

PATH DEPENDENT TRANSMISSION ACCESS

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

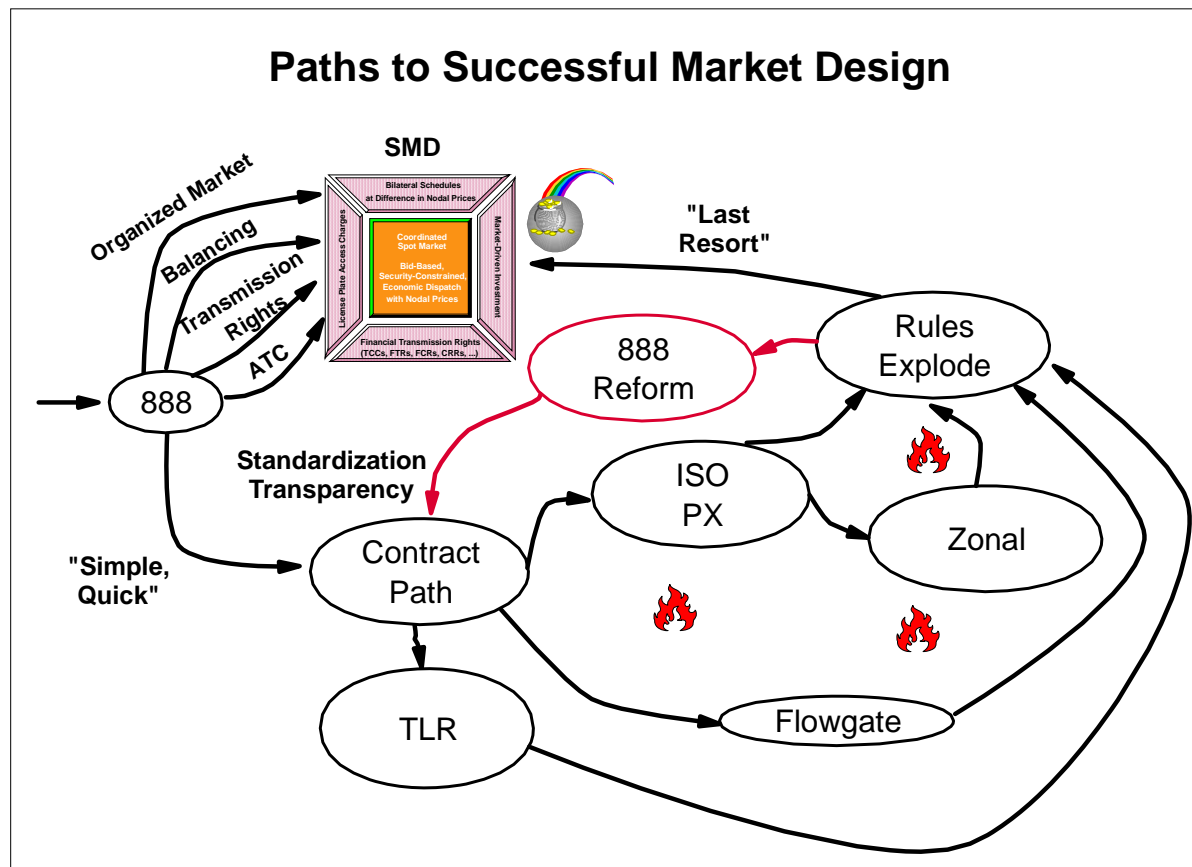
OATT Reform
Revisiting the Open Access Transmission Tariff
Infocast Conference
Washington, DC

June 9, 2006

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 Federal Energy Regulatory Commission (FERC) reform proposals for Order 888 arise from frustration with electricity restructuring efforts and providing open access to transmission needed to support competitive markets.

At its core, the debate identifies persistent disagreement 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)

“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.)

The FERC proposed reform of Order 888 emphasizes two principles for improving regulation of transmission access.

- **Consistency**

Consistency here is interpreted to mean standardization. “...the industry still has not developed a consistent, industry-wide methodology for evaluating ATC.” (OATT 2006 NOPR, p. 77)

- **Transparency**

“...transmission providers often have responded by filing very general narrative descriptions of their calculation methodologies ... without further specification of the mathematical algorithm, data inputs, and modeling assumptions used to perform the calculation.” (OATT 2006 NOPR, p. 86)

FERC’s Order 888 Reform NOPR calls for greater consistency and transparency as keys to its future success in meeting the goals of open access. These are admirable principles. The same principles should be applied to the FERC analysis supporting any reform proposal.

