UNIVERSITÀ DEGLI STUDI DI TRIESTE

Regulatory Framework and Building Energy Design

The Third topic

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Fluorinated greenhouse gases Regulation F-Gas



Fluorinated greenhouse gases Regulation (F-GAS)

What we are going to see:

1. Introduction to F-gases
2. Why F-gases matter / GWP
3. Regulation 2024/573 overview
4. **Article 1**
5. **Article 4**
6. **Article 8**
7. **Article 11**
8. **Annex IV**
9. Case study / interaction of articles
10. Conclusion

Fluorinated greenhouse gases Regulation (F-GAS)

INTRODUCTION- Regulation (EU) 2024/573

Focus:

- Article 1: Subject matter
- Article 4: Prevention of emissions
- Article 8: Recovery and destruction
- Article 11: Restrictions on placing on the market
- Annex IV: Placing-on-the-market prohibitions

How does the **EU regulate** F-gases **from production** and placing on the market through use, leakage, recovery and final disposal?

Fluorinated greenhouse gases Regulation (F-GAS)

What are fluorinated greenhouse gases?

F-gases are **man-made gases** containing **fluorine** that have been widely used because of their useful physical and chemical properties.

They are found in applications such as:

- Refrigerators
- Freezers
- Air-conditioning systems
- Heat pumps
- Chillers
- Fire protection systems
- Electrical switchgear
- Aerosols
- Solvents

Fluorinated greenhouse gases Regulation (F-GAS)

What are fluorinated greenhouse gases?

Important groups include:

HFCs: Hydrofluorocarbons

HFOs: Hydrofluoroolefins

PFCs: Perfluorocarbons

SF_6: Sulphur hexafluoride

NF_3: Nitrogen trifluoride

The F-Gas Regulation **covers gases** listed in its relevant annexes and **products/equipment** containing or relying on them.

Fluorinated greenhouse gases Regulation (F-GAS)

Why were F-gases introduced?

Many F-gases were introduced as **alternatives to substances** that **damaged** the **ozone layer**.

For example:

CFCs → ozone depletion

HCFCs → reduced ozone impact, but still problematic

HFCs → zero ozone-depletion potential, but many have high GWP

This created a new environmental problem:

A substance can be **good for the ozone layer** but still be **bad for the climate**.

For example: **HFC-134a** was widely used in refrigeration and air conditioning.

It does not destroy stratospheric ozone, but its GWP is much higher than CO_2.

This is one reason the EU has **progressively moved toward lower-GWP** alternatives.

Fluorinated greenhouse gases Regulation (F-GAS)

Where do we encounter F-gases?





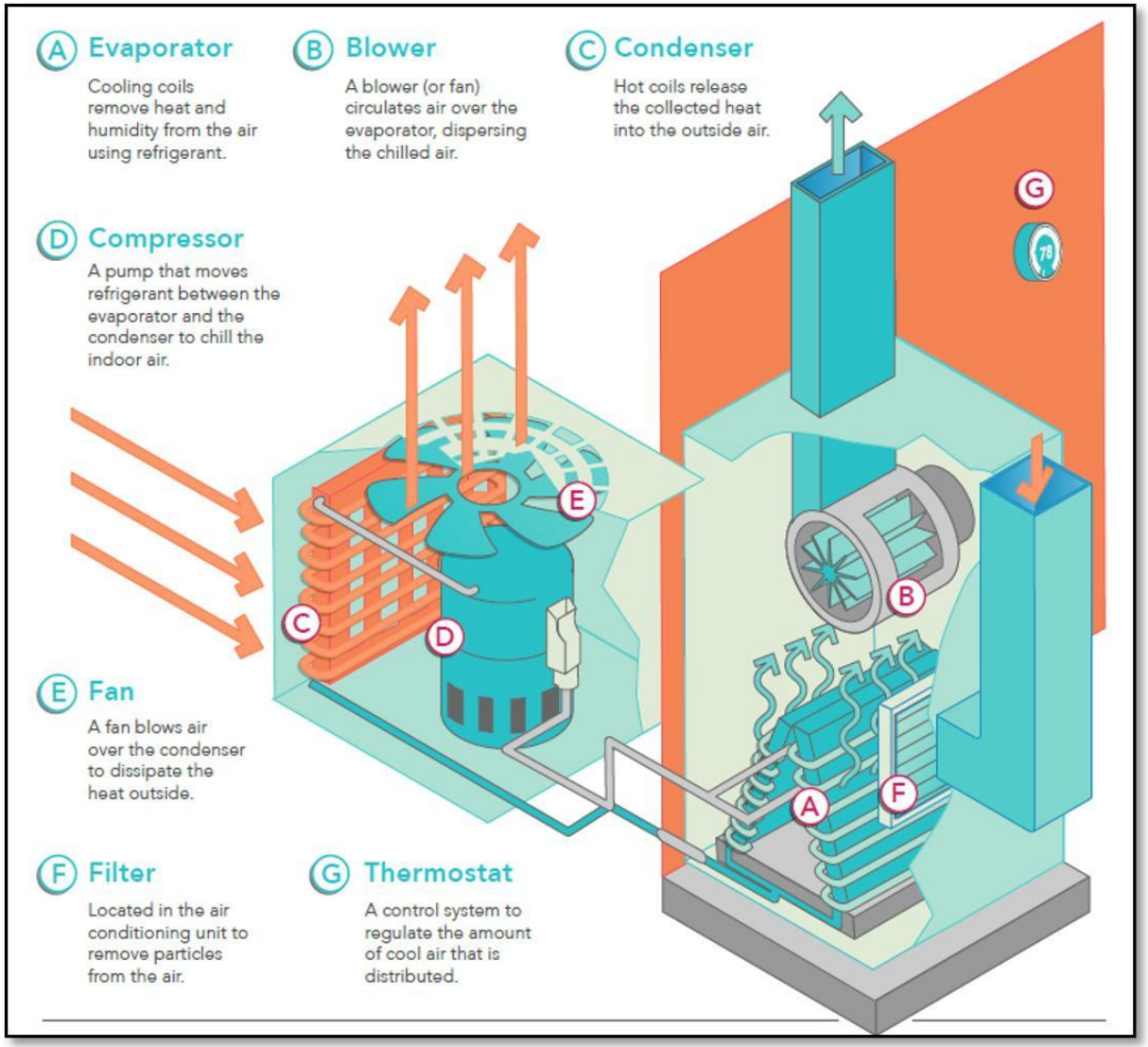
Fluorinated greenhouse gases Regulation (F-GAS)

Where do we encounter F-gases?



