ELECTRICITY MARKET DESIGN:
Energy Trading and Market Manipulation

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ELECTRICITY MARKET — Electricity Restructuring

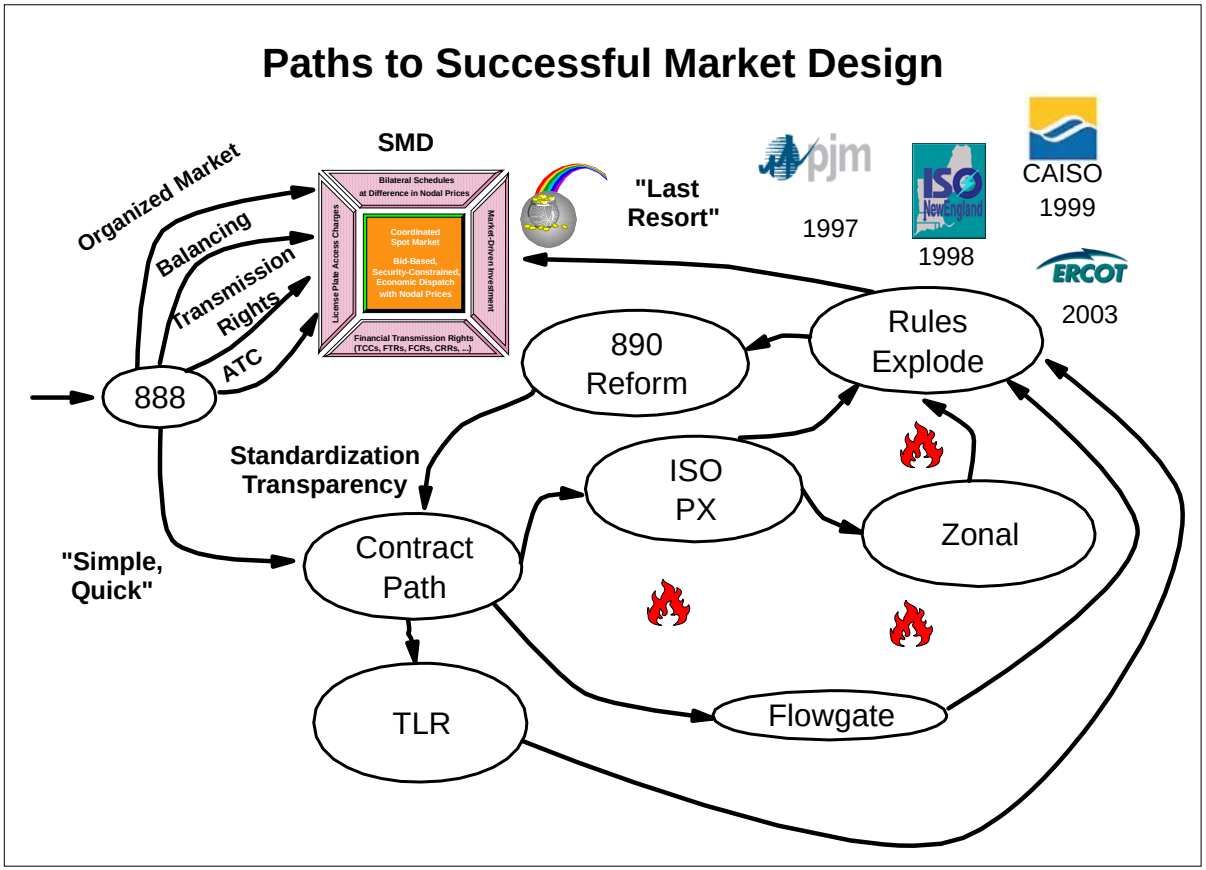
The case of electricity restructuring presents examples of fundamental problems that challenge regulation of markets.

- **Marriage of Engineering and Economics.**
  - **Loop Flow.**
  - **Reliability Requirements.**
  - **Incentives and Equilibrium.**
  - **Physical and Financial Transactions.**

- **Devilish Details.**
  - **Market Power Mitigation.**
  - **Coordination for Competition.**
  - **Transmission Expansion.**

- **Jurisdictional Disputes.**
  - **US State vs. Federal Regulators.**
  - **European Subsidiarity Principle.**

The path to successful market design can be circuitous and costly. The FERC "reforms" in Order 890 illustrate "path dependence," where the path chosen constrains the choices ahead. Early attempts with contract path, flowgate and zonal models led to design failures in PJM (`97), New England (`98), California (`99), and Texas (`03). Zonal aggregation creates conflicts with system operations. Successful market design integrates the market with system operations.

