

# US Electricity Markets 101

An overview of the different types of US electricity markets, how they are regulated, and implications for the future given ongoing changes in the electricity sector.

Explainer by **Kathryne Cleary** and **Karen Palmer** — March 3, 2020

In the United States, how electricity is bought and sold varies by region of the country. While many cities, including Austin, Texas, Los Angeles, California and Nashville, Tennessee are served by municipally owned utilities and some rural areas are served by customer-owned rural cooperatives, the majority of electricity customers in the use are served by utilities that are owned by investors. These investor-owned electric utilities can be either **regulated** and operate as vertically integrated monopolies with oversight from state public utility commissions, or they can operate in **deregulated** markets where electric energy prices are set by the market with some federal oversight of wholesale market operations. These regulatory constructs determine how retail and wholesale electricity prices are set and how power plants are procured. This explainer discusses the different types of US electricity markets, how they are regulated, and implications for the future given ongoing changes in the electricity sector.

*For definitions of bolded terms and other concepts related to the electricity grid and industry, check out [“Electricity 101.”](#)*

## Traditional Regulated Markets

Prior to the 1990s, most investor-owned electric utilities were **regulated** and **vertically integrated**, which means they own electricity generators and power lines (distribution and transmission lines). Today, while many states have abandoned this system in favor of deregulation, utilities that serve about one third of US electricity demand still operate under this construct.

Utilities in these traditionally regulated regions operate as a monopoly in their territories, which means that customers only have the option to buy power from them. In order to keep electricity rates reasonable for customers, state regulators oversee how these electric utilities set electricity prices. Retail electricity prices in these areas are set based on recovering the utility’s operating and investment costs including a “fair” rate of return on those investments (collectively called a **revenue requirement**). This revenue requirement must be approved by the state’s public utilities commission, which prevents utilities from overcharging customers for electricity.

### Future of Power Explainer Series

This explainer is part of RFF’s Future of Power Explainer Series, which outlines the fundamentals of electricity markets and policy to convey how electricity systems function today and how they may evolve in the future with decarbonization efforts.

- [Electricity 101: Terms and Definitions](#)
- [US Electricity Markets 101](#)
- [Renewables 101: Integrating Renewable Energy Resources into the Grid](#)
- [Electrification 101](#)

Regulated utilities must also seek state approval for investments in power plants. Vertically integrated utilities decide which generators to build and then recover the costs of these investments through electricity rates. Because a utility's investments determine its revenue requirement and thus its potential profit, many state regulators require utilities to demonstrate the necessity of future investments through an integrated resource planning (IRP) process. This process is used for long-term planning and requires each utility to demonstrate how it plans to meet customer electricity demand going forward and to justify any future investments. Notably, under this structure, customers bear the risk of investments because utilities can recover their costs through rates, regardless of how the power plant performs (for example, South Carolina electricity customers **paid** for nuclear plants that were never constructed).

Even though vertically integrated utilities generate their own electricity, many trade with other utilities during times of need. For example, during certain times of the year it may be cheaper for some utilities to purchase excess hydroelectric power from others rather than generate power using their own facilities. This type of wholesale bilateral trading is especially common in the west and southeast where most utilities are still regulated. These wholesale market transactions are subject to regulation by the Federal Energy Regulatory Commission (FERC).

## Deregulated Markets

Beginning in the 1990s, many states in the US decided to deregulate—also known as restructure—their electricity systems to create competition and lower costs. This transition required electric utilities to sell their generating assets and led to the creation of independent energy suppliers that owned generators. Because power lines are a natural monopoly, electric utilities held onto these assets to become transmission and distribution utilities, and those natural monopoly functions continue to be regulated.

The biggest impacts resulting from deregulation were changes to retail and wholesale electricity sales, with the creation of retail customer choice and wholesale markets.

## Retail Deregulation: Customer Choice

In deregulated areas, electricity customers have the option of selecting an electric supplier (known as **customer choice**) rather than being required to purchase electricity from their local electric utility, which introduces competition for retail electricity prices. Since many electric suppliers can exist within a region with customer choice, electric retailers offer competitive prices in order to acquire customers (contracts with generation suppliers typically offer the customer a fixed charge—dollars per kilowatt-hour of power—over a certain amount of time).

