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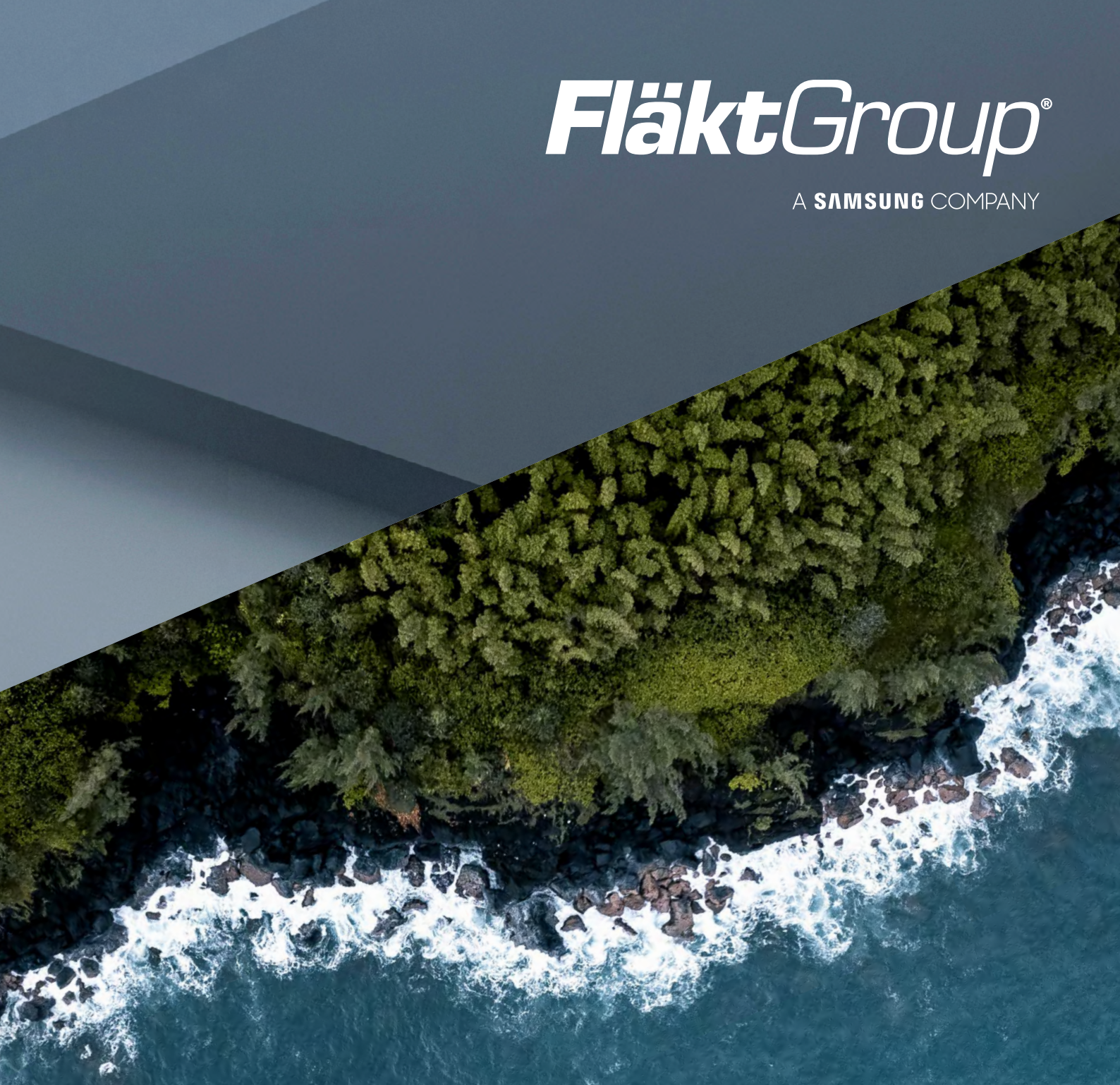

WHITE PAPER

Environmental Impacts, Regulatory Trends and the Role of PFAS-Free Refrigerants in HVAC

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Executive Summary

Per- and polyfluoroalkyl substances (PFAS) are a large group of man-made chemicals valued for their stability and repellency properties but now recognised as posing significant environmental and human health risks. Due to their extreme persistence, mobility, and potential toxicity, PFAS are widespread in the environment and increasingly detected in water, soil, food, and humans. They are also known as 'forever chemicals' due to their persistence in the environment. Scientific evidence links exposure to adverse health effects including reproductive harm, immune suppression, hormonal disruption, and increased cancer risk.

