

FERC's Standard Market Design NOPR

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OUTLINE

- **Economic Background**
- **Institutional Background**
- **Shifting Market Paradigms**
- **California and FERC**
- **The Standard Market Design**
 - ITPs and market operation
 - Congestion management and pricing
 - Long-term Resource adequacy
 - Market Monitoring and Intervention
 - Demand Response
- **DOE Concerns**
- **Discussion**

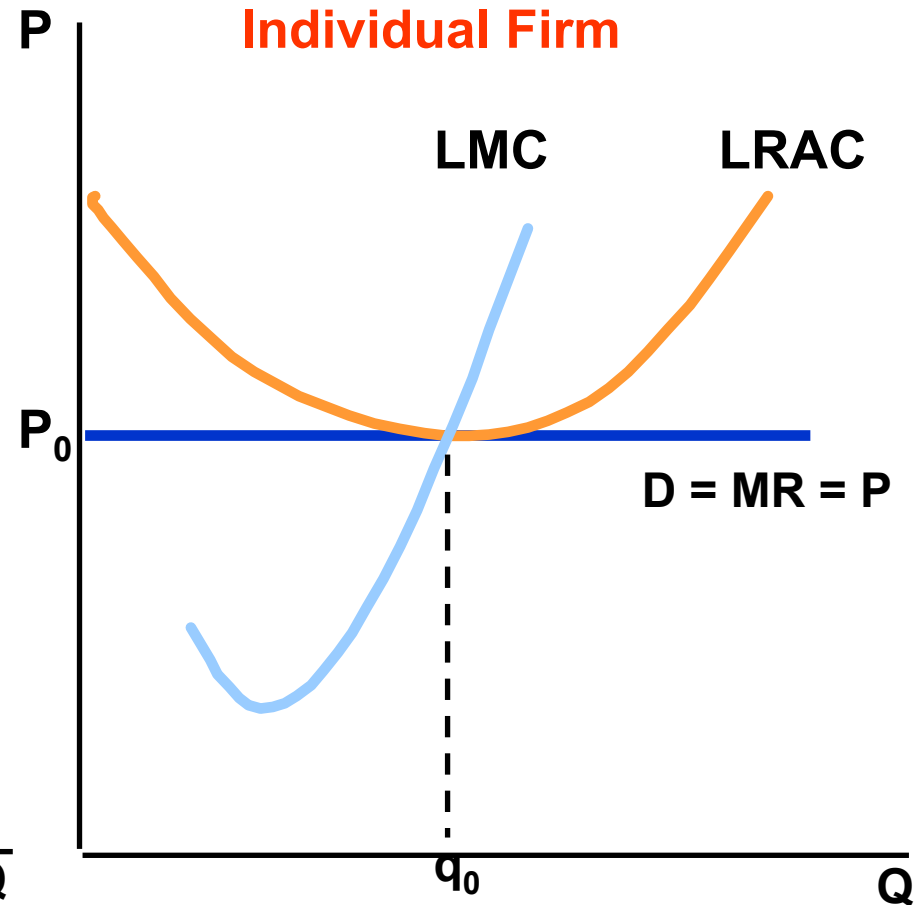
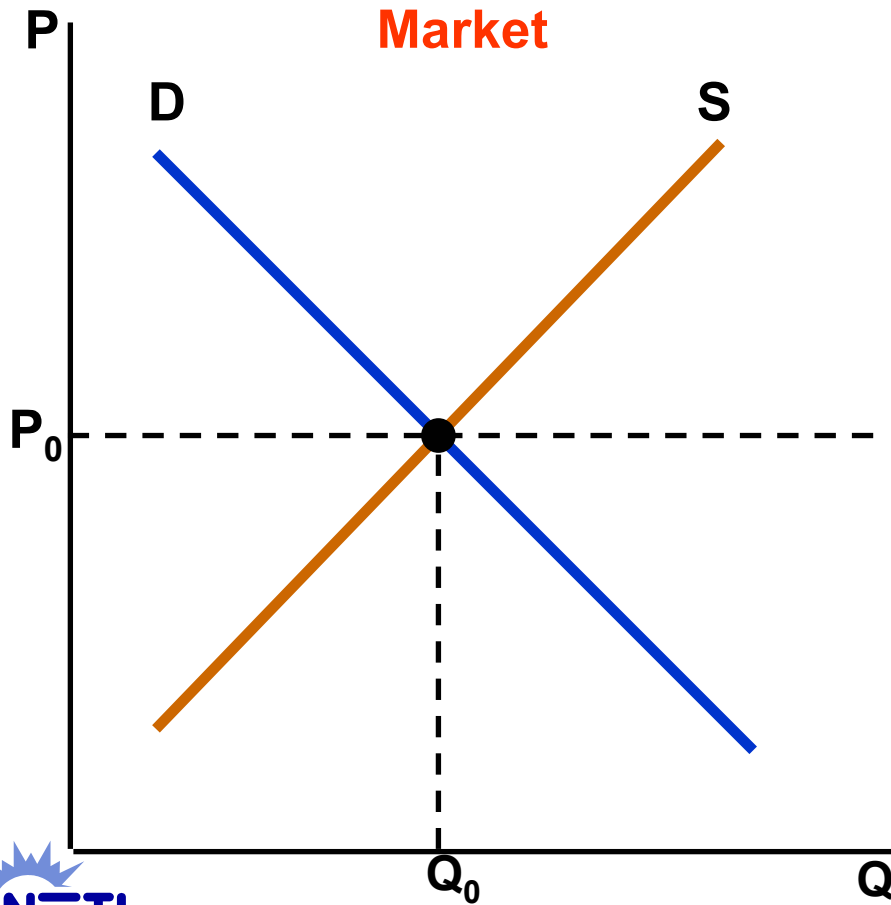


Competitive equilibrium

- **$P=MR=MC=AC$**
- **Price equals marginal revenue since firms cannot influence price (“price takers”)**
- **Firms maximize profits when MR, the revenue from the last unit sold, equals marginal cost (MC), the (opportunity) cost of the last unit produced.**
- **Marginal cost equals average cost; the firm produces as cheaply as possible; economic profits are zero**



Perfect Competition



Competitive Equilibrium, cont'd

- **$P = MC$: Allocative efficiency:** The price reflects the consumer's willingness to pay. Equality implies no other allocation of resources could obtain without making one party to the transaction worse off.
- **$P = AC$:** economic profits zero; no incentive for entry or exit
- **$MC=AC$:** Occurs at minimum of (long-run) average cost curve; firm produces as cheaply as possible at optimal scale.

