EnergyWindow
Strategic energy sourcing and management

Shedding Light on Energy Price Trends and Their Drivers

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Considering the range of energy supply prices over the last four years—for example $3.80 to $12.48 per million British Thermal Units (mmBTU) and $28.78 to $103.42 per megawatt-hour (MWh) for the average of the 12-month strip for Henry Hub natural gas and PJM electricity, respectively, as traded on the New York Mercantile Exchange (NYMEX)—a number of questions linger in every energy buyer's mind:

- How can I possibly project prices and make decisions when to buy or fix?
- Do I have to calculate cost for every one of my facilities in tracking markets?
- Do I have to keep track of natural gas and electricity prices separately?
- What indicators can I track to gain some sense of market direction?
- What kind of increases should I expect over the next five or so years, and what do I tell my stakeholders?
- Prices are really high (low) right now; can I expect them to decrease (increase)?
- What are the experts saying?

While we won't try to offer up predictions, we'll share some observations and methodologies for making your own calculations, and hopefully, provide some insight into these persistent questions. With that in mind, "caveat emptor," or "let the buyer beware"![*]

How Contract Prices Are Determined

When a supplier offers a fixed price for a retail electricity or natural gas contract, they look at load requirements for the n-month term (n typically ranges from a few months to several years) of the contract ($L_1, L_2, \ldots, L_n$), multiply them by the current future prices for each of those months ($P_1, P_2, .., P_n$), and divide by the total contract period load. They then add margin, administrative costs, transportation, and other costs to arrive at a contract price. Stated formally:

$$\mathbf{P(contract) = (L_1P_1 + L_2P_2 + \ldots + L_nP_n) / (L_1 + L_2 + \ldots + L_n) + other\ factors\ and\ costs}$$

Figure 1 provides examples of the closing NYMEX Henry Hub natural gas future price curve for 60 months on three different dates in 2005 and 2006.

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[*] *The discussion and analyses presented here are for the purpose of providing insight into changing markets. The discussion, in part or in whole, does not represent a recommendation to take specific action. Results from materials, plans, information, or advice from EnergyWindow are not warranted or guaranteed.*

So, for someone gauging how wholesale prices affect retail contract prices for a given facility (or a group of similar facilities) and fixed contract term, the answer is simple: keep track of the equation above for the facility load profile and for the given term in months, generally ignoring the other factors and costs, which may be assumed to be less time dependent.

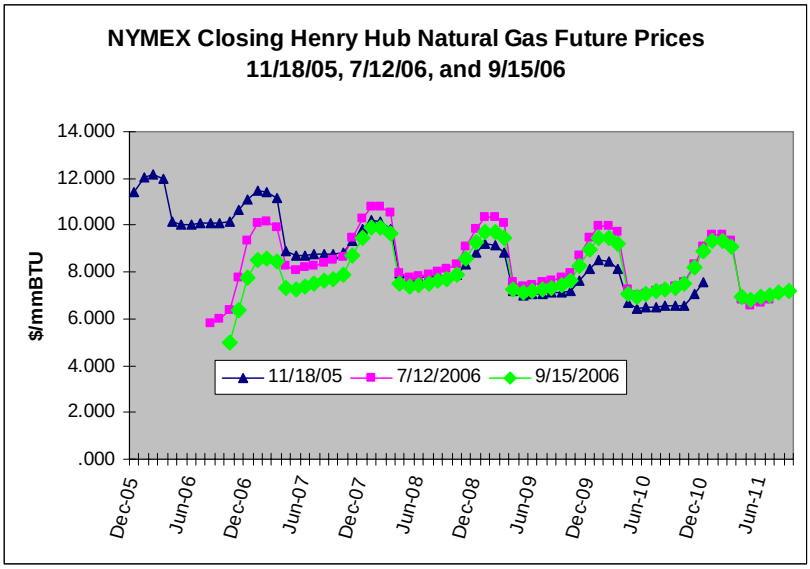

Figure 1: NYMEX Closing Future Prices

Estimate Your Costs

For a buyer who is responsible for a larger number of facilities with a range of characteristics and who is considering a range of contract terms, it will be difficult to calculate the detailed formula for all facilities. If, however, we assume the relative relationship among the facilities load requirements doesn't change much with the seasons and over time, a compromise approach is to calculate the simple arithmetic (unweighted) average of the future price strip:

