ELECTRICITY MARKET DESIGN:
Energy Trading Practice and Market Manipulation Theory

William W. Hogan

Mossavar-Rahmani Center for Business and Government
John F. Kennedy School of Government
Harvard University
Cambridge, Massachusetts 02138

Platts

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ELECTRICITY MARKET Market Design and Market Manipulation

Market manipulation enforcement actions raise important issues that affect electricity market design and energy trading.

- **Energy Trading.** Good market design supports and is supported by energy trading.
- **Financial Contracts.** Financial contracts create related positions that are an essential element of electricity market design.
- **Manipulation Theory.** A good theory is necessary to separate market manipulation from efficient market transactions.
- **Market Flaws.** Market design flaws present challenges for market participants and enforcement oversight.
- **Good Practice.** A balance is required to define good practice by market participants. A reasonable notification policy could go a long way towards improving a toxic environment.

The environment for market enforcement oversight has created a conversation, debate and dispute.

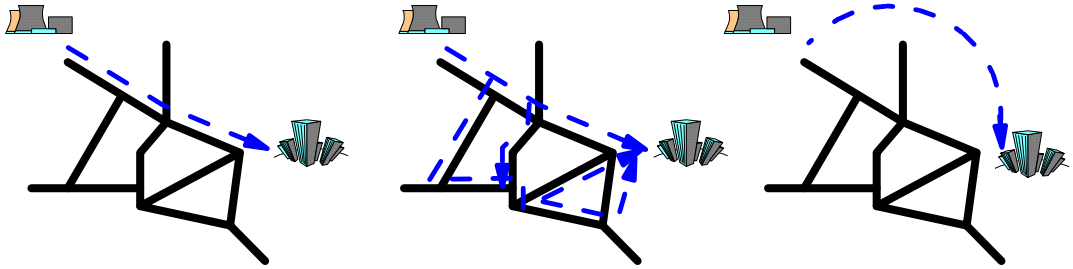
The important dispute is not about the facts.

The important dispute is about the theory.

Defining and managing transmission usage was a principal challenge in electricity markets.

Transmission Capacity Definitions

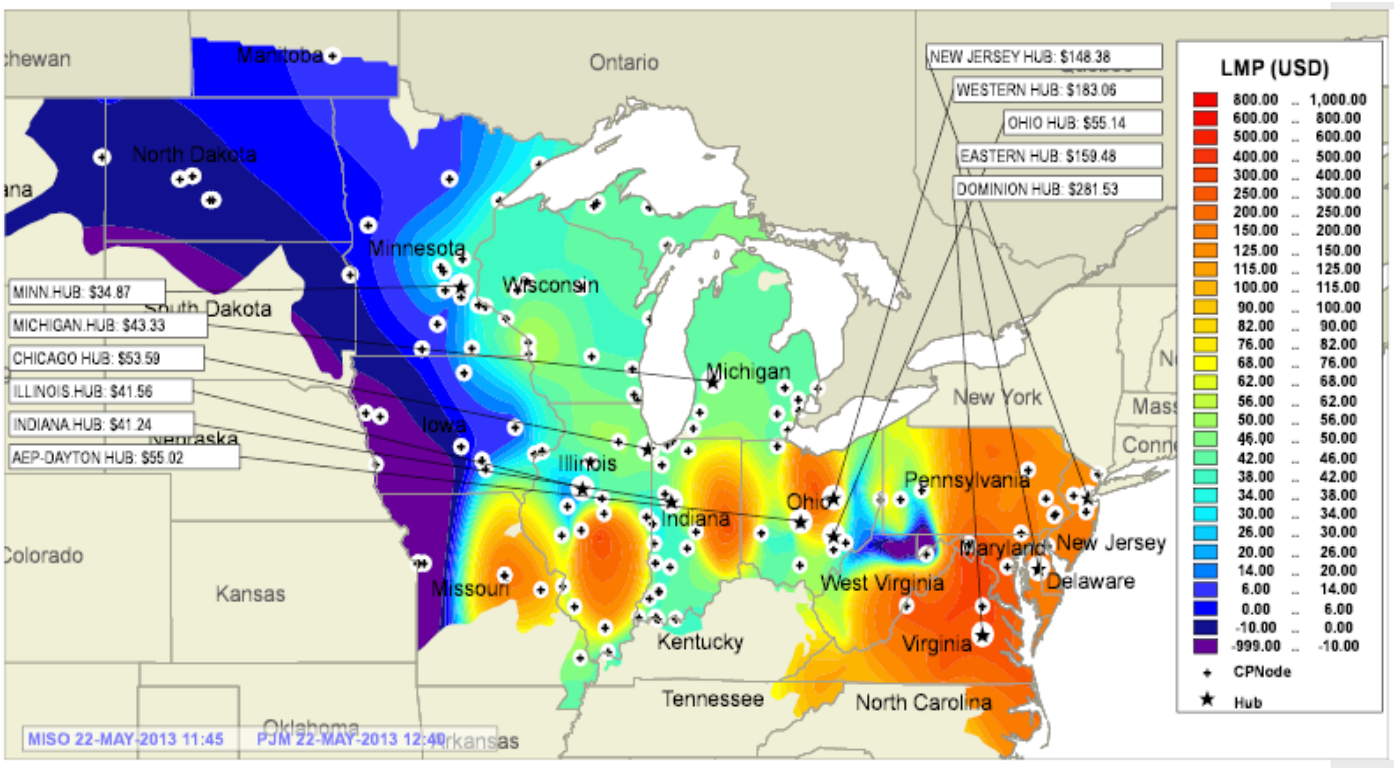
Contract Path → Flow-Based Paths → Point-to-Point



