

# OIL to *car*

An short and simple explanation of how oil is converted into gasoline and then brought to you, the consumer.

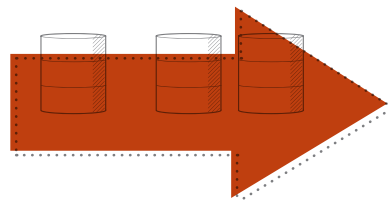
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# 1 SOURCES

The most common method of obtaining crude oil is to extract it from wells in various locations around the world. The oil that is used in California is pumped from the ground from within the state, from Alaska, and from foreign countries such as Saudi Arabia, Ecuador, and Iraq. In 2007, 45 percent of California's total crude oil came from foreign countries.



Alaska



California

**= 55%  
TOTAL OIL**



Saudi Arabia



Ecuador



Iraq

**= 45%  
TOTAL OIL\***

\*Includes oil from other foreign countries not shown.

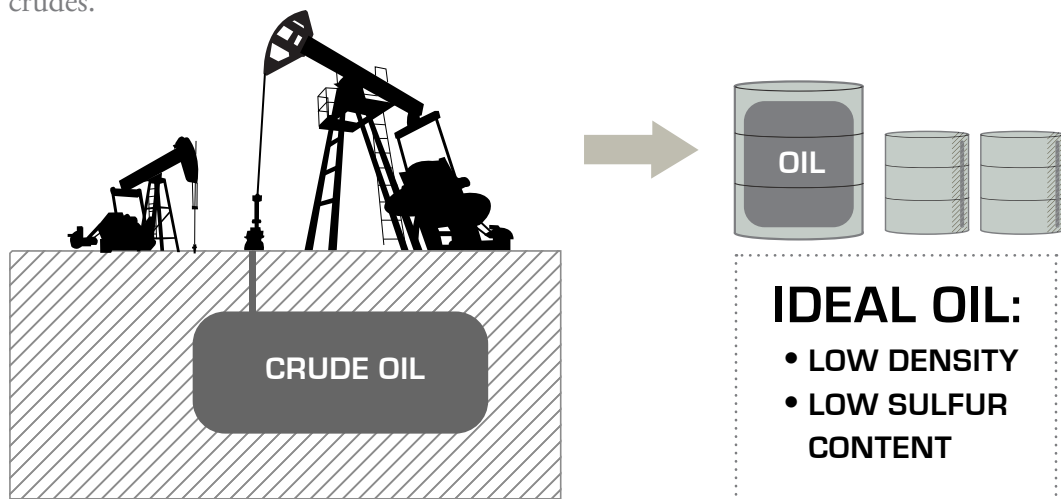
# 2 EXTRACTION

When crude oil is first extracted from the earth it is not usable. It must first be sent to a refinery where it is converted into many different products that we use every day. Crude oil is usually black or dark brown in color but varies greatly in appearance, depending on its composition.

After oil is pumped out of the ground, it is tested for two characteristics that determine its quality and overall price. The first is its “specific gravity,” or density, a measure of how thick or heavy it is. Crude oil is usually characterized as heavy, intermediate, or light. The heavier or thicker the oil, the more work the refinery must do to distill it into a useful form.

The second characteristic is the oil’s sulfur content. Low sulfur crude oil is called “sweet,” while crude with a high sulfur content is called “sour.” Because sulfur is harmful to the catalysts used in the refining process, the greater the sulfur content of an oil, the more difficult it is to refine. Sulfur also corrodes the vessels and pipes that the oil passes through. High sulfur crude also must undergo additional refining processes in order to create today’s modern fuels that result in ultra-low sulfur emissions. For that reason, the most desirable, most valuable crude is both light and sweet, with a low density and low amounts of sulfur.

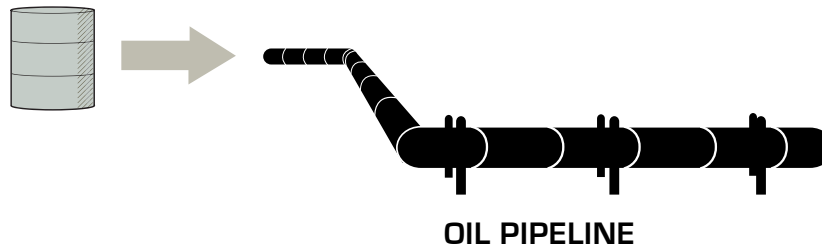
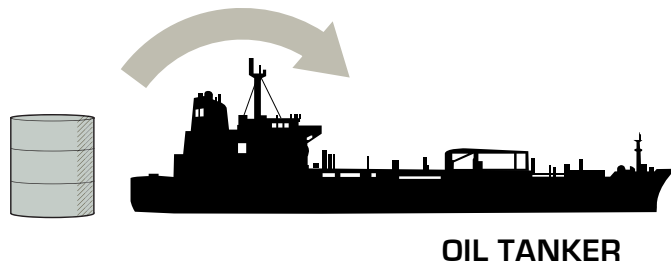
Some refiners specialize in processing less expensive, heavy, sour crudes.



