Green House Gases & Climate Change

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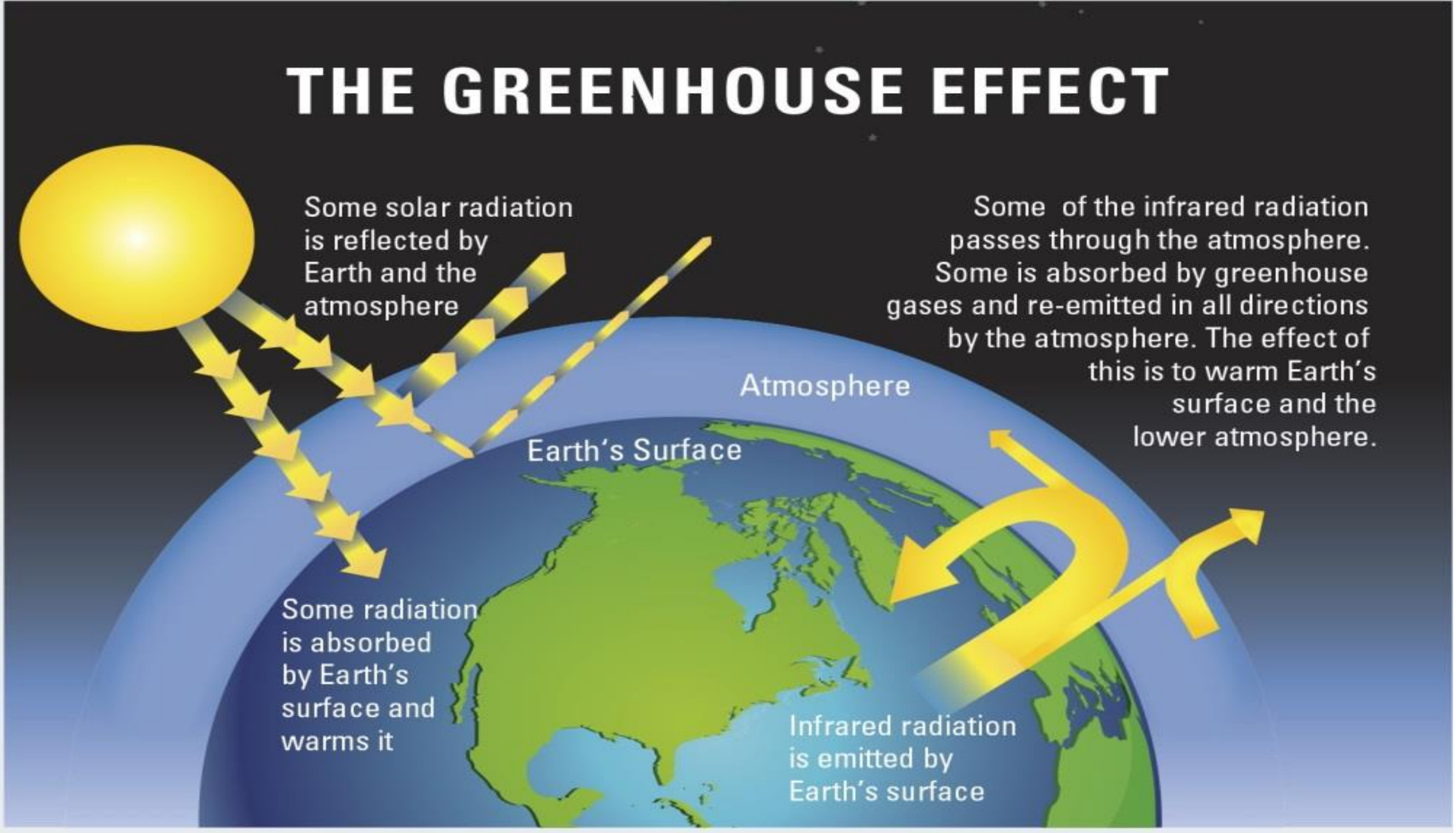
Green House Gases & Global warnimng

- Rapid urbanization and industrial revolution led to **release of greenhouse gases into the atmosphere** which has caused severe change in the Earth's climate.

- **Climate change** refers to significant changes in **global temperature**, **precipitation**, **wind pattern** and other measures of climate that occur over several decades or longer.

