Electricity Primer

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Electricity 101

How It's Generated

As we learned at a young age, electricity is generated when a turbine is spun thus creating an electric current. There are a number of ways to fuel this process, be it from burning coal, natural gas, harnessing the wind to rotate a windmill's blades, nuclear power, or capturing heat from the earth itself (geothermal energy). Regardless of how this process begins, once electricity is generated it must be transported. Competitive suppliers use all these fuels and others in providing reliable service to millions of consumers.

How It's Transmitted

Electricity must be generated and consumed at nearly the same time. To maintain a reliable and secure electricity transmission grid, an intricate physical balance must constantly be maintained between the amount of power that is generated and the amount that is consumed since storage of electricity – like other commodities such as airline seats and hotel rooms – is not a practical reality at this time. The conveyance of electricity from a generating station to end-use customers relies on complex transmission and distribution networks.

Transmission lines are generally of a higher voltage to carry more power across longer distances. They can be thought of as a highway system for electricity. As a matter of fact, transmission line towers often track along side actual highways. Distribution lines are those often seen above or below city streets, and carry power to individual consumers. Both sets of networks are critical to delivery of power to consumers.

Where It's Transmitted

The continental United States is divided into three almost entirely separate electricity "interconnections." These interconnections function on different frequencies making transfers of power between them difficult. The Eastern Interconnection generally includes everything east of the Rocky Mountains. The Western Interconnection includes everything from the inter-mountain states to the Pacific. The Electric Reliability Council of Texas (ERCOT) includes most of Texas.

Within these three interconnections differing regulatory and market structures exist (discussed further below). The physics of generating electricity, however, remains the same in all regions.

What Is a Wholesale Electricity Market?

In many cases, electricity is generated by a power company that ultimately will not deliver it to the end-use customer. A single megawatt (MW – the most common unit of electricity used in discussions – is generally enough power to light 750 to 1,000 homes), like any other commodity, is frequently bought and re-sold a number of times before finally being consumed. These transactions are considered "sales for re-sale," and make-up the wholesale electricity market.

The wholesale market is open to anyone who, after securing the necessary approvals, can generate power, connect to the grid and find a counterparty willing to buy their output. These include competitive suppliers and marketers that are affiliated with utilities, independent power producers (IPPs) not affiliated with a utility, as well as some excess generation sold by traditional vertically integrated utilities. All these market participants compete with each other on the wholesale market.

To be a participant in the wholesale market, however, one does not need to either own any generation or serve any end-use customers. Just as with many other commodities – pork bellies, oil or stocks – individual traders (or power marketers) exist who buy power on the open market and re-sell it.

Trades in the wholesale market are understood to be occurring within a multi-state interconnection, and thus are interstate sales. Due to the interstate nature of the sales, the wholesale market is regulated across the country – except in ERCOT – by the Federal Energy Regulatory Commission (FERC). ERCOT functions as an exception due to the fact – as described above – that the entire interconnection lies in a single state, Texas.

Within regional wholesale markets, however, there exists a split structure. A number of regions – including the Northeast, Mid-Atlantic, much of the Midwest, ERCOT and California – organize their markets under an independent system operator (ISO) – sometimes also referred to as a regional transmission organization (RTO). Most states in these regions also allow for retail competition (further discussed below). By adopting this ISO/RTO structure, these regions have moved to expand competition in electricity. In fact, two-thirds of the electricity consumed in the U.S. is by consumers in an ISO/RTO.[1]

Other regions – including the Southeast, Southwest, Inter-Mountain West and Northwest – chose to retain the traditional regulatory model. Under this regime, vertically-integrated utilities retain functional control over the transmission system and therefore choose what generator is dispatched when. Such a model, however, has led to preferential treatment by these utilities for their own generation rather than more affordable and environmentally responsible generation available from competitive suppliers and marketers.

[1] "The Value of Independent Regional Grid Operators," The ISO/RTO Council, November 2005.

How Is Electricity Sold At Retail?

The retail side of electricity involves the final sale of power from an electricity provider to an end-use consumer. These sales range from the service for a large manufacturing facility to small businesses and to individual households.

