GLOBAL ENERGY RISK MANAGEMENT:
TURNING RISK INTO A
COMPETITIVE OPPORTUNITY

Glenn Labhart
Partner, Labhart Risk Advisors Inc.
Chairman of Energy Oversight Committee
GARP’s Energy Risk Professional Program
GARP Energy
Risk Professional Program
“ERP”
Mission
To advance the risk profession through education, training and the promotion of best practices globally.

Independent, Non-partisan
Committed to advocating best practices in risk management.

GARP does not lobby or engage in any consulting activity.
The ERP Exam

**Part I - Physical Energy Commodity and Electricity Markets – 80 Questions**

- Intro to Energy Commodities and Risk Management: 10% - 8 Questions
- Crude Oil Markets and Refined Products: 25% - 20 Questions
- Natural Gas and Coal Markets: 25% - 20 Questions
- Electricity Markets and Renewable Generation: 30% - 24 Questions

**Part II - Financial Energy Products and Risk Management – 60 Questions**

- Financial Energy Products: 30% - 18 Questions
- Risk Assessment and Energy Price Modeling: 30% - 18 Questions
- Risk Management Tools: 30% - 18 Questions

2 years work experience

Energy Risk Professional ERP®

Continuing Professional Development (CPD)
Top ERP Companies

Over 1,500 certified ERPs globally
ERP Skills Applied to Different Careers

- **Integrated Oil & Gas Companies**: Evaluate commercial risks associated with upstream production, transportation, and processing of oil and gas.

- **Electricity Generators and Power Utilities**: Evaluate commercial risks associated with generation, transmission, and distribution of electricity.

- **Renewable Energy Companies**: Evaluate project economics, commercial risks, and challenges associated with integration of renewable power.

- **Commodity Trading, Scheduling, Structuring and Origination**: Apply knowledge of physical transport, storage, and product processing to assess market opportunities.

- **Consulting**: Leverage holistic view of energy markets to satisfy client objectives across a variety of projects, including technology applications.

- **Banking**: Assess and manage market and credit risk, model construction and validation.

- **Research and Investment Management**: Apply knowledge of market fundamentals and technical trends to inform investment decisions.

- **Enterprise Risk Management and Operational Risk**: Assess and manage firmwide op risk, implement ERM.

- **Treasury**: Assess firm’s liquidity policies and manage corporate funding needs.

- **Finance/Controllers**: Demonstrate independent thinking and aptitude to understand the full scope of business, distilled into complex accounting, finance and reporting systems.

- **Audit**: Examine adequacy of firm’s risk controls and processes.

- **Regulatory Compliance**: Understand the market rationale for proposed regulations and their impact on business models.
Candidate Resources

- Hard cover books
- E-books
- (Pricing available on GARP website)

- Exam Study Guides
- Exam Study Guide
- Changes
- Learning Objectives
- 15 Week Study Plan
- Practice Exams

- Exam Prep Providers
- Local Study Groups
- GARP Chapters

- GARP Website
- Social media
Complex view of Energy

Crude Oil, NGL, Refined Products, Natural Gas, LNG, Electricity

Supply

Production

Transportation/Storage

Refining/Processing

Distribution

Demand

Real Option Valuation

Hedging Trading

Underlying Risks

Credit
Market
Operational
Legal

Financial Disclosure
Compliance

Hedging Trading

Underlying Risks

Credit
Market
Operational
Legal

Financial Disclosure
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Market
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Legal

Financial Disclosure
Compliance

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Underlying Risks

Credit
Market
Operational
Legal

Financial Disclosure
Compliance

Risk Measurement, Structuring and Valuation, Financial Instruments, Options

Predictive Analytics
To Assess Market Drivers that Produce Value
USAEE
Program

Presented by GLENN LABHART

CONFIDENTIAL
Speakers for Today

Glenn Labhart  
Partner, Labhart Risk Advisors Inc.  
Chairman of Energy Oversight Committee  
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Spyros Maragos  
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Manager, Structuring Group  
DIRECT ENERGY

Gordon Goodman  
Independent Consultant  
Candidate for Texas Court of Appeals  
GARP EOC Board Member

Kevin Hulsey  
Director  
Shell Trading Risk Management, LLC
Welcome 1:15 to 1:30
Energy Risk Fundamentals 1:30 to 2:00
Energy Real Option Value Enhancement 2:00 to 3:00
BREAK 3:00 to 3:15
Credit Risk in Energy 3:15 to 4:00
Energy Risk Execution 4:00 to 5:00
Summary

• Understanding risk types
• Assessing risk of owning assets and creating additional value.
• A focus on defining risk at the board level and delegating acceptable risk taking to areas within the company.
• Transactional Risk & Limits
• Understanding energy pricing
• Real option valuation strategies.
• Credit Risk Management
• Risk Execution
Defining Risk Management
What is Risk?

Exposure to Uncertainty.

Risk Management

A comprehensive process to manage the impact on the total return of an enterprise, allowing it to achieve the stated business goals and objectives.
What is keeping CROs up at night?