Fluorinated greenhouse gases Regulation (F-GAS)

Where do we encounter F-gases?



Fluorinated greenhouse gases Regulation (F-GAS)

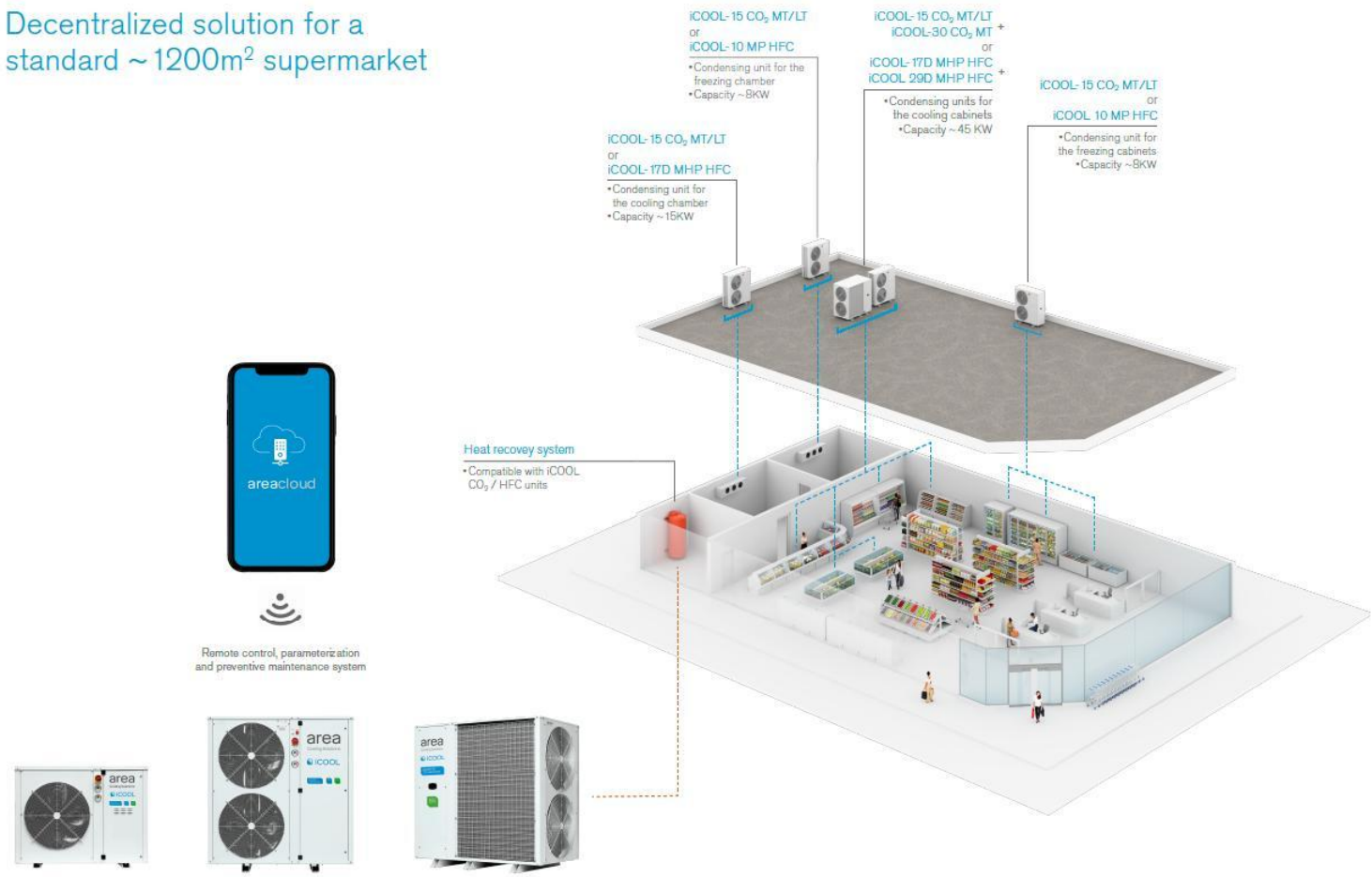
Where do we encounter F-gases?





Fluorinated greenhouse gases Regulation (F-GAS)

Where do we encounter F-gases?

