ELECTRICITY MARKET DESIGN AND INFRASTRUCTURE INVESTMENTS

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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.**

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

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

The Federal Energy Regulatory Commission has responsibility for regulating wholesale electricity markets. The stated framework emphasizes support for competition in wholesale markets as a clear and continuing national policy:

> "While competitive markets face challenges, we should acknowledge that competition in wholesale power markets is national policy. The Energy Policy Act of 2005 embraced wholesale competition as national policy for this country. It represented the third major federal law enacted in the last 25 years to embrace wholesale competition. To my mind, the question before the Commission is not whether competition is the correct national policy. That question has been asked and answered three times by Congress.
>
> If we accept the Commission has a duty to guard the consumer, and that competition is national policy, our duty is clear. It is to make existing wholesale markets more competitive. That is the heart of this review: to not only identify the challenges facing competitive wholesale markets but also identify and assess solutions."[1]

"Competition is at heart of U.S. energy policy relating to wholesale power and gas markets."[2]

A task for regulation is to support this policy framework while developing hybrid markets and dealing with both the limits of markets and the failures of market designs.

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1 Joseph T. Kelliher, "Statement of Chairman Joseph T. Kelliher," Federal Energy Regulatory Commission, Conference on Competition on Wholesale Power Markets AD07-7-000. February 27, 2007.

2 Joseph T. Kelliher, "Energy Competition and Regulation: The U.S. Experience," Sydney, Australia, June 26, 2008.

There is a tension in choosing regulation to address immediate market failures and to deal with the continuing challenge of improving electricity market design.

- **Little "r' regulation:**

  Design rules and policies that are the "best mixture" to support competitive wholesale electricity markets. A key requirement is to relate any proposed solution to the larger framework and to ask for alternatives that better support or are complementary to the market design. Many seemingly innocuous decisions appear isolated and sui generis, but on closer inspection are fundamentally incompatible with and undermine the larger framework.