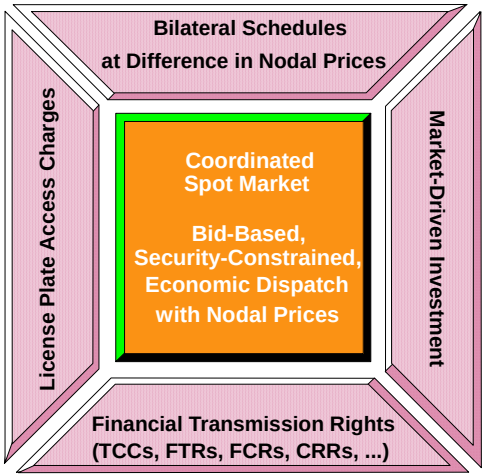


ELECTRICITY MARKET A Consistent Framework

The example of successful central coordination, ~~CRT, Regional Transmission Organization (RTO) Millennium Order (Order 2000) Standard Market Design (SMD) Notice of Proposed Rulemaking (NOPR),~~ "Successful Market Design" provides a workable market framework that is working in places like New York, PJM in the Mid-Atlantic Region, New England, the Midwest, California, SPP, and Texas. This efficient market design is under (constant) attack.

> "Locational marginal pricing (LMP) is the electricity spot pricing model that serves as the benchmark for market design – the textbook ideal that should be the target for policy makers. A trading arrangement based on LMP takes all relevant generation and transmission costs appropriately into account and hence supports optimal investments."(International Energy Agency, Tackling Investment Challenges in Power Generation in IEA Countries: Energy Market Experience, Paris, 2007, p. 16.)

The ~~RTO NOPR Order SMD NOPR~~ "Successful Market Design" Contains a Consistent Framework



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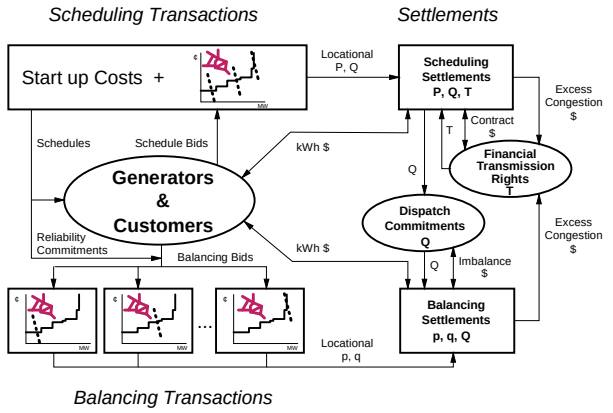
A Structure for Forward Market Scheduling, Spot Market Dispatch & Settlements



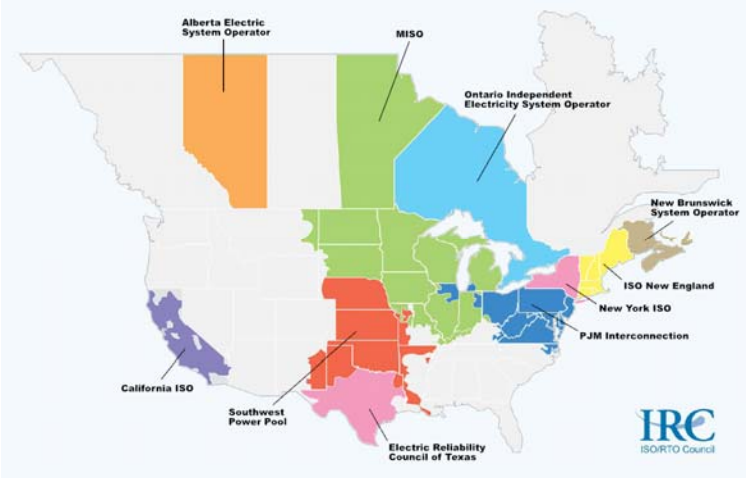
ELECTRICITY MARKET — Energy Market Transformation

Market design in RTOs/ISOs is well advanced but still incomplete and under constant stress.[1]

- **Regional Markets Not Fully Deployed**

- **Reforms of Reforms**
  Market Power mitigation through offer caps.
  California MRTU (April 1, 2009) and ERCOT Texas Nodal (December 1, 2010) reforms.

