

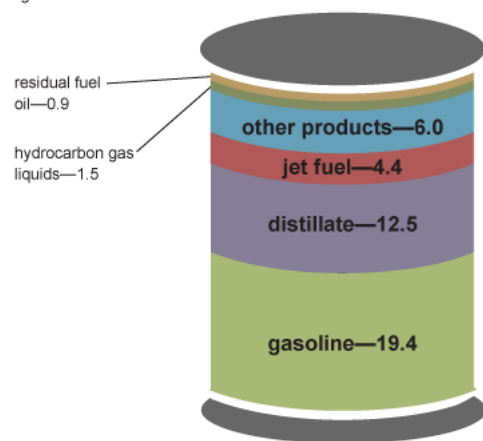
# NORTH AMERICAN CRUDE OIL

## Definition

Crude oil and petroleum fossil fuels are called such because they come from a mix of hydrocarbons that are the remaining of animals and plants who were on earth millions of years ago.[1] Hydrocarbons between 2000 and 3800 meters underground are found under a liquid form that we call crude oil; this interval is called the oil window . However, between 3800 and 5000 meters, hydrocarbons are found under the form of a very light liquid that turns into methane gas, this range of depth is called the gas window. One estimates that it takes 60 million year for dead animals to become crude oil. Therefore, that's the reason why we consider this energy as non-renewable. [2] While crude oil is extracted from the ground, it is then transformed into petroleum products through its way to the refinery. Petroleum products made from crude oil are essentially gasoline, but also distillates such as diesel fuel, heating oil, jet fuel and other products.

Below the proportion of each petroleum product made from a 42 gallon barrel of crude oil. [3] Part of the North American crude oil, West Texas Intermediate crude oil (WTI), is one of the main benchmarks. WTI crude oil has very low density which makes it light and sweet oil. It is sourced from Texas and goes through its way by pipelines to be refined in the Midwest and the Gulf of Mexico. [4]

**Petroleum products made from a barrel of crude oil, 2019**  
gallons



Note: A 42-gallon (U.S.) barrel of crude oil yields about 45 gallons of petroleum products because of refinery processing gain. The sum of the product amounts in the image may not equal 45 because of independent rounding.

Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*, April 2020, preliminary data

## Market Structure

*Fragmented vs concentrated market on supplier side ?*  
According to the 2019 figures on world oil production, published by the Energy Information Administration: N.A oil production is largely dominated by the United-States with 19.51M barrel/day vs Canada with a production of 5.5M barrel/day.

However, N.A.oil market structure is quite fragmented on the supplier side because there are hundreds of companies in the U.S. that operate in oil production. Although, the biggest oil producers in the U.S. are: Chevron, Exxonmobil, EOG Resources, ConocoPhillips, Anadarko Petroleum, Occidental Petroleum, Pioneer Natural Resources, Devon Energy, Marathon Oil, Hess. [5][6]

*Fragmented vs concentrated market on consumer side?*

US crude oil is quite concentrated on the consumer side. Indeed, as per the top ten destinations for US crude oil, we can clearly see that the main buyer is Canada.

To support this fact, we computed an herfindahl index which is a measure of market concentration, and we found an index of 3899.52. An HHI of 2,500 or greater is considered to be a highly concentrated marketplace. [7]

Here were the Top 10 destinations for U.S. crude oil exports in 2016:

Destination	Volume	Percentage
Canada	359	60.7%
Netherlands	43	7.3%
Curacao	30	5.1%
China	22	3.7%
Italy	20	3.4%
United Kingdom	15	2.5%
Switzerland	14	2.4%
South Korea	11	1.9%
Singapore	11	1.9%
Colombia	10	1.7%

Volume in Thousand barrels per day

Percentage of total U.S. petroleum exports

(Click to enlarge)

Destination of U.S. crude oil exports in 2016.

**HHI = 3899.52**

Name	% Market Share (MS)	Square of Market Share (SMS)
Canada	60.7	3684.49
Netherlands	7.3	53.29
Curacao	5.1	26.01
China	3.7	13.69
Italy	3.4	11.56
United Kingdom	2.5	6.25
Switzerland	2.4	5.76
South Korea	1.9	3.61
Singapore	1.9	3.61
Colombia	1.7	2.89
Others	9.4	88.36
$\Sigma MS = 100$		$\Sigma SMS = 3899.52$

**HHI Classification: High Concentration**

### HHI Formula

The formula that is used to calculate the HHI is as follows:

$$HHI = MS_1^2 + MS_2^2 + MS_3^2 + \dots + MS_n^2$$

Where  $MS_n$  is the market share percentage of firm  $n$  denoted as a whole number.

