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PIRINC has prepared the enclosed report, *Lessons From the Hurricanes*.

Hurricanes Katrina and Rita struck severe blows to the country's oil and gas supply and logistics systems with impacts extending far beyond the Gulf Coast. At their peak, losses exceeded 25% of US refining capacity and about 1.5 MMB/D of crude production. These sudden, unanticipated losses came at a time of little spare capacity and low inventories. Without these cushions, only price could balance demand with suddenly lower supply.

The price effects of the crude production and refinery capacity losses were first contained and then ameliorated by a combination of all-out effort by industry and timely, market-supporting, government action. Crude prices rose only modestly above pre-Katrina levels and quickly retreated. The spikes in gasoline prices have dissipated and gasoline margins for refiners are now well below pre-hurricane levels. Conditions are different for natural gas and prices remain high. There is no comparable strategic reserve to draw upon nor can US buyers easily shop the world for plus supplies.

Some lessons from the hurricanes are straightforward. Clearly, there are energy supply risks at home as well as abroad that need to be addressed. Supply cushions help, as does international cooperation and sharing. Diversity of supply sources and delivery systems also play a role. While there are historic economic reasons why oil and gas related facilities are concentrated in the Gulf Coast, another factor has been strong local opposition to building facilities elsewhere. To reduce supply vulnerability, policy should focus on building facilities where they should be as opposed to where they can be.

The supply interruptions and price spikes have contributed to very visible gains in profits for the industry---and attracted calls to tax these "windfalls." Here there is a real risk that the wrong lessons will be drawn. "Windfall" gasoline margins have already disappeared and crude prices have come down significantly from their peaks. Both upstream and downstream segments of the industry are highly cyclical and a policy that takes a bigger share when profits are high but leaves the industry to own the depressed returns discourages needed investment. The more constructive policy direction is to remove bottlenecks to supply expansion through greater access to acreage, more streamlined regulatory procedures, etc. The money for investment is available; government policy should clear the way to spend it on projects that meet national energy objectives.

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November 2005

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Lessons From the Hurricanes

Summary

Hurricanes Katrina and Rita struck severe blows to the country's oil and gas supply and logistics systems with immediate impacts on consumers extending far beyond the Gulf Coast. At their peak, losses exceeded 25% of US refining capacity and about 1.5 MMB/D of crude production. These sudden, unanticipated losses came at a time of little spare capacity and low inventories. Without these cushions, only price could balance demand with suddenly lower supply. Sharply higher prices both discouraged demand and acted as a magnet for new supply. Despite ongoing, substantial, oil and gas production losses, some of these impacts, notably the immediate surges in gasoline prices, have dissipated, while others; especially double-digit natural gas prices are expected to persist for some time to come.¹

In the case of oil, the effects of the crude production and refinery capacity losses were first contained and then ameliorated by a combination of all-out effort by industry and timely, market-supporting, government action. The industry response included intensified efforts to increase supply from undamaged domestic sources through higher runs and record gasoline yields, shopping the world market for additional supply, and moving the product to where it was most needed. The government moved promptly to use the SPR, announcing the first loans of SPR crude on September 1. A day later, a Presidential finding of "a severe energy supply interruption" authorized the sale of 30 million barrels of SPR crude.² The US action was part of a coordinated action announced the same day by the International Energy Agency to make available to the market a total of 60 million barrels of oil, including product.³ The government also acted to ease regulatory barriers to the free movement of crude and products.

The efforts of government and industry have been successful. Crude prices rose only modestly above pre-Katrina levels and quickly retreated. The spikes in gasoline prices have dissipated and gasoline margins for refiners are now well below pre-hurricane levels. Conditions are different for natural gas. There is no comparable strategic reserve to draw upon nor can US buyers shop the world for plus supplies with anything like the ease they can for oil. As a consequence spot and futures market prices for natural gas remain high, putting further pressure on the price-sensitive basic chemical and fertilizer industries that have been moving increasing volumes of production offshore. Oil is playing a role in heading off even more extreme results, in particular by substitution of fuel oil, especially by power generators.

Some lessons from the hurricanes and their aftermath are straightforward. Clearly, there are energy supply risks at home as well as abroad that need to be addressed. Supply cushions help, as demonstrated by the SPR, as does international cooperation and sharing. Diversity of supply sources and delivery systems, including refining, importing and logistics capabilities also play a role. To a certain extent, the concentration of refining and natural gas processing and import

¹ As of late-October, the NYMEX futures market showed Henry Hub gas contracts above \$10/MMBtu into the spring of 2007.

