Appraisal of Underground Natural Gas Storage Rights in Depleted Reservoirs

by Bernie Shaner, MAI, SRA

Abstract

Natural gas may be stored underground in depleted gas and oil fields. A developer of underground gas storage fields may seek to assemble the rights to several thousand acres, but the developer may only be interested in buying the rights to strata that, on average, are 1,000–5,000 feet below the surface. What is the market value of rights for these reservoirs? Where does the appraiser find comparable sales or rents? This article offers a brief discussion of the underground gas storage market, and how understanding rules relating to eminent domain valuation can guide the appraiser to a logical, defensible conclusion of value.

Introduction

Natural gas is a commodity that can be stored for an indefinite period. Land that once held naturally occurring oil or natural gas but has depleted reservoirs might now be suitable for a natural gas storage operation. Such gas storage occurs far below the surface and can encompass several hundred or several thousand acres. The land above the proposed storage field usually includes many ownerships, which means the rights must be acquired from a number of owners. Most landowners have no use for the permeable subsurface that is thousands of feet below the surface, and they give no thought to it having value until a developer for a proposed gas storage operation knocks on their door offering to buy the rights to those particular strata of rock that are permeable and partly void.

An assignment to appraise the value of underground storage rights for a proposed gas storage field might start with the appraiser researching relevant data or published reports regarding the valuation of underground gas storage rights. Although the research will produce many articles related to underground gas storage, and some articles discussing the value of the gas that is in storage, almost none will address the valuation of the rights to a subsurface layer suitable for storing and retrieving natural gas. One of the few discussions to address the valuation of underground storage rights can be found in the Internet question and answer service, “Allexperts.” There, a gas and oil expert responded to a question about valuing the renewal of an expiring underground storage lease by stating,

It’s pretty rare to have a gas storage facility under your property I’d say. $1,000 annually? Can’t say if that’s the going rate or not for sure. I’d be happy with it I suppose, as long as it wasn’t intrusive to my farming etc. Might be worth a lot more to them upon renewal though, who knows. If I come across any more info I’ll add it to this answer and you should be alerted when/if I do that.  

In essence, the expert is saying, “who knows?” One reason for such a response is that there is almost nothing written on the valuation of gas storage rights. This is not surprising since there are not many assignments for the valuation of these rights.

Appraisers looking for guidance on value of underground storage rights are likely to find that

opinions of value usually are far apart—sometimes by multiples of three, four, or more—even in court decisions regarding this issue. The differences in value can be attributed, in part, to the differing perceptions of gas storage rights. For example, one law firm’s newsletter said,

Property owners should rightfully look at this as not easements across the surface of their land, but as owning a portion of this underground gas storage facility to which they should be entitled to their proportionate share of its value. This means that the value of an underground storage facility should be considered no differently than the value of natural gas, oil, or any kind of mineral that is beneath the surface that would be utilized by a third party utility company or energy processor to achieve profits in the market place.  

Under this view, the valuation for the taking of rights to real property would be based on the profitability of the condemning authority’s use; however, this conflicts with eminent domain statutes and case law. Condemning authorities expect the valuation to be based on the value of the property rights that are to be taken, which is consistent with eminent domain statutes and case law.

This article explores the nature of the rights acquired for gas storage use, discusses how the approaches to value (cost approach, sales comparison approach, and income capitalization approach) apply to this valuation problem, and proposes a solution for the appraiser.

Background

Natural gas is in high demand in the cold weather months and low demand when it is warm, but natural gas production continues year-round. Underground storage fields can serve as warehouses that make natural gas available during times of peak demand. Along with these storage reservoirs, there must be a network of gas pipelines that allows for the movement of the gas to areas as far as halfway across the country. Natural gas storage also involves surface uses for such things as injection and withdrawal wells, observation wells, metering, and access roads.

There are three types of underground storage reservoirs: depleted gas and oil fields, aquifers, and salt caverns.

A depleted reservoir is an area where there was once gas and/or oil production but the field has been depleted of its economically productive hydrocarbons. Depleted reservoirs are the most common type of gas storage reservoirs, with nearly 75% of stored gas in these facilities. The advantage of this type of reservoir is that it already has some wells that can be converted for use in the storage field, and it also has pipelines and access roads in place nearby. The physical characteristics of the reservoir are probably fairly well known, as they already would have been studied by geologists and petroleum engineers during production. These reservoirs also have cushion gas, which is a permanent inventory of gas in the reservoir that is required for more efficient delivery of gas when it is withdrawn and delivered. These reservoirs, together with adequate buffer areas, often spread over hundreds and even thousands of acres, so for most storage operations, rights must be acquired from many different ownerships.

