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ELECTRICITY MARKETS DEVELOPMENT PROGRAM-GEMTP II

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Market Structure Design & Role of the Regulator in Competitive Electricity Markets

Day 1

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Frank Felder's Background

Frank Felder is an expert on the economics and reliability of restructured electric power systems. Frank is Associate Research Professor at the Edward J. Bloustein School of Planning and Public Policy, Rutgers University. He is also the Director of the Center for Energy, Economics & Environmental Policy, where he conducts research in electricity and energy policy.

He also consults to a wide range of clients in industry, advising them on market design, market power, electricity price forecasting, and risk management. He has testified before the Federal Energy Regulatory Commission and several state public utility commissions. He holds a Ph.D. from the Engineering Systems Division in Technology, Management and Policy from M.I.T.

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Overview of Presentation

- Our Objectives and a Clarification
- Brief Background on Sri Lanka
- Market Structure & Design
- Role of the Regulator in Competitive Electricity Markets

Our Objectives and Some Caveats

- Our Objectives
  - Provide information and experiences regarding different electricity market models
  - Provide a forum for dialogue and discussion on issues of importance to participants
- A Clarification
  - We are not suggesting, when referring to experiences elsewhere, that we are recommending that particular approach

Introduction

General

Area: 38,000 Sq. Km.

Population: 21 Million.

Capital: Colombo

Currency: Rupees

(1US$=107.6 LKR)

GDP per capita: $1,200 (2005)

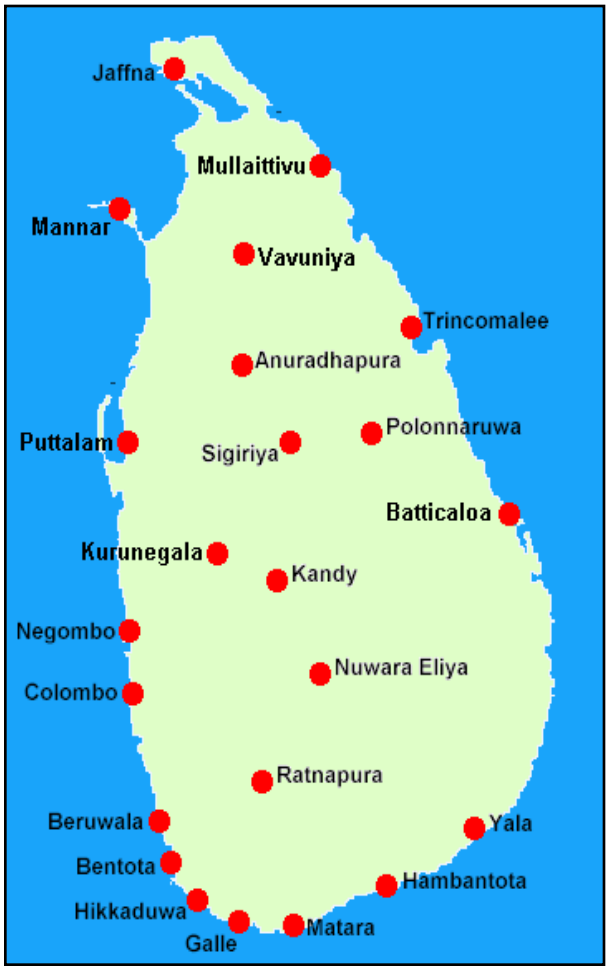
Electric Power Sector

kWh/person/year: 369 (2005)

Cost/kWh: 7.71 LKR (2005)

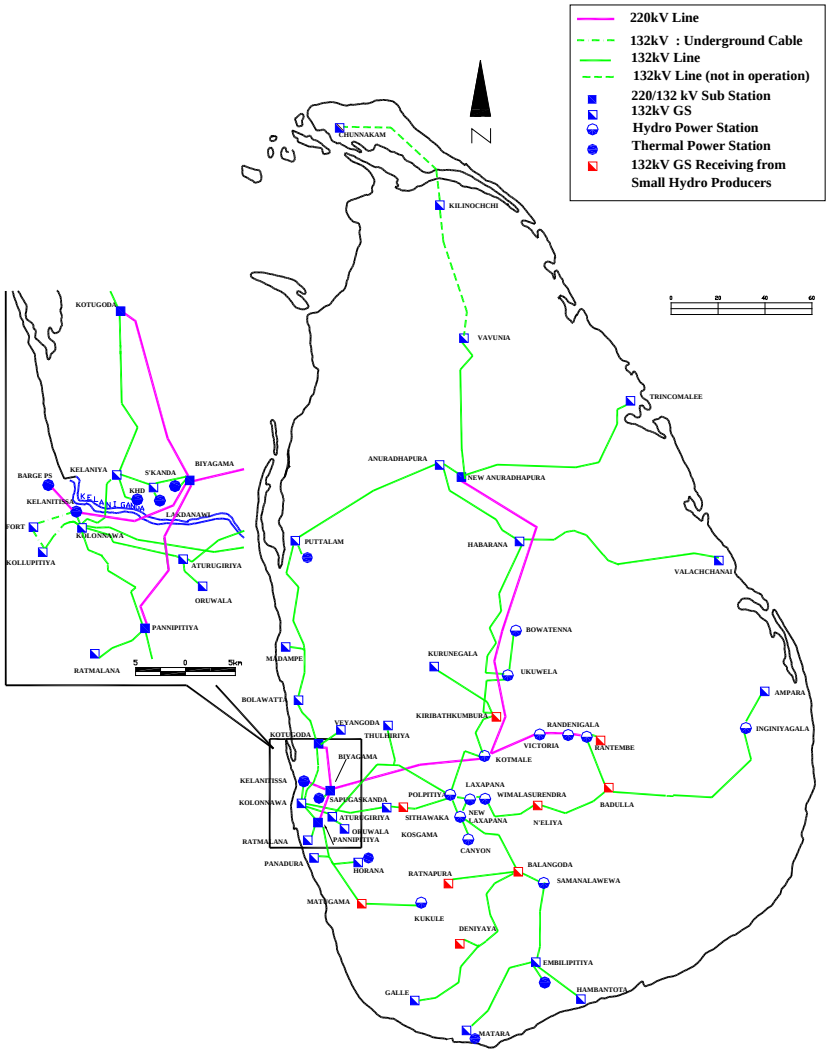
Electrification Ratio: 76.7% (2005)

Electricity demand expected to grow at 7-8% per year



Transmission and Distribution

- Sri Lankan transmission network consist of a single grid.
- Transmission is done at 220kV and 132kV.
- Medium voltage distribution is done at 33kV and 11kV.
- 80% of households electrified.
- Network loss is 15.5%.



Electricity Sector

- **Governing Structure**
  - Ministry of Power and Energy is the governing body of the sector
- **Market Players**
  - Ceylon Electricity Boar (CEB) is the owner and the operator of the national grid and the majority of power generation facilities including all major hydro power plants.
  - A specialized electricity distribution company is involved in distributing electricity to about 20% of the total electricity consumers of the country.
  - 8 independent power producers operate thermal power plants and sells the generation to CEB in accordance to long term Power Purchase Agreements.
  - More than 50 small scale power producers are in operation under a separate scheme specifically established to develop the renewable based power generation in the country.
- **Resources**
  - Sri Lanka extensively utilize hydro power for electricity generation and almost all large scale hydro sites are already being used.
  - Good potential of Renewable Energy Resources

Present Status of Electricity Sector

Electricity is generated using hydropower, petroleum fuels & renewable energy sources

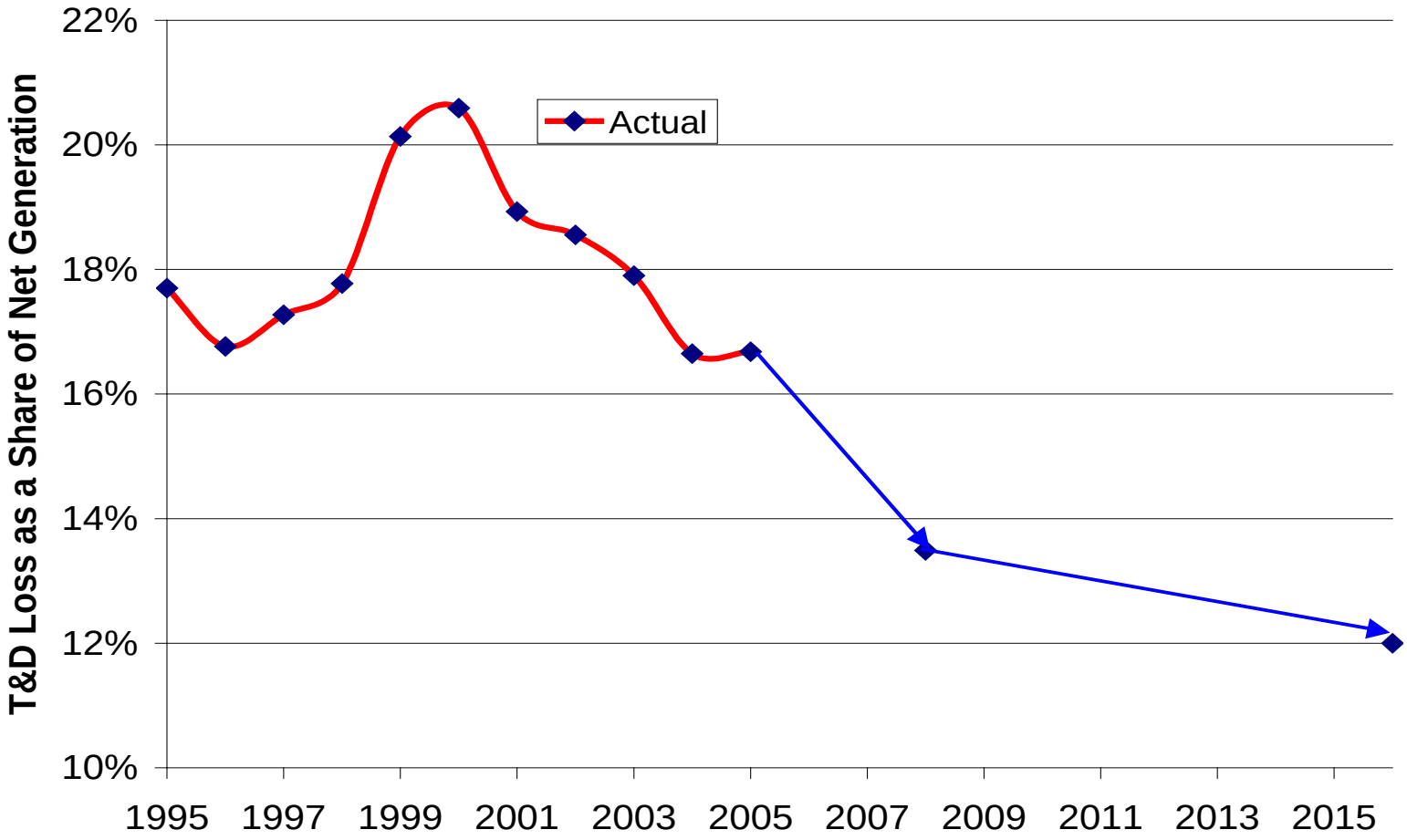
- **Generation**
- Ceylon Electricity Board (CEB)
  - Hydro 1,207MW (3,692GWh)
  - Thermal 548MW (2,523GWh)
  - Wind 3MW (2.5GWh)
- Eight Independent Power
- Producers (IPPs)
  - Thermal 566MW (2,532GWh)
- Over fifty privately-owned
- Renewable energy- based Small Power Producers (SPPs)100MW (300GWh)