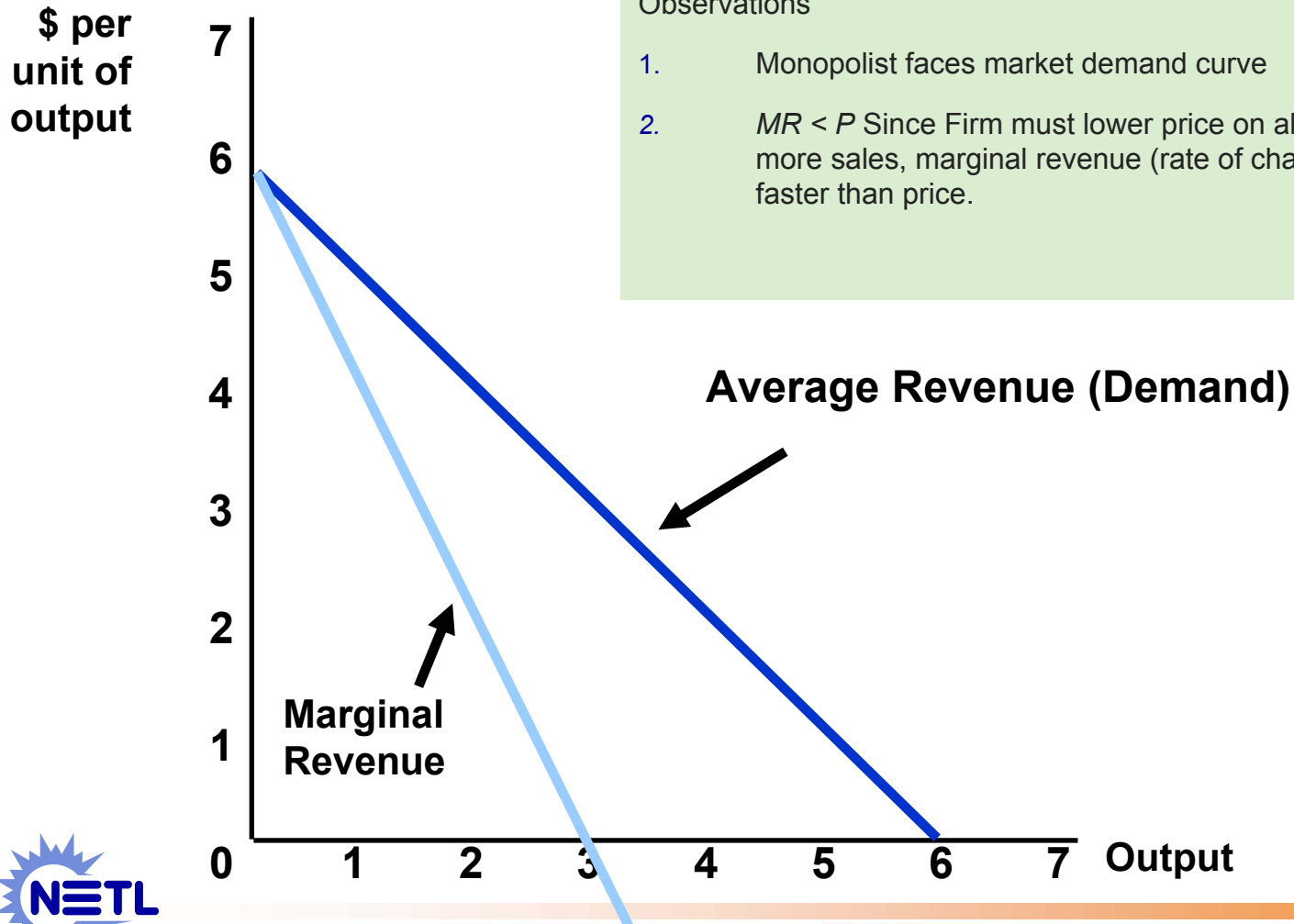


Market Power

Firm Demand Under Monopoly

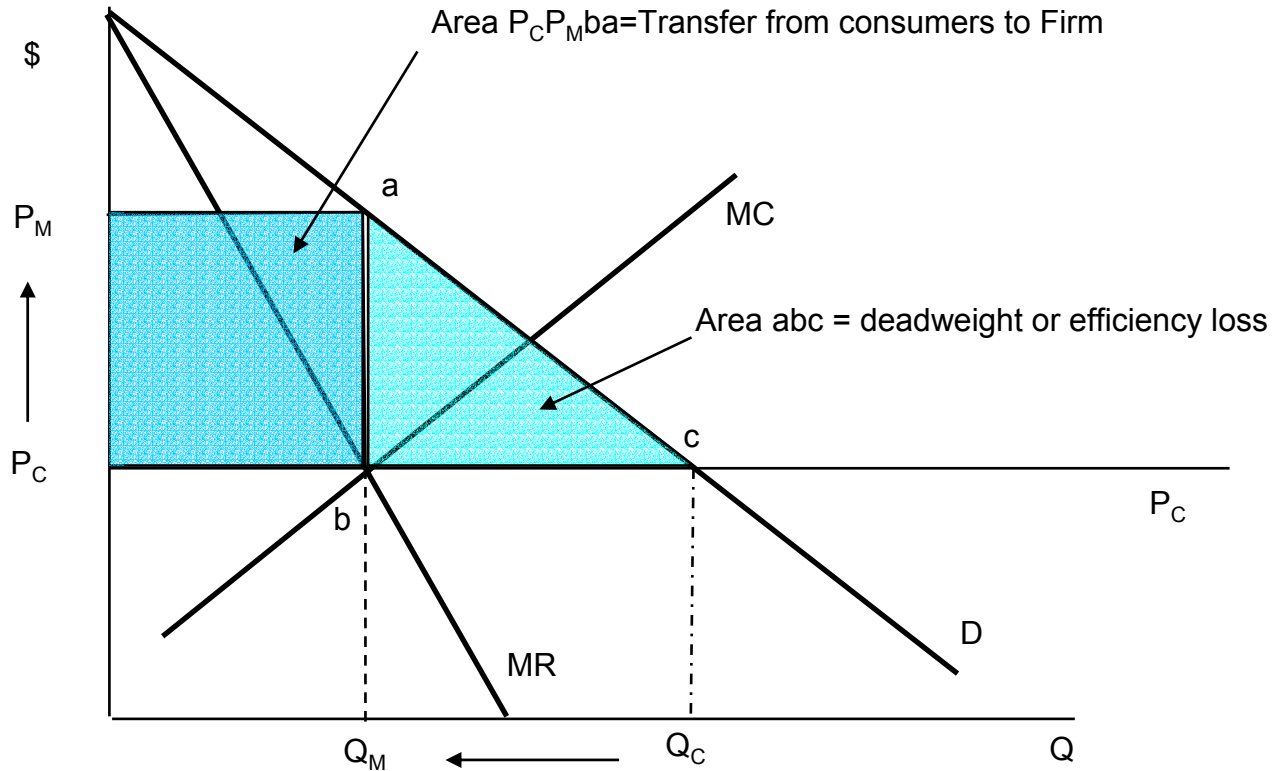
Observations

1. Monopolist faces market demand curve
2. $MR < P$ Since Firm must lower price on all goods to induce more sales, marginal revenue (rate of change in price) declines faster than price.



