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EUROPEAN CHEMICALS AGENCY

General survey

Fields marked with * are mandatory.

1 Respondent background information

Before responding to the survey, please read the following documents (see links in the sidebar):

1. **Guidance Document**
2. **Use Mapping**
3. **Privacy Statement**

☑

- I have read and understood the information in the **Guidance Document** and **Use Mapping**.
- I agree to the privacy policy as set out in the **Privacy Statement**.

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* 1.1 **[Q2.0]** Select the EU language in which you will respond to the questions (the questions themselves will be in English only).

English

* 1.2 **[Q2.1]** Which of the following best describes you or your affiliation?

Select Citizen/individual if you are responding in a personal capacity.

Select Organisation if you represent an organisation (e.g. company) or other official role.

- ◯ Citizen/Individual
- ◉ Organisation

* 1.3 **[Q2.2]** What type of organisation are you responding for?

- Government organisation
- Non-governmental organisation
- Academic institution
- (x) Industry association
- Company

* 1.4 **[Q2.3]** What is the name of the organisation you are reporting for?

Text of 1 to 300 characters will be accepted

Renewables Norway

* 1.5 **[Q2.4]** Please name a point of contact ECHA can contact if needed.

Text of 1 to 100 characters will be accepted

A point of contact is needed for seeking clarification or justification for the consultation responses if considered necessary by SEAC.

For individual respondents, the contact's name is always kept confidential.

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Jon Erling Fonneløp

* 1.6 **[Q2.5]** What is the email address for that contact point?

jon-erling.fonnelop@fornybarnorge.no

1.7 **[Q2.6]** If you submitted comments in the previous consultation on the Annex XV restriction proposal (Mar-Sep 2023), please list the comment numbers (e.g. #1234, #5678).

300 character(s) maximum

* 1.8 **[Q2.7]** Is your organisation national or international?

Organisations having activities in several countries (in EEA or globally) should choose "international".

- (x) National
- International

* 1.9 **[Q2.8]** What country are you (or your organisation) based in?

Individuals should choose the country where they permanently reside.

Respondents representing organisations, such as companies, should select the country where the largest share of their PFAS related activities occur.

Respondents representing other organisations may choose the country where the organisation is based in.

Norway (NO)

1.10 **[Q2.9]** How many members does your association have?

Provide the number of member organisations (e.g. for industry associations), or individuals (e.g. for trade unions).

430

2 General survey questions

Instructions

Please do not include links to particular websites or source literature in the response fields. For security reasons, links to external sources will not be opened.
If you wish to cite a third-party source (e.g. research paper), you can reference it in the response field. This allows SEAC to note the source and request it from you if necessary.

For more information, please see the Guidance document.

* 2.1 **[Q2.17]** Choose all sectors that are relevant or covered by your responses in this general survey.
Minimum 1 selection(s)
Select the sector(s) for which you will provide information. You can choose PFAS manufacturing and 22 sectors (14 sectors covered by SEAC sector-specific evaluation and additional eight sectors identified in the Background Document).

You can select as many sectors as you see fit. Information provided will apply to all selected sectors unless you specify otherwise in your answers. If you prefer to do it so, you can submit one survey for each specific sector of use your answers apply to.

If your use is not covered by any of the identified sectors, choose “other” and specify it in the next question.

- [ ] **[01] PFAS manufacturing**
- [ ] **[02] Textiles, upholstery, leather, apparel and carpets (TULAC)**
- [ ] **[03] Food contact materials (FCM) and packaging**
- [ ] **[04] Metal plating and manufacture of metal products**
- [ ] **[05] Consumer mixtures and miscellaneous consumer articles**
- [ ] **[06] Cosmetics**
- [ ] **[07] Ski wax**
- [x] **[08] Applications of fluorinated gases**

- [ ] **[09] Medical devices**
- [ ] **[10] Transport**
- [ ] **[11] Electronics and semiconductors**
- [ ] **[12] Energy**
- [ ] **[13] Construction products**
- [ ] **[14] Lubricants**
- [ ] **[15] Petroleum and mining**
- [ ] ***[16] Printing applications***
- [ ] ***[17] Sealing applications***
- [ ] ***[18] Machinery applications***
- [ ] ***[19] Other medical applications***
- [ ] ***[20] Military applications***
- [ ] ***[21] Explosives***
- [ ] ***[22] Technical Textiles***
- [ ] ***[23] Broader industrial uses***
- [ ] **[24] Other sector**

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* 2.2 **[Q2.18]** Please provide a general description of the use(s) of PFAS (or alternatives) you are providing comments on

Text of 1 to 2000 characters will be accepted

Briefly describe the use(s) of PFAS (or alternatives) in this sector(s).

