Why electricity market design?

• To understand the main market design choices;

• To understand the drivers of change in electricity markets;

• So you get an idea of how variable RES affects the market and vice versa.
Part I: History
Timeline

- Reforms in Chile and Argentina in the 1980s showed that competition in electricity was possible
- Telecom reforms in the UK (1983) demonstrated the possibility of competition in a network sector
- UK: The Gas Act (1986) and the Electricity Act (1989) intended to create competitive markets
- 1988 “The Internal Energy Market” (European Commission)
- These developments lead to Directive 96/92/EC (electricity) and Directive 98/30/EC.
Expectations

- State ownership/private monopolies $\rightarrow$ poor incentives
  - attempts to improve efficiency had failed
- Introducing competition appeared possible and effective, why not in electricity and gas?

Basic outline of market: competitive activities should be free, networks regulated, but:

- Choice between nTPA/rTPA
- Government tendering of capacity allowed
- Gradual phasing in of competition
- No regulator required
- No detailed market design decisions (no harmonization!)
The Electricity Directive
2003/54/EC

(Successor of 96/92/EC)
Principles:
• networks regulated monopoly, rest free market activity
• network and system managers independent
  • juridical unbundling, separate bookkeeping
• regulated access to the networks (rTPA)
• generation free, but license may be required
• supply: free after July 1st, 2007
• public service obligation for small consumers
The EU’s Third Package

- Replacements for Directives 2003/54/EC
- New regulations (e.g. regarding cross-border capacity allocation)
- Creation of European-level agencies:
  - ACER
  - ENTSO-E and ENTO-G
- Limited network unbundling
Now: reregulation?

UK energy package (currently being implemented):
- Minimum price for CO₂
- Emissions standard for power plants
- Feed-in tariffs for renewables
- Capacity mechanism
Part II: Market design
What is market design?

- The rules of the game: the directives, laws, regulations, codes that constrain the behavior of market parties.
- In a competitive market, market design is a primary means for government for achieving its objectives.
  - indirect process!
- What are the choices?
  - Evolve continually, are different everywhere
    - evolve how?
    - why different everywhere?
Where are we now?

- 1990s market ideology outdated:
  - from ‘deregulation’ to ‘restructuring’
  - ‘designing’ markets is difficult → typically the design evolves over time
  - competition in electricity is oligopolistic at best
  - the decarbonization effort requires fundamental change
    - in many ways not compatible with current market design
- But the changes are irreversible
  - strong commitment of the EU
  - many changes cannot be undone, e.g. privatization, mergers

- Need to use market design to achieve (climate) policy goals
Q: What are typical elements of the ‘textbook’ model of restructuring? (What needs to be done to create competition in electricity?)
Textbook model (Littlechild)

- privatization
- vertical unbundling
- horizontal restructuring
- independent system operator or TSO
- ancillary services markets
- regulation of transmission and distribution
- retail competition
- independent regulator
Conceptual framework

Institutional layer:
- Electricity producers
- Power exchange
- Bilateral market
- Balancing mechanism
- IM/export capacity allocation
- System operator
- Transmission network managers
- Distribution network managers
- TSO

Physical layer:
- Generation
- Transmission network
- Distribution networks
- Load

Wholesale market:
- Large consumers
- Retail companies

Retail market:
- Small consumers
Main choices for market design

• Degree of market opening  
  (Where do we allow competition?)
• Integrated versus decentralized wholesale market  
  (Governance of short-term trade and congestion management)  
  - locational marginal pricing (nodal pricing)?
• Capacity mechanism  
  (Governance of investment)
• Renewable energy support scheme

In every design the many detailed choices can be made to foster competition or to favor the incumbents!
Q: Where in the value chain is competition possible?
- Which type of competition?
- Consequences for market design?
Degree of market opening

1. Wheeling

Examples: between integrated utilities in the USA
Degree of market opening

2. The single buyer

Theoretic model
Degree of market opening

2. The single buyer

Examples: Czech Republic, Hungary, many developing countries (e.g. Indonesia)
Degree of market opening
3. Wholesale competition

Diagram:
- Producer
- Distribution company
- Small consumers
- Large consumers
Degree of market opening

3. Wholesale competition

- Example: many European countries prior to the introduction of retail competition

