REPORT

environmental investigation agency

CLIMATE

April 2026

FAKES, FRAUD AND F-GASES

How the illegal trade in HFC super-pollutants threatens climate targets and corporate supply chains.

ACKNOWLEDGEMENTS

This report was written and edited by the Environmental Investigation Agency (EIA UK). The contents are the sole responsibility of EIA.

EIA wishes to thank its numerous supporters whose long-term commitment to the organisation's mission and values helped make this work possible.

ABOUT EIA

The Environmental Investigation Agency (EIA) investigates and campaigns against environmental crime and abuse. Our undercover investigations expose transnational wildlife crime, with a focus on elephants, pangolins and tigers, and forest crimes such as illegal logging and deforestation for cash crops. We work to avert climate catastrophe by investigating the criminal trade in refrigerant gases, strengthening and enforcing regional and international agreements that tackle fossil fuels and climate super-pollutants, including ozone-depleting substances, hydrofluorocarbons and methane, and promoting sustainable cooling. We seek to safeguard global marine ecosystems by addressing the threats posed by plastic pollution, bycatch and commercial exploitation of whales, dolphins and porpoises.

EIA has been investigating and documenting the illegal trade in ozone-depleting substances (ODS) since the mid-1990s, providing unprecedented insights into the dynamics of this multi-million-dollar environmental crime and ways to combat it.

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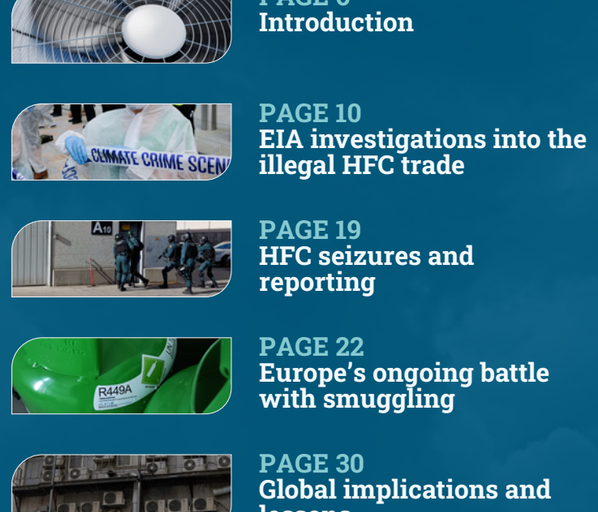

Front cover: A major 14 tonne HFC seizure carried out by Italian authorities in March 2025. **©Guardia di Finanza**

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EVEN WITH STRONGER F-GAS RULES, ORGANISED ILLEGAL TRADE CONTINUES

EXECUTIVE SUMMARY

Hydrofluorocarbons (HFCs), widely used in refrigeration and air-conditioning, are potent greenhouse gases that are being phased down globally under the Montreal Protocol.

Experience from the phase-out of chlorofluorocarbons (CFCs) and other ozone-depleting substances (ODS), and Europe's early ambitious measures to phase out HFCs, shows that without robust policy measures these transitions can give rise to large-scale illegal trade. Driven by high profits and uneven enforcement, organised criminal networks have become closely associated with illicit HFC trading, leading to increased emissions and undermining the effectiveness of climate policy.

In response, the European Union's (EU) revised F-Gas Regulation, adopted in 2024, introduced a suite of 'best-in-class' measures to tackle illegal trade. These include real-time quota checks for customs authorities, new requirements for cylinder take-back schemes, expanded bans on the use of the most climate-damaging HFCs and additional equipment bans designed to reduce overall demand.

Building on earlier investigations in 2021 and 2023, EIA carried out an in-depth investigation of the Italian refrigerant market in 2025. Italy is both one of Europe's largest cooling markets and the member state with the highest reported volume of HFC seizures. The investigation identified multiple companies operating at different points in the supply chain, from importers to regional distributors, openly admitting to practices such as exceeding quota limits, falsifying invoices, mislabelling virgin refrigerants as reclaimed and evading Value Added Tax (VAT). Some of these companies claimed to supply major manufacturers, transport operators and supermarket chains, including the Italian state railway, Carrefour and Lidl Italy, raising concerns that illegal refrigerants are entering mainstream commercial supply chains.

Despite increased enforcement efforts across Europe, EIA's findings once again highlight the interconnected nature of illegal HFC trade across borders. Investigations documented the continued use of laundering techniques, whereby illegal HFCs are first smuggled into member states with weaker customs controls, such as Bulgaria or Romania, before being distributed across the EU.

With the EU's HFC quota set to drop by nearly half in 2027, price pressures and incentives for illegal trade are likely to increase.

While the revised F-Gas Regulation is already having positive impacts, most notably a reduction in the open sale of very-high-global warming potential (GWP) gases, EIA's findings reveal new loopholes and emerging trends. These include the widespread mislabelling of virgin high-GWP HFCs as reclaimed, as well as growing sales of counterfeit lower-GWP F-gas blends.

Illegal trade is strongly fuelled by high HFC prices, which have increased tenfold since the EU phase-down began. With the EU's HFC quota set to fall by nearly half in 2027, price pressures and incentives for illegal trade are likely to intensify. These risks are compounded by the fact that once HFCs enter the EU market there is no requirement further down the supply chain to prove that they are linked to quota. This makes it difficult for end-users to be confident they are purchasing legal products. Improved supply chain traceability and greater digitisation of records could help address this concern.

As countries around the world embark on the phase-down of HFCs, Europe's experience offers important lessons. Alongside strong measures to combat illegal trade, reducing demand through early equipment bans and restrictions on high-GWP HFC use are critical to avoiding the price spikes that drive illicit activity. Ultimately, illegal trade is driven by demand. Policymakers, particularly those in developing countries beginning the HFC phase-down, should focus not only on enforcement, but on reducing reliance on F-gases in a strategic way.

RECOMMENDATIONS

1. EU-LEVEL ACTIONS

ENFORCEMENT AND COMPLIANCE

- Ensure consistent implementation of the EU F-Gas Regulation through coordinated action by customs, environmental inspectorates, market surveillance authorities and financial crime units
- Expand risk-based inspections and testing of refrigerant cylinders; confiscate illegal or mislabelled products and enforce take-back obligations
- Strengthen cross-border cooperation
- Integrate financial investigations into enforcement actions targeting illegal HFC trade
- Apply dissuasive penalties and criminal sanctions

DIGITISATION, TRACEABILITY AND IMPORT CONTROLS

- Connect all Member States to the EU Single Window for F-gases
- Fully digitalise reporting and licensing systems
- Introduce mandatory traceability linking HFCs placed on the EU market to lawful quota allocations beyond import
- Close loopholes enabling mislabelling of virgin high-GWP HFCs as reclaimed
- Expand Prior Informed Consent mechanisms

ONLINE SALES AND PLATFORMS

- Strengthen enforcement against illegal online HFC sales, including trader verification, proactive monitoring and penalties for platform non-compliance

2. MONTREAL PROTOCOL/ GLOBAL ACTIONS

HARMONISED CONTROLS AND ENFORCEMENT

- Establish and enforce minimum standards for national licensing systems, including unique consignment reference numbers and mandatory reporting of controlled substances (including recycled and reclaimed)
- Prohibit non-refillable cylinders and require take-back schemes for refillables
- Expand and formalise Prior Informed Consent mechanisms
- Strengthen cross-border customs cooperation to disrupt smuggling networks
- Integrate financial investigations to address tax evasion, VAT fraud and money laundering
- Apply dissuasive penalties and criminal sanctions

TRANSPARENCY AND REPORTING

- Mandate standardised reporting of illegal trade, including methodologies, enforcement actions and penalties
- Improve supply chain transparency through digital tracking and quota tracing

DEMAND REDUCTION AND TRANSITION

- Introduce earlier and broader HFC equipment bans to reduce demand and illegal trade incentives
- Promote natural refrigerants through incentives, capacity-building and technical assistance

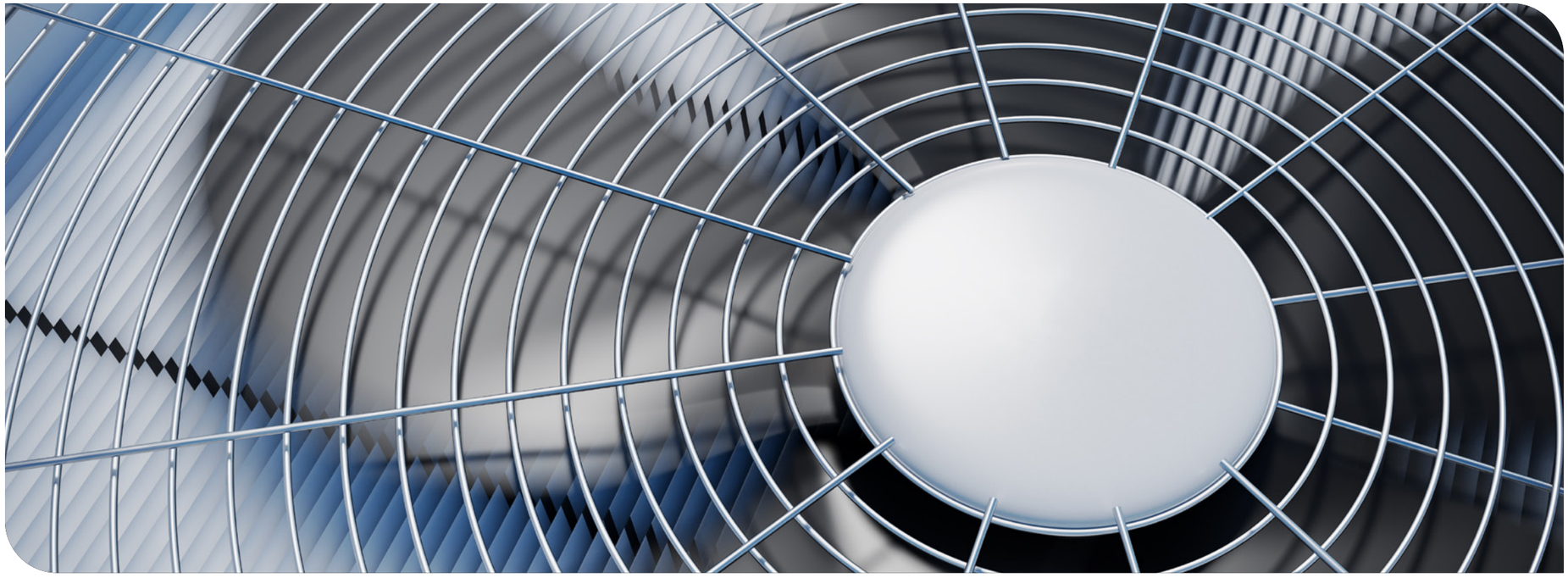
3. END-USER AND MARKET ACTIONS

SUPPLY CHAIN RESPONSIBILITY

- Conduct supply chain due diligence to ensure suppliers, products and documentation are compliant
- Avoid purchasing refrigerants or equipment from unverified or informal sources

DEMAND REDUCTION

- Accelerate phase-out of HFCs in new and existing equipment to reduce exposure to price volatility, supply constraints and illegal trade risks
- Adopt sector-specific best practice transition pathways to move away from HFCs



Discarded HFC cylinders often leak out remnants of gas into the atmosphere, further adding to their damaging impact. Refillable cylinders with robust take back schemes can help.

