Electricity and Natural Gas in the Northwest

Carbon Masters

Chuck Eberdt
The Energy Project/Opportunity Council
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History of Electricity Development in the Northwest
Turn of the Century

- Extraction economy
  - Timber
  - Wheat
  - Fish
  - Minerals

- 1908 Teddy Roosevelt
  - River development for multiple uses
Who Is This Guy?
Electricity Arrives in 1880
Why did electrification take off?

What did it replace?
Gas Lighting
Where did the gas come from?
Transportation

Seattle’s first horse-drawn streetcar on rails - 1884
The Puget Power family tree

Today's Puget Power is the result of a succession of mergers and consolidations lasting more than 50 years and involving more than 150 companies. Reading from the bottom up, this chart shows the companies and gives the dates on which they were acquired by successor companies.
Commodity vs. Essential Service

- Commodity - open to price competition, take it or leave it
- Essential service - regulated with obligation to serve
- Natural monopoly - elimination of duplication of poles and wires
- State regulation in 1907
Who Are These Guys?

J. P. Morgan

Samuel Insull
Private Utilities Running Rampant

- Holding companies milking ratepayers
- State regulation insufficient
- FDR - 1935 State of the Union
  
  “bring sound conditions to the electric power industry through abolition of the evil holding companies”
Public Utility Holding Company Act, Federal Power Act - 1935

- Electricity deemed an essential service
- Sell power at cost with an opportunity to earn a profit
- Natural monopoly in exchange for an obligation to serve
- State regulators must set just and reasonable rates
Public Utility Districts and Co-ops

- Municipals started forming late 1800s in response to private utility development
- The Grange lead the push for rural power service
- 1930 WA established special districts - eminent domain
Working River Key to Economic Development

- **Roosevelt’s vision**
  - A series of multi-purpose dams
  - Serve rural areas

- **Bonneville Project Act - 1937**
  - Preference to public and co-operative utilities
  - Wholesale power at cost
  - Uniform postage stamp rates
Bonneville Power Administration

- BPA markets 45% of region’s electric power from 31 federal hydroprojects and one nuclear plant.
- BPA power sales - about 80% from hydro.
- Has 136 customers - public utilities, DSIs, other federal agencies, private utilities.
- BPA owns and operates 75% of the NW’s high voltage electrical transmission system.
- The system includes more than 15,000 miles of transmission line and 285 substations.
Columbia River Treaty Storage Projects

- Mica
- Keenleyside
- Duncan
- Libby
- British Columbia
- Washington
- Montana
- Idaho

Canada

United States
Thermal Program

- Hydro power served all NW power needs into the 1970s
- Thermal generation seen as the future for meeting load
- Private and public utilities started fossil and nuclear construction
- BPA agreed to buy and market the output – then bill its customers
- This deal allowed WPPSS to go forward - largest public bond default in US history
Trouble in Paradise

- Economic and political fallout from WPPSS
- Rate disparity - publics and privates
- Big rate increases at BPA
- Tribes and fisherman looking for salmon
Northwest Power Act - 1980

A new era for the Northwest

- BPA must meet utility load growth if requested
- Private utilities got rate relief - residential exchange
- New 20-year power contracts for large industrial users
- Created regional planning body - NW Power Council
- New resource development order: efficiency, renewables, co-gen, thermal
- Salmon restoration on equal status as power
Sixth Plan Resource Portfolio*

*Expected Value Build Out. Actual build out schedule depends on future conditions
Cracks in the Regulatory Compact

- President Carter pushed energy independence
  - Opened the door to independent power producers
  - Promotion of new renewables
  - Co-generation, natural gas turbines

  - Non-utility generators
  - Wholesale competition
How Does the Electric and Natural Gas System Work?

