

# **ELECTRICITY MARKET RESTRUCTURING: MARKETS, MARKET DESIGN, AND RTOs**

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There have been repeated attempts to rethink the role of Regional Transmission Organizations (RTOs). The demands of electricity markets impose many requirements and challenges. As a regulated provider of monopoly services, an RTO will never have complete freedom of action. An RTO must provide certain functions to support markets under open access and non-discrimination.

- **Necessary functions for energy markets.**
  - Real-time, bid-based, security constrained economic dispatch with locational prices.
- **Necessary functions for energy markets with effective long-term hedges.**
  - Financial transmission rights (FTRs).
- **Valuable functions for non-discriminatory energy markets with effective long-term hedges.**
  - Day-ahead energy market with associated reliability unit commitment.
  - Transmission planning and investment protocols.
- **Necessary features of everything else**
  - Rules and pricing incentives compatible with the above.
    - Ancillary Services
    - Resource Adequacy

**This is not new news. A review highlights the key issues.**

**The electricity public policy debate has reached a stage of backlash and counterrevolution.**

Anonymous, once-confident-but-now-doubting designer/promoter of competitive electricity markets:

“... maybe competition in electricity was not a good idea at all. Whatever the economic arguments for it, if political and regulatory institutions cannot handle the kind of competition that is feasible in electricity, perhaps it is not worth doing. Eliminating economic regulation in electricity is different from eliminating it in eggs and trucks and airlines -- and maybe even gas and telecoms -- because in the latter the government really can just walk away and let "the market" work, while in electricity there will always be a need for a central dispatch/market process that will have to be designed, governed, regulated, modified, etc. The counterpart of "regulatory capture" in the old regulated utility model is "special interest capture" of the ISO/RTO rules and governance processes. ... Maybe the "right" way to set up and run these markets will become so obvious and well-understood that it will happen and persist naturally. But it seems at least as likely to me that there will be a constant effort to distort the rules and processes for the benefit of a few special interests, and those interests will be the only ones with the time, resources and interest to stay involved in the governance process in the long run. This is a scary prospect.” (private communication, July 27, 2002, with permission)

The backlash notwithstanding, the Federal Energy Regulatory Commission advanced an ambitious restructuring agenda in its Standard Market Design Notice of Proposed Rulemaking (SMD NOPR).<sup>1</sup>

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<sup>1</sup> Federal Energy Regulatory Commission, *Remedying Undue Discrimination Through Open Access Transmission Service and Standard Electricity Market Design*, Notice of Proposed Rulemaking, Washington, DC, August 29, 2002.

There is an underlying premise in many market design proposals that the functions of the independent system operator (ISO) can be largely separated from the operation of a wholesale spot market. This is a mistake, the “separation fallacy.”<sup>2</sup>

### **A False Goal**

**Minimize the role of the ISO:** In an attempt to have a small footprint for the ISO, there is a common argument that the ISO functions should be restricted to reliability and separated from the operation of the spot market. In practice, the lack of an efficient spot market and efficient pricing drives the ISO to intervene ever more, but without the tools of the market. The ISO ends up large and intrusive, and the market works badly or not at all.

### **Better to**

**Recognize the minimum requirements of an ISO:** There are certain functions that only the ISO can perform, and these should be done both efficiently and to support a competitive market. Done right, the result is healthy bilateral trading, liquidity, and ease of entry.

It is not good public policy to intentionally design the ISO functions to be inefficient. If we do so, we will succeed, and the ISO will not be able to provide the services that the market needs to handle the complexity of the electricity system. A well designed ISO, operating a spot market, providing price signals, and supporting transmission hedges, results in the smallest footprint possible.

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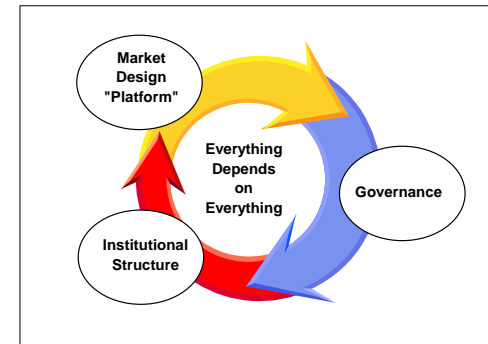
<sup>2</sup> W. Hogan, "A Wholesale Pool Spot Market Must Be Administered by the Independent System Operator: Avoiding the Separation Fallacy," The Electricity Journal, December 1995, pp. 26-37.

## ELECTRICITY MARKET

## Some Lessons of Market Formation

Cycles around the loop take months to years when it is only talk. Once implemented, cycles take years or forever.

- **Don't Assume It is Easy to Muddle Through.** Errors are costly. Bad market design leads to serious disruption itself (PJM-1997, NE-1999) or helps make bad problems worse (California-2000). Bad governance structures make all problems more difficult.
- **Get the Prices Right.** When a monopoly that makes all the decisions, the details matter less. But whenever market participants are given a choice, it is critical that they see the right prices. Market participants will respond to incentives. That after all, is the foundation for restructuring. Opportunity cost pricing supports efficient behavior. Otherwise, the system operator and regulators will be forced to intervene with non-market mechanisms that negate the broader purpose.
- **Recognize that the Market Can't Solve the Problem of Market Design.** There are too many moving parts that must move together. Absent strong public oversight, the complex interactions and the competing interests provide a textbook case for sacrificing the public interest and sinking to the least common denominator.
- **Face Squarely the Mandates of Order 2000.** If FERC means what it says, the Order goes a long way in defining how a wholesale electricity market must be organized. But it is too timid and indirect. "If it looks like a duck and walks like a duck, it must be a duck." In the SMD NOPR, FERC makes clear what it means. If it follows through, there can be a workable market.



