

The Evolution of Underground Natural Gas Storage: Changes in Utilization Patterns

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FOREWORD

The American Gas Association (AGA) has estimated weekly changes in working gas inventories (underground storage) for three large regions of the US since January 1994. Initially, the *American Gas Storage Survey* served the purpose of providing “realtime” data to a market that had very little natural gas supply accountability. A national commitment to less market regulation initiated by the Federal Energy Regulatory Commission (FERC) in favor of market forces demanded key information. In fact, the Energy Information Administration (EIA) was investigating such a mandate for storage reporting when AGA with member company support offered to collect the data and create weekly working gas estimates.

During the 1990’s as utilization of energy related financial instruments (futures, options and swaps) have increased and as they have set a standard for valuing natural gas as a commodity market information has become very prominent. Weather forecasts, reports on domestic production and storage estimates all tell stories regarding the general health of gas supply in this country. Information in the natural gas market is routinely interpreted and reflected in futures prices and other elements of the market.

Data from the *American Gas Storage Survey* also supports AGA members as a benchmark for national trends when individual company supply and purchasing practices are scrutinized by state regulatory bodies. This benchmarking has become very important as supply and demand for natural gas have become more closely balanced.

With this backdrop, AGA believes it is crucial for users of storage information to understand its benefits, its limitations and to recognize the remarkable changes in storage utilization that have occurred in the past decade. It is only with this understanding that market data can be properly interpreted. In order to educate and promote an understanding of the key changes in storage strategies during the past decade, AGA commissioned International Gas Consulting, Inc. (IGC) to study and report on these issues. IGC is clearly recognized as an industry leader in matters of natural gas storage utilization and strategic planning. The following report is intended to highlight key changes in underground storage utilization as both a winter supply

tool and commercial asset for companies owning or holding underground storage capacity.

EXECUTIVE SUMMARY

Much has been said about the changes that have occurred in the natural gas market over the past decade. These changes are profound and pervasive. In addition to impacting the way natural gas is bought and sold they have also changed the way the existing natural gas infrastructure, including natural gas storage, is being utilized.

Until the late 1980's, the storage of natural gas was primarily a utility, as opposed to commercial, function. Even though the economic justification for storage projects could be linked to the avoided cost of long-line pipeline capacity versus the cost of the storage, the decisions to develop and utilize underground storage were often driven by operational and economic requirements. The operational value was immeasurably greater because storage was the tool that allowed daily and seasonal variations in demand to be balanced with supply. Underground natural gas storage provided pipelines and local distribution companies (LDCs) with seasonal supply, swing supply, and emergency supply.

Today, storage is viewed very differently. The old rules regarding the quantities of storage required to meet seasonal load variations are no longer valid. Storage projects are being built to avoid imbalance penalties, to support peaking electric generation loads, to allow for the capture of the value of gas price volatility, and to support swing gas supply service. Storage is being used to facilitate daily nomination changes, title transfers, parking and lending services, and simultaneous injections and withdrawals. Storage economics are now often dominated by managed hedging strategies, daily and hourly balancing costs, hub services, and market based rates. Even the preferred geologic setting for underground storage facilities, in many cases, has evolved from depleted reservoir and aquifer fields with limited cycling capability to salt dome and other high deliverability settings, which can offer multiple cycles and significant physical flexibility for stored gas.

Increased efficiencies in the market for natural gas have encouraged the growth of new uses for natural gas storage. At any point in time, the amount of gas in storage represents a combination of elements.

