UNDERSTANDING
CRUDE OIL and PRODUCT MARKETS

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PREVIEW

Overview

The Changing Landscape of North American Oil Markets

After decades of decline, crude oil production in the United States has recently been increasing rapidly[1]. *Horizontal drilling* and multi-stage *hydraulic fracturing* are now utilized to access oil and natural gas resources from shale rock formations that were previously either technically impossible or uneconomic to produce. Production from the oil sands in Western Canada has also risen significantly. In aggregate, production in North America has grown from 7.5 million *barrels* per day in 2008 to 11.0 million barrels per day in 2013, an increase of over 45% in a five year period (see **Figure 1**).

These new supplies, which are available to meet U.S. domestic petroleum product demand, have substantially reduced U.S. dependence upon crude oil imports from overseas. Continued efficient development of domestic resources promises even greater improvement in the domestic supply-demand balance.

The beneficial growth in North American crude production has not come without growing pains. Much of the new production in the U.S. is not located where it can be handled by the current pipeline network, and the growth in Canadian production has simply overwhelmed existing pipeline capacity. As a result, some oil pipelines in the U.S.

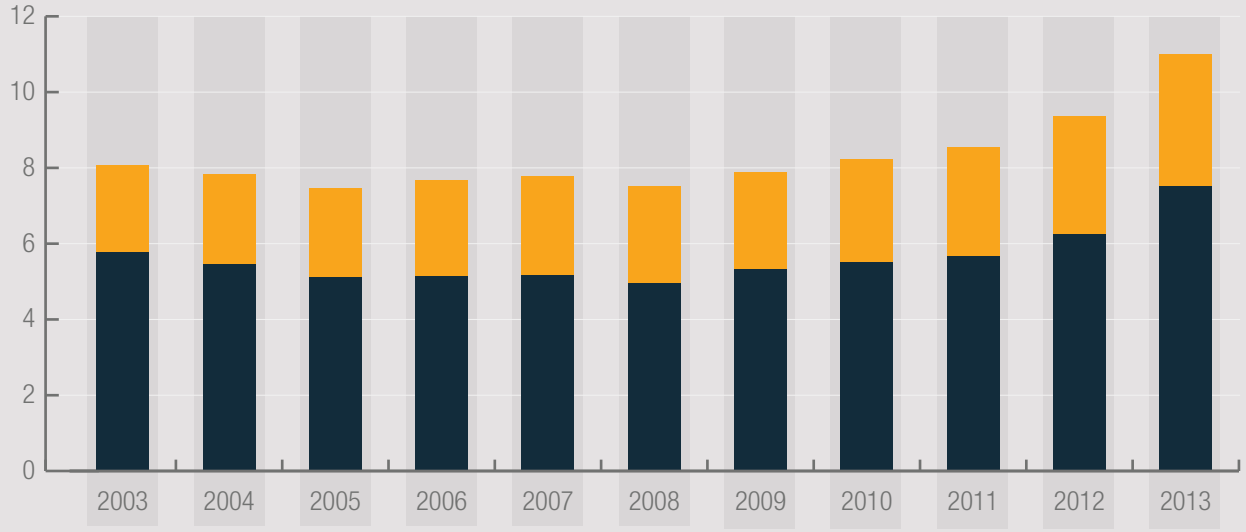
U.S. and Canadian Oil Production
(million barrels per day)

46% GROWTH

Source: U.S. Energy Information Administration (EIA) and Canadian National Energy Board (NEB)

1

TOTAL U.S. AND CANADIAN CRUDE OIL PRODUCTION, 2003–2013 (million barrels per day)



Source: EIA and NEB.
Notes: Historical U.S. data is the average of U.S. Weekly Supply Estimates. Canadian crude oil figures are annual averages.
2013 U.S. production data is from the crude oil production numbers in the EIA Short Term Energy Outlook, January 2014.
2013 Canadian production is from the NEB estimated production for 2013.

have reversed flow and/or expanded to accommodate the production growth and allow additional flows of oil. Several new pipelines are also being proposed in the U.S. to allow increasing oil production to reach refining centers and in Canada to move new supplies to export markets. Increasing volumes of oil are being transported by rail or barge in response to the slow development of new oil pipeline capacity.

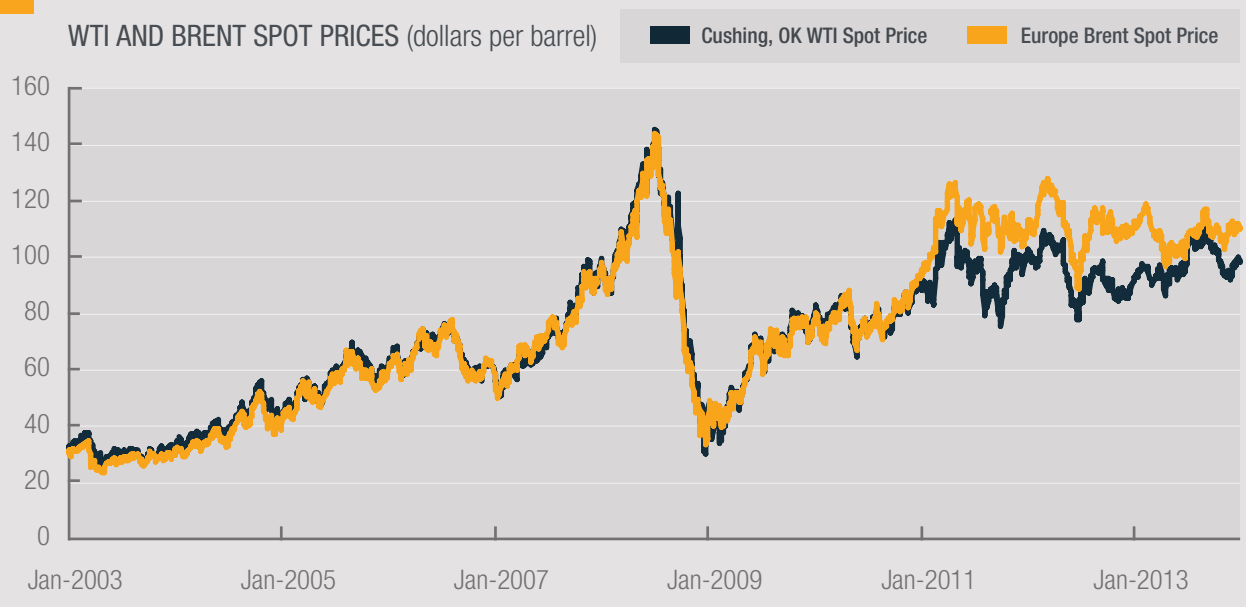
Another problem is that U.S. production is not of the type that many domestic refineries are designed to process efficiently. This mismatch necessitates movement of crude oil over longer distances to deliver it to refineries for which it is suited, potentially lifting U.S. restrictions on crude oil exports, or some combination of such measures. Thus, processing and transportation constraints have become significant issues confronting North American oil markets. Left unresolved, these constraints may limit North America's ability to take full advantage of its new crude oil resources.

While the domestic crude oil supply situation has improved, domestic prices of petroleum products remain linked to supply and demand conditions in the global market for crude. The large swings consumers have seen over the last decade in the prices of gasoline, heating oil, and other petroleum products were driven by large movements in prices established in international crude oil markets.

From 2003 through 2007 crude oil prices more than doubled from their historical level due to strong demand increases from China and India. Then in 2008, prices doubled again before falling precipitously along with worldwide economic activity. Since then, crude oil prices have climbed steadily to about three times where they started in 2003, as seen in **Figure 2**, which plots spot prices for U.S. and European *benchmark* crudes, respectively West Texas Intermediate (WTI) and Brent.

2

WTI AND BRENT SPOT PRICES (dollars per barrel)



Source: EIA

Facts about World Oil Markets

There are periods of time when the price of crude oil is relatively stable and other periods when the price can become volatile, changing quickly and by a significant amount. What are the main determinants of the price of crude oil, and what impact has it had on the prices consumers pay for petroleum products?

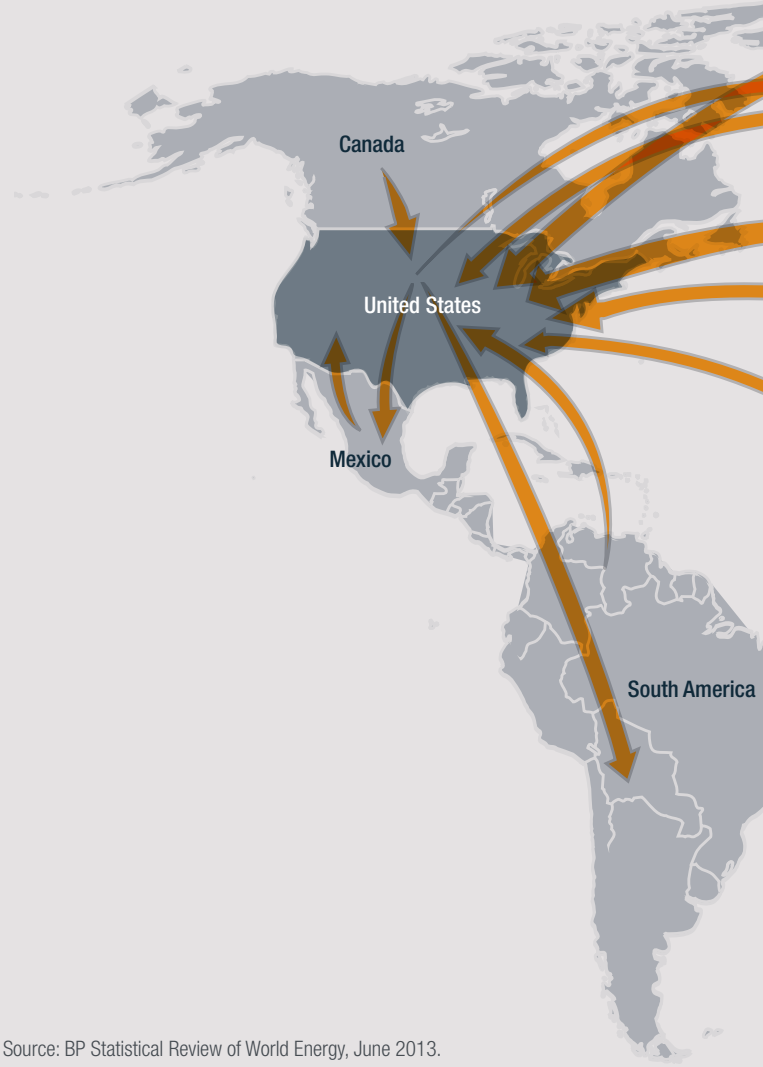
Let's start with a few basic facts.

- First, crude oil and petroleum products are global commodities and, as such, their prices are determined by supply and demand factors on a worldwide basis. They are shipped from many sources to many markets (see **Figure 3**).
- Second, the price of crude oil is the most significant factor determining the prices of petroleum products. Consequently, the price of gasoline is largely determined by the worldwide demand for and supply of crude oil.
- Third, prices reflect the interactions of many buyers and sellers, each with their own view of the demand for and supply of crude oil and petroleum products. These interactions occur both in the physical and futures markets, with the attendant prices responding quickly to both current and expected future changes in supply and demand conditions.

What has happened to cause prices to vary so much?

The answer:

Fundamental changes in actual and perceived supply and demand conditions.



- Rapid growth in demand in countries like China and India more than offset declines elsewhere, and by 2006 had all but eliminated *spare crude production capacity*. Continued growth in these regions since 2010 has also affected prices more recently.
- Conflict in the Middle East and Africa caused reductions in supply and uncertainty about future production.
- Severe worldwide recession in 2008-2009 dramatically reduced economic activity and demand for crude oil and petroleum products, thus lowering their prices until economies began

Source: BP Statistical Review of World Energy, June 2013.

to recover. Increasing crude oil prices after 2009 were also the result of production cuts by the *Organization of Petroleum Exporting Countries (OPEC)* in response to the recession and reduced demand.

- Increased crude production in the U.S. and Canada and infrastructure constraints that limit its efficient use continue to suppress prices for U.S. benchmark West Texas Intermediate crude oil relative to world oil prices (see **Figure 2**).

MAJOR FLOWS OF CRUDE OIL AND PETROLEUM PRODUCTS 3

Structure of the Crude Oil Market

Oil is the world economy's most important source of energy and is therefore critical to economic growth. Its value is driven by demand for refined petroleum products, particularly in the transportation sector.

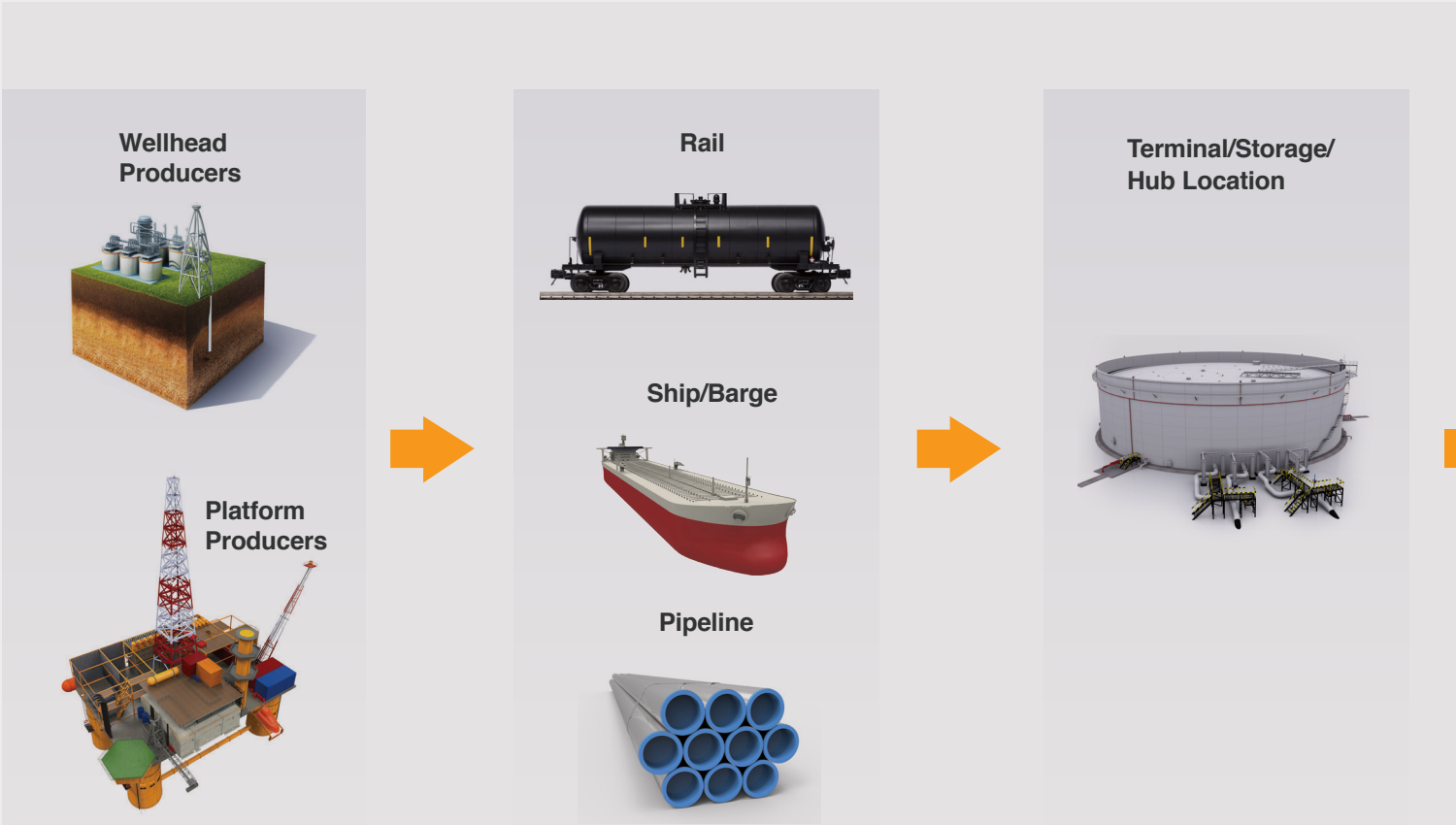
Petroleum products power virtually all motor vehicles, aircraft, marine vessels, and trains around the globe. In total, products derived from oil, such as motor gasoline, jet fuel, diesel fuel, and heating oil, supply 33% of all the energy consumed by households, businesses, and manufacturers worldwide[2]. By way of comparison, natural gas and coal supply 22% and 28%, respectively, of the world's energy needs[3].