Contract Path Fiction	Parallel Flows	Flows Implicit
OASIS Schedules and TLR	Flowgate Rights FGRs	Financial Transmission Rights FTRs

NETWORK INTERACTIONS — Locational Spot Prices

RTOs operate spot markets with locational prices. For example, PJM updates prices and dispatch every five minutes for over 10,000 locations. Locational spot prices for electricity exhibit substantial dynamic variability and persistent long-term average differences.



Missouri MPS -$71.25, Dominion Hub $281.53. May 22, 2013, 12:40pm.

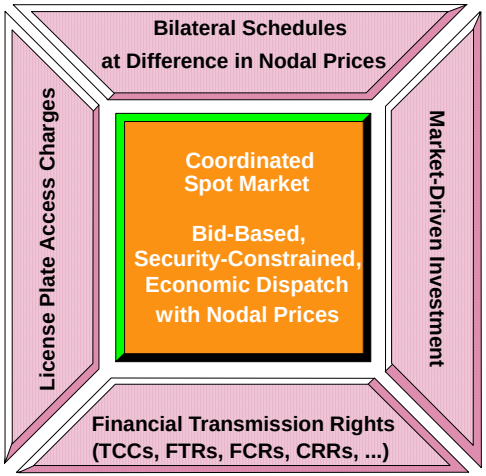
From MISO-PJM Joint and Common Market, http://www.jointandcommon.com/

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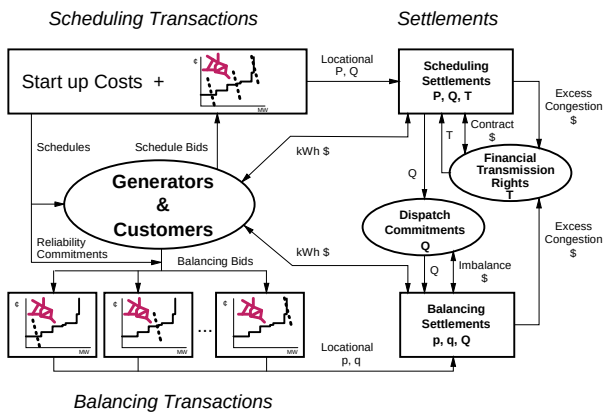
A Structure for Forward Market Scheduling, Spot Market Dispatch & Settlements



ELECTRICITY MARKET Energy Trading

Energy trading and nodal markets play a central role in efficient market design.

- **Efficient Hedging.** Volatile electricity prices over time and space are an inherent part of efficient electricity markets. Price uncertainty creates a need for hedging instruments that support physical delivery.

- **Price Arbitrage.** Day-ahead and real-time markets should converge with forward prices approximating expected real-time prices. Energy trading facilitates price discovery and price arbitrage.