$$\textbf{Average}(P_1,P_2,..,P_n)$$

One can watch the average for several different terms; but it may be adequate to simply choose one to track prices to first order. For most buyers, the next twelve months at any given point in time are the most relevant. Using a term that is a multiple of 12 months also eliminates the impact of seasonal effects on prices. Therefore, we suggest using the arithmetic average of the next 12 months' future prices for natural gas or electricity as a good measure of wholesale prices, as they affect retail contract prices.

It's Wise to Watch Gas

One circumstance that makes the task easier is the very strong correlation between wholesale natural gas and electricity prices, as reflected in the 12-month strip. As Figure 2 illustrates, NYMEX Henry Hub natural gas prices and PJM electricity prices are highly correlated. The correlation is 99%, 80%, and 77%, respectively, over the last 2, 4, and 7 years.[1] So, we can generally track gas prices alone for insights regarding both gas and electricity. The correlation between NYMEX Henry Hub natural gas monthly settle prices and Texas average monthly marginal clearing price for energy (MCPE), the wholesale price in the Texas market, is also high, at 90%.

1 Throughout this discussion, the correlation percentages we use are R, the Pearson product-moment correlation coefficient. The closer to 1 or 100%, the stronger the correlation.

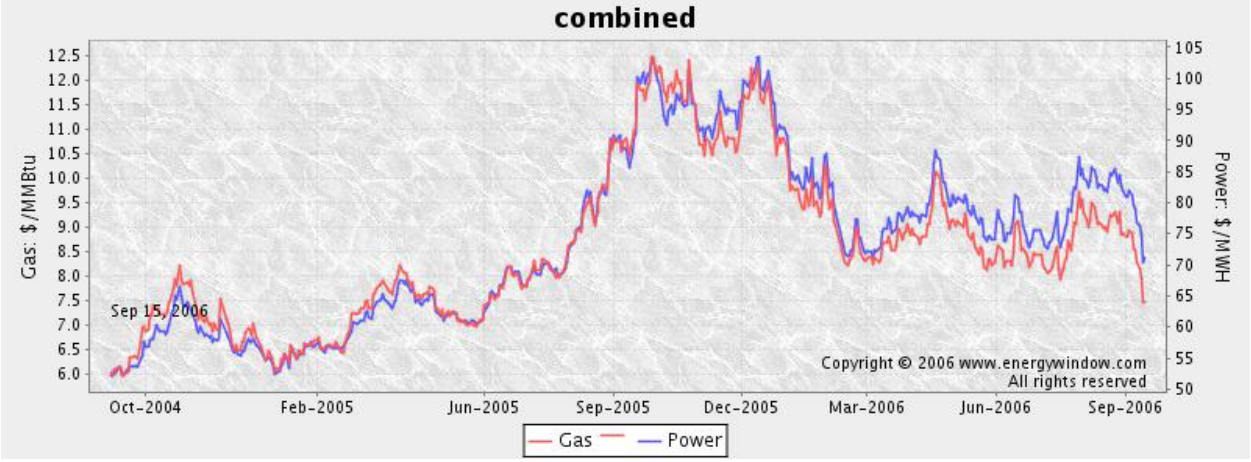

Figure 2: NYMEX Henry Hub Gas and PJM Electric Prices
Daily Averages of the Next 12-Month Future Prices

As the three curves in Figure 1 illustrate, however, short-term and long-term future prices behave differently; so, second order effects can't be ignored. Short-term behavior is driven by real and perceived factors, such as weather, storage, congestion, and economic activity. Long-term behavior is driven more by the real or perceived future supply and demand balance and risks.