The principal activities, as illustrated in **Figure 4**, involved in moving crude oil from its source to the ultimate consumer are:

- Production, which involves finding, extracting, and transporting crude oil;
- Refining, the process by which crude oil is turned into products such as gasoline; and
- Distribution and marketing, which focus on moving those products to final consumers.

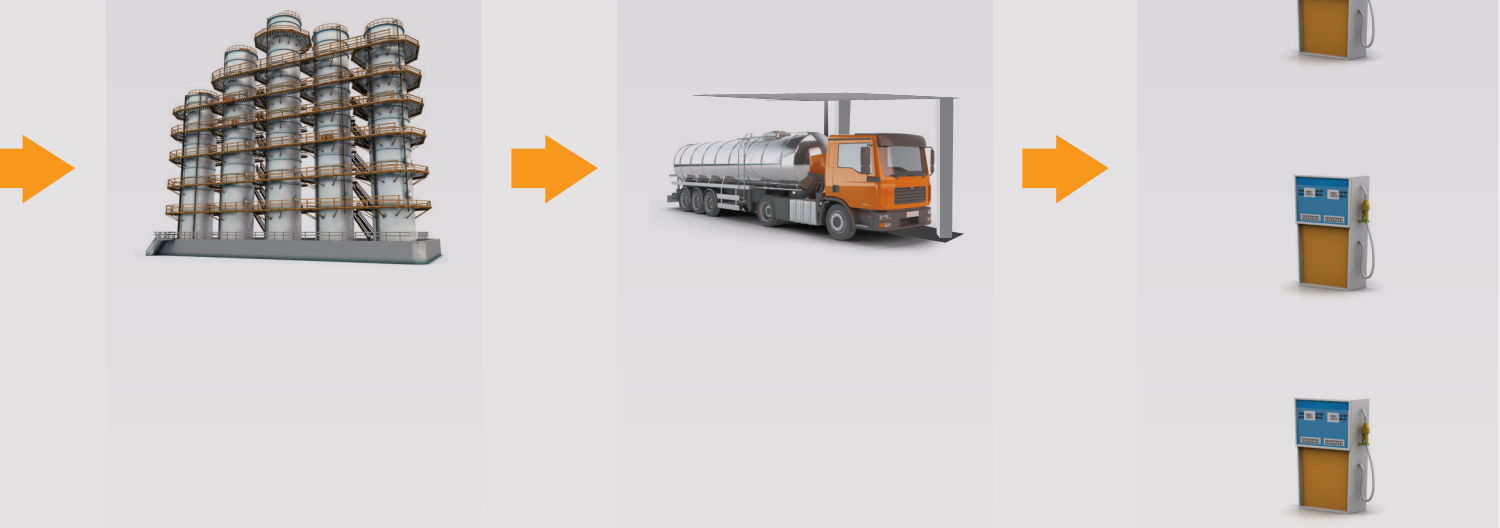
These activities occur within a global marketplace—an extensive physical infrastructure that connects buyers and sellers worldwide, all supported by an international financial market. The physical infrastructure encompasses a vast array of capital, including drilling rigs, pipelines, ports, tankers, barges, trucks, crude oil storage facilities, refineries, product terminals—right down to retail storage tanks and gasoline pumps.

The physical infrastructure links an international network of thousands of producers, refiners, marketers, brokers, traders, and consumers buying and selling physical volumes of crude oil and



petroleum products throughout this chain of production.
The international market responds to shifts in crude oil production and consumer demand in differing geographic areas. Activities in the physical markets are supported by futures and other financial contracts that allow buyers and sellers to efficiently insure themselves against significant price and other business risks, thereby minimizing the impact of price volatility on their operations. In sum, the global oil market comprises thousands of participants who help facilitate the movement of oil from where it is produced, to where it is refined into products, and from there to where those products are ultimately sold to consumers.

The following sections discuss the role of each of these different activities, focusing on how they have both affected and been affected by recent changes in oil and petroleum product supply and prices. This includes the physical segments of the industry (i.e., production, refining, and distribution) as well as the financial sector, where the knowledge and expectations of thousands of buyers and sellers interact and where prices for current and future deliveries of oil are ultimately formed.



Crude Oil Supply

Growing Oil Production in North America

Since 2008, U.S. oil production has grown by over 50%. The recent increases in U.S. oil production have largely come from *unconventional* shale and *tight oil* resources, which have become more accessible and economic due to advancements in horizontal drilling and hydraulic fracturing techniques. **Figure 5** shows the substantial growth in U.S. shale and tight oil production, from less than 0.4 million barrels per day in 2007 to more than 3.2 million barrels per day recently. The largest shale and tight oil production is from the Eagle Ford (Texas), Bakken (Montana and North Dakota) and Permian (West Texas) shale formations.

U.S. Oil Production
(million barrels per day)

>50% GROWTH

Source: EIA

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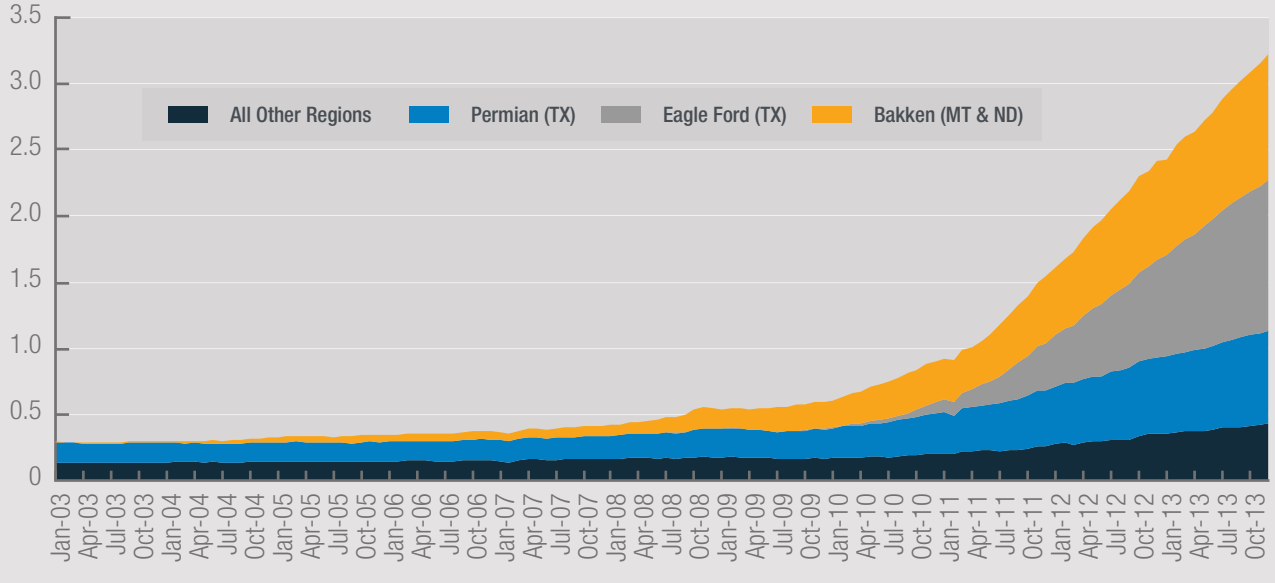
SHALE AND TIGHT OIL PRODUCTION (million barrels per day)



Source: EIA

Canadian oil production has also increased substantially in the past few years. **Figure 6** shows the substantial growth in Canadian oil production, from 2.9 million barrels per day in 2007 to nearly 3.7 million barrels per day in 2013. The majority of the increase has been heavy oil production from the oil sands in Alberta, in which *bitumen* is extracted through surface mining or *in situ processes*.

Growing production in North America has resulted in declining imports of oil from overseas sources. U.S. net imports of crude oil declined from 10.0 million barrels per day in 2007 to fewer than 8.0 million barrels per day recently (see **Figure 7**). The largest declines have been in imports from OPEC countries, but there have also been declines in imports from non-OPEC countries. Production in the U.S. and Canada is forecast to continue to increase in the coming years[4] leading to expectations of a continued decline in U.S. imports of crude oil, to less than 6 million barrels per day in the latter half of the decade.

CANADIAN OIL SANDS

The oil sands located primarily in the western Canadian provinces of Alberta and Saskatchewan represent the vast majority of Canada's crude oil reserves. Extra heavy crude oil, termed bitumen, is produced from the oil sands using differing techniques such as surface mining or *in situ* techniques utilizing steam to heat deposits depending on their depth. The bitumen is highly viscous after initial production and requires dilution or blending with lighter *hydrocarbons* for transportation by pipeline. As discussed elsewhere in this report, refinery capacity in the U.S., particularly in the Gulf Coast area, is configured to process large quantities of heavy crude. Production from Canadian oil sands is expected to increase from 1.8 million barrels per day in 2012 to 3.2 million barrels per day in 2020, and then to 5.5 million barrels per day by 2030.

Source: Canadian Association of Petroleum Producers, Crude Oil Forecast, Markets & Transportation, June 2013.

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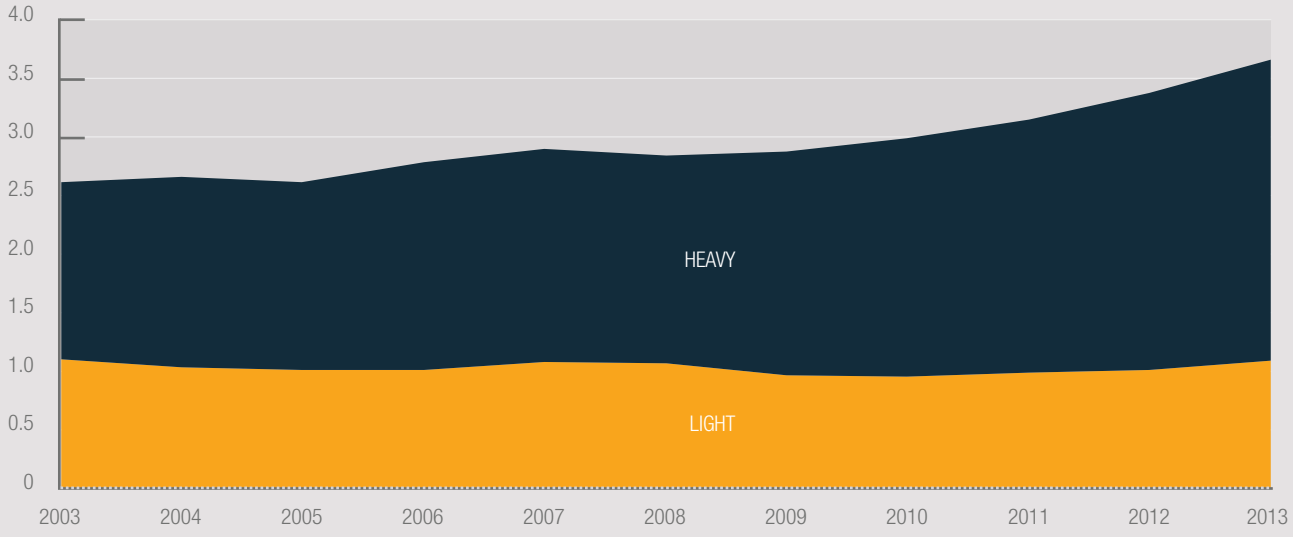
CANADIAN CRUDE OIL PRODUCTION BY TYPE (million barrels per day)



Source: NEB 2013 Crude Oil Production forecast. Heavy production includes crude oil production from In-Stu Bitumen and Mined Bitumen. Light production includes production of Condensates.

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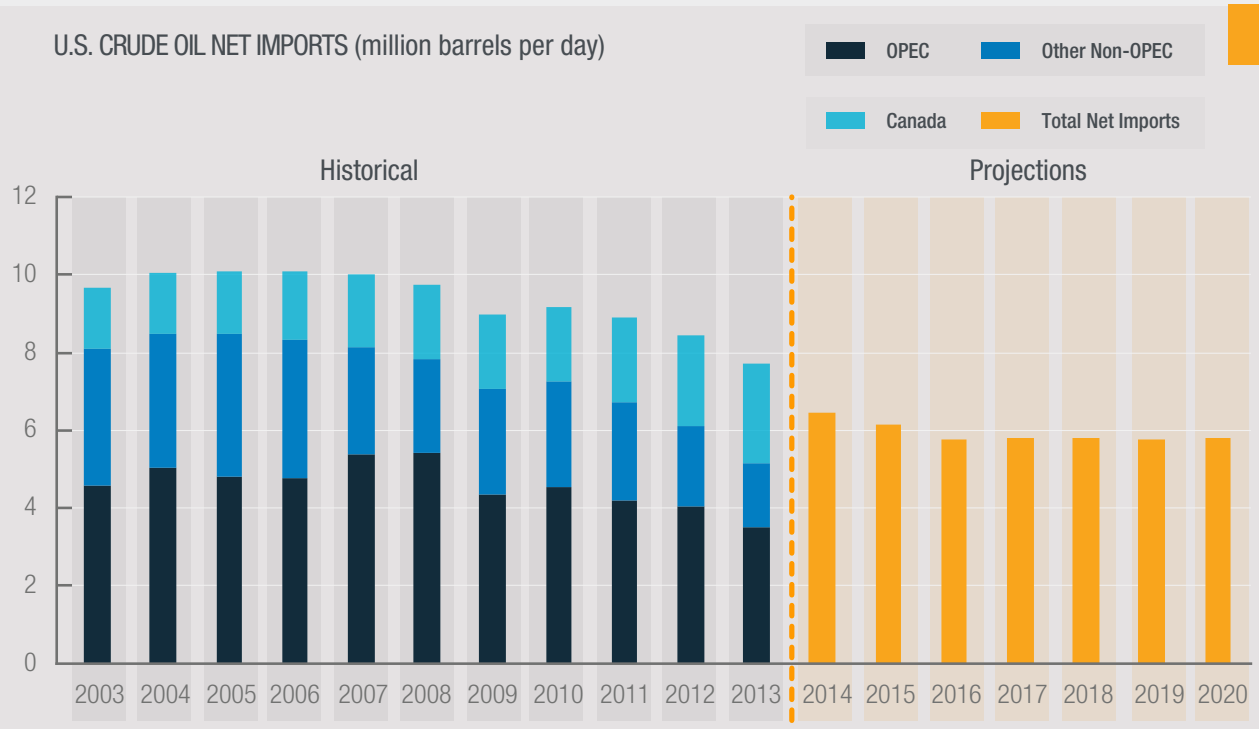
U.S. CRUDE OIL NET IMPORTS (million barrels per day)



Source: EIA. Historical data (2000-2013) taken from EIA database on U.S. Crude Oil Imports by Country. Forecast Data (2014-2020) from EIA Annual Energy Outlook 2014 Early Release.

THE TYPE OF CRUDE AFFECTS THE PRICE

Crude oils have various attributes that make them more or less attractive to refiners. West Texas Intermediate (WTI), the U.S. marker crude traded at Cushing Oklahoma, for example, is quite different than Western Canadian Select (WCS) produced and traded in Alberta.

