

EU F-Gas Regulations



IMPACT ON THE
REFRIGERATION INDUSTRY

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EU F-Gas Regulations

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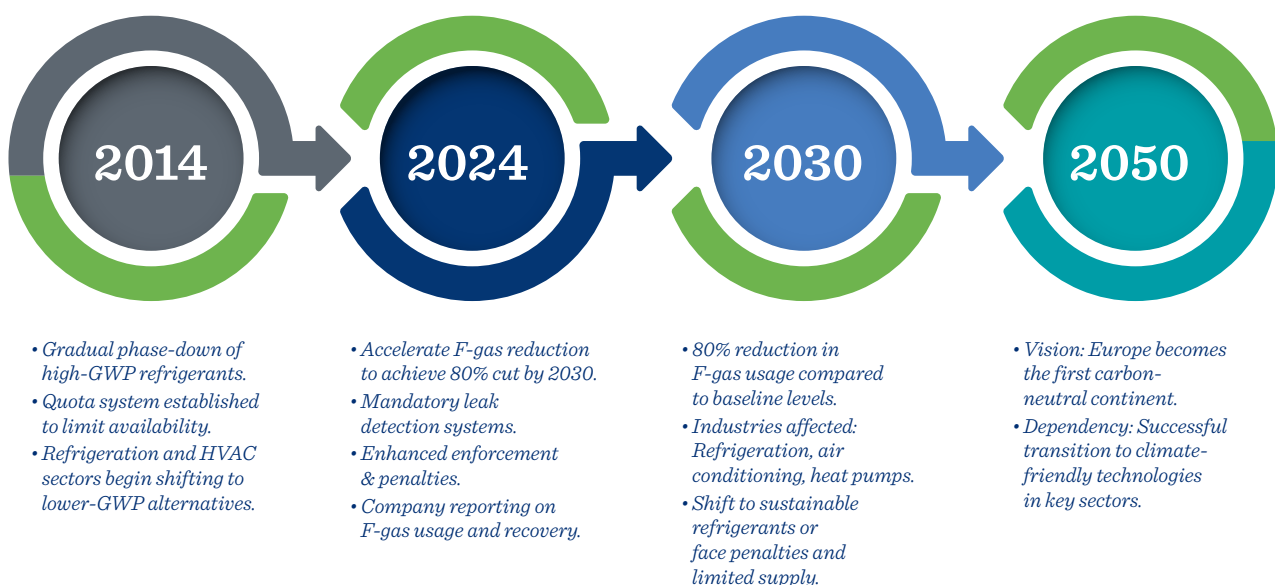
Introduction

The European Union (EU) has long been at the forefront of addressing climate change through regulatory measures that mitigate the environmental impact of greenhouse gases. One such measure is the EU F-Gas Regulation (No. 517/2014), which targets the reduction of fluorinated gases (F-gases) such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆) - all of which are highly potent greenhouse gases. As part of the EU's broader commitment to the Paris Agreement, the regulation seeks to reduce the environmental impact of refrigeration and air conditioning systems, which are key sources of F-gas emissions⁽¹⁾.

In Regulation No. 517/2014, the EU introduced a phased approach to reduce the use of high-GWP (global warming potential) refrigerants, implementing a quota system that gradually limits their availability. This framework was strengthened by the updated Regulation 2024/573, which accelerates the reduction of F-gas usage with the goal of achieving an 80% reduction by 2030⁽²⁾. The regulation also introduces stricter enforcement mechanisms, such as mandatory leak detection systems, and requires companies to report their F-gas usage and recovery efforts⁽²⁾.

These regulations are especially significant for the refrigeration industry and related sectors, where adopting sustainable alternatives to high-GWP refrigerants is not only an environmental priority but also a business necessity. The EU's broader climate ambitions, including becoming the world's first carbon-neutral continent by 2050, will rely heavily on industries like refrigeration and air conditioning transitioning to more sustainable technologies.

This paper reviews the EU F-Gas Regulations (EU 517/2014 and 2024/573), their impact on the refrigeration industry, and related environmental implications. It also highlights industry responses and the role of refrigerants in the EU's climate goals.