An aquifer is water-bearing sedimentary rock that is overlaid by an impermeable layer of cap rock. While the geology of an aquifer is similar to a depleted production field, it usually requires a greater percentage of cushion gas and lacks the infrastructure of a depleted production field. Much like a depleted oil and gas field, this type of storage operation usually requires acquisitions from many ownerships.

A salt cavern is quite different from a depleted reservoir or aquifer. A salt cavern is built by pumping water down into a salt formation and producing a brine solution. The brine solution is then pumped out and the process repeated until a cavern of sufficient size is created. Salt caverns are typically much smaller than other reservoirs, but multiple withdrawals and injections can be performed in a season, while other types of stor-

5. Ibid.
Appraisal of Underground Natural Gas Storage Rights in Depleted Reservoirs

Ownership and Regulation of Gas Storage Fields

Owners of gas storage fields are typically interstate pipeline companies, intrastate pipeline companies and local distribution companies, or independent storage service providers. According to a study by the Federal Energy Regulatory Commission (FERC), in September 2004, 172 sites were operated by interstate providers, 148 by intrastate pipeline companies and local distribution companies, and 74 were operated by independent storage service providers. 7

Acquisition of Gas Storage Rights

Interstate pipelines were granted a federal right of eminent domain in 1947 through the Natural Gas Act. In 1985, the right of eminent domain was extended to underground gas storage fields. 8 When assembling the rights to develop a gas storage field, interstate operators must obtain FERC approval. Intrastate providers and local distribution companies must have approval from state regulators. The right to condemn comes with these approvals. Gas storage rights often can be acquired through negotiation, but when negotiations fail, the rights are acquired through condemnation. This is when appraisals are necessary.

The acquisition of gas storage rights usually involves a defined area within one or two strata of rock that are far below the surface. Because the geology is not precisely known, the area taken for a storage facility includes a buffer area that surrounds the storage reservoir. Storage operators work with the FERC or the state regulatory body to get the proposed storage field certified, and during that process extensive study is undertaken to estimate the size and shape of the storage reservoir. As mentioned, because the storage field, including buffer acreage, may range from a few hundred acres to several thousand acres in size, the acquisition of rights is likely to involve several ownerships. These acquisitions can be through leasing or purchasing of the rights. When purchasing the storage rights, the rights acquired can be fee simple acquisitions of the defined strata, or they can be acquired via permanent easement of those rights. Also, in condemnation actions the rights acquired are usually a permanent taking of the fee simple estate or the specific rights defined in an easement. In some areas of the country, however, the taking of underground storage rights is done by establishing a rental rate and rate of escalation. The condemnor pays an annual rental rather than the customary one-time payment seen in most condemnations. At any time, the condemnor may cease operations, stop paying rent, and all rights revert back to the landowner.

The Appraiser’s Dilemma

Gas storage rights are not usually bought and sold on the open market. In fact, except for a few salt domes (which do not have characteristics similar to depleted oil and gas fields), appraisers are not likely to find any open market purchases. For this reason, a simple sales comparison approach using sales of gas storage rights is not possible. There may be leases of underground gas storage rights, but these leases are usually negotiated under the threat of condemnation, so the appraiser must be mindful of such conditions if they are present. Some properties within the area to be acquired may have active gas or oil production that also must be taken into account. Either the hydrocarbons will be taken and paid for or they will be specifically excluded from the taking; the valuation of hydrocarbons is beyond the scope of this article.

The following are some of the issues the appraiser should consider:

- There are no market sales of gas storage rights in depleted reservoirs, and leases of these rights are often negotiated under the threat of condemnation.
- Landowners (and tenants) have no practical use (other than hydrocarbon production)

6. Ibid.
for the subsurface where the rights to be acquired are located.

- The condemning authority may have a strong desire to acquire these subsurface storage rights, but the appraisal must conform with applicable appraisal guidelines relating to land acquisitions and applicable case law.
- The appraiser must carefully consider the highest and best use of the property and the definition of market value.