**Consider the political battle initiated with the standard market design notice. A question was: will FERC be able to follow through? The political pressure is enormous, but the Commission had the responsibility, authority, vision, and more than a little courage.**

“Since issuing the proposed rule in July, we have explored the details of market platforms and mechanisms through workshops and through several RTO filings proposed by market participants in each region, so we’re looking at what really works, not just what sounds like a good idea. This review has shown me that successful power markets have certain core design features in common. These include:

- Independent grid operator
- Long term bilateral contract market
- Voluntary short term spot market with transparent prices
- Regional transmission planning
- Locational price signals
- Transmission rights
- Mitigation rules to ensure generator bids reflect costs and scarcity not market power.

A platform designed with these core features serves customers better over the long run than any other platform.”<sup>3</sup>

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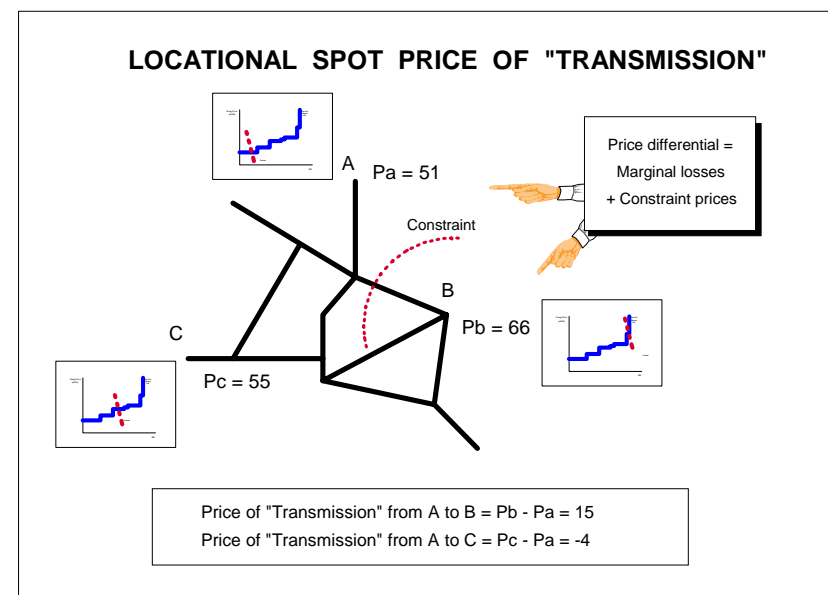
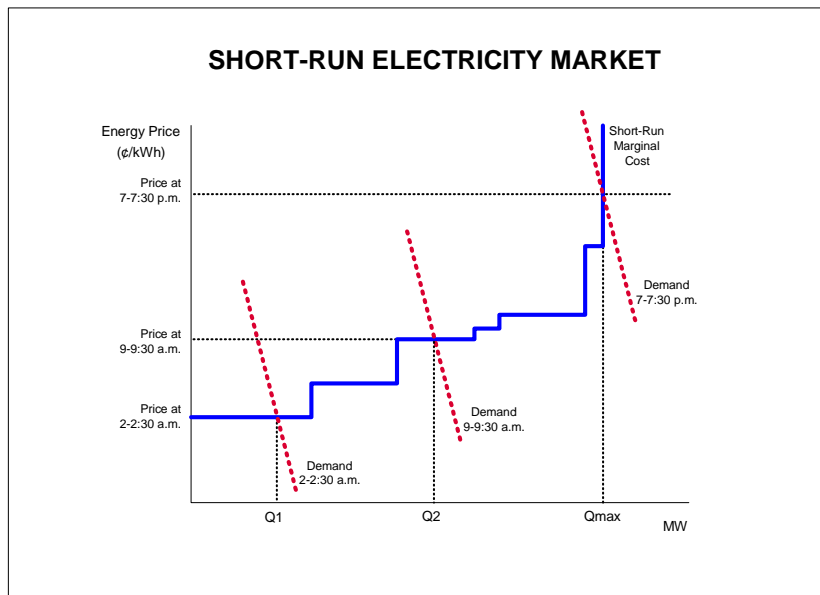
FERC Chairman Pat Wood, III, CERAWEEK 2003 Luncheon Address, Houston, Texas, February 13, 2003, p. 5.

# ELECTRICITY MARKET

## Design Centerpiece

The coordinated spot market is the design centerpiece.

One criterion would be the consistency of any feature with operation of the real-time market. There is little room for flexibility here.



The case of PJM is instructive. The market performed badly in 1997 with a poorly designed real-time market. Fixing the real-time market in 1998 corrected the most egregious problems, without requiring a day-ahead market. Later the day-ahead market began but with great care to maintain consistency with the real-time pricing, operations, grid model, and so on.

Consider the case of the NOPR day-ahead market design. There is a recognized value of day-ahead scheduling and hedging.