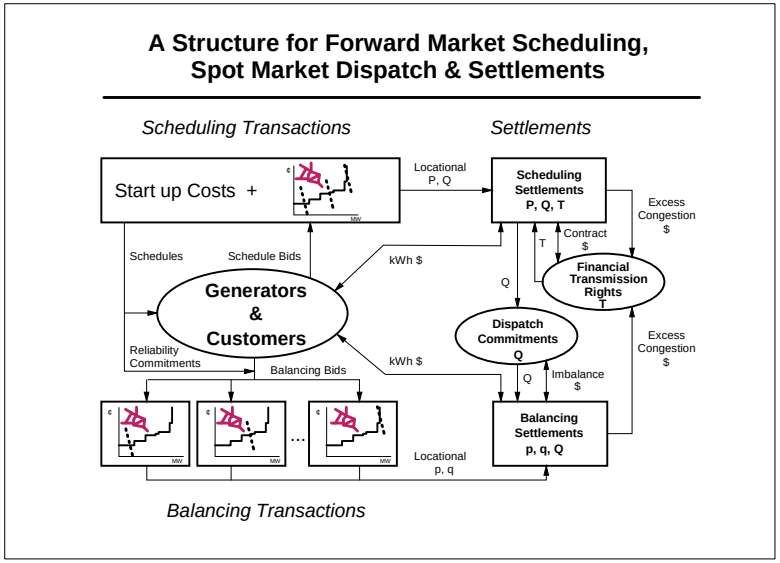
- **Market Liquidity.** Good electricity market design incorporates virtual trading in day-ahead markets. This greatly expands the group of potential market participants to provide liquidity and promote competition.

- **Market Transparency.** Energy trading within the framework of economic dispatch and locational prices exposes flaws in market design and operations. Improvement of market design can then provide a better environment for energy trading.

ELECTRICITY MARKET Related Positions

Market design in RTOs/ISOs reflects an explicit reliance on "related positions" as financial contracts. [1] Successful wholesale electricity market design depends on strong interactions between physical energy trading, virtual trading and financial contracts.

- **In a one settlement system, long-term FTRs settle against and hedge real-time prices.**
- **In markets with two settlements, a related transaction is required.**
  - FTRs settle against day-ahead prices.
  - Day-ahead schedules create new transmission rights.
  - Virtual contracts day-ahead settle against real-time prices.
  - An FTR plus an equivalent day-ahead virtual contract allows the long-term FTR to settle against real-time prices.
- **In a day-ahead market, the prices of the related transactions are interdependent.**
  - The bid for the schedule or virtual contract increases the value of the FTR.
  - The schedule or virtual contract is necessary to transfer the FTR hedge to real-time prices.



[1] S. M. Harvey, W. W. Hogan, S. L. Pope, "Transmission Capacity Reservations and Transmission Congestion Contracts," June 6, 1996, (Revised March 8, 1997), pp. 51-53, available http://www.hks.harvard.edu/fs/whogan/tccoptr3.pdf.

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

A Good Theory

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." [emphasis added][2]

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

[2] *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.

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

A Bad Theory

> "Enforcement concluded that Deutsche Bank's CRR traders acted with the requisite manipulative intent because, among other reasons, they engaged in the physical transactions with the intent to increase the value of Deutsche Bank's CRR position. Specifically, as stipulated by Deutsche Bank, the CRR traders sought for the exports at Silver Peak to change the price to benefit the bank's losing CRR position. Deutsche Bank's physical transactions were not profitable. ***Even if these physical transactions had been profitable, however, profitability is not determinative on the question of manipulation and does not inoculate trading from any potential manipulation claim (although profitability may be relevant in assessing the conduct).*** Rather, as we have recognized, the elements of manipulation are 'determined by all the circumstances of a case.' (footnote in original) Here, based on all the facts and circumstances, Enforcement determined that Deutsche Bank's conduct constituted manipulation." [emphasis added][3]

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. 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.

