agents. An integrated use of a microsimulation model to contemplate the reactions and distribution of regulatory burden across households, and a detailed model of the Spanish electricity system (origin of most of the emissions) will quantify the impacts in that sector. Thus the project intends to increase the knowledge of matters that have traditionally been overlooked in Spain (at least with respect to European standards). We believe that the project responds both to a clear academic interest (in a growing discipline in Economics) and to the need to provide rigorous answers to regulators and other social agents in a major socio-economic field.

• **Transmission system operation with large penetration of wind and other renewable electricity sources in networks by means of innovative tools and Integrated Energy Solutions**


  The aim with this project is to develop demonstration projects that will make it possible to overcome several obstacles regarding a larger integration of wind power, and its contribution to the operation of the power system. A group of 6 Transmission System Operators (Belgium, Denmark, France, Germany, The Netherlands and Spain) with 2 generator companies, 5 manufacturers and research organisations, have proposed a set of 6 demonstrations in several areas.

  The IIT is involved in different work packages of the project in three areas of activity: technological, economic and regulatory. One task is to support Iberdrola Renovables, responsible for the demonstration which will be checked frequently-active and reactive voltage-aggregation of wind farms. In addition, the IIT will lead the work package which will evaluate what is the technical-economic impact of the June demonstrations on the various countries, there will be a cross-sectional analysis of all of them to maximize European added value of the project, identify barriers that prevent scaling the results of the demonstrations, and propose solutions to eliminate these barriers, such as new rules for the regulation of electricity markets.

• **Power electronics for the integration of renewable energy in the grid**

  MICINN. 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.
Research projects

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.

• PRICE-GDI: Joint Project of smart grids in the Corredor del Henares area: Distributed Generation management
Ministerio de Ciencia e Innovación. May 2011 - December 2014. (Pablo Frías Marín, Pablo García González, Seyedmahdi Izadkhast, Andrea Rodríguez Calvo)
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 initiative, the objective of this project is focused on finding system solutions that help the efficient integration of distributed energy resources in the distribution network, mainly Distributed Generation.
More information at http://www.priceproject.es/

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.

- **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 substation, 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 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.

The use of power electronics for the integration of renewable energy sources in electric power systems
MICINN. May 2011 - December 2012. (Aurelio García Cerrada, Luis Rouco Rodríguez, Juan Luis Zamora Macho, José Daniel Muñoz Frías)

This project will look into:
(1) Power electronics control in distributed generation connected to weak grids
(2) A comprehensive set of scenarios to analyse and simulate distributed-generation schemes connected to week grids.
(3) The simulation of wind-energy-related scenarios in weak grids
(4) The development of ancillary equipment, control algorithms and protection systems to ease wind power integration in weak grids
(5) the minimization or even substitution of complex flow-control devices such as FACTS in transmission and distribution networks
(6) The design of a test bench to study wind power integration in weak grids
(7) The experimental validation of power electronics devices tailored to the integration of wind power into weak grids
(8) The design of intelligent power electronics devices tailored to the integration of wind power into weak grids
(9) The publication of new results in the specialized 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.

- **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)

- **Comprehensive solutions for power quality issues and power-flow control, using power electronics**
  MICINN. January 2012 - December 2014. (Aurelio García Cerrada, Juan Luis Zamora Macho, Javier Roldán Pérez)

  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.

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. More information at [http://www.gridtech.eu/](http://www.gridtech.eu/)
• **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.

• **Extensions of the SMAS3-Eurostag Interface**
  RTE (Gestionnaire du Réseau du Transport d'Electricité). June 2012 - December 2012. (Luis Rouco Rodríguez)
  This project addresses the development of new capabilities of the SMAS3-Eurostag interface. SMAS3 is a computer package for small-signal stability analysis and control of power systems developed by IIT. Eurostag is a computer program for long term simulation of power systems developed by RTE and Tractebel.

• **Modular development plan of the pan-european transmission system 2050**
  Unión Europea. September 2012 - December 2015. (Andrés Ramos Galán, Luis Olmos Camacho, Michel Rivier Abbad, Luis Rouco Rodríguez, Jesús María Latorre Canteli, Sara Lumbreras Sancho, Fernando Báñez Chicharro, Desta Zahlay Fitwi, Francisco Miguel Echavarren Cerezo, Lukas Sigrist)
  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.
• **Social entrepreneurship guide. Inspirations for business creation in the service of society**
  Ministerio de Empleo y Seguridad Social. October 2012 - December 2012. (David Contreras Bárcena, Pedro Linares Llamas)
  Entrepreneurship guide in the social context elaborated by the next research groups: E-SOST, el Consumidor y su Entorno, IIT y UEIA.

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

• **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:
• EU involvement in the institutional organization of distribution tasks in gas and electricity
EU involvement in the institutional organization of distribution tasks in gas and electricity

• SUSTAINABLE: Smart distribution system operation for maximizing the integration of renewable generation
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
Fundación Canal de Isabel II. June 2013 - July 2014. (Pedro Linares Llamas)
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
3.2.1.2 Consultancy and technological support

3.2.1.2.1 Private funding

- **Ausbildung in Koordinaten Messtechnik**
  AUKOM. July 2009 - July 2013. (María Ana Sáenz Nuño)
  The objective of the «Ausbildung Koordinatenmesstechnik e. V. - AUKOM» is to ensure an up-to-date, comparable, controllable and certifiable training in coordinate metrology in accordance with its capabilities. The organisation promotes the basic, comprehensive and solid training in the area of industrial production metrology, in particular in the area of coordinate metrology. The organisation ensures the standard and comparability of the courses offered by the members of the organisation within the coordinate metrology training. It organizes events for promoting the exchange between manufacturers, users and science in the area of coordinate metrology training and publishes new findings and trends from this area. It develops, promotes and spreads the «good measurement practice» and furthers the Europeanisation of cooperation in coordinate metrology training.
  The IIT will control the training in Spanish.

- **Grid access of new renewable power generation**
  Iberdrola Renovables. June 2012 - December 2012. (Luis Rouco Rodríguez)
  The aim of this project is updating the computer model developed by IIT to study of grid access of new renewable power generation. Preciseley, the access of wind and thermal and photovoltaic solar will be evaluated.

- **Optimal fleet operation management**
  REPSOL S.A. June 2012 - June 2013. (Pedro Sánchez Martín, Fernando de Cuadra García, Jesús María Latorre Canteli)
  The aim of this Project consists of developing a software tool to improve decision making process on commercial tank fleet management. The tool analyzes from the technical and economic point of view different charters to evaluate the optimal charter for each available tank ship. The tool helps on the valuation of consecutive charters taking into account market liquidity at each port. The tool takes into account simple and complex charters, bunker consumption, delay rates, port costs, channel cross payments and another operation costs. The tool can help on mid-term fleet management planning simulating different future scenarios for the fleet management.

- **Chilean network analysis for the study of value-added distribution 2012**
  SYNEX Ingenieros Consultores Ltda. June 2012 - October 2012. (Carlos Mateo Domingo, Álvaro Sánchez Miralles)
  The goal of this project is to assist Synex in the use of the Network Reference Model, named PECO, for the determination of the Aggregated Distribution Value of Chile. The results will be submitted to the Chilean Regulator (CNE) in order to perform the 2012 Tariff Revision.
  The network will be modelled and several scenarios will be analyzed. The
street map will be taken into account in full detail. The street map is built automatically by the model.

- **Tuning of the power system stabilizer of gas turbine 7 of Ibiza power station**
  Endesa. August 2012 - November 2012. (Luis Rouco Rodríguez, Ignacio Egido Cortés)
  This work is aimed at tuning the power system stabilizer of generator driven by gas turbine 7 of Ibiza power station. Stabilizer of gas turbine 7 will damp out the local mode of generator driven by gas turbine 7 and will contribute to the global mode of Ibiza power station. The study will provide the gain and the time constants of the stabilizer which will be determined using eigenvalue sensitivities techniques as implemented in SMAS3 program package. Stabilizer tuning will be validated using small-disturbance (eigenvalues) and large-disturbance (time domain simulation) techniques.

- **Power system studies of Soria-Chira pumped storage power plant**
  Endesa. August 2012 - November 2012. (Luis Rouco Rodríguez, Ignacio Egido Cortés, Inmaculada Saboya Bautista)
  Authorities of Gran Canaria province have awarded Endesa the development of Soria-Chira pumped storage hydro power plant. Soria-Chira is a novel power plant in an isolated power system. This work is aimed at studying the impact of Soria-Chiran power plant in Gran Canaria power system. Steady-state and dynamic studies will be conducted.

- **Comparison of the contribution to the system stability of conventional and renewable generation**
  Iberdrola Renovables. September 2012 - January 2013. (Luis Rouco Rodríguez, Elena Saiz Marín)
  This study is aimed at comparing the contribution to system stability of conventional and renewable generation. Three aspects are reviewed: ability to withstand faults, voltage control and frequency control.