## Key Drivers

Methods like Horizontal Drilling or multi-stage hydraulic fracturing are henceforth utilised for oil from shale rock because it wasn't profitable enough or technically impossible. Therefore, Canada has also dramatically increased its oil sand production. This is how Canada and the U.S increased their oil production by 46% in 6 years. Oil exportation has also increased these years.

That's how the U.S became the biggest oil producer and stopped the production decline where they were. These methods increased North American oil supply and reduced the crude oil dependence they have. Shale Oil they produce is useful for petrochemicals like plastic or pesticide. But the U.S still have to import heavier oil from countries like Venezuela to produce enough kerosene or diesel and others. [8][9]

## Trade History of N.A. Oil

Modern petroleum history started with the extraction of paraffin from crude oil in the 19th century. In 1847, in the Riddings colliery at Alfreton, Derbyshire, the Scottish chemist James Young found a natural petroleum filtration from which he extracted a light thin oil suitable for use as lamp oil, at the same time obtaining a thicker oil suitable for lubricating machinery. In 1875, David Beaty discovered crude oil at his Warren, Pennsylvania, home. This led to the opening of the Bradford oil field, which provided 77 percent of the world's supply of oil by the 1880s. However, the Russian Empire, especially the Branobel company in Azerbaijan, had taken the lead in production by the end of the 19th century. In 1853, on Seventh Avenue, near Grant Street, Samuel Kier founded America's first oil refinery in Pittsburgh. A major early oil well in North America was drilled by James Miller Williams in Oil Springs, Ontario, Canada in 1858, in addition to the operation in West Virginia and Pennsylvania. The Oil Springs discovery set off an oil boom that brought hundreds of speculators and workers to the region. Throughout the late 19th century, new oil fields were found nearby and the region grew into a major petrochemical processing centre and trade. The modern U.S. petroleum industry is known to have started with the drilling of a 69-foot (21 m) oil well by Edwin Drake in 1859 on Oil Creek near Titusville, Pennsylvania, for the Seneca Oil Company (originally generating 25 barrels per day (4.0 m<sup>3</sup> / d) by the end of the year). Driven by the demand for kerosene and oil lamps, the industry expanded in the 1800s. In the early part of the 20th century, it became a major national concern; the invention of the internal combustion engine created a market that has largely sustained the sector to this day. In Ohio, Texas, Oklahoma, and California, early "local" discoveries such as those in Pennsylvania and Ontario were rapidly outpaced by demand, leading to "oil booms." [10]

# Key Players

Even during this complicated period, climate change, extreme uncertainty and volatility of the market due to covid-19 pandemic and increased trade tensions. Nonetheless, many of the biggest oil company still have generated great profits. We will list the most important ones in order to have an overview of the key players and their origins. Although more than half of the companies are made up of Chinese and U.S. businesses, Saudi Arabia, Europe and Russia are also major players.

China petroleum & Chemical corp.

Revenue (TTM): \$355.8 billion

A manufacturer and distributor of a range of petrochemical and petroleum products is China Petroleum & Chemical. Among other similar offerings, the company's products include gasoline, diesel, kerosene, synthetic rubbers and resins, jet fuel, and chemical fertilizers. China Petroleum & Chemical, also known as Sinopec, is among the world's largest oil, gas, and petrochemical manufacturing firms.

Petro China CO. Ltd.

Revenue (TTM): \$320.1 billion

PetroChina, an oil and gas corporation, is engaged in the discovery, development, processing, and sale of oil products. Crude oil, petrochemical products and their derivatives are the company's main products. PetroChina is the Chinese state-owned China National Petroleum Corporation's exchange-listed branch and is today counted among the largest producers of oil and gas in the sector.

Saudi Arabian oil Co. ( Saudi Aramco)

Revenue (TTM) : \$286.9 billion

Saudi Aramco went public in 2019 and is one of the largest companies in the world in this sector. Even if it's not included in the U.S listed stock it had to be taken into account as it is such a major player.

