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ELECTRICITY MARKETS DEVELOPMENT PROGRAM-GEMTP II

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Spot and Balancing Markets
Power Procurement & Trading
Contracts and Negotiations

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Overview of Presentation

- Power Procurement and Trading
- Contracts and Negotiations
- Bilateral Trading Agreements
- Operational Planning

Electric System Timeline

Transmission Construction:
3-10 years

Generation Construction:
2-10 years

Planned Generation and Transmission Maintenance:
1-3 years

Unit commitment:
12 hours ahead for the next 24 hour day

Economic Dispatch:
Every 5 minutes but planned for 6 hours ahead

Note: diagram not drawn to scale

Characteristics of Electricity Markets Related to Power Procurement

- Volatile electricity prices
  - Volatile input fuel prices
  - Uncertain demand and generation and transmission availability
  - Emission allowances
- Type of electricity market

Types of Power Procurement

- Power Contacts
- Spot Market
- Trading and Risk Management
  - Trading desk
  - Portfolio management
  - Complex risk management instruments

Volatility of Electricity vs. Other Commodities (EIA)

Commodity	Average Annual Volatility (%)	Market	Period
Electricity			
California-Oregon Border	309.9	Spot-Peak	1996-2001
Cinergy	435.7	Spot-Peak	1996-2001
Palo Verde	304.5	Spot-Peak	1996-2001
PJM	389.1	Spot-Peak	1996-2001
Natural Gas & Petroleum			
Natural Gas	78.0	Spot	1992-2001
Light Sweet Crude Oil, LLS	38.3	Spot	1989-2001
Heating Oil	38.5	Spot	198-2001

Purpose of Forecasting

- Forecast future prices (create a forward curve)
- Forecast ranges of future prices
- Two types of forecasting
  - Technical - assumes that pricing patterns in the past will repeat themselves
  - Fundamentals - using fundamental market relationships to estimate future prices

See Modelling Prices in Competitive Electricity Markets, ed. Derek W. Bunn, Wiley 2004.

Technical Forecasting

- Identify daily, weekly, and seasonal patterns
  - Curve fitting/time series analysis - fit a curve to past data and project that curve forward in time in order to estimate future electricity prices
  - Random walks - assume electricity price movements are random in order to determine the value of various risk management instruments

Price Forecasting Using Market Fundamentals

- At its core, this type of forecasting assesses future supply and demand conditions and from that assessment forecasts future electricity prices based on the intersection of supply and demand
- Can range from simple to extremely complex modeling

Forecasting Prices Using Fundamentals

- Determine the time period and time increment of interest
- Determine the sophistication of supply-demand analysis (a tradeoff of time/money and accuracy)
- Build a data base
  - Generation
  - Transmission
  - Load

Forecasting Prices Using Fundamentals

- Determining where supply and demand intersect
  - Relative changes from history
  - Dispatch models
    - Generation constraints
    - Generation outages
    - Transmission constraints
    - Transmission outages
    - Load forecasts

Comparison of Forecasting Techniques

- Technical
  - Relatively inexpensive
  - Require historical data
  - May require advance mathematical models that are difficult for non-experts to understand
  - Do not provide intuition or predictions when structural changes occur
- Fundamentals
  - Provide intuition
  - Can be used when structural changes occur in the market
  - Can be expensive and data intensive
  - Assume perfectly competitive conditions

Types of Risk Management Instruments

- Futures contracts
- Bilateral (forward) contract
- Options, swaps and other types of derivatives
- Physical assets
  - Remember, a new physical asset changes the underlying market whereas a financial instrument does not
- Combinations of the above
- Can hedge price or some factor that affects price, e.g., weather (e.g., degree day), generation unit performance, fuel price, price differences (e.g., spark spread)….

Futures and Bilateral (Forward) Contracts

- Futures - a standardize contract with specific terms and conditions that is bought and sold on an organized exchange; the exchange assumes the credit risk of non-performance by either party
- NYMEX has futures electricity contracts in PJM
- Bilateral - a contract between two parties