- **Consistent Models:** The SMD NOPR rejects the sometimes argument that the ITP (aka RTO) can operate a day-ahead commercial market under simplified models of the grid and assumptions about pricing.
- **Coordinated Operations and Markets:** The SMD NOPR rejects the fallacy that reliable system operations and market operations can be separated. There is no separate exchange and transmission market, as failed in California. The walls between ancillary services markets are broken down to work towards coordinated optimization and clearing by the ITP. There may be differences in the timing of various implementations, but the broad outline of the design is based on sound theory and good use of the experience.
- **Unit Commitment:** The SMD NOPR contains a sophisticated discussion of economic and reliability unit commitment ideas and the choices in allocation of uplift charges to when market-clearing prices are incomplete in supporting the efficient solution. There analysis includes recognition of the necessity that the rules reinforce the incentives needed both day-ahead and in the real-time market. Since we know that there is no first-best solution to the problem, the rule might allow for some regional flexibility

Keep your eye in this ball. The basic design of the real-time market should be replicated everywhere. The day-ahead market should be consistent with the real-time market. Be wary of any suggestions to fix the real-time to support the day-ahead, or to impose inconsistent models. (RTO West ?)

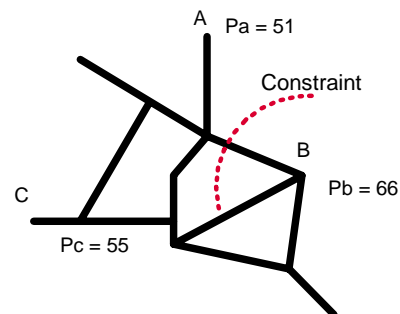


## NETWORK INTERACTIONS

## Financial Transmission Rights

A mechanism for hedging volatile transmission prices can be established by defining financial transmission rights to collect the congestion rents inherent in efficient, short-run spot prices.

### NETWORK TRANSMISSION FINANCIAL RIGHTS



Price of "Transmission" from A to B =  $P_b - P_a = 15$   
Price of "Transmission" from C to A =  $P_a - P_c = -4$

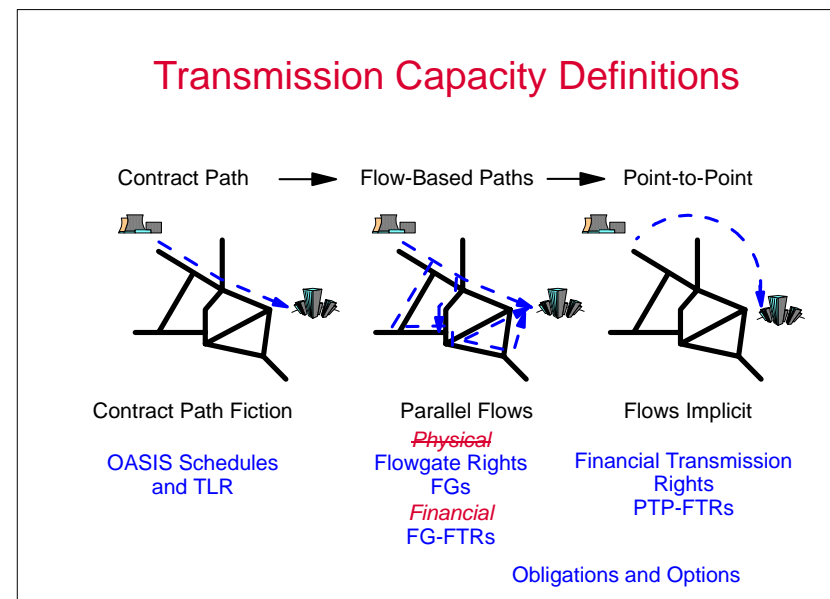
- DEFINE TRANSMISSION CONGESTION CONTRACTS BETWEEN LOCATIONS.
- FOR SIMPLICITY, TREAT LOSSES AS OPERATING COSTS.
- RECEIVE CONGESTION PAYMENTS FROM ACTUAL USERS; MAKE CONGESTION PAYMENTS TO HOLDERS OF CONGESTION CONTRACTS.
- TRANSMISSION CONGESTION CONTRACTS PROVIDE PROTECTION AGAINST CHANGING LOCATIONAL DIFFERENCES.

The evolution of electricity restructuring thread ...

## The “Contract Path” won’t work in theory, but will it work in practice?

- **Order 888, 1996.** Non-discrimination, Open Access to Transmission. Contract path fiction would not work in theory.
- **Capacity Reservation Tariff (CRT), 1996.** A new model.

"The proposed capacity reservation open access transmission tariff, if adopted, would replace the open access transmission tariff required by the Commission ..."<sup>4</sup>
- **NERC Transmission Loading Relief (TLR), 1997.** The unscheduling system to complement Order 888.
- **EPAct 2005.** Continued support for competitive markets but conflicting signals on market design.
- **Order 888 Reform NOPR, 2006.** Too little. Too late?



<sup>4</sup> Federal Energy Regulatory Commission, "Capacity Reservation Open Access Transmission Tariffs," Notice of Proposed Rulemaking, RM96-11-000, Washington DC, April 24, 1996, p. 1.