⁽¹⁾ EU Regulation No. 517/2014

⁽²⁾ EU Regulation 2024/573

The EU F-Gas Regulation: Background and Legal Framework

EU Regulation 517/2014

The EU F-Gas Regulation No. 517/2014 was established on April 16, 2014, as a critical component of the EU's strategy to reduce greenhouse gas emissions and combat climate change. This regulation specifically targets F-gases, such as HFCs, PFCs, and SF₆ - all of which have a significantly higher GWP than carbon dioxide. These gases are primarily used as refrigerants in air conditioning, refrigeration systems, and heat pumps, making the regulation especially relevant to the refrigeration industry⁽¹⁾.

The regulation is aligned with the EU's climate goals, which include reducing emissions by 40% by 2030 compared to 1990 levels and achieving carbon neutrality by 2050. The F-Gas Regulation aims to phase down the use of these high-GWP gases and transition the refrigeration and air conditioning sectors to more sustainable, low-GWP alternatives.

Key Provisions of EU 517/2014

- Quota System for F-Gas Production and Importation:** One of the most significant aspects of the EU's 517/2014 F-Gas Regulation is the quota system, which establishes a gradual phase-down of the production and importation of F-gases in the EU. This system limits the total amount of F-gases that can be placed on the market, reducing the availability of high-GWP gases over time. By 2030, the regulation aims for an 80% reduction in the quantity of F-gases on the market compared to 2015, forcing companies to seek alternatives or reduce their reliance on these gases⁽¹⁾.
- Leakage Prevention and Monitoring:** Refrigeration and air conditioning systems are prone to leakage, which can significantly undermine efforts to reduce F-gas emissions. The Regulation mandates that all operators of such equipment perform regular leakage checks to detect and repair any emissions. In addition, the regulation requires the installation of leakage detection systems in larger systems to prevent unnecessary emissions into the atmosphere⁽¹⁾.
- Training and Certification:** The F-Gas Regulation also stipulates that technicians who handle refrigerants must be properly trained and certified to ensure safe and effective management of these gases. This provision is designed to reduce the likelihood of accidental leaks and improper handling of refrigerants. As a result, training programs have been established across the EU to support industry professionals and ensure compliance with the regulation⁽¹⁾.
- Recovery and Recycling of F-Gases:** The regulation emphasizes the recovery and recycling of F-gases from equipment being decommissioned or serviced. This process helps to minimize the release of these gases into the atmosphere and encourages the reuse of refrigerants. Companies must have systems in place to recover and recycle F-gases, which is particularly relevant for businesses involved in refrigeration system maintenance and disposal⁽¹⁾.
- Reporting and Monitoring:** Under the F-Gas Regulation, operators must report their usage of F-gases annually to the relevant national authorities. This helps track compliance and provides a transparent record of industries' progress in reducing emissions. The regulation also allows for stricter enforcement, with penalties for non-compliance, ensuring that businesses adhere to the outlined guidelines⁽¹⁾.

EU Regulation 2024/573

EU Regulation 2024/573 was introduced to update and expand upon the earlier EU F-Gas Regulation No. 517/2014. This regulation, which was adopted on May 27, 2024, sets a more ambitious agenda for reducing the use of high-GWP refrigerants and accelerating the transition to low-GWP alternatives, building on the groundwork laid by its predecessor. It strengthens the measures established by Regulation 517/2014 and introduces new requirements to help the EU meet its climate goals, including achieving carbon neutrality by 2050⁽²⁾.

The main goal of Regulation 2024/573 is to continue reducing F-gas consumption at a faster pace to achieve an 80% reduction by 2030 (when compared to baseline levels, as outlined in Regulation 517/2014). This accelerated phase-down of high-GWP refrigerants ensures that Europe remains on track to meet the Paris Agreement commitments and prevent global temperatures from rising more than 1.5°C above pre-industrial levels⁽²⁾.

