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Reduce greenhouse gas in Europe through phasing out SF_6 electric switchgear

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SF_6 - the most potent greenhouse gas

With a global warming impact that is 23,500 times higher compared to CO_2 per tonne of gas and an atmospheric lifetime of 3,200 years, sulfur hexafluoride (SF_6) is the most potent known greenhouse gas.

It is used across a wide range of industries, and mainly in the electrical industry, where it is used in medium voltage (MV) and high voltage switchgear. Switchgear protect electrical equipment throughout the power transmission and distribution system, including in commercial and industrial facilities.

In the EU, there are currently about 15 million MV switchgear units installed, two thirds of these units use SF_6. SF_6 can be emitted as leakage during operation and when the switchgear is decommissioned. Due to increased demand for electricity and subsequent grid extension, demand for switchgear is steadily rising, thereby also increasing the potential for SF_6 emissions.

This makes phasing out SF_6 and introducing SF_6-free alternatives a relevant and increasingly urgent regulatory concern. As a result, in April 2022, **the EU Commission has proposed to phase out SF_6 in all new switchgear equipment by 2031**, as part of the Commission's proposal for a new F-gas regulation.

Per tonne of gas, SF_6 impact on global warming is

23,500

higher compared to CO_2

SF6-free switchgear alternatives

Siemens AG and Schneider Electric Industries SAD are two key stakeholders in the European and global switchgear markets. Anticipating legislative changes, the two industry leaders commissioned a study which included an assessment of market acceptance for SF_6-free alternatives in MV switchgear.

SF_6-free switchgear are expected to cause fewer greenhouse gas emissions, but they typically have higher investment costs and often require more space compared to SF_6 switchgear. The question therefore is whether their customers, i.e. switchgear users from power utilities, industrial sites, the services and infrastructure sectors across Europe would pay for SF_6-free alternatives.

The purpose of this research was to better understand the purchasing criteria of switchgear customers, including their willingness to accept and pay for SF_6-free alternatives. In partnership with Siemens and Schneider as well as Fraunhofer Institute for Energy Economics and Energy System Technology (Fraunhofer IEE), researchers from the energy management research team at GEM analyzed market acceptance of SF6-free medium voltage (MV) switchgear in the EU.

The research

The research team first conducted a series of semi-structured interviews with industry experts in charge of procuring switchgear for companies in Germany and France. Then, an anonymized survey was carried out between November 2019 and January 2020 with MV switchgear customers of Siemens and Schneider. The survey was completed by a total of 443 respondents from five European countries.

The experiment

Because SF6-free alternatives are not yet widely available on the market, empirical analysis cannot draw on observed adoption behavior to estimate market acceptance of these alternatives. Therefore, the survey included a stated preferences choice experiment. This experiment involved constructing hypothetic choice scenarios where alternatives (e.g., products, services) are described by a range of attributes (e.g., price, size). In this study, respondents were successively asked to choose one alternative from a set of MV switchgear alternatives. They were expected to make trade-offs between the attributes characterizing the different MV switchgear alternatives to select their most preferred alternative. This method allowed eliciting customers' preferences and willingness to pay for different attributes of MV switchgear, including for instance, impact on global warming, leaking of F-gases, and duration of warranty.

The results

MOST IMPORTANT PURCHASE CRITERIA

ECO-FRIENDLINESS

Findings from the experiment suggest that customers of MV switchgear are, on average, **willing to pay about 18% more for products with a low rather than a high global warming impact**. Similarly, they are willing to pay about 15% more for products which do not involve leakage of F-gases in the event of an accident.

Findings from the remainder of the survey further suggest that customers of MV switchgear expect to use SF6 technology less in the near future owing primarily to policies and regulations, rather than technological change or prices. Customers remain in fact uncertain which technology will most likely replace SF_6. Technological alternatives are currently not attractive to many customers, mainly because these alternatives require too much space or are too expensive.

« FINANCIAL INCENTIVES (E.G. SUBSIDIES) FOR USERS OF MV SWITCHGEAR AND A COMPLETE BAN ON SF_6 ARE CONSIDERED THE TWO MOST EFFECTIVE POLICIES »

Influencing policy and raising public awareness

Results from the study were presented in a final report publicly available on the website of the Fraunhofer IEE. They were shared and discussed with representatives from Siemens and Schneider at a final project consortium meeting. They were also shared and discussed with other stakeholders, including switchgear customers that had participated in the survey, during a public webinar (June 23, 2020). To raise awareness for potential problems surrounding the use of SF_6 in switchgear and share insights on market acceptance of alternative solutions in the MV sector among a broader audience, Marie-Charlotte Guetlein and Carine Sebi published an article in the Conversation (available in French an English). The article was republished in Energy Post and Connaissance des Energies. Another article featuring results from the research project was published in The Economist by Schneider Electric with input from Marie-Charlotte Guetlein and Carine Sebi. Moreover, results were shared and discussed with industry representatives and policy-makers at the European level at an online ATMOshere Network Event (February 9, 2022) to which Marie-Charlotte Guetlein was invited as speaker. Finally, insights from the study were shared with FORWARD.one, a venture capital firm who had contacted GEM researchers, during an online meeting (March 29, 2023).

« EU COMMISSION PROPOSED PHASE OUT OF SF_6 IN ALL NEW SWITCHGEAR EQUIPMENT BY 2031. »

Results were highly welcomed by Siemens and Schneider as they corroborated the firms' strategy to diversify their switchgear offer to include SF_6-free alternatives. As a result, the companies continued and intensified their activities to promote a phase-out of SF_6 in MV switchgear among policy-makers at the EU level (see e.g. article in The Economist published by Schneider, ATMOsphere Network Event sponsored by Schneider).

This, as well as various communications by GEM researchers mentioned above and including direct exchange with policy-makers at the EU-level, could have contributed to the EU Commission's decision to propose a phase-out of SF_6 in all new switchgear equipment by 2031, as part of its proposal for a new F-gas regulation (April 5, 2022).

Results were also acknowledged by policy-makers in Germany, as they were cited in a communication by the Scientific Services ("Wissenschaftlicher Dienst") of the German Bundestag on SF_6-free alternatives in switchgear (July 2, 2020).