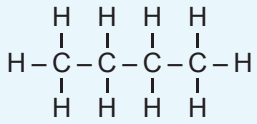
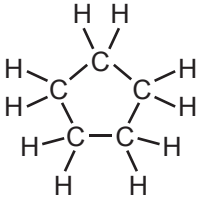
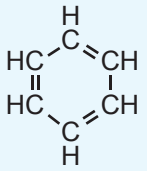
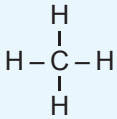
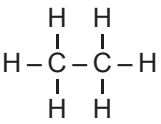
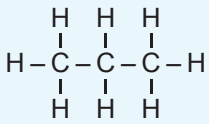
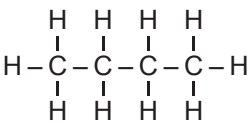
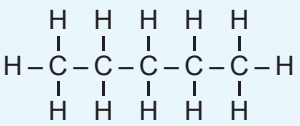
Oil

Crude oil is a thick black (sometimes brown, red or even yellow) liquid found deep within sedimentary rock beds. It was formed millions of years ago from the **decomposition** of dead organisms. The organisms that typically turn into oil are **algae** and **zooplankton** (small water-living organisms that feed off other plankton and **decaying** material). These organisms died and became covered by sediments which were compressed into sedimentary rocks. The decaying organisms were also compressed and heated, transforming them into oil.

Crude oil is primarily made up of **hydrocarbons** – long chains of carbon and hydrogen atoms. There is a large range of different hydrocarbons that make up oil but the most common groups are shown in the table below.

Group Name	Percentage in Crude Oil (%)	Description	Example Diagram
alkanes	30	Chains of carbon and hydrogen atoms.	
cycloalkanes	49	Rings of carbon atoms.	
aromatics	15	Hexagonal rings of carbon atoms.	
asphaltics	6	Carbon compounds that include H, N, O, S, V and Ni.	not applicable

In the ground, crude oil is often found beneath a layer of natural gas which consists of mainly methane. It is called 'natural gas' because it occurs naturally and is in gaseous form at normal **atmospheric** temperature. Crude oil is a high energy **yielding** fuel that can be separated into various products including petrol, diesel, LPG, jet fuel, **paraffin** and bitumen (asphalt/road tar). The key component in crude oil for these fuels are the alkanes. Alkanes are chains of carbon atoms **saturated** by hydrogen atoms. They can vary in length from one to around forty carbon atoms (though

