08. Applications of fluorinated gases I

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**.

* 1.1 **[Q1.0]** Select the EU language in which you will respond to the questions (the questions themselves will be in English only).

English

* 1.2 **[Q1.1]** 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 **[Q1.2]** What type of organisation are you responding for?

- ○ Government organisation
- ○ Non-governmental organisation
- ○ Academic institution
- ◉ Industry association
- ○ Company

* 1.4 **[Q1.3]** What is the name of the organisation you are reporting for?

Text of 1 to 300 characters will be accepted

Renewables Norway

* 1.5 **[Q1.4]** 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 **[Q1.5]** What is the email address for that contact point?

jon-erling.fonnelop@fornybarnorge.no

1.7 **[Q1.6]** 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 **[Q1.7]** Is your organisation national or international?

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

- ◉ National
- ○ International

* 1.9 **[Q1.8]** 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 **[Q1.9]** 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

* 1.18 **[Q1.17]** Are you providing information from the perspective of a **single organisation**, or **more broadly** (e.g. on behalf of multiple organisations or other broader perspective, such as, sector-wide view)?

The survey allows to provide information from a single organisation or multiple organisation perspective.

Select the single organisation perspective if your responses reflect the impact on the entity you are reporting for, where applicable.

Select the multiple organisation perspective, if you are submitting information that represents several companies (e.g. separate subsidiaries under one parent company or separate companies within the same sector or industry – such as in the case of industry associations).

- ○ I am reporting information for a **single organisation** – the responses provided reflect the impacts (e.g. losses) on the entity, which I am reporting for.
- ◉ I am reporting information **more broadly** e.g. for multiple organisations or a whole sector.

2 Information on use, sub-use, and application

Instructions

In the question below, select each SEAC evaluation level that you want to provide information on. For each selected evaluation level, specific questions open up.

When sharing information that is applicable to multiple evaluation levels assessed in the SEAC draft opinion, please consider each evaluation level individually and report the specific impacts and circumstances for that evaluation level.

If you have information on a use in this sector that is not considered under any of the SEAC evaluation levels, you can submit that information under 'other use'.

Please do only submit information under 'other use' if you are **certain** that your use does **not fall** under any of the SEAC evaluation levels listed below. Consult the use mapping document for a definition of each SEAC evaluation level.

If you are reporting as a parent company, please make sure that your responses are **not overlapping** with information submitted by a subsidiary of your company. If subsidiaries report separately, the information they provide should only reflect the impacts on that entity.

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* 2.1 **[Q1.18]** Which specific use or application do you want to comment on?

Select all specific uses or applications (i.e. SEAC evaluation level) that you wish to comment on.

If your use or application is not explicitly mentioned under an SEAC evaluation level described in the use mapping, but it would reasonably be included in that category based on the definition, you may submit information for that SEAC evaluation level.

If your use is not covered by any SEAC evaluation level in the sector but you still consider it is covered within that specific sector evaluation, select ‘other use’. If you want to provide information on multiple ‘other uses’ that are not covered by any SEAC evaluation level, you will have to submit a new survey form.

For certain evaluations, SEAC has considered an additional restriction option (RO3), for which there is a question.

- [ ] **[08.01.01] Domestic refrigerators and freezers**
  [08.01] Refrigeration

- [ ] **[08.01.02.01] Refrigerators and freezers for commercial use (self-contained equipment)**
  [08.01.02] Commercial refrigeration
  [08.01] Refrigeration

- [ ] **[08.01.02.02] Multipack centralised refrigeration systems for commercial use**
  [08.01.02] Commercial refrigeration
  [08.01] Refrigeration

- [ ] **[08.01.02.03] Primary refrigerant circuit of cascade systems for commercial use**
  [08.01.02] Commercial refrigeration
  [08.01] Refrigeration

- [ ] **[08.01.03.01] Refrigeration equipment, except chillers and self-contained refrigeration equipment**
  [08.01.03] Industrial refrigeration
  [08.01] Refrigeration

- [ ] **[08.01.03.02] Self-contained refrigeration equipment, except chillers**
  [08.01.03] Industrial refrigeration
  [08.01] Refrigeration

- [ ] **[08.01.03.03] Chillers up to and including a rated capacity of 12 kW**
  [08.01.03] Industrial refrigeration
  [08.01] Refrigeration

- [ ] **[08.01.03.04] Chillers above 12 kW**
  [08.01.03] Industrial refrigeration
  [08.01] Refrigeration

- [ ] **[08.01.04] Refrigerants for maintenance and refilling of existing HVACR equipment**
  [08.01] Refrigeration