- **Power system oscillations IBiza-Formentera power system due to diesel engine pulsating torques**
  Endesa. September 2012 - October 2012. (Luis Rouco Rodríguez, Ignacio Egido Cortés)
  Power system oscillations arise in isolated systems due to diesel engine pulsating torques. Diesel engine MAN3 of Ibiza power station is being adapted to be fed with natural gas. It will affect its pulsating torques. Power system oscillations in Ibiza-Formentera will be determined after the conversion of diesel engine MAN3 to be fed with natural gas.

- **Consultancy on protection of medium voltage power lines**
  Indra. October 2012 - November 2012. (Luis Rouco Rodríguez)
  The work has reviewed the problem of protection of medium voltage power lines and its connection with the neutral grounding system.
• **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.

• **Integration in the Jordan power system of a 20 MW PV power plant**  
ESTUDIO DE INGENIERIA LYNKA, S.L.L. February 2013 - February 2013. (Luis Rouco Rodríguez, Lukas Sigrist)

The study is aimed at checking the steady-state and the dynamic performance of a 20 MW PV power plant as connected to the Jordan power system.

• **Maintenance and new capabilities of Eon Tools 2013 to 2014**  
E.ON Generación, S. L. April 2013 - March 2014. (Enrique Lobato Miguélez, Pedro Sánchez Martín)

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

3.2.1.2.2 Public funding

• **A think tank hosting an interdisciplinary network to provide knowledge support to EU energy policy making**  
European Commission. June 2010 - June 2013. (José Ignacio Pérez Arriaga, Julián Barquín Gil, Carlos Batlle López)

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.

3.2.1.3 Services and analysis projects

3.2.1.3.1 Public funding
• Setting reliability standards in other jurisdictions
DECC. January 2013 - January 2013. (Carlos Batlle López)
As part of the EMR Delivery Plan published and consulted on July 2013, the UK Government needs to set a reliability standard for the GB market, used to inform the amount of capacity to contract in any future Capacity Market. In this project a detailed examination of reliability standards in other jurisdictions was performed; focusing not only on the standard, but how it is set, who governs the standard and what evaluation process it undergoes.

• 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 Frías 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.

- **HUMAP**
  Smoke movement study in large volume spaces, with full-scale experiments and numerical simulations.

### 3.2.2.1.2 Public funding

- **Simulation of the wind effect on the catenary-pantograph interaction of high-speed trains**
  The project aims to increase the little current knowledge that exists on the wind effect on the contact wire of railway catenaries and its influence on the dynamic interaction catenary-pantograph. Despite the fact that wind effect on cables is quite well-known, however, there is no much information about the wind effect on the dynamic interaction between catenary and pantograph and how the galloping of the catenary can affect this process.
  This subproject tries to obtain numerical models that provided with experimental data allow to understand the real effect of this phenomenon on the contact force between the catenary and the pantograph. The contact force between these two systems determines the quality of the energy collection. On one hand this contact force should be high enough to guarantee that there are no contact losses in order to avoid the production of electric arcs and the consequent damage in the contact wire and the pantograph. On the other hand, the contact force should lower enough in order to decrease the wear of the elements of the collecting system. Hence, the interest of studying the phenomenon of the vertical oscillations produced by the lateral wind. The models obtained would help to understand the effect of this phenomenon and its relationship with the different geometrical and mechanical parameters of the railway overhead.
  The aim of the project is to make an approach to the problem at two levels: the first one will consist of simplified models, computationally economics, that allow the understanding of the basic physics of the problem and the second one will develop more complex models and with a high computational cost that allow to learn about the cases which are considered of interest using a more realistic approach.
Research projects

- **3D Simulation of the wind effect on the catenary-pantograph interaction for high speed trains**
  (Alberto Carnicero López, Jesús Jiménez Octavio, Cristina Sánchez Rebollo)

  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.
3.2.2.2 Consultancy and technological support

3.2.2.2.1 Private funding

- **Dimensional metrology spanish standardization comittee**
  AENOR. February 1999 - September 2013. (María Ana Sáenz Nuño)
  Management of the Technical Secretary of the Dimensional metrology spanish standardization comittee and the development of the technical expert delegation in the mirror ISO comittee.

- **Ausbildung in Koordinaten Messtechnik**
  AUKOM. July 2009 - July 2013. (María Ana Sáenz Nuño)
  The objective of the «Ausbildung Koordinatenmesstechnik e. V. – AUKOM» is to ensure an up-to-date, comparable, controllable and certifiable training in coordinate metrology in accordance with its capabilities. The organisation promotes the basic, comprehensive and solid training in the area of industrial production metrology, in particular in the area of coordinate metrology. The organisation ensures the standard and comparability of the courses offered by the members of the organisation within the coordinate metrology training. It organizes events for promoting the exchange between manufacturers, users and science in the area of coordinate metrology training and publishes new findings and trends from this area. It develops, promotes and spreads the «good measurement practice» and furthers the Europeanisation of cooperation in coordinate metrology training. The IIT will control the training in Spanish.

- **Thermal test on a data recorder for railways**
  SEPSA. December 2012 - December 2012. (Francisco Nieto Fuentes, Carlos Rodríguez-Morcillo García)
  Thermal test on a data recorder for railways: 60 min 750º followed by 10 hours 260º

- **Computation of droppers and canvilevers in railway catenaries**
  The project develops a computer program to compute the droppers lenght and the cantilevers geometry in railway catenaries

- **Technical advice on adhesive joints**
  Technical advice on adhesive joints. Training railway workers.
3.2.2.3 Services and analysis projects

3.2.2.3.1 Private funding

- Communication project 3D CPHI
  Nekicesa Packaging S.L. September 2012 - October 2012. (Fernando de Cuadra García, José Porras Galán)
  Development of video and images in 3D for presentations in a stand of the international exhibition CPHI (Pharma industry), october 2012

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.

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 harnessed 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 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.

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.

3.2.3.2.2 Public funding
- Guide to apply the european norms to the train energy metering
  Adif. November 2011 - September 2013. (José Antonio Rodríguez Mondéjar, Yolanda González Arechavala, Rafael Santodomingo Berry)
  The aim of this project is to generate a set of rules to apply the recent European energy metering norms to the Spanish case. It is specified the full chain: on-board energy measuring system, the on-board to ground communication service, the measurements repository, the repository communications with other services as substation energy measuring system or weather forecast service, and the exchange of data for cross-border railway energy settlement.

3.2.4 Intelligent Systems Area

3.2.4.1 Research and develop projects

3.2.4.1.1 Private funding
- SMARTCITY: alignment with the DENISE project
  Endesa. October 2009 - March 2013. (Álvaro Sánchez Miralles, Álvaro Arranz Domingo, Miguel Ángel Sanz Bobi)
  The aim of the project is to determine what aspects of the DENISE project could be used in the SMARTCITY project, exploiting synergies between both projects.
Besides, activity monitoring of the SMARTCITY will be done, in order to assure an efficient alignment with the DENISE project.

- **Power generation asset management based on continuous life monitoring in the new context of high renewable energy penetration**
  Iberdrola. October 2010 - September 2012. (Miguel Ángel Sanz Bobi, Antonio Muñoz San Roque, Jesús Ángel García Matos)
  In this PhD project a model for anomaly detection and diagnosis in industrial processes and components of the energetic sector will be developed. Its major advantage will be to anticipate anomaly's evolution, what involves a major shift in asset management. The proposed model will also anticipate the impact of these anomalies, both failures and efficiency losses. This will ensure the reliability and quality of the service while avoiding the economic, social and environmental costs resulting from power cuts, accidents or loss of energy efficiency that can cause failures in a power generation plant.

- **Integration of forecasting tools at Enagas. Application to the medium-term forecasting tool for conventional demand**
  Indra. June 2011 - September 2013. (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.

- **Development of SCIA and SCA systems**
  The project consists of developing an application embedded in a PC104 board with Linux as operative system. It is installed in an electric vehicle. This application allows both managing the vehicle energy, and monitoring the state of the car and batteries. A mobile telephone is the user interface of the hole system. Besides, it communicates with an aggregator control centre.
  Besides, an application for controlling and monitoring several electrical vehicles will be developed. This application communicates with an embedded system onboard the car. The main objective of the application is to control the state of charge of each vehicle while the constraints of an energetic dispatch are accomplished.
• **MORSE: energy and reserve market, network constraints and investments signals**  
  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 improving the hourly equilibrium model (with endogenous conjecture computation) for providing energy and reserve prices, on applying the equilibrium model with network constraints and endogenous conjecture computation to the European market, and on including investments signals in the core tools to be able to make feasible extreme forecast scenarios, such as those with massive interruptible generation.