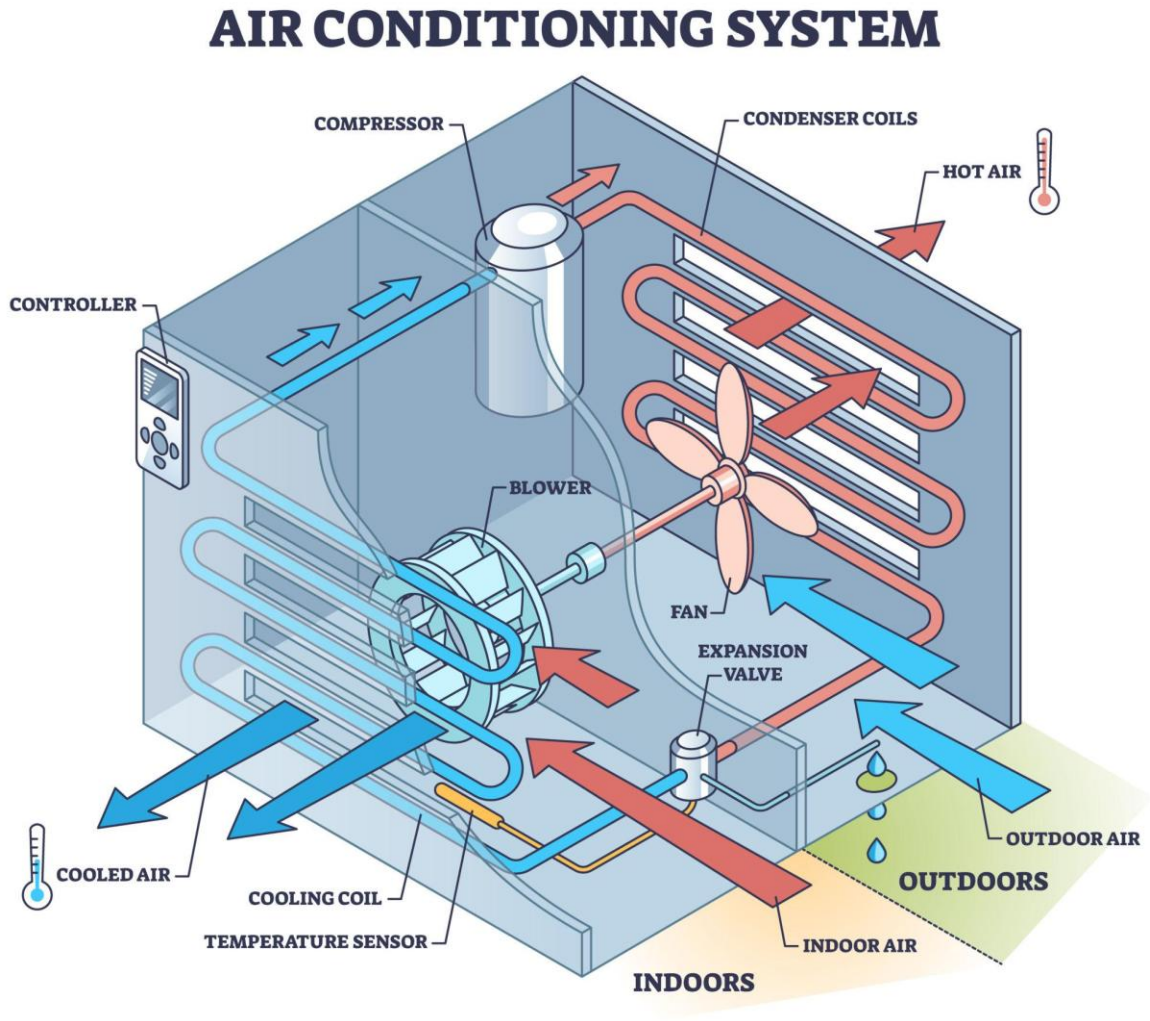


area Cooling Solutions

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Fluorinated greenhouse gases Regulation (F-GAS)

Where do we encounter F-gases?



Fluorinated greenhouse gases Regulation (F-GAS)

Where do we encounter F-gases?

How many of you have used an F-gas today?

Potential answers:

- Refrigerator
- Car air conditioning
- Building air conditioning
- Heat pump
- Supermarket refrigeration
- Fire protection system

Fluorinated greenhouse gases Regulation (F-GAS)

GWP AND Climate Impact

What is Global Warming Potential?

GWP = Global Warming Potential

GWP compares the **warming effect** of a **greenhouse gas** with **CO_2**.

For the regulation, GWP is generally based on the **100-year global warming potential** relative to CO_2.

$CO_2 \rightarrow$ GWP = 1

If a refrigerant has:

GWP = 1,430

then:

1 kg of that refrigerant has approximately the same 100-year warming impact as 1,430 kg of CO_2.

Fluorinated greenhouse gases Regulation (F-GAS)

CO_2 equivalent

This is essential for understanding the F-Gas Regulation.

CO_2 equivalent = mass of gas × GWP

Example:

A refrigeration system contains: 10 kg refrigerant

GWP: 2,500

Therefore:

10 × 2,500 = 25,000 kg CO_2e

or:

25 tonnes CO_2 equivalent

Fluorinated greenhouse gases Regulation (F-GAS)

CO_2 equivalent

What happens if only 2 kg leaks?

Answer:

2 × 2,500 = 5,000 kg CO_2e

That's:

5 tonnes CO_2 equivalent.

This demonstrates why relatively small refrigerant leaks can have significant climate impacts.

Fluorinated greenhouse gases Regulation (F-GAS)

Why the regulation is necessary?

The regulation uses several different approaches.

1. Prevent emissions → Article 4

2. Recover refrigerants → Article 8

3. Control the market → Article 11

4. Prohibit certain products → Annex IV

5. Control production and supply → Other provisions of the Regulation

So the EU does not simply say: **Don't use F-gases.**

Instead, it creates a **life-cycle regulatory system**.

Fluorinated greenhouse gases Regulation (F-GAS)

The new F-Gas Regulation:

Regulation (EU) 2024/573

Adopted:

7 February 2024

Published:

20 February 2024

It **repealed** the previous:

Regulation (EU) No 517/2014

The **new** regulation expands and **strengthens the EU framework** for reducing emissions of fluorinated greenhouse gases.

Fluorinated greenhouse gases Regulation (F-GAS)

Structure of the Regulation

F-GAS REGULATION

Production / import / export

↓

Placing on the market

↓

Installation and use

↓

Containment

↓

Leak prevention

↓

Recovery

Recycling / reclamation

↓

Destruction

Fluorinated greenhouse gases Regulation (F-GAS)

Article 1: Subject Matter

Article 1 says the Regulation:

(a)

Establishes rules on:

- containment
- use
- recovery
- recycling
- reclamation
- destruction

and related measures such as:

- certification
- training
- safe handling

Fluorinated greenhouse gases Regulation (F-GAS)

Article 1: Subject Matter

Article 1 says the Regulation:

(b)

Controls:

- production
- import
- export
- placing on the market
- subsequent supply
- use

of F-gases and certain products/equipment.

