GREENHOUSE GASES (GHG)

The Sun’s rays travel through the atmosphere and warm the Earth’s surface, generating the upward emission of infrared heat (radiation). Some of this heat is trapped on its escape to space by greenhouse gases (GHG) in the atmosphere and sent back towards the Earth’s surface. Greenhouse gases thus act like a “blanket”, trapping heat, and causing the temperature of the lower atmosphere to rise.

Greenhouse gases released by human activities increase the thickness of this “atmospheric blanket”, causing the global temperature to rise. This phenomenon is called global warming.

IPCC Special Report Global Warming of 1.5°C Summary for Teachers, OCE
WHERE DO THESE GASES COME FROM?

**H₂O**
- **WATER VAPOR**
  - From natural evaporation and clouds, it creates the natural greenhouse effect.

**O₃**
- **OZONE**
  - Naturally occurring at very high altitude (stratosphere), it filters the sun's ultraviolet rays and protects us from them.
  - Its accumulation at low altitude (troposphere), due to thermal vehicles and industrial activity, causes a greenhouse effect.

**CO₂**
- **CARBON DIOXIDE**
  - **Main Source**
    - The combustion of fossil fuels (coal, oil, gas).
  - **Other sources**
    - Deforestation and land occupation by human activities.

**CH₄**
- **METHANE**
  - **Main source**
    - Intensive livestock farming and the fermentation of organic waste.
  - **Other sources**
    - The production of fossil fuels and the extension of immersed areas (rice fields, swamps).

**N₂O**
- **NITROUS OXIDE**
  - **Main source**
    - Industrial agriculture using fertilizers containing nitrogen, and animal excrement.
  - **Other sources**
    - Certain industrial processes and vehicle catalytic converters.

**HFC / PFC / SF₆ / NF₃**
- **FLUORINATED GASES**
  - **Main Source**
    - Refrigeration and air conditioning.
  - **Other sources**
    - Insulating foams (devices, vehicles, buildings).
HOW CAN EMISSIONS BE REDUCED?

- Decarbonization of energy and mobility.
- Reducing energy consumption.
- Reforestation and landscaping.
- Atmospheric CO₂ capture.

- Reduction of intensive livestock farming.
- Better waste management.
- Reduction of fossil fuels.

• Reduction of intensive agriculture and industrial livestock farming.
• Global reduction of meat consumption.

• Capture of these gases when dismantling refrigeration and air conditioning systems (buildings, vehicles, etc.).

- H₂O WATER VAPOR
- CO₂ CARBON DIOXIDE
- CH₄ METHANE
- N₂O NITROUS OXIDE
- HFC / PFC / SF₆ / NF₃ FLUORINATED GASES
- O₃ OZONE
- Reduction of fossil fuels.
WHAT ARE THE QUANTITIES EMITTED IN A YEAR?

- **CO₂ (Carbon Dioxide)**
  - 44 Gt*
  - 75%

- **CH₄ (Methane)**
  - 10.6 Gt
  - 18%

- **N₂O (Nitrous Oxide)**
  - 2.6 Gt
  - 4.5%

- **HFC / PFC / SF₆ / NF₃ (Fluorinated Gases)**
  - 1.5 Gt
  - 2.5%

*1 Gt = 1 billion tons

Global anthropogenic GHG emissions in 2019

Source: IPCC report summary, 2022

WHAT IS THEIR LIFESPAN IN THE ATMOSPHERE?

- **CO₂ (Carbon Dioxide)**
  - Over 100 years

- **CH₄ (Methane)**
  - Approximately 12 years

- **N₂O (Nitrous Oxide)**
  - Approximately 100 years

- **HFC / PFC / SF₆ / NF₃ (Fluorinated Gases)**
  - Between 5 and 50,000 years

- **Greenhouse gases have very different lifespans.**

- **CO₂** has a lifespan of **more than 100 years**. Its accumulation makes it the most dangerous gas in the long term.

- **Methane** has an atmospheric lifespan of **approximately 12 years**. It is therefore its short-term concentration that determines its dangerousness.

Source: IPCC report, 2021
WHAT IS THEIR GLOBAL WARMING POTENTIAL?

- The global warming potential (GWP) of a greenhouse gas is the warming power of a mass of that gas, compared with the warming power of the same mass of carbon dioxide (CO₂).
  - The GWP of CO₂ is thus 1.

- The GWP of other greenhouse gases is calculated for a given time frame: usually 100 years, but sometimes 20 or 500 years.

**CO₂**
- Carbon Dioxide
- at 20 years = 1
- at 100 years = 1

**CH₄**
- Methane
- at 20 years = 82
- at 100 years = 27

**N₂O**
- Nitrous Oxide
- at 20 years = 273
- at 100 years = 273

**HFC / PFC / SF₆ / NF₃**
- Fluorinated Gases
- Between 770 and 23,000

**GWP of methane**

Due to its shorter lifespan compared to other gases, the GWP of methane is considerably lower at 100 years than at 20 years.

According to the IPCC, CH₄ is responsible for over a quarter of global warming, because of its greater warming potential.

Source: IPCC report, 2021