- Operational Risk
- Credit Risk
- Risk Culture
- Market Risk
- Financial Crime
- FinTech & Digitisation
- Regulatory change
- Geopolitical uncertainty
- Cyber security
Terms you will hear

- Risk Appetite
  - The amount of acceptable risk
- Risk Tolerance
  - The measurement of acceptable risk
- An asset’s ability to generate cash flow from current operations (also called “intrinsic value”)
- An asset’s expected future increase in cash flows through optimization, expansion, restructuring, and/or buyer strategic synergies (also called “extrinsic value”)
- Real option valuation
Terms you will hear

• **Underlying Risk**
  – The actual commodity or asset that is referenced in the business that can be defined as an option.

• **Option**
  – An option contract is an agreement between two parties to buy/sell an asset (futures contract as an example) at a fixed price and fixed date in the future.

• **Call**
  – Call option gives the buyer the right to buy the underlying asset

• **Put**
  – Put option gives the buyer the right to sell the underlying asset.
Terms you will hear

• **Delta**
  – How will the value of the option change as the market price that influences the asset changes?

• **Theta**
  – How fast will the option lose value as it approaches expiration?

• **Vega**
  – What effect will a change in the volatility have on the option value?
Risk vs. Economics
Or
The Risk of Economics

The Role of Risk Management

Presented by GLENN LABHART
The Risk of Economics

- Different Assumptions.
  - Volatility & Pricing
  - Modeling (linear vs. optionality)
  - Expenses
  - Capital Risk Costs
- Different outputs
  - P&L
  - Cash Flow
  - Effects of Risk Profile
Economics of Transactions

Approach for risk valuation for long term capital transactions. Monte Carlo based application to evaluate investment horizon, corporate capital requirements, risk measurement, and cash requirements.
Difference in Risk and Economics

- Protect the intrinsic value by setting adequate targets to achieve profit objective.
- Identifying the extrinsic by using valuation and risk aggregation.
- Monitors cash vs. projected earnings in real time or appropriate frequency.
The Role of a Risk Manager

Plan vs. Actual

- Actual
- Plan

[Graph showing the comparison between Plan and Actual values for different time periods (1 to 13)]
Managing Energy Risk

- Assess Business Risk and monitor all areas with risk reporting to ensure risk profile is in alignment with risk appetite.
- Metrics should monitor the cash flow at risk, and the drivers that influence the cash flow within acceptable risk tolerance levels.

Guard Rail Analysis

- Establish Hedge Targets
- Protect Margins
- Capture Extrinsic Value

Predictive Analytics
To Assess Market Drivers that Produce Value
## Risk is time

### Physical Pipeline Scheduling

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<th>Description</th>
<th>Monthly Primary</th>
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<td>1</td>
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<td>Electricity</td>
<td>1</td>
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Major challenges managing risk

- Metrics must fit the business challenges
- Aggregate risk is a key term
- Risk Transfer is a key term
- The big picture must be understood by all internal parties.
- Identify extrinsic value.
- Analytics is critical to communicate effectively.
- “EVERYONE IS A RISK MANAGER”
Proactive Risk Management

- Probability of Risk Occurring
- Risk Event Driver
- Risk Event
- Impact
- Impact Drivers
- Probability of Impact
- Losses
Risk Aggregation

Understand risk management techniques to ensure that long and short term transactions are in accordance with corporate risk appetite and tolerance.

• Defined as the process of defining, gathering and processing risk data.
  – Allows for satisfying all the risk regulatory reporting requirements
  – Enable measurement of portfolio performance against risk tolerances.
  – Enable the analysis of a firm’s risk data whether its sorting it, merging it, slicing it or dicing it.
Risk Aggregation Key Points

Understand risk management techniques to ensure that long and short term transactions are in accordance with corporate risk appetite and tolerance.

- Completeness
- Timeliness
- Accuracy
- Adaptability
## Risk Aggregation Example 1 & 2

### NET AGGREGATE RISK_EXAMPLE 1

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<tr>
<th>Description</th>
<th>Net</th>
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<th>Description</th>
<th>Net</th>
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A Good Risk Management Approach Should Be...

- Designed to accomplish specific financial objectives, such as:
  - Meet budget, affect desired cost structure, stabilize cash flows...

- Hedging is used to reduce price risk, not to beat the market.

- Thoroughly analyzed and continuously monitored
  - Identify goals, risks, risk tolerance, hedging tools.

- Approved by appropriate management
  - Accountability, decision process, reporting requirements.
Risk Definition

Types of Risk
Risk Types

• Market (Foreign Exchange, Interest Rate, Commodity)
• Credit (Counterparty Exposure, Credit Default swaps)
• Operational (Process, Environmental, Safety)
• Legal (Contract, Regulatory, Litigation)
• Systems
• Liquidity
• Systemic
• Sovereign
• Other
Market Risk

**Market Risk:** The risk to profitability that exists given changes in market conditions.

Market Risk encompasses risk associated with changes in price (fixed or floating) and basis (location and timing); the impact of volatility and market liquidity on price and basis risk; and the risk to performance and profits given differing levels of contract commitment.

