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Consequences of proposal for a restriction of PFAS for district heating and cooling and electricity sector

Finnish Energy is a branch organisation for the industrial and labour market policy of the energy sector. It represents companies in Finland that produce, procure, distribute, and sell electricity, gas, district heating and district cooling and related services energy and other services. Finnish Energy proudly represents its members and their ambitious climate targets. Please note the latter part for Finland specific impacts. Document also refers to answer submitted by Norwegian District Heating Association which includes referred Norwegian annexes.

<u>The Nordic District Heating and Energy Associations</u>

- Oppose the timeline for a ban on PFAS classified F-gases that are used in district heating and cooling, as there is currently no technological or economical viable drop-in alternative available on the market, able to deliver near 100% availability and the temperature ranges needed in most Nordic district heating networks.

- Underline that an immediate ban on the usage of PFAS classified F-gases in existing and new installations, could lead to a switch away from heat pumps in district heating and cooling networks towards less efficient electric and fossil boilers, as well as making it harder to make use of excess heat sources in society, with the accompanied negative socio-economic, environmental and climate effects this would have. This could hamper further electrification of society, as district heating and cooling networks, currently play an important role in freeing up electricity for other purposes. This development would therefore be contrary to the goals set out by the Energy Efficiency Directive and the larger EU strategies, such as the European Green Deal, the RePowerEU and the Green Deal Industrial Plan, as well as the upcoming EU Heat Pump Action Plan.

- Emphasize that the district heating and cooling sector has a long tradition for adhering to the strictest environmental and climate regulations and is well-positioned to safely handle refrigerants containing PFAS. Many of our members already have strict monitoring systems in place, which we believe should be replicated where possible in a customized way.

<u>For existing heating and cooling installations,</u>

- We consider the proposed 12 years derogation for “Maintenance and refilling of existing HVACR equipment put on the market before [18 months after EiF] and for which no drop-in alternatives exist” as a minimum derogation period. Most industrial installations have up to 50 years lifetime and replacing them too early will have negative environmental and economical effects for both consumers and society.

- We strongly recommend instead, the derogation period to be extended for the remaining lifetime of existing installations, as long as operators can prove to have strict customized PFAS leakage monitoring systems is in place to avoid PFAS leakages from district heating and cooling installations.

- Propose that derogation permits must be granted and supervised by a competent authority and renewed every 12 year, on the condition that there is sufficient evidence that drop-in alternative solutions are not available during the next derogation period.

For new district heating and cooling installations, we

- Strongly recommend, due to the non-existence of technically and economically feasible alternatives, a 12-year derogation followed by an independent review and a possible prolongment, in order to give investors some regulatory certainty and not slow down the transition away from fossil heating and cooling in Europe.

- Emphasize the need for a level playing field in the heating and cooling market. The proposed unlimited time derogation for heating, ventilation, air conditioning, and refrigeration (HVACR) equipment installed in buildings, will create a market distortion in favour of less societal beneficial and decentralised heating and colling solutions. This must be avoided, and the derogation therefore also needs to be valid for industrial district heating and cooling installations placed both in urban areas and industrial complexes.

<u>Finally, we would like to underline that we</u>

- Understand ECHA's ambition for a group ban on PFAS classified substances, due to its simplicity compared to independently regulating each substance.

- Believe that future heat pump installations and chillers in district heating and cooling should be built with natural or other sustainable refrigerants. However, we know from our members' experiences that more research and development is necessary to make this happen.

- Agrees that the use of scientifically proven dangerous PFAS substances must be minimized and in the long run completely phased out. Only applications that lack viable technical and economical alternatives, and are critical to society, shall be permitted in a transitional period.

Background

The authorities in Sweden, Denmark, Norway, Germany, and the Netherlands have developed a joint and broad restriction proposal for PFAS within the EU/EEA under the European REACH regulations. According to the proposal the use of PFAS substances must be minimized and in the long run completely stopped. Only uses that lack alternatives and are critical to society shall be permitted. A broad restriction of PFAS is expected to enter into force in 2025 at the earliest.

Three proposals are being discussed, partly a full ban after 18 months or an alternative with a phase-out over a longer period (5 or 12 years) with transitional rules. The ban covers PFAS occurring as a single substance, as components of another substance, or as a mixture in a product. As a consequence of the proposal, the presence of PFAS in many applications for electricity grids, production of electricity as well as common refrigerants in district heating and cooling, with both high and low GWP, would be banned.

Whilst Finnish Energy supports strong ambition to protect the nature from harmful PFAS substances, we kindly ask to note harmful impacts this ban would cause on district heating and cooling and electricity sector. The proposed PFAS restriction must differentiate between unnecessary PFAS use with large emissions (non-essential and short-lived products and applications), versus essential industrial use of long-life products and solutions with low emissions. The restriction should also differentiate between PFAS applications for which alternatives already exist and PFAS applications for which there is currently no alternative available and for which specific derogations are needed. This is in line with the article 68 in REACH regulation, which states that any new restriction "must take into account the socio-economic impact, including the availability of alternative solutions".

