NATURAL GAS AND ENERGY PRICE VOLATILITY

PREPARED FOR THE
OAK RIDGE NATIONAL LABORATORY

BY THE

American Gas Foundation

400 North Capitol Street, NW
WASHINGTON, D.C. 20001

PRINCIPAL AUTHORS:
BRUCE HENNING, MICHAEL SLOAN, MARIA DE LEON
ENERGY AND ENVIRONMENTAL ANALYSIS, INC.
1655 N. FORT MYER DRIVE, SUITE 600
ARLINGTON, VIRGINIA 22209
(703) 528-1900

October 2003

ENERGY AND ENVIRONMENTAL ANALYSIS, INC.

TITLE: NATURAL GAS AND ENERGY PRICE VOLATILITY

PREPARED BY:
The American Gas Foundation

PRINCIPAL AUTHORS:
Energy and Environmental Analysis, Inc.
Bruce Henning, Michael Sloan, Maria de Leon

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Summary and Findings

Introduction

Over the last five years, price volatility has become the most significant issue facing the natural gas industry and its customers. Natural gas, electricity, crude oil and oil product markets have all exhibited extreme price volatility for some portion of the period. But the volatility of natural gas and electricity prices increased more dramatically than the rest. The increase in price volatility has contributed to a climate of uncertainty for energy companies and investors and a climate of distrust among consumers, regulators, and legislators.

Energy price volatility creates uncertainty and concern in the minds of consumers and producers, who may delay decisions to purchase appliances and equipment or to make investments in new supply. Such delay may result in inefficient long-run resource allocations and an inability to introduce energy efficient and environmentally sensitive new technologies. In addition, volatility may create pressures for regulatory intervention that can bias the market and penalize regulated entities and market participants by generating wide and unpredictable revenue swings. Finally, volatility can hurt the image of energy providers with customers and policymakers and create doubt about the industry's integrity and competency to provide a vital economic product in a reliable fashion.

However, price volatility in energy markets is a complex issue that affects the various stakeholders in different ways. In addition, energy price volatility is poorly defined, and there is not a consistent frame of reference for talking about and evaluating price volatility, let alone developing strategies designed to mitigate its impacts.

This document presents a summary of an in-depth study of the issue of energy price volatility and the impact of volatility on consumers, industry participants, and the penetration of new technologies such as distributed generation (DG). The primary focus of the study is natural gas price volatility and the interaction of gas and electricity markets. Other energy and commodity markets are discussed to a lesser degree. The study is intended to improve the understanding of the root causes of natural gas price volatility, to project the likely level of natural gas price volatility in the future, and to analyze strategies that may reduce the destructive impact of future volatility.

This document also presents several of the key findings of the study specifically related to natural gas price volatility. These findings are intended to focus discussions among industry leaders, government policymakers, and utility regulators regarding recent gas price volatility.

Key Findings Regarding Recent Natural Gas Price Volatility

Natural gas has exhibited particularly large increases in price volatility. The increase in gas price volatility has three primary causes:

- Supply-demand fundamentals – Post-1999, there has been virtually no underutilized supply capacity available to respond to demand increases driven by weather. At the same time gas requirements for power generation, which can fluctuate rapidly with the demand for electricity, have increased significantly. The magnitude of the short-term demand response to changes in gas prices is relatively small. As a result, large movements in market prices have been needed to balance gas supply with demand.

- Effects of commodity trading techniques (Technical Trading) on short-term prices – All commodities traded, whether in exchanges or "over-the-counter," exhibit short-term volatility that can be attributed to short-term imbalances in buy-sell orders from speculators in financial markets. This effect can be seen empirically in the natural gas futures market and the Henry Hub "cash market" price. The impact of these forces on the Henry Hub reference price sends ripples through cash prices throughout the North American Market.

- Market imperfections and market designs that allow for market manipulation – Market imperfections, such as imperfect information or asymmetric information[1], result in price movements. In the natural gas market, a lack of liquidity or concentration of trades in the hands of a limited number of large market participants added to volatility in various regional markets.