Crude oil that is less viscous and flows more easily, is referred to as "light," while more viscous crudes that may require heating or *diluent* to flow are considered "heavy." In general, light crudes require less processing at a refinery to produce a more valuable mix of finished products such as gasoline, diesel, and jet fuel. Without more intensive processing (and associated investment in complex refining capacity) heavier crudes tend to produce proportionally higher quantities of less valuable products such as residual fuel oil and asphalt. Similarly, certain impurities in crudes make them much more difficult to process effectively into refined products that meet current standards. Sulfur is a common impurity in crude oil that must be removed from most transportation fuels to meet ever more stringent air quality requirements. Crudes with a low level of sulfur are designated "sweet," while those with a high level are called "sour."

Because of the need for much more complex processing, heavy, sour crude oil typically sells at a lower price than light, sweet crude. The economics of a refinery depend upon the mix of crudes processed (*crude slate*), the complexity of the refinery processing units, and the desired output mix of finished products such as gasoline, diesel, jet fuel, home heating oil, residual fuel, and asphalt (*product slate*). While a refinery can handle some variance in its crude slate, the combination of refining units installed limits the degree to which the properties of the slates can change and still efficiently be converted into a particular mix of finished products.

For example, numerous U.S. refineries have invested in complex refinery units to process slates consisting primarily of heavy, sour crudes efficiently into gasoline, diesel jet fuel and other high valued products. Adding light, sweet crudes to the input slates for such refineries increases their crude oil input costs, but does not necessarily provide a significant enough improvement in valuable product yields to be profitable.

Oil Transportation Infrastructure: A critical part of the supply chain

An important part of the supply chain is the system of pipelines, railways, barges, tankers, and trucks that deliver crude oil to refineries in North America. Oil pipelines are particularly important in that they deliver the vast majority of domestic crude oil supplies to U.S. refineries. However, oil pipeline development in North America has not kept pace with the substantial growth in crude oil production. The resulting bottlenecks prevent efficient transportation of oil from production areas to consuming markets. Pro-rationing (apportionment) has been necessary on some pipelines because shipper requests for transportation have exceeded the capacity of the pipelines. Thus, local production that should be reaching U.S. refineries to displace overseas imports is not doing so to the extent of its potential.

Bottlenecks on the oil pipeline system have also depressed crude oil prices in North America relative to prices in world markets. This can be seen in a comparison of prices for West Texas Intermediate (WTI), the U.S. benchmark crude to those of the European benchmark, Brent. The WTI price historically tracked the price of Brent, but in early 2011 WTI prices declined substantially relative to Brent as seen in **Figure 2**. **Figure 8** provides more detail on the price differentials that have recently developed between Brent and North American benchmarks due to production stranded by transportation constraints. Since late 2010 WTI prices have fallen from parity with Brent to a persistent discount in the $10 to $25 per barrel range (see **Figure 8**). Likewise, prices for light, sweet crude oil produced from the Bakken shale in North Dakota have declined relative to Brent as a result of takeaway pipeline capacity constraints. Indeed, Bakken crude has sometimes traded at lower prices than WTI. Very recently the prices for Louisiana Light Sweet (LLS) (a crude oil produced along the U.S. Gulf Coast) have also fallen below Brent prices, indicating that the Gulf Coast has become over-supplied with light crude oil relative to refinery demand. These price relationships are dynamic and will likely change as takeaway capacity and production changes.

The largest discounts relative to Brent shown in **Figure 8** are for Western Canadian Select (WCS), which is a heavy crude oil stream consisting of conventional crude oil and bitumen delivered to the Hardisty terminal in Alberta. The growth in the discounts for WCS from about $10 (which is to be expected due to its low *API gravity*) to $50 per barrel or more reflects constraints in oil pipeline capacity necessary to move it out of Alberta to refining centers. Pipeline development has simply not kept pace with production.

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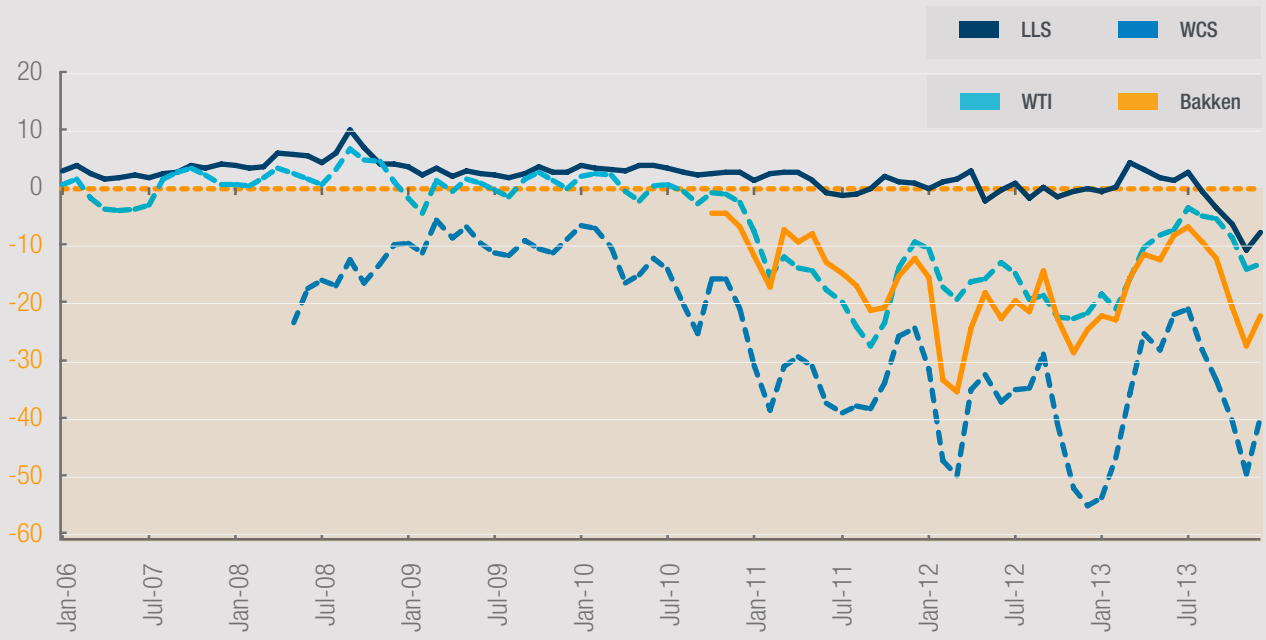
AVERAGE MONTHLY CRUDE OIL PRICE DIFFERENTIALS TO BRENT
(alternative less Brent) (dollars per barrel)

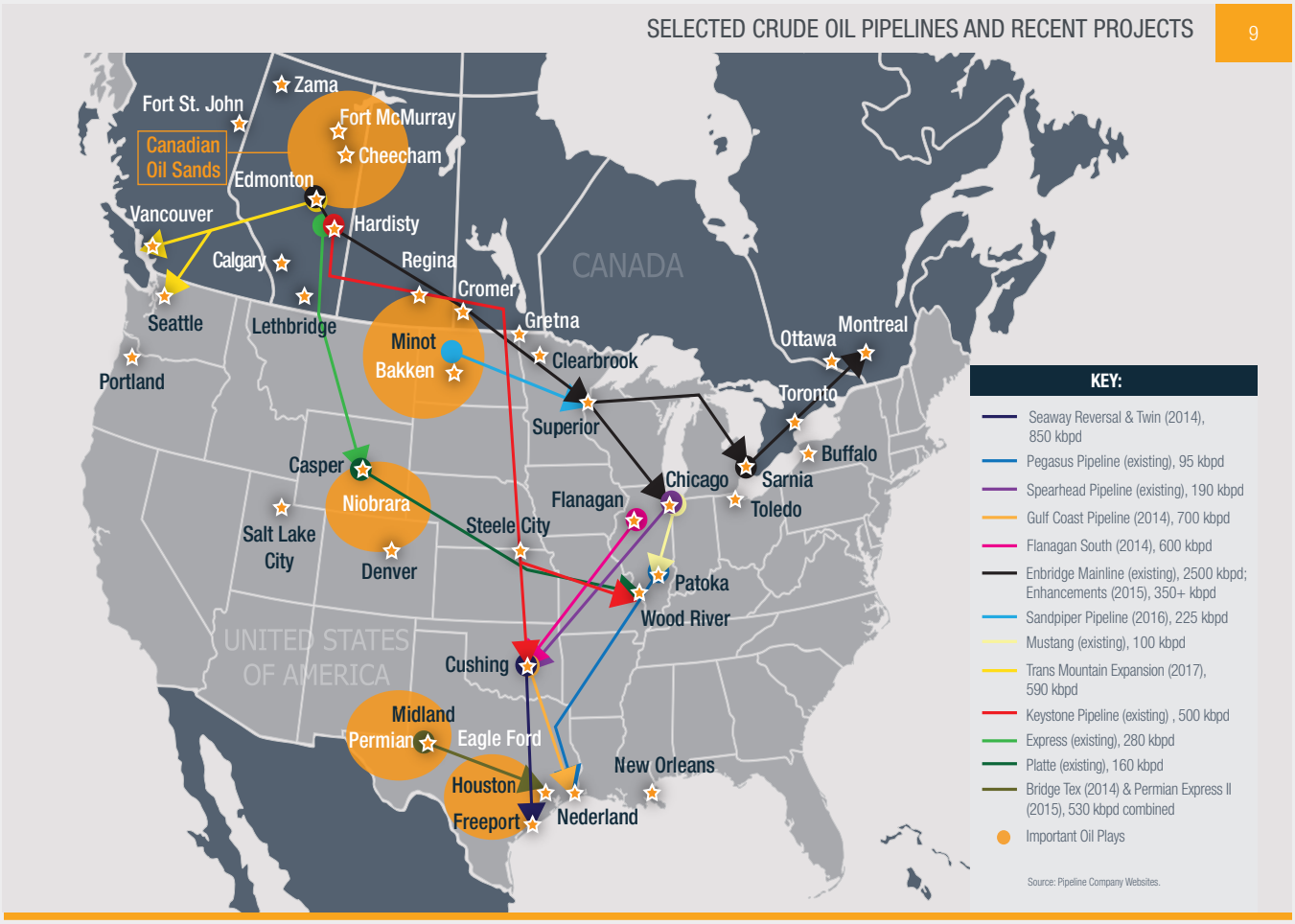


Source: EIA and Bloomberg.

The growth in North American oil production and the large locational price differentials are leading to infrastructure investments to transport these supplies to market. In the past few years, pipeline companies have built new pipelines and expanded or reconfigured existing pipelines to transport growing supplies in the Bakken, Eagle Ford, Permian, and Western Canadian supply areas to refining markets in the United States, and many additional pipeline projects are being proposed and developed to accommodate the supply growth.

While pipelines historically transported crude oil supplies from the Gulf Coast to northern locations (such as the Midwestern U.S.), some pipelines have recently reversed flow to transport the growing production from northern locations in the U.S. and Canada to the Gulf Coast. These reversals include the Seaway Pipeline (from Cushing, Oklahoma to Freeport Texas) and the Pegasus Pipeline (from Patoka, Illinois to Nederland, Texas). Earlier reversals included the Spearhead pipeline, which was reversed in 2006 to transport supplies from Chicago to Cushing. A new pipeline, the Gulf Coast Pipeline Project (from Cushing to Nederland, Texas), has recently come on line to further alleviate these constraints and another new pipeline, Flanagan South, is also being developed along the same corridor as Spearhead to transport supplies from Chicago to Cushing. **Figure 9** shows some of these pipelines that will allow additional crude oil supplies to flow to the Gulf Coast.

SELECTED CRUDE OIL PIPELINES AND RECENT PROJECTS 9



Growing oil sands production and low Canadian heavy oil prices have resulted in several proposals for new greenfield pipelines to transport these supplies out of Alberta, including Keystone XL, Energy East, and Northern Gateway. Keystone XL would transport additional Canadian supplies to the U.S., while Energy East would target eastern Canadian refineries and export markets and Northern Gateway would transport supplies to the west coast of British Columbia for export purposes. Existing pipelines are also proposing expansions, including Trans Mountain pipeline (to the west coast of British Columbia) and Alberta Clipper Pipeline (for export to the U.S.). **Figure 10** shows the relationship between projected Canadian oil production growth and takeaway oil pipeline capacity.

Rapidly growing production and the comparatively slow development of new pipeline capacity has led to an increasing amount of oil transported by barge, truck, and rail. Several rail terminals have been developed in North Dakota in the past few years, and by the end of 2013 roughly 700,000 barrels of Bakken crude oil were being shipped daily by rail to refineries in the Gulf Coast, East Coast, and West Coast[5]. Bakken supplies have also been barged down the Mississippi River to Gulf Coast refineries. Eagle Ford supplies are being shipped by tanker and barge to refineries in the Gulf Coast and East Coast, with the port of Corpus Christi being one of the key locations where Eagle Ford supplies are loaded onto tankers and barges.

As shown in **Figure 11**, U.S. refineries are obtaining nearly 6% of their crude oil inputs from domestic supplies via barge, truck, and rail (up from only 2% a few years ago). While the use of these alternative modes of oil transportation is increasing, refineries still obtain most (over 90%) of their crude oil supplies from pipelines and ocean-going tankers.

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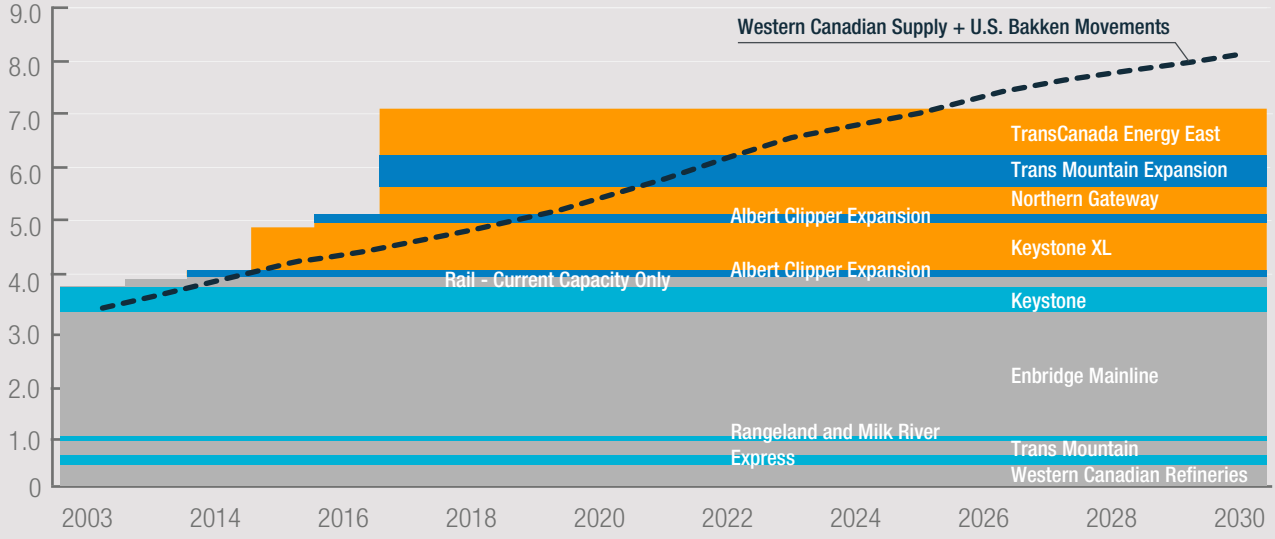
WCSB TAKEAWAY CAPACITY VS SUPPLY FORECAST (million barrels per day)



Source: "Crude Oil: Forecast, Markets and Transportation," Canadian Association of Petroleum Producers, June 2013.