² As of October 24th, 9.5 million barrels of oil had been delivered. Of the 11 million barrels sold through competitive bidding, nearly half had been delivered.

³ The September 2nd announcement by the International Energy Agency noted that "IEA member countries are aware that products and, in particular, gasoline, will be the most useful contribution."

capability on the Gulf Coast is a natural result of the region's historic role as the country's most important oil and gas producing area. But the concentration also reflects the opposition facing any company attempting to build facilities elsewhere and to this extent, adds to the country's supply vulnerability. Policy should focus on building facilities where they should be as opposed to where they can be. Markets again show they work, especially when regulatory bottlenecks are removed.

The supply interruptions and price spikes have contributed to very visible gains in profits for the industry---and attracted calls for the government to tax these "windfalls." Here there is a real risk that the wrong lessons will be drawn. First, the "windfalls" with respect to gasoline have already dissipated, thanks in large part to the industry response to the high profit signals sent by the market. Secondly, refining historically has been a Rip Van Winkle business, with short, high-profit periods followed by long stretches of poor returns. If government sets a precedent of taking a bigger share of the temporarily high profits while letting the industry own the depressed returns, the result is to discourage investment just as companies who know this history well are making decisions whether to commit to new, needed refining capacity.

Crude oil prices too have moved sharply down as well as up, and could do so again despite some projections of continuing extreme prices. After all, for most of the 1990s, crude oil prices were at or below \$20/barrel, falling to an average of \$14/barrel in 1998. Here again, allowing industry to keep its poor returns but not its high ones creates adverse investment incentives.⁴ The more constructive policy direction is to remove bottlenecks to supply expansion through greater access to acreage, more streamlined regulatory procedures, etc. The money for investment is available; government policy should clear the way to spend it on projects that meet national energy objectives.

Hurricane Price Paths for Oil and Gas

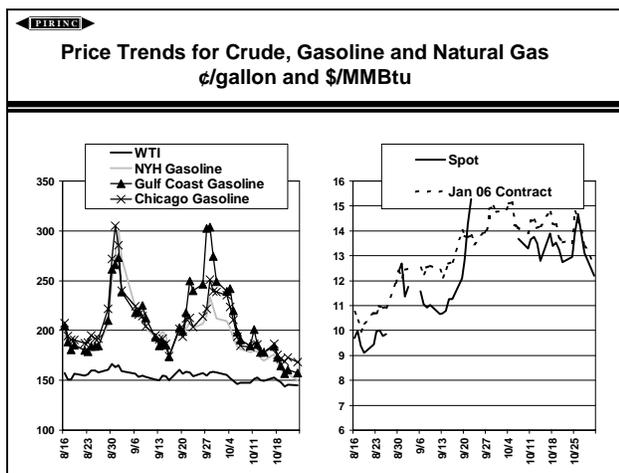
On the eve of Hurricane Katrina, there were few cushions against adverse supply developments. Refiners were operating at 97% capacity for the week ending August 26, three days before the hurricane made landfall, while gasoline stocks were 12 million barrels or nearly 6% below year-earlier levels. Under these conditions, there were first anticipatory price effects and then even stronger price effects as the extent of the disruption became apparent. The left panel of the chart below tracks daily spot prices for WTI and for gasoline in three specific locations, New York Harbor, Chicago, and the Gulf Coast. Prices are shown in cents/gallon from mid-August through late October. The right panel shows spot and January 2006 NYMEX contract prices for Henry Hub gas in \$/MMBtu.

As the left panel indicates, movements in crude prices were relatively small both in the run-up and the aftermath of both hurricanes. In mid-August, WTI prices were already averaging about

⁴ According to the Congressional Research Service, the last experiment with a windfall profits tax introduced in 1980 resulted in the loss of 500 MB/D of domestic production in each of the first two years of enactment and a corresponding increase in imports. The Congressional Research Service report, **The Windfall Profits Tax on Crude Oil: Overview of the Issues**, September 12, 1990.