Royal Dutch Shell PLC

Revenue (TTM) : \$263.1 billion

Based in the Netherlands, Royal Dutch Shell, through its subsidiaries, discovers, manufactures, and refines petroleum. Shell manufactures and sells oils, lubricants, and other ingredients, in addition to running gas stations across the globe.

BP PLC

Revenue (TTM) : \$230.7 billion

The British oil company BP is engaged in the discovery, development and supply of oil and petrochemicals.

We could also include in this list : Exxon Mobil Corp., Total SE, Chevron corp., Marathon petroleum corp., Pjsc Lukoil. [11]

# Trade Flows

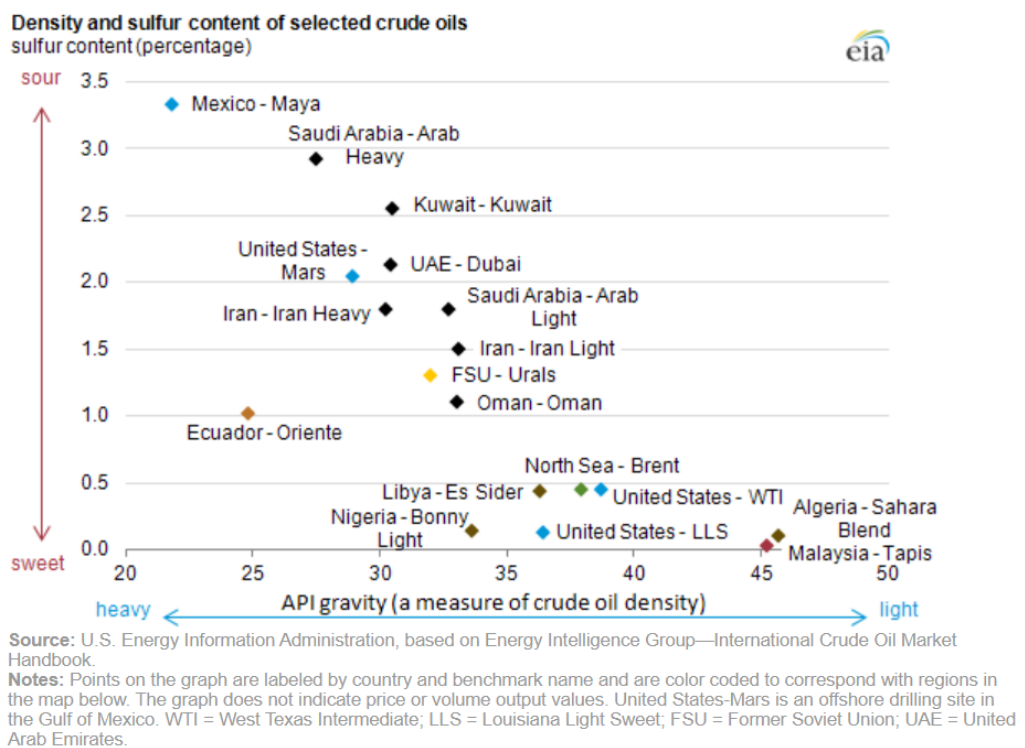
In North America, the largest shale and tight oil production companies are located in Eagle Ford, Bakken, Permian and Alberta. From 2008 to 2013, the growth of oil production allows a decline of oil import by 23% in the U.S.

The new U.S production isn't the type of oil that most of domestic refineries are able to correctly process. Therefore, it arrives that the storage capacity is saturated. Oil sand in Canada or shale oil in Bakken (north west) don't have access to port and the capacity of pipelines are not enough to transport all the production to refineries that are in the Midwest. A mismatch that necessitates over longer distances the movement crude of produced oil to deliver to adapted refineries where it's suited. [12][13][14]

# Specifications

West Texas Intermediate (WTI) is an exceptionally high-grade crude oil that is highly priced because it is of such high quality that more and cheaper gasoline can be refined from a single barrel than from any other forms of oil available on the market.