- **Transmission and Distribution**
- CEB operates HV transmission system and a major part of the distribution network
  - 220kV- 331km
  - 132kV -1,875km
  - 33kV -1,9661km
  - 11kV- 1,655km
  - Grid Substations - 43
- LECO distribute electricity to about 20% of the consumers

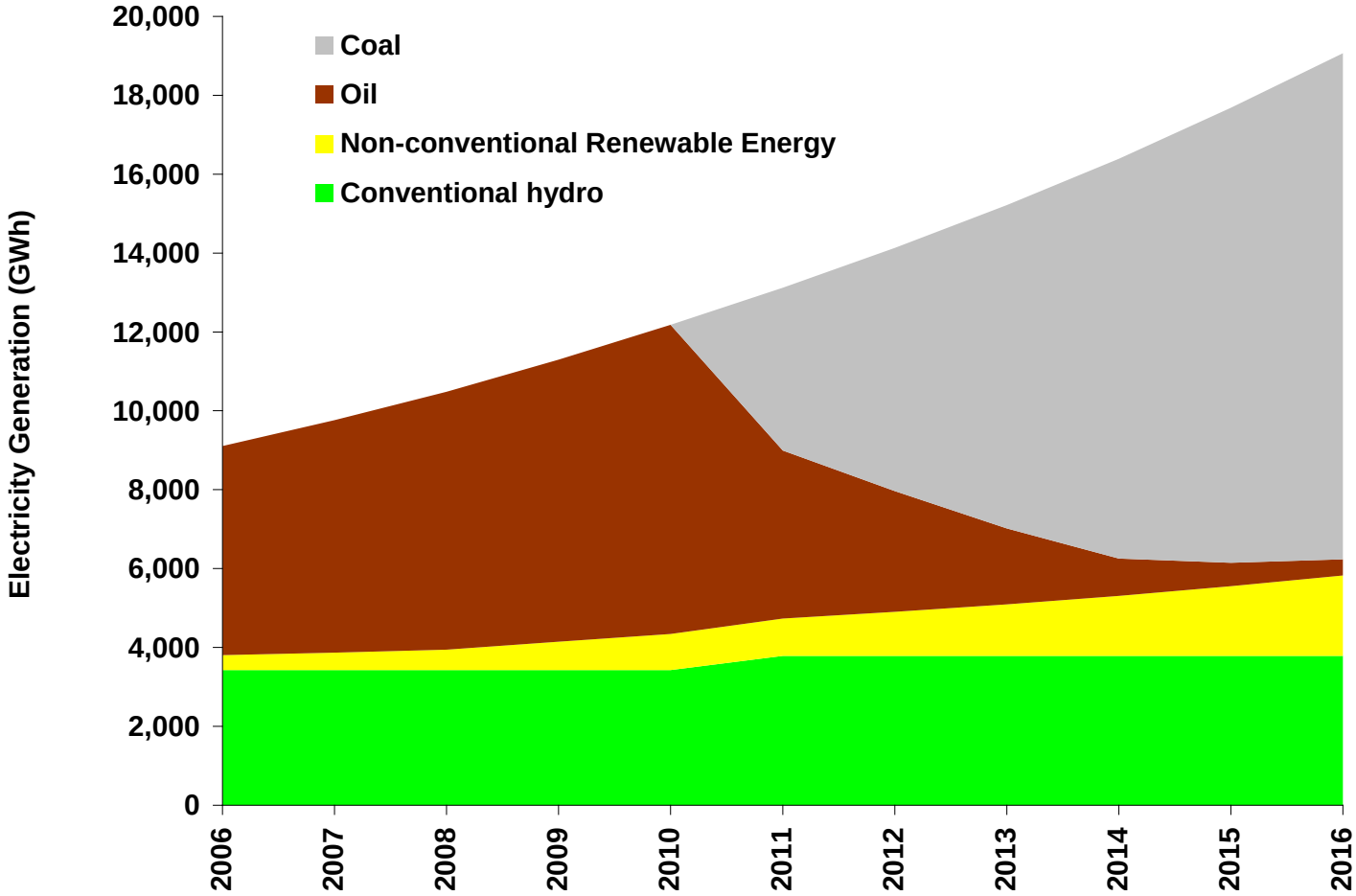
Key Issues In Electricity Sector

- Access to electricity
- Electricity tariff rationalization, debt restructuring and targeted subsidies.
- Fuel diversity and energy security in power generation (conventional and renewable)
- Transmission and distribution network development
- Supply-side energy efficiency
- Demand-side energy efficiency
- Energy sector knowledge management, planning and funding

Transmission & Distribution Loss Reduction Targets



Targeted Fuel Diversification in Electricity Generation



Electric Utility Industry Production & Distribution

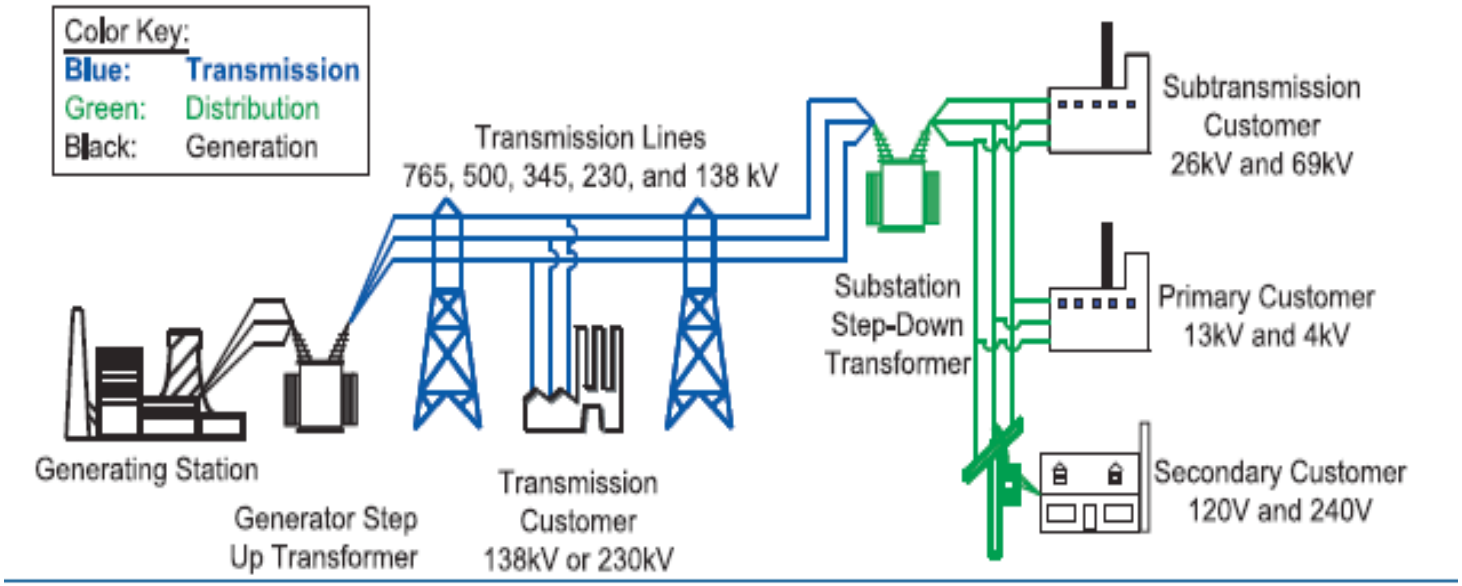


Figure from the U.S.-Candian Power System Outage Task Force final report On the 2003 Blackout, p. 5.

Electric System Timeline

Transmission Construction:
3-10 years

Generation Construction:
2-10 years

Planned Generation and Transmission Maintenance:
1-3 years

Unit commitment:
12 hours ahead for the next 24 hour day

Economic Dispatch:
Every 5 minutes but planned for 6 hours ahead

Note: diagram not drawn to scale

General vs. County Unique Aspects of the Power Sector

- General
- Capital competes in international markets
- Fossil fuel prices are set in international markets
- Laws of physics
- "Laws" of economics
- Technology and many associated costs

- Country Specific Aspects
- Availability of input fuels
- History & legacy
- Political & social context
- Economic development
- Expertise
- Gov't politics, structure, and policies
  - Energy, electricity, environmental, natural resource development

Objectives for Electric Power Systems

- Economic efficiency
  - Technical (production) efficiency
  - Allocative efficiency
  - Efficient product and service variety
  - Dynamic efficiency
  - Economic development
- Reliability
- Environmental objectives
- Broader social objectives such as equity

Privatization Description

- In many countries, the electric power system or parts thereof is owned by the government
- Prior to or in conjunction with establishing electricity markets, at a minimum, the generation assets need to be sold to private entities
  - This is called privatization
- In contrast, corporatization is making state owned enterprises look, act and behave as if they were for-profit private entities

Motivation for Privatization & Examples

- Motivation:
  - Need multiple generation companies to have sufficient competition for electricity markets
  - The premise that private companies are more efficient and less subject to political intervention
  - Raise money for the government
- Examples
  - England and Wales
  - Ontario
  - Victoria, Australia
  - Italy