INTRODUCTION

HFCs are highly potent greenhouse gases used in cooling, making them a significant driver of climate change and the focus of global phase-down efforts under the Montreal Protocol and its Kigali Amendment.

While this has the potential to deliver huge emission reductions, rising HFC demand and regional price differentials fuel illegal trade, which undermines compliance, distorts markets and delays the transition to low-GWP alternatives.

i) WHAT ARE HFCs?

HFCs are potent synthetic fluorinated greenhouse gases (F-gases) commonly used in cooling systems but also in foams, aerosols and other sectors.

Emissions occur across their lifetimes, from production and use to end-of-life disposal. Their climate impact is measured by the global warming potential (GWP) index, which compares their warming effect to carbon dioxide (CO_2) over a specific time frame, usually 100 years. HFCs used in commercial refrigeration typically have very high GWPs. For example, HFC-404A (or R404A), which is a commonly used HFC refrigerant, has a GWP of 3,922.[1] Globally, HFC emissions account for two per cent of total greenhouse gas (GHG) emissions annually, a significant contribution, and more than the aviation sector which accounted for 1.7 per cent of GHG emissions in 2023.[2]

Natural refrigerant alternatives to HFCs include CO_2, ammonia, hydrocarbons, water and air. They have low GWPs, from zero to three. Their use in different refrigeration equipment has rapidly increased, particularly in Europe.

In addition, and in part due to the restrictions being imposed on HFCs globally under the Montreal Protocol, F-gas producers have developed a new generation of low-GWP fluorinated refrigerants, hydrofluoroolefins (HFOs). HFOs are commonly blended with HFCs in order to reduce the GWP of the refrigerant and ensure it meets the thermodynamic properties of the HFC refrigerant for which cooling systems where originally designed. However, many of the resulting blends still have high GWPs. For example, R449A, a commonly used HFO-HFC blend in supermarkets, has a GWP of 1,397.

ii) THE ROLE OF THE MONTREAL PROTOCOL

Widely hailed as the world's most successful international environmental treaty, the Montreal Protocol has played a critical role in mitigating climate change for almost 40 years. By driving the phase-out of over 99 per cent of controlled ozone-depleting substances (ODS), which are also highly potent greenhouse gases, the Protocol has helped set the ozone layer on a path to recovery, shielding people and ecosystems from harmful ultraviolet radiation.[3] Scientists estimate that these actions will have avoided around 2.5°C of global warming by the end of the century.[4]

In 2016, Parties to the Montreal Protocol unanimously agreed to build on this success with the Kigali Amendment, committing to phase down the production and consumption of HFCs. If fully implemented, the Kigali Amendment is expected to avoid up to a further 0.5°C of warming.[5] Under the Kigali Amendment, developed countries were required to begin reducing HFC consumption and production in 2019, while most developing countries capped HFC production and consumption in 2024 and begin reductions from 2029.

The differentiated control schedules, also in place for ODS, have been fundamental to the success of the Montreal Protocol as they recognise that developed and developing nations have different capabilities and historical responsibilities. However, they also created conditions that unintentionally enabled illegal trade. By requiring industrialised countries to phase out substances more rapidly than developing countries, large price differences emerged between markets. While consumption was being rapidly phased out in industrialised countries, production in developing countries was growing, creating a cheap and readily available supply.

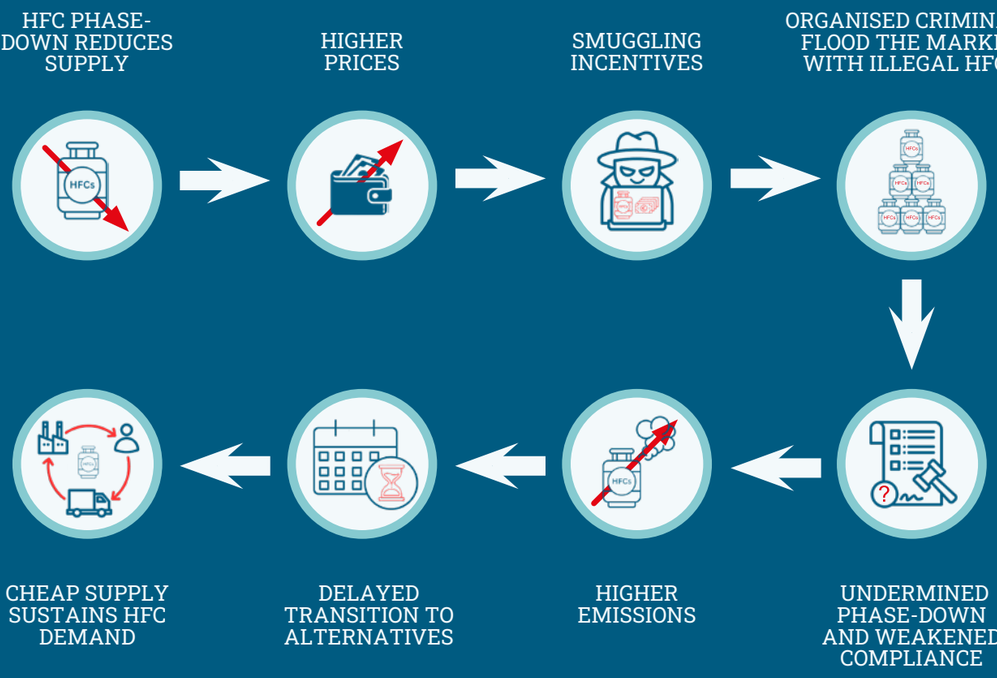
This imbalance fuelled the first major wave of illegal trade in the mid-1990s, when the US and EU banned CFCs. Smuggling later spread to developing countries as they began to cut CFC supply and controls expanded to include hydrochlorofluorocarbons (HCFCs).

The HFC phase-down brings significant new challenges in comparison to the previous ODS phase-outs, not least because of the growth of the global refrigerant market, which is projected to increase from $27.2 billion in 2025 to $36.7 billion by the end of 2030.[6] Additionally the plethora of HFC blends poses considerable challenges for enforcement.[7]

Throughout its history, a range of measures have been introduced under the Montreal Protocol to try to counter illegal trade. At the core of these is Article 4B, which requires that parties establish licensing systems covering the import and export of controlled substances, allowing authorities to monitor legitimate trade and, theoretically, detect illicit activity.[8] These systems are most effective when coupled with quota controls which set permitted import and export limits at the national or regional level. While quota controls are not mandatory under the Montreal Protocol, they are a prerequisite for Article 5 (developing) countries to receive funding under the Multilateral Fund (MLF) and have been implemented by most parties.

Another important tool is the Informal Prior-Informed Consent (iPIC) mechanism. Launched in 2006 and now used by 112 countries plus the EU, iPIC facilitates information-sharing on trade intentions, with the goal of preventing unwanted or illegal shipments. In 2023-24, 5,834 queries were initiated through iPIC. These queries were linked to the verification of 250,465 tonnes of controlled substances, equating to roughly 424 million tonnes of CO_2-equivalent ($MtCO_2e$).[9] During the past decade, it is estimated that iPIC has avoided at least 7,000 tonnes of illegally traded substances. However, as an informal mechanism, participation in iPIC is voluntary and the bulk of international trade still occurs outside of the system.

WHY ILLEGAL F-GAS TRADE IS A PROBLEM



HFC phase-downs reduce the legally available supply of HFCs over time.

Where demand remains strong, this supply constraint increases market prices. Organised criminal networks exploit price differentials by smuggling HFCs from regions with weaker controls and lower prices into higher-priced markets such as the EU. These products are typically sold below the legal market price while still generating substantial illicit profit.

By flooding the market with lower-cost HFCs, illegal trade punishes legitimate businesses and reduces the economic incentive to invest in more efficient natural refrigerant-based systems. This not only increases direct refrigerant emissions but can also result in higher indirect emissions due to delayed uptake of more efficient systems.

Illegal trade undermines the rule of law and a country's ability to comply with Montreal Protocol obligations.

Estimating the scale of illegal trade in any product is difficult. In 2022, the European F-gas industry estimated that illegal HFC trade could account for as much as 30 per cent of the market, resulting in lost profits of up to €640 million a year.[10]

WHAT ILLEGAL HFC TRADE LOOKS LIKE TODAY: SMUGGLING METHODS, PAST AND PRESENT

EIA's investigations over the past five years reveal that smugglers commonly abuse weak entry points to smuggle contraband F-gases onto EU markets.

Criminals effectively launder HFCs by smuggling non-quota HFCs into an EU country with less rigorous enforcement, often Bulgaria or Romania, then releasing them onto the market, where they are sold to customers across the bloc without proving they have quota.

Common methodologies used for smuggling ODS and HFCs globally include:

- **front door smuggling:** In situations where there is no effective licensing system in place or where checking of shipments at customs borders is not carried out in a vigilant manner, smugglers openly import chemicals without quota
- **false labelling:** False labelling is a common technique to disguise controlled substances as legal replacements. Recent examples of this include HFCs falsely labelled as HFOs
- **misdeclaration:** ODS and HFCs are disguised using incorrect chemical names, customs codes or other designations on shipping documents and invoices.
- **fake recycled or reclaimed material:** In one of the first smuggling methods uncovered in the 1990s illegal ODS were falsely described as 'used', 'recovered', 'reclaimed' or 'recycled'. Similar patterns are emerging with HFCs
- **concealment:** Controlled substances are hidden in ships, cars, passenger buses or trucks and moved across borders.
- **transshipment and transit fraud:** Consignments of ODS and HFCs ostensibly destined for legitimate end markets are diverted onto black markets. This type of fraud often involves elaborate shipping routes, passing through various customs points. In the EU, exploitation of the bloc's transit regime, which allows goods to pass through EU countries without being subject to full customs controls, has been one of the main methods for smuggling consignments of non-quota HFCs onto the market.

HFC-134a seized in Serbia en route by bus to Germany with undeclared Botox and perfume.

HFCs concealed in LPG tanks, one of the many inventive methods used to smuggle HFCs.

EIA INVESTIGATIONS INTO THE ILLEGAL HFC TRADE

In 2025, EIA carried out investigations into Italy's HFC market, engaging across the supply chain with importers, distributors and sellers via online trading platforms.

EIA's investigations in Italy have uncovered companies across the supply chain suspected of large-scale trading in illegal HFCs, revealing how regulatory loopholes are being exploited and pointing to clear priorities for strengthened enforcement action.

Despite restrictions on very high-GWP refrigerants such as R404A, many operators were willing to sell them, also claiming to supply HFCs to major end-users including shipyards, rail operators, supermarkets and manufacturers. These findings underscore the need for stronger corporate due diligence and a faster phase-out of high-GWP HFCs.

In 2025, EIA carried out investigations into Italy's HFC market, engaging across the supply chain with importers, distributors and sellers via online trading platforms. As the EU's largest consumer of air-conditioning, Italy is a major HFC market.[12] Industry associations have claimed that nearly half of the refrigerant gas available on the Italian market is illegal and EIA's seizure database shows that the country reported more HFC seizures in 2024 than any other member state.[13]

Our findings focus on three companies situated across Italy at various levels of the supply chain.

