

Sulfur Hexafluoride (SF₆)

Basics

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Greenhouse Gas

Sulfur hexafluoride (SF₆) is a synthetic fluorinated compound with an extremely stable molecular structure. Because of its unique dielectric properties, electric utilities rely heavily on SF₆ in electric power systems for voltage electrical insulation, current interruption, and arc quenching in the transmission and distribution of electricity. Yet, it is also the most potent greenhouse gas known to-date. Over a 100-year period, SF₆ is 23,500 times more effective at trapping infrared radiation than an equivalent amount of carbon dioxide (CO₂). SF₆ is also a very stable chemical, with an atmospheric lifetime of 3,200 years. As the gas is emitted, it accumulates in the atmosphere in an essentially un-degraded state for many centuries. Thus, a relatively small amount of SF₆ can have a significant impact on global climate change.

More information on long-lived fluorinated greenhouse gases, their emissions, emission sources, and trends is available on EPA's [overview of greenhouse gases page](#).

Use in Electric Power Systems

Since the 1950's, the U.S. electric power industry has used SF₆ in circuit breakers, gas-insulated substations and other switchgear used in the transmission system to manage the high voltages carried between generating stations and customer load centers. Disconnectors and ground switches use SF₆ primarily for insulation, and individually, they contain only slightly less SF₆ than a circuit breaker. These devices are used to isolate portions of the transmission system where current flow has been interrupted (using a circuit breaker). Gas-insulated substations also use a significant amount of SF₆, and GIS installations house SF₆-insulated circuit breakers, busbars and monitoring equipment. The largest use of SF₆ occurs in high-voltage circuit breakers, where, in addition to providing insulation, SF₆ is used to quench the arc formed when an energized circuit breaker is opened.

Several factors affect SF₆ emissions from electric power systems, such as the type and age of the SF₆-containing equipment (e.g., old circuit breakers can contain up to 2,000 pounds of SF₆, while modern breakers usually contain less than 100 pounds) and the handling and maintenance procedures practiced by electric utilities.

Because of its long-life span and high global warming potential (GWP), even a relatively small amount of SF₆ can impact the climate.

The electric power industry can reduce the nation's SF₆ emissions through cost-effective operational improvements and equipment upgrades. Through improvements in the leak rate of new equipment, refurbishing older equipment, and the use of more efficient operation and maintenance techniques, utilities often find economical solutions to reduce SF₆ emissions.

Under the partnership, EPA shares information on best management practices and technical issues to help reduce emissions. Some cost-effective options to reduce SF₆ emissions are:

- Leak Detection and Repair
- Use of Recycling Equipment
- Employee Education/Training

Reducing SF₆ emissions helps electric power systems:

- Save Money - Purchasing SF₆ can be expensive, so reducing emissions can save money.
- Increase Grid Reliability - Use of improved SF₆ equipment and management practices helps protect system reliability and efficiency.
- Protect the Environment - SF₆ is the most potent greenhouse gas known. It is 23,500 times more effective at trapping infrared radiation than an

equivalent amount of CO₂ and stays in the atmosphere for 3,200 years.

Common Emission Sources

SF₆ is used in several different industries including:

- electrical transmission and distribution equipment
- manufacture of electronics / semiconductors
- production of magnesium

The most common use for and largest emission source of SF₆, both domestically and internationally, is as an electrical insulator in high voltage equipment that transmits and distributes electricity. Approximately 75 percent of all SF₆ emissions in the United States is attributed to the electrical transmission and distribution sector in 2021 based on the [Inventory of U.S. Greenhouse Gas Emissions and Sinks](#).

SF₆ containing equipment is designed to avoid emitting any of this gas into the atmosphere. However, SF₆ gas can inadvertently escape into the atmosphere as leaks develop during various stages of the equipment's lifecycle. In some cases, significant leaks can occur from aging equipment. Gas can be released at the time of equipment manufacturing, installation, maintenance and servicing, and de-commissioning.