Competition v. Monopoly

Price Rises, Quantity Falls

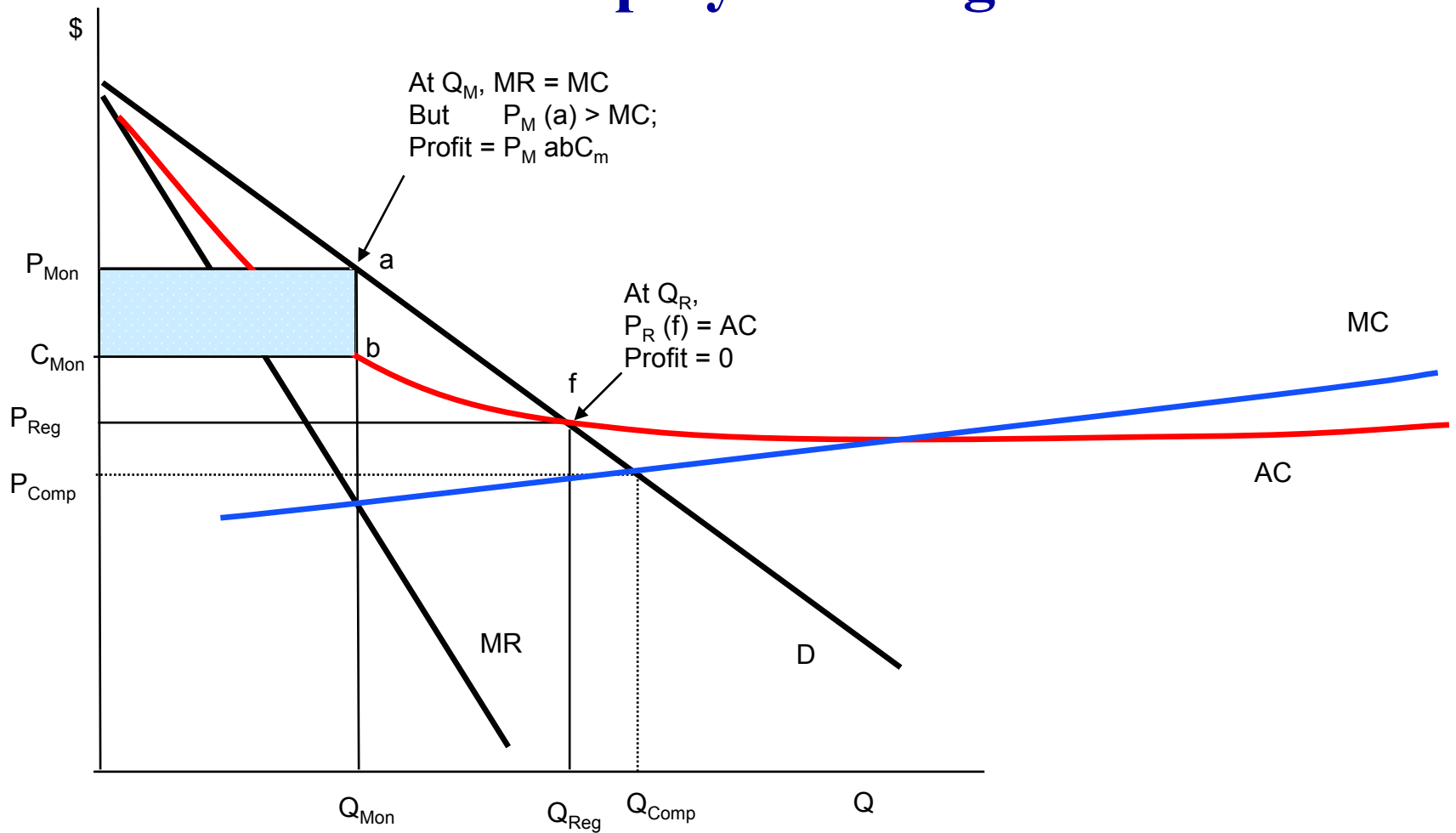


“Natural” Monopoly

- **Economies of Scale**
 - Falling average costs, could be barrier to entry (e.g. capital–intensive)
- **“Ruinous Competition”**
 - competitive prices lead to economic losses
- **“Natural” monopoly**
 - One firm faces market demand; average cost curve still in decline at intersection with market demand curve
- **Regulation**
 - ensure zero economic profits



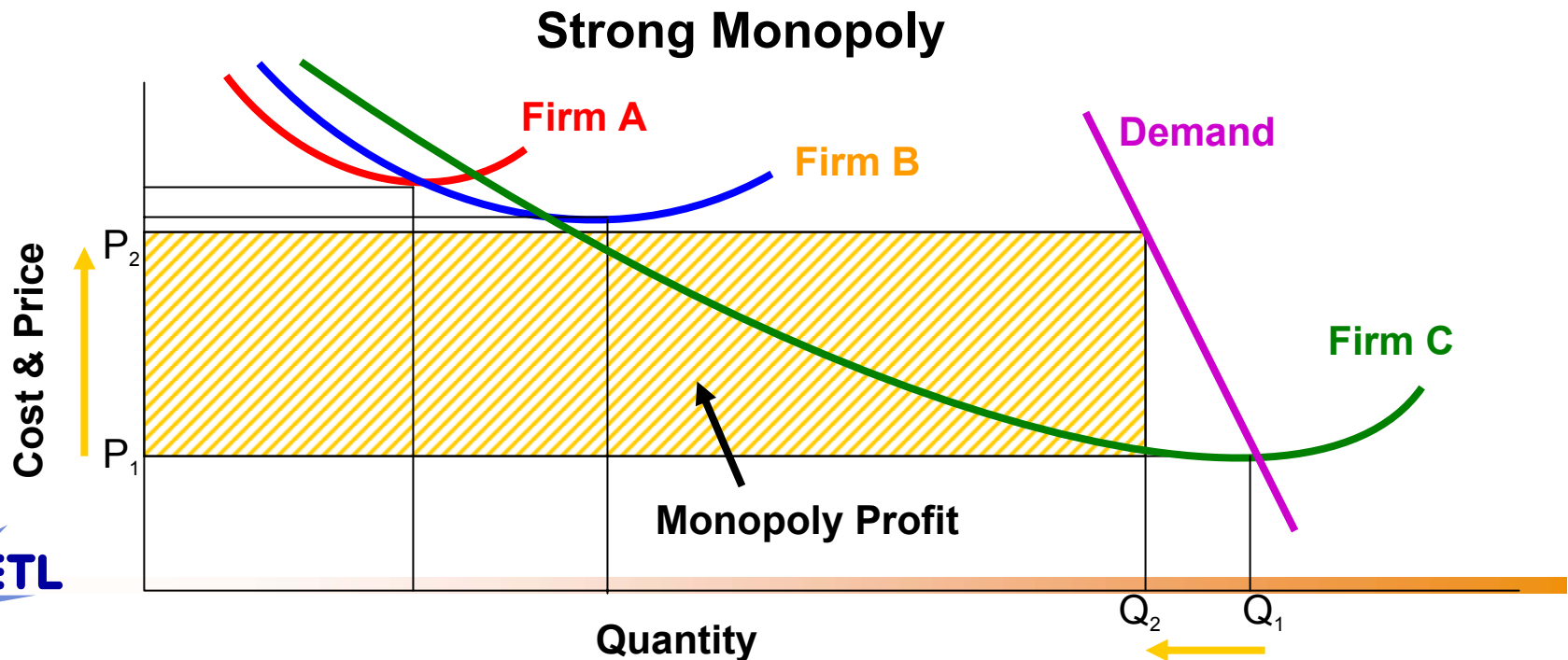
Natural Monopoly and Regulation



Strong & Weak Monopoly

- **Utilities Were Perceived to be Natural Monopolies**

- Natural Monopoly: When one firm can produce the desired level of output at a lower total cost than any combination of multiple firms (subadditivity)
 - Strong Condition: One firm can always provide the next increment of production at a lower cost than any competitor
 - Weak Condition: Dominant firm unable to prevent entry of competitors into selected segments of the business even when increases total costs
- Reflects Economies of Scale (strong) and/or Scope (weak)
- Entry Can Produce Losses to New Entrant (strong) or Existing Firm (weak)



Regulation, Theory and Controversy

- **Goal of regulation: zero economic profits**
 - Set price = normal rate of return = average cost
 - $P_{\text{reg}} > MC \rightarrow$ allocative inefficiency
 - $AC > MC \rightarrow$ productive inefficiency
- **Contestable markets (Baumol, Kahn)**
 - Scale effects not so great
 - Open access to (long recouped) infrastructure
 - Ease of entry
 - Ease of exit? (e.g. airlines, trucking) reduces risk
 - Inapplicable to Central Power Stations
 - Contestability = Effectively or Potentially competitive
 - Change Regulatory Regime

Chapters in Deregulation

- **Airlines, Railroads, Trucking (b.1978)**
- **Long-Distance Telephone (1978)**
- **Banking and Finance (1980s - ?)**
- **Natural Gas (1979-1993)**
- **Electricity (1996...?)**
 - Retail (state level)
 - Wholesale (federal, beg. 1996)



Federal Energy Regulatory Commission

- **Roles:**

- Regulation of Natural Gas Transportation
 - Over 100 pipelines subject
 - Rates, services, construction licensing
- Regulation of Electricity Industry
 - Wholesale sales
 - Interstate Electric Transmission
 - All facilities used in sale and transmission of electric energy
- Hydroelectric Licensing
- Regulation of Interstate Oil Pipelines