Key Provisions of EU 2024/573

- 1. Stricter Phase-Down Schedule and Reduction Targets:** Regulation 2024/573 introduces an accelerated phase-down schedule for high-GWP refrigerants, aiming for a more aggressive reduction in availability in the European market. By 2030, the use of F-gases is expected to be reduced by 80% compared to 2015 levels, a target that exceeds the original reduction goal set under Regulation 517/2014. This tightening of the phase-down target is aimed at driving quicker transitions to more sustainable and lower-GWP refrigerants⁽²⁾.
- 2. Enhanced Leak Detection and Prevention Measures:** One significant change in Regulation 2024/573 is the introduction of more stringent leak detection requirements. The regulation recognizes that air conditioning and refrigeration systems often have higher leakage rates due to vibrations during transport and the operational nature of the equipment. As such, operators are now required to conduct leak checks more frequently and install leakage detection systems in larger refrigeration systems, particularly those in transportation and storage⁽²⁾. This measure aims to ensure tighter control over F-gases emissions and improve the overall effectiveness of leakage prevention in the industry.
- 3. Reporting and Monitoring Enhancements:** The regulation introduces new reporting and monitoring systems that ensure companies and operators comply with the phase-down schedule and track F-gas usage. This includes annual reporting on the amount of refrigerants used, quotas allocated, and the progress made toward achieving reduction targets. The new measures also emphasize monitoring systems to provide more accurate tracking of refrigerant flows and better oversight by national authorities⁽²⁾. These reporting systems are expected to improve transparency and accountability across the refrigeration and air conditioning sectors.
- 4. Compliance and Enforcement Measures:** Regulation 2024/573 also strengthens the compliance and enforcement mechanisms in place to ensure that companies adhere to the new, stricter provisions. Under this regulation, non-compliance with leakage checks, refrigerant reporting, and quota restrictions will result in more severe penalties. The enforcement framework is designed to hold businesses accountable and ensure that they actively contribute to the EU's long-term climate goals⁽²⁾.
- 5. Training, Certification, and Technological Development:** Regulation 2024/573 reiterates the importance of training and certification for technicians handling F-gases. Additionally, the regulation emphasizes the need for the development of new technologies to support the transition to low-GWP refrigerants. The EU is investing in research and innovation to create safer, more efficient refrigerants and improve the overall performance of refrigeration systems. The regulation aims to foster technological advancements that not only reduce emissions but also enhance energy efficiency in the sector⁽²⁾.

Key provisions of the EU F-Gas Regulations



Key Impacts on the Refrigeration Industry

Operational Costs

The introduction of EU Regulations 517/2014 and 2024/573 has had a direct impact on the operational costs for businesses in the refrigeration industry. Companies must adapt to stricter rules on refrigerant use, which, while beneficial in the long term, have brought immediate financial implications.

Upfront Costs of Transition

To comply with the regulations, companies must either retrofit existing refrigeration systems or replace older units with those compatible with low-GWP refrigerants. This transition will require an initial capital investment, which can be a considerable burden, particularly for businesses with large, outdated systems.

Ongoing Maintenance Costs

While low-GWP refrigerants can offer improved energy efficiency, businesses may face higher maintenance costs due to the new systems. For example, systems using CO₂ or ammonia may require more specialized maintenance and equipment compared to their previous counterparts. Additionally, compliance with leak detection and monitoring systems adds ongoing maintenance costs, as more frequent checks are required to prevent and detect leaks in accordance with the regulations⁽¹⁾.

Training and Certification Costs

In response to the regulatory shift, companies must invest in training and certification programs for technicians handling the new refrigerants. These training programs, designed to meet the standards set by the regulations, may add further financial strain on businesses. For smaller companies in particular, this can represent a significant operational cost⁽¹⁾.

Energy Efficiency and Long-Term Savings

Despite the upfront costs, low-GWP refrigerants typically result in lower energy consumption, offering companies the potential for long-term savings. Energy-efficient systems reduce the overall operating expenses, particularly in large-scale applications such as grocery stores and cold storage facilities, where energy consumption is a key factor in operational costs. Over time, businesses that transition to these systems can expect to see a reduction in energy bills, which can help offset the initial investment⁽²⁾.

Cost of Non-Compliance

Non-compliance with these regulations can result in significant financial penalties, further affecting operational budgets. Companies that fail to meet phase-down targets, leak detection requirements, or other provisions risk facing fines and enforcement actions. These costs can add up quickly, especially as enforcement becomes more stringent under Regulation 2024/573⁽²⁾.

Technological Innovation

The push for low-GWP refrigerants and stricter compliance under EU Regulations 517/2014 and 2024/573 has driven significant technological innovations in the refrigeration sector. As businesses adapt to these changes, manufacturers and solution providers are compelled to develop and implement new technologies to meet the evolving demands of the regulations and market.

