

environment briefing01

sulphur hexafluoride

Introduction

Sulphur hexafluoride (SF6) is a gas with excellent electrical insulation and other properties, which have led to its widespread use in electrical switchgear and in a number of other industrial applications. However, there is concern over the SF6 that escapes into the atmosphere since it is a potent greenhouse gas. The Kyoto Protocol to the Climate Change Convention has recognised the need to curb emissions of all greenhouse gases, including SF6.

This briefing looks at the uses of SF6, its potential impact on the environment and the implications for the electricity industry.

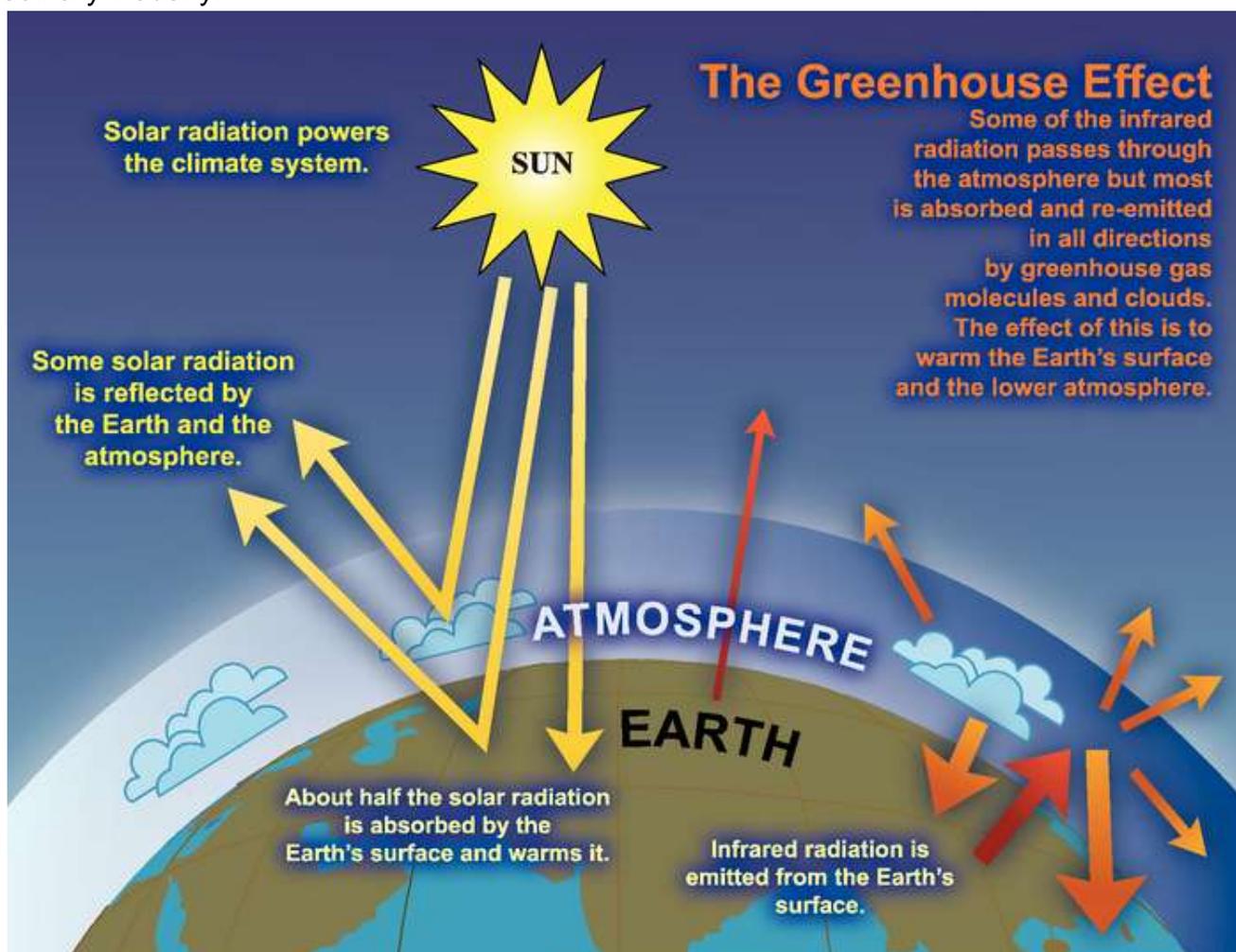


Figure 1

Source: IPCC

Global Warming Impact of SF₆

Like CO₂, methane and various other gases in the atmosphere, SF₆ is a 'greenhouse gas'. As such, it lets sunlight through to the Earth's surface, but it captures infra-red radiation from the Earth and re-radiates some of it back to the ground, effectively acting as an insulating blanket. This raises the temperature of the atmosphere and surface above what it would otherwise be. The addition of greenhouse gases to the atmosphere from man's activities is thought to be adding to the natural greenhouse effect, thus causing a warming of the global climate, which could have serious consequences in the next century.