One of these, Albanian HFC distributor Halpha Refrigerant claimed to supply half of southern Italy, suggesting significant amounts of non-quota HFCs are entering Italy from Albania.

In northern Italy, Carma Metal's representative claimed to exceed quota and source HFCs from outside of the EU via countries such as Bulgaria and Romania, noting that the HFCs were 'sorted' in these countries. This company also named equipment manufacturer Frigo System and major retail chains Lidl and Carrefour within its supply chain.

A third company, regional distributor Puglia Oxygen, initially offered EIA investigators 200kg of virgin R404A over the phone, noting that a different HFC ("other material") would be invoiced. However, during a face-to-face meeting, the offer of R404A was retracted by a senior representative of the company who instead noted the impact of illegal HFC traders from Bulgaria, suggesting that millions of euros worth of HFCs were coming though Italian ports. This company also claims to supply refrigerants to major clients such as Italy's state railway and international truck and bus manufacturer Iveco.

Above, left: Illegal trade in F-gases results in additional emissions, fuelling climate change and undermining efforts to transition to more sustainable alternatives.

All the companies investigated and named within these findings were given right to reply.

Despite claiming to be quota-holders, some of the companies do not appear on the European Commission's annually updated list of quota-holders. While it is possible these companies have purchased quota elsewhere, the average quota price in spring/summer 2025 was €16/tonne CO_2e.[14] This would add approximately €62 to the cost of one kilo of R404A, meaning it would be unable to sell refrigerants at such low prices.

Finally, given the importance of online marketplaces in facilitating illegal trade, EIA conducted a short analysis of HFC adverts posted on Facebook Poland, a country with large amounts of reported HFC seizures (see Table 1, page 18) The analysis found that none of the adverts fully complied with the EU's Digital Services Act's trade information transparency policy, nor did they openly offer a cylinder-takeback scheme as required under the F-Gas Regulation.

i) HALPHA REFRIGERANT AND ARVISA SRL

ROLE IN THE SUPPLY CHAIN

Arvisa Srl is a major Italian HFC distributor. Incorporated in 2014, the company is headquartered in Forli and has an operational unit in Pompei. Financial records show its revenue doubled between 2023-24, from €3.9 million to €8.2 million.[15]

According to the Italian Ministry of Environment, the company was linked to a seizure of 14 tonnes of non-quota HFCs carried out in spring 2025.[16] Although Arvisa is listed as a 2025 quota-holder by the European Commission, the Italian Ministry of the Environment subsequently requested the European Commission to cancel the company's quota following the seizure.[17,18] Arvisa is not listed as a 2026 F-gas quota-holder.

EIA's research suggests Arvisa may have acted as a distributor for Albanian HFC producer Halpha Refrigerant, with Arvisa's name highlighted as the company's Italian distributor on signage and a website relating to a refrigerant fair. According to the European Commission's list of quota-holders for 2025, Halpha Refrigerant is not among them.[19]

EIA was able to meet with a person acting as a Halpha Refrigerant representative based in Italy who was offering HFCs for sale on Facebook Marketplace. During the meeting, he informed EIA investigators that Halpha Refrigerant had a 50 per cent share of the HFC market in southern Italy, with a turnover of €15 million over five years.

MODUS OPERANDI

The Halpha Refrigerant's representative described difficulties in obtaining EU F-gas quota, stating that unless a company is a large multinational it can expect to receive only about 5,000 tonnes of CO_2e per year, an amount too negligible to enable meaningful trading.

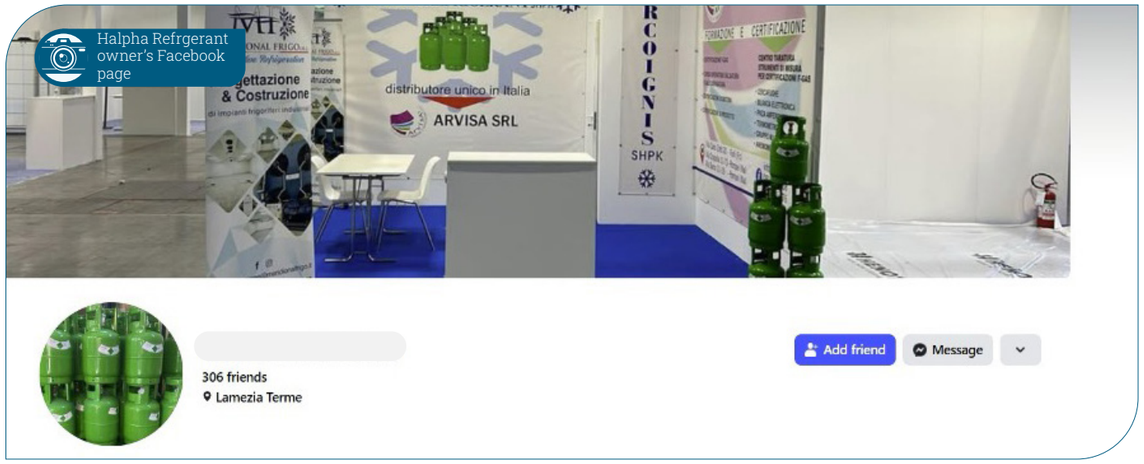
Undercover footage from meeting with Halpha Refrigerant. The white board on the wall says F-GAS HALPHA R-404A.

Despite these claimed constraints, the representative offered a range of HFCs, including R134a, R410A and R404A, at prices of €30-35/kg. These are well below the level that EIA considers plausible for quota-compliant product, raising concerns regarding the source and legality of the gases.

EIA's investigation suggests that Halpha Refrigerant is illegally importing virgin R404A and marketing it as reclaimed. While the company claims to import 'reclaimed' R404A, this assertion seems unlikely for two reasons. First, under the EU F-Gas Regulation, imports of reclaimed gas are still subject to quota requirements. Second, Albania (which is identified as the country of export) has limited reclamation capacity compared to EU member states, making large-scale exports of genuinely reclaimed refrigerant unlikely.

Further evidence indicates that Halpha Refrigerant may be placing HFCs on the EU market without holding the required quota and, when questioned about this, the representative stated that the Albanian export company "deals with customs and everything", implying that compliance responsibilities rest with the exporter. As the representative explained: "For us, the container arrives and that's it, we just need to unload it." This statement implies a deliberate distancing from customs and regulatory obligations, despite Halpha Refrigerant's apparent role in introducing the product to the EU market.

The representative also indicated that invoices for HFCs are issued from Albania and therefore Halpha Refrigerant does not pay VAT, suggesting instead that responsibility for VAT declaration lies with Italian purchasers. If true, this suggests that the representative regards the buyers of HFCs as importers. However, this claim contradicts the company's actual business practices. The HFCs are placed on the market by Halpha Refrigerant and subsequently transported by the company throughout



Italy for onward sale. On this basis, Halpha Refrigerant is acting as the importer and EU law requires that it hold sufficient quota to place HFCs on the market.

Taken together, Halpha Refrigerant's claimed minimal quota holdings, the unusually low prices offered, the suspected mislabelling of virgin R404A as reclaimed, statements suggesting potential avoidance of customs and VAT responsibilities and information regarding the company's market share lead EIA to suspect that Halpha Refrigerant is placing non-quota HFCs on the EU market.

Although Halpha's representative did not refer to the major seizure of HFCs involving the company in spring 2025, they did acknowledge that four containers were blocked in 2023 after banned disposable cylinders were discovered in one shipment. This admission further reinforces concerns regarding persistent non-compliance with the EU F-Gas Regulation.

In a right-to-reply, EIA asked Arvisa whether it sources HFCs directly from Halpha Refrigerant and acts as its Italian distributor. The company was also asked to respond to allegations that, in conjunction with Halpha Refrigerant, it imports virgin HFCs and sells them as reclaimed gas and that it sells HFCs placed on the market by Halpha Refrigerant outside of the F-gas quota system.

A spokesperson from Arvisa rejected the suggestion that the company has knowingly imported virgin HFCs and marketed them as reclaimed product, or that it has placed gases on the EU market outside the applicable regulatory framework. Import documents from an Albanian refrigerant supplier indicating the presence of regenerated gases was shared, although a check on the exporting company website does not openly offer regenerated gases for sale. Additionally, Arvisa did not respond to EIA's request for clarification about its relationship with Halpha Refrigerant.

IMPLICATIONS

The claims made by Halpha Refrigerant's representative suggest that a distributor with a substantial footprint in southern Italy may be supplying significant volumes of HFCs outside the quota system.

Halpha Refrigerant's representative made certain claims, such as assertions of controlling half of the regional market, combined with offers of thousands of cylinders at prices below typical quota-compliant levels, indicate the potential for large-scale placement of non-quota HFCs into Italian supply chains.

"Of course, we operate between Naples, Forlì and everywhere else, and we make 15 million euros in five years."

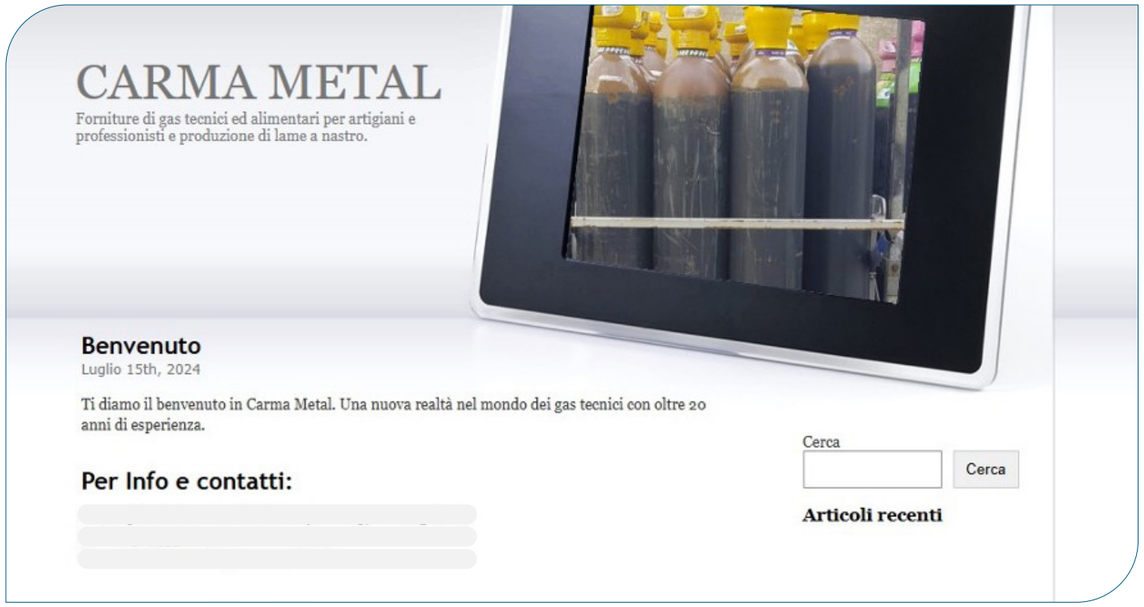
HALPHA REFRIGERANT Representative

These claims, if accurate, suggest that a distributor with a substantial footprint in southern Italy may be supplying significant volumes of HFCs outside the quota system. The marketing of virgin R404A as reclaimed undermines the functioning of the EU phase-down by disguising new production as recycled material, weakening incentives for legitimate EU-based reclamation and obscuring the true volume of virgin gas entering the market.