Success will depend not only on consistency of methodologies across transmission providers, but also on consistency with the actual operation of the transmission system. On this subject, the transparency of FERC’s approach has decreased compared to the relative clarity of some of its earlier analyses.

The Open Access Rule of Order 888 followed from a lengthy debate about the many details of electricity markets.

“Today the Commission issues three final, interrelated rules designed to remove impediments to competition in the wholesale bulk power marketplace The legal and policy cornerstone of these rules is to remedy undue discrimination in access to the monopoly owned transmission wires that control whether and to whom electricity can be transported in interstate commerce.” (FERC, Order 888, April 24, 1996, p. 1.)

- **What did Order 888 anticipate for the development of electricity market design?**
- **Did FERC jump too soon to an RTO model with a “standard market design” that foreclosed other options?**
- **What other electricity market design options are available to achieve the objectives of open access and Order 888?**
- **Is it possible to reform Order 888 to achieve the open access objective to remove impediments to competition?**

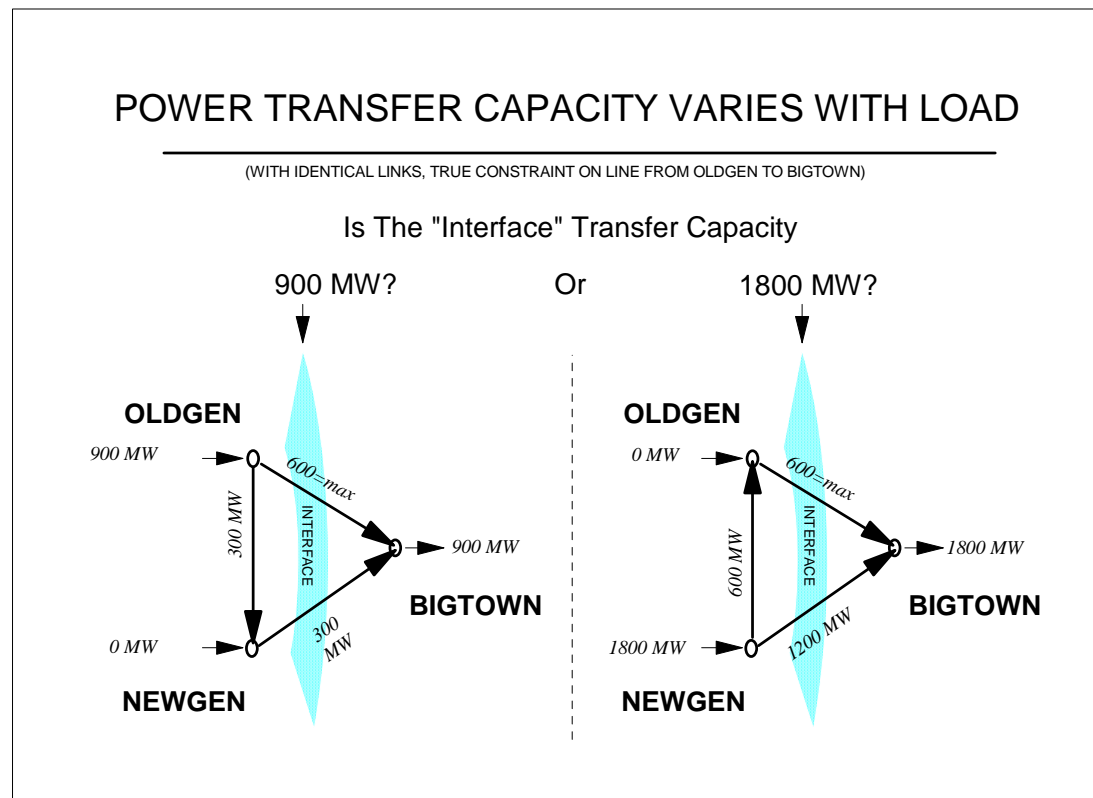
Can open access not be about market design?

Under Order 888 the FERC made a crucial choice regarding a central complication of the electricity system.

“A contract path is simply a path that can be designated to form a single continuous electrical path between the parties to an agreement. Because of the laws of physics, it is unlikely that the actual power flow will follow that contract path. ... Flow-based pricing or contracting would be designed to account for the actual power flows on a transmission system. It would take into account the "unscheduled flows" that occur under a contract path regime.” (FERC, Order 888, April 24, 1996, footnotes 184-185, p. 93.)

