

Dr. Ignacio Pérez Arriaga

Curriculum Vitae

Personal Information

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| Name | Ignacio J. Pérez-Arriaga |
| Address-1 | Institute for Technological Research (IIT, Instituto de Investigación Tecnológica) Comillas University Alberto Aguilera, 23 – Madrid 28015, Spain |
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| E-mail | ipa@mit.edu , ignacio@iit.comillas.edu |
| Webpage | https://www.iit.comillas.edu/people/ignacio |
| Address-2 | MIT Energy Initiative Room E19-432H MIT 77 Massachusetts Avenue Cambridge, MA 02142 USA |
| Nationality | Spanish |
| Date of birth | 23/06/1948 |
| Languages | <ul style="list-style-type: none">• Spanish (first language)• English (ability to read, write and speak: excellent)• French (ability to read, write and speak: good) |
| University Degrees | <ul style="list-style-type: none">• Ph. D. in Industrial Engineering, Universidad Politécnica de Madrid, June 1982.• Ph. D. in Electrical Engineering, Massachusetts Institute of Technology (MIT), USA, June 1981.• Master of Science in Electrical Engineering, Massachusetts Institute of Technology (MIT), USA, June 1978.• Electrical Engineer, Instituto Católico de Artes e Industrias (I.C.A.I.), Universidad Pontificia Comillas, Madrid, June 1970. |
| Present Positions | <ul style="list-style-type: none">• APR. 2000 – PRESENT. Full professor of Electrical Engineering, Universidad Pontificia Comillas, Madrid.• SEP. 2008 – PRESENT. Visiting professor (on a permanent basis), Engineering Systems Division (ESD) (2008 – 2014) and the Sloan School of Management (2015 – PRESENT), MIT, Boston, USA.• MARCH. 2004 – PRESENT. Part-time professor and Director of Energy Training of the Florence School of Regulation (Robert Schumann Center) at the European University Institute in Florence (Italy) and of the FSR Global.• DEC. 2002 – 2018. Director of the BP Chair on Energy and Sustainability, |

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Universidad Pontificia Comillas.

- SEPT. 2012- PRESENT. Member of the International Advisory Board of the Enel Foundation.
 - MARCH. 2004 – PRESENT. Member of the European Energy Institute, www.eeinstitute.org/ a think tank of academics with the purpose of advising the European Commission on energy matters.
 - OCT. 2003 – PRESENT. Elected member of the Spanish Royal Academy of Engineering.
 - JUL 2013 – PRESENT. Member of the Advisory Board of ONGAWA, Madrid, Spain.
 - JUNE 2015 – PRESENT. Member of the Editorial Board of the journals “European Review of Energy Markets” and “Papeles de la Energía”.
 - May 2018 – PRESENT. Member of the Advisory Board - Payne Institute for Earth Resources. Colorado School of Mines. USA.
- Previous Positions**
- OCT. 2011 – OCT. 2016. Member of the Board of Appeal of the Agency for the Coordination of Energy Regulators (ACER) in the European Union.
 - MAY 2010 – DEC. 2014. Review Editor of the 5th Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC).
 - NOV. 2007 – October 2012. Independent Member of the Irish Regulatory Committee for the Single Electricity Market. President of the Committee for one third of this time.
 - SEP. 2013 – 2018. Director of the International Doctoral School, Universidad Pontificia Comillas.
 - SEPT. 2006 – SEPT. 2015. Member and Chairman since 2010 of the Scientific Advisory Board of the “Next Infrastructures Program”, Delft University, The Netherlands.
 - SEPT. 2007 – SEPT. 2012. Member of the Scientific Committee of IEFE, Bocconi University, Milano, Italy.
 - JUN. 2000 – JUN. 2005. Chairman of the Advisory Board to the Central American Governments for the development of the Electricity Regional Market.
 - OCT. 2001 – JAN. 2012. Director and lecturer of the Master Program (500 hours) on “Technical and Economic Management of the Electric Power Sector”, Comillas University.
 - SEPT. 2000 NOV. 2004. Advisor to the Electricity Working Group of the Council of European Energy Regulators (CEER).
 - May 2011 – December 2011. Member of the Advisory Committee for the EU General Direction for Energy on the Energy Roadmap 2050.
 - APR. 1995 – APR. 2000. Commissioner at the Comisión Nacional del Sistema Eléctrico (Spanish National Electric Regulatory Commission).
 - SEP. 1994 - APR. 1995. Vice-Rector for Research and Doctoral Programs of the Universidad Pontificia Comillas, Madrid.
 - FEB. 1984 - SEP. 1994. Full professor of Electrical Engineering. Founder and Director of the INSTITUTO DE INVESTIGACION TECNOLÓGICA (IIT) of the Universidad Pontificia Comillas, Madrid.
 - SEPT. 1981 - FEB. 1984: Director of Research Programs in the Energy Division of the INSTITUTO TECNOLÓGICO DE POSTGRADUADOS (ITP), Madrid.
 - MAY - AUGUST 1981: Electric Power Systems Engineering Laboratory, MIT, consultant for the research program RP1764-8 of the USA Electric Power Research Institute on advanced concepts in power systems analysis.

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- 1975-1981. Graduate student, Electric Power Systems Engineering Laboratory, MIT. Occasional collaborations with ITP in the identification of research programs for the Spanish electricity industry.
 - 1970 - 1975. Lecturer in the Electrical Engineering School (courses in Physics and Electromagnetic Theory), ICAI, Comillas University.
 - 1970 - 1972. Undergraduate Officer of the Engineering School, ICAI, Comillas University.
- Honors**
- Life Member of the Spanish Royal Academy of Engineering since October 2003.
 - Director of the BP Chair on Energy and Sustainability at Comillas University, Madrid, Spain.
 - Life Fellow of IEEE (Institute of Electric and Electronic Engineers). First IEEE Fellow in Spain in the area of power systems.
 - “Chapter Outstanding Engineer Award” of the Spanish Chapter of the IEEE Power and Energy Society.
 - Javier Benjumea Award 2005 to the “Engineer of the year”, from ICAI Engineering Association.
- Practice of the profession as an energy regulator**
- Ten years of professional practice as energy regulator. Only European who has been commissioner in the Energy Regulatory Authority of two countries: Spain (1995-2000) and Ireland (2007-2012; President of this Commission for one third of this time).
 - Member of the Court of Appeal (six members) of the Agency for the Coordination of Energy Regulators of the European Union, since this Court was created in October 2011, for a five-year term.
 - Advisor of the Electricity Working Group of the Council of European Energy Regulators (CEER) from 2001 to 2005.
 - Author of the White Paper on the Reform of the Electric Power Sector for the Spanish Government in 2005.
 - Advisor of the European Commission (EC) in multiple occasions: Transmission cost allocation in international trade (2001 and 2003); as one of the sixteen members of the European Energy Institute, an advisory body to the Energy Directorate of the EC; as member of the Advisory Group for the Energy Roadmap 2050 (2011); as member of the Steering Committee of project THINK to advise the EC in Energy Policy (2009-2014); member of several advisory groups to the Agency for the Cooperation of Energy Regulators (ACER) on specific matters: transmission investment and pricing and capacity instruments.
 - Consultant and advisor of companies and institutions on energy regulation in more than 40 countries.
 - Chairman of the Advisory Board (2000 to 2005) to the Governments of Central America about the development of a regional electricity market. Significant contributions to the design of this market (1988-2000).
 - As an academic, my research has been very much applied to addressing practical problems of power systems. Principal investigator of about one hundred research projects, most of which on request from electric utilities, governments, development banks, foundations or regulatory commissions. The Institute for Research in Technology that I founded in 1984 at Comillas University in Madrid and was its Director for eleven years, presently has about one hundred members and is 100% financially supported from research projects that address actual problems of firms and institutions.
 - Responsible for the professional training of the staff of the European Energy

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Regulatory Commissions (2001-present). Appointed by the Council of European Energy Regulators (CEER) as the Director of Energy Training at the Florence School of Regulation (FSR) in the European University Institute (Florence, Italy), since its creation. FSR was the first headquarter of the World Association of Energy Regulation.