- First, the amount of natural gas in storage reflects that volume required to serve the traditional utility functions, assuring the operational availability of natural gas.
- In addition, the amount of gas in storage captures the desire by companies to make a profit from marketing opportunities. Individual companies are making daily decisions about how best to meet their obligations and to maximize their profits.
- Utility and commercial users of storage coexist side-by-side, sometimes within a single company. However, utilities have a regulatory obligation to ensure supply reliability at the lowest cost to firm ratepayers and, therefore, establish specific goals pertaining to the levels of inventory that must be maintained. In addition, utilities are charged with utilizing storage for the economic benefit of gas consumers – but only to the extent that supply reliability is not compromised. Larger utilities also implement strategies to market surplus inventories to non-utility customers in order to generate a net margin that is credited back to the utilities' gas consumers. There is no bright line between the inventory needed and the inventory desired. Therefore, it is impossible to look at any particular inventory level, injection rate, or withdrawal rate and determine if it is sufficient or excessive.
- Given the degree of uncertainty with the weather during the winter heating season, storage is a critical physical hedge for utilities. This is nothing new. What is new is that there are many new participants in the business, each with its own motivation to store natural gas. This diversity of judgement coupled with the tools in the market place ensure that gas is made available for its highest value use. This allows some of the risk of supply decisions, including storage, to be shifted to the private sector and away from end users and LDC customers.

Several significant changes in the natural gas markets have promoted this evolution in the use of storage facilities:

- The deregulation of natural gas prices has resulted in increasing seasonality and increasing volatility. Previously, the industry balanced load using curtailments, wellhead shut-ins,

and storage. With deregulation of the commodity, changes in supply and demand are reflected in the price of natural gas. This development made the commercialization of underground natural gas storage possible because it became possible to inject gas into storage with the expectation of profiting from price changes.

- The increasing industry use of the NYMEX futures contracts and derivatives has provided buyers and sellers of gas the ability to manage the risk of price volatility and to capture a margin on stored gas at the time of injection.
- Order 636 opened the opportunity for marketers to use storage and underutilized pipeline capacity to support their business. These marketing companies have sought and found new ways to serve markets and new ways to profit from the use of gas storage.
- The growth of natural gas market centers and hubs support has increased liquidity, which has freed the traditional utility users of storage to make a portion of the capacity they control available for use by marketing companies through Agency Agreements. Storage clients use storage associated with market centers and hubs to take advantage of location and transportation price variations that take place on a daily, monthly, and seasonal basis.
- Along with Agency Agreements, the development of new storage projects has placed an increasing share of storage assets in the hands of commercial users.

The market has found a wide range of profitable opportunities to utilize storage.

- Storage is used as a variable source supply to support services such as daily and even hourly swing gas, warranted supplies, emergency back up, and balancing services. It also supports natural gas parking and lending services.
- Storage is used to ensure liquidity at market centers to help contain price volatility and maintain orderly gas markets. Storage can be used to balance a marketer's obligations across multiple pipelines and in multiple regions. Most significantly, natural gas storage in conjunction with the futures market allows marketers to profit from the changes in gas prices over time through arbitrage transactions.

Because these uses are new, they represent a disproportionate share of the new transactions, the current interest, and opportunity to enhance the usefulness of underground natural gas storage. However, the new uses have not displaced the traditional uses. The commercialization of storage takes place primarily within new facilities, production area facilities not previously committed to LDC use, and capacity made available by LDCs through Agency Agreements. The capacity that the LDCs believe that they need to serve their traditional utility role is still available to use, as they deem necessary. A majority of the storage capacity in this country is still used to assure the availability of seasonal gas supplies. The commercial uses of storage not only co-exist with the utility/operational use of storage; the two uses actually complement one another.

THE EVOLUTION OF UNDERGROUND NATURAL GAS STORAGE: CHANGES IN UTILIZATION PATTERNS

INTRODUCTION

Not so very long ago, if you asked an expert on natural gas storage why storage was built, the most likely answer was that storage was necessary to assure winter time supply and to provide emergency backup. If you asked that same expert how storage was used, he would say that it was filled in the spring and summer and withdrawn in the winter. Any discussion of storage economics would focus on the avoided cost of long distance pipeline capacity and cost of service rates.

Today, storage developers explain that their projects are being built to avoid imbalance penalties, support peaking electric generation loads, allow for the capture of the value of gas price volatility, and to support swing gas supply service. When you ask how storage is being used, you might hear about daily nomination changes, title transfers, parking and lending services, and simultaneous injections and withdrawals. A modern discussion of storage economics would not be complete without a consideration of managed hedging strategies, daily and hourly balancing costs, hub services and market based rates.