The invoicing structure described (where gas is billed from Albania and Italian purchasers are left responsible for VAT) would create an additional fiscal risk, mirroring patterns seen in other parts of the illegal HFC trade.

These features point to vulnerabilities in quota enforcement, import controls and VAT oversight and illustrate how companies may continue trading even after seizures or suspected quota cancellation.

For downstream users, including installers and distributors, such practices increase the likelihood that non-compliant HFCs are circulating through legitimate commercial channels without clear traceability or lawful placement on the market.



ii) CARMA METAL

ROLE IN THE SUPPLY CHAIN

Carma Metal S.R.L.S., incorporated in November 2023, is an Italian importer and distributor of refrigerant gases with a main processing facility in Salerno and a smaller depot in Milan.[20,21] Financial records for 2024 show a revenue of €1.4 million and a profit of €55,410.[22]

During a meeting with EIA investigators, a company representative claimed that Carma Metals imports HFCs from outside the EU as well as from other EU countries, notably Bulgaria. He explained how Carma Metals supplies a broad section of industry including cold room manufacturers, shipyards and the major cooling equipment manufacturer Frigo System.

The representative indicated that, ultimately, its gas is used in major supermarkets including Lidl and Carrefour. In a right-to-reply, Carrefour noted that Carma Metals is not an authorised supplier and does not have any commercial relationship with the company. Based on this information, it may be that Carma Metals is not a direct supplier but instead provides goods to Carrefour's direct suppliers. EIA asked Lidl Italy to comment on our findings, but we received no response.

The representative claimed that its parent company, Tecno Polgas, holds EU F-gas quota, yet neither Tecno Polgas nor Carma Metal are named on the EU list of 2025 quota-holders.[23]

In a right-to-reply from Tecno Polgas and Carma Metals, both companies rejected EIA's statements, noting that they have nothing to justify or confirm and that their company complies with internal and international standards and regulations and will take all necessary measures to make changes required by the regulatory framework.

MODUS OPERANDI

During EIA's engagement with Carma Metal, a company representative made a number of statements indicating what may be systematic non-compliance with EU F-gas controls.

He openly acknowledged that the business routinely exceeds its authorised F-gas quota, stating that Tecno Polgas holds quota sufficient to import approximately 3,200 cylinders per year, while Carma Metal in practice sells between 6,000-7,000 cylinders annually. The representative further claimed that such over-quota activity could not be detected by authorities, describing quota enforcement as "impossible to control" and incorrectly asserting that quota requirements do not apply when refrigerant is purchased for resale.

The representative went on to describe the company's sourcing routes, indicating that Carma Metal receives HFCs from Romania and Bulgaria, which he characterised as "sorting" points for gas produced elsewhere. He also stated that the company receives maritime shipments of HFCs originating in Türkiye, which are imported into the EU via Bulgaria or Romania before reaching Italy.

Despite restrictions on the use of virgin R404A, the representative stated that Carma Metal continues to sell this product, noting that it remains the most popular refrigerant. He acknowledged that R404A "is not billable" and admitted that cylinders containing virgin R404A are invoiced as R448A to avoid detection.

Above: Carma Metal website.


©Igor Paszkiewicz/iStock

The representative also indicated a willingness to operate outside normal fiscal channels, stating that Carma Metal accepts cash payments where convenient. This raises further concerns that the company may be avoiding the declaration of income, and associated tax implications, from these transactions.

In addition, the representative also referred to the high-profile Arvisa enforcement case, stating that Arvisa sourced gas from Albania and alleging that the product was smuggled, remarking that "it's like he's selling cocaine".

Throughout the discussions, the representative emphasised the profitability of the trade. He claimed that an investment of €200,000 in refrigerant cylinders could yield nearly €500,000 in returns. He further suggested that selling 100 cylinders a month would generate around €3,000 in profit at modest margins, rising to about €5,000 with higher mark-ups.

These statements underscore the strong financial incentives driving continued non-compliance with the F-Gas Regulation.

Above: Illegal trade in F-gases can reap huge profits, proportionate penalties should be applied

IMPLICATIONS

The statements made by Carma Metal's representative point to persistent vulnerabilities in Italy's enforcement of the EU F-Gas Regulation.

His description of exceeding quota limits, using opaque cross-border supply routes and continuing to sell restricted gases indicates a regulatory landscape in which large quantities of non-compliant HFCs may still enter and circulate within the Italian market.

The representative's account of how such practices evade detection, combined with admissions of off-book payments, suggests scope for better enforcement not only by customs, but also in financial oversight and market surveillance. These dynamics raise concerns about the ease with which both quota rules and fiscal obligations can be circumvented.

Statements indicating that potentially non-compliant HFCs may be supplied into supermarket refrigeration systems further highlight the risks to downstream operators which may unknowingly rely on gas that is not legally placed on the market.

Taken together, these features underline the need for stronger traceability and reporting mechanisms, more robust enforcement at import and clearer accountability across the Italian refrigerant supply chain.

Undercover footage from meeting with Puglia Oxygen. The company name and several cylinders can be seen in the background.

iii) PUGLIA OXYGEN

ROLE IN THE SUPPLY CHAIN

Puglia Oxygen Srls is a distributor of refrigerant gas headquartered in Manfredonia, Italy. The company reported a turnover of over €700,000 in 2022 and retails industrial and refrigerant gases, as well as domestic fuel.

The company claims to supply refrigerants to major transport sector clients, including Ferrovie dello Stato (Italy's national railway company) and international truck and bus manufacturer Iveco. In a right-to-reply, Iveco notes that its suppliers are required to commit to a Code of Conduct and pointed to its supplier audit, compliance and sustainability functions outlined in the company's annual report.[24]

Iveco did not respond to EIA's request for confirmation as to whether the company does indeed source HFCs from Puglia Oxygen.

Puglia Oxygen does not hold quota under the F-Gas Regulation, instead claiming to source from a wholesale supplier based in Rome at whatever frequency or quantity is needed to meet its demand. Undercover footage collected by EIA reveals cylinders in Puglia Oxygen's warehouse labelled 'Halpha Refrigerant', an Albanian company identified in our investigation as suspicious.

MODUS OPERANDI

EIA's engagement revealed evidence of potential regulatory evasion in Puglia Oxygen's sales practices. A junior representative stated that the company would be able to supply 200kg of virgin R404A under the EU F-Gas Regulation.

He suggested that the transaction would require amendment of documentation, explaining: "I can even give you the 404, the price is not a problem, but you should know that I will have to put other material on the invoices." When EIA later enquired about the availability of R404A with a senior company representative, the claim was quickly dismissed and the offer of R404A was retracted.

The company also appears to be non-compliant with cylinder management obligations. Rather than operating a formal cylinder take-back scheme, Puglia Oxygen sells empty refillable cylinders as scrap metal for profit. One representative explained that a staff member dismantles the valves and recovers the scrap metal, generating between €300-500 per batch. This practice constitutes a

This photo and below: Images of cylinders taken in Puglia Oxygen's warehouse. The close-up shows Halpha Refrigerant's name on it, suggesting that Puglia may source HFCs from Halpha Refrigerant.

clear breach of the EU F-Gas Regulation, which requires refillable HFC cylinders to be returned to the supplier for refilling and reuse. It may also lead to additional emissions of HFCs as a residual amount of gas is often left in the heel of the cylinder.

In addition, Puglia Oxygen's representative provided insight into what appears to be the wider illicit refrigerant market in Italy, particularly the role of Bulgarian traders. He stated these traders are able to maintain low prices by illegally importing non-quota HFCs into Italy. Although he acknowledged a crackdown by Bulgarian authorities two years earlier, he claimed the market had since rebounded, with large volumes of refrigerant entering through Italian sea ports. As he described it, "millions of euros are coming in [to the port]. When five to six thousand cylinders arrive, do you know how much money that is? Ships full of cylinders, do that every week, do it for a month, do it for a year! I mean, there's definitely VAT evasion going on that you don't even know about!"

The representative further noted that HFCs imported from Bulgaria are also transported into Italy by road. He claimed that, to avoid detection, Bulgarian traders have adapted their operations by using rented trucks which do not display Bulgarian licence plates, thereby reducing the likelihood of attracting attention from enforcement authorities.

IMPLICATIONS

The potential ongoing sale of virgin R404A by Puglia Oxygen is particularly concerning, as it demonstrates a lack of effective enforcement of the use ban on very-high-GWP HFCs. Allowing such practices to continue undermines the credibility of the phase-down and prolongs the climate damage associated with these gases.

In addition, although the 2024 EU F-Gas Regulation introduced clear requirements for the return and reuse of refillable cylinders, intelligence collected by EIA indicates that this provision is not being implemented effectively. The scrapping of refillable cylinders weakens traceability, facilitates illegal trade and further erodes regulatory oversight.

Finally, this case highlights the transnational nature of the illegal HFC trade and the need for stronger international cooperation, particularly in relation to illicit imports routed through Bulgaria.

"I have the 404, it's not a problem, the problem is putting it on the invoices … I can even give you the 404, the price is not a problem, but you should know that I will have to put other material on the invoices."

PUGLIA OXYGEN
Junior company representative

iv) ILLEGAL HFC TRADE ON ONLINE MARKETPLACES

Online marketplaces are estimated to account for almost 60 per cent of global e-commerce sales by the end of 2027.[25] However, the large audiences and easy distribution networks which help drive their popularity also play a key role in fueling sales of illegal goods, including refrigerant gases. A 2024 investigation by Forbes into the sale of HFCs on Facebook Marketplace in the United States documented sales of HFCs well below market price, as well as sales of banned ozone-depleting refrigerants.[26]

In response to this, some regions and governments have developed regulatory frameworks to make marketplaces safer. The EU's Digital Services Act (DSA) requires platforms to offer transparent trader information, including their address and contact details and any trader registry information.[27] Platforms are also required remove illegal adverts when alerted to them, while Very Large Online Platforms (VLOPs) and search engines with more than 45 million EU users, such as Facebook, are further required to assess the systematic risks of illegal trade and mitigate these with effective measures.[28] The EU F-Gas Regulation also recognises the role of online marketplaces, noting that competent authorities should take a risk-based approach to checks and that these should include online platforms.[29]

EIA has carried out an initial analysis of 50 adverts posted between 30 July 2025 and 21 January 2026 for HFCs on Poland's Facebook Marketplace. Poland was selected as it has previously been identified as a high-risk country for illegal HFC trade by EIA and has reported significant HFCs seizures recently (*see Figure 1*).[30]