Fluorinated greenhouse gases Regulation (F-GAS)

Article 1: Subject Matter

Article 1 says the Regulation:

(c)

Controls specific uses.

(d)

Establishes quantitative limits for HFC placing on the market.

(e)

Establishes reporting rules.

Fluorinated greenhouse gases Regulation (F-GAS)

Understanding Article 1

Article 1 answers five questions:

1. What happens to F-gases?

→ They must be contained, recovered, recycled, reclaimed or destroyed.

2. Who controls them?

→ Producers, importers, exporters, operators, technicians and others.

3. What equipment is affected?

→ Refrigeration, air conditioning, heat pumps and other equipment.

4. Can all F-gases be freely sold?

→ No.

5. Does the regulation also control information and competence?

→ Yes, certification, training and reporting are part of the framework.

Fluorinated greenhouse gases Regulation (F-GAS)

Article 1 example

Supermarket refrigeration

Imagine a supermarket with a refrigeration system containing an HFC.

Article 1 tells us that the regulation can apply to:

Gas → production/import

Equipment → placing on market

Operation → containment

Maintenance → recovery

Technician → certification

End of life → recovery + recycling/reclamation/destruction

Key message:

Article 1 establishes the "universe" of the F-Gas Regulation.

Fluorinated greenhouse gases Regulation (F-GAS)

Preventing emissions throughout the F-gas lifecycle

- Article 4: Production and supply
- Article 5: Leak checks
- Article 6:Leakage detection systems

Fluorinated greenhouse gases Regulation (F-GAS)

Preventing emissions throughout the F-gas lifecycle

Article 4: Production and supply

- Requires **producers** and **importers** to provide declarations and supporting evidence concerning the **origin** and **production of F-gases**.
- Includes **requirements** concerning the **destruction or recovery** of HFC-23 generated as a by-product of production.
- Supports **traceability** and compliance with **production-related** requirements.

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Fluorinated greenhouse gases Regulation (F-GAS)

Preventing emissions throughout the F-gas lifecycle

Article 5: Leak checks

- Requires **periodic leak checks** for specified refrigeration, air-conditioning, heat pump and other equipment containing F-gases **above applicable thresholds**.
- Requires **detected leaks** to be **repaired** without undue delay.
- Helps **prevent refrigerant losses** during equipment operation.

Fluorinated greenhouse gases Regulation (F-GAS)

Preventing emissions throughout the F-gas lifecycle

Article 6: Leakage detection systems

- Requires **leakage detection systems** in **specified equipment** above the applicable refrigerant charge thresholds.
- Enables **leaks** to be **identified** promptly and helps operators respond before significant quantities of refrigerant **escape**.
- Requires applicable **detection systems** to be **checked** at the prescribed **intervals**.

Fluorinated greenhouse gases Regulation (F-GAS)

Preventing emissions throughout the F-gas lifecycle

How are these articles connected?

Together, the three articles address different stages of F-gas management:

Production and supply → Equipment operation → Leak detection and prevention

Article 4 addresses **production-related compliance**, while Articles 5 and 6 focus on **preventing refrigerant emissions** during the operational life of equipment.

Overall objective: Reduce **F-gas emissions**, **limit** their contribution to **global warming**, and **improve** refrigerant **management** throughout the equipment lifecycle.

Fluorinated greenhouse gases Regulation (F-GAS)

Article 4: Prevention of Emissions

We call all three articles 4,5, and 6: Article 4

They are one of the most practical provisions.

Its central principle is:

Prevent F-gas emissions.

- The **intentional release** of F-gases is **prohibited** where the release is not technically necessary for the intended use.
- Where a release is technically necessary, operators must take **technically and economically feasible measures** to prevent it as far as possible, including recapturing emitted gases.

Fluorinated greenhouse gases Regulation (F-GAS)

Intentional vs accidental release

This distinction is important.

Intentional release

Someone deliberately releases refrigerant.

Example: Technician opens a refrigeration circuit and vents the refrigerant directly into the atmosphere.

Accidental/unintentional release

A component fails.

Example: A damaged pipe causes refrigerant to escape.

The regulation addresses **both** situations, but the mechanisms are **different**.

For accidental releases the operator should:

- prevent leaks;
- detect leaks;
- repair leaks;
- minimize emissions.

Fluorinated greenhouse gases Regulation (F-GAS)

Article 4 practical example

Scenario

A supermarket refrigeration system contains:

100 kg of refrigerant

GWP: 2,500

A leak develops.

If all 100 kg escapes:

100 × 2,500 = 250,000 kg CO_2e

= **250** tonnes CO_2e

Therefore:

Leak prevention is **climate policy**.

"The **best refrigerant recovery system** is the one that **prevents** the refrigerant from **escaping** in the first place."

Fluorinated greenhouse gases Regulation (F-GAS)

Article 4 and technicians

Imagine a technician needs to repair a compressor.

Incorrect approach:

1. Open valve
2. Release refrigerant
3. Repair
4. Recharge

Fluorinated greenhouse gases Regulation (F-GAS)

Article 4 and technicians

Correct approach:

1. Identify refrigerant
2. Recover refrigerant
3. Isolate system
4. Repair
5. Leak-test
6. Recharge/reuse appropriate refrigerant
7. Record relevant information

This is where Article 4 connects with certification and training.

Fluorinated greenhouse gases Regulation (F-GAS)

Article 8: Recovery and destruction

Article 8 requires operators of relevant equipment to ensure that F-gases are recovered.

After decommissioning, the substances must be:

- recycled;
- reclaimed; or
- destroyed.

Recovery must be carried out by appropriately **certified persons** under the regulation.