- [ ] **[08.02.01.01] Plug-in room air-conditioning equipment, monoblock air-conditioning equipment, other self-contained air-conditioning equipment and self-contained heat pumps, with a maximum rated capacity of up to and including 12 kW**
  [08.02.01] Self-contained air-conditioning equipment and heat pumps
  [08.02] Air conditioning and heat pumps

- [ ] **[08.02.01.02] Monoblock air-conditioning equipment and heat pumps, with a maximum rated capacity of more than 12 kW but not exceeding 50 kW, except monoblock hydronic space and water heater pumps with a maximum rated capacity up to 70 kW**
  [08.02.01] Self-contained air-conditioning equipment and heat pumps
  [08.02] Air conditioning and heat pumps

- [ ] **[08.02.01.03] Monoblock hydronic space and water heater pumps with a maximum rated capacity up to 70 kW**
  [08.02.01] Self-contained air-conditioning equipment and heat pumps
  [08.02] Air conditioning and heat pumps

- [ ] **[08.02.01.04] Other self-contained air-conditioning equipment and heat pumps (regardless of maximum rated capacity, but above 12 kW), except industrial uses of self-contained heat pumps**
  [08.02.01] Self-contained air-conditioning equipment and heat pumps
  [08.02] Air conditioning and heat pumps

- [x] **[08.02.01.05] Industrial uses of self-contained heat pumps with a maximum rated capacity above 12 kW**
  [08.02.01] Self-contained air-conditioning equipment and heat pumps
  [08.02] Air conditioning and heat pumps

- [ ] **[08.02.02.01] Split systems of a rated capacity up to and including 12 kW**
  [08.02.02] Split air-conditioning equipment and heat pumps
  [08.02] Air conditioning and heat pumps

- [x] **[08.02.02.02] Split systems of a rated capacity of more than 12 kW, except industrial uses**
  [08.02.02] Split air-conditioning equipment and heat pumps
  [08.02] Air conditioning and heat pumps

- [ ] **[08.02.02.03] Industrial uses of split systems with a maximum rated capacity above 12 kW**
  [08.02.02] Split air-conditioning equipment and heat pumps
  [08.02] Air conditioning and heat pumps

- [x] **[08.02.03] Refrigerants for maintenance and refilling of existing HVACR equipment**
  [08.02] Air conditioning and heat pumps

- [ ] **[08.09] Other use as part of this sector (use not considered under the SEAC evaluations listed above)**

[08.02.01.05] Industrial uses of self-contained heat pumps with a maximum rated capacity above 12 kW

[08.02.01] Self-contained air-conditioning equipment and heat pumps

[08.02] Air conditioning and heat pumps

* 2.158 **[Q1.19]** What is or are the process(es) or product(s) PFAS (or an alternative to PFAS) are used in? How and why are they used?

Text of 1 to 2000 characters will be accepted

Briefly describe how PFAS (or alternatives) are used in your uses or applications. This should include e.g. the function provided by PFAS and the type of part/article/product they are used in.

If your use is covered by the scientific research and development exemption from the restriction (Article 67(1) of REACH) please indicate so.

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.

* 2.159 **[Q1.20]** Do suitable alternatives exist for this use/application?

Suitable alternatives are those that are technically and economically feasible, safer for human health and the environment, and available in sufficient quantities.

- ( ) Yes
- (•) No
- ( ) I do not know

2.160 **[Q1.21]** What is the availability of alternatives for this use/application?

Select all options that apply in general for this use/application and provide an explanation of each point in the next question.

between 1 and 4 choices

Select the option that best describes the overall situation for application(s) you described above.

If your response concerns multiple applications, you can provide more detailed information for each application and its alternatives in the question below.

Option 6 is available for stakeholders who do not have information on the availability of alternatives.

- [ ] **1. Alternatives are not available due to insufficient quantities**: PFAS-free alternatives are not available in sufficient quantities for this use/application.
- [x] **2. Alternatives are not available because of safety concerns**: PFAS-free alternatives are not safer for human health or the environment.
- [x] **3. Alternatives are not available because of technical feasibility**: PFAS-free alternatives do not meet the functional requirements for this use/application.
- [x] **4. Alternatives are not available because of economic feasibility**: It is not possible to operate profitably using the alternatives.
- [ ] **5. None of the above - Alternatives are available**: There are suitable alternatives for this use/application. They exist in sufficient quantities, they are safer than PFAS, and they are technically and economically feasible.
- [ ] **6. No information on alternatives**

2.161 **[Q1.22]** Please give a justification for your responses above by providing an explanation for each of the four points. Make sure to name which specific application and alternative you are referring to:

1. **Sufficiency**: Are the alternatives available in a sufficient quantity for this use/application?