- Market risk is managed through adherence to Value-at-Risk, Open Position Limits, Transaction Limits, and day-to-day commercial procedures.
Credit Risk

**Credit risk** reflects the risk of potential credit losses due to a counterparty default event (default risk), or a credit migration event (a downgrade from one rating grade to another) or a country transfer event.

**Credit spread risk**, which is part of the market risk incurred by a bank, reflects the market risk due to fluctuations in daily credit spreads (assuming no rating change) as distinct from the credit risk arising from a rating downgrade.

**Credit Risk** requires daily aggregate financial oversight to ensure that adequate corporate liquidity is maintained to execute the business strategies. Financial risk includes but not limited to:

- Daily Cash Balances
- Exposure to Banking Credit Lines
- Credit Rating Triggers
- Adequate Assurance of Counterparties
- Potential Exposure related to adverse market conditions of the corporate portfolio
Operational Risk

• **Operational Risk** is broadly defined as the risk of losses occurring as a result of failed processes, human error, management failure, transmission problems, scheduling problems, and force majeure (acts of God).

• **Operational Risk** is managed through maintaining and continually improving human and information systems, processes and controls; and through prudent contracting and monitoring practices with external parties and insurance and alternative risk products.

• Companies are willing to accept operational risk as a part of its business, to the extent that adequate systems, contracts, insurance policies, and controls are in place to procedurally manage the business risk.
Legal Risk

- Legal Risk can be described as contract risk and regulatory risk.
- Legal risk is the risk of loss resulting from the unenforceability of a contract due to legal deficiency or operation of governmental regulation or law.
- Regulatory The risk from non-compliance with the various laws and regulations set by regulatory bodies that govern a company’s legal entities.
Systems Risk

• **Systems Risk** is the risk that threatens the operations of an entire financial or business information system. This risk includes data loss from the failure of information systems due to loss of power, sabotage, or fraud.

• These requirements span a diverse range of risk functionality including market and credit risk analysis systems, asset and liability management, performance measurement and regulatory reporting, trade processing, and Cyber security.

• Companies instruct the Technology division (CIO) to provide appropriate security controls, back-up processes and recovery procedures.
Liquidity risk is the current and prospective risk to earnings or capital arising from a bank’s inability to meet its obligations when they come due without incurring unacceptable losses.

Liquidity risk includes the inability to manage unplanned decreases or changes in funding sources.

Liquidity risk also arises from the failure to recognize or address changes in market conditions that affect the ability to liquidate assets quickly and with minimal loss in value.

Liquidity Risk in energy comes from when you are on the wrong side of the market, overexposed to a defaulting counterparty either directly or indirectly.
Systemic Risk

• **Alan Greenspan** has summed up the confusion, observing that although “it is generally agreed that systemic risk represents a propensity for some sort of financial system disruption, one observer might use the term ‘market failure’ to describe what another would deem to have been a market outcome that was natural and healthy, even if harsh.”

• **CFTC Systemic Risk**: The risk that a default by one market participant will have repercussions on other participants due to the interlocking nature of financial markets. For example, Customer A’s default in X market may affect Intermediary B’s ability to fulfill its obligations in Markets X, Y, and Z.

• A common factor in the various definitions of systemic risk is that a trigger event, such as an economic shock or institutional failure, causes a chain of bad economic consequences—sometimes referred to as a domino effect.
Sovereign Risk

- **Sovereign Risk** is the risk that a government defaults, may refuse to repay or be unable to repay money.

- The risk of owning the security of an issuer in a country other than the one in which the investor lives. For example, an investor residing in the United States incurs sovereign risk in purchasing a bond issued by the government of Brazil. This risk stems from the fact that a foreign country may nationalize its private businesses, stop paying interest, or repudiate its debt.

- A serious form of credit issue where a nation's government is either unwilling or incapable of paying its loan obligations, or the chances that a nation will change its currency policy in a way that affects its currency's forex market value.
Strategy
How much risk can be managed
Underlying Risks
Marketing and Trading Optimization

Foundation

Execution

Valuation Methodology

Risk Allocation

Organizational Structure
- Trading
- Marketing
- Analytical
- Asset Execution
Risk Transformation

• Risk transformations is at all levels of the value chain
• Transformation in space (transportation)
• Transformation in time (storage)
• Transformation in form (processing)
• Main exposure is to basis risk.
Owning Assets & Trading

- Ownership of transactions costs provide opportunity to locate assets strategically.
- Benefit of taxation through multiple subsidiaries by utilizing transfer costs.
- Rapid access to asset on an unpredictable basis necessary to execute arbitrage transactions.
- Many assets are also large scale, site specific, often move volumes sufficient to utilize a large fraction of capacity.
- Capture value in the spot market during extreme supply/demand situations.
Trading/Hedging

- Spreads and pricing relationships, not flat prices, are the essence of physical commodity trading (basis risk)
- Trading and managing the risk of such price exposures requires an understanding of the value chain
- Merchant/trading companies specialize in understanding the value chain and enhancing value by identifying physical “arbitrages” and managing the associated risks
Basis Risk

- Risk that the same commodity has different prices in different places
- The price differential can be due to geographical factors or quality factors
- Hedging strategy needs to account for basis risk
Energy Basis Price Examples

Figure 4. Texas and Louisiana Natural Gas Hubs in Relation to Henry Hub

- Flow Direction
- Market Center/Hub

Note: DEFS = Duke Energy Field Services Co. EPGT = EPGT Texas Pipeline Co.
Source: Energy Information Administration, Office of Oil and Gas, Natural Gas Division, Natural Gas Market Hubs Database, as of August 2003.
Power is differentiated across regional markets based on transmission “inter-connects” or hubs and geographical pricing referencing points called “control areas” as defined by NERC.

