Models of Regulatory Reform Regimes: Strengths and Weaknesses

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Research
Expanding the body of knowledge in public utility regulation, market reform, and infrastructure operations (e.g. benchmarking studies of Peru, Uganda, Brazil and Central America)

Education
Teaching the principles and practices that support effective utility policy and regulation (e.g. PURC/World Bank International Training Program on Utility Regulation and Strategy offered each January and June)

Service
Engaging in outreach activities that provide ongoing professional development and promote improved regulatory policy and infrastructure management (e.g. in-country training and university collaborations)
The Body of Knowledge on Infrastructure Regulation
Session Overview

• Components of the electric system
  – Generation
  – Transmission and system operation
  – Distribution, metering, and billing
  – End-use customers, prices, and rate design

• Structure of the industry
  – Vertical integration
  – Horizontal and vertical unbundling

• Market considerations
  – Market reform
  – Renewable energy and environmental considerations
Electricity Generation

• Functions:
  – Generates power from fuel, water, or other resource for delivery to the transmission system

• Accounts for the largest share of costs in the electricity industry

• Cost Drivers:
  – Technology vintage, cost, and reliability
  – Fuel cost and availability
  – Technological efficiency
  – Scale at which technology is employed
Generation Technology Cost Profiles

- **Base Load Power Generation**: For generating power requirements that are needed during most hours and times of year.
  - Traditional pulverized coal technologies
  - Nuclear
  - Hydro
  - Highest capital costs, but lowest running costs

- **Intermediate Load Generation**: For producing power needed in period between base and peak
  - Oil and/or natural gas steam (older technologies)
  - Combined cycle natural gas or oil (may sometimes be used as base load generation)
  - Lower capital cost than base load, but higher running costs
Generation Technology Cost Profiles

- **Peak Load and Emergency Power Generation**: For generating power requirements that are needed for only a few hours each year or for ramping and reserve capacity requirements that are needed during most times of year
  - Combustion turbines using oil or natural gas
  - Diesel engines
  - Lowest capital costs, but highest running costs
- **Fuel use will depend on availability**
  - Many countries do not have natural gas
  - Precipitation is necessary for operation of hydro facilities
- **Older technologies are not going to be as efficient as newer technologies**
- **Choices may be constrained by local situation or needs**
Electricity Generation Costs

• The costs of engineering, planning, and construction can be predicted and controlled fairly well.
  – This is especially true for well known technology-fuel combinations.

• The cost and availability of fuel is not so easily predicted, nor is it controllable over a long period of time.
  – Fossil fuels such as oil and gas are governed by regional or world markets
  – Short-term uncertainty (price and volume) can be hedged through contracts
  – Coal, where available, has a tradition of more price certainty and predictability with long-term contracts the norm
  – Renewable resources such as water or wind are not always available or predictable and definitely not controllable
Transmission and System Operation

• Commitment and dispatch of generation at “least-cost”
• In charge of system reliability
  – Ancillary service provision
  – Transmission system security
  – Load forecasting
  – Contingency analysis
  – Coordination of maintenance to ensure enough capacity is available in the short-term.
  – Long-term planning of generation and transmission adequacy.
  – Individual generator constraints such as start-up, minimum load, and run times.
• Delivers power from generators at high voltages to substations that reduce voltages for distribution customers
• Delivers power directly to large customers where applicable
• Meters power at generation and substation levels
• Implements transmission rate design
Cost Minimization in System Operation

- Can be done from every 5 minutes to a week-ahead
- Objective is to minimize production cost
- Constraints:
  - Supply equals demand, where demand is based upon load forecasts and actual use
  - Ancillary services needs (reserves, AGC, voltage, etc.) and in the “right” location.
  - All transmission limits are satisfied. Congestion is internalized in the dispatch and commitment of units
  - Contingencies can be met
  - Generator constraints satisfied
- Reliability needs (and associated costs) are internalized under the vertically integrated utility. Often times the system operator meets security needs heuristically (by feel)
Transmission Pricing

• Point to Point Pricing
  – Reflects the cost to transmit electricity from one point to another
  – Theoretically varies with distance
  – Electricity doesn’t always follow the contract path