Teaching Activity

- FEB. 2017 – PRESENT. MIT Spring term course: “Planning, policy, and technology for energy access in developing countries”, graduate course 15.S02, Boston, USA.
- FEB. 2015 – JUNE 2015: Director and instructor of the MOOC (Massive On-line Open Course; 5-month duration; twice a year) on Regulation of the power sector, Florence School of Regulation and Comillas University.
- FEB. 2009 – PRESENT. MIT Spring term course: “Engineering, Economics and Regulation of the Electric Power Sector”, graduate course ESD.162, 15.032 and 6.695 at MIT, Boston, USA.
- JAN. 2018 – PRESENT. Director of the MOOC (Massive On-line Open Course; 5 month duration; twice a year) on “Regulation for Sustainable Development Goal 7”, Florence School of Regulation.
- FEB. 2006 – 2013: Graduate course on “Advanced topics in electricity regulation”, Comillas University doctoral program.
- OCT. 2001 – JAN 2012: Director and lecturer of the Master Program (500 hours) on “Technical and Economic Management of the Electric Power Sector”, Comillas University. Graduate course on “Electricity regulation”.
- Director of Energy Training and lecturer of several short training courses and the annual e-learning and residential course (8 months) for the staff of European energy regulatory authorities at the Florence School of Regulation, European University Institute, since 2001 until present time.
- Director of the e-learning courses (3 editions, 5-month duration) for staff of Administrations and regulatory institutions in Latin America on “Electricity regulation”, in cooperation with the World Bank, the Spanish Ministry of Industry and CEDDET. 2004-2008.
- Director of two courses for the Energy Regulators Regional Association (ERRA), (one-week course in Budapest, 2003, and a three-month e-learning course).
- SEP. 1994 - APR. 1995. Vice-Rector for Research and Doctoral Programs of the Universidad Pontificia Comillas, Madrid.
- 1988-1995. Tenured professor in the School of Engineering (ICAI) of Comillas University. Graduate courses in "Optimal planning, operation and control of electric energy systems", "Electric energy markets", “Regulation of the electric power sector”, “Regulation of electricity transmission” and “Wholesale and retail electricity markets”.
- Tenured assistant professor in the School of Engineering of the Madrid Polytechnic University (October 1986 to May 1990. Presently with a permanent leave of absence). Graduate course on "Reliability of Electric Power Systems".
- JULY 1988 - JULY 1989. Visiting professor in the Massachusetts Institute of Technology, Laboratory for Electromagnetic and Electronic Systems. Graduate course on "Planning, operation and control of electric power systems".
- 1970 - 1975. Lecturer in the Electrical Engineering School (courses in Physics and Electromagnetic Theory), ICAI, Comillas University.

Research and

Principal researcher of about 100 research projects (see details below) and consultant for firms and institutions in more than 40 countries on the following topics:

- Electricity economics and regulation. Energy and sustainability.

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Consulting

- Universal access to electricity. Development of electrification planning computer tools and design of regulatory and business models.
- Transmission regulation: investment, access and pricing.
- Modelling, analysis and optimization of the operation and planning of large generation, transmission and distribution electric energy systems.
- Modelling, stability analysis and control of large dynamic systems. Techniques for model order reduction. Applications to large electric networks.
- Reliability engineering of generation, transmission and distribution systems.
- Computer-aided optimal design of electric machinery.
- Development of expert systems for incipient fault diagnosis of complex industrial systems. Applications to thermal power plants. Optimization of maintenance strategies.

Energy Modelling Activity

Many of the projects that are listed below had the final objective of producing a computer model for industrial use. The applications range from analysis of stability of large interconnected networks to reliability evaluation of large integrated power systems, expert systems for various applications, production cost models for electric power systems or expansion models of transmission networks or electric generation. Some representative examples are:

- "REM" (Reference Electrification Model", a model that, given the position and estimated hourly profile of annual demand for each building in a territory (with up to millions of buildings), plus the existing network infrastructure and its reliability, determines the optimal electrification mode for each building (grid extension, off-grid microgrids or stand alone systems), the layout of the network that is needed to reach each building, and the optimal design (generation and network layout) of each microgrid, and estimates the operation and capital costs of the electrification plan. If the position of the buildings is unknown, the model can identify the position of the buildings from satellite imagery.
- "PERLA" and "CHOPIN", for long-term expansion planning of electric transmission networks. They were developed and have been used by the Spanish National Grid Company (Red Eléctrica de España).
- "MODEX", a production cost model for a large hydro-thermal generation system (developed for ENDESA).
- "JUANAC", a model to compute nodal prices (short-term marginal costs) in the nodes of a generation / transmission system (the model has been used by IBERDROLA, Red Eléctrica de España, and firms and institutions of more than 10 countries, including the dispatch of generation of the Argentinean system).
- "MEPAM", a model for the allocation of costs of a transmission network among its users in an electricity market (IBERDROLA, Rumanian Regulatory Commission, DG TREN of the European Commission, Council of European Energy Regulators).
- "SEQA", an expert system for predictive analysis of water chemistry in power plants.
- "SMAS3", a model for oscillatory stability analysis of large interconnected power systems (IBERDROLA, Red Eléctrica de España, Electricité de France, CAMMESA in Argentina).
- "MARGEN", a model for the analysis of marginal prices and production costs in competitive electricity markets (ENDESA).

Projects:

1. "Development of a production cost model of electric generation" for ENDESA (1981-1985).
2. "Data base and methodology development for generating plant reliability analysis" for HIDROELECTRICA ESPAÑOLA, S.A. (1982-1985).
3. "Perturbations in distribution electric networks" for UNION ELECTRICA

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- FENOSA (1982-1984).
4. "Insulation and protection system coordination" for UNION ELECTRICA FENOSA (1982-1984).
 5. "Reactive power planning" for UNION ELECTRICA FENOSA (1982-1984).
 6. "Specification of the computer requirements for the Energy Control Center and technical support at an electric utility" for ENDESA (1983).
 7. "Computer-aided optimization of air-core reactors" for ARTECHE HERMANOS, S.A. and IBERDUERO (1984).
 8. "A data base for global management of a distribution system" for UNION ELECTRICA FENOSA (1984).
 9. "Reliability and economic assessment of the penetration of thermo-solar power plants in an electric system" (National Center for Energy Studies, 1984).
 10. "A reliability data base for operation and maintenance of electric power plants" for ENDESA (1985-1987).
 11. "Determination of the average supply cost of electricity" for the Department of Industry and Energy (1984-1985).
 12. "Comprehensive reliability plan for the retrofit of a coal power plant to a fluidized bed combustion technology" for ENDESA (1985).
 13. "Expert system for diagnostic and maintenance control of industrial equipment", internally funded by the UNIVERSIDAD PONTIFICIA COMILLAS (1986) and CAICYT (1987-1988).
 14. "Capacity expansion planning of generating equipment" for ENDESA (1986-1987).
 15. "Comparative reliability analysis of alternative substation configurations", internally funded by the UNIVERSIDAD PONTIFICIA COMILLAS, 1985-87.
 16. "Conceptual design of satellites using knowledge-based engineering techniques" for the EUROPEAN SPACE AGENCY (1986-1987).
 17. "State-of-the-art in long term expansion planning of electrical transmission networks" for RED ELECTRICA DE ESPAÑA (1987).
 18. "Expert system for monitoring and diagnosis of the steam-water chemistry in a generating power plant" for UNION ELECTRICA FENOSA (1987-1988).
 19. "Explanatory and predictive models of electricity demand" for the GOVERNMENT DELEGATION IN RED ELECTRICA DE ESPAÑA (1987).
 20. "Cargo accommodation in the HERMES vehicle using knowledge engineering techniques for EUROPEAN SPACE AGENCY (1989-1990).
 21. "Cost evaluation of transmission services" for RED ELECTRICA DE ESPAÑA (1988-1989).
 22. "Static optimization model for network capacity expansion" for RED ELECTRICA DE ESPAÑA (1988-1990).
 23. "Studies on a regional transmission network in Central America" for ENDESA (1988).
 24. "Automatic diagnostic system for monitoring and diagnosis of large power transformers" for Unión Eléctrica Fenosa (1991-93).
 25. "Selective Modal Analysis of Oscillatory Instability" for Iberdrola (1988-92).
 26. "An expert system consultant for on-line security assessment of electric power systems" for Iberdrola (1991-93).
 27. "Regulatory and economic study of transmission issues in a system of generation, transmission and distribution of electrical energy" for Iberdrola (1991-92).
 28. "A regulatory approach for quality of service in electric power supply" for Iberdrola (1992).
 29. "Technical and regulatory analysis of alternative schemes of third party access to transmission networks" for Iberdrola (May 92-Feb. 93).
 30. "Coordinated operation of the electric power systems of the European Community in the context of the Single Market", (Comisión Interministerial de Ciencia y Tecnología, CICYT, Julio 1992 - July 1993).
 31. "Quantitative analysis of alternative regulatory schemes for third party access in