2. **Safety**: Are there concerns for risks on human health or the environment that could limit the substitution potential of alternatives?

3. **Technical feasibility**: Are there technical requirements for this use/application? How do potential alternatives perform against the requirements?

4. **Economic feasibility**: What is the impact of using the alternative on profitability? How much would switching to the alternative cost?

Text of 1 to 3000 characters will be accepted

Safety concerns
In densely populated areas, large quantities of flammable or toxic refrigerants pose significant challenges.
Several large district heating (DH) heat pumps are located underground — e.g. Skøyen, Oslo (30 MW) and Sandvika (15 MW). Such locations are incompatible with flammable refrigerants under current regulations.
A report by Norsk Energi for Hafslund Oslo Celsio (2023) analyzed the regulatory framework for hydrocarbons in large Norwegian heat pumps. For 5–30 MW systems requiring 2,000–20,000 kg charge, Seveso III is triggered at 10,000 kg (QRA, DSB consent taking 3–6+ months, public consultation, land-use restrictions extending to neighboring properties). ATEX equipment and blast panels are mandatory. Norwegian regulations prohibit flammable gas storage below ground, with unresolved ambiguity for heat pump refrigerant circuits. For ammonia, toxicity requires exclusion zones constraining urban siting.
Natural refrigerants are viable in principle, but their safety profiles create substantial barriers in dense urban settings where DH heat pumps are most needed.
Source: Norsk Energi (2023), "Hydrocarbons as refrigerant in large heat pumps for district heating in Norway — Safety aspects, standards and regulations," Doc ID 36807-13.

In densely populated areas, large quantities of flammable or toxic refrigerants pose significant challenges.
Several large DH heat pumps are located underground — e.g. Skøyen, Oslo (30 MW) and Sandvika (15 MW).
Such locations are incompatible with flammable refrigerants under current regulations.
Technical feasibility
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."
Two independent Norwegian operators report that no ammonia supplier could offer sufficient operational reliability at the required capacity and temperature. Drammen District Heating's ammonia heat pumps are rated for 90°C but operate at 72–76°C for stable output — operational experience indicates significantly increased wear above 85°C. For CO2 heat pumps, return temperatures must stay below 40°C — incompatible with many networks at 50–70°C.
Source: IIR (2026), 61st Technical Brief; Norwegian DH operator survey (2026), 17 companies, 191 MW; Drammen District Heating (2026).
Economic feasibility
No published study quantifies the total cost differential between PFAS and natural refrigerants for MW-scale DH heat pumps.
This knowledge gap is significant. Without total-cost-of-ownership comparisons covering safety infrastructure, regulatory compliance, and reduced site flexibility, the assumption that alternatives are economically available lacks an adequate evidence base.

2.162 **[Q1.23]** How many years would it take to develop alternatives to a stage where they can be implemented for the use/application?

Only values of at most 20 are allowed

If you cover several applications in your response, provide an estimate that allows PFAS to be substituted in all of them.
If you cannot provide an estimate, do respond to the question.

10 years

2.163 **[Q1.24]** What is the total annual volume (tonnes) of PFAS used (or imported) for this specific use /application in the EEA?

Provide the annual volume (tonnes) for each type of PFAS used (or imported) in the EEA by your organisation, or by the organisations included in your response if reporting for a group. Do not include tonnages used outside the EEA.

	Annual volume of PFAS used	
Non-polymeric PFAS		tonnes/year
Polymeric PFAS		tonnes/year
Fluorinated gases	2	tonnes/year

2.164 **[Q1.25]** If PFAS could not be used in this use/application, what would be the most likely impact on organisation(s) covered by your response?

Maximum 1 selection(s)

Consider a situation where PFAS could not be used in this use/application by you or your competitors (including articles imported from outside the EEA).

Select the option that best describes the situation for applications you described above. When responding on behalf of a group of organisations, choose the option that is most representative of the covered companies.

- [ ] Permanent closure of business or parts of it (including relocation outside EU)
- [ ] Temporary closure of business or parts of it (including relocation outside EU)
- [x] Continued operations with increased costs or lower quality
- [ ] Positive impact (e.g. business opportunity)
- [ ] No impact or minor impact

2.165 **[Q1.26]** What is the average annual gross profit in euros, based on the past three years, from business operations that depend on this PFAS use/application in the EEA?

The figure should include only profits for the organisation you are reporting for i.e. the reported profits should not include profits of any clients or other parties in the supply chain, as those are considered separately.

Report a value covering all applications you described in the response above. When responding on behalf of multiple companies, report a total value for all concerned companies.

Profits generated by companies outside the EEA should not be included.