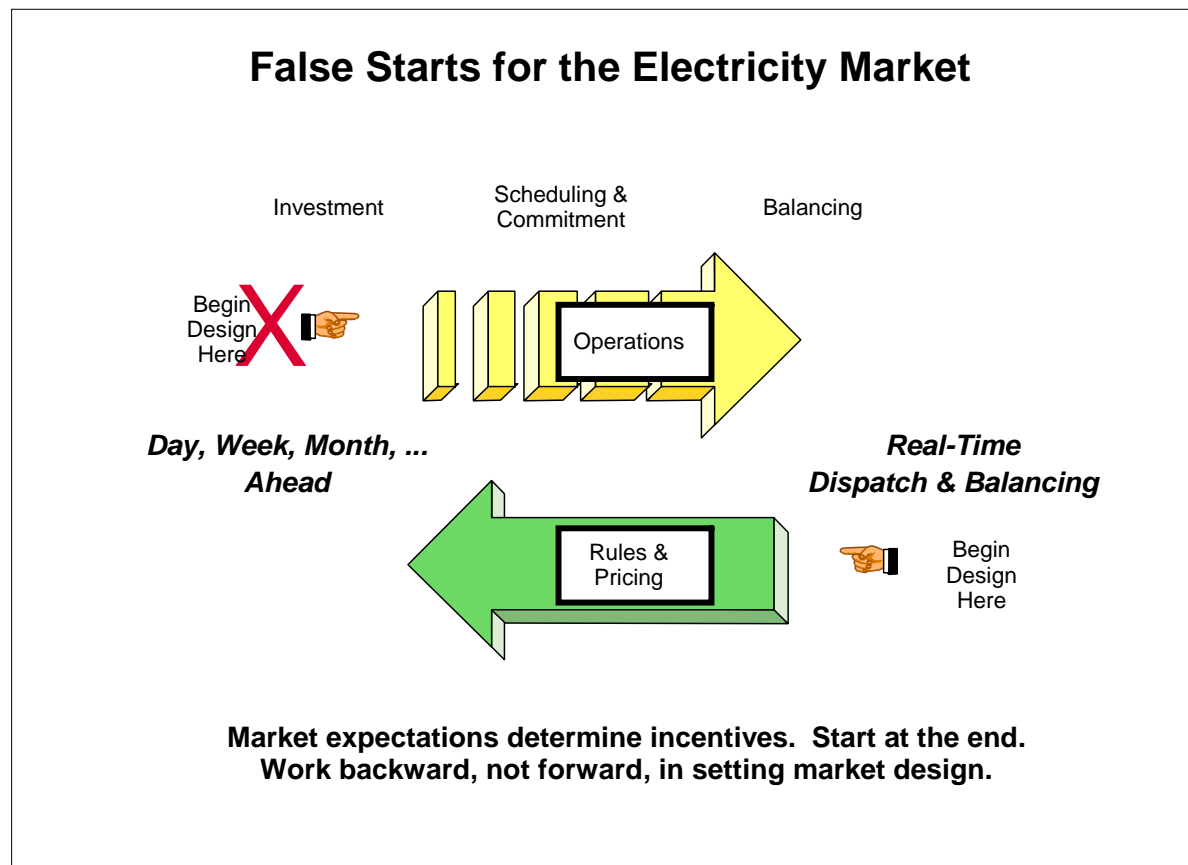
Given where the Order 888 path leaves us, what could be done within the constraints to move onto a path where we move closer to achieving our stated objective? A modest proposal:

- Adopt a consistent and transparent framework for FERC regulation.
- The framework is security constrained economic (re)dispatch.
- Follow the logic of the framework for a principled design.
- Focus on balancing first and foremost.
- Design other Order 888 reforms to be compatible with economic balancing and consistent pricing.

# ELECTRICITY MARKET

## Focus on Balancing First

The solution to open access and non-discrimination inherently involves market design. Good design begins with the real-time, and works backward. A common failure mode starts with the forward market and long-term rights or rules, without specifying the rules and prices that would apply in real time. Focus on balancing and redispatch to meet transmission constraints.



**The principal flexibility in balancing and redispatch is with pricing.**

- **Balancing Requires Security Constrained (Re)Dispatch.**

To maintain frequency, any electricity system must maintain essentially instantaneous balance between generation and load plus thermal losses. To achieve this balance, the system operator adjusts flexible generating plants and loads. Whether this is described in terms of dispatch, net dispatch, or redispatch relative to schedules, the result is the same. Changes in load or generation, whether scheduled or not, must be balanced in real time, all the time.

Transmission limits and other constraints restrict the dispatch choices available to the system operator. There is a reliability requirement to stay within the operating limits of the grid, in order to protect against events which could cause cascading failures. These requirements for system balancing and dispatch existed before electricity restructuring, and continue in the context of wholesale electricity markets. Whether intentionally or as a byproduct, by whatever name, these actions amount to providing a security constrained dispatch.

- **Economics Matter in the Balancing Choices.**

In addition, system operators have traditionally considered cost in order to achieve an economic dispatch. This is not new. There must be some criterion to guide the choice of which generation and load should be adjusted to achieve the security constrained dispatch, and the natural choice is to seek the most economical combination within the many constraints. In a traditional system the costs might be determined by engineering estimates. In organized wholesale markets the offers of generation and bids by load would serve the same function. This criterion leads to a security constrained economic dispatch.

**A challenge for Order 888 reform would be to require economic balancing and consistent pricing.**

- **Balancing Through Security Constrained Economic (Re)Dispatch.**

There is no dispute that there must be security constrained (re)dispatch to address transmission constraints and imbalances. The only question is whether or not FERC should require economic redispatch or rather should support uneconomic redispatch.

- **Consistent Pricing.**

Given a security constrained economic dispatch, there is only one known pricing method that is consistent with actual operation of the grid and can be consistently applied to all transmission users. This pricing uses the marginal opportunity cost of redispatch at each location. This is distinct from the average cost of redispatch and various load-ratio cost allocation approaches.

- **Virtuous Circle.**

Experience with economic balancing and consistent pricing exhibits the benefits of a virtuous circle. A well-designed balancing function creates incentives to reinforce reliability and further simplify other remaining problems associated with open access and support of competitive markets.