Important Regulatory Events

- Federal Water Power Act (1920)
 - Created Federal Power Commission (FPC) to regulate hydroelectric projects
- *Rhode Island PUC v. Attleboro* (1927)
 - Supreme Court restricts state jurisdiction over interstate transactions
 - Led to development of Holding Companies & high cost interstate affiliate transactions
- Public Utility Holding Company Act (1935)
 - Provides SEC jurisdiction over holding companies
 - Requires holding company territories be geographically contiguous
- Federal Power Act (1935)
 - Gave FPC authority to regulate transmission and wholesales of electricity



Regulatory Events, Cont'd

- Natural Gas Act (1938)
 - Extended FPC authority to Natural Gas Pipelines
 - Price volatility and supply shortages
- *Phillip's Decision* (1954)
 - Supreme Court grants FPC control over wellhead gas prices
 - Cheap prices; reserves diminish
- Natural Gas Policy Act (1978)
 - Creates FERC, gas price reform: ceilings removed
- Public Utility Regulatory Policies Act (1978)
 - Authorizes non-utility generators ('qualified facilities')
 - Cogenerators, Small Power (renewables)
 - Utilities must interconnect and buy power at 'avoided cost'



Regulatory Events, Cont'd

- FERC Order 436 (1985) & FERC Order 500 (1987)
 - Opens Non-Discriminatory Access to Gas Transmission
- Natural Gas Wellhead Decontrol Act (1989)
- FERC Order 636 – Natural Gas (1992)
 - Unbundles Supply and Transportation Services by interstate pipelines
 - Open Access to Transmission and Storage
 - Separation of Pipeline transport and sales functions
 - market-price gas sales
 - Gas Spot Market evolves
 - Flexible receipt and delivery for firm customers
- Energy Policy Act (1992)
 - FERC authorized to open electricity transmission
- California PUC Blue Book Retail Access Proposal (1994)
 - California AB1890 Retail Access Legislation



Regulatory Events, concl'd

- **FERC Orders 888/889 (1996)**
 - Requires non-discriminatory open access
 - Utilities must file tariffs and accept service
 - General tariff for ancillary services
 - Unbundling of transmission, generation, and marketing
 - Electronic (internet) same-time information system (OASIS)
 - Recovery of Stranded Costs
- **FERC Order 2000 (1999)**
 - Transmission-utilities *encouraged* to turn operational control of their high-voltage power lines over to independent entities called Regional Transmission Organizations (RTO's)
 - RTOs intended to be large, independent
 - Utilities maintain ownership of grid assets and derive revenue from grid use.
 - RTOs most developed in East.



Shifting Market Paradigms

- **Natural Monopoly/Cost of Service**
 - Bricks, Mortar, and Steel
 - Chronic Capacity Surplus
 - Unused Capacity
 - Adequate Transmission for Reliability
 - Stable, regulated prices
 - Average cost pricing for everyone
- **Competition/ Market Pricing**
 - Real Time Information and Control
 - Demand Response to Price Signals
 - Increased capacity utilization
 - Economic Transmission
 - Hourly Price Volatility
 - Transmission Constraints: Load Pockets and risk of higher prices



Shifting Market Paradigms, cont'd

- **Natural Monopoly/Cost of Service**
 - Price signals distorted; excessive use
 - Full Cost Recovery
 - Large Central Power Stations meet demand
 - 99.9% Reliable
 - Limited Innovation
 - Integrated Operation of Generation and Transmission
- **Competition/ Market Pricing**
 - Accurate Real-Time Prices Needed
 - Losses Possible
 - Merchant Plants v. Load Shifting v. Distributed Generation
 - Premium for Ultra-reliability
 - New Technologies and Business Models
 - Security constrained Spot Markets



California and FERC

- **California 2000-2001: Factors -**
 - Weather
 - Over-dependence on gas
 - Rising Input Costs
 - Lack of Demand Response
 - Retail Rate Caps
 - Infrastructure Constraints
 - Pipeline Failure; Capacity withholding?

California and FERC

- **California 2000-2001: Factors -**
 - Over-dependence on spot markets
 - Separation of Power Exchange from ISO
 - Fodder for games
 - Market Power Abuses (e.g. generation capacity withheld)
 - Delays in permitting of New Generation
 - Lack of Market Monitoring and Intervention
 - FERC refuses to act until spring 2001
 - SMD a Response to California

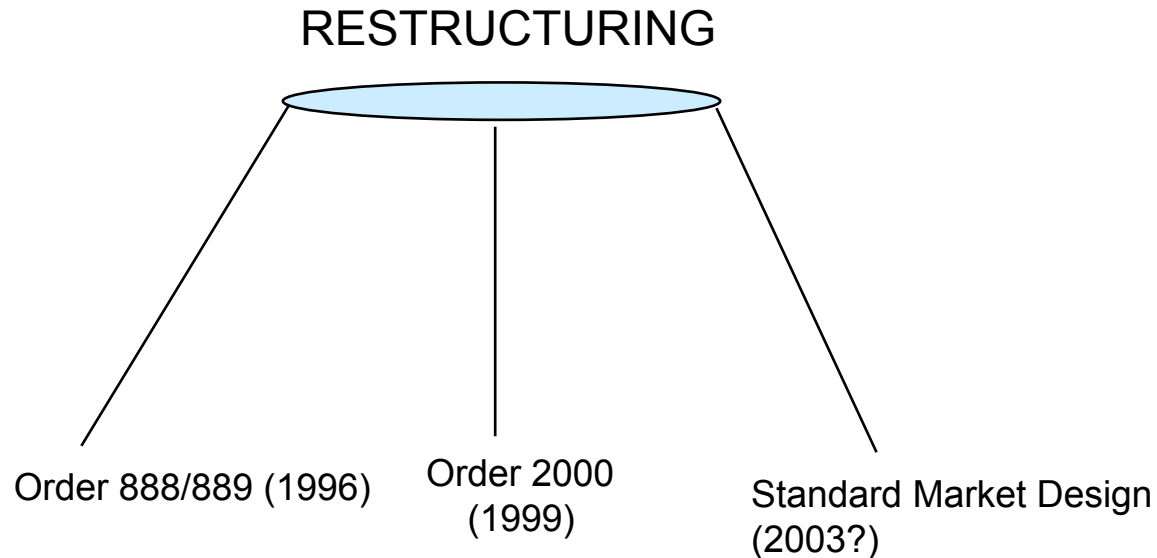


California and FERC, Cont'd

- **California 2000-2001: Verdict?**
 - Ongoing FERC Investigations
 - Concurrent DOJ, SEC investigations
- **Borenstein, Bushnell, and Wolak, *American Economic Review*, Dec. 2002)**
 - Wholesale electricity costs increase \$8.98 billion , Summer 2000 over Summer 1999
 - Production Costs, 21 %
 - Competitive “Rents” (return to producers given demand changes), 20%
 - **Market Power, 60%**



FERC'S Three Legged Stool of Restructuring



STANDARD MARKET DESIGN



Precipitating Events

- FERC Decisions on Specific RTO Proposals
 - Preference for 4 Large RTOs
 - RTO must Use “Best Practices”
- Supreme Court Decision in *NY v. FERC* and *Enron v. FERC* (March 2002)
 - Upholds Order 888
 - Finds FERC may defer decision to assert jurisdiction over bundled transmission – asserted in SMD NOPR
- FERC National Grid Interconnection Standard NOPR (May 2002)
- FERC GIGA-NOPR –SMD- (July 2002)



FERC's Market Design Goal

To Create Efficient Markets with Clear Rules:

- Eliminate discrimination in the use of transmission
- Establish Standardized, Flexible Transmission Service
 - reduce uneconomic rate disincentives to transactions
 - eliminate “pancaking”
 - reflect congestion costs
- Open & Transparent Spot Markets
- Level Playing Field in Wholesale Power Markets
- Price Signals that provide appropriate incentives for investment in Transmission, Generation, & Demand Response
 - Accelerate needed additions to the Grid
 - Regional Planning for Resource Adequacy
- Protect against the exercise of Market Power



SMD HIGHLIGHTS

- **Single, non-discriminatory open access transmission tariff**
- **Independent Transmission Providers (ITPs)**
- **Interaction of Spot Markets and Bilateral Contracts**
- **Locational Marginal Pricing and Congestion Management**
- **Market Power Mitigation and Monitoring**
- **Long-Term Resource Adequacy**



Open Access Tariff

- **Single, non-discriminatory open access transmission tariff + Network Access Service**
 - Ability to schedule power deliveries using multiple receipt and delivery points
 - Flow based, abandons contract path fiction
 - Aimed at Utilities who favored native load
- **Applicable to all users of interstate transmission grid**
 - Wholesale customers
 - Bundled and unbundled retail customers
- **Access charge recovers embedded transmission costs**
 - Shifts cost recovery from transmission transactions
 - Based on customer's load ratio share of grid operator's costs
 - Paid by all customers taking power off the grid.