150 to 160 cents/gallon (about \$65/barrel). Prices moved up to a peak of 166 cents/gallon (\$70/barrel) immediately after the hurricane made landfall but then eased back. Rita had even less of an impact on the crude price and within the first week of October, crude prices had fallen below pre-Katrina levels. Two factors account for the subdued price response; first, crude production losses were accompanied by losses in refiner capability to use the crude, and second, the Administration made it clear early on that crude from the SPR

would be made available to refiners with specific needs through exchanges and to the market through outright sales. Gasoline prices moved very differently. Between August 26 and September 1, gasoline prices in the three spot markets rose by between 89 cents and \$1.16/gallon, with New York Harbor showing the largest increase and the Gulf Coast, the lowest---although only by cents versus Chicago. By mid-September, gasoline prices in all three markets had fallen back to below pre-Katrina levels, only to be pushed up sharply again by hurricane Rita. This time the price surges in the New York and Chicago spot markets were significantly less than before, but the price surge in the Gulf Coast was far greater. However, by the end of the first week of October, prices had fallen back in all three markets to at or below pre-Katrina levels and have continued to fall despite ongoing losses in refining capacity and in crude production. The critical role of market forces was re-emphasized in a recent statement submitted to Congress by the Federal Trade Commission.⁵



“Consumers understandably are upset when they face dramatic price increases within very short periods of time, especially during a disaster. But price gouging laws that have the effect of controlling prices likely will do consumers more harm than good.---Prices play a critical role in our economy: they signal producers to increase or decrease supply, and they also signal consumers to increase or decrease demand. In a period of shortage – particularly with a product like gasoline, that can be sold in many markets around the world – higher prices create incentives for suppliers to send more product into the market, while also creating incentives for consumers to use less of the product.”

As discussed in detail in the next section, all-out efforts by refiners and importers, and cooperation among International Energy Agency members all contributed to the fallback in gasoline prices. But before turning to this discussion, it is necessary to note the very different price results for natural gas. As shown in the right panel, natural gas prices were already high to begin with, pushed up by the impact of the unusually hot summer on electricity requirements. Before trading was suspended in late September, spot prices had moved up from nearly \$10/MMBtu in late August to just over \$15. Since trading resumed in early October, spot prices

⁵ Prepared Statement of the Federal Trade Commission, **Market Forces, Competitive Dynamics, and Gasoline Prices: FTC Initiatives to Protect Competitive Markets**, Presented by Deborah Platt Majoras, Chairman before the U.S. Senate Committee on Commerce, Science and Transportation and the Committee on Energy and Natural Resources, November 9, 2005, page 9.

have remained well above pre-hurricane levels, although down somewhat from their peak. Prices for the NYMEX January 2006 contract have also stayed high, indeed generally somewhat above spot levels, as well as their own pre-Katrina levels, indicating market expectations of continued hurricane impacts on prices. There is no comparable Strategic Reserve of natural gas to draw upon in emergencies, nor is it as easy to shop the world for plus supply, as in the case of oil. Natural gas issues are discussed in more detail in the last section of the report.

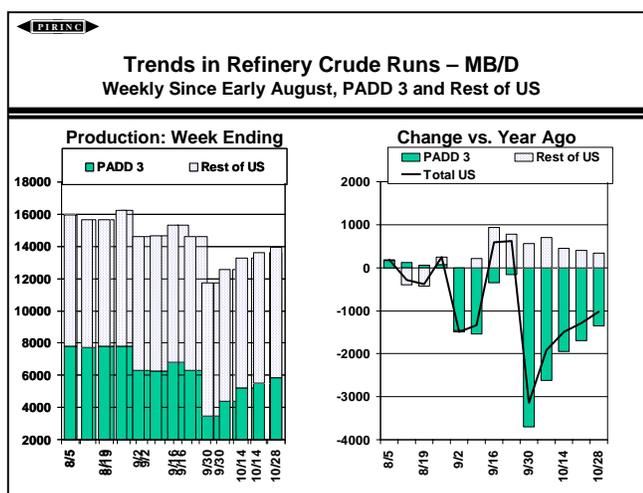
Industry Responses

The industry responses to the hurricanes had two main features; intensified utilization of remaining refining capacity, and expanded imports, especially of gasoline, the product in most immediate short supply.

Toward the end of August, on the eve of Hurricane Katrina, total US crude runs reached 16.25 MMB/D, representing a 97% capacity utilization rate. Typically, as demand falls off from summer peaks, crude runs gradually come down as refineries undergo seasonal maintenance and adjustments to produce winter fuels.