District heating distributes hot water through insulated pipe networks for space heating and domestic hot water. In the EU, it accounts for approximately 12% of heating demand, with higher shares in Nordic countries. In Norway, district heating supplies approximately 7 TWh annually. Supply temperatures range from 85 to 95°C, reaching 115–120°C at peak winter demand.
Heat pumps are a key production technology in district heating. They upgrade low-temperature waste heat — from sewage, seawater, industrial processes, and data centers — into high-temperature heat for the network, displacing fossil fuels.
Heat pumps will grow substantially in importance. The Heat Roadmap Europe project estimates 25–30% of district heating capacity could be heat pump-based by 2050. Rapid data centre expansion will make increasing waste heat volumes available. Heat pumps also provide electricity system flexibility: coupled with thermal storage, they shift consumption to periods of high wind and solar generation, facilitating renewable integration.
PFAS are used as refrigerants — working fluids in the thermodynamic cycle. The refrigerant circulates in a closed loop, absorbing heat at low temperature through evaporation and releasing it at high temperature through condensation. Under normal operations no PFAS is released to the surroundings, and larger units have leakage monitoring systems. The most common PFAS refrigerant in new installations is R1234ze(E). Older units use R134a (GWP 1430) and R410A. In Norway, PFAS refrigerants account for approximately 142 MW of 191 MW total installed heat pump capacity in district heating. Non-PFAS alternatives — primarily ammonia — are used where feasible, but operators report that ammonia solutions with adequate reliability are not yet available at the capacity and temperature levels required for the largest urban installations.

2.3 **[Q2.19]** Please provide your comments on section 1.2. SEAC opinion

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.4 **[Q2.20]** Please provide your comments on section 2.2. Summary of the opinion and 2.2.2. SEAC opinion summary

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.5 **[Q2.21]** Please provide your comments on section 3.2. Justification that action is required on a Union-wide level

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.6 **[Q2.22]** Please provide your comments on section 3.3.1 Availability and technical and economic feasibility of alternatives

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.7 **[Q2.23]** Please provide your comments on section 3.4.1. Regulatory risk management options other than restriction

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.8 **[Q2.24]** Please provide your comments on section 3.4.2.2.1. Socio-economic analysis: Approach

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

1. NATURAL REFRIGERANT ALTERNATIVES ARE NOT YET COMMERCIALLY VIABLE AT REQUIRED SCALE

Norwegian district heating operators actively seek natural refrigerant solutions. Survey data from 17 companies (~191 MW installed heat pump capacity) show that ammonia is already the preferred choice where it works — multiple operators run ammonia heat pumps successfully at capacities up to 5.5 MW, and one company operates ten ammonia units with zero reported leakage.

However, for heat pumps above 5 MW with supply temperatures above 80°C in urban locations, two independent operators report the same finding: no ammonia heat pump supplier could offer sufficient operational reliability at the required capacity. Both chose R1234ze as the only viable option

The IIR Technical Brief on HTHPs (April 2026) confirms that closed-cycle products above 10 MW and 90°C are limited to very few suppliers. At >10 MW only centrifugal compressors are suitable; oil-free designs are essential but not widely deployed. The IIR identifies safe flammability management of hydrocarbons as a "critical technical challenge."

SEAC's analysis assumes alternatives are available for many F-gas applications. For this specific segment — MW-scale urban district heating above 80°C — the evidence does not support that conclusion today.

2. SAFETY AND REGULATORY BARRIERS ADD SUBSTANTIAL UNQUANTIFIED COSTS

No published study quantifies the total cost of using natural refrigerants versus HFOs in large urban district heating heat pumps. The following cost categories are not captured in equipment-level comparisons:

For hydrocarbons: charge rates of 2,000–20,000 kg at 5–30 MW trigger Seveso III (lower tier at 10,000 kg), requiring QRA, regulatory consent (3–6+ months), ATEX equipment, blast panels, and land-use restrictions that may extend to neighboring properties. Norwegian regulations prohibit flammable gas storage below ground, with unresolved legal ambiguity for heat pump circuits. In dense urban areas these constraints can be prohibitive (Norsk Energi, 2023).

For ammonia: toxicity requires exclusion zones and emergency protocols in urban settings. For CO_2: return temperatures must stay below 40°C, incompatible with many existing networks (50–70°C) without costly modifications; operating pressures of 80–130 bar add component costs.

SEAC should acknowledge this evidence gap and avoid assuming cost-neutrality of alternatives in the proportionality assessment.

3. TRANSITION PERIODS MUST REFLECT ACTUAL PROJECT TIMELINES

District heating heat pump projects require 5–8 years from concept to operation. The Esbjerg (Denmark) CO_2 heat pump (70 MW) took seven years; preliminary COP is 2.8 versus guaranteed 3.6, with full testing outstanding. Aalborg, Denmark: 177 MW CO_2, construction 2024, handover 2027. Norwegian operators planning >10 MW installations report timelines extending to the mid-2030s.

These heat pumps replace fossil boilers and deliver immediate CO_2 emission reductions. A restriction that delays investment is counterproductive to climate objectives. We propose a minimum 10-year derogation from entry into force for district heating heat pumps >5 MW with supply temperatures >80°C, with a mandatory review after 7 years assessing actual commercial availability of non-PFAS alternatives at the required scale, temperature, and urban siting conditions.