Fluorinated greenhouse gases Regulation (F-GAS)

Recovery ≠ recycling ≠ reclamation ≠ destruction

Recovery: Removing the refrigerant from equipment and collecting it.

↓

Recycling: Cleaning recovered refrigerant for reuse.

↓

Reclamation: Processing recovered refrigerant to a specified quality comparable to newly produced material.

↓

Destruction: Permanently eliminating the F-gas.

Think of a bottle of water:

Recovery = collect the water

Recycling = filter/clean it

Reclamation = process it to a high standard

Destruction = eliminate it

Fluorinated greenhouse gases Regulation (F-GAS)

Article 8 example: end-of-life refrigerator





Fluorinated greenhouse gases Regulation (F-GAS)

Article 8 example: end-of-life refrigerator

Imagine an old commercial refrigerator.

It contains: 8 kg refrigerant

GWP: 2,500

The equipment is being taken out of service. What should happen?

Step 1: Technician recovers the 8 kg.

Step 2: Refrigerant is placed in an appropriate recovery container.

Step 3: It is assessed.

Step 4: Depending on the circumstances:

→ recycle

→ reclaim

→ destroy

What should NOT happen?

Venting it into the atmosphere.

Fluorinated greenhouse gases Regulation (F-GAS)

Article 8

Such obligation also applies to refrigerating or similar systems used on vehicles like:

- trains
- planes
- light and heavy-duty vehicles
- …

Fluorinated greenhouse gases Regulation (F-GAS)

Article 11: Market restrictions

Now we move from:

"What happens to gas **during operation**?"

to:

"Can this product legally **enter the EU market**?“

Article 11 states that placing on the market of products and equipment listed in Annex IV is prohibited from the dates specified in that Annex, with certain distinctions according to gas type or GWP.

This is extremely important:

Article 11 + Annex IV must be read **together**.

Fluorinated greenhouse gases Regulation (F-GAS)

What does "placing on the market" mean?

It does **not simply mean**:

"Using equipment."

It concerns putting products/equipment into the EU market.

Therefore:

Manufacturer: "Can I sell this new product?"

Importer: "Can I bring this product into the EU market?"

Distributor: "Can I supply this product?“

These questions are affected by the market restrictions.

Fluorinated greenhouse gases Regulation (F-GAS)

Article 11 repair exception

Article 11 is not simply:

"**All prohibited equipment must disappear**."

There are **important rules** concerning parts needed for **repair** and **servicing** of existing equipment.

Such parts can be **placed on the market** if the repair/service does not result in:

- increased **equipment capacity**;
- increased **quantity of F-gas**;
- or a **change to** an **F-gas** that increases the **GWP**.

Fluorinated greenhouse gases Regulation (F-GAS)

Article 11 repair exception

Example

Old refrigeration system: **10 kW** capacity

Technician replaces a failed component.

New capacity: **10 kW**

Gas charge: same

GWP: not increased

This is fundamentally different from using the repair as an opportunity to increase the system's capacity and refrigerant burden.

Fluorinated greenhouse gases Regulation (F-GAS)

ANNEX IV

What is Annex IV?

"Placing on the market **prohibitions** referred to in Article 11"

It contains:

- Product/equipment category
- Type/GWP of F-gas
- Date of prohibition

This makes it possible to answer:

"**Can this particular type of equipment be placed on the EU market?**"

Fluorinated greenhouse gases Regulation (F-GAS)

How to read Annex IV

STEP 1: Identify the equipment. Example: Commercial refrigerator

↓

STEP 2: Determine whether it is self-contained, centralized, chiller, etc.

↓

STEP 3: Identify refrigerant.

↓

STEP 4: Determine GWP.

↓

STEP 5: Look at Annex IV.

↓

STEP 6: Check the prohibition date.

↓

STEP 7: Check exceptions.

Fluorinated greenhouse gases Regulation (F-GAS)

Annex IV: Domestic refrigerators

Annex IV includes **domestic refrigerators** and **freezers**.

For example:

From 1 January 2015

Domestic refrigerators/freezers containing **HFCs** with GWP ≥ 150

were subject to a placing-on-market **prohibition**.

From 1 January 2026

Domestic refrigerators/freezers containing **fluorinated greenhouse gases** are prohibited, subject to the stated safety exception.

Why?

Because the EU is progressively moving toward refrigerants with much **lower climate impact**.

Fluorinated greenhouse gases Regulation (F-GAS)

Annex IV: Commercial refrigeration

For self-contained commercial refrigeration:

2020 → HFCs with: **GWP ≥ 2,500** prohibited.

2022 → HFCs with: **GWP ≥ 150** prohibited.

2025 → Other F-gases with: **GWP ≥ 150** prohibited.

The regulation progressively moves from:

Very high GWP

↓

Lower GWP

↓

Very low GWP alternatives

This is sometimes described as a **technology transition**.

Fluorinated greenhouse gases Regulation (F-GAS)

ANNEX IV

REGOLAMENTO (UE) …
› preambolo
› articolato
Formule conclusive
allegato I
allegato II
allegato III
allegato IV
allegato V
allegato VI
allegato VII
allegato VIII
allegato IX
allegato X

