

EU F-gas regulation factsheet

2024/03, V4

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F-gases¹: why they need to go

The decarbonization of the energy industry requires the phasing out and elimination of greenhouse gases in electrical switchgear and power grids at the earliest opportunity – particularly SF₆.

SF₆ is the most potent greenhouse gas there is – around 24,300² times more climate-hostile than CO₂ – and it stays in the atmosphere for up to 1,000 years.

Some switchgear contains other F-gases such as fluoronitrile³, but these still have a global warming potential (GWP) of several hundred, even if used in gas-mixture with a very small volume share.

By far the cleanest insulation option is clean air – a mixture of natural origin gases which has a GWP of zero and causes zero harm to the environment or to human health.

F-gases can be phased out

Legislators around the world have an important role to play in supporting and accelerating the end of F-gases.

The revision of the EU F-gas regulation has called for tighter restrictions on F-gases. In October 2023, a provisional agreement was reached on the phasing out of F-gases (GWP ≥ 1) in new high-voltage switchgear by 2028/2032. In January 2024 the European Parliament and the European Council have formally adopted their provisional agreement.

This is not just good news for the environment. This EU regulation gives a clear technical framework and thus investment certainty to all switchgear manufacturers and grid operators.

Now it's up to manufacturers and grid operators to use the transitional phases ahead to make concerted progress away from all F-gases and towards clean power transmission.

¹ Fluorinated gases

² GWP-100 of sulphur hexafluoride (SF₆) acc. to IPCC Sixth Assessment Report (AR6), 2023

³ Iso-C3F7CN, GWP-100 = 2,750

Timetable for F-gas phase out



Revised EU F-gas regulation March 2024 - [link](#) to the final text

Switchgear restrictions

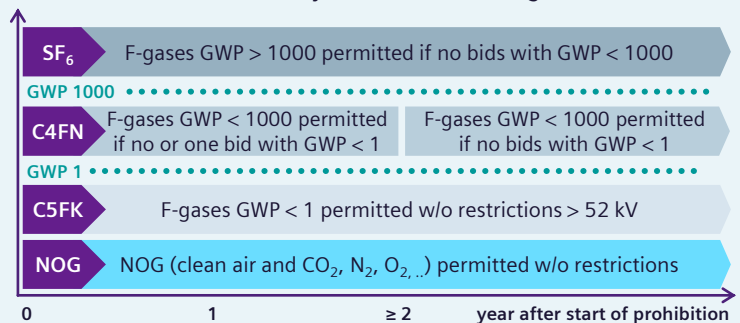
- 1) Prohibition of F-gases when putting new switchgear into operation:
- 2) New (virgin) SF₆ gas is prohibited from 2035 for servicing and maintenance use, reclaimed & recycled SF₆ is possible.
- 3) SF₆ and C4FN as part of Annex I are subject to specific obligations, e.g. reporting, certification of personnel, labelling, regular checks of leakage detection systems, prohibition of gas release into the atmosphere.
- 4) Financing obligations of producer responsibility to be established for SF₆/C4FN by member states in 2027.

medium voltage		
≤ 24 kV	all F-gases	01.01.2026
> 24 kV ... ≤ 52 kV	all F-gases	01.01.2030
high-voltage		
> 52 kV ... ≤ 145 kV	F-gases GWP ≥ 1	01.01.2028
> 145 kV	F-gases GWP ≥ 1	01.01.2032

Derogations

- 1) No prohibition for equipment contracted and ordered ahead of the entry into force of the regulation (03/2024).
- 2) Cascading principle for prohibition:

In general, natural origin gases (NOG) and gases with GWP < 1 in high-voltage have to be applied if bids are available!



- 3) Repair is generally allowed. Extension of existing switchgear with SF₆ is possible if the equipment with lower GWP is not compatible and would require the replacement of the existing entire electrical switchgear.
- 4) Mobile substations (taking out of service and putting into service at different site) are allowed.
- 5) Life-cycle-assessment and Eco-design requirements do not apply to switchgear products as they are not part of Eco-design Directive 2009/125/EC and Eco-design for Sustainable Products Regulation (ESPR).