The amount of SF₆ in the atmosphere is minute - only about 3 parts per trillion by volume. While this is a very small proportion, strict control over its use is essential. This is because the effect of a given quantity of SF₆ is proportionately more significant, as it has a global warming potential which is 22,200 times that of CO₂, on a weight for weight basis. With appropriate controls over the use, handling, recycling and disposal procedures, it is estimated that, by the year 2100, the contribution to global warming from SF₆ will be not more than about 0.2% of the projected total. It is estimated that SF₆ currently contributes about 0.2% of the global warming potential of the annual greenhouse gas emissions in the UK.

Thus the global warming effect of SF₆ is likely to remain small compared with other greenhouse gases for the foreseeable future, provided good practice is widely followed. It should be noted that SF₆ is not an ozone depleting gas.

SF₆ and its Uses

SF₆ occurs naturally in trace quantities in sulphur- and uranium-bearing rocks, but the SF₆ used commercially is man-made. It is a very stable, chemically inert, non-toxic, non-flammable gas which is about five times heavier than air. These characteristics, along with its excellent sound and electrical insulation properties, have given rise to a number of particular uses for SF₆ in the electricity industry.

SF₆ is widely used by the electricity industry throughout the world in medium and high voltage switchgear and circuit breakers, because it is extremely effective as an electrical insulator and for quenching electric arcs. Some of the advantages of SF₆ over compressed air or oil in such applications are:

- in particular, no risk of land or water contamination, as with oil-filled equipment;
- more compact equipment, requiring a smaller land area and reducing the visual impact of substations;
- quieter operation, particularly when compared with air blast circuit breakers;
- longer equipment lifetime, reduced maintenance and higher reliability through hermetic sealing of high voltage conductors inside an earthed enclosure;
- non-flammability.

These advantages, most of them environmental, make SF₆ a cost-effective insulation medium for switchgear. It was first used some 50 years ago, but its use by the electricity industry has only become widespread over the last 20 years or so. It is estimated that the UK electricity industry has about 500 tonnes (t) in use in its switchgear.

Emissions of SF₆

SF₆ is a very stable compound in the atmosphere, with an average residence time of about 3,200 years. Consequently nearly all the SF₆ which has been released is still in the atmosphere. Only limited information is available on worldwide SF₆ emissions.

In recent years much work has been done by the electricity industry through its international organisations to quantify the SF₆ entering the atmosphere. To date, this has proved very difficult, as emissions from other industries are so uncertain. In most of these industries SF₆ is not recycled, but is released to the atmosphere. Most of the SF₆ emissions worldwide are believed to have come from

applications such as magnesium and aluminium smelting and from military uses, where the SF₆ is not contained.

SF₆ in electrical equipment is contained and not intentionally released during operation. Recycling of SF₆ from electric power equipment, using commercial gas reclaimers, is becoming common practice on the basis of environmental responsibility and for economic reasons.

Governmental Actions

At the Conference of the Parties to the UN Climate Change Convention in Kyoto in 1997, it was agreed that the developed countries would reduce their emissions of a basket of six greenhouse gases to 5.2% below their 1990 level by the period 2008-2012. SF₆ was included in the basket of gases, but it was agreed that 1995 could be used as the base year for the reductions, since data on emissions prior to 1995 are very uncertain. The European Union's commitment was for an 8% reduction of the basket of gases and the UK's share of the EU burden commits it to a 12.5% reduction.

The UK Government's second report on its Climate Change Programme in 1997 included SF₆ for the first time in its inventory of greenhouse gases whose emissions are to be reduced.

Post Kyoto, the Government is developing a revised Climate Change Programme, which will address its Kyoto commitments. The Government has called on top companies to take a lead in reporting on all their greenhouse gas emissions. For SF₆, a priority will be to introduce better monitoring of usage and atmospheric releases from all sources.

Electricity Transmission and Distribution Industry Action

The UK electricity transmission and distribution industry is supporting the Government initiatives to ensure the implementation of sound policies for the control and use of SF₆. The European electricity industries have agreed a set of actions with the manufacturers of electrical equipment using SF₆, to reduce emissions of the gas to the atmosphere. Leakage rates are being reduced in cooperation with power equipment manufacturers under a programme of continuous improvement.

Summary

- SF₆ is an extremely effective insulating and switching medium in electrical equipment and is used worldwide in electrical switchgear.
- SF₆ is a powerful greenhouse gas, but the current amount in the atmosphere only contributes 0.09% to global warming.
- Global SF₆ emissions are rising steadily and, because it is a very stable gas, most of the

emissions accumulate in the atmosphere. However, with the introduction of appropriate controls, its impact will remain small over the next 100 years.

- Under the Kyoto Protocol to the Climate Change Convention, developed countries must reduce their emissions of a basket of six greenhouse gases which includes SF₆.
- The UK electricity transmission and distribution industry is supporting the UK Government to ensure that sound policies for the control and use of SF₆ are implemented.
- The UK electricity transmission and distribution industry and equipment manufacturers are already taking action to avoid the deliberate release of SF₆ to the atmosphere, to promote recycling and to reduce leakage rates.