ALLEGATO IV

DIVIETI DI IMMISSIONE SUL MERCATO AI SENSI DELL'ARTICOLO 11, PARAGRAFO 1

Prodotti e apparecchiature		Data del divieto
1) Contenitori non ricaricabili per gas fluorurati a effetto serra elencati nell'allegato I, vuoti oppure riempiti del tutto o in parte, usati per l'assistenza, la manutenzione o la ricarica di apparecchiature di refrigerazione e di condizionamento d'aria, per pompe di calore o per sistemi di protezione antincendio o per commutatori elettrici, ovvero usati come solventi.		4 luglio 2007
REFRIGERAZIONE FISSA		
2) Frigoriferi e congelatori domestici:	a) contenenti HFC con GWP pari o superiore a 150;	1° gennaio 2015
	b) contenenti gas fluorurati a effetto serra, tranne se necessari per rispettare le norme di sicurezza nel sito di attività.	1° gennaio 2026
3) Frigoriferi e congelatori per uso commerciale (apparecchiature autonome):	a) contenenti HFC con GWP pari o superiore a 2 500 ;	1° gennaio 2020
	b) contenenti HFC con GWP pari o superiore a 150;	1° gennaio 2022
	c) contenenti altri gas fluorurati a effetto serra con GWP pari o superiore a 150.	1° gennaio 2025
4) Apparecchiature di refrigerazione autonome, esclusi i refrigeratori (chillers), contenenti gas fluorurati a effetto serra con GWP pari o superiore a 150, tranne se necessari per rispettare i requisiti di sicurezza nel sito di attività.		1° gennaio 2025
5) Apparecchiature di refrigerazione (chillers), ad eccezione dei refrigeratori e delle apparecchiature di cui ai punti 4 e 6, che contengono o il cui funzionamento dipende da:	a) HFC con GWP pari o superiore a 2 500 a eccezione delle apparecchiature destinate ad applicazioni intese a raffrescare prodotti a temperature inferiori a – 50 °C;	1° gennaio 2020
	b) gas fluorurati a effetto serra con GWP pari o superiore a 2 500 , a eccezione delle apparecchiature intese a raffrescare prodotti a temperature inferiori a –50 °C;	1° gennaio 2025
	c) gas fluorurati a effetto serra con GWP pari o superiore a 150, tranne se necessari per soddisfare i requisiti di sicurezza nel sito di attività;	1° gennaio 2030
6) Sistemi di refrigerazione centralizzati multipack per uso commerciale di capacità nominale pari o superiore a 40 kW che contengono gas fluorurati a effetto serra elencati nell'allegato I con GWP pari o superiore a 150 o il cui funzionamento dipende da tali gas, tranne nel circuito refrigerante primario di sistemi a cascata in cui possono essere usati gas fluorurati a effetto serra con GWP inferiore a 1 500 .		1° gennaio 2022

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Fluorinated greenhouse gases Regulation (F-GAS)

Annex IV: Chillers

For chillers, the rules depend on **capacity**.

Chillers ≤ 12 kW

From 1 January 2027: certain F-gases with **GWP ≥ 150** are prohibited, subject to the specified safety exception.

From 1 January 2032: the restriction becomes **stricter** for this category, again subject to the relevant safety provision.

Chillers > 12 kW

From 1 January 2027 certain F-gases with **GWP ≥ 750** are prohibited, subject to the safety exception.

Fluorinated greenhouse gases Regulation (F-GAS)

Annex IV: Air conditioning and heat pumps

For certain self-contained air-conditioning equipment and heat pumps up to **12 kW**

From 1 January 2027:

equipment containing F-gases with **GWP ≥ 150** is generally prohibited, subject to the safety-related exception.

Where safety requirements mean that an F-gas with **GWP<150** cannot be used, the regulation provides a different threshold in the specified circumstance.

Why is this important?

Because **heat pumps** are expected to **play a major role** in **decarbonizing** heating.

The EU therefore wants:

electrification + low-GWP refrigerants

rather than:

electrification + high-GWP refrigerants

Fluorinated greenhouse gases Regulation (F-GAS)

ANNEX IV

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REFRIGERATORI FISSI (CHILLERS)		
7) Refrigeratori (chillers) che contengono o il cui funzionamento dipende da:	a) HFC con GWP pari o superiore a 2 500 , a eccezione delle apparecchiature destinate ad applicazioni intese a raffrescare prodotti a temperature inferiori a – 50 °C;	1° gennaio 2020
	b) gas fluorurati a effetto serra con GWP pari o superiore a 150 per i refrigeratori di capacità nominale pari a 12 kW, tranne se necessari per soddisfare i requisiti di sicurezza nel sito di attività;	1° gennaio 2027
	c) gas fluorurati a effetto serra per i refrigeratori di capacità nominale fino a 12 kW inclusi, tranne se necessari per soddisfare i requisiti di sicurezza nel sito di attività;	1° gennaio 2032
	d) gas fluorurati a effetto serra con GWP pari a 750 per i refrigeratori di capacità nominale superiore a 12kW, tranne se necessarie per soddisfare i requisiti di sicurezza nel sito di attività;	1° gennaio 2027
APPARECCHIATURE FISSE DI CONDIZIONAMENTO D'ARIA E POMPE DI CALORE FISSE:		
8) Apparecchiature autonome di condizionamento d'aria e pompe di calore, esclusi i refrigeratori:	a) apparecchiature di condizionamento d'aria inseribili (plug-in) che l'utilizzatore finale può spostare da una stanza all'altra contenenti HFC con GWP pari o superiore a 150;	1° gennaio 2020
	b) apparecchiature di condizionamento d'aria inseribili (plug-in), apparecchiature di condizionamento d'aria monoblocco, altre apparecchiature di condizionamento d'aria autonome e pompe di calore autonome, con una capacità nominale massima fino a 12 kW inclusi, contenenti gas fluorurati a effetto serra con GWP pari o superiore a 150, tranne se necessari per soddisfare i requisiti di sicurezza. Se i requisiti di sicurezza nel sito di attività non consentono di utilizzare gas fluorurati a effetto serra con GWP inferiore a 150, il limite del GWP è pari a 750;	1° gennaio 2027
	c) apparecchiature di condizionamento d'aria inseribili (plug-in), apparecchiature di condizionamento monoblocco, altre apparecchiature di condizionamento autonome e pompe di calore autonome con una capacità nominale massima fino a 12 kW inclusi, contenenti gas fluorurati a effetto serra, tranne se necessari per soddisfare i requisiti di sicurezza. Se i requisiti di sicurezza nel sito di attività non consentono di utilizzare alternative a gas fluorurati a effetto serra, il limite del GWP è pari a 750;	1° gennaio 2032
	d) apparecchiature di condizionamento d'aria e pompe di calore monoblocco e autonome, con una capacità nominale massima superiore a 12kW ma inferiore a 50 kW, contenenti gas fluorurati a effetto serra con GWP pari o superiore a 150, tranne se necessari per soddisfare i	1° gennaio 2027