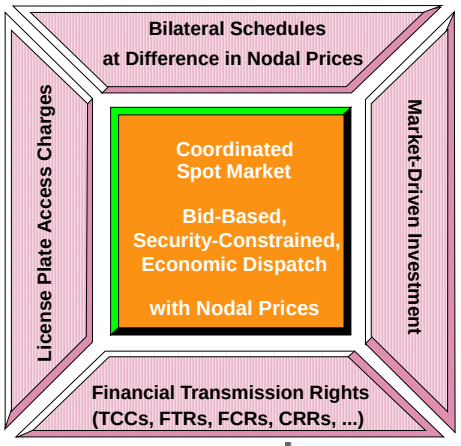
- **Big "R" regulation:**

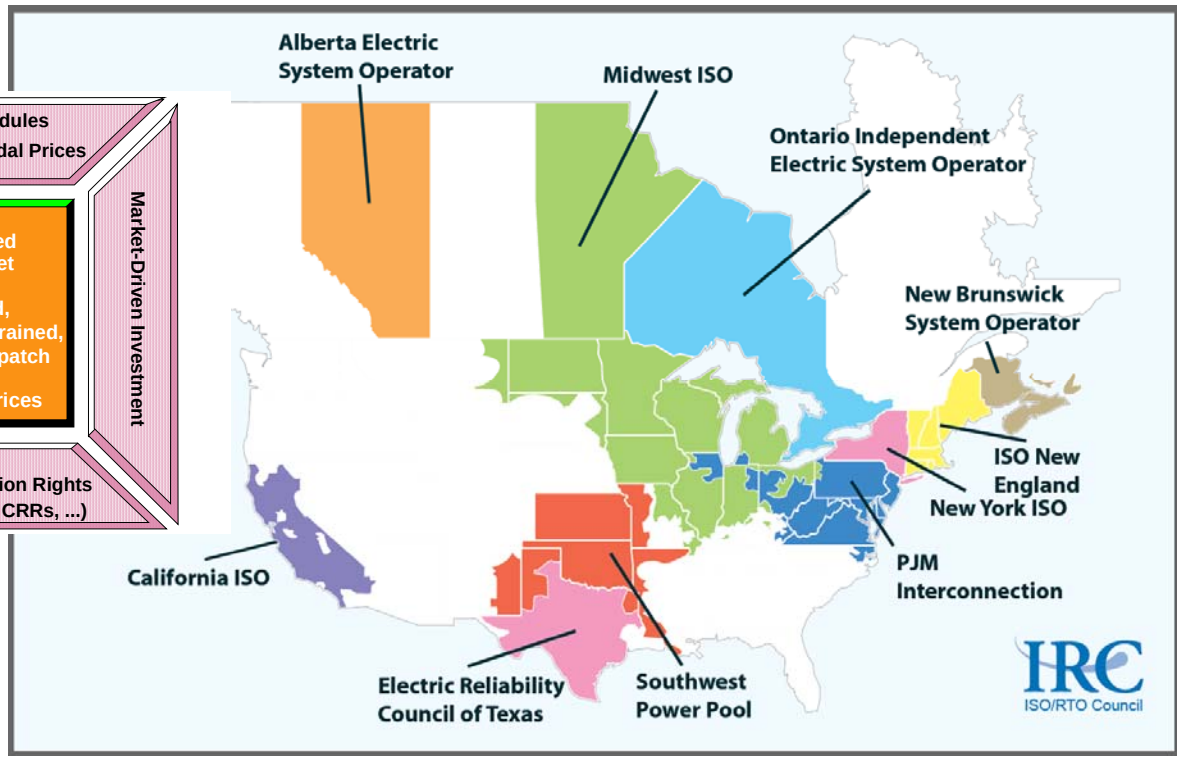
  Frame every problem in its own terms—inadequate demand response, insufficient infrastructure investment, or market power—and design ad hoc regulatory fixes that accumulate to undermine market incentives. This creates a slippery slope problem, where one ad hoc solution creates another problem, and regulators are driven more and more to intervene in ever more ad hoc ways.

For example, socialized costs for preferred infrastructure investment can easily reduce the incentives for other market-based investments, thereby increasing the need for regulators to select among additional appropriate investments and socialize even more costs.

ELECTRICITY MARKET — A Consistent Framework

Regional transmission organizations (RTOs) and independent system operators (ISOs) have grown to cover two-thirds of electricity consumers in the United States.





ELECTRICITY MARKET Coordination for Competition

The Successful Market Design challenge dictates the need for some central institutions to support markets through the seeming oxymoron of "coordination for competition."

Central institutions differ in the degree of involvement and impact on the market.

- **Central Coordination.** Organized markets required to facilitate exchange between willing buyers and willing sellers in voluntary transactions. (E.g., energy purchase and sales in spot markets.)
    - Design can be compatible with largely decentralized decisions.
    - Emphasis is on consistent incentives.
    - Evaluation remains neutral on market choices.

- **Central Procurement.** Administrative determination of required products and services with imposition of mandatory payments as a condition of participation in the system. (E.g., operating reserves with charges collected through uplift payments.)
    - Emphasis is on assured outcomes.
    - Central judgment and mandatory payment replace market forces.
    - Slippery slope could undermine broad purpose of electricity restructuring.

ELECTRICITY MARKET Challenges

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.
- **Address Externalities**
  - Targeted subsidies for innovation.
  - Pricing pollution.
- **Support Investment**
  - Transmission planning and investment.
  - Adapting the Argentine model.

Balancing little "r" regulation through market design and decentralized decisions, and big "R" regulation through mandates and socialized costs.

ELECTRICITY MARKET Market Defects and Market Failures

Consider two cases of interest that present difficult challenges for regulators.

- **Market Defect: Scarcity Pricing**

  Better scarcity pricing to support resource adequacy.

- **Market Failure: Transmission Investment**

  Regulatory mandates for lumpy transmission mixed with market-based investments.

ELECTRICITY MARKET — Generation Resource Adequacy

The "missing money" problem produces too little generation and infrastructure investment. The policy responses illustrate the tension between market design and regulation.

- **Regulated investment in new generation.**
  - SPP and balanced scheduling requirements.
  - State procurement initiatives.
- **Capacity Markets.**
  - PJM and the Reliability Pricing Model (RPM).
  - New England and the Forward Capacity Market (FCM).
- **Energy pricing reforms.**
  - High bid caps as in Australia ($10,000/MWh), Texas ($2,250/MWh) and PJM ($1,000/MWh).
  - Operating reserve demand curves, beyond New York and New England.