- Typical feature: distribution and retail integrated
  - no need for retail/distribution unbundling
  - much simpler organization
  - distribution companies can enter into long-term contracts for generation.
Degree of market opening

4. Retail competition
Degree of market opening

4. Retail competition

- Current EU model (although not all countries are here yet)
- Need unbundling of retail and distribution
  - high transaction costs
    - restructuring costs and permanent costs
Transaction cost associated with degree of market opening

- Degree of market opening
  - Single buyer model
  - Wholesale competition
  - Retail competition

- Need TSO unbundling
- Need TSO unbundling
- Need distribution network unbundling
- Capacity mechanism

- Low contractual cost and little regulatory burden
- Some contracting cost for industries + need of transmission regulation
- More contractual cost for generators & retailers + more regulatory burden to regulate transmission and distribution operation

Increasing transaction costs
Integrated market

- All power traded through a single *pool* (mandatory!)
- Pool typically operated by ISO or TSO
- Allows for high degree of central optimization.
  - the pool operator knows market bids and network data
  - there is no need to clear the market in advance
  - possibility to incorporate congestion management as *nodal pricing*

Q: using the conceptual framework, what would an integrated market look like?
Electricity market design

TSO
im/export
capacity
allocation
bilateral
market
power exchange
balancing mechanism
im/export capacity allocation

Conceptual framework

institutional layer

electricity producers

power exchange

bilateral market

system operator

transmission network managers

distribution network managers

TSO

wholesale market

retail market

large consumers

retail companies

small consumers

physical layer

generation

transmission network

distribution networks

load

Electricity market design

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Capacity markets and RES support schemes...

• ... will be discussed in separate lecture
Part III: The market design process: how are markets shaped?
At the start of the liberalization process

- One-off, ‘blueprint’ concept of market design.
- Dominated by neo-classical economic theory
  - static equilibrium
  - focused on short-term economic efficiency

- What’s wrong with this view? (Which assumptions are not met?)
How we see it now

- Perfect market design unlikely to be achieved
- Markets never in equilibrium
  - insufficient knowledge
  - regulatory uncertainty
- Different interests keep affecting market design
  → cyclical process
- Limited knowledge and understanding
  → uncertainty about what is the best market design

→ Market design is an evolutionary process
Starting point: New Institutional Economics (Williamson, 1998)

- Informal institutions, customs, traditions, norms, religion
  - Institutional environment: Formal rules of the game, esp. property
    - Governance: play of the game, esp. contracts
      - Resource allocation and employment (prices and quantities; incentive alignment)

Level

<table>
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<th>Time Constant (years)</th>
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<td>1 to 10</td>
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<td>Resource allocation and employment</td>
<td>continuous</td>
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Applying the model to electricity

Informal institutions

Customs, traditions, norms, religion

Formal institutions

General: polity, judiciary, bureaucracy, competition law

Sector-specific: **Electricity laws and decrees**, e.g.:

- degree of network unbundling
- regulation methodology
- capacity mechanism
Applying the model to electricity (2)

Governance

- **Sector regulator**: regulations, codes etc.
- **Inter-firm**: spot market rules, industry standards & codes
- **Within firms**: contracts, market structure, horizontal/vertical integration, investment, private/public ownership

Resource allocation and employment

- **Operation and maintenance**:
  - plant
  - network
  - system
The market design process: conceptual framework

- There are certain ‘design variables’
  - in principle chosen by the government
  - government decisions are influenced by stakeholders
- Environmental conditions constrain the choices
  - e.g. presence of hydropower, economic stability
- Different people want different things
  - range of policy goals & drivers for restructuring!
- We don’t start from a clean slate
  - past decisions affect our current options.
General policy goals: AAA

• Availability
  • reliability, security of supply

• Affordability
  • economic efficiency
    • efficient prices
    • dynamic efficiency: adequate investment
  • welfare distribution
    • reasonable profits

• Acceptability
  • reasonable environmental and social impact, nuclear safety
Related policies

The restructuring process is influenced by related policies, such as:

- Fuel policy/nuclear policy
- Poverty policy
- Social policy, e.g. employment in coal mines
- CO₂ policy
- Renewables policy, other environmental policies
- Political relations with interconnected neighbors
Motives for restructuring