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Fluorinated greenhouse gases Regulation (F-GAS)

Annex IV: Timeline

F-GAS MARKET TRANSITION

2015: **Domestic** refrigerators. GWP ≥150 HFC restriction

↓

2020: **High-GWP commercial** refrigeration restrictions

↓

2022: **Further commercial** refrigeration restrictions

↓

2025: Further restrictions on **self-contained** refrigeration

↓

2026: **Domestic** refrigerators/freezers, broader **F-gas restriction**

↓

2027: Major restrictions for:

Fluorinated greenhouse gases Regulation (F-GAS)

Annex IV: Timeline

↓

2027: **Major** restrictions for:

- chillers
- air conditioning
- heat pumps

↓

2030: Further **refrigeration** restrictions

↓

2032: Further **chiller** restrictions

The exact applicability depends on the equipment category and exceptions, so this timeline is a simplified overview, not a substitute for Annex IV.

Fluorinated greenhouse gases Regulation (F-GAS)

The "life of an F-gas"

1. Production / import

↓

2. Product placed on market

Article 11 + Annex IV

↓

3. Installation

↓

4. Operation

Article 4

↓

5. Leakage prevention

Article 4

↓

↓

6. Maintenance

Article 4 + other requirements

↓

7. Recovery

Article 8

↓

8. Recycling / reclamation / destruction

Article 8

Fluorinated greenhouse gases Regulation (F-GAS)

Complete case study

Case: Supermarket refrigeration

A supermarket wants to install a new refrigeration system.

Step 1: Choose equipment

The supermarket selects a refrigeration system.

Step 2: Check refrigerant

Suppose the system uses an F-gas.

Step 3: Check GWP

Suppose: GWP = 2,500

Step 4: Check Annex IV

Is this equipment category prohibited from being placed on the EU market?

If yes: Cannot simply place it on the market.

Step 5: Select alternative technology

The manufacturer chooses a lower-GWP solution.

Fluorinated greenhouse gases Regulation (F-GAS)

Complete case study

Step 6: Operate

The supermarket must minimize emissions and leakage.

→ Article 4

Step 7: Maintenance

Technician performs servicing while preventing emissions.

Step 8: End of life

Refrigerant is recovered.

→ Article 8

Step 9: Recycle/reclaim/destroy

Gas is appropriately managed.

Result

The regulation has influenced:

design → purchase → installation → operation → maintenance → disposal

Fluorinated greenhouse gases Regulation (F-GAS)

A second case study: Heat pump

A company wants to install a:10 kW heat pump

Refrigerant: F-gas

GWP: 500

Question 1

Can it be placed on the EU market?

→ Check Article 11

→ Check Annex IV

→ Check date

→ Check GWP

→ Check exceptions.

Fluorinated greenhouse gases Regulation (F-GAS)

A second case study: Heat pump

Question 2

Once installed, what happens?

→ Prevent emissions

→ Article 4

Question 3

At end of life?

→ Recover refrigerant

→ Article 8

This demonstrates:

Article **11** controls **entry into the market**, while Articles **4** and **8** control what **happens during** and **after use**.

Fluorinated greenhouse gases Regulation (F-GAS)

Article comparison

Provision	Main question	Practical meaning
Article 1	What does the Regulation regulate?	Defines the regulatory framework
Article 4	How do we prevent emissions?	Don't intentionally release; prevent/minimize leaks
Article 8	What happens to the gas during/end of life?	Recover, recycle, reclaim or destroy
Article 11	Can equipment be placed on the market?	Prohibits listed products after specified dates
Annex IV	Which products are prohibited and when?	Detailed product + GWP + date table

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Fluorinated greenhouse gases Regulation (F-GAS)

The central concept

The F-Gas Regulation uses TWO major strategies:

1. CONTROL THE GAS

Article 4 + Article 8

Prevent emissions

↓

Recover gas

↓

Recycle/reclaim/destroy

Fluorinated greenhouse gases Regulation (F-GAS)

The central concept

The F-Gas Regulation uses TWO major strategies:

2. CONTROL THE EQUIPMENT

Article 11 + Annex IV

Restrict high-GWP equipment

↓

Promote alternatives

↓

Transform the market

Fluorinated greenhouse gases Regulation (F-GAS)

Why not simply ban all F-gases?

"If F-gases have climate impacts, why doesn't the EU simply ban all F-gases immediately?“

Possible answers:

Safety: Some applications have specific safety requirements.

Technical feasibility: Not every application can immediately use the same alternative.

Energy efficiency: A refrigerant change can affect equipment efficiency.

Economic considerations: Existing installations have long lifetimes.

Availability: Alternative refrigerants and technologies need to be available.

Transition: Industry needs time to redesign products and supply chains.

This helps explain why Annex IV uses different dates, categories, GWP thresholds and exceptions.

Fluorinated greenhouse gases Regulation (F-GAS)

Alternatives to high-GWP F-gases

natural refrigerants:

CO_2 - R744

GWP ≈ 1

Used increasingly in:

- supermarkets
- refrigeration
- heat pump applications

Ammonia - R717

Very low GWP.

Used especially in:

- industrial refrigeration

Fluorinated greenhouse gases Regulation (F-GAS)

Alternatives to high-GWP F-gases

Propane - **R290**

Very low GWP.

Used in:

- heat pumps
- refrigeration
- air conditioning in suitable applications

Water - **R718**

Can be used in specialized applications.

Important point

"Low GWP" does not automatically mean "easy."