- These **long-term shifts in temperatures and weather patterns** may be caused to due to
  - Natural activities
  - Anthropogenic activities – **Green House Gases (GHGs)**

THE GREENHOUSE EFFECT



Green House Effects

Atmospheric layers acts as glass house for the earth

Glass House representing Green House

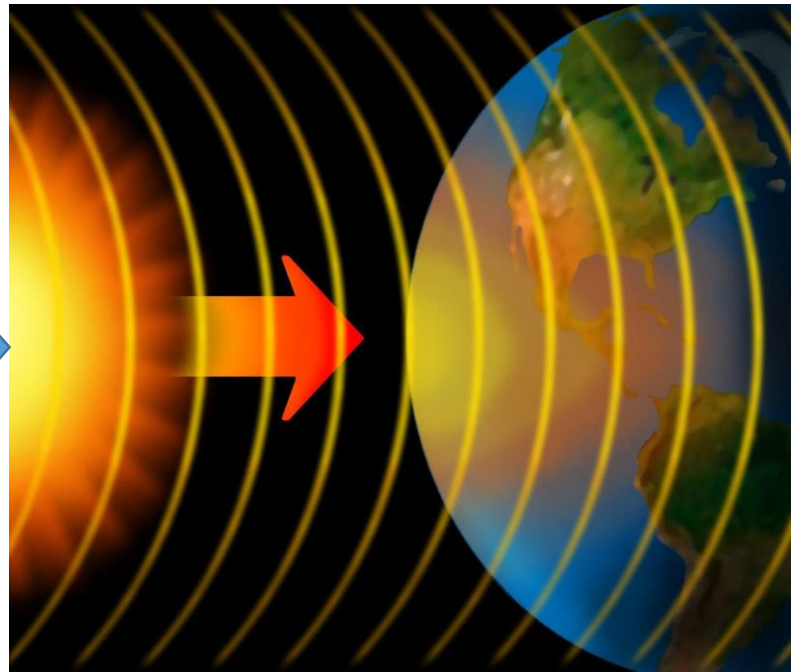
Car with closed windows get heated inside

What Causes the Greenhouse Effect?

- 30% of the solar energy that reaches our world is reflected back to space.

- Approximately 70% passes through the atmosphere to the earth's surface, where it is absorbed by the land, oceans, and atmosphere, and heats the planet.

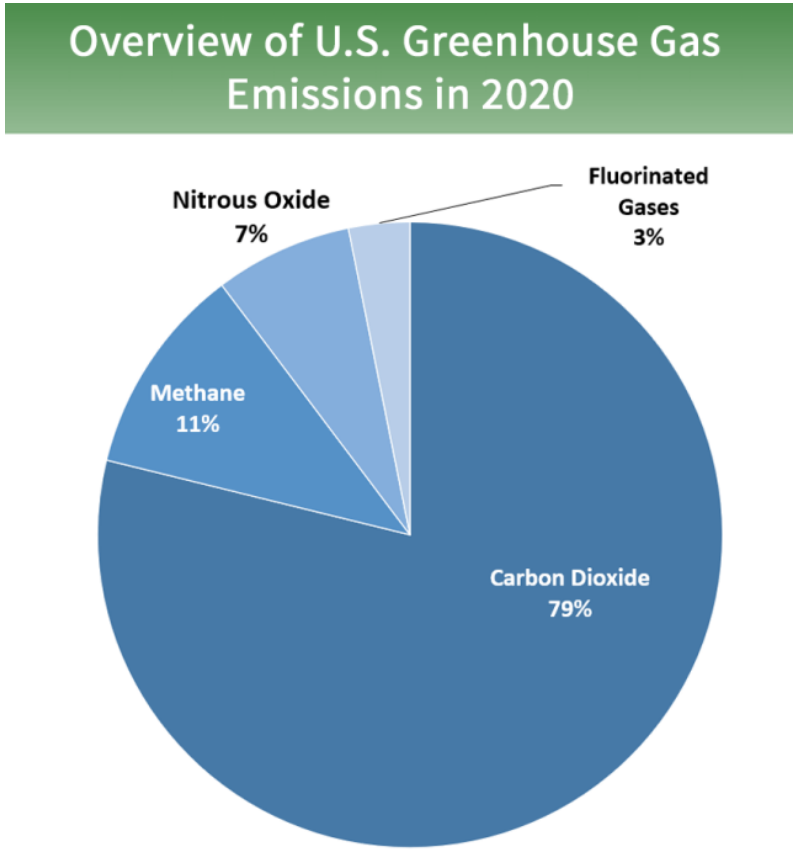
- While some of this infrared light continues on into space, and about 90% absorbed by atmospheric gases, known as greenhouse gases, and redirected back toward the earth, causing further warming.