As shown in the left panel of the chart below, instead of a gradual decline, Hurricane Katrina led to an immediate curtailment in PADD 3, refining runs of about 1.5 MMB/D. Hurricane Rita led to an immediate further curtailment of nearly 3 MMB/D although since then, PADD 3 runs have been recovering, up by 2.4 MMB/D from their low point. Elsewhere, runs remained relatively stable at pre-Katrina peak levels, with some slight declines in October. However, this trend represents a substantial change from prior year developments.

The right panel of the chart shows differences in crude runs versus last year. The differences for PADD 3 by and large parallel the weekly trends in runs shown in the left panel. But outside PADD 3, what was a stable trend now appears as a significant increase in runs versus last year. In mid-September, the increase exceeded 900 MB/D, 12% above the prior year level and more than offsetting the lingering effects on runs in PADD 3. Effectively, by intensive use of undamaged refining capacity, the industry was able to achieve crude runs in the second half of September that for the country as a whole were about 600 MB/D, or about 4% above year-earlier levels, helping to push spot gasoline prices back toward pre-Katrina

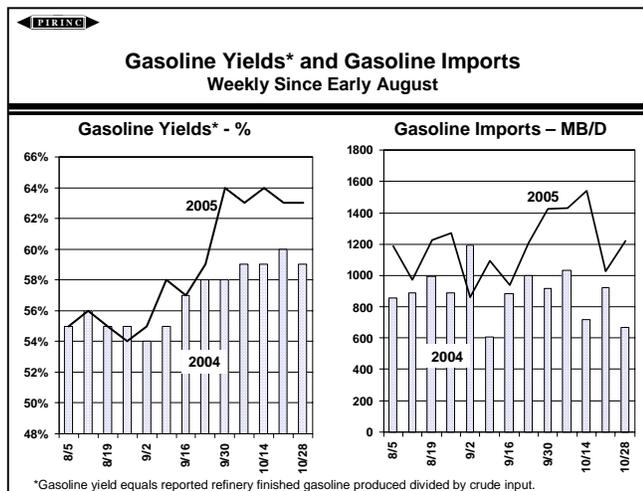


levels.⁶ Although runs outside PADD 3 continued ahead of year-earlier levels, the gains were then overwhelmed by the new losses resulting from Hurricane Rita.

In addition to higher crude runs, the undamaged refineries also pushed up gasoline yields, as illustrated in the left panel of the next chart. Although reported yields rose in the immediate weeks following Katrina, the biggest gains came in the second half of September reaching a peak of about 64% in late September through mid-October.⁷

The right panel of the chart shows a critical element in eroding the price spikes, especially the spike following Rita, namely, the substantial increases in gasoline imports. From the week ending mid-September through mid-October, imports moved up from about 900 MB/D to about 1.5 MMB/D, more than double the year-earlier level. Although they have receded from their highs, gasoline imports were still running well above year earlier levels through the end of the month. Surging imports have played a key role in moderating gasoline prices, especially after the more devastating refining capacity losses resulting from hurricane Rita, and especially in PADD 3, where the capacity losses were concentrated. Imports of gasoline in October averaged about 380 MB/D, far above their typically minimal levels, as illustrated by the 2004 October average of 25 MB/D.

The physical supply reactions, higher utilization rates by operable refineries, higher gasoline yields, and surging imports, all show how markets work to resolve a supply crisis. In effect, the initial price spikes produce extraordinary incentives for supply that, when permitted to work, ease the crisis and bring down prices. In these particular supply crises, timely US and international action helped clear the way for markets to do their work. While prompt use of the SPR has already been noted, the government took other critical actions to support market responses. The EPA immediately issued temporary waivers of summer RVP requirements and of sulfur limits for road diesel. Later, temporary waivers were issued to raise the sulfur cap for gasoline produced at certain refineries, and to allow sales of conventional gasoline in certain reformulated gasoline areas in Texas and Virginia. The Administration also temporarily waived the Jones Act requirements for American flag shipping of crude oil and products on September 1 and again on September 27.



⁶ These gains were achieved in part by adjusting maintenance schedules. However, given safety priorities, such actions can only be temporary.

⁷ The reported figures for both years include some gasoline blending within the refinery gates.