**US Power**

ECAR - East Central Area Reliability Coordination Agreement  
ERCOT - Electric Reliability Council of Texas  
FRCC - Florida Reliability Coordinating Council  
MAAC - Mid-Atlantic Area Council  
MAIN - Mid-America Interconnected Network  
MAPP - Mid-Continent Area Power Pool  
NPCC - Northeast Power Coordinating Council  
SERC - Southeastern Electric Reliability Council  
SPP - Southwest Power Pool  
WECC (formerly WSCC) - Western Electric Coordinating Council
Energy Basis Price Examples
LNG / Logistics
### GLOBAL LNG ARBITRAGE

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<th>Source Supply</th>
<th>Avg of MEast</th>
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<th>Avg of Nigeria</th>
<th>Avg of Far East</th>
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</table>
Supply New Pricing / Logistics

Flow pattern changes and shifting constraints have had significant implications for gas basis markets:

- The shift of gas production from offshore to onshore has prompted a redrawing of the North American pipeline network.
- Traditional flow patterns have been disrupted as the industry seeks to release oil and gas production from new producing regions.
South America

- Punta Caucedo - AES
- Penuelas - EcoElectrica
- Point Fortin - Atlantic LNG
- Pecém Port - Petrobras/Golar
- Salvador da Bahia - Petrobras/Golar
- Pampa Melchorita - Peru LNG
- Guanabara Bay - Petrobras/Excelerate
- Mejillones - GNL Mejillones
- GNL Escobar - Enarsa/Excelerate
- Quintero - GNL Quintero S.A.
- Bahia Blanca - Enarsa/Excelerate

Liquefaction plants
Regasification plants
Develop stress testing and simulations that incorporate spot physical pricing and transport/capacity charges.

LMP pricing, FTR pricing, ISO ancillaries - operating, ISO ancillaries - regulation, ISO ancillaries - spinning, ISO capacity / demand, ISO day ahead purchases, ISO real time purchases, MBR.
Managing Physical Energy Risk

- Report VAR 95/1 day and Monthly Component VAR (24 months)
- Assess and view the distribution of the risk by VAR region
- STRESS Testing 15% parallel shift in price curves
- STRESS Test 40% increase in volatility

VAR (Prompt-forward)
Risk Definition

Market Risk
Measurement
VAR Definition

- The maximum loss that a portfolio can suffer in the course of an investment period,
  - Under normal market conditions
  - Within a given level of confidence

Standard Industry Measurement for Risk
Value at Risk Definition

• Example:
  – The Value at Risk is $1 MM.
  – Given the Mark to Market value of a portfolio today at $10 MM, we can expect that tomorrow the Mark to Market Value to be greater than or equal to $9 MM (95% of the time).
Value at Risk: Stress Testing

- Value at Risk (VaR) is a statistical measure of potential market losses.
- Stress testing focuses on extreme market movements that are not captured in VaR assumptions.
VAR: Level of Confidence

- Level of confidence
  - 95% (1 day in 20 trading days)
  - 99.99% (1 day in 10,000 trading days or 40 years)

- Purpose for setting the level of confidence
  - Define Threshold triggering RM processes
  - Reporting Purposes
VAR: Holding Period

- Determined by factors like:
  - Portfolio turn-around
  - Reporting frequency
  - Liquidity considerations
  - Familiarity
  - Frequency of Review
  - Type of market risk exposure
<table>
<thead>
<tr>
<th>Holding Period</th>
<th>Risk Exposure</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$2,276,840</td>
<td>Daily</td>
</tr>
<tr>
<td>5</td>
<td>$5,091,169</td>
<td>Weekly</td>
</tr>
<tr>
<td>20</td>
<td>$10,182,338</td>
<td>Monthly</td>
</tr>
<tr>
<td>60</td>
<td>$17,636,326</td>
<td>Quarterly</td>
</tr>
<tr>
<td>250</td>
<td>$36,000,000</td>
<td>Annual</td>
</tr>
</tbody>
</table>

Frequency is based on the use and delegation of authority.
Holding Period

Risk Exposure

Liquidation Time

$\text{Risk Exposure}$

$5,000,000$

$10,000,000$

$15,000,000$

$20,000,000$

$25,000,000$

$30,000,000$

$35,000,000$

$40,000,000$

$\text{Liquidation Time}$
VAR: Results and Interpretation

• Change in VAR signifies a combination of:
  • Change in volatilities
  • Change in correlations/diversification
  • Change and/or shift in portfolio positions
  • Delta, gamma, theta
VAR Analysis Example