Development of Low-GWP Refrigerants

One of the most notable innovations is the development and adoption of low-GWP refrigerants, which are a key component of the EU's efforts to reduce greenhouse gas emissions. Natural refrigerants, such as carbon dioxide (CO₂), ammonia (NH₃), hydrocarbons (HCs), and propane (R-290) have emerged as leading alternatives to high-GWP refrigerants like HFCs. These alternatives offer better environmental performance, aligning with both Regulation 517/2014 and the more recent 2024/573⁽²⁾.

System Redesign and Integration

Adapting to new refrigerants requires a complete rethink of refrigeration systems. For example, CO₂-based systems operate at much higher pressures than traditional HFC-based systems, necessitating new system designs and upgraded components such as compressors, heat exchangers, and piping systems to ensure safety and efficiency. Similarly, the adoption of hydrocarbons and HFOs (hydrofluoroolefins) has driven the development of specialized equipment that can safely handle the unique properties of these refrigerants, such as their flammability and pressure requirements⁽¹⁾.

Energy-Efficient Technologies

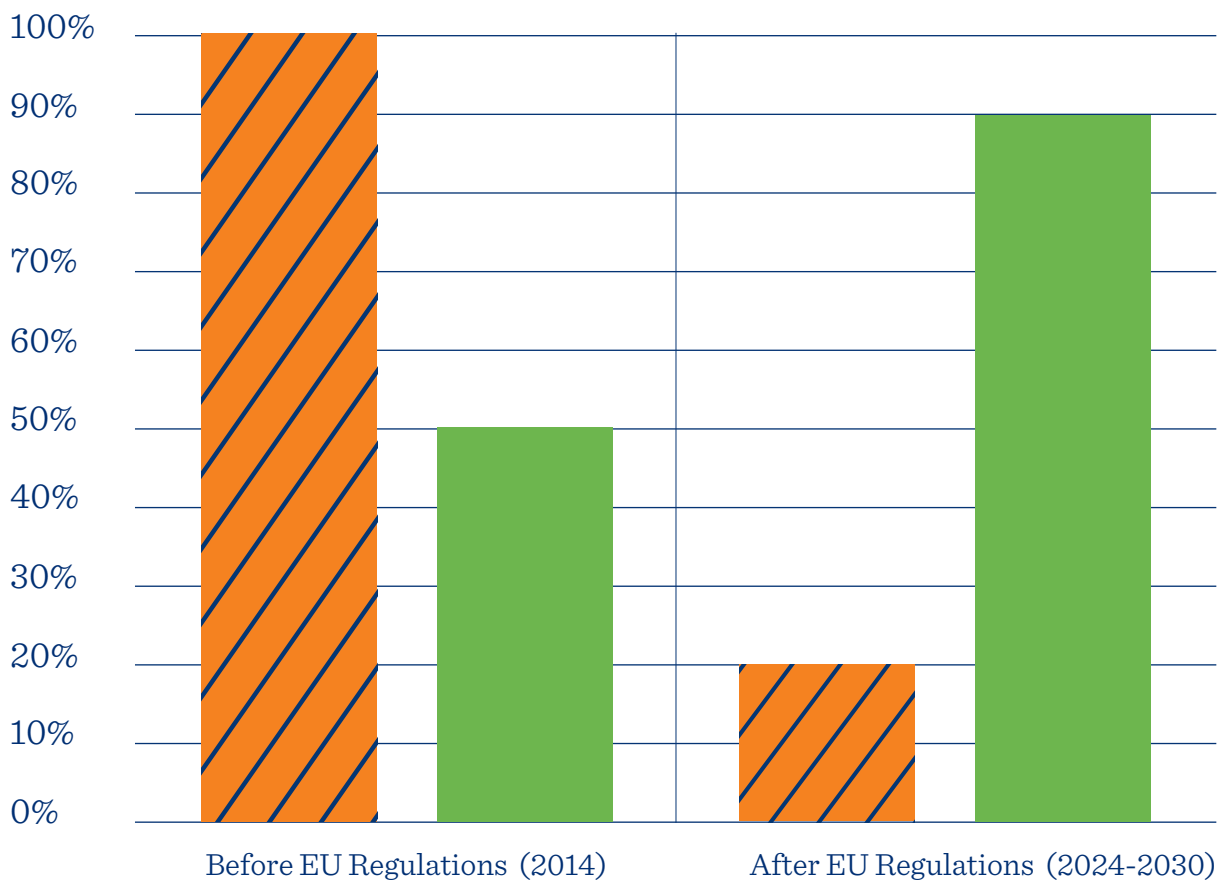
Another area of technological advancement is in the development of energy-efficient refrigeration systems. Regulations pushing for the phase-out of high-GWP refrigerants also drive the adoption of advanced energy-saving technologies. Newer systems that incorporate variable-speed compressors, intelligent controls, and heat recovery systems are designed to optimize energy use. These systems not only reduce environmental impact but also deliver long-term cost savings as energy-efficient systems can lower operational costs over time⁽²⁾.