Like the gas industry as a whole, the underground natural gas storage segment has undergone dramatic change in the past few years. Natural gas storage is in the process of being transformed from a utility function to a commercial business.¹ That transformation is underway and incomplete but nonetheless has significant implications for understanding how gas storage is being used today and for understanding the publicly available information

¹ Throughout this paper, we make the distinction between the utility versus the commercial use of storage. This is not a distinction that is intended to suggest that utility companies are not commercially motivated or that all non-utility companies seek to use storage only for commercial applications. The concept presented distinguishes between storage being used for operational purposes, to promote some other business objective, as opposed to storage for commercial applications where its profitable use is itself an objective.

regarding storage utilization. The purpose of this report is to examine those changes and the implications they have for natural gas industry stakeholders.

HISTORICAL DEVELOPMENT OF UNDERGROUND NATURAL GAS STORAGE

The U.S. Geological Survey first proposed the concept of underground natural gas storage in 1909 as a waste conservation measure. The first recorded underground gas storage facility was a depleted gas reservoir converted for storage service in 1915 in Welland County, Ontario, Canada. In 1916, the first storage field in the U.S. began operating near Buffalo, New York at the depleted Zoar Field. That field remains active today.

The early success of storing gas in depleted gas fields resulted in the gradual development of other fields as it was realized that utilities with access to storage possessed a powerful tool to better serve demand. In fact, the development of the entire natural gas industry was linked to the newly proven ability to provide reliable gas service year round to industrial, manufacturing, and residential users.

Long distance pipeline transmission systems first appeared on the national energy scene in the late 1920s and early 1930s with the discovery of three major gas production areas. The Panhandle/Hugoton Field in Kansas and the Oklahoma panhandle anchored three long distance pipelines. Five pipelines used gas from the Monroe Field in North Louisiana to support deliveries to Houston, St. Louis, Atlanta, Memphis, and New Orleans. Pacific Gas and Electric Company constructed a 300-mile pipeline from the San Joaquin Valley gas fields to serve the market of San Francisco.

The pipeline industry recognized that building pipelines with sufficient capacity to meet winter seasonal and peak demand was not only extremely inefficient, it was not possible. The steel industry, in the early days of the natural gas pipeline industry, did not have the ability to manufacture pipe any larger than 24" in diameter, and furthermore, steel mills were operating at capacity for other construction needs. Laying numerous small lines was cost prohibitive. In addition, it was an obvious waste of resources to build a pipeline that could carry sufficient gas to meet the peak day requirements in the winter when less than half of that capacity is

used in the summer. Without the ability to store gas near the point of consumption during the summer months, capital intensive facilities such as large compressors would be left idle or would be operating in very inefficient ranges relative to design capabilities. In the middle to late 1940s, nationwide economic expansion in Canada and the U.S. greatly increased demand for energy.