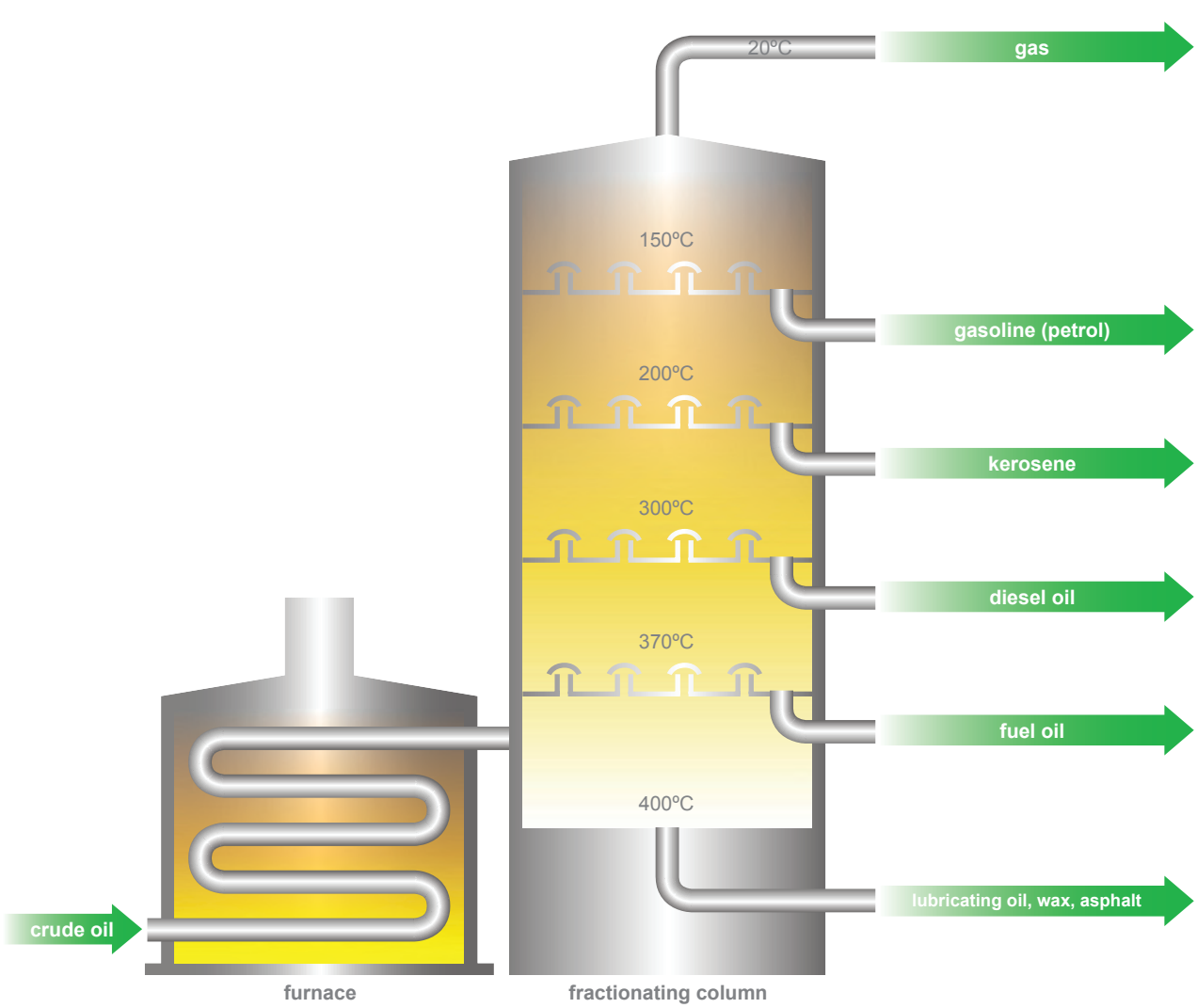
Number of Carbon Atoms	Number of Hydrogen Atoms	Formula	Example Diagram	Name
1	4	CH_4		methane
2	6	C_2H_6		ethane
3	8	C_3H_8		propane
4	10	C_4H_{10}		butane
5	12	C_5H_{12}		pentane

longer ones do exist). The first five are outlined in the table at the bottom of the previous page. They show a common trend in their ratio of carbon to hydrogen atoms which can be expressed as the equation: C_nH_{2n+2}

For example, methane with one carbon would be: $C_1H_{(2 \times 1)+2}$ which equals CH_4

If we looked at propane with three carbons then it would be: $C_3H_{(2 \times 3)+2}$ which equals C_3H_8

These different length chains are used for different products and need to be separated from the crude oil in order to be useful. Luckily, each one has a different **boiling point** (temperature that they turn from a liquid to a gas) which is determined by their chain length. The crude oil is put into a special apparatus called a **fractionating column** which carries out the process of **fractional distillation**. It is called 'fractional' because it splits the crude oil into fractions or parts.



The crude oil enters the column at its base where it has been heated to around 400°C. The longer chains of 25 carbons or more remain in liquid form and are removed to be used as paraffin or asphalt. The remaining alkanes (which are in gas form) rise up the tower to the higher levels. The next section is cooled to around 370°C and alkanes with 16 to 25 carbons **condense** (become liquid again) and are removed for fuel oil (oil that is used in heating and running furnaces). This process continues, removing different fractions along the way. The shortest chains (5 to 8) don't condense until they reach the very top where they are cooled to around 150°C. These chains are used for petrol production. Any remaining smaller chains (those under 5) exit out the top remaining in gas form. From here they can either be used to power the **refinery's** furnace, compressed to form LPG or burnt so as not to pollute the atmosphere. Some of these smaller gases have more specific uses; butane is used in cigarette lighters and propane for cooking, BBQ's and gas heaters.

It is fascinating to think that something made from dead and decaying **aquatic** life has been transformed into something humans have relied on for heating, cooking and transport for many, many years. Crude oil is an amazing material with a diverse range of uses but using it releases CO_2 gas. Is there another way to get the energy we need without relying on fossil fuels?