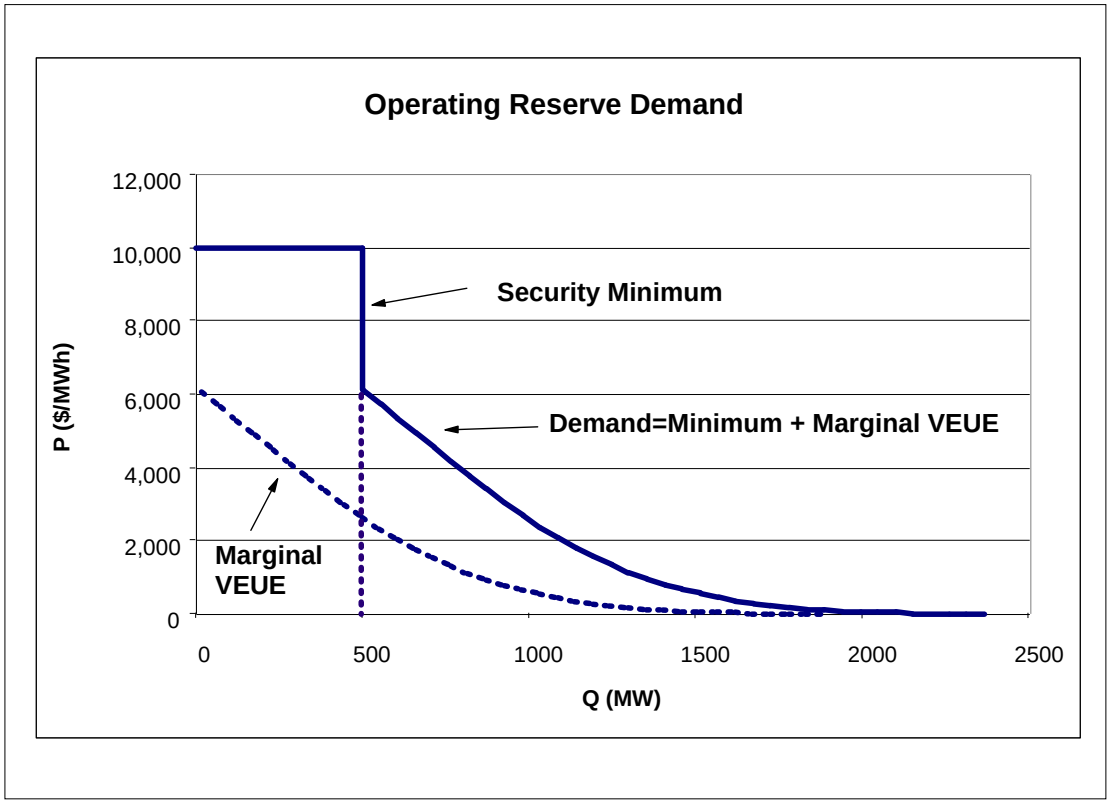
ELECTRICITY MARKET — Operating Reserve Demand

Existing market designs underprice scarcity and provide poor signals for investment. Hence we have the resource adequacy debate. A market would approached 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.

A realistic operating reserve demand curve would address the missing money problem and help jump start greater demand participation.



Improved pricing through an explicit operating reserve demand curve raises a number of issues.

Demand Response: Better pricing implemented through the operating reserve demand curve would provide an important signal and incentive for flexible demand participation in spot markets.

Price Spikes: A higher price would be part of the solution. Furthermore, the contribution to the "missing money" from better pricing would involve many more hours and smaller price increases.

Practical Implementation: The NYISO and ISONE implementations dispose of any argument that it would be impractical to implement an operating reserve demand curve. The only issue is the level of the appropriate price.

Operating Procedures: Implementing an operating reserve demand curve does not require changing the practices of system operators. Reserve and energy prices would be determined simultaneously treating decisions by the operators as being consistent with the adopted operating reserve demand curve.

Multiple Locations: Transmission limitations mean that there are locational differences in the need for and efficacy of operating reserves. This would continue to be true with different demand curves for different locations.

Multiple Reserves: The demand curve would include different kinds of operating reserves, from spinning reserves to standby reserves.

Reliability: Market operating incentives would be better aligned with reliability requirements.

Market Power: Better pricing would remove ambiguity from analyses of high prices and distinguish (inefficient) economic withholding through high offers from (efficient) scarcity pricing derived from the operating reserve demand curve.