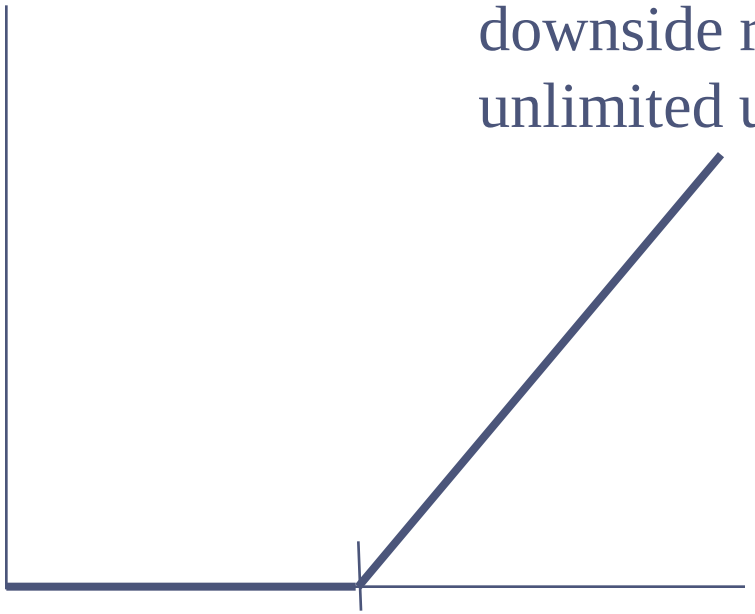
Option Example

- e.g., Option to buy 100 MWh of electricity tomorrow at 12 noon at $100/MWh
  - Buyer pays the seller an agreed to price
  - If the electricity price tomorrow at noon is greater than $100/MWh the buyer of the option exercises the option
  - Otherwise, the option expires without being exercised

Call Option Payout

Option Value ($/MWh) not including purchase price

A call option has a limited downside risk and an unlimited upside potential.



Strike Price

$100/MWh

What would the payout for a put option look like?

What Determines the Value of an Option

- Black-Scholes Formula
- Volatility -the higher the volatility, the more valuable the option is
- Expiration date - the longer the expiration date, the more valuable the option is
- Strike price - the lower the strike price, the more valuable the option is
- Risk free interest rate (a technical issue)

Swaps and Esoteric Options

- Swap - an agreement whereby a floating price is exchanged for a fixed price over a specified period
- Esoteric Option - fundamentally combinations of puts and calls at different strike prices to manage specific types of risks
  - Caps, floors, collars, swaptions, calendar spreads, Asian options, barrier options, floating strike, ladder and cliquet options

Other Key Risk Management Terms

- ICE – Intercontinental Exchange operates a global future marketplace for trading energy commodity contracts and other services
- OTC - over the counter; indicates a customized risk management contract as opposed to a standardize one sold on an exchange
- NYMEX - New York Mercantile Exchange
- Basis risk - is the risk that the value of a futures contract does not move in line with that of the underlying exposure
  - e.g., locational basis risk
- Liquidity - the ability to get out of a position quickly without driving the price down

Credit Issues & Trading Limits

- Markets and exchanges require sufficient credit in order to by in the market
  - This is an active area of concern of ISOs
- Mark-to-market
  - An entity's risk exposure and therefore the amount of credit it has available is adjusted as the value of its position changes, usually daily
- Value-at-Risk (VAR) - measures the risk of a portfolio
  - A portfolio is a set of positions, each of which is composed of some underlying instrument/asset.
  - To calculate the risk of a portfolio, must be able to compute the risks of the positions that compose the portfolio
- Netting
  - See EEI web's site for generic netting agreement

Contracts and Negotiations

- Economic Characteristics of Contracts
- Objectives of Well-written Contract
- Elements of a Typical Power Contract
- Contracting Do’s and Don’ts

Purpose of Contracts

- Providing and Improving Incentives
  - Principal-agent problem
- Allocation of Risk
  - Reallocating, sharing, and spreading risk
- Reduction in Transaction Costs
  - Transaction costs: costs of negotiating, executing and enforcing contracts
  - Long-term contracts, umbrella contracts, and vertical integration reduce transaction costs

Types of Power Contracts

- Spot Contracts
  - Contracts for immediate delivery
- Forwards and Futures Contracts (see below)
- Power Purchase Agreements (PPAs)
- Wholesale Contracts
  - Full requirements contracts
  - System contracts
- Retail Contracts

Power Purchase Agreements

- Energy Payments
  - May be fixed, indexed, based on actual or stipulated heat rates
- Availability Payments
  - Payments based on availability of unit
  - E.g., bonuses or penalties for exceeding or missing target availabilities
- Capacity/fixed Cost Payments
- Ancillary Services Payments
- Other Contractual Components
  - Operational control, maintenance scheduling, treatment of forced outages

Other Key Elements of a Bilateral Contract

- Transaction terms and conditions
- Obligations and deliveries
- Remedies for failure to deliver/receive
- Events of default
- Payment and netting
- Limitations
- Credit and collateral requirements
- Miscellaneous
- See Edison Electric Institute's (EEI) webpage:

http://www.eei.org/industry_issues/legal_and_business_practices/master_contract/index.htm

Ancillary Services

- Operating Reserves
  - Ten minute spinning reserves
  - Ten minute non-spinning reserves
  - Thirty minute reserves
  - Replacement reserves
- Automatic Generation Control (AGC)
- Black Start Service, Voltage Control (VARs) aka Reactive Power, ...
- Definitions are not consistent
- Problems arise when ancillary services are such that they interact with the energy market