For <u>essential industrial use of long-life products and solutions</u> assess and legislate how to minimize and eliminate the environment and health impacts by avoiding, collecting, and destruction of leakages.

A heat pump for large-scale production of district heating and cooling has high availability, no to little refrigerant leakage, is well-monitored and has a long lifetime, up to 50 years if well maintained (see annex Norway 2).

As there are currently no viable alternatives for these Nordic district heating systems, a potential ban on PFAS based refrigerant blends could jeopardise the last decades' work, by moving more of the heat production towards less efficient and climate friendly fossil and electric boilers. Early retirement of existing equipment will also lead to a welfare loss for consumers, large additional costs and could endanger the profitability of district heating companies, who operate with low margins and long horizons when making their investments decisions.

A ban will furthermore create obstacles for Europe's nascent carbon capture and storage (CCS) industry, as projects in the bioenergy and waste-to-energy sector are planning to utilise the excess heat generated by the carbon capture process and feed it into the district heating system with the help of industrial-scale heat pumps.

This clearly goes against the recent goals and objectives set by the European Union. The REPowerEU Plan encourages frontloading investments in renewables and energy efficiency to reduce fossil fuel imports as well as doubling the current deployment rates of heat pumps in buildings. It also calls for faster deployment of large district heating and cooling network heat pumps. To make this possible, the Commission has announced a Heat Pump Action Plan, which aims to accelerate heat pump deployment and markets in the EU. The European Commission has also promised an EU CCUS Strategy to be presented in Q4 2023 and it is important that the PFAS regulation is developed with the EU Green Deal and these EU objectives in mind.

The Nordic District Heating and Energy Associations are ready to contribute to realizing the goals of REPowerEU, the future Heat Pump Action Plan and the EU CCUS strategy, but strongly believe that existing infrastructure investments need to be safeguarded, while working towards minimizing any potential PFAS leakages, and rolling out heat pumps across Europe.

The PFAS ban – Good intentions but based on the wrong assumptions

The Nordic District Heating and Energy Associations understand ECHA's ambition for a group ban PFAS classified substances, due to its simplicity compared to independently regulating each substance. We also agree that the use of scientifically proven dangerous PFAS substances must be minimized and in the long run completely phased out. Only applications that lack viable technical and economical alternatives, and are critical to society, shall be permitted in a transitional period.

We also agree to the ambition that future heat pump installations and chillers in district heating and cooling should be built with natural or other sustainable refrigerants. However, we know from our members' experiences, as well as through a thorough market screening and discussions with heat pump suppliers (see annex Norway 1), that more research and development is necessary to make this happen. There are also several safety challenges that would need to be overcome (more below and in annex Norway 4).

Contrary to the statements made by the reputable scholars, e.g. Hafner and Ciconkov[1] and the Heat Roadmap Europe[2], that natural cooling blends are easily technically and economically available in the market, we argue that this is not true for heat pumps operating in high temperature district heating grids, as the few large-scale heat pumps in operation with natural cooling blends suffers from regular break downs, high maintenance costs and struggles to deliver the required temperatures (see annex Norway 1). This means that the PFAS restriction proposal is built on misleading claims, and we believe that the ban can have severe and un-intended consequences for the necessary green European transition away from fossil fuel-based heating and cooling if it is implemented too quickly and before drop-in alternatives are in place.

Health and Safety

We acknowledge the concerns related to the spread of PFAS in society and would like to underline our commitment towards limiting potential leakages from our industry. Many of our members already have strict monitoring systems in place, which we believe should be replicated where possible in a customized way. Intensive work is already underway to change energy production for reduced climate impact, where existing phase-out requirements according to the f-gas regulation for refrigerants are considered.

We are also certain that the Nordic district heating and cooling industry is more well-positioned to efficiently take measures aimed at secure management of PFAS substances, compared to many other sectors, which do not operate in the same controlled environment as we do. Seen from a socio-economic perspective, we therefore believe that measures for the phase out of PFAS should primarily and in the shorter term be aimed at the industries and areas of the use that account for the largest refrigerant leakage and emissions. For the reasons listed in the document and the attached annexes, the energy sector needs a sufficiently long adjustment, minimum 12 years, period to have the opportunity to reach the climate goals in a sustainable way while harmful substances such as scientifically proven dangerous PFAS are being phased out.

Another important consideration is that HFC/HFO fluorinated gases (F-Gases) as refrigerants are fully contained and function in closed loop systems. Their emissions are subject to rigorous obligatory

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1 Current state and market trends in technologies with natural refrigerants. Hafner, Armin og Ciconkov, Risto. 2021.