These considerations present a significant problem for the appraiser. Consider the project enhancement rule (also called the scope of project rule) discussed in the Uniform Appraisal Standards for Federal Land Acquisitions. The project enhancement rule provides that the condemning authority in federal land acquisitions cannot be charged “for values it has created in constructing the project for which the property is being acquired; nor can an owner be penalized for any diminution in value attributable to the project.” The project enhancement rule applies in all federal land condemnations and most state condemnations. There is also much case law, both state and federal, that supports this rule. Basically, this rule provides that if the project—in this case the proposed or existing gas storage field—results in an increase or decrease in the property value, the appraiser cannot consider any increase or decrease in value that is due to the project. The condemning authority should not have to pay more for the property rights taken when the value enhancement is due to the project, and the landowner should not be penalized by a diminution in value that results from the project.

The project enhancement rule presents a problem for landowners, because there is likely no other use for the rights being taken if the project cannot be considered. Landowners may argue that because the subsurface is suitable for gas storage, then the highest and best use is for gas storage and should be valued accordingly, and such argument sounds reasonable until one examines several issues.

In condemnation, and in most appraisal assignments, the appraiser develops an opinion of value, and that value is defined as market value. Market value definitions vary but most definitions include consideration of reasonably knowledgeable buyers and sellers, with neither under duress to buy or to sell, and a competitive and open market. However, with underground gas storage, only those who hold certificated rights to operate underground gas storage fields are potential buyers for the storage rights. To the extent that there may be only one potential buyer, the exchange of storage rights conflicts with the part of the definition of market value that calls for a “competitive and open market.” The threat of condemnation also presents a problem due to the requirement that for market value neither the buyer nor the seller should be under duress to buy or to sell.

When a market value appraisal is developed, a highest and best use analysis is necessary. With a depleted reservoir, the subsurface is likely suitable for use as gas storage since the geology was formed thousands of years ago. If there is market demand or value attributable to the fact that the subsurface has permeability and can serve as a container for gas, there should be market sales that show such enhancement, even in circumstances when no gas storage operation has been certificated or proposed.

Consider that an underground gas storage field must be appropriately permitted by FERC or by the relevant state agency. In a condemnation, the condemning authority will have already obtained such a permit for all of the properties named in the condemnation as well as others that it has already acquired through negotiations. The appraiser should not appraise individual properties as permitted however, because the permit is part of the project—in fact, permitting is usually step one in obtaining the power of eminent domain. The appraiser must consider the property as it is on the date of taking, with no consideration given to the project.

The appraisers also must determine the unit, or the property to be appraised. In a condemnation, the appraiser is tasked with appraisal

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11. Ibid., 42–43.
of each individual property. The unit to be appraised is not an assemblage of several own-
erships. It is a single property, so in its as-is condition, or valuation before the taking, the subject property does not usually have the capability of being an underground gas storage field. Unless the property is assembled with every other property that is part of the subsurface structure that would comprise a future gas storage reservoir, the highest and best use is not for underground gas storage.

Applicability of Common Valuation Methods

Appraisers typically consider three approaches to value: the cost, income capitalization, and sales comparison approaches. Clearly the cost approach does not apply to underground rights, as there are no improvements to be built; however, the income capitalization approach and sales comparison approach can be considered.

Income Capitalization Approach

Underground gas storage rights are often leased. In the income capitalization approach, the appraiser estimates market rent, arrives at an estimate of net operating income, and capitalizes net income into an opinion of value. Since gas storage rights are leased, does income capitalization work for underground gas storage rights?

Only an operator of an existing or proposed storage field leases underground gas storage rights. There are no other lessees of underground gas storage rights. This operator likely has already obtained approval and a certificate to operate a storage field. The operator has the right to condemn, so this taints the leases as non-market transactions. Also, since the operator with a permit is the only potential lessee, the lease does not meet the definition of a market transaction as there is not an open and competitive market.

The appraiser’s research will also reveal that lease rates are not consistent from one storage field to another, as annual rents can range from a few dollars per acre to a few hundred dollars per acre. The rents often appear to be based on the lessee’s motivations more than the attributes of the real property. Some rents are also based on injection and/or withdrawal fees charged at the storage field, meaning such rents are based on the success of the project—something that an appraisal for condemnation should not consider.

These factors make the income capitalization approach inappropriate for the valuation of underground gas storage rights. The rents are not market derived, there is not an open and competitive market, and the leases are based on the proposed use by the condemning authority. Without the project, there would be no potential lessee.

Sales Comparison Approach

The factors that are obstacles in application of the income capitalization approach also are problematic in the sales comparison approach. As discussed earlier, the appraiser is not likely to find a comparable sale of underground gas storage rights except to an operator who already had a certificate to operate a storage field. Sales to an operator, of course, carry the threat of condemnation, so they would not usually be considered market transactions suitable for use as comparable sales. Certainly the lack of comparable sales poses a difficult situation for the appraiser.