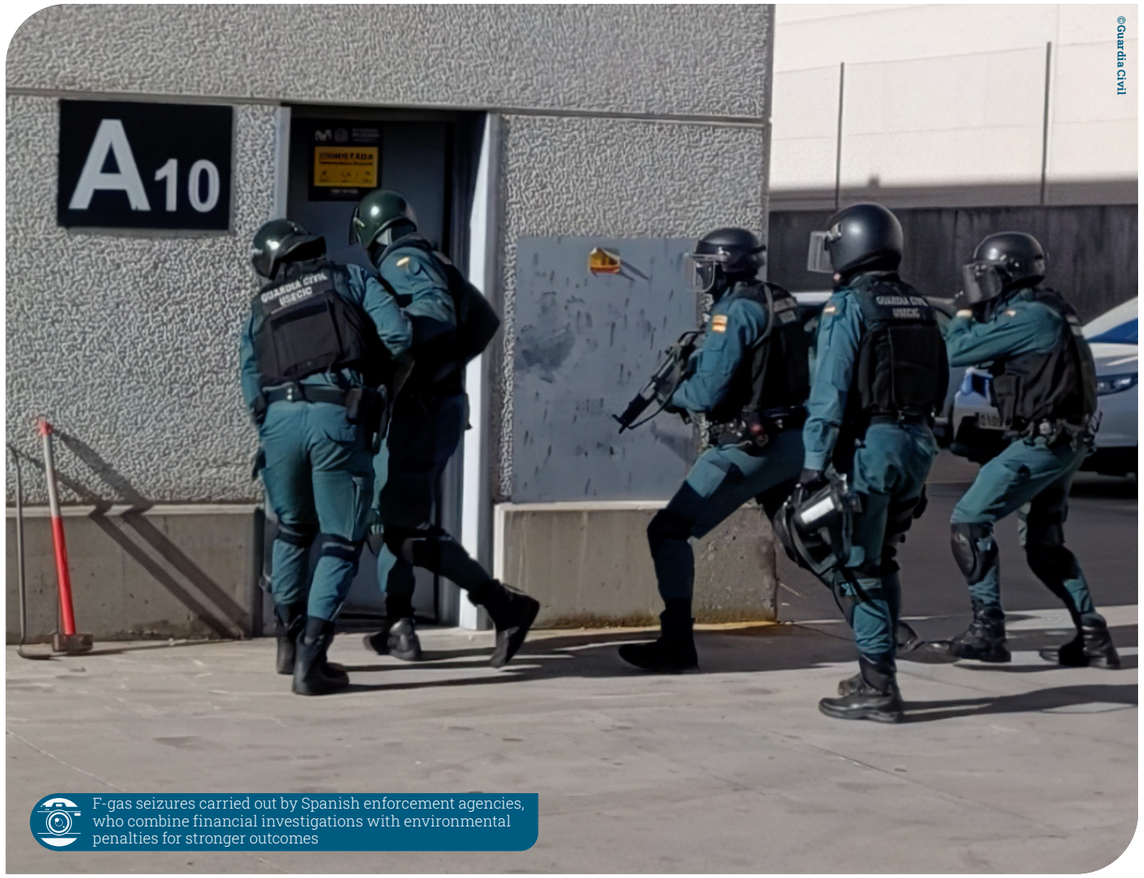
The analysis found that none of the adverts fully complied with the DSA's trade information transparency policy, nor did they openly offer a cylinder takeback scheme, as required under the F-Gas Regulation. In fact, three adverts showing refillable cylinders stated that they were not required to be returned for exchange. Out of the 50 adverts collected, 36 per cent (18) offered disposable cylinders which lack a refilling valve. Five of the adverts used images of refillable cylinders while stating availability of disposable 13.6kg R134a in the caption, suggesting attempts to conceal the sale of this prohibited cylinder.

Average prices for both R404A and R134a refillable and disposable cylinders are noted in Table 1 and were significantly below the industry service company purchase price offered to service companies. As disposable cylinders have been banned in the EU since 2007, their industry price isn't noted.[31]

As a VLOP, the fact that 100 per cent of 50 adverts analysed by EIA were suspected to be illegal is of grave concern. There is little evidence that Meta has carried out any systematic risk assessment of illegal trade in HFCs or taken effective counter measures to stop illegal sales of this high-risk commodity.

***Table 1:** Average price of R134a and R404A for sale on Polish Facebook marketplace.*

REFRIGERANT	POLISH FACEBOOK MARKETPLACE	SERVICE COMPANY PURCHASE PRICE [32]
DISPOSABLE CYLINDER		
R404A	€18.5/kg	N/A
R134a	€14.9/kg	N/A
REFILLABLE CYLINDER		
R404A	€21.1/kg	€ 80/kg



F-gas seizures carried out by Spanish enforcement agencies, who combine financial investigations with environmental penalties for stronger outcomes

HFC SEIZURES AND REPORTING

Enforcement against illegal HFC trade in the EU has intensified, with reported seizures nearly tripling between 2023-24 and Italy identified as a major hotspot. Coordinated action by enforcement authorities reflects a growing focus on F-gas crime, although rising volumes suggest illicit trade remains significant. Globally, World Customs Organisation operations continue, but weak reporting under the Montreal Protocol means the true scale is likely underestimated.

i) INCREASING EU SEIZURES

As EU awareness of the threats posed by illegal HFC trade have grown and additional policy interventions designed to tackle it have been implemented, enforcement efforts have also increased.

Europol continues to play a pivotal role in encouraging and coordinating police activity on F-gases via its EMPACT Operational Action Plans, highlighting the role of criminal F-gas smuggling networks in its 2025 EU Serious and Organised Crime threat assessment.[33]

The EU's Anti-Fraud office (OLAF) also plays a key role in supporting enforcement by EU customs agencies and has contributed to many high profile seizures. Recently, efforts to improve European cooperation in market surveillance of illegal F-gases have been supported by the establishment of an EU Administrative Cooperation group on F-gases.[34]

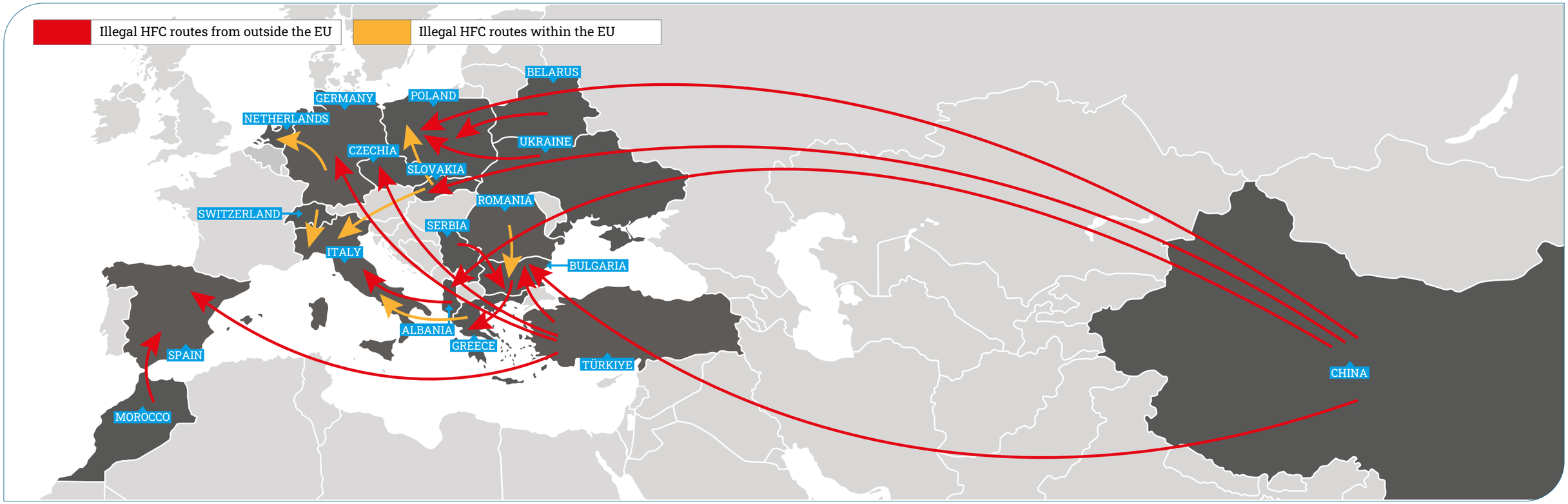


Figure 1: *Commonly reported illegal trade routes into and within the EU.*

EIA's Global Environmental Crime Tracker, a publicly accessible interactive dashboard that holds and visualises up-to-date data on environmental crime, documents global refrigerant gas seizures with data collated from various sources, including media outlets, reporting by Parties to the Montreal Protocol and via a periodic survey sent to EU customs. Findings are reported in Figure 2.

Evidence of increased enforcement activity is reflected in the sharp rise in reported HFC seizures in recent years, particularly during 2023-24 when the volume of seized HFCs almost tripled, from approximately 250 tonnes in 2023 to about 670 tonnes in 2024.

The high volume of HFC seizures in Italy in these years stands out in particular and is supported by reports from the Italian Ministry of Finance, which claimed to have seized nearly 500 tonnes of illegal refrigerants in 2024.[35] The comparatively low level of seizures reported for 2025 could potentially be related to reporting timelines lagging behind actual enforcement actions.

The overall trend of elevated seizure volumes could point to an increasing amount of illegal activity or it could reflect the European enforcement community's increasing attention on F-gases, or both. Either way, the significant volume of seizures in Italy in 2024 was consistent with the findings of EIA's investigations, which identified the country as a hotspot for illegal HFC trade.

In response to the growing threat of illegal F-gas trade in Italy, in January 2026 the Italian Ministry of the Environment and Energy Security, Customs and Monopolies Agency and the Carabinieri announced a permanent F-gas roundtable aimed at fostering information sharing and co-ordination in tackling illegal trade.[36]

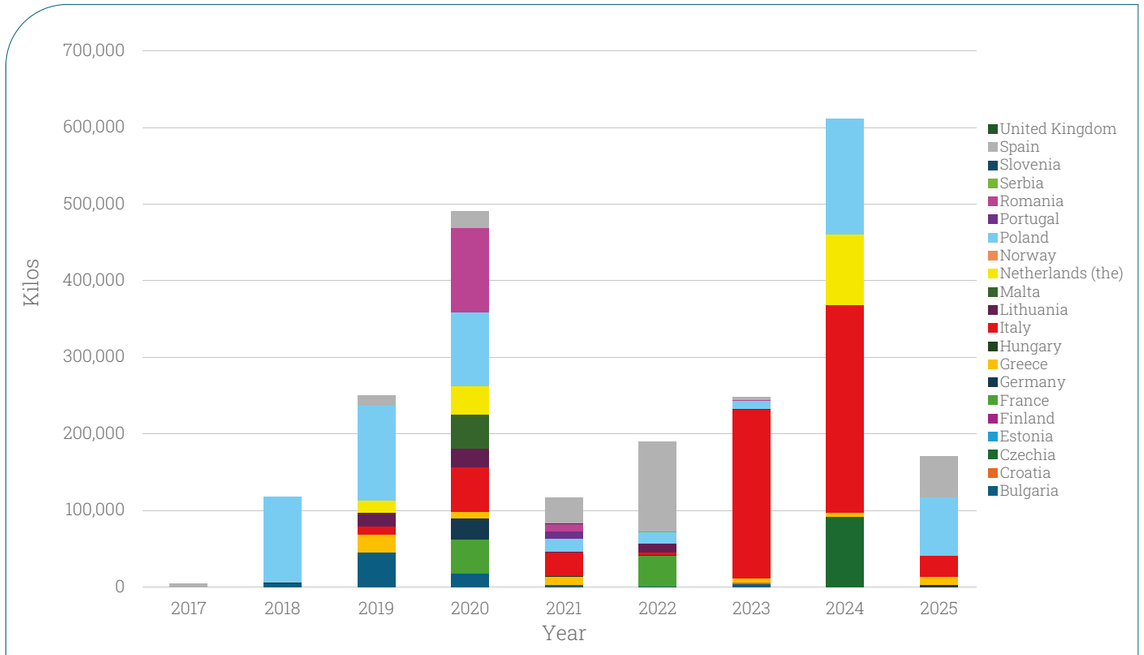
Figure 1 (above) shows common HFC illegal trade routes into and within the EU. Data has been compiled using information shared publicly by enforcement authorities as well as responses to EIA's request for information.