Section 2
Properties of Electricity

- Cannot be stored (easily)
  - Feedstocks are stored
  - Electrons move when generated
- Follows path of least resistance
  - Regardless of seller or buyer - goes to need
- Travels at the speed of light
  - Interconnected grid positives and negatives
Power Plant Generates Electricity

Transmission Lines Carry Electricity Long Distances

Distribution Lines Carry Electricity To Houses

Transformer Steps Up Voltage For Transmission

Neighborhood Transformer Steps Down Voltage

Transformers On Poles Step Down Electricity Before It Enters Houses
Glossary

- **Kilowatt (kW)** - A unit of power, equals 1000 watts
- **Kilowatthour (kWh)** - A unit of power expended for 1 hour. One kWh is equivalent to 3,412 Btu or 3.6 million joules
- **Megawatt (MW)** - A unit of power equal to 1000 kilowatts or one million watts
- **Average MW** - 1 megawatt of power produced over time (usually a year or 8,760 hours)
• **Capacity output** - maximum amount of energy a generator can produce at one time

• **Energy output** - amount of energy delivered over a designated period of time
Natural Gas

- **Measures**
  - Therm - a unit of heating value equivalent to 100,000 British thermal units (Btu)
  - Cubic Foot - the amount of gas required to fill a volume of one cubic foot under stated conditions of temperature, pressure, and water vapor

- Natural gas is almost entirely methane
  - Propane, butane, other “anes”
Generating Resources

- **Hydropower**
  - Storage, Run of River

- **Nuclear**

- **Fossil**
  - Coal, Natural Gas

- **Renewables**
  - Wind, Solar, Geothermal, Biomass, Ocean

- **Efficiency, CHP, Load Management**
Grand Coulee Dam
Lower Granite Dam
Fossil Fuels

- 9 coal plants - Serving the NW
  - WA, OR, MT, NV, WY
  - Considered a low cost fuel
  - Rail and mine mouth
  - Carbon constraints eminent
  - 48% of US electricity

- 26 natural gas fired plants all over the region
  - Gas turbine technology advance
  - 2000-01 energy crisis spikes prices
  - 21% of US electricity
Renewable Energy Technology

- **Wind** - fastest growing in US and NW
  - Bigger turbines, off-shore, slower wind speeds, small scale
  - Intermittent

- **Solar** - fastest growing worldwide
  - Photovoltaics, concentrating solar thermal, hot water, passive
  - Expensive but dropping in cost

- **Geothermal** - 24/7 resource
  - hot water, hot rocks
  - low and high temperature
Renewables Cont.

- **Biomass**
  - Combustion
  - Gasification
  - Liquid fuels

- **Ocean Energy**
  - Wave
  - Pressure
  - Tidal
  - Current
Conservation Has Come a Long Way

Dang it all! There's that word again! Why do they use words we ain't never heard of? Somebody look it up!

GOT IT!
CONSERVATION
Energy Efficiency

Time magazine calls energy efficiency "Miracle Juice"

- Helps stabilize prices and lower energy bills
- Generates good, local jobs
- Boosts the bottom line for businesses and utilities
- Makes our built and natural environments healthier and more comfortable
- Frees up electric grid and pipeline capacity
Load Management

- **Customer side of the meter**
  - Direct load control
  - Price signal notification
  - Demand response - paid to shut down

- **Time of Use & Block Rates**
  - Peak prices
  - Inclining block rates - use more, pay more
  - Seasonal rates
Energy Efficiency is Still the Cheapest Option

Levelized Lifecycle Cost (2006$/MWh)

\[\text{Emission (CO2) cost} \quad \text{ Transmission & Losses} \quad \text{System Integration} \quad \text{Plant costs}\]

Assumptions:
- Efficiency Cost = Average Cost of All Conservation in Draft 6th Power Plan Under $100 MWh
- Transmission cost & losses to point of LSE wholesale delivery
- 2020 service - no federal investment or production tax credits
- Baseload operation (CC - 85% CF, Nuclear 87.5% CF, SCPC 85%)
- Medium NG and coal price forecast (6th Plan draft)
- 6th Plan draft mean value CO2 cost (escalating, $8 in 2012 to $47 in 2029).
PACIFIC NORTHWEST GENERATING CAPABILITY