2 Heat Roadmap Europe: Large-scale Electric Heat Pumps in District Heating. David, Andrei, et al. 2017.

containment RRMs (on leaks controls, end-of-life collection, and disposal, etc.), under the EU F-Gas legislation. According to the very first words of Article 1 of the F-Gas Regulation, its key objective is the same as that aimed by the Proposal - reduction of emissions, i.e.: “The objective of this Regulation is to protect the environment by reducing emissions of fluorinated greenhouse gases”. According to the European Commission, F-Gas legislation is an example of “European success story”.[1] Therefore, uses of HFC/HFO substances are already adequately controlled from the perspective of the main goal of the REACH restriction Proposal therefore a proposed restriction under REACH would be a case of double regulation.

Derogation periods
Existing installations
We consider the proposed 12 years derogation for “Maintenance and refilling of existing HVACR equipment put on the market before [18 months after EiF] and for which no drop-in alternatives exist” as a minimum derogation period. Most industrial installations have up to 50 years lifetime (see annex Norway 2) and replacing them too early will have negative environmental and economical effects for both consumers and society. Something which is also pointed out in the Annex XV report from ECHA (p. 124)[3].
We strongly recommend instead, the derogation period to be extended for the remaining lifetime of existing installations, as long as operators can prove to have strict customized PFAS leakage monitoring systems is in place to avoid PFAS leakages from district heating and cooling installations.
New Installations
As thoroughly explained in annex 1 Norway and reflected on in later part of the text, there are no existing technically and economically feasible alternatives to PFAS-based refrigerants today, able to operate in high temperature district heating grids. At the same time, national governments and the EU are betting on heat pumps as a key tool in the ongoing energy transition. It is therefore crucial that the potential PFAS ban, does not create uncertainty for companies that want to contribute to this endeavour by investing in large-scale industrial heat pumps, but who require long horizons to make a return on the investment.
Under RO2, two types of time-limited derogations are considered, five and twelve years. Based on the information provided in the following annexes to this consultation response, it is clear that there are no viable alternatives to PFAS based cooling blends. And while there are work ongoing to develop ammonia, CO_2, propane or Isobutane based solutions, it is not expected that these will be ready for a large-scale market roll-out within the next five years. Nor do they offer a drop in solution, as the large differences in molecular weight, and not least in thermodynamic properties, refrigerants such as ammonia, carbon dioxide or propane cannot simply be used in heat pumps designed for synthetic alternatives. Meaning that existing and fully functioning technical equipment would need to be replaced, even though it could have an expected remaining lifetime of up to 45 years (if installed just before the transition period begins).
It is obvious that no company would invest in technology it might be forced to retire after only five years of operation, and at the same time, there are no functioning technological alternatives. This could force companies to postpone investments until there are, potentially, technology on the market able to deliver the high temperatures required in the Nordic district heating grids, something which could put the energy and climate targets in danger and jeopardize the heat pump roll-out envisioned by the European Union.
Therefore, we propose at least a 12-year derogation period for new installations, followed by an independent review of available drop-in alternatives in the market. This would give investors some

[3] https://echa.europa.eu/documents/10162/f605d4b5-7c17-7414-8823-b49b9fd43aea

certainty for their investments, while keeping the pressure up to further develop natural drop-in cooling refrigerants. If there are no alternatives after 12 years, the derogation should be prolonged with 12 new years, in order not to slow down the transition away from fossil heating and cooling in Europe.

Time-unlimited derogation due to safety regulations

We support the proposed time-unlimited derogation for heating, ventilation, air conditioning, and refrigeration (HVACR) equipment installed in buildings where national building codes or safety regulations prohibit the use of alternatives. We have members in all countries operating district heating centrals in basements of a wide range of buildings, e.g. residential, hotels and offices where the use of natural cooling blends, could become a safety hazard (see annex Norway 4), even though existing rules and regulations do not directly forbid it. Existing energy centrals were specially designed to fit within the parameters of each individual building, and should be able to continue operate to the end of its lifetime, as there are no drop-in alternatives available and that replacing the retiring fully functional equipment before its end-date would lead to costs for both consumers and the environment.

It is important to note that this unlimited time derogation should not only be valid for HVACR equipment in buildings, but also for district heating and cooling centrals placed in urban and industrial complexes. If not, there is a risk that HFO chillers/heat pumps, in for example, office buildings can continue to use PFAS classed refrigerants, but the larger units placed at, or operated by, the utilities that are classified as industrial applications are forbidden to use the same refrigerant. This will create an uneven playing field in the heating and cooling market, favorizing stand-alone solutions over more societal beneficial solutions such as district heating and cooling.