Crude Oil Demand:
The U.S. Refining Sector

Crude oil supplies are delivered to refineries throughout the United States. About 50% of U.S. refining capacity is located in the Gulf Coast, and another 21% is located in the Midwest[6]. Refineries process crude oil into petroleum products such as gasoline, diesel, heating oil, jet fuel, and other products. Refining a barrel of crude oil involves a series of complex processes.

The first stage for all refineries focuses on the initial distillation in which the barrel of crude oil is heated and separated into its component parts. Subsequent processes, often referred to as "conversion," focus on transforming lower-valued products, such as bunker fuel suited for ships, into higher-valued products, such as gasoline for automobiles. Conversion processes include the removal of sulfur and other impurities, as well as various chemical transformations performed under specific temperature and pressure conditions. It is the nature and scale of these conversion processes that distinguish one refinery from another. Because of local variations in crude availability and desired product output, refineries may be configured differently to optimize their conversion capabilities.

As discussed above, numerous U.S. refineries have complex units designed to process a higher percentage of heavy crudes and produce a larger quantity of gasoline relative to fuel oil or other lower-valued finished products.

U.S. refining capacity stands at approximately 17.8 million barrels per day. At the beginning of 2013, this capacity was spread across 57 refinery companies operating 139 refineries[7]. These companies include vertically integrated operations (i.e., companies involved in the production of crude oil), as well as independent refiners (i.e., those with little or no crude production capabilities).

The U.S. Refining Sector

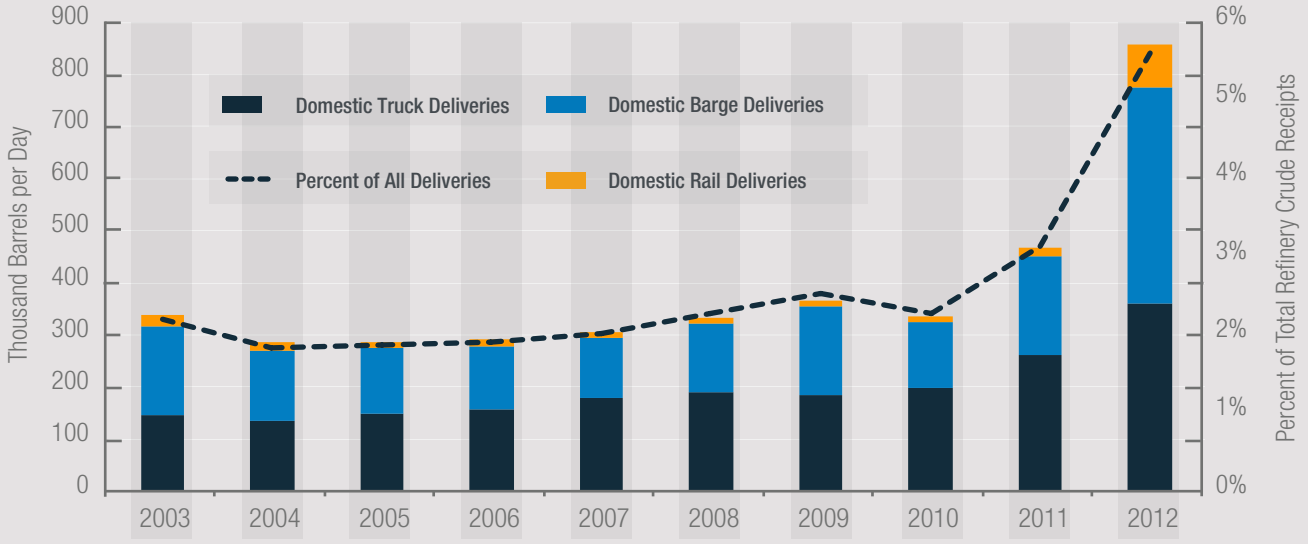
U.S. refining capacity stands at approximately

17.8
MILLION
barrels per day

Source: EIA

11

CRUDE OIL DELIVERIES TO U.S. REFINERIES BY TRUCK, BARGE, AND RAIL



Source: EIA.
The domestic rail, barge and truck deliveries are calculated as a percentage of the total for all foreign and domestic deliveries.

Operations, reflecting both the economics of the industry as well as each company's particular business strategy, range in scale from millions of barrels per day down to thousands of barrels per day. No refiner, however, owns more than 10.5% of total U.S. refining capacity[8]. In addition, the U.S. market has seen a decline in the ownership of refining capacity on the part of major U.S. oil companies. Today, more than 50% of refinery capacity is owned by companies without significant exploration and production activity.

One of the significant trends affecting U.S. refiners is the declining demand for refined petroleum products in U.S. markets. Consumption of refined products in the U.S. has fallen from 18.7 million barrels per day in 2005 to 16.4 million barrels per day recently, a decline of roughly 2.5 million barrels per day or 13% (see **Figure 12**). This decline in refined product demand in U.S. markets is due to various factors, including slow recovery from the 2008-2009 economic recession and reduced demand for gasoline due to more fuel efficient vehicles and renewable fuel standards (which require biofuels to be blended with gasoline).

U.S. Net Imports of Refined Products have fallen:

2005–2013

3.8

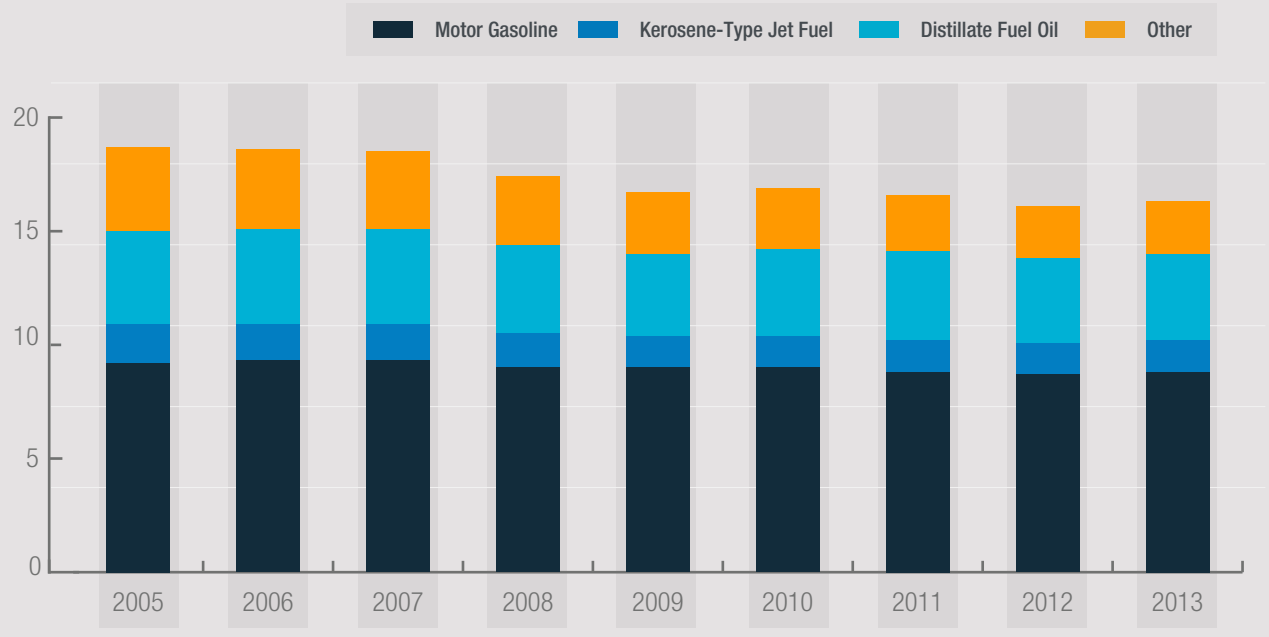
MILLION

barrels per day

Source: EIA.

12

U.S. FINISHED PETROLEUM PRODUCTS DEMAND (million barrels per day)



Source: EIA. Data for 2013 is the average of January through November.

Refined product demand has been strong in some regions outside the U.S., which has resulted in exports of refined products by U.S. refineries. Unlike crude oil, which is generally prohibited from being exported to overseas markets, refined products are allowed to be exported from the U.S. In 2011, the U.S. became a net exporter of petroleum products for the first time since 1949 (see **Figure 13**)[9]. While some regions of the U.S. (such as the East Coast) still rely on imports of refined products, in aggregate the U.S. is now exporting more refined products than it is importing, and these trends are expected to continue. Export destinations for U.S. refiners include Mexico, Central and South America, and Western Europe.

The majority of U.S. exports in recent periods have been *distillate fuel oil*, which has been in high demand in foreign markets (especially in Mexico and Central and South America) that do not have sufficient refining capacity to meet domestic distillate needs. Other U.S. exports tend to involve products for which there is little or no domestic demand. This would include by-products of the refining process that are consumed in limited quantities domestically, as well as products, such as gasoline that does not meet regional and/or national fuel specifications, for which the domestic market is constrained by environmental regulations.

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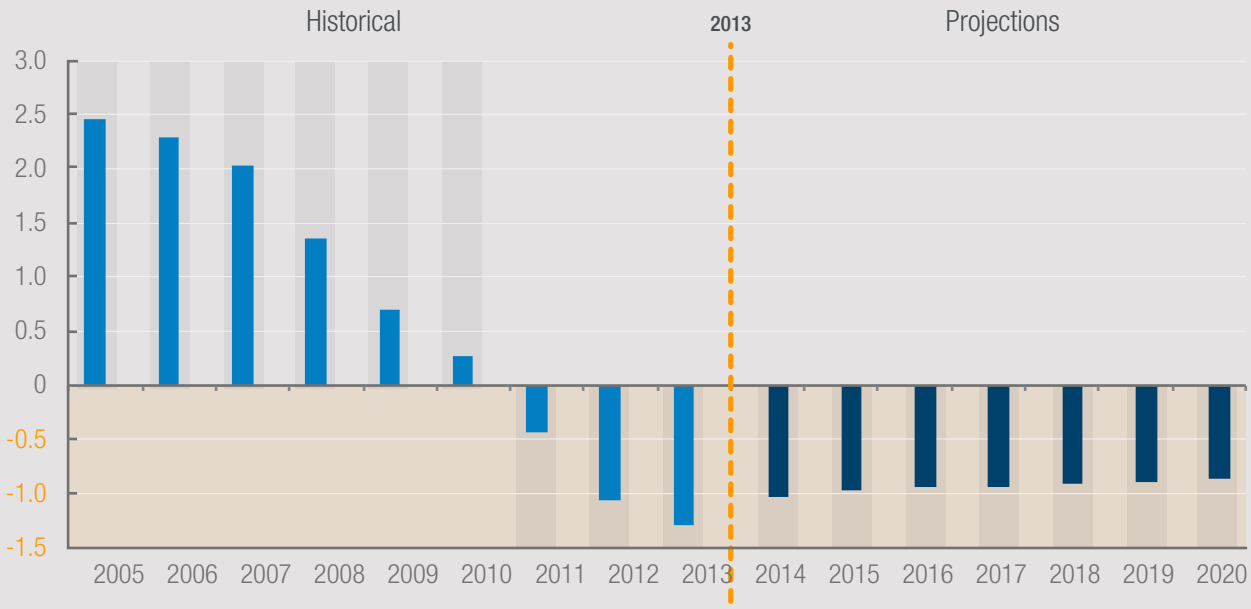
U.S. NET IMPORTS OF PETROLEUM PRODUCTS (million barrels per day)



Source: Historical values (2005-2013) from EIA Petroluem Supply data. Data for 2013 is the average from monthly data through November 2013. Projections (2014-2020) from EIA Annual Energy Outlook 2014 Early Release. Net imports are calculated using zero for exports of distillate fuel oil with sulfur contents of 0-15 ppm and greater than 2000 ppm.

How Has the Refining Sector Been Affected by Today's Crude Market?

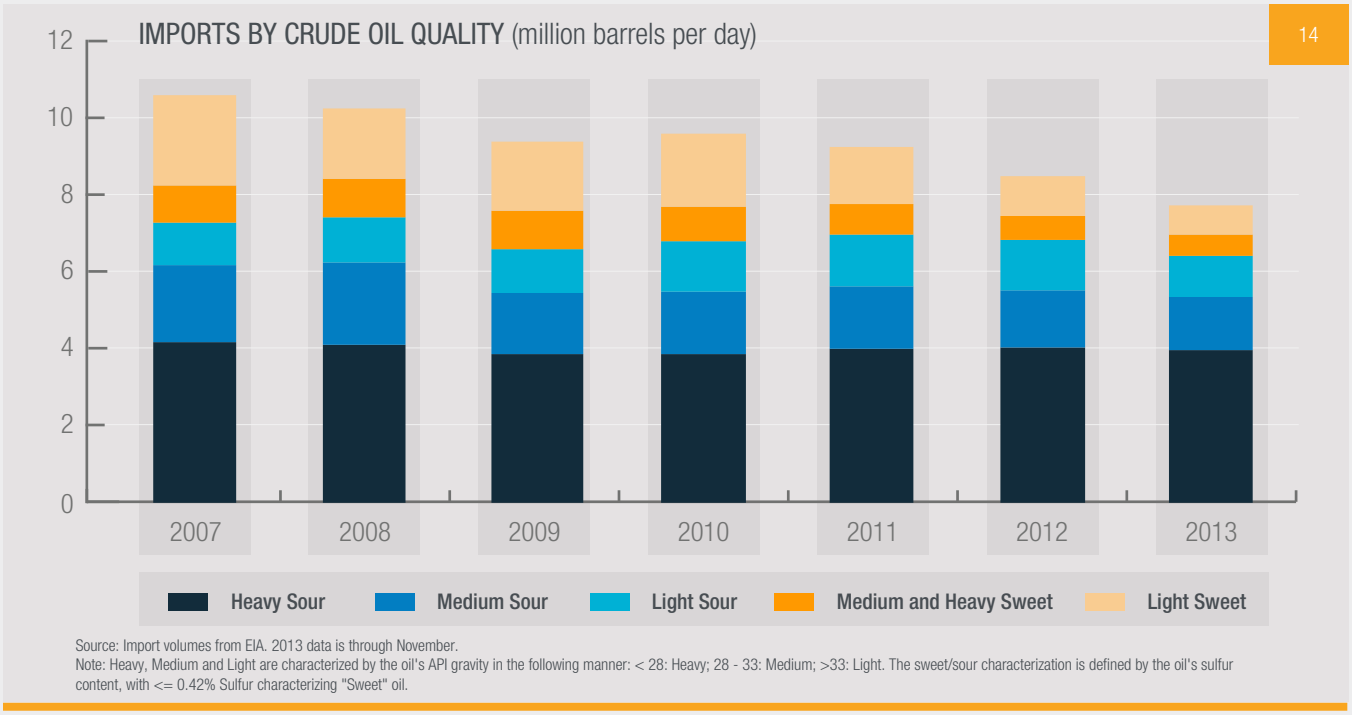
Refineries in the U.S. have been adjusting their *crude slates* to take advantage of the increasing, relatively low-priced supplies in the U.S. and Canada. The growing U.S. production of crude oil in the Bakken, Eagle Ford, and Permian basins is primarily light sweet crude oil. Many U.S. refineries are relying more heavily upon these domestic crudes, displacing imports of light sweet crude from overseas. Imports of light sweet crude have declined considerably as a result of the growing domestic supplies (see **Figure 14**).

Refineries on the east coast of the United States are among those seeking to take advantage of the relatively low-cost domestic oil supplies. Some refineries have started to access Bakken oil supplies via rail and barge, and others are planning to do so. Likewise, some east coast refineries are now accessing Eagle Ford oil supplies via barge and tanker. Not all refineries will make the switch to run the growing domestic supplies of light sweet crude oil. Many refineries in the U.S. (particularly in the Midwest, mid-continent, and Gulf Coast) have invested in complex refining units designed to run lower-priced heavy crude oils, which are being produced in increasing volumes from the oil sands of Canada, as well as from Mexico and other places. For example, refineries in Illinois, Indiana, and Michigan have undertaken projects that have added an estimated 500,000 barrels per day of heavy crude refining capacity during 2011-2013.[10]

These refineries are now optimally designed to run crude slates consisting primarily of heavy sour crude oil supplies. Refineries that have invested in complex refinery capacity continue to run mostly imported heavy crude oil because any potential improvement in product realizations from running light sweet crude in these refineries is generally more than offset by the higher cost of the light crudes as compared to heavy crudes.

