

## What is Combustion?

Combustion is the sequence of exothermic (releases heat and light) chemical reactions between a fuel and an oxidant (usually oxygen), which generates flame and produces carbon (soot or ash) and gases such as carbon dioxide. Biomass combustion simply means burning organic material. Throughout history people have used this basic technology to create heat and generate power through steam.

Complete combustion means that the fuel source reacts completely and generates only heat, water vapour, ash and carbon dioxide, but complete combustion is almost impossible to achieve.

Incomplete combustion occurs when not enough oxygen is present and the burning gases are partially cooled below the ignition temperature. The flue gases then contain burnable components or carbon monoxide, soot and creosote. Since these by-products are pollutants that can harm our environment, measures have to be taken to prevent them

from being emitted into the atmosphere. Modern day biomass combustion technology utilizes high quality air filtration systems to minimize particulate matter that is released into the atmosphere over traditional methods, such as fireplaces and wood stoves. Better combustion efficiency lowers particulate matter and greenhouse gas emissions. This has positive environmental, economic, and health benefits.

## How Combustion Works?

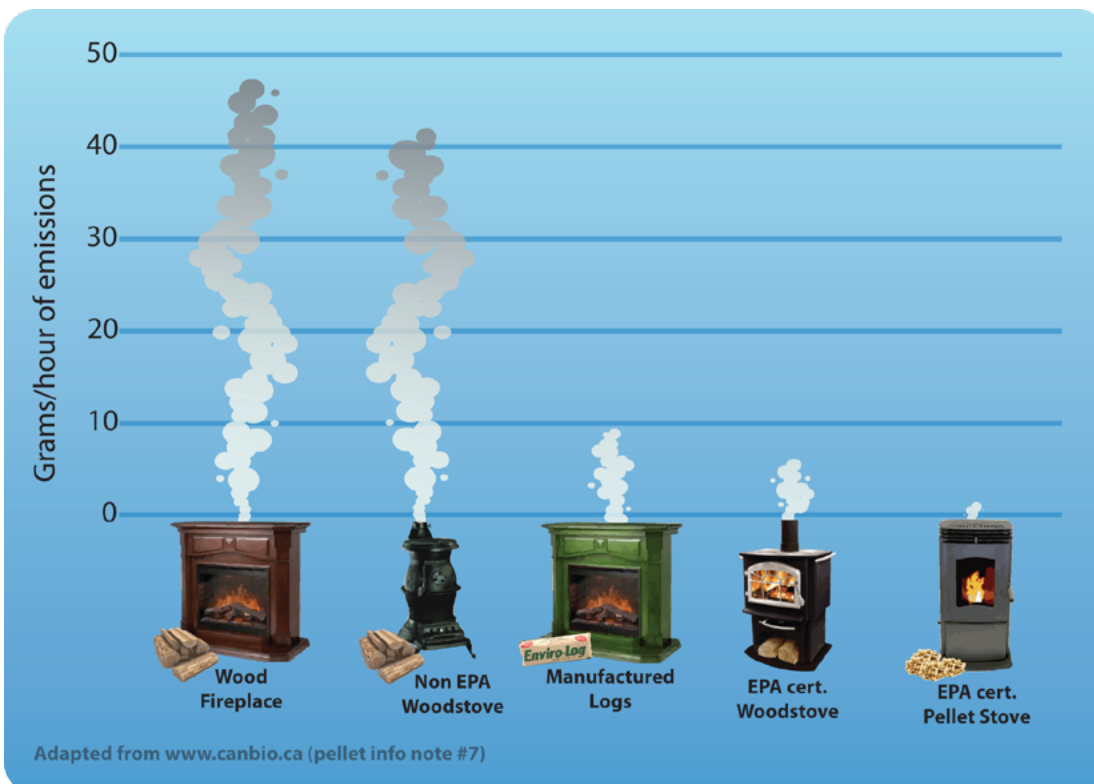
In order for combustion to take place, three elements are necessary:

- A fuel source, which is commonly solid wood, but almost anything will burn including liquids and gases.
- An oxidant, which is usually oxygen, although there are many oxidizing agents including fluorine, chlorine, bromine, etc.
- And heat, which can be generated through friction, chemical reaction, solar energy, high pressure, and electricity.

## Combustion follows three stages:

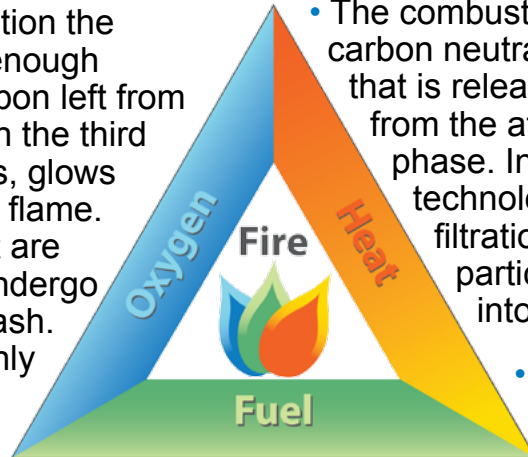
The first stage begins when wood fuel is heated but before it reaches about 200°C also known as its ignition temperature in the presence of oxygen.

Under the influence of heat, the chemical bonds of the fuel are split causing water vapour and CO<sub>2</sub> to be driven off in the form of smoke.



The second stage begins with ignition, when visible flames form and burn the pyrolysis gases, which are formed when the bonds of the fuels molecules split and off-gas. Throughout the second stage of combustion the temperature of the fire rises from the chemical reactions taking place.

In the third stage of combustion the fire reaches 450°C, a high enough temperature to burn the carbon left from stage two. Burning carbon in the third stage, referred to as embers, glows and burns without smoke or flame. The particles of the fuel that are non-combustible, or don't undergo complete combustion form ash. These particles consist mainly of calcium, carbon, and potassium.



## Benefits of Wood Combustion for Heat

Aside from being aesthetically pleasing and exceptionally cozy, new certified wood heating units offer high efficiency rates and savings on fuel costs. The major benefit to wood burning appliances and technology is their fuel source, wood. The use of wood fuel, otherwise known as woody biomass, offers environmental, economic and energy related benefits.

- Trees, waste from agricultural crops and other purpose grown energy crops can all be grown and harvested in a sustainable way. Harvesting biomass following sustainable techniques will ensure biomass is replenished continuously, leading to a renewable supply.
- By converting to wood fuels, home and business owners can reduce their carbon footprint by displacing the use of fossil fuels.
- Biomass is a locally available fuel source that can increase a region's energy independence and security. When used for home heating, district heating, or in combined heat and power plants, it can help to stimulate

economic development.

- Additionally, transporting raw biomass over a long distance is not economical. This ensures that biomass is sourced and processed locally, injecting money and creating new jobs in the local economy.
- The combustion of biomass to create heat is carbon neutral because the carbon dioxide that is released when burning is recaptured from the atmosphere during the growth phase. In addition, current combustion technology utilizes high quality air filtration systems to minimize the particulate matter that is released into the atmosphere.
- The price of woody biomass per unit of thermal energy is far less than the current price of oil. Fuel costs associated with operating a large boiler system using wood chips or pellets results in significant cost savings when compared to oil. This results in good economic opportunities for communities who rely on oil for their heating needs.
- Many people also prefer heat from a wood burning appliance as it is a more ambient, cozy warmth that improves the comfort level of a home.

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