Combining two major qualities, being light and sweet as well as the location make WTI a prime crude oil which is refined in the U.S, mostly in the Midwest and Gulf Coast region. "OPEC Basket" and "Brent Blend" are the two other most common types of crude oil



# Price

Crude oil is a global commodity and, as such, its price is determined by supply and demand factors on a worldwide basis. Global supply and demand decide the price of crude oil. Economic growth is one of the major factors driving demand for petroleum products, and hence for crude oil. Rising economies are increasing demand for energy in general and for the transport of goods and materials from manufacturers to consumers in particular. Therefore, this shows how the price of crude oil is interconnected to economic growth in general. Crude oil can be traded on the “spot” or with “futures contracts”. Nonetheless, one of the main ways to negotiate crude oil is the futures contracts. Spot prices are almost never used for actual transactions, but instead they are used as reference prices to settle future prices. The key difference between spot and futures markets is that spot prices are for direct buying and selling, while futures contracts defer payment and delivery to future dates that are determined. Price and quantity is also fixed in advance with future contracts. There are a variety of platforms where oil is traded depending on the country. WTI futures are traded on the New York Mercantile Exchange (NYMEX), which is owned by the Chicago Mercantile Group (CME). WTI futures are available in Cushing, Oklahoma. Cushing is a site with pipelines and storage facilities providing easy access to refiners and suppliers.

Crude oil price is influenced by several characteristics that are the following:

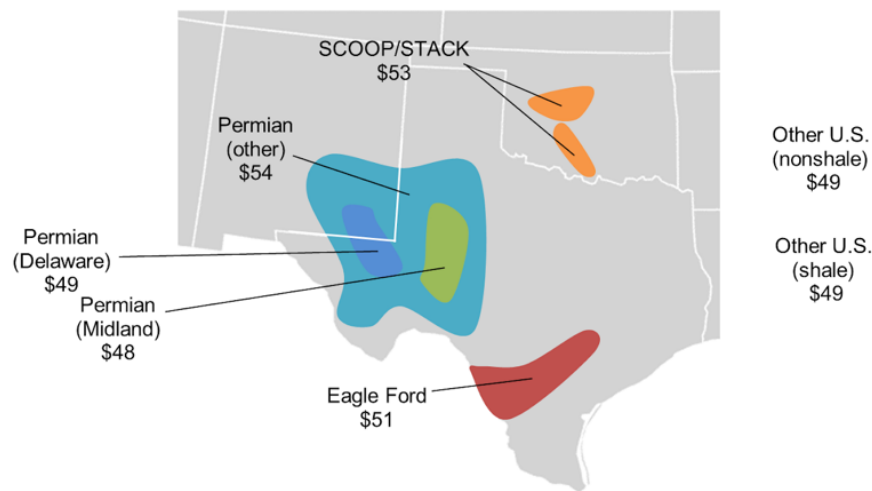
- Supply: Non-OPEC - 60% world oil production
  - shortage vs surplus of oil production, WTI crude prices, change in production capacity, projected supply, GDP
- Supply: OPEC - 40% world oil production
  - change in Saudi production, spare production capacity, change in production capacity, GDP
  
- Spot price
  - World crude oil prices
  - U.S. retail gasoline price
  - Crude price reaction to events
- Financial Market
  - Futures positions by producers, processors and end users
  - Correlation with other commodities
  - Composition of the Dow Jones UBS commodity index
- Demand:
  - Consumption and GDP
  - World oil consumption, world GDP & WTI crude oil prices

Depending on the type of oil, we can find some price differences, that are mainly due to divergence from regional demand variation and regional geopolitical tensions. For instance, in 2011 during the Arab spring, the spread between WTI and Brent oil could be explained by the fear that the canal of suez might close. Hence, Brent crude oil price - which is the European, African and Australian benchmark - rose between 11-16 USD above WTI crude. [15][16][17][18]

# Cost Curves

The breakeven price, the oil price required to drill a new well profitably, is of great interest because it provides information about how oil sector operation will change if oil prices shift drastically. With the rise of shale oil in the United States, its importance has only increased over the past decade. Compared to offshore exploration and other conventional oil ventures, shale has a shorter lead time between drilling and development, making it more prone to changes in oil prices. According to the march 2019 Dallas Fed Energy Report , the average breakeven price of oil has fallen 4 percent (or \$2 per barrel) over the past year, to \$50 per barrel. Some important differences are obscured by the \$50 top-line figure. On average, areas such as the Permian Basin's Midland and Delaware basins, hotbeds of shale activity, are regularly lower than other locations (Chart 1). Between 2019 and 2020 prices have decreased from 1 to 5\$ per Barrel.