Electric transmission network interactions can be large and important.

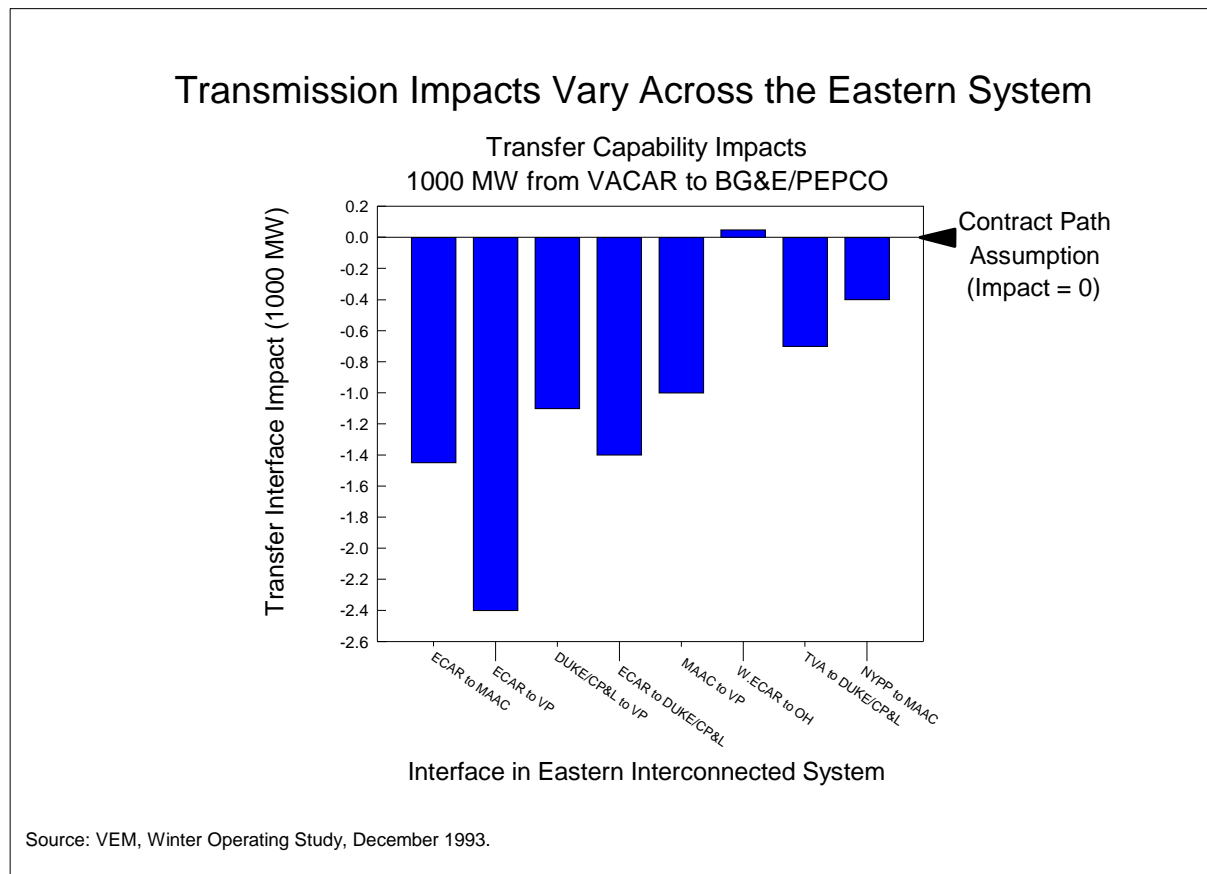
- Conventional definitions of network "Interface" transfer capacity depend on the assumed load conditions.
- Transfer capacity cannot be defined or guaranteed over any reasonable horizon.



NETWORK INTERACTIONS

Loop Flow

There is a fatal flaw in the old "contract path" model of power moving between locations along a designated path. The network effects are strong. Power flows across one "interface" can have a dramatic effect on the capacity of other, distant interfaces.