• Network Pricing
  – Reflects the cost to transmit electricity to any point in the sink’s transmission or distribution network
  – Transmission cost across a network is constant (or sometimes “free”)

• Congestion Charges
  – Reflects the opportunity cost on the transmission network
  – Implemented in markets where pricing varies with nodes
  – Can be positive or negative
Application of Congestion Charges

Energy Price = $50

WEST

EAST

-50MW

+50MW

$50

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Effects of Congestion Charges

Energy Price = $50
Congestion Charge = $5

Energy Price = $50
Congestion Charge = -$5

WEST

-30MW

$55

EAST

+30MW

$45
Transmission Pricing Considerations

• Transmission pricing isn’t just about access to generation, but system reliability as well
• System reliability benefits everyone, but the benefit can be very hard to quantify
• Congestion charge pricing attempts to accomplish this, but requires multiple daily runs of complicated computer models
• Distinct pricing of ancillary services is still required
Cost Allocation

• Cost allocation is always a difficult proposition because it’s difficult to quantify benefits

• Consider an example of a transmission line built from Florida to South Carolina, through Georgia, for example
  – Provides market for South Carolina generation
  – Provides needed electricity for Florida
  – Provides what for Georgia?
Cost Allocation Problems

• Different types of transmission may be regulated by different agencies
• Regional transmission organizations are responsible for maintaining reliability with their territory
• Need to recover both fixed and variable costs of transmission
• Cost allocation manuals standardize the way costs are allocated
• Procedures in the manual may not be the ‘best’ way, but everyone has agreed to them and everyone is aware of the rules
Transmission and System Operation Costs

• Fairly predictable costs drivers
  – Personnel costs
  – Capital costs for towers, conductors, metering
  – Technical losses (as a percent of load)
  – Characteristics of service area
  – Required quality and reliability

• Cost drivers that are controllable to some extent
  – Personnel costs
  – Capital costs for poles, conductors, metering
  – Congestion and re-dispatch costs
  – Technical losses (as a percent of load)
  – Non-technical losses
Distribution, Metering, and Billing

• Functions:
  – Delivers power at lower voltages to end-use customers
  – Reads meters and bills customers
  – Implements the rate design
  – Maintains quality of service
Distribution, Metering, and Billing Costs

• Most costs drivers are fairly predictable
  – Personnel costs
  – Capital costs for poles, conductors, metering
  – Technical losses (as a percent of load)
  – Characteristics of service area
  – Required quality and reliability

• The most important cost drivers are controllable to some extent
  – Personnel costs
  – Capital costs for poles, conductors, metering
  – Technical losses (as a percent of load)
  – Non-technical losses
Vertically Integrated Structure

- Generation
- Transmission
- Distribution
- Metering and Billing
Vertical Integration

• One company provides all of the functions in the electric market
• Simplest market structure to implement
• Monopoly structure raises questions about pricing and efficiency
Vertical Unbundling

- Generation
- Transmission
- Distribution
- Metering and Billing
Vertical Unbundling

- One business unit responsible for each function (generation, transmission, distribution, and metering & billing)
- Decide whether each unit is functionally responsible or fiscally responsible
- Fiscal responsibility can be used as a precursor to horizontal divestiture
- Can be used to promote efficiency
Prerequisites to Unbundling

• Uniform System of Accounts
  – System that ensures that all costs are accounted for in the same way
  – Allows comparison across utilities and across time

• Cost Allocation Manual
  – System for allocating costs to specific functions
  – May not be a ‘best’ system, but need a system that everyone can accept
Market Structure

• Functional (Vertical) Unbundling
  – Separate any or all of generation, transmission, or distribution functions
  – Need to be aware whether cross-subsidies exist

• Horizontal Divestiture
  – Break up any or all of generation, transmission, or distribution functions
  – Can you accomplish your goals with behavioral rules?