• **Application of data mining techniques for the monitoring and analysis of the Spanish electricity market**  
  Endesa. January 2012 - December 2012. (Eugenio Francisco Sánchez Úbeda, Alberto Gascón González)  
  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.

• **Optimal bidding strategies for the secondary reserve market**  
  Endesa. February 2012 - September 2012. (Antonio Muñoz San Roque, Eugenio Francisco Sánchez Úbeda, Francisco Alberto Campos Fernández, José Portela González)  
  The primary aim of this project is the development of a set of tools for monitoring and forecasting the Spanish secondary reserve market.

• **Algorithm for detection of physical accesses from unknown sites to a social network for kids**  
  SIMACH. March 2012 - September 2012. (Miguel Ángel Sanz Bobi, Rodrigo José Andrade Vieira)  
  This subproject is inside a wider project which name is SIMACH that is an intelligent system for detection of risk human conducts in a social network for kids. The main objective of SIMACH is to protect the users of the social network from possible risks. The objective of the subproject is to identify physical accesses to the social network that are not the typical used by a kid when access to the social network according to his/her behavior pattern. In the case that an improper
access is detected an alarm is issued to the other modules of SIMACH in order to investigate the case, and if necessary, to inform the person in charge of the kid.

- **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 planing 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.

- **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 establishes 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.

- **Tools for identifying patterns of behavior related to the consumption of internet content: feasibility study**  
  Zoomnews. April 2013 - June 2013. (Eugenio Francisco Sánchez Úbeda, Alberto Gascón González)  
  The primary aim of this project is the development of a methodology for identifying patterns of behavior related to the consumption of internet content based on machine learning techniques.

- **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.

### 3.2.4.1.2 Public funding

- **Active distribution networks with full integration of demand and distributed energy resources**  
  ADDRESS will research, develop and deploy technologies and processes to increase usage of distributed Generation and Renewable Energy Resources thereby engaging in a new relationship between customers, generators and network operators. ADDRESS aims to develop new innovative architectures for
Active Distribution Networks (ADN) able to balance in real time power generation and demand allowing network operators, consumers, retailers and stakeholders to benefit from the increased flexibility of the entire system. Innovative use of communications, automation and household technologies will be combined with new trading mechanisms and algorithms providing ADN with low cost and reliable solutions. Customers will be encouraged into active participation enabling them to change their consumption habits, adopting a smarter use of energy and saving money. A cost/benefit analysis of different solutions will be developed: the most promising will be tested in three sites with different geographic, demographic and generation characteristics.

- **New systems, technologies and operation models based on ICTs for the management of energy positive and proactive neighbourhoods**
  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 Angel Sanz Bobi, Rodrigo Jose 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.
3.2.5 Electronics and Automatic Group

3.2.5.1 Research and develop projects

3.2.5.1.1 Private funding

- **Project ENERGOS: technologies for automated and intelligent management of energy distribution networks of the future**
  Sistemas Avanzados de Control. January 2010 - December 2012. (Sadot Alexandres Fernández, Carlos Rodríguez-Morcillo García, José Daniel Muñoz Frías, Ainhoa Cabetas Azcoitia, David Contreras Bárcena, Javier Juárez Montojo)

  The goal of Project ENERGOS «Technologies for automated and intelligent management of energy distribution networks of the future» is the development of knowledge and technologies that advance the deployment of Intelligent Networks.

  The main technological challenges of Intelligent Networks, are tackled in different lines of work of the Project. In the area of Business Management, includes the development of technologies for the creation of new environments Operation of the Network (including tools for simulation and estimation of states), the active demand management and the Planning and Optimizing.

  In the Area of Platform Integration and Communication, will work on the processes of acquiring and processing information in real time (with the difficulties of the large volume of information being generated and the criticality of its availability), the infrastructure necessary for the management and recharging of electric vehicles and the requirements of supervision and control of micro.

  Smart Network Devices, new techniques include signal acquisition, the development of intelligent devices and energy recording equipment Automation Network.

  The consortium, led by natural gas - Unión Fenosa Distribución, has the presence of a leader in technologies such as Indra and prestigious companies in the electricity sector as ZIV, AIA, Ormaizabal, SAC, Diagnostica and the technology sector information as Visual Tools, Brainstorm, Prodevelop, and Indra Answare Software Labs.

- **Development of a tunable pulse generator between 20ps and 4ns at a frequency between 1kHz and 10GHz**
  FIDIAS Consulting. July 2012 - September 2012. (Carlos Rodríguez-Morcillo García, Sadot Alexandres Fernández, José Daniel Muñoz Frías)

  The objective of the proposed collaboration is to design and develop a prototype of a tunable electrical pulse generator. The pulses will be generated with a minimum and maximum frequencies as close to 1 kHz and 10 GHz, respectively, with a minimum and maximum temporal pulse width as close to 20 ps and 4 ns, respectively, and with an amplitude between 3 and 5 V at the input of the generator and between 1 and 2 V at the output.
• **Analysis and development of a microsite for Nekicesa**  
NEKICESA PACKAGING S.L. September 2012 - January 2013. (David Contreras Bárcena)  
The aim of this project is to analyze, design and develop a microsite to show an innovation image of the company. This new site must show the progress of Nekicesa on products and services innovation, improve its search positioning and upgrade the european and national image of the company.

• **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.

3.2.5.1.2 Public funding

• **Active distribution networks with full integration of demand and distributed energy resources**  
ADDRESS will research, develop and deploy technologies and processes to increase usage of distributed Generation and Renewable Energy Resources thereby engaging in a new relationship between customers, generators and network operators. ADDRESS aims to develop new innovative architectures for Active Distribution Networks (ADN) able to balance in real time power generation and demand allowing network operators, consumers, retailers and stakeholders to benefit from the increased flexibility of the entire system. Innovative use of communications, automation and household technologies will be combined with new trading mechanisms and algorithms providing ADN with low cost and reliable solutions. Customers will be encouraged into active participation enabling them to change their consumption habits, adopting a smarter use of energy and saving money. A cost/benefit analysis of different solutions will be developed: the most promising will be tested in three sites with different geographic, demographic and generation characteristics.

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

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.

The use of power electronics for the integration of renewable energy sources in electric power systems

MICINN. May 2011 - December 2012. (Aurelio García Cerrada, Luis Rouco Rodríguez, Juan Luis Zamora Macho, José Daniel Muñoz Frías)

This project will look into:
(1) Power electronics control in distributed generation connected to weak grids
(2) A comprehensive set of scenarios to analyse and simulate distributed-generation schemes connected to weak grids.
(3) The simulation of wind-energy-related scenarios in weak grids
(4) The development of ancillary equipment, control algorithms and protection systems to ease wind power integration in weak grids
(5) The minimization or even substitution of complex flow-control devices such as FACTS in transmission and distribution networks
(6) The design of a test bench to study wind power integration in weak grids
(7) The experimental validation of power electronics devices tailored to the integration of wind power into weak grids
(8) The design of intelligent power electronics devices tailored to the integration of wind power into weak grids
(9) The publication of new results in the specialized arena

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

![Image](image1)

**Project funded by Ministerio de Economía y Competitividad.**

![Image](image2)

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

MICINN. January 2012 - December 2014. (Aurelio García Cerrada, Juan Luis Zamora Macho, Javier Roldán Pérez)

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:

- To contribute to the global analysis of the integration of renewable energy in the grid using power electronics.
- To contribute to the global analysis of the use of power electronic converters to improve voltage and current quality in electrical grids.
- To contribute to the global analysis of the use of power electronic converters to optimize power flows in electrical grids.
- To contribute to find new electronic devices to improve the operation of future electric grids (from micro-grids to HVDC super grids).
- 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.

Project funded by Ministerio de Economía y Competitividad.

- **Social entrepreneurship guide. Inspirations for business creation in the service of society**
  Ministerio de Empleo y Seguridad Social. October 2012 - December 2012. (David Contreras Bárcena, Pedro Linares Llamas)
  Entrepreneurship guide in the social context elaborated by the next research groups: E-SO ST, el Consumidor y su Entorno, IIT y UEIA.

### 3.2.5.2 Consultancy and technological support

#### 3.2.5.2.1 Private funding

- **Technical advice on irrigation systems of SAT Albatana, in Albatana (Albacete), and Sociedad Cooperativa La Mora y Los Tollos of Castilla La Mancha, in Ferez (Albacete)**
  ABB. June 2012 - October 2012. (Carlos Rodríguez-Morcillo García)
  The goal of the collaboration is to technically assist ABB on automated irrigation systems in the irrigation communities the SAT Albatana and Cooperativa La Mora y Los Tollos.