Of these three factors, the tightening of the overall supply-demand balance and the limited size of the demand response to price changes accounted for the vast majority of the volatility in gas prices since 2000.

Gas industry restructuring that has continued since the passage of the Natural Gas Policy Act (NGPA) in 1978 – and the implementation of restructuring embodied in decisions made by regulators – has contributed to lower natural gas prices, on average, but has also contributed to a large increase in natural gas price volatility. Restructuring of the gas industry increased the incentive for efficiency improvements and cost cutting in a manner that reduced the amount of underutilized supply capability available to moderate volatility.

Restructuring of the natural gas industry was rooted in a philosophy that the goal of economic efficiency was the primary objective. As a result, policies and implementation promoted the transfer of market price signals to gas producers and purchasers as quickly as possible. Distributors were often discouraged from contracting for additional gas transportation capacity or entering into long-term, fixed price supply contracts. Increased reliance on spot gas purchases ensured that volatility in the commodity market was transferred to consumers.

---

[1] Asymmetric information refers to conditions where one party has information regarding market conditions that is not available to other parties in the same market.

In addition, natural gas wellhead deregulation and the elimination of production prorationing promoted an increase in gas production utilization and a reduction in any overhang in production deliverability. As a result, no short-term supply capability capacity reserve was available to satisfy short-term increases in demand, thus increasing price volatility.

With little reserve supply capability or delivery infrastructure, imbalances in the gas market were thrust upon the demand-side for the response needed to bring the market into balance. However, only a limited number of natural gas applications can easily switch to an alternative energy source in the short-term. Stricter environmental and land use policies prevented more dual fuel capable power generating units, which would moderate volatility, from being constructed. Despite periods of relatively high gas prices in recent years, the amount of electricity generated with gas grew by more than 62% since 1997 while the amount of electricity generated with oil in 2002 was 38% below the 1989 level. Developers of power generation projects often eliminated plans for dual-fuel capability to obtain permits for construction. In total, the percentage of gas applications that have a demonstrated capability to burn alternative fuels has declined significantly since the late 1980s. ***With limited fuel flexibility and little reserve supply and delivery infrastructure, large price movements are inevitable.***

The price signals transferred to consumers increased volatility seen by market participants. The reduction in the prevalence of long-term contracts and limited infrastructure investment in facilities that could moderate price volatility resulted in growing volatility in gas prices, particularly in the populous Northeast United States.

Summary of Analysis

1. Energy prices have become increasingly volatile over the past decade, with natural gas and electricity exhibiting the greatest increase in volatility.

Commodity markets exhibit increased volatility when there is little or no underutilized supply capability to meet natural fluctuations in demand. In order to remain competitive and profitable, or to comply with regulatory requirements, companies have an incentive to increase efficiency and reduce the amount of unutilized capacity or assets held by the company.

The large capital requirements and significant lead times associated with energy production and delivery make energy markets more susceptible to the imbalances in supply capability and demand that result in price volatility.

Energy markets such as natural gas, electricity, and heating oil are particularly susceptible to market and price volatility because fluctuations in weather can change the underlying demand for the commodities significantly, and the increase or decrease in demand affects all of these commodities in the same direction.

2. Barring structural changes, natural gas markets will be at least as volatile or more volatile in the future.

The large increase in gas-fired power generation capacity characterized by rapid and less predictable swings in gas requirements will increase fluctuations in natural gas demand. The majority of the new natural gas power generating stations will not be operated as a baseload source of power. As a result, they will cycle on and off as the marginal sources of electricity supply, leading to larger day-to-day swings in natural gas demand. In addition, the limited amount of dual-fuel capacity being installed in new power plants compounds the effect of the plants on gas market volatility. In fact, large amounts of dual-fuel power generation would have the impact of moderating gas market volatility.

