Nordic criteria for Green Public Procurement (GPP) for alternatives to high GWP HFCs

in refrigeration, air conditioning and heat pump (RACHP) products

Nordic Council of Ministers

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Foreword

The importance of Green Public Procurement, GPP, has increasingly been recognised by those who work to promote sustainable development. In the communication on Integrated Product Policy, IPP[1], the EU Commission encourages Member States to draw up publicly available action plans to improve sustainable public procurement. The Nordic Council of Ministers has stressed the importance of GPP in the strategy for sustainable development and has initiated various co-ordination efforts so that public buyers in all the Nordic countries can benefit from each other's experience.

A number of eco-criteria for specific product groups have been developed in different eco-labelling schemes. Eco-criteria are useful for public procurers in cases where environmental priorities need to be included in the tender procedure. However, there are still needs for expanding the range of GPP relevant products with eco-criteria.

Public procurement of products containing high GWP HFCs is relevant in a number of situations, e.g. tenders involving:

- Kitchen services/cantinas (stand-alone refrigeration, refrigeration systems or/ and walk-in cold stores)
- Building and construction (air condition and heat pumps)
- Hospitals (air conditioning and laboratory refrigeration)
- New white goods in public institutions, kinder gardens, schools etc. (stand-alone household fridges and freezers)
- Small air conditioners (split A/C) are placed in some public buildings and for some IT servers in public buildings.

Overall, the Refrigeration & Air Conditioning (RAC) sector in the Nordic countries contains large installed amounts of HFCs. According to a Nordic study, the total Nordic installed amount in 2018 is estimated to be approx. 43.5 million tons CO_2 eqv.[2] 16.7 million tons CO_2 eqv. are installed in stationary air condition, 13.8 million tons CO_2 eqv. are installed in medium and large refrigeration systems and commercial stand-alone appliances, and 0.6 million tons CO_2 eqv. are installed in stand-alone household appliances. A part of these installations are publicly procured. A Danish market study roughly estimates that approx. 10% are publicly owned installations.[3] The potential for reducing the CO_2 emissions through the GPP criteria is therefore to be considered substantial at a Nordic level.

A number of EU and national legal frameworks for reducing HFCs are already in force, but supporting GPP initiatives will contribute to accelerating the phase out of HFCs and to stimulating the market for further development of natural and more environmentally friendly alternatives.

In addition to applying regulative forces, Nordic and other countries can use their purchasing power as a tool to boost the market mechanism by directing public procurement according to e.g. environmental criteria for alternatives to high GWP HFCs.

1. Official link to EU IPP - https://ec.europa.eu/environment/ipp/
2. F-gas methodologies and measurements in the Nordic Countries, Tomas Sander Poulsen et al. Nordic Council of Ministers Tema report, 2019.
3. Kriterier for offentlige grønne indkøb af køleanlæg, DTI, Per Henrik Pedersen m.fl. Miljøprojekt nr. 1853, 2016, Miljøstyrelsen.

Some Nordic countries like Finland and Denmark have published their GPP criteria on alternatives to high GWP HFCs for certain RAC applications, but the whole sector is in a very dynamic technological transformation and a new wider approach is needed.

The project contributes with applicable GPP criteria for RAC products in several categories.

The project was conducted by the consultants Provice ApS and Danish Technological Institute and is supported by the Nordic working group for Chemicals, Environment and Health (NKE).

The steering group consisted of:

- Alice Gaustad, Norwegian Environment Agency
- Ditte Secher Paludan, Danish Environmental Protection Agency
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- Maria Ujfalusi, Swedish Environmental Protection Agency
- Tapio Reinikainen (chair) and Nufar Finel, Finnish Environment Institute
- Tomas Sander Poulsen, Provice
- Per Henrik Pedersen, Danish Technological Institute.

Objective and purpose

The overall objective of the project is to reduce emissions of high GWP HFCs by facilitating the technological transformation to environmentally friendly alternatives in the RAC sector through GPP.

The purpose of the project is to develop, publish and disseminate GPP criteria for environmentally friendly alternatives in the RAC sector in the form of a concise report and thereby support the updating of the Nordic Swan ecolabel criteria documents concerning refrigerant choice in different product sectors.

The real estate and cold chain sectors are very important in the Nordic countries. All houses need warming, some may need cooling in the summer, and transportation distances of food products can be very long. In light of this, implementations of RAC technologies are ubiquitous. The project aims to support these sectors to implement requirements raising from global, regional and national regulations on HFCs through information on the environmentally friendly alternatives that have little or no impact on the climate. The documentation and guidance produced by the project will be used to this effect when advising public procurement officers and even consumers in Nordic countries.

Summary

To assist contracting authorities in identifying and procuring low GWP RAC products, green procurement criteria have been developed for 25 product groups. The criteria can be directly inserted into tender documents.

The GPP criteria are based on screening data from a variety of sources, including supplier information and regulation, to determine the current technology stage for low GWP refrigerants and energy efficiency in different RAC product categories relevant for public procurement.

The procurement directives allow the procurer to include requirements regarding production or provision processes and methods in technical specifications for supply contracts. However, it is not allowed to insist upon a production process which is proprietary or otherwise only available to one supplier. The proposed GPP criteria for RAC products comply with the procurement directive requirements and do not favour single suppliers in the market.

The proposed GPP criteria also reflect the dynamics of achieving the best offer due to both environmental and economical preferences. The procurement criteria are structured in three levels:

- Exclusion criteria
- Selection criteria
- Award criteria.

Exclusion criteria

The exclusion criteria stipulate five comprehensive criteria focusing on F-gas and ODS compliance with EU legislation, national bans and illegal trade.

To be considered as bidder, the entity (individual companies or all companies in a consortium) should declare full legal compliance during the last three years with the regulations mentioned above.

Selection criteria

The selection criteria demand the minimum levels for the RAC products' environmental performance according to the lowest possible GWP of refrigerants.

The general principle is that the selection criteria seeks to exclude HFC refrigerants in RAC categories, where alternative low GWP or zero GWP refrigerants are approved in the market.

Based on the conducted technology screening, the overall conclusion is that almost all RAC product categories have applications with zero or low GWP refrigerants, which are appropriately represented by manufactures in the market.

It is easy for procurement entity and an effective sustainable choice when it is

possible to apply a GPP criterion where RACs with only natural refrigerants are allowed.

Depending on the particular RAC product category, two levels of selection criteria are proposed.

In cases where RAC products exist with natural refrigerants, the selection criterion is:

1. Only products with natural refrigerants (hydrocarbon, ammonia, CO2 or other natural refrigerants) will be selected.

The main objective is to achieve more green public procurement of low GWP RAC products, and by setting a GPP selection criteria threshold that excludes all HFCs and HFOs, where possible, it assures that only natural refrigerant RACs will be procured.

Compensations for lower energy efficiency are not relevant, when applying products with natural refrigerants because the state-of-art in RACs using natural refrigerants is an energy efficient at the same level as HFC based products and up to 20–30% more energy efficient.

In cases where RAC products do not exist with natural refrigerants but with various low GWP refrigerants based on HFCs and HFOs, the selection criterion is:

2. Only products using refrigerants with a GWP of 675 or lower will be selected.

This GPP criterion is relevant for the following product categories:

- Small and large split A/C (below/above 12 kW)
- Heat pumps up to 200 kW (air-water, air-air, air-brine).

For RAC product categories with no low HFC or HFO alternatives, selection criteria cannot be formulated, as it does not make sense to stipulate selection criteria for low GWP HFC refrigerants. From a GPP criteria perspective, the objective is instead to achieve the best possible environmental performance. This will be implemented through the *award criteria*.

This case is relevant only for the RAC product category *Roof top A/Cs.*

Award criteria

The purpose of the award criteria is to distinguish and favour the best environmentally performing RAC products that passes the selection criteria.

For evaluation purpose, the award criteria should be accomplished with a scoring model, e.g. points for best performance within each award criterion and with a lowest price.

A high weighting of price, e.g. a 50% weighting of total score or more, is commonly applied in such tenders. The result is that it has a major influence on the total scoring result. This highlight the fact that it is the *selection criteria* which should ensure that the proposed RAC applications are using zero or low GWP refrigerants.

If the selection criteria does not function as gatekeeper for the fundamental technology and refrigerant choice, there might be a risk that key environmental priorities are undermined when price issues are over-weighted in scoring models.

It should be noted, that HFC technologies in general have increased in price since HFC's have been affected by setting of steeply lowering quotas and subsequent quota-trading (from the EU F-gas regulation). Especially in 2018, the quota-trading effects have been visible in terms of price increase for high GWP HFC refrigerants. Combined with HFC taxes in some Nordic countries (Denmark and Norway), both investment costs and life cycle costs have increased considerably for owners of HFC based installations.

The award criteria related to environmental performance in the context of this project are considered as:

- GWP value of the refrigerant
- Energy efficiency
- Use of HFC as foam blowing agent in insulation.

A number of other environmental performance criteria could in principle also be included, e.g. material use, waste, lifetime, environmental management etc. But as the overall objective is to reduce the carbon footprint, it is proposed only to focus on the listed subjects above.

GWP of refrigerant

In product categories where natural refrigerants are not available, an alternative award criteria for measuring low GWP refrigerant must be applied. At the time of publication of this report, this award criterion is relevant for:

- Small and large split A/C below/above 12 kW (use among others R32)
- Heat pumps up to 200 kW, air-water, air-air, air-brine (use among others R32 and trend is propane)
- Roof top A/C (use R407C. No low GWP alternative so far).

For RAC products where natural refrigerants are not introduced, the award criterion is proposed with a highest score for:

- *Lowest GWP for refrigerant.*

The points can be awarded as follows:

- 100% of all points if the GWP of the refrigerant used is less than 150
- 50% of all points if the GWP of the refrigerant used is less than 675.