Globally, PFAS are subject to growing regulatory scrutiny. In the European Union, REACH serves as the central regulatory framework under which many PFAS are already classified as substances of very high concern or restricted, placing increasing compliance obligations on industry.

Within HVAC and air treatment technologies, PFAS may be present in refrigerants, components, lubricants, and materials, driving the need for transparency, safer alternatives, and supply-chain engagement.

In response, FläktGroup is introducing R32 as a PFAS-free refrigerant solution. R32 combines strong energy performance, lower climate impact, regulatory compliance, and improved sustainability outcomes, while supporting future-ready HVAC design.

Looking ahead, continued innovation, regulatory preparedness, and industry collaboration will be essential to accelerate the transition toward PFAS-free and low-impact air treatment technologies.

Read more about our ReCooler with R32 PFAS-free refrigerant →

Introduction

Per- and polyfluoroalkyl substances (PFAS) are a large group of manufactured chemicals that have been widely used since the 1940s due to their unique and valuable technical properties. Over time, however, increasing scientific evidence has highlighted the significant environmental and health risks associated with the accumulation of these substances.

Chemical substances may be environmentally hazardous in several ways. They can be toxic, causing harm or mortality to living organisms; persistent, meaning they do not readily degrade and remain in the environment for extended periods of time; bioaccumulative, accumulating in fatty tissues and magnifying through the food chain; and/or mobile, allowing them to spread easily through water systems.

The PFAS-family of substances comprises more than 10,000 individual substances which contain at least one fully fluorinated carbon. They have traditionally been classified under the PBT/vPvB criteria (persistent, bioaccumulative, toxic/ very persistent, very bioaccumulative). Increasingly, however, they are considered more closely aligned with the PMT/vPvM criteria (persistent, mobile, toxic/ very persistent, very mobile), reflecting their tendency to spread widely through water and resist removal.

PFAS possess several attractive functional properties, including resistance to fat, dirt, and water, as well as high thermal stability and chemical inertness. These characteristics arise from the carbon–fluorine (C–F) bond, which does not occur naturally in the environment and is exceptionally stable. As a result, PFAS are not readily broken down. Despite the relatively small quantities required to achieve their intended functions, PFAS are now detected at low concentrations across nearly all environmental compartments worldwide.

Environmental and Health Impact of PFAS

Exposure Pathways and Environmental Presence

Human exposure to PFAS occurs through multiple pathways, including inhalation, food consumption, and drinking water. PFAS contamination of groundwater, surface water, and soil is frequently observed, and remediation of affected sites is technically complex and costly. The most significant concerns, however, relate to the documented impact on human health (ECHA[1]).

Documented Health Effects

Studies of well-characterised PFAS substances indicate that exposure at certain levels may lead to a range of adverse health effects. These include reproductive impacts such as reduced fertility, increased blood pressure during pregnancy, developmental effects in children, elevated risk of certain cancers, suppressed immune system response, endocrine disruption, and increased cholesterol levels (EPA[2]).

[1] https://echa.europa.eu/hot-topics/perfluoroalkyl-chemicals-pfas
[2] https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas

Global Regulatory Landscape

Expanding Global Controls

PFAS are subject to an expanding set of regulations at global, regional, and national levels. Internationally, several PFAS compounds have been listed under the global treaty of Stockholm Convention on Persistent Organic Pollutants since 2009, leading to bans or severe restrictions. In response, many countries in the Asia-Pacific region have introduced national standards and regulatory controls. The U.S. Environmental Protection Agency (EPA[2]) has also established its own PFAS restriction and monitoring strategies.

The European Union Regulatory Framework

Within the European Union, PFAS are regulated through a complex framework of horizontal and sector-specific legislation. REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) serves as the primary regulatory instrument, complemented by regulations such as POPs (Persistent Organic Pollutants) and CLP (Classification, Labelling and Packaging).

