

# Engineering, Economics and Regulation of the Electric Power Sector

Spring term 2009-2010

**Instructor:** Ignacio J. Pérez-Arriaga.

**Course number:** ESD.934, 6.974.

## RESOURCES

(last update: Jan-10-2010)

### Books<sup>1</sup>

#### a) Economic principles of regulation and competition.

- Kahn, A.E. (1988) *The economics of regulation: Principles and institutions*. The MIT Press. <an excellent classic book on regulatory economics>\*\*
- Joskow, P. and Schmalensee, R. (1983) *Markets for Power*. MIT Press. <a truly pioneer book that inspired the liberalization process of the electricity sector in the US and elsewhere; obviously many things have happened during the last 25 years, which can be followed in the many subsequent publications of the authors>
- Hunt, S. (2002) *Making competition work in electricity*. Wiley Finance. \*\*
- Hunt, S. and Shuttleworth, G. (1996) *Competition and choice in electricity*. Wiley. \*\*
- Ashford, N.A. and Caldart, C.C. (2008) *Environmental law, policy and economics*. MIT Press. <focused on legal implications of environmental issues. Some excellent chapters on economic & regulatory issues>\*\*
- Gómez, T. & Rothwell, G. (2003) *Principles of electricity economics: Regulation and deregulation*. John Wiley. <introductory chapters>\*\*
- International Energy Agency (2001) *Regulatory institutions in liberalised electricity markets*. OECD.
- Green, R., Rodríguez Pardina, M. (1999) *Resetting price controls for privatized utilities. A manual for regulators*. The World Bank.
- Fernández Ordóñez, M.A. (2000) *La competencia*. Alianza Editorial. <in Spanish>

#### b) Engineering & economic foundations of electric power systems planning, operation & control.

This first Group of books is more in the style of the course: less emphasis on the numerical aspects of power systems analysis and focused on the economic and regulatory implications.

- Kirschen, D.S. & Strbac, G. (2004) *Fundamentals of power system economics*. Wiley. <this book is a close as I have found to the objectives of the course; accessible to most backgrounds; in general excellent treatment of the issues of interest, although with a few exceptions & some relevant missing topics; a more rigorous engineering treatment of power systems topics can be found in Gómez-Expósito, Wood, Grainger or Bergen, see below>\*\*\*
- Soft, S. (2002) *Power System Economics: Designing markets for electricity*, Wiley-IEEE Press. <centered on wholesale electricity markets; excellent &

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<sup>1</sup> The more stars (\*) the more adequate the book is for the course. Obviously this also depends on the student's background. All highlighted books have been placed on reserve at Dewey Library.

