Conclusions of Supply Portfolio Optimization Analysis

Conducted For Centra Manitoba by ICF International

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Overview of Analysis

As part of our engagement to review Centra Manitoba (Centra) supply portfolio options, ICF conducted a supply portfolio optimization analysis of potential future natural gas supply options. The analysis considered the range of reasonable Centra supply portfolio options for a set of potential price and weather conditions within the five year period starting April 2013. The analysis considered daily dispatch requirements, daily natural gas prices, design day capacity requirements, pipeline capacity options, and storage space and deliverability options, and optimized the supply portfolio on an annual basis for five years, for 30 different five year weather scenarios developed using the most recent 34 years of actual weather data.

The analysis focused on the following questions:

1) Should Centra continue to rely on U.S. storage to meet winter load requirements?

2) If Centra should continue to rely on U.S. storage to meet winter load requirements, which storage options would likely provide the best value, and how much storage capacity and deliverability would be needed to optimize the Centra supply portfolio?

3) What sources of natural gas supply are likely to be the most economic source of natural gas for meeting direct (e.g., not from storage) natural gas requirements?

4) What sources of natural gas supply are likely to provide the most economic source of natural gas for filling storage?

Approach

ICF used two proprietary natural gas market forecasting models to conduct the analysis:

1) The ICF Proprietary Gas Markets Model (GMM) was used to provide monthly natural gas price projections for all of the potential natural gas purchase points considered viable by Centra. The GMM was run for 30 different weather scenarios based on actual North American Weather patterns to develop 30 different price forecasts reflecting the impact of weather on natural gas commodity prices by location. Monthly natural gas price forecasts from ICF's October 2011 Base Case were used to develop daily natural gas prices for each key market center based on daily HDD and natural gas price volatility.

2) The ICF proprietary Natural Gas Storage and Supply Portfolio Optimization Model (NGSSPOM) was used to optimize natural gas commodity and capacity requirements on an annual basis, based on daily load requirements and natural gas prices over a wide range of potential weather conditions. The optimization was based on lowest overall portfolio cost.

The daily dispatch requirements used in the NGSSPOM were developed based on an assessment of daily weather volatility, combined with 34 years of actual monthly weather data for the Centra service territory, with load projected based on algorithms developed from the Centra load forecasts.

ICF completed the optimization analysis considering two different storage options with different storage providers and for storage at different facilities. While a wide range of potential storage and pipeline options were considered, the number of storage options was narrowed to two primary options based on storage capacity availability, cost, and operational considerations before the comprehensive optimization analysis was conducted.

The two options are referred to as Storage Option A and Storage Option B. For each storage option, ICF evaluated three different levels of storage deliverability. These included 50-Day, 60-Day, and 70-Day storage deliverability.

The specific characteristics of the two different storage options were based on negotiated rates and services offered by the two different storage providers. Both storage providers developed specific proposals to provide service to Centra. The proposals were provided to Centra in confidence. Storage Option A has been selected by Centra as the preferred option, and can be identified as a renewal under renegotiated terms of the existing storage contract with ANR Storage. Because Storage Option B was not selected, we do not identify the specific storage provider associated with Storage Option B.

ICF relied on Centra to provide accurate cost and capacity availability data for all pipeline and storage capacity options considered.

Interpretation of Optimization Modeling Results

It is important to recognize that no optimization modeling approach can consider all of the factors that should be considered by an LDC in determining its actual supply portfolio. Hence, the results of the optimization analysis should be viewed as one additional source of information during the portfolio development process.

Like all optimization analyses, this analysis includes several fundamental simplifications that must be considered when evaluating the modeling results. These simplifications include:

1) The optimization modeling approach relies on perfect foresight considering weather conditions and natural gas prices. This tends to increase the value of supply options that facilitate daily and seasonal flexibility in natural gas purchasing and storage utilization decisions relative to options that rely on longer term decisions such as monthly gas purchase contracts.

2) The optimization approach used in this analysis selected the least cost supply portfolio option. There is often a difference between the "least cost" and the "best" portfolio option based on factors, such as market risk, company operational guidelines, regulatory factors, environmental and sustainability concerns, and other issues that are difficult to define in strict economic terms.

3) The supply portfolio was optimized on an annual basis, and each different weather scenario considered in the analysis resulted in a different optimized portfolio. We have summarized the results of the analysis across the range of scenario results and provided the range of optimized solutions for key elements of the analysis. However, selection of final portfolio from among the range of optimized solutions depends on a range of factors including risk tolerance and other issues.

Analysis Results:

1) The ICF optimization analysis indicates that Storage Option A (ANR Storage) is a slightly better value than Storage Option B. While the two options are very close in value, with about a one percent difference in average supply portfolio costs, Option A (ANR Storage) is preferred under most scenarios. (See Table 1 for numeric results).
    a. For normal weather, Option A (ANR Storage) provides slightly higher value than Option B under all different space and deliverability scenarios.
    b. When averaged across all of the different weather scenarios evaluated, Option A (ANR Storage) provides slightly higher value than Option B.

