The Impact of Recent Hurricanes on U.S. Gas Markets for the Upcoming Winter

A Study Performed For INGAA
by Energy and Environmental Analysis, Inc.

Background

In early October 2005, INGAA contracted with Energy and Environmental Analysis, Inc. (EEA) to conduct a study of the effects of the Gulf Coast hurricanes on the natural gas markets for the 2005-2006 winter season. The study utilized EEA’s Gas Market Data and Forecasting System (GMDFS), which is widely used by government, institutional and private sector clients. The GMDFS is a dynamic general equilibrium representation of the North American gas markets. EEA’s GMDFS solves for monthly natural gas production and demand, storage injections and withdrawals, pipeline flows, and natural gas prices in about 120 regional market centers (see Figure 1).

The GMDFS allows users to examine regional, seasonal and monthly conditions and can explicitly consider infrastructure and deliverability constraints and their impact on natural gas availability, consumption and prices. The GMDFS predicts the economic behavior of the natural gas marketplace, but does not explicitly model the makeup or performance of specific contracts or the performance of specific supplies and infrastructure. In this particular use of the GMDFS model, the scenarios are analyzed to determine if the economic market continues to perform or if other actions (e.g. local regulatory allocation) are necessary to balance the supply and demand.

In instances where the GMDFS identifies a gas supply/demand imbalance after all economic alternatives have been taken to reduce demand have been exhausted, allocation of gas supply must be addressed by a non-market mechanism. In this analysis, it is assumed that these supply/demand imbalances will be absorbed by industrial and power generation customers, consistent with priorities established by state and local regulation.

The GMDFS has been utilized in a number of landmark natural gas studies including the 2003 National Petroleum Council study, Balancing Natural Gas Policy – Fueling the Demand of a Growing Economy, the 2005 American Gas Foundation study, Natural Gas Outlook To 2020 For The U.S. Natural Gas Market — Outlook and Options for the Future and various INGAA Studies.
Inputs for this study were obtained from a wide variety of publicly available data sources. In addition, EEA vetted the scenario inputs with a number of individual companies, numerous natural gas and energy industry trade associations and various government agencies, and adjusted the specifics of the scenarios based upon those consultations.

**Summary of Conclusions**

Based on the results of the GMDFS Model runs:

- Prompt recovery of Gulf Coast supplies is very important for the upcoming winter.
  - Between 2.5 and 3.5 Bcf/d (5 to 7 percent) of U.S. gas production is projected to be missing from the gas market this winter due to hurricane damage.

- Relatively high gas prices (greater than the closing price for the November futures contract) are to be expected under most weather scenarios.
  - Supply/demand balance was already in a very tight situation before supply disruptions due to recent hurricanes.
  - The lost production capability will exacerbate the tight balance and result in the expected high prices.

- Winter weather will be an important determinant of how the gas market is likely to balance during the upcoming winter.
Industrial demand destruction will be the primary factor keeping the market in balance.

Under colder weather scenarios, regulatory allocation\(^1\) of gas load may be necessary. **Assuming state and local regulatory allocation plans work as expected, residential and commercial customers served by local distribution companies that hold sufficient firm transportation, storage and gas supply entitlements should continue receiving natural gas service to meet their requirements throughout the winter, even during periods of peak demand.**

Localized regulatory allocation for industrial and power generation load may occur if the winter weather is colder than normal by 5 percent or more.
- Over the last 72 years, this type of winter weather occurs in 1 out of every 7 winters.
- If these situations occur, regulatory allocation of gas would happen toward the end of the heating season and are extremely unlikely before the end of January or February.
- Regulatory allocation is likely to be concentrated east of the Mississippi River, with the likelihood increasing as gas flows from the Gulf Coast moving toward the Northeast further away from the Gulf Coast.

Delayed recovery of Gulf Coast supply significantly increases the likelihood of regulatory allocations, particularly on the East Coast.

Regulatory allocations, if and when necessary, will not be large as a percent of total winter gas load. However, because they would most likely be concentrated in a cold week or two, they could be a large percent of total industrial and power load if and when they occur.