Fluorinated greenhouse gases Regulation (F-GAS)

Alternatives to high-GWP F-gases

Alternatives can have other challenges:

- flammability
- toxicity
- pressure
- system design
- efficiency
- safety requirements

Fluorinated greenhouse gases Regulation (F-GAS)

Discussion exercise

A company wants to buy a new refrigeration system.

The equipment:

- is self-contained;
- uses an F-gas;
- has GWP = 300;
- will be placed on the EU market in 2027.

Question 1: Which Article should we check first? → Article 11

Question 2: Where do we find the specific equipment prohibition? → Annex IV

Fluorinated greenhouse gases Regulation (F-GAS)

Discussion exercise

Question 3: What information do we need?

→ Equipment category

→ Refrigerant

→ GWP

→ Date

→ Applicable exceptions

Question 4: After installation, which article addresses emissions? → Article 4

Question 5: At end-of-life? → Article 8

Fluorinated greenhouse gases Regulation (F-GAS)

Common mistakes

Mistake 1: "F-gas = one specific gas." ❌ → F-gases are a broad group.

Mistake 2: "GWP and CO_2e are the same thing." ❌ → GWP is a factor.

CO_2e is the resulting quantity after applying the factor to a mass of gas.

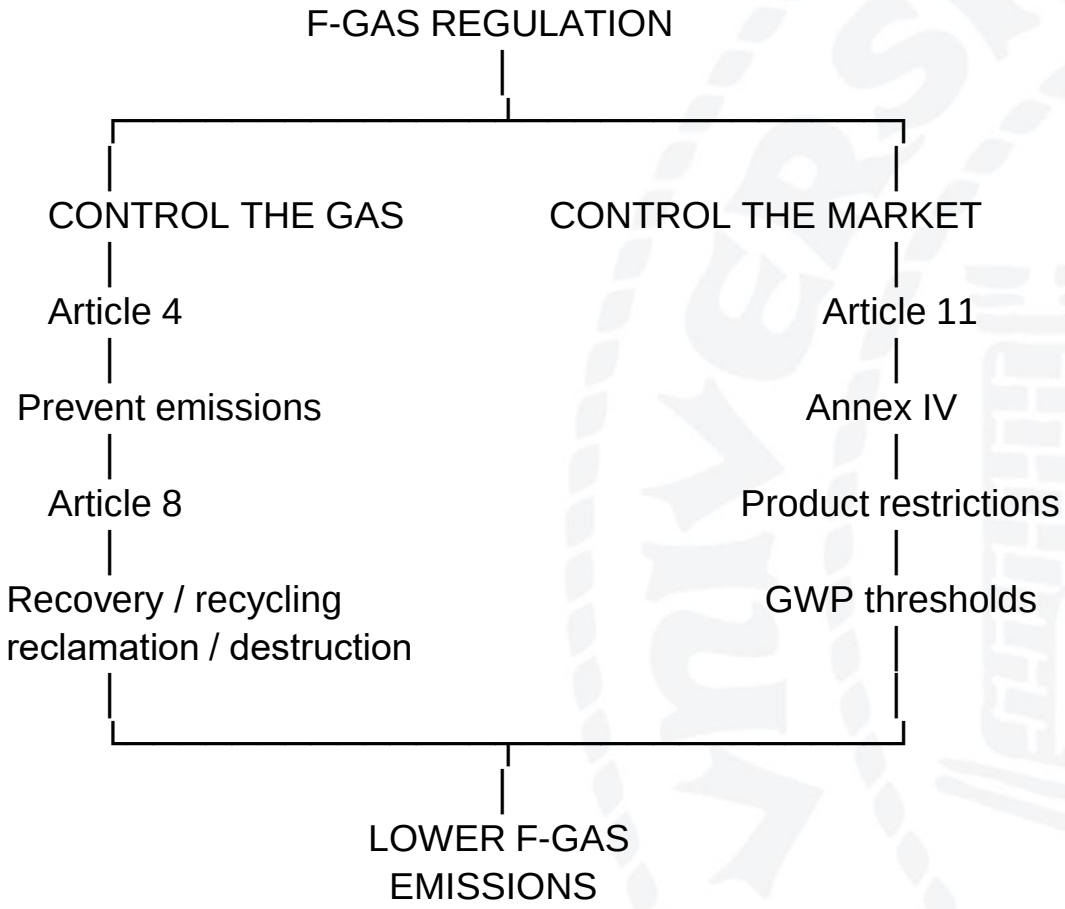
Mistake 3: "Article 11 bans all F-gases.“ ❌ → Article 11 concerns specified products/equipment listed in Annex IV and the relevant dates/categories.

Mistake 4: "Annex IV tells us how to recover gas." ❌ → Annex IV primarily concerns placing-on-the-market prohibitions.

Mistake 5: "Once equipment is installed, the regulation no longer matters." ❌ → Containment, emissions, recovery and other requirements continue to matter.

Fluorinated greenhouse gases Regulation (F-GAS)

Final conceptual diagram



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Fluorinated greenhouse gases Regulation (F-GAS)

Final conclusion

The five things to remember

ARTICLE 1: **Defines** what the F-Gas Regulation **controls**.

ARTICLE 4: **Prevent** and **minimize emissions**.

ARTICLE 8: **Recover** F-gases and ensure appropriate **recycling**, **reclamation** or **destruction**.

ARTICLE 11: **Restricts** the placing on the **EU market** of specified products and equipment.

ANNEX IV: Tells us **which equipment** is **restricted**, according to gas/GWP/category, and from which **date**.

Final message: The F-Gas Regulation is not **simply a ban** on refrigerants.

↓

It is a **life-cycle system** for reducing the climate impact of fluorinated gases.

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Fluorinated greenhouse gases Regulation (F-GAS)

Link to the ministry of environment and security of Energy:

https://www.mase.gov.it/portale/regolamento-ue-2024-573-sui-gas-fluorurati-a-effetto-serra-che-modifica-la-direttiva-ue-2019-1937-e-che-abroga-il-regolamento-ue-n-517-2014