Sustainability and Circular Economy Innovations

The drive for sustainability will also spark innovation in the field of refrigerant recovery and recycling. The regulations' emphasis on reducing the use of F-gases and increasing the efficiency of refrigeration systems has led to innovations in refrigerant recovery, reuse, and recycling technologies. New systems will be designed to capture and re-purpose refrigerants at the end of their life cycle, contributing to a more circular economy within the refrigeration industry. These technologies help prevent harmful refrigerants from being released into the atmosphere and reduce the need for new refrigerants to be produced, thereby lowering environmental impact and costs⁽¹⁾.



Changes in the refrigeration industry before and after the implementation of regulations



- High-GWP refrigerants use (%)
- Energy efficiency (%)

Supply Chain Challenges

The implementation of EU Regulations 517/2014 and 2024/573 has introduced a range of supply chain challenges for the refrigeration industry. These regulations have significant implications for the sourcing, manufacturing, and distribution of refrigerants, equipment, and components used in refrigeration systems.

Refrigerant Availability and Pricing

One of the most immediate supply chain challenges is the availability and cost of refrigerants. As EU regulations progressively phase out high-GWP refrigerants, there has been an increasing demand for low-GWP alternatives like CO₂, ammonia, hydrocarbons and propane (R-290). However, these alternatives are currently less widely available than traditional refrigerants, leading to potential supply shortages or fluctuating prices.

For example, CO₂ is a promising alternative; however, the limited availability of CO₂-based systems and specialized components can sometimes cause supply bottlenecks. This can lead to higher costs for businesses that need to retrofit or replace existing systems with newer technologies⁽²⁾.

Logistics and Distribution Issues

The shift to low-GWP refrigerants will likely require a complete overhaul of the logistics and distribution networks that support the refrigeration industry. Many low-GWP refrigerants require specialized containers and safety protocols for storage and transportation, which complicates logistics. For instance, refrigerants like ammonia are hazardous, and transporting them requires compliance with strict safety regulations, further increasing logistical complexity⁽¹⁾.

Moreover, some refrigerants, such as CO₂, may require specific pressurized systems and careful handling during shipping, which can create additional layers of coordination within supply chains. Companies must ensure they have the right infrastructure in place to meet these safety and regulatory requirements, or they may face delays and increased costs.

Production and Manufacturing Delays

As manufacturers switch to producing low-GWP refrigerants and compatible systems, production timelines may be impacted. The need to develop new manufacturing processes and redesign systems to accommodate these refrigerants can slow down the overall supply chain. Manufacturers must balance the transition to new technologies with the continued demand for legacy systems, creating pressure on production schedules⁽²⁾.

Furthermore, raw material shortages may also impact the availability of components for refrigeration systems. The specialized materials required for low-GWP refrigerant systems, such as certain metals for CO₂-based equipment, may not be as readily available, leading to delays in production and increased manufacturing costs⁽¹⁾.

Skill Shortages and Technological Expertise

Another challenge to the supply chain is the shortage of workers with the required skills and expertise to work with low-GWP refrigerants and advanced refrigeration technologies. As the industry transitions to more complex systems and refrigerants, there is a growing demand for technicians, engineers, and design specialists trained in these new technologies. However, the pace of workforce training has not always kept up with the demand, creating a potential bottleneck in the supply chain.

The lack of skilled labor can delay installation, retrofitting, and maintenance processes, impacting the overall efficiency of the refrigeration industry's supply chain⁽²⁾.

Compliance with International Regulations

For companies operating both inside and outside of the EU, navigating the differing regulatory frameworks around refrigerants can be challenging. Some regions may still allow the use of high-GWP refrigerants, which complicates the global supply chain. Companies that need to meet EU standards while also complying with international regulations must manage the complexities of dual compliance, adding extra costs and potential delays to their global operations.