**Hurricane Recovery Scenarios**

The study was conducted utilizing information that was publicly available by the end of the third week of October 2005. A Base Case Recovery scenario was constructed, reflecting the best estimate of the gas supply projected to be available during the winter season (November 1, 2005 through March 31, 2006). Figure 2 presents a summary of the Base Case Recovery scenario and compares the gas supply for the 2005-2006 winter season to the amount of supply that was available for 2004-2005.

\(^1\) In this Study, regulatory allocation conditions describe situations when the supply into a market region is not sufficient to meet all demand even when all economic alternatives have been exhausted.
At the time of the release of the study on November 2, 2005, there remains considerable uncertainty regarding the extent of damage caused by the hurricanes and the pace of recovery. Therefore, the study was conducted using three possible recovery scenarios. In addition to the Base Case that reflects our best estimate of the recovery, the study considered two alternative scenarios: a Worst Case, and a Best Case. Figure 3 presents the profile of gas supply restoration projected under the three recovery cases examined.
In addition to the difference in the recovery profiles, the three supply scenarios considered differences in the availability of LNG. While there is approximately 4.2 Bcf per day of LNG terminal capacity in the United States, limited numbers of “spot market” cargoes, logistical constraints, and competing demands from other markets, especially Europe, limited average deliveries of LNG during the 2004-2005 winter season to 1.6 Bcf per day. The Base Case Recovery scenario assumes that incremental supplies from Egypt and Trinidad will result in an average of 1.7 Bcf per day of LNG deliveries to the U.S. market over the 2005-2006 winter heating season. The Worst Case Recovery scenario assumes that cold weather in Europe and/or other factors increasing world LNG demand limit deliveries to the United States to 1.3 Bcf per day. The Best Case Recovery scenario assumes that additional supplies are available to the U.S. so that an average of 2.1 Bcf per day of LNG is delivered.

In summary, excluding storage, the Base Case projects that an average of 59.1 Bcf per day of gas supply will be available while the Best Case projects that 60.0 Bcf per day will be available and the Worst Case projects that 58.1 Bcf per day will be available. The result is that natural gas supplies (excluding storage) will be 0.6 to 2.5 Bcf per day below the supply that was available last winter.
**Natural Gas Supply/Demand Balance**

Natural gas demand is projected by EEA’s GMDFS based upon economic activity, gas prices, alternative fuel prices and weather. Figure 4 presents a summary of projected consumption for the three scenarios for the 2005-2006 winter, assuming normal weather.\(^2\) In addition, Figure 4 compares the supply/demand balance in each of the three scenarios with comparable data for last winter, including the net withdrawal of gas from storage.

**Figure 4**  
Natural Gas Demand/Supply Balance  
Average Bcf per Day

<table>
<thead>
<tr>
<th></th>
<th>2004-05</th>
<th>Worst</th>
<th>Base</th>
<th>Best</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Demand</td>
<td>73.8</td>
<td>71.9</td>
<td>72.3</td>
<td>72.6</td>
</tr>
<tr>
<td>R/C Gas Use</td>
<td>35.7</td>
<td>36.8</td>
<td>36.9</td>
<td>37.0</td>
</tr>
<tr>
<td>Industrial Gas Use</td>
<td>21.5</td>
<td>18.2</td>
<td>18.3</td>
<td>18.4</td>
</tr>
<tr>
<td>Power Gas Use</td>
<td>11.2</td>
<td>11.8</td>
<td>11.9</td>
<td>12.0</td>
</tr>
<tr>
<td>Other Gas Use</td>
<td>5.3</td>
<td>5.1</td>
<td>5.2</td>
<td>5.2</td>
</tr>
<tr>
<td>Net Injections</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Gas Supply</td>
<td>74.3</td>
<td>72.6</td>
<td>73.0</td>
<td>73.3</td>
</tr>
<tr>
<td>U.S. Production /2</td>
<td>50.8</td>
<td>48.0</td>
<td>48.6</td>
<td>49.0</td>
</tr>
<tr>
<td>Net Imports</td>
<td>9.8</td>
<td>10.1</td>
<td>10.5</td>
<td>10.9</td>
</tr>
<tr>
<td>Net Withdrawals</td>
<td>13.7</td>
<td>14.5</td>
<td>13.9</td>
<td>13.4</td>
</tr>
<tr>
<td>System Losses</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>

1. Normal winter weather assumed for 2005-06 winter.  
2. Includes impact of all recent hurricanes  
3. Includes supplemental gas supplies.