accessible discussions; easy reading>\*\*

- Gómez-Expósito, A., Conejo, A.J. & Cañizares, C., editors. (2009) *Electric energy systems: Analysis and Operation*. CRC Press, Taylor & Francis Group. <excellent up-to-date book on power system analysis, covering all major topics of interest; not a fully introductory book; it requires some engineering background>\*\*
- Wood, A.J. & Wollenberg, B.F. (1996) *Power generation, operation & control*. Wiley. <excellent classic reference on power systems, with more emphasis than usual on operation & economic functions>\*\*
- Schavemaker, P., van der Sluis, L. (2008) *Electrical power system Essentials*. Wiley. <Good introductory book to electric power systems. Simpler to read than most and with useful comments on applications and economic issues>\*\*
- Philipson, L., Lee Willis, H. (1999) *Understanding electric utilities and De-Regulation*. Marcel Dekker. <The first part of the book is very suitable for non-engineers who want to understand power systems by means of a serious explanation but without specialized formulations. The second half covers the major regulatory topics of the power sector reasonably well>\*\*
- Momoh, J.A. (2009) *Electric power systems applications of optimization*, CRC Press. <A good book for those interested in optimization techniques applied to power systems. The first part is a solid introduction to best known optimization techniques, while the second part reviews relevant applications to power systems>\*\*
- Wangensteen, I. (2007) *Power system economics. The Nordic electricity market*. Tapir Academic Press. <Excellent textbook, also very close to the objectives of the course; covers most topics of interest; the Scandinavian power system is used as case example>\*\*
- Schweppe, F.C., Caramanis, M.C., Tabors, R.D., Bohn, R.E. (1988) *Spot pricing of electricity*. Kluwer Academic Publishers. <pioneer book on the fundamentals of electricity markets; excellent material, research oriented, a bit arduous to read>\*\*
- Bergen, A.R. and Vittal, V. (1999) *Power system analysis*. Prentice Hall. <good textbook on power system analysis with an engineering orientation; little emphasis on economic issues; a bit more accessible than Grainger & Stevenson for non-engineers>\*
- Grainger, J.J. and Stevenson, W.D. (1994) *Power system analysis*. Mc Graw Hill. <good textbook on power system analysis with an engineering orientation; little emphasis on economic issues>\*
- Lee Willis, H. (2004) *Power Distribution Planning Reference Book*. Marcel Dekker, Inc. <excellent coverage of distribution issues under most viewpoints>\*\*
- Momoh, J.A. (2008) *Electric power distribution, automation, protection and control*. CRC Press.
- Fumagalli, E., Lo Schiavo, L. & Delestre, F. (2007) *Service quality regulation in electricity distribution and retail*. Springer. <excellent and very complete treatment of quality of service under a regulatory perspective>\*\*

c) International experiences in the reform of the electric power sector.

- Sioshansi, F.P. & Pfaffenberger, W., editors. (2006) *Electricity market reform. An international perspective*. Elsevier. <excellent and up-to-date critical review of international experiences in power sector regulation and major regulatory topics>\*\*
- Sioshansi, F.P., editor. (2008) *Competitive electricity markets. Design, implementation, performance*. Elsevier. <excellent; more of the same>\*\*
- International Energy Agency. (2001) *Competition in electricity markets*. OECD.

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d) Review of electricity & energy technologies.

- Tester, J.W., Drake, E.M., Driscoll, M.J., Golay, M.W., Peters, W.A. (2005) *Sustainable energy. Choosing among options*. MIT Press. <excellent review of energy technologies, with economic, environmental and other implications>\*\*
- Jamash, T., Nutall, W.J., Pollit, M.G., (2006) *Future electricity technologies and systems*. Cambridge University Press <novel aspects & trends in energy technology>\*\*

e) Other books of interest.

- Smil, V. (2001) *Energy at the crossroads: Global perspectives and uncertainties*. MIT Press <sustainability of the energy model in general>\*\*

f) Basic introductory texts on electricity and power systems for those lacking some background on these topics.

- Von Meier, A. (2006) *Electric power systems. A conceptual introduction*. Wiley Survival Guides in Engineering & Science, jointly with IEEE Press. <useful for those without an engineering background who want to learn the engineering jargon and the basic concepts of power systems at a very accessible level>

## General web resources

- A collection of very basic articles on electricity for those in need of some introduction to its physics and technology can be found in <http://amasci.com/ele-edu.html>. Or you can explore Wikipedia, starting for instance at [http://en.wikipedia.org/wiki/Power\\_engineering](http://en.wikipedia.org/wiki/Power_engineering)

Regulation of the power industry is a fast evolving field that requires to be followed on a real time basis. The websites listed below provide a broad overview of relevant regulatory institutions and recent developments, and they are also a good starting point for searches on specific topics

