Introduction: from regulated to liberalized markets in electricity

Péter Kaderják
Lecture overview

1. Alternative power market models
2. Electricity market segments
3. The changing role of regulators
1. ALTERNATIVE POWER MARKET MODELS

Vertical integration
Single Buyer
Wholesale competition
Retail competition
Hybrid model
Traditional market structure: vertical integration

Vertically integrated, privately / publicly owned, regulated monopolies
- Generation
- Transmission
- Distribution
- Supply
- System operation

Within one regulated company

-Self-sufficient national systems
-Supply obligation
-Central dispatch of generation
-Centrally decided investments
-Regulated end-customer prices: cost of generation + cost of transmission + cost of distribution & SO + taxes
Motivations for power sector reforms

Problems with traditional regulated monopolies

- Lack of operating efficiency: no motivation to reduce operating cost
- Motivation to over-invest – gold plating
- Abusing state-owned companies: industry-politics nexus and corruption
- Distorted pricing mechanisms, aversion to raising tariffs

- Increasing costs & depressed (non cost-reflective) prices
- Loss-making -public- utilities & heavy government subsidies
- Underinvestment, degrading infrastructure, low service quality

Challenges and goals of reforming power sector

- Changing landscape in the 1980s
  - large but ageing/degrading infrastructure with huge investment need
  - increasing tight/scarcе government budgets » private capital needed

- Promises of power sector reforms
  - Increase the quantity and quality of power supply to support economic growth
  - Raise technical and commercial performance to improve cost efficiency
  - Markets provide transparency
  - Maintain growth prospects while pursuing sustainable energy policy
Standard electricity sector reform components prescribed for developing and CEE countries

- Gradual removal of price subsidies
  - energy price increase far exceeding CPI
- Unbundling (horizontal and vertical restructuring) and corporatisation of vertically integrated state-owned companies
  - power plants
  - distribution companies
  - transmission network operator & independent system operator
- Regulatory reform
  - enacting new laws and decrees setting up the regulatory framework
  - establishment of regulator (with separate staff, financing and statutory authority)
  - designing complex price regulatory framework (separation retail prices from network charges and tariffs regulation)
- Privatisation (power plants and distribution companies)
  - often long term power purchase agreements (PPAs) concluded with private power plants
- Customer choice and price liberalisation
  - gradual process, different subsequent models
- Environmental clean-up
- EU market integration of Central Eastern European (CEE) countries
  - harmonizing energy regulation with EU legislation
The first step toward power market reform: the Single Buyer model

Independent Power Plants (IPPs) can enter into the market

Single Buyer (SB) at wholesale level and transmission company

Long-Term Power Purchase Agreements (PPAs) between IPPs and SB

Distribution and supply: regulated local monopolies

Legend
- Energy sales
- Energy flows in same company
Single Buyer: discussion

Pros:
- Opens the generation market for new entrants & private ownership
- Competition for new investment opportunities in generation (tendering procedure) increases dynamic efficiency
- Creates investor security through the application of long-term Power Purchase Agreements (PPA) signed by the Single Buyer and the IPPs

Cons:
- PPAs are serious obstacles to electricity wholesale and retail competition
  - Large share of generation capacity is contracted by Single Buyer -> no free capacities left for free market customers
  - Overly generous, rigid PPAs -> increasing costs for the Single Buyer
- Incompatibility with the EU market model

- **Imports**
  - IPP
  - PPA
- **System Operator**
- **Transmission grid**
- **Utility wholesaler**
  - Baseload nuclear plant
  - Secondary reserve plants
- **Exports**
  - DisCo
  - PPA

PPA connections indicate power purchase agreements.
Brazil: a modified single buyer

- Power rationing in 2001-02
- Second reform: emphasis on ensuring sufficient capacity through auctioning generation contracts of different length (1-3-5 years) and kind ("old", "new", RES) to meet DSO needs
- 2004-12: 31 auctions; successfully promoted investment into generation, although still majority government owned

<table>
<thead>
<tr>
<th>Auction type</th>
<th>Traded Volume MW Avg</th>
<th>Average Price US $/MWh</th>
<th>Number of Contracts</th>
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<tr>
<td>Existing energy</td>
<td>19,987</td>
<td>45.46</td>
<td>1612</td>
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<tr>
<td>New energy</td>
<td>22,478</td>
<td>61.90</td>
<td>6728</td>
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<tr>
<td>Alternative renewable</td>
<td>900</td>
<td>74.85</td>
<td>1146</td>
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<tr>
<td>Reserve</td>
<td>2189</td>
<td>72.83</td>
<td>176</td>
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<tr>
<td>Total</td>
<td>45,554</td>
<td>59.17</td>
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The principal idea behind moving towards more competition: unbundling the networks

Resulting market segmentation

Wholesale markets
- Wholesale product market
- Balancing market
- Cross border capacity market

Retail markets
- Retail market
Competitive electricity markets

Promises of competitive markets

• Improving operating efficiency in generation (short run)
• Improving investment efficiency in generation (long run)
• Cost reflective, transparent market prices for consumers
• Least-cost supply security
• Technology and product innovation
• Integrated fuel, electricity and environmental markets

'Receipt’ for efficient competition

• Unbundling of monopoly activities (network and system operation) from competitive activities (generation, trading, supply)
• Regulated Third Party Access to the network
• Free sale of electricity (supply side liberalisation)
• Cross-country market integration (= sufficiently low market concentration in generation)
• Independent sector regulator
• Free choice of supplier (demand side liberalisation)
• Removal of end customer price regulation
The Wholesale competition model