- **Integration of Wireless-MBus in Polaris system**
  Sistemas Avanzados de Control (SAC). April 2013 - July 2013. (Carlos Rodríguez-Morcillo García, Javier Juárez Montojo)
  The goal of the collaboration is to provide technical assistance for integration Wireless-MBus system, developed by IIT within ENERGOS project, with the communications hub system: Polaris.
3.2.5.2.2 Public funding

- **Guide to apply the european norms to the train energy metering**
  Adif. November 2011 - September 2013. (José Antonio Rodríguez Mondéjar, Yolanda González Arechavala, Rafael Santodomingo Berry)
  The aim of this project is to generate a set of rules to apply the recent European energy metering norms to the Spanish case. It is specified the full chain: on-board energy measuring system, the on-board to ground communication service, the measurements repository, the repository communications with other services as substation energy measuring system or weather forecast service, and the exchange of data for cross-border railway energy settlement.

3.3 Publications

3.3.1 Chapters in books


3.3.2 Publications in journals


Publications


3.3.3 Presentations in congress


3.3.4 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.


- K. Dietrich, A. López-Peña, "Is the European 2050 emissions path viable for Spain? How much renewables are needed? Is the power system able to deal with it?". January 2013. Ref: IIT-13-005A.


- R. Dias, P. Linares, "Introducing electricity load level detail into a CGE model - Part II - The GEMED model applied to a DR policy". May 2013. Ref: IIT-13-041A.
- C. Maté, "Stationarity and cointegration in Interval time series". June 2013.


### 3.3.5 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
- Participación activa de la demanda en la operación de las redes de distribución
  Fernando Alfonso Bermejo. Supervised by Pablo García González.

- Automatización de una casa a escala. Gestión energética
  Teresa Basagoiti Fernández de la Puente. Supervised by Álvaro Sánchez Miralles.

- Aplicación del equilibrio de Stackelberg al mercado europeo

- Modelo de previsión de demanda de electricidad de corto plazo
  Ignacio Cobo Berberana. Supervised by Eugenio Francisco Sánchez Úbeda y Alicia Mateo González.

- Estudio de viabilidad de un mercado secundario de distribución
  Virginia Garmendia Cobo. Supervised by Ismael Jaime Fernández Fernández.

- Estrategias de gestión del mantenimiento de un parque eólico en base a indicadores del estado de salud de sus aerogeneradores
  Íñigo Girón de Velasco Sada. Supervised by Miguel Ángel Sanz Bobi y Rodrigo José Andrade Vieira.

- Optimización del control de tensiones en parques eólicos
  Carmen Gómez Sánchez. Supervised by Ignacio Egido Cortés, Enrique Lobato Miguélez y Elena Saiz Marín.
- Influencia de las energías renovables, mix tecnológico y aspectos climatológicos sobre los servicios complementarios
  Andrea Hernández Calle. Supervised by José Villar Collado, Cristian Andrés Díaz Durán y Pablo González Gascón y Marín.

- Cost assessment of the RES-E penetration in the Spanish ancillary services market
  Rafael de Juan Astray. Supervised by Eugenio Francisco Sánchez Úbeda y Carlos Batlle López.

- Analysis of the impact of a large deployment of solar generation in the Spanish electric power market
  Fernando de Juan Astray. Supervised by Carlos Batlle López y Pablo Rodilla Rodríguez.

- Modelado de un mercado eléctrico mediante un sistema multiagente
  Elena de Juan Salgado. Supervised by José Villar Collado, Miguel Ángel Sanz Bobi y Rodrigo José Andrade Vieira.

- Análisis de viabilidad de la implantación de una herramienta con tecnología 3G para el sector del taxi
  Víctor Láiz Pérez. Supervised by Susana Ortiz Marcos.

- Gestión energética de una casa inteligente
  Francisco Martín. Supervised by Álvaro Sánchez Miralles y Jaime Boal Martín-Larrauri.

- Análisis de los beneficios de la gestión activa de la demanda para los consumidores domésticos
  Alberto Ogbechie Condés. Supervised by Pablo Frías Marín y Mercedes Vallés Rodríguez.

- Análisis de la demanda eléctrica española
  Rodrigo Javier Pérez Domínguez. Supervised by José Villar Collado, Cristian Andrés Díaz Durán y Pablo González Gascón y Marín.

- Interval Time Series (ITS) analysis and forecasting system
  Javier Redondo Alastraüé. Supervised by Carlos Maté Jiménez.

- Modelado y simulación de un banco de pruebas de generadores síncronos
  Jaime Renedo Anglada. Supervised by Luis Rouco Rodríguez y Luis Díez Maroto.
- Evaluación de las cargas medioambientales y cálculo de la huella de carbono mediante análisis de ciclo de vida de un pan de molde elaborado y comercializado en España según normas de ecoetiquetado de productos Hugo Roquero Herranz. Supervised by Yolanda González Arechavala y Carlos Martín Sastre.

- Determinación de la condición de un parque eólico a través del seguimiento de las curvas de potencia de sus aerogeneradores Jaime Rubio González. Supervised by Miguel Ángel Sanz Bobi y Rodrigo José Andrade Vieira.


- Análisis de la integración de generación solar fotovoltaica y vehículo eléctrico en un cliente doméstico Carlos Sánchez León. Supervised by Pablo Frías Marín y Andrea Rodríguez Calvo.

- Diseño e implantación en un generador síncrono real de un regulador de potencia primario Alejandro Sanz Ull. Supervised by Ignacio Egido Cortés y Lukas Sigrist.

- Análisis de costes y beneficios de la implantación del vehículo eléctrico Ignacio Trigo Martínez. Supervised by José Villar Collado, Cristian Andrés Díaz Durán y Pablo González Gascón y Marín.

4.1.1.2 Electronic Engineering

- Sistema de comunicaciones GPRS y localización de un vehículo Isabel Comas Montero. Supervised by Álvaro Sánchez Miralles y Jaime Boal Martín-Larrauri.


- Sistema domótico para una casa inteligente Rodrigo de Marcos Peirotén. Supervised by Álvaro Sánchez Miralles y Jaime Boal Martín-Larrauri.

- Amplificador de auriculares con interfaz USB y "crossfeed" digital Fernando de Miguel de Couto. Supervised by José Daniel Muñoz Frías.
- Comparación metrológica de termómetros clínicos infrarrojos
  José Manuel Fernández de Valderrama. Supervised by Romano Giannetti y María Ana Sáenz Nuño.

- Operación y regulación de un aerogenerador marino de última generación
  Ramón Gonzalo Moreno. Supervised by Juan Antonio Talavera y Carlos Mateo Domingo.

- Desarrollo de un robot 4x4 para la navegación por terrenos agrestes
  José Guijarro Bueno. Supervised by Jaime Boal Martín-Larrauri.

- Simulador de conducción manual y automática de un tren bajo parámetros de confort moviéndose en Moving Block e una línea equipada con ERTMS Nivel 3
  Jose Diego Hebrero Sanchez. Supervised by Fernando Montes Ponce de León y Yolanda González Arechavala.

- Optimización de la posición de balizas infil en línea suburbana para ERTMS nivel 1 mediante la creación de una herramienta de simulación
  Alejandro López Fuentes. Supervised by Fernando Montes Ponce de León y Yolanda González Arechavala.

- Desarrollo de una plataforma de aprendizaje basada en problemas
  Ines Mesías. Supervised by Alberto Carnicero López, Cristina Puente Águeda y Jesús Jiménez Octavio.

- Seguimiento de trayectorias con dispositivos móviles para estrategias de marketing avanzadas
  Enrique Murube. Supervised by Álvaro Sánchez Miralles y José Villar Collado.

- Monociclo eléctrico robotizado
  Daniel Prieto-Renieblas. Supervised by José Daniel Muñoz Frías.

- Avances en el control de convertidores electrónicos fuente de tensión conectados en serie con el sistema eléctrico
  Alberto Rodríguez Cabero. Supervised by Juan Luis Zamora Macho y Javier Roldán Pérez.

- Creación de una plataforma online para visualizar contenido multimedia
  Juan Taracena Arenillas. Supervised by Rafael Palacios Hielscher, Cristina Puente Águeda y Antonio Prieto.

- Desarrollo de un vehículo eléctrico para ciudades inteligentes
  Pablo Zulaica Pérez. Supervised by Álvaro Sánchez Miralles.
4.1.1.3 Mechanical Engineering

- Gestión eficiente y económica de la carga de vehículos eléctricos bajo incertidumbre
  Antonio Alberdi. Supervised by Pedro Sánchez Martín.

- Obtención de grafeno mediante métodos químicos de exfoliación
  Carmen Alcolea Sánchez. Supervised by Yolanda Ballesteros Iglesias.

- Rediseño del chasis de una motocicleta: Ducati Monster S2R 800
  Manuel Ayllón Escudero. Supervised by Jesús Jiménez Octavio.

- Análisis de la integración de generación solar fotovoltaica y el vehículo eléctrico en un centro comercial
  Adelaida Bastón Castiñeiras. Supervised by Pablo Frías Marín y Andrea Rodríguez Calvo.