Environmental restrictions that limit the ability of large gas loads to switch to oil during periods of tightness in the gas market will increase gas market volatility. Public opinion and policy have yet to recognize the linkage between price levels and price volatility with environmental restrictions.

In the short-term, capital constraints that have developed in the wake of the Enron bankruptcy and decline in equity prices for many energy marketers will continue to inhibit the flow of investment into natural gas and electricity infrastructure to at least some degree. It is not clear how long these capital constraints will last, but the impact will be felt for at least several years after the constraints are alleviated.

Finally, public policy and natural gas industry regulation continues to focus on short-run economic efficiency that inhibits the use of long-term contracts and the investment in facilities that provide a reserve supply capacity. While there has been increased discussion regarding the desirability of longer-term contracts and the need for additional infrastructure, there remains no consensus regarding the appropriate mechanism to provide economic incentives for such investment or to allow for the recovery of costs that may be "at risk" in the commodity market.

3. **Strategies designed to address volatility fall into two categories: 1) Strategies and policies that are designed to reduce volatility, and 2) Strategies that are designed to manage volatility and allocate the risks associated with volatility.**

There is no "silver bullet" to address market volatility that is guaranteed to reduce gas and electricity prices in the long-term. Rather, there are real, and in some cases, significant costs associated with all of the analyzed strategies that would increase prices over time, but result in more stable prices in return.

Strategies and policies that are designed to reduce volatility

Strategies and policies designed to reduce volatility create incentives or regulatory requirements to invest in facilities that increase the availability of "reserve supply" capacity or increase the amount of demand that is shed in response to increasing prices. Returning to a greater use of longer-term contracts could be an effective method of financing the infrastructure required to supply the reserve supply capacity needed to moderate price volatility.

During restructuring over the last several decades, policies that foster price stability through long-term contracts and investment in facilities that provide a reserve supply capability were often abandoned in favor of policies promoting market efficiency goals with the effect of increasing price volatility. Adopting policies that would provide incentives for increased use of long-term contracts could recreate a balance that would moderate volatility compared to a continuation of current trends.

Strategies and policies designed to reduce volatility must be adopted by a large number of participants to be effective. Without structural changes that create broad incentives or regulatory requirements to make the required investments, an individual participant would incur additional costs compared to their competitors without the ability to affect volatility to a significant degree. Hence individual market participants typically do not undertake such investments on their own without an identified mechanism to recover the cost of the investment. ***A market structure design that relies solely on market determined basis differentials for the recovery of transmission and distribution infrastructure costs is unlikely to recover the costs of investment in reserve capacity. Similarly, there is no incentive for a producer of natural gas or any other energy resource to voluntarily develop production capacity that is held as reserve supply capability.***

Without a cost recovery mechanism, participants often see the reserve capacity requirements as the imposition of unnecessary costs that are at risk. As a result, they generally oppose these types of requirements. Compounding this problem, regulated entities have been directly or indirectly restrained from entering into long-term contracts needed to finance the infrastructure investments that could moderate volatility even if a cost recovery mechanism in regulated rates could be constructed in the structure of utility rates.

It will likely be difficult to achieve consensus on adopting policies to increase demand response or create reserve supply capacity without significant support from the general population. Moreover, the general population does not understand the fundamental causes of energy price volatility and is more likely to attribute price movements to market manipulation and profiteering. As a result, there is a significant risk that any public outcry for policies designed to address volatility would not result in the needed investment in infrastructure.

Strategies that are designed to manage volatility and allocate the risks associated with volatility

There are many risk management tools available that a company can use to manage the risks of price volatility. Moreover, unlike the strategies designed to reduce volatility, individual companies can implement strategies that are designed to manage volatility. However, for regulated entities, such as gas local distribution companies (LDCs), regulatory approval and/or review of the results of a price volatility management program can be problematic. Risk management and hedging programs are not yet well understood by many regulators.

