

Houston Business

A Perspective on the Houston Economy

Refining and Chemicals on the Gulf Coast: Three Key Industries

(Part 1 of a two-part series)

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Refineries and chemical plants sprawl for miles along the Houston Ship Channel, from Houston to Pasadena, Deer Park and La Porte. Dozens more plants lie north and south of where the channel meets Galveston Bay—to the north at Mont Belvieu and Baytown, and to the south at Seabrook, Texas City and Freeport. This scene is repeated up and down the Gulf Coast at Corpus Christi, Victoria, Beaumont, Port Arthur, Orange, Lake Charles, New Orleans and Baton Rouge. This Texas and Louisiana refining and petrochemical complex is the largest in the world and the dominant economic feature of the Gulf Coast.

After the oil downturn in the 1980s, Houston sought economic diversification and shelter from the whims of world oil markets. As oil prices fell, the upstream industries—oil and gas drilling, production, services and machinery—led the regional economic downturn. The expansion of downstream refining and chemicals, in contrast, was a critical part of the Houston area's recovery between 1987 and 1991, as billions of dollars of new construction occurred along the Gulf Coast.

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LOOKING DOWNSTREAM

Most people know little about the downstream industries, and for good reason. Without a degree in chemical engineering, even reading a list of industry products—ethylene dichloride, cumene and acrylonitrile, for instance—can be daunting. At the simplest level, we define the downstream as three industries—natural gas processing, oil refining and petrochemical production.

Natural gas processors separate natural gas liquids from the methane gas stream that is the dominant natural gas product; the liquids are ethane, propane, butanes and natural gasoline. *Refiners* turn oil into energy products such as gasoline, fuel oil and kerosene. *Petrochemical producers* turn oil and natural gas liquids into intermediate materials that eventually become plastics, synthetic rubber, fibers and other products. These industries are thoroughly intertwined; they rely on each other for inputs, and all three industries may be found at work at the same site.

The Gulf Coast refinery industry was born with the 1901 Spindletop gusher. Two new oil companies that had formed at Spindletop, Gulf and Texaco, quickly discovered they could not compete with industry giant Standard Oil without products and their own distribution systems. Gulf had built a small refinery at Port Arthur to remove sulfur from sour Spindletop crude; in 1902, Gulf quickly upgraded this plant to produce kerosene, which it marketed throughout the Southeastern United States. Texaco followed with a Port Arthur refinery in 1903, the same year that Security, a subsidiary of Standard Oil, built a refinery in Beaumont. Antitrust actions would later lead to the confiscation and auction of the Security refinery by the state of Texas. Standard Oil moved its operations to Baton Rouge, the only Gulf Coast refinery outside Texas until World War II.

Houston's first refineries were built after completion of the ship channel and World War I. By 1931, Humble Oil (later a Standard Oil subsidiary) had expanded its Baytown refinery to become the largest on the Gulf Coast, a distinction it would exchange over the decades with Standard's Baton Rouge plant. By 1941, Houston had displaced Beaumont/Port Arthur as the largest refining center on the Gulf Coast.

World War II was a watershed event for the refining industry and for its role in Texas and Louisiana. The war suddenly altered refining

demand against gasoline and for aviation fuel, diesel and butadiene for synthetic rubber. During the war, refining capacity would grow 15 percent, and catalytic cracking capacity by 45 percent. Strategic demands for synthetic rubber created a petrochemical industry; abundant natural gas supplies and inland locations safe from attack concentrated these new chemical plants along the Gulf Coast. About 60 percent of wartime government spending for refining and synthetic rubber went to Gulf Coast towns and cities, including plants at Baton Rouge, Baytown, Corpus Christi, Houston, Ingleside, Lake Charles, Port Neches, Texas City and Velasco. The Houston area led the region in attracting this spending. Its advantages as a refining center and inland port helped, but some advantage also came from Houston businessman Jesse H. Jones, who served as head of the Reconstruction Finance Corporation and Rubber Reserve Co.