The decision by International Energy Agency members to release stocks, including gasoline stocks also smoothed the market response. With the onset of Rita, the spike in US gasoline prices made the US an instant magnet for foreign supply at the same time it inspired US buyers to shop abroad. While both elements encourage the movement of product to the US initially via stock drawdowns and then by increased foreign refinery runs, they also put upward pressure on foreign prices. In effect, in a world market, a supply problem in part of the world is thereby transmitted to the rest of the world. By releasing stocks of both crude and product, the IEA eased the worldwide price impact of accommodating the US supply shortfall.⁸

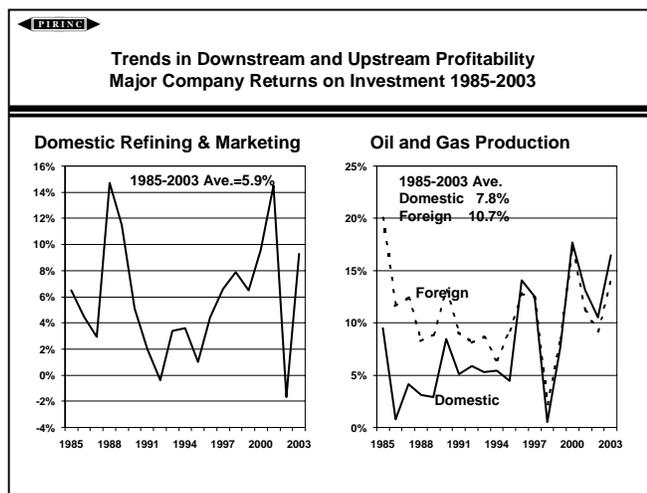
Prices and Profits

Limited supply and rising prices mean higher profits for those with product to sell. Of course it is the prospect of higher profits that motivates the market-correcting push for supply alternatives. This limited supply/high price phenomenon is not confined to the oil industry but there is little doubt public reaction is much stronger in the case of oil than other commodities (or in other sectors such as real estate) as evidenced by calls for “windfall” profits taxes. But in the oil industry price---and profit--- volatility have become the norm rather than the exception and public focus on only the upswings leads to a very distorted view of the industry and potentially damaging policy decisions.

The chart below summarizes returns on investment for the refining and marketing and oil and gas production from 1985 through 2003, the latest year available, as reported by the major US oil companies.⁹

The left panel shows return on investment for domestic refining and marketing. Over the 19 years shown, this business segment showed an average return of 5.9%, less than a percentage point above the average 3-month Treasury bill rate for the same period. But the average included three years of double-digit returns and 5 years of returns below 3%, including two with outright losses. The worst year, 2002, came right after one of the best, 2001.

With mediocre overall returns, this segment of the industry focused on rationalization rather than expansion,



⁸ There was nonetheless an immediate international price impact. Between August 26 and September 1, the Rotterdam spot price for regular unleaded gasoline rose by 32%---less than the 63% price rise in New York Harbor unleaded but substantial nonetheless.

⁹ These are the companies submitting annual financial and operating data to the EIA on a uniform, standardized basis on the Financial Reporting System (FRS) Form EIA-28.

although with significant investments in refinery upgrading. Profitability has clearly improved since 2003, with spectacular, but fleeting, gains coming in the aftermath of the hurricanes (and only for those with undamaged facilities). The improvement is encouraging renewed investment interest in expanded capacity, but those doing the investing remain fully aware of the cyclical nature of the industry.

Although returns (and business risks) have tended to be higher in the upstream, there too, as illustrated in the right panel of the chart, returns on investment have been highly volatile. Returns on investment in domestic oil and gas production averaged just under 8%, with individual years ranging from lows of near zero in 1986 and 1998 to a high of nearly 18% in 2000. Note that returns were generally much higher on upstream investment abroad than at home from the mid-80s through the early 90s but since then returns on foreign and domestic upstream investment have been about the same.¹⁰ Volatility in rate of return is closely related to volatility in crude prices. Over the course of 1985 through 2003, yearly prices for WTI averaged about \$21.50/barrel with a range of from a low of about \$14.50 in 1998 and a high of \$31 in 2003.¹¹ Of course recent prices have been much higher.

Low prices and profitability have impacted US production, primarily production from higher cost marginal wells in mature areas. Beginning in 1986 through 1989, when returns on investment in US oil and gas production were under 5%, lower-48 on-shore crude production fell by an average of about 125 MB/D per year, after stabilization and modest increases in the preceding years. Poor profitability in 1998-99 witnessed significant declines in lower-48 on-shore production with a two-year total of about 150 MB/D.¹² It should be kept in mind that the chart focuses on major companies only. The profitability swings among the smaller independent companies would be more pronounced since they are more heavily involved in the more vulnerable production from marginal wells.