ii) GLOBAL HFC SEIZURES AND REPORTING

The World Customs Organization (WCO) Operation DEMETER, now in its 11th year, has played a key role in supporting global efforts to tackle illegal trade in ODS and HFCs. Following a record year in 2024, when aproximately 345 tonnes of ODS and HFCs were seized, the 2025 operation resulted in seizures of 168 tonnes of controlled substances.[37,38]

Reporting of illegal trade by Parties to the Montreal Protocol remains weak. Multiple decisions of the Montreal Protocol have invited or encouraged parties to report proven cases of illegal trade to the Ozone Secretariat, which is tasked with preparing an annual compilation of the information provided.[39] However, with no mandatory requirement to report and an inconsistent approach to reporting taken between parties, the Secretariat has recently acknowledged that the number of illegal trade incidents reported is "quite low" compared to the potential scale of the trade.[40]

Figure 2: *EIA recorded European HFC seizures between 2017-25 (kilos).*



KEY TAKEAWAY

EIA GATHERS DATA ON REPORTED REFRIGERANT SEIZURES

KEY TAKEAWAY

POLAND, ITALY AND SPAIN CONSISTENTLY REPORT HIGH SEIZURES

KEY TAKEAWAY

IN 2023 AND 2024 ITALY REPORTED THE HIGHEST HFC SEIZURES

EUROPE'S ONGOING BATTLE WITH SMUGGLING: HOW ILLEGAL TRADE HAS EVOLVED SINCE THE EU F-GAS REGULATION REVISION

The EU's strengthened F-Gas Regulation has significantly accelerated the HFC phase-down but soaring prices, driven by tighter quotas and persistent demand, continue to incentivise illegal trade, including counterfeit and mislabelled refrigerants. While new measures such as real-time quota monitoring, stricter licensing, cylinder controls and enhanced penalties mark major enforcement advances, gaps in supply chain traceability, exemptions for reclaimed gases and uneven coordination still enable illicit activity.

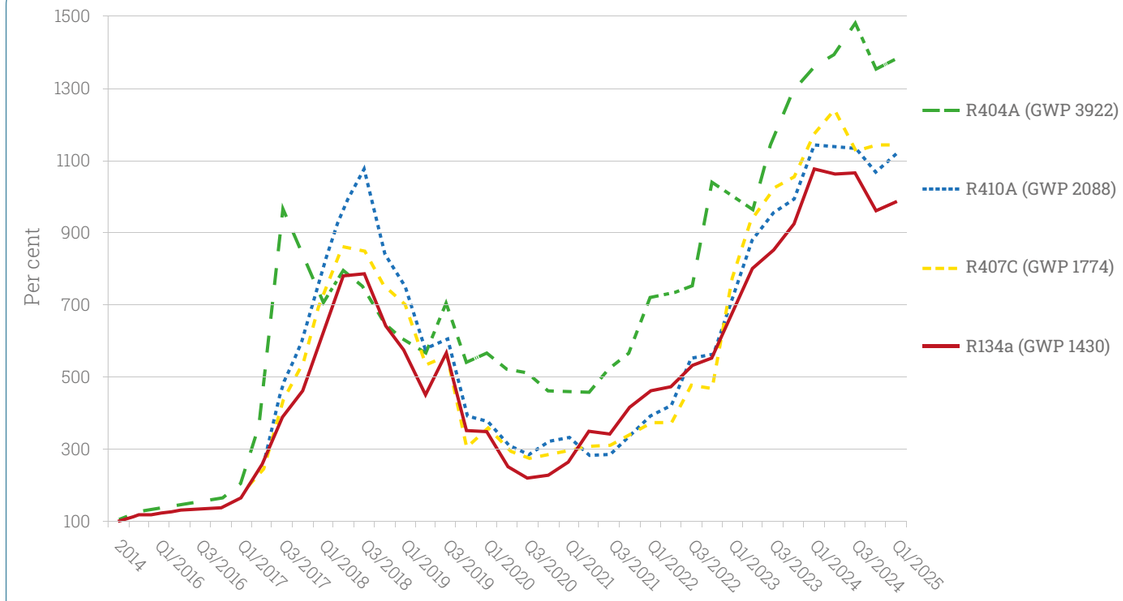
i) MOTIVATED BY PROFIT, EUROPEAN F-GAS SMUGGLING IS LINKED TO CONTINUED DEMAND

Between 2014-25, the average HFC price at gas distributor levels has increased by approximately 950-1,350 per cent (see Figure 3). The high EU price compared to much lower market prices of HFCs outside the EU incentivises illegal traders to import cheap non-EU HFCs without quota in order to sell at a premium on EU markets, making vast profits even when undercutting legitimate sellers.

HFC prices vary significantly depending on the location in the EU and the amount purchased, however as an illustration, Table 2 compares EU industry refrigerant price information with prices offered by companies suspected of trading illegal HFCs in Italy. Service company purchase price information was gathered from industry sources.

Falsely labelled R-449A cylinder, which upon testing contained a higher GWP refrigerant, R-404A. This trend of counterfeit refrigerants is increasing across Europe.

Figure 3: *Development of average HFC purchase prices at gas distributor levels (Source: Oeko Recherche).*[41]



KEY TAKEAWAY

HFC PRICES HAVE GONE UP BY ABOUT 10 TIMES SINCE THE PHASE-DOWN BEGAN

KEY TAKEAWAY

HIGH HFC PRICES ARE DRIVEN BY LARGE CONSUMER DEMAND

KEY TAKEAWAY

AS SUPPLY CUTS PERSIST, PRICES WILL CONTINUE RISING

Table 2: *EU industry refrigerant price information compared with prices offered by companies suspected of trading illegal HFCs in Italy*

REFRIGERANT	SERVICE COMPANY PURCHASE PRICE [42]	AVERAGE PRICE OFFERED TO EIA DURING ITALIAN INVESTIGATIONS
R-134a	€ 35/kg	€ 28/kg
R-404A Reclaimed	€ 70-110/kg	€ 38/kg
R-404A Virgin	€ 80/kg	€ 38/kg
R448A	€55/kg	€ 32/kg
R449A	€ 55/kg	€ 52/kg
R-452A	€ 80/kg	€ 47/kg
R-744	€ 4/kg	N/A
R-290	€ 14/kg	N/A

EIA's investigations have revealed a complex web of distributors who sell HFCs to other distributors, each taking their cut. The potential profits from HFC smuggling depend on where the illegal trader sits along the supply chain.

During a meeting with Italian importer Carma Metals, the representative suggested that selling about 100 cylinders a month could lead to profits of thousands of euros each month. He suggested an investment of €200,000 would result in a return of about €500,000. Similarly, a representative from Albanian importer Halpha Refrigerant, suspected of engaging in widespread illegal HFC imports, noted that the company has turned over €15 million in five years.

PRICES AND ILLEGAL TRADE ARE FORECAST TO GROW

The EU's 2024 F-Gas Regulation significantly increases the pace of the HFC phase-out. From 2027 the EU HFC quota will drop from approximately 43 $MtCO_2e$ to about 22 $MtCO_2e$, cutting the amount of quota released onto the EU market by almost half. The economic theory of supply and demand dictates that if supply is reduced yet demand remains strong then prices will rise. Unless ongoing demand is rapidly addressed, there will be even stronger price incentives for criminals to engage in the illegal HFC trade.

Despite the upcoming HFC supply cut, EIA's recent analysis of HFC dependency by five major EU supermarket chains, as well as engagement with equipment manufacturers, indicates that major end-users are still highly dependent on HFCs in their systems.[43] For example, in 2025 major retailer Carrefour reported that 76 per cent of its global stores were still reliant on HFC systems.[44] Although the retailer has not disclosed HFC use specifically within the EU, Carrefour's 2023 Climate Action Plan indicated that globally just 293 of its 11,408 global franchise stores were F-gas-free.[45]

Similarly, another retail giant, Ahold Delhaize, noted 60 per cent of its EU stores still relied on HFCs in 2023.[46] As market leaders, these companies are aware of upcoming HFC supply restrictions, yet their reported progress in phasing out HFCs does not align with EU requirements. Ongoing demand from these major end-users will further restrict supply for smaller end-users that may be less aware of upcoming cuts.

WHY F-GAS-FREE IS GOOD FOR THE PLANET AND YOUR POCKET

The switch to F-gas-free systems requires initial capital expenditure; however, EIA analyses using climate disclosures from major supermarket retailers indicate that energy savings due to better performing natural refrigerant systems lead to pay back periods of just 4-10 years, depending on site-specific factors.[47]

With supermarket cooling systems typically lasting about 15 years,[48] the annual savings continue well beyond the payback period, offering a strong and sustained return on investment.

End-users should also be aware of the impact that increasingly expensive HFCs will have on operational costs. Supermarkets are major HFC consumers, with a single store commonly using 400-700kg of HFCs per year to refill systems.[49] Based on the current price of R448A of €55/kg (see Table 1), this would amount to annual refrigerant costs of up to €38,500 per store.

Moving away from F-gases also mitigates the risk of substantial regulatory fines. Carrefour, for example, has estimated that its financial risk from fines associated with non-compliance of the F-Gas Regulation would be more than €100 million.[50]

As global HFC supply cuts begin, retailers across the world must urgently stop installing new HFC systems and transition existing systems to natural refrigerant alternatives.

ii) SUPPORTIVE EU F-GAS POLICY CHANGES

In February 2024, the EU adopted Regulation (EU) 2024/573 on fluorinated greenhouse gases, significantly strengthening the previous 2014 framework. The revised regulation enacts the world's first full HFC phase-out by 2050 and significantly accelerates the phase-down of HFCs to just 5.2 per cent of the 2015 baseline by 2030. It is estimated that this will prevent about 500 $MtCO_2e$ emissions by 2050, comparable to the annual emissions of 129 coal-fired power stations.[51,52]

The revised regulation takes a comprehensive approach that combines an accelerated HFC reduction schedule with additional demand-reduction measures, including new equipment bans and stronger actions to combat illegal trade.[53]

Below: The EU F-gas Regulation is an example of global best practice; however, full implementation of the F-gas Single Window for customs is urgently needed.

KEY MEASURES IN THE EU 2024 F-GAS REGULATION AIMED AT COMBATTING ILLEGAL TRADE IN F-GASES

The F-gas Regulation strengthens controls through real-time quota tracking via linked customs systems, mandatory licensing in the F-gas Portal, designated customs offices, stricter rules on cylinders, tougher penalties, limits on new entrants, re-export bans, and enhanced cooperation and traceability.