**Good design of the real-time market simplifies everything else. The basic principles stand at the center of successful market design (“SMD”) and the virtuous cycle.**

- Efficient real-time operations conform to economic dispatch, and the prices or opportunity costs at the margin equal the much discussed locational marginal prices (LMP). This fact dictates the core elements of successful market design. Any other outcome will create problematic incentives requiring intrusive mandates and rules to maintain reliability and achieve efficiency.
- Available Transmission Capacity (ATC) calculations required for the contract path model are not well defined. The problem is conceptual and not just a requirement for better information. Hence, ATC estimates are arbitrary and controversial. By contrast, the point-to-point financial transmission rights found in successful market design provide an alternative, well-defined and workable set of rights to support forward markets.
- Security limits dictated by reliability standards are implemented as contingency constraints which inherently require coordinated and simultaneous evaluation. Evaluation of the (many) constraints requires calculation and not just observation.
- Bid-based dispatch or balancing systems can incorporate the elements needed for efficient operations to support coordination and competition.

**Suspend disbelief to focus on economic balancing and consistent pricing. ...**

- **Is the combination of economic balancing and consistent pricing necessary for open access and non-discrimination?**

Yes. The transmission provider must operate a balancing system that becomes security constrained (re)dispatch. With economic (re)dispatch, the only pricing system consistent with open access and non-discrimination is the use of locational marginal opportunity costs.

- **Anathema. Is the combination of economic balancing and consistent pricing a stealth version of “Standard Market Design?”**

No. The proposal developed by FERC for Standard Market Design covered much more ground. It is true that economic balancing and consistent pricing would be consistent with the Standard Market Design, but only because it is consistent with actual use of the transmission system. Economic balancing and consistent pricing would be consistent with the CRT, Order 2000, and any other successful system of open access and non-discrimination.

- **Is the combination of economic balancing and consistent pricing necessary for supporting competitive electricity markets and efficient investment?**

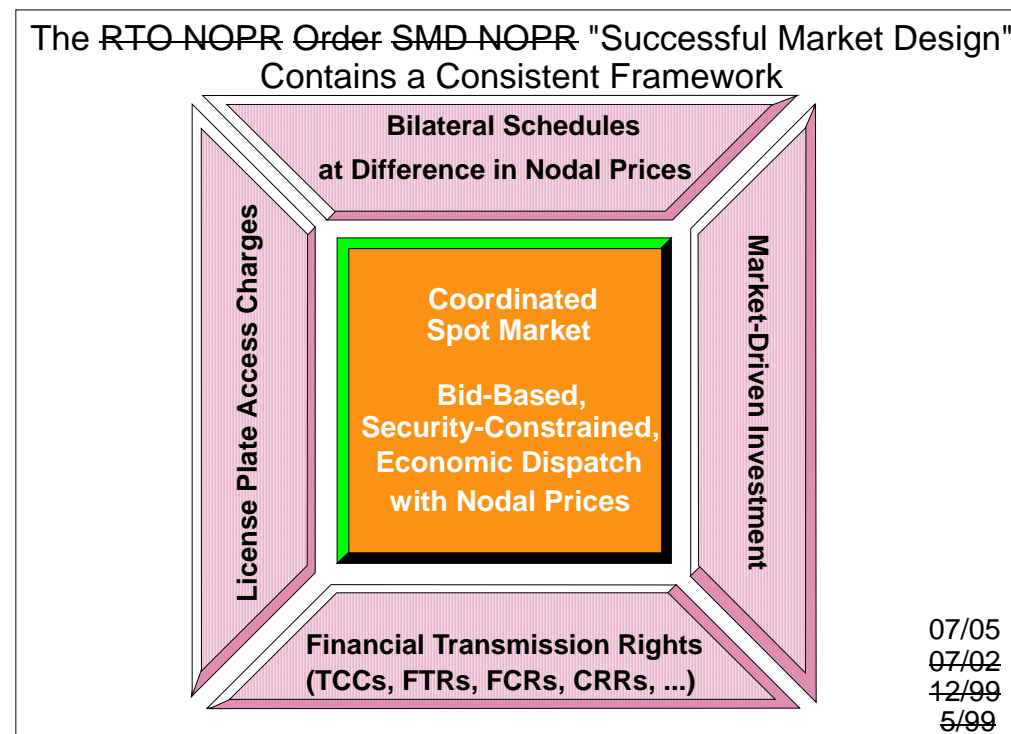
Yes. Any other system will create perverse incentives that either undermine operations or undermine investment. Inexorably, the perverse incentives will create the need and pressure for regulators, including FERC, to take on more and more obligations to mandate and control electricity investments.