- Integración de un campo solar en una central térmica de ciclo combinado
  Francisco Javier Becerro González. Supervised by Pablo Frías Marín y Alfonso Junquera Delgado.

- Procedimiento de medición e implementación de una maqueta de Ferrari FXX Evoluzione de la marca Hot Wheels Elite en 3D mediante brazo de medición con láser
  Fernando Cordero Tosal. Supervised by María Ana Sáenz Nuño.

- Diseño de un prototipo comercial de vehículo impulsado por aire comprimido
  Luis de la Orden Fresno. Supervised by Luis Manuel Mochón Castro.

- Análisis y optimización del sistema de inyección del INNO-MOTOR

- Métodos de optimización de diseño automático aplicados a un disco de ensayo de turbina

- Alternativas en el consumo energético sostenible de una flota de transporte industrial
  Laura Garrido Fernández. Supervised by Miguel Ángel Sanz Bobi.

- Un plan de negocio real: la explotación económica de una patente
- Estructura de cúpula
  Carlos José Gómez Durbán. Supervised by Alberto Carnicero López y Juan Antonio Hernández Bote.

- Alternativas de diseño y explotación de una planta de biogás
  Héctor Jiménez Sánchez. Supervised by Miguel Ángel Sanz Bobi y Fernando de Cuadra García.

- Procedimiento de calibración y verificación de tensiómetros analógicos y digitales dentro del sistema de calidad de un hospital
  Raquel María Lorente Pedreille. Supervised by María Ana Sáenz Nuño.

- Planificación de la gestión de una flota de transporte aplicando técnicas de simulación
  Miguel Miranda Arcos. Supervised by Pedro Sánchez Martín.

- Desarrollo de un modelo de gestión para la electrificación de comunidades rurales aisladas en el estado de Oaxaca (México) mediante pequeños sistemas fotovoltaicos domiciliarios
  Sara Molina Bandín. Supervised by Susana Ortiz Marcos y José Gabriel Martín Fernández.

- Análisis del cambio de hora en la demanda energética en España
  Reyes Rubio Roa. Supervised by Pedro Linares Llamas y Eugenio Francisco Sánchez Úbeda.

- Simulador de máquinas de fluidos
  Luis Suárez Nieto. Supervised by Rafael Palacios Hielscher y Luis Manuel Mochón Castro.

- Modelado, simulación, análisis y control de oscilaciones debidas a pares pulsatorios de motores diesel
  Francisco Suárez Ortiz. Supervised by Luis Rouco Rodríguez.

4.1.1.4 Industrial Engineering

- Análisis económico de viabilidad de un parque de hélices submarinas
  Belén Díaz de la Cruz. Supervised by Susana Ortiz Marcos y José María Rodríguez Fernández.

- Análisis del sector del automóvil: evaluación de la competitividad, causas de la deslocalización de la fabricación y eficiencia económica
  Miguel Utrilla Burgaz. Supervised by Susana Ortiz Marcos, Mercedes Fernández García y Raquel Caro Carretero.
4.1.1.5 Computer Engineering (communications branch)
- Sistema de posicionamiento para superficies comerciales mediante dispositivos móviles
  Carlos Dobarco Álvarez. Supervised by David Contreras Bárcena.

- Back-end y aplicación para iOS de Slypter
  Carlos Balduz Bernal. Supervised by David Contreras Bárcena.

- Sistema web de gestión y optimización de tareas
  Pedro Ángel Cano Ramos. Supervised by David Contreras Bárcena.

- BT vs BLE: estudio experimental de la nueva especificación Bluetooth Low Energy (BLE)
  David Sánchez de la Torre. Supervised by David Contreras Bárcena.

4.1.1.6 Computer Engineering (intelligent systems branch)
- Simulador funcional en PC de un enclavamiento ferroviario adaptado a la normativa europea
  Pablo Hermoso Muñoz. Supervised by Fernando Montes Ponce de León y Yolanda González Arechavala.

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 the Post-Graduate Institute in collaboration with 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 Erasmus Mundus International Master in Economics and Management of Network Industries (EMIN)

Coordinator: Javier García González
More information at http://www.upcomillas.es/emin/

- Advanced analysis of electric power systems
  Luis Rouco Rodríguez

- Advanced topics in regulation of the electric power industry
  José Ignacio Pérez Arriaga

- Decision support models in the electric power industry
  Efraim Centeno Hernández, Javier García González, Andrés Ramos Galán

- Environmental impact and renewable energy
  Pedro Linares Llamas

- Fundamentals on electrical engineering and optimization techniques
  Francisco Miguel Echavarren Cerezo, Pablo Frías Marín, Javier García González, Damián Laloux Dallemagne, Andrés Ramos Galán, Javier Reneses Guillén, Michel Rivier Abbad

- Introduction to electric power systems
  Damián Laloux Dallemagne, Michel Rivier Abbad

- Master thesis
  Javier García González

- Models for risk analysis and management in energy markets
  Julián Barquín Gil

- Regulation of the electric power industry
  Carlos Batlle López

- The electric power distribution business
  Rafael Cossent Arín, Pablo Frias Marín, Pablo García González, Joao Abel Peças Lopes, Javier Reneses Guillén

- The electric power transmission business
  Luis Olmos Camacho, Michel Rivier Abbad

- The natural gas industry and fuel markets
  Javier García González
4.2.1.2 Master in Electric Power Industry

Director: Javier García González
More information at
http://www.upcomillas.es/eng/estudios/estu_mast_sect_elec.aspx?idIdioma=ENG

- Advanced analysis of electric power systems
  Luis Rouco Rodríguez

- The electric power distribution business
  Rafael Cossent Arín, Pablo Frías Marín, Pablo García González, Javier Reneses Guillén, Joao Abel Peças Lopes

- The electric power transmission business
  Luis Olmos Camacho, Michel Rivier Abbad

- The natural gas industry and fuel markets
  Javier García González

- Fundamentals on electrical engineering and optimization techniques
  Francisco Miguel Echavarren Cerezo, Pablo Frías Marín, Javier García González, Damián Laloux Dallemagne, Andrés Ramos Galán, Javier Reneses Guillén, Michel Rivier Abbad

- Environmental impact and renewable energy
  Pedro Linares Llamas

- Introduction to electric power systems
  Damián Laloux Dallemagne, Michel Rivier Abbad

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

- Decision support models in the electric power industry
  Efraim Centeno Hernández, Javier García González, Andrés Ramos Galán

- Regulation of the electric power industry
  Carlos Batlle López

- Master Thesis monitoring
  Javier García González
- Regulation of the electric power industry
  José Ignacio Pérez Arriaga

4.2.1.3 Master in Railway Systems

Director: Antonio Fernández Cardador
More information at
http://www.upcomillas.es/eng/estudios/estu_mast_sist_ferr.aspx?idIdioma=ENG

- Railway Systems Electrification
  Eduardo Pilo de la Fuente, Luis Rouco Rodríguez

- Catenary mechanics
  Alberto Carnicero López, Jesús Jiménez Octavio

- ERTMS and RAMS
  Yolanda González Arechavala

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

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

4.2.1.4 Master in Electrical Technology

Director: Luis Rouco Rodríguez
More information at
http://www.upcomillas.es/eng/estudios/estu_mast_tecn_elec.aspx?idIdioma=ENG

- Power economy and markets
  Carlos Batlle López, Enrique Lobato Miguélez, Mariano Ventosa Rodríguez

- Reliability
  Francisco Alberto Campos Fernández, Andrés Ramos Galán, Javier Reneses Guillén

- Electricity fundamentals
  Ignacio Egido Cortés, Enrique Lobato Miguélez

- Fundamentals thermal generation
  Luis Manuel Mochón Castro, José Ignacio Linares Hurtado
- Renewable generation  
  Luis Manuel Mochón Castro

- Hydraulic generation  
  Luis Manuel Mochón Castro

- Nuclear generation  
  Luis Manuel Mochón Castro

- Conventional thermal generation  
  Alexis Cantizano González

- Environmental impact of electricity industry  
  Julián Barquín Gil, Eduardo Pilo de la Fuente

- High-voltage networks  
  Eduardo Pilo de la Fuente, Luis Rouco Rodríguez

- Medium- and low-voltage networks  
  Francisco Miguel Echavarren Cerezo, Pablo García González, Eduardo Pilo de la Fuente, Luis Rouco Rodríguez

- Central electrical systems  
  Luis Rouco Rodríguez

4.2.1.5 Master in Electricity Generation. Promotion, Technology and Operation (On-line)

Director: David Soler Soneira  
More information at http://www.structuralia.com/mge

- Economic operation of electricity generation. Electricity markets.  
  Pablo Rodilla Rodríguez, Damián Laloux Dallemagne, Javier García González, Andrés Ramos Galán, Mariano Ventosa Rodríguez, Carlos Batlle López

- Solar generation  
  Luis Manuel Mochón Castro

- Hydroelectric Power Station Promotion, Investment analysis and economic viability  
  Susana Ortiz Marcos

- Electrical Systems of Power Stations  
  Luis Rouco Rodríguez
4.2.1.6 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 infrastructure projects: electric infrastructure policy in Spain
  Michel Rivier Abbad

4.2.1.7 Master in Biomechanics Applied to Damage Assessment; Advanced Physical Therapy Techniques

- Clinical biomechanics research
  María Ana Sáenz Nuño

4.2.2 Comillas master theses

4.2.2.1 Erasmus Mundus International Master in Economics and Management of Network Industries (EMIN)

- An advanced analysis of energy intensity in Spain and future scenarios

- Impact of virtual power plants in liberalized markets: the Spanish case study
  Jesús Manuel Rentería Rentería. Supervised by Pedro Sánchez Martín and Javier García González.
4.2.2.2 *Master in Regulation of the Electricity Industry*

- Análisis del riesgo y su impacto en la regulación del sector eléctrico
  Miselani Franco Pérez. Supervised by Carlos Batlle López and Víctor Pascual Guzmán Feliz.