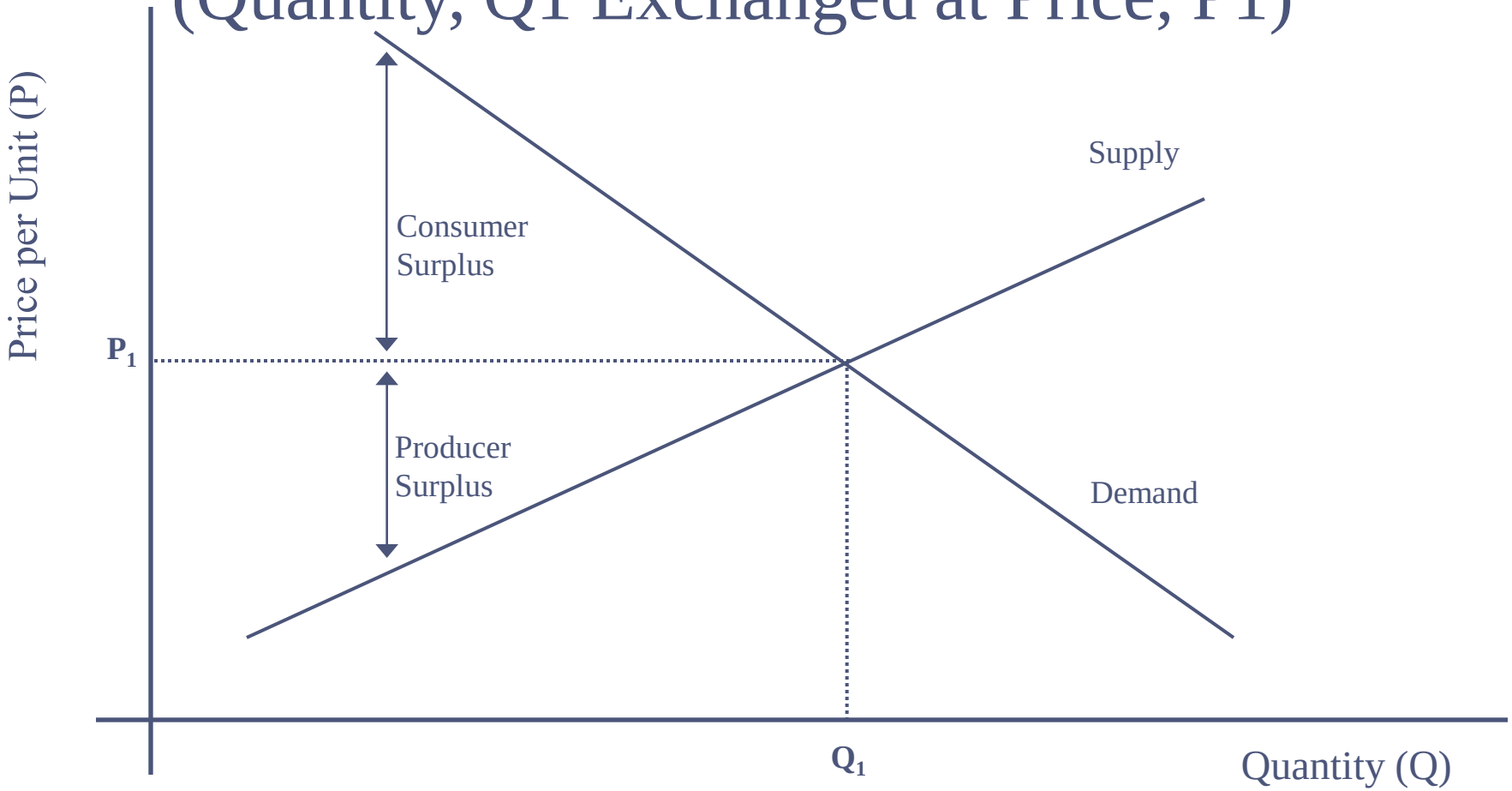
Preconditions for Electricity Markets

- Sufficient number of generation units at key locations on the transmission system
- Broad political and regulatory support
  - Understanding of electricity fundamentals as they pertain to electricity markets
  - Understanding of the benefits and limitations of markets
- => Tradeoff is between imperfect regulation and imperfect markets

Key Issues and Constraints that Electricity Markets Need to Address

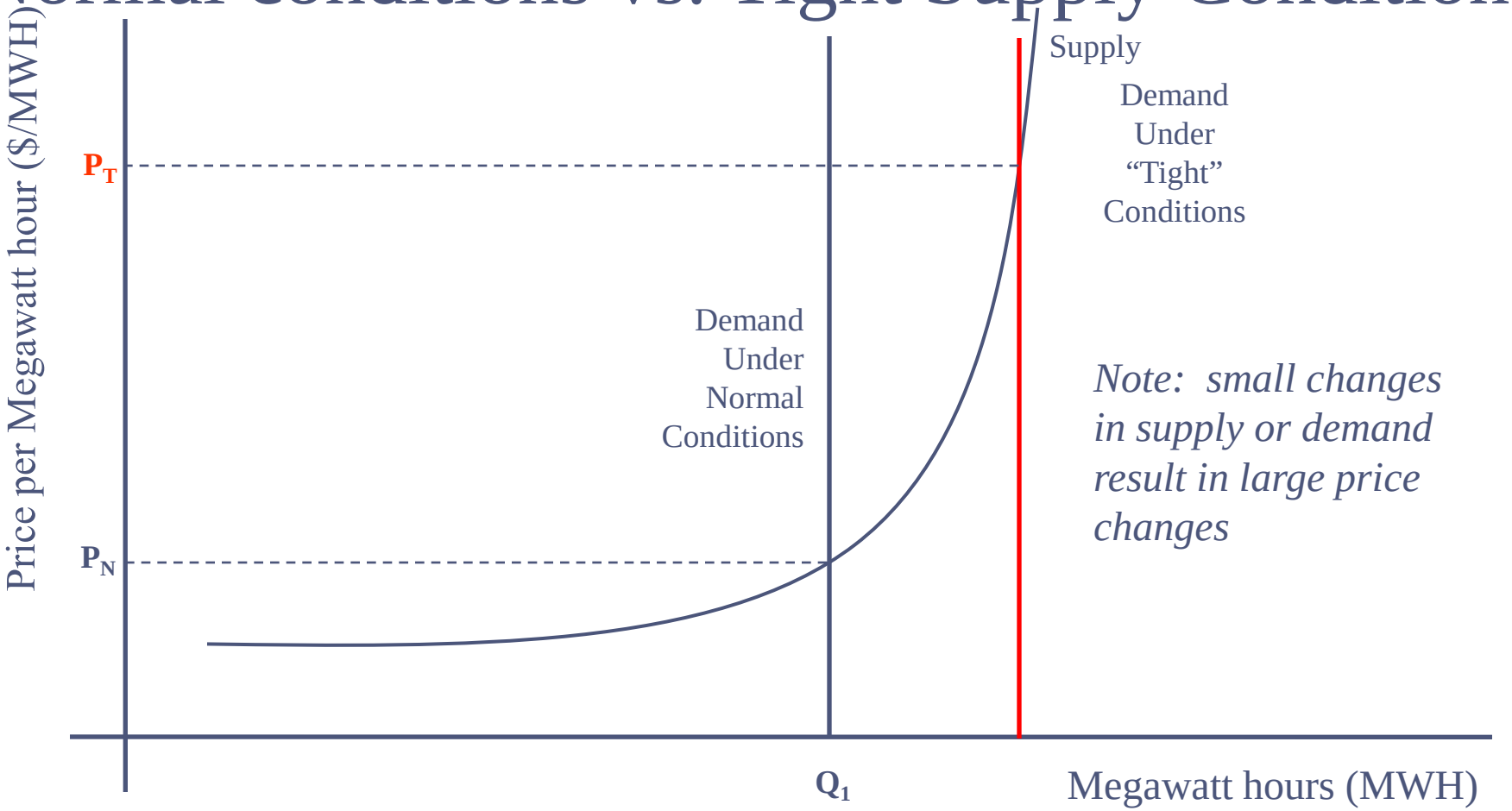
- System operations and reliability
- Loop flows (parallel flows) and transmission congestion
- Transmission expansion
- Demand response
- Market power
- => Defining property rights is difficult to do on electric power systems

Simple Illustration of Efficient Pricing: (Quantity, Q1 Exchanged at Price, P1)



Social Welfare = Consumer Surplus + Producer Surplus

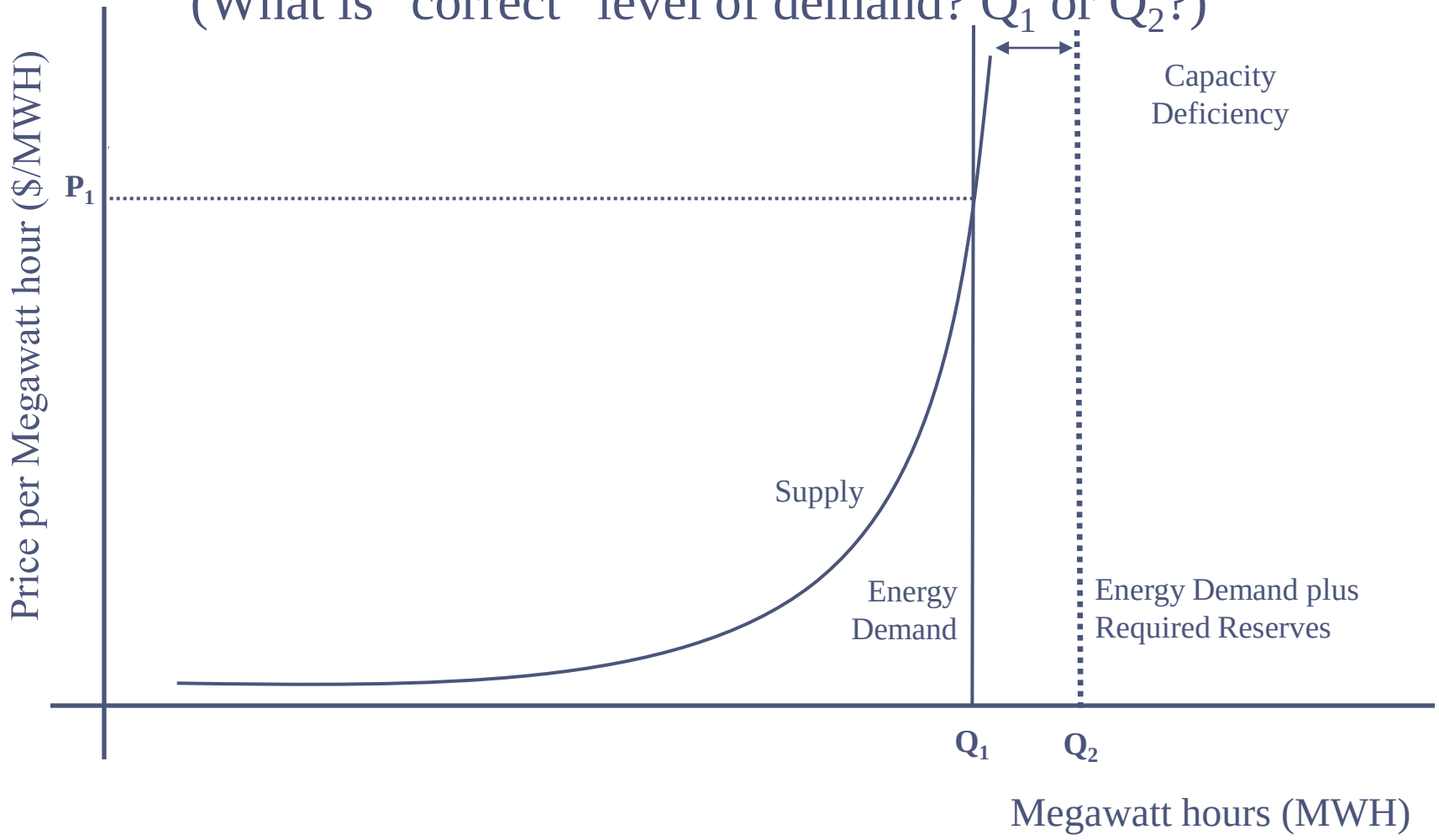
Electricity Example: Normal conditions vs. Tight Supply Conditions