4. COMPLEMENTARITY WITH F-GAS REGULATION

We support SEAC's position that the PFAS restriction should complement the F-gas Regulation. The F-gas phase-down already incentivizes transition to natural refrigerants. An additional restriction exceeding the F-gas timeline would create regulatory uncertainty discouraging heat pump deployment — contrary to REPowerEU objectives. The derogation should be aligned with the F-gas schedule.

EVIDENCE: Norwegian DH operator survey (17 companies, ~191 MW, 2026); Norsk Energi (2023) safety report on hydrocarbons in large heat pumps; IIR Technical Brief 61 (April 2026); DBDH Hot|Cool Esbjerg operational data (2025).

2.9 **[Q2.25]** Please provide your comments on section 3.4.2.2.2. Socio-economic analysis: Costs

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

SEAC's cost assessment for the fluorinated gases sector does not adequately quantify the costs of substituting PFAS-containing refrigerants in large-scale district heating heat pumps. We identify four categories of cost that are either absent or significantly underestimated.

1. SUBSTITUTION COSTS ARE UNQUANTIFIED

No published study quantifies the total cost differential between HFO-based and natural-refrigerant heat pumps at the scale relevant for district heating (>5 MW. It excludes the additional cost categories outlined below, which can be substantial and, in some cases, prohibitive.

SEAC therefore cannot conclude that substitution costs are manageable without a documented total-cost-of-ownership comparison. The absence of such data is itself a finding that should inform SEAC's cost assessment: the costs are not quantified because they have not been studied, but this does not mean they are negligible.

2. REGULATORY AND SAFETY COMPLIANCE COSTS

For hydrocarbon refrigerants (R290, R600a): at the 5–30 MW scale typical for urban district heating, charge quantities of 2,000–20,000 kg are required (Norsk Energi, 2023). At 10,000 kg, Seveso III lower-tier obligations are triggered. The associated costs include Quantitative Risk Assessments, competent authority consent processes (3–6+ months), ATEX-classified electrical equipment throughout the machinery room, blast-resistant building construction, land-use restrictions extending to neighboring properties, public consultation, and ongoing independent inspection. These costs are not captured in SEAC's analysis.

For ammonia (R717): toxicity requires exclusion zones, emergency ventilation, gas detection, and emergency response planning — in urban locations, this can necessitate alternative siting with added land and infrastructure costs.

Norwegian regulations additionally prohibit flammable gas storage below ground. Several existing large district heating heat pumps (e.g. Skøyen, Oslo — 30 MW; Sandvika — 15 MW) are located in underground installations incompatible with flammable refrigerants. Relocation or reconstruction of such facilities represents a cost that SEAC has not assessed.

3. REDUCED OPERATIONAL EFFICIENCY — A HIDDEN ONGOING COST

SEAC's cost analysis does not address the operational cost penalty associated with natural refrigerants at high temperatures. Operational data from Drammen District Heating Company illustrates this: their ammonia heat pumps are rated for 90°C supply temperature but are operated at 72–76°C during stable winter production to manage compressor vibration and component wear. Operational experience indicates significantly increased degradation above 85°C.

This means natural-refrigerant systems that nominally meet the required temperature specification may in practice deliver lower temperatures — requiring supplementary heating from peak boilers, reducing overall system COP, and increasing operating costs. The cost of this efficiency gap over a 20–25 year asset lifetime is potentially significant but is not reflected in SEAC's analysis.

For CO_2 (R744): transcritical systems require return temperatures below 40°C. Many DH networks operate at 50–70°C. Achieving low returns necessitates costly network modifications — hydraulic separation, substation upgrades, and in some cases full redesign. These costs should be included in the substitution cost assessment.

4. STRANDED ASSET COSTS

Norwegian district heating data show that all newly installed PFAS-containing heat pumps in the period 2022–2024 use R1234ze(E), with individual units up to 9 MW and expected lifetimes of 20–25 years. SEAC's cost analysis should quantify the stranded asset risk: if these installations cannot be recharged or serviced due to a PFAS restriction before end of life, the economic loss — and the climate cost of reverting to fossil heating —

must be included in the cost assessment.

RECOMMENDATION
We urge SEAC to commission or require a documented total-cost-of-ownership comparison between HFO-based and natural-refrigerant heat pumps at capacities above 5 MW and supply temperatures above 80°C, covering equipment, safety infrastructure, regulatory compliance, operational efficiency, and network adaptation costs. Without such analysis, the cost section of SEAC's opinion lacks an adequate evidence base for this application segment.

Sources: Norwegian DH operator survey (2026), 17 companies, 191 MW; Norsk Energi (2023), Doc ID 36807-13; IIR (2026), 61st Technical Brief; Drammen District Heating (2026), operational data.