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- electric power systems" (Iberdrola, Mayo 1993 - Mayo 1994).
32. "A generation expansion and production cost model for the strategic evaluation of alternative regulation schemes of the electric power industry" (ENDESA, January - December 1994).
 33. "Specification of an advanced annual production cost model for the Spanish electric power system" (ENDESA, March 1994 - January 1995).
 34. "Regulatory developments on the proposal of the new Spanish Law for the Electric Power Industry" (Iberdrola, October 1994 - December 1994).
 35. "An analysis of competitive bidding for incorporation of generation and load management projects in electric power systems", (Iberdrola, October 1994 - October 1995).
 36. "A proposal for regulatory development of third party access in the context of the new Spanish Law for the Electric Power Industry" (Iberdrola, December 1994 - June 1995).
 37. "Analysis of competitive regulatory models for electricity generation and evaluation of alternative schemes", (ENDESA, January 1995 - December 1995).
 38. "Evaluation of the proposals for reform of the regulatory framework of the electric power sector", consultancy for the Energy Regulatory Commission of Honduras, (May 2000 – October 2000), sponsored by the World Bank.
 39. "Benchmark of electricity transmission tariffs in the EU countries", for the TREN General Direction of the European Commission, (September 2000 – January 2001).
 40. "Studies for the implementation of the Internal Electricity Market of the European Union", external consultant for the working groups of the Council of European Energy Regulators (CEER) for regulatory development of cross-border trade (September 2000 – October 2005).
 41. "External expert advisor for the Italian Energy Regulatory Authority", (June 2000 to June 2004).
 42. "Assistance in the development of secondary regulation of electricity and heat markets for Romania", European project PHARE, for the Rumanian Energy Regulatory Commission, (June 2000 – September 2001).
 43. "Member of the Economic Council of the French Electricity Regulatory Commission, CRE", (January 2001 – December 2002).
 44. President of the Advisory Council to the Central American governments on the implementation of the Central American Regional Electricity Market, 2001 to present.
 45. "Consultancy for the Italian Market Operator (GME)", (November 2001 – May 2002).
 46. "Analysis of the costs of cross-border trade of electricity", for the Direction General TREN of the European Commission, (January 2002-December 2002).
 47. "Consultancy for the Hungarian Energy Regulatory Office, HEO", (May 2004 – September 2002).
 48. "Short consultancy for the Dutch Ministry of Economic Affairs", September 2002.
 49. "Private expert report for the Competition Authority on the events that occurred in the Spanish daily market during 19, 20 and 21 November, 2001", for ENDESA, December 2002.
 50. "Extension of the study on analysis of the costs of cross-border trade of electricity", for the Direction General TREN of the European Commission, (January 2003-October 2003).
 51. "Market design and transmission regulation for the Central American Regional Electricity Market", expert consultant for project PREEICA, SNC-Lavalin, (January 2001 – December 2003).
 52. "Trends and fundamentals of models of liberalization of electricity markets". (ENDESA. April 2002- September 2003)
 53. "Regional Electricity Market for South East Europe, SEETEC", expert

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- consultant for SNC Lavalin, (May 2002 – May 2004).
54. “Long-term guarantee of supply in the Dutch electricity market: the role of reliability options”, for the Dutch Energy Regulatory Commission, DTe, (September 2003 – January 2004).
 55. “Conceptual design of electricity tariffs for Costa Rica”, for the Costa Rican Electricity Institute, ICE, April 2003- November 2003). This study was sponsored by the World Bank.
 56. “Long term generation adequacy for the Dutch electricity market”, for the Amsterdam Power Exchange, (July 2003 – November 2003).
 57. “Impact of environmental policies on the European electricity markets”, (BBVA Bank, April 2003- March 2005).
 58. Extension of the project on “Trends and fundamentals of models of liberalization of electricity markets”. (ENDESA. April 2004- December 2004).
 59. “Technical assistance for the reform of the regulatory framework of the electricity sub-sector”, consultancy for the Ministry of Economics in Honduras, (March 2004 – June 2004), sponsored by the World Bank.
 60. “Regulatory reform of transmission regulation in the Peruvian electricity system”, for the OSINERG Regulatory Agency in Peru, (November 2005 – May 2006).
 61. “Sustainable Energy Specific Support Action, SESSA”, for the European Commission, DG Research, (May 2004 – October 2005).
 62. “Development of a capacity payment mechanism for the Russian electricity market”, jointly with Mercados Energéticos for the Russian Energy Regulatory Authority, (October 2004 – May 2005).
 63. “Member of the Supervisory Board for the Central and Eastern European Energy Market (C3EM) project, for the Regional Centre for Energy Policy Research (REKK) at the Corvinus University of Budapest, (May 2005- present).
 64. “Inter-TSO compensation mechanism for cross-border trading in the EU Internal Electricity Market”, Florence School of Regulation for GRTN (Italy), February 2005 – June 2005.
 65. “Analysis of the proposal of a White Paper for the regulatory reform of the wholesale electricity market in Peru”, for the OSINERG Regulatory Agency in Peru, (September 2005 – April 2006).
 66. “Study of the Spanish regulatory deficiencies that perturb the correct development of the supply activity”, for the Association of independent suppliers ACIE, (November 2005 – January 2006).
 67. “Enhancement of sustainable electricity supply through improvements of the regulatory framework”, European Research Project, Energy Intelligent Europe 2003-06 Project EIE 2003-015, (January 2005 – June 2007).
 68. “Virtual Balkan Power Centre for Advance of Renewable Energy Sources in Western Balkans”, for the European Commission, 6th Framework Program, (January 2005 – December 2006).
 69. “Coordinated action to consolidate RTD activities for large scale integration of Distributed Energy Resources into the European electricity market”, for the EU Commission, 6th Framework Program, (November 2005 – April 2008).
 70. “Evaluation of regulatory schemes of transmission services and system operation in the context of the Internal Electricity Market”, for the Spanish Transmission System Operator (Red Eléctrica de España), (May 2004 – May 2006).
 71. “Study on the obstacles to trade and the compatibility of market rules”, SEETEC Balkans, Southern Europe Electrical System Technical Support Project, (January 2006 – present), external expert.
 72. “Regulatory mechanisms for efficient siting of electricity generators in the Spanish transmission network”, (June 2006 – June 2007), Spanish Energy Regulatory Commission, CNE.
 73. “Training Course on the regulatory reform of electricity tariffication in Costa

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- Rica”, San José, Costa Rica, September 2006.
74. “DG-GRID: Enhancement of sustainable electricity supply through improvements of the regulatory framework” for the EU Commission, 6th Framework Program, (January 2005 – May 2007).
 75. “Coordinating energy security of supply actions (CESSA)” for the EU Commission, (January 2007 – May 2008).
 76. “Enertrans: A sustainable transport model for Spain” for CEDEX (January 2007 – December 2008).
 77. “ENERMA” for the Spanish Environmental Ministry (January 2007 – December 2008).
 78. “Proposal of electricity tariff determination methodology” for Spanish Energy Regulatory Commission, CNE. (December 2007 – March 2008)
 79. “Local Economic Signals for the connexion and the electrical transmission network” for Spanish Energy Regulatory Commission, CNE. (January 2007 – June 2008)
 80. “Analysis of the impact of large penetration of intermittent generation of electricity in the operation of the Spanish power system” REE (January 2008 – present)
 81. "The future of Natural Gas", as a member of the team of the MIT Energy Initiative, Massachusetts Institute of Technology, Boston, USA. (January 2009 – May 2011).
 82. "The future of the Electric Grid", as a member of the team of the MIT Energy Initiative, Massachusetts Institute of Technology, Boston, USA. (June 2009 – December 2011).
 83. "Road map 2050". External advisor for the European Climate Foundation. 2009-2010.
 84. "RealiseGrid", a EU project, sponsored by the 7th Framework Program, to improve transmission planning methodologies at European-wide level. Member of the Stakeholders Committee. (September 2009 - present).
 85. "THINK", a EU project to assess the EU Commission on energy policy matters. Member of the Steering Committee. (September 2009 - present). Member of the Steering Committee and leader of the module: “EU involvement in the institutional organization of distribution network tasks in gas and electricity”.
 86. “Design and development of a UK Capacity Mechanism” developed for DECC. Sep/2011-Dec/2011.
 87. “Regulatory instruments for the financial viability of an efficient and reliable power system under market-based rules, with a strong presence of renewable intermittent generation in a low carbon economy context”, developed for Nov/2010-Mar/2012.
 88. Modular Development Plan of the Pan-European Transmission System 2050, Developed for the European Commission (2012-2015).
 89. “The future of solar”, as a member of the team of the MIT Energy Initiative, Massachusetts Institute of Technology, Boston, USA. (January 2012 – present).
 90. “Low cost energy technologies for universal access” for the Enel Foundation within the COMITES consortium (January 2013 - present).
 91. “Comparative analysis of electric market regulatory systems in different Latin American countries” for the Enel Foundation within the COMITES consortium (January 2013 - present).
 92. The MIT “Utility of the future” study within the COMITES consortium (March 2013 – December 2016), three years duration for a consortium of 15 large energy companies.
 93. Natural gas fuelled distributed generation (NGDG): Opportunities and challenges”, for Eni (Italy) (April 2014-March 2016).
 94. Collaborative Research: Towards resilient computational models of electricity-gas. Collaborative research project with MIT Dr. Annaswamy, for the National Science Foundation.

