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# The Future of the Gulf Coast's Petrochemical Industry

by Stephen V. Arbogast  
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In a region long dominated by "elephant" oil fields and massive refineries, petrochemicals quietly emerged as a Gulf Coast giant. Growing up alongside those refineries, the Gulf Coast has developed the densest concentration of chemical plants in the world. In Texas alone, the chemical industry is responsible for 70,000 jobs and \$15 billion in annual exports. For decades the industry grew at rates that exceeded the average for the U.S. economy. That growth has now come to a screeching halt. Shaken by stubbornly high natural gas prices, the Gulf Coast's petrochemical industry today is enveloped by a pessimism not equaled since the recession of 1980. While major chemical companies announce plans for new plants in Qatar, Oman, Singapore and China, silence envelops the Gulf Coast. How did this deep pessimism take hold? Is it exaggerated? Will the Gulf Coast's petrochemical industry actually begin to decline in the years ahead?

To answer these questions, one needs to examine the premises on which this pessimism rests. A closer look reveals a different, more nuanced picture. It appears that the Gulf Coast's competitiveness will likely improve over the next decade. It will be possible to reinforce this improving trend with sound public policy. The major challenge for the Gulf Coast's industry is uncertain petrochemical demand. Solutions for this issue likely lie outside the industry's grasp; answers will instead have to be sought within the realm of national economic and trade policies.

## Examining the Conventional Wisdom

Today, the Gulf Coast's petrochemical industry is the object of an unusually broad and negative consensus. This "conventional wisdom" is built upon the following assumptions:

1. The run-up in natural gas prices has converted a Gulf Coast competitive advantage into a cost disadvantage.
2. Demand for petrochemicals in the United States will no longer grow at rates approaching the almost 5 percent per annum that long characterized the industry.
3. U.S. chemical exports will be displaced by more cost-competitive supplies from the Middle East or by new capacity constructed within this hemisphere.
4. The combination of slow demand growth in the United States and lost exports translates into future Gulf Coast spare capacity. There will be no need for major new investment.
5. Lost exports and spare capacity will trigger a deeper level of industry restructuring. Eventually the Gulf Coast petrochemical industry will become smaller, serving only the local market.



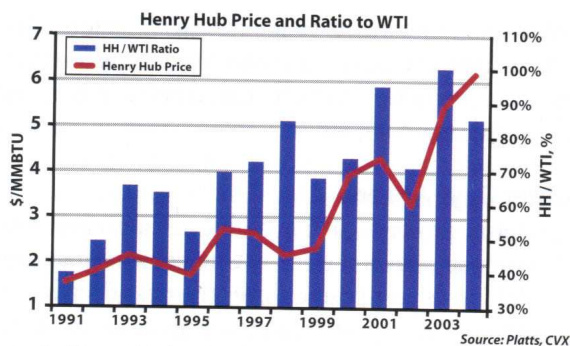


Figure 1: Henry Hub price has strengthened significantly relative to crude oil.

This consensus emerged from the difficult conditions the industry experienced from 2001 to 2004. The most dramatic event was the more than 200 percent increase in natural gas prices. Figure 1 illustrates how gas prices, which averaged about \$2 per million BTUs as recently as 1999, have soared and (ignoring the Katrina/Rita price spike) are now stuck at the \$6-7 MBTU level.

This development implies two things for industry costs. Clearly the cost of electric power consumed by chemical producers climbs with higher natural gas prices. More fundamentally, the cost of ethane gas, a basic industry feedstock, has also risen. Ethane can be left dissolved in natural gas. The chemical industry obtains the ethane it needs by paying a premium over natural gas. More than half of the Gulf Coast's ethylene capacity is geared to run ethane feedstock. Much of this capacity was built when natural gas traded at a big discount to crude oil on a BTU-equivalent basis. Now this ethane-based industry struggles with dramatically higher feed costs.