We also risk jeopardising large district heating and cooling projects that are already in the pipeline and part of cities' decarbonisation strategies. For example, currently, our members are planning large investments in central urban areas, such as in energy centrals placed below city parks. As thoroughly explained in the report from Norsk Energi (annex Norway 4), these centrals will also be subject to numerous national and EU safety directives in-directly limiting the possibility of using natural cooling blends, and without the same time-unlimited derogation as for equipment placed in buildings, these projects risk being scrapped or postponed. This is highly critical, as energy centrals need to be planned from the start when an area is developed, meaning that if a company is not able to make an investment decision at the right time, each building in the whole area the planned energy central was supposed to serve, would need to go for other more suboptimal energy solutions, such as stand-alone energy wells, electrical boilers and air conditions equipment.

How the ban will affect EU policy objectives

Currently, there are 17 000 DHC networks in the EU, covering 12% of the heating and cooling market. 70 million EU citizens are supplied by DHC networks, while 140 million citizens live in cities equipped with DHC. Based on national objectives and estimates from the sector to reach national energy and climate goals of selected countries, over 5 million additional households are expected to be connected to District Heating by 2030, while this number is expected to grow towards 2040 and 2050.

Heat pumps have been and will increasingly be the key for decarbonizing the European heating and cooling sector, both for independent buildings and large urban areas. Each building will need to make energy efficiency measures, such as better insulation, energy management and using its surfaces to produce energy. However, it is only district heating and cooling networks that is positioned to make use of excess energy sources such as heat from waste incineration, datacenters the sewage system and

sea water, as emphasized by the Norwegian Government-appointed Energy Commission[4]. Going forward, our members are also aiming at recovering heat from new industrial processes such as carbon capture and green hydrogen production. District heating and cooling is energy efficiency on a systemic scale, and therefore crucial for Europe to reach its decarbonization and climate targets.
The REPowerEU Plan encourages frontloading investments in renewables and energy efficiency to reduce fossil fuels imports as well as doubling the current deployment rates of heat pumps in buildings. It also calls for faster deployment of large district heating and cooling network heat pumps. To make this possible, earlier this year, the Commission announced a Heat Pump Action Plan, which aims to accelerate heat pump deployment and markets in the EU. It will include a partnership between the European Commission, Member States, the sector itself, financial institutions and training providers across the whole heat pump value chain; targeted communication and a Heat Pump Skills Partnership. It will also help focus the ongoing policy work and facilitate access to financing.

In the Forword to the 2023 DHC Insights & trends5, EU Energy Commissioner Kadri Simson writes that;

"The new rules established in the Energy Efficiency Directive will drive the decarbonisation of district heating and cooling and be a powerful vehicle for clean energy use in the sector.

Delivering on these objectives also requires sharply reducing energy use from new and existing buildings. The Renovation Wave Strategy set out measures aiming to at least double the annual energy renovation rate by 2030; and the ongoing revision of the EU regulatory framework on buildings will be an essential building block in decarbonising heating and cooling. It will increase the rate of renovation, modernise the building stock and allow strong synergies with heat pumps, district heating and other renewables".

The proposed PFAS restriction is putting all this at risk, despite its good intentions, by creating uncertainty for investors, possibly forcing early retirement of fully functioning heat pumps, as well as threatening the energy security in heat pump dependent countries such as the Nordics.

Annexes explained
In the annexes, you will find the following information regarding different aspects of the Nordic District heating and cooling systems, an overview of existing installations, technological and operational experiences, lifetime assessments of current installations and a risk assessment of natural cooling refrigerants.

Annex Norway 1: District Heating and Cooling in Europe
Annex Norway 2: Assessment of the technical lifetime of industrial heat pumps
Annex Norway 3: Overview of Norwegian district heating companies with heat pumps
Annex Norway 4: Risk- natural refrigerants in large heat pumps
Annex Finland: DHC in Finland, problems of the ban and impacts of the ban (**included within this document**)

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[4]https://www.regjeringen.no/contentassets/5f15fcecae3143d1bf9cade7da6afe6e/no/pdfs/nou202320230003000dddpdfs.pdf

[5] https://www.euroheat.org/policy/2023-dhc-insights-and-trends.html

Annex Finland

District heating and cooling in Finland

Strong growth of heat pump capacity expected during this decade

District heating is the most common way of heating in Finland with a market share of circa 45%. District heating has strong market position especially in urban areas. Heat pumps produced circa 1650 GWh of DH during 2021 which is about 4% of the produced district heating. Total heat pump capacity is roughly 270 $MW_{Thermal}$. Practically all heat pumps are running on synthetic refrigerants, predominantly R134a, R1234ze and R454b Currently largest heat pump fleets are located in Helsinki, Espoo and Turku with respective capacities being (123 $MW_{Thermal}$, 60 $MW_{Thermal}$ and 42 $MW_{Thermal}$). All three companies are extending their heat pump capacities with Helen and Fortum having the largest investment pipelines to heat pumps. For instance, Helen will atleast double their heat pump capacity from 2021 during the next couple of years as they have invested in more heat pump capacity with investments into a new 32 $MW_{Thermal}$ (commissioned during 2023) heat pump in an existing facility and to a new 90 $MW_{Thermal}$ facility (commissioned late 2025) utilizing waste heat from wastewater. Additionally, Helen is investing into a 14 $MW_{Thermal}$ air-to-water heat pump (commissioned during 2024-2025). Helen is also growing their waste heat utilization capacity from a local datacenter.

