**Petroleum refining:**

The primary uses of crude oil to this point have been in the production of fuel. A single barrel of crude oil can produces the following components, which are listed by percent of the barrel they constitute.

* 42% Gasoline
* 22% Diesel
* 9% Jet Fuel
* 5% Fuel Oil
* 4% Liquefied Petroleum Gases
* 18% Other products

**Refining**

Petroleum refining refers to the process of converting crude oil into useful products. Crude oil is composed of hundreds of different hydrocarbon molecules, which are separated through the process of refining.  The process is divided into three basic steps: separation, conversion, and treatment.

**Separation**

Separation refers to the process of distillation. Crude oil is heated in a furnace so that hydrocarbons can be separated via their boiling point.  Inside large towers, heated petroleum vapors are separated into fractions according to weight and boiling point.  The lightest fractions, which include gasoline, rise to the top of the tower before they condense back to liquids.  The heaviest fractions will settle at the bottom because they condense early.

**Conversion**

Conversion is simply the process of changing on kind of hydrocarbon into another. Of the, the desired product is gasoline.  Cracking is the process of taking heavier, less valuable fractions of crude and converting them into lighter products.  Cracking uses heat and pressure to break heavier elements into lighter ones.  Alkylation is another common process, which is basically the opposite of cracking.  In alkylation, small gaseous byproducts are combined to form larger hydrocarbons.

**>Treatment**

Treatment is the final process of refining, and includes combining processed products to create various octane levels, vapor pressure properties, and special properties for products used in extreme environments. One common example of treatment is the removal of sulfur from diesel fuel, which is necessary for it to meet clean air guidelines. Treatment is highly technical and is the most time consuming step of refining.

**Gasoline**

Gasoline is the most popular product derived from petroleum and constitutes the largest fraction of product obtained per barrel of crude oil. The hydrocarbons in gasoline have a chain length of between 4 and 12 carbons. Internal combustion engines burn gasoline in a controlled process called deflagration.  Of importance in this process is the timing of combustion, which can be adversely impacted by autoignition of gasoline. This leads to the phenomenon commonly referred to as “engine knock.”  In fact, the resistance to autoignition is the largest difference between gasoline and jet fuel, jet fuel being highly resistant to autoignition.  A gasoline’s resistance to autoignition is expressed in its octane rating.  Octane levels are manipulated by the addition of a particular hydrocarbon called octane.  The higher the octane rating of the gasoline, the more the fuel can be compressed.  Higher compression means higher temperature and pressure can be achieved inside the engine, which translates to higher power output.

**Diesel**

Diesel fuel consists of hydrocarbons of a chain length between eight and 21 carbon atoms.  Diesel has higher energy content per volume than gasoline.  Because they hydrocarbons in diesel are larger, it is less volatile and therefore less prone to explosion, which is one reason it is preferred in military vehicles.

Unlike gasoline engines, diesel engines do not rely upon electrically generated sparks to ignite the fuel. Diesel is compressed to high degree along with air, creating high temperatures within the cylinder that lead to combustion. This process makes diesel engines highly efficient, achieving up to 40% better fuel economy than gasoline powered vehicles.

Until recently, diesel fuel contained a high degree of sulfur, which contributes to acid rain. Because of their similar distillation points, diesel and sulfur contaminants are removed from crude at the same time during refining. Government regulation now requires that additional steps be taken to remove the sulfur so that diesel fuel is more environmentally friendly. This is part of reason that diesel fuel costs more than gasoline

**Heating Oil and Fuel Oil**

Fuel oil is one of the “left-over” products of crude refining. It is often less pure than other refined products, containing a broader range of hydrocarbons. Because of its contaminants, fuel oil has a high flash point and is more prone to autoignition. It also produces more pollutants when burned.

**Jet Fuel**

Jet fuel requires specific characteristics. Namely, it must have a low flammability and it must be able to experience the cold temperatures associated with high altitude without freezing. Jet fuel is based on kerosene, which is slightly heavier than gasoline. Additives help to ensure that it is highly compressible, has a low volatility, and will be free from freezing. Jet fuel comes in three main types:

**Jet A**

Used only in the United States. Flash point of 38 C (100 F) and autoiginition temperature of 210 C (410 F). This makes jet fuel safer than traditional gasoline.

**Jet A-1**

Jet A-1 is similar to Jet A, but with a lower freezing point of 47 C.

**Jet B**

Jet B is designed for use in cold climates. It has a lower autoignition temperature, which makes it more dangerous than Jet A fuels.