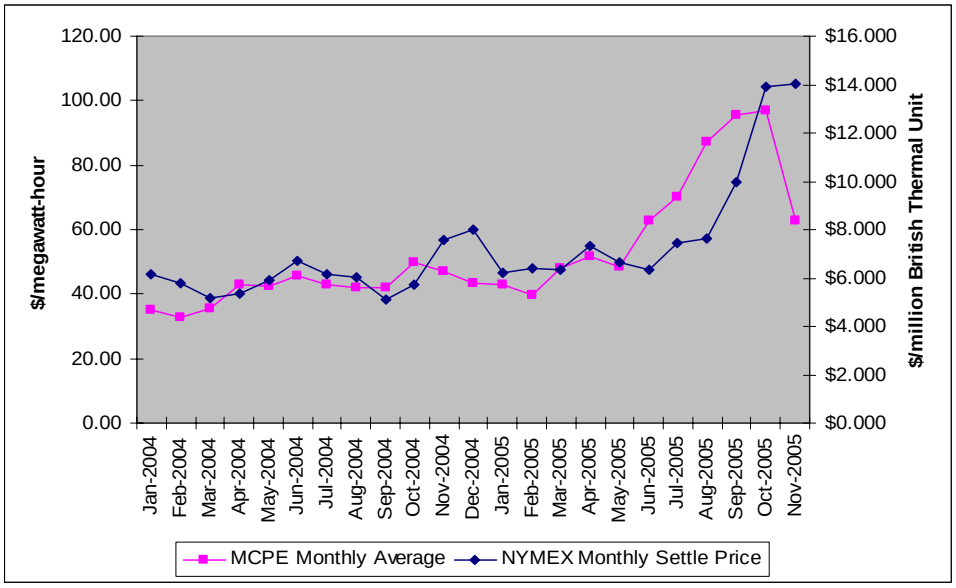

Figure 3: NYMEX Henry Hub Gas and Texas MCPE Electric Monthly Prices

They've Got It All Backwards

Conventional characterizations refer to "backwardation" for future prices that *decrease* for contract periods further in the future and to "contango" for prices that *increase* for contract periods further in the future. One common misperception is that future prices provide a forecast or a market view of where prices are headed. *They do not.* They are simply the prices buyers are willing to pay and sellers are willing to receive for contracts for delivery at some time in the future.

The shape of the future price curve is related to the convenience yield—the net benefit minus the cost of possession of a commodity. It is a general measure of the balance between supply and demand, and it is proportional to the difference between the current price and some equilibrium price, which may

not be constant.[2] In a fashion similar, but inverse to the interest rate yield curve (which usually increases with debt maturities further in the future, because investors demand greater return for more distant and riskier investments), future prices reflect the market views of the relative risk associated with longer- versus shorter-term energy supply commitments.

The generally prevalent, longer-term backwardation of energy curves reflects the view of greater risk and consequent greater discounting of the value (lower price) of energy available further in the future. This also explains why shorter-term future prices are more likely to be affected by acute factors such as storage, weather, etc., and tend to be more volatile than longer-term future prices, as suggested by Figure 1.

Get It Wholesale

Figure 4 shows the relationship of retail default gas supply prices in several example local distribution company (LDC) territories with the NYMEX monthly settlement prices.