Independent Transmission Provider

- **An ITP is a “public utility” that**
 - Owns, controls, or operates facilities used for transmission of electric energy in interstate commerce
 - Administers day-ahead and real-time energy and ancillary services markets under the SMD tariff
 - Is independent – zero financial interest – in any market participant in its region or any neighboring region
 - Is governed by independent board that reports to FERC
 - Strict rules on board eligibility



Independent Transmission Provider, cont'd

- **All FERC-jurisdictional, transmission owning utilities must either:**
 - Become an ITP;
 - Turn over transmission facilities to an ITP;
 - Contract with an ITP to operate transmission facilities
- **Existing regional transmission operators and/or independent system operators may be ITPs**



Contracts and Markets

- **“Central” Reliance on Bilateral Contracts**
 - Preference for Load Serving Entities to purchase “small” percentages in spot markets
- **Parallel Energy and Ancillary Service Markets**
 - Each has separate “day ahead” and “real time” spot markets
 - All load scheduled through day-ahead market, including bilateral amounts, subject to system feasibility (security-constrained dispatch)
 - “imbalances” settled in real-time market
 - Buyers and sellers submit hourly bids
 - Transparent market-clearing prices for each node



Locational Marginal Prices

- **Competitive market outcome at specific locations**
- **Def'n: (PJM):** Cost of supplying next MW of load at a specific location, considering generation marginal cost, cost of transmission congestion, (and losses).
- **Def'n: (ISO-NE):** Cost to serve the next MW of load at a specific location, using the lowest production cost of all available generation, while observing all transmission limits.

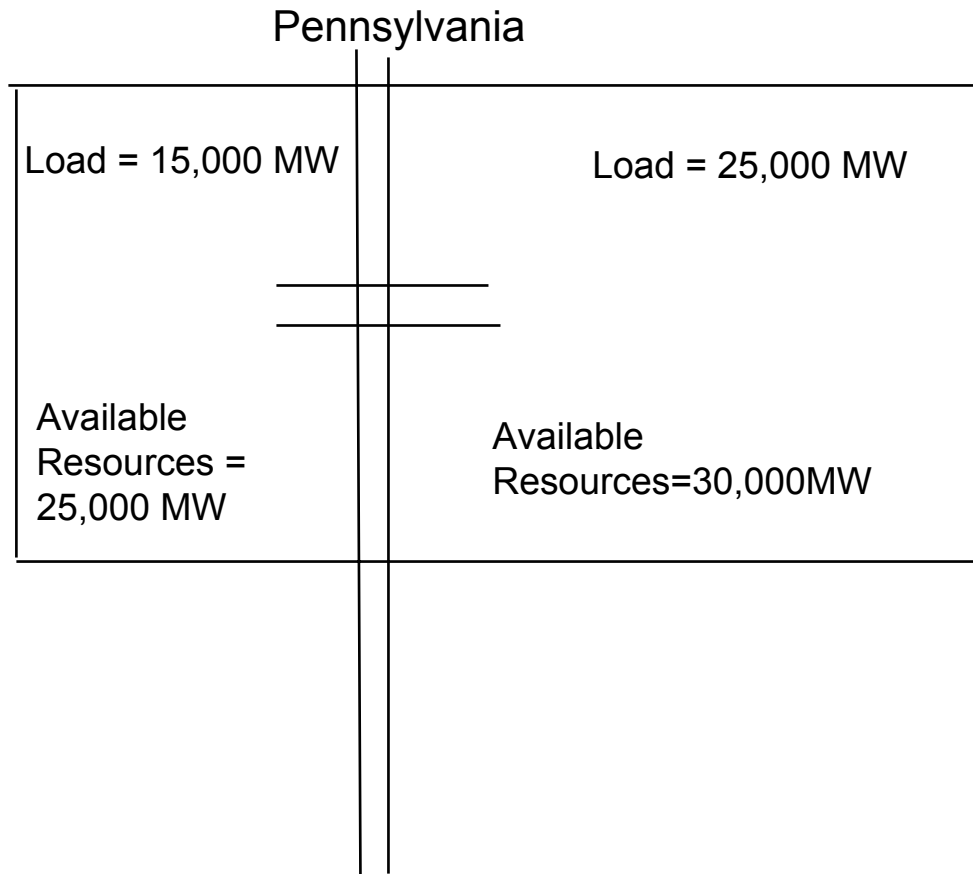
OR:

- *Shadow price of the nodal energy balance with respect to nodal load in security constrained optimal dispatch.*
- **Problem: Min:** *Total Energy Cost,*
 - Subject to: *Generation+Imports-Exports = Load*
- **Formula: Marginal Cost =** $\partial(\text{Total Cost}) / \partial(\text{Load})$



Locational Marginal Pricing

- Consider stylized example at the East/West PA interface

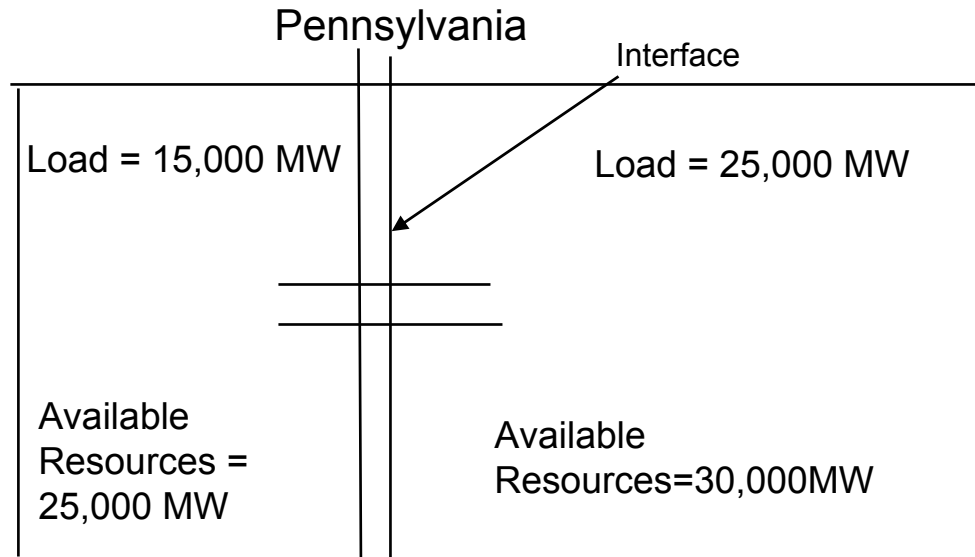


Assume Bilateral Contract for 750MW
Sold by generator at receipt point
In west for transmission to delivery Point in East

Balance to be traded on spot market::
15,000 MW in West
24,250 MW in East

Locational Marginal Pricing

- Sellers bid based on marginal cost, market clearing price set by bid of last generator selected:



Resources	Bid (/mWh)
A: 10,000	\$16
B: 5,000	\$18
C: 2,000	\$20
D: 2,000	\$22
E: 2,000	\$24
2,000	\$26
2,000	\$28