5 violations
116 observations

Mathematically accurate
VALUE AT RISK

**VaR**
- Average = -$12,400,142
- Minimum = -$4,785,247
- Maximum = -$21,579,925

**PnL**
- Average = $1,587,888
- Minimum = -$29,244,653
- Maximum = $44,550,709

**VaR Limit:**
- Acceptable number of violations: 7-19
- 2001 actual: 10

**VaR - US Gas**
- Average = -$5,283,594
- Minimum = -$2,195,731
- Maximum = -$12,113,072

**VaR - US Power**
- Average = -$9,161,863
- Minimum = -$2,909,181
- Maximum = -$15,984,130

**VaR - Canada**
- Average = -$2,647,392
- Minimum = -$331,917
- Maximum = -$7,489,264

**VaR - Europe**
- Average = -$1,681,056
- Minimum = -$529,378
- Maximum = -$3,367,727

**Change in Open Equity**
- **Daily VaR**
### US Gas Income Model (USD)

<table>
<thead>
<tr>
<th>Regions</th>
<th>Gas PNL</th>
<th>MTD PNL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corp</td>
<td>$132,451</td>
<td>$777,212,245</td>
</tr>
<tr>
<td>Fixed Price</td>
<td>$220,033</td>
<td>$1,212,780</td>
</tr>
<tr>
<td>Mid-Cent</td>
<td>$832,888</td>
<td>$75,937</td>
</tr>
<tr>
<td>NE</td>
<td>($74,023)</td>
<td>$1,299,546</td>
</tr>
<tr>
<td>Retail</td>
<td>($1,410)</td>
<td>($16,123)</td>
</tr>
<tr>
<td>SE</td>
<td>$679,229</td>
<td>$884,247</td>
</tr>
<tr>
<td>TX</td>
<td>$591,067</td>
<td>$1,071,721</td>
</tr>
<tr>
<td>West</td>
<td>$517,702</td>
<td>$1,115,316</td>
</tr>
<tr>
<td>Gas-Phys-Orig-W</td>
<td>$726</td>
<td>$33,552</td>
</tr>
<tr>
<td>Gas-LocFP-W</td>
<td>$64,687</td>
<td>$251,460</td>
</tr>
<tr>
<td>Gas-FP-Cleaning-W</td>
<td>$290,689</td>
<td>$74,212</td>
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</tbody>
</table>

### UK Gas Income Model (GBP)

<table>
<thead>
<tr>
<th>Portfolio Name</th>
<th>Today PNL</th>
<th>Today MTD PNL</th>
<th>Last Month</th>
<th>Market</th>
<th>Market Price as of</th>
<th>Risk Description</th>
<th>Risk Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DUK_GasEntryCapacity</td>
<td>553</td>
<td>590</td>
<td>Oct-01.02.2000</td>
<td>5.04PM</td>
<td>Stop Loss</td>
<td>(19,146)</td>
<td></td>
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<tr>
<td>DUK_Gas_FinancialReserves</td>
<td>0</td>
<td>0</td>
<td>Nov-01.02.2000</td>
<td>2.54P5</td>
<td>Stop Loss Limit</td>
<td>4,000,000</td>
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<tr>
<td>DUK_Gas_InsuranceDirection</td>
<td>82,028</td>
<td>93,133</td>
<td>Dec-01.02.245</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DUK_Gas_Storage_Hornsea</td>
<td>(2,161)</td>
<td>16,977</td>
<td>Jan-02.02.659</td>
<td></td>
<td>Value at Risk</td>
<td>1,621,500</td>
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<tr>
<td>DUK_Gas_Storage_Rough</td>
<td>(32,315)</td>
<td>118,483</td>
<td>Feb-02.02.282</td>
<td></td>
<td>Daily Value at Risk Limit</td>
<td>4,000,000</td>
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</tr>
<tr>
<td>DUK_Gas_Storage_Virtual</td>
<td>0</td>
<td>0</td>
<td>Mar-02.02.399</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>DUK_Gas_Trading_Index</td>
<td>1,294</td>
<td>6,014</td>
<td>Apr-02.02.173</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>DUK_Gas_Trading_Prompt</td>
<td>(21,795)</td>
<td>27,135</td>
<td>May-02.02.41</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DUK_Gas_Trading_Spot</td>
<td>(1,954)</td>
<td>4,521</td>
<td>Jun-02.02.1965</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>DUK_Gas_Trading_Term</td>
<td>(213,926)</td>
<td>155,010</td>
<td>Jul-02.02.1891</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Last Updated: Sep 5, 2001 11:04:44 AM
VAR Review

**VAR is:**
- A measure of the riskiness of the portfolio
- A prediction of tomorrow's (next period's) "benchmark" market loss
- Based on assumptions of commodity time series data and volatility

**VAR is not:**
- A guarantee that the P&L losses will be less than this "benchmark" number
- A ceiling on P&L losses
- Will not tell you if you are long or short.
- Will not tell you if you make or lose money.
What does VAR accomplish?

