

CPET 581 Smart Grid and Energy Management
Lecture
2013/8/29

Planned Topics of Discussion

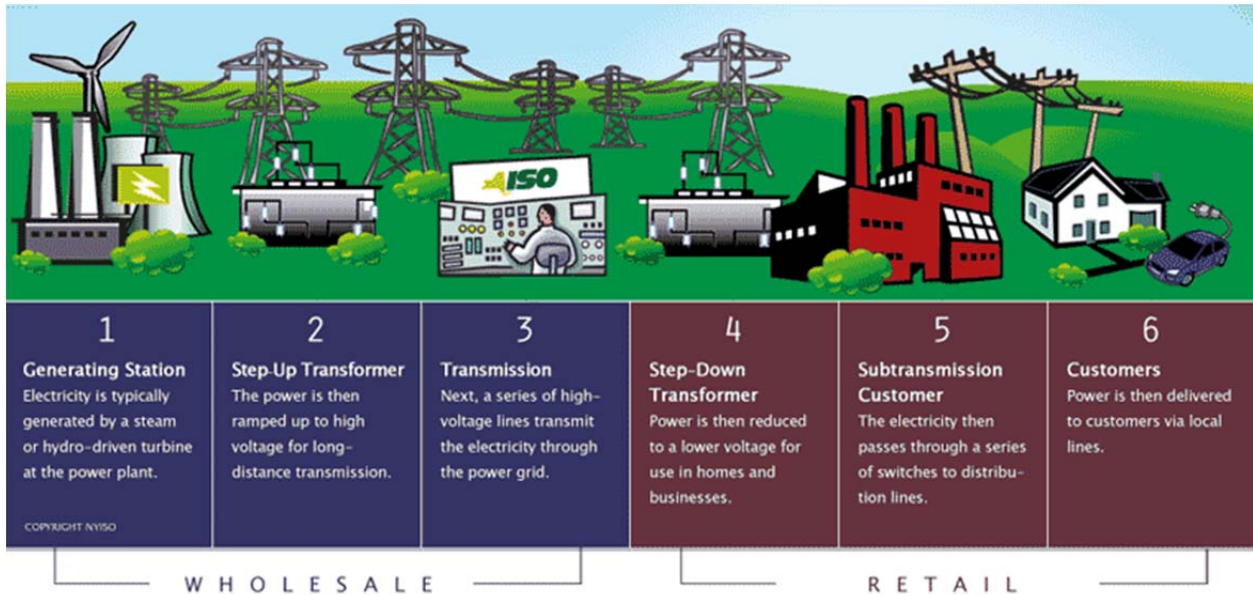
- **Electric Power Generation & Quick Overview of Markets**
- **Federal Energy Acts & Bills**
 - **The Energy Policy Act of 2005 (EPAAct 2005)**
 - **The Energy Independence and Security Act of 2007 (EISA), Executive Order (E.O) 13424**
 - **S. 1401 Domestic Energy and Jobs Act**
 - **Energy Independence & Security Act, Section 432 (EISA 432)**
 - **H.R. 1394 Planning for American Energy Act of 2013**
- **Federal Energy Policies**
- **U.S. EPA, DOE, and Homeland Security Agencies**
- **House Hearing on American Energy Security and Innovation: The Role of a Diverse Electricity Generation Portfolio**
 - **Energy and Power Subcommittee Chairman Ed Whitfield, The Committee on Energy & Commerce – 113 Congress, House Hearing, Tuesday March 5, 2013**
- **An Energy Generation Resource Management Exercise**
 - **Portfolio Planning**
 - **Risks**
 - **Environmental**
 - **Stability**
 - **Sustainability**
 - **Politics**
 - **Other Public Interest & Check/Balance**
 - **New, Innovative , and Sustainable Technologies**
 - **Economic Cost, Affordability**
 - **Efficiency**
 - **Diversifying portfolio**
 - **Security**
 - **Safety**
 - **Benchmarking**
 - **Implementation**
 - **Operations & Maintenance**
- **Electric Power Market/Business**

Electric Power Generation & Quick Overview of Markets

The Electric Power from Generation to End Consumer: Whole Sale to Retail, recreated based on http://www.nyiso.com/public/about_nyiso/understanding_the_markets/wholesale_retail/index.jsp

- **Wholesale**
 - **Power generating stations**
 - **Coal-fired**
 - **Gas**
 - **Nuclear**
 - **Hydropower**
 - **Renewable (solar, wind, geothermal, biomass, etc)**

- Step-up transformer
- Transmission
- Retail
 - Step-down transformer
 - Sub-transmission customer (distribution)
 - Customers