This award criterion does not distinguish between the use of HFCs and HFOs or combinations hereof. It only values the lowest GWP possible.

Energy efficiency

Energy efficiency is the second most important award criterion in the context of this project. Documentation of energy efficiency can basically be applied in two ways:

- Through the Energy Label
- Through energy efficiency documentation (Energy Efficiency Information (EEI) or similar expressions).

Both types of documentation are standardized in the EU Energy Label Regulations and the EU Ecodesign regulations or through ISO standards.

From the procurement perspective, scoring according to the Energy Label is easy and accurate. RACs covered by the Energy Label are:

- Professional stand-alone cabinets for refrigeration and freezing
- Professional refrigerated counters
- Commercial sales cabinets (from 1/3 2021)
- Household fridges and freezers
- Dry tumblers
- Split units below 12 kW
- Heat pumps up to 70 kW.

For these RAC products, the recommended award criterion for assuring best energy efficiency is:

- *Highest Energy Label.*

As additional information when products have the same Energy Label, EEI documentation should be provided, and the lowest value according to the annexes in the Energy Label Regulation should be awarded the highest score.

The award criterion for RAC products not covered be the Energy Label is:

- *Highest energy efficiency.*

Standardized EEI documentation should be provided, and the highest energy efficiency should achieve the highest score. While EEI documentation are uncertain to some degree an uncetaincy factor of 5% should be considered.

The reference to EEI can be applied for all remaining product categories, except for:

- Walk-in cold room (WICR)
- Remote blast chillers.

In case of WICR, there is no appropriate standard for calculating EEI. A simple method for assessing the energy efficiency is therefore the level of insulation thickness and the U-level[4] applied for the offered product. For assessing EEI of WICR, the documentation should be provided as thickness of PUR insulation walls, and the award criteria are:

- *Minimum 100 mm insulation thickness for freezer rooms with a lambda value of 0.023 W/mK or better (U-value of 0.23 W/m^{2}K or smaller);*
- *Minimum 80 mm insulation thickness for chiller refrigeration rooms with a lambda value of 0.023 W/K or better (U-value of 0.29 W/m^{2}K or smaller).*

It should be noted that insulation of the floor is as important as walls and roofs.

4. The U-value value shows, in units of W/m²·K, the ability of an element to transmit heat from a warm space to a cold space in a building, and vice versa. The lower the U-value, the better insulated the building element.

The standard *PREN 17432 Packaged refrigerating units for walk-in cold rooms – Classification, performance and energy consumption testing* offers testing methods to determine the energy efficiency of cold and frozen storage units used in WICR's.

In case of remote blast chillers and plug-in blast chillers, the method for calculating EEI is related to the products' volume and *amount of food (kg) cooled to a certain degree/kWh.* This method does not necessarily favour the best EEI, while manufactures can improve EEI by reducing the wall insulation to save more space. In case of blast chillers, it is therefore recommended not to include EEI as an award criteria. In practise, it means that the best offer will depend on price and eventually on HFC free insulation.

Use of HFC as foam blowing agent in insulation

An award criterion for HFC free foam is considered relevant. HFC-134a[5] is still used as blowing agent for foaming of insulation by some manufactures, and this production process causes substantial HFC emissions. For RAC products using insulation foam, the award criteria is:

- *HFCs (HCFCs, CFCs) are not allowed to be used as foam blowing agent.*

5. According to the EU F gas regulation, HFC-134a will be banned from 1 January 2023 in foam blowing.

Overview table with GPP criteria

The proposed GPP criteria for RACs are summarized in the table below.

Table 1: Proposed RAC GPP criteria.

Product category	GPP criteria	Status of alternatives
- Professional stand-alone cabinets for refrigeration and freezing. - Refrigerated counters. - Household fridges and freezers. - Condensed dry tumblers. *After 1/3 2021 Energy Label is introduced for:* - Commercial sales cabinets. - Stand-alone bottle refrigerators. - Refrigerated (bottle) automates). - Ice cream freezers.	<u>Exclusion criteria</u> *Comply with all five exclusion criteria.* <u>Selection criteria</u> *Only products with natural refrigerants (hydrocarbon, ammonia, CO_2 or other natural refrigerant).* <u>Award Criteria</u> Energy Efficiency: *Highest Energy Label.* HFC free foam: *No use of HFC (CFC/HCFC) as foam blowing agent.*	Only natural refrigerant + Energy Label
- Ice rink. - Air-based or water-based cooling products and high temperature process chillers. - District cooling, district heating (large heat pumps above 300 MW). - Chillers for air condition. - Server refrigeration, usually chillers for liquid refrigeration with calorifares. - Server refrigeration – switch cabinets. *Until 1/3 2021, when Energy Label is introduced for:* - Commercial sales cabinets. - Stand-alone bottle refrigerators. - Refrigerated (bottle) automates). - Ice cream freezers.	<u>Exclusion criteria</u> *Comply with all five exclusion criteria.* <u>Selection criteria</u> *Only products with natural refrigerants (hydrocarbon, ammonia, CO_2 or other natural refrigerant).* <u>Award Criteria</u> Energy Efficiency: *Highest energy efficiency.* Standardized EEI documentation should be provided, and the highest energy efficiency should achieve the highest score. HFC free foam: *No use of HFC (CFC/HCFC) as foam blowing agent.*	Only natural refrigerant
- Small walk-in cold room (WICR) up to 10 m^2.	<u>Exclusion criteria</u> Comply with all five exclusion criteria. <u>Selection criteria</u> *Only products with natural refrigerants (hydrocarbon, ammonia, CO_2 or other natural refrigerant).* <u>Award Criteria</u> Energy Efficiency: *For assessing EEI from WICR, the documentation should be provided as thickness of PUR insulation walls. The award criteria are:* *- Minimum 100 mm insulation thicknesses for freezer rooms with a lambda value of 0.023 W/mK or better (U-value of 0.23 W/m^2K or smaller).* *- Minimum 80 mm insulation thicknesses for chiller refrigeration rooms with a lambda value of 0.023 W/mK or better (U-value of 0.29 W/m^2K or smaller).* HFC free foam: *No use of HFC (CFC/HCFC) as foam blowing agent.*	

- Plug-in Blast cabinet chillers.	Exclusion criteria *Comply with all five exclusion criteria.* Selection criteria *Only products with natural refrigerants (hydrocarbon, ammonia, CO_2 or other natural refrigerant).* Award Criteria Energy Efficiency: *In case of remote blast chillers and plug-in blast chillers, the method for calculating EEI is related to the product volume and amount of food (kg) cooled to a certain degree/kWh. This method does not necessarily favour the best EEI, while manufactures can improve the EEI by reducing the wall insulation to save more space, it is therefore recommended not to include EEI as award criteria. In practise, this means that best offer will depend on price and eventually on HFC free insulation.* HFC free foam: *No use of HFC (CFC/HCFC) as foam blowing agent.*	
- Small split A/Cs below 12 kW. - Heat pumps up to 70 kW, air-water, air-air, air-brine.	Exclusion criteria *Comply with all five exclusion criteria.* Selection criteria *Only products using refrigerants with a GWP of 675 or lower.* Award Criteria Energy Efficiency: *Highest Energy Label.* HFC free foam: *No use of HFC (CFC/HCFC) as foam blowing agent.*	Lowest possible GWP for refrigerant + Energy Label
- Heat pumps 70–200 kW, air-water, air-air, air-brine (use a.o. R32 and the trend is propane). - Hospital low temperature freezers. - Heat recovery systems in large installations.	Exclusion criteria *Comply with all five exclusion criteria.* Selection criteria *Only products using refrigerants with a GWP of 675 or lower.* Award Criteria Energy Efficiency: *Highest energy efficiency. Standardized EEI documentation should be provided, and the highest energy efficiency should achieve the highest score.* HFC free foam: *No use of HFC (CFC/HCFC) as foam blowing agent.*	Lowest possible GWP for refrigerant
- Medium size and large walk-in cold room (WICR) above 10 m^2.	Exclusion criteria *Comply with all five exclusion criteria.* Selection criteria *Only products using refrigerants with a GWP of 675 or lower.* Award Criteria Energy Efficiency: *For assessing EEI from WICR, the documentation should be provided as thickness of PUR*	

	insulation walls. The award criteria are: *- Minimum 100 mm insulation thicknesses for freezer rooms with a lambda value of 0.023 W/mK or better (U-value of 0.23 W/m^{2}K or smaller).* *- Minimum 80 mm insulation thicknesses for chiller refrigeration rooms with a lambda value of 0.023 W/mK or better (U-value of 0.29 W/m^{2}K or smaller).* HFC free foam: *No use of HFC (CFC/HCFC) as foam blowing agent.*	
- Remote Blast chillers.	<u>Exclusion criteria</u> *Comply with all five exclusion criteria.* <u>Selection criteria</u> *Only products using refrigerants with a GWP of 675 or lower.* <u>Award Criteria</u> Energy Efficiency: *In case of remote blast chillers and plug-in blast chillers, the method for calculating EEI is related to the product volume and amount of food (kg) cooled to a certain degree/kWh. This method does not necessarily favour the best EEI, while manufactures can improve the EEI by reducing the wall insulation to save more space. It is therefore recommended not to include EEI as an award criteria. In practise, this means that best offer will depend on price and eventually on HFC free insulation.* HFC free foam: *No use of HFC (CFC/HCFC) as foam blowing agent.*	
- Large split A/Cs above 12 kW. - Roof top A/Cs (comfort refrigeration in offices, institutions etc.).	Exclusion criteria Comply with all five exclusion criteria. Selection criteria None. Award Criteria GWP value for refrigerant: Lowest GWP refrigerant. - 100% of all points if the GWP of the refrigerant used is less than 150. - 50% of all points if the GWP of the refrigerant used is less than 675. Energy Efficiency: *Highest energy efficiency.* Standardized EEI documentation should be provided, and the highest energy efficiency should achieve the highest score. HFC free foam: *No use of HFC (CFC/HCFC) as foam blowing agent.*	No low GWP alternatives

Sammenfatning

For at bistå offentlige indkøbere med at indkøbe RAC-produkter med naturlige kølemidler og lav-GWP-kølemidler er der udviklet grønne indkøbskriterier for 25 produktgrupper, som direkte kan indsættes i udbudsdokumenter.