What This Means for Industry

REACH places the burden of proof on industry, requiring manufacturers and importers to demonstrate that risks associated with their substances are understood and adequately managed. Substances may be subject to information requirements or formal regulatory controls. For example, substances listed on the Candidate List are identified as Substances of Very High Concern (SVHCs) and must be communicated throughout the supply chain. Eventually some of the substances on the Candidate List become regulated by being placed on the Authorisation List, where a defined sunset date is set which applies to all use. Other substances which are considered problematic in certain applications are placed on the Restriction List, where more specific limitations on use apply according to the conditions specified in the entry.

Many PFAS are already regulated under REACH as restricted substances or SVHCs. Several are also prohibited or tightly controlled.

[2] https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas

PFAS in HVAC and Air Treatment Technologies

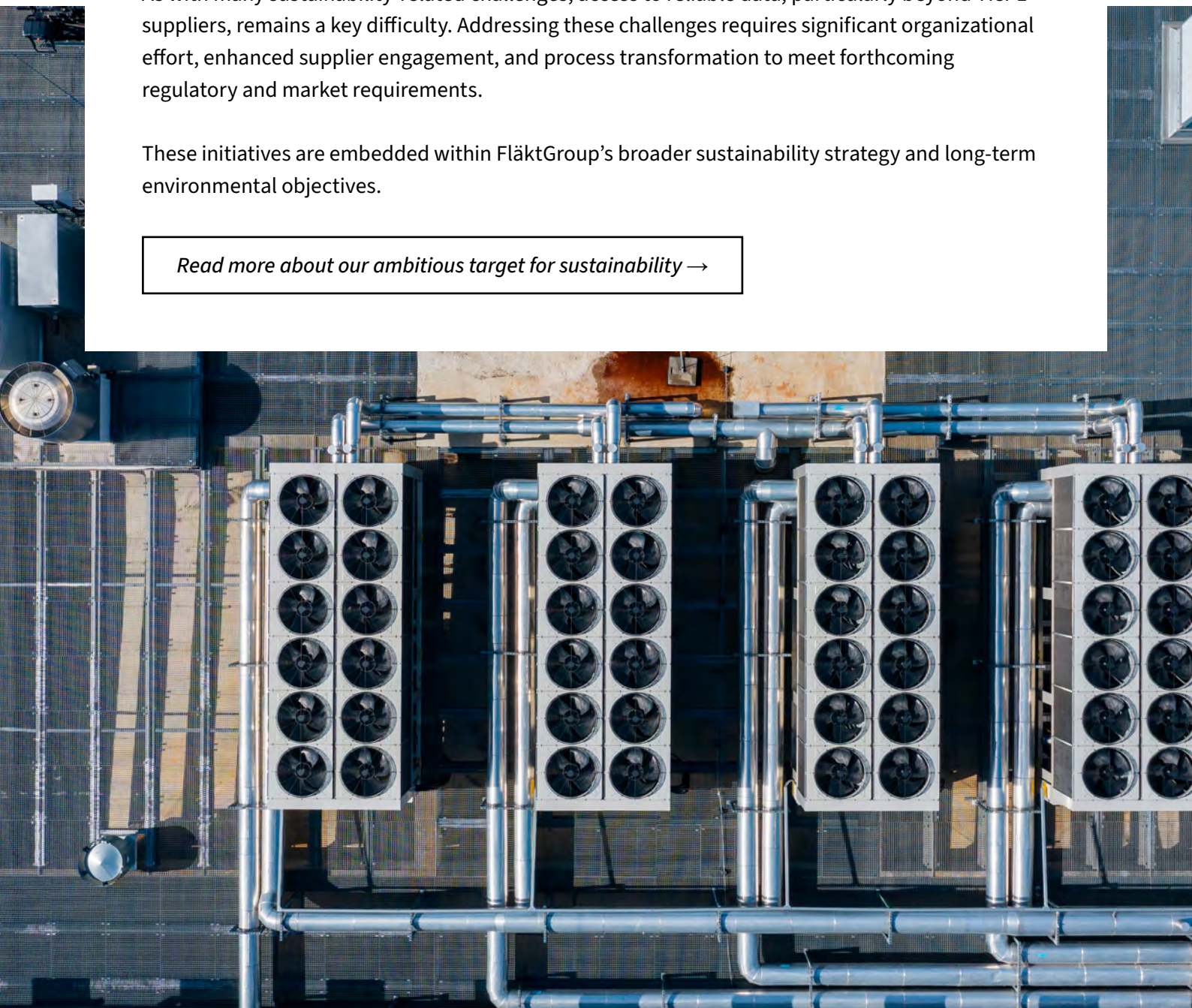
Within heating, ventilation, and air conditioning (HVAC) equipment, PFAS may be present in refrigerants, components, lubricants, and materials.