As shown in Figure 4, assuming normal weather, consumption of natural gas by residential and commercial customers (R/C Gas Use) is projected to be greater this winter compared to last winter despite higher prices. There are two factors leading to this result. First, the gas industry continues to hook-up new gas heated households each year, adding to the customer base. More importantly, the 2004-2005 winter was a little more than 3 percent warmer than normal. As a result, even with price induced conservation, consumption per customer will be up if weather returns to normal.\(^3\)

---

\(^2\) Normal weather is defined as the average heating degree-days from 1971 through 2000.  
\(^3\) The GMDFS model calculates demand based upon price elasticity in each end-use sector. However, there could be some amount of additional conservation this winter in response to public service announcements and communications campaigns directed towards natural gas consumers and designed to reduce gas load that is well beyond historical price elasticity.
Similarly, power generation consumption of gas for the 2005-2006 winter is projected to be larger than the previous year assuming normal weather. The colder temperatures associated with the return to normal weather will increase electricity space heating demand. In addition, continued year over year growth in economic activity contributes to the increase in electric generation with gas-fired units dispatched at the margin to meet much of the increased load.

As Figure 4 shows, industrial sector gas demand “balances” the market. Despite increased economic activity, price induced “demand destruction” occurs in the industrial sector. The projections show that more than 3 Bcf per day (more than 13 percent) of industrial gas consumption is lost.

**Impact of Weather on the Natural Gas Supply/Demand Balance**

Weather-based demand has the biggest impact on the performance of the natural gas market. The previous discussion was based upon the assumption of “normal” weather. However, regardless of long-term forecasts, the unpredictable nature of weather requires that a prudent examination of gas markets for this winter consider alternative weather scenarios. To accomplish this, EEA compiled actual weather data for each of the past 72 years and ran each of the three supply recovery scenarios using each of the 72 weather cases.

Not surprising, warmer than normal weather scenarios reduce projected gas consumption in the residential, commercial and power generation sectors and decrease the draw-down of gas that has been placed into storage in preparation for the winter. By contrast, weather scenarios that are colder than normal increase residential, commercial and power generation demand and increase the need for storage withdrawals. Figure 5 shows the national end of season storage levels in each of the 72 weather cases for the Base Case Recovery scenario.
As the figure shows, normal or warmer than normal weather results in national storage inventory levels of 1000 Bcf or greater, which provides a margin of supply to assure reliability throughout the winter. However, in 11 of the observations, the national working gas levels fall to less than 700 Bcf, a level that is well below the end of season working gas levels for every year since 1993.4

A very low storage inventory at the end of the winter season (< 700 Bcf) is indicative of low deliverability on peak natural gas usage days for the nation as a whole. The inadequate storage deliverability effect combined with lower predicted pipeline flows from the Gulf Coast production areas and pipeline infrastructure constraints existing in certain areas create a precarious supply/demand balance and the possibility of conditions that could require “Regulatory Allocation” or governmental intervention.

For this study, a Regulatory Allocation situation occurs when the EEA Model indicates that supply into a market region is not sufficient to meet all demand even when all economic alternatives have been exhausted. While there may be differences in implementation of these processes across the country, industrial and power generation load is at risk particularly where the transportation contracts do not assure firm

---

4 EIA Monthly Storage Data.
pipeline capacity back to a location where there is available firm supply. For example, a natural gas shipper may have a firm transportation contract that references a primary receipt point in the market area but does not have a firm commodity contract for the gas at the same point. In this instance, the shipper may not be able to schedule or confirm a nomination and could be subjected to a disruption.