# 3 TRANSPORTATION

Over land, the most economical way to transport crude oil from the well to the refinery is through pipelines. While pipelines can be installed under water, the process is technically demanding and costly over long distances. For that reason, oil is usually transported at sea in large oil tankers.

Today, 21 refineries operate in California. They are clustered primarily in the San Francisco Bay area, the Los Angeles area, and the Central Valley near Bakersfield. A large network of crude oil pipelines connect oil-producing areas to the refineries, and major ports in northern and southern California receive foreign and Alaska North Slope crude oil brought in by tanker for processing.



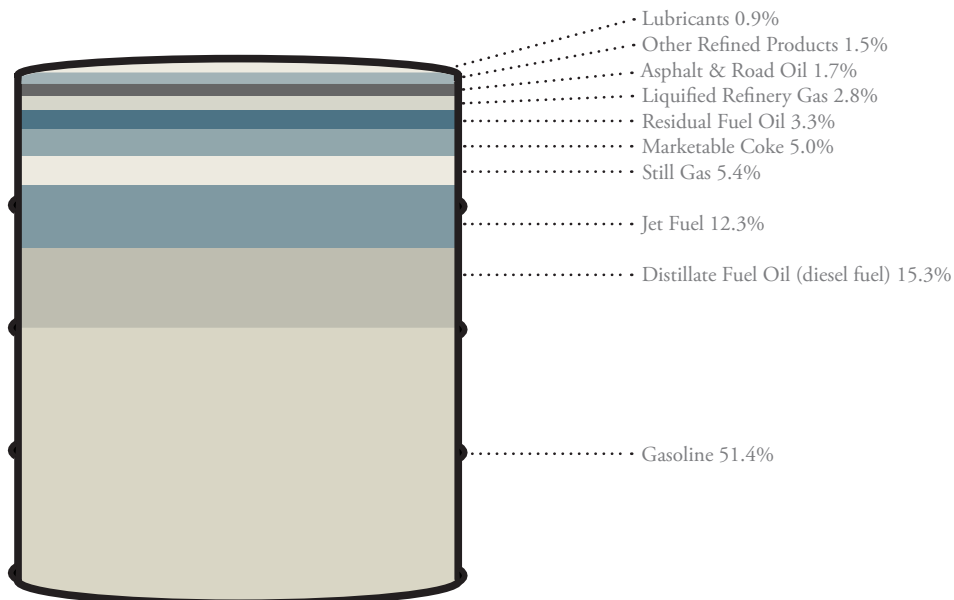
# 4 REFINING

An oil refinery is basically a density-changing machine. At a refinery, crude oil undergoes several processes that change it into many useful products, from fuels to fertilizers, from plastics to paving materials.

Every day in the United States, refineries process approximately 15.4 million barrels of petroleum. (Since a barrel holds 42 U.S. gallons, that figure translates into roughly 647 million gallons of oil processed a day!) Of all the products produced from this petroleum, gasoline represents about half of the total product volume. The illustration below shows how much of each petroleum product on average comes from a single barrel of crude oil here in California.

Oil goes through three processes inside a refinery – Distillation, Conversion, and Alkylation.

During all three of these processes, oil also goes through a de-sulfurization process to remove this unwanted chemical. Refined products are then blended with other additives to make transportation fuels and other consumer products.