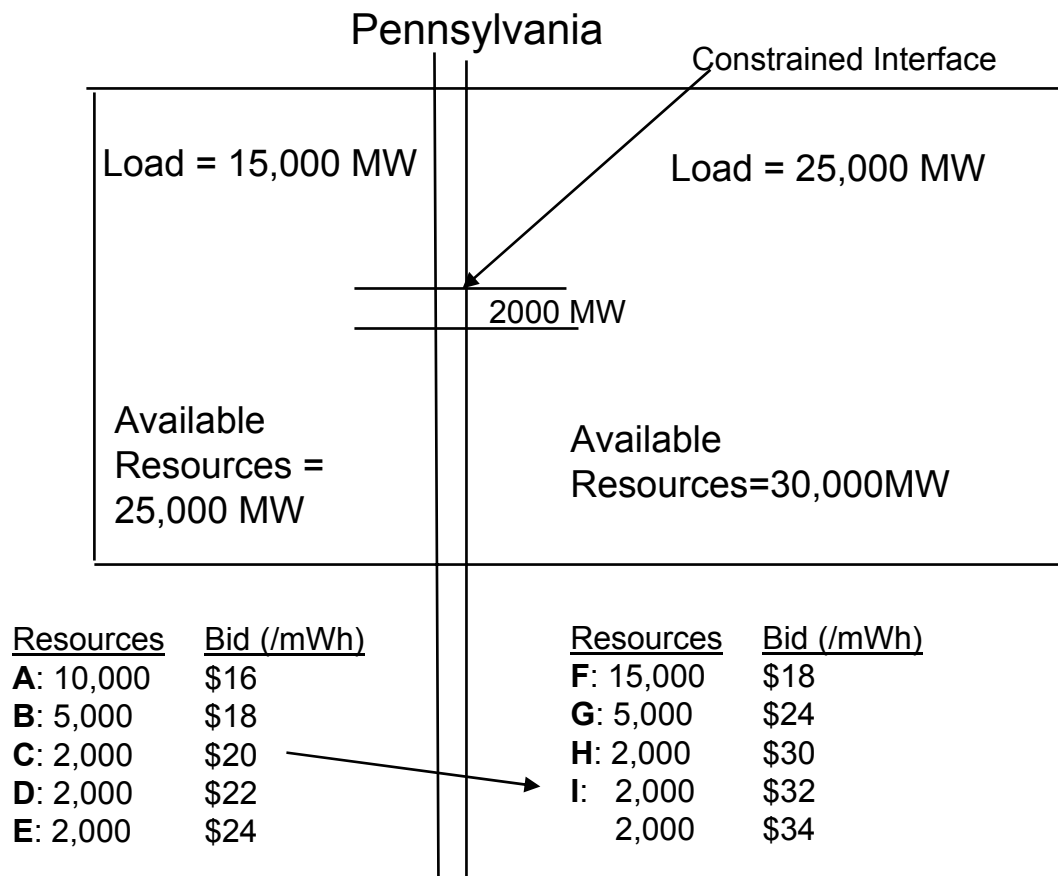
Resources	Bid (/mWh)
F: 15,000	\$18
G: 5,000	\$24
H: 2,000	\$30
I: 2,000	\$32
2,000	\$34
2,000	\$26
2,000	\$28

ITP dispatches A,B to satisfy West load; E,G, to satisfy some of East load;
ITP dispatches C,D, and 250MW from E to satisfy remainder of East Load.
E sets market clearing price = \$24.
All generators paid \$24/mWh.
Total of 5000MW sent to West from East.



LMP, Security Constrained Dispatch, and Congestion Revenue Rights

- A 2000 MW transmission constraint creates congestion and different LMPs:



ITP dispatches A, B to satisfy West load; $LMP_W = \$20$;
 F, G, satisfies some of East load;
 ITP can only dispatch 1250MW of power from C across interface + 750MW from bilateral contract;
 H and 1000MW from I at \$32/mWh must be dispatched to satisfy remainder of East Load.
 I sets $LMP_E = \$32$
 Load_W charged \$20
 Gen_W paid \$20
 Load_E charged \$32
 Gen_E paid \$32
Congestion Cost:
 $LMP_E - LMP_W =$
 $\$32 - \$20 = \$12/mWh$
 If Load_E owns a CRR, it can off-Set congestion charge component of LMP.



Congestion Revenue Rights

- Congestion cost:
 - Under security – constrained dispatch, the value of transmission, or the cost of out-of-order merit dispatch
- Congestion Revenue Right (alt. Financial Transmission Right (FTR)):
 - A property right or financial contract that entitles the holder to a stream of revenues (charges) based on the hourly energy price differences across the path
- Congestion Charge:
 - $MWh * (\text{Day-Ahead } LMP_{\text{sink}} - LMP_{\text{source}})$



Congestion Revenue Rights

- Congestion Revenue Right:
 - Tradable, may be used up to value of congestion charges
 - Offsets Congestion charges
 - If holder owns right in direction of power flow
 - Initial Allocation to existing Load Serving Entities
 - Post-initial Allocation, auction receipt point to delivery point (source to sink) obligations, then options.
 - Various Terms (hourly, daily, monthly) offered through ITP auctions, but details not resolved.
- SMD requires ITPs to allocate/auction CRRs
 - Customers' hedge against congestion costs.
 - Preference for regional auction of CRRs
 - 4-yr transition period option
 - Regional allocation to LSEs, or auction with revenues distributed to existing customers
- Day-Ahead bidding and tradable CRRs
 - to add liquidity to market
 - cause forward and real time prices to converge.