2.10 **[Q2.26]** Please provide your comments on section 3.4.2.2.3. Socio-economic analysis: Benefits

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.11 **[Q2.27]** Please provide your comments on section 3.4.2.2.4. Socio-economic analysis: Other relevant impacts

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

The socio-economic analysis should account for broader systemic benefits of large district heating heat pumps that extend beyond the direct heating function. Delays caused by insufficient availability of non-PFAS alternatives would forgo these benefits.

1. WASTE HEAT RECOVERY FROM DATA CENTERS AND INDUSTRY
Large heat pumps are uniquely capable of upgrading low-grade waste heat into district heating supply. This is increasingly relevant as European data center capacity grows rapidly due to digitalization and AI workloads. Without heat pumps, this waste heat is rejected to the environment unused. With heat pumps, it displaces fossil fuel combustion.
In Norway, operators already recover heat from data centers (5 MW, R1234ze) and waste incineration flue gas (14 MW, R1234ze) — applications where no natural refrigerant solution was available at the required capacity and temperature.
The revised EU Energy Efficiency Directive (2023/1791) requires data centers above 500 kW to make waste heat available where feasible. Heat pumps are the enabling technology. Restricting HFO refrigerants before natural alternatives are proven at the necessary scale would undermine this directive's implementation.

2. POWER SYSTEM FLEXIBILITY AND RENEWABLE INTEGRATION
Large district heating heat pumps provide significant flexibility to the electricity system. Coupled with thermal energy storage, they shift electricity consumption to periods of high renewable generation and low prices, reducing consumption during scarcity.
The Esbjerg 70 MW CO2 heat pump demonstrated 8 MW electrical load change in 30 seconds and can provide 16 MW continuous flexibility for grid services. This positions large heat pumps as dispatchable demand-side assets facilitating higher wind and solar penetration. This flexibility reduces renewable curtailment, lowers peaking gas plant requirements, and improves grid infrastructure utilization.
The IIR Technical Brief (April 2026) identifies combining HTHPs with thermal energy storage as a key innovation for system flexibility. For countries with fossil-heavy electricity, heat pumps offer even greater CO2 reduction by enabling higher renewable utilization.

3. CO2 EMISSION REDUCTIONS FROM REPLACING FOSSIL BOILERS
In many EU Member States, district heating relies on gas, coal, or oil boilers. Large heat pumps offer immediate CO2 reductions when replacing these — independent of refrigerant choice.
The Aalborg project (177 MW CO2 heat pumps) will reduce emissions by 210,000 tons CO2 annually, replacing a coal-fired plant. The IIR report documents that with renewable electricity (100 gCO2/kWh), a heat pump with COP 3 produces less than one-third of natural gas heating emissions. Even with current grid mixes, HTHPs already outperform diesel and LPG boilers in Norway, Germany, and the EU.
Every year of delayed deployment represents foregone CO2 reductions that cannot be recovered. In countries actively transitioning from fossil heating, this opportunity cost is substantial.

4. PROPORTIONALITY
These impacts — waste heat recovery, power system flexibility, CO2 reductions — are positive externalities not captured in a narrow-fluorinated gases assessment. SEAC's proportionality assessment should weigh the environmental cost of delayed heat pump deployment against the benefit of phasing out HFO refrigerants. For large urban district heating heat pumps where natural alternatives face documented barriers, the balance favors a time-limited derogation allowing continued deployment while alternatives mature.
EVIDENCE: IIR Technical Brief 61 (April 2026); DBDH Hot|Cool Esbjerg data (2025); Norwegian DH operator survey (2026); EU Energy Efficiency Directive 2023/1791.

2.12 **[Q2.28]** Please provide your comments on section 3.4.2.2.5 Socio-economic analysis: Proportionality