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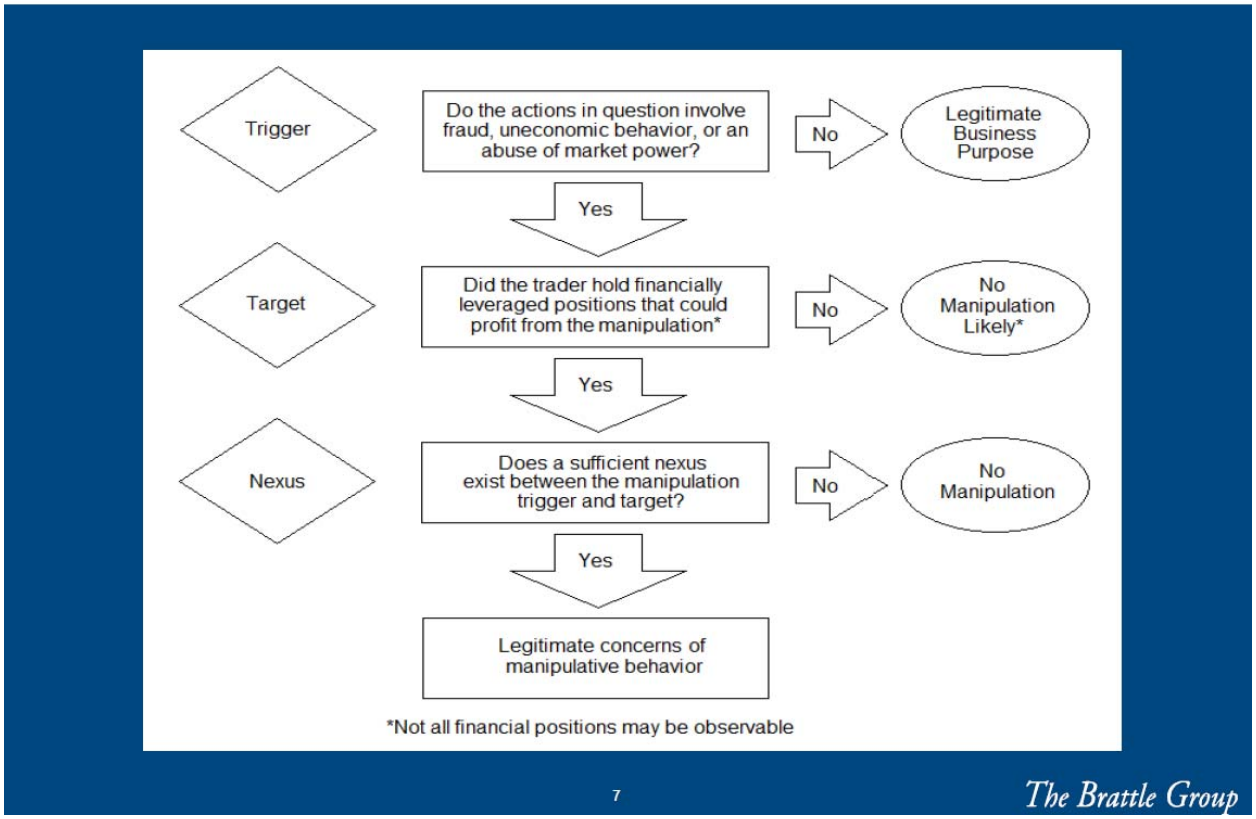
[3] Federal Energy regulatory Commission, "Deutsche Bank Energy Trading, Order Approving Stipulation and Consent Agreement," LLC Docket No. IN12-4-000, January 22, 2013, ¶20, p. 5.