In every state, regardless of whether they allow retail competition or not, supply for end-use customers is obtained either through the open, competitive wholesale market, from utility-owned rate-based (cost-plus) generation, or some combination of the two.

In states where full retail competition (often called "retail choice") is provided, customers may choose between their incumbent utility supplier and an array of competitive suppliers, as opposed to being a captive customer to a single provider. Competitive retail suppliers provide a variety of service plans that give consumers and businesses flexibility in their energy purchases. They may also offer services to hedge against price fluctuations, more choices for alternative energy resources, and newer energy efficiency projects, among others. These opportunities allow consumers and businesses to choose the services that best meet their needs.

In most states providing retail competition, customers who don't choose a supplier are served by their incumbent utility through a service called "provider of last resort" (POLR - also sometimes referred to as standard offer service, SOS). The POLR or SOS supplier will then secure its needed power on the wholesale market through a competitive bid process.

Retail markets are regulated at the state level. State regulatory commissions are most often called the state "Public Utility Commission" or "Public Service Commission." In every state, these commissions regulate a distribution utility's costs and rate of return for use and upkeep of the distribution system.

In retail choice states, the commissions approve any alternative competitive supplier before they can serve customers. The commissions also oversee a POLR or SOS utility's power procurement, and approve the results of the process if the process was fair.

In states not offering retail competition, the commissions regulate the expenditures of the monopoly utilities by allowing a rate of return on most costs. In these states, utilities are vertically-integrated and may construct, own and operate power plants – at the ratepayers' expense. To curb inefficiencies that occur under any monopoly system, many states with vertically-integrated utilities require utility power resources to be acquired through a competitive bid process - similar to how government contracts are filled.

What Are RTOs and Organized Markets?

A regional transmission organization or independent system operator (RTO or ISO) serves as a third-party independent operator of the transmission system. There is an inherent conflict of interest when the same single company owns all of the transmission and distribution system and some of the generation. These third-party independent operators, however, ensure that no preference is given in the dispatch of a utility-owned generator over a competitive generator. ISO/RTOs also conduct "spot" (also called "Day 1" or real-time) markets and "day-ahead" (or "Day 2") markets.

ISO/RTOs provide fair transmission access to facilitate competition for the benefit of consumers. They provide transaction support as part of their market duties and engage in regional planning to ensure that the right infrastructure gets built in the right place, at the right time. They accomplish all of this over a large regional area providing greater value to customers at every level of the supply chain than would be seen in the more piecemeal utility-by-utility approach.

This wide, regional approach also improves the reliability and coordination of what has been called the "most complex machine ever devised by man." ISO/RTOs have worked to eliminate "seams" between regions. This has helped to facilitate more efficient power flows and transactions, which previously may have had to cross numerous individual utility areas and had to pay transaction charges for every utility border crossed.

As previously noted, ISOs and RTOs cover many regions of the country with two-thirds of the United States' economic activity occurring within their boundaries. Current organized markets include:

1. ISO New England;
2. New York ISO;
3. PJM (Mid-Atlantic, a portion of the Midwest);
4. Midwest ISO;
5. Southwest Power Pool;
6. ERCOT (most of Texas); and the
7. California ISO.

Taking such a regional planning approach allows for the pooling of resources and therefore the need for fewer plants than on a state-by-state basis. By cutting the need for more power plants, ISO/RTOs help save consumers money and substantially reduce emissions.

ISO/RTOs conduct vigorous oversight of both their market and transmission functions and are regulated by the Federal Energy Regulatory Commission (FERC). As a further check, each organized market is overseen by an independent market monitor. All stakeholders in the market have input into ISO/RTO activities while the transparency of a fluid and liquid market also helps to make sure markets are fair.

How Wholesale Electricity Prices Are Set

ISO/RTOs use a uniform (or single) clearing price auction in which electricity generators place bids with an independent market administrator for a particular time period. The independent administrator then dispatches the generators from lowest to highest bids until all power demand is met. Each generator that is dispatched is then paid the same price as what was paid to the last unit of electricity needed to meet total demand.