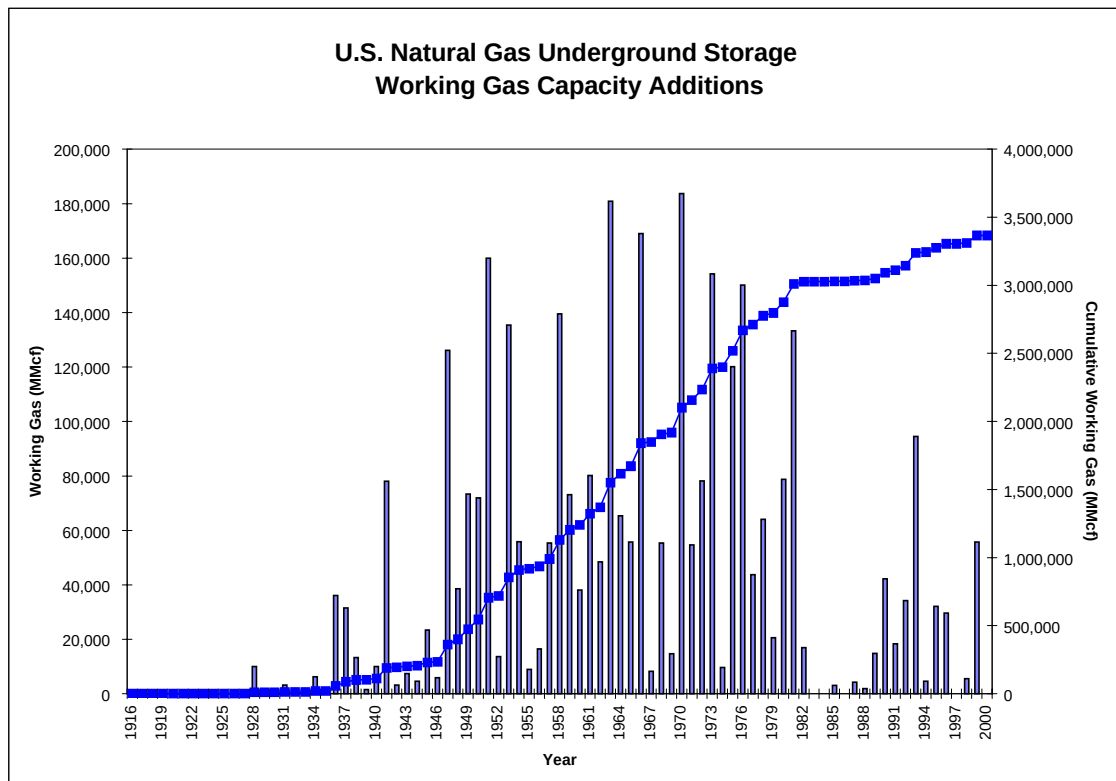


Figure 1. U.S. Underground Natural Gas Storage Working Gas Capacity

New large-diameter, long-distance natural gas pipelines were laid (and oil pipelines converted) to connect supply areas of Texas, Louisiana, Oklahoma, and Kansas to the large population centers of the Midwest and Northeast. Gas from the Permian Basin in West Texas and the San Juan Basin in New Mexico was connected to market outlets in California. Canada's Western Sedimentary Basin production was linked first to population centers in Ontario and Quebec and later into the Pacific Northwest and Northern California. Storage capacity was added to complement the development of these expanding pipeline systems. From 1941 to 1981, the number of new gas storage fields increased dramatically, with storage

working gas capacity² increasing an average of 7.5% per year. Figure 1 shows the rate of storage development that has occurred in the U.S. over the last 85 years.

As the market for natural gas service grew so did the need for underground storage. Storage developers looked for additional geologic targets to allow the injection of gas into storage during the summer and withdrawals in the winter to satisfy this need. In 1941, Hope Natural Gas Company developed storage in a depleted, combination oil and gas reservoir in West Virginia. By 1946, Louisville Gas and Electric Co. had developed the first aquifer storage facilities in Muldraugh and Doe Run Fields in Meade County, Kentucky. In 1970, the first salt cavern natural gas storage was opened in Mississippi by Transcontinental Gas Pipeline (“Transco”) as a system supply backup for Gulf of Mexico production in case of disruption during hurricanes.

THE EMERGENCE OF COMMERCIAL USES FOR GAS STORAGE

Through out this period and until the late 1980’s, the storage of natural gas was a purely utility as opposed to commercial function. The decisions to develop and utilize underground storage were driven by operational and economic requirements. The commodity price of natural gas was regulated from the wellhead to the burnertip. Pipeline’s, and LDCs generally passed through the cost of gas and earned a profit based on their investment in the assets necessary to deliver it.

The economic value of storage was the regulated return on the asset. The operational value was immeasurably greater because storage was the tool that allowed daily and seasonal variations in demand to be balanced with supply. Underground natural gas storage provided pipelines and LDCs with seasonal supply, swing supply, and emergency supply. For these utilities, the value of storage was the avoided cost of meeting their needs for these services through other means such as additional pipeline capacity, fuel switching, curtailments, and lost market. In most cases, storage was a cost-effective alternative.