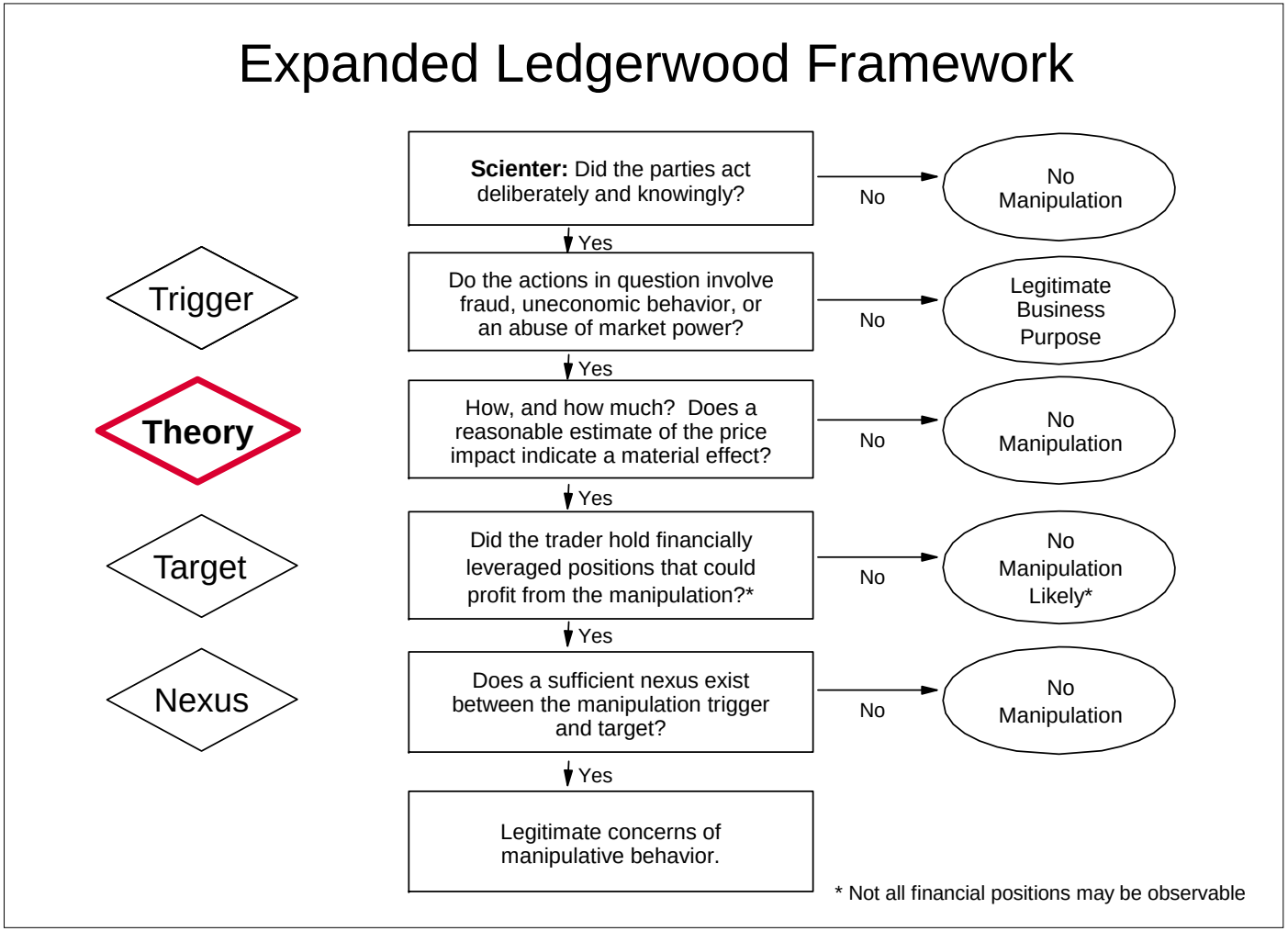
ELECTRICITY MARKET Market Manipulation Framework

The basic Ledgerwood framework provides a logical sequence to guide consideration of possible market manipulation.