High crude prices in both 2004 and even more so this year are boosting upstream profitability to record levels and, especially in view of the hurricane-related spikes in product prices, triggering calls for so-called “windfall” profits taxes. However, given the history of prior brief periods of unusually high prices and profits followed by what can be substantial, prolonged declines, there is good reason to step back and consider carefully the implications of going down this path. A tax policy that takes disproportionately more when profits are high but leaves the poor return years for the industry to bear on its own lowers expected returns and thereby creates a disincentive to invest at a time when expanding supply is a clear priority.

¹⁰ In the early and mid-80s there were wide disparities in reported finding costs between the US and abroad. These narrowed sharply as reductions in US onshore and offshore costs exceeded reductions elsewhere. The most recent years reported show an up tick in both domestic and foreign finding costs.

¹¹ The range of prices on a monthly basis was higher; with lows of about \$11.50 in July 1986 and December 1998 and highs of nearly \$36 in October 1990 and February 2003.

¹² In 1989, total domestic exploration and development wells for oil and gas stood at about 28,000, down from 70,000 in 1985. In 1999, the number of such wells was about 18,500, down from 27,500 in 1997. In 2004, with price and profitability recovery, the number of wells stood at 35,000.

Price and profit volatility means that industry tends not to invest on the basis of prices prevailing at any given moment in time. With long time periods required for many investments, especially for frontier and unconventional oil projects, industry cannot instantly ratchet spending up or down dramatically in response to changes in immediate market conditions. Moreover, investment economics have to be robust enough to survive over a cycle of disappointing as well as good times. In terms of long-term price prospects, the Department of Energy's Annual Energy Outlook released in January was projecting a Reference Case constant 2003-dollar world oil price of \$30.31/barrel in 2025. In July, when the latest International Energy Outlook was released, a price of \$35 was considered a more likely projection for 2025, with sensitivities of \$21 and \$48 also assessed. All these prices are well below the peak levels seen recently and a reminder to policy-makers to look beyond the current market in setting energy policy.

Natural Gas

Although there has been some improvement, shut in gas production in the Gulf of Mexico as of mid-November is still averaging about 40% of normal levels and about 8% of total year-earlier national marketed production. While there may be some room for higher imports, this option is far more limited than for oil. Last year, net gas imports accounted for only about 15% of total US gas consumption (as opposed to nearly 60% for oil). In effect, gas imports would have to rise by about 50% to cover the latest, diminished volumes of shut-in production---an infeasible proposition. For the first 8 months of 2005, gas imports were running at about the same level as the same period in 2004. What has been the most rapidly growing component of imports, LNG, was running slightly behind year-earlier levels and in any case, LNG accounted for only 15% of total imports in 2005 through August and only about 2% of total consumption. Moreover, much of what had been comfortable levels of gas in storage at the beginning of the summer were drawn down as a result of high demands for use in power generation triggered by the exceptionally hot weather in July and August. As a result, both current and winter futures prices for gas are continuing well above pre-hurricane levels, although down somewhat from their peaks.¹³

In 2003, the latest year for which such data were available, nearly half of US LNG imports entered through the terminal at Lake Charles, Louisiana and therefore subject to hurricane-related risks of interruption.¹⁴ The facility was not significantly impacted by hurricane Katrina but Rita was another story. Ship unloadings and gas send-outs were suspended on September 22nd. On October 6 it was reported that commercial power supplies had been restored and the facility was back to full normal operations. As of mid-June 2004, the Department of Energy published a list of proposed new LNG terminals with a combined capacity of 31.5 BCF/D. Of this total, about 60% was proposed for the Gulf Coast and a further 8% in the Bahamas/Florida.

¹³ While supply options for gas are limited, oil is playing a significant role in preventing even more extreme prices. Fuel oil use has risen sharply, particularly as a substitute for gas in power generation.

¹⁴ The facility at Everett, Massachusetts accounted for 31%, followed by Cove Point, Maryland (13%) and Elba Island, Georgia (9%).

As with oil, there are good historic reasons why the Gulf Coast should have a strong role in the country's LNG import capability. The pipeline system is well developed and gas imports to that region can easily move to the consuming regions of the country. However, there are other reasons that should perhaps have less weight in the future, in particular, the greater intensity of local opposition to proposed sites closer to the consuming regions. The hurricanes have demonstrated for gas as well as oil the value---and need---of supply diversity. Looking forward, this consideration deserves greater weight in public policy decisions regarding the country's evolving energy infrastructure.