² Working gas is the volume of gas injected into storage and available to be withdrawn for delivery. Base gas, in contrast, is “permanently” contained in the reservoir to maintain operating pressures to provide desired flow rates.

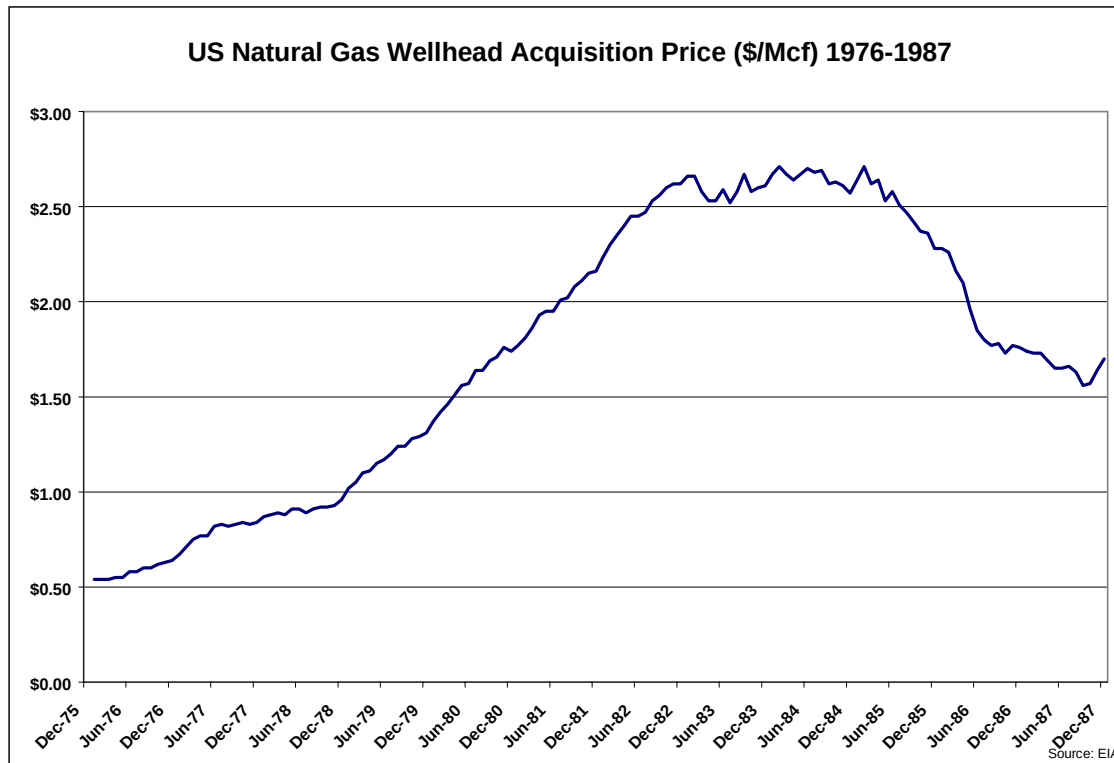


Figure 2. Monthly Natural Gas Prices 1976-87

As shown in Figure 2, there was historically little or no commercial value to underground natural gas storage. That is to say, historically the regulated pricing structure for natural gas made it unreasonable to inject gas into storage with the expectation that you could sell it for a higher price when it was withdrawn. While there were some independent storage developments³ and some industrial users developed their own storage; these facilities, like the Pipeline and LDC developed storage, were used to support seasonal and operational swings in demand and to provide emergency supply.

The original open access regulations were enacted when the Federal Energy Regulatory Commission (FERC) issued Order 436 in 1985. This began the process of transforming the natural gas commodity market from a tightly regulated “cost of service” pricing structure to

³ Honeoye Storage Corp. developed the Honeoye facility in Ontario County, New York in 1975 for the purpose of selling storage services for a profit to third parties. This facility was the first Independent storage development in that it included sponsors who were neither pipelines nor LDCs. However, all of its initial customer base were traditional utilities and its utilization fit the same pattern as other storage facilities in the region.