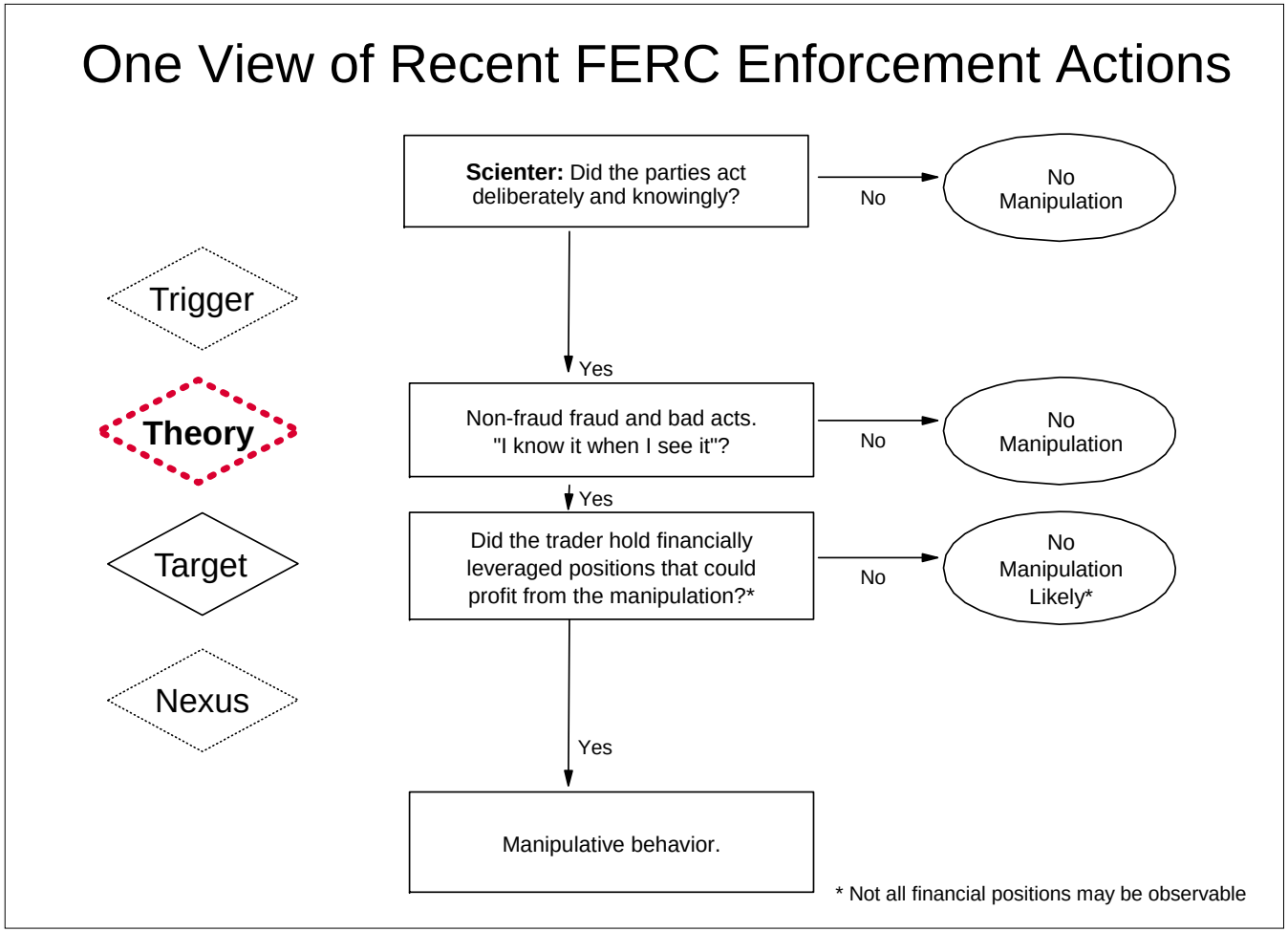


Source: S. Ledgerwood, "Market Manipulation post Hunter vs . FERC : A Framework for Unified Analysis," HEPG Presentation, June, 2013, http://www.hks.harvard.edu/hepg/Papers/2013/Ledgerwood.pdf

Important elements such as knowledge, intent, and the underlying market theory are implicit in Ledgerwood's framework. All the elements are necessary, and no subset is sufficient.



FERC Enforcement actions are taking place behind a shroud of opaque settlements. Recent apparent changes in policy are both poorly understood and alarming. An interpretation of current practice has necessary elements ignored and remaining components both (i) recast independent of market theory and (ii) deemed to be sufficient to trigger an enforcement action.



ELECTRICITY MARKET — Market Interactions

Electricity markets are unlike other commodity markets. Real-time physical and forward financial markets interact. But the lack of storability, the market-clearing process and easy entry imply that market power ~~cannot be sustained~~ may not be sustainable in forward 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; real-time actions cannot sustain manipulation of forward prices. Workably competitive.