GPP-kriterierne er baseret på screeningsdata fra en række forskellige kilder – herunder leverandørinformation og reguleringskrav. Dette grundlag er anvendt til at definere det aktuelle teknologiniveau for kølemidler og energieffektivitet i forskellige RAC-produktkategorier, der er relevante for offentlige indkøb.

Udbudsdirektivet gør det muligt for indkøberen at inkludere krav vedrørende produktions- eller leveringsprocesser og metoder i tekniske specifikationer for leveringskontrakter. Men det er ikke tilladt at insistere på en produktionsproces eller en produktteknologi, som favoriserer enkelte leverandører. De foreslåede GPP-kriterier for RAC-produkter i projektet opfylder udbudsdirektivet krav om ikke at favorisere enkeltleverandører på markedet. De foreslåede GPP-kriterier tager hensyn til dynamikken i at modtage det bedste tilbud – både i forhold til miljømæssige og økonomiske præferencer.

Indkøbskriterierne er struktureret i tre niveauer:

- Udelukkelseskriterier
- Udvælgelseskriterier
- Tildelingskriterier.

Udelukkelseskriterier

Udelukkelseskriterierne indeholder fem kriterier, der fokuserer på overholdelse af EU F-gas- og ODS-regulering, nationale forbud og illegal handel med HFC'er. For at komme i betragtning som budgiver skal virksomheden (individuelle virksomheder eller alle virksomheder i et konsortium) erklære at have overholdt de specificerede regler i de seneste tre år.

Udvælgelseskriterier

Udvælgelseskriterierne definerer minimumsniveauer for RAC-produkterne i forhold til lavest mulige GWP for de anvendte kølemidler. Det generelle princip er, at udvælgelseskriterierne udelukker produkter med HFC-kølemedier i RAC-kategorier, hvor alternative kølemidler er implementeret på markedet.

Baseret på den gennemførte teknologiscreening er den overordnede konklusion, at næsten alle RAC-produktkategorier har applikationer med nul eller lav-GWP-kølemiddel, som er passende repræsenteret på det nordiske marked. Det er både enkelt og effektivt, når det er muligt at definere en klar ramme for GPP, hvor kun RAC med naturlige kølemidler er tilladt.

Afhængigt af de konkrete RAC-produkter anvendes der to niveauer af udvælgelseskriterier. I tilfælde, hvor der findes produkter med naturlige kølemidler, er kriteriet:

1. Kun produkter med naturlige kølemidler (kulbrinter, ammoniak, CO2 eller andre naturlige kølemidler) kan udvælges.

Hovedmålet er at øge grønne indkøb af lav-GWP-produkter, og ved at definere et GPP-kriterie, der ekskluderer alle HFC'er og HFO'er, hvor det er muligt, sikres det, at kun produkter med naturlige kølemidler bliver anskaffet.

Det er ikke relevant med en vurdering af eventuel reduceret energieffektivitet, når man anvender produkter med naturlige kølemidler i stedet for HFC'er. Fakta er, at produkter med naturlige kølemidler er på samme niveau eller ofte op til 20-30% mere energieffektive end HFC-baserede produkter.

I tilfælde, hvor produkter ikke findes med naturlige kølemidler, men med forskellige lav-GWP-kølemidler baseret på HFC'er og HFO'er, er udvælgelseskriteriet:

2. Kun produkter, der bruger kølemidler med en GWP på 675 eller lavere kan udvælges.

Disse GPP-kriterier er relevante for følgende produktkategorier:

- Små og store split A/C'er (under/over 12 kW)
- Varmepumper op til 200 kW (luft-vand, luft-luft, luft-væske).

For RAC-produkter uden lav-GWP-HFC'er eller -HFO'er kan et udvælgelseskriterie ikke formuleres. Målet er i stedet at opnå bedst mulig miljøperformance på andre områder – f.eks. energieffektivitet. Dette håndteres derfor i forbindelse med tildelingskriterier. Denne situation er kun aktuel for produktkategorien Roof top A/C.

Tildelingskriterier

Formålet med tildelingskriterierne er at favorisere de mest miljøeffektive produkter, som opfylder udvælgelseskriterierne. Tildelingskriterierne evalueres typisk med en scoringsmodel – f.eks. point for bedste performance inden for hvert tildelingskriterium samt laveste pris.

En høj vægtning af pris – f.eks. 50% vægt af total score eller mere – anvendes ofte i offentlige udbud. Det betyder, at pris har en stor indflydelse på det samlede scoringsresultat. Derfor er det centralt, at det er *udvælgelseskriterierne*, der sikrer, at de tilbudte produkter er baseret på naturlige kølemidler eller lav-GWP-kølemidler.

Hvis udvælgelseskriterierne ikke fungerer som "gatekeeper" for det grundlæggende teknologivalg, kan der være risiko for, at miljøprioriteter bliver undermineret, når pris vægtes højt ved evaluering af tildelingskriterier.

Det skal bemærkes, at HFC-teknologier generelt – da HFC'erne er blevet påvirket af kvotehandel (fra EU's F-gasforordning) – er steget i pris. Især i 2018 har kvotehandelseffekterne været synlige med hensyn til prisstigning på høj-GWP HFC-kølemidler. Og kombineret med HFC-afgifter i nogle af de nordiske lande (Danmark og Norge) stiger både investeringsomkostninger og livscyklusomkostninger betydeligt for ejere af HFC-baserede installationer.

Kriterier for miljøperformance i forbindelse med dette projekts formål er:

- GWP-værdi for kølemiddel
- Energieffektivitet
- Brug af HFC som skumblæsemiddel i isolering.

Andre miljøperformancekriterier kunne i princippet også inkluderes – f.eks. materialebrug, affald, levetid, miljøstyring osv. Men eftersom det overordnede mål er at reducere bidrag til drivhuseffekten, foreslås det kun at fokusere på de ovenfor nævnte emner.

GWP for kølemiddel

I produktkategorier, hvor et naturligt kølemiddel ikke er tilgængeligt, skal der anvendes et tildelingskriterie, der favoriserer kølemidler med laveste GWP. Et tildelingskriterie for GWP-niveau er relevant for:

- Små og store split A/C'er under/over 12 kW (brug a.o. R32).
- Varmepumper op til 200 kW, luft-vand, luft-luft, luft-væske (bruger bl.a. R32, og trenden er propan).
- Roof top A/C (bruger R407C og har indtil videre ikke noget lavt GWP-alternativ).

For produkter, hvor naturligt kølemiddel ikke findes, foreslås et tildelingskriterie med den højeste score for:

- *Laveste GWP for kølemiddel.*

Point kan tildeles, som følger:

- 100% af alle point, hvis GWP for det anvendte kølemiddel er mindre end 150.
- 50% af alle point, hvis GWP for det anvendte kølemiddel er mindre end 675.

Dette tildelingskriterium skelner ikke mellem brug af HFC'er og HFO'er eller kombinationer heraf. Det prioriterer kun efter laveste GWP.

Energieffektivitet

Energieffektivitet er det næst vigtigste tildelingskriterie. Dokumentation for energieffektivitet kan foreligge på to måder:

- Gennem energimærket
- Gennem dokumentation om energieffektivitet (EEI eller lignende udtryk).

Begge typer dokumentation er standardiseret i EU's energimærkningsforordninger og EU's Ecodesign Direktiv eller gennem ISO-standarder. Fra et indkøbsperspektiv er en scoring i forhold til energimærket let og præcis. RAC produkter, der er dækket af energimærket, er:

- Professionelle fristående køleskabe og frysere
- Køleborde
- Kommercielle køleskabe (fra 1. marts 2021)
- Husholdningskøleskabe og frysere
- Tørretumbler
- Splitanlæg under 12 kW

- Varmepumper op til 70 kW.

For disse produkter er det anbefalede tildelingskriterie for at sikre den bedste energieffektivitet:

- *Højeste energimærke.*

Som supplerende information, når produkter har samme energimærke, skal EEI-dokumentation leveres, og den laveste værdi i henhold til bilagene i energimærkningsforordningen skal opnå den højeste score.

For produkter, der ikke er omfattet af energimærket, er tildelingskriteriet:

- *Højeste energieffektivitet.*

Tilbudsgiver skal levere standardiseret EEI-dokumentation, og højeste energieffektivitet får den højeste score. Henvisningen til EEI kan anvendes på alle resterende produktkategorier bortset fra:

- Kølerum (WICR)
- Blæsekølere.

For kølerum findes der ingen brugbar standard til beregning af EEI. En enkel metode til vurdering af energieffektiviteten er derfor isoleringstykkelse og U-niveau, der anvendes på det tilbudte produkt. Tildelingskriteriet er:

- *Minimum 100 mm isoleringstykkelse til fryserum med en lambda-værdi på 0,023 W/mK eller bedre (U-værdi på 0,23 W/m^{2}K eller mindre).*
- *Minimum 80 mm isoleringstykkelse til kølerum med en lambda-værdi på 0,023 W/ mK eller bedre (U-værdi på 0 ,29 W/m^{2}K eller mindre).*

Det skal bemærkes, at isolering af gulvet er lige så vigtig som vægge og loft.

Standarden *PREN 17432 Packaged refrigerating units for walk-in cold rooms - Classification, performance and energy consumption testing* indeholder testmetoder til at bestemme energieffektiviteten for emner opbevaret i WICR's.