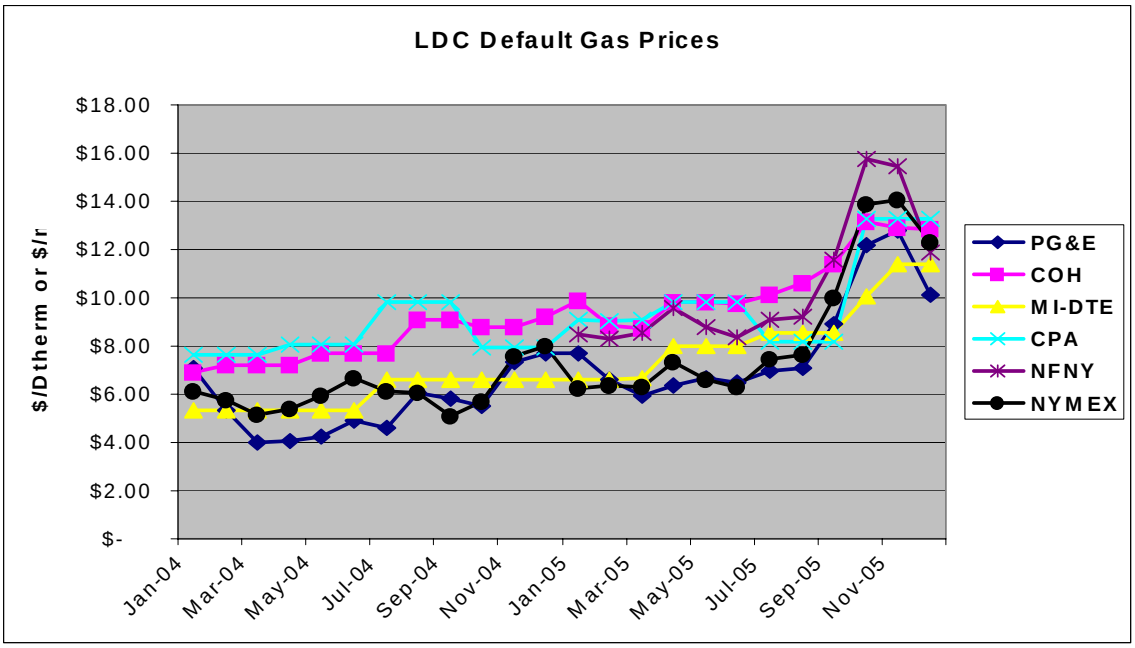

Figure 4: Example LDC Default Monthly Prices

PG&E=Pacific Gas & Electric in California; COH=Columbia Gas of Ohio; MI-DTE=Detroit Edison in Michigan; CPA=Columbia Gas of Ohio; NFNY=National Fuels of New York; NYMEX=NYMEX Henry Hub monthly settle prices

The correlation between NYMEX and the LDC prices range from 77% to 97%, relatively high. The best-fit linear annual increase rates for most of these example default rates range from 14% to 29%. In some LDCs, retail prices may lag wholesale (NYMEX monthly settlement prices), due to regulatory and price-setting process delays—an effect that can and should be considered in timing contract and fixed price setting decisions.

2 For more on these definitions and further discussion of the convenience yield, see Dragana Pilipovic, Energy Risk, McGraw-Hill, 1998.

Similarly, the correlation between the default retail electric price (the Price to Beat) in Texas and both the MCPE and NYMEX Henry Hub settle prices are also relatively high, greater than 70%. Figure 5 shows how the Price to Beat in Texas has increased for representative commercial load in three distribution territories since it was first established at the outset of deregulation in Texas in 2002. The best-fit (greater then 94% correlation) annual increase rate has been 15%.