Sometimes the electricity supply curve is characterized as a "hockey stick"

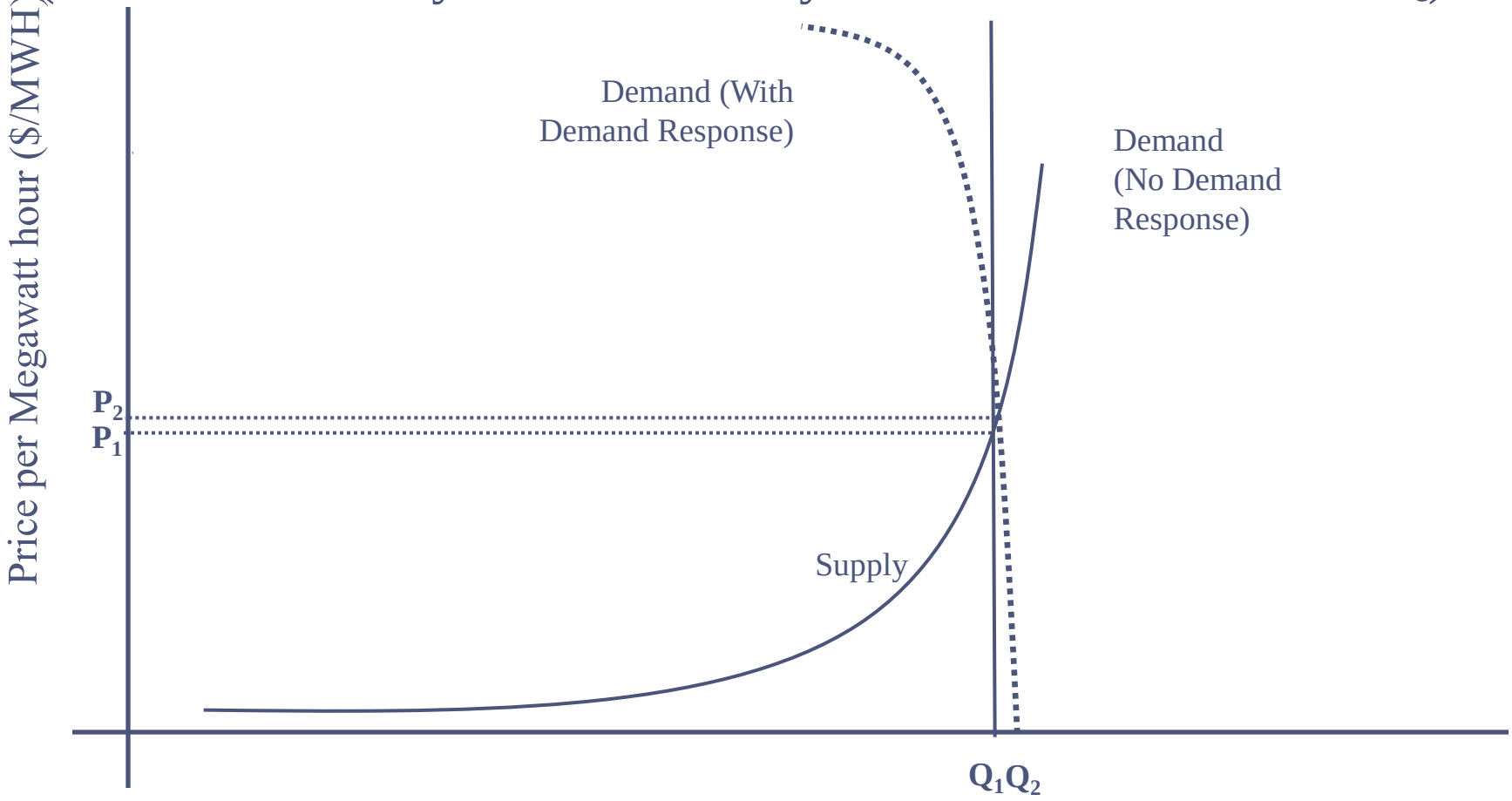
Electricity Under Capacity Deficiency Conditions

(What is "correct" level of demand? Q_1 or Q_2?)



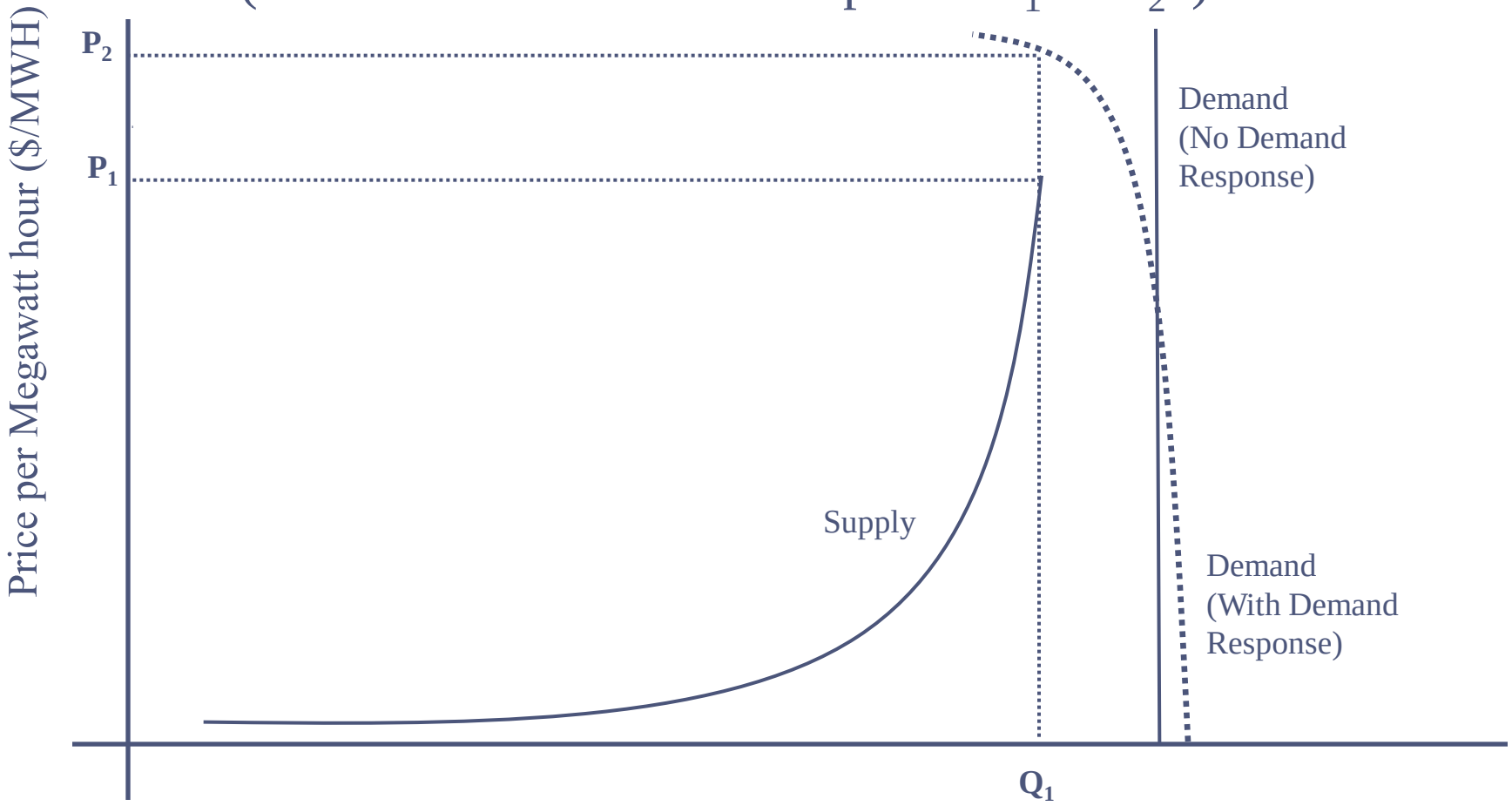
Effect of Demand Response in Normal Conditions

(Demand elasticity would normally have little effect on P or Q)



Demand Response in Capacity Deficiency Conditions

(What is "correct" level of price? P_1 or P_2?)



