Primer: How Power Markets Work

Before delving into the quantitative studies, this paper begins with a primer on the fundamentals of power markets and utility rate design. Establishing this foundation provides the critical framework needed to assess the existing literature and more rigorously evaluate when and how large loads may influence retail prices, and under what circumstances they may produce neutral or even beneficial effects for other customers.

Electric power markets exist to solve a physical constraint: electricity must be produced when it is consumed. Because development and deployment of large-scale storage technology systems remain limited, system operators must match supply and demand continuously. The market and regulatory structure that govern this process determines who builds generation, how investment risk is allocated, how prices are determined, and ultimately how customers pay for service.

Utility Models in the US

Utility structures generally follow one of two basic models that vary by state. The choice determines whether regulation or competition drives generation investment.

Vertically Integrated States

In vertically integrated states, a single entity (utility) owns and controls generation, transmission, and distribution infrastructure within a defined service territory. A state public utility commission (PUC) regulates the utility's retail rates and reviews its investment decisions.

The utility forecasts demand, plans new resources, builds or procures those resources, and is permitted to recover prudently incurred operating costs, depreciation, taxes, and an authorized return on invested capital. Capital investments are included in the utility's rate base, whereas the approved return on equity is applied to that base. Regulators examine whether the utility acted prudently through regulatory proceedings.

An Integrated Resource Planning (IRP) process is conducted by the utility to evaluate demand forecasts, resource planning, fuel price assumptions, reliability requirements, and policy mandates to determine a least-cost portfolio over a long-term planning horizon.

This structure relies on regulatory oversight rather than competition to discipline investment. Customers bear much of the long-term investment risk because approved costs flow into rates. While vertically integrated utilities may participate in bilateral or organized markets for short-term energy balancing, they retain the primary responsibility for ensuring resource adequacy and system reliability within their service territory.

Wholesale Market States

In states with wholesale markets, utilities procure generation through competitive wholesale markets, where independent power producers build and operate plants. Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs) operate the wholesale electricity markets and manage the transmission system within defined regional footprints. They administer market rules, conduct economic dispatch, and oversee reliability planning, but they do not regulate retail rates or directly site generation facilities.[2]

Given this structure, utilities' generation costs are driven by market-clearing prices rather than traditional cost-of-service regulation. Utilities also usually retain ownership of transmission and distribution assets and continue to operate under regulated retail rate structures.

Under this structure, investment risk is more exposed to market outcomes than in vertically integrated models. Generators rely primarily on market revenues (as opposed to guaranteed rates), placing greater risk on these private investors. The overall market structure's effectiveness ultimately depends on whether its rules produce prices that both support efficient short-term dispatch and sustain adequate long-term investment. Accordingly, this next section focuses on the market mechanisms that generate these price signals, which play a central role in how revenues are earned, investment decisions are made, and overall market performance and reliability are determined.

[2] The RTOs and ISOs operate under oversight of the Federal Energy Regulatory Commission (FERC), which regulates interstate transmission and wholesale markets, approving market rules and tariffs and ensuring wholesale rates are just and reasonable.