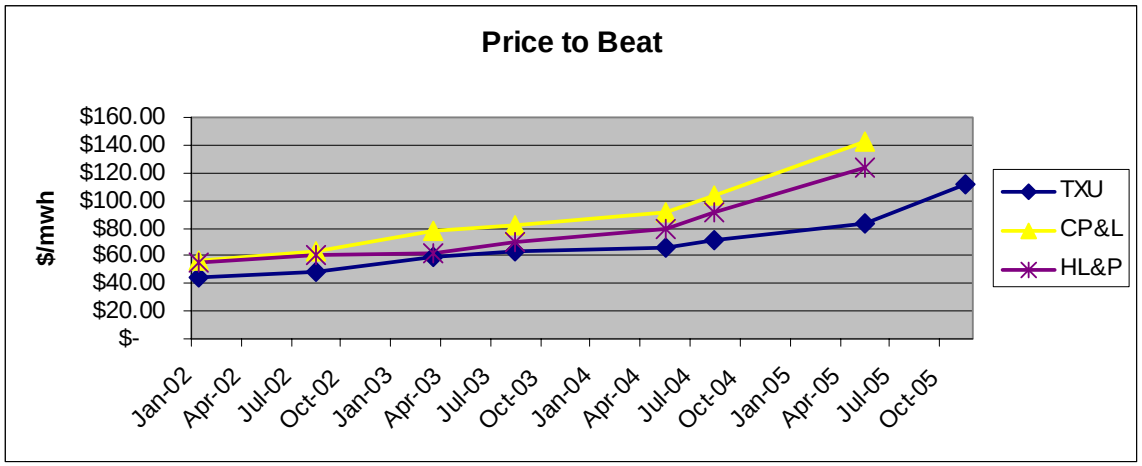

Figure 5: Historical Retail Prices to Beat in Texas for Example Commercial Load

Based on these examples, as well as many other analyses, we suggest that wholesale gas prices, as reflected in the average of NYMEX Henry Hub future prices, are good gauges or proxies of retail gas and electric prices in most energy markets in North America. This includes both competitive and regulated default prices in markets where they are set frequently, annually or more frequently. Of course, while all regulated energy costs are ultimately driven by wholesale prices, they do not correlate well in markets in which regulatory and rate-setting relationships, processes, formulas, and delays result in rate setting less frequent than annual.

Track to the Futures

Figure 6 shows the Henry Hub daily 12-month strip average over the last decade. We can make several observations. The trend line is a constant rate of increase of 14.6% per year. Intuitively, one might expect that prices for commodities, like prices for many other goods, services, and assets (like stocks) would increase over time in this lognormal fashion (the graph is drawn with a semi-log scale so that the curve shows up as a straight line). The 92% R is very high. The curve also demonstrates mean-reversion behavior whereby perturbations (due to changes in the supply and demand balance) appear to cause prices to move away from the mean trend line and then revert to back to the mean trend line but with under-damped oscillations.[3]

A little closer examination and analysis of the graph reveals that a relatively larger perturbation and upward inflection in the curve around 2000; and since then the mean annual rate of increase has been closer to 26%. While we can't definitively explain this inflection, it might be relevant that for at least a

3 Examples can also illustrate how, as the current prices moves above or below the trend line the impact of the convenience yield also tends to build more or less, respectively backwardation into the future price curve.

decade before 1995, the fraction of natural gas used for electricity generation was very close to 15%, +/- 1%; from 1995 to 2000, the fraction increased to 25%, very close to where it remains today. It was also at approximately this time that rolling blackouts, utility bankruptcies, and other disruptions hit California and other regions.