=> Price Responsive Demand is Needed

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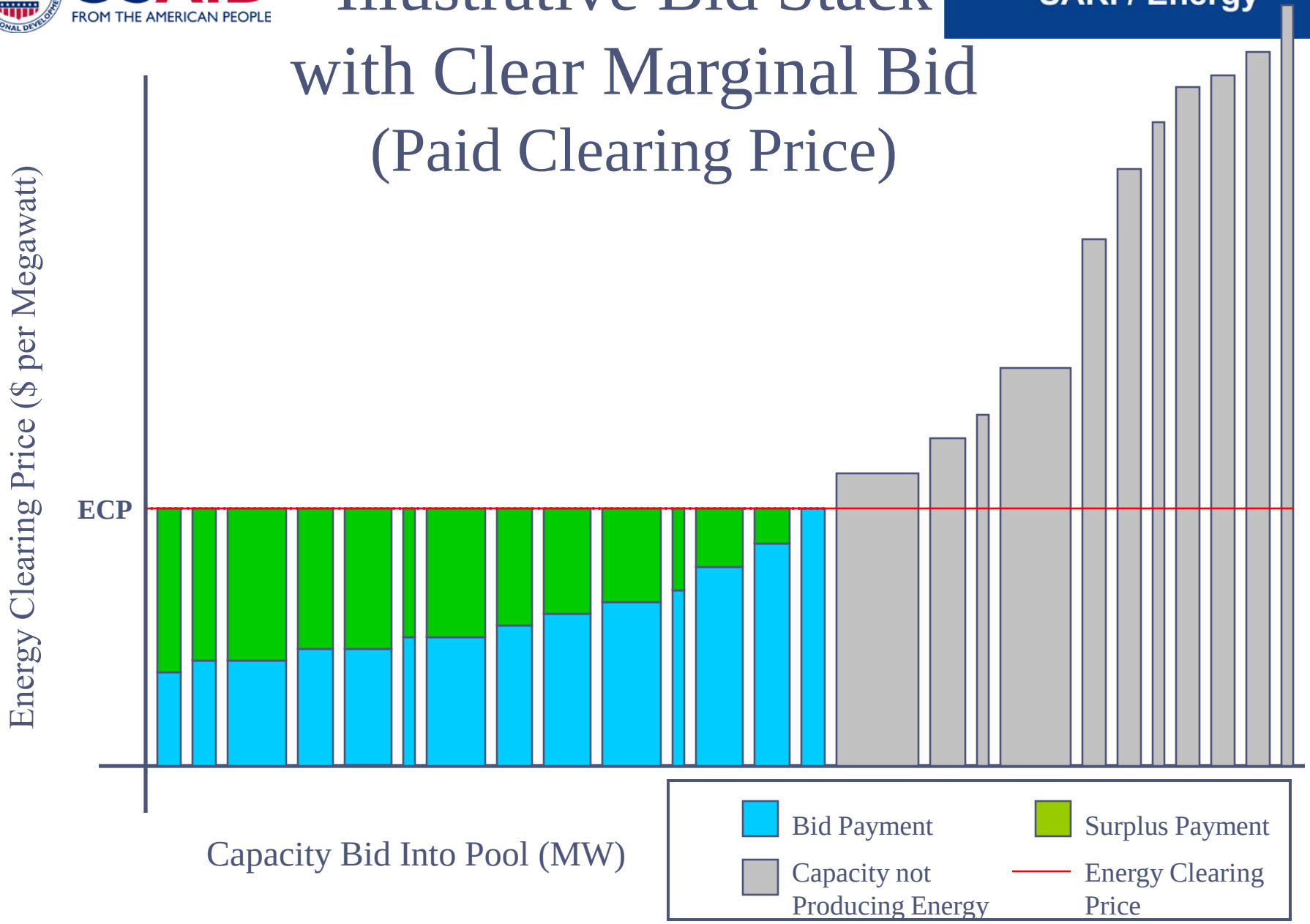
Illustrative Bid Stack with Clear Marginal Bid (Paid Clearing Price)

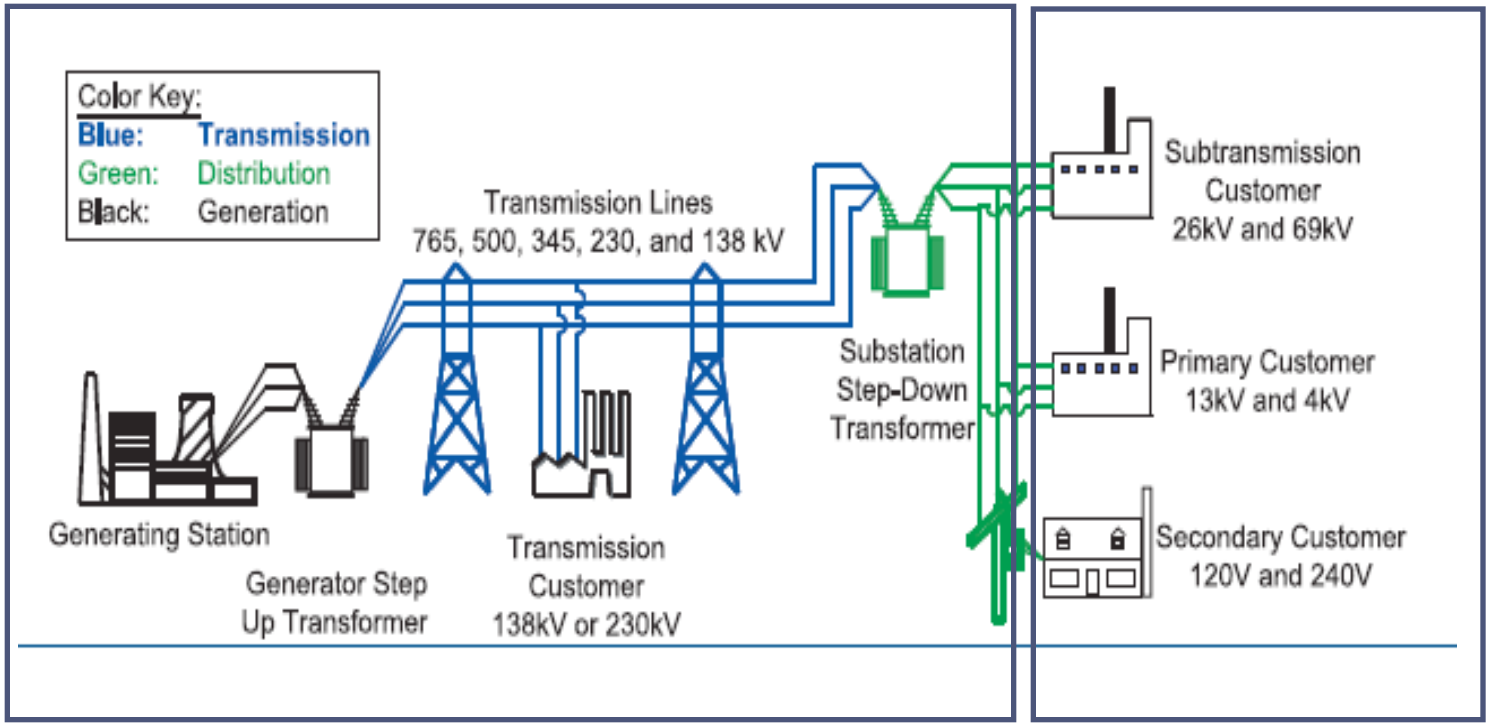


Possible Market Models

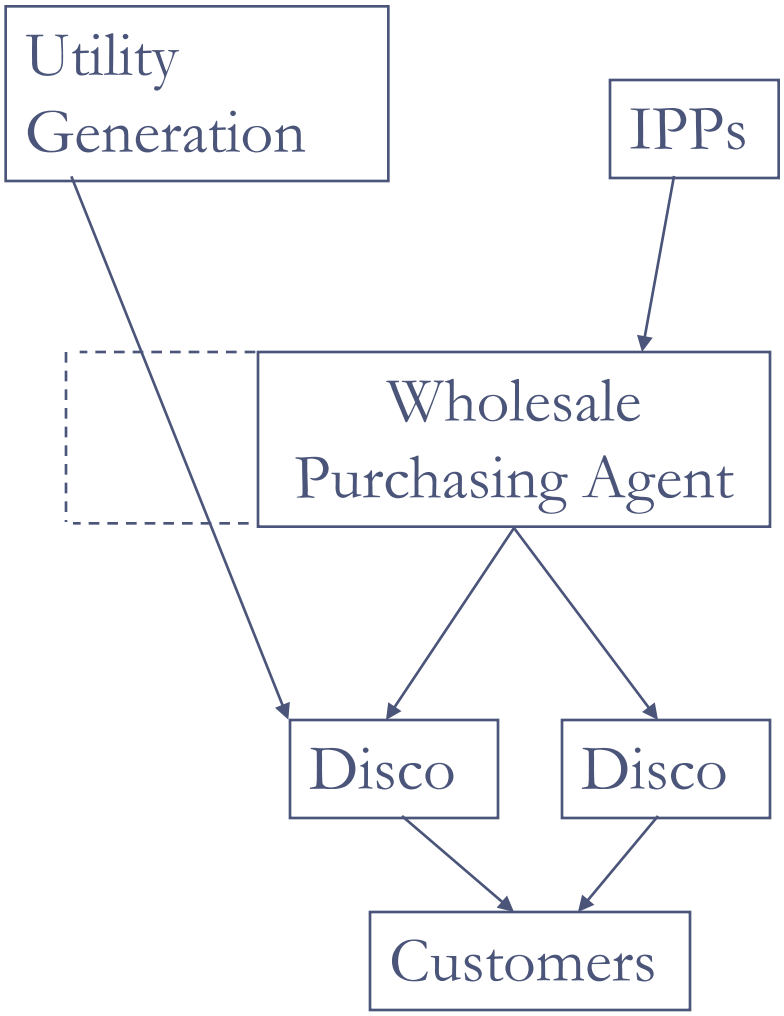
- Competitive procurement
  - Generation, transmission and distribution
- Wholesale competition
  - Physical bilateral markets
  - System operator without unit commitment
  - System operator with unit commitment
    - Zonal pricing
    - Locational (nodal) pricing
- Retail competition

Integrated Utility Industry Structure

Utility either owned by the government or investors and regulated by the government based upon costs



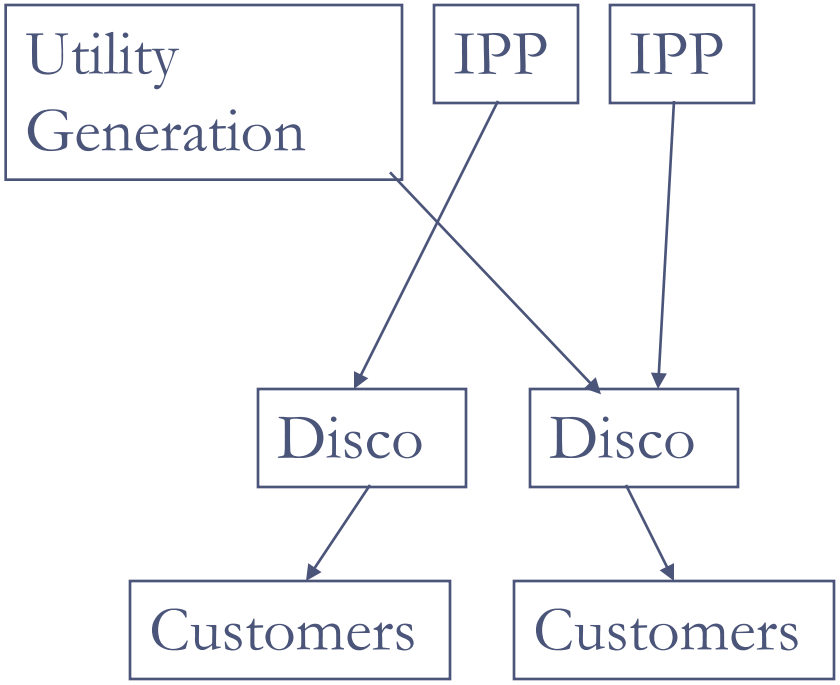
Competitive Procurement



- Independent power producers (IPP) are formed
  - Possibly from existing generation units
  - New entry
- Allows for generation competition via power purchase agreements (PPA)
- Requires PPA procurement process
- Examples
  - US (1978-1992)
  - Ireland