For blæsekølere er metoden til beregning af EEI relateret til produktets volumen og mængde mad (kg) afkølet til en bestemt temperatur/kWh. Denne metode favoriserer ikke nødvendigvis den bedste EEI, da producenter kan forbedre EEI ved at reducere isoleringstykkelse for at få mere plads. Derfor anbefales det ikke at medtage EEI som tildelingskriterie her. I praksis betyder det, at det bedste tilbud vil afhænge af pris og HFC-fri isolering.

Brug af HFC som opskumningsmiddel

Et tildelingskriterium for HFC-frit skum betragtes som relevant. HFC-134a bruges stadig som blæsemiddel til opskumning af isoleringsskum af nogle producenter, og denne produktionsproces er en betydelig kilde til HFC-emission. For produkter, der bruger isoleringsskum, er tildelingskriterierne:

- *Ingen brug af HFC som skumblæsningsmiddel.*

1. Legal background

1.1. Regulation of F-gases

At the 28th Meeting of the Parties under the Montreal Protocol in Kigali, Rwanda, a global phase down of HFC refrigerants was decided (Kigali amendment 2016). In the negotiations leading up to the decision, the estimates on the current and future availability of alternatives to high GWP HFCs were presented in several TEAP (Technical and Economic Assessment Panel of the Montreal Protocol) reports throughout the amendment negotiations (2009–2016).

The EU Regulation 517/2014 on fluorinated greenhouse gases (F-gas regulation) is sufficient to implement the Kigali amendment of HFCs and it restricts the use of high GWP HFCs in certain applications and radically reduces the amounts of HFCs placed on the EU market.

Similar legislation is in place or planned also in many non-EU Nordic countries. Taxes and reduced availability of F-gases have led to strong increases in prices, which means that using alternatives can, in addition to environmental benefits, also lead to financial savings.

1.2. The legal framework for GPP

The legal framework for public procurement in the European Union is defined by the provisions of the Treaty on the Functioning of the European Union (hereafter the Treaty) and by the EU Procurement Directives[6] as interpreted by the European Court of Justice.

From an international perspective, the EU is bound by the conditions of the General Procurement agreement (GPA) of the World Trade Organisation (WTO) on fair international competition for public contracts. The GPA has 20 parties covering 48 WTO members including the 27 EU countries and UK. The agreement bans discrimination in the awarding of public contracts and lays down procedural rules.

The GPA 1994 is flexible on whether the contract should be awarded to the lowest offer or to "the most advantageous" tender on the basis of "specific evaluation criteria". The GPA 1994 does not give any examples on suitable award criteria; neither are there indications on what weight should be given to those criteria.

The later revision of GPA has made it more flexible to include environmental considerations in the tender process. Article X(6) of the revised GPA on technical specifications reads as follows: "A Party, including its procuring entities, may – for greater certainty – in accordance with this Article, prepare, adopt or apply technical specifications to promote the conservation of natural resources or protect the environment."

The later revisions of GPA emphazise that environmental concerns are allowed when

6. Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC.

determining the award criteria, According to article X(9) this provision stipulate "the evaluation criteria set out in the notice of intended procurement or tender documentation may include, among others, price and other cost factors, quality, technical merit, environmental characteristics and terms of delivery."[7]

Some Nordic Countries legislation, for example in Finnish legislation, environmental aspects are required to be taken into account in public procurement procedures in national procurement law.

EU Directives and national legislation govern public procurement. For smaller contracts under certain thresholds there is more flexibility in the awarding of these contracts, which are subject only to national rules and EU principles (Directive 2014/24/EU and Directive 2014/25/EU).

1.2.1. Sectorial legislation

Sector-specific EU legislation creates mandatory obligations for the procurement of certain goods and services, for example by setting minimum energy efficiency standards which must be applied.

Mandatory obligations currently apply in a number of sectors, amongst others:

- *Office IT equipment* – IT products purchased by central government authorities must meet the latest minimum energy efficiency requirements prescribed by the EU Energy Star Regulation (Regulation No 106/2008 on a Community energy efficiency labelling programme for office equipment).
- *Buildings* – Minimum energy performance standards apply to public buildings. These are set at national level based on a common EU methodology. From 1 January 2019, all new buildings occupied and owned by public authorities must be "nearly zero-energy buildings" (Directive 2010/31/EU on the energy performance of buildings (recast)). The Energy Efficiency Directive also sets mandatory requirements regarding renovation of public buildings and purchase or new rental agreements meeting minimum energy efficiency standards.

1.2.2. Public procurement procedures

Due to the Procurement Directive, four types of procurement procedures can be applied:

Open procedure: In an open procedure, any interested economic operator may submit a tender.

Restricted procedure: In the case of restricted procedures, any economic operator may request to participate, and only candidates invited to do so may submit a tender.

Negotiated procedure: In a negotiated procedure, the contracting authority consults the economic operators of its choice and negotiates the terms of the contract with them.

Competitive dialogue: A contracting authority may make use of the competitive dialogue for complex contracts if it is not able to define by itself the technical

7. The WTO GPA: Assessing the scope for green procurement, Marc Steiner, Government Procurement, Biores, vol 9, number 10, 2015.

solutions to satisfy its needs, or it is not able to specify the legal and/or financial make-up of a project. Large infrastructure projects would seem to lend themselves to this type of dialogue.

In the framework of the project concerning Nordic criteria for Green Public Procurement (GPP) for alternatives to high GWP HFCs in RACHP products and equipment, only open procedures and restricted procedures are relevant. Negotiated procedures and competitive dialogue are rarely used and mostly only in situations where a procurement entity request products or services that are not readily available in the marked yet.

1.3. Purchasing power of public procurement and possibilities of GPP related to alternatives of high GWP F-gases

GPP is defined in the European Commission's Communication "Public procurement for a better environment" as "a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life-cycle when compared to goods, services and works with the same primary function that would otherwise be procured."[8]

The 2014 Procurement Directives enable public authorities to take environmental considerations into account. This applies during pre-procurement, as part of the procurement process itself, and in the performance of the contract. Rules regarding exclusion and selection aim to ensure a minimum level of compliance with environmental law by contractors and sub-contractors.

Public purchasers can refer to a specific label or eco-label when laying down the environmental characteristics of the work, goods or services they wish to purchase. Public purchasers can consider all factors of the production process, provision or trading, even where such factors do not form part of the material substance of the product.

GPP can be a major driver for innovation, particularly in sectors where public purchasers represent a large share of the market. In the case of RACs, the public sectors' share of the market is not significant, and public purchasing powers impact as a driver for the general innovation within the RAC sector is limited, except in case of large heat pumps and ice rinks. However, there is a strong innovation in the RAC industry towards the use of natural refrigerants in all kind of RACs. This innovation is especially driven by the before mentioned F-gas regulations and the increased focus on climate actions towards all areas in the market. Besides, these criteria may as well be used by private companies.

1.3.1. EU GPP criteria

The EU has developed GPP criteria for a number of products and service groups, which are regularly reviewed and updated. The criteria are designed to be inserted directly into tender documents and include information on verification methods. Most of the criteria are available in all official EU languages[9]. At the time of writing,

8. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0400:FIN:EN:PDF, chapter 1.3, page 4
9. Link to EU GPP criteria documents: https://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm

the product and service groups covered are:

- Cleaning products and services
- Copying and graphic paper
- Combined heat and power (CHP)
- Office Buildings
- Electrical and electronic equipment in the health care sector
- Electricity
- Food and catering services
- Furniture
- Gardening products and services
- Imaging equipment
- Indoor lighting
- Office IT equipment
- Road design, construction and maintenance
- Sanitary tap ware
- Street lighting and traffic signals
- Textiles
- Toilets and urinals
- Transport
- Wall panels
- Wastewater infrastructure
- Water-based heaters.

1.4. EU framework of GPP

1.4.1. Relevant EU Directives and policies

Following is a list of EU Directives and policies, which constitute the legal framework for green public procurement of RACs in the EU.

Treaty on the Functioning of the European Union 2012/C 326/01: Provides the basis for EU procurement regulation and sets out fundamental principles.

Directive 2014/24/EU on public procurement and repealing Directive 2004/18/EC: Public sector procurement directive.

Directive 2014/23/EU on the award of concession contracts: Concessions directive (applies to both public and utilities sectors).

Europe 2020: A strategy for smart, sustainable and inclusive growth COM (2010) 2020: EU strategy which sets specific targets to be achieved by 2020. GPP is mentioned as one of the measures to achieve sustainable growth and in the Innovation Union, Resource-efficient Europe and Energy 2020 initiatives.

Public procurement for a better environment COM (2008) 400: Provides guidance on how to reduce the environmental impact caused by public sector consumption and how to use GPP to stimulate innovation in environmental technologies, products and services.

Staff Working Document accompanying COM (2008) 400 SEC (2008) 2126: Provides useful guidelines for public authorities on the definition and verification of

environmental criteria, tools for stimulating GPP and examples for a number of product groups. It also offers legal and operational guidance.

Closing the loop - An EU action plan for the Circular Economy COM/2015/0614 final: Identifies GPP as a key component of the circular economy, the need to address issues such as durability and reparability in GPP criteria, and for the Commission to support GPP implementation.

Pre-commercial Procurement: Driving innovation to ensure sustainable high-quality public services in Europe COM (2007) 799: Sets out a methodology for the procurement of research and development services that are exempt from the directives.

Directive 2012/27/EU on energy efficiency: The Energy Efficiency Directive requires central government authorities to only purchase highly energy efficient products, services and buildings. Annex III of the Directive sets out the approach which applies to each product/service sector.

Directive 2010/31/EU on the Energy Performance of Buildings: The EPBD provides indicators and thresholds for energy efficient construction, including future mandatory requirements for nearly zero buildings.

Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products: The Energy Labelling Directive requires certain products (e.g. air conditioners, dishwashers, lamps) to be labelled with a standardised energy class. These classes are currently subject to revision under a proposal from the Commission.