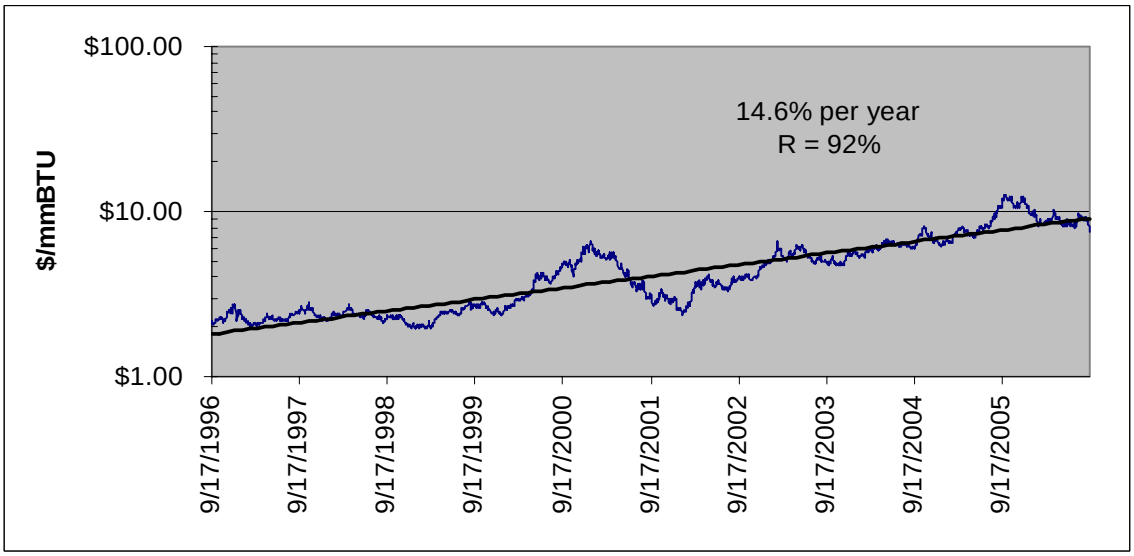

Figure 6 Henry Hub 12-Month Future Price Daily Average 1996-2006

Figure 7 is a plot of the average of the 12-month NYMEX Henry Hub closing gas future prices over the last 4 years with a constant rate or lognormal trend line (the correlation coefficient is 82%). The constant rate of increase of the trend line is approximately 21%. In this case we have added a confidence line. The line shows that on October 16, 2006, the closing 12-month strip average was at

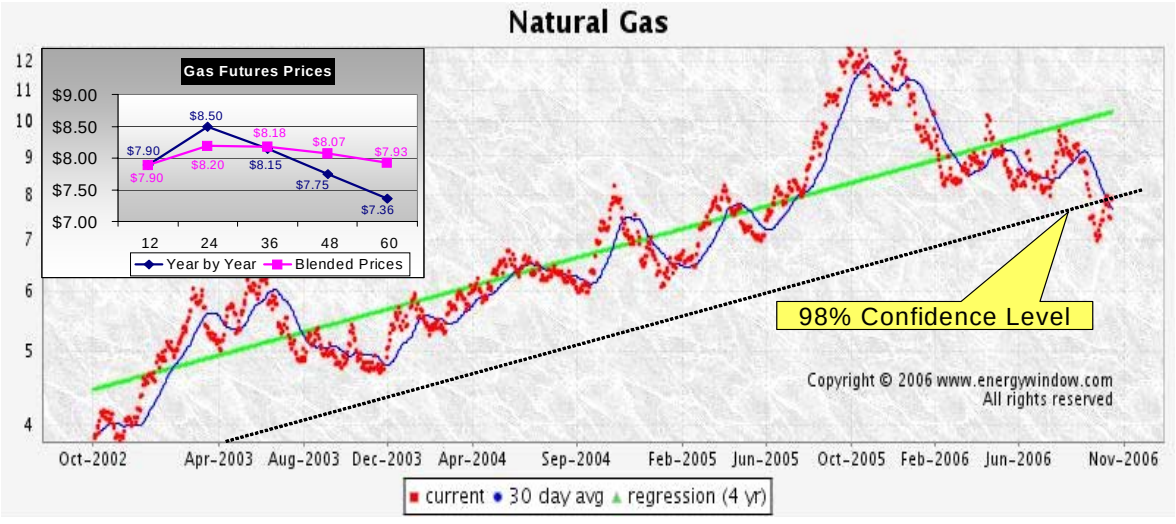

Figure 7 NYMEX Henry Hub Gas 12-Month Strip Average

the 98% confidence level; that is, relative to the average trend line, prices were likely to be above the value that day 98% of the time during the previous four years. Barring some discontinuity or shift in energy market behavior, prices may be expected to be above that confidence line 98% of the time over the next four or more years. The confidence level may be useful in deciding when it's a relatively good time to buy, or fix prices. Conversely, it can be used to set a "trigger" point (say 70%) when to fix prices or to execute contracts for fixed prices.

More is Better

No expert can reliably predict prices, and we certainly are not going to try. There are a number of divergent opinions on the direction in which the markets will head, however, and taken together, they can provide a great deal of insight. Some of the more enlightening expert views (as we see it) on market drivers and future prices follow.