REAL TIME QUOTA TRACKING

The F-gas Portal for import licensing and quota will link to the EU Single Window Environment for Customs, with member states required to connect their national systems to it from March 2025.[54] This allows customs authorities to check in real time whether importers have sufficient quota when goods enter the EU, reducing the risk of undeclared or illegal imports. As of February 2026, it is not clear which member states have connected their national systems for F-gases, enabling customs to monitor real-time quota allowance for importing companies. Current data suggests Belgium may be the only country to have done so.[55]

IMPORTS AND LICENSING

Registration in the F-gas Portal now serves as a formal licence for importing and exporting F-gases. Importers and exporters must present this licence to customs and provide detailed information, including quantities, CO_2e values and identification numbers.[56] By treating all imported F-gases as "virgin", the regulation prevents mislabelling of non-reclaimed or illegal gases.[57]

CUSTOMS OFFICES

Member states must designate specific customs offices to handle F-gases and pre-charged equipment. These offices must be staffed by trained personnel with access to appropriate inspection tools. Limiting transit procedures to designated offices strengthens oversight and consistency of controls.[58]

NEW ENTRANTS

To prevent misuse of the quota system, only companies with at least three years of experience in F-gas trading or servicing can apply as new entrants. Applicants must provide a physical address for their business, with only one undertaking allowed to be registered at the same address.[59]

CYLINDERS

The regulation tightens rules on non-refillable cylinders, which are often linked to illegal trade. Cylinders without a takeback system are considered non-refillable and must be confiscated. Importers of refillable cylinders must prove that systems exist to return and refill them.[60]

PENALTIES

While member states set penalties, EU-level guidance now ensures they are consistent and sufficient to act as a deterrent. Penalties can include large fines, confiscation, criminal sanctions, activity bans and quota reductions, especially for repeat offenders. Furthermore, the revision includes maximum financial penalties of at least five times the market value of the gases or equipment concerned, and eight times the value for repeat infringements within a five-year period.[61] Additionally, quota exceedance infringements will be penalised with a reduced quota allocation in the following allocation period, set at 200 per cent of the amount by which quota was exceeded.[62]

RE-EXPORT PROHIBITION

Non-compliant F-gases cannot be re-exported. Authorities may instead order destruction or controlled auctioning, provided compliance is ensured.[63] EIA is aware of several national enforcement agencies which have auctioned seized HFCs at below the market price.[64] While the approach has merit, as it can avoid new HFC production, concerns have been raised around the potential for market distortion resulting from the lower prices. Sufficient guardrails must be in place.

TRACING

The Commission is empowered to amend the Regulation to introduce supply chain tracing methodologies to better track F-gases and detect illegal movements; however, it is yet to take this step.[65]

COOPERATION

Stronger cooperation and information-sharing between authorities is required. When violations are detected, relevant national authorities, other affected member states and the Commission must be informed, triggering targeted inspections, including checks of online platforms.[66]

Figure 4: *New EU definition of non-refillable F-gas cylinders.*

UNTAPPED POTENTIAL OF NEW CYLINDER TAKE-BACK REQUIREMENTS

The use of non-refillable cylinders has long been associated with illegal refrigerant trade because their disposability enables lower levels of traceability through the supply chain.

The placing on the market of cylinders which cannot be refilled was banned in the EU in 2007.[67] However, as European authorities have cracked down on trade in non-refillable cylinders, illegal traders have shifted to using more robust cylinders, designed to be refillable but provided with no intention of return or reuse.

Despite their refillable design, EIA investigations and analysis of online platforms suggests that many F-gas sellers are not offering cylinder takeback schemes. In our latest Italian investigation, only one seller from the three highlighted offered to collect cylinders, although it was for onward scrap sale and not for refilling.

In response to this shifting dynamic, the revised EU F-gas Regulation takes an innovative and much needed approach to defining what constitutes a non-refillable cylinder. To prevent refillable cylinders being used as disposable, importers are now required to submit a declaration of conformity when bringing cylinders into the bloc. This declaration must include logistical evidence of the arrangements in place for the return of the container for refilling throughout its entire distribution network (ie, right down to the end-user).[68] The regulation further stipulates that both customs and enforcement agencies engaged in market surveillance are required to confiscate and dispose of non-refillable containers.[69]

Despite this supportive policy environment, responsible authorities have noted challenges in information sharing between customs, which receives the document of conformity upon cylinder import, and the environment inspectorates which are responsible for market surveillance further down the supply chain.

Nonetheless, several member states are beginning to improve coordination between environment inspectorates and customs to address this issue. For example, the Dutch Human Environment and Transport Inspectorate (ILT) is working with customs to share operational information to support enforcement activities on non-refillable cylinders. ILT has already carried out several seizures of non-refillable cylinders that are being used, sold or placed on the market illegally.

According to the ILT, for seizures involving a smaller number of non-refillable cylinders, the offending company is required to provide proof of destruction, with failure to cooperate resulting in administrative fines. Larger seizures are handled directly by the ILT, with higher penalties applied

iii) FURTHER MEASURES WHICH SHOULD BE INTRODUCED VIA THE F-GAS REGULATION

WHY SUPPLY CHAIN TRACEABILITY IS NEEDED

The fact that illegal HFC trade in the EU remains high, despite improved enforcement, is influenced by the bloc's unique situation as a political and economic union of 27 member states. One of the key benefits to this union, free movement of goods, also creates significant enforcement challenges when it comes to tackling organised crime.

The limitation of the EU F-Gas Regulation is that it places the only legal requirement for demonstrating quota at the point of entry onto EU markets, with no subsequent requirements to prove that HFCs are associated with quota throughout the supply chain. As such, despite the significant effort going into enforcement, Europe's illegal HFC trade remains persistently high. EIA's engagement with non-customs enforcement agencies, including police and environmental inspectorates indicates that this is, at least in part, due to the difficulties these agencies have in seizing HFCs already circulating on EU markets.

In 2019, a market survey of car repair shops by the regional government of Hessen, Germany, found that about 25 per cent of the HFC-134a being used in the region was illegal. The study revealed weak quota traceability in the HFC-134a supply chain due to a lack of legal requirements, with 68 per cent of respondents unaware whether the gas they purchased was covered by quota.[70]

In 2021, Germany amended its Chemical Act to require all supply chain actors to provide documentation proving their HFCs are linked to quota.[71] Although a recent proposed amendment to the act will exempt users of pre-charged equipment from requiring documentation,[72] requirements remain for bulk HFCs, ie, those in containers.[73]

Germany's action is a good first step, although a more comprehensive EU-wide refrigerant traceability scheme is needed, integrating a digital platform with GPS tracking to create a verifiable chain of custody for the HFCs and associated quota as they move through the supply chain.

DIGITISATION OF REPORTING COULD IMPROVE SUPPLY CHAIN TRACEABILITY

Under the F-Gas Regulation, records must be kept by undertakings (certified personnel) on quantities and types of F-gases used during installation, maintenance and servicing. This includes information on whether the gas is recycled or reclaimed and the name and address of the facility where the recycling or reclamation occurred, as well as information on the purchaser of the gas (known as one-down traceability).[74] These records must be kept for at least five years or stored in a database set up by member states.

To facilitate implementation, the Commission is empowered to adopt an implementing act to "determine the format of the records" and "specify how they should be kept and established."[75] This is a course of action that the Commission should pursue, requiring at minimum that records be kept in digital format and specifying their storage in an electronic database.

To support this, the Commission could develop open-source software for member states in the 24 official EU languages, ensuring interoperability for data analysis and tracking, while providing a mobile phone application for the on-site recording of such information, which is a common practice in other industries.

iv) UNINTENDED CONSEQUENCES OF THE HIGH-GWP SERVICING BAN AND THE RISE OF COUNTERFEIT HFO BLENDS

Under the previous F-Gas Regulation, the use of virgin F-gases with a GWP of 2,500 to service and maintain refrigeration equipment with a charge size of 40 tCO_2e has been prohibited since 2020. The 2024 EU F-Gas Regulation has extended this provision to all refrigeration equipment since January 2025. Reclaimed and recycled F-gases are exempt until 2030.[76]

EIA's investigations into the HFC market in Italy indicate that this servicing ban has been widely interpreted and applied as a de facto sales ban, with many retailers no longer offering common high-GWP refrigerants such as R404A and R507.

However, a significant number of traders are exploiting the exemption which permits the continued use of reclaimed gas to meet residual demand from the servicing sector in order to sell illegal gas, as evidenced by EIA's investigations which identified availability of virgin R404A which is falsely labelled and sold as reclaimed refrigerant.

EIA worked with Guardia Civil to share intelligence which led to seizure of HFC404A mislabeled as an HFO alternative

©Guardia Civil

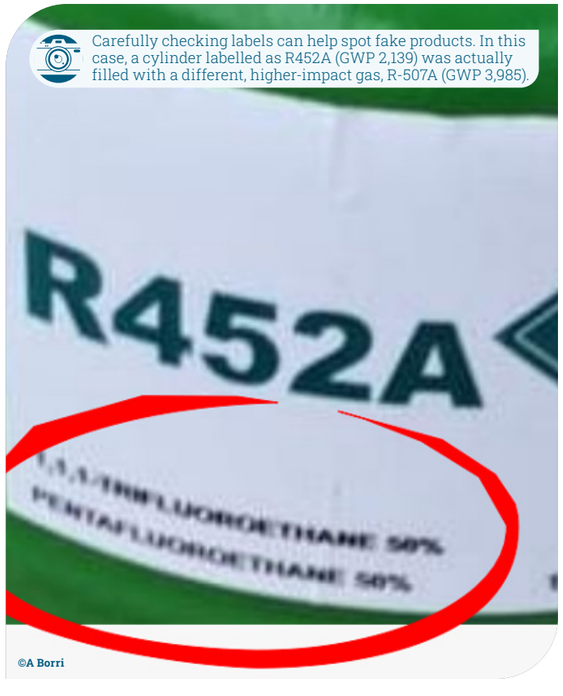
According to industry stakeholders and EIA's investigations, R404A is also being deliberately mis-sold as patented HFO-HFC blend refrigerants, including R448A, R449A and R452A, which are marketed as alternatives to R404A.

In November 2025, Spain's refrigeration association (AEFTY) warned that the market for counterfeit HFO blends, namely R448A, R449A and R452A, is continuing to grow.[77]

The Polish NGO Prozon, which provides free laboratory testing of refrigerant cylinders, has recently identified cases involving counterfeit R449A. In one instance, a servicing supplier offered one tonne of R449A at a significantly reduced price, with subsequent testing confirming that the product was in fact R404A. A further case in 2025 involved system performance issues in equipment believed to have been charged with R449A. Laboratory analysis of the refrigerant recovered from the system again confirmed it to be R404A.[78]

In addition to having a detrimental impact on the climate, counterfeit blends may also pose significant health and safety issues. In December 2025, the Canadian Environmental Protection Agency warned of counterfeit R410A cylinders containing chloromethane, a highly flammable and corrosive chemical which can damage human nervous and reproductive systems.[79]

The extent to which counterfeit refrigerants have penetrated supply chains is not clear; however, in April 2025 a representative from a major Italian F-gas distributor, General Gas, warned that the market was being flooded by counterfeit HFO blends.[80] Despite a request for comment from EIA, the European Partnership for Energy and Environment which represents the refrigeration, air-conditioning and heat pump sector in Europe did not respond.



Carefully checking labels can help spot fake products. In this case, a cylinder labelled as R452A (GWP 2,139) was actually filled with a different, higher-impact gas, R-507A (GWP 3,985).