Regulation No 66/2010 on the EU Eco-label: The EU Ecolabel and EU GPP criteria are harmonised to the extent possible.

Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products (recast): The Ecodesign Directive provides the main EC framework for the development of environmental criteria for energy related products.

Directive 2012/19/EU on waste electrical and electronic equipment (WEEE): Directive providing for the separate collection, treatment and recovery of waste electrical and electronic equipment, and setting relevant design requirements.

Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS): Sets requirements for manufacturers, importers and distributors of electrical and electronic equipment regarding hazardous substances identified in the Directive, and rules regarding the CE marking.

Directive 2008/98/EC on waste (Waste Framework Directive): Sets the basic concepts and definitions related to waste management and lays down waste management principles such as the "polluter pays principle" and the "waste hierarchy".

1.5. GPP in Nordic countries

In the Nordic countries, there are different cross border initiatives to strengthening GPP. Some of them are on national and others are on capitol (e.g Scandinavian Green Procurement Alliance, see below) or municipality level. These platforms focus on information exchange and binding obligations or GPP within certain product groups, but could be expanded to other product categories as well, e.g. RACs. Some of the initiatives are mentioned below as examples.

1.5.1. The Nordic Swan Ecolabel[10]

The Nordic Swan Ecolabel was established in 1989 by the Nordic Council of Ministers as a voluntary Ecolabelling scheme for the Nordic countries. It is an effective tool to help companies that want to go ahead with sustainable solutions – and thereby enable consumers and professional buyers to choose the environmentally best goods and services available.

It is possible to obtain a certification with the Nordic Swan Ecolabel within 60 different product groups counting more than 200 different product types. At the moment, more than 25,000 different products are sold with the Nordic Swan ecolabel in the Nordic countries.

1.5.2. Nordic cooperation on guidelines for green public procurement

The Nordic Council of Ministries has initiated a number of Nordic projects concerning Green Public Procurement to assure development of GPP strategies in common direction with coordinated guidelines from various national experiences. The project *Nordic Guidelines – Green Public Procurement* aims to create a common understanding of the implementation of green public procurement policies in practice. The core activities in the project were national workshops held in each of the five Nordic Countries, with 20–30 attendants in each workshop. Participants included legal and environmental experts as well as procurers, suppliers and representatives from labelling and certification organisations. At each workshop, the same questions relating to ecolabels were discussed, enabling all representatives to give their views on how ecolabels should be used in public procurement.[11]

1.5.3. Scandinavian Green Procurement Alliance

In the project Scandinavian Green Procurement Alliance on Non-Road Mobile Machinery, capital cities of Copenhagen, Oslo and Stockholm work on lowering their carbon emission footprints[12]. This happened, among other ways, through a coordinated green public procurement process within non road mobile machinery, and the purpose is to ensure climate impact reduction, cost effectiveness and bring that knowledge out to other cities. By joining forces in the project, the cities are strengthening the cooperation between large cities across country borders.

10. Text edit from the official Nordic Ecolabel Home page https://www.nordic-ecolabel.org/the-nordic-swan-ecolabel/
11. Nordic Guidelines, Green Public Procurement, 2017 https://norden.diva-portal.org/smash/get/diva2:1087097/FULLTEXT01.pdf
12. https://www.usdn.org/cnca.html

1.5.4. National partnerships for Green Public procurement

In some of the Nordic countries, partnerships and/or networks for Green Public Procurement are established. These are collaborative efforts of public organisations, which are committed to make extra efforts in partnership with other organisations to reduce their environmental impact from their procurement actions and drive the market in a more sustainable direction.

The work of the Partnerships and networks are constructively and openly aimed at developing concrete procurement objectives that will make a difference to the environment, locally as well as globally. The procurement objectives usually constitute a guide for municipalities wanting to incorporate environmental requirements in their procurement practices and a forum for sharing knowledge and procurement solutions.

The Partnership is based on joint, mandatory procurement objectives. For example as a partner in the Danish partnership you are obliged to:[13]

- Follow jointly specified green procurement objectives
- Have a procurement policy in which environmental concerns play a significant part
- Publish the procurement policy on the respective authority's website.

1.5.5. KEINO

In Finland a network-based consortium, Competence Centre for Sustainable and Innovative Public Procurement (KEINO), consisting of several research institutes and public procurement organizations works towards the objectives set for public procurement – across all governmental levels in Finland. The centre's main objectives for 2018–2021 are that:

- the number of innovative and sustainable procurements in Finland increases;
- public procurement is recognised and actively used as a management tool;
- contracting entities openly disseminate information on their own experiences and learn from one another.

The value of the Finnish public sector's procurements is approximately EUR 35 billion annually, or on average 16% of the country's GDP.

13. www.gronneindkob.dk

2. Survey of RAC technologies

As a part of the preparation for formulating GPP criteria, the project has screened the current RAC market for determining the technology stages for applying low GWP and natural refrigerants in different RAC product categories. The objectives of the screening of RAC technologies were to:

- Define RAC product categories operational for green public procurement
- Assess stage of alternative low GWP and natural refrigerants
- Identify the RAC product categories included in the Energy label Directive
- Identify the RAC product categories included in the Ecodesign Directive
- Assess energy efficiency parameters and other environmental issues of relevance in relation to green public procurement

2.1. Overview of RAC product categories and screening result

Public procurement of RAC products is relevant in a number of situations, e.g. tenders involving:

- Kitchen services/cantinas (stand-alone refrigeration, refrigeration systems or/ and walk-in cold room);
- Building and construction (air condition and heat pumps);
- Hospitals (air conditioning and laboratory refrigeration);
- New white goods in public institutions, kinder gardens, schools etc. (stand-alone household fridges and freezers);
- Small air conditioners (split A/C) are placed in some public buildings and for some IT servers in public buildings;
- New energy infrastructure involving heat pumps.

The screening results are summarized below, and an overview table including references is provided in Annex 1. The screening results are based on official sources, e.g. Energy Label and EU Eco Design documents, standards, information from manufactures and existing knowledge. Results and links from Internet search are presented in Annex 2.

2.1.1. Professional Kitchens

For all professional kitchen RAC applications, natural or low GWP refrigeration can be applied.

Picture 1a: Professional storage cabinet, horizontal e.g. counters are widely used in professional kitchens.

Picture 1b: Professional storage cabinet, vertical.

Note: Traditionally professional storage cabinets are using HFC's (R134a or R404A) as a refrigerant, but during last decade they have been mostly replaces by HC's (R290). Significant amount of counters are connected in to the remote units typically using HFC/HFO blends as an interim solution. (Photo by Ari Kahrola/Porkka).

Table 2: Overview of alternatives for professional kitchens.

Professional kitchens	*Use*	*Description*	*HFC alternatives*
Small walk-in cold room (WICR) up to 10 m^2	Professional use for kitchens, cantinas etc. with remote rooms for cooling or freezing.	Integrated refrigeration system and mono-blocks or condensing units. There are four different types for up to 10 m^3 (fresh food) and up to "5 – 10 m^3" (frost).	Propane (R290). CO_2 (Condensing Unit). For future innovation IEC 60335-2-89:2019 allow flammable refrigerants to be used in a single circuit up to max. charge for R290 of 494 g and R600 up to 559 g.
Medium size and large walk-in room (WICR) above 10 m^2	Professional use for kitchens, cantinas etc. with remote rooms for cooling or freezing.	Mono-blocks or condensing units.	Condensing units with CO_2. Systems also use R452 (HFC/HFO blend GWP 2141). Also experiences with R32 (GWP 675) and HFO drop in. A Nordic manufacture introduces HC or CO_2 in 2020 in medium size WICR.
Plug-in Blast cabinet chillers	Stand-alone cabinet for quick refrigeration or freezing of food.	Integrated refrigeration system.	Propane (R290). For future innovation IEC 60335-2-89:2019 allow max. charge for R290 of 494 g.
Remote Blast cabinet chillers	Remote cabinet for quick refrigeration or freezing of food.	Condenses unit system.	CO_2 condensing units Low GWP refrigerants for smaller units (R448, R449, R452).
Professional stand-alone cabinets for chillng	Professional use for kitchens, cantinas etc.	All models.	Standard with propane (R290) and other Hydrocarbons (R600a).
Professional stand-alone cabinets for freezing	Professional use for kitchens, cantinas etc.	All models.	Standard with propane (R290) and other Hydrocarbons (R600a).
Refrigerated counters	Professional use for kitchens, cantinas etc.	All models.	Standard with propane (R290), and other Hydrocarbon (R600a).
Commercial sales cabinets: - Stand-alone bottle refrigerators - Refrigerated (bottle) automates - Ice cream freezers	Professional use for kitchens, cantinas, schools, hospitals etc. Some bottle refrigerators and ice cream cabinets are provided for free with commercial displays.	All models.	Propane (R290), Isobutane (R600a).

Energy Label exists for:

- Professional stand-alone cabinets for chilled food storage
- Professional stand-alone cabinets for frozen food storage
- Refrigerated counters.

Ecodesign is required for:

- Plug-in Blast cabinet chillers (only measurement required)
- Professional stand-alone cabinets for chilled food storage
- Professional stand-alone cabinets for frozen food storage
- Refrigerated counters.

Energy Label and Ecodesign introduced in 2021 for:

Commercial sales cabinets:

- Stand-alone bottle refrigerators
- Refrigerated (bottle) automates
- Ice cream freezers.

2.1.2. Household appliances

These appliances are used in all kind of public buildings. For all household appliances, natural refrigeration can be applied.

Picture 2: Household refrigerator.

Note: Household appliances do use mostly HC's, such as R600a. (Photo by Whirlpool).

Table 3: Overview of alternatives for household appliances.