Hedging: The Basic Generation Service auction in New Jersey provides a prominent example that would yield an easy means for hedging small customers with better pricing.

Increased Costs: The higher average energy costs from use of an operating reserve demand curve do not automatically translate into higher costs for customers. In the aggregate, there is an argument that costs would be lower.

ELECTRICITY MARKET Transmission Investment

Transmission investment presents the most difficult challenges for an electricity market. In practice and in theory, market failures can be significant. If regulatory intervention is required to plan, coordinate and mandate transmission investment, how can the intervention reinforce the larger market design? A focus on market failures provides a framework that might work in theory. Comparison with the Argentine experience suggests the framework would work in practice. Getting this right is important, with implications for the ultimate success of electricity restructuring.

- **Level Playing Field.** A fundamental assumption of electricity restructuring is that market incentives and decentralized decisions would serve better than regulated decisions in determining investment and allocating risk.
    - Get the prices right.
    - Allow the market to determine the balance among investment alternatives.
    - Recognize that transmission is both a complement and a substitute for other investments.
- **Slippery Slopes.** Mandated investments not supported by market signals reveal or create requirements for expanding the scope of central planning and regulatory rather than market decisions.
    - All investments change the economics of all other investments.
    - Mandated investments tend to reinforce the distortions in price signals.
    - The regulatory cure could be worse than the market disease.

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).

TRANSMISSION INVESTMENT — Argentine Approach

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.**

TRANSMISSION INVESTMENT Supporting Markets

How would the Argentine model translate into the Unites 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.

TRANSMISSION INVESTMENT Supporting Markets

How do the developing transmission investment frameworks integrate with markets?

- **Texas ERCOT and Competitive Renewable Energy Zones**
  - Competitive Construction
  - PUCT Procurement
  - Socialized Cost
- **California and Locationally Constrained Resource Interconnection Facilities**
  - CAISO Procurement
  - Beneficiary Pays Ex Post
  - Socialized Risk
- **Wyoming-Colorado Intertie**
  - Market Decision
  - Beneficiary Pays.

"As part of the Open Season process, the project sponsors had offered up to 850 megawatts of transmission capacity in a public auction. This has resulted in 585 megawatts of capacity purchase commitments from credit-worthy parties. … The project sponsors are optimistic that the remaining 265 megawatts of capacity will be sold. The project sponsors expect to complete the siting, permitting, and construction of the line and begin operation by mid-2013." (WAPA Press Release, August 26, 2008)

- **NYISO Transmission Expansion Proposal**
  - Mixed Market and NYISO Decision. Supermajority vote (80%).
  - Load Beneficiary Pays.

ELECTRICITY MARKET Electricity Restructuring Summary

With current technology, property rights are difficult to define and there is a continuing need for coordination to support markets. Regulation must adapt to the requirements of hybrid markets.

- **Little "r' regulation:** Design rules and policies that are the "best possible mix" to support competitive wholesale electricity markets.
  - **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 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

- **Big "R" regulation:** Frame every problem in its own terms—inadequate demand response, insufficient infrastructure investment, or market power—and design ad hoc regulatory fixes that accumulate to undermine market incentives. The slippery slope.

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, Barclays, Brazil Power Exchange Administrator (ASMAE), British National Grid Company, California Independent Energy Producers Association, California Independent System Operator, Calpine Corporation, Canadian Imperial Bank of Commerce, Centerpoint Energy, Central Maine Power Company, Chubu Electric Power Company, Citigroup, Comision Reguladora De Energia (CRE, Mexico), Commonwealth Edison Company, Conectiv, Constellation Power Source, Coral Power, Credit First Suisse Boston, Detroit Edison Company, Deutsche Bank, 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), Exelon, GPU PowerNet Pty Ltd., GWF Energy, Independent Energy Producers Assn, ISO New England, Luz del Sur, Maine Public Advocate, Maine Public Utilities Commission, Merrill Lynch, Midwest ISO, Mirant Corporation, JP Morgan, 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, PSEG Companies, Reliant Energy, Rhode Island Public Utilities Commission, San Diego Gas & Electric Corporation, Sempra Energy, SPP, Texas Genco, Texas Utilities Co, Tokyo Electric Power Company, Toronto Dominion Bank, 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).