Managing Risk of a Power Generation Portfolio
Portfolio Management Project

- Background
- Market Characteristics
- Financial Risks
- System requirements
- System design
- Benefits
Overview

- TransAlta Corporation is Canada's largest non-regulated electric generation company,
  - more than $7-billion in assets
  - 9,500 megawatts of capacity.

- Energy Marketing plays a key strategic role for the Corporation
  - delivering generation output to the best markets;
  - optimizing individual generation asset returns
  - managing a portfolio of generation assets to meet shareholder expectations.

- SAS Risk Management is working with TEM
  - developing a solution to manage price risk of operating in a volatile deregulated power market

- Dynamics of the North American power market require
  - timely and informed decisions be made
  - management of a mix of contracts and products that are sold for the total generation portfolio
  - requires that risks such as price, credit, operational and foreign exchange are both measured and managed within shareholder expectations.

- First phase of this project is focused on managing revenue risk and earnings,

- Subsequent phases of SAS Risk Management project could include
  - everything from market information to better risk mitigation against the fluctuation in foreign exchange; and credit risk
Volatility Comparison

Volatility Comparison Energy & Equities

30 Day Average Volatility

Dow Jones
Nasdaq
Crude Oil
Natural Gas
Mid C Peak Power

'Jun 2000' 'Sep 2000' 'Jan 2001' 'Apr 2001'

Market
Volatilities and Correlations

- Annualized daily volatilities for power ranged from a high of 413% in 1999 to a low of 241% ytd 2001

- Natural gas annualized daily volatilities ranged from a high of 188% in 2000 to a low of 91% in 1999

- Quarterly correlations of power to gas ranged from a low of 7% to a high of 45%
Characteristics of Energy Commodities

Power Market Characteristics create both risk and opportunities

Characteristics include:

- Convenience yield
  - power has no storage
- Seasonality
- Volatility
- Mean Reversion
- Jumps
- Autocorrelation
- Cross commodity correlation
Forward market

- prices are volatile
- greatest volatility in current year
- prices are shaped to reflect seasonality
- risk premiums are built for uncertainty and liquidity
Supply / Demand

Key Factors Impacting

Supply
- current supply stack for hydro; nuclear; coal; gas
- plant derates
- new additions
- export capability

Demand
- seasonality
- weather
- time spreads
- market segmentation
- price
Impact on Revenues

Price volatility requires good operations and continual margin management

Risks
Finding Optimal Level of Risk

- Manage power sales from term to physical delivery

- Optimal balance of
  - price
  - volume
  - credit risk
  - is just one risk number
Outage Risk

Generation Plant Position Report

- Sch. Gen
- Actual Gen
- Firm Contracts
- Contract Price
- Daily Avg. Price

MWHs

$ / MWh

12/01/00 12/03/00 12/05/00 12/07/00 12/09/00 12/11/00 12/13/00 12/15/00 12/17/00 12/19/00 12/21/00 12/23/00 12/25/00 12/27/00 12/29/00 12/31/00 01/01/01 01/03/01 01/05/01 01/07/01 01/09/01 01/11/01 01/13/01 01/15/01 01/17/01 01/19/01 01/21/01 01/23/01 01/25/01 01/27/01 01/29/01 01/31/01

Risks
Sequence of events

- Plant generation full out and fulfilling contracts
- One plant generation unit goes down and must source supply from market to fulfill contract obligation
- Real time desk mitigates risk by switching from buying to selling in matter of minutes
Business Needs

Financial risk associated with a deregulated power market requires the Generation Companies to develop sophisticated and real-time decision-making tools to manage their business.

Decisions are continuously being made and updated on:
- Short and long term business plans
- Optimal hedges
- Adding value and optimizing revenue of generation assets
- Contract negotiations
- Fuel diversity and contracts
- Geographic diversity
- Fuel contracts
- New asset build or acquisition

Requirements

Tools must be capable of modeling:
- Generation asset diversity
- Multiple markets with changing and different characteristics
- Integration of vast amounts of data:
  - market prices
  - supply / demand
  - transmission flow
  - weather
  - credit, FX, interest rates
  - emissions
- Timely
- Interaction with other systems
- Sophisticated and easily modified reporting capability
Incorporating Market and Risks - Models

Factors to consider in models
- Non Goemetric Brownian Motion
  Returns do not follow a normal distribution
- Speed of mean reversion varies but gravitates price to marginal cost of production
- Spikes are usually asymmetric – process is considered to be a “floor reverting process”
- Incorporating jump - diffusion models is standard practice
- What you need to remember
  - Price volatility constantly changes
  - Fat tails in price distribution

Model Parameters
- Generation assets modeled as a series of European call options
- Asset owner will run unit as long as marginal price of power higher than marginal cost of generating
- Payoff for each spark spread option = \( \text{Max}[P_e - h \times P_g - K, 0] \)
  - \( P_e \) = market price of electricity (probably day ahead market)
  - \( P_g \) = market price of fuel
  - \( H \) = generation asset heat rate
  - \( K \) = other variable cost of operating including maintenance, ramp rates etc.
Data Flow Map

Tier 1
External Data

ISO Hourly Prices
Exchange Data
Web Scrapers
Plant data

Message Application Tier

Tier 2
Staging Area

Tier 3
Data Warehouse

Risk Data Storage
SAS Data Storage
Real time data Storage

Message Business Tier

Tier 4
Data Mart

Risk Dimensions

Message information Transformation Infrastructure
Logical System Design

SAS Risk Dimensions

Markov chain model

Physical plant revenue
- dispatch costs
- economic dispatch
- startup costs

Contract revenue

Derate costs

Replacement power costs

Foregone spot sales

Foregone contract revenue

Asset Model
- decide if generation plant should be economically dispatched

Two factor model

Plant availability net of maintenance

Financial & Physical contracts
- price
- volume
- duration
- interruptible

Non-interruptible flat volume

Interruptible contracts

Market upticks

Maintenance impact

Outage cost model
Portfolio optimization project will initially provide

- Earnings at Risk and distribution of expected cash flows
- Nonlinear optimization of risk adjusted returns
- Return / risk tradeoffs
- Risk propensity
- Short term optimization

Future potential includes integration of all corporate risks and developing management tools for

- Credit, FX and Interest rate exposure
- Real time market price analysis
- Structured products
- Continuous hedge optimization