Fortum is also investing heavily into electrification of heating. Fortum has partnered up with Microsoft to build new mega scale data centers to Espoo and Kirkkonummi. Fortum has said that circa 40 % of district heat consumption in Espoo could be provided by waste heat from these data centers. This would equal to circa 1 TWh of heat which makes it one of the largest if not the largest waste heat utilization projects from data centers in the world. For instance, Fortum has currently 3 different projects of which two are pure air-to-water heat pumps and one is hybrid heat pump system utilizing air and waste heat as heat source. The total heating capacity of the planned heat pumps is over 30 $MW_{Thermal}$. Largest project is the heat pump planned to be in Kera is 20 $MW_{Thermal}$ This chapter focuses mainly on Kera-project. The key features of the Kera project are:

- Low-temperature district heat network in the area
- Modularity of the heat pump system
- Two-way heat trading

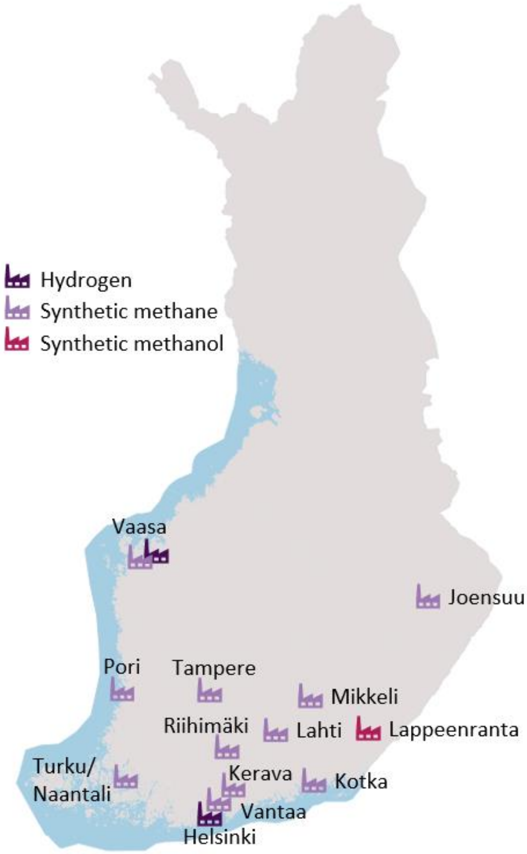
This project is particularly interesting as it is combined with building a new neighborhood with low-temperature district heat network. In addition to the low-temperature district heat network the Fortum is piloting a new kind of modular construction method that enables duplication and scalability for the needs of also other different sized and growing areas. The heat pump will also be used to supply the Espoo city district heat network as the heat pump is planned to have over capacity over the needs of the residential area. The planned solution allows and encourages two-way heat trading, in which 3rd parties can also be part of the energy solution of the area. For example, buildings can be cooled with a building-specific heat pump, from which the condensate heat generated can be used in the low-temperature network. The other larger air-to-water heat pump project has capacity of circa 11 $MW_{Thermal}$). Overall Fortum plans that circa 70% of the total heat demand in their network area would be covered mainly by heat pumps by 2030.

Other examples of heat pump projects are for instance from Savon Voima who owns multiple different networks and is planning to invest into heat pumps to most of them utilizing waste heat for instance from industries showing that heat pumps are a good option also in smaller networks.

Alholmens Kraft and Imatran Lämpö are investing in heat pumps to utilize waste heat from the forest industry. Lempäälän Lämpö is investing in a heat pump system and a sand battery. This pilot project is helping to pilot sand storages in district heating networks as a method to store heat. In Oulu waste heat from Nokia's office and test center is utilized in Oulu's DH network. Many members are also investing into waste heat utilization from wastewater with heat pumps such as Vaasan Sähkö, Lahti Energia, Seinäjoen Energia and Alva.

Additionally, hydrogen production provides an interesting opportunity for waste heat utilization with heat pumps. Based on existing plans of projects, hydrogen production could provide a few TWh of waste heat for Finnish district heating operators. Publicly announced projects and the green hydrogen derivatives of these projects are shown in **FIGURE** 1.