- **Market Defect: Scarcity Pricing, Extended LMP**
  Smarter pricing to support operations, infrastructure investment and resource adequacy.



- **Market Failure: Transmission Investment**

  - Regulatory mandates for lumpy transmission mixed with market-based investments.
  - Design principles for cost allocation to support a mixed market (i.e., beneficiary pays).

- **Market Challenge: Address Requirements for Climate Change Policy**

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[1] William W. Hogan, "Electricity Market Structure and Infrastructure," Conference on Acting in Time on Energy Policy, Harvard University, September 18-19, 2008. (available at www.whogan.com).

Market manipulation covers a wide range of topics. The focus here is on virtual and physical energy trading in organized markets. Set aside for now related but different problems of manipulation, such as:

- **Fraud and misrepresentation.**
- **Price index manipulation.**
- **Collusion among market participants.**
- **Capacity auctions in organized markets.**
- **Demand response mandates.**

With attention to wholesale electricity markets, under what conditions can energy trading result in price manipulation inconsistent with workably competitive markets?

Two attributes of perfectly competitive electricity markets:

- Taking prices as fixed, transactions are profit maximizing.
- Prices clear the market, satisfying the no-arbitrage condition.

There is no perfect definition of "workably competitive." Real transactions in real markets have some impact on prices. Changes in prices have some impact on the profitability of transactions and related financial contracts. Electrical network interactions and constraints have wide ranging effects. A workable definition of "workably competitive" requires judgments about the acceptable degree of approximation of the attributes of competitive markets.

"A market in which each supplier decides how much to supply at market prices that it cannot profitably affect for long is said to be workably competitive."[2]

[2] Larry Ruff, Market Power Mitigation: Principles and Practice," Charles River Associates, November 14, 2002, p. 3.

A prior top ten list of issues and challenges in market power mitigation included:

…

3. **"Scarcity pricing is good, withholding is bad.** *High prices may be politically unpopular, but absent withholding of generation there is no exercise of monopoly power. Regulators who support markets must face the periodic need for high prices during shortage conditions, at least in the real-time balancing market that sets the incentives for everything else through anticipation and arbitrage.*
4. **Electricity markets make control of real time generation, transmission or load essential in exercising market power.** *Derivative markets and long term contracts can change the incentives to exercise market power, but at least in organized markets withholding in real time is required to exercise market power. Otherwise, simple financial arbitrage would preclude any sustained exercise of market power.*

…

6. **Monopsony is a problem as well as monopoly.** *Compensating expensive generators for running when cheaper alternatives are available produces prices that are too low and should be as much a focus of policy concern as withholding to increase prices. Support of markets requires that system operators run the system to reflect the bid-based costs, not to minimize price.*" [3]

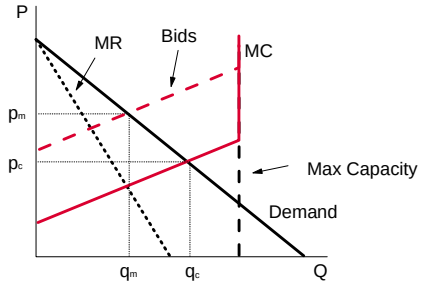
[3] William W. Hogan, "Local Market Power Mitigation," Technical Conference on Compensation for Generating Units Subject to Local Market Power Mitigation In Bid-Based Markets, PJM Interconnection, L.L.C., Docket Nos. PL04-2-000, EL03-236-000, Federal Energy Regulatory Commission, Washington, D.C., February 4, 2004.

The Federal Energy Regulatory Commission policies confront decisions increasingly inconsistent with basic market design principles.

> "In the face of these diverging opinions, the Commission observes that, as the courts have recognized, 'issues of rate design are fairly technical and, insofar as they are not technical, involve policy judgments that lie at the core of the regulatory mission.' We also observe that, in making such judgments, the Commission is not limited to textbook economic analysis of the markets subject to our jurisdiction, but also may account for the practical realities of how those markets operate. (FERC, "Demand Response Compensation in Organized Wholesale Energy Markets," Order No. 745, ¶ 46, March 15, 2011.)

This rejection of textbook economic analysis is a bad sign: "It won't work in theory, but will it work in practice?" The problem appears in policies to deal with or exploit market power.