**Chart 1**  
Average Breakeven Prices in U.S. Range from \$48 to \$54 per Barrel

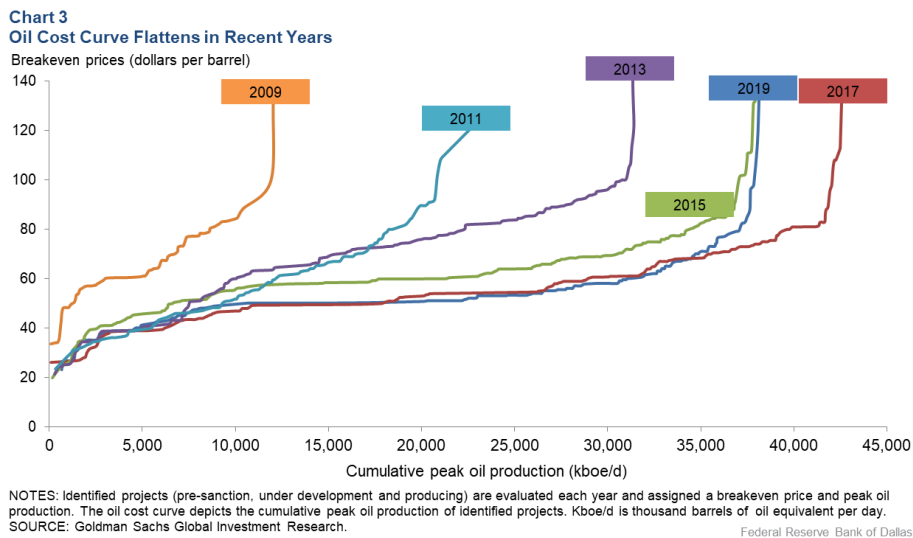


NOTES: In the March 2019 Dallas Fed Energy Survey, executives from 82 exploration and production firms answered the question, "In the top two areas in which your firm is active: What WTI oil price does your firm need to profitably drill a new well?" The survey collection period was March 13–21. WTI refers to West Texas Intermediate crude oil.  
SOURCES: Energy Information Administration, Federal Reserve Bank of Dallas.

The marginal cost of supply has been dramatically influenced by increasing U.S. shale production, which is likely to be a major source of incremental supply in the coming years, providing a reasonable correlation between the average breakeven price of the Dallas Fed and the long-dated future price.



Horizontal drilling and hydraulic fracturing have made large quantities of oil reserves that were previously considered inexpensive to grow viable. In addition, over the past 10 years, production costs for those reserves have decreased significantly. More recently, corporations have tried to minimize costs associated with other onshore and offshore oil holdings that are more conventional. As a result, at much lower prices than would have been feasible before, greater amounts of oil are economical to manufacture.



An oil cost curve attempts to provide information on how much extra supply at a given oil price might be available. The price of oil on the left-hand axis is generally seen. If the upward curve is steep, very high oil prices are required in order to produce relatively limited volumes of new output.

Over the past 10 years, as the industry has added capacity and as prices have decreased, oil cost curves have changed from being very steep to having a long, flat portion between \$50 and \$60 (chart 3). In other words, shale production implies that, given a much smaller price rise than in the past, there is a much greater amount of supply that can be called into action. [19][20]



# Form of Shipping

## Marine Vessel:

Since 1873, oil tanker or petroleum tanker is a ship designed for the bulk transport of oil or its products with a capacity up to 550,000 DWT (deadweight tonnage is a measure of how much weight a ship can carry). There are two types of them:

Crude tankers move large quantities of unrefined crude oil from the extraction point to the refineries.

Product tankers are generally smaller and designed to move the refined products from the refineries to the points near consumer markets.

## Pipeline:

Crude oil pipelines are one of the most common, safest and cheapest modes of transportation for crude oil and refined products. They need an high upfront investment cost but they are used for decades.

## Rail:

Crude-by-rail movements are a great financial option and create access options in different types of land. The capacity of the pipelines becoming insufficient opened a great alternative to move oil.

## Truck:

Over-the-road transportation is the most expensive and inefficient mode for crude oil transport. The capacity of the truck cannot exceed 250 barrels which makes it the most expensive option. However it is used for short distances during final-mile segments of the movement when pipelines and rail are not accessible. [21][22]



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