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95. Solar integration in the Chilean energy system. MISTI Global Seed Fund. Dec-2013 to August 2005.
96. Rural electrification planning and microgrid design in India. MIT-Tata Center for Technology and Design. September 2013 – August 2016.
97. GCC Electricity Market Trade Forecasting. MIT project in collaboration with the National Science Agency of the Kingdom of Saudi Arabia (KACST). June 2016 – June 2018.
98. Pilot project for the electrification of a village in Rwanda taking the local school as the anchor load. For Iberdrola and with Energy without borders (Spain). Oct-2014 to Sept-2016.
99. Effective capacity expansion of renewable electricity with mosaic design of state energy and environmental regulations in the U.S. MIT Seed Fund project. May 2018 – June 2019.
100. “Application of the Reference Electrification Model (REN) to case studies in Colombia and Kenya”. For the Enel Foundation. September 2016 to February 2017.
101. Challenges of Universal Access to modern energy, and their impact on climate change. Models to support decision-making, developed for Spanish Ministry of Economy, Jan/2015-Mar/2018.
102. “Scoping the energy company of the future (to provide electricity access in developing countries)”. For the Shell Foundation. May-2017 – present.
103. “Exploratory Electrification Planning in the South Service Territory of Uganda applying the Reference Electrification Model (REM)” for Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH Promotion of Renewable Energy and Energy Efficiency Programme (GIZ PREEEP) in Uganda.
104. Adapting policies and regulation to the changing ownership structure in the electricity generation sector, developed for: International Renewable Energy Agency (IRENA). Apr/2015-Dec/2015.
105. Intelligent Distributed Management and Control of Power Systems for Isolated Communities based on Interconnectable Microgrids Energy Analytics (MULTIMICRO). MIT Seed Fund project in collaboration with Loyola University, Seville, Spain. May 2018 – August 2020.
106. Geospatial workshop for the National Universal Electrification Plan of Bolivia, developed for: Banco Interamericano de Desarrollo (BID). Sep/2019-Oct/2019
107. Least-cost electrification plan of Maluku-Papua region of Indonesia, developed for: Asian Development Bank. Nov/2018-Jun/2019
108. Identification of appropriate sites for mini-grids and development of adequate regulatory approach for integration in selected states in India. MIT, November 2018 – June 2019.
109. Mozambique geospatial options analysis towards universal electrification, developed for: World Bank. May/2018-Apr/2019.
110. Computational modeling of Distributed Energy Resources (DERs) within integrated energy stations. MIT project for ENN. January 2019 – March 2020.
111. Proposal of a business and regulatory model for the completion of electrification access in the non-connected rural areas of Colombia, developed for the Government of Colombia and funded by the Inter-American Development Bank, June 2019-March 2020.
112. Accelerating electrification in developing countries. The Global Commission to End Energy Poverty (GCEEP). MIT research project funded and in partnership with the Rockefeller Foundation. April 2019-September 2020.
113. Member and Chair of the Regulation Committee of the the Africa-Europe High-Level Platform for Sustainable Energy Investments in Africa. European Commission DG-Energy and DevCo. April 2019 – November 2019. Co-author of the final report.
114. Lessons learned from international experiences for the deployment of solar photovoltaic individual systems in non-connected rural areas of Colombia,

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developed for the Government of Colombia and funded by the Inter-American Development Bank, April 2020-July 2020.

115.

Supervision of doctoral theses

SUPERVISION OF DOCTORAL THESES

1. Analysis of subsynchronous resonance (Angel Sáiz Chicharro).
2. Dynamic stability of large electric power systems by selective modal analysis (José Luis Sancha Gonzalo)
3. Adaptive control of dynamic stability in electric power systems (Francisco Luis Pagola y de las Heras)
4. Availability analysis of power plants using event trees (Francisco. Nieto Fuentes)
5. Optimal planning of reactive compensation in transmission networks with simultaneous consideration of economic and security criteria (Tomás Gómez San Román)
6. Mid term production cost model for electric generation (Andrés Ramos Galán)
7. The generalized problem of computer-aided design optimization: Application of knowledge engineering techniques (Fernando de Cuadra García)
8. Oscillatory stability of multiarea power systems (Luis Rouco Rodríguez)
9. Static models for long-term electricity transmission network planning (Gerardo Latorre Bayona)
10. A methodology for the selection of availability improvements in medium voltage distribution networks (Luis Puertas Medina)
11. Probabilistic production cost model: A contribution to marginal pricing (Michel Rivier Abbad)
12. Optimal operation of medium voltage electricity distribution systems (Gilberto Carrillo Caicedo)
13. A methodology for cost allocation of transmission network costs in a competitive regulatory framework (Francisco Javier Rubio Odériz)
14. Marginal pricing in the remuneration of electric generation services (Claudia Meseguer Velasco)
15. Dedicated models for incipient failure detection (Rafael Palacios Hielscher). Co-director: Miguel Angel Sanz Bobi.
16. Switching planning models in electric networks: Application of knowledge engineering models (Juan José Alba Ríos). Co-director: Alain Germond.
17. Algorithms for bid matching in competitive energy markets (Carlos Vázquez Martínez). Co-director: Michel Rivier.
18. A regulatory framework for the transmission network in regional electricity markets (Luis Olmos Camacho)
19. Energy intensity in Spain. Key factors in understanding its evolution (María Mendiluce). Co-director: Carlos Ocaña.
20. Regulación versus liberalización: Evaluación de la transición a la competencia en el sector eléctrico (Alberto Núñez).
21. Designing Market Rules for Electric Power Systems with Intermittent Renewables

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(Fernando de Sisternes, MIT).

22. Integrating Dynamics and Generator Location Uncertainty for Robust Electric Transmission Planning (Pearl Donohoo, MIT).

23. Evaluation and design of sustainable energy policies: Application to the Spanish case (Alvaro López-Peña)

24. Understanding the Impact of Large-Scale Penetration of Micro Combined Heat & Power Technologies within Energy Systems (Karen Tapia, MIT).

25. Incorporating Operational Flexibility into Electric Generation Planning (Bryan Palmintier, MIT).

26. Technology Investment Decisions under Uncertainty: A New Modeling Framework for the Electric Power Sector (Nidhi Santen, MIT).

27. Engineering future power systems: the role of renewable electricity generation in transitioning to a low-carbon economy (Claudia Octaviano, MIT).

28. Optimal Decision-Making Under Uncertainty for Portfolio Owners of Natural Gas Power Plants (Tommy Leung, MIT).

29. Improving the performance of regional electricity markets in developing countries: The case of the Southern African Power Pool (Amy Rose, MIT).

30. "Creating Markets for Wind Electricity in China: Case Studies in Energy Policy and Regulation" (Michael Davidson, MIT)

31. Electricity System Planning with Distributed Energy Resources: New Methods and Insights for Economics, Regulation, and Policy (Jesse Jenkins, MIT)

32. Rate Design for the 21st Century: Improving Economic Efficiency and Distributional Equity in Electricity Rate Design (Scott Burger, MIT)

At MIT, member of the thesis committees of the (already defended) doctoral theses of, Kathleen L. Araujo ("Energy at the Frontier: Low Carbon Energy Transformation and Innovation in Four Prime Mover Countries"), Rhonda Jordan ("Incorporating Endogenous Demand Dynamics into Capacity Expansion Power System Models for Developing Countries"), Claudio Vergara ("The Contribution of Electrochemical Energy Accumulators to the Operation of Electric Power Systems"), and Maite Peña (Analyzing Capacity Pricing and Capacity Allocation Mechanisms in Shared Railway Systems).

Presently supervisor or co-supervisor of the on-going doctoral theses of Stephen Lee (MIT), Marc Barbar (MIT), Pedro Ciller (Comillas), Andrés González (Comillas) And Eduardo Sánchez (Universidad Politécnica de Madrid).