Greenhouse Gases (GHGs)

- **Greenhouse gases absorb and emit heat energy in all directions (including downwards), keeping Earth's surface and lower atmosphere warmer.**

- **Major GHGs :**
  - **Methane (CH_4)**
  - **Carbon dioxide (CO_2)**
  - **Nitrous oxide (N_2O)**
  - **Fluorinated gases**: Hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride.
  - **Water vapour (H_2O)**



Total U.S. Emissions in 2020 = 5,981 Million Metric Tons of CO2 equivalent (excludes land sector).

GREENHOUSE GASES

60%	CO_2	Carbon dioxide*	Burning fossil fuels, deforestation
16%	HFCs	Hydroflurocarbons	Aerosols, refrigerants
15%	CH_4	Methane*	Organic waste, cattle, fuel production
5%	N_2O	Nitrous oxide	Fertilizers, soil, fuels
2%	PFCs	Perfluorcarbons	Paint, textile and aluminum production
1%	SF_6	Sulphur hexafluoride	Electrical industry, rubber/Mg production
1%	H_2O	Water vapour*	Irrigation, evaporation, ice melting

http://commons.wikimedia.org/wiki/File:Greenhouse_Gases.jpg

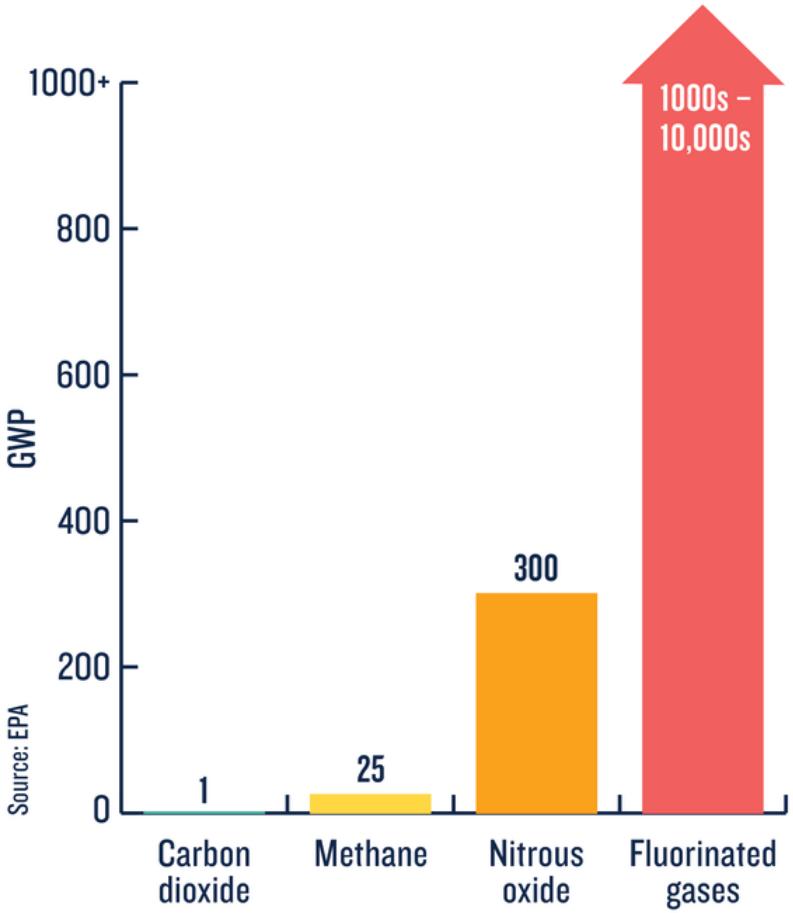
Effect on climate

*Natural Greenhouse gases

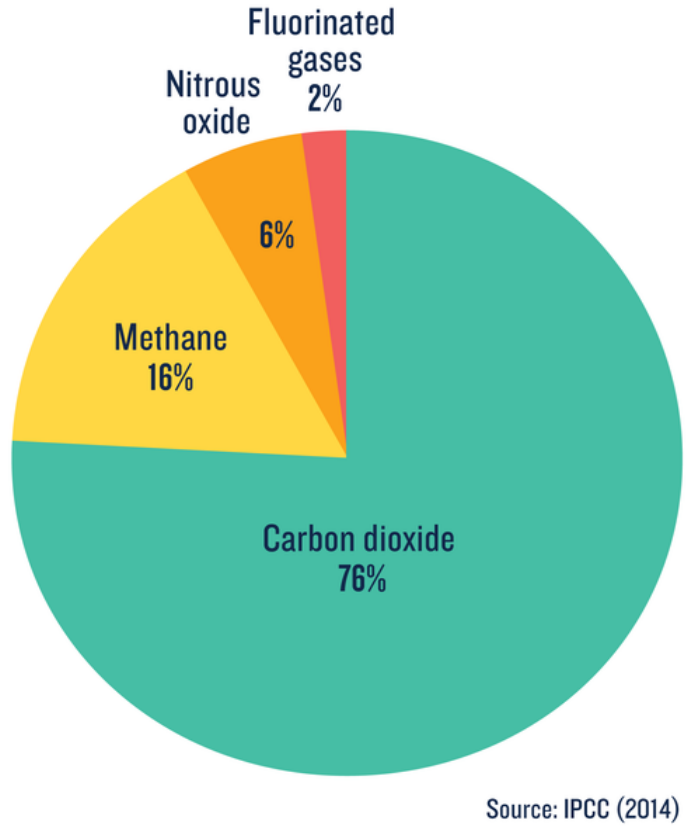
Global Warming Potential (GWP)

- The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases.
- It is a measure of heat energy that is absorbed by the emissions of 1 ton of a particular gas relative to CO_2.
- CO_2 having its highest residence time in the air was taken as standard for comparison of GWP of other gases.
- **Thus the amount of heat absorbed by 1 ton of CO_2 was taken as GWP = 1.**

HOW GREENHOUSE GASES WARM OUR PLANET



The global warming potential (GWP) of human-generated greenhouse gases is a measure of how much heat each gas traps in the atmosphere, relative to carbon dioxide.

