Sulfur hexafluoride: The truths and myths of this greenhouse gas

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The atmospheric concentration of the highly-potent greenhouse gas SF_6 has never been higher. Fingers have been pointed at the expanding renewables industry, but is that a fair assessment?

Sulfur hexafluoride, commonly known as SF_6, has made a splash in the mainstream media of late. Several articles are pointing the finger at the growth in renewables—specifically wind turbines—as being responsible for the growth in SF_6 emissions, with some going as far as saying that the gas is the energy industry's dirty little secret.

In this spirit of transparency, we asked several experts from NTNU and SINTEF to separate the truths from the myths.

SF_6 is damaging to the environment: TRUE

Along with CFCs, HCFCs, HFCs and PFCs, SF_6 is an industrial gas that doesn't exist naturally in the atmosphere and so impacts the radiation balance, contributing to climate change.

"It is true that SF_6 has between 22,000 and 23,500 times higher global warming potential than CO_2 when taken over a 100-year perspective. Because it's so stable, the gas has an estimated lifetime of up to 3,200 years. Considered together, these facts make SF_6 the most potent chemically reactive greenhouse gas investigated by the IPCC," says NTNU Professor Francesco Cherubini.

"The concentration of the gas in the atmosphere is increasing so it's good to have some attention on this. However, it's important to put it into context. While it's a dangerous greenhouse gas, SF_6 today contributes less than 1 percent of man made global warming," he adds.

SF_6 is the energy industry's "dirty little secret": FALSE

SF_6 is certainly no secret in the Norwegian energy industry. Its use is highly regulated, and many of its users are working together to share experience and come up with viable alternatives:

"There are no secrets surrounding the use of SF_6 in Norway's energy industry. In fact, it's quite the opposite," says SINTEF researcher Maren Istad. She is secretary of the SF_6 User Group, an association of 47 public and private companies all openly sharing their experiences with SF_6.

Since 2003, the user group has collected data on emissions and reported them to the Norwegian Environment Agency. "Norway's history with switchgear using SF_6 goes back many years. The equipment is very reliable but any failure makes a big impact, so everyone is keen to share knowledge and experience. There's even a spare parts exchange facilitated by the forum," adds Istad.

SF_6 is used in wind turbines: TRUE

SF_6 is used not in the turbine itself, but in the switchgear that controls the current generated by the turbine. But there is nothing unique about wind turbines. The gas is used in switchgear in many other power applications.

SF_6 has two uses: as an interruption agent and an insulator. "Unlike a light switch that breaks a simple electrical circuit, doing the same in a higher-rated application is more challenging and additional protection is needed. Typically, a mechanical circuit breaker is used inside a pocket of SF_6 gas that to extinguish the electric arc. At present, it is the most compact and cheapest method of safely stopping the flow of electricity," explains SINTEF researcher Atle Pedersen.

However, comparing wind turbines with other power applications of SF_6 must be set in context. "The amount of the gas used in the switchgear of a wind turbine is typically less than three kilograms. A substation for overhead power lines may require several tonnes, creating a substantially bigger environmental problem should a leak occur. Suitable alternatives to SF_6 will also be available more quickly for lower-voltage applications

such as turbine switchgear," adds Pedersen.

There are no viable alternatives to SF_6: PARTLY FALSE

Bodies including the European Union are known to be considering a ban on SF_6 at low-to-medium voltage levels in the future. This can't happen without viable alternatives, such as vacuum technology or different gas mixtures.

"Such alternatives are commercially available now for use in electrical switchgear at low-to-medium voltages. Solutions for use at higher-voltages are more challenging, although pilot installations do exist at 145kV," says SINTEF researcher Nina Sasaki Støa-Aanensen.

However, it is true to say there is no short-term catch-all fix. One leading alternative, vacuum technology, just solves the interruption aspect. SF_6 or an alternative gas is still needed to provide insulation. "Even when solutions are developed for all voltage levels, switchgear typically lasts for around 40 years. It will take time for a complete shift away from SF_6," she adds.

SF_6 is unmonitored and unregulated: FALSE

The European Union leads the world in the regulation, monitoring and management of SF_6 emissions. Norway has consistently adopted the EU regulations into Norwegian law because of its membership in the European Economic Area. The most recent example is the new regulation on fluorinated greenhouse gases, Regulation (EU) No 517/2014.

"Within Norway, all utilities with switchgear have to collect and report their SF_6 inventory and emissions. The SF_6 User Group collects this information and reports it to the Norwegian Environment Agency,"

explains SINTEF researcher Magne Runde.

"In many countries, there are rules in place dictating which industries can use the gas and how they can use it. In Norway, SF_6 is only permitted in relation to switchgear. Strict training requirements are set for those who work with the gas," adds Runde.

He delivers the theoretical part of the two-day SF_6 certification course that provides the required environmental certification to be able to perform work on SF_6 plants, both in Norway and across the EU. This includes education on the physical, chemical and environmental properties of SF_6, along with techniques for safe transport, storage and recycling.

More information: You can learn more about the SF6 User Group in Norway: www.sintef.no/projectweb/sf6/

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