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251. "Estimating the Aggregate Impact of Distributed Photovoltaic Generation over Distribution Networks". (co-authors: Claudio Vergara, Carlos Mateo and Pablo Frías). Submitted to *IEEE Transactions on Power Systems*, April 2014.
252. "A Framework for Redesigning Distribution Network Use of System Charges Under High Penetration of Distributed Energy Resources: New principles for new problems". (co-author: Ashwini Bhaskar). Working Paper CEEPR-2014-006, Center for Environmental and Energy Policy Research, MIT. October 2014.
253. "Low-cost energy technologies for universal access: Preliminary candidate list of appropriate technologies, business models and enabling environment for universal access to modern heat" (co-authors: R. Amatyá, A. González-García, R.J. Stoner. Working Paper Series 17. Enel Foundation, MIT. October 2014
254. "Low-cost energy technologies for universal access: Preliminary candidate list of appropriate technologies, business models and enabling environment for universal access to electricity" (co-authors: A. González-García, R. Amatyá, R.J. Stoner. Working Paper Series 16. Enel Foundation, MIT. October 2014
255. "From distribution networks to smart distribution systems: Rethinking the regulation of European electricity DSOs" (co-authors: Sophia Ruester, Sebastian Schwenen, Carlos Batlle). *Utilities Policy*. vol. 31, pp. 229-237, December 2014.
256. "Renewable energy and transmission networks" (co-authors: L. Olmos, M. Rivier) in *Green energy and efficiency: an economic perspective*. Green energy and technology. Editors: Ansuategui, A.; Delgado, J.; Galarraga, I.; Ed. Springer International Publishing. Cham, Switzerland, 2014.
257. "Acceso universal a la energía y lucha contra la pobreza" (co-author: A. González-García) in *Energías renovables como instrumento de lucha contra la pobreza*. Ed. Fundación ETEA para el Desarrollo y la Cooperación. Sevilla, Spain, 2014.
258. "The impact of bidding rules on electricity markets with intermittent renewables" (co-authors: F. de Sisternes, M. Webster). *IEEE Transactions on Power Systems*. vol. 30, no. 3, pp. 1603-1613, May 2015.
259. "The system adequacy problem: lessons learned from the american continent" (Co-authors: C. Batlle, P. Mastropietro, P. Rodilla) in *Capacity Mechanisms in the EU Energy Market: Law, Policy, and Economics*. Editores Hancher, L.; [et al]. Ed. Oxford University Press. Oxford, U.K., 2015.
260. "Retos para la sostenibilidad social, económica y medioambiental del acceso universal a la electricidad" (Co-author: A. González-García), VII Congreso Nacional de Ingenieros del ICAI. Madrid, España, 19-21 November 2015
261. "Modeling intermittent renewable electricity technologies in general equilibrium models" (Co-authors: K. Tapia Ahumada, C. Octaviano, S. Rausch). *Economic Modelling*. vol. 51, pp. 242-262, December 2015.
262. "Energía y Sostenibilidad" (Co-authors: J.M. Bellver, A. Conchado, R. Cossent, A. Danesin, P. Linares, J.C. Romero) in *Informe España 2015*. Editores Blanco, A. [et al]. Ed. Fundación Encuentro. Madrid, Spain, 2015.
263. "Prospects for grid-connected solar PV in Kenya: a systems approach" (Co-authors: A. Rose, R.J. Stoner) *Applied Energy*. vol. 161, pp. 583-590, January 2016. [Online: August 2015]
264. "Finding a representative network losses model for large-scale transmission expansion planning with renewable energy sources" (Co-authors: D. Fitiwi, L. Olmos, M. Rivier, F. de Cuadra) *Energy*. vol. 101, pp. 343-358, April 2016. [Online: March 2016]

Dr. Ignacio Pérez Arriaga

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265. "The transmission of the future: the impact of distributed energy resources on the network". *IEEE Power and Energy Magazine*. vol. 14, no. 4, pp. 41-53, July 2016. [Online: Junio 2016]
266. "A regulatory framework for an evolving electricity sector: highlights of the MIT utility of the future study". (Co-authors: J. Jenkins, C. Batlle.) *Economics of Energy & Environmental Policy*. vol. 6, no. 1, pp. 71-92, March 2017.
267. "Modeling unit commitment in political context: case of China's partially restructured electricity sector" (Co-author: M.R. Davidson), Working Paper CEEPR-2017-010, Center for Environmental and Energy Policy Research, MIT. April 2017.
268. "Improved regulatory approaches for the remuneration of electricity distribution utilities with high penetrations of distributed energy resources" (Co-author: J. Jenkins). *Energy Journal*. vol. 38, no. 3, pp. 63-91, May 2017.
269. "New regulatory and business model approaches to achieving universal electricity access". *Papeles de Energía*. no. 3, pp. 7-47, June 2017 [Online]
270. "A model for better electrification planning". (Co-authors: Y. Borofsky, R.J. Stoner). *ABB Review*, no.2, pp. 23-27, June 2017.
271. "Assessing the value of forecast-based dispatch in the operation of off-grid rural microgrids" (Co-authors: S. Mazzola; C.R. Vergara Ramírez; M. Astolfi; V. Li; E. Macchi). *Renewable Energy*, vol. 108, pp. 116-125, Aug 2017.
272. "A review of the value of aggregators in electricity systems" (Co-authors: S. Burger, J.P. Chaves, C. Batlle). *Renewable & Sustainable Energy Reviews*. vol. 77, pp. 395-405, September 2017.
273. "Inter-temporal R&D and capital investment portfolios for the electricity industry's low carbon future" (Co-authors: N.R. Santen; M. Webster; D. Popp). *Energy Journal*, vol. 38, no. 6, pp. 1-24, Nov 2017.
274. "Security of supply in a carbon-free electric power system: the case of Iceland". (Co-authors: P. Dueñas, A. Ramos, K. Tapia Ahumada, L. Olmos, M. Rivier). *Applied Energy*. vol. 212, pp. 443-454, Febr 2018.
275. "Restructuring revisited: competition and coordination in electricity distribution systems" (Co-authors: S. Burger, J. D. Jenkins, C. Batlle). Working Paper CEEPR-2018-007, Center for Environmental and Energy Policy Research, MIT. March 2018.
276. "Transmission expansion benefits: the key to redesigning the regulation of electricity transmission in a regional context" (Co-authors: L. Olmos, M. Rivier). *Economics, of Energy & Environmental Policy*. vol. 7, no. 1, pp.47-62, March 2018.
277. "Sistemas integrados de suministro eléctrico aislado conectado a la red: innovación y gobernanza organizativa para el acceso universal". (Co-author: A. González-García). *Economía Industrial*, no.408, pp. 101-112, June 2018.
278. "Stochastic sizing of isolated rural mini-grids, including effects of fuel procurement and operational strategies". (Co-authors: D. Fioriti, R. Giglioli, D. Poli, G. Lutzemberger, A. Micangeli, R. Citto, P. Dueñas). *Electric Power Systems Research*. vol. 160, pp. 419-428, July 2018.
279. "Electric energy systems: an overview" (Co-authors: H. Rudnick, M. Rivier) chapter of the book "Electric energy systems: analysis and operation". ISBN: 978-1138724792. July 2018.
280. "Modeling unit commitment in political context: case of China's partially restructured electricity sector". (Co-author: M. R. Davidson). *IEEE Transactions on Power Systems*. vol. 33, no. 5, pp. 4889-4901, September 2018.
281. "A design and dispatch optimization algorithm based on mixed integer linear programming for rural electrification". (Co-authors: L. Moretti, M. Astolfi, C.R. Vergara Ramírez, E. Macchi, G. Manzolini). *Applied Energy*. [Online: Noviembre 2018]
282. "Fair, equitable, and efficient tariffs in the presence of distributed energy resources". (Co-authors: S. Burger, I. Schneider, A. Botterud), chapter of the

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- book: *Consumer, prosumer, prosumer: how service innovations will disrupt the utility business model*. ISBN: 978-0128168356. March 2019.
283. "A utility approach to accelerate universal electricity access in less developed countries: a regulatory proposal". (Co-authors: R.J. Stoner, R. Rahnama, S.J. Lee, G. Jacquot, E. Protzer, A. González-García, R. Amatya, M. Brusnahan, P. Dueñas, F.J. Santos). *Economics of Energy & Environmental Policy*. vol. 8, 1, pp.33-50 March 2019.
 284. "Why distributed? A critical review of the tradeoffs between centralized and decentralized resources". (Co-authors: S. Burger, J. D. Jenkins, S. Huntington). *IEEE Power and Energy Magazine*. vol. 17, 2, pp.16-24, March 2019.
 285. "Restructuring revisited part 1: competition in electricity distribution systems." (Co-authors: S. Burger, J. D. Jenkins, C. Batlle). *Energy Journal*. vol. 40, no. 3, pp. 31-54, Mayo 2019.
 286. "Restructuring revisited part 2: coordination in electricity distribution systems." (Co-authors: S. Burger, J. D. Jenkins, C. Batlle). *Energy Journal*. vol. 40, no. 3, pp. 55-76, May 2019.
 287. "FSR Global Forum Report" (Co-authors: J.M. Glachant, P.L. Alessi, P. Bhagwat, S. Bhagwat, S.Y. Hadush, G. Montesano, C. Papa, N. Rossetto.) June 2019.
 288. F. Heymann, V. Miranda, F.J. Soares, P. Dueñas, I.J. Pérez-Arriaga, R. Prata. *Orchestrating incentive designs to reduce adverse system-level effects of largescale EV/PV adoption - The case of Portugal*. *Applied Energy*. vol. 256, no. 113931, pp. 1-17, December 2019. [Online: September 2019] 8.426 - Q1 (2018.)
 289. "Optimal electrification planning incorporating on- and off-grid technologies: the Reference Electrification Model (REM)" (Co-authors: P. Ciller, D. Ellman, C.R. Vergara Ramírez, A. González-García, S.J. Lee, C. Drouin, M. Brusnahan, Y. Borofsky, C. Mateo, R. Amatya, R. Palacios, R.J. Stoner, F. de Cuadra. *Proceedings of the IEEE*. [Online: Julio 2019]
 290. Jacquot, G., Pérez-Arriaga, I., Stoner, R., Nagpal, D. "Assessing the potential of electrification concessions for universal energy access: towards integrated distribution frameworks". MIT Energy Initiative Working Paper, September 2019. <http://energy.mit.edu/publication/assessing-the-potential-of-electrification-concessions-for-universal-energy-access/>
 291. Pérez-Arriaga, I. et al. "The Global Commission to End Energy Poverty. Inception report". September 2019. <https://www.endenergypoverty.org/reports>
 292. S. Burger, Ch. Knittel, I.J. Pérez-Arriaga, I. Schneider, F. Scheidt. *The efficiency and distributional effects of alternative residential electricity rate designs*. *The Energy Journal*. vol. 41, no. 1, pp. 199-239, January 2020. 2.456 - Q1 (2018).
 293. Co-author of the report "Scaling-up energy investments in Africa for inclusive and sustainable growth" as Chair of the Regulatory Committee of the Africa-Europe High-Level Platform for Sustainable Energy Investments in Africa. November 2019.
-
- Courses and lectures in Conferences**
1. Director of the annual seminar on "History of Science and Technology", School of Engineering, Comillas University, (1972-75).
 2. Organizer and speaker in the Workshop on "New operation and planning methods for the electric energy industry", jointly with the MIT Energy Laboratory, for UNESA, Madrid, June 1980 (1 week).
 3. Director and speaker of the course on "Reliability of electric power plants", for Hidroeléctrica Española, S.A., January 1984 (3 days).
 4. "Reliability of electric energy systems", for Red Eléctrica de España, S.A. Sept. 1986 (30 hours).

