

# Forecasting the Prices of Crude-Oil, Natural-Gas and Refined Products

## INTRODUCTION

- A critical component of decision-making in the energy industry deals with the aspect of “Whither oil prices?”: Where do we expect prices to move in the near- and distant-terms? Participants in the Energy Industry are constantly confronted with a wide range of information regarding current and prospective prices in their industry. Broadly, this data comes from analyses of supply-and-demand changes, geopolitical events and the financial markets, including the commodity markets.
- While providing the requisite background on the economics of financial commodity markets, as well as the statistical tools required to understand them, this training course demonstrates how the financial and commodity markets provide useful information for the generation of “expected prices”, or forecast prices, in the critical areas of oil, natural-gas and refined products. In so doing, the course will also demonstrate the important distinction between valuation and risk / return analysis.

This training course on Forecasting the Prices of Crude-Oil, Natural-Gas and Refined Products will develop an understanding of pricing, risk management, asset valuation and derivatives within the energy markets:

- Learn to use financial models to analyze and forecast energy prices; extrapolate forward prices beyond the liquidity tenor
- Understand the risk of and return from futures and options contracts on energy commodities
- Manage and optimize your organization’s energy risk exposure
- Learn to estimate and calculate volatility in energy prices
- Utilize real options theory to value energy assets; use information from futures / option prices to make optimal production decisions: Optimal timing for extraction, optimal rate at which to extract oil (gas) from a field; value oil fields, pipelines and storage facilities, power plants

## OBJECTIVES

- The objectives of this training course are to provide a comprehensive introduction to the computation and application of forecast prices in the energy industry, with a focus on the oil, natural-gas and refined products segments. Inter alia, the course presents the basic statistical tools required to operationalize these concepts.

At the end of this training course, participants will learn to:

- Use financial models to analyze and forecast energy prices; extrapolate forward prices beyond the liquidity tenor
- Understand the risk of and return from futures and options contracts on energy commodities
- Manage and optimize their corporations' energy risk exposure
- Estimate expected returns and calculate volatility in energy prices
- Obtain a comprehensive understanding of the financial-economics techniques used to forecast prices
- Apply option valuation techniques to the energy markets
- Utilize real options theory to value energy assets; use information from futures / option prices to make optimal production decisions: Optimal timing for extraction, optimal rate at which to extract oil (gas) from a field; value oil fields, pipelines and storage facilities, power plants

## TRAINING METHODOLOGY

- Clear presentation of notes with the requisite supportive analytics
- Detailed presentation of the relevant empirical regularities / stylized facts of the energy markets
- Presentation of several case studies designed to exemplify the application of risk-management and valuation principles
- Interspersed in the lectures are relevant problem-sets, designed to afford participants with the opportunity to apply the principles conveyed and see their implementation
- Dissemination to and sharing with participants critical spreadsheets that will permit them to address issues within the course, as well as utilize these concepts once they have completed the course

## ORGANISATIONAL IMPACT

From the perspective of the organization, this training course conveys to critical personnel the:

- Computation and correct uses of price forecasts applicable to the energy industry
- Application of concepts on risk and return on energy commodities
- Manage and optimize their corporations' energy risk exposure
- Apply option valuation techniques to the energy markets
- Understanding of the key elements of information conveyed by financial markets, and how to apply these to make better business decisions

## PERSONAL IMPACT

As a means of preparing individuals for the higher managerial rungs in their organization, the skills acquired in this training course include understanding the:

- Main terminology used in the industry
- Role of financial markets as efficient conveyors of information and assessors of risk
- Valuation and role of futures contracts and swap agreements
- Principles of option and derivative-claim valuation, hedging and uses
- Necessary tools of financial-economics and statistics to forecast near and distant prices for oil, natural-gas and refined products
- Means to utilize price forecasts to make better business decisions

## WHO SHOULD ATTEND?

- This training course is suitable to a wide range of professionals but will greatly benefit individuals working in financial analysis, valuation, trading, risk management or quantitative analysis positions with oil and gas exploration companies; investment and commercial banking, consulting, and financial services firms in the energy sector; production and distribution companies; energy trading firms; and corporations outside the energy industry with a significant cost exposure to energy prices.