These shifts in the geographic sources for refinery crude oil inputs have had varying impacts on U.S. refineries. Refineries in the Midwest and mid-continent have benefited from the less expensive crude oil supplies that have resulted from growing production and infrastructure constraints. Refining margins have been relatively strong in these markets, as indicated by the *crack spreads* shown in (**Figure 15**) that measure the difference between wholesale prices for refined products and crude oil prices.

In the past few years, refining margins on the east coast of the U.S. have been under pressure, in part because the refiners lack access to low-cost domestic supplies. While some east coast refiners are now starting to access these low-cost supplies, their historic dependence on sweet crude oil imports that track the higher Brent oil prices has hurt their refining margins.[11] Three refineries in New Jersey, Pennsylvania, and Virginia have closed in the past few years as a result of their low refining margins and the small scale of their operations. Other factors leading to their closure and affecting east coast refineries more generally include the declining demand for refined products, competition from product imports from other

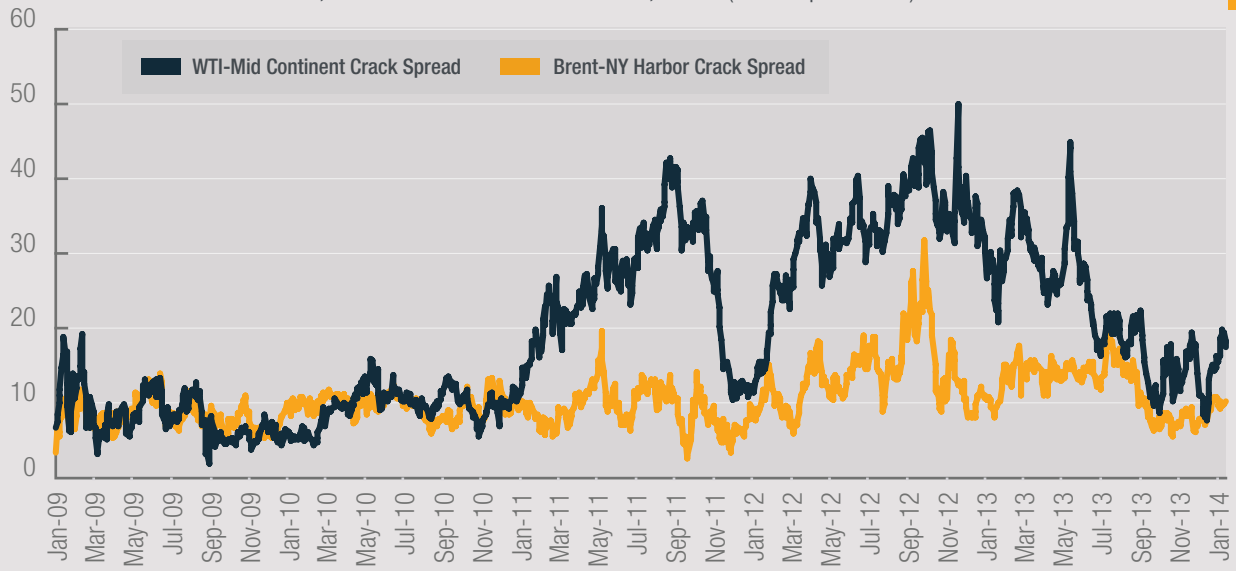


Source: Import volumes from EIA. 2013 data is through November.
Note: Heavy, Medium and Light are characterized by the oil's API gravity in the following manner: < 28: Heavy; 28 - 33: Medium; >33: Light. The sweet/sour characterization is defined by the oil's sulfur content, with <= 0.42% Sulfur characterizing "Sweet" oil.

regions, costly environmental regulations, and the limited capability of some refiners to increase their production of distillate (which has been more valuable in recent periods).[12] Some of these same difficult market conditions have resulted in low utilization rates for refineries on the east coast relative to other areas, as shown in **Figure 16**. Overall, utilization of U.S. refineries declined between 2005 and 2009 due to declining demand for refined products and increased refining capacity, but has increased in more recent periods, in part due to the closures of some refineries and the improving economy.

15

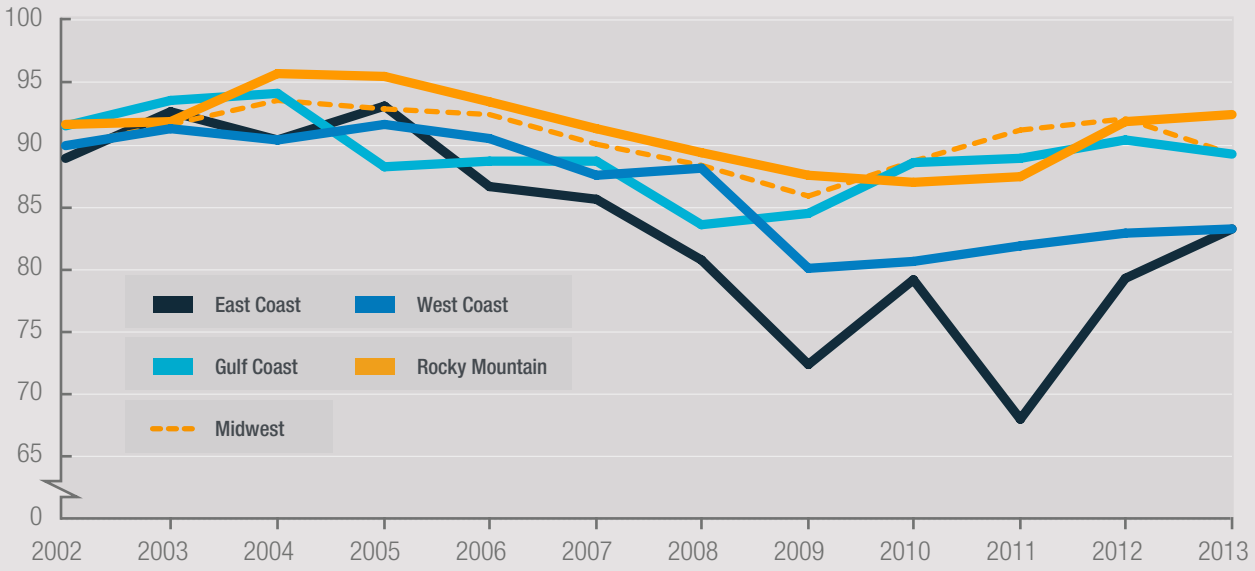
3–2–1 CRACK SPREADS, JANUARY 2009-JANUARY 15, 2014 (dollars per barrel)



Source: Bloomberg. Ratio indicates number of barrels of crude refined into barrels of gasoline and heating/gasoil.
Note that the Brent-NY Harbor Crack Spread uses Brent crude spot prices unadjusted for transportation costs from its North Sea trading hub, and thus is likely an overestimate as a proxy for East Coast refiner margins.

16

U.S. REGIONAL REFINERY UTILIZATION (%)



Source: EIA. Data for 2013 is the average of January through November.

The future profitability of the refining sector will depend on the future relationship between crude oil prices and refined product prices, as well as on various other factors (such as the cost of compliance with pending environmental regulations). While some refineries have benefited in the current environment of low prices of domestic supplies, there is much uncertainty as to whether North American oil supplies will retain their price advantage relative to world oil prices. As discussed earlier, there are proposals to build pipelines to both the east and west coasts of Canada. These pipelines, if built, would allow Canadian heavy oil supplies to be exported to overseas markets, and could result in higher prices for Canadian heavy crudes in Alberta. There are also proposals to build pipelines to the U.S., which could allow Canadian supplies to displace U.S. imports of heavy oil, and also put upward pressure on Canadian oil prices as takeaway pipeline capacity constraints are alleviated.

Likewise, the prices for domestic supplies—especially of light sweet crude oil—have their own uncertainties. While pipeline, rail, and barge infrastructure is being developed to allow these crudes to reach consuming markets, there is significant uncertainty regarding the degree to which this might increase domestic prices for light sweet crude oil. There is also uncertainty as to whether the U.S. may lift restrictions on U.S. crude oil exports, which some market participants have called for amid concerns that U.S. refineries cannot absorb much more of the increasing domestic production of light sweet crudes.

Refined Petroleum Product Markets

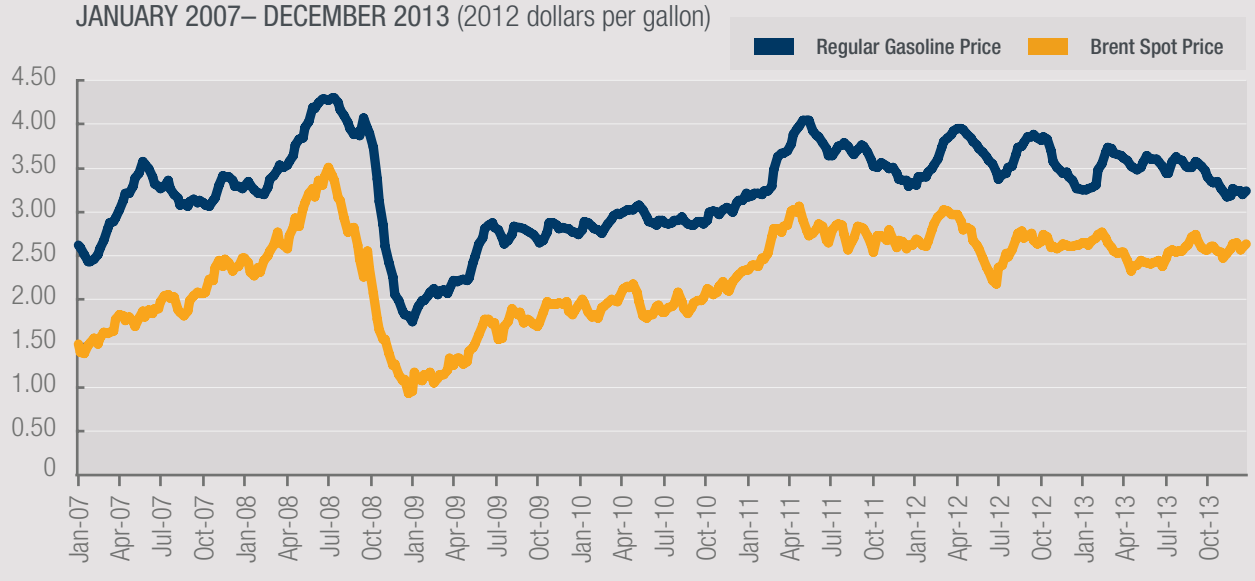
Conceptually, the market for refined petroleum products is very similar to the crude oil market in that there is widespread buying, selling, and trading of products in both the physical market (e.g., *spot market*) and the futures market. And just as with crude oil, there are significant international flows of refined products.[13, 14]

Like crude oil, petroleum products and futures are traded on organized exchanges, such as NYMEX and the Chicago Mercantile Exchange. Thus, the interactions of traders on organized exchanges establish transparent prices for petroleum products. Prices for petroleum product deliveries in particular areas are often set based on prices determined on an organized exchange, with adjustments for differences in location and the precise type of petroleum product being traded.

The price of crude oil is the most significant factor determining the price of gasoline because it represents the largest component of the underlying cost of producing and marketing gasoline. In 2013, crude oil accounted for 68% of the average retail price of gasoline, while taxes (12%), refining (11%), and distribution and marketing (9%) account for the rest.[15] **Figure 17** shows the relationship between the price of gasoline and the price of crude over the last 7 years, illustrating that the change in the price of gasoline is closely related to a change in the price of crude oil.

17

INFLATION-ADJUSTED PRICE COMPARISON OF RETAIL MOTOR GASOLINE PRICE AND BRENT SPOT PRICE
JANUARY 2007– DECEMBER 2013 (2012 dollars per gallon)



Source: EIA and Bureau of Labor Statistics (BLS).

The Price of Gasoline

Crude Oil	68%
Taxes	12%
Refining	11%
Distribution and Marketing	9%

Source: EIA.

Clearly, changes in crude oil prices have a significant effect on petroleum product prices and changes in expectations about future crude oil prices can lead to changes in both current and future prices of gasoline and other petroleum products through the building up or drawing down of inventory. However, prices for petroleum products can also change due to supply-and-demand factors unrelated to the crude market. Such factors would include, for example, an unexpected hurricane that interferes with refinery operations, colder-than-normal weather in the Northern Hemisphere, or environmental mandates and regulatory requirements. These events can cause the price paid for petroleum products to be delivered today or months from now to rise or fall independently of crude oil price changes.

As with the crude oil market, there exists a dynamic relationship between current prices and prices for petroleum products to be delivered in the future. A change in the futures price of gasoline or heating oil to be delivered some months in the future can lead to a similar change in the price paid for the same product to be delivered next month. That, in turn, can have implications for prices of products throughout the chain of distribution.

For example, futures price changes provide market participants with signals about whether they should be building up or drawing down inventories. When futures prices rise sufficiently above spot prices, this makes it economic to store gasoline and sell a *futures contract*. This reduces the supply available for immediate sale, thus raising spot prices. Similarly, when futures price fall below current spot prices, suppliers are motivated to sell products from inventories, placing downward pressure upon spot prices. Changes in the spot price motivated by futures price movements would typically lead to similar changes in wholesale or "rack" price paid for gasoline by retailers and, in turn, to the prices paid by motorists at the pump.

Distribution and Marketing

Distribution and marketing of petroleum products represent the third segment of the petroleum supply chain, after oil production and refining. They involve the movement of refined products—gasoline, diesel, heating oil, kerosene, and jet fuel—from the refinery to the end consumer (see **Figure 18**). The majority of finished products are transported from the refinery through pipelines to product terminals.[16] From the terminal, gasoline, diesel fuel and other petroleum products typically move to retail locations via tanker truck.

Petroleum products are bought and sold throughout the chain of distribution. Distribution and marketing, however, represent a relatively small share of the retail price paid by consumers. For example, over the last decade marketing and distribution have represented approximately 10% of the pump price of gasoline paid by the average motorist.[17]

Gasoline, which represents nearly 50% of the domestic production of all refined products, is the petroleum product most demanded by U.S. consumers.[18] There are about 162,000 retail gasoline outlets in the United States, selling a wide variety of formulations of gasoline designed to meet different air quality standards around the country. While the cost of crude oil is the largest single component of the retail price of gasoline, gasoline prices are ultimately established by the forces of supply and demand, with retail prices reflecting local, state, and federal taxes and the cost of the distribution of gasoline as it moves from the refinery to the ultimate consumer.