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5. Invited lecture on "Expert systems for security control of electric energy systems" in the seminar on "Energy control centers" organized by ACD, Seville, Oct. 1986.
6. Director and speaker of the course "Analysis of electric energy systems" for ENDESA, Nov. 1986 (30 hours).
7. "Reliability of electric power and distribution systems", Industrial University of Santander, Bucaramanga, Colombia, Feb. 1988.
8. Director and speaker in the course "Planning, operation and economy of electric energy systems", Valle University, Cali, Colombia, June 1990 (30 hours).
9. Invited lecture on "Evaluation and control of the economic operation of electric energy systems" in the Seminar on Supervision and Control of Engineering Systems of the Menéndez Pelayo International University, El Ferrol, July 1990.
10. Invited lecture on "Spot prices for the economic valuation of transmission services", in the Energy Economic Training Limited Workshop on "Access and pricing of grid systems", Paris, Nov. 1990.
11. Course on "Economic evaluation of transmission services" (18 hours), Pontificia Universidad Católica de Chile, Santiago, Dec. 1990.
12. Invited lecture on "Electric tariffs with real time discrimination" in the Seminar on Energy Conservation of the Menéndez Pelayo International University, El Ferrol, July 1991.
13. Instructor of the course "Expert systems in electric power systems", Decision Systems International, Monaco, July 1991. Director and instructor of the same course, Madrid, Sept. 1992.
14. "Economic valuation, spot prices and transmission services in electric power systems" (16 hours), Pontificia Universidad Católica de Chile, Dec. 1991.
15. Invited lecture on "Selective modal analysis", Seminar on Applied Mathematics, Carlos III University, Nov. 1992.
16. Invited lecture on "The electric energy market in England and Wales", within the course on Energy Economy of the Spanish Energy Institute, May 1992, Feb. 1993.
17. "Marginal pricing of electricity: Remuneration of generation and transmission services. Recent experiences, difficulties and proposed solutions", invited lecture (4 hours) within the Seminar on "The Marginal Tariff in the Argentinean Electric Power Industry", Buenos Aires, 9-10 September 1993.
18. Lectures on "Decentralized Competitive Planning", "Short Term Operations in Deregulated Markets" and "Transmission Network Planning" in the course on "Advanced Planning Methods in Generation, Transmission and Distribution of Electric Energy Systems", within the European COMETT program, El Escorial, Spain, September 1993.
19. Lectures on "Transmission pricing" and "Coordination of independently operated power systems" in the course on "Operation of the Interconnected

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European Power System: Economic and reliability Issues", within the European COMETT program, Paris, October 1993.

20. "New Strategies in operation and planning of electric power systems in the new competitive markets", invited conference in the XIII National Meeting of Specialized Engineering, Colombian Association of Electrical, Mechanical and Electronic Engineers (ACIEM), Bucaramanga, Colombia, October 1993.
21. "Electric power markets", 20 hours course at the Universidad Industrial de Santander, Bucaramanga, Colombia, October 1993.
22. "The regulation of the electric power industry in Argentina and Chile", in an Energy Economic Training Limited Workshop on "Competition and deregulation in the electricity industry", Paris, December 1993.
23. "Electric Power Markets", 30 hours course for the Association of Generators of the Argentine Power Market, Buenos Aires, Argentina, June 1994.
24. "International Experience in Transmission Open Access", invited paper in the Panel on Transmission Open Access, IEEE Power Engineering Society Summer Meeting, San Francisco, July 1994.
25. "Quantitative and Regulatory Analysis of Competitive Electricity Markets", Instituto de Estudios Superiores de la Empresa (IESE), Barcelona (Spain), September 1994.
26. "Competitive generation markets", Iberdrola, 1st Convention of generation executives, Madrid (Spain), March, 1995.
27. "Argentina, what should have been done differently?" in the "Competitive Restructuring of Electricity Supply Industries" workshop, London (U.K.), April 1995.
28. "Operation in deregulated markets", 1995 Latin American Power Industry Summit, Santiago de Chile (Chile), May 1995.
29. "The Spanish Experience", VI Repsol-Harvard Seminar, S'Agaró (Spain), June 1995.
30. "Planning of the future of electricity sector in Spain" in the Seminar "Southern Europe versus single electricity market". Club Diálogos para la Democracia, Madrid, October 1995
31. "Principles of network pricing, access and investment". Colloquium on Network Pricing, Investment and Access, London, October 1995.
32. "Regulation of the Electric Power Sector in Spain", World Bank Workshop on Legal and Regulatory Reform for the Power Sector in China, Beijing, November 1995
33. "The regulation of the electricity sector: Trends in an international context". Course on Systems Engineering,UPCO-ICAI. Madrid, January 1996
34. "The regulation of electricity sector: trends in an international context, Specialization Course on Electricity Engineering Markets, Universidad Carlos III, Madrid, February 1996

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35. "The LOSEN in the context of the proposal of Directive of Internal Energy Market", Edison European Forum Specialized course of Competitive Electricity Markets, organized by Iberdrola Instituto Tecnológico. Madrid, March 1996.
36. "The regulation of electricity sector: trends in an international context", Seminar "Regulation of the electricity sector in Spain", organized by Instituto Español de la Energía. Madrid, May 1996.
37. Closure speech, "Economic and social outcomes of demand management", Conference on Demand Management in the Power Sector. Organized by Club Español de la Energía. Madrid, May 1996
38. "The role of the regulator", round table on "Technical challenges of the new organization of the Spanish electricity sector", IEEE PES Spanish Chapter, Madrid, June 1996
39. Organizer of the Colloquium "Pricing of Ancillary Services: an International Perspective", Institution of Electrical Engineers, London, June 1996
40. "General overview of remuneration and pricing of electrical services", "Remuneration of pricing service" and "Regulatory schemes of distribution services". Course on Remuneration and Pricing of Electric Engineering Services, organized by Universidad Industrial de Santander, Colombia. Bogotá, September 1996
41. "Electricity Pricing", conference on "The New Electricity Model: competitiveness in an open international market. Organized by Instituto de Fomento Empresarial y Expansión. Madrid, November 1996
42. "Development of the new Spanish Electricity Act: The competitive Generation Market", EDF-EPRI Workshop Technical impacts of Electric Utility Restructuring in the US and Europe. Paris, December 1996
43. "Planning in the electricity sector: the international experience", 7th National Meeting of Investigation Groups in Electrical Engineering, Bilbao, January 1997.
44. "The international experience in the regulation of the electricity sector", Informative meeting CSEN with specialized Economy Press, Segovia, February 1997.
45. Round table on "The internal energy market. Revision of Maastricht Treaty. A new energy policy", VI Forum Energetic, Barcelona, February 1997.
46. "Current trends in the regulation of the electricity sector", Club Español de la Energía, Madrid, March 1997
47. "The remuneration for guarantee of supply in competitive generation markets. Application to Argentinean and Spanish electricity systems". Seminar "Mechanisms of Capacity Payment in Competitive Environments". Comisión de Regulación de Energía y Gas (CREG, Colombia), Bogotá, April 1997
48. "Development of the new Spanish electricity act: the competitive generation market". 2nd APEX (Association of Power Exchanges) Meeting, Melbourne, Australia, April 1997