After World War II, refining and petrochemicals continued to grow rapidly in Houston, Beaumont and Port Arthur. However, the key feature of this period was the proliferation of downstream industries outside the upper Texas Gulf Coast and throughout Texas and Louisiana. Corpus Christi saw a boom in refining capacity in the 1950s, as did New Orleans in the 1960s and 1970s. Both oil and chemical companies found themselves drawn to opportunities in the petrochemical industry, and drawn to the Gulf Coast by a cheap and abundant supply of natural gas. Large companies dominate the industry because of the scale of investment required. Oil companies often located new chemical capacity next to their refineries; chemical companies opened their new plants apart from refineries and at sites scattered along the Gulf Coast.

NATURAL GAS PROCESSING

The two major groups of petrochemicals that make up the bulk of production are the olefins and the aromatics. Base chemicals for the olefins are ethylene, propylene and butadiene. For the aromatics, base chemicals are benzene, toluene and the xylenes. Products made from both olefins and aromatics include plastics, synthetic fibers and synthetic rubber. The important distinction between the two groups is that aromatics *must* be derived from oil, whereas olefins can be produced from either oil or natural gas liquids (NGLs). Thus, both refiners and natural gas processors are important suppliers to the petro-

chemical industry.

A distinctive feature of the Gulf Coast petrochemical industry is olefin production based on an abundant supply of NGLs. Europe and Japan, in contrast, produce olefins from oil-based naphtha. U.S. refinery schedules emphasize gasoline production, and they typically divert naphtha fractions to the gasoline pool. European and Japanese refiners emphasize fuel oil, leaving naphtha surpluses for petrochemical production. Ethylene, for example, is the key chemical building block among the olefins, and NGLs form the basis of 75 percent of U.S. output. In contrast, oil-based production accounts for 90 percent of Japanese and 80 percent of Western European ethylene production.

NGLs are usually separated from the gas stream in the producing field. As gas leaves the well, it is sent to a field separator that allows pressure to drop and heavier hydrocarbons to liquify into *condensate*. The usual equipment for this job is a low-temperature separator that chills the gas before the pressure drop, with reduced temperatures dehydrating the gas and allowing greater recovery of liquid hydrocarbons. A small gas field might use a portable, skid-mounted refrigeration unit, while large fields may support much larger cryogenic units that reduce the temperature of the gas stream to -150°F or below. Refrigeration will recover 50 to 75 percent of the ethane and all higher hydrocarbons; cryogenic plants push ethane recovery to 90 to 95 percent.

Condensate moves to fractionation facilities by truck, rail or pipeline (perhaps simply mixed with oil pipeline shipments). Fractional distillation of condensate is similar to crude oil distillation, taking advantage of small differences in boiling points to separate the liquids in distillation towers. The final products are ethane, propane, butanes and a mixture of heavier hydrocarbons that include natural gasoline.

Large integrated companies divert condensate from their own gas fields through fractionation facilities dedicated to their own feedstock needs. The largest fractionation units, however, operate as intermediaries between gas producers and the petrochemical industry. These plants separate liquids from many sources, provide storage facilities and supply feedstock to the petrochemical industry. Mont Belvieu, just east of Houston, is the site of the world's largest concentration of fractionation plants. Mont Belvieu's ethane price is the basic reference

point for natural gas feedstocks in the international petrochemical industry. Its counterpart in the oil-based European petrochemical market is the spot price of naphtha in Rotterdam.

This merchant market for NGLs works well because of a complex web of pipelines that moves feedstocks and other inputs to petrochemical plants throughout the region. The so-called Texas Spaghetti Bowl includes several thousand miles of product pipeline that connects 200 salt domes, fractionation plants, chemical plants and refineries on the Texas Gulf Coast. Another major network connects the Baton Rouge, New Orleans, Napoleonville Dome area in Louisiana. Both distance and volumes influence pipeline shipping rates, and a high load factor can dramatically decrease costs. Access to this convenient, low-cost transportation promotes and reinforces the heavy regional concentration of refining and chemical facilities.

This pipeline system emerged under private ownership and in piecemeal fashion after the 1940s. Gulf Oil was an early and active proponent of the Texas pipeline network, largely because the company began ethylene production at its Port Arthur refinery in the 1950s. Although these pipelines carry a variety of products, ethylene is by far the most important. Road and rail transportation of ethylene is too hazardous and expensive for short trips.