Regulatory Compliance and Penalties

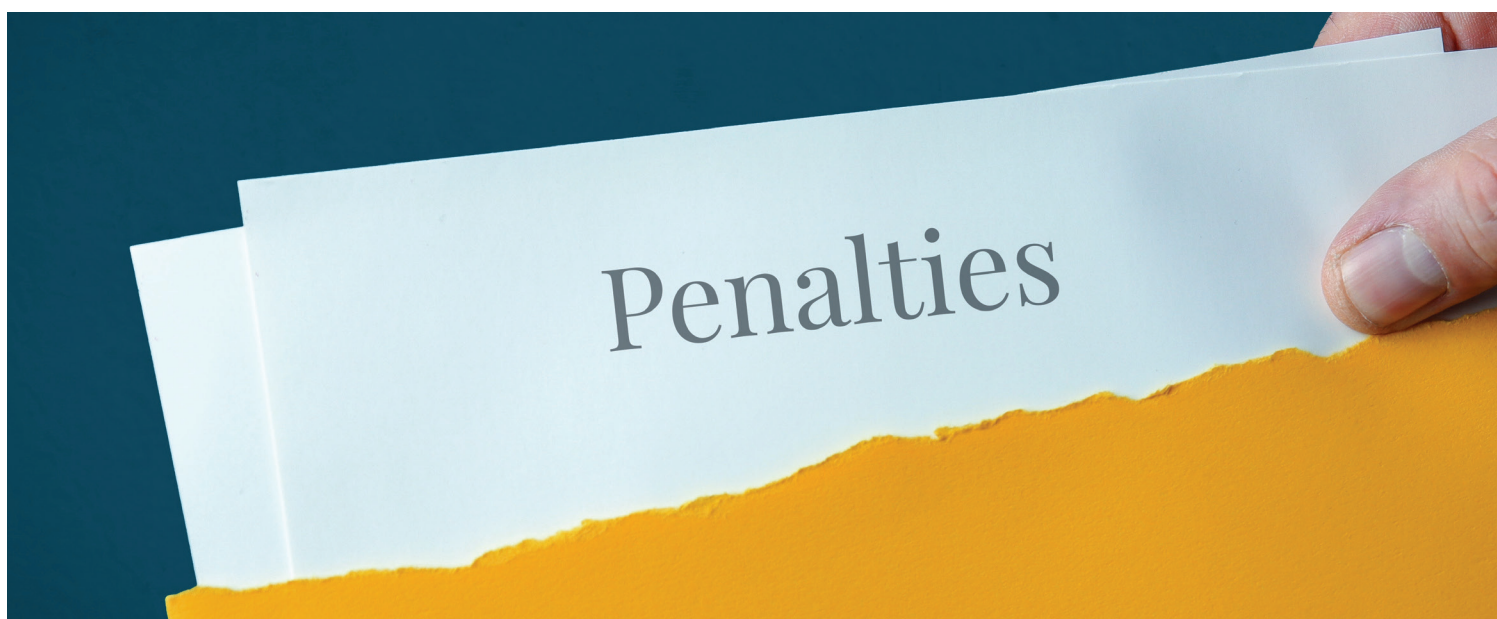
Adhering to EU Regulations 517/2014 and 2024/573 is essential for businesses in the refrigeration industry. These regulations impose strict requirements regarding the use, handling, and reporting of F-gases, and failure to comply can result in significant penalties, legal risks, and reputation damage.

Key Compliance Requirements

Under Regulation 517/2014, companies in the refrigeration sector must comply with several key provisions aimed at reducing F-gas emissions:

- **Leak Checks and Monitoring:** Companies are required to conduct regular leak checks, particularly for high-risk systems like air conditioning units and refrigeration systems, to ensure leaks are detected and promptly repaired. Monitoring and reporting systems must also be implemented to track the use of F-gases, ensuring that businesses adhere to their quotas and emission reduction targets⁽¹⁾.
- **Refrigerant Phase-Down:** The regulation establishes a gradual reduction of the quantities of high-GWP refrigerants available for sale. Businesses must manage their usage in line with their assigned quotas and report their compliance regularly to ensure they do not exceed their limits⁽¹⁾.
- **Recovery and Recycling:** Companies are required to recover and recycle F-gases from equipment at the end of its life cycle, thereby preventing the release of harmful gases into the atmosphere. This can involve installing or upgrading recovery systems and ensuring that proper waste management practices are in place⁽¹⁾.

