

THE GREENHOUSE EFFECT

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1 What is greenhouse effect

The greenhouse effect is a natural phenomenon that contributes to allow the life on Earth.

It is due to the natural greenhouse gases (mainly water vapour, carbon dioxide, methane) which are transparent to the radiation coming from the Sun, but absorb the infrared radiation reflected back from the Earth.

Without the greenhouse gases the heat from the sun would be radiated back into space and the temperature of the Earth would be lower.



Natural Greenhouse effect

The presence of the greenhouse gases traps some solar energy in the atmosphere. The consequence is a higher average temperature of the planet compared with the temperature that would prevail if no greenhouse effect exists. Scientific estimations evaluate the increase to as much as 33°C (from -18°C to the actual 15°C).

This natural phenomenon -being by far the dominant- and human activities contribute to the total "Greenhouse effect". The greenhouse effect is today a major concern as a result of the growing concentration of greenhouse gases due to human activities. According to some studies, the actual trend, if not reversed, will cause a significant increase of the average temperature of the planet, the consequences of which are still unclear but potentially dangerous.



Enhanced Greenhouse effect

2 Greenhouse gases

Other than the naturally occurring greenhouse gases there are manmade gases that contribute to the greenhouse effect. The Kyoto Protocol⁽¹⁾ is an international agreement to control the emission of manmade greenhouse gases.

The basket of greenhouse gases, to be monitored according to Kyoto Protocol is composed of Carbon dioxide (CO₂), Methane (CH₄), Nitrous oxide (N₂O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulphur hexafluoride (SF₆).

The concentrations of different gases relevant to the environment including those in the Kyoto Protocol are regularly monitored by several scientific bodies. In particular IPCC (Intergovernmental Panel on Climate Change) prepares periodically Assessment Reports, up-dating the existing information on emissions and evaluating their potential future impact on the environment according to different hypothesis of their emission's trends. The latest published is the Third Assessment Report (TAR) October 2001. IPCC stands for Intergovernmental Panel on Climate Change, that was established by the World Meteorological Organisation (WMO) and the United Nations Environmental Programme (UNEP) in 1988.

For manufacturers and users of electrical switchgear, SF₆ requires a particular attention, because it is used broadly in modern electrical equipment.

⁽¹⁾ Climate Change, UNFCCC: <http://www.unfccc.de/>

SF6 is an efficient absorber of the infrared radiation. Additionally SF6 is estimated to persist in the atmosphere for a very long time.

The strong infrared absorption of SF6 and its long lifetime in the environment are the reasons for its high GWP (Global Warming Potential) which is 23,900 CO₂ equivalent according to IPCC guide 1996^[1] (latest studies suggest 22,500 as a more accurate value^[2], or even 22,200^[3]).

It is important to underline that SF6 gas is used not only in electrical industry but also in aluminium and magnesium foundries, tires inflating, semiconductors industry, as tracer gas for meteorological measurements, sport shoes, noise-insulated windows, etc. In the case of most non-electric applications the SF6 gas is used in “open” systems, that means usually the gas is emitted to the atmosphere and not recoverable. On the contrary, in electric industry applications the SF6 gas is always used in closed or sealed systems and at the end of life of the equipment the gas can be recovered, recycled and reused.

Furthermore, the SF6 concentration in the atmosphere is extremely low with respect to other Greenhouse gases. Therefore, even taken its high GWP of 23900 into consideration, its relative contribution to the Greenhouse effect is very low. For electrical switchgear applications, inventories of SF6 emissions from the electric sector 1999 show some 50 Mt of CO₂ equivalent. In comparison with the total anthropogenic GHG (Greenhouse Gas) emission of 43000 Mt CO₂ equivalent, this represents a contribution of about 0.1 %.^{[4]-[5]}

It must also be noted that the emission trend of SF6 tends to decrease:

Atmospheric measurements (Northern Hemisphere)
show reversed trend in SF6 emission^[6]



Reasons:

- Reduction of substitutable open and semi-open applications.
- Emission is better controlled by the electrical industry.
- Improved handling procedures in case of closed and non-substitutable applications

[1] <http://www.ipcc-ugqip.iges.or.jp/public/gl/invs1.html>

Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories

[2] F Moore et al.: Measured SF6-loss and its influence on age of air calculation. IX Intern Symposium on Gaseous Dielectric, 21-25 May 2001. Ellicott City, USA).

[3] IPCC Climate Change 2001: the scientific basis Working Group I

[4] EPA Conference “SF6 and the Environment, Emission Reduction Strategies”, San Diego – November 2-3, 2000.

[5] CIGRE’ – SC 23 “SF6 in the electric industry, status 2000”, 2001

[6] M. Maiss, C.A. Brenninkmajer. “A reversed trend in emission of SF6 into the atmosphere?” 2nd Int. Symp. On Non-CO₂ Greenhouse Gasses, Noordwijkerhout, The Netherlands, 8-10 September 1999.