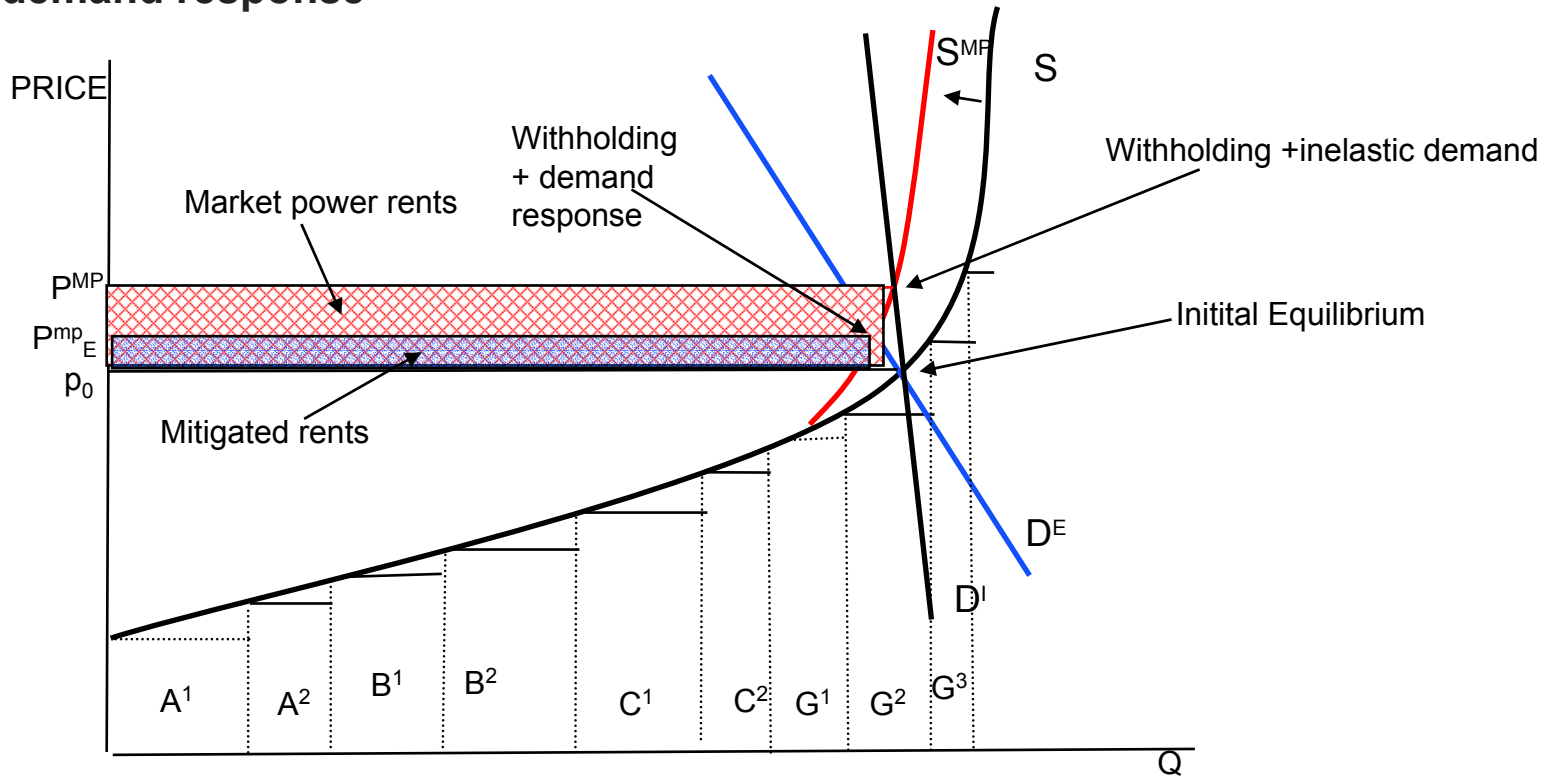
Bidding, Congestion and Demand Response

- **Under SMD, the transmission customers (parties scheduling power flow) may:**
 - Specify the maximum transmission usage charge it is willing to pay, or
 - Specify the maximum congestion charge it will pay, or
 - Commit to pay congestion rent.
- **In day-ahead market, selected bids are financially binding on buyers and sellers.**
 - Real-time deviations incur charges valued at real-time prices.



Responsive Demand and Market Power

Effect of simple gaming and demand response



If Generator G withholds capacity (G^2), then market supply S shifts in to S^{MP} , and the market-clearing price rises from P_0 to P^{MP} . If, due to demand response, market demand has shape of D^E rather than D^I , then price only rises to P^{MP}_E . Demand response mitigates market power.

Demand Response

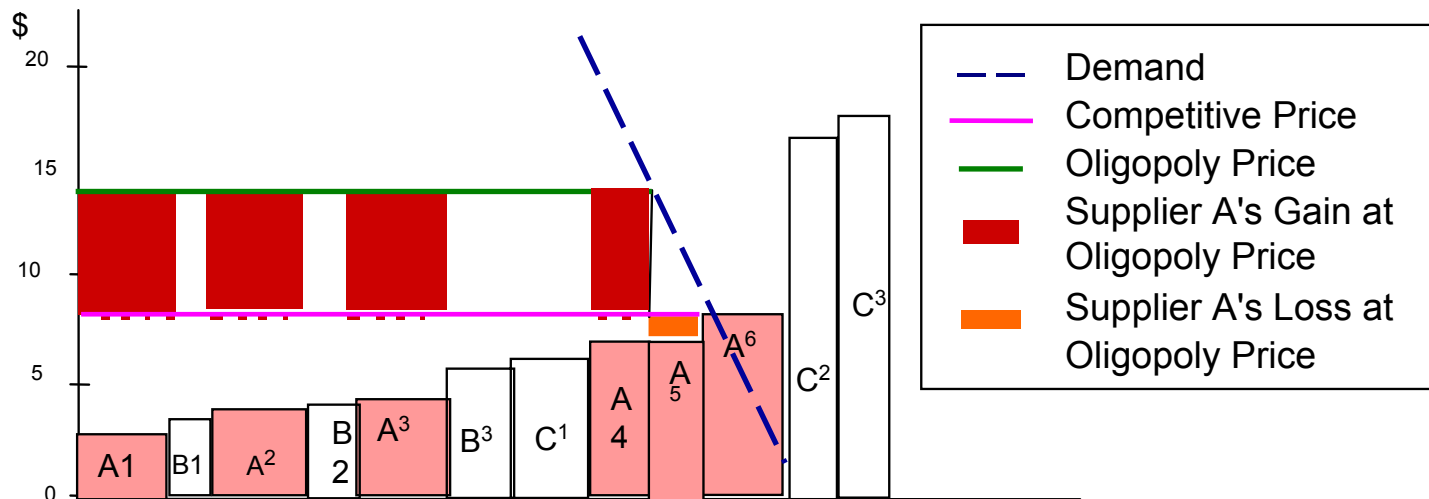
- **Demand Response Bidding**
 - Biddable decrements, interruptible service
 - Supports variable pricing programs
 - Increases the elasticity of consumer demand
 - “Encouraged” by FERC
 - Controversy
 - Does it exist beyond large industrials?
 - Dramatic California consumer response to variable pricing
 - Impose pressure for retail competition?
 - Would Load Serving Entities really turn off the lights?
 - Security through bilateral contracts vs. lure of spot markets
 - Cart before horse?



Oligopolies & Market Power

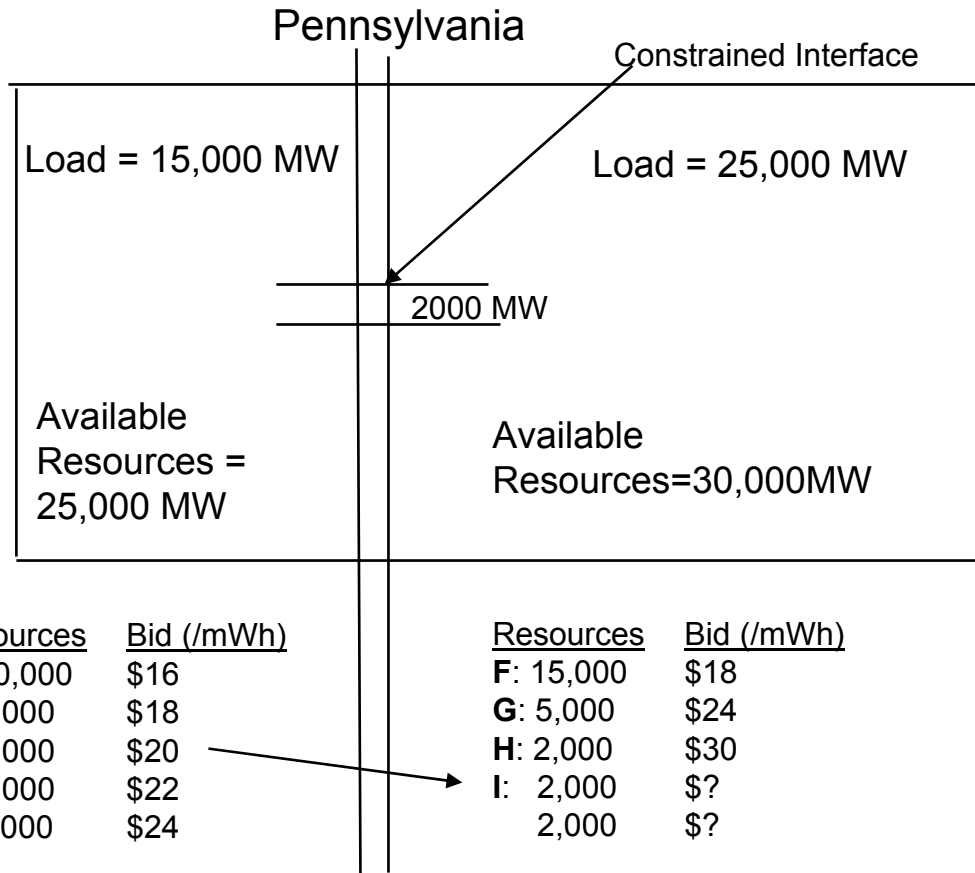
- Concentrated Ownership within a particular market creates opportunities to profitably Withhold Supply and/or Bid Up Prices
- Does Not Require Collusion among Market Participants
- In Markets with Volatile Prices, Market Power Can be Difficult to Distinguish
 - Is the extension of a maintenance outage withholding capacity or proper completion of required maintenance?