Electricity restructuring requires open access to the transmission essential facility. A fully decentralized competitive market would benefit from tradable property rights in the transmission grid. However, the industry has never been able to define workable transmission property rights:

"A primary purpose of the RIN is for users to learn what Available Transmission Capacity (ATC) may be available for their use. Because of effects of ongoing and changing transactions, changes in system conditions, loop flows, unforeseen outages, etc., ATC is not capable of precise determination or definition. "

Comments of the Members of the PJM Interconnection, Request for Comments Regarding Real-Time Information Networks, Docket No. RM95-9-000, FERC, July 5, 1995, p. 8.

The problems are not unique to the U. S. The same issue arises in any meshed network, as in Europe and the regulations for European Transmission System Operators {ETSO}:

"Does the draft Regulation set the right objective when it requires TSOs to compute and publish transfer capacities? ETSO says both yes and no ...in many cases the (Net transfer capacity or NTCs) may be a somewhat ambiguous information...The core of the difficulty raised by transfer capacities lies in the fact that they do not obey usual arithmetic: 'it makes no sense to add or subtract the NTC values...' Put it in other ways, in order to compute the maximal use of the network, one needs to make assumptions on the use of the network! This definition is restated and elaborated in ETSO (2001a) (p. 6)."

J. Boucher and Y. Smeers, "Towards a Common European Electricity Market--Paths in the Right Direction...Still Far From an Effective Design," Belgium. September, 2001, pp. 30-31. (see HEPG web page, Harvard University)

Under Order 888 the FERC made a crucial choice regarding a central complication of the electricity system.

“A contract path is simply a path that can be designated to form a single continuous electrical path between the parties to an agreement. Because of the laws of physics, it is unlikely that the actual power flow will follow that contract path. ... Flow-based pricing or contracting would be designed to account for the actual power flows on a transmission system. It would take into account the "unscheduled flows" that occur under a contract path regime.” (FERC, Order 888, April 24, 1996, footnotes 184-185, p. 93.)

“We will not, at this time, require that flow-based pricing and contracting be used in the electric industry. In reaching this conclusion, we recognize that there may be difficulties in using a traditional contract path approach in a non-discriminatory open access transmission environment, as described by Hogan and others. At the same time, however, contract path pricing and contracting is the longstanding approach used in the electric industry and it is the approach familiar to all participants in the industry. To require now a dramatic overhaul of the traditional approach such as a shift to some form of flow-based pricing and contracting could severely slow, if not derail for some time, the move to open access and more competitive wholesale bulk power markets. In addition, we believe it is premature for the Commission to impose generically a new pricing regime without the benefit of any experience with such pricing. We welcome new and innovative proposals, but we will not impose them in this Rule.” (FERC, Order 888, April 24, 1996, p. 96.)

Hence, although the fictional contract path approach would not work in theory, maintaining the fiction would be less disruptive in moving quickly to open access and an expanded competitive market!

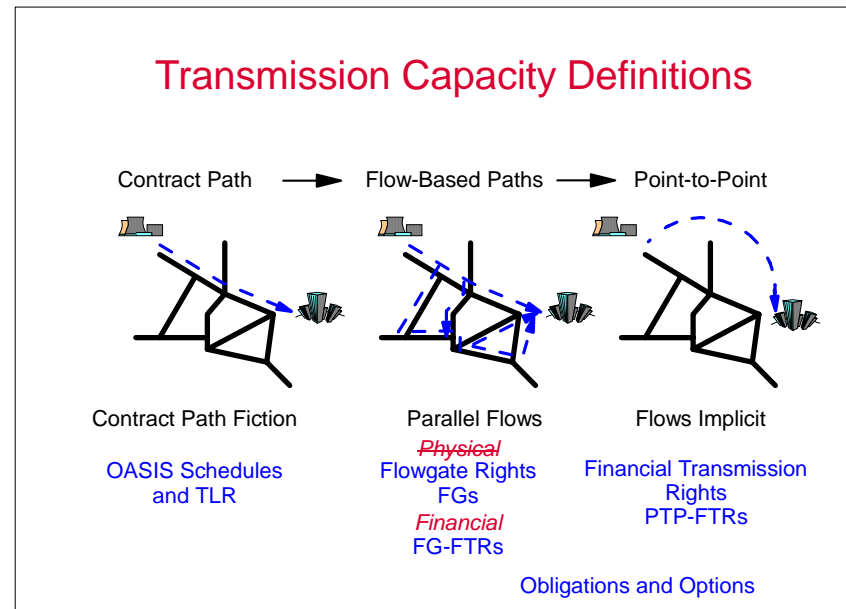
Order 888 would not work in theory, but might it work in practice? The CRT provided striking evidence that FERC knew there was a serious problem.

