

Greenhouse gases. Is it just a lot of hot air?

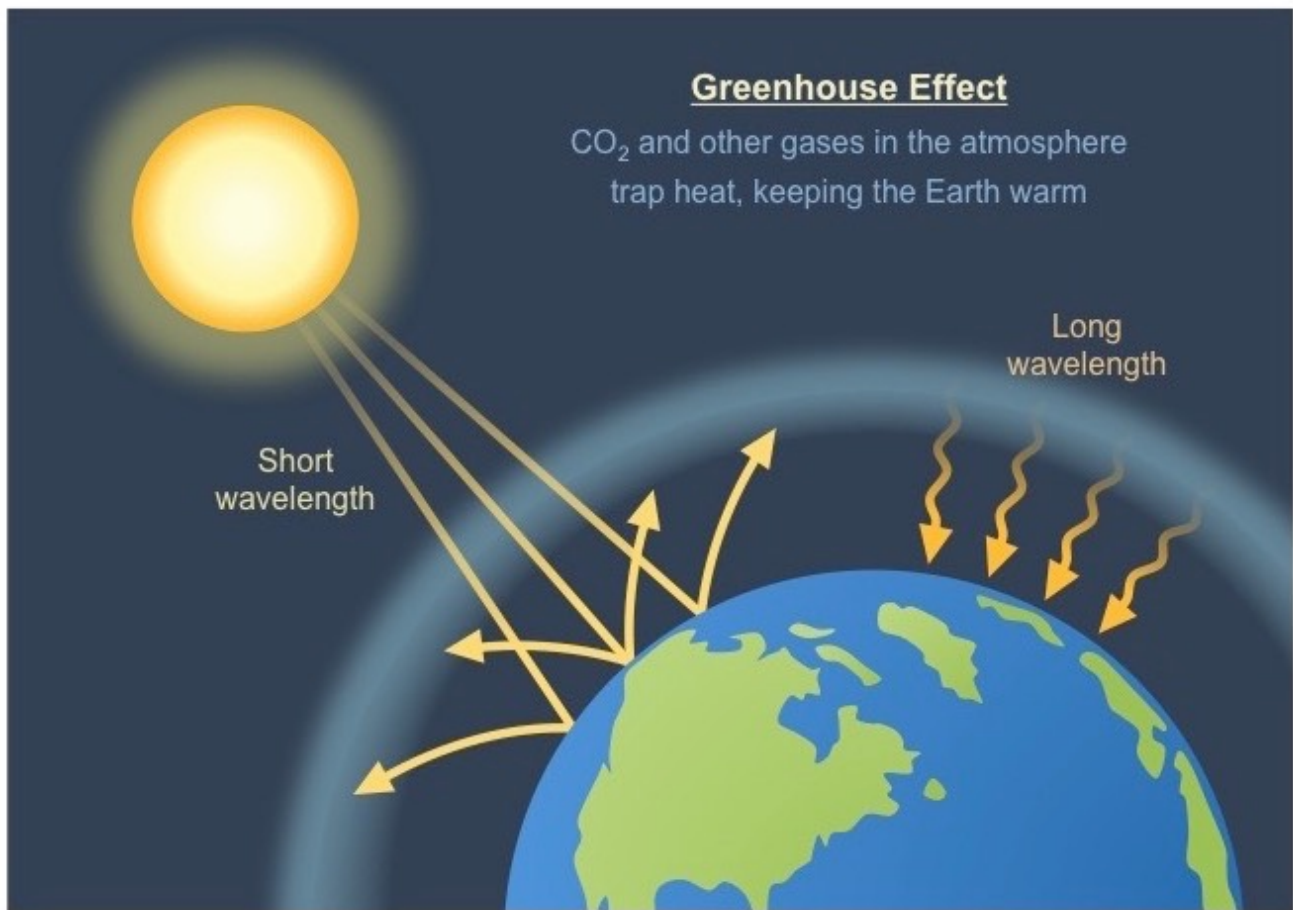
What are Greenhouse Gases? How do they work?

Over the past decade, environmental awareness has drastically increased, it has made mainstream news, our social media feeds, billboards and lunchtime discussions. With all this jargon and influx of information regarding climate change and global warming, it is difficult to understand how driving our cars too much will increase the temperature of the atmosphere and better still, how our small improvements will make a difference at all considering the larger impact of air travel, industry and larger nations such as China or the United States (Somerville & Hassol, 2011). To gain an understanding of these interactions and the significance of the Anthropocene and civilization, we must lay the foundation of how greenhouse gases warm our atmosphere.

The Greenhouse Effect

The gases and our atmosphere (greenhouse gases) protect and insulate Earth making it inhabitable for life. This effect has been around for as long as life on Earth and will continue well into the future.

During the day, short wavelength solar energy (ultraviolet radiation) is generated from the sun and transmits through space until it breaks the Earth's atmosphere. When this radiation hits the Earth's surface and is either absorbed or reflected towards the atmosphere as long wavelength (or infrared) radiation, also called heat (University Corporation for Atmospheric Research, 2011). This infrared radiation is captured the gases in our atmosphere and held until night, where they get re-radiated to maintain the heat of the atmosphere during the night - otherwise, Earth would drop to below freezing (Pierrehumbert, 2011).



Retrieved from:
<https://ib.bioninja.com.au/standard-level/topic-4-ecology/44-climate-change/greenhouse-effect.html>

The unique characteristic of a greenhouse gas is their ability to bend and reflect only infrared radiation and not ultraviolet radiation, as a result, they are the ultimate one-way filter of solar radiation and heat for our atmosphere (University Corporation for Atmospheric Research, 2011).