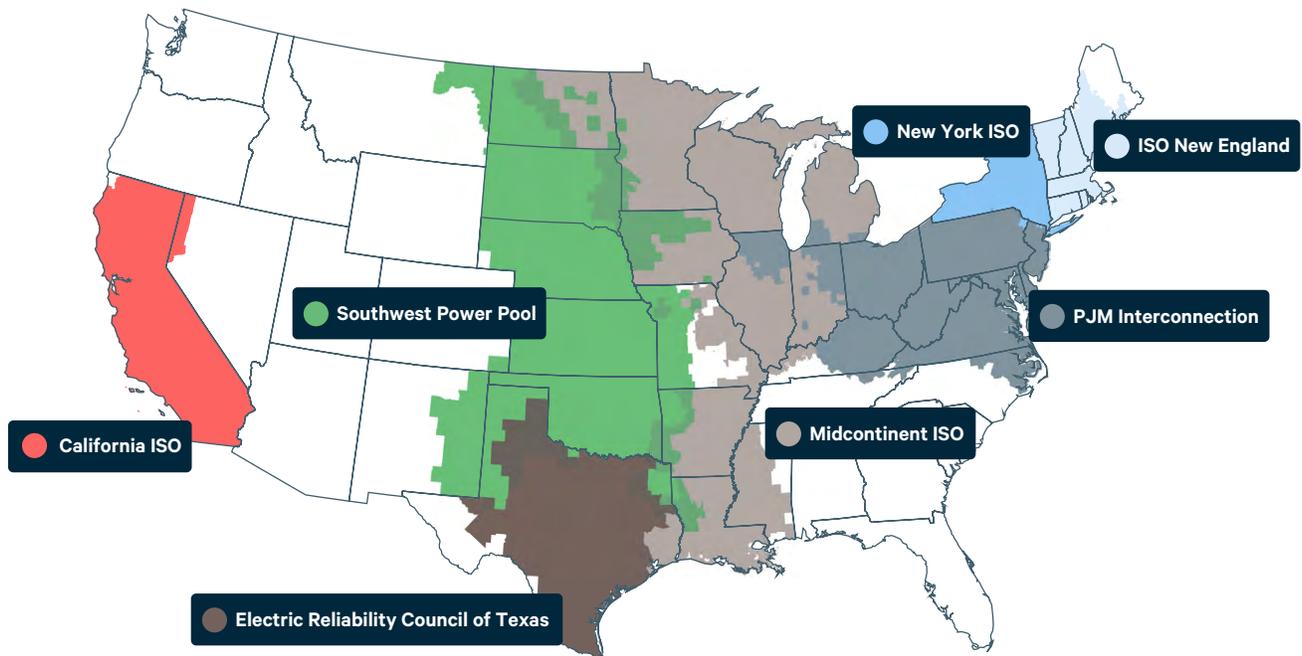
For consumers, there are pros and cons to selecting a supplier other than their local utility company. Retail competition can help lower a customer's electric bill and also allow them to tailor their energy to their preferences, such as selecting a clean energy supplier. However, independent companies often require customers to sign contracts, which can lock them into a set electricity price for multiple years. While fixed rates could be beneficial for some customers, they could also negatively impact others if the rate they agree to ends up being more expensive than the rate set by the local utility. Also, it is important to note that customer choice is only applicable for the generation portion of a customer's utility bill because transmission and distribution services are still provided by the local utility company, since these services are a natural monopoly (as discussed above). Consequently, only a portion of electric rates in these areas are set competitively.

For customers who choose not to select an independent power supplier, their local utility is still obligated to provide them with electricity that the utility will purchase from generators.

## Wholesale Deregulation: Creation of Competitive Wholesale Markets

Unlike regulated states that plan for investment, deregulated states use markets to determine which power plants are necessary for electricity generation. As utilities and competitive retailers in deregulated regions do not generate their own electricity, they must acquire power elsewhere for their customers. Centralized

## Regional Transmission Organization Map



Source: Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), Idaho National Laboratory (INL), National Geospatial-Intelligence Agency (NGA) Homeland Security Infrastructure Program (HSIP) TeamSour

wholesale markets—in which generators sell power and **load-serving entities** purchase it and sell it to consumers—provide an economically efficient method of doing so (discussed more in the next section). Notably, under this structure, investment risk in power plants falls to the electric suppliers and not to customers, unlike in regulated markets.

Following deregulation, **regional transmission organizations (RTOs)** replaced utilities as **grid operators** and became the operators of wholesale markets for electricity. These RTOs have evolved over time.

Since many RTOs operate wholesale markets that encompass multiple states, they are regulated by FERC (with the exception of ERCOT, the Texas RTO). FERC has oversight of all wholesale power transactions on the two large interconnected grids: the eastern and western interconnects.

While regulated utilities base retail rates on a regulated rate of return on investments (as described above), deregulated retail utilities purchase electricity at market-

determined wholesale prices and then sell that electricity to customers at market-determined retail prices, given competition from other retailers. RTOs typically run three kinds of markets that determine wholesale prices for these services: energy markets, capacity markets, and ancillary services markets.