- The **International Energy Regulatory Network (IERN)** is a web platform that facilitates information exchange on electricity and natural gas market regulation, to the benefit of regulators, but also of other interested users. This website is a good starting point when searching about detailed energy regulation of a specific country. It is maintained by the regulatory agencies themselves, under the coordination of the Florence School of Regulation. IERN is an initiative of several regional regulatory organizations, CEER, ERA and ARIAE and in 2009 it has become the home of the International Confederation of Energy Regulators (ICER). The information is updated by the regulatory agencies themselves, under the supervision of the Florence School of Regulation, which is a centre for training, research and debate on regulation based at the European University Institute in Fiesole (Italy). <http://www.iern.net/>
- See also the information in the website of last **World Forum on Energy Regulation**. <http://www.worldforumiv.info/>
- The two following sites are maintained by the **South Asia Forum for Infrastructure Regulation (SAFIR)**, which was established in May 1999 with the support of the World Bank. SAFIR provides high quality capacity building and training on infrastructure regulation & related topics in South Asia and stimulates research on the subject by building a network of regional and international

institutions & individuals that are active in the field<sup>2</sup>.

- The site <http://www.safirasia.org/Reference/general.aspx> has a good commented list of relevant websites dealing with general utility regulation.
- And <http://www.safirasia.org/Reference/electricity.aspx> is a specific site for regulation of the electric power sector, with links to many significant regulatory agencies, utility organizations and think tanks.
  
- The **Asociación Iberoamericana de Entidades Reguladoras de la Energía (ARIAE)**, Latin American Association of Energy Regulators) was formally created on the 17th of March 2000 in Buenos Aires (Argentina), as an association of electricity regulators. ARIAE expanded its scope to all energy sectors in occasion of its General Assembly of May 2000 in Lisbon and today regroups energy regulators from 17 Latin American and 2 European countries. 23 energy regulators belong to this association/forum. <http://www.ariae.org/>.
  
- The website of the **Public Utilities Research Center of the University of Florida** contains a wealth of interesting documents covering most aspects of utility regulation. The **Body of Knowledge on Utility Regulation** is a project jointly conducted by the University of Florida Public Utility Research Center, the University of Toulouse and the Pontificia Universidad Católica del Perú for the World Bank. <http://www.purc.org/>
  
- The official energy site for the **European Commission** (General Directorate of Energy and Transport). [http://ec.europa.eu/energy/index\\_en.htm](http://ec.europa.eu/energy/index_en.htm)
  
- The **Council of European Energy Regulators (CEER)** acts as a focal point for contacts between regulators and the European Commission's Directorate for Energy and Transport (DG TREN) and participates actively in the Florence Regulatory Process and the Madrid Regulatory Process. It maintains close working relations with regulatory authorities in North America and EU Candidate Countries. The website contains documents and links relevant to the European electricity sector. <http://www.ceer-eu.org/>
  
- The **Energy Information Administration (EIA)**, created by Congress in 1977, is a statistical agency of the U.S. Department of Energy. Its mission is to provide policy-neutral data, forecasts, and analyses to promote sound policy making, efficient markets, and public understanding regarding energy and its interaction with the economy and the environment. This is the site that is devoted to electricity statistics: <http://www.eia.doe.gov/fuelectric.html>
  
- The **Edison Electric Institute (EEI)** is the association of U.S. shareholder-owned electric companies, international affiliates and industry associates worldwide. EEI helps members compete effectively by advancing equitable policies and ensuring maximum options in a restructured industry. The site provides information on Energy Issues/News; their Energy Services Group; Energy Issues/News contains a section on Competition/Regulation; EEI Online - the most online timely way to access key industry information - a daily utility newswire. <http://www.eei.org>
  
- The **Electric Power Research Institute (EPRI)** is a non-profit organization providing science and technology-based solutions of indispensable value to global

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<sup>2</sup> Many of the links that are provided below have been borrowed from the lists in the SAFIR website.

energy customers. The site provides information on its products, research areas, events calendar, and key contacts. It also includes online journal and newsletter. <http://www.epri.com>