For a variety of reasons, the United States currently exhibits the highest natural gas prices in the world. This renders the Gulf Coast's petrochemical industry not only high cost in an absolute sense but also less competitive relative to other regions. Figure 2 illustrates the higher

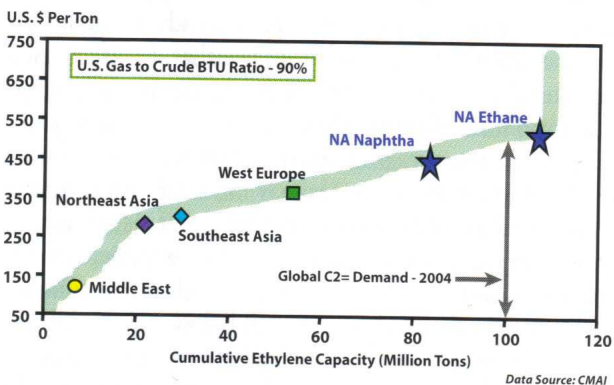


Figure 3: Global ethylene cash costs, 2004

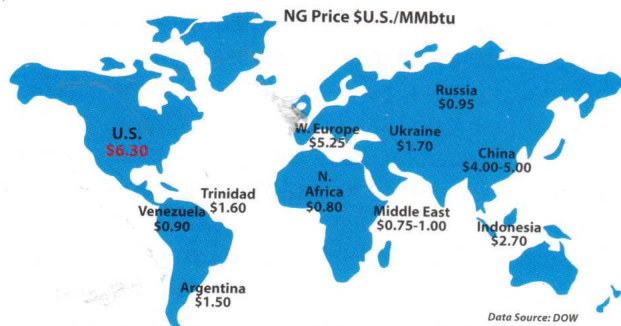


Figure 2: The problem: The United States has the highest natural gas prices in the world.

price of U.S. gas relative to other locations, while Figure 3 shows how these prices have affected the Gulf Coast's cost structure.

While high natural gas prices receive most of the blame, lackluster demand growth has also influenced the "conventional wisdom." The industry was not expecting this development, and it still has not completely digested it. Figure 4 provides an indication of the problem. This chart shows U.S. demand for polyethylene. From 1980 to 1999, demand grew at an average 4.5 percent annual rate. This was consistent with an industry "article of faith" that said petrochemical demand would grow at rates exceeding U.S. economic growth (GDP). After 1999, the relationship broke down. U.S. economic growth continues to average the same 3-plus percent per annum. However, the growth of polyethylene demand advanced at less than 1 percent per annum over the same period. It has not escaped the attention of industry observers that chemical demand simultaneously boomed in Asia. This has fostered a view that the chemical industry is following its customers out to Asia. Said differently, the migration of U.S. manufacturing to Asia has meant the demand for chemicals by these manufacturers – for all manner of inputs and packaging – is also migrating.

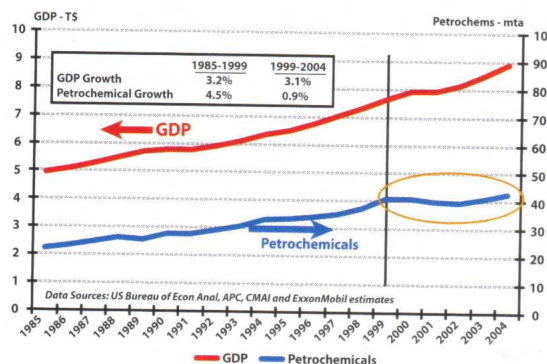


Figure 4: U.S. GDP and U.S. petrochemical demand

It is easy to miss some of the significance of North American chemical demand growing at 1 to 2 percent rather than 5 percent per annum. The petrochemical industry is highly cyclical. Prices can vary by 200 to 300 percent from trough to peak. New grassroots facilities can cost upward of \$2 billion to construct. Industry has long counted on high demand growth to absorb spare capacity and assure that large-scale plant additions will eventually be fully utilized. When demand growth falls to "creep" levels, minor plant expansions can satisfy requirements. Major new capacity becomes a risky proposition.