In Outlook for Natural Gas: 2005 and Beyond, published in January 18, 2005[4] (Simmons International), Jeff Dietert, Robert Kessler, and Molly Morris say:

> *"While investors remain concerned about high natural gas inventories (almost 15% above the five-year average), we believe that storage levels are becoming less relevant in determining natural gas prices. Notwithstanding that weather remains a critical swing factor affecting short-term price volatility, we believe that the long-term challenges associated with falling domestic production, declining Canadian imports and limited ability to increase LNG imports will likely continue to support high natural gas prices."*
>
> *"U.S. supply is not likely to grow meaningfully over the remainder of the decade in our view. The limited ability to increase drilling activity, lack of attractive drilling prospects, and accelerating decline rates highlight the probability of future domestic production declines. Canadian imports have reversed trend and are now declining, a significant change from the 10% average annual growth experienced during the 1990s. LNG import capacity, even if fully utilized, will likely struggle to offset declines in domestic production and Canadian imports. Lack of supply will likely constrain demand growth and keep natural gas prices relatively high. The historical relationship between natural gas inventories and prices has disconnected and will likely remain disconnected until sufficient supply is developed."*

In America's Natural Gas Challenge 2006, a presentation given at the Defense Energy Support Center Worldwide Energy Conference on April 19, 2006,[5] Chris McGill (Managing Director Policy Analysis, American Gas Association) concluded the following:

4 See http://www.simmonsco-intl.com/files/011805.pdf.

5 See http://www.energywindow.com/press/DefenseEnergyAgency20060419.pdf.

North American Gas Market:

- *North American supply/demand balance is and will remain tight*
- *Gas consumption grows*
- *"New Frontier" [such as LNG, the Alaskan Gas Pipeline, etc.] gas supplies are necessary and take time*
- *Gas prices remain relatively high*
- *High levels of gas price volatility continue*
- *LNG imports become an important player in natural gas pricing*

One dissenting view is presented by the Energy Information Agency (EIA) of the Department of Energy in their Annual Energy Outlook, December 2006. Figure 8 shows their predictions for gas and electricity prices.

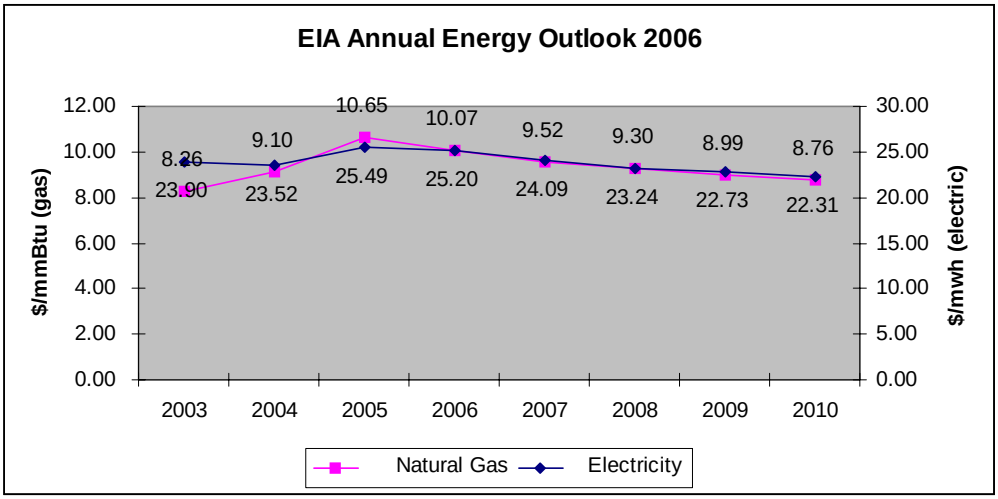

Figure 8: EIA Energy Price Predictions: Annual Energy Outlook 2006

However, in a memorandum: Comparison of AEO 2006 Natural Gas Price Forecast to NYMEX Futures Prices, Mark Bolinger and Ryan Wiser, of Lawrence Berkeley National Lab (LBNL), in December 19, 2005[6] present the graph in Figure 9 and then opine:

6 See http://www.energywindow.com/press/LBNL-59233.pdf.

"Though the number of lines on the graph make it difficult to follow, it is nevertheless clear that past forecast accuracy has been wanting: the EIA grossly over-projected the price of gas in the late 1980s, and conversely has grossly under-projected the price of gas since the mid-1990s (we suspect that other providers of fundamentals-based long-term forecasts have experienced similar levels of inaccuracy)."