2) The ICF optimization analysis suggests a small economic benefit for higher (50 day) deliverability storage when compared to the 60-day or 70-day options. (See Table 1 for numeric results). The additional costs of higher deliverability storage are offset in part by lower space requirements, and by the ability to take greater advantage of daily changes in natural gas prices to optimize the mix of gas purchases, storage injections, and storage withdrawals on a daily basis.

3) The optimum level of storage capacity depends on the specific storage option considered, the amount of deliverability associated with the storage capacity, and the specific weather scenario being evaluated.

   The distribution of optimum storage capacity for the six different storage options considered (Storage Option A with 50, 60, and 70 day deliverability, Storage Option B with 50, 60, and 70 day deliverability) is shown in Figure 1. As shown in Figure 1, extreme weather can have a significant impact on the optimum level of storage capacity. However, the optimum level of storage capacity for most of the weather cases fall within a fairly narrow range. For about 50 percent of all the weather cases evaluated for each storage option for 50 days of deliverability, increasing to about 70 percent of all weather cases evaluated for the 70-day storage options, the optimized level of storage capacity falls within a range of about two PJ of working gas capacity.

4) The ICF optimization analysis indicates that Canadian gas purchased to the west of the Centra system, and transported to the Centra Service Territory will remain the most economic source of gas for the Centra System for about 80 percent of Centra's commodity purchases. (See Table 3 for numeric results).

   a. The ICF optimization analysis indicates that Canadian gas purchased to the west of the Centra system will remain the most economic source for the preponderance of natural gas purchased to meet direct (e.g., not injected into storage) customer requirements.

   b. The ICF optimization analysis indicates that Canadian gas purchased to the west of the Centra system, and transported to storage in the U.S will remain the most economic source for the majority of the natural gas to be injected into storage.

Table 1: Impact of Alternative Storage Options on Overall Supply Portfolio Costs ($)

	Impact of Portfolio Options on Overall Portfolio Cost Volatility					
Average	**2013**	**2014**	**2015**	**2016**	**2017**	**5-Year Average**
Option A (ANR) 50-Day Storage	324,026,162	339,508,033	354,687,153	374,142,114	389,486,484	356,369,989
Option A (ANR) 60-Day Storage	324,888,222	340,438,246	355,708,563	375,656,876	391,568,115	357,652,005
Option A (ANR) 70-Day Storage	327,044,266	343,867,473	358,657,803	376,921,360	396,321,578	360,562,496
Option B 50-Day Storage	326,736,969	342,582,523	358,328,804	379,023,752	394,586,243	360,251,658
Option B 60-Day Storage	327,193,644	343,045,176	358,820,470	379,826,512	396,115,156	361,000,192
Option B 70-Day Storage	329,764,024	345,696,483	361,484,194	383,038,803	399,916,955	363,980,092
Standard Deviation	**2013**	**2014**	**2015**	**2016**	**2017**	**5-Year Average**
Option A (ANR) 50-Day Storage	53,003,366	43,486,419	34,868,318	55,489,334	45,116,673	46,392,822
Option A (ANR) 60-Day Storage	52,670,383	43,674,552	34,477,010	55,660,476	45,610,700	46,418,624
Option A (ANR) 70-Day Storage	52,222,326	43,988,987	34,033,471	55,681,280	46,032,297	46,391,672
Option B 50-Day Storage	53,730,657	44,239,443	35,247,033	57,151,367	46,170,257	47,307,751
Option B 60-Day Storage	53,396,171	44,471,460	34,736,123	57,018,148	46,387,469	47,201,874
Option B 70-Day Storage	53,000,358	44,877,684	34,341,684	56,900,157	53,113,526	48,446,682
Standard Deviation/Average	**2013**	**2014**	**2015**	**2016**	**2017**	**5-Year Average**
Option A (ANR) 50-Day Storage	0.164	0.128	0.098	0.148	0.116	0.131
Option A (ANR) 60-Day Storage	0.162	0.128	0.097	0.148	0.116	0.130
Option A (ANR) 70-Day Storage	0.160	0.128	0.095	0.148	0.116	0.129
Option B 50-Day Storage	0.164	0.129	0.098	0.151	0.117	0.132
Option B 60-Day Storage	0.163	0.130	0.097	0.150	0.117	0.131
Option B 70-Day Storage	0.161	0.130	0.095	0.149	0.133	0.133

Table 2: Range of Optimized Storage Capacity Due to Weather and Price Variation

Optimum Working Gas Storage Capacity (PJ)					
	Average	**Maximum**	**Minimum**	**Median**	**75th Percentile**
Option A (ANR) 50-Day Storage	15.61	30.00	10.39	13.15	19.88
Option A (ANR) 60-Day Storage	16.24	29.80	12.47	13.87	19.17
Option A (ANR) 70-Day Storage	17.03	29.28	14.54	15.09	18.09
Option B 50-Day Storage	14.10	21.85	10.78	12.41	17.99
Option B 60-Day Storage	15.65	22.64	12.94	12.94	17.76
Option B 70-Day Storage	16.79	26.27	15.09	15.09	16.98

