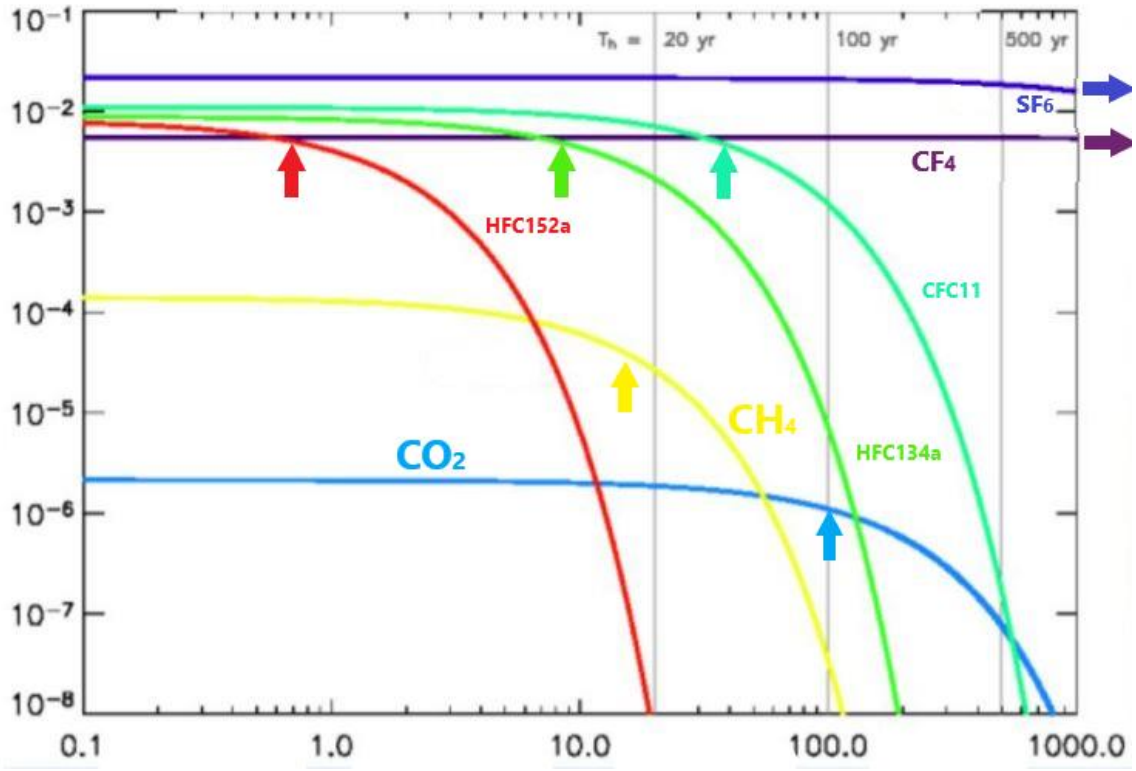
## GLOBAL WARMING POTENTIAL (GWP) . CO2 EQUIVALENT

**More or less persistent greenhouse gases**

It was the GIEC, in its first assessment report, that proposed the use of the unit of CO2 equivalent (or CO2eq) to facilitate the comparison of the various gases involved in the warming process.

As shown in the graph below, greenhouse gases eventually disappear from the atmosphere over very different timescales. This is the main reason for establishing the Global Warming Potential.




If we pay attention to the logarithmic time scale used by the authors of this graph, we can see from the thick coloured arrows that CO2 starts to disappear significantly from the atmosphere after about 100 years; CH4 takes about 10 years, HFCs less than 10 years. However, fluorocarbon (CF4) and fluorosulphur (SF6) compounds do not decay for several hundred to thousands of years.

Understanding that the persistence of greenhouse gases in the atmosphere is highly variable, it is absolutely necessary to compare each of their respective impacts to that of CO2 in the global warming of the atmosphere. Using the unit of CO2 eq, it is possible to assign a global warming potential (GWP) for each greenhouse gas for a given period of time. The GWP is therefore considered to be 1 for the CO2 used as a reference.

| | $CO_2$ | $CH_4$ | $N_2O$ | HFC | PFC | $SF_6$ | $NF_3$ |
|---|---|---|---|---|---|---|---|
| Concentration atmosphérique 2016 (en 2005 entre parenthèses) | 403 ppm (379 ppm) | 1 842 ppb (1 773 ppb) | 329 ppb (320 ppb) | > 183 ppt (> 49 ppt) | > 88 ppt (> 4,1 ppt) | 8,9 ppt (5,6 ppt) | 1,4 ppt (> 0 ppt) |
| Potentiel de réchauffement global (cumulé sur cent ans) | 1 | 28-30 | 265 | [ 1,4 ; 14 800 ] | [ 6 630 ; 11 100 ] | 23 500 | 16 100 |

*Sources : Giec, 1er groupe de travail, 2013 ; NOAA, 2018 ; Agage, 2018*
Microsoft Word - Global-Warming-Potential-Values.docx (ghgprotocol.org)
The comparisons in the table above show that 1 kg of CH4 will contribute as much to global warming as 28-30 kg of CO2.