➔ **Natural-origin gases with GWP < 1 are future-proof with no risk for regulatory exposure!**

Is the industry ready?

Yes, F-gas free technology is proven, available and already operating at up to 420 kV (GIB) around the world. It doesn't require major changes to existing infrastructure; clean air units are compact enough to fit within the footprint of existing substations.

Siemens Energy has over 4,200 circuit-breakers and gas-insulated switchgear from the clean air Blue portfolio contracted worldwide. Of these, 1,500 are in operation and to date have saved 4.4 million tons of CO₂ emissions.

The technology is well established and reliable. Siemens Energy has over 50 years experience in developing electrical switchgear and has been working on vacuum switching and air insulation for over 40 years. The aim is to have a fully F-gas-free portfolio in place by 2030 – and to that end, the company has invested over € 60 million in a new production facility in Berlin.

More and more companies and suppliers are following suit. There is after all no patent or monopoly on natural origin gases.



How will the revised EU regulation impact the industry and environment?

This important change in EU regulation raises a number of questions. For your convenience we have compiled a selection of the most frequently asked questions below; please contact us for any further details.

When will the regulations take effect?

The revised EU F-gas regulation will come into force 20 days after publication in the Official Journal of the EU. This is likely to take place in March 2024.

When will the bans for new switchgear begin?

- 01.01.2026: full ban of F-gases in switchgear ≤ 24 kV
- 01.01.2028: ban of F-gases with $GWP \geq 1$ in switchgear from 52 kV up to ≤ 145 kV
- 01.01.2030: full ban of F-gases in switchgear from 24 kV up to ≤ 52 kV
- 01.01.2032: ban of F-gases with $GWP \geq 1$ in switchgear > 145 kV

When do the obligations start to be applied for SF₆ and C₄FN as part of Annex I?

The obligations start to be effective when the revised EU regulation comes into effect (likely in 03/2024).

What are the advantages of clean air and vacuum switching technology?



Zero environmental impact

- Zero SF₆ and other F-gas emissions
- Zero Global Warming Potential (GWP)



Zero regulation

- Zero reporting and handling obligations
- Zero issues with current and potential legislation against PFAS F-gases



Zero impact on health & safety

- Zero toxic insulation gases or toxic decomposition products
- Zero gas-related safety measures during maintenance and at end of life
- Zero X-rays in operating modus (closed position); in open position value below IEC limitations

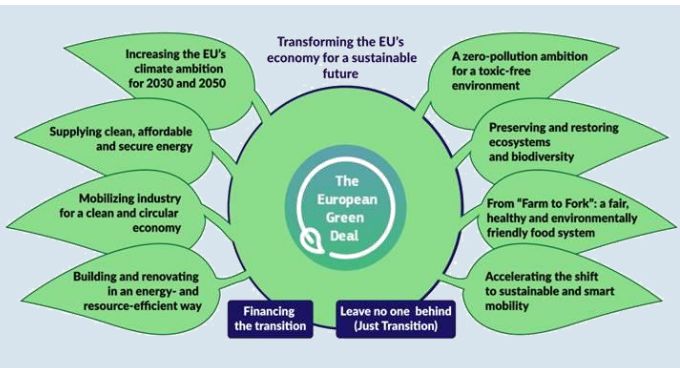


Zero compromise on performance and reliability

- High operational safety and switching performance
- Proven technology with 10+ years of experience in high-voltage vacuum switching in clean air
- Lowest carbon footprint across entire life cycle

Why was the F-gas regulation revised and the use of fluorinated gases further restricted?

The revision of the F-gas regulation follows the EU Green Deal targets and reaffirms Europe's ambition to become the first climate-neutral and zero pollution continent by 2050 and aims to protect the health and well-being of citizens from environment-related risks and impacts. It was adopted to reverse the increase in fluorinated greenhouse gas emissions belonging to the group of greenhouse gas emissions covered by the Paris Agreement adopted under the United Nations Framework Convention on Climate Change (UNFCCC) (the 'Paris Agreement').