To date, regulatory oversight of hedging programs generally has not provided the "pre-approval" of the objectives of programs that is needed to rationally implement hedging strategies. As a result, utilities are at risk for hedging decisions and have limited incentive to allow their supply portfolio to deviate significantly from market prices. As a result, gas consumers have been subjected to greater price volatility than might have otherwise occurred had such approval been in place. A concerted effort to add to regulators' understanding and to engage regulators in discussions regarding hedging is necessary.

Importantly, regulators and customers must understand that risk management programs are likely to result in some increase in costs. Just like insurance, hedging and price volatility management involves a payment to a counterparty that is willing to take the risk of an unfavorable outcome. For regulated energy companies, the company and the regulator should determine the appropriate amount of risk management. The appropriate review for a price volatility management program is the prudent implementation of program that is agreed upon in advance.

Managing Price Volatility: Techniques, Issues, and Barriers

Strategies designed to manage price volatility all involve allocating price risk among the market participants. The strategies do not impact the underlying volatility of natural gas prices. In a real sense, the re-allocation of risk embodied in these strategies largely represent a "zero sum" game. To the extent that the price risk for one participant is reduced, the price risk for another participant is increased. In considering these strategies, a market participant should carefully assess the nature of the risk and quantify the magnitude of any risk that is assumed.

For a regulated entity such as a natural gas LDC, it is important to fully integrate any strategy that is adopted into the framework of regulatory review and oversight. Many elements of the strategies presented will require regulatory approval and, in some instances, regulators have been reticent to grant approval of the type of program suggested by the strategy. As a result, approval of some elements of the strategies may be difficult to obtain and will require intensive education on the relationship between price volatility management and the way in which the strategy addresses volatility. Moreover, certain regulatory models, (e.g., performance-based rates or rate cap regulation) may present additional challenges to the adoption of individual strategies.

There are four basic elements that are common to a number of the management strategies analyzed in this report. They are:

- Market segmentation – Market segmentation refers to the differentiation of customers based upon their characteristics. In the context of strategies to manage price volatility, segmentation involves differentiating the customers based upon their need for price stability and level of risk tolerance.

- Long-term (multi-year) contracts – The effect of a long-term contract is to transfer an entitlement and/or obligation between two or more parties. Contracts are the basic business tool to allocate risk between parties.

- Asset acquisition and diversification – The value of energy production or delivery assets is highly correlated to the market price of energy. As a result, a diversified portfolio of energy production or delivery assets can be used to balance risk that is related to energy price. When the energy production assets span energy commodities with prices that are uncorrelated or loosely correlated, the portfolio provides additional insulation from price volatility and may provide arbitrage opportunities.

- Financial derivatives – Financial derivatives (e.g., futures, options, swaps) are contractual vehicles that conveys a right and/or obligation to buy or sell a commodity (such as natural gas) at a specified price. Financial derivatives can offer a method of offsetting price risk with modest transaction costs.

These elements may be combined into an effective price-hedging program. Analyzed strategies include:

- Creating a balanced business book of purchase obligations and sales commitments using longer-term contracts;

- Managing volume risk with weather derivatives;

- Seeking regulatory pre-approval of contract and derivative management strategy;

- Offering multi-year fixed price service offerings to customers;

- Increasing customer class segmentation with balanced supply portfolios and service contracts; and

- Developing integrated gas and electric generation fuel supply portfolios.

In the wake of the bankruptcy of Enron and subsequent pressure on the equity prices of many of the major energy trading companies, it is quite difficult to enter into bilateral forward contracts more than a few months out in either the physical or financial energy markets. There is a lack of market liquidity and a lack of creditworthy counterparties that limits the number of long-term contracts. Going forward, there is likely to be some return of liquidity as other parties with sufficiently strong balance sheets return to energy markets. However, it is likely that the cost of hedging will be relatively high for any party that is attempting to lock in prices more than a year out into the future.

