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U.S. Power Markets: What Every MBA Needs to Know

Executive Summary

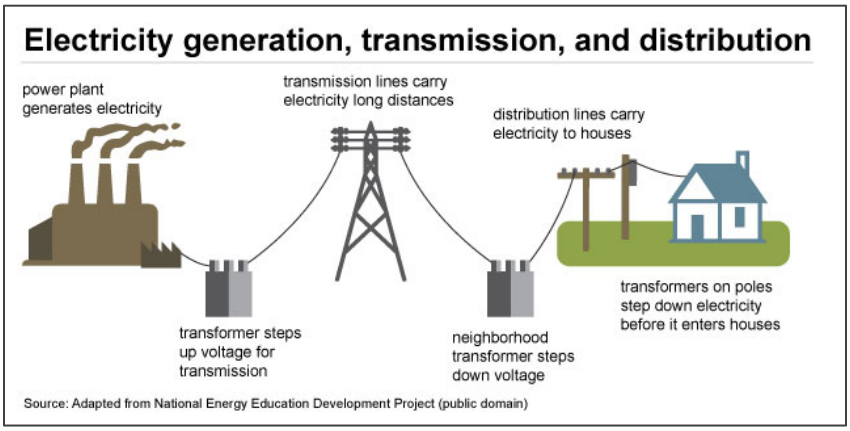
A power market is a marketplace where electricity is bought and sold. Participants in the market include utilities, independent power producers, and users of electricity. Power markets can be organized as either regulated or deregulated markets. In a regulated market, the utility controls the price and supply of electricity (within bounds set by a regulatory framework), while in a deregulated market, prices are determined by supply and demand economics in which multiple providers compete to sell electricity. The growth of renewable energy production and changes in consumer behavior are leading to a transformation of the power market, with an increased focus on distributed energy resources and the integration of new technologies.

The energy industry is currently in the midst of a radical change—often referred to as the global "energy transition." Demand from customers, regulators, and the general public to adopt low-carbon power production, combined with instability in global energy markets due to geopolitics, is accelerating the transition. In the U.S., the 2022 passage of the Inflation Reduction Act (IRA) created $370 billion in new incentives for decarbonization across the energy system, which will affect power markets and create an estimated 9 million clean energy jobs.[1]

An understanding of power market dynamics is relevant to MBAs in many roles—whether working in the energy sector directly, working in a corporate role that involves the procurement of power or development of a climate or sustainability strategy, investing in infrastructure projects, or joining a climate tech startup.

The Issue

A power market is a marketplace where electricity is bought and sold. Participants in the market include utilities, independent power producers, and users of electricity. Typically, power markets are organized by governments, regulatory agencies, and/or independent organizations that oversee the generation, transmission, and distribution of electricity.



Source: https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php

Put simply, power markets involve the following components:

- Generation: This is the production of electricity from various sources, including coal, natural gas, hydroelectric, wind, solar, or nuclear. Electricity is typically generated by power plants that are owned by utilities or independent power producers such as Duke Energy, Pacific Gas & Electric, or NextEra Energy (to name just a few). The "energy mix" refers to the different types of fuels (e.g., coal, nuclear, wind, solar) used to produce electricity in any given region,[2] and can vary significantly from state to state based on existing infrastructure as well as regulatory incentives and mandates.

- Transmission: This is the process of moving electricity long distances from the generation source. Transmission typically ends at a sub-station before the electricity is "stepped down" and put on a