What equipment is affected by the regulation?

Only new switchgear is affected. According to the revised EU F-gas regulation 'electrical switchgear' means switching devices and their combination with associated control, measuring, protective and regulating equipment, and assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures, intended for usage in connection with the generation, transmission, distribution and conversion of electric energy.

Is the repair or extension of existing equipment still possible?

Repair is generally allowed. The extension is possible with some preconditions, see page 2 under derogations.

Will the revised regulation affect existing orders or frame contracts?

Any orders including frame contracts placed before the revised EU F-gas regulation comes into force (most likely in 03/2024) will not fall under the prohibition rules.

Can products using fluoronitrile C₄FN or SF₆ still be ordered?

Yes, orders can be placed in cases where no F-gas free / GWP < 1 alternatives are available (see timeline and derogations overview on page 2).

When is the latest an order for equipment containing SF₆ can be accepted?

The ban applies to the date when the equipment is put into operation. Therefore, the lead time, transportation, assembly and commission of the equipment needs to be taken into account when calculating the last feasible order date.

Is the use of new SF₆ gas on the existing equipment allowed after 2035?

From January 1, 2035, the use of new SF₆ for maintenance or servicing of electrical switchgear is not allowed unless it is reclaimed or recycled, except if it is proved that reclaimed or recycled SF₆

- (a) cannot be used on technical grounds; or
- (b) are not available in the event of an emergency repair situation.

What derogations exist?

- Time limited derogations (see table on page 2)
- Mobile substations (taking out of service and putting into service at different site) are allowed.
- Orders placed before the regulations come into force are exempt.
- Repair is allowed. The extension is possible with some preconditions, see page 2 under derogations.
- Life-cycle assessment and Eco-design requirements do not apply to switchgear products as they are not part of the Eco-design Directive 2009/125/EC and the Eco-design for Sustainable Products Regulation (ESPR). It is currently not foreseeable whether - and if so, when - eco-design requirements will be adopted that enable the proof required for this derogation.

How to proceed in the event of derogations?

The operator shall keep documentation establishing the evidence for the derogation for at least 5 years and shall notify the competent authority in the Member State where the electrical switchgear is put into operation.

When may new SF₆ equipment be put into operation after the ban dates have come into force (table from page 2)?

SF₆ devices may only be put into operation after the ban dates have come into force if no bid was received for electrical switchgear with insulating or breaking medium with a global warming potential of less than 1000. The derogation does not apply if one "F-gas free" offer was submitted in the medium voltage range or one offer with GWP > 1 or GWP < 1000 in the high voltage range.

Will the regulation be transposed into national law?

As it is a regulation, it comes into force immediately on March 11, 2024, in all EU member states and does not require any further transposition into national law.

What does "putting into operation" mean and who is responsible?

"Putting into operation" is not defined in the published regulations. In our opinion, this could be interpreted as the time at which the system is fully installed, handed over to the customer and ready for operation. The responsibility for compliance lies with system operators.

How does the installation and project lead time need to be considered?

The ban applies to the date when the equipment is put into operation. Therefore, the lead time, transportation, assembly and commission of the equipment need to be taken into account to be compliant with the regulation.

What reporting requirements and obligations are in place for fluoronitrile (C4FN)?

SF₆ and C4FN as part of Annex I are subject to specific obligations, e.g. reporting, certification of personnel, labelling, regular checks of leakage detection systems (at least every 6 years), prohibition of gas release into the atmosphere.

Does this have an impact on personnel training?

The renewal of training certificates for maintenance and servicing with F-gases is mandatory every 7 years.