Power vs. Energy Units and Recording Equipment or Devices

- Power
 - DC Power = $V \times I$ = voltage x current = volt x ampere = watts
 - Single Phase AC Power (120V, 220V) = $V \times I \times \cos\theta$
 - Three Phase AC Power (balance 3 phase) = $\sqrt{3} V \times I \times \cos\theta$
 - Watt, kilo Watts (KW), Mega Watts (MW), Giga Watts (GW)
 - kW = k Joules/sec
 - Recorded with Watt, **kW meter**
- Electrical Energy
 - Energy = \int Power x dt
 - kWh = kW x Hour
 - 1 kWh = 1 kJ-hr/sec = 1k J 3600 sec/sec = 3600 kJ
 - Recorded with **kWh meter**

Wholesale Electricity

- Minimum quantity one (1) Megawatt – 1000 kW, which can power between 600 to 1000 homes

Retail Electricity

- Power purchased by consumers or businesses, and delivered through a low-voltage local distribution system

US Energy Acts & Bills

- Congress Energy & Commerce Committee, <http://energycommerce.house.gov/>

- **Congress Track Committee**, <http://www.govtrack.us/>
- **S. 1401 Domestic Energy and Jobs Act**, Introduced: Jul 31, 2013, Sponsor: Sen. John Hoeven [R-ND], <http://www.govtrack.us/congress/bills/113/s1401>
- **H.R. 1394 Planning for American Energy Act of 2013**, Introduced Mar. 21, 2013, Sponsor: Rep. Scott Tipton [R-CO3], <http://www.govtrack.us/congress/bills/113/hr1394>
- Videos
 - Re. Cassidy Urges Support for **Energy Consumers Relief Act**, <http://www.youtube.com/watch?v=6Wi-EkiMgdw>
 - Oversight of DOE Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste, <http://www.youtube.com/watch?v=KSlqeQUCavA>
- **U.S. Senate Committee on Energy & Natural Resources**, <http://www.energy.senate.gov/public/index.cfm/>
 - US Energy Acts & Bills (SENS, Wyden, Murkowski)
 - Seek Clarity on DOE Authority
 - Applaud passage of two Hydropower Bills
 - Introduce legislation to encourage marine hydropower
 - Bipartisan Nuclear Waste Bill move forward in Committee on Energy & Natural Resources
 - Public Lands, Energy Measures

The Energy Policy Act of 2005 (EPAct 2005), Public Law 109-58, 551 pages – Established a number of energy management fleets, <http://www1.eere.energy.gov/femp/regulations/epact2005.html>

- Metering and Reporting
- Energy-Efficient Product Procurement
- Energy Savings Performance Contracts
- Building Performance Standards
- Renewable Energy Requirement
- Alternative Fuel Use

The Energy Independence and Security Act of 2007 (EISA), <http://www1.eere.energy.gov/femp/regulations/eisa.html>

- Energy Reduction Goals for Federal Buildings
 - Facility Management/Benchmarking
 - Performance and Standards for New Building and Major Renovations
 - High-Performance Buildings
 - Energy Saving Performance Contracts
 - Metering
 - Energy-Efficient Product Procurement
 - Office of Management and Budget (OMB) Reporting
 - Reducing Petroleum/Increasing Alternative Fuel Use
- and **Executive Order (E.O) 13424**, <http://www1.eere.energy.gov/femp/regulations/eo13221.html>, Aug. 2, 2001, by The President of U.S., have been issued subsequently to the passage of EPAct 2005.
- Requirements for Energy Efficiency and Standby Power

Energy Independence & Security Act, Section 432 (EISA 432): Use of Energy and Water Efficiency Measures in Federal Buildings; Compliance Tracking System, http://www1.eere.energy.gov/femp/regulations/facility_cts.html

U.S. Energy Policy, <http://energy.gov/public-services/energy-economy/energy-policy>

- Building an American Economy to Last: American Competitiveness in Manufacturing, Aug. 16, 2012, <http://energy.gov/articles/building-american-economy-last-american-competiveness-manufacturing>
- Wind Energy in America: Supporting our Manufacturers, Aug. 16, 2012, <http://energy.gov/articles/wind-energy-america-supporting-our-manufacturers>
- Seizing a Clean Energy Opportunity, Aug. 10, 2012, <http://energy.gov/articles/seizing-clean-energy-opportunity>
- International Cooperation
 - CERC: U.S. – China Clean Energy Research Center, <http://www.us-china-cerc.org/>
 - Building Energy Efficiency, http://www.us-china-cerc.org/Building_Energy_Efficiency.html
 - Lead by Lawrence Energy Lab – Environmental Energy Technologies Division, <http://eetd.lbl.gov/>
 - Intellectual Property, http://www.us-china-cerc.org/Intellectual_Property.html
 - Technology Management Plan
 - Clean Energy Ministerial (Global Forum), <http://www.cleanenergyministerial.org/>
 - Energy and Climate Partnership of the Americas
- U.S. Energy Independence

