ENTSO-E position paper on the reduction of SF_6 emissions and introduction of alternative technologies

Fluorinated greenhouse gases reported under the United Nations Framework Convention on Climate Change accounted for approximately 3% of EU overall greenhouse gas emissions, expressed in tonnes CO_2 equivalent, in 2017. One of the fluorinated greenhouse gases - SF_6 - is widely used in TSO applications e.g. in high voltage (52 kV to 170 kV) and extra high voltage (above 220 kV), such as switchgear, gas-insulated lines and gas insulated substations. European industry using SF_6 accounts for less than 0.2%[1] of the total EU greenhouse emissions (or approx. 9 Mtons CO_2 per year). The contribution of TSO's to these emissions is significantly below latter value. Nevertheless, the manufacturers of high voltage products and TSOs have been working hard towards reducing their SF_6 emissions over the last decades through diverse and innovative techniques and the introduction of closed-cycle management of SF_6. They have achieved significant progress in these efforts over the last years.

ENTSO-E supports the EU commitment to reduce the global greenhouse gas emissions towards climate neutrality in 2050, and the TSO community is willing to commit further efforts to reduce SF_6 emissions as far as possible within the next decades:

1. For the existing fleet, minimize annual SF_6 emissions to levels below 0.5%[2] of the installed SF_6 in 2019.
2. For new equipment, work towards achieving either SF_6 free or very low GWP[3] equipment by 2050.

In order to reach these targets, ENTSO-E suggests the following actions:

1. *Improve reporting* to include all SF_6 (banked and annually leaked) at national and European levels. Simplified and standardised reporting would provide a complete picture of the SF_6 gases currently used and emitted in the European transmission grids. **ENTSO-E encourages the EU to provide recommendations for harmonized SF_6 reporting in Europe** (as recommended already in the 2018 Ecofys report). This harmonized reporting system should also cover alternative gases (A-gases). ENTSO-E is willing to support the efforts that will be made at European level to collect these data, and on the basis of these data, to assist in **setting reduction targets** using its expertise and experience.
2. *Best practice exchange:* for the existing fleet, TSOs will document and share existing best practices on how to report and handle SF_6, on procedures and means to mitigating SF_6 leakages during the lifetime of the equipment and to recover it during the decommissioning phase. As regards the development of alternative technologies to SF_6, ENTSO-E will further facilitate the sharing of the results of pilot projects developed by its members. **The EU is invited to support this exchange of experience between TSOs.**

[1] Reference: European Environment Agency, Prod-ID: IND-354-en, 31 Oct 2019, https://www.eea.europa.eu/data-and-maps/indicators/emissions-and-consumption-of-fluorinated-2/assessment-2

[2] The leakage rate is the average leakage rate for the total fleet of assets installed over the last 40-45 years in the grid. Not to be confused with the present <0.5% leakage rate for new equipment. An important number of assets were put into service before the present maximum leakage rate was introduced into the IEC standards. In addition, the <0.5% is a value at commissioning and it is not specified that this leakage rate is guaranteed during the whole lifetime of the equipment.

[3] Global Warming Potential

3. *Increase further R&D efforts into SF_6 alternative technologies:* TSOs are committed to team up and work further with manufacturers and research institutes in order to develop ways to find alternatives to the use of SF_6 in electrical equipment.

   There are several barriers that need to be addressed in order to find replacement alternatives, also in existing equipment. Since the revision of the F-gas regulation in 2014, important A-gases development progress in medium (up to 52 kV) and high voltage have taken place. Some progress has also been achieved for extra-high voltage applications but far behind in reaching the sufficient industrial Technology Readiness Levels. Hence, further development and testing is still required to ensure that these alternatives technologies can match the operational, technical and safety features required to replace the existing equipment containing SF_6 gas.

   Since the substitution of SF_6 in existing equipment is not yet possible with the current technology development level, existing equipment containing SF_6 will remain in operation for decades. Moreover, once substitutive solutions to SF_6 would have been found, the complete replacement of SF_6 gas in existing equipment would require a significant financial and human resources effort to be realised[4].

   Therefore, it is important to make funds available for activities which promote innovation in clean alternative technologies for new equipment and substitutive gases for existing fleet throughout the whole product path: research, development, demonstration and implementation. **ENTSO-E encourages the European Commission to ensure that the future Horizon Europe program supports research on these clean alternative technologies** for new equipment and substitutive gases for existing fleet

   In particular, the following challenges will need to be addressed:

   - Alternative technologies do not yet fully cover the wide SF_6 field of application required by TSOs and in some high duty applications (e.g. over 170 kV), SF_6 is the only solution today and is expected to remain so in the coming years due to the lack of alternatives that can provide equivalent rating and operational security for the equipment.
   - Regarding the maintenance phase of equipment using alternative technologies, there has been only a limited and short-term service experience available until now. More testing and real application of the alternatives under various conditions will be needed before they can be deemed sufficiently mature to replace SF_6 gas in those applications.
   - The diversity of alternative solutions developed by manufacturers combined with the high confidentiality requirements associated with strong competition in the market restrict the sharing of experience and considerably slow down the process of deployment of alternative technologies.

ENTSO-E and the TSO community will continue working on the development of SF_6 alternative technologies and substitutive gases for existing fleet. The upcoming Horizon Europe research and innovation program would be instrumental in supporting further such efforts. Moreover, **an appropriate framework provided by regulators and complemented by suitable financial incentives should be put into place to mitigate the uncertainties related to the implementation and then the operation of SF_6 alternative technologies.** Such measures will be key to facilitate the successful development and large deployment of alternative solutions and support the EU ambition of climate neutrality by 2050.

[4] The integration of renewable energy stated in TYNDP requires significant extension of existing assets. The latter one is much more challenging than “green field” projects due to network availability requirements and requires already today significant financial and human resources. With present restrictions, the potential replacement of existing SF_6 equipment before their end of life would significantly slow down the process of renewables integration.