- The **Federal Energy Regulatory Commission (FERC)** is an independent regulatory agency within the Department of Energy that regulates specific aspects of the electricity, oil, natural gas and hydroelectric power sectors. The website provides information related to these sectors. <http://www.ferc.gov/>
- The **European Network of Transmission System Operators for Electricity (ENTSO-E)** has as members the Transmission System Operators of the EU Member States, plus some other associated countries. The networks represented by ENTSO-E supply more than 490 million people with electric energy. <http://www.entsoe.eu>
- The **International Energy Agency (IEA)**, based in Paris, is an autonomous agency linked with the Organization for Economic Co-operation and Development (OECD). The site includes publications, energy statistics, oil market reports, and technological reviews. Key World Energy Statistics containing data on supply, transformation, and consumption of all major energy sources is available in the site. <http://www.iea.org/>
- **EURELECTRIC** is the association of the Electricity Industry within the European Union representing it in public affairs, in particular in relation to the institutions of the EU and other international organisations, in order to promote the interests of its members at a political level and to create awareness of its policies. The site provides documents, publications, electricity issues, news, initiatives, statistics, and useful links. <http://www.eurelectric.org/Public/content/>
- The **World Energy Council (WEC)** is the foremost global multi-energy organisation in the world today. WEC has Member Committees in over 90 countries, including most of the largest energy producing and energy consuming countries. The 75-year-old organisation covers all types of energy, including coal, oil, natural gas, nuclear, hydro, and renewables, and is UN-accredited, non-governmental, non-commercial and non-aligned. <http://www.worldenergy.org/wec-geis/>
- The **National Association of Regulatory Utility Commissioners (NARUC)** is a non-profit organization founded in 1889. Its members include the governmental agencies that are engaged in the regulation of utilities and carriers in the fifty US States, the District of Columbia, Puerto Rico and the Virgin Islands. NARUC's member agencies regulate the activities of telecommunications, energy, and water utilities. The site provides congressional testimonies, programmes and meetings, resolutions, and resources. <http://www.naruc.org/>
- The **National Regulatory Research Institute (NRRI)**, established in 1976, provides research and assistance designed to help public utility commissions accomplish their missions. Though most noted for its research reports and analytic studies, the NRRI also provides a wide array of other services such as assistance in commission restructuring, contract assistance, and commissioner tutorials and executive dialogue. <http://www.nrri.org/>
- The **African Forum for Utility Regulation (AFUR)** was formally established as a voluntary association of utility regulators in November 2002. This website provides detail information about the forum, its members, events, AFUR newsletter and links to websites of African Regulatory Agencies. <http://www.afurnet.org>
- The following personal webpages include relevant material on power systems regulation, plus links to other relevant organizations:

- Webpage of Steven Stoft. <http://www.stoft.com>
- Webpage of Prof. William Hogan, Harvard University. <http://ksghome.harvard.edu/~whogan/>
  
- In most countries there are organizations that publish electronic newsletters with current news, announcements of events or publication of regulatory dispositions. In the US you may receive the *Washington Energy Report* by contacting Troutman & Sanders at <http://www.troutmansanders.com/contactus/>. In Spain Intermoney Energía distributes daily news at <http://www.enervia.com/noticias.asp>. News about energy developments at European level can be found at [http://ec.europa.eu/energy/index\\_en.htm](http://ec.europa.eu/energy/index_en.htm)
  
- The following websites offer information on current research projects sponsored by the European Union. <http://www.smartgrids.eu/> is the website of the European Technology Platform for the Electricity Networks of the Future. [http://cordis.europa.eu/fp7/home\\_en.html](http://cordis.europa.eu/fp7/home_en.html) provides information on the present European Framework Program for Research and Development, where energy is a major component, while [http://ec.europa.eu/energy/technology/set\\_plan/set\\_plan\\_en.htm](http://ec.europa.eu/energy/technology/set_plan/set_plan_en.htm) describes the research plan in low carbon technologies.

MIT OpenCourseWare  
<http://ocw.mit.edu>

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