Of course, for any particular retailer, a number of factors go into determining the pump price, including location advantages (e.g., with respect to the flow of traffic or proximity to locations like shopping malls that attract large number of motorists), delivery costs, cost differences among stations (e.g. rent, insurance, wages), the commercial arrangements with the station's supplier, whether

GASOLINE DISTRIBUTION SYSTEM AND VALUATION FLOWS 18

CRUDE OIL

Spot Price CRUDE

Futures Price CRUDE

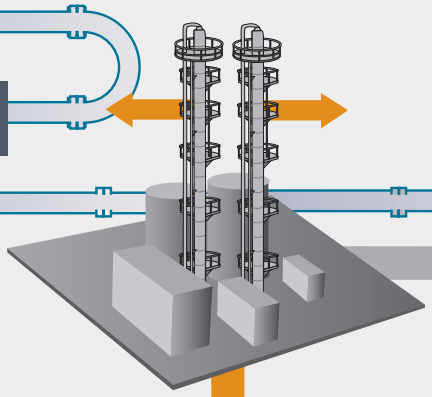
Refiner Acquisition COST OF CRUDE

REFINED PRODUCTS

Refineries

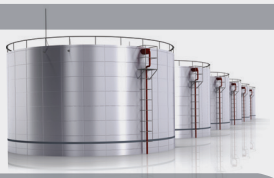
Spot Price GASOLINE

Futures Price GASOLINE



Hypermarket

Terminal Rack Price



Company Owned & Operated Outlets

Franchised Dealer Outlet Leased From Refiner

Franchised Dealer Outlet Dealer Owns Land

Franchised Dealer Outlet Dealer Leases from Third Party

Other Operated Outlets

Other Dealer Outlets

the station sells branded or unbranded gasoline, the size of the station, and taxes to name just a few.[19]

Competition in the retail sector is robust. The overwhelming trend has been the increasing efficiency with which gasoline is delivered to the consumer. The entry of hypermarketers, such as Wal-Mart® and Costco®, into the retail gasoline sector on a large scale reflects the level of competition within this segment of the industry. A retailer's pump prices must be competitive with those of other local retail stations to attract customers. That is, retail pricing behavior is limited by the fact that pump prices are transparent and readily known by motorists. Stations that set prices that are not competitive quickly lose business as motorists change their buying patterns.

Although over time a dealer's retail product prices must recover upstream costs in the distribution chain, this does not mean that at any given point in time retail prices will be based on what the dealer has paid for the gasoline currently in his storage tanks. Retail prices for petroleum products, particularly gasoline and diesel fuel, are a function of current and expected future supply and demand conditions, not historical costs.

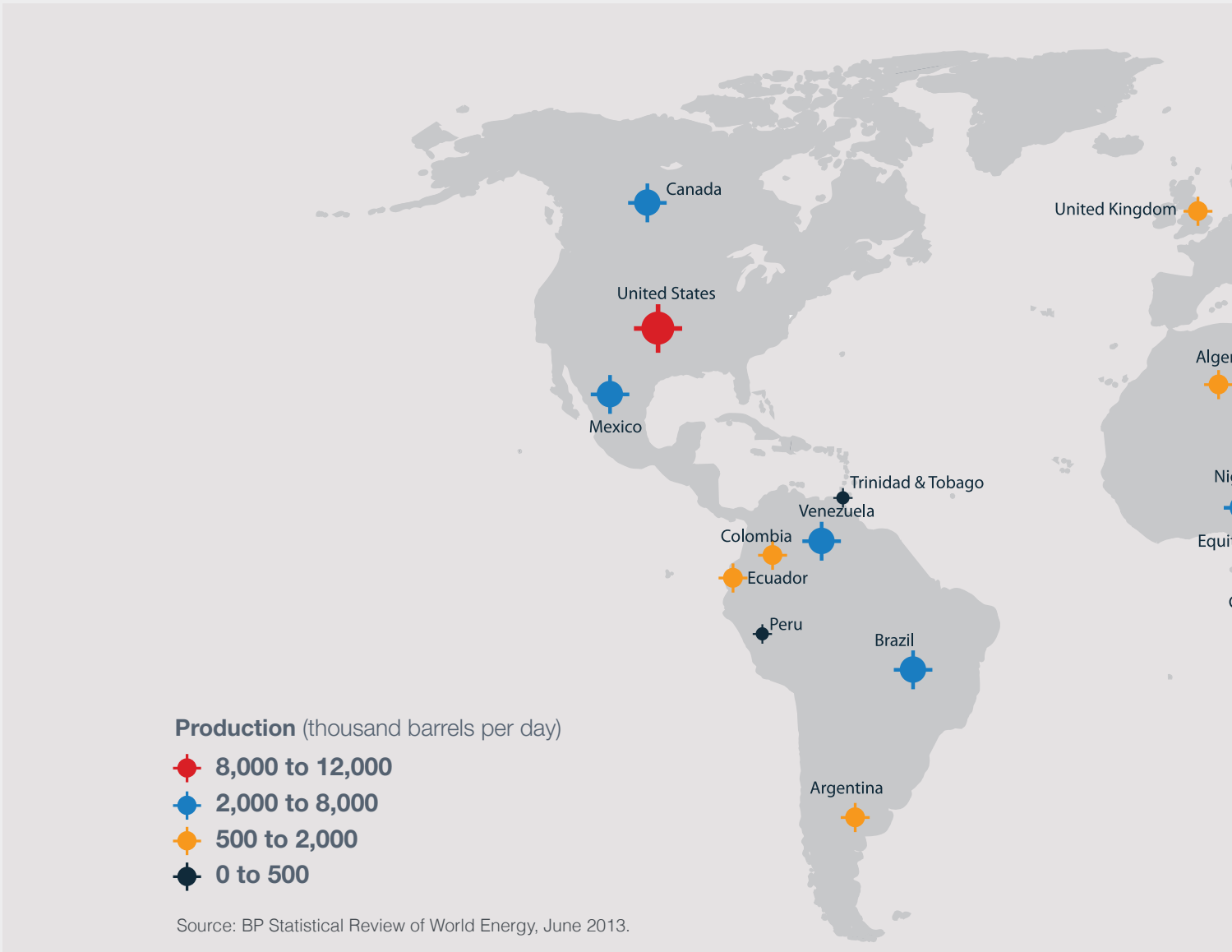
For example, if a retailer has relatively full tanks but other stations raise their prices due to increasing wholesale prices or strong consumer demand, the retailer will have an incentive to raise prices even before the retailer's own actual costs have increased, based on the expectation that the retailer's future replacement costs will be higher. The market is telling the retailer that the cost of gasoline has increased or will increase and, therefore, so will the retailer's cost of replacing existing inventory. (This is sometimes referred to as the retailer's opportunity cost: the retailer must replace whatever inventory is sold with higher-cost supply.) On the other hand, when wholesale prices are falling and other retailers are lowering their prices, the same retailer faces the following stark choice: either lower retail prices regardless of his supply costs (thus lowering margins on existing inventory) or accept lower sales.[20]

International Crude Oil Markets

As noted elsewhere, the U.S., as an importer of oil, is linked to the international crude oil market. The United States accounts for 21% of the world's total daily consumption of crude oil. In comparison, China's share of world consumption is currently 11%, up from 7% in 2003.[21] In total, the world consumes nearly 90 million barrels of oil per day.[22] This supply comes from oil fields (or reserves) located around the world (see **Figure 19**), produced by thousands of companies.

The largest sources of supply are in Saudi Arabia, Russia, the United States, China, Canada, and Iran. Within the United States, the largest areas of production are Texas, the Gulf of Mexico, North Dakota, California, and Alaska. Particularly noteworthy is the growing oil production from shale plays including the Eagle Ford shale (Texas), the Bakken Shale (North Dakota and Montana), and the Permian shale (West Texas).

OPEC, an international cartel of oil-producing countries, is the single most important production-related entity in the global crude oil market.[23] Its members produce about 40 % of the world's daily consumption of crude oil.[24] OPEC's objective has been to manage its members' collective supply through production quotas in order to prop up world oil prices. While OPEC has sought to limit supply to the marketplace, its policies have also recognized that it is not in the organization's interest for crude prices to rise above levels that would harm global economic growth.



Source: BP Statistical Review of World Energy, June 2013.

Despite its large share of reserves and global production, OPEC's ability to influence crude oil prices has varied over time, as evidenced by the precipitous decline in world prices for crude oil in the second half of 2008. The volatility in crude prices highlights the fact that supply and demand forces in the global oil market limit OPEC's effectiveness in influencing world prices.

In contrast to OPEC members, the major private oil companies compete individually in the world crude oil market. Despite being large industrial enterprises, they have relatively small shares of global oil reserves and production. These small shares ensure that private oil companies cannot individually cut output to influence world oil prices. **Figure 20** ranks the world's largest oil producing countries by their respective shares of the world's oil reserves.[25] OPEC members collectively represent 73% of world oil reserves and 43% of world oil production. Venezuela, Saudi Arabia, and Iran together represent 43% of world oil reserves and 21% of world oil production. In contrast, none of the U.S.-based multinational oil companies has more than 0.4% of the world's oil reserves or 2.3% of the world's oil production. These small percentages speak directly to the inability of the major oil companies to influence the world price of crude oil.

2012 Proved Oil Reserves (million barrels) and Production (million barrels per day).

20

Country/Region/Company	Reserves	% of Total	Production	% of Total
Venezuela	297,571	17.8%	2.7	3.2%
Saudi Arabia	265,850	15.9%	11.5	13.4%
Canada	173,888	10.4%	3.7	4.3%
Iran	157,000	9.4%	3.7	4.3%
Iraq	150,000	9.0%	3.1	3.6%
Kuwait	101,500	6.1%	3.1	3.6%
United Arab Emirates	97,800	5.9%	3.4	3.9%
Russian Federation	87,232	5.2%	10.6	12.4%
Libya	48,014	2.9%	1.5	1.8%
Nigeria	37,200	2.2%	2.4	2.8%
US	34,990	2.1%	8.9	10.3%
Kazakhstan	30,000	1.8%	1.7	2.0%
Qatar	23,900	1.4%	2.0	2.3%
China	17,335	1.0%	4.2	4.8%
Brazil	15,314	0.9%	2.1	2.5%
Angola	12,667	0.8%	1.8	2.1%
Algeria	12,200	0.7%	1.7	1.9%
Mexico	11,362	0.7%	2.9	3.4%
All Others	95,106	5.7%	15.0	17.4%
Total World	**1,668,929**	**100.0%**	**86.2**	**100.0%**
OPEC	1,211,942	72.6%	37.4	43.4%
Non-OPEC	456,987	27.4%	48.7	56.6%
OECD	238,268	14.3%	19.5	22.6%
Non-OECD	1,430,662	85.7%	66.7	77.4%
ExxonMobil Corp.	7,152	0.4%	2.0	2.3%
Chevron Corp.	6,481	0.4%	1.8	2.0%
ConocoPhillips	2,779	0.2%	0.6	0.7%

Sources and Notes: BP Statistical Review of World Energy, June 2013. ExxonMobil: see 2012 10K, pp. 5 and 8. Crude oil production also includes NGLs. Chevron: see 2012 10K, pp. FS-68 and 5. Crude oil reserves and production include condensate, synthetic oil and NGLs. ConocoPhillips: see 2012 10K, pp. 3 and 152.

Global Trading Pattern

Existing global trading patterns, as illustrated by **Figure 3**, reflect the result of international buyers and sellers responding to market forces and various legal and geopolitical constraints to get each type of crude oil from where it is produced to where it is most valued, accounting for the cost of transportation. That is, trade flows at any point in time are largely a result of the relative advantages in transportation costs and buyers' preferences for different qualities of crude oils.

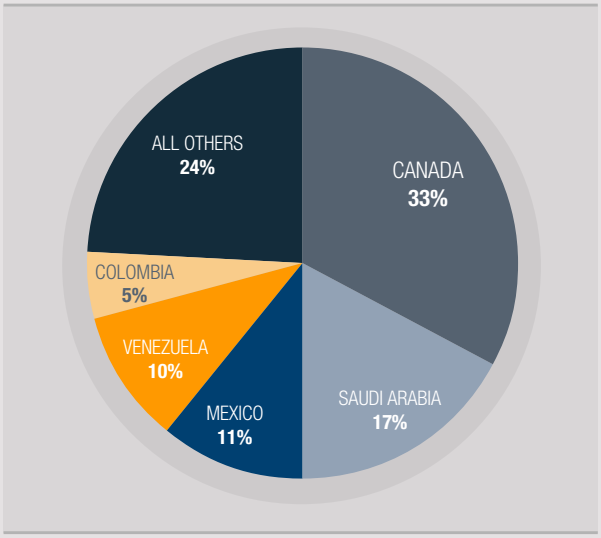
However, because buyers and sellers can and do substitute one type of oil for another (e.g., Mexican Mayan Heavy for Venezuelan Bachaquero Heavy), on the global scale, specific trading patterns are not crucial to evaluating supply and demand or pricing. For example, if the supply of crude oil from a source were cut off—regardless of whether that oil flowed to the United States—competition from buyers for the world's remaining supplies would drive up all oil prices.

Alternatively, if an individual country decided to cut off shipments of oil to the United States but maintained its production, there would be relatively little long-term impact on price. (This is, of course, holding aside any price changes due to an increase in geopolitical risk or smaller influences, such as shifting transportation and refining patterns.) Those supplies previously flowing to the United States would find new buyers who, in turn, would release their existing purchases to the market. U.S. buyers would then seek those newly released supplies. In sum, what affects prices in the long term is the global supply and demand for crude oil; global trade flows are significantly less important. However, in contrast to global trading patterns, shifting production coupled with transportation constraints can have a significant impact on local pricing, causing local prices for crude to be significantly lower than global prices, which do not reflect constraints on getting crude oil production to refineries or market centers.

In order to meet the nation's demand for petroleum products, U.S. refiners must import about 7.7 million barrels of crude oil per day,[26] representing about half of their crude oil refinery inputs. These imports come from many countries, including Canada, Saudi Arabia, Mexico, Venezuela, and Colombia, which in 2013 represented the top five sources of foreign supply as shown in **Figure 21**.[27] The growth in U.S. oil production has resulted in a decline of nearly 23% in U.S. oil imports since 2007.[28] However, the U.S. still imports significant quantities of oil and continues to depend upon world oil markets to a significant degree.

21

2013 U.S. CRUDE OIL IMPORTS BY COUNTRY



Source: EIA. Reflects average imports for January through November 2013.

The Growth in U.S. Oil Production has resulted in a decline of nearly

23% IN U.S. OIL IMPORTS SINCE 2007

Source: U.S. Energy Information Administration, U.S. Petroleum Supply Monthly, January 2014.

Factors Contributing to High and Volatile World Oil Prices

Between 2000 and 2008, the price of crude oil increased as worldwide demand increased in response to global economic growth—and supply did not fully keep pace. In this period, consumption growth was particularly strong in Asia Pacific and Middle East markets, which resulted in a tightening world market for oil and increasing prices until 2008.[29]

In 2008, the financial crisis and widespread economic recession reduced annual worldwide oil consumption for the first time since 1993.[30] The decline in oil consumption in 2008-2009 was particularly severe in North America, and more than offset the consumption growth experienced in some other regions (see **Figure 22**). The decline in consumption occurred as OPEC production was growing, which resulted in a price collapse in the second half of 2008.