The conventional wisdom's gloom is only reinforced by the prospect of the Gulf Coast losing its export markets. Upwards of 10 to 20 percent of Gulf Coast production is routinely exported. Much of this goes to Mexico and Latin America, but exports to Asia have also been material at times. In past years these exports were rendered economic by the Gulf Coast's favorable cost position.

With that position now exhibiting a disadvantage (Figure 3), the conventional wisdom anticipates the Gulf Coast losing its export markets to cheaper sources of supply. Indeed, fears exist that low-cost Middle East facilities could confront the Gulf Coast with competitive chemical or finished goods exported to the United States. Two new world-scale olefins projects, the Fenix project in Mexico and the José project in Venezuela, have the potential to exacerbate this risk. Both projects would target demand now served by Gulf Coast facilities. The José project might also have the capacity available to export directly into the United States.

If the conventional wisdom is correct, this loss of export markets would condemn the Gulf Coast to years of spare capacity. Margins would then suffer. Returns on capital would not be high enough to support new investment. Some high-cost producers certainly would fail, and the Gulf Coast's petrochemical industry would shrink. While the surviving capacity might ultimately see improved profitability, the days where the Gulf Coast's industry was a world-class player would definitively be over.

This sobering scenario needs to be taken very seriously. The most knowledgeable firms in the industry, Dow, ExxonMobil, Shell and others, all indicate they have no plans for major Gulf Coast investments any time soon. These firms have not soured on the chemical business. Indeed, they all plan to add capacity in the Middle East or Eastern Hemisphere over the next five years. However, these firms accept the conventional wisdom outlined above. Are they right? Is the Gulf Coast's future likely to be this dark? Or, as often happens in this industry, are current events being extrapolated into the future, leading to an exaggerated pessimism? It is also necessary to ask

whether the future might be influenced by factors not now in evidence. Can the industry make adjustments to improve its position? Can well-crafted public policy also help the industry compete?

### Brighter Days Ahead

In fact, future prospects are not as dire as the conventional wisdom implies. Several elements are going to improve the Gulf Coast's cost position over the next decade. Fears of losing all export markets are also exaggerated. The Gulf Coast is likely to remain dominant in Mexico, Central America and the Caribbean, and continue to compete elsewhere in the Western Hemisphere. Sluggish U.S. demand growth is more of an issue and may continue to cast a pall over new investment in segments like the ethylene chain.

Let's look first at the brightening cost picture. The United States is not likely to retain the highest global natural gas prices forever. The natural gas market is being transformed by the rapid growth of the liquefied natural gas (LNG) market. For the first time, natural gas is becoming a fungible, traded commodity. This will create a global gas price, probably within the next five years. Regional premiums like those now prevailing in the United States will tend to shrink back to transportation differentials.

Moreover, \$6-7 per barrel MBTU for natural gas is not the disadvantage at \$60 per barrel for crude oil that it seemed when crude prices were \$35 per barrel. To put this in perspective, gas feedstock for chemicals was considered to be an advantage when natural gas sold at 60 to 70 percent of the crude oil price on a BTU basis. When a parity price prevails among gas and crude, gas – as a chemical feedstock – is considered disadvantaged. A parity situation occurred in 2003 and in early 2004. Much of the industry's heartache stems from those moments. Again ignoring the Katrina/Rita price spike, the relationship is essentially back to gas being at 80 percent of crude oil's price, not quite an advantage for gas but certainly not a disadvantage either. Figure 1 also illustrates these relationships. Note the dip in the gas/crude ratio from 2003 to 2004.

Even more encouraging, strong fundamentals support the idea that future gas prices may fall relative to crude oil. Major oil producers don't say much on this subject. For many reasons, including painful past experiences with the oil industry's own price cycles, they continue to forecast long-term crude prices well below \$30 per barrel. These outlooks look increasingly challenged, however, given the industry's failure to replace production and add reserves, the disappearance of spare capacity outside the

Persian Gulf and the surprise of double-digit oil demand growth in Asia. Natural gas, on the other hand, exhibits more plentiful supply options ready to come to market from more diverse sources. Lower-cost logistics for LNG are making this possible. Natural gas must also compete with coal, nuclear and renewable energy in its major demand sector, electric power. There is no comparable substitute available for petroleum in its key demand sectors, which are motor fuels.