Regulation 2024/573 introduces more stringent enforcement measures, placing additional responsibility on businesses to ensure compliance through enhanced reporting and documentation requirements. The regulation emphasizes leakage detection and mandates record keeping to demonstrate compliance with the refrigerant phase-down and reporting obligations⁽²⁾.



Penalties for Non-Compliance

The implementation of EU Regulations 517/2014 and 2024/573 has introduced a range of supply chain challenges for the refrigeration industry. These regulations have significant implications for the sourcing, manufacturing, and distribution of refrigerants, equipment, and components used in refrigeration systems.

- **Fines:** Companies found in violation of the regulations can face substantial fines. The severity of these fines depends on the nature of the violation, with larger companies or repeated offenses facing higher penalties. Non-compliance with phase-down schedules or improper handling of refrigerants can result in financial penalties, which may escalate for continuous violations⁽¹⁾.
- **Suspension or Revocation of Licenses:** In severe cases, companies that repeatedly fail to comply with the regulations can have their licenses suspended or revoked. This could severely disrupt operations, particularly for businesses relying on refrigeration as a core part of their business, such as supermarkets, cold storage facilities, or food processing plants⁽²⁾.
- **Reputation Damage:** Beyond financial and legal consequences, non-compliance can lead to significant reputation damage. With growing public and consumer awareness of environmental issues, companies that fail to follow sustainability regulations may face consumer backlash and a loss of business, which can have long-term negative effects⁽²⁾.

Mitigation and Risk Management

To minimize the risk of penalties, businesses should implement robust compliance programs that include:

- **Regular Training:** Ensuring all personnel involved in refrigerant handling are properly trained and certified to comply with the regulations is critical. This includes understanding the legal obligations, the safe handling of refrigerants, and the importance of leak detection⁽¹⁾.
- **Monitoring and Reporting Systems:** Companies should invest in advanced monitoring systems that track refrigerant use, emissions, and compliance in real time. This makes it easier to generate the required reports and demonstrate compliance during inspections⁽²⁾.
- **Third-Party Audits:** Conducting regular audits by third-party organizations can help ensure that compliance procedures are followed correctly and identify any areas for improvement before an official inspection or audit by regulatory authorities⁽²⁾.



Environmental Impact

The EU Regulations 517/2014 and 2024/573 are pivotal in reducing the environmental impact of the refrigeration industry by curbing emissions from high-GWP gases. These regulations align with the EU's climate goals and help mitigate the effects of global warming.

Reducing Greenhouse Gas Emissions

High-GWP refrigerants, such as HFCs, PFCs, and SF₆, are potent greenhouse gases that trap far more heat than CO₂. By gradually phasing out these gases and replacing them with low-GWP alternatives like CO₂, ammonia, hydrocarbons and propane (R-290), the EU will significantly reduce F-gas emissions from refrigeration and air conditioning systems⁽¹⁾. This shift will help lower the overall global warming potential of products within the refrigeration industry.

Energy Efficiency and Sustainability

Low-GWP refrigerants are often used in energy-efficient systems, reducing overall energy consumption. For example, CO₂ and ammonia-based systems are more efficient than traditional refrigeration, decreasing energy use and lowering emissions from power plants. This supports the EU's target of carbon neutrality by 2050⁽²⁾.

Circular Economy and Recycling

The regulations promote refrigerant recovery and recycling, reducing the need for new refrigerants and preventing harmful emissions. By reusing refrigerants, the industry minimizes waste and adopts more sustainable practices, aligning with the principles of a circular economy⁽¹⁾.

Supporting EU Climate Goals

Regulations 517/2014 and 2024/573 support the EU's ambitious climate targets by reducing greenhouse gas emissions and encouraging sustainable practices within the refrigeration sector. These efforts contribute to the EU Green Deal and the goal of becoming the first carbon-neutral continent by 2050⁽²⁾.



Strategic Responses by the Refrigeration Industry

In response to EU Regulations 517/2014 and 2024/573, the refrigeration industry has adopted a range of strategic responses to ensure compliance, mitigate risks, and capitalize on opportunities arising from the transition to low-GWP refrigerants. These strategies encompass areas such as technology adaptation, business model innovation, collaboration, and market differentiation.