4. **Gas and electricity price volatility presents an additional obstacle to Distributed Generation (DG) and other emerging markets because it creates uncertainty in the minds of potential purchasers of DG and other nascent technologies. However, owners and potential purchasers of DG equipment do not identify price volatility as a principal factor in the evaluation of investment.**

Research shows that DG customers and potential customers have not explicitly focused on price volatility as an issue that affects their investment decisions. Rather, the uncertainty surrounding future prices is one additional factor that the customer evaluates in considering the investment. For large combined heat and power (CHP) applications where the technology is well understood, the additional price uncertainty does not seem to deter investment significantly. In smaller DG applications where the customer is less familiar with the technology, the price uncertainty seems to exacerbate concerns about the technology and delays or deters the investment.

In interviews with end-use customers and ESCOs who are the current and potential owners and operators of such systems conducted through the fall of 2002, gas and electric price volatility *per se* was not identified as a major factor influencing the decision to invest in DG or CHP applications. The overwhelming majority of installed CHP in the industrial sector reflects the positive economics of being able to serve large thermal loads with heat recovered from on-site generation that serves the entire facility's electrical load, often with excess to sell to the grid. Potential impacts of volatility are dampened in this sector through use of dual-fuel CHP technologies and sophisticated commodity purchasing practices with use of price risk management tools.

DG technologies are less well understood by smaller commercial customers. These customers have a lesser ability to engage directly in commodity purchasing and price risk management. For these customers, the marketer or regulated LDC performs the price risk management function. These customers do not understand the elements of energy market pricing and can be somewhat distrustful. In addition, they have less experience with and awareness of DG/CHP technologies. Uncertainty surrounding DG/CHP investments tends to be complicated by uncertainty about future levels and relationships of natural gas and electricity prices. Competing uses for capital, typically in high-visibility projects, push energy project investments down the priority queue, and harsh financial criteria such as one-year paybacks constrict opportunities.

Conclusions

Over the next twenty years, the natural gas market will rely less on the conventional sources of natural gas supply that have supplied most of the natural gas consumed in the past. Increasingly, new sources of natural gas will need to be developed to meet demand. Much of the new supply will come from frontier gas resources that are not currently an important part of the overall supply portfolio. These frontier resources will include a mix of LNG imports, Arctic gas from Alaska and Canada, Canadian Maritimes production, deep offshore production, and other sources of remote supply. Some mix of these sources of supply is clearly needed to meet gas requirements. These supplies will result in increased availability of gas supply and a lower average price than would occur in the absence of these sources of gas. However, these frontier supplies will not reduce volatility. Rather, reliance on these resources tends to increase natural gas volatility relative to other more conventional supply sources due to several of the characteristics of frontier supplies.

Frontier projects tend to require huge up-front investments, but have very low incremental costs after the initial investment is completed. As a result, there is a stronger than normal incentive to maintain maximum production levels from frontier projects and the price at which a production shut-in would occur is typically lower than for conventional resources. This tends to decrease short-term supply response to price. Most frontier projects can be expected to flow at as close to capacity as is operationally possible, regardless of market conditions.

Daily demand volatility is also expected to continue to increase over time in absolute terms. The growth in weather sensitive load will increase demand response to changes in weather, increasing overall demand volatility. In addition, the growth in power generation load is expected to increase daily demand volatility in most regions. The majority of the new natural gas power generating stations will be used to meet peak and intermediate electric load requirements. As a result, they will cycle on and off as the marginal sources of electricity supply, leading to larger day-to-day swings in natural gas demand.

Without structural changes in natural gas and electricity markets, the analysis conducted in this study effort concludes that natural gas markets will remain volatile, with potentially even larger price swings in the future.

Unfortunately, there is no "silver bullet" available to address volatility. There are real and potentially substantial costs associated with any of the approaches identified in this analysis. It is important that industry, consumers, regulators, and policymakers consider the alternatives in an informed manner to develop a consensus approach to addressing energy price volatility.