CONCLUSION

It is the olefins that provide a common meeting ground among three downstream industries on the Gulf Coast. Natural gas provides the resource base for the industry's growth, and an extensive natural gas processing industry and transportation infrastructure delivers feedstocks for olefin production. From a process-oriented perspective, olefin plants are similar to petroleum refineries and bridge the gap between refining and the chemical industry. It is common along the Gulf Coast to find world-scale olefin plants fully integrated into giant refineries. Many important interactions take place between these integrated plants, where junk by-products in the refinery have much higher value on the petrochemical side, and vice versa.

The next issue of Houston Business will look more closely at Gulf Coast refining and petrochemicals. It also will explore linkages from the downstream to other regional industries, particularly engineering and construction.

Economic conditions remain slow in Houston. Strong retail and auto sales in December indicate some revival of local consumer confidence. However, a sharp year-end drop in energy prices introduced another reason for caution about Houston's prospects for 1994. Health care reform and continuing cutbacks for the space station continue to hurt the most important nonenergy centers of the Houston economy.

RETAILING AND AUTO SALES

Christmas brought a pleasant surprise for Houston merchants, who saw a solid 6 to 7 percent increase in sales over a year earlier. Like the rest of the United States, electronics and home furnishings sold best. Profit gains may not have matched the increased sales, however, as a slow start to the holiday season led many stores to discount merchandise well before holiday sales picked up.

Auto sales finished 1993 with a 2-percent increase over 1992. Four of the last five months of 1993 were better than their corresponding months in 1992.

ENERGY PRICES AND DRILLING

Energy prices took center stage in December, and prices remain volatile. The January NYMEX contract for West Texas Intermediate expired on December 22 at \$14.30. It had traded at more than \$19 per barrel in early October, then fell to less than \$16 by late November and briefly to less than \$14 in mid-December. Neither cold temperatures on the East Coast nor the Los Angeles earthquake could keep prices above \$15 per barrel. These are the lowest oil prices in more than five years.

Lower prices for residual fuel oil keep downward pressure on natural gas prices, as oil substitutes for gas under utility and industrial boilers. Warm weather in December kept natural gas prices below \$2 per thousand cubic feet; bitter cold on the East Coast in late January pushed prices above \$2.30.

Analysts are divided over whether oil has moved to a new trading range of \$13 to \$16 per barrel, or whether this is a temporary glut that

can be cured by renewed OPEC resolve and global economic expansion.

Domestic drilling activity remains disappointing, as the rig count did not make expected seasonal gains in late 1993. Oil service and machinery companies reported a good fourth quarter, however, as the lucrative Gulf of Mexico remained strong. Also, drilling has tripled in Canada over the past year.

DOWNSTREAM ENERGY

Domestic demand for both refined products and petrochemicals has strengthened in recent weeks, but slow economic conditions in Europe continue to hurt chemical producers. Declining energy prices should help margins for both refiners and petrochemical producers, but both industries suffer from high inventories and overcapacity. Product prices have simply followed crude and natural gas prices downward and left margins very weak.

LUMBER AND BUILDING SUPPLIES

Overall sales are down. Some slowdown is seasonal, but builders and their lenders remain cautious in the face of the slow local economy. The effects of a strong Texas and U.S. housing market are visible in Houston only through higher prices and allocations for lumber, wallboard and fiberglass insulation.

REAL ESTATE

Existing home sales in Houston ended 1993 with a strong 6-percent increase in sales over December 1992 sales; for the entire year, sales were up 3.6 percent. New home sales also were strong in December, but total 1993 sales of new homes fell 1.7 percent below the 1992 total. New home starts inched up only 1.9 percent in 1993. New and existing homes sales are expected to remain slow in 1994.

For the first time since 1987, the amount of office space leased in Houston declined in 1993, primarily because of a weak downtown market. Apartment rents and occupancy continue to improve slowly. The retail market remains active, although real retail sales have had no significant increase in two years.

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