## ELECTRICITY MARKET

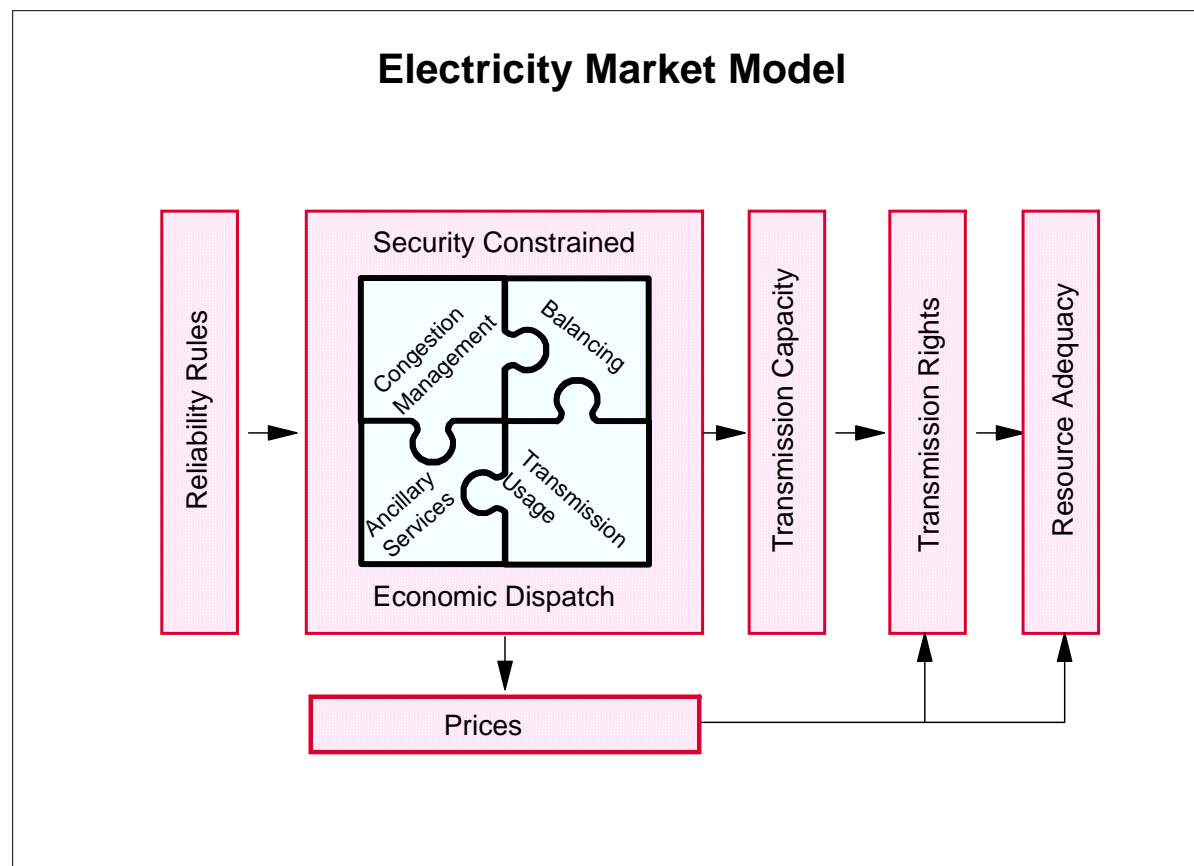
## A Consistent Framework

The example of successful central coordination, ~~GRT, 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, and the Midwest.



Poolco...OPCO...ISO...IMO...Transco...RTO... ITP...WMP...: "A rose by any other name ..."

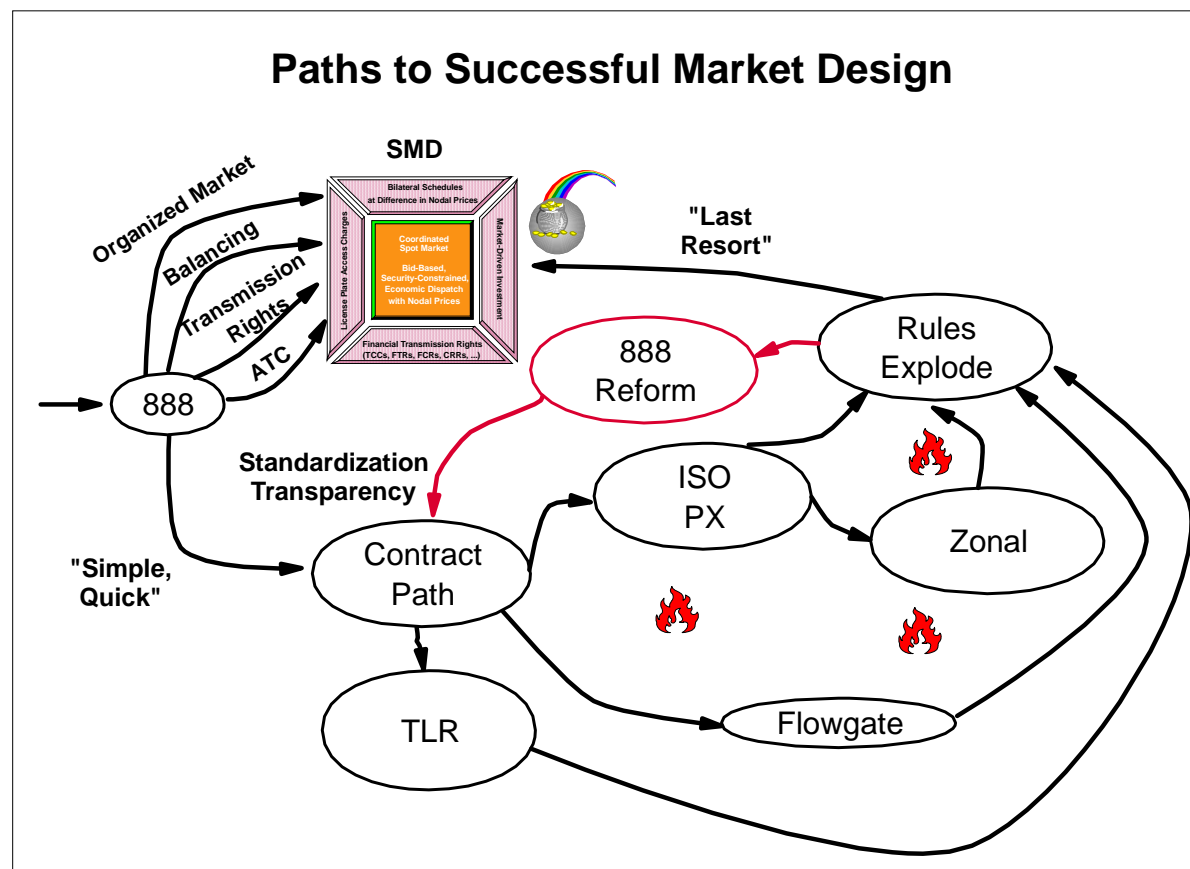
(Re)formulating the model around the well-known principles of security-constrained economic dispatch integrates the pieces and simplifies or solves many of the most difficult policy problems.