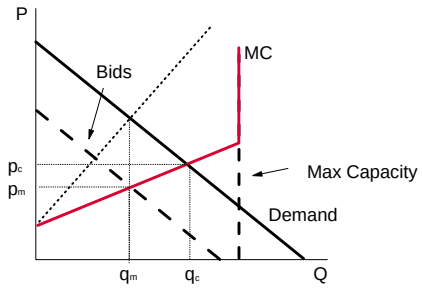
Defining Market Power: Monopoly Withholding



Seller Withholding

$p_m > p_c = MC$

Defining Market Power: Monopsony Withholding

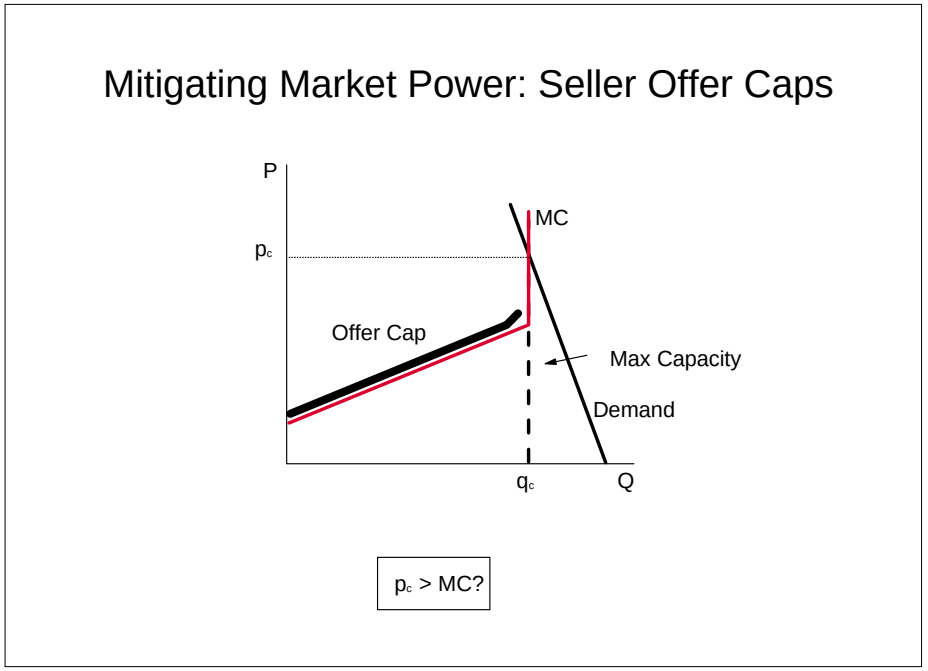


Buyer Withholding

$p_m < p_c = MC$

Offer caps and seller market power. Generators have an obligation to offer production at no more than a predetermined offer cap. Actual production compensated at the market-clearing price.

- Distinguishes between monopoly rents and scarcity rents.
- Generator has an obligation to offer at least the designated amount. Offers for additional quantities are unregulated.
- Provides the right incentives for supply and demand, for entry and operations.
- If high prices caused by withholding, the offer cap will lower market clearing price. If high prices caused by scarcity, offer cap could produce high prices.



- The information burden is greater than for price caps but less than for cost-of-service regulation.
- Offer caps are generator specific and compatible with a workably competitive market.

ELECTRICITY MARKET — Market Interactions

Successful wholesale electricity market design depends on strong interactions between physical energy trading, virtual trading and financial contracts.

- **Financial contracts interact with energy trading.**
  - Financial transmission rights substitute for unavailable physical rights.
  - Contracts for differences integrate with organized spot markets.
- **Forward markets interact with real-time trading.**
  - Financial transmission rights settle day-ahead.
  - Schedules and virtual transactions integrate day-ahead and real-time markets.
- **Market hedges are imperfect.**
  - Imbalances for financial transmission contracts.
  - Portfolios for forward contracts integrated with virtual trading.
- **Barriers to entry differ in physical and financial markets.**
  - Real-time physical markets have high short-run but lower long-run barriers.
  - Day-ahead financial markets with virtual trading have low barriers to entry.
- **Prices clear the market under economic dispatch with bids and offers.**

ELECTRICITY MARKET — Market Interactions

Electricity markets are unlike other commodity markets. Real-time physical and forward financial markets interact. But the lack of storability and the market-clearing process imply that market power cannot be sustained in forward financial markets without manipulating real-time markets.