Capacity Reservation Tariff (CRT), 1996. A new model, on the same day as Order 888 (April 24, 1996).

"The proposed capacity reservation open access transmission tariff, if adopted, would replace the open access transmission tariff required by the Commission ..."¹

The new model outlined in the CRT moved away from the contract path to embrace point-to-point rights. The CRT was roundly rejected by industry, and received little support. But it was to reappear, again and again.

NERC Transmission Loading Relief (TLR), 1997. The reliability watchdogs saw the impending problem and soon created the unscheduling system to complement the contract path scheduling required under Order 888.



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

FERC's Order 888 reform NOPR is largely silent on these issues. What little is said obscures the inconvenient truth.

The Order 888 Reform NOI raised the question.

“In Order No. 888, the Commission stated that its use of the contract path model of power flows and embedded cost ratemaking was intended to initiate open access, but was not intended to signal a preference for contract path/embedded cost pricing for the future. The Commission further stated that it would entertain non-discriminatory tariff innovations to accommodate new pricing proposals in the future. Order No. 888 at 31,734-35. Should the Commission continue to use the contract path model in the future?” (FERC Order 888 Reform, NOI (emphasis in original), p. 13)

The resulting Order 888 Reform NOPR deflects the issue.

“...there are two main approaches to calculating [Available Transfer Capability] used in the industry. The first is the contract path approach, which is more commonly used by transmission providers in the Western Electricity Coordinating Council (WECC) region.[fn] The contract path methodology derives ATC directly from predetermined [Total Transfer Capability] ... values derived consistent with contract path transmission rights. The second method is the flowgate[fn] approach, which is used more widely in the Eastern Interconnection.[fn] The flowgate methodology is based on physical power flow models. The flowgate calculation first determines [Available Flowgate Capability] and then converts AFC into ATC and derives TTC for the OASIS posting. *The differences between the two approaches may not result in significantly different ATC values if consistent data inputs and industry acceptable modeling assumptions are used.*” (OATT 2006 NOPR, pp. 79-80, emphasis added.)

Order 888 reform needs more transparency regarding the consistency of its fundamental logic.

The Order 888 Reform NOI raised the question.

“Should the Commission continue to use the contract path model in the future?” (FERC Order 888 Reform, NOI (emphasis in original), p. 13)

A reasonable answer is “No.” (William W. Hogan, “Comments On Preventing Undue Discrimination And Preference In Transmission Services,” Docket No. RM05-25-000, November 22, 2005, p. 2.)

The resulting Order 888 Reform NOPR deflects the issue.

“The differences between the two [ATC and AFC] approaches may not result in significantly different ATC values if consistent data inputs and industry acceptable modeling assumptions are used.” (OATT 2006 NOPR, pp. 79-80, emphasis added.)

Under what consistent data inputs and modeling assumptions would the two methodologies produce results there were both consistent with each other and consistent with actual operation of the transmission system?

- The AFC methodology incorporates all the (many) contingency constraints on lines and interfaces.
- The contract path capability calculation is independent of the actual use (not just the ATC) of other contract paths.

The first requirement presents a practical difficulty, because there are too many flowgates. The second requirement is more fundamental, because it applies only to radial or controllable lines. The second requirement is inconsistent with actual operation of a transmission network system with loop flow.