# ELECTRICITY MARKET

## Path Dependence

The path to successful market design can be circuitous and costly. The FERC reform proposals for Order 888 illustrate “path dependence,” where the path chosen constrains the choices ahead. Can Order 888 be reformed to overcome its own logic? Or is FERC trapped in its own loop flow?



The modest proposal leaves important tasks for RTOs. Wherever there is choice, it is critical to define the property rights and get the prices right. Wherever there are central mandates, it is important to design the rules and prices to be consistent with the fundamental market design. For example:

- **Get the Prices Right**
  - Scarcity pricing and resource adequacy.
  - Operating reserve demand curves.
- **Support Investment**
  - Transmission planning and investment.
  - Adapting the Argentine model.

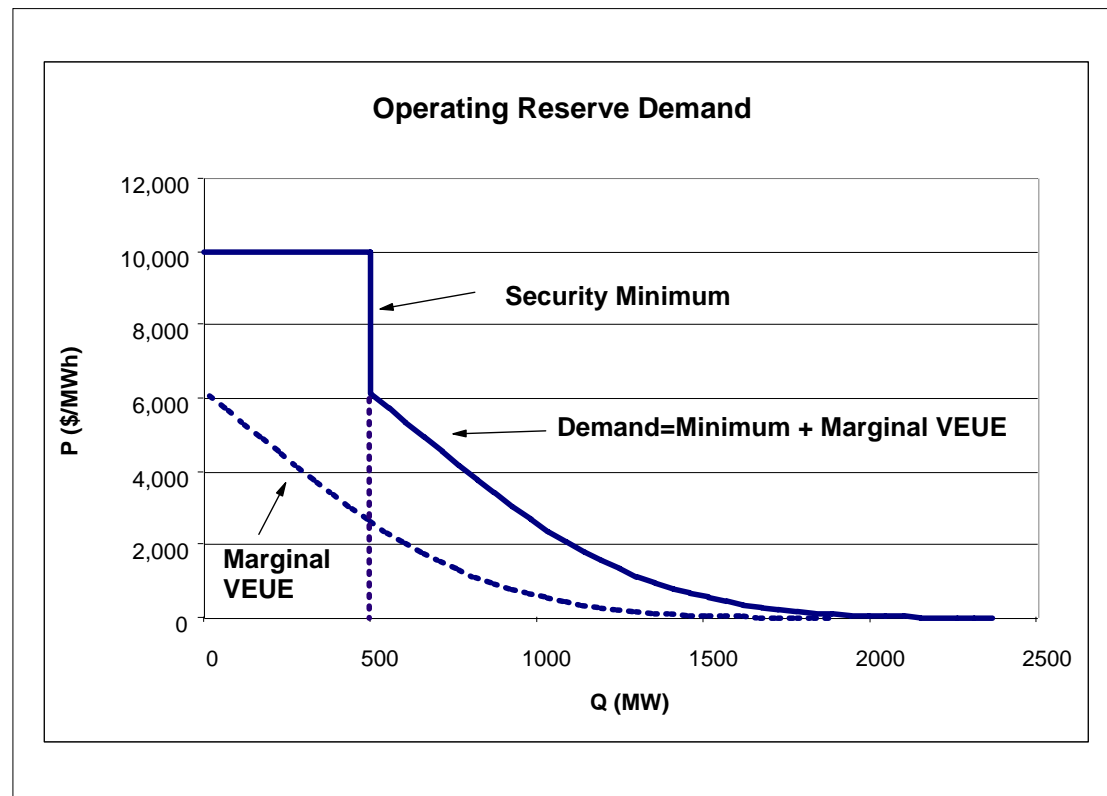
## ELECTRICITY MARKET

## Operating Reserve Demand

Existing market designs underprice scarcity and provide poor signals for investment. Hence we have the resource adequacy debate. A market would be reinforced by adopting an explicit operating reserve demand curve.

The maximum generation outage contingency quantity provides a vertical demand curve that adds horizontally to a probabilistic operating reserve demand curve.

If the security minimum will always be maintained over the monitored period, the VEUE price at  $r=0$  applies. If the outage shocks allow excursions below the security minimum during the period, the VEUE starts at the security minimum.



## **TRANSMISSION INVESTMENT**

## **Argentine Approach**

**An outline of the Argentine experience bears directly on the debate in the United States and elsewhere.** (For details, see Stephen C. Littlechild and Carlos J. Skerk, "Regulation of Transmission Expansion in Argentina Part I: State Ownership, Reform and the Fourth Line," CMI EP 61, 2004, pp. 27-28.)