FIGURE 1 – PUBLIC PLANNED GREEN HYDROGEN PROJECTS THAT INCLUDE WASTE HEAT UTILISATION IN FINLAND



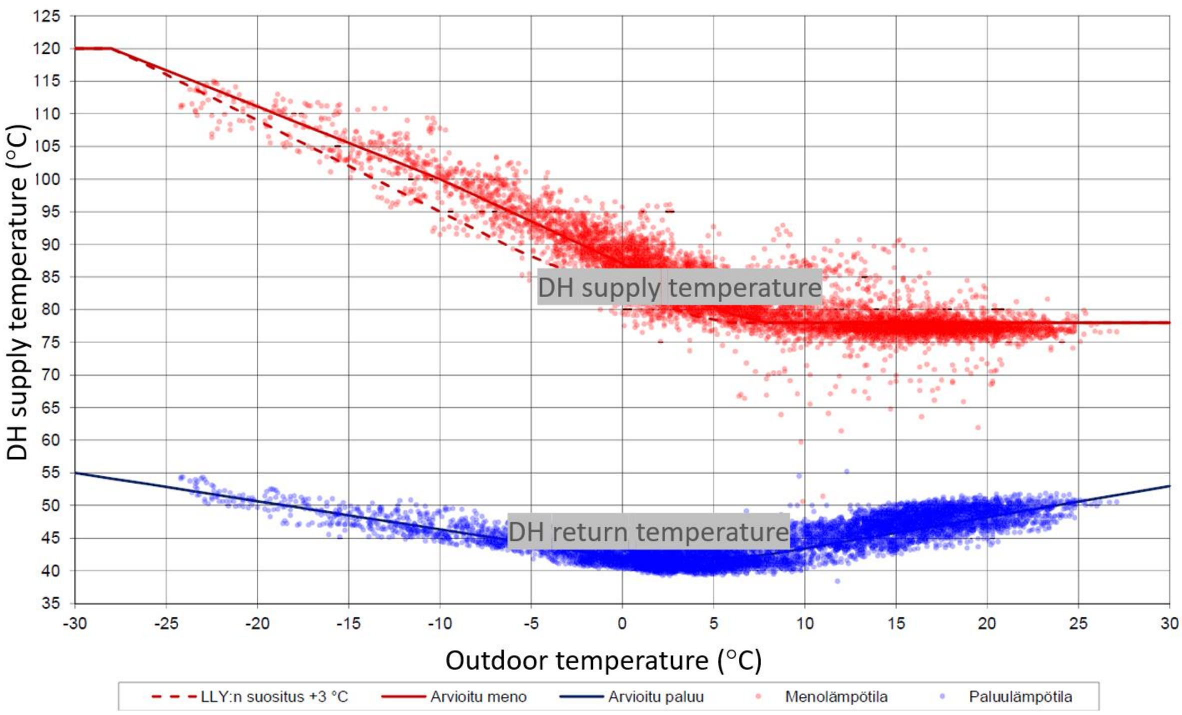
Source: Public sources

Overall, it can be concluded that electrification of district heating in Finland is on a great track. However, this extremely positive and important development can be endangered by the PFAS ban, since currently no suitable alternatives exist for synthetic refrigerants as elaborated in the following chapters.

General operational requirements for heat pumps in Finland

Finnish district heating networks are generally operated between 65-70 °C to 115 °C. Most of the heat demand is fullfilled around supply temperatures of 85 °C upwards, however the maximum temperature is rarely needed. Finnish Energy alongside our members have started to push down the flow temperatures so that in the future 90 °C would be the maximum needed temperature. The change requires switching the customer substations to ones that can transfer enough heat to buildings even on the coldest days. Additionally, the operation of the network will have to be improved to ensure that customers will get the heat they need at all times. The change does not happen overnight, and the lowering of the supply temperatures happens gradually, and it will vary between networks. Most networks should be quite close to 90 °C in 20-25 years. An example on current operating temperatures based on real data is given in Figure 2.

FIGURE 2 – DH SUPPLY AND RETURN TEMPERATURES IN A REAL NETWORK



Source: Finnish Energy

The supply temperature is one of the key technical challenges as this requires refrigerants to be able to function at higher temperatures (85+°C). Fortum used ammonia whilst testing a new heat pump unit producing DH from outdoor air. Based on their experience, ammonia can be used to produce heat to 90 °C. However, the system is barely able to reach this temperature and operating close to the maximum temperature with ammonia causes high wear for the equipment which increases maintenance costs significantly. The same problem exists with commercially available heat pumps using carbon dioxide as their refrigerant. One of our members, Riihimäen Kaukolämpö, has good experience with heat pumps using carbon dioxide as their refrigerant in a smaller separate network with small unit sizes. The key here is lower supply temperatures and small size; the pumps are used to supply heat at 80-85 °C and the units are small. As mentioned above these temperature ranges are not enough on most networks during heating season until the changes to the system have been made.