Figure 1: Optimized Storage Capacity Distribution

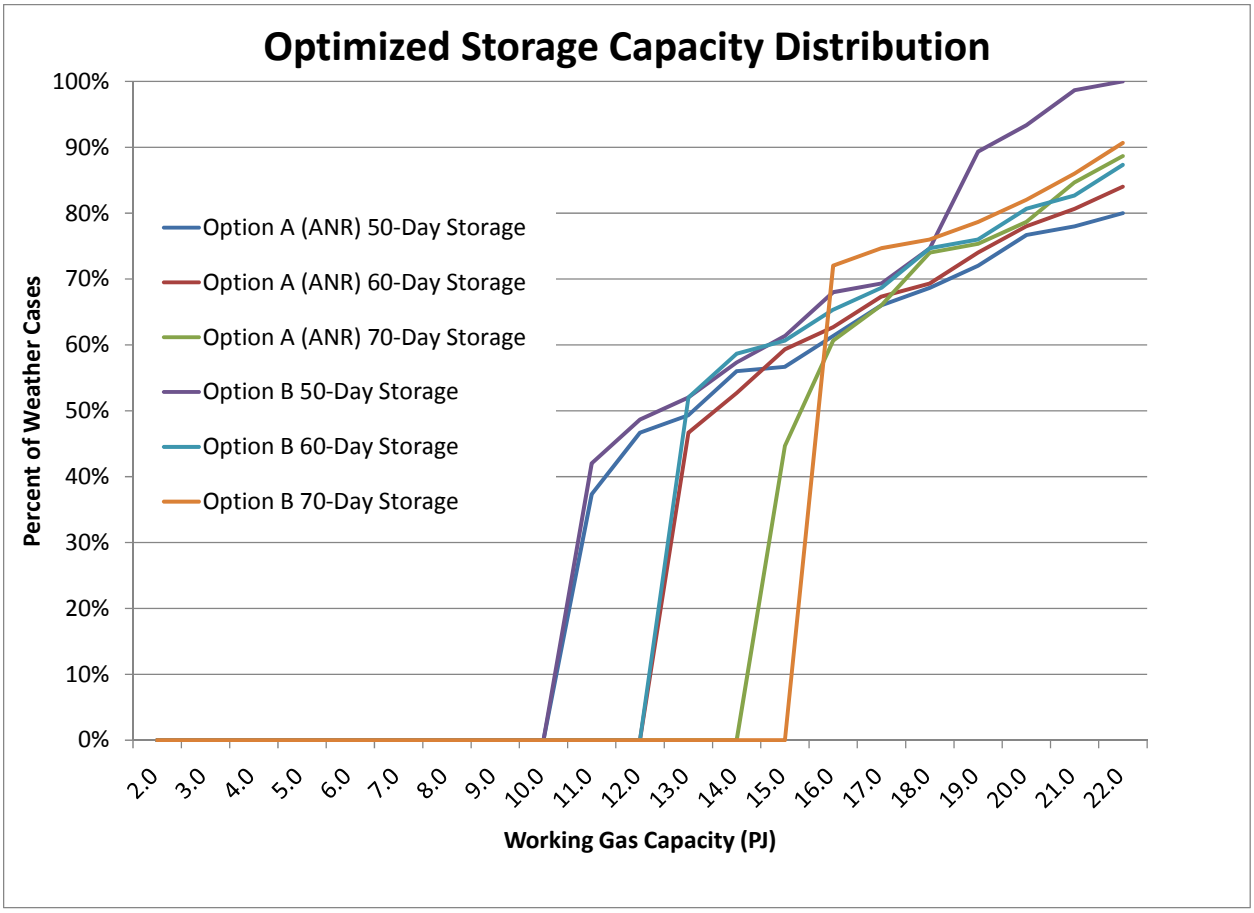

Table 3: Location of Optimized Natural Gas Commodity Purchases

Location of Natural Gas Commodity Purchases						
Average of Optimized Values for Five Years						
(April 2013 through March 2017)						
Average of 30 Years of Actual Weather						
	Storage Option A			Storage Option B		
	50-Day	60-Day	70-Day	50-Day	60-Day	70-Day
WCSB Purchases	79.7%	79.6%	79.3%	83.9%	82.7%	81.7%
Direct Delivery to Centra Citygate	1.1%	1.0%	1.0%	1.3%	1.2%	1.1%
Emerson Purchases	0.3%	0.4%	0.4%	0.9%	1.0%	1.1%
U.S. Midwest Market Area Purchases	11.0%	9.7%	8.4%	13.9%	15.1%	16.1%
U.S. Supply Basin Purchases	7.9%	9.3%	10.8%	0.0%	0.0%	0.0%