

THE FUTURE OF OIL REFINING PROFIT MARGINS

By Brad VanTassel

IN RECENT YEARS, OIL refining margins have been extremely volatile. Unknowns about the future growth rate of the world economy, the price of crude oil, government regulations, as well as the economics of alternative transportation fuels are causing many uncertainties for the industry. It is difficult to reach a consensus about where profitability is headed over the next five to ten years. Some companies are selling assets and disintegrating their refining businesses—or even splitting upstream and downstream businesses—while others are planning significant expansion. In predicting the outlook for the industry and attempting to maximize refinery profitability, companies need to be aware of the mix of global and local drivers. BCG has developed a microeconomic refining model that considers all these factors and provides an outlook for each region. We believe that there are a number of strategies that refining companies can employ in order to maximize long-term value, depending on the regions in which they operate.

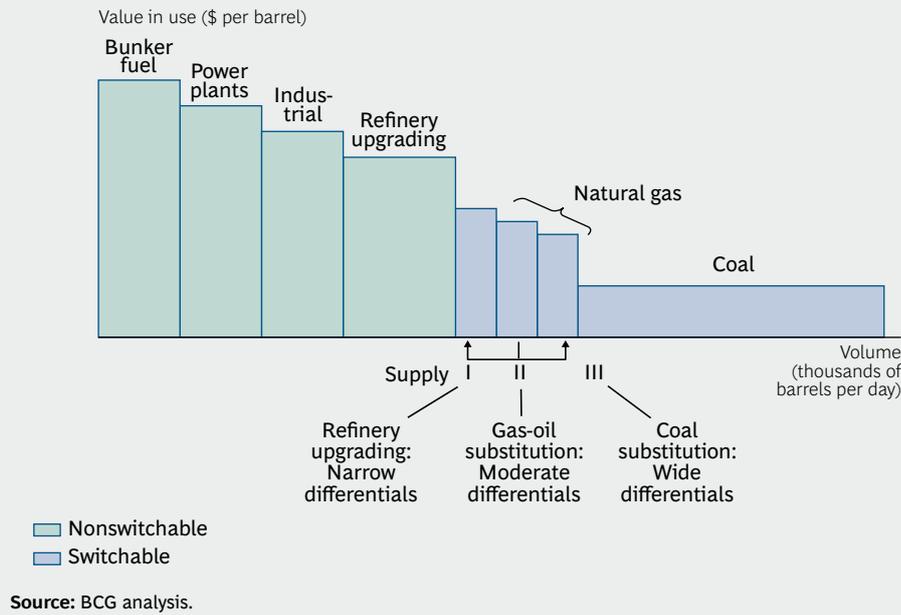
Global Drivers

There are three key global factors that will drive profitability.

Absolute Crude Price. BCG estimates that, barring major economic decline, crude prices will range from \$85 per barrel to \$110 per barrel. Prices are unlikely to dip below \$85 because this is the minimum price that new upstream projects require in order to generate a desirable return. At the other end of the scale, OPEC should have the capacity to increase supply and moderate prices in order to prevent high crude prices from stalling the global economy. High crude prices are beneficial for refiners because they lead to wider spreads in light/heavy-product price differentials.

Light/Heavy Price Differentials. BCG's analysis of heavy products indicates that residual fuel oil prices are set by the lowest value in use in order to clear the global supply of 650°F+ boiling-range material. (See Exhibit 1.) Price setting is a global mechanism—a result of the fact that ships

EXHIBIT 1 | The Worldwide Demand Curve for 650°F+ Sets the Price of Residual Fuel Oil



use bunker fuel and can buy it anywhere in the world based on price. The price is set by the lowest value that is in use to consume the byproduct supply from all refineries.