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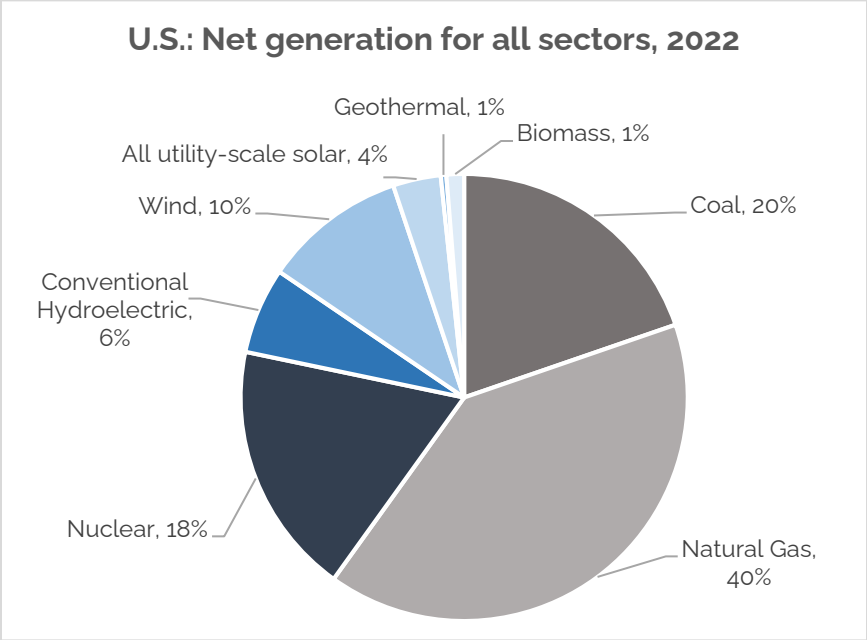
distribution system to reach the end consumer. The transmission network is typically owned and operated by utilities or independent organizations and is regulated by government agencies.

- Distribution: This is the delivery of electricity from the transmission network to retail and commercial consumers. This is typically done by local utilities and is also regulated by government agencies.



Data source: U.S. Energy Information Administration, https://www.eia.gov/electricity/data/browser

Overall, power markets are designed to ensure that sufficient electricity is generated to meet the "load" (or demand) and transmitted and distributed in an efficient and reliable manner, while also balancing the needs and interests of various stakeholders, such as producers, distributors, consumers, and the environment.

It's impossible to understand the nuances of power markets without understanding a fundamental characteristic of the grid as a whole.[3] Unlike any other commodity market, at any moment in time, the electricity demand must be matched by an exact amount of supply in real time. Large-scale, long-duration storage capacity has historically been prohibitively expensive at the scale required by the grid (though some innovations have begun to bring costs down). Demand tends to be inelastic and varies based on time of day, time of year, weather etc., so measures need to be in place to meet the varying levels of demand.[4] In North America, Independent System Operators (ISOs) and Regional Transmission Organizations (RTOs) were thus created to keep the power grid balanced between generation and load (more on this below).

Overview of the U.S. power marketplace

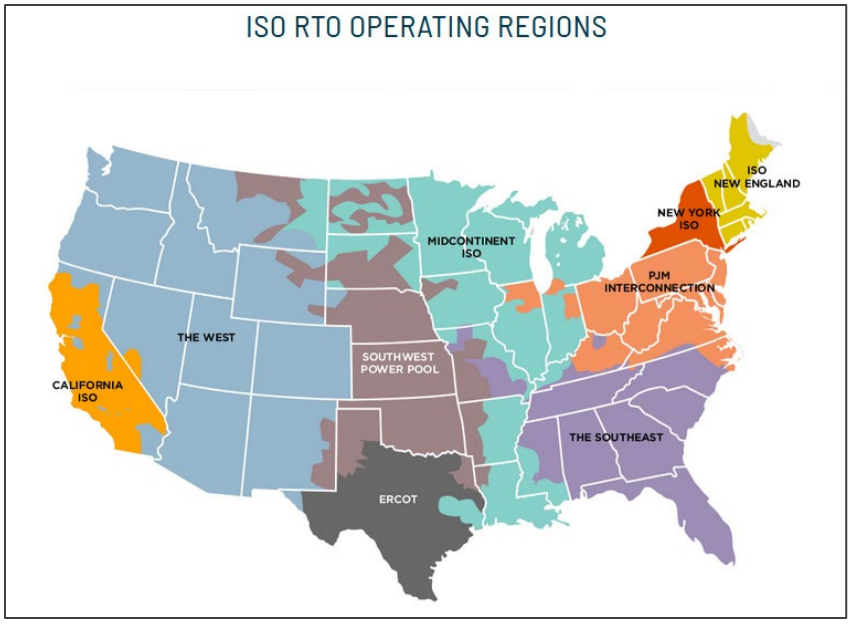
In the 1930s, the federal government began to regulate the power industry through the Public Utilities Holding Company Act (PUHCA) and the Federal Power Act, which gave the Federal Energy Regulatory Commission (FERC) authority over where utilities could operate and expand, as well as interstate electricity sales and transmission. In the 1960s and 1970s, the power industry experienced significant growth and expansion, driven in part by the construction of large-scale power plants and the development of new technologies like nuclear power. Several historic blackouts demonstrated the importance of regulation and ultimately led to the creation of the North American Electric Reliability Council (NERC) and the first regional interconnections.[5]

