

Improving the methodology of investment activities of oil and gas enterprises

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It is appropriate to begin this White Paper entitled "Investment Decision-Making in the Oil and Gas Supply Sectors" with the quote from Robert S. Pindyck, a well-known economics professor at MIT: "Despite its importance to economic growth and market structure, the investment behavior of firms, industries, and countries remains poorly understood. Economic models have had a limited success in explaining and predicting changes in investment spending". . . . (Pindyck, 1991). The above comment by Pindyck is equally true today as it was in 1991, particularly on how "price foresight" is used in making investment decisions in the energy supply sector. Still, observations from over two decades of data on investments in oil, gas and coal supply help provide empirical evidence of how industry investments relate to prices, cash flow and other decision variables, as set forth in this White Paper. **PURPOSE** The purpose of this White Paper is to provide an independent perspective on how industry makes capital investment decisions in the oil and gas supply sector. As such, this White Paper will address three topics:

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1. How are expectations about future market prices formed;
2. What factors are central to making investment decisions in the oil and gas supply sector;
3. To what extent is "perfect foresight", with respect to future prices, used in making investment decisions in the oil and gas supply sectors. The intended use of the information in this White Paper is to provide insights as to whether and how the National Energy Modeling System (NEMS) might be revised in the way the oil and gas supply modules incorporate price (and cost) expectations in formulating supply investment decisions. Currently NEMS, in general, uses the economic paradigm of "perfect foresight" in representing how the energy supply sector investment function operates. (However, the oil and gas supply models use the minimum of the current price and the five year average price for making investment decisions.) This theoretically convenient paradigm has been challenged, calling for a review of the validity of the use of "perfect foresight" in NEMS. A key aspect of the review is to provide information, supported by public literature and other verifiable data, on how overall capital investment decisions are made by the oil and natural gas supply sectors.

HISTORICAL REVIEW OF OIL AND GAS PRICES. After years of relative stability, oil and natural gas prices began to fluctuate and then increase sharply in recent years, adding uncertainty as to what is the appropriate price track for making long-term investment decisions. □ Oil prices (WTI spot) were relatively stable for tens years, from the early 1990s to the early 2000s. During this time, oil prices ranged from \$20 to \$30 per barrel (nominal) with one sharp decline to below \$15 per barrel in 1998. Since 2003, oil prices have climbed steadily to over \$90 per barrel at the end of 2007.

Natural gas prices (Henry Hub spot) had their own, more than a decade, period of price stability (from mid 1980s through 1999). During this time, natural gas prices averaged about \$2/Mcf, with a modest price spike in 1996/97. Since 1999, natural gas prices have experienced major volatility. Prices doubled from these historical levels in 2000, then declined, only to reach a new high of \$9/Mcf in 2005, Figure 2. Weekly natural gas prices experienced even more volatility, reaching a high of \$13/Mcf in the winter of 2005/2006 and a low of \$5/Mcf in the fall of 2006, Figure 3. Of particular interest is the recent sharp divergence of oil and natural gas prices, from their traditional relationships, adding further uncertainty to future price expectations for natural gas.

This historical review of oil and natural prices provides background and context for examining price expectations for capital investment decision-making in these two important energy supply sectors.

ALTERNATIVE SOURCES FOR PRICE PROJECTIONS. In addition to the price projections in EIA's AEO, a variety of sources provide price forecasts, expectations and guidelines for making investment decisions by the oil and natural gas industry. These sources (whose price projections are regularly reviewed in the AEO), include firms such as GII (Global Insight, Inc.), EVA (Energy Ventures Analysis, Inc.), EEA (Energy and Environmental Analysis, Inc.), DB (Deutsche Bank), SEER (Strategic Energy and Economic Research, Inc.), and Altos (Altos Partners North American Regional Gas Model). In addition, numerous other firms provide private, confidential guidance on projections of energy prices, such as CERA (Cambridge Energy Research Associates).

One challenge industry faces in using oil and natural gas price projections (by AEO and other sources) is the significant differences that have occurred between projected and actual prices. EIA provides valuable information on this topic by examining the reliability of its own oil and natural gas price projections. While we have not undertaken a rigorous review of the price projections provided by other sources, we believe that the track record of these other price projection sources is similar to that of EIA.

RELATIONSHIP OF PRICES AND COSTS. One of the major considerations in deciding how to use future prices (price projections) for making investment decisions is judging how future costs will track future prices. Historical data, assembled by EIA as part of the FRS company reporting system, clearly shows that changes in oil and gas lifting costs as well as changes in upstream finding costs (finding costs also include well productivity) are closely related to changes in oil and natural gas prices. When examining the oil and natural gas price expectations of the Independent Producers and Lenders (Bankers) made in year 2004, it is instructive to note that both groups anticipated increases in costs equal to or in excess of increases in prices

The insight to be derived from these price and cost expectations are that Lenders (Bankers) expected costs increases to outpace oil and natural gas price increases. Producers expected costs and prices to track for crude oil but believed that for natural gas, higher future prices and an increasing economic margin might enable additional projects to meet an economic threshold. Because costs have risen so dramatically in the past few years, it is useful to take a

more in-depth look at the relationship of prices and costs and how this may be affecting investment decisions

ESTABLISHING GUIDELINES FOR FUTURE PRICES. Significant differences exist among individual companies and types of companies in their formulation of price expectations for making long-term capital investment decisions. Major oil companies have Economics Departments that invest significantly in understanding market fundamentals, using this information to provide a corporate-wide “price deck” to be used for evaluating investment options. In contrast, the independent sector of the oil and gas industry relies much more on private “energy forecasting” firms and lenders for establishing their price outlook. □ **Major Oil Companies.** The large, integrated oil and natural gas companies, such as BP, Chevron, ConocoPhillips and Shell, use an internally generated “price deck” for evaluating investment options and deciding which of these investment options to incorporate into the annual capital investment budget. In general, although the actual “price deck” information is kept confidential, some of this information is divulged in public announcements. One common “price deck” model uses a lagging three year average of prices, held constant (in real terms) for future years.

In recent years, major companies have steadily increased the values used in the “price deck”, either by incorporating newer (and higher) price data into the three year average or by benchmarking a higher value for the “mean.” **Independent Oil and Gas Companies and Banks.** To a large extent, the independent oil and gas companies, net borrowers of capital, rely on oil and gas price forecasts and expectations provided by outside firms and bankers.

FACTORS CENTRAL TO INVESTMENT DECISION-MAKING FOR ENERGY SUPPLY. The above review of price forecasts and expectations provides a useful starting point for understanding how expectations about future market prices are formed. However, price expectations are only of the factors that help form investment decisions in the energy supply sector. Other key factors central to investment decision-making in the energy supply sector include: **Cash Flow.** The amount of annual investment that a company makes is governed greatly by its cash flow (and the borrowing capacity this cash flow will support). The key variable for evaluating return on investment is the economic margin, the difference between prices and costs. As such, in addition to price expectations, an equally central investment factor is expectations for changes in costs. **Portfolio of Opportunities.** A third factor central to investment decisions in the energy supply sector is the portfolio of upstream opportunities available to individual companies, as well as to the overall industry. In recent years, a number of major companies have used their cash flow to “buy back” company stock, implying a lack of investment opportunities that would provide a higher return on investment than their existing portfolio of past investments. **Other Factors.** In addition to the above, a number of other factors enter an investment decision in energy supply, including market demand, access to resources, and acceptable risk.

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