For higher temperatures our members have identified that transcritical carbon dioxide heat pumps could be a good alternative considering also safety and unit size requirements. However, there are currently no functioning reference facilities in Europe. More R&D and experiences must be done before solutions can be implemented on a larger scale. The current commercially available CO2 refrigerant heat pumps have small unit sizes as the compressors that can be used are small in size. The higher number of compressors increases the investment costs. Additionally, the high pressure of refrigerant also requires sturdier components and better materials which also increases the CAPEX. The COP of the heat pump also reduces if the return temperature is above 40 °C. In most DH networks the return temperature is most of the times higher than 40 °C. These problems would have to be solved before CO2 heat pumps are commercially ready for large-scale DH solutions.

District heating companies operate in urban areas and safety of people living in the area and the employees wellbeing is one of the core values of the DHC companies. Natural refrigerants, especially ammonia, but also others are problematic from this perspective. Some installations exist underground which poses additional challenges for safety considerations as complex ventilation systems will have to be developed in case an emergency occurs. It is also risky to store large amounts of ammonia in the city areas. For instance, in Helsinki, the city wants to close down a refrigeration system facility as it prevents, due to safety regulation, building of apartment buildings close by[6]. Significantly higher pressure levels with carbon dioxide also pose a safety hazard of its own.

Availability is one key parameter for heat pumps in DH. In Finland heat pumps run baseload which means when ever there is enough demand, the capacity is practically running at full load unless electricity prices are extremely high, as they occasionally were in 2022 indicating lack of electricity. Hence new solutions must be thoroughly tested before significant capacity increases can be done. Additionally, the refrigerant-solutions must not cause major problems to heat pump equipment as the installations must be able to run reliably.

For large facilities running on natural refrigerants, obtaining environmental permits may be necessary, prolonging project timelines and increasing costs. Safety considerations are especially crucial in urban environments. For example, building inspection authorities may (and have) require(d) leak simulation and comprehensive risk assessments, adding to costs.

CAPEX and OPEX impacts

One of the most significant challenges in transitioning to ammonia or other natural refrigerants is the investment costs. Switching to ammonia requires substantial investments compared to alternative refrigerants like R1234ze. This is because of two main reasons: retrofitting existing equipment that operates for instance on R134a with ammonia is not possible. Renewing practically the whole heat pump is costly. Additionally, the ammonia-based systems are physically larger and require bigger buildings. This significantly raises construction costs, and this is particularly problematic with existing installations, some of which are underground. Mining extra space is extremely expensive.

Another important aspect is the corrosive nature of ammonia in its environment. Even minor leaks can cause significant damage and shorten the lifespan of equipment, leading to higher operational costs.

Overall, the use of ammonia demands substantial investments in risk management and safety, significantly increasing overall costs.

In terms of completely new pumps in new areas, costs are a bit less significant component. However, it is good to note that retrofitting equipment is from cost perspective practically impossible in short term without a feasible drop-in alternative.

Other impacts of conversions and to new investments

Maintaining ammonia-based systems requires specialized expertise, and the availability of skilled personnel can be challenging particularly in the short to medium term. This increases maintenance costs and makes companies dependent on a limited workforce.

It is also important to note that switching refrigerants does not happen overnight. Considering the time it takes to do renovations, delivery time of equipment, and that renovations can’t all be done at the same time as capacity is needed for heat and cooling production it could take 15-20 years with larger heat pump fleet.

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[6] https://www.helsinginuutiset.fi/paikalliset/6218965

Leaks are already carefully monitored and prevented with maintenance

Refrigerant leaks are monitored using refrigerant leak sensors integrated into the process automation, which are installed in equipment rooms and, when necessary, in proximity to relief valve discharge pipes. Furthermore, flow meters are employed within the systems to ensure that relief valves do not release refrigerants. Additionally, maintenance conducts semi-annual inspections of refrigerant-containing equipment using separate measuring devices. Cooling centers and heat pump facilities are visually and sensory inspected every 48 hours. During these inspection rounds, any potential issues, such as oil leaks with a risk of refrigerant leakage, are detected as needed. Records of purchased and disposed refrigerants are meticulously maintained.

Impacts to the Finnish district heating and cooling system

Finnish Energy posits that, in the case of extant district heating and cooling plants and plants with pre-established investment commitments, a derogation period of a minimum of 12 years and a maximum equivalent to the remaining operational lifespan of the facility may be considered, provided there is ample substantiation that no alternative solutions are viable within the designated derogation timeframe. Substantial research and development efforts are imperative to identify natural or sustainable alternatives to PFAS-classified F-gases for district heating installations operating within higher temperature ranges. Ensuring future compatibility with natural refrigerants and guaranteeing the continued functionality of extant installations in accordance with their remaining technical and economic depreciation periods, which apply to the majority of existing district heating and cooling facilities in Finland, is paramount. It is advisable to safeguard the longevity of already commissioned and planned investments, contingent upon the installation of a rigorous monitoring system aimed at preventing any leaks. Inclusion of plants with concrete investment decisions is necessary, considering the huge pipeline of projects. If these plants are not included, could this result in a stalling of heat pump investments until feasible solutions are found.