In the 1990s, some states (but not all) adopted policies that allowed for more competition in the generation and sale of electricity (known as "deregulating" their power market; note that "deregulated" markets allow competition but are not exempt from other types of regulation). This led to the breakup of many vertically integrated power companies and the emergence of independent power producers. Today, the U.S. has a complex electric power grid that is highly regulated and comprises a diverse mix of traditional power plants, renewable energy plants, and distributed energy resources, which are small-scale power generation systems located near the source of consumption (for instance, rooftop solar on a residential home or commercial site).

Market participants

In the production of electricity, generation utilities and independent power producers—such NextEra Energy, Dominion Energy, Duke Energy, Southern Company, and American Electric Power (AEP)—plan, finance, manage, and operate power-generating facilities like nuclear plants, natural gas plants, and wind farms.

Transmission facilities are usually held by private companies, many of which are overseen by large regional non-profit entities called independent system operators (ISOs) or regional transmission organizations (RTOs).



Source: Sustainable FERC Project, https://sustainableferc.org/

ISOs such as California ISO, Electric Reliability Council of Texas (ERCOT), and New York ISO act as market operators, balancing generation and load in real time. They forecast and schedule generation to assure that sufficient generation and back-up power is in place to meet unexpected demand or generation loss.[6] ISOs operate the transmission system independently of wholesale market participants, and foster competition for electricity generation.[7] They act as exchanges and clearinghouses for trading activities, using bid-based markets where buyers and sellers can bid for or offer generation in different electricity markets.[8] RTOs such as Pennsylvania New Jersey Maryland Interconnection (PJM) have similar functions of ISOs but cover a larger geographic area.

ISOs/RTOs don't actually own any assets. Their objective is to ensure the security of the system and maximize the use that other participants can make of the system, running an efficient market to encourage trading. There are currently seven ISOs/RTOs in the U.S, which cover two-thirds of the nation's electricity load.

Finally, distribution utilities operate local electricity grids, which include the distribution lines, transformers, and other equipment to distribute electricity to end-users. They also provide a range of services to ensure that electricity is delivered safely and reliably. Depending on the market, distribution may be done by large investor-owned utilities (like Duke Energy, Southern Company, or DTE Energy) or it may be done by delivered by publicly owned utilities or regional electric cooperatives.

Regulation

The power industry is a highly regulated one. The U.S. Department of Energy (DOE) is the agency primarily tasked with establishing and implementing federal energy policies. The Federal Energy Regulatory Commission (FERC) is an independent agency under DOE that is responsible for regulating the more technical aspects of the electricity industry. FERC regulates wholesale prices and investigates suspected abuses of market power, sets prices for products and services provided by natural monopolies. Its objective is to make sure that the industry operates in an economically efficient manner and the quality of supply is appropriate.