Federal Government Agencies

U.S. Department of Energy (DOE), <http://energy.gov/>

Federal Energy Regulatory Commission (FERC), www.ferc.gov

Nuclear Regulatory Commission (NRC)

Energy Efficiency & Renewable Energy - Federal Energy Management Program (FEMP), <http://www1.eere.energy.gov/femp/>

U.S. Energy Information Administration, www.eis.gov

- Statistics on Electric Power Plants, Capacity, Generation, Fuel Consumption, Sales, Prices and Customers -U.S. Energy Information Administration, <http://www.eia.gov/electricity/>
 - Overview
 - Data
 - Analysis & Projections

EPA (Environmental Protection Agencies)

EPA Regulatory Actions: Final Mercury and Air Toxics Standards, 2013/3/28, <http://www.epa.gov/mats/actions.html>

- Carbon Pollution Standards for the Power Sector, <http://epa.gov/carbonpollutionstandard/>
- EPA Emission Limits
- Report: EPA rules to shut down more than 280 coal-fired units, The Daily Caller, <http://dailycaller.com/2013/05/03/report-epa-rules-to-shut-down-more-than-280-coal-fired-units/>
- Coal Plants affected by EPA Regulations, <http://www.governing.com/gov-data/energy-environment/coal-plants-to-shut-down-from-epa-regulations.html>
- Impact of EPA’s Regulatory Assault on Power Plants: New Regulation to Take 34GW of Electricity Generation Offline and the Plant Closing Announcement Coming, June 12, 2012, <http://www.instituteforenergyresearch.org/epa-powerplant-closures/>

Other Not For Profit Organizations

Energy Laws Research Guide, Georgetown Law,

<http://www.law.georgetown.edu/library/research/guides/energylaw.cfm>

Center for Climate and Energy Solutions, <http://www.c2es.org/federal/congress/111/acesa>

- White House, EPA & Other Agencies
- Congress
- Publication Library
 - The American Clean Energy and Security Act (Waxman-Markey Bill), <http://www.c2es.org/federal/congress/111/acesa>
 - Summary of Energy Saving and Industrial Competitiveness Act of 2013 (S.761), May 2013
 - Carbon Pricing Proposals of the 113th Congress, April 2013
 - Domestic Policies to Reduce the Near-term Risks of Climate Change, March 2013
 - Options and Considerations for a Federal Carbon Tax, Feb. 2014
 - Summary of the Climate Protection Act of 2013 (S. 232), Feb. 2013

The Future of Electricity Generation, Electric Power Supply Association (EPSA),

http://www.epsa.org/documents/industry/EPSA_Power_On_brochure_FINAL.pdf

The recreated table shows: % U.S. electricity generated from **Competitive Suppliers** based on the report listed above.

Power Generation Type	% of U.S. Electricity Generated from Competitive Suppliers (power generators + power marketers) – 40% of installed generating capacity in the U.S.	% of U.S. Electricity Provided
Coal-fired generation	35% (35% * 0.4 = 14%)	49%
Natural gas generation	32% (32% * 0.4 = 12.8%)	20%
Nuclear power (zero carbon emission)	25% (25% * 0.4 = 10%)	19%
Renewable Solar, Wind, Geothermal, Biomass	4% (4% * 0.4 = 1.6%)	2%
Hydropower	2% (2% * 0.4 = 0.8%)	7%
Total	98% (39.2%)	97%

American Energy Security and Innovation: The Role of a Diverse Electricity Generation Portfolio

- Energy and Power Subcommittee Chairman Ed Whitfield, The Committee on Energy & Commerce – 113 Congress, House Hearing, Tuesday March 5, 2013
 - Memo of Hearing, <http://docs.house.gov/meetings/IF/IF03/20130305/100392/HHRG-113-IF03-20130305-SD002.pdf>
 - **American Energy Security and Innovation: The Role of a Diverse Electricity Generation Portfolio**, <http://energycommerce.house.gov/hearing/AESI-role-diverse-electricity-generation-portfolio>
 - Hearing Contents (68 pages), <http://www.hsdl.org/?view&did=733360>

Entergy Wholesale Commodities (EWC), headquartered in White Plains, New York, President Bill Mohl, <http://www.govtrack.us/congress/bills/113/hr1394>