€ / year

2.166 **[Q1.27]** If PFAS could not be used in this use/application, how many full-time equivalent (FTE) jobs would be lost in your organisation or the companies covered by your response within the EEA?

Consider a situation where PFAS could not be used in this use/application by you or your competitors (including articles imported from outside the EEA).

Report a value covering all applications you described in the response above. When responding on behalf of a group of companies, report a total value for all covered companies.

FTEs

2.167 **[Q1.28]** Please clarify how you have calculated your responses in the two previous questions above on profits and employment losses.

Text of 1 to 2000 characters will be accepted

Clarify your calculations and name any sources you may have used.

We are unable to produce exact numbers for FTEs lost and loss in annual gross profit. District heating companies have obligations to deliver heat to their customers; the heat is provided by several technologies. Heat pumps represent a large part of this activity. If PFAS restrictions limit the use of heat pumps the companies must turn to more expensive heat delivery, leading to reduced income, possibly change of staff and in the worst-case closure for pure heat pump-based district heating companies. District heating is important for efficient energy use and the green transition, but nevertheless district heating is not a very profitable business today. Regulations leading to increased costs may therefore worsen an already low profit in the companies, hindering investments and challenging continued heat delivery. The consequences can be fatal for some companies, where they do not have enough time to secure an appropriate refrigerant equivalent to the benefits PFAS have. Other companies might turn to other technologies such as electric boilers and increasing the pressure on the already tight power grid. By providing enough derogation time, companies have hope that the technical developments will become better and a more appropriate refrigerant equivalent to PFAS will be in place to make a secure transfer.

2.168 **[Q1.29]** If PFAS could not be used in this use/application, what is the magnitude of potential negative impacts on society, e.g. from lack of access or worse quality of products (in addition to impacts on employment and profit losses)?

Consider other societal impacts than profits or employment and indicate their expected magnitude.

Impacts are considered greater, for example, when they affect large populations or significantly reduce quality of life. There is no exact and objective definition of what constitutes each category -please provide your best estimate. This question is used to gauge the responses and SEAC will assess the impacts based on the information in the following question.

Do not include information on health and environmental impacts of PFAS itself.

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

2.169 **[Q1.30]** Please explain your response to question above, e.g. by describing the elements leading to your judgement on the magnitude of additional impacts. If possible, provide quantified or monetised estimates of the impacts.

2000 character(s) maximum

Describe additional negative impacts, such as changes in quality of life resulting from reduced availability or lower quality of products. It is sufficient to describe the impacts, but quantified or monetised estimated can also be provided.

Do not include information on health and environmental impacts of PFAS itself here, but in the general survey.

High-temperature heat pumps (HTHPs) using fluorinated refrigerants are critical for decarbonizing district heating. They replace fossil boilers and enable the use of low-temperature waste heat sources such as seawater, sewage, data centers, and industrial surplus heat, supporting national and EU climate targets.
In Norway, district heating delivers about 7 TWh annually to ~300,000 households, as well as commercial buildings and public institutions. Large-scale HTHPs are needed to raise low-grade heat (5–30 °C) to required network temperatures (70–120 °C).
If fluorinated refrigerants are restricted without viable large-scale alternatives, operators would need to rely on direct electric boilers, biooil peak-load, or biomass—all significantly more costly. Direct electric heating would triple electricity demand for the same output, straining already constrained Nordic grids and increasing costs for end users.
Refrigerants circulate in closed systems, with no emissions under normal operation, and large units have leakage monitoring. A PFAS ban in heat pumps would significantly impact district heating operation, while likely giving limited reductions in environmental PFAS.
Although operators aim to transition to natural refrigerants, these face major technical and regulatory barriers at >10 MW scale, including flammability, toxicity, strict permitting, and restrictions on underground installations common in Norway. A 5–10 year transition period is needed to allow technological development, regulatory adaptation, and investment planning without disrupting the shift to efficient renewable heating.

[08.02.02.02] Split systems of a rated capacity of more than 12 kW, except industrial uses

[08.02.02] Split air-conditioning equipment and heat pumps

[08.02] Air conditioning and heat pumps

* 2.182 **[Q1.19]** What is or are the process(es) or product(s) PFAS (or an alternative to PFAS) are used in? How and why are they used?

Text of 1 to 2000 characters will be accepted

Briefly describe how PFAS (or alternatives) are used in your uses or applications. This should include e.g. the function provided by PFAS and the type of part/article/product they are used in.

If your use is covered by the scientific research and development exemption from the restriction (Article 67(1) of REACH) please indicate so.

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.

* 2.183 **[Q1.20]** Do suitable alternatives exist for this use/application?