# REFINING

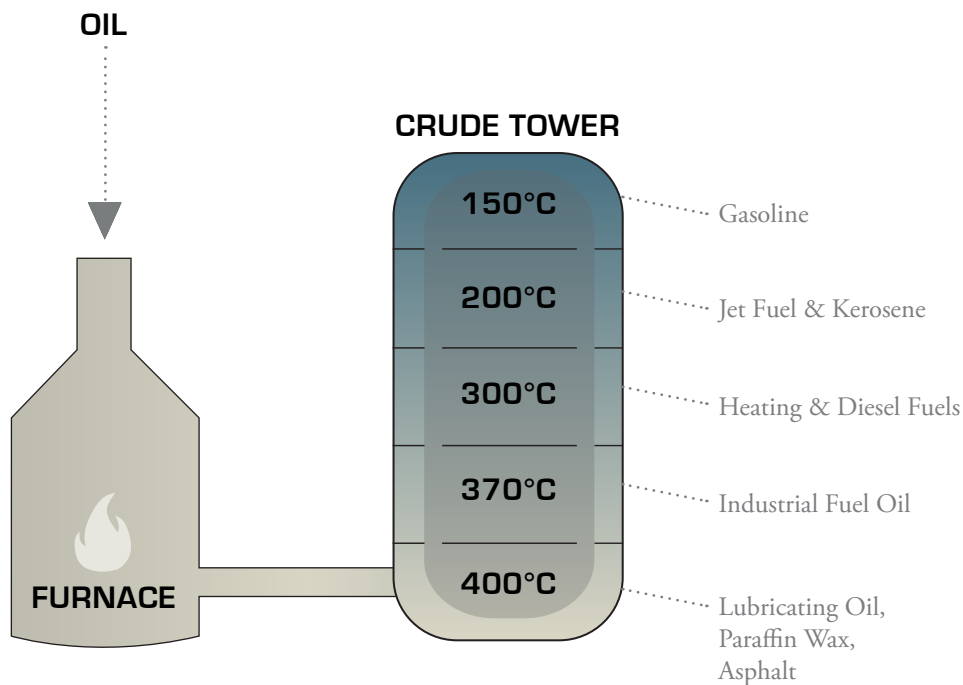
## *Distillation Process*

Simply put, distillation uses heat to separate petroleum into different products. This occurs in two areas of the refinery – the crude tower and the vacuum tower.

In the crude tower (which is also known as the fractionating tower), heat from a furnace is applied to crude oil. The heated oil then separates into various components based on their boiling temperatures. Gasoline, for example, boils at a relatively low temperature and rises to the top of the tower. Components such as asphalt, with a higher boiling temperature, remain near the bottom of the tower.

At boiling point temperatures approaching 730 to 850 degrees F, the heaviest components from the bottom of the crude tower will begin to break up, or “crack.” Cracking these heavy components in the crude tower, however, fouls the equipment and reduces product yields, so these heavy components are sent to a vacuum tower. Here, in a partial vacuum, these heavy products are distilled at lower-than-atmospheric-pressure that reduces the temperatures necessary to break them down.

Once separated and collected, these various components are processed more completely in conversion units throughout the refinery.



# REFINING

## *Conversion Process*

The conversion process uses chemicals, catalysts, pressure and heat to change the chemical makeup of the various product streams that were separated by the distillation process. What began as crude oil is now converted into finished products like gasoline.

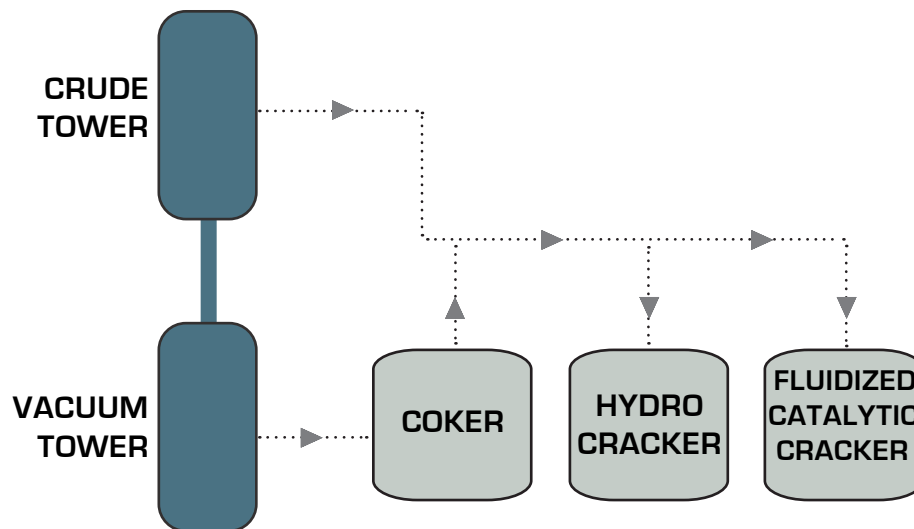
Conversion occurs in three areas of a refinery – the Coker, the Hydrocracker, and the Fluidized Catalytic Cracker (FCC).

The Coker receives heaviest products from the vacuum tower and converts them into lighter components through the use of high temperatures and pressure.