In terms of job titles, these individuals include:

- Financial Analysts
- Quantitative Analysts or Researchers
- Energy Traders
- Risk Managers
- Commercial and Investment Bankers dealing with Commodities
- Consultants in the Commodity Arena

## Course Outline

### The Current State of the Equity & Commodity Markets

- Measuring Nervousness / Uncertainty of Equity and Commodity Markets
- The Crude-Oil Markets: Level and Slope of Crude-Oil Futures Markets; Impact of Economic, Financial and Geopolitical Events on Implied Volatilities in the Crude-Oil Market
- Impact of Seasonality on Global NatGas Markets
- Future Inflation Rates
- The Refining Spread and Retail Gasoline Prices
- The Domestic NatGas Market: The Impact of Seasonality
- The March / April 2007 Futures Contract

## A Primer on the Interest-Rate Markets

- Financial Markets' "Message from Markets"; Interpret bond-market moves in conjunction with those in equity markets
- Empirical Regularities of Global Fixed Income Markets
- Understanding the Fundamentals of Bond Valuation
- Eurodollar Futures and Interest Rate Swaps
- Duration and Convexity: Hedging Interest Rate Exposure
- Interest-Rate Volatility
- Forecasting Future Interest Rates Using
- A Financial-economics Approach
- Practitioners' Approaches

## Overview of Statistical Concepts

- Basic Statistical Concepts: Average and Volatility; Stationarity of Time Variables
- Regression Analysis
- Using Solver to Solve Constrained Optimization Problems

## Forward, Futures and Swap Contracts in Energy Markets

- Fundamentals of Forwards and Futures Contracts: Definition, Payoff Diagram, Pricing by Arbitrage
- Forward / Futures Prices and Forecast Prices
- Commodity Swaps
- The Key Difference between Real-Asset Valuation and Expected Value

## Part I: Option Pricing

- Payoffs and Put-Call Parity
- Black-Scholes Formula
- Option "Sensitivities" (the "Greeks"): Delta and Gamma
- The Binomial Model and the Valuation of American-Style Options
- Real Options in Energy Markets: Power Plants as a Strip of Spark Spread Options; Oil Fields as the Valuation of an Extraction Option

## Part II and , Part I: The Statistics of the Price Processes in Energy Markets

- Historical Volatility: The Term Structure of Volatility (TSOV)
- Estimating Volatility from Market Prices of Options in Energy Markets
- Historical or Implied Vols?
- Estimating a Mean-Reverting Process
- Characterizing the Volatility "Surface" Across Time and Strike
- Jump-Diffusion Process
- The Need to Extrapolate in Energy Finance: Valuation of Long-Dated Real Assets and Financial Structured Products; Extrapolating Crude-Oil Prices; Extrapolating Natural-Gas Prices; Extrapolating the Term Structure of Volatilities (TSOV); Extrapolating Correlations

## Part II and : Forecasting the Prices of Oil, Natural-Gas and Refined Products

- The “Market Price of Risk”: Estimating a Risk Premium in Finance, and Applying it to Energy Prices
- How Can Use Regression Analysis to Fortify Our Understanding of Financial Markets’ Perspective on Forecast Prices?
- Where Can We Observe Forecast Prices?
- What is the Difference between Futures Prices and Forecast Prices?
- What is the Capital Asset Pricing Model (CAPM) and How Can We Use it to Forecast Oil Prices?
- Applying a Jump-Diffusion Model to Oil Futures Options
- Using the Market Price of Risk to Implement Risk-Management from a Corporate Perspective

## Energy Derivative Products: The Role of Structuring, Calibration, Valuation and Hedging in Profitable Market-Making

- Commercial Structured Products
- Categorizing Derivative Products: Option Collars, Average Options, Spread Options, Swing Options, Weather Derivatives, Commodity-linked Bonds; “Swing” Options; Weather Derivatives
- Structuring and Valuing Option Collars
- Structuring and Valuing Average (Asian) Options
- Example of Calibration: Using Vanilla Options to Determine the Value of Volatility for Valuation of Average Options