Suitable alternatives are those that are technically and economically feasible, safer for human health and the environment, and available in sufficient quantities.

- ( ) Yes
- (•) No
- ( ) I do not know

2.184 **[Q1.21]** What is the availability of alternatives for this use/application?

Select all options that apply in general for this use/application and provide an explanation of each point in the next question.

between 1 and 4 choices

Select the option that best describes the overall situation for application(s) you described above.

If your response concerns multiple applications, you can provide more detailed information for each application and its alternatives in the question below.

Option 6 is available for stakeholders who do not have information on the availability of alternatives.

- [ ] **1. Alternatives are not available due to insufficient quantities**: PFAS-free alternatives are not available in sufficient quantities for this use/application.
- [x] **2. Alternatives are not available because of safety concerns**: PFAS-free alternatives are not safer for human health or the environment.
- [x] **3. Alternatives are not available because of technical feasibility**: PFAS-free alternatives do not meet the functional requirements for this use/application.

- [x] **4. Alternatives are not available because of economic feasibility**: It is not possible to operate profitably using the alternatives.
- [ ] **5. None of the above - Alternatives are available**: There are suitable alternatives for this use/application. They exist in sufficient quantities, they are safer than PFAS, and they are technically and economically feasible.
- [ ] **6. No information on alternatives**

2.185 **[Q1.22]** Please give a justification for your responses above by providing an explanation for each of the four points. Make sure to name which specific application and alternative you are referring to:

1. **Sufficiency**: Are the alternatives available in a sufficient quantity for this use/application?

2. **Safety**: Are there concerns for risks on human health or the environment that could limit the substitution potential of alternatives?

3. **Technical feasibility**: Are there technical requirements for this use/application? How do potential alternatives perform against the requirements?

4. **Economic feasibility**: What is the impact of using the alternative on profitability? How much would switching to the alternative cost?

Text of 1 to 3000 characters will be accepted

Safety concerns
In densely populated areas, large quantities of flammable or toxic refrigerants pose significant challenges. Several large district heating (DH) heat pumps are located underground — e.g. Skøyen, Oslo (30 MW) and Sandvika (15 MW). Such locations are incompatible with flammable refrigerants under current regulations.
A report by Norsk Energi for Hafslund Oslo Celsio (2023) analyzed the regulatory framework for hydrocarbons in large Norwegian heat pumps. For 5–30 MW systems requiring 2,000–20,000 kg charge, Seveso III is triggered at 10,000 kg (QRA, DSB consent taking 3–6+ months, public consultation, land-use restrictions extending to neighboring properties). ATEX equipment and blast panels are mandatory. Norwegian regulations prohibit flammable gas storage below ground, with unresolved ambiguity for heat pump refrigerant circuits. For ammonia, toxicity requires exclusion zones constraining urban siting.
Natural refrigerants are viable in principle, but their safety profiles create substantial barriers in dense urban settings where DH heat pumps are most needed.
Source: Norsk Energi (2023), "Hydrocarbons as refrigerant in large heat pumps for district heating in Norway — Safety aspects, standards and regulations," Doc ID 36807-13.

In densely populated areas, large quantities of flammable or toxic refrigerants pose significant challenges. Several large DH heat pumps are located underground — e.g. Skøyen, Oslo (30 MW) and Sandvika (15 MW). Such locations are incompatible with flammable refrigerants under current regulations.
Technical feasibility
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."
Two independent Norwegian operators report that no ammonia supplier could offer sufficient operational reliability at the required capacity and temperature. Drammen District Heating's ammonia heat pumps are rated for 90°C but operate at 72–76°C for stable output — operational experience indicates significantly increased wear above 85°C. For CO2 heat pumps, return temperatures must stay below 40°C — incompatible with many networks at 50–70°C.
Source: IIR (2026), 61st Technical Brief; Norwegian DH operator survey (2026), 17 companies, 191 MW; Drammen District Heating (2026).
Economic feasibility
No published study quantifies the total cost differential between PFAS and natural refrigerants for MW-scale DH heat pumps.
This knowledge gap is significant. Without total-cost-of-ownership comparisons covering safety infrastructure, regulatory compliance, and reduced site flexibility, the assumption that alternatives are economically available lacks an adequate evidence base.

2.186 **[Q1.23]** How many years would it take to develop alternatives to a stage where they can be implemented for the use/application?

Only values of at most 20 are allowed

If you cover several applications in your response, provide an estimate that allows PFAS to be substituted in all of them.
If you cannot provide an estimate, do respond to the question.

5 years

2.187 **[Q1.24]** What is the total annual volume (tonnes) of PFAS used (or imported) for this specific use /application in the EEA?