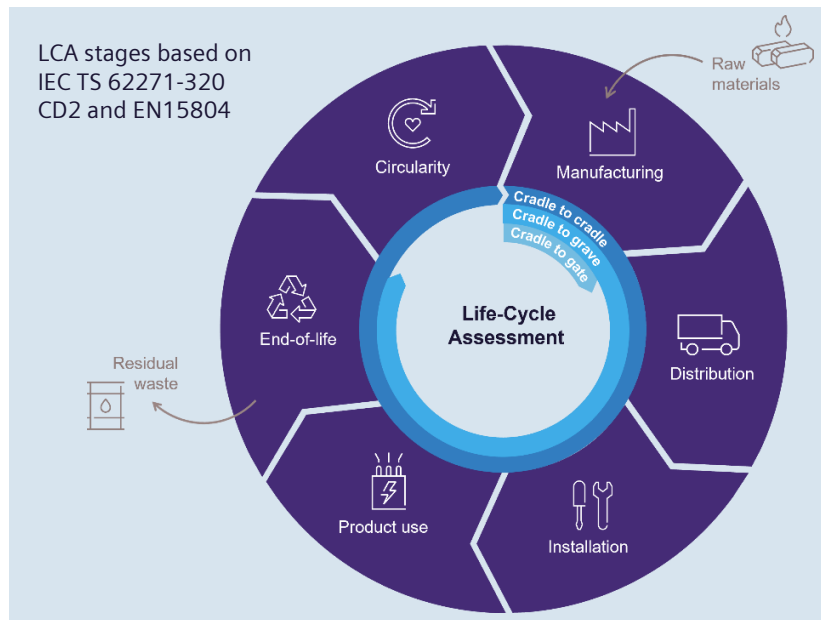
To what extent does the material impact the overall life cycle footprint?

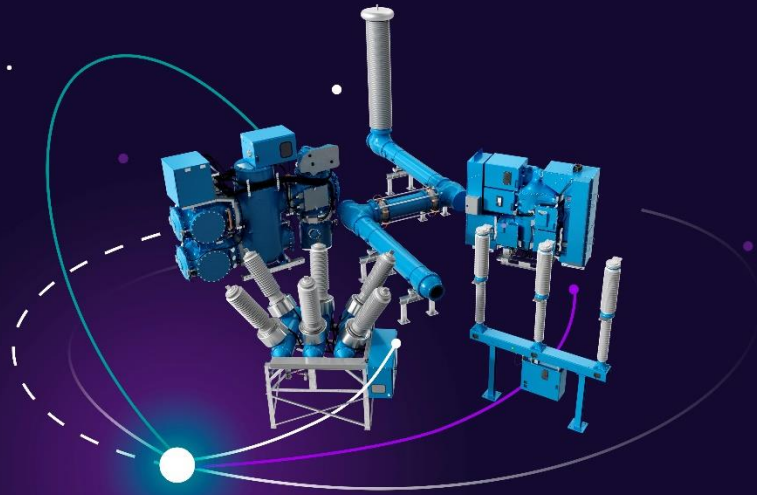
The amount of material used to create a product brings expenses at the start of its lifecycle, but what happens from cradle to cradle (holistic lifecycle) has to be considered when making LCA assessments. This circular material flow should be taken into account and given as a net impact value to better understand the true footprint of a product, now and in the future, see figure on page 5.

A complete cradle-to-cradle LCA evaluation shows that clean air gives the equipment the lowest carbon footprint across its life cycle compared to other solutions. Further CO₂ reduction will be achieved in the future by using emission-free power for material production and innovative manufacturing methods (e.g. aluminium inert instead of carbon anodes).

Are LCA results from different manufacturers comparable?

No. Even when applying existing standards and product category rules including the including IEC TS 62271-320, the LCA results from different manufacturers cannot be directly compared because of different boundary conditions for individual parameters such as allocation method, database of calculation tools, and material flows.





Our clean air Blue portfolio is ready for future-proof substations and unaffected by the coming restrictions. Learn more on our website: [siemens-energy.com/blue-high-voltage-products](https://www.siemens-energy.com/blue-high-voltage-products)

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