Before and After Valuations

Before and after valuations are frequently used in condemnations. In a before and after valuation, the appraiser forms an opinion as to the value of the property immediately before the taking, and the value of the property immediately after the taking. The valuation before the taking usually includes the entire bundle of rights, or the fee simple estate. The valuation before the taking for most properties will routinely be accomplished by applying one or more of the traditional valuation methods. The valuation after the taking usually can be done by applying the same approach or approaches to
value, although some method of measuring any diminution of value must be considered and applied. The appraiser’s dilemma is how to measure diminution of value.

In the context of before and after, the appraiser considers how the property will change due to the taking of rights defined in the condemnation action. In the valuation before the taking the appraiser must consider all rights in the property. The valuation after the taking is made under the same assumptions except for the property rights that are described in the condemnation petition or complaint.

In the taking of rights for underground gas storage, the appraiser must be careful to understand exactly what is to be taken and determine how that might impact the use or utility of the property. Are the rights only for underground gas storage? How is the location of the taking described? What are the exact boundaries of the proposed taking? Does the taking include or somehow inhibit the extraction of other hydrocarbons or minerals?

After the appraiser has a clear understanding of these factors, a likely solution to the appraisal problem might be the use of paired data analysis.

**Paired Data Analysis**

Even though the appraiser is not likely to find market sales of gas storage rights, paired data analysis can be useful in valuing storage rights. In a paired data analysis using comparable sales, the appraiser would look for sales of property that did not include the rights that are to be acquired, then look for sales of otherwise similar property that included all rights (fee simple transactions). For the fee simple sale properties, the appraiser should look for sales where there is or was active gas or oil production, because these characteristics indicate a potential for future underground gas storage.

If the appraiser can find pairs of sales that are nearly identical except for the single element being measured, the pairs of sales can be the foundation for quantitative adjustments in the sales comparison approach. The appraiser should find pairings from more than one storage field if possible. Because no two properties are alike in every attribute except for the one being measured, the results of pairings of sales might produce somewhat inconsistent results. For this reason, a meaningful analysis should include many pairs of sales, just like a sales comparison approach should include several comparable sales.

The appraiser also needs to use caution to ascertain the rights retained by the landowners over the storage area. The ideal data analysis pairing would be of a property that had sold the underground storage rights rather than leased them. However, if the sale property’s rights were leased rather than sold, then the selling price should be adjusted downward by the capitalized value of the lease income.

Exhibit 1 presents a case study example of paired data sets in valuation for compensation related to condemnation. In the exhibit, the first sale of each pair is located within a certificated gas storage field, and the second sale of each pair is located just outside the certificated storage area. In Paired Sale 1, sale property 1a is within a certificated underground gas storage field, but the storage rights had been conveyed to the operator of the storage field. Sale property 1b includes all rights (fee simple) located outside the storage area. Since there is gas and oil production in the area, sale property 1b has likely potential future use as part of an underground gas storage field (either as part of the reservoir or as buffer). The sale of property 1a for 6.8% less than the fee simple tract indicates that the storage rights have value; therefore, the adjustment to a fee simple sale based on this one pairing should be negative, and it is shown as -6.8% on the exhibit. Paired Sale 1 is just one of several pairings, however, and in the case study example overall there is no discernable difference in the sale prices. For example, Paired Sales 2 and 4 indicate higher value for land without storage rights. Based upon these pairings, the appraiser can conclude a minimal value loss due to the proposed taking.

As previously noted, in searching for sales with and without underground gas storage rights, the appraiser might not always be able to find perfect pairings. In fact, appraisers seldom find perfect pairs of sales, but they can find pairings that will lead to reasonable conclusions. One difficulty in finding like pairs is that some land has improvements,
while some is completely vacant. Other issues, such as differences in topography or utility, also must be considered. In such cases, the appraiser might not have to discard the pair of sales, as some adjustment for differences can be included in the analysis. Nonetheless, the appraiser must consider that pairs of sales that require adjustments are likely to produce less reliable results. The appraiser’s conclusion from this analysis must weigh the results accordingly.

As is the case with any comparable sale, the appraiser is well advised to interview buyers, sellers, and brokers of the sale properties with storage areas to ascertain the impact they believe the storage rights have had on the value of their properties. The conclusion in the paired data analysis can be used as the basis for an adjustment of comparable sales in the sales comparison approach after the taking.