State Public Utility Commissions (PUCs) regulate distribution at the state level and address issues that are not reserved for the federal government which differ from state to state (such as renewable portfolio standards).[9] The U.S. Environmental Protection Agency (EPA) regulates emissions and environmental impacts of power plants, and the Commodity Futures Trading Commission (CFTC) regulates the sales of futures and derivatives markets for potential abuses and certain commodity trades (including electricity hedges and trade options).

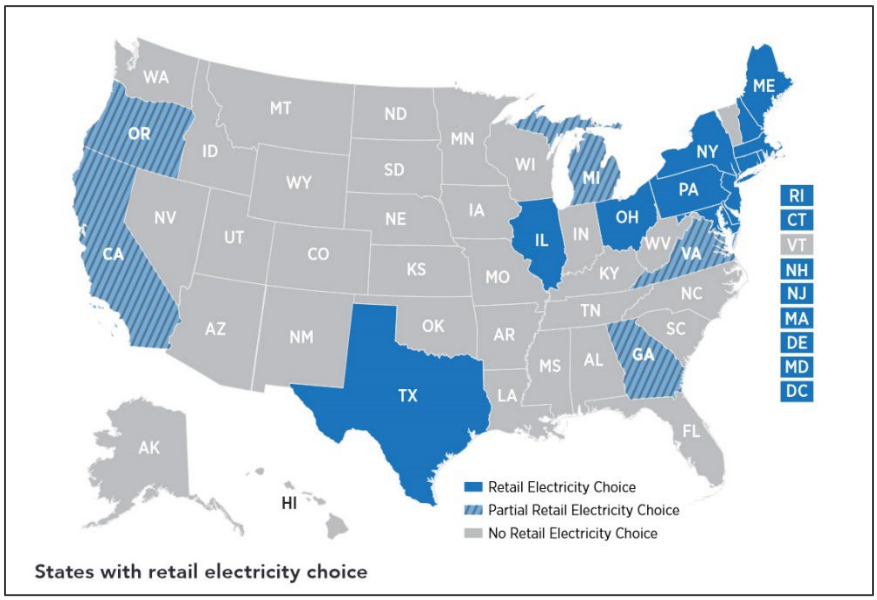
Regulated power markets

Until the 1990s, most power in the U.S. was delivered by vertically integrated utilities. In these markets, utilities control the entire power value chain—from generation at the plant to the distribution of electricity to the end user, and customers have no choice in their electricity provider. In return for their market monopoly, utilities in regulated markets are constrained by state regulators as to what they can charge customers and what a fair rate of return is on their investments. Compared to deregulated utilities, regulated utilities are less exposed to market-driven power prices due to their business models and predictable earnings.[10] Today, about one-third of the U.S. electricity demand is serviced by regulated utility markets, including Florida, North Carolina, South Carolina, and Georgia.[11]

Deregulated power markets

Deregulation in the U.S. was initiated through the Public Utilities Regulatory Policies Act (PURPA) in 1978 to introduce competition and lower costs but the process of deregulation wasn't implemented until 1992 when the Energy Policy Act created the outline for competitive wholesale electricity generation market.[12] Deregulation in the US, however, has not been pursued in all states.

In deregulated markets, electricity rates are mostly driven by the market, capitalizing when the demand is high and attracting relatively higher margins. Texas and Ohio are major deregulated markets in the U.S. CenterPoint Energy and FirstEnergy are example of utilities that operate in these deregulated markets. Customers in deregulated markets have the option to choose from a variety of power suppliers, and competition naturally encourages companies to offer better prices and plans to consumers.[13] (Note that deregulation only applies for electricity generation and retail sales. Transmission and distribution continue to be regulated, as a single company manages the power lines, transmission towers, utility poles, transformers, substations, etc.)