- Aplicación del sistema de información regulatoria y de fiscalización y técnicas estadísticas avanzadas para la medición y fiscalización de la calidad de servicio de la calidad de servicio de las empresas distribuidoras en la República Dominicana

- Compensación económica de la regulación de frecuencia en la República Dominicana
  Alfonso Antonio Marmolejos Paulina. Supervised by Pablo Frías Marín and José Luis Moreno San Juan.

- Desarrollo de un sistema de gestión para optimizar los mantenimientos de la Empresa de Transmisión Eléctrica Dominicana (ETED) de cara al sector

- Determinación de índices de penetración eólica en el sistema eléctrico nacional interconectado de República Dominicana
  Sixfredo Alexis Martínez Cadena. Supervised by Luis Olmos Camacho and Rodolfo Fermín Maldonado.

- Eficiencia energética en el subsector de electricidad en República Dominicana: propuestas para desarrollar su potencial en materia de eficiencia en el uso de energía eléctrica
  Méjico Ángeles-Lithgow. Supervised by Pedro Linares Llamas and Rafael Burgos Domínguez.

- Esquema de transición para la implementación de la tarifa técnica en la República Dominicana
  Cesar Augusto Olivero. Supervised by Javier Reneses Guillén and Joan Genao Pichardo.

- Implementación mediante interconexiones de un mercado de compra y venta de energía eléctrica entre la República Dominicana, Colombia y Puerto Rico
  Ernesto Amancio Caamaño de los Santos. Supervised by Luis Olmos Camacho and Víctor Pascual Guzmán Feliz.
- Las centrales eólicas y su impacto positivo en el desarrollo sostenible de la República Dominicana
  Cirilo Peguero Ramírez. Supervised by Pedro Linares Llamas and Edison Manuel Neris Comprés.

- Metodología para auditar los costos variables de producción en el mercado eléctrico dominicano
  Ruben Antonio Coste Diaz. Supervised by Michel Rivier Abbad and Luis Julián Zuluaga López.

- Propuesta de normativa complementaria de regulación para la explotación óptima y conexión a redes de distribución de la generación distribuida en República Dominicana
  Claudio García Pérez. Supervised by Pablo Frías Marín and José Luis Moreno San Juan.

- Propuesta regulatoria para el servicio complementario de Black Start en el sistema eléctrico dominicano
  Luinyx Aviastar Ongando Ballenilla. Supervised by Pablo Frías Marín and Andrés Manzueta Cepeda.

- Readeucación del código de conexión del SENI de la República Dominicana
  Ivan de Jesús Veras Arnó. Supervised by Luis Rouco Rodríguez and Luis Julián Zuluaga López.

- Revisión de conceptos de remuneración de potencia firme de centrales térmicas en el mercado eléctrico mayorista de la República Dominicana y propuesta de adecuación
  Máximo Alberto Domínguez Garabitos. Supervised by Pablo Rodilla Rodríguez and Richard Ismael Núñez Taberas.

- Revisión del mecanismo de seguridad en la República Dominicana y propuesta de modificación
  Ronald Pacheco Letona. Supervised by Pablo Rodilla Rodríguez and Néstor Ramírez Mamani.

4.2.2.3 Master in Electric Power Industry
- Análisis de los requerimientos de reserva de potencia adicional a subir e influencia de la tecnología no gestionable sobre los mismos
  Julia de la Haza Gómez. Supervised by José Villar Collado and Juan Bogas Gálvez.

- Analysis of the accuracy of weekly time aggregation in the generation optimization problem of an electric power system. Analysis for different wind penetration levels.
  Juan Arregui Altuna. Supervised by Javier García González.
- Estudio de la gestión a corto plazo, medio plazo y oportunidades de ciclado en una central térmica de ciclo combinado en el mercado eléctrico español
  Iván Acha Fernández. Supervised by Carlos Batlle López and David Soler Soneira.

- Revision of the Peruvian distribution regulatory framework to smart grids implementation
  Miguel Juan Révolo Acevedo. Supervised by Javier Reneses Guillén.

- Stochastic MPEC to assess the effect of wind penetration on investments in traditional technologies
  Fernando Usera Rodés. Supervised by Efraim Centeno Hernáez and Sonja Wogrin.

4.2.2.4 Master in Railway Systems

- Costes de mantenimiento de infraestructura de vía
  Julian Gonzalez Martín. Supervised by Eduardo Pilo de la Fuente and Ignacio González Franco.

- Estudio del transitorio térmico de confort de un coche de pasajeros ante parada en vía y falta de suministro eléctrico
  Víctor Barreira Losada. Supervised by Luis Manuel Mochón Castro.

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).


4.3.2 Developed Master Thesis in other Universities

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 Master in Research in Engineering Systems Modelling and the Master in Power Systems, 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 Master in Research in Engineering Systems Modelling

Director: Pablo García González
More information at http://www.upcomillas.es/eng/estudios/estu_mast_inve_mode.aspx?idIdioma=ENG

- Data analysis
  Carlos Maté Jiménez
- Advanced Computing Tools for Applied Research
  Rafael Palacios Hielscher, Fernando de Cuadra García

- Elaboration of a PhD thesis
  Francisco Luis Pagola y de las Heras

- Modeling of Physic Systems in Engineering
  Alberto Carnicero López

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

- Stochastic Optimization
  Andrés Ramos Galán

- Preliminary research
  Andrés Ramos Galán

- Master thesis
  Andrés Ramos Galán

- Writing technical papers in English
  Aurelio García Cerrada

5.2.2 Master in Power Systems

Director: Pablo García González
More information at
http://www.upcomillas.es/eng/estudios/estu_mast_sist_ener.aspx?idIdioma=ENG

- Advanced analysis of electric power systems
  Luis Rouco Rodríguez

- Elaboration of a PhD thesis
  Francisco Luis Pagola y de las Heras

- The electric power distribution business
  Rafael Cossent Arín, Pablo Frías Marín, Pablo García González, Joao Abel Peças Lopes, Javier Reneses Guillén

- The electric power transmission business
  Luis Olmos Camacho, Michel Rivier Abbad
- Strategies in energy markets under the perspective of game theory
  Javier García González

- Environmental impact and renewable energy
  José Ignacio Linares Hurtado

- Internacional experiences in energy sector II
  Pablo García González

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

- Decision methods
  Pedro Linares Llamas

- Analisys and Management Risk Models in Electricity Markets
  Julián Barquín Gil

- Decision support models in the electric power industry
  Efraim Centeno Hernáez, Javier García González, Andrés Ramos Galán

- Regulation of the electric power industry
  Carlos Batlle López

- Review of state of the art
  Andrés Ramos Galán

- Seminars on research methods and tools
  Eugenio Francisco Sánchez Úbeda

- Regulation of the electric power industry
  José Ignacio Pérez Arriaga

- Master thesis
  Andrés Ramos Galán

- Writing technical papers in English
  Aurelio García Cerrada
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.

- **An introduction to decision theory**
  Pedro Linares Llamas

- **Applied forecasting**
  Antonio Muñoz San Roque

- **Bibliographic search and reference management**
  Yolanda González Arechavala

- **Data mining**
  Eugenio Francisco Sánchez Úbeda

- **Database systems**
  Álvaro Sánchez Miralles

- **Developing web-based applications**
  Rafael Palacios Hielscher

- **Fuzzy logic**
  José Villar Collado

- **Genetic algorithms**
  Eugenio Francisco Sánchez Úbeda

- **Graphic visualization with Matlab**
  Eugenio Francisco Sánchez Úbeda

- **Multivariate analysis techniques**
  Carlos Maté Jiménez

- **Object oriented programming**
  José Villar Collado

- **Optimization techniques**
  Andrés Ramos Galán

- **Oral presentation of scientific papers**
  Aurelio García Cerrada
- Scientific computing with Matlab
  Rafael Palacios Hielscher

- Simulation techniques
  Pedro Sánchez Martín

- Visual basic for applications
  Jesús María Latorre Canteli

- Writing scientific papers with LaTeX
  Romano Giannetti

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
- Strong versus weak sustainability indices in a urban context. A case example in Spain
  José Carlos Romero Mora. Supervised by Pedro Linares Llamas.