"Because of non-storability, manipulators of power markets must be producers of power, so speculative corners are not possible. Moreover, a manipulator must have market power in generation."[4]

Market Activities and Price Impacts		
	Real-Time Prices	**Forward Prices**
Real-Time Physical Transactions	Issue: Monopoly and Monopsony, Energy Withholding. Policy: Mitigation with Offer Caps, Must-Run Requirements. Workably competitive.	Forward contracts leverage incentives, but real-time mitigation and easy entry in forward markets leave workably competitive conditions. Day-ahead price should approximate expected real-time price, with transaction costs and small possible risk premium.
Forward Financial Transactions	Issue: Unit Commitment? Policy: Reliability Unit Commitment. Negligible competitive effects?	Forward transactions do not create physical real-time energy withholding; cannot sustain manipulation of forward prices. Workably competitive.

[4] Craig Pirrong, "Manipulation of Power Markets," Washington University, March 24, 2000, p. 1.

Interactions among physical energy trading, market-clearing prices, and financial contracts are intended and necessary for successful electricity market design.

The mere fact that a physical transaction can affect prices to some degree, and thereby influence the prices of related financial contracts, cannot be a *per se* definition of price manipulation.

Nearly every physical transaction can have some impact on prices. This is basic supply and demand economics.

If holding a financial contract that benefits from the price impact of a physical transaction were to be deemed all that is required to establish price manipulation, then the entire foundation of successful electricity market design would be destroyed with one stroke.

A FERC solution for distinguishing economic transactions from price manipulation is, has been, and should be an application of a stand-alone profitability test.

"…HQ Energy did not use a combination of market power and trading activity to act against its economic interest in one market in order to benefit its position in another market by artificially moving the market price. There is no evidence that HQ Energy acted against its economic interest in any market. Rather, the facts of this case show that HQ Energy made price-taker bids and used [Transmission Congestion Contracts] to hedge congestion risk in a manner explicitly contemplated by the Commission."[5]

[5] *DC Energy, LLC v. H.Q. Energy Servs. (U.S.), Inc.*, 124 FERC ¶ 61,295 at 22 (2008) [footnote in original omitted]. Transmission Congestion Contract is another term for Financial Transmission Right.

A stand-alone profitability test does not require perfection, and is compatible with a workably competitive market.

"…HQ Energy ***did not*** use a combination of market power and trading activity ***to act against its economic interest*** in one market in order to benefit its position in another market by ***artificially*** moving the ***market price***. There is no evidence that HQ Energy acted against its economic interest in any market. Rather, the facts of this case show that HQ Energy made ***price-taker*** bids and used [Transmission Congestion Contracts] to hedge congestion risk in a manner explicitly contemplated by the Commission." [emphasis added]

- **Conventional application with unique market-clearing price.**
  - Taking the market price as given.
  - Not "against economic interest." Profitable, or at least not loss making.
- **Generalized application with degenerate case of multiple market-clearing prices.**
  - Taking market prices as given.
  - Not "against economic interest" for all prices in the degenerate range. In other words, meets the stand-alone test for some price in the degenerate range. A symmetric rule would apply for evaluating transactions not undertaken (i.e., withholding).

Passing the stand alone test would provide a safe harbor. Failing the stand-alone test would raise a question of possible price-manipulation "to act against its economic interest in one market in order to benefit its position in another market by artificially moving the market price."

ELECTRICITY MARKET Market Manipulation Summary

Electricity markets are unlike other commodity markets. Real-time physical and forward financial markets interact. But the lack of storability and the market-clearing process imply that market power cannot be sustained in forward financial markets without manipulating real-time markets.

Offer caps address the problem of generator market power mitigation for physical transactions and real-time markets.

Interactions among physical energy trading, market-clearing prices, and financial contracts are intended and necessary for successful electricity market design.

The mere fact that a physical transaction can affect prices to some degree, and thereby influence the prices of related financial contracts, cannot be a *per se* definition of price manipulation.

A FERC solution for distinguishing economic transactions from price manipulation is, has been, and should be an application of a stand-alone profitability test.

Passing an appropriate stand-alone profitability test should provide a safe harbor. Otherwise, the entire foundation of successful electricity market design would be destroyed with one stroke.

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