Household appliances	Use	Description	HFC alternatives
Fridges	Schools, nursery, kindergartens, nursing homes, other public buildings and institutions.	All models.	Isobutane (R600a).
Freezers	Schools, nursery, kindergartens, nursing homes, other public buildings and institutions.	All models.	Isobutane (R600a).
Tumble dryers (condenser)	Schools, nursery, kindergartens, nursing homes, other public buildings and institutions.	Condenser tumble dryers only.	Smaller units using less than 150 grams of propane (R290) are in the market.

Energy Label exists for all product categories mentioned above.

Ecodesign is still required for:

- Fridges
- Freezers.

2.1.3. Hospital equipment

Picture 3: Medical refrigerator.

Note: Medical refrigerators are purpose built refrigeration appliances using mostly HC's (R600a and R290). For improved temperature accuracy they are equipped with plug-in units. (photo by Ari Kahrola/porkka).

Low GWP refrigerants exist for specialized low temperature freezers.

Table 4: Overview of alternatives for hospital equipment.

Hospital equipment	Use	Description	HFC alternatives
Specialized low temperature freezers	Used for laboratory purposes, plug-in systems.	All models.	Hydrocarbon blends with GWP below 5.
Specialized equipment	A range of hospital instruments and equipment has integrated refrigeration or ventilation, e.g. scanners and other electronic devices for monitoring, operation and care purposes.	Individual.	It is not recommended to set GPP criteria because functionality and safety requirements are the dominating consideration at procurement, and products are very individual.

No Energy Label or Ecodesign exist for RACs in hospital equipment.

2.1.4. Large public installations

Natural refrigeration alternatives exist for large public installations. Heat recovery system heat pumps are not yet available with propane, but they are assumed to be standard within a few years.

Picture 4. Ice rink.

Note: Photo by Kai Ylikangas.

Table 5: Overview of alternatives for large public installations.

Large public installations	Use	Description	HFC alternatives
Ice rink	Arenas for ice skating.		CO_2, R717 (Ammonia)
Heat recovery systems	Heat pumps.	Systems for heat ventilation (hot air and hot water).	None in the market, but general development trend is propane (R290) as refrigerant.
Air-based or water-based cooling products and high temperature process chillers	Probably not relevant due to GPP.		R290, Ammonia, CO_2.
District cooling, district heating (large heat pumps above 300 MW)	Large heat pumps for district heating. Large chillers for cooling, e.g. A/C in office buildings.	Large heat pumps above 300 kW.	HFO 1234ze, Ammonia, and R290 or other hydrocarbons.

Picture 5: District cooling in Vaasa Central Hospital.

Note: District cooling with ammonia as refrigerant. Photo by Heikki Viitamäki.

No Energy Label exist for this product category.

Ecodesign is still required for:

- Air-based or water-based cooling products and high temperature process chillers
- District cooling, district heating (large heat pumps above 300 kW) for chillers up to 2MW and heat pumps up to 400 kW.

2.1.5. Air conditioning

These appliances are used in all kinds of public buildings. Some natural refrigerants and low GWP HFCs are introduced. But roof top A/C has, so far, no low GWP alternatives.

Picture 6: Roof top A/C (chiller).

Note: The appliances use HFC 407C as refrigerant and there is no available low GWP alternatives so far. Photo by Teknologis Institute.

Table 6: Overview of alternatives for air conditioning equipment.

Air conditioning	Use	Description	HFC alternatives
Chillers	Comfort refrigeration in public buildings (offices, institutions etc.).	Chillers for liquid refrigeration with calorifares.	Ammonia, Hydrocarbons HFO.
Roof top (air-to-air air conditioner, driven by an electric compressor, of which the evaporator, compressor and condenser are integrated into a single package)	Comfort refrigeration in public buildings (offices, institutions etc.).	Medium to large size stationary A/C units with medium to large charge.	No HFC alternatives. Use R407C (GWP 1774).
Split units (small – below 12KW)	Comfort refrigeration with one inside part.	Direct refrigeration with individual control and regulation. Consists of one outside part and one inside part. Reversible unit for A/C and heat pumps.	Hydrocarbon alternatives in Asia. R32 introduced recently (GWP 675).
Split top (large – above 12 KW)	Comfort refrigeration where many inside parts are required, e.g. hotels and some office buildings.	Direct refrigeration with individual control and regulation. Consists of one outside part and one or more inside parts.	No HFC alternatives in Europe. Use R410A (GWP 2088). R32 introduced recently (GWP 675). No direct HFC alternatives, but system alternatives (e.g. chillers). Systems using an outdoor unit working on propane (R290) have been marketed, and the cooling and heating to e.g. hotel rooms is distributed with water.

Energy Label exists for small split units below 12KW.

Ecodesign is still required for all product categories.

2.1.6. Heat pumps

Only small air-water heat pumps exist with natural refrigerant in the European market. Other types of heat pumps can be applied with low GWP refrigerants. There is a strong development trend in introducing propane as a refrigerant and it is widely used in heat pumps in Asia already, but safety reasons are, so far, a constraint for market introduction in Europe.

Picture 7: Air-water heat pump.

Note: Photo by Teknologis Institute.

Table 7: Overview of alternatives for heat pumps.

Heat pumps	Use	Description	HFC alternatives
Heat pumps – water/air up to 1,5 kW domestic water	Used for domestic hot water heating in one-family houses or similar.		Propane (R290).
Heat pumps – water/air 4-12 kW radiators	Used for domestic heating in one-family houses.	Air/water heat pumps for heating with radiators.	Low GWP (R32). Propane is a trend for development.
Heat pumps – water/air 4-12 kW floor heating	Used for domestic heating in one-family houses.	Air/water heat pumps for floor heating.	Low GWP (R32). Propane is a trend for development.
Heat pumps – water/air + 12 KW	Used for domestic heating in larger buildings, e.g. schools and similar size public institutions.	Air/water heat pumps for floor heating or heating with radiators.	Low GWP (R32) and propane (R290) above 200kW.
Heat pumps – brine/water	Used for domestic heating in one-family houses.	Brine/water ground source heat pumps.	Low GWP.
Heat pumps – air/air (all sizes)	Used for domestic heating in one-family houses.	Air to air heating – 30 to 100 m^2 space.	No HFC alternatives in Europe (R410A). R32 introduced recently (GWP 675). Hydrocarbon alternatives in Asia.

Energy Label exists for all heat pumps (water-air and brine/water up to 70 kW).

Ecodesign is still required for all heat pumps (water-air and brine/water up to 400 kW).

2.1.7. Refrigeration of IT equipment

Natural refrigeration alternatives with substantially better energy performance are available for most sizes of server refrigeration.

Table 8: Overview of alternatives for refrigeration of IT equipment.

Refrigeration of IT equipment	Use	Description	HFC alternatives
Server refrigeration	Used for refrigeration of central server rooms etc.	Usually chillers for liquid refrigeration with calorifares.	Ammonia, Hydrocarbon CO_2.
Server refrigeration – switch cabinets	Used for refrigeration of central server rooms etc.	Switch cabinets. Usually chillers for liquid refrigeration with calorifares.	R718 (water), CO_2.

No Energy Label exists for this product category.

Ecodesign is still required.

3. GPP criteria and eco-labelling

3.1. General

At the national level, most EU Member States have now published GPP National Action Plans (NAPs), which outline a variety of actions and support measures for green or sustainable public procurement (SPP). Many have set targets for GPP or SPP, either in terms of overall procurement or for individual product and service groups. A number of countries and regions have also developed GPP or SPP criteria sets. In many cases, these are similar to the EU GPP criteria, with adjustments to reflect the particular circumstances or priorities of the authorities developing them, e.g. for the Nordic Swan label.

Most of the criteria sets rely upon life-cycle assessment (LCA) data when available, together with eco-labels and the references these are based upon.

3.1.1 Principles of public procurement

Public procurement is about matching supply and demand in order to deliver the goods, services and the work, which the public sector is responsible for providing. Value for money is clearly a key consideration as is the need to ensure a good level of competition and to respect the EU and national legal framework.

GPP can be combined with these objectives, and, in many cases, it will positively contribute to them – for example by reducing life-cycle costs or encouraging suppliers to update their product or service offer.

Contracting authorities have an obligation to get the best value for money for everything they procure. Identifying the most economically advantageous tender does not necessarily mean going only for the cheapest offer. It means finding a solution which meets the requirements identified – including the environmental ones – in the most cost-effective way. Best value not only measures the cost of goods and services, but also takes into account factors such as quality, service and efficiency. Protection of the environment is one of these factors and can therefore act as an equal consideration amongst others for the award of the contract.

The most important principles are the following:

Non-discrimination – contracting authorities must ensure equal access to the contract by operators from all EU countries and from countries with equivalent rights.

Equal treatment – comparable situations must not be treated differently, and different situations must not be treated in the same way, unless such treatment is objectively justified. For example, the same deadlines must be applied to all tenderers and the same information provided to each, but tenders with different levels of environmental performance should receive different marks under an environmental award criterion.

Transparency – tender opportunities must be advertised widely enough to ensure

competition. The procurement decision-making process must also be transparent to preclude any risk of favouritism or arbitrariness on the part of the contracting authority. Contracting authorities have the obligation to inform unsuccessful tenderers of the reasons for rejecting their tenders.

Proportionality – means that measures adopted in a procurement process should be appropriate to the objectives pursued and should not go beyond what is necessary to achieve them.

3.2. Ecolabels

Many environmental labels exist which aim to help purchasers identify sustainable products or services. The most valuable labels from a GPP perspective are those which are based on objective and transparent criteria and which are awarded by an independent third party. These labels can play a particular role in developing technical specifications and award criteria, and in verifying compliance.

The different types of environmental labels are outlined below:

Multi-criteria labels – These are the most common type of environmental labels and also the most commonly used in GPP. Multi-criteria labels are based on scientific information about the environmental impact of a product or service throughout its life cycle, from extraction of the raw materials, through production and distribution, the use phase, and final disposal. These apply a number of criteria that set the standard for the label in question. Different sets of criteria are established for each product or service group covered. Examples of this type of label include the EU Ecolabel (EU flower), the Nordic Swan, and the Blue Angel.