Adoption of Low-GWP Refrigerants

One of the primary strategies employed by the refrigeration industry is the transition to low-GWP refrigerants, which align with the regulations' goal of reducing environmental impact. Many companies, such as Paul Mueller Company, are replacing traditional refrigerants like HFCs with alternatives such as CO₂, ammonia, hydrocarbons, or propane (R-290). These refrigerants are not only environmentally friendly but also often offer better energy efficiency. Refrigerant manufacturers and equipment suppliers have rapidly expanded their portfolios to include low-GWP options, allowing them to meet demand and diversify their product offerings⁽¹⁾.

Technological Innovations and System Upgrades

To comply with the regulations and improve energy efficiency, refrigeration companies will invest in technological innovations. This will include the development of advanced leak detection systems, smart monitoring tools, and automated control systems that enable real-time tracking of refrigerant use and system performance.

Furthermore, there is a growing trend toward system upgrades, where companies retrofit existing equipment with components that support low-GWP refrigerants. While the initial investment may be significant, the long-term savings in energy consumption and maintenance costs, as well as the environmental benefits, make these upgrades a worthwhile investment⁽²⁾.

Business Model Innovation and Market Differentiation

To thrive in the evolving market, many companies will need to adapt their business models. Some refrigeration companies will expand their services beyond the sale of equipment, moving into maintenance, refurbishment, and consulting on regulatory compliance. These value-added services help create a sustainable revenue stream while supporting customers through the transition to low-GWP technologies.

Additionally, businesses that can demonstrate their commitment to environmental sustainability and regulatory compliance can differentiate themselves in the market. This approach is becoming increasingly important as customers and stakeholders demand greater transparency and environmental responsibility. Companies that proactively address the regulations are well-positioned to attract environmentally conscious consumers and gain a competitive edge in a rapidly changing market⁽²⁾.

Training and Workforce Development

As the industry adopts new technologies, there is also a significant focus on training and workforce development. Companies are investing in training their workforce to handle the complexities of new refrigerants and technologies. This includes training technicians on safe handling practices, the installation of new systems, and compliance with environmental standards.

By ensuring their teams are equipped with the necessary skills and certifications, companies can improve operational efficiency, reduce risks, and ensure smoother transitions during regulatory audits. This workforce development is essential not only for compliance but also for enhancing the overall quality and reliability of refrigeration systems⁽¹⁾.

Conclusion

The European Union's Regulations 517/2014 and 2024/573 represent a significant step toward reducing the environmental impact of the refrigeration and air conditioning industries. By targeting the phase-down of high-GWP refrigerants, these regulations play a pivotal role in the EU's broader goals of mitigating climate change, improving energy efficiency, and achieving carbon neutrality by 2050.

For the refrigeration industry, these regulations have sparked a transformation, driving innovation, technological advancements, and shifts toward more sustainable practices. Companies are responding by adopting low-GWP refrigerants, investing in energy-efficient technologies, and enhancing their compliance strategies. Although challenges remain, such as the high initial costs of transitioning to new refrigerants and maintaining compliance, these regulations present long-term opportunities for growth, market differentiation, and environmental responsibility.

In particular, industry players who adopt these changes will be better positioned to comply with stringent regulatory frameworks and meet the growing demands for sustainable and energy-efficient solutions. Collaboration within the industry and with regulatory bodies will be crucial in ensuring a smooth and effective transition, as businesses leverage new technologies and innovative business models to stay competitive.

Ultimately, the EU F-gas regulations present an opportunity for the refrigeration industry to contribute significantly to global climate goals while positioning itself at the forefront of a more sustainable, future-focused economy.

The overview provided in this white paper doesn't cover all the details of each regulation regarding refrigerants or specific exceptions. As regulations are broad and constantly evolving, please contact your local Mueller consultant for more detailed information.

Who We Are

At Mueller®, we are united by a belief that the only quality that matters is quality that works for life. With every piece of processing equipment we build, our goal is to have lasting impact. This collective vision has led us from a small sheet metal shop to a global supplier of heating, cooling, processing, and storage solutions. Our equipment allows farmers, brewers, and engineers to keep their products fresh and their inventory strong. Whether our equipment preserves milk in rural areas or helps manufacture medicine with broad health benefits, we are making an impact across the globe.

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