OUT-OF-MERIT GENERATION OF REGULATED COAL PLANTS IN ORGANIZED ENERGY MARKETS

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Overview

Energy markets in the United States first formed in restructured states to provide newly-private generation owners access to customers through a competitive framework. The energy market rules in those states were designed around an assumption that market participants act rationally, i.e., bidding in the full production cost of energy and providing energy according to centralized market signals (via locational marginal prices, or "LMP"). In the years thereafter, non-restructured states with vertically-integrated utilities adopted energy markets to promote operational efficiencies and allow the participation of new participants. Despite the similarities in market designs between the restructured and non-restructured states, centralized energy markets appear to have resulted in different bid, commitment, and dispatch behaviors of participants. The centralized market is supposed to select units based on their merit order and dispatch those units to meet load at the lowest cost; however, some unit operators self-select assets to generate, and in doing so can incur market losses. Observers have noted that rate-regulated utilities may be incentivized to capture an increasing share of costs outside of the energy market through rate proceedings and fuel cost adjustments, a direct mechanism not otherwise available to energy market participants (Daniel 2017, Nelson 2018).

I observe that rate-regulated coal is far more likely to operate at a market loss than merchant generators. Presumably, these rate-regulated coal plants recover costs through rate proceedings. These observations suggest that a trend towards self-subsidy through rate-making is significant, consistent, and prevalent in all markets with significant amounts of rate-regulated coal in the resource mix.

In this research, I gather the operational behavior of coal plants participating in four centralized energy markets (PJM, MISO, ERCOT, and SPP) in the years 2015 through 2017. I calculate and compare the idealized capacity factor of these units against their observed capacity factor, and characterize units as operating within a cost competitive framework or operating at a market loss. For each unit, I examine the pattern of dispatch relative to wholesale market energy prices and estimate the losses incurred by those plants.

Methods

The analysis is separated into two modules; the first acts as a screening test for the second. Both aim to answer the fundamental question: Are coal plants operating the way market theory would expect them to? In the first module I examine this question by calculating and comparing idealized capacity factor to the actual capacity factor of every coal unit in each of the four major markets. In the second module, I refine and improve upon the ability to answer this question by considering the hourly changes in output from electric generating units.

In this analysis, I compare generation output from individual units and estimated unit-specific production costs with energy market prices at corresponding energy nodes to determine both idealized and actual capacity factors, as well as net losses. I draw on public data sources for hourly generation, market prices, and production costs. Finally, I compare energy market revenues with production costs at the hourly, monthly, and annual levels.

Results

While both merchant and rate-regulated owners ramp the output of coal-fired generation units in response to market prices, merchant generators are more likely to decommit coal units during low market price hours while rate-regulated utilities maintain output even during very low-cost hours. As a result, regulated utility owners can and do incur substantial losses in regional energy markets. This out-of-merit generation likely leads to the further depression of market energy prices, and inefficiencies. These rate-regulated utilities variously rely on the market for full recovery of costs and appear to use energy markets as a short-term balancing mechanism, leading to substantial irregularities.

Similar trends in out-of-merit generation can be observed across each of the four RTOs investigated. Those trends include consistent and widespread out-of-merit generation from coal-fired units that have productions costs above

market price. Coal plants operated by regulated utilities are more likely to generate at a loss in frequency, duration, and magnitude, with few exceptions.

In these four markets, market losses from coal-unit operations surpassed $4.6 billion (gross, nominal) over the three-year study period when measured on a monthly level. Approximately $3.2 billion of that burden is incurred by rate-regulated coal and is presumably borne by captive customers. PJM was the possible exception, with nearly $1.4 billion in market losses being incurred by merchant regulators. Meanwhile regulated owned units only incurred $700 million. The largest captive customer burden was observed in MISO, at a price tag of $1.5 billion over 3 years. Earlier research estimating that this practice costs SPP customers $150-$200 million dollars per year (Daniel 2017) proved a dramatic underestimation: this new research found that customers were saddled with twice that amount in 2017 and saw nearly $900 million in gross market losses over 3 years. In ERCOT, no merchant plant was identified in Module 1; thus, only regulated (municipal- and cooperative-owned) units were analyzed in Module 2. These ERCOT units burdened customers with $154 million in market losses.

This practice costs consumers money and artificially suppresses wholesale prices, which impacts entry of new, more efficient, lower cost, cleaner resources. The extent to which wholesale prices are being suppressed requires additional modeling.

Conclusions

Energy market rules are designed to provide low-cost energy to customers by providing a competitive framework for generators with few impediments to efficient trade. However, the design of these markets typically relies on dispatchable generators to act rationally - i.e., as competitive interests that will recover production costs through energy market revenues. Instead, rate-regulated generation owners appear to be operating relatively high-cost units during low-cost hours, resulting in market distortions, inefficient markets, out-of-merit generation, and excessive emissions. This phenomenon is not isolated to “power pool” style energy markets like SPP and can be found to some degree in the three other coal-heavy energy markets. If rate-regulated utilities are recovering these losses through retail rates, then retail customers are being burdened by hundreds of millions of dollars a year and deprived of the benefits of low wholesale prices. The practice should call into question the extent to which consumers are benefiting from the energy market structure. I also argue it calls into question the use of LMP for calculating avoided costs of energy in PURPA and net metering dockets.

To craft well-designed solutions to this problem, several research questions need to be addressed. This includes finding answers to how market losses are recovered and calculating the cost of replacing this generation. The losses incurred by merchant coal plants also require additional investigation to determine if these losses are being incurred by investors, or if the owners of these units also have access to out-of-market subsidization in the form of affiliate transactions. A combination of regulatory awareness for rate regulators, as well as modification of some market rules, could provide a more consistent use of the energy market platform. Should state legislatures require distribution utilities to divest their ownership of generation assets? Should utility regulators disallow costs associated with out-of-merit generation? These policy questions will untimely need to be answered to ensure proper incentives are created for rational energy dispatch.

References

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