Implementing shorter timeframes, such as an immediate ban or a 5-year derogation period, would lead to the shutdown of existing plants and the abandonment of established investment initiatives. Consequently, within the current decade, this would entail an increased reliance on fossil fuels and other combustion-based technologies. We believe that the adverse societal and environmental consequences of such actions would be substantial, far outweighing the advantages of banning synthetic refrigerants in district heating and cooling systems.

As elucidated earlier, leakages from district heating and cooling (DHC) installations are minimal, thanks to diligent professional maintenance and rigorous accounting practices. Therefore, we recommend putting the focus on further reducing these already small leakages through technological solutions, rather than opting for a ban on the usage of these substances. For the existing and planned district heating and cooling plants, we oppose the timeline for a ban on PFAS classified F-gases, for which there is no alternative available on the market. Instead, we suggest the strictest customized monitoring system to avoid leakage. Both small and large leakages must be quickly identified and stopped.

There are already technical solutions to minimise emissions into the atmosphere. As there is need of research and development to find natural or sustainable substitutes to the PFAS classified F-gases, it is required to ensure future solutions with natural refrigerants while guarantee operation of existing installations corresponding to the remaining technical and economic depreciation periods of the existing installations in district heating and cooling. Therefore, we argue that it is better to guarantee the lifetime of investments that are already commissioned, conditioned that a strict monitoring system must be installed to avoid leakage.

Electricity grids and production of electricity

Electricity networks DSOs, TSOs, industry and power stations need long testing periods before the introduction of new products into the network operation. These testing and piloting periods, that are part of the certification process of new products, are necessary to ensure a reliable and secure system and in some cases are expected to exceed the transition period proposed by the regulation.

A significant part of the electrical equipment in networks is designed with a lifespan over 40 years, given that proper maintenance and repairs are carried out regularly. Very often, spare parts needed must be of the same properties as originally designed, otherwise the technical performance of the whole installation might change. For the security of supply and the continuous expansion of electricity networks, essential for the integration of renewable energy sources, the possibility to repair existing and future installations is of utmost importance. This would also allow the reduction of waste and climate and environmental impacts until the completion of the entire lifespan of the plant or the equipment.

Need of consistent approach with the EU F-GAS Regulation

Fluorinated gases serve as insulating and switching agents in switchgear. While some PFAS-free alternatives exist for gas-insulated electrical switchgear under 145 kV, there are no ready-to-market PFAS-free products available for equipment above 145 kV, particularly for circuit breakers, and development in this voltage range seems limited with physical constraints making market maturity in the next 10-15 years unlikely.

At present, only one manufacturer can supply F-gas-free products to meet European switchgear requirements for the next decade or more regarding high voltage. Competitors have not shown any development strategy for non-PFAS, gas-insulated high-voltage switchgear in the European market.

With the ongoing energy transition to renewable energy and the necessity for substantial grid expansion, it would be an economic and political concern to have just one manufacturer dominate the switchgear market across Europe. There is a risk that this single manufacturer may not be able to meet the demand from all switchgear users in Europe, potentially leading to monopolistic conditions.

It is crucial to adopt a consistent approach with the EU F-GAS Regulation. Banning both SF6 and PFAS would require using solutions that demand physical space often unavailable in electricity distribution substations, especially in urban areas, offshore substations, and offshore converter stations. Derogations are necessary to allow the use of alternative F-gases to replace SF6 in these scenarios.

Set an adequate transition period for PFAS when an adequate alternative exists

PFAS is currently used in production of among others insulation materials, gaskets and coating, circuit breakers, wind turbine generators, nuclear power plants, fuel cells, electrolysers, and manufacturing of semiconductors. In some cases, there are alternative solutions while in many cases there are no alternative solutions on the market. It urges the experts and legislators to investigate extensively the compounds and equipment before deciding the regulatory regime and transitory delays to apply. There is need of an adequate transition period for PFAS when an adequate alternative exists.

Assess impacts on transition of energy production to renewables and EU's decarbonisation strategy

Both lithium-ion and Redox batteries use components with PFAS for their operation. The current PFAS proposal might severely impact the batteries' availability, which are necessary for the ecological transition and the decarbonisation processes of electricity production. At present, no alternative is foreseen to substitute these elements. A transitional period of at least 12 years will allow battery technology to be adapted and is necessary to achieve the ambitious objectives set up by the EU to deploy storage systems especially for production of electricity from renewable sources.