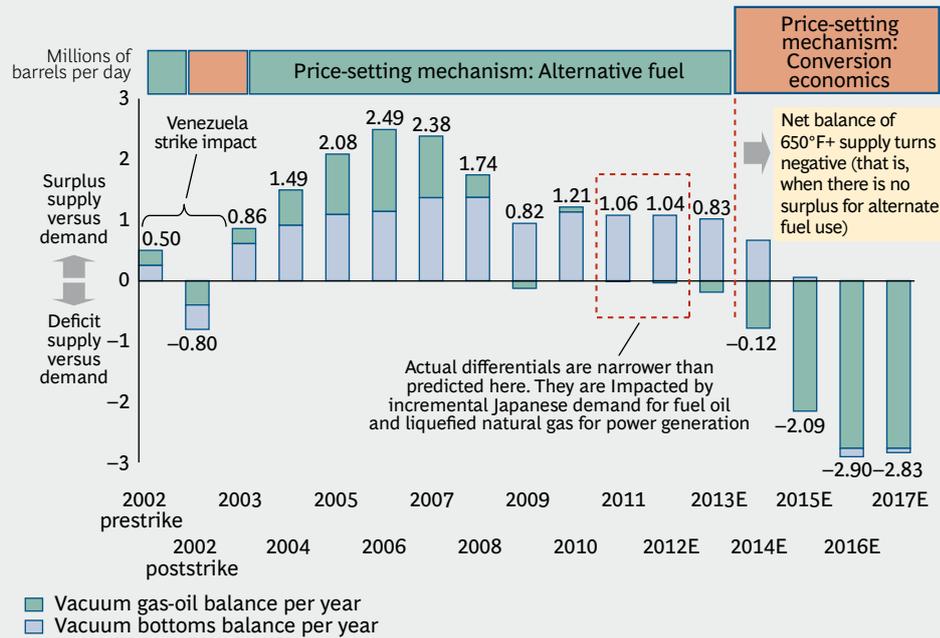
Light product prices are set by breakeven economics—given the price of residual fuel oil—in the least-complex configuration needed to meet demand in each refining center. This marginal capacity in many refineries is typically breakeven after crude cost, transportation to the refinery, energy, and other variable costs are taken into consideration.

A supply of 650°F+ boiling-range material that is greater than the demand for nonswitchable end uses—including refinery conversion units—creates low prices for residual fuel oil, wide light/heavy-product differentials, and high refining margins. During the “golden age” of refining, from 2005 through 2008, global supply of 650°F+ material was greater than the demand for nonswitchable end uses, meaning substitution for natural gas set residual fuel prices, generating large light/heavy differentials. Since 2008, Asia, South America, the Middle

East, the former Soviet republics, and other areas added material 650°F+ conversion capacity, while Japan, after the Fukushima disaster, greatly increased fuel oil consumption. This drove a large reduction in light/heavy differentials. (See Exhibit 2.) BCG forecasts that differentials will remain narrow until 2018. Later in the decade, they may open again when global-crude runs reach a level that shifts the price-setting mechanism back to natural gas. For now, however, BCG expects a prolonged period of low light/heavy differentials and low refining profitability.

Gasoline-Distillates Spreads. The price spreads in gasoline and distillates are the third global factor affecting refining margins. The price of distillates is currently high because of a worldwide shortage, and, as a direct result, the global price of gasoline is depressed—resulting in reduced profitability for many refineries that are designed to maximize gasoline production. Refineries are now increasing investments in hydrocracking capacity, however, due to today’s attractive economics. This will eventually take relative gasoline and diesel prices back to historical levels.

EXHIBIT 2 | The Price-Setting Mechanism for Fuel Oil Is Expected to Shift to Conversion Economics in 2014



Sources: BP Statistical review; World Energy Outlook, IEA; BCG analysis.

Note: Assumed conversion percentages include coking: 77 percent; vis-breaking: 10.5 percent; FCC: 95 percent; and hydrocracking: 100 percent.

Local Drivers

On top of global factors, local supply and demand determines the marginal capacity that must run in order to meet demand. The marginal capacity's yield sets local-product prices and relative crude-oil prices based on quality and yields in the marginal configuration. There is currently excess refining capacity on a worldwide basis, with global refinery utilization down to 81 percent in 2011, versus 83 percent from 2006 through 2008. However, developing economies such as China and most countries in Asia and South America have strong demand growth that will entice significant capacity addition in those regions as well as in the Middle East. In the next five years, we expect China to add more than 2 million barrels per day of refining capacity and the Middle East to add more than 1 million barrels per day. Many of these investments are being undertaken by national oil companies with a desire to integrate downstream. In direct contrast, the U.S. and Europe will see a slow decline in refined-product demand (about 1 percent) and capacity rationalization. This two-speed world requires the

analysis of individual regions in order to forecast future profitability.

