Markets for Resource Adequacy

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Goals of electricity markets

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

• Long-run efficiency
  – Right quantity and mix of resources
A tale of two markets

• New England (33 GW)
  – Thermal dominated
  – Reliability
    • Resources to serve annual peak
    • Resources to respond to contingencies
  – Product
    • Capacity: Ability to supply energy during hours short of reserves

• Colombia (13 GW)
  – Hydro dominated
  – Reliability
    • Resources to supply energy in dry period
  – Product
    • Firm energy: Ability to supply energy during dry periods
Why a firm energy market at all?
Other industries don’t have one

**Short run**

**Long run**

\[ E(Rent) = \text{Fixed cost} \]
Electricity demand is inelastic

Result: Generators cannot cover fixed costs from energy revenues
Why have a market?

- Absence of demand response
- Market power during scarcity
- Spot prices too low during scarcity
  - Price caps
  - Operator decisions, such as voltage reduction, which impact price
Energy-only is problematic

- High risk (occasional NZ$17,000 price)
- Market power
- Weak investment signal
- Intervention likely
  - Government’s Whirinaki 155 MW reserve plant
  - Needed for 1 in 60 dry year
Purpose of market

- Induce just enough investment to maintain adequate resources
- Induce efficient mix of resources
- Reduce market risk
- Avoid market power in firm energy market
- Reduce market power in energy market
- Pay no more than necessary
Key features
Forward procurement

• New projects compete in advance of entry
  – Coordinated entry
    • Less uncertainty in achieving target
    • Avoid boom/bust
  – New entry sets price directly

• Long-term commitment for new resources
  – Reduced investor risk
  – Better price signal for new investment
Product

• Firm energy — availability of energy during scarcity events
  – Dry period (seasonal scarcity)
  – Outages (spot scarcity)
• Scarcity event defined by high energy price
  – Energy price is a *transparent* trigger
  – Energy price is a *reliable* trigger
Product is:

- Firm energy + mandatory hedge
- Firm energy =
  - Expected energy contribution to system in dry period
- Mandatory hedge = (call option)
  - Obligation follows load
    - Unit’s daily obligation based on its firm energy sold
    - Obligation over day tied to dispatch
    - Matching obligations with dispatch improves the performance of the spot energy market
  - Rewarded if shift output to higher priced hours
Planning period

- Time between auction date and start of commitment
- 4 years — long enough for new entry to occur (except large hydro projects)
- Makes firm energy market contestable and allows new entry to set the price
  - Existing resources would set the wrong price because of sunk costs and market power
Commitment period

• New resource — up to 20 years
  – Long commitment lets new resource lock-in firm energy price, reducing risk and encouraging investment

• Existing resource — one year
  – Does not need long commitment, since costs are already sunk
  – Short commitment reduces risk (more draws from price distribution)
Demand curve

Curve reflects marginal value of firm energy

Able to withstand scarcity events worse than worst-case benchmark

CONE = Cost of New Entry (marginal unit)
Descending clock auction

Price

starting price

$12.00 = P_0$

$6.17 = P_6$

$6.00 = P_6'$

Demand

Quantity

Aggregate supply curve

excess supply

Round 1

Round 2

Round 3

Round 4

Round 5

clearing price

$P_1$

$P_2$

$P_3$

$P_4$

$P_5$
Market power

• Addressing market power in firm energy market is essential

• Strong incentive to exercise market power
  – Existing resources have substantial sunk costs
  – New resources are only a tiny fraction of total
  – Market is concentrated
    • Any of top-4 suppliers could unilaterally set price

• Long-term price signals are more stable and efficient if determined from competitive forces, rather than market power
Market power solution

• New resource
  – Bids are not mitigated in any way
  – Assumes competition for new resources

• Existing resource
  – Resource can opt out of market or retire
  – Opt-out bid
    • Not revealed during auction
    • Cannot impact the price for existing supply
  – Retirement
    • Can impact price, but exit is permanent
Performance incentives

- Performance incentives come from energy spot price; this is not changed by hedge
- Hedge assures that normal performance will receive normal reward in wet and dry years alike
- Every extra MWh of energy is rewarded the same with or without hedge
  - Those that perform better receive more
  - Those that perform worse receive less
Why not have a very high strike price? (US$250 or more)

• Benefits of call option are largely lost
  – Load hedge
  – Mitigation of market power in spot energy market

• No reason to set strike price higher than marginal cost of an expensive thermal unit
Simulation
Purpose

• Assess supplier risk
• Consider variations of market design
• Evaluate alternative auction parameters
Distribution of annual profits per MWh of firm energy

- Hedge dramatically reduces risk
- Energy rent primary source of risk
- Impact of higher strike price
  - Profit distribution shifts toward no hedge case
    - Large increase in energy rent risk
    - Small decrease in hedge payment risk
    - Large increase in profit risk overall
Conclusion
Physical resource with hedge

• Coordinated entry reduces boom/bust cycle
• Hedge reduces risk
  – Load is hedged from high spot prices
  – Suppliers get nearly constant payment, rather than highly variable peak energy rents
• Hedge improves spot market
  – Mitigates market power problem during scarcity
    • Can rely on demand response rather than rationing
  – Better spot market improves forward energy market
    • Spot energy prices are more stable and predictable