Existing regulations, together with increasing customer and market expectations, are placing growing pressure on manufacturers to assess material composition, evaluate chemical risks, and design safer or more sustainable alternatives. Transparent communication regarding current status and progress has also become increasingly important.

As with many sustainability-related challenges, access to reliable data, particularly beyond Tier 1 suppliers, remains a key difficulty. Addressing these challenges requires significant organizational effort, enhanced supplier engagement, and process transformation to meet forthcoming regulatory and market requirements.

These initiatives are embedded within FläktGroup's broader sustainability strategy and long-term environmental objectives.

Read more about our ambitious target for sustainability →



R32 Refrigerant: A PFAS-free Alternative

FläktGroup’s refrigerant strategy focuses on transitioning its product portfolio toward more sustainable, integrated cooling solutions for air handling units (AHUs). As part of this strategy, R32 (difluoromethane) is being introduced as a best-available-technology refrigerant that balances regulatory compliance, environmental performance, and system efficiency.

R32 Refrigerant: A PFAS-free Alternative

Environmental and Regulatory Performance

R32 is PFAS-free, addressing increasing concerns related to persistent chemicals and human health while maintaining strong technical performance. Compared to R410A, R32 offers higher cooling capacity and improved energy efficiency, resulting in enhanced Life Cycle Climate Performance (LCCP) through reduced operational energy consumption.

R32 also compares very favorably compared to other refrigerants commonly used for cooling in the HVAC sector. The table below compares R32 with three commonly used refrigerants.

Refrigerant	PFAS Components	PFAS % (by weight)	Non-PFAS % (R-32)
R410A	R125	50%	50%
R454B	R1234yf	31.1%	68.9%
R454C	R1234yf	78.5%	21.5%
R32	None	0%	100%

With a Global Warming Potential (GWP) of 675, R32 complies with EU F-Gas Regulation requirements through 2033 and remains outside current and anticipated PFAS restrictions, providing regulatory certainty in an evolving policy landscape. The reduced refrigerant charge required for R32 systems leads to an approximately 70% reduction in CO_2-equivalent emissions compared to legacy refrigerants. R32 also meets EU Taxonomy criteria for refrigerants used in applications such as data centre cooling.

Technical and Certification Advantages

As a single-component refrigerant, R32 avoids composition shifts associated with blended refrigerants, supporting stable pricing and long-term availability. Its compatibility with reversible heating and cooling systems and variable-speed compressor technology makes it well suited for modern, high-efficiency AHU designs.

Furthermore, R32 contributes to improved sustainability certification outcomes, delivering two additional BREEAM credits: one for reduced refrigerant environmental impact and one for mandatory leak detection.

Discover how BREEAM enhances building performance through energy efficiency, pollution reduction and long-term cost savings.