1 kg of SF6 will warm the atmosphere as much as 23.5 tonnes of $CO_2$.

**In other words, 1 kg of $CH_4$ = 28 kg $CO_2$eq  1 kg of SF6 = 23,500 kg $CO_2$eq**

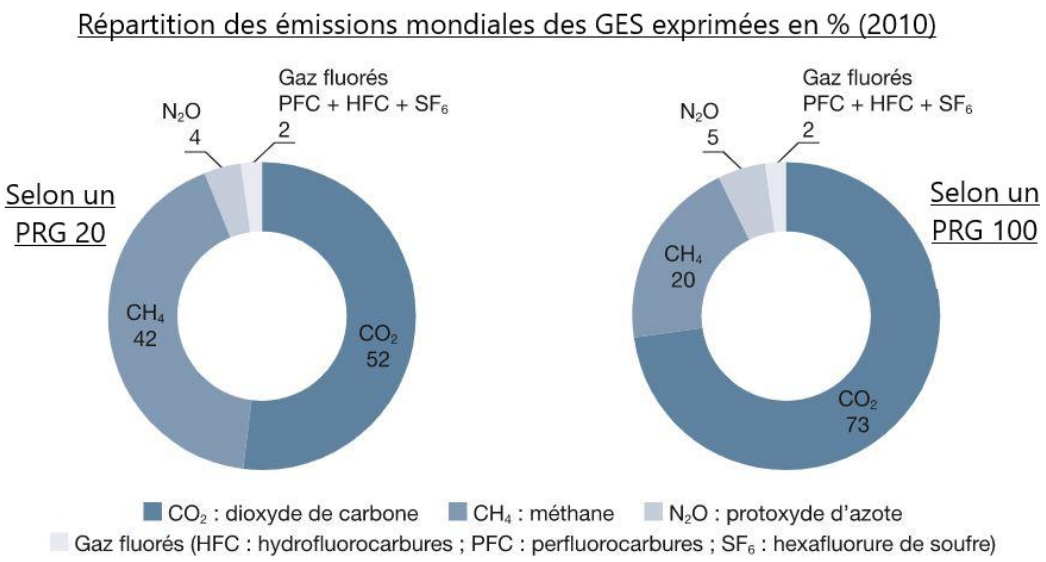
**Short, medium and long term GWPs.**

However, a clarification is needed on the expression of the global warming potential. As previously stated, the reference greenhouse gas is $CO_2$, the impact of which is assessed over a given period of time. This last parameter has been arbitrarily fixed at 100 years, but more and more publications take into account GWPs for 20 years or 500 years. A distinction is then made between short, medium and long term GWPs.

This may seem anecdotal, but calculating the 20-year GWP or 100-year GWP highlights the different impact of GHGs according to their duration of persistence in the atmosphere.

Thus $CO_2$, which by convention has a GWP20 equal to the GWP100 of a value of 1, $CH_4$, which is not very persistent, has a GWP100 of 28, but a GWP20 equal to 82

It can therefore be seen that, depending on the method of calculation used, the impact of persistent GHGs (GWP100 and $CO_2$) or the impact of non-persistent GHGs (GWP20 and $CH_4$) will be highlighted, as clearly illustrated in the 2014 GIEC document.




**<u>The carbon footprint</u>**

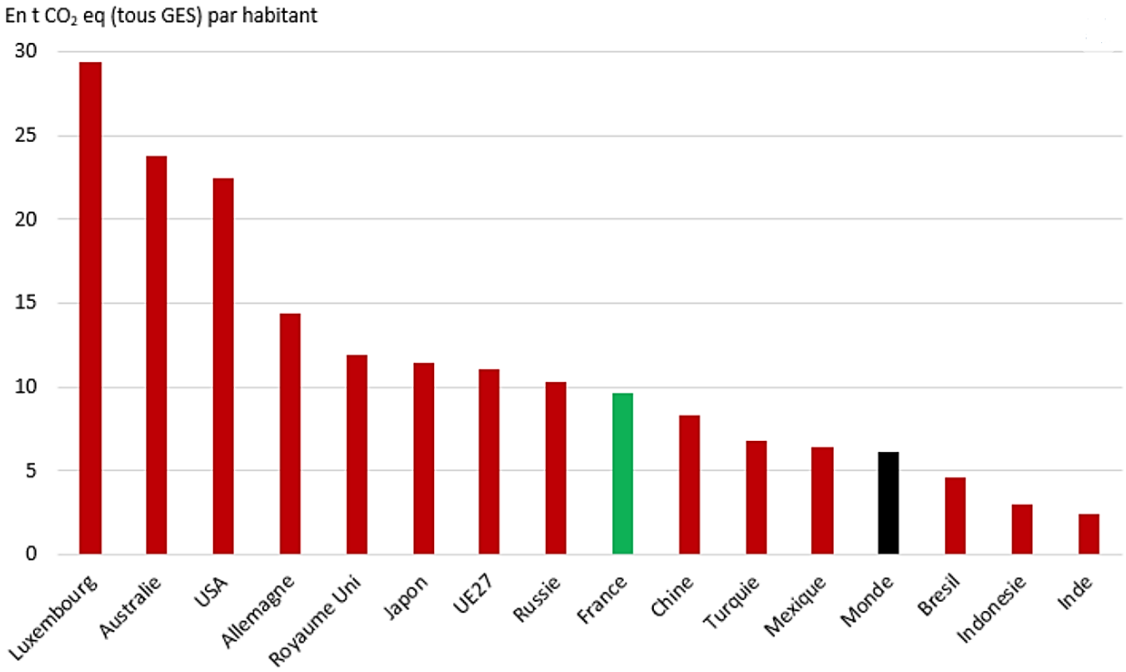
Taking into account the values provided by the GIEC, in 2010 the volume of GHGs was 49 Gigatonnes CO2eq and will reach 59.1 Gigatonnes $CO_2$eq in 2019.