Note: Disco stands for distribution company

Wholesale Competition – Physical Bilateral

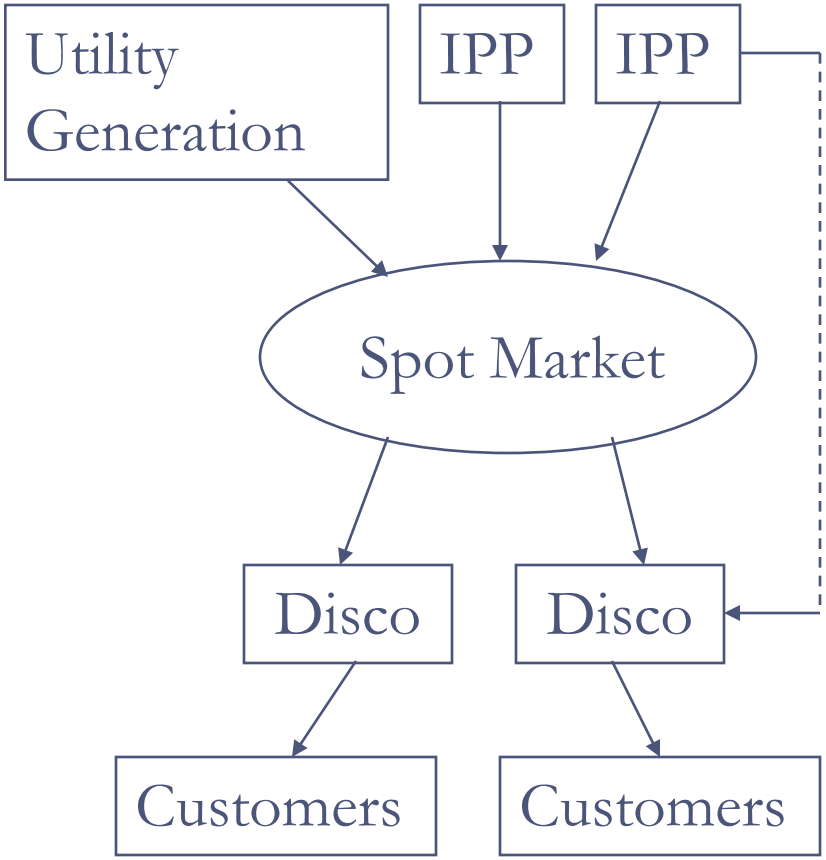


- IPPs compete to sell to distribution companies (wholesale wheeling)
  - Decentralized "spot" markets form
- Issues
  - Open access needs to be established
  - Transmission capacity and congestion management is a concern
- Examples
  - UK in 1990s
  - Parts of US (1992-today)

Open Access Issues

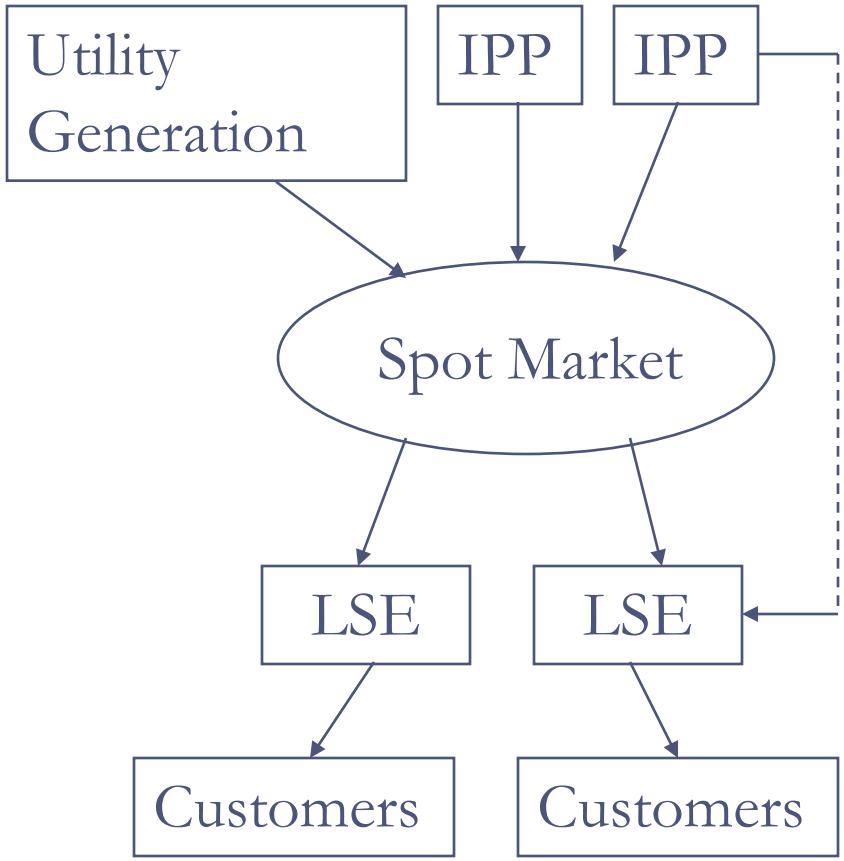
- Open Access (3rd Party Access)
  - Rules that allow IPPs to use the transmission system under the same prices, terms and conditions as utility generation
- Issues
  - Requires open access tariff
  - Several ways to enforce open access
    - Functional unbundling – regulatory solution
    - Divestiture (corporate unbundling) – structural solution

Wholesale Competition – Organized Spot Markets



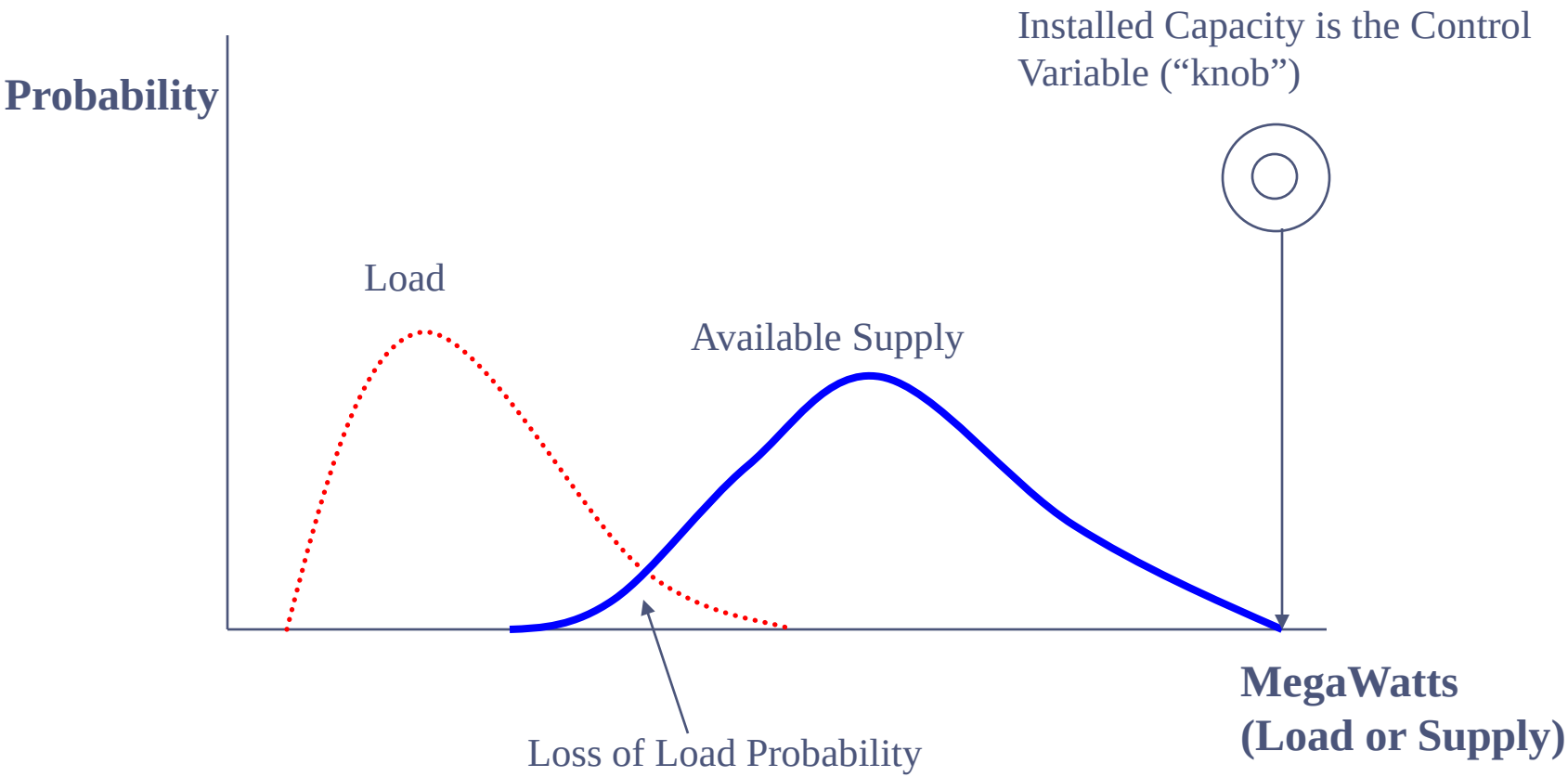
- IPPs compete to sell to into an organized spot market or bilateral contracts to Disco
  - Provides transparent spot prices
  - Provides balancing market
  - Does not preclude long-term contracts
- Issues
  - Forming the ISO
  - Rules are complex
- Various spot market designs exist
  - Nodal vs zonal
  - Centralized vs decentralized unit commitment
- Examples
  - Argentina
  - PJM (US)

Retail Competition – Organized Spot Markets



- IPPs are formed
- IPPs compete to sell to into an organized spot market or bilateral contracts to Load Serving Entities (LSEs)
- Issues with retail competition
  - Getting customers to switch
  - Monitoring & Regulating LSEs
- Examples
  - New York, Texas (US)

Markets for Installed Capacity (ICAP)



Markets for Installed Capacity

- Determine the amount of installed capacity for the region
- Assign a portion to Load Serving Entities (LSEs), usually based on a LSE's % of peak load
- LSE's must procure enough ICAP to satisfy their obligation otherwise pay a deficiency penalty
  - LSE's can build or buy ICAP or reduce their peak demand
  - The deficiency charge is usually based on the cost to build new capacity