Regional Analysis

As a further step, the analysis examined regional markets to determine the likelihood that Regulatory Allocation conditions could occur. Figure 6 presents the results of the analysis assuming the Base Case Recovery scenario.

Figure 6

INGAA Base Case Recovery Scenario
Regulatory Allocation Probability

Note: 30% probability means that there is an approximate 1 in 3 chance that the weather will be cold enough to require regulatory allocation on a few days.

Figure 6 graphically presents the regional results of the 72 weather scenarios run using the Base Case Recovery assumptions. In New York and New England, regulatory allocation conditions occurred in 22 of the 72 weather season scenarios examined (approximately 30%). Not surprisingly, these were the coldest weather scenarios. The likelihood of regulatory allocation conditions for New Jersey and Eastern Pennsylvania occurred less frequently. The frequency was still less in the remaining shaded states with regulatory allocations occurring in only the very coldest years.
It is important to note that under all of the scenarios examined, assuming state and local regulatory allocation plans work as expected, residential and commercial customers served by local distribution companies that hold sufficient firm transportation, storage and gas supply entitlements should continue receiving natural gas service to meet their requirements throughout the winter, even during periods of peak demand. Nevertheless, regulatory allocation conditions can be problematic, possibly requiring closing of industrial facilities and restricting gas-fired generation for a number of days.

Figure 7 presents the results of the regional analysis for the Worst Case Recovery scenario. With more restricted supply than the Base Case, the likelihood of regulatory allocation conditions is increased significantly. In this scenario, regulatory allocation occurs in New York and New England in roughly two out of every five winter seasons based on the last 72 years of actual weather.

![INGAA Worst Case Recovery Scenario Regulatory Allocation Probability](image)

**Figure 7**

INGAA Worst Case Recovery Scenario Regulatory Allocation Probability

40% (See Note Below)

Note: 40% probability means that there is a 2 in 5 chance that the weather will be cold enough to require regulatory allocation on a few days.

Figure 8 presents the regional results for the Best Case Recovery scenario. The increase in the availability of flowing supplies from the Gulf in this scenario relieves some pressure and decreases the likelihood of regulatory allocation conditions.
The regulatory allocations are expected to follow local regulatory plans. In most cases, priorities have been given to residential and commercial demand customers at the expense of industrial and power generation customers. While the expected shortfall is small during these coldest winters, compared to the overall demand for the season, the effect will probably be concentrated during a cold period in late January, February or early March.

Any regulatory allocation conditions would be particularly troublesome in regions where gas-fired generation contributes significantly to the region’s winter generation mix even when gas prices are quite high. These conditions exist in New England, New York and Florida.

It is important to recognize that the natural gas supply/demand balance in New York and New England was quite tight even before the loss of supplies resulting from hurricane damage. A number of infrastructure projects have been proposed to increase gas supplies into the region, but only limited increases in storage or pipeline capacity has been completed in the last few years. Figure 9 quantifies the risk of a supply/demand imbalance that would have existed even if the hurricanes had not reduced supplies.
INGAA Recommendations

INGAA makes the following recommendations to address the situation. Some of the recommendations are designed to address the immediate situation. Others are intended to reduce the likelihood that these conditions will repeat themselves in future years.

Recommendations for the Short-Term

As previously mentioned, the short-term imperative is repairing the hurricane damaged infrastructure as quickly as possible. That means expediting permitting and approvals for repair work. It also means the various levels of government should consider the value of granting individual companies some forbearance from legal restrictions that might frustrate their ability to coordinate assessment and repair activities. The multiple hurricanes have resulted in extraordinary damage, and extraordinary measures are needed to get systems repaired on a timely basis.