Collectively, these trends suggest a natural gas price that should lower over time; in particular, the price should decline toward the full cost of delivering LNG into major consuming markets. Crude oil prices may, however, remain stubbornly high. The result for chemicals could be a trend back to advantage-gas, albeit at higher absolute price levels than during the days of the gas bubble in the United States.

More good news for ethane crackers comes in the form of the likely composition of imported LNG supplies. As shown in Figure 5, these are likely to carry ethane fractions at least as generous as those characterizing local natural gas. This prospect helps assure that ethane-based chemical plants will not be squeezed for supplies as imports supplement local gas production; indeed, ethane-rich LNG may imply some new, favorable supply opportunities for chemical producers.

Nor is the Gulf Coast's improving cost outlook limited to brighter prospects for gas feedstocks. A significant portion of the industry is being cracked by heavier liquid feeds such as naphtha gas oils or even heavier residual materials. It may seem paradoxical in light of the previous discussion, but the liquids-cracking chemical business may also see better days ahead. The key here is the type of liquid feedstock that will run. While naphtha feed costs can be expected to track crude oil prices, residual fuels often lag behind. This relative relationship is about to intensify. Rising crude oil prices are being compounded by bottlenecks in refining. These bottlenecks are felt most acutely in the production of naphtha and distillate, where surging motor fuels demand is applying pressure.

There is no comparable demand pressure for residual fuels, so prices lag for these products. Over the next several years, the average crude oil barrel going into refining will become heavier, implying a lower fraction of naphtha and distillate production and a greater portion of residual fuel. As one example, almost all spare capacity and the new production coming in Saudi Arabia will be medium or heavy in grade. This means refiners will increasingly struggle with the disposition of residual fuel. They can either invest in expensive conversion capacity

Greater Role for LNG May Shift Gas Liquids Supply

Mole %	Indigenous Gas at Wellhead				LNG		
	South TX	GOM Shelf	Onshore		Trinidad	Qatar	Nigeria
			LA	TX			
Methane	88.9	94.0	86.8	95.1	96.2	90.1	90.7
Ethane	5.9	2.9	6.2	1.2	3.4	6.5	8.5
Propane	2.1	1.1	2.5	0.3	0.3	2.4	0.8
Butane & Heavier	1.6	1.1	2.0	0.4	0.1	1.0	0.1
N <sub>2</sub> & CO <sub>2</sub>	1.6	0.9	2.5	2.9	0.0	0.1	0.0

Source: Industry Data, CVX

Figure 5

or offer residual fuel to chemical producers at a discounted price. Refiners are likely to do some of both. As a result, Gulf Coast liquids crackers may see offers for new advantaged heavy feeds from refiners. This will mean an improving cost position not only for products like ethylene but also for propylene, butadiene and all the other co-products routinely derived from cracking heavy feed.

This improved cost outlook combines with the dynamics of global chemical markets to imply the continued retention of the Gulf Coast's export markets. The conventional wisdom's pessimism is especially exaggerated in this area. It is true that substantial low-cost production will be added in the Middle East. This production, however, will almost certainly be dedicated to Asian and European markets. Transportation costs are lower for Middle East products entering those markets, which implies higher earnings after such costs are netted out.

This means the spare production from the Eastern Hemisphere will not be in the Middle East but will lie elsewhere and have a higher cost structure. Typically, Korean and Japanese naphtha crackers suffer spare capacity when regional demand falters. These plants are not likely to be highly competitive exporting into the Western Hemisphere. A Gulf Coast industry experiencing an improving cost trend should more than be able to hold its own exporting into nearby markets. Nowhere is this more obvious than in Mexico, where Gulf Coast producers have the advantages of overland rail transport, the North American Free Trade Agreement (NAFTA) and long-standing relationships.