### Energy Markets

Energy markets are auctions that are used to coordinate the production of electricity on a day-to-day basis. In an energy market, electric suppliers offer to sell the electricity that their power plants generate for a particular bid price, while load-serving entities (the demand side) bid for that electricity in order to meet their customers' energy demand. Supply side quantities and bids are ordered in ascending order of offer price. The market "**clears**" when the amount of electricity offered matches the amount demanded, and generators receive this market price per megawatt hour of power generated.

RTOs typically run two energy markets: the day-ahead and real-time markets. The **day-ahead market**, which

represents about 95 percent of energy transactions, is based on forecasted load for the next day and typically occurs the prior morning in order to allow generators to prepare for operation. The remaining energy market transactions take place in the **real-time market**, which is typically run once every hour and once every five minutes to account for real-time load changes that must be balanced at all times with supply.

RTOs use energy markets to decide which units to **dispatch**, or run, and in what order. In the day-ahead market, RTOs compile the list of generators available for next-day dispatch and order them from least expensive to most expensive to operate. For example, since wind plants operate without fuel, they are able to bid \$0 into the energy market and get dispatched first. Dispatching units by lowest cost allows the market to meet energy demand at the lowest possible price. During periods of high demand, wholesale prices rise accordingly because more high-cost units need to be dispatched in order to meet electric load.

Base wholesale market prices typically reflect the price for power when it is able to flow freely without transmission constraints across the RTOs territory. When that is not possible, RTOs account for congestion on transmission lines by allowing prices to differ in different locations. As a result, areas with high demand and scarce electric resources typically have higher prices than those with abundant generation relative to load.

## Capacity Markets

Electricity retailers are required by the North American Electric Reliability Corporation (NERC), an independent organization that ensures grid reliability, to support enough generating capacity to meet forecasted load plus a reserve margin to maintain grid reliability. Some RTOs run a capacity auction to provide retailers with a way to procure their capacity requirements while also enabling generators to recover fixed costs, i.e. those costs that do not vary with electricity production, that may not be covered in the energy markets alone.

The capacity market auction works as follows: generators set their bid price at an amount equal to the cost of keeping their plant available to operate if needed. Similar to the energy market, these bids are arranged from

lowest to highest. Once the bids reach the required quantity that all the retailers collectively must acquire in order to adequately meet expected peak demand plus a reserve margin, the market “clears”, or supply meets demand. At this point, generators that “cleared” the market, or were chosen to provide capacity, all receive the same clearing price which is determined by the bid price of the last generator used to meet demand.

Payments to generators in the capacity market are essentially a reward for that generator being available to operate and provide electricity if needed. Consequently, if generators are unavailable to operate during a time when they are called upon, they may face fees under capacity performance requirements.

## Ancillary Services Market

RTOs use the ancillary services market to reward other attributes that are not covered in the energy or capacity markets. Ancillary services typically include functions that help maintain grid frequency and provide short-term backup power if a generating unit stops.

## Variation Across Regions

Not all states fall neatly into one of these categories. Participation in RTOs and wholesale markets does not require retail customer choice or divestment of generation assets, and many states have chosen to embrace certain aspects of deregulation while maintaining some parts of regulation.

Some regulated states with vertically integrated utilities still join an RTO for grid services. In West Virginia, for example, utilities are rate-regulated and own their own generation, but the state still participates in wholesale markets in PJM, the mid-Atlantic RTO.

Some states have deregulated their wholesale markets but not retail markets. California, for example, is partially deregulated and formed its own RTO, the California Independent System Operator (CAISO), which operates the grid and wholesale markets. However, the state does not offer individual customer retail electricity choice, although communities can opt out of the local utility through community choice aggregation under which

a company hired by the community buys power in wholesale markets for all residents who do not opt out of this arrangement.

The structure of wholesale markets varies across regions as well. For example, ERCOT, the RTO of Texas, does not run a capacity market and instead relies on price signals in the energy market alone to ensure reliability. High prices in the energy market, typically caused by low supply and high demand, provide an economic signal for more generators to enter the market, which can then lower energy prices and provide a signal that enough generating capacity is available to meet demand. CAISO similarly does not run a capacity market and relies on retailers to ensure resource adequacy to meet NERC reliability requirements.

## The Future of Electricity Markets

Many states have policies in place that promote a long-term transition to cleaner renewable sources of energy, like wind and solar power. As renewable generators become a larger portion of the grid's resources, complications may arise with the existing wholesale market structure in deregulated states. Renewable energy sources do not require fuel inputs to run since they use energy from the sun, wind, and other natural sources. Consequently, they are able to offer bids of \$0

into the energy and capacity markets. As these sources make up a larger portion of the grid over time, these \$0 bids can significantly reduce wholesale prices for energy and capacity and could discourage long-term investment for all resources. As a result, wholesale markets may need to adapt in the future to better accommodate different types of resources.

*For more detailed information on all of the above, see FERC's [Energy Primer](#).*

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