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

We agree with SEAC's conclusion that a full PFAS ban without use-specific derogations is likely not proportionate, and that a general ban combined with tailored, time-limited derogations represents the correct framework. However, we wish to highlight specific proportionality concerns relevant to the fluorinated gases sector — in particular, large-scale, high-temperature heat pumps for district heating.
Proportionality and the energy transition
The proportionality assessment must account for the critical role heat pumps play in the EU's decarbonization strategy. REPowerEU and the Energy Efficiency Directive rely on rapid heat pump deployment, including large-scale systems supplying district heating networks at temperatures of 80–120 °C. Any restriction on fluorinated refrigerants that delays or disrupts deployment of these systems risks undermining the EU's own climate objectives. This creates a proportionality tension that SEAC's current analysis does not sufficiently quantify: the environmental cost of continued PFAS use must be weighed against the environmental cost of slower decarbonization.
Insufficient operational experience with natural refrigerants at large scale and high temperature
For residential and small commercial heat pumps, we acknowledge that the transition to natural refrigerants such as propane (R290) is well advanced and that restriction is broadly proportionate. However, for large-scale, high-temperature heat pumps (>1 MW, supply temperatures above 80 °C), the situation is fundamentally different. While natural refrigerants such as ammonia (R717), CO_2 (R744), and hydrocarbons are used in some reference projects, the operational track record at high temperatures and large capacities remains limited. Key concerns include:
(1) Ammonia systems are well proven for moderate temperatures but face a practical ceiling around 90 °C in single-stage configurations. Reaching higher supply temperatures (95–120 °C) add significant complexity, cost, and maintenance burden. Operational experience with such systems in district heating remains sparse. Furthermore, ammonia's toxicity imposes siting constraints that limit deployment in urban environments — precisely where district heating demand is highest.
(2) CO_2 transcritical systems can achieve high output temperatures but require return temperatures below 40 °C, which is incompatible with many existing district heating networks operating at 50–70 °C return. Retrofit of networks is costly and time-consuming. Additionally, CO_2 operates at pressures of 80–130 bar, demanding specialized components and highly skilled engineering teams that are not yet available at scale across the EEA.
(3) Hydrocarbon-based systems (propane, butane) face charge size limitations due to flammability. Butane can reach higher temperatures in cascade configurations, but large-scale deployment experience remains limited.
In contrast, certain fluorinated refrigerants — including HFOs such as R-1234ze(E) — offer proven performance at high temperatures with moderate operating pressures, lower toxicity than ammonia, and no flammability risk. These refrigerants are currently enabling the deployment of district heating heat pumps that would otherwise face significant technical and safety barriers.
The proportionality gap in SEAC's analysis
SEAC's evaluation follows the categorization in Annex IV of the F-gas Regulation, which does not differentiate between heat pump applications by scale or temperature level. This means the proportionality assessment for a 5 kW residential unit is conflated with that for a 20 MW district heating installation operating above 90 °C, delivering heat equivalent of 4000 residential units. These are fundamentally different technical and economic realities.
We urge SEAC to recognize that for large-scale, high-temperature heat pumps, the costs of premature restriction — including delayed decarbonization of heating networks, stranded capital, and reliance on fossil-fuel boilers during an extended transition — are likely to outweigh the benefits of immediate PFAS phase-out. A time-limited derogation for this specific segment would be proportionate and consistent with SEAC's own framework of granting derogations where socio-economic costs outweigh the benefits of a complete ban.
Data gaps
SEAC acknowledges significant data gaps. For large-scale, high-temperature heat pumps, the absence of comprehensive data on substitution costs and timelines should not be interpreted as evidence that substitution is straightforward. We encourage SEAC to actively seek data on operational experience, failure rates, and total cost of ownership for natural-refrigerant systems operating above 80 °C at capacities exceeding 1 MW before concluding on proportionality for this segment.

2.13 **[Q2.29]** Please provide your comments on section 3.4.2.3. Practicality, including enforceability

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

We wish to highlight several practicality and enforceability challenges specific to large-scale district heating heat pumps that are not adequately reflected in SEAC's assessment.

1. COMPRESSOR TECHNOLOGY LOCK-IN MAKES SUBSTITUTION A PLATFORM REPLACEMENT
SEAC's analysis implicitly treats refrigerant substitution as a component change. For large-scale heat pumps this is incorrect. At capacities above 10 MW, centrifugal turbocompressors are the only viable compressor technology. These machines are engineered for specific working fluid properties — impeller geometry, seals, bearings, and lubrication are optimized for the selected refrigerant. While it is entirely feasible to build heat pumps with turbo compressors that use ammonia or isobutane, these systems require compressors that are purpose-designed for the specific refrigerant from the outset. A straightforward retrofit or conversion of an existing turbo compressor originally designed for a different refrigerant (such as R134a or HFO) to ammonia or isobutane presents significant challenges related to material compatibility (ammonia is corrosive to copper alloys), aerodynamic impeller design (each refrigerant has different volumetric flow and pressure ratio requirements), safety (ammonia is toxic and isobutane is flammable, requiring ATEX-rated components and dedicated ventilation), and lubrication (specialized lubricants are needed for both refrigerants).
For these reasons, such conversions are generally not recommended by compressor manufacturers, and the practical path forward is to specify purpose-built turbo compressor systems designed for the target natural refrigerant.

2. SERVICING EXISTING INSTALLATIONS — THE RECHARGING PROBLEM
If PFAS refrigerant supply is restricted before end of equipment life, operators face a practical dilemma: decommission functioning equipment with 10–20 years of remaining life or operate without the ability to maintain correct charge levels — leading to reduced efficiency, accelerated component wear, and eventual forced shutdown. SEAC should clarify how the restriction interacts with servicing needs for the existing installed base, and whether a servicing exemption is practically enforceable.

3. REGULATORY OVERLAP WITH THE F-GAS REGULATION
The PFAS restriction and the F-gas Regulation create overlapping regulatory obligations for the same equipment. For operators, practical questions arise: which regulation governs the timeline for phase-out? If the F-gas Regulation permits continued use of an HFO refrigerant that the PFAS restriction prohibits, which prevails? How are inspection, reporting, and compliance obligations coordinated?
This dual regime creates regulatory uncertainty that is already affecting investment decisions. Norwegian operators report delaying procurement of new heat pump systems because the regulatory landscape is unclear. SEAC should address the practical interaction between the two regulatory frameworks explicitly and ensure that enforcement mechanisms are aligned to avoid conflicting obligations on the same installation.