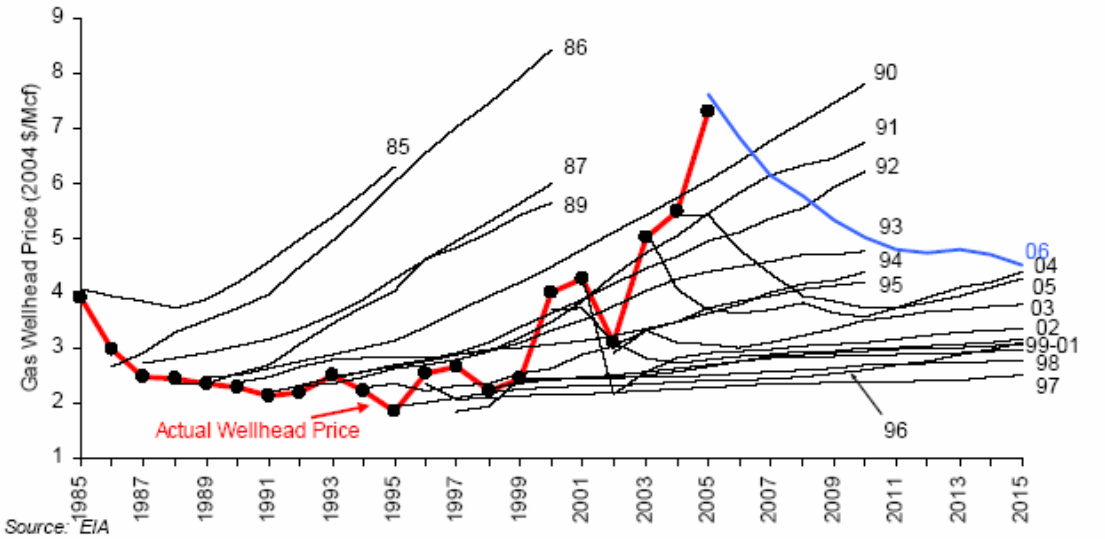

Figure 9: Historical AEO Wellhead Gas Price Forecasts vs. Actual Wellhead Price

Put the Pieces Together

Historical trends, contemporary patterns in the futures markets, and expert opinions can all provide support for energy buyers' most challenging decisions. A little analysis and calculation on the part of the buyer helps make this information relevant, as pertains to choosing the best time to shop markets, sign contracts, and fix prices. In summary,

- Retail and wholesale energy prices are highly correlated. They are likely to become more so in the future.
- Natural gas and electricity prices move in a highly correlated fashion on most markets; you only need to track gas prices to get a sense of where prices are or are going.
- The average of the next 12 months' NYMEX Henry Hub natural gas future prices is a good indicator of both gas and electric wholesale prices as they impact retail prices.
- Futures prices do not forecast where prices are expected to go.
- Short- and long-term behaviors are driven by different factors: storage, weather, etc., drive short-term prices; supply/demand balance and risk drive long-term prices.
- Backwardation (and conversely, contango) is the result of (real or perceived) differences between current and equilibrium prices and short versus long-term risk. If your risk tolerance or circumstances differ from other buyers, you may be able to take advantage of it.

- Tracking the NYMEX 12-month future price average and contracting or exercising options for fixed prices when prices are some confidence level below the average trend line may be a useful strategy for energy buying decisions.
- Energy prices (gas and electric) have exhibited 15% or average higher annual increases for the last decade, much higher rates in more recent years.
- Few experts offer reasons to expect that supply/demand tightness, upward pressure on prices, and volatility are likely to abate for the rest of this decade, or even well into the next.