Single issue labels – These are based on one or more pass/fail criteria linked to a specific issue, e.g. energy efficiency. If a product meets those criteria, then it may display the label. Examples of this type of label are the EU Organic label or the Energy Star label for office equipment.

Sector specific labels – Sector-specific labels include forestry certification schemes operated by organisations such as the FSC (Forest Stewardship Council) or PEFC (Programme for the Endorsement of Forest Certification).

Graded product labels – These grade products or services according to their environmental performance on the issue in question, rather than using pass/fail criteria. Examples include the EU Energy Label, which grades energy-related products according to their energy efficiency.

3.3. GPP criteria

To assist contracting authorities in identifying and procuring more sustainable products, services and work, environmental procurement criteria have been developed for a number of product and service groups which can be directly inserted into tender documents. These GPP criteria are regularly reviewed and updated to take into account the latest scientific product data, new technologies, market developments, and changes in legislation. Most of the criteria are available in all official EU languages.

The GPP criteria are based on data from a variety of sources, and a technical background report is prepared for each product group to identify the considerations taken into account. The evidence base uses available scientific information and data, adopts a life-cycle approach, and engages a variety of stakeholders.

The EU GPP criteria include two "levels" for each sector covered:

- The core criteria are designed to allow easy application of GPP, focus on the key area(s) of environmental performance of a product or service, and aim to keep administrative costs for companies to a minimum.
- The comprehensive criteria take into account more aspects or higher levels of environmental performance and can be used by authorities that want to go further in supporting environmental and innovation goals.

In the following, the logic and principles behind the various types of GPP criteria are described.

3.3.1. Standards and other technical reference systems

Standards have a major role in influencing the design of products and processes, and many standards include environmental characteristics such as material use, durability or consumption of energy or water. References to technical standards, including such environmental characteristics, can be made directly in the tender specification, helping to define the subject matter in a clear way. The procurement directives refer to European, international or national standards and various other technical reference systems as one of the means by which specifications can be defined. When reference to a standard is used, it must be accompanied by the words "or equivalent". This means that evidence of compliance with an equivalent standard must be accepted. Such evidence may be in the form of a test report or certificate from a conformity assessment body. A tenderer may also seek to rely upon a manufacturer's technical dossier if it is not able to obtain third-party evidence within the relevant time limits for reasons, which are not attributable to it. The contracting authority must then determine whether this establishes compliance.

3.3.2. Specifying materials

As a contracting authority, you have the right to insist that the product you are purchasing is made from a specific material or contains a certain percentage of recycled or reused content. You can also set requirements regarding the restriction of hazardous substances in the product. As a starting point, you should refer to legislation, which restricts hazardous or dangerous substances, for example the RoHS Directive or REACH and CLP Regulations. To ensure that the Treaty principle of non-discrimination is respected, such restrictions should be based on an objective risk assessment. Labels and GPP criteria are a useful reference point, as they are based on scientific information and life-cycle assessment of the materials and substances found in the covered products and services.

3.3.3. Production processes and methods

The procurement directives allow you to include requirements regarding production or provision processes and methods in technical specifications for supply, service and works contracts. It is not allowed, however, to insist upon a production process,

which is proprietary or otherwise only available to one supplier – or to suppliers in one country or region – unless such a reference is justified by the exceptional circumstances of the contract and is accompanied by the words "or equivalent".

3.3.4. Exclusion criteria

The exclusion criteria deals with circumstances in which an operator can find itself, that normally cause contracting authorities not to do any business with it. The cases where a contracting authority may exclude an operator are listed in full in the public procurement directives. In some particularly serious criminal cases, exclusion is mandatory. From a GPP perspective, the most relevant exclusion criteria are:

- Non-compliance with applicable national, EU or international environmental agreements, protocols and laws.
- Grave professional misconduct which renders integrity questionable.
- Significant/persistent deficiencies in performance of substantive requirement under prior contract which led to termination or comparable sanctions.
- Misrepresentation of any of the above or inability to submit supporting documents.

3.3.5. Selection criteria

The selection criteria assess the suitability of an economic operator to carry out a contract. In two-stage procedures, these form part of the initial expression of interest stage and can also be used to shortlist or reduce the number of candidates invited to tender. In an open procedure, they may be assessed on a pass/fail basis, either before or after tenders are evaluated. The procurement directives provide an exhaustive list of the criteria, which can be applied to select operators, and the types of evidence, which may be requested from them. The most relevant selection criteria for GPP purposes relate to environmental performance based technical and professional ability:

- Human and technical resources
- Experience and references
- Educational and professional qualifications of staff (if not evaluated as an award criterion)
- Environmental management systems and schemes (e.g. EMAS, ISO 14001)
- Supply chain management/tracking systems
- Samples of products
- Conformity assessment certificates.

3.3.6. Award criteria

At the award stage, the contracting authority evaluates the quality of the tenders and compares costs. When you evaluate the quality of tenders, you use predetermined award criteria, published in advance, to decide which tender is the best.

Under the 2014 procurement directives, all contracts must be awarded on the basis of the most economically advantageous tender.

A number of different approaches are possible under this general heading, some of which may be considered particularly appropriate for GPP.

Cost or price will form part of the assessment in any procedure and may be calculated on the basis of lifecycle costs as discussed below. Beyond costs, a wide range of factors may influence the value of a tender from the point of view of the contracting authority, and this includes environmental aspects.

The main difference between technical specifications and award criteria is that whereas the former are assessed on a pass/fail basis, award criteria are weighted and scored so that tenders offering better environmental performance can be given more marks. It is up to each contracting authority to determine what award criteria to apply and the weighting to assign to each of them.

3.3.7. The legal rules for award criteria

1. Award criteria must not confer an unrestricted freedom of choice

Award criteria must never confer an unrestricted freedom of choice on contracting authorities. This means that they must provide an objective basis for distinguishing between tenders and be adequately specific. In the words of the Court, award criteria must be formulated in such a way that allows all "reasonably well-informed and normally diligent tenderers" to interpret them in the same way. A further element of the objectivity requirement for award criteria concerns verifiability. If award criteria relate to factors, which cannot be verified by the contracting authority, it will be difficult to demonstrate that they have been applied objectively. This means you should consider in advance what means of proof tenderers can offer under each award criterion, and how you will evaluate this.

2. Award criteria should ensure the possibility of effective competition

Environmental award criteria should not be formulated in a way, which artificially forecloses the market. As one of the objectives of award criteria is to encourage the market to develop and deliver environmentally preferable solutions, it should always be possible for different operators to obtain marks under such criteria.

3. Award criteria must be advertised in advance

The procurement directives require that award criteria and their weightings are set out either in the contract notice or in the procurement documents. Case law has helped to establish the level of detail required for the advertisement of award criteria. You must indicate in the notice or documents:

- The criteria you will apply to identify the most economically advantageous tender.
- The relative weightings you will apply to the criteria, either as precise numbers or as a range with an appropriate maximum spread.
- Any sub-criteria you will apply and, in most cases, their weightings.

Specifications or award criteria

A number of considerations should be taken into account when assessing whether an environmental characteristic should be a minimum requirement (specification) or a preference (award criteria). Applying environmental award criteria may make sense, for example, if you are not sure of the cost and/or market availability of products, works or services which meet certain environmental objectives. By including these factors in your award criteria, you are able to weigh them against other factors including cost. You may also wish to set a minimum level of

performance in the technical specifications and then allocate extra points for even better performance at the award stage. This approach is used successfully by a number of contracting authorities to retain flexibility while implementing GPP.

Using labels

The same rules apply to the use of labels in the award criteria as for other stages of the procurement process, i.e.:

- You can only require a label if all of its requirements are linked to the subject-matter of the contract and the label meets certain standards of objectivity, transparency and availability to the market.
- Even where such a label is required, you must still accept labels meeting equivalent criteria and, in cases where bidders cannot obtain a label within the relevant time limits for reasons not attributable to them, other appropriate forms of evidence.
- For other types of labels, you can refer to individual criteria, which are linked to the subject-matter of the contract, but not require the label as such.

Environmental labels can be useful to distinguish products and services, which will save energy or are produced in a more sustainable way. By including some or all of their requirements in your award criteria, you can weigh these considerations against cost and other factors such as product availability or delivery time

3.4 RAC sector GPP criteria

This section identifies and describes the different existing National, Nordic and EU initiatives for setting eco-criteria to RAC products, either through eco-labels or through GPP criteria.

3.4.1. Ecolabels

The relevant ecolabels in the Nordic countries are:

- The Nordic Swan
- EU ecolabel.

In addition, the German ecolabel *Blue Angel* is common for a number of products placed in the Nordic Market. The ecolabels are described further in the following.

3.4.2. The Nordic Swan ecolabel for RACs

The official ecolabel of the Nordic countries is the Nordic Swan. It covers a wide range of products, including refrigerators and freezers (plug-in) and as well as heat pumps. However, currently there are no Nordic Swan ecolabelled heat pumps or refrigerators/freezers available on the market.[14] A number of available products in the marked fulfil the ecolabelling requirement, but due to the cost for certifications and maintenance of the ecolabel, no manufactures has choosen to apply for an ecolabel.

There are two criteria documents for the Nordic Swan ecolabelling of RAC products:

14. https://www.ecolabel.dk/da/produkter/

- Nordic ecolabelling of refrigerators and freezers, Version 5.4, 30 April 2014.
- Heat pumps. Background document to requirement for ecolabelling, Version 3.5, 19 December 2018.