- Improving multimedia traffic performance in WLAN through time reassignation procedures
  Alejandro García San Luis. Supervised by Rafael Palacios Hielscher and David Contreras Bárbara.

- Effect of antibiotic, the concentration and environmental conditions on the mechanical properties and the absorption process of antibiotic-bone cement
  Eva Paz Jiménez. Supervised by Juan Carlos del Real Romero.

- Efficient multiple-reference-frame controller for harmonic suppression in active power filters
  Miguel Ochoa Giménez. Supervised by Aurelio García Cerrada, Juan Luis Zamora Macho and Ramón Rodríguez Pecharromán.

- Forecasting day-ahead residual demand curves in electricity markets: multivariate vs. functional time series models
  José Portela González. Supervised by Antonio Muñoz San Roque.
5.4.2 Master in Power Systems

- Reallocating greenhouse gas emissions to consumption?
  Marcos López-Brea Baquero. Supervised by Pedro Linares Llamas.

- Security-constrained optimal power and natural-gas flow
  Carlos Mario Correa Posada. Supervised by Pedro Sánchez Martín.

- Economic impact of the provision of active power control by wind farms from system’s perspective
  Alejandro Contreras Alfonsín. Supervised by Javier García González.

- Improvement of voltage ride through capability of synchronous generators with supplementary excitation controllers
  Luis Díez Maroto. Supervised by Luis Rouco Rodríguez and Fidel Fernández Bernal.

- Regulation for off-grid electrification of isolated rural areas in Guatemala
  Andrés González García. Supervised by José Ignacio Pérez Arriaga.

- A conjectural supply function equilibrium in energy and reserve for a weekly horizon
  Pablo González Gascón y Marín. Supervised by José Villar Collado and Francisco Alberto Campos Fernández.

- Optimal investment in smart MV/LV substations to improve continuity of supply
  Andrea Rodríguez Calvo. Supervised by Pablo Frías Marín.

- Revisiting strategic bidding models based on the residual demand in european electricity PXS: the role of renewables
  Samuel Vázquez Martínez. Supervised by Carlos Batlle López and Pablo Rodilla Rodríguez.

- Analyzing spot prices in a context with high penetration of variable energy resources: the key role of the pricing rules
  Andrea Veiga Santiago. Supervised by Carlos Batlle López and Pablo Rodilla Rodríguez.

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: Conducción eficiente de trenes metropolitanos con ATO  
  Author: María Domínguez Gago  
  Supervisors: Antonio Fernández Cardador and Asunción Paloma Cucala García  
  Date: May 10, 2013

- Title: Nonlinear dynamics of viscoelastic fluids in a closed loop thermosyphon  
  Author: Justine Yasappan  
  Supervisors: Angela Jiménez Casas and Mario Castro Ponce  
  Date: June 19, 2013

- Title: Using semantic web resources to achieve metadata interoperability in the scope of future smart grids  
  Author: Rafael Santodomingo Berry  
  Supervisors: José Antonio Rodríguez Mondéjar and Miguel Ángel Sanz Bobi  
  Date: June 25, 2013

- Title: Generation expansion planning in electricity markets with bilevel mathematical programming techniques  
  Author: Sonja Wogrin  
  Supervisors: Efraim Centeno Hernández and Julián Barquín Gil  
  Date: June 26, 2013

- Title: Economic regulation of distribution system operators and its adaptation to the penetration of distributed energy resources and smart grid technologies  
  Author: Rafael Cossent Arín  
  Supervisor: Tomás Gómez San Román  
  Date: July 11, 2013

- Title: Diseño eficiente de servicios ferroviarios y control de la conducción en alta velocidad  
  Author: Carlos María Sicre Vara del Rey  
  Supervisors: Asunción Paloma Cucala García and Antonio Fernández Cardador  
  Date: July 22, 2013

5.5.2 Submitted Theses in other universities

- Title: Contributions to cascade linear control strategies applied to grid-connected voltage-source converters  
  Author: Ana Rodríguez Monter  
  Supervisors: Emilio José Bueno Peña and Aurelio García Cerrada  
  Universidad de Alcalá de Henares. Alcalá de Henares, Madrid (Spain).  
  Date: July 01, 2013
5.5.3 Comillas ongoing theses

- Title: Metodología de ayuda a la decisión para la electrificación rural apropiada en países en vías de desarrollo
  Author: Francisco Javier Santos Pérez
  Supervisor: Pedro Linares Llamas

- Title: Análisis de mercados eléctricos no ideales: interconexiones y funciones de costes no convexas
  Author: Félix Fernández Menéndez
  Supervisors: Julián Barquín Gil and Begoña Vitoriano Villanueva

- 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: Predicción a corto plazo del precio de la electricidad mediante modelos de series temporales con cambio de régimen
  Author: Alberto Miguel Cruz García
  Supervisor: Antonio Muñoz San Roque

- Title: Contributions to interpretable nonparametric regression. An application to mid-term forecasting of energy demand
  Author: Ana Berzosa Muñoz
  Supervisor: Eugenio Francisco Sánchez Úbeda

- Title: Analysis of oligopolistic electricity markets with network constraints
  Author: Cristian Andrés Díaz Durán
  Supervisors: Francisco Alberto Campos Fernández and José Villar Collado

- 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

- Title: Hybrid modeling for electricity policy assessments
  Author: Renato Dias Bleasby Rodrigues
  Supervisors: Pedro Linares Llamas and Antonio Gómez Gómez-Plana

- 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
- Title: Modelos de detección de comportamientos de personas en situaciones reales usando visión artificial. Aplicación a los sistemas de seguridad
  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: Kristín Dietrich
  Supervisors: Luis O'Imos 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: Improvements in the PLC systems for smart grids environments
  Author: Javier Matanza Domingo
  Supervisors: Sadot Alexandres Fernández and Carlos Rodríguez-Morcillo García

- Title: A new decision support system for large-scale flexible transmission expansion planning
  Author: Sara Lumbreras Sancho
  Supervisor: Andrés Ramos Galán

- Title: Indoor topological SLAM using frontal computer vision
  Author: Jaime Boal Martín-Larrauri
  Supervisor: Álvaro Sánchez Miralles

- Title: Modelling and assessment of sustainability in transport policies
  Author: Alessandro Danesin
  Supervisors: Pedro Linares Llamas and José Ignacio Pérez Arriaga
- Title: Improving the integration of systems in smart homes using semantic techniques
  Author: Javier Juárez Montojo
  Supervisors: José Antonio Rodríguez Mondejar and Carlos Rodríguez-Morcillo García

- 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
6. Other activities

6.1 EES-U ETP

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

The Electric Energy Systems - University Enterprise Training Partnership (EES-U ETP) 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-U ETP is to increase the competitiveness and profitability of the electricity sector through technology training. In this sense, the main activities of the EES-U ETP are the organization of advanced courses in electric power systems and exchanges of students and researchers.

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

6.1.1 EES-U ETP partners

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

- **Austria**
  - Graz University of Technology

- **Belgium**
  - Katholieke Universiteit Leuven (KU Leuven)

- **Croatia**
  - Energy Institute Hrvoje Požar
  - University of Osijek

- **Denmark**
  - Danmarks Tekniske Universitet

- **Finland**
  - Graduate School in Electrical Energy Engineering (GSEEE)

- **France**
- École Supérieure d’Electricité (SUPELEC)
- Electricité de France
- Gestionnaire du Réseau de Transport d’Electricité (RTE)

- **Germany**
  - Technische Universität Dortmund

- **Greece**
  - National Technical University of Athens

- **Ireland**
  - University College Dublin

- **Italy**
  - ENEL
  - Università degli Studi di Bologna
  - Università degli Studi di Cagliari
  - Università degli Studi di Genova

- **Latvia**
  - Riga Technical University

- **Portugal**
  - INESC Porto

- **Spain**
  - Catalonia Institute for Research in Technology (IREC)
  - Iberdrola, S.A.
  - Universidad de Sevilla
  - Universidad Politécnica Valencia
  - Universidad Pontificia Comillas

- **Sweden**
  - KTH Royal Institute of Technology

- **Switzerland**
  - École Polytechnique Fédérale de Lausanne (EPFL)
  - ETH Zürich

- **United Kingdom**
  - University of Manchester
  - University of Strathclyde

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

### 6.1.2 Teached courses

- Cyber-Physical system security of the power grid
  KTH Royal Institute of Technology, Stockholm, Sweden; ETH Zürich, Zürich, Switzerland; University College Dublin, Dublin, Ireland

- Co-Simulation of energy and ICT systems
  KTH Royal Institute of Technology, Stockholm, Sweden
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:

- Manuel Alvar Miró, in Department of Environmental Sciences, Informatics and Statistics, Università Ca'Foscari Venezia, Venice (Italy). July-October 2012.