The Hydrocracker breaks up the next heaviest components using hydrogen and catalysts.

The FCC uses chemical catalysts to break large molecules into smaller, more useful ones, while components too light to become gasoline can go through a process called alkylation, which combines lighter molecules to make heavier, higher-octane ones.

After these steps, gasoline, diesel and other fuels move to other areas of the refinery for final blending.



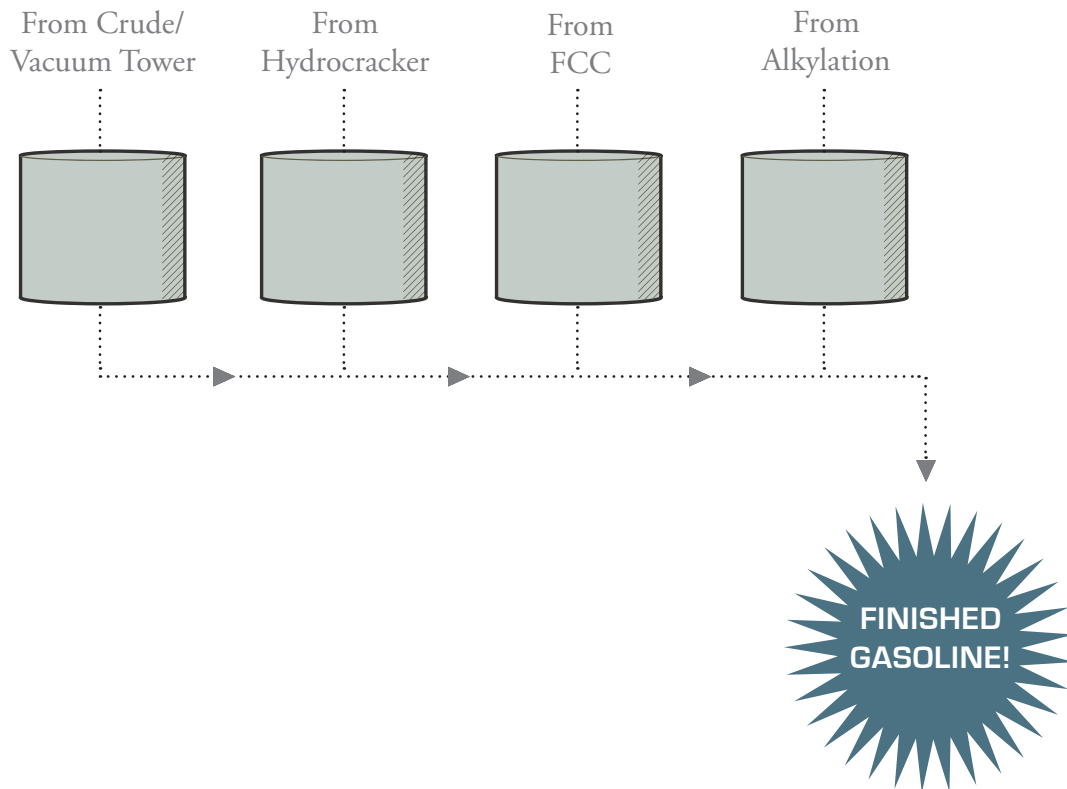


# REFINING

## *Blending Process*

Several components from different areas of the refinery are brought together in the blending process to create products with specific characteristics.

Refineries, for example, usually create between 3 and 8 different chemical compounds that can be blended to make gasoline. These compounds are combined using specific formulas to create various grades of gasoline formulated to burn efficiently and to produce a minimum of harmful emissions.