U.S. Midwest. Midwestern refiners have been enjoying low crude-oil prices caused by excess supply from heavy-oil production in Canada and light-crude oil from the Bakken. Refiners that can acquire this low-cost crude are enjoying windfall profits. The Brent-WTI differential peaked at \$27 per barrel but has recently fluctuated between \$10 and \$25 per barrel. Because the Midwest is lacking in refining capacity, it imports refined product from the U.S. Gulf Coast, which sets Midwestern light-product prices.

Additional pipeline capacity will be installed over the next 24 to 36 months, re-connecting mid-continent crude to the Gulf Coast and reducing the Brent-WTI spread to the \$5- to \$7-per-barrel range but still providing a larger advantage than during the years of 2006 through 2010, when the two crudes were roughly at parity. Depending on the production rates in the region, crude supply may exceed pipeline capacity again toward the end of the decade.

U.S. West Coast. Refining on the West Coast has lost a significant amount of its traditional profitability as falling demand has shifted the diesel price from import parity from Singapore to export parity to Mexico. In addition, refiners on the West Coast are faced with California's Global Warming Solutions Act (AB32), which requires a reduction in the carbon intensity of fuels and requires refineries to reduce their carbon emissions. If AB32 is fully implemented, there will be significant capacity rationalization in California, as prices for gasoline also decline from import parity to export parity. (See *Understanding the Impact of AB 32*, BCG report, June 2012; http://www.cafuelfacts.com/wp-content/uploads/2012/07/BCG_report.pdf.)

The full impact of the regulation is not expected to be felt until 2017, so the industry will have to live with uncertainty for the next five years while regulators debate potential changes. Margins will benefit from widening light/heavy-product price differentials that are associated with rising crude-oil prices, but profitability will remain below historical averages.

U.S. Gulf Coast. The Gulf Coast depends on its ability to supply marginal-refined products to the East Coast and Midwest. A decline in product demand from the East Coast, or increased imports from Europe, would therefore reduce crude runs in the Gulf Coast. In addition to this, the federal renewable fuel standard will require ethanol blending of E22 by 2021 based on 2010 gasoline volumes. If this regulation is fully implemented, there will be a large amount of capacity rationalization on the Gulf Coast.

BCG estimates that ethanol volumes will reach about E15, causing moderate capacity rationalization. The Gulf Coast's profitability will be primarily driven by light/heavy differentials, thus the outlook for local refining margins is not very attractive. A partial mitigation will come in the form of increased shale-gas production, however, which is lowering Gulf Coast

energy costs and enhancing competitiveness in international markets.

U.S. East Coast. East Coast refiners have a structural advantage over their Gulf Coast counterparts as their crude cost is lower and light-product prices are higher because of the Colonial pipeline tariff. But refineries on the East coast tend to be smaller and less complex than their Gulf Coast counterparts. Most East Coast refiners can only run light sweet crudes that make a large yield of gasoline. Because of low gasoline prices, profitability has declined. Sunoco has closed its Marcus Hook refinery and turned its Philadelphia plant into a joint venture. Phillips 66 sold its East Coast refinery to Delta Airlines, and the refinery has recently restarted.

Closures will be limited in the near term. However, as major turnaround expenses or large environmental capital investments are required, further rationalization may occur. When gasoline and distillate spreads revert to more traditional values and gasoline prices rise, East Coast refiners' profitability will improve.

Northwest Europe. The situation in Northwest Europe is similar to that of the Gulf Coast of the U.S. Continuing decline in demand for gasoline and low gasoline prices will result in the closure of small-scale, low-conversion refineries. Europe has seen more than 1 million barrels per day in refining capacity shut over the past two years, with more likely to follow suit (at least 300,000 barrels per day in 2013) as gasoline demand continues to decline. Some European refineries that have experienced low profitability have not shut down as expected, however, after several private-equity groups and traders purchased plants and continued to run them. Gunvor, for example, purchased the Ingolstadt refinery, surprising the market.