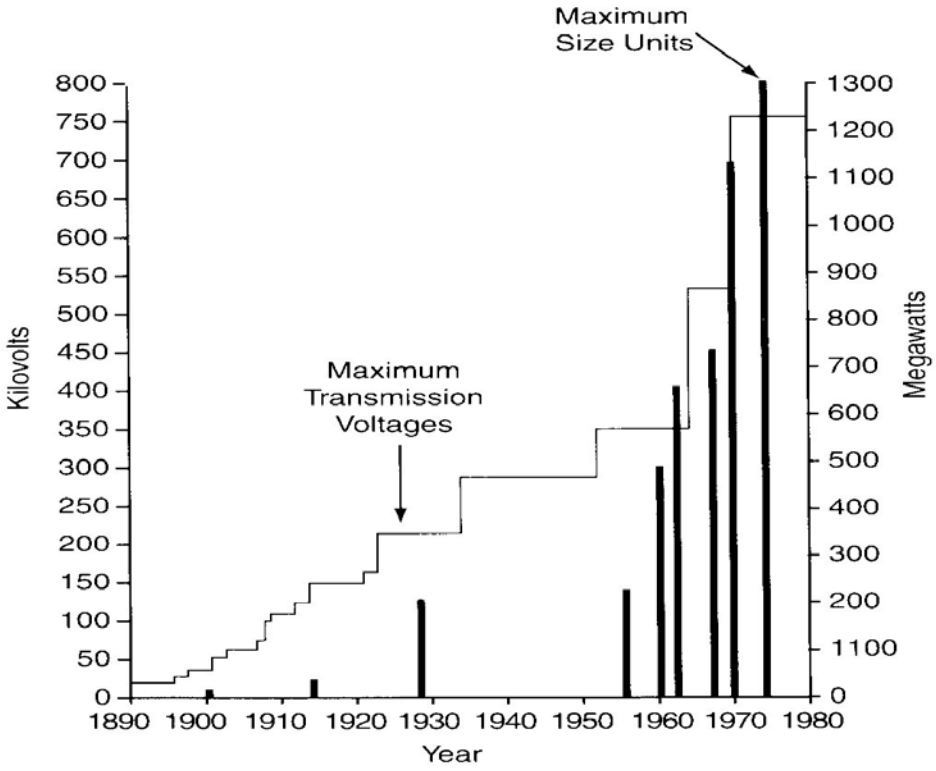
Installed Capacity Issues

- Is this market really needed?
- How to make it not susceptible to market power during times of shortages?
- What should the deficiency charge be?
- How should small generation units and load management be accommodated?
- How far in advance should ICAP be procured?
- Should there be a demand curve for ICAP?
- Are there different types of capacity resources (e.g., based on location, quick start, fuel source)?

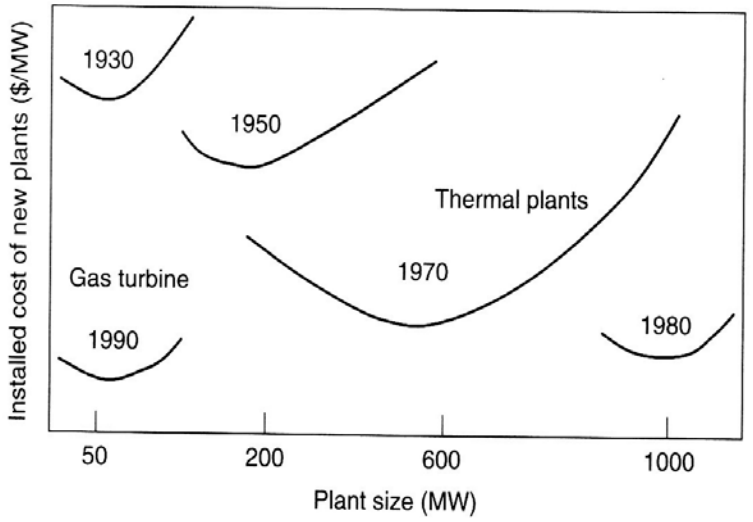
Power Pools - Motivation

- Driven by economies of scale
  - Per unit costs decrease as size increases
  - Reliability increases as size increases, resulting in smaller reserve margins as a percentage of peak capacity for larger systems than smaller systems
- As size expands beyond the size of a utility or country, a settlement system is needed, i.e., a means of paying one entity for its use of another entity's resources
  - A single utility is never perfectly positioned to serve its demand in the most cost effect manner, resulting in the need to buy power from another utility

Power Pools – Economies of Scale



Source: J. Casazza and F. Delea, Understanding Electric Power Systems: An Overview of the Technology and the Marketplace, IEEE Press, 2003 p. 4.



Source: C. Bayliss, "Less is More: Why Gas Turbines Will Transform Electric Utilities," *Public Utilities Fortnightly*, Dec. 1, 1994, pp. 21-25.

Power Pools – Need to Trade

- Even if individual utilities are perfectly built for expected demand, the “expected” may not occur
  - Changes in peak (MW) and total demand (MWh)
  - Changes in generation costs, technology and fuel prices
  - Maintenance outages
- The optimal size for a generation or transmission asset may be larger than the need of an individual utility, requiring multiple utilities to build and operate that asset
- => utilities form a power pool to take advantage of economies of scale (both in costs and reliability)

Benefits of Cross-border & International Trade*

(*Adapted from Pierce Atwood law firm presentation)

- Improved efficiencies
- Fuel diversity
- Non-coincident peaks
- Greater system stability

Power Pools – Need for Settlement System

- Once a power pool is set up to take advantage of reducing capital costs, it makes sense to coordinate maintenance, conduct unit commitment and dispatch jointly not utility by utility
- A settlement system is needed
  - When fuel prices are low, not volatile, and power exchanges are small among the utilities within a power pool, then settlement can be based on MWh not money
  - Otherwise, a monetary settlement system is required
    - Costs vary every dispatch decision, which is on the order of minutes, and the settlement system must reflect this

Power Pools – Key Settlement Choices

- What governance process is necessary to govern the settlement process?
  - Transaction cost economics, a branch of microeconomic, suggests under conditions of large uncertainties and limited capabilities to understand the all future outcomes, self-interested parties need to enter into governance relationships, not just contracts
- Are utilities forced to use the settlement system or can they make side deals or arrangements?
- What does the buyer pay and the seller receive?
  - A power pool creates savings and the issue is how to divide up these savings

Power Pools – Example of Savings

- Utility A
  - Load = 1,000 MW
  - Supply
    - 800 MW at $50/MWh
    - 200 MW at $70/MWh
- Utility B
  - Load = 800 MW
  - Supply
    - 600 MW at $50/MWh
    - 400 MWh at $60/MWh
- => Utility B sells 200 MWh of excess to Utility A but at what price?

Market Structure Summary

- The powerful reasons for power pools lead towards markets
- Multiple market structures exist
- A logical transition path exists but do not need to complete the whole path
- Big Picture Outstanding Issues Issues
  - Price Responsive Demand
  - Markets for Capacity
  - Transmission Expansion
  - Market Power Monitoring and Mitigation
- Policymakers need to understand up front the advantages and disadvantages of each

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Role of the Regulator in a Competitive Electricity Market

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What Do the Regulatory Commissions Do?

- **Traditional Role -- Regulate the Rates, Terms and Conditions of Service of "Fixed Utilities" – Telecommunications, Electricity, Natural Gas, and Water**
- **New Role -- Manage the Development of Competitive Markets for Telecommunications and Energy Services**
- **Even Newer Role -- Help Ensure Safety, Reliability and Security of Utility-based Critical Infrastructure Facilities**
- **Coordinate State Policies and Procedures with Federal Counterparts – FERC and the FCC**

Key Characteristics of Regulatory Commissions (1)

Autonomy

I. Appointment of Commissioners
- Staggered terms
- Quality criteria
- Who makes appointments

II. Exemption from civil service/government salary rules

III. Financing Commission
- License fees
- Budget approval

IV. Removal from office – for cause only

Key Characteristics of Regulatory Commissions (2)

Authority

I. Full Tariff Authority
II. License Issuance
III. Market (design)
IV. Information Collection, Monitoring, Enforcement

Key Characteristics of Regulatory Commissions (3)

Accountability

I. Public Participation & Transparency
II. Annual Report & Audit
III. Appeal of Decisions to Courts Only or International Arbitration
IV. Budget Review
V. Code of Ethics
VI. Removal from Office – for cause only

Key Characteristics of Regulatory Commissions (4)

Ability/Capacity

I. Capable Trained Staff
II. Procedures & Management
III. Sound Tariff Methodologies & Prices
IV. Licensing Practices
V. Monitoring & Enforcement

Basis and Goals of Competition*

(*Adapted from Pierce Atwood law firm presentation)

System where market forces make economic decisions, instead of regulators or central planners

- Attract Private Investment
- Increase Economic Efficiency
- Improve Service & Reliability
- Lower Prices
- Promote Customer Choice

Energy Regulation: State Responsibilities (1)

- Regulation of retail electricity and natural gas sales to consumers
- Approval for the physical construction of electric generation transmission, or distribution facilities
- Facility siting of electric generation and transmission
- Regulation of activities of the municipal power systems, federal power marketing agencies, and most rural electric cooperatives

Energy Regulation: State Responsibilities (2)

- Regulation of local distribution pipelines of natural gas
- Resource planning, including regional activities
- Power supply acquisition
- Infrastructure investment, including security measures
- Environmental impacts of utility operations
- Market monitoring

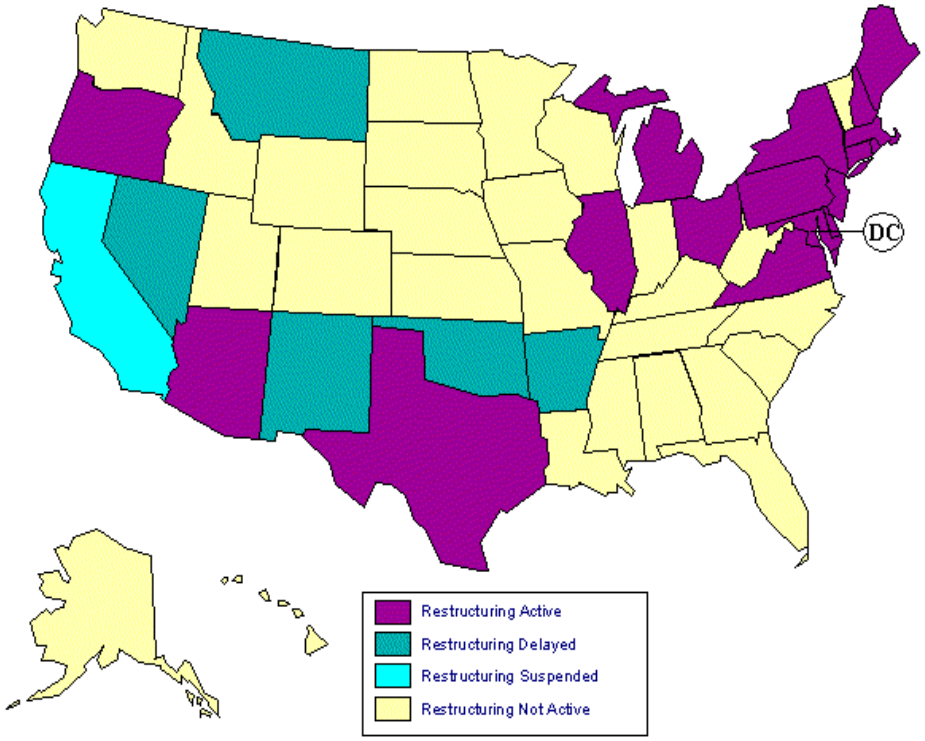
Energy Regulation:
Federal Responsibilities