If there is a threat to Gulf Coast exports, therefore, it comes from the prospect of new, low-cost capacity built within the region. What then of the much-publicized Fenix and José projects? Each complex would be built around a world-scale ethylene cracker. The former would displace most of the ethylene imports now coming in from the U.S. Gulf. The latter could supply polyethylene import demand on the west coast of South America and still have pounds available to export into the United States.

It is in contemplating these projects that one of the Gulf Coast's key advantages and one of conventional wisdom's biggest blind spots comes into focus. Projects

and operations along the Gulf Coast reside largely in the control of the firms who own the plants. Such is not the case for operations in either Mexico or Venezuela. In those locations, joint ventures and supply contracts with state companies are the rule. Heavy nationalistic political agendas inevitably dog project development.

The José project was first awarded to Mobil Corporation in 1996. It remains in its preliminary development stage in 2005. The Fenix project has suffered a similar odyssey, with numerous factors, including the site location, becoming political issues. Looking forward, the Fenix project will struggle with the fact that its fundamentals are not that robust. Pricing proposed for its natural gas liquid feedstock is not especially advantaged, implying marginal project returns for a capital-intensive project. Chances for these project economics to improve are not good. Chemicals are a second-tier priority inside a Mexico that must soon worry about declining oil and inadequate natural gas production. Energy politics are likely to move further to the left during that country's presidential election in 2006.

As for José, this project is blessed with attractive fundamentals. However, the Chávez administration has created several complications now impeding development of the chemical sector. Foremost among these are uncertainties about the robustness of any contract concluded with Venezuelan state companies. The Chávez regime has ended the traditional independence and commercial orientation of Petroléos de Venezuela. It also has pursued an aggressive series of royalty increases, retroactive tax claims and unilateral contract adjustments with the foreign oil companies.

These events can only increase the caution of foreign lenders and investors in the chemical sector, who are likely to seek enhanced protections necessitating further negotiations. The bottom line is that neither the Fenix nor the José project is likely to proceed on its announced schedule. Gulf Coast producers can thus be confident of retaining their export outlets for the next decade, if not indefinitely.

Unfortunately, the good news for Gulf Coast producers stops here. Nothing has yet surfaced to suggest the sluggish demand growth of the last five years is about to change. Indeed, 2004-05 trade figures with China suggest that the displacement of U.S. industrial production with Asian imports continues apace. Chemical company announcements of new plants in Asia correlate with and confirm the robustness of this demand migration. If industry perception solidifies that U.S. demand will never again match GDP growth, major new Gulf Coast investment will be very problematic.

Taken together, this modified view of the conventional wisdom adds up to an improved financial outlook for current producers but little prospect of large-scale investment in the major ethylene chain. Some investment may occur in other products where demand growth is higher. To the extent that some higher-cost ethylene capacity may shut down, producers with lower-cost options may undertake some expansions. Overall, however, the industry will lose market share relative to other regions and be primarily concerned with defending the markets it presently serves.

### Public Policy Options

Astute public policy could further improve this outlook. Accelerating the arrival rate of LNG imports could make the most immediate difference. These imports, which totaled less than 2 billion cubic feet per day (bcf/d) in 2004, are projected to grow to between 7 and 10 bcf/d by 2010. Ensuring the import regasification facilities embedded in these projections receive timely approval is the first step toward causing that U.S. natural gas price premium to disappear. Industry executives will be quick to argue that LNG is not a silver bullet. Numerous other measures are needed to encourage gas-supply development. Without taking anything away from their arguments, nothing will stabilize U.S. natural gas prices like a convincing demonstration that LNG supplies can be expanded as needed.

Regional public policy officials should see an opportunity in LNG that also can help the chemical industry. The Gulf Coast has an opportunity to be the dominant point for LNG entry into the United States. While other states debate whether to permit import facilities, the Gulf Coast enjoys conditions favorable for moving ahead. Its communities are used to living alongside oil and gas facilities, and the region deploys an extensive infrastructure for moving molecules to other markets. The Gulf Coast's public policy officials can capitalize on these conditions, accelerating reviews and approvals while other regions drag out their deliberations. In light of recent events, they will have to pay due attention to each site's exposure to severe weather. Assuming this can be addressed, the result would be to add a concentration of LNG regasification to the region's existing infrastructure assets.