Europe exports gasoline to the East Coast of the U.S. and imports distillates from the Middle East and Russia. Its refined product prices and refining margins, therefore, are set by these trade flows rather than local marginal-configuration economics. As a

result, profitability for high-conversion refineries will likely be higher than their U.S. Gulf Coast counterparts. In addition, the inland markets of Europe offer stronger margins than the coastal regions that are subject to competition from imported products. But high energy costs and the regulation of carbon dioxide emissions threaten utilization rates in Northwestern European refining.

China. China has seen a rapidly increasing demand for gasoline as its car fleet expands, and the country is now the fastest-growing refined-products market. Although China has announced the building of several new refineries, it will continue to be a major importer of refined products over the next 15 years, providing capacity expansion opportunities in other parts of Asia. Margins in Asia should be stronger than in the U.S. or Europe because the marginal configuration is hydroskimming, which provides larger margins for high-conversion refineries. China's demand for product means that there will be opportunities to build new refineries in China or elsewhere in Asia for export to China. The Chinese government has price controls on local refined products that are typically below world prices, so building in China is difficult and risky.

South America. South America represents a high-growth area and has a simple marginal configuration, resulting in strong margins for complex facilities. The developing economies in South America will have growing demand and will add new capacity to create low-cost supply. Brazil has plans to build five new refineries, and Argentina and Colombia are also set for major expansion. With some uncertainty about investment and the delayed timing of these plans, however, surrounding regions will continue to benefit.

Companies considering opportunities in Asia or South America will need to create joint ventures with organizations in those regions. Negotiating profitable roles may be difficult unless companies already have active joint-venture operations in their target region.

Winning Strategies

Given the somewhat bleak outlook for refining margins, BCG believes that there are several “no-regrets” moves that can be made in order to maximize profitability during the next ten years. Refineries will need to take a number of key steps, including improving refinery optimization, reducing energy consumption, decreasing operating costs, and increasing organizational capability and effectiveness. Refiners that implement a comprehensive program with BCG that includes all these steps have consistently shown profit improvement in the range of \$1.50 to \$2.50 per barrel.

Optimization. Facing a future of slim margins, refineries will need to optimize their flexibility. Running a wide variety of crudes, eliminating bottlenecks, reducing quality giveaway, and maximizing yields of the highest-valued products will be essential. Companies with multiple refineries in the same region should use horizontal integration in order to increase profitability and reduce capital spending.

Reducing Energy Consumption. In order to minimize energy costs and maximize CO₂ credits, refineries should use efficient cogeneration for steam and power, continuous tuning of process heaters, hot bypasses on streams between process units, and process-heat-recovery optimization.

Balancing Maintenance Costs with Reliability. Excess capacity and low margins outside the growth areas will require balancing maintenance costs with the cost of reliability. This will require the use of reliability concepts in order to minimize routine maintenance as well as superior planning and execution of turnarounds to create a cost structure that will generate consistent profitability during this low-margin period. The refining industry has made great strides in the past decade on these issues, but another tranche of sustained improvement will be needed.

Reducing Costs, Increasing Effectiveness. Although refining is one of the most capital-intensive industries in the world, companies will need to find ways to do

more with less. BCG estimates that most refineries need to trim their cost structures by more than 10 percent, which will be challenging given increasing environmental regulation and growing concerns about process safety. Redesigning core processes and automation—and concentrating on the work that drives performance—will be essential.

Reducing costs will require organizations to focus on capabilities and effectiveness. This will mean driving accountability deep into an organization and motivating employees to act as owners. BCG's experience in implementing operational excellence programs in refining organizations has shown that these behavioral changes are not easy and will require training, clarity about responsibilities, and incentives, rewards, and recognition. Recruiting, training, and retaining top talent will also improve organizational capability. In addition, refining companies will have to establish a culture that promotes continuous improvement and embraces best practices from within and outside the industry.

IN THE NONGROWTH oil-refining regions, superior execution will be required in order to maximize returns. The industry will have to focus much more on all of the elements of profitable operation for an extended period of time. In the growth areas, companies must actively manage major capital projects—to ensure that they are delivered on time and within budget targets—and focus on cost structures and superior execution.

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