34,100 MWa

- Hydro (average) 48.0%
- Natural gas 24.6%
- Coal 18.0%
- Nuclear 3.0%
- Wind 3.6%
- Biomass 2.4%
- Petroleum/PetCoke 0.3%

February 2010
2009 Washington State Electric Utility Fuel Mix
Electricity Sales to Washington Customers by Fuel Source

Reported to utility customers in 2009, Produced by Washington Department of Commerce
Map Instructions: For statistical information for a given State, hover over the State. For full information about the State, click to zoom in and then click the when it appears. To zoom out, right-click and select "Zoom Out!"

Electricity Residential Prices Data Source

Legend (cents/kWh)
- > 14.20
- 10.40 - 14.20
- 8.81 - 10.39
- < 8.81
- NA

State Ranking 12. Electricity Residential Prices, January 2010 (cents/kWh)
Chart 3: Washington State: Monthly Electricity Prices by Sector 2004-08

Source: EIA Electric Power Monthly
Natural Gas

- Canada supplies most of WA and NW natural gas
- Northwest Pipeline Corp. supplies western WA and OR, Gas Transmission Northwest supplies the eastern part of both states
- Residential sector leads natural gas consumption - then industrial and electric power generation
- Roughly one-third of households use natural gas for home heating
Squeezing Gas From a Stone
Location of shale fields believed to contain large natural-gas reserves.
Gas Price Drivers

- Electric Generation
- Oil Prices
- Domestic Gas Production
- Canadian Gas Production
- LNG
- Alaska Gas
- Shale Gas Field Discoveries - “Fracking”
Home Heating Fuel Comparison

- **Electricity**
  - WA = 53%
  - US = 33%

- **Natural Gas**
  - WA = 33%
  - US = 51%

- **Fuel Oil**
  - WA = 6%
  - US = 9%
Who are the players in the electric and natural gas system?
The Cast

- Investor-Owned Electric and Natural Gas Utilities
- State Regulators
- Consumer-Owned Electric Utilities
- Governing Boards
- Attorney General’s Office - Public Counsel
- Stakeholders - large and small consumers, advocates, unions
Investor-Owned Utilities Serving WA

- Puget Sound Energy - Electric & Gas
- Avista Utilities - Electric & Gas
- PacifiCorp (Pacific Power) - Electric
- Cascade Natural Gas - Gas
- Northwest Natural - Gas
Consumer Owned Utilities

- **Municipal - 10 cities**
  - Department of city government - City Council is governing board
  - Tacoma is different - utility governing board

- **Public Utility Districts - 28 PUDs**
  - Electric, water, wastewater, and telecom
  - 23 PUDs provide electricity to 815,000 customers
  - Locally elected Commissioners
  - Mostly within County boundaries but not all
Washington PUDs
Consumer Owned cont.

- Cooperatives and Mutuals
  - 20 in the state
  - Serve 280,000 customers
  - Rates about the same as state average
    - But bills are higher
  - 8 customers per mile of line vs. 41 customers per mile of line as the state average
  - Costs to serve higher
Utilities and Transportation Commission

- Regulates - Electric and natural gas utilities, transportation services
- Ensures fairly priced, available, reliable and safe services
- **Strategic Goals**
  * Protect life and property
  * Support strong, stable industries
  * Use public resources efficiently
  * Protect consumers from poor service and unfair rates
  * Promote environmentally responsible energy production and services
Ratepayer Advocates

- Designated in state law as independent ratepayer advocates
  - Attorney General’s office - Public Counsel
  - State government department
  - Citizen’s Utility Board
  - Not every state has established this role

- Most established in early 1970’s as energy rates started to climb
  - Rates, service quality, reliability, price stability, resource choices, customer services
Stakeholders

- The Energy Project
- NW Energy Coalition
- Industrial Customers - gas and electric
- On occasion:
  - Unions
  - Federal agencies - representing DOD
BRIGHT FUTURE

NW Energy Coalition