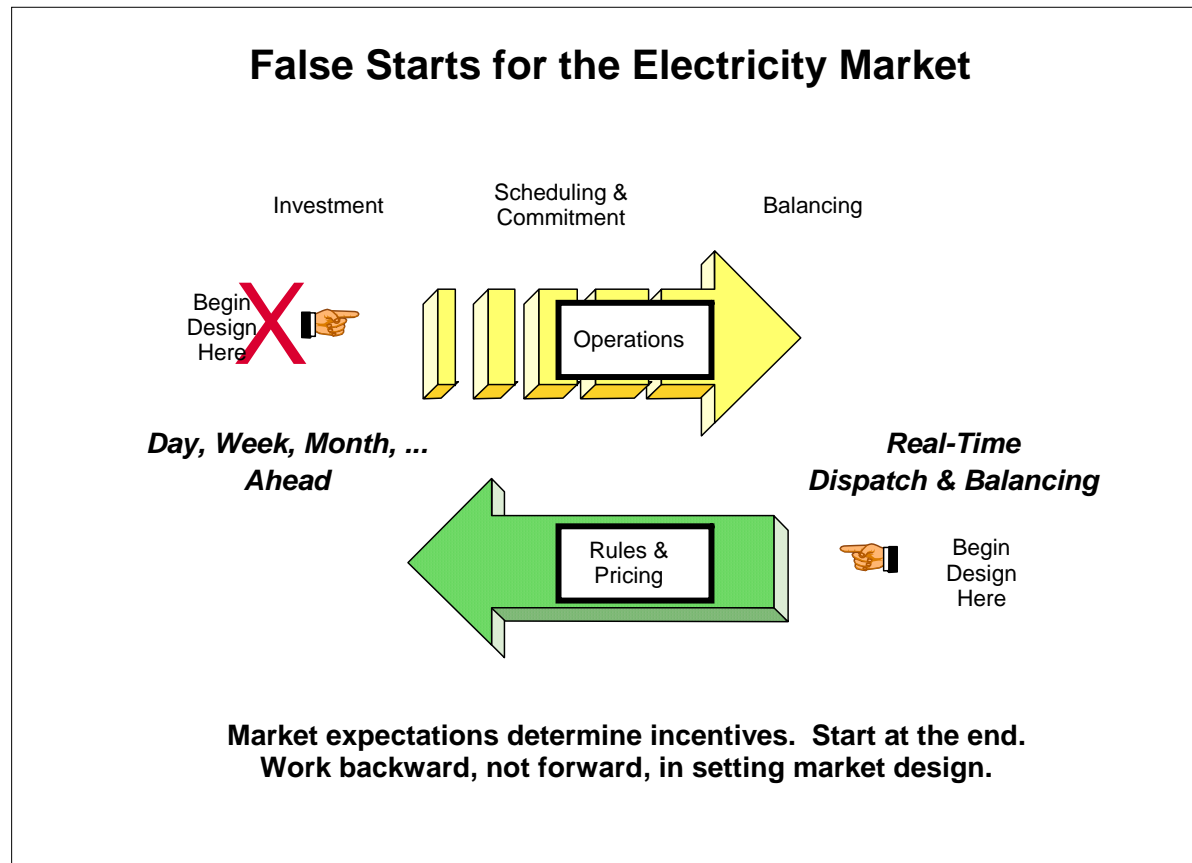
Given where the Order 888 path leaves us, what could be done within the constraints to move onto a path where we move closer to achieving our stated objective? A modest proposal:

- **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. Address other design features to make them consistent with economic balancing rather than the reverse.

- **Cherry Picking on Transmission Service Choices.**

One objection is that economic balancing with consistent and transparent pricing would be too good a deal. Transmission customers would cherry pick across network service, point-to-point service, firm and non-firm, to avoid paying for other costs not included in locational balancing costs (grid costs, regulation, operating reserves, reactive support, system operations, and so on). This implicates the cost allocation rules, and inconsistencies in regulatory design for alternative services. A solution would focus on the cost allocation rules, or on a more consistent definition of network access service.

- **Penalties to Support Reliability.**

An objection is that imbalance penalties relative to hour-ahead schedules are needed to promote good scheduling practice and protect reliability. The assertion is repeated often without explanation. If consistent pricing that reflects marginal opportunity cost at a location is not applied, then penalties may be needed. But with consistent locational pricing, arbitrary and substantial penalties that conflict with efficient incentives may interfere with reliability.

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

- **Organized Day-Ahead Markets.**

An objection is that efficient balancing and pricing require an organized day-ahead market to support unit commitment. However, unit commitment issues are amenable to other narrower reliability solutions. And with the Order 888 emphasis on flexibility to change schedules 20 minutes before the hour, without penalty, the balancing penalties provide little incentive for long-lead time commitments.

- **ATC Calculations.**

ATC calculations for a contract path would be inconsistent with economic balancing and consistent pricing. This is true, but it arises because ATC calculations for a contract path are inconsistent with actual use of the transmission system. When ATC calculations are intended to determine actual use of the grid, this inconsistency is highly problematic. But with economic balancing and consistent pricing, ATC calculations reduce to a determination of long-term hedges and become much less important. The defects of the contract path approach would create incentives to develop financial transmission rights (FTRs) that would be consistent with the balancing system.