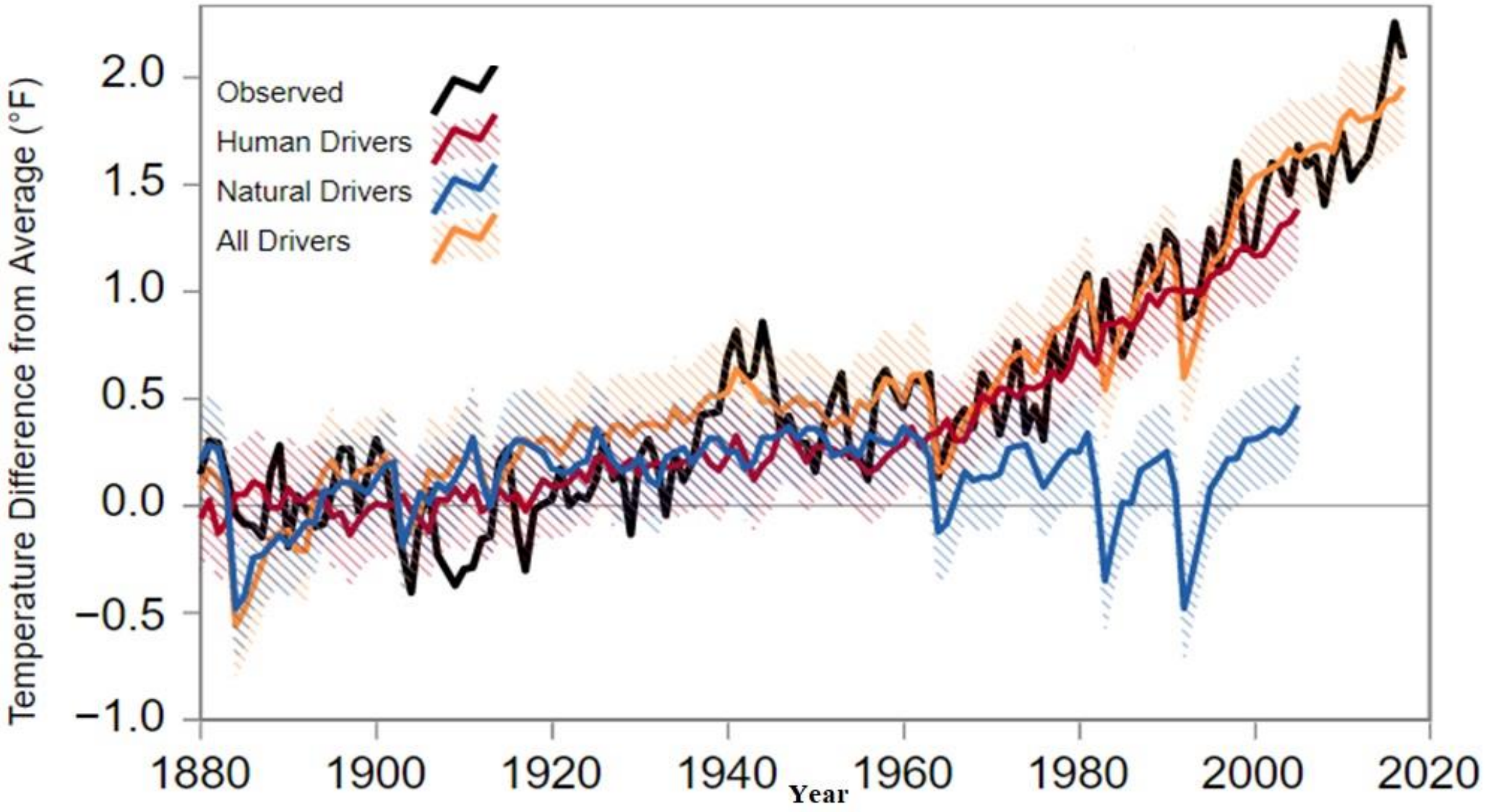


How much each human-caused greenhouse gas contributes to total emissions around the globe.

GWP of Major GHGs

Greenhouse Gas (GHG)	Atmospheric Lifetime (yrs)	Global Warming Potental (GWP)	Primary Current Sources
Carbon dioxide (CO_2)	50-200	1	Fossil fuel use, land use, cement
Methane (CH_4)	12±3	21	Fossil fuel use, agriculture
Nitrous oxide (N_2O)	120	310	Mostly agriculture, ~1/3 are anthropogenic
Hydrofluorocarbons (HFCs)	1.5 to 209	150 to 11,700	Alternative to ozone depleting substances
Perfluorocarbons (PFCs)	2,600 to 50,000	6,500 to 9,200	Primary aluminum production; semiconductor manufacturing
Sulfur Hexafluoride (SF_6)	3,200	23,900	Used in electric power transmission, magnesium and semiconductor industries

Influence of Human and Natural Drivers on Rise in Global Temperature



❖ **After 1950 it is extremely likely that human activities have been the dominant cause of the temperature rise**

Concentration of Greenhouse Gases (GHGs)

- Concentrations of the **key greenhouse gases in the atmosphere have increased** since the industrial revolution. **These GHGs emissions led to the rise in Earth's surface temperature.**

- Carbon dioxide, methane, and nitrous oxide concentrations are the most abundant in the Earth's atmosphere.

CO_2 (280 ppm in the 18th century) → **414 ppm in 2020**

CH_4 (722 ppb in the 18th century) → **1,867 ppb in 2019**

N_2O (270 ppb at preindustrial level) → **332 ppb in 2019**

Reflectivity or Absorption of the Sun’s Energy

- **Activities such as agriculture, road construction, and deforestation can change the reflectivity of the earth's surface, leading to local warming or cooling**.