Oligopoly and Gaming



Load Pockets and Local Market Power

Assume generator I owns high cost power in EAST
 Behind constraint:



ITP dispatches A, B to satisfy West load; $LMP_W = \$20$;
 F, G, satisfies some of East load;
 ITP can only dispatch 1250MW of power from C across interface + 750MW from bilateral contract; H and 1000MW from I at must be dispatched to satisfy remainder of East Load.

If I sets $LMP_E = \$100$, rather than $\$32/MWh$, then $\$68/MWh$ in economic rent flows to I and all Eastern generators



Mitigating Local Market Power

- **Four-Prong approach**

- 1) “must-offer” obligations

- Determined by market monitor
- For reliability or generators in load pockets
- Accompanied by bid-caps
 - Question: ‘loose’ or ‘tight’?
 - Market-Clearing price may still vary

- 2) “safety-net” bid cap (distinct from bid caps above)

- \$1000/mWh
- Outer bound on withholding
 - Still permits significant scarcity pricing
- Most likely applicable in the most inelastic (non-price responsive) demand zones



Mitigating Local Market Power

- **Four-Prong approach, Cont'd**
 - 3) Resource adequacy requirement
 - Long-term response
 - Expand resource alternatives
 - Diminish withholding capability
 - 4) Direct intervention (optional)
 - Automatic mitigation Procedures (AMP)
 - Addresses perceived withholding
 - Caps bids from specific suppliers
 - Addresses exogenous events (droughts)
 - Must be ordered by Market Monitor



Market Monitoring

- **FERC's Office of Market Oversight and Investigation (OMOI)**
 - *"charged with being 'the Cop on the Beat' overseeing and assessing the operations of wholesale electricity and natural gas markets and enforcing Commission rules and regulations." ". . . OMOI analyzes market data, measures market performance, recommends market improvements and prepares reports detailing the status of the electricity and natural gas markets."*
 - Director Reports to Commission
 - Provides Guidance to Market Monitoring Units



Market Monitoring, cont'd

- **Office of Market Oversight and Investigation**
 - Two Divisions
 - Market Oversight and Assessment
 - Integrated Market Assessment and Information Development
 - Engineers, Economists, Information Analysts, Statisticians, Operations Research
 - Investigations and Enforcement
 - Attorneys, Auditors, Engineers, Quantitative Economists and Financial Experts



Market Monitoring, cont'd

- **Market Monitoring Units (MMUs)**
 - Report to both FERC and the governing board of the ITP
 - Autonomous of ITP management and market participants
 - May be housed within ITP offices
 - Share analysis with ITP mngm't and Regional Advisory Panels
 - Prepare comprehensive regional structural analysis prior to SMD implementation, and then annually
 - Market concentration
 - opportunities for new supply
 - Demand response conditions
 - Transmission constraints and load pockets



Responsibilities of Market Monitoring Units

Market Monitoring Units (MMUs)

- **Efficiency of regional market**
 - Detect market design flaws and inefficient market rules
 - Identify barriers to entry to new generation (incl. distributed generation)
 - Verify demand-side resources and barriers to them
 - Identify Transmission Constraints
- **Detection of Market Power**
 - Economic and Physical Withholding
 - E.g. Too-high bids; convenient down-time
 - Enforcement Power : Penalties \geq Economic rent
- **Monitoring ITPs?**



Long-Term Resource Adequacy

- **To promote Development of Infrastructure that ensures reliable transmission**
 - Cf. May 2002 DOE Study
- **Spot Markets not sufficient**
 - Especially if prices capped, or resources “must-run”
 - Insufficient demand side response
 - Bureaucratic barriers to new entry
 - Free-Riding on Reserves (during crises)



The Resource Adequacy Requirement

- The Independent Transmission Provider must:
 - Forecast future regional demand
 - Work with Regional State advisory Committee determine adequate future Resources
 - Including generation, transmission, and demand response infrastructure
- Assign each LSE a share of needed future resources
 - Based on ratio of LSE's load to regional load
 - LSEs must submit plans to ITP
 - Generation, demand response, capacity contracts
 - Penalties for LSEs who do not provide share
 - Includes curtailment of violators in times of shortage
 - Minimum 12% reserve margin



Regional State Advisory Committees

- **RSACs:**
- **Have direct contact with ITP governing Board**
 - Up to states how to form
- **Mechanism for state input**
 - State PUCs
 - Environmental groups
 - Canadian provinces
 - Other public interests



Regional State Advisory Committees

- **RSAC Areas of concern are issue of shared jurisdiction:**
 - Resource adequacy standards (e.g. higher reserve margins)
 - Transmission planning and expansion
 - Rate design, revenue requirements
 - Market power/monitoring
 - Demand Response/Load Management
 - Distributed Generation and Interconnection Policies
 - Energy Efficiency and Environmental Issues
 - RTO Management and Budget Review
- **Avenue for DOE input?**



Implementation

- **July 2003:**
 - Interim SMD tariff
 - ITP Implementation plan
- **December 2003**
 - ITPs must file SMD Tariff
 - Must include ITP plans for
 - Market monitoring/Market Power Mitigation
 - Long-term Resource Adequacy
 - Transmission Planning, expansion, and pricing
 - Regional exceptions
- **September 2004**
 - Final SMD tariff



Recent Developments, I

- *Atlantic City Electric Co. v. FERC (2002)*
 - DC Circuit limits FERC ability to
 - Insist on divestiture with only generic industry findings
- FERC Proposed Pricing Policy for Efficient Operation and Expansion of the Transmission Grid (January 2003)
 - Return on Equity Incentive to join RTOs
 - Incentive to Divest Transmission Assets
 - Incentive for Investment in New Transmission Facilities
- SMD in Congress
 - Regional Opposition



Recent Developments, II

Capacity Bubble

- > 130GW of capacity added since 1999
 - 80GW under construction
- Reserve margins of 34% by summer 2003?
- Capacity surplus may take years to work off
- Longer than anticipated economic slowdown
 - Eases pressure on SMD implementation
 - Mitigates gas price pressure



DOE Concerns

- **Economic and Energy Efficiency**
 - Elimination of pancaking
 - Will market monitoring and market power mitigation reduce “non-market” price volatility and increase investment, or not?
- **Infrastructure Reliability**
- **Penetration of New Technologies/ Economic Security**
 - Central power station concepts
 - Distributed generation (cf. EPA letter)
 - What is proper forum for communication of concerns?
- **System Security**
 - SMD will require annual NERC-style certification for all utilities and customers



Summary

- **Goals: Clear transmission pricing and planning policies for grid expansion and capital infusion**
- **FERC-jurisdictional utilities must transfer operational control over their transmission to ITP's**
- **Implementation of Locational Marginal Pricing and Congestion Revenue Rights**
- **Load Serving Entities (LSE's) to bear Embedded Cost Charge based upon pro rata share of the total load in a region**
- **Establishment of single regional transmission tariffs to eliminate rate pancaking (accumulation of fees across control areas)**



Summary, cont'd

- **ITP's w/ RSAC's to develop specific resource planning requirements for each region (initial minimum reserve margin requirement of 12%)**
- **Customer protection through market power mitigation measures and oversight**
 - MMU's to establish Bid Caps and Must Offer requirements for generators with Local Market Power
 - Safety-Net Caps (\$1000/MWh) and Automated Mitigation Procedures (AMP) during shortages or other extreme events



Acknowledgements

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