The Greenhouse Gases

Collectively, greenhouse gases make up less than 1% of the Earth's atmosphere but have the greatest impact on life below it. The most potent greenhouse gases, as described by their radiation absorbance and concentration in the atmosphere, are;

- **Carbon dioxide;** the primary long-lived greenhouse gas, of which atmospheric concentrations have surpassed 400 parts per million, a 46% increase since the pre-industrial era (before 1760) (World Meteorological Organization, 2018). Carbon dioxide are primarily man-made, from industrial processes, the automotive industry and the burning of fossil

fuels. Additionally, carbon dioxide sinks, such as forests, are being rapidly reduced by deforestation to make way for agriculture and civil infrastructure, that only lead to further greenhouse gas emissions. As the most abundant greenhouse gas in the atmosphere, carbon dioxide is used as the benchmark for estimating greenhouse and radiative forcing effects (as tonnes of CO₂ equivalent).

- **Water vapour;** with an atmospheric concentration between 0.01 and 4%, water vapour is generated by the evaporation of open water bodies and plays a large role in regulating the warming effect by means of clouds and vaporisation. However, water vapour has a short lifespan in the atmosphere (roughly 1-5 days) and its concentration and behaviour are largely unaffected by anthropogenic and industrial shifts.

Other gases have less impact on the greenhouse warming effect, they include;

- **Methane;** as another long-lived greenhouse gas, 60% of atmospheric [methane](#) come from anthropogenic sources such as livestock farming, agriculture, fossil fuel harvesting and landfills. Naturally produced from anaerobic respiration in wetland biomes (otherwise known as bog), the atmospheric concentration of methane is over 1859 part per billion, a 157% increase since the pre-industrial era (World Meteorological Organization, 2018).
- **Nitrous oxides;** nitrous oxides are an incredibly toxic gases with an atmospheric concentration of over 330 parts per billion (a 22% increase since the pre-industrial era) (World Meteorological Organization, 2018). Approximately 40% of this is sourced from anthropogenic causes such as biomass burning, fertiliser and industrial processes. Possibly the most dangerous gas to human life, nitrous oxides play a large role in the destruction of the stratospheric ozone layer, the outer atmosphere that protect Earth from the majority of harmful ultraviolet radiation.

The link between the Greenhouse Gases, their effect and Climate Change

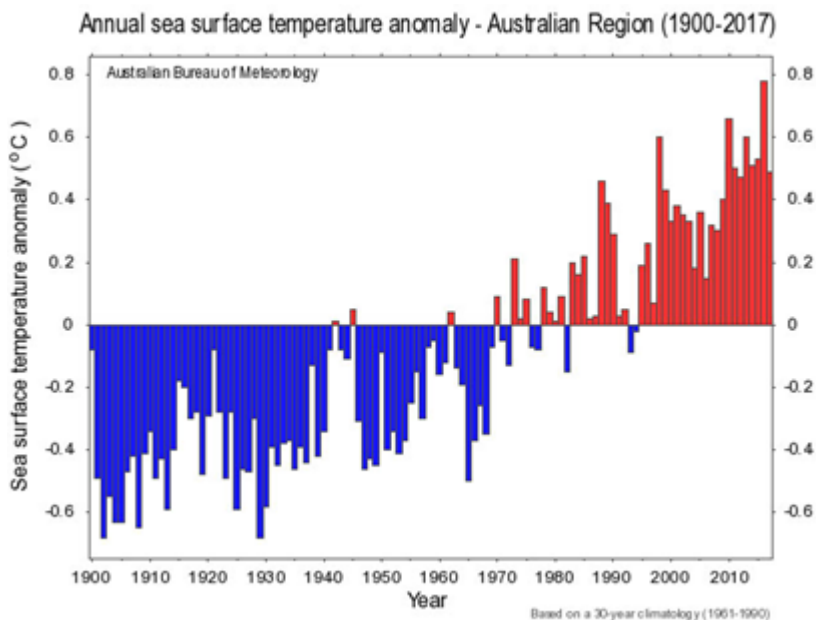
Traditionally, the concentration of greenhouse gases in our upper atmosphere optimised the absorption, reflection and filtering of ultraviolet and infrared radiation – a key process in regulating atmospheric temperatures on Earth. However, after key historical shifts such as the industrial era, the increased emission and pollution of these greenhouse gases, as well as the reduction in

available sinks (such as deforestation) have led to sharp increases in their concentrations and an increase in atmospheric warming.

According to the US National Oceanic and Atmospheric Administration (quoted by the World Meteorological Organization), there has been a 41% increase in total radiative forcing or greenhouse warming since 1990, of which 82% of radiative forcing over the past decade can be attributed to carbon dioxide (World Meteorological Organization, 2018).

These increases in greenhouse gas concentrations and radiative forcing have led to a number of measurable changes in our atmosphere and environment globally (CSIRO, 2016):

- Global air temperatures have risen by 1.1 °C since the end of the 19th century;
- Global seas levels have risen 0.19 m since the end of the 19th century; and
- Ocean temperatures surrounding Australia have increased by 0.73 above the 1960 – 1990 average.



Retrieved from the State of the Climate 2016 Report (CSIRO, 2016)

These changes have had ongoing and accelerating effects on our climate, as science continues to produce more accurate and inclusive data, conduct longitudinal research and correlate changes in greenhouse gas concentration against key climate parameters, the anthropogenic effect on enhancing the greenhouse effect is becoming undeniable and demanding immediate action

(Knutti & Hegerl, 2018).

For further information about Climate Change, important innovations and your environmental footprint, do visit [THRIVE Project](#), designed to guide you towards sustainable prosperity.

Written in collaboration with THRIVE Tribe member Thomas Jackson.

References

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