Source: National Renewable Energy Lab (NREL), "An Introduction to Retail Electricity Choice in the United States," https://www.nrel.gov/docs/fy18osti/68993.pdf

Wholesale & retail electricity markets

Energy markets refer to the trading of power among producers, intermediaries, and consumers. The primary difference between wholesale and retail power markets is the end user. Wholesale markets sell large amounts of power at bulk prices to utilities and industrial customers, while retail markets serve smaller-scale users such as residential customers and small businesses.

Wholesale markets

Organized wholesale power markets emerged following the deregulation and restructuring of utilities and are often regulated by government agencies to ensure fair competition and prevent market manipulation.[14] Wholesale power is sold to distribution utilities (who then resell it to retail consumers) and to large commercial and industrial users who need large quantities of electricity. The prices in wholesale markets are typically more volatile and influenced by supply and demand factors like weather patterns, global economic trends, and geopolitical events. Wholesale markets are typically organized as auction-style exchanges where buyers and sellers submit bids and offers. The price for wholesale electricity can be predetermined by a buyer and seller through a bilateral contract or it can be set by organized wholesale markets. In addition, wholesale markets may also have forward contracts, or long-term agreements that allow buyers to lock in prices for future deliveries. ISOs coordinate, control, and monitor the wholesale market operations.

Retail markets

Retail markets sell electricity at the distribution level to smaller-scale users such as residential and small business customers after it has been bought in the wholesale market. These markets are more localized and often regulated by state or local authorities to ensure that prices are fair and transparent. Customers can choose from a variety of plans, including fixed-rate plans, variable-rate plans, and renewable energy options.

Business Risks

Given the volatility of electricity prices and demand, and the stringent regulatory environment, utilities and power purchasers must be proactive to mitigate and hedge several risks.

Price risks

Factors such as changes in fuel prices, weather events, equipment outages, and shifts in supply and demand make power market prices highly volatile. For instance, in the PJM region in February 2023, day-ahead wholesale rates ranged from $21.90 per megawatt-hour (MWh) to $143.00/MWh. [15] Both consumers and producers are exposed to electricity price risks.

Mechanisms to hedge against price risk include forward contracts, which are agreements between two parties to buy energy at fixed price in the future. For instance, companies might enter into a forward contract for the purchase of natural gas for use in their manufacturing operations, or sign a power purchase agreement (PPA) to agree to purchase solar or wind energy at a specified price over a specific period of time. Other hedging mechanisms include energy futures (forward contracts that are exchange-traded) and options (contracts that give the holder the right, but not the obligation, to buy or sell electricity at a predetermined price).

Regulatory risks

Power markets are subject to a range of regulations at both the federal and state levels, which can change over time, creating uncertainty in investment decisions. Regulatory changes might increase the cost of producing or distributing power (for instance, by imposing new environmental or permitting requirements) or might create incentives or mandates for certain technologies.

The 2022 passage of the Inflation Reduction Act (IRA) incentivized investment in many types of cleaner energy and extended two important renewable energy incentives, the Production Tax Credit (PTC) and Investment Tax Credit (ITC).[16] However, developers are still left with implementation hurdles; thousands of renewable energy projects are stuck at a standstill, as backlogs of permitting requests and transmission constraints sit with local regulators and ISOs/RTOs.[17] To manage regulatory risk, in 2022, electric utilities spent an estimated $124 million on lobbying.[18]

Operational risks

The complex physical infrastructure supporting the power system is subject to dramatic and costly operational risks from equipment failure, domestic terrorism, cyberattacks, extreme weather, and natural disasters. These disrupt operations, cause outages, and result in huge financial losses. In 2018, the U.S. Department of Homeland Security disclosed that Russian hackers nearly caused widespread electricity blackouts in the U.S.[19] In 2021, Texas experienced unusually freezing weather conditions, impeding power plant performance. ERCOT was criticized for enforcing rolling blackouts which left millions of people without power in extremely low temperatures. This failure resulted in over 100 deaths, $195+ billion in property damage, and reforms to state legislation requiring weatherization standards for power plants.[20]