4. PROJECT TIMELINES ARE INCOMPATIBLE WITH SHORT TRANSITION PERIODS
Large-scale heat pump projects may require 5–8 years from concept to operation. The Esbjerg CO2 heat pump (70 MW) took seven years from initiation to first operation. Norwegian operators planning new >10 MW installations report timelines extending to the mid-2030s. Any transition period must account for the fact that refrigerant selection occurs at the design stage — typically 1–3 years before commissioning. A restriction that takes effect before projects currently in planning can be completed will strand investment already committed. For practical enforceability, the restriction should include a clear date-of-order or date-of-design-commitment criterion, not only a date-of-placing-on-market, to avoid penalizing projects that made refrigerant decisions in good faith before the restriction entered into force.
Sources: Norwegian DH operator survey (2026), 17 companies, 191 MW; Norsk Energi (2023), Doc ID 36807-13; IIR (2026), 61st Technical Brief; Drammen Fjernvarme (2026), operational data.

2.14 **[Q2.30]** Please provide your comments on section 3.4.2.4. Monitorability

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.15 **[Q2.31]** Please provide your comments on section 3.4.3.2.1. Conclusion whether the suggested restriction is the most appropriate EU-wide measure: (i) PFAS definition

Text of 1 to 1000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.16 **[Q2.32]** Please provide your comments on section 3.4.3.2.1 Conclusion whether the suggested restriction is the most appropriate EU-wide measure: (ii) Exclusion of PFAS from the scope

Text of 1 to 1000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.17 **[Q2.33]** Please provide your comments on section 3.4.3.2.2 Conclusion whether the suggested restriction is the most appropriate EU-wide measure: Scope of the proposed restriction

Text of 1 to 1000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.18 **[Q2.34]** Please provide your comments on section 3.4.3.2.3. Conclusion whether the suggested restriction is the most appropriate EU-wide measure: Concentration limits

Text of 1 to 1000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.19 **[Q2.35]** Please provide your comments on section 3.4.3.2.4. Conclusion whether the suggested restriction is the most appropriate EU-wide measure: General 18-month transition period

Text of 1 to 1000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.20 **[Q2.36]** Please provide your comments on section 3.4.3.2.5. Conclusion whether the suggested restriction is the most appropriate EU-wide measure: Derogations

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

We welcome SEAC's differentiated approach to derogations, which recognizes that a blanket ban without exemptions would be disproportionate. However, we note a significant gap: the absence of a specific derogation for large-scale, high-temperature heat pumps used in district heating.

The missing derogation

SEAC's evaluation of fluorinated gases follows the categorization in Annex IV of the F-gas Regulation, which does not distinguish between heat pump applications by scale or temperature level. A 5 kW residential heat pump and a 20 MW district heating installation at 120 °C are assessed under the same framework. This fails to reflect fundamentally different technical realities and substitution timelines.

For residential and small commercial heat pumps, natural refrigerants — particularly propane (R290) — are commercially mature. We do not contest SEAC's assessment that derogations for these applications are largely not justified.

However, for large-scale, high-temperature heat pumps (>1 MW, supply temperatures above 80 °C), a time-limited derogation is necessary and justified:

Insufficient maturity of natural refrigerant alternatives at high temperature and large scale

While natural refrigerants are used in some reference projects, the operational track record at high temperatures remains insufficient to support a reliable, large-scale transition within the proposed timeframes:

(1) Ammonia (R717) faces a practical ceiling around 90 °C in single-stage systems. Supply temperatures of 100–130 °C require cascade configurations (e.g. ammonia/butane) that add substantial complexity, cost, and maintenance burden. Operational experience with such cascades in district heating remains limited. Ammonia's toxicity further restricts deployment in urban areas where district heating demand is concentrated, requiring exclusion zones and specialized safety infrastructure.

(2) CO_2 (R744) transcritical systems can reach high output temperatures but impose a strict return temperature constraint (below 40 °C), incompatible with many existing networks operating at 50–70 °C return. Network adaptation is a multi-year, capital-intensive process. CO_2 also operates at 80–130 bar, demanding specialized components and engineering expertise not yet available at scale across the EEA.

(3) Hydrocarbons: propane (R290) is limited to approximately 65 °C supply temperature. Isobutane (R600a) can reach higher temperatures, but large-scale deployment experience is very limited, and flammability constraints impose charge size limitations.

Consequences of restricting without derogation

District heating heat pumps are long-lived capital assets (25–30 year design life) with multi-year planning and construction cycles. Restricting fluorinated refrigerants without derogation would likely delay decarbonization projects, prolong reliance on fossil-fuel boilers, strand investment in systems under development, and discourage new commitments — directly undermining the EU's heating decarbonization objectives.