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49. "Introduction of competitiveness. Radical change versus gradual change". Latin-American Regulators Conference, Santiago de Compostela, May 1997
50. "The new regulatory framework of the electricity sector: the bulk power market". Specialization Course on Economy of Electricity Sector. Universidad Carlos III de Madrid, May 1997
51. "The experience of restructuring in Spain within the European context". Course Electric Utility Planning & Restructuring. Madrid, May 1997
52. "Transmission Access, Pricing & Regulation in Spain". Conference Access and Pricing of Electricity Transmission and Distribution. Koln, June 1997.
53. "The new regulatory framework of the Spanish electricity sector". Keynote speech at the REN price award, Lisbon, June 1997
54. "The experience of restructuring in Spain within the European context", "Distribution and retail" and "Planning in a competitive electricity market". Seminar Towards a competitive electricity market: theoretical and practical issues. University of Lausanne, Switzerland, June 1997.
55. "Pricing of transmission and ancillary services in Spain". IEEE Power Engineering Society, Summer Meeting 1997, Berlin, July 1997
56. "Marginal pricing of transmission services: cost recovery & network expansion", CENTREL Workshop on Transmission Services and Pricing, organized by United States Agency for International Development (USAID), Warsaw, September 1997
57. "Market structure & transmission service pricing. The case of Spain", CENTREL Workshop on Transmission Services and Pricing, organized by United States Agency for International Development (USAID), Warsaw, September 1997
58. "Market structure & transmission service pricing. The case of Argentina", CENTREL Workshop on Transmission Services and Pricing, organized by United States Agency for International Development (USAID), Warsaw, September 1997
59. "Market structure & transmission service pricing. The case of Chile", CENTREL Workshop on Transmission Services and Pricing, organized by United States Agency for International Development (USAID), Warsaw, September 1997
60. "The regulation of the power sector", II Jornadas Hispano Lusas de la Energía. Panel on "The future of energy towards 21st Century in Spain and Portugal", Santiago de Compostela, October 1997.
61. "The competitive electricity market under the new Spanish Act. A case in electricity regulation". ITBA - Instituto Tecnológico de Buenos Aires, November 1997.
62. "Reliability of electricity systems in a competitive environment. Relevant aspects and basic options. The Spanish case". 5th Anniversary of CAMMESA & the Argentine Electricity Market, Buenos Aires, November 1997.

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63. "Models of Competition. Pool vs. Third Party Access. The Spanish Option". Regulatory Forum, Paris, November 1997.
64. "The New Market in Spain", Pool Reform Conference, National Liberal Club, London, November 1997.
65. "The New Market in Spain", Seminar on System of Regulation & Deregulation of the Electricity Sector in the Czech Republic. Prague, December 1997
66. "The competitive electricity market under the new Spanish Act". Seminar Energy Market Functioning: Experience and problems of electricity and gas markets. Warsaw, December 1997.
67. "System operation and network access". Seminar: "The Spanish Electricity Act and the development of its regulations" organized by Club Diálogos para la Democracia. Madrid, January 1998.
68. "The market operation". Conference "The start of the electricity market", organized by Instituto de Fomento Empresarial. Madrid, January 1998.
69. "The competitive Electricity Market under the new Spanish Act", "Market structure and transmission service pricing. The case of Chile & Argentina", "Marginal pricing of transmission services: cost recovery & network expansion". Participation (3 conferences) in the Workshop on Pricing of Transmission and Ancillary Services in Competitive Markets. Organized by The World Bank and USAID. Riga, Latvia, March 1998.
70. "The future of the electric market". Meeting of CNSE with specialized economic press. Salamanca, March 1998.
71. "The Role of the Regulator: the Experience of Spain", "Power Sector Restructuring: the Experience of Spain", "Marginal Pricing of Transmission Services: Cost Recovery & Network Expansion" and "Comparison Between Spain and Portugal". Power Sector Reform Workshop, Jakarta, Indonesia, 4-6 May 1998. Organized by The World Bank.
72. "Spain's Approach to an Open Electricity Market" and "Identification & Treatment of Stranded Investments in Spain". 9th IIR Utilities Conference, Vienna, June 8-10, 1998.
73. "Fundamental aspects of electricity regulation" and "Remuneration and tariffs of electricity services". Participation at the Seminar "The regulation of the Colombian power sector", Santafé de Bogotá, 16-17 June 1998. Organized by Ministerio de Minas y Energía, Colombia.
74. "Regulatory and Political Forum: Developing the Regulatory Structure". Participation at the European Electricity Conference, Brussels, 6th July 1998. Organized by Business Seminars International, Ltd.
75. "The Spanish approach to an open electricity market", ICAI, School of Engineering, Comillas University, invited lecture, October 5, 1998.
76. "The experience of a transition period: Spain", lecture in the EES-UETP Course on Electricity Markets, Oporto, October 26-30, 1998.

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77. "Progress and difficulties in the restructuring of the Spanish electric system", invited lecture, IESE, Barcelona, January 25, 1999.
78. "A proposal for cross-border trading in the European Internal Electricity Market", presentation in the International Energy Agency Regulatory Forum on Pricing and Congestion in Internal Electricity transmission. The Hague, 8-9 February 1999.
79. "Progress and difficulties in the restructuring of the Spanish Electricity Sector", presentation in "Meeting on regulation of the electric power sector", organized by the High Technical School of Industrial & Telecommunication Engineering, Cantabria University, Santander, March 15, 1999.
80. "The restructuring of the Spanish electricity sector: Progress and difficulties in the development of the wholesale market", presentation in the "Meeting on the new regulation of the National Power Sector", Cádiz University, April 8, 1999.
81. "The electricity market", invited lecture in the "Introductory course to the electricity market", organized by OMEL and Enerclub, Seville, April 29, 1999.
82. "Restructuring and liberalization in Spain and the joint approach of Italy, Portugal and Spain to cross-border-trade in the EU". Brussels, September 23, 1999.
83. "The distribution activity in the new regulatory environment". Distributech Europe '99 & Power Delivery Europe '99. Madrid, September 1999.
84. Closure speech at the Conference on International Experiences about the development of electricity markets. International Association of Power Exchanges, Madrid (España). October 21-22, 1999.
85. "Regulating transmission pricing: The experience of Spain", Workshop on Regulation & Opening up to Competition, Leiden, 26 October 1999.
86. "Pricing of electricity to final consumers in Spain", European Regulatory Seminar, Roma, October 8th, 1999.
87. "Transmission and distribution pricing in Spain", European Regulatory Seminar, Roma, October 8th, 1999.
88. "Developing and regulating and new market in Spain", EEE Limited Workshop "Regulation: Where have we come from, where are we going?" London, December 1, 1999.
89. "Congestion and loss management in cross border trading", "Price regulation: The experience of Spain" and "The role of the regulator: The experience of Spain", Ljubljana Technical University (Eslovenia), January 17, 2000.
90. "Regulación de la transmisión en un ambiente nacional y multipaís", Workshop on "Problemas, oportunidades y acciones futuras para incorporar reformas de segunda generación en el sector eléctrico del Istmo Centroamericano", Managua, February 4, 2000.
91. "International transmission pricing: encouraging or hindering trade?", 3rd Euroelectric Workshop, The Electricity Industry adapting to change, Brussels, April 2000.

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92. “Aciertos y limitaciones en la liberalización del sector eléctrico español”, X Meeting of Power Systems Research Groups, Santander, March 2000.
93. “Planteamiento de los Mercados regionales de América Central y de la Unión Europea: Analogías y diferencias”, Workshop on the development of the Regional Market and cross-border transmission tariffs in Central America, Association of Electricity Regulators of Central America (ACERCA), San Salvador, June 2000.
94. Course (30 hours) “Regulación del Sector Eléctrico” given to Autorità per l’Energia Elettrica e il Gas. Milán, April 2000.
95. Organizer and speaker in Workshop on Electricity transmission system operation in liberalising markets & the Florence Regulation Forum. Madrid, June 2000.
96. Metodología de peajes de transmisión propuesta en el diseño general del MER”, Reunión sobre peajes internacionales. Consorcio PREEICA Honduras, July 25, 2000
97. “Models of power exchanges”, Conference on the Electricity Market organized by the Italian Ministry of Industry. Rome, 4 July 2000.
98. “Present charging structure. The need for an EU-wide approach”, The Adam Smith Institute International Conference on EUROPEAN ELECTRICITY TRANSMISSION PRICING. Frankfurt, September 20, 2000.
99. Training course on regulation (15 hours) in the European Project “Phare Assistance in the Development of Secondary Legislation for the Regulation of Electricity & Gas Markets”. Bucarest, September 2000.
100. “El papel de la red de transporte en el Mercado Interior de Electricidad de la Unión Europea”, Seminar “Desarrollo del Mercado Eléctrico y Peajes Internacionales en América Central”, Madrid, October 2000.
101. Course (8 hours) given to CEARE (Centro de Estudios de la Actividad Regulatoria Energética): Seminar: “Sistema de precios y tarifas en la energía”. Buenos Aires, November 2000.
102. “La decisión de expansión a través de mecanismos de mercado, ¿es compatible con el desarrollo eficiente de las redes de transporte?”, CIER (Comisión de Integración Eléctrica Regional), Buenos Aires, November 2000.
103. International Seminar Director on “Open Access in Transmission Networks” and speaker in the Conference “Principles of Transmission Regulation”. Utility Energy Systems University Enterprise Training Partnership. Madrid, December 2000.
104. Training course on regulation (10 hours) in the European Project “Phare Assistance in the Development of Secondary Legislation for the Regulation of Electricity & Gas Markets”. Bucarest, January 2000.
105. “Hacia una nueva organización del sector eléctrico en Europa”, conference in the Curso Superior de Negocio Energético, Club Español de la Energía, February 2001.
106. “El desarrollo de la infraestructura regional: Oportunidades y desafíos en

Dr. Ignacio Pérez Arriaga

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subsector de energía eléctrica”, Meeting of the Grupo Consultivo Regional para Centroamérica, Madrid, March 9, 2001.