- Measures risk across all markets in the same standard way (Holding Period)
- Capital Allocation (Annualize VAR)
- Combines into a single number all the information.
  - RAROC (Risk Adjusted Return on Capital)
  - RAVA (Risk Adjusted Value Added)
Daily vs. Annualized VAR

- We are comparing the two time periods simultaneously to monitor short and long term risk
- Extend one day to one year holding period
- The difference in average daily VAR vs. Annualized VAR is the square root of time
- Useful in determining capital allocation and RAROC
Economics of Transactions

Approach for Value at Risk for long term capital transactions. Monte Carlo based application to evaluate investment horizon, corporate capital requirements, risk measurement, and cash requirements.
Governance
Organization & Structure
Risk Management Governance

Based on Risk History, Corporate Strategic Plan, market conditions and management decision.
Risk Methodology

Top Down Corporate Risk Strategic Assessment

Strategic and Tactical Risks
Managerial Priorities
Solutions

Bottom-up risk inventory

Business Management

Senior Management
Methodology

To strengthen the communication to the Board, management should clearly define the metrics that are used to manage the strategic risk allocated by the Board that describe the business operations and the implementation of risk culture in the organization.

- **Defining the risk appetite to assess what level of risk the Board will accept over the course of time that is aligned to the strategic plan.**
  - Board issues a Risk Appetite Statement
- Develop metrics to monitor their risk profile against the risk appetite so that the Board can approve a risk tolerance.
  - Cash Flow at Risk, Value at Risk, Stress Testing for Market Risk
  - Financial Targets
  - Capex Targets
  - Growth Targets
- Develop meaningful metrics for their daily business risk.
- Impose Metrics / Risk Limits that roll up to the tolerance level that is approved by the board.
- Management Risk Reporting should focus on the operational aspects of the assets and risks.
Risk Management Components

- Policies & Limits
- Systems & Procedures
- Capital Allocation
- Independent Evaluation
- Performance Measurement
- Management Information
- Accounting/Disclosure
- Strategies/Plans/Objectives
- Corporate Risk Tolerance
- Transactions, Market Conditions and Execution
- Valuation
- Control Environment

CONFIDENTIAL
Centralized Risk

The benefit is reduced risk at lower cost.
Risk Process Overview

Value at Risk
Monthly Stop Loss
Greeks (Decay, Volatility)
Equity Change
Cash Outlay

Enterprise Cash Flow Mapping

Asset
Market
Financial

Transportation
Fixed Price
Interest Rate

Capacity
Basis
Foreign Exchange

Operating Costs
Index
Credit

Quantified Risk Exposures
Defined Risk Parameters

Corporate Risk Tolerance

Value at Risk
Monthly Stop Loss
Greeks (Decay, Volatility)
Equity Change
Cash Outlay
Aggregation & Scoring Mechanisms to Establish Right Risk Appetite

**Predictive Analytics**

- **Assessment**
  - RISK APPETITE
  - Strategic Plan
- **Articulation**
  - Risk Control
  - Risk Identification
  - Risk Assessment
  - Risk Balancing
  - Risk Limits
- **Action**
  - Results

**Management Committee**
- Agrees on Risk Appetite

**Management Committee Agreement on Strategic Direction and Business Objectives**

**Business Initiative Brainstorming session**

**Business Unit Articulation of Viable Initiatives**

**Risk Management Highlights Potential Risks of Offerings**

**Business and Functional Groups Access Controls**

Functional support areas play a critical role in evaluating a company’s strategic risks
Risk Assessment

Results from Global Group Exercise to assess risk appetite and profile of project development for Mediterranean energy program
## Consolidated Results

<table>
<thead>
<tr>
<th>Average of Total Risk</th>
<th>Offices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Row Labels</strong></td>
<td>Amsterdam</td>
</tr>
<tr>
<td>Compliance Risk</td>
<td>6.20</td>
</tr>
<tr>
<td>Construction</td>
<td>7.00</td>
</tr>
<tr>
<td>Credit Risk</td>
<td>6.50</td>
</tr>
<tr>
<td>Financial Risk</td>
<td>7.00</td>
</tr>
<tr>
<td>Market Risk</td>
<td>6.82</td>
</tr>
<tr>
<td>Operational Risk</td>
<td>5.77</td>
</tr>
<tr>
<td>Exploration Risk</td>
<td></td>
</tr>
<tr>
<td>Production risk</td>
<td></td>
</tr>
<tr>
<td>Geopolitical risk</td>
<td>7.50</td>
</tr>
<tr>
<td>Security risk</td>
<td></td>
</tr>
<tr>
<td>Environmental risk</td>
<td></td>
</tr>
<tr>
<td>Regulatory Risk</td>
<td></td>
</tr>
<tr>
<td>Competition Risk</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6.51</strong></td>
</tr>
</tbody>
</table>
Arlington