Our recommendation

We urge SEAC to introduce a specific time-limited derogation for fluorinated refrigerants in large-scale, high-temperature heat pumps (>1 MW, above 80 °C) for district heating. A period of 13.5 years (including transition) would allow natural refrigerant technologies to mature, supply chains to develop, and network operators to execute infrastructure adaptations. This should be accompanied by reporting obligations to track substitution progress.

This would be consistent with SEAC's framework of granting exemptions where socio-economic costs of restriction outweigh the benefits and would avoid the perverse outcome of a PFAS restriction slowing the EU's energy transition.

2.21 **[Q2.37]** Please provide your comments on section 3.4.3.2.6.1. Conclusion whether the suggested restriction is the most appropriate EU-wide measure: Reporting requirements

Text of 1 to 1000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

For large-scale heat pumps (>1 MW) used in DH and industrial applications, operators using fluorinated refrigerants (HFCs/HFOs) are already subject to comprehensive reporting obligations under the F-gas Regulation (EU) 2024/573, Art 26, including annual reporting via the F-gas Portal and independent auditor verification above 1 000 t CO_2eq. Any PFAS restriction reporting requirements must avoid duplicating these existing obligations for the same substances and operators. Furthermore, the large-scale heat pump sector is increasingly transitioning to natural refrigerants (ammonia, CO_2, propane) which are non-PFAS. Imposing additional PFAS-specific reporting on operators who have already invested in this transition would create a disproportionate administrative burden without corresponding environmental benefit. We urge SEAC to ensure coherence with the F-gas reporting framework and to consider reduced or waived reporting for operators demonstrating verified use of non-PFAS refrigerants.

2.22 **[Q2.38]** Please give an indication of the costs related to the reporting requirements.

Consult the SEAC draft opinion section 3.4.3.2.6.1. Conclusion whether the suggested restriction is the most appropriate EU-wide measure: Reporting requirements.

Provide an estimate of the magnitude of the costs for the implementation of the reporting requirements, from very low when the impacts are estimated to be insignificant to very high when they may result in a decision to discontinue your business activities.

- ○ Very low or none
- ○ Low
- ● Moderate
- ○ High
- ○ Very high
- ○ I do not know

2.23 **[Q2.39]** Please provide your comments on section 3.4.3.2.6.2. Conclusion whether the suggested restriction is the most appropriate EU-wide measure: Site-specific PFAS management plan

Text of 1 to 1000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.24 **[Q2.40]** Please give an indication of the costs related to the implementation of a site-specific PFAS management plan

Consult the SEAC draft opinion, section 3.4.3.2.6.2. Conclusion whether the suggested restriction is the most appropriate EU-wide measure: Site-specific PFAS management plan.

Provide an estimate of the costs for monitoring of emissions at industrial sites. Use the scale from very low (minimal impact) to very high (may result in a decision to discontinue business activities).

- ○ Very low or none
- ○ Low

- (selected) Moderate
- High
- Very high
- I do not know

2.25 **[Q2.41]** Please give an indication of the costs related to monitoring of PFAS emissions at industrial sites

Consult the SEAC draft opinion, section 3.4.3.2.6.2. Conclusion whether the suggested restriction is the most appropriate EU-wide measure: Site-specific PFAS management plan.

Provide an estimate of the costs for monitoring of emissions at industrial sites. Use the scale from very low (minimal impact) to very high (may result in a decision to discontinue business activities).

- Very low or none
- Low
- (selected) Moderate
- High
- Very high
- I do not know

2.26 **[Q2.42]** Please provide your comments on section 3.4.3.2.6.3. Conclusion whether the suggested restriction is the most appropriate EU-wide measure: Additional conditions considered by RAC

Text of 1 to 1000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

No comments

2.27 **[Q2.43]** Please give an indication of the costs related to the additional conditions considered by RAC

Consult the SEAC draft opinion, section 3.4.3.2.6.3. Conclusion whether the suggested restriction is the most appropriate EU-wide measure: Additional conditions considered by RAC.

Provide an estimate of the costs for implementing these conditions. Use the scale from very low (minimal impact) to very high (may result in a decision to discontinue business activities).

- Very low or none
- Low
- Moderate
- High
- Very high
- (selected) I do not know

2.28 **[Q2.44]** Please provide your comments on section 3.4.3.2.7. Conclusion whether the suggested restriction is the most appropriate EU-wide measure: Interaction with other relevant legislation

Text of 1 to 1000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

The proposed PFAS restriction under REACH and the revised F-gas Regulation (EU) 2024/573 both regulate fluorinated refrigerants, but through different mechanisms, definitions and timelines. This creates significant regulatory uncertainty for operators of long-lived capital assets such as large-scale DH heat pumps (20+ y design life). The F-gas Regulation already provides a framework for phasing down fluorinated gases — including quota systems, equipment bans, leak prevention, reporting and end-of-life recovery. Adding a parallel REACH-based restriction on the same substances risks contradictory obligations, particularly for maintenance and refilling of existing installations, where REACH's broader "placing on the market" definition captures supply chain actors, the F-gas Regulation doesn't. We strongly recommend that all regulation of fluorinated refrigerants — including those classified as PFAS — be consolidated under the F-gas Regulation to ensure a single coherent regulatory pathway

2.29 **[Q2.45]** Please provide your comments on section 3.5.2. Uncertainties evaluated by SEAC

Text of 1 to 5000 characters will be accepted

Consult the SEAC draft opinion and provide your comments relevant to this specific section of the opinion.