- **Testimony on the Role of a Diverse Electricity Generation Portfolio**, by Bill Mohl, Nuclear Energy Institute (NEI), <http://www.nei.org/Issues-Policy/Policy-Resources/Testimony/Testimony-on-the-Role-of-a-Diverse-Electricity-Generators>
 - Introduction
 - Baseload nuclear generators provide vital reliability, economic, and environmental benefits
 - Nuclear power plant operators are focused on safety
 - Nuclear power is an essential component of a diverse energy portfolio
 - Challenges to Merchant nuclear generators
 - Conclusion
- EWC Generation Capability (MW)
 - Nuclear 5,011 MW
 - Natural Gas/Fuel Oil 1,340 MW
 - Coal 181 MW
 - Wind 80
- EWC Facilities
 - Nuclear Generating Facilities/Assets (Plant, Unit, Maximum Dependable Capacity, Ownership, Reactor Type, Reactor, Turbine Generator, Architect Engineer, Commercial Operation Date, License Expiration Date, Location), http://www.energy.com/content/operations_information/EWC_Nuclear_Portfolio.pdf
 - Indian Point Energy Center (5 Units, Max Dependable Capacity: 2,022 MW), Buchanan, N.Y.
 - James A. FitzPatrick (1 unit: Max Dependable Capacity 838 MW), Scriba, N.Y.
 - Palisades (1 unit: Max Dependable Capacity 811 MW), Covert Township, Michigan
 - Pilgrim (1 unit: Max Dependable Capacity 688 MW), Plymouth, Mass
 - **Vermont Yankee Nuclear Power Station** (1 unit: Max Dependable Capacity 605 MW), Vernon, VT
 - Fossil and Renewable Generating Facilities Assets, http://www.energy.com/content/operations_information/EWC_Fossil_and_Renewable_Portfolio.pdf

Nuclear Power Plants

- Plant's Closure is Tied to Cheap Gas, by Rebecca Smith, The Wall Street Journal, Aug. 28, 2013, <http://online.wsj.com/article/SB10001424127887323407104579038682331577924.html>
- U.S. Nuclear Plant Sales Summary, www.nei.org
- Japan Studies Plan to Contain Radioactive Water, by Phred Dvorak, http://online.wsj.com/article/SB10001424127887324324404579040520540137690.html?mod=WSJ_article_MoreInWorld
 - Video

The Business Pressures-Responses-Support Model

Vermont Yankee Nuclear Power Station – Entergy Wholesale Commodities, <http://www.govtrack.us/congress/bills/113/hr1394>

- Power Business Environmental Factors
 - Disaster lesson learned (safety concerns)
 - Vermont Yankee Nuclear Power plant features a boiling-water reactor (similar to the Fukushima Daiichi plant in Japan)
 - Safety concerns
 - Government Regulations
 - Federal government: U.S. Nuclear Regulations
 - Approve a 20-year license renewal in March 2011
 - State government law makers
 - The company was seeking a certificate from Vermont to keep plant running, after the state passes laws in 2003 and 2006 giving itself greater regulatory authority over the plant
 - Opposition from antinuclear activists
 - Citizen Awareness Network -1986 demonstration at the facility
 - Customer Demand
 - Cost/Revenue
 - Maintenance cost rise 15% to 20% over the period
 - Does not include Fukushima (Tokyo Power Co)-related costs – upgrades required by U.S. nuclear regulation
 - Only was expected to break even in 2013
 - Alternative Fuels
 - Cheap natural gas from the shale boom
 - Gas is putting coal and nuclear out of business
 - Market conditions
 - In the deregulated market
 - Whole sale power price per MegaWatts: \$90-100 (2008's price) =>Drop => \$40-50 (2013's price)
- Organization Responses
 - Strategy
 - Collaboration
 - Cost
 - New fuel sources
 - New business model
 - Detail financial assessment of each power plant that sell electricity on the open market
- Decision
 - Decommission, shut down Vermont Yankee Nuclear Power plant by the end of 2014
 - Two other single-reactor plants with similarities to the Fukushima unit
 - FitzPatrick plant in New York
 - Pilgrim plant in Massachusetts

References

- [1] Plant's Closure is Tied to Cheap Gas, by Rebecca Smith, The Wall Street Journal, Aug. 28, 2013, <http://online.wsj.com/article/SB10001424127887323407104579038682331577924.html>
- [2] U.S. Nuclear Plant Sales Summary, www.nei.org
- [3] Japan Studies Plan to Contain Radioactive Water, by Phred Dvorak, Aug. 29, 2013, http://online.wsj.com/article/SB10001424127887324324404579040520540137690.html?mod=WSJ_article_MoreIn_World