• Typical structure
  – Divest generation
  – Retain single transmission entity
  – Either treatment for distribution
  – Why is this the most popular?
Market Structure Considerations

- Energy Markets
  - Real Time, Day Ahead, and Forward Markets
  - Granularity of Prices (Daily, Hourly, 15 minutes, 5 minutes)
  - Pool (Auction) or Bilateral
  - Market Controls
  - Aggregated Purchasing

- Capacity Markets
  - Market Products (Firm, Non-firm)
  - Pool or Bilateral

- Responsibility for Congestion Management
- Responsibility for Conducting Auctions
- Responsibility for Enforcing the Rules
Restructured Generation

- Operating characteristics and fuel prices are used to establish a ‘price to beat’ for new generation
- ‘Price to beat’ should reflect only the costs of generation
- Market entrants that can produce for less than the ‘price to beat’ will enter the market
- Customers charged separately for the new, lower, generation price
Unbundling Considerations

• Cost of Service Information
  – If generation costs are allocated to transmission, then the generation ‘price to beat’ is too low and potential market entrants are deterred
  – If transmission costs are allocated to generation, then the ‘price to beat’ is too high, market entrants are encouraged, and the transmission utility does not recover its costs
Reactions to Cross Subsidies

• If industrial and large commercial customers subsidize, they may try to bypass system
• Bypassing the system may harm ability to provide service to residential and small commercial customers
• Result will be higher costs for residential and small commercial customers, and political uproar
• Government policies to subsidize groups of customers may be better accomplished outside of utility rates
Unbundling Generation

- Generation
- Transmission
- Distribution
- Metering and Billing
Unbundling Multiple Functions

- Generation
- Transmission
- Distribution
- Metering and Billing
Divesting Generation

- Generation
- Transmission
- Distribution
- Metering and Billing
Incorporating IPPs

- Additional provider(s) of electric service
- Degree of regulation
  - Regulator may still want to determine need
  - Regulator may still want to specify type of generation
- Degree of responsibility for other generators
  - Reliability
  - Long term planning
Single Buyer Market

• Non-discriminatory access to transmission system
  – Market rules and enforcement

• Take or Pay Contract
  – Buyer must purchase power whenever it is produced
  – Power may displace more economical units
Retail Access for IPPs

• Guaranteed “market price” for electricity
• May have very few potential buyers for electricity
• Assign responsibility for billing and collections
• Assign responsibility for service standards
Unbundling Generation

- Generation
- Transmission
- Distribution
- Metering and Billing

Leadership in Infrastructure Policy
Unbundling Generation

- Generation
- Generation
- Transmission
- Distribution
- Metering and Billing
- Metering and Billing
Retail Choice

- Customers choose retail provider of electricity
- Service providers aggregate load and purchase electricity
- Need a designated Provider of Last Resort for customers who do not want to choose or are unattractive to marketers
- Strict market rules to protect customers from unfair practices and protect providers from customers manipulating the system
Capacity Markets

• Higher capacity prices provide an incentive to enter the market

• Higher capacity prices may provide disincentives for existing participants to build more capacity
Capacity Regulation

• Since there may be a limited number of firms willing (or able) to provide capacity at any time, restructured capacity markets may not do a good job of ensuring adequate reserves

• Regulators need to work with utilities to ensure adequate reserves, and to ensure recovery of prudent costs
Reliability as a Public Good

• Public goods are
  – Non-rival in consumption (my usage doesn’t diminish your right to use the good)
  – Non-excludable (cannot deny access to the good)

• Suppliers in a competitive market have little incentive to produce public goods

• Reliability of the electric grid can be seen as a public good
Thinking about Improving Industry Performance

- Two Main Areas:
  - Reducing costs in providing service or enhance service provided
  - Ensuring that the prices paid (revenues collected) cover the cost of service.
- Work up from the end-use customer to follow the flow of money.
- If any link in the chain of money flows is broken, the industry performance can be jeopardized.
  - Money is needed to make the necessary investments and maintain the current infrastructure
- If any link in the chain of money flows is broken, the industry is perceived to be more risky which has cost consequences.
  - Higher interest rates or rates of return required to accept the risk
- If any link in the cost flows increases, it may be an indication of declining performance
  - Or an increase in uncontrollable costs
Implementing Reforms

• The question now becomes:
  – How do we reform so as to best facilitate needed improvements to provide reliable electricity service at the lowest possible cost to as many people as possible?