107. “Conceptos sobre la regulación de la actividad de transmisión. Experiencias internacionales”, Taller sobre presentación de propuestas para la modificación regulatoria y la tarificación de la transmisión, organized by the Ente Regulador de los Servicios Públicos de Panamá. Panamá, March 2001.
108. “Conceptos sobre regulación de la actividad de transmisión”, Comisión de Tarifas de Energía – Compensaciones y tarifas de transmisión. Reunión de trabajo del sector eléctrico, Organized by Ministerio de Energía y Minas, Lima, March 30, 2001.
109. President of the board of thematic area: “Liberalización del sector eléctrico”, XII Reunión de Grupos de Investigación de Ingeniería Eléctrica, Badajoz, April 4-7, 2001.
110. “Electricity markets within a European context”, 9th Workshop of Marie Curie Fellows, Madrid, April 2001
111. Course (16 hours) given to Organismo Coordinador: “Curso de capacitación sobre regulación del sector eléctrico”. Santo Domingo, República Dominicana, May 2001
112. “The process of implementation of the EU Internal Electricity Market”, PHARE: Assistance in the Development of Secondary Legislation for the Regulation of Electricity & Gas Markets, Bucarest, June 2001
113. “A market approach to long-term security of generation supply”. Invited Conference in the 25th Plenary Session, Harvard Electricity Policy Group, Cambridge, Massachusetts, June 2001.
114. Opening Conference “Overview & introduction to deregulation experiences”, and invited lecture “Restructuring & liberalization of the Spanish power sector”, Deregulation Workshop, Bergen, Norway, June 2001.
115. Chairperson in IEEE Power Engineering Society-Capítulo Español in the conference about “El mercado eléctrico europeo: Próximos pasos”, Madrid, June 2001.
116. Chairman of de la session 77^a Jornadas Hispano-Lusas de Ingeniería Eléctrica. Universidad Carlos III, Madrid, July 2001.
117. Invited Conference “Transport Tariff in Spain”, for the French Electricity Regulatory Commission, Paris, October 2001.
118. Chairman of session in the 7th World Conference of the APEX “Creating Powerful Market”, Amsterdam, October 2001.
119. “Regulation of cross-border trade in the EU: An update”. 7th Conference of Association of Power Exchanges, Noordwijk, October 2001.
120. Invited Conference in the Instituto de Fomento Empresarial, “Mecanismos para incentivar inversiones en generación y en transporte”, Madrid, October 2001.
121. Director organizer and instructor of the First Training Course for Energy

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- Regulators (2 weeks) organized by the Council of European Energy Regulators, Palma de Mallorca, March 4-15, 2002.
122. “La pobreza y el deterioro medioambiental ¿cuánto y cómo debemos preocuparnos?, Conference, Aula de Opinión, Universidad Pontificia Comillas, Madrid, March 2002
 123. “Challenges and solutions in the implementation of the EU Internal Electricity Market” Fundación Hidrocantábrico, Oviedo, Spain, July 4th, 2002.
 124. Invited Conference. Iberdrola Forum “Desarrollo y Energía Sostenible”, July 15, 2002.
 125. “Energy and sustainable development”, Conference in the XXIX Meeting of the Asociación Interdisciplinar José de Acosta (ASINJA), September 26, 2002.
 126. “Energy and sustainable development”, Inaugural lecture of the academic year 2002-03 at Universidad Pontificia Comillas, October 2002.
 127. “Congestion management in the EU Internal electricity market”. Conference for the French Electricity Regulatory Commission (CRE), Paris, October 2002.
 128. “Restructuring & liberalization of the Spanish power sector. A European perspective”. Energy & Development 2002. 7th National Energy Conference. Athens, November 2002.
 129. President of a Panel on “Wholesale Markets for Electricity” in the CEPR Workshop: Competition & Coordination in the Electricity Industry. Toulouse, November 2002.
 130. “Key regulatory topics in electricity markets liberalization”. Curso Superior de Negocio Energético. Club Español de la Energía. Madrid, December 2002.
 131. “Sustainability of the Energy model in the Spanish context: Responsibilities and technical answers”. Fundación Encuentro. January 2003.
 132. Director, organizer and instructor of the course "First ERRA-CEER Training Course for Electricity Regulators of EU Accession Countries” organized by request of the Council of European Energy Regulators, Budapest, Hungary, February 3-7, 2003 (1 week).
 133. “Characteristics of the electricity sector & implications for the regulatory activity”. Italian Energy Regulatory Commission, Milan, February 2003.
 134. “The Iberian electricity market (MIBEL)”. 1st Market Facilitation Group Workshop. Sofia, Bulgaria, March, 2003.
 135. “Nuclear energy and sustainable development. Pros and cons under the environmental, economic and ethical perspectives”. Fundación Encuentro. May 2003.
 136. “Incentive-based transmission pricing for the Internal Electricity Market”. CIEP Electricity Market Seminar. Meeting the challenges of the Internal Electricity Market. The Hague, June 2003.
 137. “Methodology for design of electricity tariffs”. Director, organizer and instructor

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of the course for the Costa Rican Electricity Agency (ICE), Costa Rica, June 23-25, 2003.

138. "Locational prices in transmission networks", CMI Transmission Workshop: "The EU Internal Electricity Market. Current state of debate". Cambridge University, July 18-19, 2003.
139. Director of the on-line Internet course for Latin America "Regulation of the electric power sector", sponsored by the World Bank, the Spanish Ministry for Economics and Finance and the Center for E-learning for the Economic and Technical Development (CEDDET), September 2003.
140. "Solutions to Market Power and Congestion Management? An academic perspective". Conference on Market Power and Congestion Management, organized by the European Association of System Operators (ETSO). Brussels, October 2003.
141. "Training program for European Energy Regulators". Conference at the World Forum on Energy Regulation. Rome, October 2003.
142. "Energy and Sustainable Development", Acceptance Speech at the Spanish Royal Academy of Engineering, October 2003.
143. Director and instructor of the 2nd Training Course for Energy Regulators (2 weeks) of the Council of European Energy Regulators, European University, Florence, November 2003.
144. "Reliability options for security of generation supply in electricity markets: Considerations for the retail market". Invited conference at the CEPR Workshop on Competition & Coordination in the Electricity Industry. Toulouse, January 2004.
145. "Restructuring the electric power sector: the Spanish case". Conference in the Master Program on Railway Systems, Universidad Pontificia Comillas. Madrid, 16 February 2004.
146. "Electric network planning & regulation", a three day course for the Lithuanian regulatory Agency, as part of a PHARE twinning project of the European Union. Vilnius (Lithuania), March 2004.
147. "The future of the energy sector and its environmental implications for a sustainable development". Panel in the Heliatom Forum. School of Industrial Engineering, Technical University of Madrid, March 2004.
148. Director and instructor of a seminar on "Regional electricity markets: regulatory treatment of interconnections and power exchanges", (3 days), Montevideo, Uruguay, for the Energy Regulatory Agency, URSEA, May 2004.
149. Director and instructor of the 3rd Training Course for Energy Regulators (2 weeks) of the Council of European Energy Regulators, European University, Florence, October 2004.
150. "Electric network planning & regulation", a five day course for the Turkish Regulatory Agency, as part of a PHARE twinning project of the European Union. Ankara (Turkey), September 2005.

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151. “Advanced electricity transmission network regulation”, Three day training course at the Florence School of Regulation, European University Institute in Florence, November 2005.
152. Director and instructor of the annual Training Course for Energy Regulators (two weeks presential plus 7 months e-learning) of the Council of European Energy Regulators, European University Institute, Florence, until present time.

<There have been so many conferences and invited speeches since 2005 that the list has been discontinued; only major courses have been listed elsewhere>