Uniform price auctions are used for the "spot" (or real-time) markets of all federally approved and independently run regional electricity markets. In practice, the spot market is used to serve only a portion of demand. Like a mutual fund, retail electricity suppliers serve their customers through a diverse portfolio of long-, medium- and short-term contracts, as well as the spot market.

The uniform clearing price auction drives generators to reduce their operating costs so that their bids can be lower and, hence, will be accepted – the generators that set the clearing price, and therefore meet the last increment of demand, earn little or no contribution to their fixed costs. The lower cost generators in turn are able to recover some of their long-term debt and other expenses under this auction design.

Because the last increment of demand set the clearing price, an explicit price signal to conserve electricity is established. For certain customers who can reduce their demand, a price incentive can be transparently seen.

By contrast, under a pay-as-bid auction design, the selection process for which generators will run at a given time is the same as in a uniform clearing price construct with the difference being that each auction winner is paid exactly what it bid - a significant distinction.

In a pay-as-bid auction, generators will roll all their costs into a single bid and attempt to guess what the highest price selected will be, and then bid to match it. Inevitably, some lower cost generators will bid too high – because all generators will be bidding above their operating costs, market transparency is lost and the risk of manipulation is raised.

For these simple reasons, economists – and some critics[2] – agree that uniform clearing price auctions generally result in lower prices for consumers than pay-as-bid auctions.[3]

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[2] Lester Lave of Carnegie Mellon University and Kenneth Rose of Michigan State University speaking at the American Public Power Association's "Assessing Restructured Electricity Markets" Symposium, Feb. 5, 2007 in Washington, DC.

[3] "Pricing in the California Power Exchange Electricity Market: Should California Switch from Uniform Pricing to Pay-as-Bid Pricing?" Peter Cramton, Alfred E. Kahn, Robert H. Porter, and Richard D. Tabors, Blue Ribbon Panel Report, California Power Exchange, January 2001.

Competition in Electricity Markets

Competition in electricity markets – as with competitive market structures for other commodities – creates incentives for efficiency and innovation while providing the most affordable prices consistent with long-term investments. From 1995-2004, significant gains in efficiency, attributable to competitive markets, were seen in coal and nuclear plants in the eastern United States.[4] Competition also led to the innovation and increased deployment of new gas-fired generation technologies providing significant new efficiencies and environmental controls. These efficiency gains translate to reduced fuel use, lower costs, lower emissions and fewer power plants needed to meet demand.

Competitive markets also transfer much of the risk of a costly and long-term power plant investment from the captive rate-payers of a vertically-integrated utility to competitive suppliers. In states with ISO/RTOs and in regions that hold independently overseen competitive bidding for generation resources, the days when a rate-based plant was built 200 or 300 percent or more over the initial cost projections, with the excess costs footed by captive ratepayers, are over so long as robust competitive electricity markets discipline plant development costs.

The decision to move to increased competition in electricity markets was not made by Congress and the states in a vacuum. It was no accident that competitive electricity markets were developed after electricity rates skyrocketed in the 1970s and 1980s due to a number of factors, including large cost over-runs in building traditional utility-owned capital intensive baseload power plants. As the nation faces a situation again where the need for new baseload plants is looming, it is important to remember the past to avoid repeating costly mistakes.

Today, rates are rising everywhere because of significant input cost increases such as for fuel, labor, and construction materials, as well as regulatory uncertainty. It is important to note, however, that these costs are rising in <u>all</u> regions of the country regardless of market structure. In fact, states that have chosen to further pursue competitive markets have seen a comparative decrease in their power costs when compared to other states.[5]

The path to competitive power markets has been one affirmed numerous times by both state and federal governments. As stated by the Federal Energy Regulatory Commission in a June 5, 2006 press release, “The Energy Policy Act of 2005 represents the third major federal law enacted in the past 30 years to promote wholesale competition... These laws promoted competition by lowering barriers to entry and increasing transmission access.” While refinements are necessary as these markets evolve and mature, competition is bringing real benefits to consumers across the country.

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[4] Global Energy Decisions, Inc., “Putting Competitive Power Markets to the Test,” 2005

[5] Howard J. Axelrod, David W. DeRamus and Collin Cain, “The Fallacy of High Prices,” *Public Utilities Fortnightly*, November 2006