Group 1

Group 2
Panama Results

Group 1

Group 2

Group 3

Group 4
Amsterdam Results

Group 1

Group 2

Group 3

Group 4
Asia

Risk Heat Map

Group 1

Risk Heat Map

Group 2

Risk Heat Map

Group 3

Risk Heat Map

Group 4
Risk Assessment

Setting risk appetite and delegation of authority.
Managing Energy Markets

Risk Management Appetite

Capture Extrinsic Value
Trading Management
Risk Committee

Delegation of Authority

Predictive Analytics
Risk Limits Example

I. Value at Risk (VaR)
   a) Stress Testing
   b) Backtesting Value at Risk

II. Delta Adjusted Volume

III. Equity Change – Monthly, Quarterly, and Annually

IV. Daily and Monthly Stop Loss

V. Cash Limits
   – Premiums Paid or Received
   – Cash – Accumulated Premium
   – Cash – Premium + margin call
   – Cash – Premium + margin call + operating cash flow

X. Options Limits
   – Theta – Base limit and Prompt month limit
   – Vega

Independent Limits
Risk Concentration

Retail risk requires a focus on time and volatility to ensure adequate coverage from terms to actual delivery. Segmented risk into specific time horizons to allow for the alignment of business strategy, liquidity in underlying markets and to protect the long term value of the organization.

- Assumes sufficient liquidity to support the liquidation of positions
- Reflects the most recent volatility in the underlying markets
- Assumes market illiquidity
- Reflects both market volatility and the risks of underlying capital commitments
- Fundamental strategic long term investment capital commitments

### Cash Month Delivery

- Real Time
- Hourly
- Day Ahead
- Monthly
## Value at Risk Analysis (Market Risk) Example 3

### Risk Aggregation Example 3

<table>
<thead>
<tr>
<th>Region</th>
<th>Category</th>
<th>Trader</th>
<th>Monte Carlo VaR</th>
<th>VaRParametric</th>
<th>Region</th>
<th>Category</th>
<th>Trader</th>
<th>Monte Carlo VaR</th>
<th>VaRParametric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ercot</td>
<td>Ercot Total</td>
<td>Management</td>
<td>$ (321,956)</td>
<td>$ (366,589)</td>
<td>Ercot</td>
<td>Ercot Total</td>
<td>Management</td>
<td>$ (263,884)</td>
<td>$ (289,282)</td>
</tr>
<tr>
<td></td>
<td>Ercot Basis 2008</td>
<td>Trader 1</td>
<td>$ (172,553)</td>
<td>$ (171,176)</td>
<td>Ercot</td>
<td>Ercot Total</td>
<td>Trader 1</td>
<td>$ (153,005)</td>
<td>$ (151,002)</td>
</tr>
<tr>
<td></td>
<td>Ercot Term</td>
<td>Trader 2</td>
<td>$ (228,524)</td>
<td>$ (234,826)</td>
<td>Ercot</td>
<td>Ercot Term</td>
<td>Trader 2</td>
<td>$ (174,432)</td>
<td>$ (181,309)</td>
</tr>
<tr>
<td></td>
<td>Ercot Forward</td>
<td>Trader 3</td>
<td>$ (68,746)</td>
<td>$ (74,288)</td>
<td>Ercot</td>
<td>Ercot Forward</td>
<td>Trader 3</td>
<td>$ (38,336)</td>
<td>$ (47,522)</td>
</tr>
<tr>
<td></td>
<td>Ercot Cash</td>
<td>Trader 4</td>
<td>$ (89,247)</td>
<td>$ (90,771)</td>
<td>Ercot</td>
<td>Ercot Cash</td>
<td>Trader 4</td>
<td>$ (55,565)</td>
<td>$ (58,917)</td>
</tr>
</tbody>
</table>