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

A good theory of forward market manipulation would meet reasonable standards of analysis. A plausible theory for electricity market manipulation would provide empirical implications that could be tested to determine if the actions were consistent with market manipulation.

- **Defining a coherent theory is not easy.** The tests would meet certain requirements.
  - Include all the necessary elements of the expanded Ledgerwood framework.
  - Define an equilibrium model that accounted for entry of virtual traders.
  - Explain the degree of observed convergence of day-ahead and real-time markets.
- **Defining a coherent theory is not impossible.**[5] Key elements include market results and activities that would be detectable.
  - **Convergence.** The manipulation model implies a reduced variation in the difference between day-ahead and real-time prices compared to a naïve model of uncertainty.
  - **Randomization.** The manipulation requires randomization of trading strategies. This includes randomization of the related financial positions, which could be observed.
  - **Correlation.** Successful manipulation requires correlation of day-ahead prices and related financial positions.

[5] Lo Prete, C., & Hogan, W. W. (2014). "Manipulation of Day-ahead Electricity Prices through Virtual Bidding in the U . S .," IAEE Energy Forum, 31–32.

ELECTRICITY MARKET Market Manipulation and Market Defects

No market design is perfect. The problem of poor market design should be remedied through notification, improvements in the market design, and ex ante rules. It should not be the case that price-taking, profit-maximizing behavior is treated as manipulation and pursued through an enforcement action.

- **Competitive Market Theory.** The theory of competitive markets assumes that participants make profit maximizing decisions; for a well-designed market the result is an efficient outcome. It should not be the responsibility of market participants to deviate from competitive behavior to advance undefined broader social objectives.

- **Electricity Market Practice.** Enforcement actions that deem it manipulative when profits arise from indirect collateral payments rather than direct energy payments confront inherent complications. For example, what principles distinguish:
  - **Uplift Payments.** Energy market transactions that avoid or receive tariff defined uplift payments have been the object of enforcement actions.
  - **Green Payments.** Energy market transactions to receive green production tax credits (e.g. wind and negative energy prices).
  - **Demand-Response.** Demand-response double payments (FERC Order 745) were lauded as good public policy. Now struck down, but market participants would not be seen as manipulators for accepting or seeking the payments.

ELECTRICITY MARKET — Market Defects

The existence of market design defects is undisputed. Some defects are unintended flaws. And there are many examples of intended but inefficient features. The challenge is to identify the proper response by market participants and enforcement oversight. What is the proper policy?

- **All that is not explicitly prohibited is allowed.** Market design and operations contain many elements to help market participants and promote trading. This reality imposes obligations on market participants. The notion that any possible profit maximizing opportunity should be pursued without restraint is untenable.

- **All that is not explicitly allowed is prohibited.** Key purposes of electricity restructuring and the associated electricity market design were to promoted innovation and provide the flexibility to meet many different needs of market participants. A narrow definition of allowed commercial transactions would defeat this larger purpose.

- **I know it when I see it.** A vague definition such as supporting a "well-functioning market" is neither consistent with the rule of law nor supportive of a well-functioning market.

These positions cannot be workable policies.

What is the proper policy when there are market defects that may flaws that need correction or features that are intentional policy?

Good practice would apply a rule of reason based on notification.

- **A duty to notify.** A middle ground would be notification. Many market design flaws are inadvertent and unrecognized by the FERC or market operator. Market participants cannot be responsible for correcting market flaws. Nor should market participants be assigned responsibility to make the judgment call that distinguishes between features that are accepted deviations from efficient design and flaws that should be corrected. But market participants should know that some design elements may be such flaws and market participants should share a fiduciary responsibility to bring possible flaws to the attention of the FERC and the market operator.

- **A safe harbor.** The basic idea would be to create a safe harbor for a bidding practice that might be suspect. Once the market participant notified the market operator, the market participant would have discharged its responsibility. The FERC or market operator should make the decision whether to change the market design, adopt a general behavioral rule, or leave the practice alone.

Market manipulation enforcement actions raise important issues that affect electricity market design and energy trading. Current market manipulation enforcement policy is in flux. The entire foundation of successful electricity market design is under threat. The need for a coherent enforcement policy is compelling. The basic outlines of reform would include:

- **A Coherent Theory (or Theories).** Market manipulation actions would be evaluated and explained within a context that embraces the outline of the expanded Ledgerwood framework. The opaque settlement process would be made more transparent.