Federal Energy Regulatory Commission (FERC):

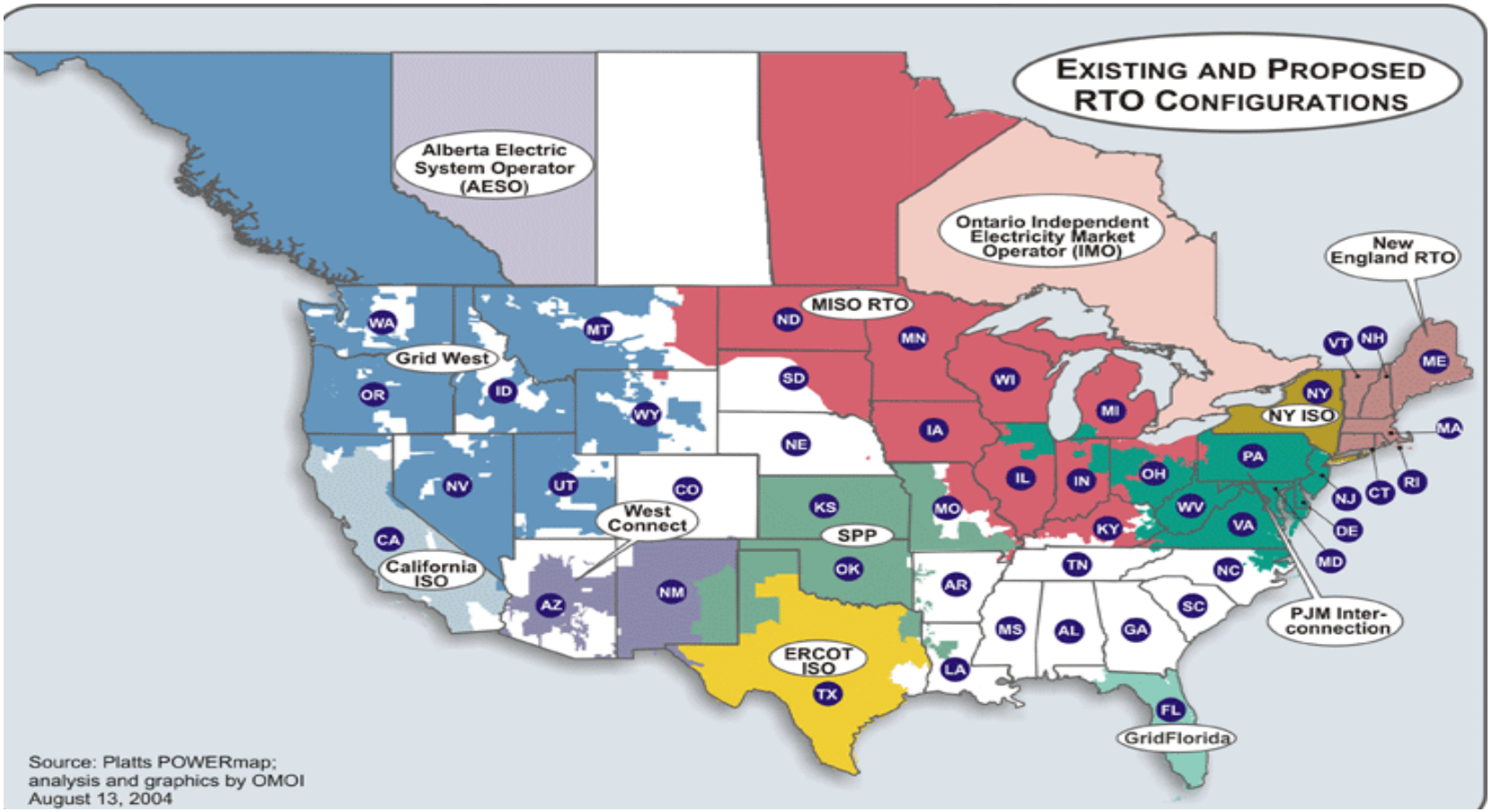
- regulates the interstate transmission of electricity, natural gas, and oil
- reviews proposals to build liquefied natural gas (LNG) terminals and interstate natural gas pipelines
- licenses hydropower projects

Status of Retail Competition

- **In the U.S., there was considerable interest in competition during the late 1990s. A combination of events such as the "meltdown" in California and the perception by consumers that the benefits of retail choice are small seemed to have limited the interest in retail competition among those states that haven't already enacted retail competition**



RTOs in the United States



Expectations of Strategic Investors*

(*Adapted from Pierce Atwood law firm presentation)

- Commercial Infrastructure (economic, regulatory, financial, legal)
- Predictable Rules
- Open & Transparent Decision-Making by Regulator (independence, public participation, objective, written decisions, appeal process)
- Non-Discrimination (Liability, Taxes, Profit Repatriation)
- Absence of Corruption or other Market Distortions
- Free Capital Flows
- Rules of Law/Justice System
- Adequate and Predictable Risk Management

Regulatory Competencies*

(*Adapted from Pierce Atwood law firm presentation)

Competition changes *nature* of regulation, but does not eliminate *need* for regulation

- Traditional structure (monopoly) emphasizes price setting, rate design, engineering, resource planning
- Competition focuses on market oversight, level playing field, market power, information
- Coordination among national regulators and/or anti-monopoly offices critical to avoid anti-competitive behavior

Electricity – Implementation of EPAct

Five big sets of issues

- **Reliability**
- **Infrastructure**
- **Transmission Access/Wholesale Competition**
- **PURPA Implementation**
- **PUHCA/Mergers**

Infrastructure

Transmission Siting

- EPAct – Backstop Siting Authority
- DOE Congestion Study and National Interest Corridor Designation
- FERC Backstop Authority

Transmission Investment Incentives

- EPAct – Transmission Investment Incentives
- FERC Rulemaking on Pricing Incentives

Transmission Access to Support Wholesale Competition

- **EPAct – "FERC Light;" Native Load Service/Long-term Rights New England LICAP**
- **FERC Implementation – Market Manipulation Rules**
- **Native-load/Long-term Transmission Rights – NOPR issued**
- **FERC OATT Reform – NOPR Issued – Focus on ATC and Planning – "FERC Light" addressed in NOPR**
- **Outreach to States on OATT Reform**

PURPA

- **EPAct**
- **State implementation of 5 new standards:**
  1. **Net metering**
  2. **Fuel Diversity**
  3. **Generation Efficiency**
  4. **Smart Metering**
  5. **Interconnection**

PURPA (cont)

- EPAct - Revision of PURPA's Mandatory Purchase Rules

- FERC Rulemakings – Competitive Market Tests; Ownership and Efficiency Standards (Issued)

PUHCA/Mergers

- EPAct - PUHCA Repeal
- EPAct – Expanded FERC Merger Authority
- FERC Implementation Rulemakings – PUHCA Repeal Rules; Merger Rules; USoA Reform
- State Response – Ring-fencing; Accounting/Affiliate rules
- NRRI Study

FERC Order 888

- Implementation of open access transmission policy to support development of competitive wholesale power markets
- Non-discriminatory access principle is critical
- NARUC supported Order
- Order 890 issued in 2007 to update Order 888

Unbundling

- Policy implemented by State legislatures and commissions to disaggregate generation from delivery
- Two Models – "Functional" unbundling (G and T are separate but under common ownership); and "Structural" unbundling (G and T placed in separate corporations)
- Creation of affiliate interest issues – precursor of more systematic market monitoring

Third Party Access

- Implementation of principle of non-discrimination
- PURPA initiative followed by EPAct 1992
- State role on interconnection; netmetering

Market Monitoring

- FERC leadership under the FPAct in restructured markets
- RTO issue – Internal or external
- State role – work with the market monitor (MMU)
- State concern – access to data; communication with MMU
- Intl Pilot Project – Southeast Europe Market Monitoring (www.naruc.org/see_monitoring)

Organization of MISO States (OMS)

Organization

- State regulatory agencies in MISO footprint: 14 states and Manitoba
- Board of Directors has 15 members – one from each member agency
- Executive Committee composed of 5 members
  – Includes the 3 members of the MISO Advisory Committee
- Funding Agreement with MISO, treated as an administrative expense of the RTO in its cost recovery.
- http://misostates.org/

OMS – Role of Regional Regulators (II)

Three Major Functions

- Advise MISO
- Advise FERC
- Resource to states

- NOT a decision-making body

OMS – Role of Regional Regulators (III)

Seven Working Groups

1. Pricing (interconnection policies)
2. Congestion Management and FTR Allocation
3. Market rules and Implementation Timelines
4. Market Monitoring and Market Power Mitigation (Tariff provisions, State access to market monitoring data)
5. Resource Adequacy and Capacity Markets (Reliability)
6. Seams Issues
7. Transmission Planning and Siting

Organization of PJM States, Inc. (OPSI)

States' Relationship With PJM

- In 1998, PJM and state utility commissions in the PJM region signed a Memorandum of Understanding (MOU) to create a State Commission Liaison Committee
- The State Committee is a direct channel of communication between PJM's Board of Managers and all state commissioners in the PJM region
- With the expansion of PJM, the Organization of PJM States, Inc. (OPSI) has been formed that includes all 14 jurisdictions

OPSI – Role of Regional Regulators (II)

- Board of Directors (BOD) = 14
  (one commissioner from each state)
- Executive Committee from BOD = 8
- Staff from all states commissions participate based on issues
- Affiliate of NARUC
- Funded by a PJM tariff as a small charge on per MWh basis as approved by the FERC *(less than one cent per customer annually)*
- www.opsi.us
- Email: opsi-ed@comcast.net

OPSI – Role of Regional Regulators (III)

Activities:

- Monthly teleconference among Board and Staff
- Monthly teleconference between Board and PJM's Board and chief executives
- Monthly working group teleconference between PJM staff and staff from all states
- Annual Meetings
- Other meetings/teleconferences
- Staff participates in various PJM member committees and workgroups (non-voting status)