For the chemical industry, several benefits will ensue. During times of surplus gas supplies, chemical producers will again see advantaged power and feedstock costs. Moreover, concentrating the nation's LNG imports on the Gulf Coast could recreate an ethane-rich environment. Gas importers would likely see some incentives to sell ethane locally rather than transport it to more distant markets. Such circumstances can only add to

the improving feedstock and cost fundamentals of Gulf Coast gas crackers described earlier.

Public policy can also act to neutralize a major advantage that foreign governments employ to attract major chemical projects. The grassroots plants in the Middle East and Singapore were constructed on the basis of ample fiscal incentives offered by host governments. For example, the original Saudi plants were funded with loans from its Public Investment Fund and enjoyed a 10-year tax holiday. More recent plants in Singapore also benefited from attractive land leases, an investment tax credit and a tax holiday with the unlimited ability to carry forward tax losses.

Accustomed to an industry that enjoyed a basic cost advantage, Gulf Coast states have no programs comparable to the foreign locations with whom they compete. Since these states cannot offer federal income tax holidays, they need to consider amplified incentives built around public infrastructure and financing. More competitive fiscal incentives would help encourage Gulf Coast producers who encounter interesting feedstock opportunities to act on them.

The major challenge for the Gulf Coast remains the future growth of chemical demand. Public policy is confronting these issues on a broader plane, through trade and exchange rate policies. The conventional wisdom assumes little will be accomplished to slow the migration of chemical demand to Asia. Developments may occur that would cause such assumptions to be too pessimistic. These could take the form of effective anti-dumping provisions, a major Chinese currency revaluation or retaliatory tariffs on imports from China. Should any of these occur, they will need to be recognized and incorporated into revised industry planning bases.

One regionally specific policy that would aid chemical demand concerns future trade with Mexico and Central America. As noted above, Gulf Coast chemical producers are likely to retain their export markets in these countries. To the extent that the United States and Mexico act to intensify trade under NAFTA and the Central American Free Trade Agreement (CAFTA) ratification is achieved, prospects improve for chemical export demand to be above expectations. It will certainly be in the Gulf Coast's interests for labor-intensive manufacturing to be located just to its south rather than in Asia. Many major chemical producers profess to being indifferent to such a development since as they can service demand from plants and projects in either region. They would, however, find North American demand to their liking, allowing them to invest in a secure location and operate fully-owned capacity.

### **A Concluding Word**

The Gulf Coast's petrochemical industry is far from becoming a depressed industry. Its prospects are brighter than widely perceived, and it retains considerable advantages. Sound public policy can render it even more competitive and perhaps create conditions for some large-scale investment. For this to happen, however, public policy will probably have to lend a hand on the demand side. Unless something alters the perception that chemical demand will inexorably move to Asia, the Gulf Coast's leading industry firms will continue to follow demand and pursue the opportunities they can create in that region. ■

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**Prior to joining Bauer College, Mr. Arbogast spent 32 years working in finance for Exxon and Exxon Mobil Corporation. His assignments included overseas postings as finance and planning manager of Esso Brasileira and finance director of Esso Standard Thailand Limited. From 1986 to 1989 he served as treasurer of Exxon Capital Corporation, during which time he helped arrange more than \$3 billion in long-term financing for Exxon. In 1997 he became treasurer of Exxon Chemical Company and then treasurer of ExxonMobil Chemical Company following the Exxon-Mobil merger in 1999. In that capacity, he served as a director of the al-Jubail Chemical Company (Exxon's joint venture with Sabic in Saudi Arabia), Dexco (a Dow/Exxon joint venture) and Qenos Pty. Ltd. (a joint venture with Orica) in Australia. He retired in September 2004.**

**Mr. Arbogast has taught finance at the University of Houston since 1995. At present he teaches two courses on project financing and one on international finance. His specialty is to teach using case studies based upon his experience in the energy and chemical industries. He has authored over 30 case studies. Mr. Arbogast has also taught at Rice and Fordham Universities.**

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