In 2009, oil demand remained weak because of the recession but prices rebounded as OPEC made substantial production cuts in 2009 that were not fully reversed until 2012 (see **Figure 23**).[31]

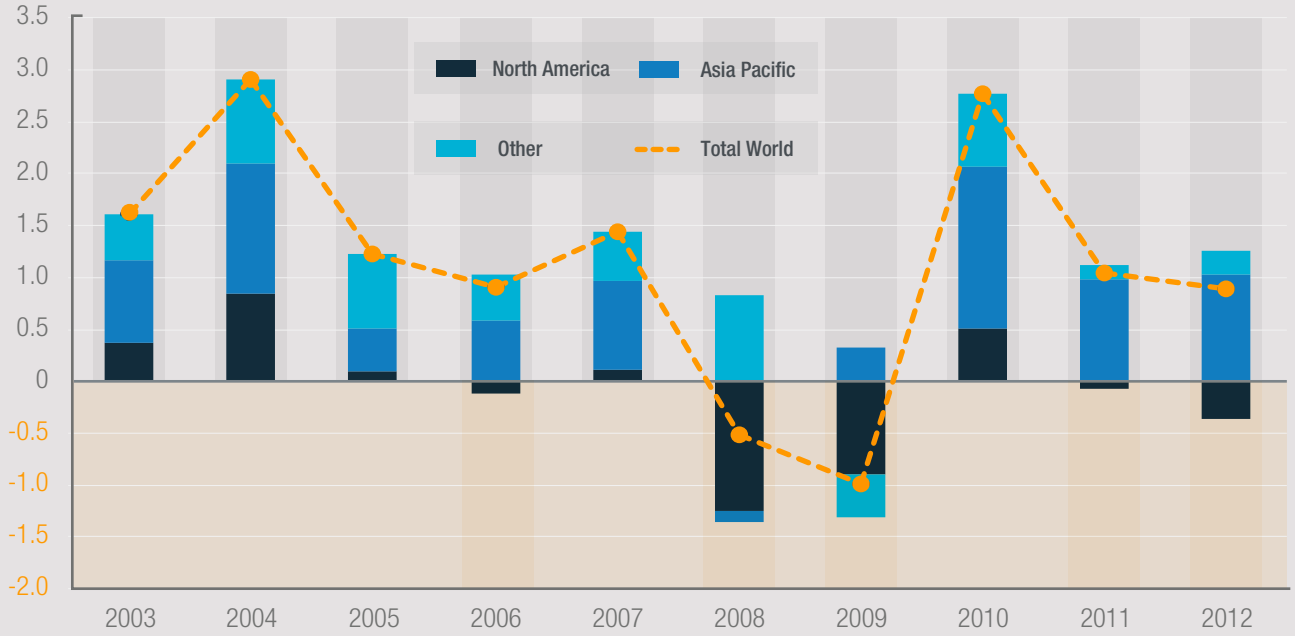
In the 2010-2012 period, economic recovery resulted in growing oil demand, with the largest growth occurring in Asia Pacific markets. There have also been supply disruptions due to political instability in North Africa and the Middle East, sanctions imposed against Iran that have reduced supplies, and declines in production from mature areas such as the United Kingdom and Norway. All of these factors have resulted in historically high oil prices in world markets over the past few years.

These developments have also resulted in declines in the level of worldwide spare oil production capacity in the 2012-2013 period (see **Figure 24**). Spare production capacity has recently dropped to roughly 2 million barrels per day, which is not much more than the levels seen last decade when prices spiked as markets tightened. Excess production capacity tends to stabilize world oil markets, and can help mitigate supply disruptions that periodically occur.

Supply disruptions are a feature of world oil markets that cause substantial uncertainty and can immediately impact market prices. An example occurred in 2011 during the Arab Spring, when Libyan oil production dropped by over 1 million barrels per day relative to 2010 levels. Supply disruptions can have an impact because there can be uncertainty surrounding how long the disruption will last or how quickly other production can ramp up quickly to replace the lost

22

YEAR-OVER-YEAR CHANGE IN WORLD DEMAND FOR OIL (million barrels per day)



Source: BP Statistical Review of World Energy, June 2013.

supply. In periods of low excess production capacity it is more difficult to absorb a loss of supply without increases in prices.

In summary, a combination of increasing demand in Asia Pacific markets, supply disruptions and uncertainty (supply risk) have caused global spare production capacity to decline and spot and forward crude prices to rise. Put another way, the global price of oil has risen in order to balance demand with available supplies. This is particularly the case for the prices of lighter, sweeter crude oils for which prices are typically reported in the press and which tend to establish prices for gasoline and home heating oil. Although growing domestic light sweet crude production is somewhat isolated from global markets (due to regulations and constraints on infrastructure and refining as discussed above), and has therefore been selling at discounts to world crude benchmarks such as Brent, U.S. consumption of crude oil and refined petroleum products remains dependent on the international crude oil market.

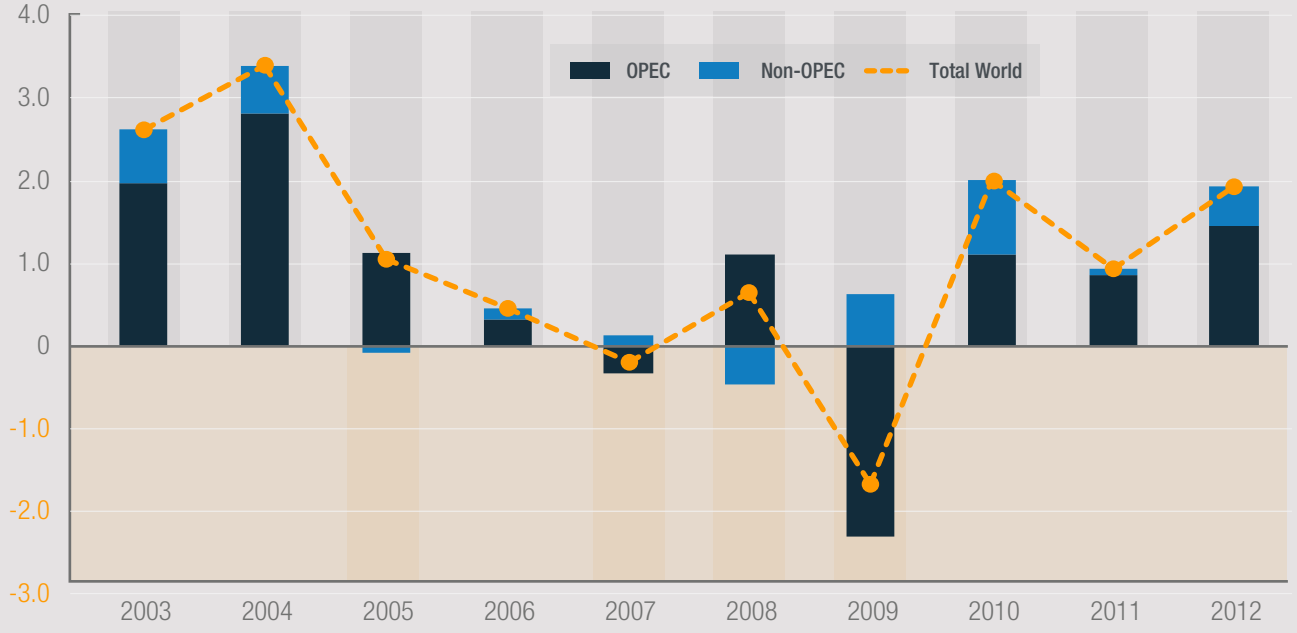
Financial Markets and Crude Oil Prices

Changes - Market Structures have Transformed

Over the last 25 years, the global oil industry has seen a transformation in the contractual structures used to purchase and sell crude oil. A market structure formerly based on rigid long-term, commercial arrangements has been replaced by a more efficient one that allows buyers and sellers greater flexibility in establishing commercial relationships that better meet their respective needs. Whereas “spot” and “futures” markets have been long-established institutional structures for many commodities, they are relatively new to the oil industry. Their use has grown rapidly and they are now a well-developed part of the market. Today it is from the spot and futures markets that participants in the global oil market—producers, refiners, marketers, traders, consumers, investment banks, hedge funds, and so forth—receive market signals that inform buyers and sellers on current and future supply and demand conditions.

23

YEAR-OVER-YEAR CHANGE IN OIL PRODUCTION (million barrels per day)



Source: BP Statistical Review of World Energy, June 2013.

Spot Markets Versus Futures Transactions

The term "spot markets" is used to describe transactions which involve the purchase or sale of a commodity, such as crude oil or refined products for near-term delivery. In the crude oil market, "spot" contracts typically involve delivery of crude over the coming month, e.g., a contract signed in June for delivery in July. Spot markets are often referred to as the "physical market" since they entail the buying and selling of physical volumes. There are numerous spot markets at different trading locations around the United States, as well as around the world. The price of WTI crude oil, commonly reported in the news as the prevailing price of crude oil in the United States, is established at one particular trading hub (Cushing, Oklahoma). Each spot market consists of many buyers and sellers, including refiners, traders, producers, and transporters, transacting throughout the chain of supply—from the oil well right through to the refinery. These allow buyers and sellers (e.g., refiners and marketers) to more easily adjust their crude oil and petroleum product supplies to reflect near-term supply and demand conditions in both the product markets and the crude oil markets.

A futures contract, in contrast to a spot transaction, concerns the future purchase or sale of crude oil or petroleum products.[32] Specifically, it is a contract that carries the obligation for delivery of a given quantity of crude in the future. The contract specifies the volume, type or grade of crude oil, the price, the future time in which the crude is bought or sold, and the particular location to which it is to be delivered. The buying and selling of futures contracts occurs on organized exchanges. Since the vast majority of traders "close out" their positions (i.e., cancel out a contract prior to the time it would require the trader to actually deliver or take delivery of the crude oil), futures transactions rarely entail the actual delivery. As a result, the futures market is often referred to as the "financial market."
The specific crudes underlying futures contracts are often called "marker" or "benchmark" crudes. An important example is WTI, which is the principal crude underlying the futures contract traded on the New York Mercantile Exchange, or NYMEX. Brent crude similarly serves as the marker crude for futures traded on the Inter-Continental Exchange, or ICE. These organized exchanges reflect interactions among thousands of independent traders, including both commercial as well as financial institutions.

Prices of futures contracts are connected to prices in the physical market because futures positions that are not closed out will lead to either delivery or receipt. Thus, the closing "futures" price for any

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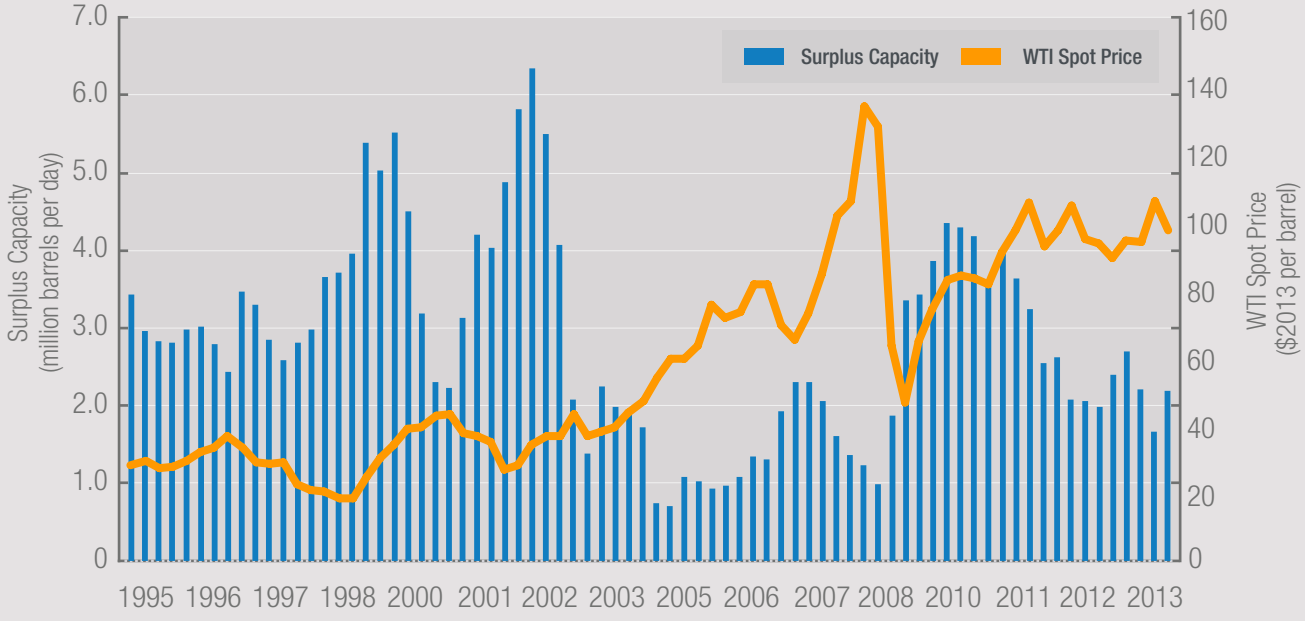
HISTORICAL WORLD SPARE OIL PRODUCTION CAPACITY & WTI SPOT PRICE
AVERAGE QUARTERLY, 1995–2013



Source: EIA. WTI Spot Price in $2013 using CPI data from BLS.

given monthly contract must equal the "physical" price at the time trading in the futures contract ends. With delivery, the futures price effectively becomes a physical price at the time the futures contract matures. So, for example, the closing price of a futures contract for delivery in June must equal the spot price for oil in June. If the prices differed, a trader would buy in the market in which the price is lower and immediately sell it into the market where the price is higher and earn a profit. No one wants to leave such profit opportunities on the table.

The prices in the spot market transactions described above are often tied to prices for crude oil on organized exchanges (e.g., NYMEX) with price adjustments to account for differences in the quality of the crude oil being traded and the location of the spot market transaction. In fact, even OPEC countries often rely upon formulas using prices determined on organized exchanges in establishing their own sales prices, with appropriate quality and other differentials. The benefit of these arrangements is that the price of the physical crude oil will be set at the market level at the time of delivery. This protects buyers from dramatic price fluctuations that could occur while crude oil is in transit to its final markets.

Benefits of Futures Markets

Futures markets bring a number of benefits to the global oil market. First, crude oil futures markets provide information about future expectations regarding supply and demand conditions. Second, these expectations are made transparent, (i.e., known to the market), in the form of a series of futures prices for crude to be delivered at different dates in the future. Finally, crude oil producers, marketers, refiners, and others are able to use the financial contracts on the exchanges to manage risk, facilitated, in part, by the participation of investors with no commercial interest in the petroleum industry (i.e., no capacity to produce, refine, store, or sell physical volumes of crude or petroleum products), but who provide beneficial liquidity in the marketplace.

As an example of how a market participant might use NYMEX futures contracts to reduce the risk that results from highly volatile oil prices in the physical market, consider a refinery that faces highly volatile cash flows as a result of dramatic fluctuations in crude oil prices from month to month and day to day. To reduce these risks, the refinery can hedge its physical purchases in the spot market by also purchasing futures contracts that rise in value when oil prices rise and fall in value when oil prices fall. The result is that when prices (and, hence, the refiner's acquisition costs) increase in the spot market, the value of the futures contracts will rise to offset the additional cost of oil, and vice versa. The refiner could use NYMEX gasoline and heating oil futures to lock in refined product prices, thus

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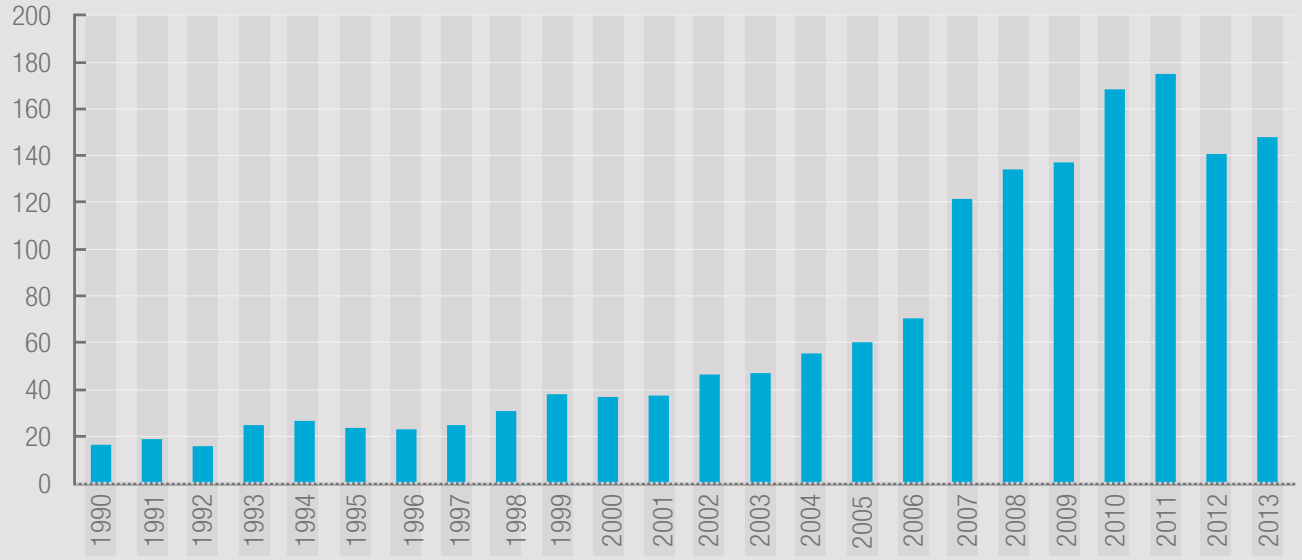
WTI CRUDE OIL FUTURES CONTRACTS TRADED BY YEAR, 1990-2013 (millions of contracts traded)



Source: Bloomberg.

reducing its exposure to volatile refining margins. In a similar fashion, an oil producer could sell NYMEX crude oil futures contracts to lock in crude prices to protect its cash flows from spot market volatility. In this instance, the sold contracts will rise in value when spot oil prices fall and fall in value when oil prices rise. The result is that when prices are low, the value of the futures contracts will rise to offset the lower price of oil received by the producer from its spot market sales.