Provide the annual volume (tonnes) for each type of PFAS used (or imported) in the EEA by your organisation, or by the organisations included in your response if reporting for a group. Do not include tonnages used outside the EEA.

	Annual volume of PFAS used	
Non-polymeric PFAS		tonnes/year
Polymeric PFAS		tonnes/year
Fluorinated gases	2	tonnes/year

2.188 **[Q1.25]** If PFAS could not be used in this use/application, what would be the most likely impact on organisation(s) covered by your response?

Maximum 1 selection(s)

Consider a situation where PFAS could not be used in this use/application by you or your competitors (including articles imported from outside the EEA).

Select the option that best describes the situation for applications you described above. When responding on behalf of a group of organisations, choose the option that is most representative of the covered companies.

- [ ] Permanent closure of business or parts of it (including relocation outside EU)
- [ ] Temporary closure of business or parts of it (including relocation outside EU)
- [x] Continued operations with increased costs or lower quality
- [ ] Positive impact (e.g. business opportunity)
- [ ] No impact or minor impact

2.189 **[Q1.26]** What is the average annual gross profit in euros, based on the past three years, from business operations that depend on this PFAS use/application in the EEA?

The figure should include only profits for the organisation you are reporting for i.e. the reported profits should not include profits of any clients or other parties in the supply chain, as those are considered separately.

Report a value covering all applications you described in the response above. When responding on behalf of multiple companies, report a total value for all concerned companies.

Profits generated by companies outside the EEA should not be included.

€ / year

2.190 **[Q1.27]** If PFAS could not be used in this use/application, how many full-time equivalent (FTE) jobs would be lost in your organisation or the companies covered by your response within the EEA?

Consider a situation where PFAS could not be used in this use/application by you or your competitors (including articles imported from outside the EEA).

Report a value covering all applications you described in the response above. When responding on behalf of a group of companies, report a total value for all covered companies.

FTEs

2.191 **[Q1.28]** Please clarify how you have calculated your responses in the two previous questions above on profits and employment losses.

Text of 1 to 2000 characters will be accepted

Clarify your calculations and name any sources you may have used.

We are unable to produce exact numbers for FTEs lost and loss in annual gross profit. District heating companies have obligations to deliver heat to their customers; the heat is provided by several technologies. Heat pumps represent a large part of this activity. If PFAS restrictions limit the use of heat pumps the companies must turn to more expensive heat delivery, leading to reduced income, possibly change of staff and in the worst-case closure for pure heat pump-based district heating companies. District heating is important for efficient energy use and the green transition, but nevertheless district heating is not a very profitable business today. Regulations leading to increased costs may therefore worsen an already low profit in the companies, hindering investments and challenging continued heat delivery. The consequences can be fatal for some companies, where they do not have enough time to secure an appropriate refrigerant equivalent to the benefits PFAS have. Other companies might turn to other technologies such as electric boilers and increasing the pressure on the already tight power grid. By providing enough derogation time, companies have hope that the technical developments will become better and a more appropriate refrigerant equivalent to PFAS will be in place to make a secure transfer.

2.192 **[Q1.29]** If PFAS could not be used in this use/application, what is the magnitude of potential negative impacts on society, e.g. from lack of access or worse quality of products (in addition to impacts on employment and profit losses)?

Consider other societal impacts than profits or employment and indicate their expected magnitude.

Impacts are considered greater, for example, when they affect large populations or significantly reduce quality of life. There is no exact and objective definition of what constitutes each category -please provide your best estimate. This question is used to gauge the responses and SEAC will assess the impacts based on the information in the following question.

Do not include information on health and environmental impacts of PFAS itself.

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

2.193 **[Q1.30]** Please explain your response to question above, e.g. by describing the elements leading to your judgement on the magnitude of additional impacts. If possible, provide quantified or monetised estimates of the impacts.

2000 character(s) maximum

Describe additional negative impacts, such as changes in quality of life resulting from reduced availability or lower quality of products. It is sufficient to describe the impacts, but quantified or monetised estimated can also be provided.

Do not include information on health and environmental impacts of PFAS itself here, but in the general survey.