Thanks to a good understanding of the concept of $CO_2$ equivalent, it is now possible to accurately establish the carbon footprint of a product or service; compare the carbon footprint of a plane flight with the consumption of a beef steak.

The carbon footprint is calculated by adding up all the greenhouse gas emissions at each stage of the product's life cycle (construction materials, production, use, waste treatment) or of a service. The carbon footprint is then expressed in units of mass of $CO_2$ equivalents.

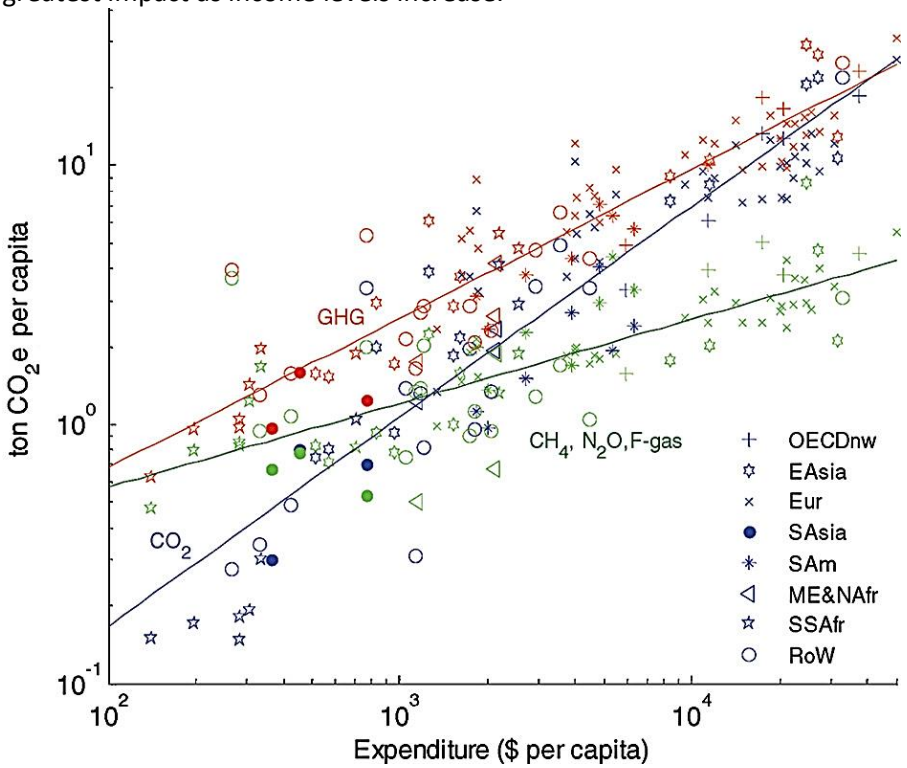
The domestic carbon footprint is useful for highlighting differences between inhabitants of different countries.

***Source :*** *Giec, 3e groupe de travail, 2014*




*émissions de $CO_2$, $CH_4$ et $N_2O$ et autres GES- © Source: Exiobase 3.7. Traitements SDES, 2021.*

Carrying out these calculations on a national scale makes it possible to determine the national carbon footprint of GHGs induced by the direct emissions of inhabitants (housing and transport), production emissions (food, consumer goods) and all emissions from external activities intended for import.
In a 2009 study of more than 70 countries, the authors draw some remarkable conclusions: Food and services are more important in developing countries, while mobility and manufactured goods are the 2 activities that have the greatest impact as income levels increase.




- Blue indicates $CO_2$,
- green other GHGs,
- red total GHGs measured in GWP-100.

The regions are:

- OECD new world,
- East Asia,
- Europe,
- South Asia,
- South America,
- Middle East and North Africa,
- Sub-Saharan Africa,
- Rest-of-World.

Per capital GHG emissions due to the consumption in different countries as a function of consumption volume, base year 2001.

Such work makes it possible to adjust GHG emission reduction policies according to the level of development.

Edgar G. Hertwich - Glen P. Peters Carbon Footprint of Nations: A Global, Trade-Linked Analysis | Environmental Science & Technology (acs.org)