The Essential Role of Investment Markets in Electricity Market Design

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Based on joint work with Axel Ockenfels and Steven Stoft
Goals of electricity markets

• Short-run efficiency
  – Least-cost operation of existing resources

• Long-run efficiency
  – Right quantity and mix of resources
Challenges of electricity markets

• Must balance supply and demand
  at every instant
  at every location
• Physical constraints of network
• Absence of demand response
• Climate policy
Climate policy

• Transformation to renewable

• Germany
  – Replace nuclear with renewable
  – 80% renewable (mostly wind) by 2050
  – Significant probability of multiple days with wind in-feed less than 5% of capacity
  – Must back-up wind with peaker capacity
  – Require additional 30 GW of peakers by 2030
  – *How to get this built?*
Three Markets

• Short term (5 to 60 minutes)
  – Spot energy market

• Medium term (1 to 3 years)
  – Bilateral contracts
  – Forward energy market

• Long term (4 to 20 years)
  – Capacity market (thermal system)
  – Firm energy market (hydro system)

• Address risk, market power, and investment
Why not energy only?

- **Market failure**
  - Absence of demand side

- **Practical realities**
  - Price caps
  - Operator decisions
  - *Missing money*
Long-term market: Buy enough in advance
Purpose of market

• Induce just enough investment to maintain adequate resources
• Induce efficient mix of resources
• Reduce market risk
• Reduce market power during scarcity
• Pay no more than necessary
The four P’s to a successful design

• Planning
• Product
• Performance
• Pricing
Planning

• How much do you need?
  – Transmission and generation

• Rating of resources
  – Contribution of resource during scarcity events

• Planning by experts, not politicians

• Planning responsive to new information

• Planning optimizes reliability tradeoff: more capacity vs. more blackouts
Product

• What is load buying?
  – Energy during scarcity period (capacity)

• Enhance substitution
  – Technology neutral where possible
  – Separate zones only as needed in response to binding constraints

• Long-term commitment for new resources to reduce risk
Performance

• Strong performance incentives
  – For timely development of new resource
  – To provide energy and reserves as required
    • Penalties for underperformance
    • Rewards for overperformance

• Tend to be too weak, leading to
  – Contract defaults
  – Unreliable resources
Pricing

• Good price formation
  – Advance purchase before project costs are sunk
  – Descending clock auction to encourage price discovery
  – Downward sloping demand curve for price stability (buy more when price is low)
Example long-term markets

• United Kingdom and New England (thermal dominated)
  – Product
    • Capacity: Ability to supply energy during hours short of reserves

• Colombia and Brazil (hydro dominated)
  – Product
    • Firm energy: Ability to supply energy during dry periods

• Comparison of what load is buying
  – UK and New England: price coverage only during shortages
  – Colombia: price coverage during extended dry periods
  – Brazil: full price coverage from long-term contract with new entry and medium-term contracts with existing resources

• Supplier exposure to the energy price
  New England > Colombia > Brazil
Conclusion
Forward markets address key problems of wholesale markets

- **Investment**
  - Coordinated entry to have what is needed

- **Risk**
  - Lock in price for capacity
  - Both suppliers and demanders face less risk

- **Market power**
  - Suppliers/demanders in more balanced position entering spot
Conclusion

• Long-term market requires a sound market framework
  – Predictable and stable regulatory setting
  – Effective market rules that support efficient medium and short-term operation of existing resources

• With sound framework, capacity market can produce complementary benefits
  – Coordinated efficient investment
  – Reduced risk
  – Improved performance in periods of scarcity