• The point of reform is to facilitate improvements in industry performance

• Reform is not to be done for its own sake...

• ...Or from outside pressure
Decide How Reform is Sold Politically

- **Dangerous Sales Pitch:** Under reform prices will be lower today than yesterday
  - Creates unrealistic expectations that either cannot be met, or will not be met for many, many years

- **Correct sales pitch:** Under reform prices will be lower down the road (5, 10, 15 years) than under the old regulatory/ownership regime had it continued OR...

- Prices may increase, but access and quality will also increase
  - The problem is that this is tough to sell politically to constituents who have benefited from the implicit subsidy of low prices.
  - Politicians and their constituents are impatient expecting changes to happen immediately.

- Expectations must be carefully managed
Transition Issues in Reform

• Subsidies may be removed as part of the reform process and tariffs may be more cost reflective
• If new facilities need to be built, these capital costs must be recovered and the existing capital may not exist
• Poor incentives can lead to unintended consequences and abuses...the transition problem
• The question of who keeps the gains from cost savings must be addressed
  – Do utilities or consumers get to keep the gains?
  – Can the gains be shared in some manner?
Renewable Energy Standards

• The mandate to produce a certain amount of electricity from renewable (alternatively clean) energy sources

• Popular market structure
  – Generators receive credits (RECs) for the production of renewable energy
  – Distributors purchase RECs from generators (and pass costs on to customers) and surrender them to the regulatory authority
Renewable Energy Credit Markets

- The question exists whether to create a Renewable Energy Credit (REC) market
  - Price controls may not incentivize utilities to produce energy from renewable resources
  - Lack of price controls may lead to higher costs than anticipated
- No REC market leads to production from renewable resources, but may not be efficient or economical
- Rolling time frames (i.e. production over a 2 or 3 year period) may help to smooth annual volatility in production
- Regional production authority may mitigate some problems, but with administrative and enforcement costs
Renewable Energy Incentives

• **Subsidies**
  - Fixed supplementary payment per unit of output ($0.05/kWh)
  - Energy revenue for generator still depends on market price of electricity

• **Grants**
  - Payments in advance that can be used to secure project financing
  - May not provide an incentive to produce

• **Feed-In Tariffs**
  - Guaranteed payment per unit produced for a specified time period (e.g. $0.35/kWh for the next 20 years)
  - May be used to secure financing
  - May be necessary to limit participation
Market Solutions for Limiting CO$_2$

- **Carbon Tax**
  - Known and direct cost associated with emission
  - Entities balance cost of emission with cost of abatement

- **Cap and Trade**
  - Regulator sets emissions levels across scope of program
  - Tradable emissions allowances
  - Entities balance expected cost of emission with cost of abatement

- **Cap and Dividend**
  - Gaining traction in DC
  - Implemented through tax in British Columbia
  - Subset of Cap and Trade
Carbon Tax

- Regulator assigns a price for carbon emissions and collects from each entity
- Largely dismissed in the U.S.
  - Proposed by Clinton in 1993
  - Preference for the market to determine the price for carbon
- Limited global implementation
  - British Columbia fuels tax through 2012
  - Finland and Sweden have had carbon taxes since early '90s
  - City of Boulder, Colorado
Cap and Trade Programs

• Regulator sets cap on emissions volume
• Tradable emissions allowances
• Implemented in EU ETS Phase II, New Zealand (forestry sector only)
  – EU plans Phase III for 2013
• Planned for Australia & Japan (voluntary trial program)
• New Zealand forestry sector participation began January 2008
  – Other sectors enter 2010-2013
Copenhagen Summit

• No binding agreement reached
• Copenhagen Accord drafted by US, Brazil, South Africa, India, and China
• ‘Taken note of’ in plenary session
• Emissions guidelines proposed
Conclusions

• Many options in market structure
• Establish policy goals and design market to achieve goals ("Let’s reform the market" is not a goal)
• Weigh the costs of reform against the gains from reform
• Weigh long term goals against short term ones
Thank You

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