- Increase economic efficiency of power sector
- Lower end user prices (esp. for large consumers)
- Achieve integration with neighboring markets
  - for general economic advantages
  - in order to export power
- Attract (foreign) investment
- Part of general economic liberalization program
- Comply with higher authorities: e.g. FERC, EU, World Bank, IMF.
Market design variables

- Degree of market opening
- Integrated versus decentralized market
- Capacity mechanism
- RES support
- Public versus private ownership
- Pace and sequencing of restructuring process
- Network regulation (unbundling, tariffs, access, congestion)
- Regulation of system and network operation
- Price regulation (wholesale, end user)
- Position of regulator
- Balancing mechanism

And don’t forget competition policy and horizontal unbundling!
Impact of the status quo

Something is a variable if at least one of the actors in the system (government, industry, regulator, TSO, consumers) can influence its value.

→ Market design is a political process.
  • Risk of inconsistent choices,
  • Risk of stalemate.
  • Therefore the current situation impacts the available market design choices.

→ Path dependence!
Uncertainty

The best choice may not always be clear, e.g.:
- integrated or decentralized market?
- capacity mechanism yes or no, and if yes, which one?
- the benefits of retail competition?

Causes:
- Lack of transparency, lack of data
- (Mental) models inadequate for explaining the data
  - e.g. a simple price spike: due to scarcity, market power, collective trader behavior (panic?).

→ Given uncertainty, tendency to minimize change.

Q: Which sources of uncertainty affect which stakeholders?
# The context for restructuring

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<td>Influence of stakeholders</td>
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The dynamics of restructuring market design

context:
- institutional
- economic
- physical/technical

related policies

past policies

starting conditions

policy objectives
- economic efficiency, low prices
- security of supply
- environment
- security of supply
- labor, social stability
- etcetera

feedback:
- time delay
- limited data
- bounded rationality

horizontal unbundling, competition policy

market design

market parties’ strategies

market outcome

context:
- institutional
- economic
- physical/technical

related policies

past policies

starting conditions

policy objectives
- economic efficiency, low prices
- security of supply
- environment
- security of supply
- labor, social stability
- etcetera

feedback:
- time delay
- limited data
- bounded rationality

horizontal unbundling, competition policy

market design

market parties’ strategies

market outcome
Consequences of this view

- There is limited understanding of the impact of market design choices
  → Uncertainty about the best market design.
- Markets never in equilibrium
  - insufficient knowledge
  - regulatory uncertainty
  - path dependence
- Different interests, changing circumstances keep affecting market design
  → Market design is an evolutionary process.
Implications for developing countries

- The textbook model is not necessarily optimal (or feasible).
- Market design depends on policy goals and local context, e.g.
  - Options for attracting foreign investment, e.g.:
    - Capacity mechanism (e.g. capacity market).
    - Single Buyer model
    - Mandatory long-term contracts (Brazil)
  - To keep the institutional structure simple and the overhead small, an option is to retain the consumer franchise.
  - Single Buyer model: possible to lower investment risk for IPPs, but susceptible to corruption.
Conclusions 1: Market design choices

- Main choices:
  - degree of market opening
  - organization of wholesale market
  - capacity mechanism
- Best practices can be identified (unbundling, independent regulator etc.)
Conclusions 2: Market design process

- Think in terms of physical infrastructure and actors layers
- The market design is affected by
  - the starting situation
  - physical, economic and institutional environment
  - goals of government and other actors
  - delayed feedback, bounded rationality
- Therefore one size does not fit all!
Conclusions 3: Current EU market design

EU

- Lack of harmonization is costly
- Decentralized markets: high transaction costs
- No retail competition + prohibition of vertical integration may create more effective wholesale competition
- Need for capacity mechanism?
Conclusions 4: Energy transition

- Markets create efficient short-term equilibria
- But the energy transition requires different thinking
  - gradual adjustment of market constraints may not work
  - technical, economic and institutional path dependence
- Additional policy instruments available:
  - RES-E, capacity mechanism, emissions standards, CO$_2$-price regulation...
- Risk of ‘pancaking’ policy instruments, different ones in each country.
Conclusions 5: Developing countries

The need to keep investment risk low is often dominant. Options:

- Single Buyer
- Wholesale competition, no retail competition, capacity mechanism optional
- Wholesale competition with retail competition and capacity mechanism