Wholesale natural gas customers (e.g. LDCs, electric generators, industrials) should also be consulting with their suppliers about their firm supply and transportation arrangements. This includes portfolios of storage, flowing supply, pipeline transportation and peak shaving. Pipelines are providing alternate paths and alternate supply choice opportunities for those shippers that may have been affected by the damage to the natural gas infrastructure. Still, pipelines will enforce gas balance clauses and penalties as necessary to maintain operational stability of the pipeline system. Under stressed conditions, pipelines can be expected to enforce strictly the requirements under their

Note: 20% probability means that there is a 1 in 5 chance that the weather will be cold enough to require regulatory allocation on a few days.

Figure 9

EEA Reference Case (without Hurricane Outages)
Regulatory Allocation Probability

Note: 20% probability means that there is a 1 in 5 chance that the weather will be cold enough to require regulatory allocation on a few days.
tariffs that receipts into the pipeline on behalf of a customer match the gas deliveries to the customer. Synchronization and risk alignment of these supply, transportation and storage arrangements is necessary for expected performance during periods of tight supply and demand.

Also in the short-term, both the energy industry and the government must educate consumers in advance so they are prepared for higher bills and have the ability to implement strategies for conserving energy. This is important, because unlike the gasoline price that is posted at the local gas station, the consumer sees the price of natural gas after the fact when he or she receives a bill for the previous month’s consumption. These measures include weatherization of homes, regular inspections of furnaces and changing of filters, installing programmable thermostats and setting thermostat a couple of degrees cooler than normal. Funding the Low-Income Heating Energy Assistance (LIHEAP) program is also critical in helping needy families cope with rising heating costs.

INGAA also feels that it would be prudent to review state and local allocation programs. The last time that natural gas supply curtailments were a major issue – during the 1970s – FERC regulated interstate pipelines played a major role in instituting curtailments. Due to the restructuring of the natural gas industry, however, interstate pipelines no longer are gas merchants and pipeline tariffs no longer address supply curtailment based on end-use priority. Such curtailments now are largely the purview of state public utility commissions, and state regulators should be reviewing their plans and preparing to implement them if necessary. This would include coordinating any plans with local electric generators who would be some of the most likely customers to be curtailed.

The most likely occurrence of conditions that would cause regulatory allocation this winter would occur during the end of a cold winter season. Having updated forecasts will be useful. An updated forecast should be reviewed by the government and industry in December. New information on repairs, winter weather progress and customer behavior will clarify the situation for this winter.

**Recommendations for the Longer-Term**

INGAA recommends that more must be done to diversify our supplies of natural gas. Hurricanes Katrina and Rita have clearly demonstrated the nation’s high degree of reliance on the Gulf region to meet its energy needs. Other regions within the United States can, and should, be a part of the nation’s energy supply and infrastructure development strategy.

In addition, the United States must build new liquefied natural gas import terminals to keep pace with our demand for this fuel. Most of the new terminals that recently have been approved by FERC are proposed to be constructed in the Gulf of Mexico region. While there are good reasons why this region is attractive, such as access to an extensive pipeline network and gas storage, it stands out that the Gulf has been attractive for energy infrastructure development because it offers the “path of least resistance” in terms of “Not in My Back Yard” type opposition.
For both supply and infrastructure development, a re-focus on long-term contracting is needed. When natural gas commodity prices were low due to excess supply, state public utility commissions discouraged their regulated gas LDCs from entering into long-term contracts for natural gas supply and transportation. Long-term contracts, however, are critical to financing and developing new supplies and infrastructure (pipelines, storage and LNG terminals). Long-term contracts also are an insurance policy against high prices and volatility.

Finally, it is worth examining the factors that have precluded electric generators from installing dual-fuel capability when building a gas-fired power plant or obtaining firm natural gas transportation and storage service. Over the last decade, dual-fueled facilities – facilities that can operate on both natural gas and fuel oil – have been discouraged by emissions limits and by the difficulty in siting oil storage facilities on site. Also, the rules in some electric power markets provide such generators no assurances that the additional capital cost of such facilities can be recovered in the price received for electricity. These factors have compelled developers to build power plants totally dependent on natural gas. These same market rules have discouraged electric generators from contracting for firm natural gas transportation and storage service.