High-temperature heat pumps (HTHPs) using fluorinated refrigerants are critical for decarbonizing district heating. They replace fossil boilers and enable the use of low-temperature waste heat sources such as seawater, sewage, data centers, and industrial surplus heat, supporting national and EU climate targets.
In Norway, district heating delivers about 7 TWh annually to ~300,000 households, as well as commercial buildings and public institutions. Large-scale HTHPs are needed to raise low-grade heat (5–30 °C) to required network temperatures (70–120 °C).
If fluorinated refrigerants are restricted without viable large-scale alternatives, operators would need to rely on direct electric boilers, biooil peak-load, or biomass—all significantly more costly. Direct electric heating would triple electricity demand for the same output, straining already constrained Nordic grids and increasing costs for end users.
Refrigerants circulate in closed systems, with no emissions under normal operation, and large units have leakage monitoring. A PFAS ban in heat pumps would significantly impact district heating operation, while likely giving limited reductions in environmental PFAS.
Although operators aim to transition to natural refrigerants, these face major technical and regulatory barriers at >10 MW scale, including flammability, toxicity, strict permitting, and restrictions on underground installations common in Norway. A 5–10 year transition period is needed to allow technological development, regulatory adaptation, and investment planning without disrupting the shift to efficient renewable heating.

[08.02.03] Refrigerants for maintenance and refilling of existing HVACR equipment

[08.02] Air conditioning and heat pumps

* 2.206 **[Q1.19]** What is or are the process(es) or product(s) PFAS (or an alternative to PFAS) are used in? How and why are they used?

Text of 1 to 2000 characters will be accepted

Briefly describe how PFAS (or alternatives) are used in your uses or applications. This should include e.g. the function provided by PFAS and the type of part/article/product they are used in.

If your use is covered by the scientific research and development exemption from the restriction (Article 67(1) of REACH) please indicate so.

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.

* 2.207 **[Q1.20]** Do suitable alternatives exist for this use/application?

Suitable alternatives are those that are technically and economically feasible, safer for human health and the environment, and available in sufficient quantities.

- ( ) Yes
- (x) No
- ( ) I do not know

2.208 **[Q1.21]** What is the availability of alternatives for this use/application?

Select all options that apply in general for this use/application and provide an explanation of each point in the next question.

between 1 and 4 choices

Select the option that best describes the overall situation for application(s) you described above.

If your response concerns multiple applications, you can provide more detailed information for each application and its alternatives in the question below.

Option 6 is available for stakeholders who do not have information on the availability of alternatives.

- [ ] **1. Alternatives are not available due to insufficient quantities**: PFAS-free alternatives are not available in sufficient quantities for this use/application.
- [x] **2. Alternatives are not available because of safety concerns**: PFAS-free alternatives are not safer for human health or the environment.
- [x] **3. Alternatives are not available because of technical feasibility**: PFAS-free alternatives do not meet the functional requirements for this use/application.

- [x] **4. Alternatives are not available because of economic feasibility**: It is not possible to operate profitably using the alternatives.
- [ ] **5. None of the above - Alternatives are available**: There are suitable alternatives for this use/application. They exist in sufficient quantities, they are safer than PFAS, and they are technically and economically feasible.
- [ ] **6. No information on alternatives**

2.209 **[Q1.22]** Please give a justification for your responses above by providing an explanation for each of the four points. Make sure to name which specific application and alternative you are referring to:

1. **Sufficiency**: Are the alternatives available in a sufficient quantity for this use/application?

2. **Safety**: Are there concerns for risks on human health or the environment that could limit the substitution potential of alternatives?

3. **Technical feasibility**: Are there technical requirements for this use/application? How do potential alternatives perform against the requirements?

4. **Economic feasibility**: What is the impact of using the alternative on profitability? How much would switching to the alternative cost?

Text of 1 to 3000 characters will be accepted

Safety concerns
In densely populated areas, large quantities of flammable or toxic refrigerants pose significant challenges. Several large district heating (DH) heat pumps are located underground — e.g. Skøyen, Oslo (30 MW) and Sandvika (15 MW). Such locations are incompatible with flammable refrigerants under current regulations.
A report by Norsk Energi for Hafslund Oslo Celsio (2023) analyzed the regulatory framework for hydrocarbons in large Norwegian heat pumps. For 5–30 MW systems requiring 2,000–20,000 kg charge, Seveso III is triggered at 10,000 kg (QRA, DSB consent taking 3–6+ months, public consultation, land-use restrictions extending to neighboring properties). ATEX equipment and blast panels are mandatory. Norwegian regulations prohibit flammable gas storage below ground, with unresolved ambiguity for heat pump refrigerant circuits. For ammonia, toxicity requires exclusion zones constraining urban siting.
Natural refrigerants are viable in principle, but their safety profiles create substantial barriers in dense urban settings where DH heat pumps are most needed.
Source: Norsk Energi (2023), "Hydrocarbons as refrigerant in large heat pumps for district heating in Norway — Safety aspects, standards and regulations," Doc ID 36807-13.