In a paired data analysis the fee simple sale properties might not have the ability to hold gas in the subsurface (so the value of the storage rights would be zero); but even if that were true, the sales exactly reflect the value to the landowner whether the property has the capability to be developed for underground gas storage or not.

Except for hydrocarbon production, which is excluded from consideration in this article, the paired sales exactly reflect the owner’s position before and after the taking. The landowner has the rights before the taking but has no use for those rights. After the taking, the landowner does not own those subsurface rights, but that has no bearing on the use or utility of the surface unless there are related surface takings that would also be compensated.

Conclusions

Underground gas storage rights are seldom bought and sold, and in the few cases where they do sell, it is almost always under the threat of condemnation. In a condemnation of underground storage rights the appraiser’s task is to evaluate the rights to be taken and determine a reasonable method of valuing those rights. Even though such rights are sometimes leased, the leases are not arm’s-length transactions, as they are negotiated under the threat of condemnation. Any leases within the proposed storage field should not be considered because the project enhancement rule precludes the consideration of values that are created by the project. The leasing of underground gas storage rights is the result of a project that is, or will be, certificated, and

### Exhibit 1 Paired Data Set Case Example

<table>
<thead>
<tr>
<th>Paired Sale 1</th>
<th>S/T/R</th>
<th>Sale Date</th>
<th>Size (acres)</th>
<th>Sale Price ($)</th>
<th>Price per Acre ($)</th>
<th>Difference (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Sec 3 Twn 22 Rng 19</td>
<td>12/14/2008</td>
<td>122.3</td>
<td>100,000</td>
<td>817.66</td>
<td>-6.8</td>
</tr>
<tr>
<td>1b</td>
<td>Sec 5 Twn 22 Rng 19</td>
<td>5/04/2009</td>
<td>224.2</td>
<td>196,620</td>
<td>876.98</td>
<td></td>
</tr>
<tr>
<td>Paired Sale 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a</td>
<td>Sec 11 Twn 22 Rng 19</td>
<td>5/17/2007</td>
<td>79.0</td>
<td>70,000</td>
<td>886.08</td>
<td>0.73</td>
</tr>
<tr>
<td>2b</td>
<td>Sec 25 Twn 22 Rng 19</td>
<td>7/28/2006</td>
<td>77.3</td>
<td>68,000</td>
<td>879.69</td>
<td></td>
</tr>
<tr>
<td>Paired Sale 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>Sec 15 Twn 21 Rng 19</td>
<td>9/08/2008</td>
<td>78.5</td>
<td>64,000</td>
<td>815.29</td>
<td>-8.8</td>
</tr>
<tr>
<td>3b</td>
<td>Sec 20 &amp; 21 Twn 21 Rng 9</td>
<td>9/16/2008</td>
<td>120.8</td>
<td>108,000</td>
<td>894.04</td>
<td></td>
</tr>
<tr>
<td>Paired Sale 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4a</td>
<td>Sec 22 Twn 21 Rng 9</td>
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<td>83.2</td>
<td>82,000</td>
<td>985.58</td>
<td>7.3</td>
</tr>
<tr>
<td>4b</td>
<td>Sec 23 &amp; 21 Twn 21 Rng 9</td>
<td>12/03/2008</td>
<td>78.4</td>
<td>72,000</td>
<td>918.37</td>
<td></td>
</tr>
</tbody>
</table>
a gas storage company plans to operate an underground gas storage business.

Normal market sales of underground storage rights in depleted gas reservoirs are not to be found, and storage rights sales are not likely to be arm’s-length transactions for the same reason as storage leases. However, a paired sales analysis can be used in the sales comparison approach to ascertain the market reaction to land values with and without underground gas storage rights. The result using paired sales analysis is reflective of the market, which should always be the appraiser’s goal.

**About the Author**

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**Additional Resources**

Suggested by the Y. T. and Louise Lee Lum Library

**American Gas Association—Natural Gas Storage**
https://www.aga.org/fact-sheets/natural-gas-storage

**AmericanOilman.com**
http://americanoilman.homestead.com/Home.html

**American Petroleum Institute, “Understanding Natural Gas Markets”**

**Federal Energy Regulatory Commission—Natural Gas Storage**

**Interstate Natural Gas Association of America—Natural Gas Storage**
http://www.ingaa.org/Topics/1330/4689.aspx

**Natural Gas Supply Association—Storage of Natural Gas**
http://naturalgas.org/naturalgas/storage/

**US Energy Information Administration—Natural Gas Data and Analysis**
http://www.eia.gov/naturalgas/