- Competing generators & imports
- Free access (TPA) to transmission network
- Distribution and supply: regulated local monopolies
The Retail competition model

- Competing generators & imports
- Free access (TPA) to transmission network
- Competing traders, suppliers
- Free access (TPA) to distribution network
- Free choice of supplier
Europe: Enduring price regulation for household customers

Source: ACER MMR (2016)
Reality: Hybrid Models (former Serbian example)

Dominant producer & wholesaler

Free access (TPA) to transmission network

Competing traders, suppliers

Free access (TPA) to distribution network

Regulated and free priced markets, low cost switching
Private ownership + incentive price regulation brings efficiency improvement in the regulated segments

Comparison of the efficiency of electricity DSOs in selected CSEE countries

Despotovic, 2012
Global distribution of electricity market structures

Unbundled systems

Vertically integrated systems

Power systems size above 1000 MW
GDP per capita above $ 900

Power System Size and Per Capita Income Appear to Matter
Large and wealthier countries are more likely to implement power market reform
(introducing IPPs, single buyer or wholesale competition)

Global distribution of electricity market structures

2. ELECTRICITY MARKET SEGMENTS

Wholesale market (no direct sale for end-customers)
- Product (power) market
- Balancing market
- Transmission capacity rights market
Retail market (direct sales of electricity for end-customers)
Load served by competing suppliers on the product market

Daily load curve: demand variation within day

Weakly load curve and generation mix

Load duration curve: demand pattern over the 8760 hours of a year

Total cost curves of different technologies
Supply curve (merit order), demand curve and price formation in power market

If there was fully centralized trading (obligatory pool)...

Prices are set by the marginal plant
Price formation on competitive short-term electricity markets

Assumed range of power demand

Market price

Low Demand (off-peak)

Hydro
Nuclear
Lignite
Coal
CCGT
GT

Supply (merit order)

Source: EU Energy Sector Inquiry Report

6th ERRA Training: Principles of Electricity Markets
May 7-11, 2018 Budapest, Hungary
Market dynamics: impact of demand and supply shifts on prices

...price over time would be formed by the interaction of the demand and supply curves...

Demand shock (heatwave)

Supply shock (outages)
Organized markets: power exchanges

- **Day Ahead - Intraday PX:** ‘public service character’ - TSO or state ownership
- **Futures - Derivative PX:** profit oriented activity. Private ownership by financial investors (Nasdaq, Deutsche Borse, ICE),

- **Regional PXs** – mainly in state/TSO ownership, with regulated income
- **Exchanges with futures options** are mainly in private ownerships
- **Three main PXs:** NASDAQ, EEX, THEICE
The balancing responsibility of TSOs

Balancing energy = Load curve – aggregate schedule – operational imbalance

- In case of vertical integration: own generation and dispatching
- In case of electricity markets: separate sub-market for system services
Procurement of system services

- TSO is a monopoly buyer (monopsony)
- Room for competitive tendering
- **Forward** contracting of primary, secondary and tertiary reserves (difference in speed to react)
  - Generators and large customers can participate
  - Capacity payments for availability
  - Financing through regulated system charges
- **Real time** procurement of balancing energy
  - Financing by those causing the imbalance
- Is there a scope for cross border trade in system services?
  - EU: yes!
Transmission services

- Transmission grid serves as a neutral ‘electricity highway’ to implement transactions
  - Physical law (Kirchoff laws) make the highway more ‘complex’
- Non-discriminatory and regulated access (including regulated access tariffs) is key
- Transmission capacity might be scarce: congestion
  - How to manage?
- Europe: congestion is typical at national borders
  - Main issue: cross-border trade and capacity allocation
Cross-border capacities and electricity exchange

- National electricity prices are different (countries with huge hydro or coal resources can produce electricity at lower cost)
- Market participants are interested in electricity exchange: importing low-cost electricity (produced in country A) into high-cost country (country B)
- Cross-border capacity rights are auctioned by neighbouring TSOs (daily/monthly/yearly auctions)
  - Market participants are bidding for cross-border capacities
  - Capacities are allocated to market participants who offered the highest prices for capacities
  - Successful bidders pay the market clearing price (as a rent) for using the cross-border capacity for a day/month/year
- As a result of cross-border trade national market prices are converging

Country A with low electricity prices

Country B with high electricity prices
3. THE CHANGING ROLE OF REGULATORS
The changing role of regulators

- Price regulation is reduced to
  - network access pricing
  - pricing public service obligations (universal service, renewable energy pricing)
- Guaranteeing non-discriminatory network access conditions
  - Cross-border trade regulation
  - Market integration support
- Data and information transparency
- Market monitoring and supervision
- Cooperation with antitrust
- Encouraging competition and new entrance
Market monitoring: rationale and major areas

- Detecting the flaws in market rules and functioning
  - Signal: market price seems ‘too’ high
- Generation: potential for market power
- Network: foreclosure based on network ownership
- Cross Border Trade distortions

Figure 1. Next day baseload prices on the relevant exchanges before and after market coupling
Few conclusions

• Proper diagnosis of the problem to be addressed is key for sector reform success
  – lack of investment or inefficient operation of existing assets or both?
• Massive private investment into new generation requires either the prospect of massive economic growth (Turkey) or contractual guarantees
• Only very rich countries (e.g. UAE) can recover the cost of new investment without cost reflective pricing (that is, by government subsidies)
• Private ownership is a friend of cost efficiency
• Competitive electricity arrangements sweat assets in the short run
THANK YOU FOR YOUR ATTENTION!

Your Name

E-mail: your email address

Web: website address