- **Coordinated Spot Market.** Organized under an Independent System Operator with Locational Marginal Pricing.
- **Expansion of Transmission Capacity by Contract Between Parties.** Allowed merchant transmission with voluntary participant funding.
- **Minor Expansions of Transmission Capacity (<\$2M).** Included regulated investment with assignment of cost, either through negotiation or allocation to beneficiaries as determined by regulator, with mandatory participant funding.
- **Major Expansions of Transmission by “Public Contest” Method.** Overcame market failure without overturning markets.
  - Regulator applies the “Golden Rule” (the traditional Cost-Benefit Test).
  - 30%-30% Rule. At least 30% of beneficiaries must be proponents. No more than 30% of beneficiaries can be opponents.
  - Assignment of costs to beneficiaries with mandatory participant funding under “area of influence” methodology.
  - No award of Financial Transmission Rights!
  - Allocation of accumulated congestion rents to reduce cost of construction (“Salex” funds).

**What impact did the Argentine approach have on transmission investment?**

“To illustrate the change in emphasis on investment, over the period 1993 to 2003 the length of transmission lines increased by 20 per cent, main transformers by 21 per cent, compensators by 27 per cent and substations by 37 per cent, whereas series capacitors increased by 176 per cent. As a result, transmission capacity limits increased by 105 per cent, more than sufficient to meet the increase in system demand of over 50 per cent.” (Stephen C. Littlechild and Carlos J. Skerk, “Regulation of Transmission Expansion in Argentina Part II: State Ownership, Reform and the Fourth Line,” CMI EP 61, 2004, p. 56.)

### **Lessons**

- **Transmission investment could be compatible with SMD incentives.**
- **Beneficiaries could be defined.**
- **Participant funding could support a market.**
- **Award of FTRs or ARRs would be an obvious enhancement.**

**How would the Argentine model translate into the United States context?**

- **Coordinated Spot Market.** Organized under an Independent System Operator with Locational Marginal Pricing. The Successful Market Design with financial transmission rights.
- **Expansion of Transmission Capacity by Contract Between Parties.** Allow merchant transmission with voluntary participant funding. This is the easy case. Allocate long-term financial transmission rights for the transmission expansion.
- **Minor Expansions of Transmission Capacity (<\$2M).** Includes regulated investment with assignment of cost either through negotiation or assignment to beneficiaries as determined by regulator with mandatory participant funding. Leaves small investments to the initiative of the existing wires companies. Auction incremental FTRs along with FTRs for existing system.
- **Major Expansions of Transmission by “Public Contest” Method.** Overcoming market failure without overturning markets.
  - Regulator applies the “Golden Rule” (Cost-Benefit Test). Use the same economic cost benefit analysis to identify expected beneficiaries.
  - 30%-30% Rule. At least 30% of beneficiaries must be proponents. No more than 30% of beneficiaries can be opponents. This provides an alternative, or a complement, to the “Market Failure Test” to help the regulators limit intervention and support the broader market.
  - Assign costs to beneficiaries with mandatory participant funding.
  - Award either Auction Revenue Rights or long term FTRs to beneficiaries along with costs.



## **TRANSMISSION INVESTMENT**

## **Supporting Markets**

Apply the same general rules to all generation and demand investments that compete with transmission.

- **Coordinated Spot Market.** Organized under an Independent System Operator with Locational Marginal Pricing. The Successful Market Design with financial transmission rights.
- **Voluntary Investment by Contract Between Parties.** Allow merchant generation and demand investment with voluntary participant funding. This is the easy case.
- **Major Investments by “Public Contest” Method.** Overcoming market failure without overturning markets.
  - Regulator applies the “Golden Rule” (Cost-Benefit Test). Use the same economic cost benefit analysis to identify expected beneficiaries.
  - 30%-30% Rule. At least 30% of beneficiaries must be proponents. No more than 30% of beneficiaries can be opponents. Absent a very lumpy investment, the beneficiaries should be a very limited group. Virtually all demand investments and most generation investments would have a single beneficiary.
  - Assign costs to beneficiaries with mandatory participant funding.

**In principle, this provides a level playing field while recognizing that there may be market failures that require regulated investments.**

**Where do the Federal Energy Regulatory Commission (FERC) reform proposals for Order 888 fit in this picture? Nowhere. There is a fundamental disconnect, a denial of analysis and experience.**

The FERC of 2006 promotes a fundamentally flawed view about what open access means, and what models are available to achieve the purported benefits.

*“Now, the goal of the NOI in this proceeding is very clear. It is spelled out in the title: Preventing Undue Discrimination and Preference in Transmission Service. We are not talking about market design. We are not talking about restructuring. We are talking about preventing undue discrimination and preference.”*

(Statement of Joseph Kelliher, Chairman, Federal Energy Regulatory Commission, Regarding Notice of Inquiry on Preventing Undue Discrimination and Preference in Transmission Service, Docket No. RM05-25-000, September 16, 2005, emphasis added)

“The first time the Commission found Order No. 888 allowed undue discrimination and preference in transmission service occurred in 1999. The solution advanced by the Commission was restructuring: encouraging voluntary RTO formation, in Order No. 2000. ... The second time the Commission found Order No. 888 allowed undue discrimination and preference took place in 2002. The solution advanced by the Commission at the time was also restructuring, this time mandating RTO participation and a standard market design. ... The solution we advance today is not restructuring, but more effective regulation, reform of the open access rules themselves, for the first time in nearly a decade.”

(Statement of Joseph Kelliher, Chairman, Federal Energy Regulatory Commission, Regarding Open Access Transmission Tariff (OATT) Reform (RM05-25-00), May 16, 2006.)

**Can open access not be about market design?**

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