Read more about BREEAM here →

Future Outlook

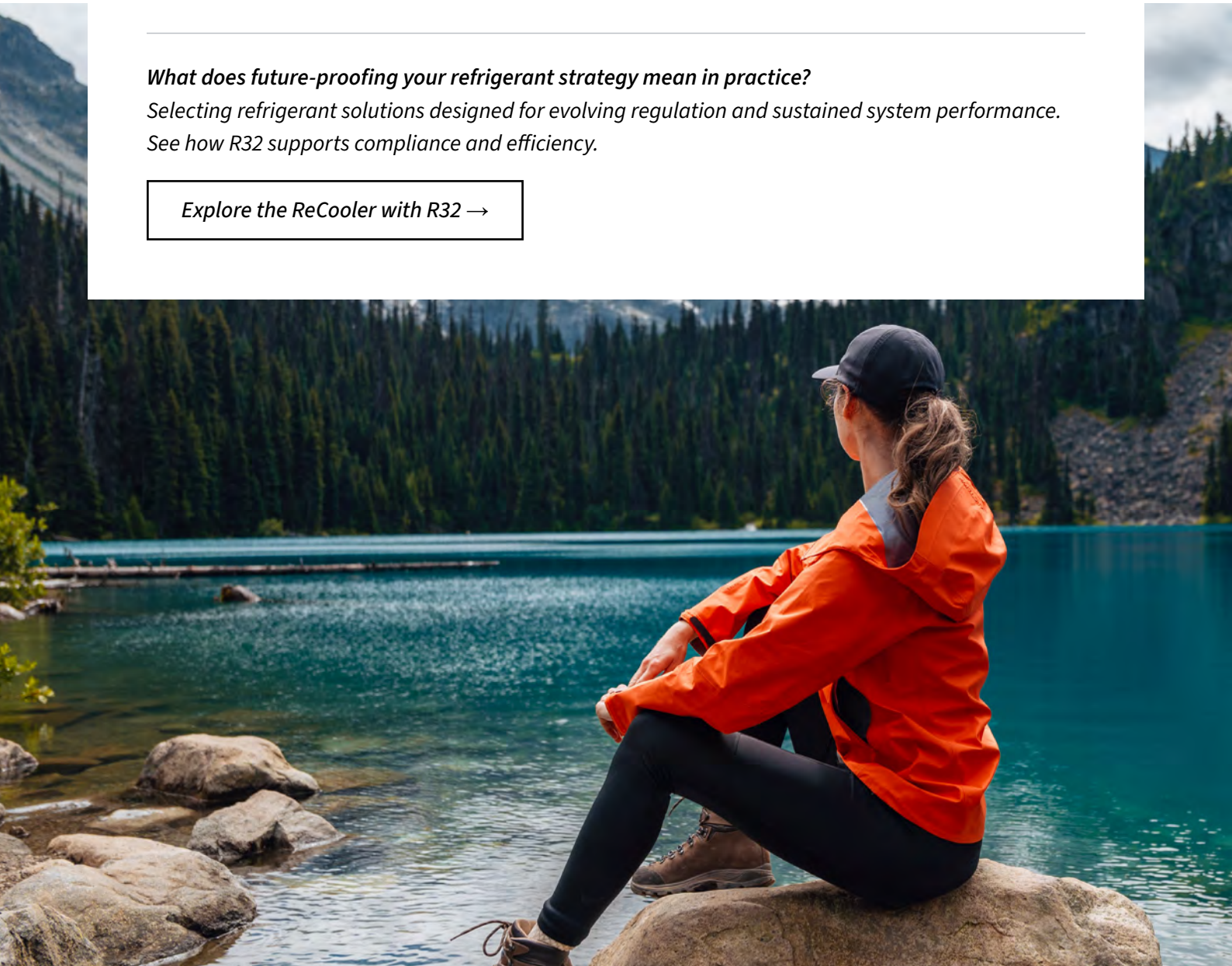
As scientific understanding of PFAS and their associated risks continues to evolve, regulatory frameworks are expected to become increasingly stringent.

For manufacturers, this necessitates deep technical understanding, robust documentation, and proactive product development to not only meet regulatory requirements but also actively drive sustainability performance.

Looking ahead, future refrigerant strategies will increasingly include the adoption of natural refrigerants, such as carbon dioxide (R744), which remains a priority within FläktGroup's long-term roadmap. More broadly, successful transition away from PFAS will require active collaboration across the value chain, driven by the needs and expectations of those designing, constructing, and operating buildings and indoor environments.

What does future-proofing your refrigerant strategy mean in practice?
Selecting refrigerant solutions designed for evolving regulation and sustained system performance. See how R32 supports compliance and efficiency.

Explore the ReCooler with R32 →



Navigating the transition away from PFAS requires informed decisions and close technical collaboration

If you would like to explore how this applies to your project, our experts are available to support you.

Request a consultation →

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FläktGroup, a Samsung company, is a leader in air technology, delivering best in class, innovative and energy-efficient HVAC solutions, whilst reducing customer's carbon footprint. FläktGroup's premier brands have been setting technological standards for more than 100 years and can fulfil the most demanding customer requirements.

Headquartered in Germany, FläktGroup operates all over the world with production sites across Europe, Asia, and the USA.

PRODUCT FUNCTIONS BY FLÄKTGROUP

Air Movement | Air Treatment | Air Diffusion | Air Filtration
Air Management & ATD's | Air Conditioning & Heating
Data Centre & IT Cooling | Service

» Learn more on ***www.flaktgroup.com*** or contact one of our offices