In densely populated areas, large quantities of flammable or toxic refrigerants pose significant challenges. Several large DH heat pumps are located underground — e.g. Skøyen, Oslo (30 MW) and Sandvika (15 MW). Such locations are incompatible with flammable refrigerants under current regulations.
Technical feasibility
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."
Two independent Norwegian operators report that no ammonia supplier could offer sufficient operational reliability at the required capacity and temperature. Drammen District Heating's ammonia heat pumps are rated for 90°C but operate at 72–76°C for stable output — operational experience indicates significantly increased wear above 85°C. For CO2 heat pumps, return temperatures must stay below 40°C — incompatible with many networks at 50–70°C.
Source: IIR (2026), 61st Technical Brief; Norwegian DH operator survey (2026), 17 companies, 191 MW; Drammen District Heating (2026).
Economic feasibility
No published study quantifies the total cost differential between PFAS and natural refrigerants for MW-scale DH heat pumps.
This knowledge gap is significant. Without total-cost-of-ownership comparisons covering safety infrastructure, regulatory compliance, and reduced site flexibility, the assumption that alternatives are economically available lacks an adequate evidence base.

2.210 **[Q1.23]** How many years would it take to develop alternatives to a stage where they can be implemented for the use/application?

Only values of at most 20 are allowed

If you cover several applications in your response, provide an estimate that allows PFAS to be substituted in all of them.
If you cannot provide an estimate, do respond to the question.

5 years

2.211 **[Q1.24]** What is the total annual volume (tonnes) of PFAS used (or imported) for this specific use /application in the EEA?

Provide the annual volume (tonnes) for each type of PFAS used (or imported) in the EEA by your organisation, or by the organisations included in your response if reporting for a group. Do not include tonnages used outside the EEA.

	Annual volume of PFAS used	
Non-polymeric PFAS	0	tonnes/year
Polymeric PFAS	0	tonnes/year
Fluorinated gases	2	tonnes/year

2.212 **[Q1.25]** If PFAS could not be used in this use/application, what would be the most likely impact on organisation(s) covered by your response?

Maximum 1 selection(s)

Consider a situation where PFAS could not be used in this use/application by you or your competitors (including articles imported from outside the EEA).

Select the option that best describes the situation for applications you described above. When responding on behalf of a group of organisations, choose the option that is most representative of the covered companies.

- [ ] Permanent closure of business or parts of it (including relocation outside EU)
- [ ] Temporary closure of business or parts of it (including relocation outside EU)
- [x] Continued operations with increased costs or lower quality
- [ ] Positive impact (e.g. business opportunity)
- [ ] No impact or minor impact

2.213 **[Q1.26]** What is the average annual gross profit in euros, based on the past three years, from business operations that depend on this PFAS use/application in the EEA?

The figure should include only profits for the organisation you are reporting for i.e. the reported profits should not include profits of any clients or other parties in the supply chain, as those are considered separately.

Report a value covering all applications you described in the response above. When responding on behalf of multiple companies, report a total value for all concerned companies.

Profits generated by companies outside the EEA should not be included.

€ / year

2.214 **[Q1.27]** If PFAS could not be used in this use/application, how many full-time equivalent (FTE) jobs would be lost in your organisation or the companies covered by your response within the EEA?

Consider a situation where PFAS could not be used in this use/application by you or your competitors (including articles imported from outside the EEA).

Report a value covering all applications you described in the response above. When responding on behalf of a group of companies, report a total value for all covered companies.

FTEs

2.215 **[Q1.28]** Please clarify how you have calculated your responses in the two previous questions above on profits and employment losses.

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2.216 **[Q1.29]** If PFAS could not be used in this use/application, what is the magnitude of potential negative impacts on society, e.g. from lack of access or worse quality of products (in addition to impacts on employment and profit losses)?

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Impacts are considered greater, for example, when they affect large populations or significantly reduce quality of life. There is no exact and objective definition of what constitutes each category -please provide your best estimate. This question is used to gauge the responses and SEAC will assess the impacts based on the information in the following question.

Do not include information on health and environmental impacts of PFAS itself.

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

2.217 **[Q1.30]** Please explain your response to question above, e.g. by describing the elements leading to your judgement on the magnitude of additional impacts. If possible, provide quantified or monetised estimates of the impacts.

2000 character(s) maximum

Describe additional negative impacts, such as changes in quality of life resulting from reduced availability or lower quality of products. It is sufficient to describe the impacts, but quantified or monetised estimated can also be provided.

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3 Confidentiality and submission

3.1 **[Q1.32]** 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. Please note that some questions may be only visible depending on the response to another question.

- [ ] Respondent background information
- [ ] Information on use, sub-use, and application

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

Privacy Statement

Contact

https://comments.echa.europa.eu/comments_cms/Contact_REACH.aspx