- **A Duty to Notify.** Market participants would have a duty to notify FERC about possible market defects. The FERC or market operator should make the decision whether to change the market design, adopt a general behavioral rule, or leave the practice alone.

William W. Hogan is the Raymond Plank Professor of Global Energy Policy, John F. Kennedy School of Government, Harvard University. This paper draws on research for the Harvard Electricity Policy Group and for the Harvard-Japan Project on Energy and the Environment. The author is or has been a consultant on electric market reform and transmission issues for Allegheny Electric Global Market, American Electric Power, American National Power, Aquila, Atlantic Wind Connection, Australian Gas Light Company, Avista Corporation, Avista Utilities, Avista Energy, Barclays Bank PLC, Brazil Power Exchange Administrator (ASMAE), British National Grid Company, California Independent Energy Producers Association, California Independent System Operator, California Suppliers Group, Calpine Corporation, CAM Energy, Canadian Imperial Bank of Commerce, Centerpoint Energy, Central Maine Power Company, Chubu Electric Power Company, Citigroup, City Power Marketing LLC, Cobalt Capital Management LLC, Comision Reguladora De Energia (CRE, Mexico), Commonwealth Edison Company, COMPETE Coalition, Conectiv, Constellation Energy, Constellation Energy Commodities Group, Constellation Power Source, Coral Power, Credit First Suisse Boston, DC Energy, Detroit Edison Company, Deutsche Bank, Deutsche Bank Energy Trading LLC, Duquesne Light Company, Dyon LLC, Dynegy, Edison Electric Institute, Edison Mission Energy, Electricity Corporation of New Zealand, Electric Power Supply Association, El Paso Electric, Energy Endeavors LP, Exelon, Financial Marketers Coalition, FTI Consulting, GenOn Energy, GPU Inc. (and the Supporting Companies of PJM), GPU PowerNet Pty Ltd., GDF SUEZ Energy Resources NA, Great Bay Energy LLC, GWF Energy, Independent Energy Producers Assn, ISO New England, Koch Energy Trading, Inc., JP Morgan, LECG LLC, Luz del Sur, Maine Public Advocate, Maine Public Utilities Commission, Merrill Lynch, Midwest ISO, Mirant Corporation, MIT Grid Study, Monterey Enterprises LLC, MPS Merchant Services, Inc. (f/k/a Aquila Power Corporation), JP Morgan Ventures Energy Corp., Morgan Stanley Capital Group, National Independent Energy Producers, New England Power Company, New York Independent System Operator, New York Power Pool, New York Utilities Collaborative, Niagara Mohawk Corporation, NRG Energy, Inc., Ontario Attorney General, Ontario IMO, Ontario Ministries of Energy and Infrastructure, Pepco, Pinpoint Power, PJM Office of Interconnection, PJM Power Provider (P3) Group, Powerex Corp., Powhatan Energy Fund LLC, PPL Corporation, PPL Montana LLC, PPL EnergyPlus LLC, Public Service Company of Colorado, Public Service Electric & Gas Company, Public Service New Mexico, PSEG Companies, Red Wolf Energy Trading, Reliant Energy, Rhode Island Public Utilities Commission, Round Rock Energy LP, San Diego Gas & Electric Company, Secretaría de Energía (SENER, Mexico), Sempra Energy, SESCO LLC, Shell Energy North America (U.S.) L.P., SPP, Texas Genco, Texas Utilities Co, Tokyo Electric Power Company, Toronto Dominion Bank, Transalta, TransAlta Energy Marketing (California), TransAlta Energy Marketing (U.S.) Inc., Transcanada, TransCanada Energy LTD., TransÉnergie, Transpower of New Zealand, Tucson Electric Power, Twin Cities Power LLC, Vitol Inc., Westbrook Power, Western Power Trading Forum, Williams Energy Group, Wisconsin Electric Power Company, and XO Energy. The views presented here are not necessarily attributable to any of those mentioned, and any remaining errors are solely the responsibility of the author. (Related papers can be found on the web at www.whogan.com).