Introduction to EI. Energy Systems

October 1, 2014





Importance of Energy Systems

Energy systems enabled industrial revolution and arguably caused one of the largest changes in human society ever.



1882: Pearl street power plant



Typical Structure of an Energy System

- Four key elements:
- 1. Sources
- 2. Interconnects:
 - switch-mode el. energy converters (power electronics), and
- 3. Utility Network
- 4. Loads
 - Electric machines and others





Structure of Electrical Energy System







Relevant Courses







Energy Systems Examples

- Utility systems (conventional)/ hundreds of GW
- Marine, aircrafts, and electric/ hybrid vehicles/ from several kW to MW
- Electronic devices/ from a fraction of watt to several kW





Traditional Energy Systems (Ac)





Modern utility system



Aircraft contains or three elements of the energy system (sources, power electronics, and various loads)





Hybrid/Electric Vehicles







Energy system of an electronic device



• Power from a fraction of a watt to hundreds of watts

OGE Usually parts of a multi-supply power management systems



Traditional Energy Systems – Areas





Utility Network Elements: Generation



http://en.wikipedia.org/wiki/Sir_Adam_Beck_Hydroelectric_Generating_Stations





Utility Network Elements: Generation



http://img.directindustry.com/images_di/photog/offshore-wind-turbines-29644-3517357.jpg



http://www.alstom.com/Global/Hungary/Resources/Images/Therm al%20Power%20CCS/04_ThermalP_Products_services.jpg





EI. Energy Generators & EI. Machines



http://abbcloud.blob.core.windows.net/public/images/04915fd2-32c9-4598-ab4f-6507807aa023/presentation.jpg



http://www.alstom.com/Global/Germany/Resources/Images/Press %20Releases%20and%20Highlights/2011-06-09_Pressefoto%20Alstom%20Power_KA26%20Gaskraftwerkstech nologie.jpg





Utility Network Elements: Transmission





http://www.cneec.com.cn/Achievements/sy gd/200907/707.html





Utility Networks Control and Security



http://www.scientificamerican.com/sciam/cache/file/FBE4111E-8509-4128-BF8662142373B3BF.jpg





SCADA – Control and Communication



http://www.tepco.co.jp/en/corpinfo/consultant/facilities/2-sub-e.html





http://www.elp.com/content/dam/etc/medialib/new-lib/powergrid/2012/july/89598.res/_jcr_content/renditions/pennwell.web.400 .300.jpg





Power Electronics



Efficient and controlled el. Energy conversion from one form to another

-Dc/dc

-Ac/dc

-Dc/ac

-Ac/ac





Power Electronics: Dc – Ac Converters





Energy system of an electronic device



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Dc-Dc Converters and IC Design



http://www.ifixit.com/Teardown/iPad-FCC-Teardown/2197/1









Interdisciplinary Nature

- Circuit analysis
- Communications
- Control Theory
- Computer and Software Engineering
- IC design
- Mechanical design
- Economics

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Jobs in Energy Systems & Power Electronics

- Microelectronics industry
- Power electronic companies
- Utility companies
- Software design companies
- Communication systems
- Economics

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