### Value at Risk by Time Series (Market Risk)

<table>
<thead>
<tr>
<th>query_name</th>
<th>index</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ercot Group</td>
<td>rskDriver_ERCOT_HOUSTON_2x16</td>
<td>$ (5,698)</td>
<td>$ (2,006)</td>
<td>$ (1,906)</td>
<td>$ 9,915</td>
<td>$ 17,105</td>
<td>$ 17,167</td>
<td>$ 15,353</td>
<td>$ 4,646</td>
<td>$ 2,819</td>
</tr>
<tr>
<td>Ercot Group</td>
<td>rskDriver_ERCOT_HOUSTON_7x8</td>
<td>$ 12,333</td>
<td>$ 7,360</td>
<td>$ 7,036</td>
<td>$ 16,113</td>
<td>$ 16,154</td>
<td>$ 13,845</td>
<td>$ 13,539</td>
<td>$ 8,137</td>
<td>$ 7,595</td>
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<tr>
<td>Ercot Group</td>
<td>rskDriver_ERCOT_HOUSTON_PK</td>
<td>$ 7,523</td>
<td>$ (104,155)</td>
<td>$ 69,697</td>
<td>$ (78,367)</td>
<td>$ 60,580</td>
<td>$ 42,973</td>
<td>$ 33,784</td>
<td>$ (8,480)</td>
<td>$ (8,106)</td>
</tr>
<tr>
<td>Trader 1</td>
<td>rskDriver_ERCOT_HOUSTON_2x16</td>
<td>$ 6,601</td>
<td>$ 1,092</td>
<td>$ 359</td>
<td>$ 1,402</td>
<td>$ 3,094</td>
<td>$ 3,499</td>
<td>$ 2,115</td>
<td>$ -</td>
<td>$ -</td>
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<tr>
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<td>rskDriver_ERCOT_HOUSTON_7x8</td>
<td>$ 11,787</td>
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<td>$ (2,066)</td>
<td>$ 3,008</td>
<td>$ 2,171</td>
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<td>$ 1,193</td>
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<tr>
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<td>rskDriver_ERCOT_HOUSTON_PK</td>
<td>$ 7,226</td>
<td>$ (12,776)</td>
<td>$ 7,111</td>
<td>$ (6,125)</td>
<td>$ 7,173</td>
<td>$ 8,245</td>
<td>$ 3,437</td>
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<td>Trader 2</td>
<td>rskDriver_ERCOT_HOUSTON_2x16</td>
<td>$ -</td>
<td>$ -</td>
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<td>$ -</td>
<td>$ (682)</td>
<td>$ (381)</td>
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<td>$ -</td>
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<td>$ -</td>
<td>$ -</td>
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<td>$ (310)</td>
<td>$ (148)</td>
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<td>rskDriver_ERCOT_HOUSTON_PK</td>
<td>$ (28,900)</td>
<td>$ (34,093)</td>
<td>$ 4,626</td>
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<td>$ (2,952)</td>
<td>$ (334)</td>
<td>$ (1,279)</td>
<td>$ 1,242</td>
<td>$ 1,150</td>
</tr>
</tbody>
</table>

What's Different?
Risk Limits Example

Definitions

- Asset Management is the targeted hedge requirement of the asset.
- The risk exposure levels of the forward targeted output that could be hedged are volumetric caps set where management would accept forward price protection.
- Annual Fuel Consumption is 120,000,000 MMBTU.
- Annual Production is 10,500,000 bbls.

Risk Exposure

- Division President Marketing Up to 50% of fuel requirement
- Division President Production Up to 75% of production requirement
- CEO 100% of requirement With Board Notification
Risk Definition

Energy Pricing and Risk

Simple and Complex
# Global Energy Prices

## Regulated
- New York Mercantile Exchange
- Intercontinental Exchange
- Dubai Mercantile Exchange
- NORD Pool

## Non-Regulated
- Platts McGraw Hill
- Argus
- Major Oil Company Posted Prices
- OPIS
- Trading HUB Platforms
- ICIS for LNG
Energy Pricing

The Key to Understanding Energy

April - October

November - March
Fixed Price

• Fixed Price trading has probably the simplest structure: the price is predetermined at the onset of the transaction.

• The price is usually determined at a highly liquid hub location (WTI for Crude Oil, Henry Hub for Natural Gas) that is a regulated exchange.
Basis Price

- Basis is the location differential between two physical market places for a specific trade.
- The basis price represents the pricing differential between two locations.
- Basis locations are geographic by nature.
- Basis is synonymous with Arbitrage.
Basis Price

• Consider a situation where the price for natural gas is $7.00 at the Houston Ship Channel (Texas) and is $8.00 at the NYMEX Henry Hub.

• The basis between these two points is $1.00
Index Price

- The physical price risk component of a transaction as is the index price reported by published price reports.
- Index risk is intended to mirror the physical price locations that are used in physical trading as reflected in the monthly and daily index publications.
Managing Risk Component

- Fixed, Basis, Index all work together
- Create a means to manage price risk exposure.
- Underlying risk must be identified to understand hedging requirements.
- By transacting hedges, this creates financial offset to the underlying risk.
Basis Risk

- Risk that the same commodity has different prices in different places
- The price differential can be due to geographical factors or quality factors
- Hedging strategy needs to account for basis risk
Basis Differentials

Rotterdam product prices
US dollars per barrel
- Gasoline
- Gas oil
- Heavy fuel oil

US Gulf Coast product prices
US dollars per barrel
- Gasoline
- Gas oil
- Heavy fuel oil

From second quarter 1992: unleaded gasoline.
Source: Platts.
The Relationship of Spot & Futures Prices

- Prices in the two markets are related
  - Two different relationships
    - Contango and backwardation
- Convergence
  - As the expiration date approaches, the spot and futures price must converge.
  - At maturity, “exchange futures for physicals”
Contango & Backwardation

- **Contango**
  - Futures price exceeds the spot price
  - Future price for longer delivery dates have higher price than for shorter delivery dates
  - Often a result of very good supply conditions

- **Backwardation**
  - Spot prices exceed futures prices
  - Future price for longer delivery have lower price than for shorter delivery
Contango vs. Backwardation

Futures Price of a Contract Due in One Year
(Going Forward in Time)

- Expected Future Spot Price
- Contango
- Normal Backwardation

Source: Investopedia.com