

Lec #16: "The Grid"

LAST TIME: Electricity and Magnetism

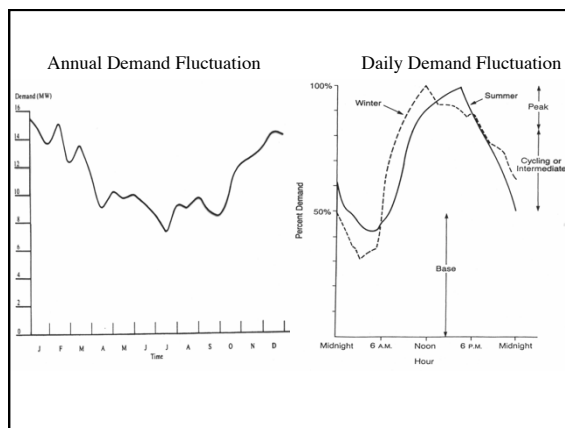
- Motors and Generators
- Electricity Fundamentals
- Introduction to "The Grid"

TODAY: Restructuring The Electrical Power Industry

- Just What is the "Grid"?
- History of the Electrical Power Industry
- Is the current system adequate?
- How should it change/evolve?

Practical Concerns for Electric Power Production and Distribution

- can't **store** electricity; must produce on demand
- demand **fluctuates** with time of day, season, weather, population change, industrial change
- how to cope?
 - use mix of fuels/sources
 - mix of generator types
 - try to plan
 - cooperate through wholesaling and "wheeling"
 - creative costing (industrial and residential)
 - real-time metering; smart appliances
 - when all else fails: rolling **brownouts** & blackouts



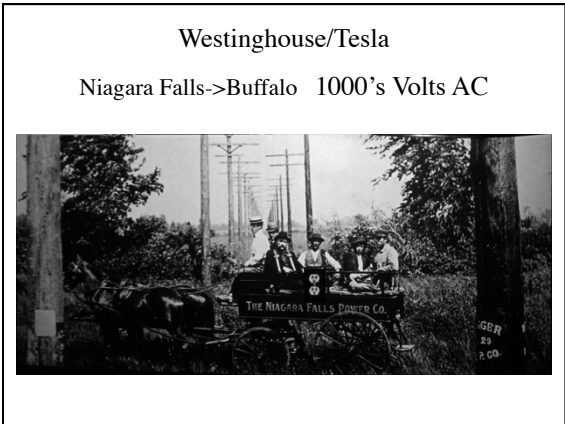
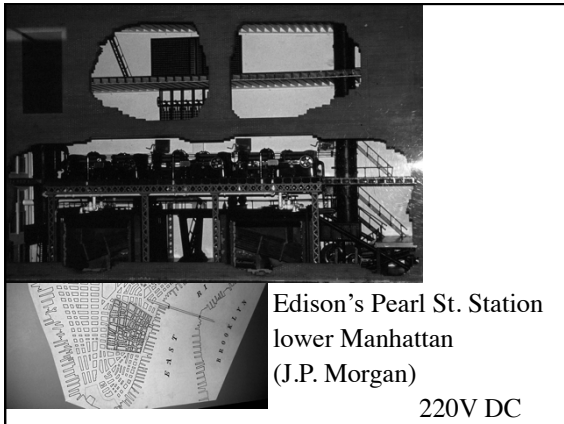
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- other approaches
 - centralize transmission system
 - futures market, etc
 - encourage conservation and cogeneration (cheaper than building new facilities)
- Electric Power industry is *transforming* from 'vertically-integrated' megalopolies to *specialists* in
 - production/generation (power plants)
 - distribution (local power lines)
 - transmission (cross-country lines)
 - customer service (oxymoron?)

The Emergence of Electric Utilities

- Edison; Pearl St. Station (1882); 220V DC
- Westinghouse; Niagra Falls->Buffalo; AC
- General Electric
- Explosion of franchise producers
 - no standards
 - no cost controls
 - lots of duplication
 - lots of corruption
- earliest users: heavy industry, street lighting, street cars



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- state and regional regulatory “compacts”
 - franchise area with no competition
 - guarantee of service at reasonable price
 - (fixed % of cost) rather than (cost +) profit
 - standardized *distribution* “grid”
 - better quality of life, but inefficient use
- emergence of giant Public Utilities 75%
- *Public Utilities Holding Company Act* (1935)
 - until recently, the principal regulatory organ
 - long under attack as obsolete barrier to competition
- Other providers, not under PUHCA:
 - municipally owned (~2000) 11%
 - federal (e.g. TVA) 10%
 - rural electric coops (~1000 dist; ~60 prod.) 4%

- *National Energy Act* (1978)
 - response to oil crises of the 70's
- *Energy Policy Act* (1982)
 - repealed it all except...
- *Public Utility Regulatory Policies Act*
 - requires utilities to purchase power from “qualifying facilities” that produce electricity through renewable sources or cogeneration
 - and to pay “avoided cost” equivalent to building a new plant for equivalent production
 - whether they need it or not!

- PURPA Qualifying Facilities

- small power producers (< 80 MW), over 75% from renewable sources
- cogenerators; at least 5% of steam for electricity production (rest for industrial applications)

- PURPA impact

- rejuvenation of small-scale hydro
- development of wind mills
- tremendous growth in co-generation

How Popular is PURPA?

- electrical industry has been fighting very hard for its repeal on the grounds that
 - it is costly (\$8 billion / year)
 - they could do it better on their own
- by many measures, it has been tremendously effective
- deciding factors
 - total cost
 - how cost is paid; by whom
 - stimulate or stifle development of renewables?
 - is there a better way to do it?

Evaluating the Current System

ADVANTAGES

- reliable supply
- reliable service
- cost controls
- states can encourage responsible long-range planning and investment
- profits guaranteed
- profits limited
- able to (required to) provide for peak demand

DISADVANTAGES

- can limit expansion funds
- can discourage necessary expansion
- profit \propto costs !!
- inefficient transmission grid
- no overall transmission grid authority
- state \neq national interests
- doesn't encourage renewables
- doesn't encourage creative costing

The Electric Industry is Changing

- Electric Power industry is *transforming* from 'vertically-integrated' megalopolies to *specialists* in
 - production/generation (power plants)
 - distribution (local power lines)
 - transmission (cross-country lines)
 - customer service (oxymoron?)
- Why would it want to do this? What's driving the change? Is it good or bad? How can we control it? Should we try?