- Álvaro Arranz Domingo, in Institute of Systems and Robotics (ISR-UC), Universidad de Coimbra, Coimbra (Portugal). July-September 2012.

- Renato Dias Bleasby Rodrigues, in Department of Civil and Environmental Engineering, University of Maryland, Maryland (USA). July-October 2012.


- Pablo Dueñas Martínez, in MIT Energy Initiative, Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). July-October 2012.

- Carlos María Sicre Vara del Rey, in Department of Engineering and Applied Sciences, Universidad de Sophia, Tokyo (Japan). July-November 2012.

- Cristian Andrés Díaz Durán, in Department of Engineering System Division (ESD), Massachusetts Institute of Technology (MIT), Cambridge, MA (USA). November 2012-February 2013.

- Pablo Ayala Santamaría, in Department of Flow, Heat and Combustion Mechanics. Faculty of Engineering, Ghent University, Ghent (Belgium). February-June 2013.

International exchanges


- Sonja Wogrin, in Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, Maryland (USA). March-May 2013.


- Ana Moreno Barrado, in Physik Farberai AG Urbassek, Technische Universität Kaiserslautern (TU), Kaiserslautern (Germany). June-September 2013.

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

- Mariano Ventosa Rodríguez, in Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, Maryland (USA). July-August 2013.

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

- Jesús Jiménez Octavio, in Department of Agricultural Engineering in the Tropics and Subtropics, Universität Hohenheim, Stuttgart (Germany). August 2013.

- Cristina Sánchez Rebollo, in Department of Agricultural Engineering in the Tropics and Subtropics, Universität Hohenheim, Stuttgart (Germany). August 2013.

6.3 Visiting professors

- Tad Gonsalves, from Information & Communication Sciences, Sophia University, Tokyo (Japan). September 2012.


- Joseph Eto, from Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, Berkeley, California (USA). November 2012.

6.4 Visiting students


- Juliana Mesquita, Universidad Pontificia Comillas, March-July 2013.

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


- Alexander Cafee, from Department of Mechanical Engineering, Johns Hopkins University, Baltimore (USA). May-July 2013.

- Alexander Kaczkowski, University of Illinois Urbana-Champaign, Chicago (USA). May-July 2013.

- Michael Peven, from Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore (USA). May-July 2013.


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

Courses offered to external companies and institutions


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


- Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque, "Curso sobre técnicas avanzadas de predicción aplicadas a la demanda de electricidad". Endesa. October-December 2012.

- Carlos Batlle López, Javier Reneses Guillén, Mariano Ventosa Rodríguez, Michel Rivier Abbad, Rafael Cossent Arín, "FSR e-learning course on regulation of energy utilities (8th Edition)". European University Institute, Florence School of Regulation. November 2012-June 2013.


- Javier Reneses Guillén, Pablo Frías Marín, Carlos Mateo Domingo, Rafael Cossent Arín, "Curso de formación sobre el negocio de distribución eléctrica: aspectos técnicos y regulatorios". CIDE. January-July 2013.

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:

- Efraim Centeno Hernáez, "Oportunidades de innovación en procesos industriales y el sector de la energía". Jornada Día del Emprendimiento Comillas/ICAI/ICADE. Universidad Pontificia Comillas.


- Mariano Ventosa Rodríguez, "Identificar los actores privados y los itinerarios formativos que se están desarrollando para formar a los ingenieros en sus competencias". I Congreso Internacional de Formación y Movilidad en el Sector de la Ingeniería. Fundación Madrid Centro Mundial.


- Joseph Eto, "Use of frequency response metrics to assess the planning and operating requirements for reliable integration of variable renewable generation". Aula de investigación. Universidad Pontificia Comillas.

- Joern Constantin Richstein, "Modelling power system transitions with an agent-based model". Aula de investigación. Universidad Pontificia Comillas.

- Ana Moreno Barrado, "Taller: Ripple dynamics driven by stress induced solid flow". X Workshop of the GISC. Universidad Carlos III de Madrid.

- Tomás Gómez San Román, "La sostenibilidad del sector eléctrico en España: Retos y recomendaciones". Cátedra BP de Energía y Sostenibilidad (ICAI) Universidad Pontificia Comillas.


- Tomás Gómez San Román, "Modelo conceptual para la regulación de la actividad de distribución de electricidad". Programa Superior de Dirección de Empresas de Distribución de Electricidad. CIDE.


- Tomás Gómez San Román, "Enhancing the retail market functioning. DSO unbundling and metering data handling in Europe". CEER-CRE-FSR Workshop. CEER-CRE-FSR.

- Pedro Linares Llamas, "El ecosistema emprendedor en la Universidad Pontificia Comillas". Jornada Día del Emprendimiento Comillas/ICAI/ICADE. Universidad Pontificia Comillas.

- Carlos Batlle López, ""The US experience" in Session I: A common understanding and available experience in promoting adequacy and security in the European electricity market". FSR Workshop on Generation adequacy and security of supply in the internal electricity market. Florence School of Regulation.

- Mario Castro Ponce, "Climate variables and seasonal influenza". Seminars of the Theoretical Biology Department. Utrecht University.

- Tomás Gómez San Román, "Enfoque hacia el cliente como eje de las actividades". El papel del cliente en el nuevo modelo energético. UIMP; E.ON.
- Tomás Gómez San Román, “Importancia de la seguridad del suministro eléctrico en la red del presente y del futuro”. Jornada sobre “Seguridad del suministro eléctrico”. Fundación para el Fomento de la Innovación Industrial (FFII) ; CNE.

- Tomás Gómez San Román, "Regulación para el desarrollo de las Smart Grids". I Congreso Smart Grids. AFME; FutuRed; Grupo Tecma Red;.


- José Ignacio Pérez Arriaga, "Wholesale markets’ performance with high participation of RES". 3rd OMIE International Workshop The impact of RES on wholesale electricity markets: Special reference to the German case. OMIE.


- José Ignacio Pérez Arriaga, ""Developing a common taxonomy & shared understanding" in Session I: A common understanding and available experience in promoting adequacy and security in the European electricity market". FSR Workshop on Generation adequacy and security of supply in the internal electricity market. Florence School of Regulation.

- José Ignacio Pérez Arriaga, "Chair in Session II: Capacity adequacy and system security in the Electricity Target Model". FSR Workshop on Generation adequacy and security of supply in the internal electricity market. Florence School of Regulation.

- José Ignacio Pérez Arriaga, "Task Force on Electricity Security of Supply (ESS TF). Workstream on Capacity Mechanisms and Market Integration (CMI WS)". HACER.

- José Ignacio Pérez Arriaga, "Dual gas and electric modeling". 16th MITEI Symposium: "Growing concerns, possible solutions: The interdependency of natural gas and electricity systems". Massachusetts Institute of Technology (MIT).

Seminars


- Carlos Batlle López, José Ignacio Pérez Arriaga, "The value and impact of renewables". Fall 2012 CEEPR Workshop. MIT CEEPR.


6.7 Congress, seminars and journals organization


6.8 Other academic activities organization


### 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, Director of Energy Training in Florence School of Regulation (FSR). Florence (Italy). March 2001- 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.


- 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.

Other activities


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


- Eugenio Francisco Sánchez Úbeda, External course in "Estadística aplicada a mercados energéticos (segunda edición)". Endesa. Madrid (Spain). June 2013.


- Carlos Maté Jiménez, Journal reviewer in "IEEE Transactions on Neural Networks and Learning Systems". Institute of Electrical and Electronics Engineers (IEEE). Piscataway (USA). February-June 2013.

- Rafael Palacios Hielscher, External dissertation committee in "Anomaly detection in airline routine operations using flight data recorder data" por Lishuai Li. Massachusetts Institute of Technology, Department of Aeronautics and Astronautics. Cambridge, MA (USA). May 2013.
7. Data about IIT

The relevant numbers of the academic year 2012 - 2013 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:

5,40 M€ Turnover
60 Professors and researchers
63 Research assistants
91 Research projects
25 Consultancy projects
3 Services and analyses projects
23 Chapters in books
31 Papers published in JCR journals
19 Papers published in other journals
88 Papers presented at conferences
19 Technical reports
6 Submitted theses
23 Ongoing theses
15 Visiting professors and students
18 International exchanges
15 Courses offered to external entities
Data about IIT

**Turnover**

- Million

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**Staff**

- Academic Staff
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