The futures market for oil has grown rapidly since 1990. **Figure 25** shows the number of WTI oil contracts traded on the NYMEX each year between 1990 and 2013. This market is made up of a large number of buyers and sellers that vary markedly in character. Parties with commercial interests (such as the refinery and oil producer described above) frequently use futures contracts to reduce their exposure to volatile crude and product prices. However, the market also includes parties who are not commercial entities seeking to hedge their exposure to price risk. These non-commercial traders may include investment banks, hedge funds and other commodity investors who hold oil futures contracts as part of a diversified investment portfolio, or who buy and sell futures contracts in response to contract prices, seeking to earn a return for bearing risk.

While the role of non-commercial traders in oil markets has been a controversial subject at times, it is clear that these non-commercial participants play an important role in helping commodity markets function efficiently. They serve as counterparties to commercial hedgers in futures markets, providing liquidity that assures the commercial parties will not incur excessive costs to effectively manage their risks. The market benefits from the activity of all types of traders because—by bringing different perspectives—they help ensure that market prices reflect all of the information available about current and future supply and demand conditions.

As described above, futures markets provide valuable information about the market's expectations regarding future supply and demand conditions in the physical market—conditions that will ultimately determine the price for oil. If, for example, the price today of an oil futures contract for the delivery of oil three months from now is $95 per barrel, that "futures" price represents thousands of buyers' and sellers' expectations of what the price of oil will be for physical delivery three months hence.[33] And, if in this hypothetical situation, the current (spot) price were $90 per barrel, the futures market would be revealing the market's current expectation that prices will increase over the near future. That is, based on the information of thousands of commercial participants and sophisticated financial institutions, futures prices are telling producers and consumers alike that the crude oil market is likely to remain tight for the next few months.

Of course, actual prices for crude oil in the future may be different than those implied by today's futures contract prices. As expectations about future supply and demand conditions change, (e.g., due to colder than expected weather or unforeseen political events that could cause temporary supply disruptions), so too will current and future expected prices.

This trading process (i.e., the interactions among various market players in the futures markets) is beneficial because it provides transparent price information to those who can respond to this information by putting additional oil in storage or taking steps to reduce their consumption in the future. To illustrate, when prices of futures contracts with early delivery dates exceed those with later delivery dates, the market consensus is for prices to fall in the future.[34] This provides an economic incentive to draw down inventory today, thereby softening prices today. On the other hand, when prices of futures contracts with early delivery dates are lower than those with later delivery dates, the market consensus is for prices to rise in the future.[35] This provides the economic incentive to build inventories if the higher futures prices will cover the cost of storage. This saves supply for the future when the market consensus indicates it is most needed. In short, futures market prices provide information about expected future supply and demand conditions that producers and consumers can act on today. The effect of these actions is to shift the supply of crude oil from periods of relatively lower prices to periods where crude oil prices are expected to be higher. These actions, in turn, tend to ameliorate price swings.

Summary

Global Markets, Growing Domestic Production, Infrastructure Needs

Growth in North American crude oil production—light crudes in the U.S. and heavy crudes in Canada—is leading to changes in the crude supply sources for U.S. refineries, and U.S. imports of crude oil from overseas have declined substantially as a result. However, the slow development of pipeline infrastructure in North America, in the face of growing supply and restrictions on U.S. crude exports, has given rise to significant price differences among crude oil supplies produced in different parts of the U.S and more generally has resulted in U.S. crude oil prices declining relative to world prices. With constraints developing on the oil pipeline system, alternative oil transportation modes have been used in recent years, including transportation by rail, truck, and barge.

U.S. demand for refined products has been declining in recent years, but strong demand in some regions outside of the U.S. has resulted in the U.S. recently becoming a net exporter of refined products for the first time in over 60 years. Despite the declining domestic demand for refined products, some refineries in the U.S. that have access to cheap domestic supplies of crude oil have experienced increasing profitability—perhaps temporarily depending on whether constraints are relieved with the development of new oil pipeline capacity. In contrast, refineries on the East Coast have been facing economic pressures, in part due to their more limited access to cheap inland crudes, and some smaller refineries have closed in recent periods.

The increasing supplies of light, sweet crude oil are raising questions about whether the U.S. should lift restrictions on crude oil exports, especially since many U.S. refineries are designed to run heavy crude oil supplies, and face limits on how much light crude they can refine. Growing oil supplies in Canada are also leading to pipeline proposals for new capacity to the east and west coasts of Canada that would allow for the export of oil to international markets, in part because of the difficulty in developing pipeline export projects to serve U.S. markets.

The prices for gasoline, distillate, and jet fuel in the U.S. have been and will continue to be driven primarily by international supply and demand factors and their impact on world crude oil prices. These factors include consumption growth in Asia Pacific markets, supply disruptions in oil producing countries, the levels of spare crude production capacity, and production targets set by OPEC. The recent price swings observed in both refined product and global benchmark crude oil prices have all been the result of these changing world market conditions. Prices for petroleum products in the U.S. will continue to be set in world markets as long as our domestic markets remain linked to them through trade.

The changes in the North American petroleum markets have been quite dramatic in the recent past. How the markets change over the next several years will largely depend on world oil market conditions, continued changes in crude oil production, the response to additional infrastructure needs, and whether North American oil supplies are made available for export to overseas markets.

Glossary

API Gravity

The American Petroleum Institute's degree scale for measuring the specific gravity of crude oil or *condensate*. The higher the API gravity, the lighter (less viscous) the petroleum, with most values for most substances falling within the range 10-40; substances with API gravity greater than 10 float in water.

Barrel

A barrel of oil (or other petroleum product) contains a volume equal to 42 U.S. gallons.

Benchmark Crude

Benchmark crude oils (also known as “marker crude oils”) are used as references for pricing oils. There are numerous benchmark crudes, each with particular quality characteristics trading at a specific hub. Two of the most important benchmarks are West Texas Intermediate (U.S. mid-continent crude traded at Cushing Oklahoma) and Brent (North Sea and North Atlantic crude traded at Sullom Voe terminal in Scotland).

Bitumen

Bitumen is a naturally occurring viscous mixture, mainly of hydrocarbons heavier than pentane, that may contain sulphur compounds and that, in its natural occurring viscous state, is not recoverable at a commercial rate through conventional production (drilling).

Condensate

Condensate is a low-density hydrocarbon mixture that exists as a gas in an oil or natural gas reservoir, but condenses to a liquid as temperature and pressure decrease during extraction. Condensate is sometimes called "natural gasoline" because it has a similar boiling point to refined gasoline; it generally enters the crude oil stream after production.

Conventional Oil

In conventional crude oil production, a well is drilled into a geologic formation in which the reservoir and fluid characteristics permit the oil to readily flow to the wellbore.

Crack Spread

A crack spread is a proxy measure of refiner gross margins, calculated to represent the hypothetical simultaneous purchase or sale of crude against the sale or purchase of refined petroleum products. These spread differentials are normally quoted in dollars per barrel by converting the product prices into dollars per barrel and subtracting the crude price. For example, a 3-2-1 crack spread is the difference between the price of 3 barrels of a particular crude oil and the combined price of 2 barrels of motor gasoline and 1 barrel of diesel fuel.

Crude Slate

See Refinery Slate

Diluent

Diluent is a hydrocarbon fluid that is used to dilute heavy and especially extra-heavy crude oil in order to reduce its viscosity for easier transportation. Generally a distillate is used for heavy oil dilution and transportation. The added diluent may be recovered at the destination using distillation and the diluent may be subsequently pumped back for blending.

Distillate

Distillate or distillate fuel oil is a general classification for the petroleum fractions produced in conventional distillation (i.e., before thermal or catalytic cracking). It includes diesel fuels and fuel oils. Products known as No. 1, No. 2, and No. 4 diesel fuel are used in on-highway diesel engines, such as those in trucks and automobiles, as well as off-highway engines, such as those in railroad locomotives and agricultural machinery. Products known as No. 1, No. 2, and No. 4 fuel oils are used primarily for space heating and electric power generation.

Futures Contract

A futures contract is a binding, legal agreement between a buyer and a seller for delivery of a particular quantity of a commodity at a specified time, place, and price. These contracts are traded on regulated exchanges and are settled daily based on their current value in the marketplace. Many oil contracts traded on the New York Mercantile Exchange (NYMEX) and other exchanges end without actual physical delivery of the commodity. Futures contracts most often are liquidated or cancelled out by purchasing a covering

position prior to the delivery date and are generally used as a financial risk management and investment tool rather than for supply purposes.

Horizontal Drilling

Horizontal drilling or directional drilling is a drilling methodology in which wellbores are turned horizontally at a certain depth. It is normally used to extract energy from a specific geologic stratum, such as a layer of shale rock.

Hydraulic Fracturing

Hydraulic Fracturing is the propagation of fractures in a rock layer, as a result of the action utilizing a pressurized fluid, chemical additives, physical proppants, or a combination thereof, to release petroleum, natural gas, or other substances to be extracted. Hydraulic fracturing along with horizontal drilling is utilized to produce hydrocarbons from shales.

Hydrocarbon

A hydrocarbon is any organic chemical compound of hydrogen and carbon in the gaseous, liquid, or solid phase. The molecular structure of hydrocarbon compounds varies from the simplest (methane, a constituent of natural gas) to the very heavy and very complex.

In situ Process

In situ processes involve the recovery, by chemical leaching or heating, of the valuable components of a mineral deposit without physical extraction of the mineralized rock from the ground. They are used in unconventional oil production, including from oil sands.

Organization of Petroleum Exporting Countries (OPEC)

OPEC is an intergovernmental organization whose stated objective is to "coordinate and unify the petroleum policies of member countries." OPEC acts as a cartel by setting production quotas. It was created in 1960 and it's current members are Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, UAE, and Venezuela.

Refinery Slate

A refinery's crude slate is the mix of crude oils used as inputs; its product slate comprises the types and qualities of products yielded as outputs. Based on their installed equipment, refineries are configured to use and produce different optimal crude and product slates.

Product Slate

See Refinery Slate

Spare Oil Production Capacity

Spare oil capacity is defined by the EIA as the volume of production that can be brought on within 30 days and sustained for at least 90 days. Saudi Arabia, the largest oil producer within OPEC and the world's largest oil exporter, historically has had the greatest spare capacity. Saudi Arabia has usually kept more than 1.5 - 2 million barrels per day of spare capacity on hand for market management.

Spot Market

Spot markets are markets in which commodities such as crude oil and petroleum products are bought and sold for immediate or very near-term delivery, usually within a period of 30 days or fewer. The transaction does not imply a continuing arrangement between the buyer and the seller. A spot market is more likely to develop at a location with numerous pipeline interconnections, thus allowing for a large number of buyers and sellers. Cushing Oklahoma is one important spot market for crude oil – specifically the WTI benchmark.

Tight Oil

Tight oil refers to deposits of (primarily light sweet) crude oil contained in formations such as shale or tight sandstone, whose low porosity and permeability makes it difficult for producers to extract hydrocarbons except by unconventional techniques such as horizontal drilling and hydraulic fracturing.

Unconventional Oil

Unconventional oil production is an umbrella term for production by means that do not meet the criteria for conventional production. These methods include horizontal drilling, hydraulic fracturing, surface mining, and in situ processes.

References

1. Crude production in the U.S. peaked in 1970 and declined steadily from 1985 until 2008.
2. U.S. Energy Information Administration, International Energy Outlook 2013, Table A2.
3. Id.
4. U.S. Energy Information Administration, International Energy Outlook 2013, Table G2
5. See "December 2013 Monthly Update," North Dakota Pipeline Authority.
6. U.S. Energy Information Administration, Refinery Capacity Report, 2013.
7. Id.
8. Id.
9. See "U.S. petroleum product exports exceeded imports in 2011 for the first time in over six decades," Energy Information Administration," March 7, 2012.
10. See "Midwest refineries boost capacity for heavy crude oil," Energy Information Administration, March 27, 2013.
11. See "Impacts of East Coast Refinery Closures," prepared by EnSys Energy for the American Petroleum Institute, June 9, 2012.
12. Id.
13. U.S. Energy Information Administration, Petroleum Supply Monthly, November 2013.
14. The United States, for example, exports approximately 1.9 million barrels per day of finished refined products and imports approximately 0.6 million barrels per day of finished refined products.
15. Energy Information Administration, Gasoline and Diesel Fuel Update, February 2014. Annual percentages are the simple averages of monthly figures.
16. As with domestically produced crude oil, pipelines represent the most efficient method of moving large quantities of liquid petroleum products. Pipeline rates are generally regulated by the Federal Energy Regulatory Commission (FERC) or by state regulatory commissions.
17. Energy Information Administration, Gasoline and Diesel Fuel Update, February 2014.
18. U.S. Energy Information Administration, "Gasoline Explained", July 2013.
19. In the wholesale gasoline market, there are generally several different prices quoted, depending on the relationship between the supplier and retailer and on the terms, if any, of their contractual relationship. Thus, the wholesale price paid by different retailers can differ depending on such factors as whether there is a long-term supply agreement or whether the retailer has the right to use the supplier's brand.
20. Despite the fact that retail gasoline (or other refined product) prices might not move in lock step with inventory costs, movements in wholesale and retail prices are correlated, as the retailer must cover increases in product costs or go out of business.
21. BP Statistical Review of World Energy, June 2013.
22. BP Statistical Review of World Energy, June 2013. One barrel equals 42 U.S. gallons.
23. OPEC member countries include:
    Africa: Algeria, Angola, Libya, Nigeria.
    South America: Ecuador, Venezuela.
    Middle East: Iran, Iraq, Kuwait, Qatar, Saudi Arabia, United Arab Emirates.
24. U.S. Energy Information Administration, Short-Term Energy Outlook, January 2014.
25. BP Statistical Review of World Energy, June 2013.
26. US Energy Information Administration, U.S. Petroleum Supply Monthly, January 2014.
27. Id.
28. Id.
29. For changes in individual countries' consumption of crude oil, see, for example, the BP Statistical Review of World Energy, June 2013.
30. BP Statistical Review of World Energy, June 2009, p.3.
31. BP Statistical Review of World Energy, June 2010 and June 2011.
32. There are many other types of contractual structures and financial instruments used by the oil industry, as well. These include futures (an agreement today to sell at an agreed-upon future date), swaps (an agreement to trade or "swap" commodities of different qualities or at different locations or at different times), options (an agreement that provides the right, i.e., the "option," to buy or sell a commodity), and swaptions (an agreement combining a swap and an option). Prices of futures contracts are the most commonly reported by the trade press and most watched by the public.
33. The academic finance literature discusses whether there are risk premiums in futures prices that affect the relationship between futures prices and expected future spot prices, a subject that is beyond the scope of our discussion here.
34. The futures market is commonly said to be "backwardated" under these conditions.
35. The futures market, under these conditions, is commonly termed "in contango."

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