Business Opportunities

Increasing electrification

Since 2007, demand for power in the U.S. has been relatively flat.[21] However, climate concerns are spurring investments in the increased electrification of transportation, buildings, and other economic sectors, which may stimulate new growth in electricity demand. Electric vehicles (EVs)—including not only passenger cars, but also buses, vans, and semi trucks—will drive up demand for electric power from utilities. In 2022, globally, EV sales roughly doubled and could double again in 2023.[22]

Energy storage

Until recently, large-scale energy storage has not been economical, thus leading to an underdeveloped market. Energy storage technologies such as batteries and pumped hydropower are becoming increasingly important as more intermittent renewable resources (e.g., solar and wind) come onto the power grid. Storage helps balance supply and demand, improve grid resilience, and provide backup power. Following robust

growth in 2022, energy storage is expected to expand significantly in the coming years, increasing utility-scale battery storage capacity in the U.S. nearly fourfold by the end of 2025.[23]

Power market reforms
Power market reforms are being implemented in many regions to promote competition, facilitate the integration of renewables, and improve market efficiency. The current wholesale market was established around the infrastructure of yesterday; as markets rapidly decarbonize and more renewables are pushed onto the grid, the system must be reformed to accommodate the flexibility needed to accommodate the variability and intermittency of renewable power. Renewable energy certificates (RECs) can provide long-term price certainty and incentives to develop renewable energy.[24] Capacity markets help ensure grid reliability and ability to meet demand. Other market innovations include the introduction of carbon pricing and peer-to-peer energy trading.[25, 26]

Decarbonization & the shift to renewables
The transition to a low-carbon energy system is accelerating, driven by global commitments to mitigating climate change. Power markets are increasingly focused on adding renewables such as wind and solar and retiring coal-fired power plants. The U.S. renewable energy sector received a massive boost from the IRA, setting up 2023 to be a year of both expansion and continuing growing pains as companies take advantage of the $370 billion in tax credits.

Power Market Reform Trends

Capacity markets
In a capacity market, electricity generators are paid based on both the ability to produce electricity in the future, as well as the electricity produced. It is used in some wholesale electricity markets to pay for the availability of resources to meet peak electricity demand.

Renewable energy certificates (RECs)
Renewable energy certificates (also known as renewable energy credits) are tradeable commodities. Each REC represents one megawatt-hour (MWh) of electricity generated from a renewable energy resource. RECs can be purchased by utilities to meet renewable energy mandates, or by individuals or corporate buyers who wish to voluntarily incentivize renewable development and/or offset their carbon emissions.

Peer-to-peer energy trading
Peer-to-peer energy trading is the decentralized approach of buying and selling electricity directly between parties using a digital platform, which manages price and volume risk.

Takeaways for MBAs

1. Global power markets are in the midst of large-scale transformation, driven by demand from customers and regulators to transition to a decarbonized energy system.
2. Power markets are complex and regulated at both the federal and state level. The value proposition looks different from state to state depending on the regulatory environment, state-level incentives or mandates for particular types of power generation, fuel costs, infrastructure, and demand.
3. From banking opportunities to consulting to energy companies, power markets offer an exciting opportunity for MBAs looking to work in complex and diverse industry, that is experiencing significant tailwinds from recent U.S. legislation, including the Inflation Reduction Act (IRA).

Further Reading

U.S. Electricity Markets 101, Resources for the Future

Utility Accountability 101: How Do Utilities Make Money?, NRDC

2020 Energy Primer: A Handbook on Energy Market Basics, Federal Energy Regulatory Commission (FERC)

Utility Dive website

What is Power Trading?, Next Kraftwerke website.

Electricity Data, Issues & Trends, U.S. Energy Information Administration (EIA)

Insights on Electric Power & Natural Gas, McKinsey & Co.

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