©A Borri

EIA's investigations indicate that illegal HFCs may already be present within the supply chains of major retailers and manufacturers. This suggests that, at least in Italy, the sale of counterfeit and illegal refrigerants is widespread and that retailers and manufacturers face elevated supply chain risks. As a result, due diligence efforts limited to tier-one suppliers are insufficient and deeper supply chain scrutiny is required.

Given the extended web of transnational connectivity in Europe's illegal HFC trade supply chains, documented in this report and in previous investigations, it is likely that similar patterns of rapid growth in illegal counterfeit HFO blends are occurring across the EU.[81]

Remedial actions from policy-makers, F-gas producers and end-users are needed. These include removing exemptions around use of reclaimed gas under the very-high-GWP servicing ban, and industry action against counterfeits which infringe Intellectual Property Rights. If they have not already, end-users of F-gases should implement robust due diligence systems to ensure that F-gases used are not linked to illegal supply chains. These will become legal obligations for large companies from 2028, when the EU's Corporate Sustainability Due Diligence Directive takes effect, with penalties for non-compliance of up to three per cent of global turnover.[82]

v) SUPPORTING ENFORCEMENT WITH THE USE OF FINANCIAL INVESTIGATIONS

Illegal HFC trade is commonly carried out by organised criminal networks which systematically evade the payment of taxes and duties. According to EIA estimates, illegal trade in HFCs across Europe between 2018-20 may have resulted in the loss of approximately €77 million per year in VAT and customs duties.[83]

Recent enforcement actions illustrate both the scale of these fiscal losses and the value of financial investigations in addressing them. In March 2025, Romania's Directorate General for Anti-Fiscal Fraud prosecuted two companies for damages of approximately €2 million arising from the sale of F-gases without the proper application of taxes.[84] Similarly, in October 2025 an investigation by the Spanish tax agency resulted in the seizure of 53 tonnes of refrigerant and nearly €1 million in cash, further illustrating the effectiveness of financial enforcement measures in disrupting illegal HFC trade.[85]

Although limited in number, these cases underscore the magnitude of tax evasion within the illegal HFC market and demonstrate how financial investigations can uncover illicit activity while enabling the imposition of more robust penalties.

ILLEGAL HFC TRADE: GLOBAL IMPLICATIONS AND LESSONS

Europe's experience shows that enforcement alone cannot prevent illegal HFC trade without early and decisive demand reduction measures.

Equipment bans, servicing restrictions and tighter controls under the Kigali Amendment to the Montreal Protocol must be paired with targeted import bans, digital licensing and stronger traceability to ensure demand declines in line with supply cuts and to limit opportunities for illegal trade.

i) THE IMPORTANCE OF DEMAND REDUCTION MEASURES

Europe's experience shows that, even with advanced regulation and strong enforcement, illegal trade flourishes unless strong HFC demand-reduction measures are implemented at early stages of the phase-down. Europe's 2014 F-Gas Regulation introduced significant demand reduction measures, focused on banning new HFC containing equipment.

A prime example was the EU's 2022 ban on the use of some HFCs in centralised refrigeration systems commonly used in supermarkets. This has played a key role in supporting a shift away from very-high-GWP HFCs, such as R404A, in the supermarket sector. Without it, demand for illegal HFCs would be much higher today.

However, with a 10-20-year life span of centralised refrigeration systems, the transition is too slow. As of 2024, just 30 per cent of the centralised refrigeration systems in the EU have transitioned to natural refrigerants, meaning many systems still rely on HFCs.[86]

In the 2024 F-Gas Regulation, policy-makers in Europe introduced further bans across sectors, including heat pumps, residential and commercial air-conditioning, industrial cooling and transport refrigeration. These bans will play a key role in delivering the EU's ambitious HFC phase-out schedule.

Banning the use of very-high-GWP HFCs in the servicing sector is also key. Europe's recent move to expand its very-high-GWP servicing ban to cover the broader refrigeration sector will make an impact, but closing loopholes around the use of reclaimed and recycled gas is needed to reduce illegal trade.

As Parties to the Montreal Protocol discuss how best to improve existing legislative frameworks and ensure they are prepared for the challenge of illegal trade in HFCs, it is important to be mindful of lessons learned in Europe. In particular, parties must recognise the importance of early and robust regulation to drive a reduction in demand for HFCs.

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ii) KIGALI IMPLEMENTATION PLANS (KIPs)

Article 5 (A5) Parties are developing countries that are eligible for financial support from the Multilateral Fund (MLF) to assist with treaty compliance. These countries benefit from a grace period, with most facing their first HFC phase-down obligations in 2029. In preparation, multi-year Kigali Implementation Plans (KIPs), funded by the MLF, are now being developed and implemented.

With the lessons from Europe's HFC phase-out in mind, EIA has welcomed the commitments made by numerous A5 Parties in their KIPs to introducing bans on the import and/or sale of HFCs. Most often, these bans have either been based on HFC species (eg, Fiji's ban on the import and sale of R410A-based residential air-conditioners from 1 January 2029) or they have concerned a specific sector (eg, Uruguay's ban on the manufacture and import of HFC-based domestic refrigerators by 1 July 2027).[87]

KIPs are a critical opportunity for those countries approaching the start of their HFC phase-downs to establish firm regulatory measures which can encourage the faster transition away from HFCs towards non-fluorinated alternatives. While recognising that parties are entitled to pursue the HFC phase-down in the manner they see fit, EIA strongly urges all parties to include tailored bans as part of their KIPs, focusing first on sectors where high-GWP HFCs are most pervasive and non-fluorinated alternatives are readily available, such as domestic and commercial refrigeration. ExCom should support related necessary actions such as appropriate safety standards, technician training and financing mechanisms.

iii) STRENGTHENING THE MONTREAL PROTOCOL TO TACKLE ILLEGAL TRADE

In December 2025, ahead of the 37th Meeting of Parties (MoP37), parties and other stakeholders attended an informal workshop on facilitating the implementation of the Montreal Protocol. Illegal trade was one of the central issues discussed at meeting, alongside other relevant topics including licensing systems and data collection and reporting. The issues raised reflect many of the lessons learnt in Europe which could therefore provide direction to strengthening the institutions of the Montreal Protocol and the ability of developing countries to ensure strong implementation of the Kigali Amendment.

Discussions acknowledged that fully digital and automatic single window licensing systems are central to monitoring and preventing illegal trade, including enhanced information sharing and strengthened inter-agency cooperation, particularly between national ozone units and customs authorities, to address the evolving challenges of illegal trade.[88]

The importance of regulating domestic trade, including e-commerce platforms, and the need for improved supply chain tracking was also discussed extensively during the workshop and was drawn out by the Ozone Secretariat as a key outcome from the meeting.[89] The difficulties inherent in monitoring multiple HFC blends was repeatedly raised by Article 5 Parties, given that they are not covered by individual customs (HS) codes. The informal meeting highlighted the challenge of non-refillable or disposable cylinders and that a ban on such cylinders would contribute to the circular economy, if accompanied by measures to ensure the return of refillable containers to avoid them being treated as disposable.[90]

It was also acknowledged that the full scale of illegal trade remains underreported, highlighting the lack of reporting of cases by most parties, including on how illegal trade cases are addressed. Some participants raised the prospect of developing Standard Operating Procedures to harmonise case handling, seizure management and sanctions,[91] an effort which EIA would fully support.

Finally, the informal Prior Informed Consent (iPIC) mechanism was repeatedly cited as a valuable tool for verifying authorised traders, although suggestions to formalise the system faced significant resistance.[92]

EIA'S FINDINGS DEMONSTRATE THAT ILLEGAL TRADE IN HFCs WITHIN THE EU IS NOT CONFINED TO ISOLATED OR OPPORTUNISTIC ACTORS, BUT IS SYSTEMIC, COORDINATED AND INCREASINGLY PROFESSIONALISED

CONCLUSION

Despite recent regulatory improvements, substantial volumes of non-quota and non-compliant refrigerants continue to circulate openly within the Italian market and potentially across the wider EU. The infiltration of illegal HFCs into legitimate supply chains poses significant risks to equipment manufacturers, service companies, retailers and end-users, while undermining the integrity of the EU's HFC phase-out and distorting competition for compliant businesses.

EIA's Italian investigations reveal that some traders operate with a high degree of confidence and apparent impunity. Practices such as mislabelling virgin refrigerants as reclaimed, issuing false regeneration certificates, exceeding quota limits and evading VAT and customs obligations are widely understood within the market and, in some cases, openly acknowledged. These behaviours point to persistent enforcement gaps, limited downstream oversight and penalties that are not yet acting as an effective deterrent.

EIA's findings also underscore the transnational nature of illegal HFC trade. Smuggling networks exploit differences in enforcement capacity between member states, with non-quota HFCs laundered through countries with weaker controls before being distributed across the EU. Once these gases enter the internal market, the absence of effective supply chain traceability makes seizure and enforcement increasingly difficult.

The rapid growth of online trading platforms further exacerbates these challenges by enabling illegal sales to reach a wide customer base with minimal oversight. Given the high risk of a significant illegal trade in HFCs through online marketplaces, further action is needed. The European Commission should address the apparent failure of VLOPs, such as Facebook, to address systematic risks around illegal trade in HFCs.

Looking ahead, the risk of illegal trade in Europe is likely to intensify. The EU's next major quota reduction in 2027 will almost halve the volume of HFCs that can be legally placed on the market, increasing prices and further strengthening incentives for illicit activity. At the same time, many major end-users and manufacturers remain heavily dependent on HFC-based systems. This creates significant exposure to illegal supply chains and, from 2028 onwards, potential legal and financial risks under the Corporate Sustainability Due Diligence Directive.

Ultimately, illegal trade is driven by continued demand for HFCs. The growing prevalence of counterfeit and mislabelled HFO-HFC blends illustrates the limits of substitution-based approaches alone. Companies seeking to avoid exposure to illegal trade should accelerate the transition to natural refrigerant alternatives. F-gas end-users, particularly those that rely on HFO blends in commercial and industrial refrigeration, should rapidly switch to systems using natural refrigerants.

In 2025, EIA published a Net Zero Supermarket Cooling Pathway. The pathway is structured around four key pillars retailers should adopt to deliver genuine emission-reductions. These are data disclosure, reducing refrigerant emissions, lowering energy use and engaging the supply chain. As part of this pathway, retailers worldwide are urged to stop installing new refrigeration systems which rely on F-gases.[93]

On the regulatory side, this transition must be supported by early and decisive demand-reduction measures, including new equipment bans and tighter servicing restrictions to prevent future price shocks that fuel illegal trade.

The lessons that can be learnt from the EU's experience have application far beyond its borders. As global efforts to phase down HFCs under the Kigali Amendment gain momentum, the EU's challenges highlight how regulatory loopholes and uneven enforcement can be exploited by criminal networks, undermining international climate commitments.

For countries yet to strengthen their own controls, the EU's experience demonstrates that delay is not an option – illegal trade thrives where oversight is weak, with the urgency to act amplified by the interconnected and global nature of HFC supply chains.

By closing enforcement gaps, harmonising approaches to licensing, reporting and information sharing and accelerating the shift to sustainable non-fluorinated alternatives, countries around the world have the opportunity to pre-empt the challenges they are likely to face and address the illegal trade in HFCs before it takes root.

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