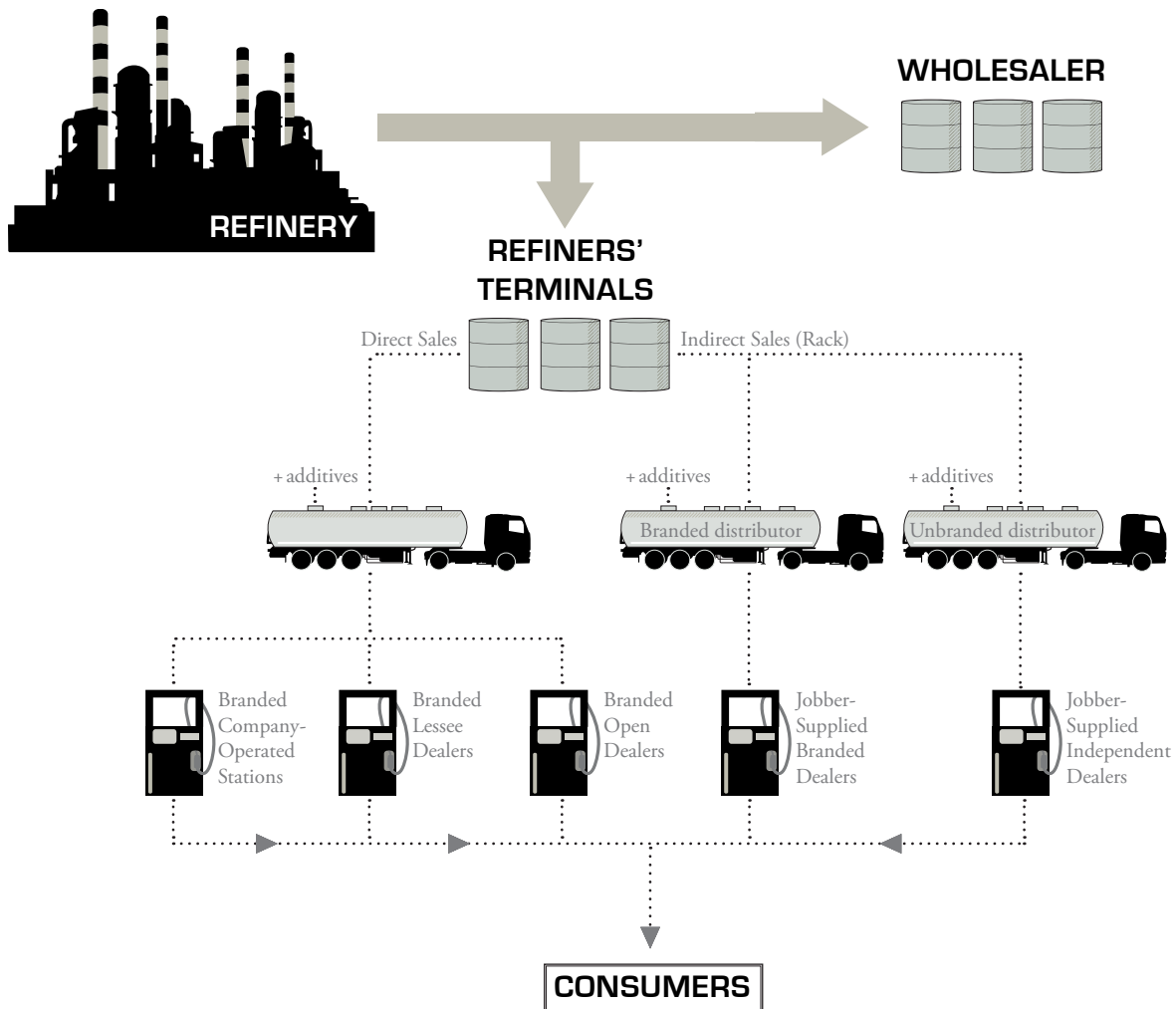
# 5 DISTRIBUTION

Once oil has been processed into gasoline or diesel, the fuel is shipped from the refinery, usually through a pipeline, to a refiner's terminal or to a wholesaler. As the chart shows, from here it is sold, either directly or indirectly.

Additional blending can also take place at this point in the process. At distribution terminals around the state, additives and ethanol are mixed into the fuel as it is loaded into tanker trucks for delivery to retail stations. After a final test to ensure the fuel meets stringent California standards, it is ready for sale to consumers.

These truckloads of fuel can be sold directly to what are called "branded" stations. These sell a specific company's brand of fuel -- like Chevron, Shell, Arco and others. Branded stations can be owned by the refiner and operated by their own employees, owned by the refiner but leased to an individual to run, or owned and operated by a retailer who agrees to carry that company's products exclusively.

If the fuel is sold indirectly, it goes to a distributor, or "jobber." This middleman can deliver fuel from a variety of sources to independent stations -- stations not affiliated with a well-known brand name. Even though this fuel may not have a national brand attached to it, it comes from the same refineries and meets the same stringent standards set by the California Air Resources Board for all fuels sold in the state.



# 6 CONSUMER USE

After working its way through the refining and distribution channels, the finished gasoline and diesel fuel is available for purchase at approximately 10,200 outlets around California – outlets that include retail stations, marinas, truckstops, and fleet fueling stations.

In 2007, California drivers used nearly 15.7 billion gallons of gasoline and 3 billion gallons of diesel fuel, according to figures from the state Board of Equalization.