- **Exceptions Needed for Intermittent Generation Sources.**

The proposed Order 888 reform discusses exceptions for intermittent resources. But all the qualitative arguments apply as well to any generation resource. With economic balancing and consistent pricing, the balancing flexibility envisioned for intermittent resources would apply to all resources.

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.

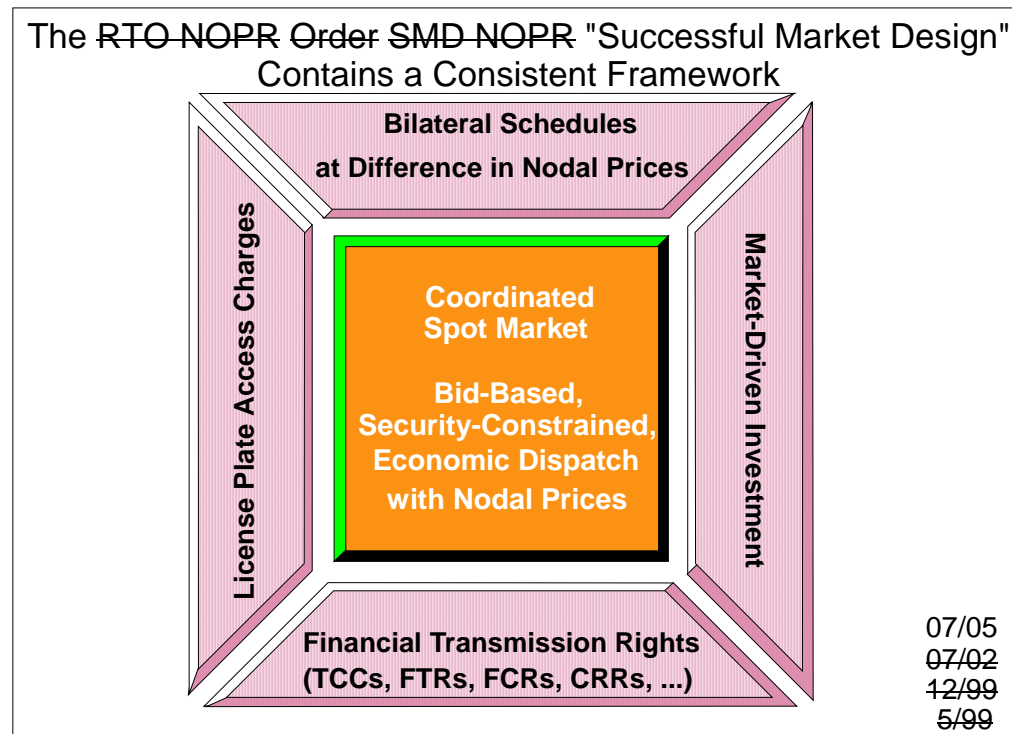
- **Is the combination of economic balancing and consistent pricing necessary for supporting competitive electricity markets and efficient investment?**

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 ..."

William W. Hogan is the Raymond Plank Professor of Global Energy Policy, John F. Kennedy School of Government, Harvard University and a Director of LECG, LLC. This paper draws on work for the Harvard Electricity Policy Group and 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, Australian Gas Light Company, Avista Energy, Brazil Power Exchange Administrator (ASMAE), British National Grid Company, California Independent Energy Producers Association, California Independent System Operator, Calpine Corporation, Central Maine Power Company, Comision Reguladora De Energia (CRE, Mexico), Commonwealth Edison Company, Conectiv, Constellation Power Source, Coral Power, Detroit Edison Company, Duquesne Light Company, Dynegy, Edison Electric Institute, Edison Mission Energy, Electricity Corporation of New Zealand, Electric Power Supply Association, El Paso Electric, GPU Inc. (and the Supporting Companies of PJM), GPU PowerNet Pty Ltd., GWF Energy, Independent Energy Producers Assn, ISO New England, Luz del Sur, Maine Public Advocate, Maine Public Utilities Commission, Midwest ISO, Mirant Corporation, 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 IMO, Pepco, Pinpoint Power, PJM Office of Interconnection, PPL Corporation, Public Service Electric & Gas Company, Reliant Energy, Rhode Island Public Utilities Commission, San Diego Gas & Electric Corporation, Sempra Energy, SPP, Texas Utilities Co, TransÉnergie, Transpower of New Zealand, Westbrook Power, Western Power Trading Forum, Williams Energy Group, and Wisconsin Electric Power Company. 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).