We appreciate that SEAC acknowledges significant uncertainties in its assessment. However, for large-scale district heating heat pumps, we believe the uncertainties are more consequential than SEAC's evaluation suggests, and that they are systematically asymmetric — consistently pointing toward higher substitution costs and longer timelines than the draft opinion assumes.

1. OPERATIONAL PERFORMANCE UNCERTAINTY IS UNDERESTIMATED
SEAC's assessment assumes that natural-refrigerant heat pumps can deliver the temperatures and efficiencies required for district heating. Available operational data suggests otherwise:
Drammen District Heating's ammonia heat pumps are rated for 90°C supply temperature but are operated at 72–76°C during stable winter production due to increased compressor vibration and component wear. Operational experience indicates significantly increased degradation above 85°C. This is not a design margin — it represents a fundamental gap between nominal specification and achievable real-world performance.
The Esbjerg CO_2 seawater heat pump (70 MW) reported a measured COP of 2.8 during its first winter versus a guaranteed value of up to 3.6. Full guarantee testing remains outstanding. While preliminary, a 22% shortfall against guaranteed performance is a material uncertainty that SEAC should reflect in its assessment.
These are not isolated data points. A survey of 25 Danish and Norwegian operators (Aguilera et al., 2021) of ammonia heat pumps documented refrigerant leakage from material selection errors, COP degradation of 12% over 11 years, and operational difficulties from fluctuating source temperatures. The operational track record contains significant unresolved uncertainties.

2. COST UNCERTAINTY IS NOT SYMMETRIC
SEAC acknowledges data gaps on substitution costs but does not assess the direction of these uncertainties. For large-scale district heating heat pumps, the missing cost categories consistently increase the total cost of natural-refrigerant alternatives relative to HFO systems:
Safety and regulatory compliance: Seveso III obligations (triggered at 10,000 kg hydrocarbon charge), ATEX infrastructure, blast panels, exclusion zones for ammonia, land-use restrictions — none quantified in SEAC's cost assessment.
Network adaptation for CO_2: existing networks with return temperatures of 50–70°C require costly modifications (hydraulic separation, substation upgrades) to achieve the sub-40°C returns that CO_2 systems need.Reduced operational efficiency: systems operating below rated temperature to manage wear (as documented at Drammen) require supplementary peak load boilers, reducing both COP and CO_2 savings.
SEAC should acknowledge that the cost uncertainty for this application segment is not symmetric — the likely direction is toward substantially higher costs than the draft opinion assumes.

3. TECHNOLOGY MATURITY UNCERTAINTY
The IIR Technical Brief on High-Temperature Heat Pumps (April 2026) confirms that the market above 10 MW and 90°C is real but in early-stage commercialization with very few suppliers of closed-cycle systems.
SEAC should treat this as a material uncertainty: the supplier base for natural-refrigerant alternatives at the scale and temperature required for district heating is narrow, and commercial maturity has not been demonstrated over full equipment lifecycles (20–25 years).

4. THE CONSEQUENCES OF UNDERESTIMATING UNCERTAINTY
For most PFAS applications, underestimating substitution uncertainty leads to higher-than-expected compliance costs — an undesirable but manageable outcome. For district heating heat pumps, the consequences are different and more severe: delayed or cancelled heat pump investments mean continued reliance on less efficient heat production. This asymmetry — where regulatory uncertainty delays climate action — should be weighted explicitly in SEAC's uncertainty evaluation.
We recommend that SEAC conduct a specific uncertainty assessment for large-scale, high-temperature heat pumps, distinguishing this segment from residential and commercial applications where uncertainties are smaller and substitution is well advanced.
Sources: Drammen Fjernvarme/Drammen District Heating (2026); DBDH Hot|Cool (2025), Esbjerg operational data; Aguilera et al., (2021), ECOS 2021; IIR (2026), 61st Technical Brief; Norwegian DH operator survey (2026).

3 Confidentiality and submission

3.1 **[Q2.46]** Indicate each section for which your response contains confidential information.

Select all the questions for which you consider your responses confidential. The options below include all questions in the survey.

- [ ] Respondent background information
- [ ] General survey questions

Useful links

Guidance Document (https://echa.europa.eu/documents/10162/17091/upfas-seac-do_consultation_guidance-for-respondents_en.pdf/68d5b13b-d7d6-f14b-2c3e-9b3c07c98113?t=1765956675386)

Use Mapping (https://echa.europa.eu/documents/10162/17091/pfas_use-mapping_annex_to_guidance_for_respondents_en.pdf/e242dcf0-0aab-2619-234e-09445bb181c5?t=1765893415372)

Background Documents

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