- **Buildings, pavement, and roofs tend to absorb more sunlight (Infrared) than natural surfaces hence these areas are warmer**.

- **Deforestation can increase the earth’s reflectivity** globally by replacing dark trees with lighter surfaces such as crops.

- **Emissions of aerosols, into the air also lead to reflection or absorption of the sun's energy**.

Effects of Green House Gases

- **Global Warming/ Hotter temperature**
- **More severe storms**
- **Increased drought**
- **Rise in the level of ocean**
- **Loss of species**
- **More health risks**

Control of Greenhouse Effect

- Alternate sources of energy are to be used
- Advanced and efficient technologies for reducing emissions from fossil fuels.
- Afforestation and reforestation on a large scale
- Water logging should be avoided
- Reduction of the use of CFC
- Carbon market

Kyoto Protocol (1997)

- The Kyoto Protocol was an **international treaty** which extended the 1992 United Nations Framework Convention on Climate Change that commits state parties to reduce greenhouse gas emissions, in accordance with agreed individual targets.

- The Protocol to the United Nations Framework Convention on Climate Change (the 'Kyoto Protocol') was adopted at the third session of the Conference of the Parties (COP 3) in **Kyoto, Japan, on 11 December 1997**.

- Apart from national measures, the agreement has **three mechanisms** that are means to achieve the Kyoto targets:
  - **International Emissions Trading.**
  - **Clean Development Mechanism.**
  - **Joint Implementation.**


thank you