3.4.3. EU ecolabels for RACs

The EU ecolabel covers a wide range of products, but in the RAC sector only *heat pumps* are included in the EU ecolabel scheme. So far, no manufactures have applied for an EU ecolabel licence to place certified products on the market.[15]

Refrigeration appliances are not included in the EU ecolabel. They are, however, subject to energy labelling and ecodesign requirements.[16]

3.4.4. Blue Angel Ecolabel for RACs

The German ecolabel *Blue Angel* sets national standards for environmentally friendly product design. The label covers a wide range of products, including criteria for stationary air conditioners and professional refrigeration appliances. There is currently one stationary air conditioner on the market labelled with Blue Angel[17].

The following relevant Blue Angel basic award criteria documents are available:

- Blue Angel criteria for stationary air conditioners last published in August 2016 (basic award criteria, version 1).[18]
- Blue Angel criteria for climate-friendly grocery stores, last published in March 2013 (basic award criteria, version 2.1).[19]

An updated technical background analysis of the criteria focuses on energy efficiency and environmental characteristics of refrigerant.[20]

The life cycle analysis of the study revealed, among other things, that propane air heat pumps, compared to conventional high GWP HFCs, typically achieve 30% energy savings. In hot air countries, savings can be as high as 50%.

3.4.5. EU Ecodesign Directive

The Ecodesign Directive (Directive 2009/125/EC)[21] establishes a framework to set mandatory ecological requirements for energy-using and energy-related products sold in the EU. Its scope currently covers more than 40 product groups (such as boilers, light bulbs, TVs, and fridges).[22]

The ultimate aim of the Ecodesign Directive is that manufacturers of energy-using products will, at the design stage, be obliged to reduce the energy consumption and

15. http://ec.europa.eu/ecat/category/en/24/heat-pumps
16. https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/energy-efficient-products/fridges-and-freezers_en
17. Midea Split-type Room Air Conditioner All Easy Series MSAEBU-09HRFN7-QRD6GW, MSAEBU-12HRFN7-QRD6GW, Kältemittel: R290.
18. https://produktinfo.blauer-engel.de/uploads/criteriafile/en/DE-UZ%20204-201608-en%20Criteria.pdf
19. https://produktinfo.blauer-engel.de/uploads/criteriafile/en/DE-UZ%20179-201303-en%20Criteria.pdf
20. The Blaue Angel for Stationary Room Air conditioners – market analysis, technical development and regulatory framework for criteria development. Background Report. Texte 22/2018. German Environment Agency, 2018.
21. This section refers to https://en.wikipedia.org/wiki/EU_Ecolabel
22. https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign_en

other negative environmental impacts of the products. While the Directive's primary aim is to reduce energy use, it is also aimed at enforcing other environmental considerations, including material use, water use, polluting emissions, waste issues, water issues, and recyclability.

The Ecodesign Directive is a framework directive meaning that it does not directly set minimum ecological requirements. These are adopted through specific implementing measures for each group of products in the scope of the Directive.

Implementing measures are based on EU internal market rules governing which products may be placed on the market. Manufacturers who begin marketing an energy-using product covered by an implementing measure in the EU area have to ensure that it conforms to the energy and environmental standards set out by the measure.

In practice, the introduction of a new minimum requirement results in effectively banning all non-compliant products from being sold in the EU.

The implementing measures focus on those products which have a high potential for reducing greenhouse gas emissions at low cost, through reduced energy demand.

The first Working Plan of the Ecodesign Directive was adopted on 21 October 2008.

It establishes a list of 10 product groups to be considered in priority for implementing measures in 2009–2011:

- Air conditioning and ventilation systems
- Electric and fossil-fuelled heating equipment
- Food-preparing equipment
- Industrial and laboratory furnaces and ovens
- Machine tools
- Network, data processing and data storing equipment
- Refrigerating and freezing equipment
- Sound and imaging equipment
- Transformers
- Water-using equipment.

Nine implementing measures have already been adopted – for a total energy saving of 341 TWh, or 12% of the electricity consumption of the EU. Several preparatory studies by DG Energy are completed or ongoing.

3.4.6. EU Energy Label Regulation

The 2010/30/EU[23] establishes an energy consumption-labelling scheme. The EU Energy Labels provide a clear and simple indication of the energy efficiency of products at the point of purchase.

It was first introduced for a number of household appliances in 1994 and subsequently it expanded in 2004 – with a comparative scale from A (most efficient) to G (least efficient). The concept has been a key driver for helping consumers choose products which are more energy efficient. At the same time, it also encourages manufacturers to drive innovation by using more energy efficient technologies.

23. This section refers to https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/about_en

The Energy Labels are separated into four categories:

- The appliance's details: According to each appliance, specific details of the model and its materials.
- Energy class: A colour code associated to a letter (from A to G) that gives an idea of the appliance's electrical consumption.
- Consumption, efficiency, capacity, etc.: This section gives information according to appliance type.
- Noise: The noise emitted by the appliance.

As a result of increasingly more development of energy efficient products, and because the difference between A++ and A+++ is less obvious to the consumer, the categories will be gradually adjusted to reintroduce the simpler A to G scale. This means that five product groups will be "rescaled" in the course of 2021.

- Fridges
- Dishwashers
- Washing machines
- Electronic displays including televisions
- Lamps.

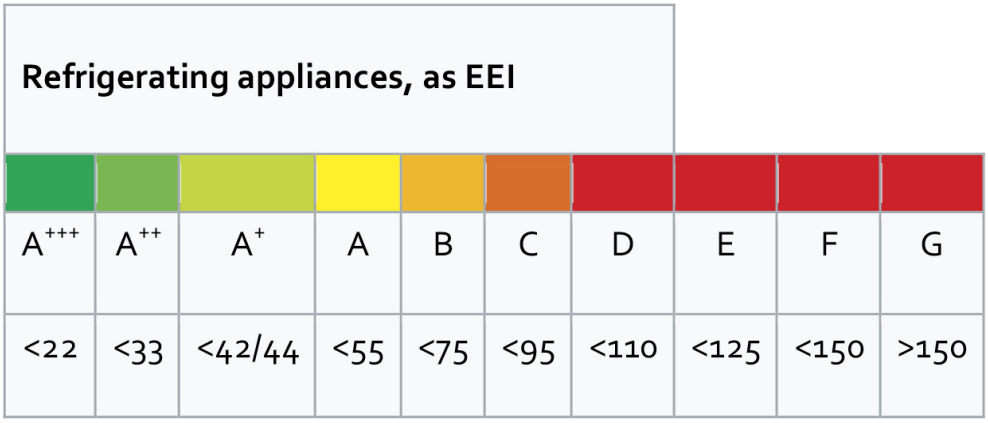
A product showing an A+++ energy efficiency class could for example become a class B after rescaling, without any change in its energy consumption. The final format was adopted by the Commission on 11 March 2019. In addition, from 1 January 2019, suppliers (manufacturers, importers or authorised representatives) will have to upload information about their products into the European product database for energy labelling (EPREL) before placing products on the European market. Consumers will be able to search the database for energy labels and product information sheets by early 2020.

Companies can also create their own labels for energy efficiency products using the energy label templates or the energy label generator.

3.4.7. Refrigerating appliances

For refrigerating appliances, such as household refrigerators, household freezers, commercial plug-in refrigerators and combined appliances, the labelling is specified in terms of an energy efficiency index, EEI, which is an indication of the annual power consumption relative to a reference consumption that is based on the storage volume and the type of appliance (refrigerator or freezer). The boundary between the A+ and A classes is 44 up to 1 July 2014, and 42 after that date. Commercial sales cabinets will be introduced from 2021.

Figure 1: EEI for household fridge and freezers. This scheme is for the existing regulation. A new scheme will be introduced 1 March 2021.



The label also contains:

- The annual energy consumption in kWh.
- The capacity of fresh foods in litres for refrigerators and combined appliances.
- The capacity of frozen foods in litres for freezers and combined appliances.
- The noise in dB(A)

For cold appliances (and this product alone), for models that are more economical than those of category A, categories A+, A++ and A+++ have been assigned.

3.4.8. Air conditioners

For air conditioners, the directive applies only to units under 12 kW. Every label contains the following information:

- The model.
- The energy efficiency category from A+++ to G.
- The Seasonal Energy Efficiency Ratio (SEER).
- The annual energy consumption.
- The cooling output at full load in kW.
- The energy efficiency ratio in cooling mode at full load.
- The appliance type (cooling only, cooling/heating).
- The cooling mode (air- or water-cooled).
- The noise rating in dB (where applicable).

Labels for air conditioners with heating capability also contain:

- The energy efficiency category from A+++ to G in European average climate. Also available for colder and warmer climate (voluntary).
- The Seasonal Coefficient of Performance (SCOP).
- The heat output at full load in kW.
- The heating mode energy efficiency category.

Table 9: Energy efficiency classes for split AC-systems and heat pumps (<12kW). This regulation from 2011 is under revision.

Energy Efficiency Class	SEER	SCOP
A+++	SEER ≥ 8.50	SCOP ≥ 5.10
A++	6.10 ≤ SEER < 8.50	4.60 ≤ SCOP < 5.10
A+	5.60 ≤ SEER < 6.10	4.00 ≤ SCOP < 4.60
A	5.10 ≤ SEER 5.60	3.40 ≤ SCOP < 4.00
B	4.60 ≤ SEER < 5.10	3-10 ≤ SCOP < 3.40
C	4.10 ≤ SEER < 4.60	2.80 ≤ SCOP < 3.10
D	3.60 ≤ SEER < 4.10	2.50 ≤ SCOP < 2.80
E	3.10 ≤ SEER < 3.60	2.20 ≤ SCOP < 2.50
F	2.60 ≤ SEER < 3.10	1.90 ≤ SCOP < 2.20
G	SEER < 2.60	SCOP < 1.90

Below figure is an illustration from the Energy Label Regulation for a split A/C/heat pump. For reversible units, both heating and cooling shall be Energy Labeled.

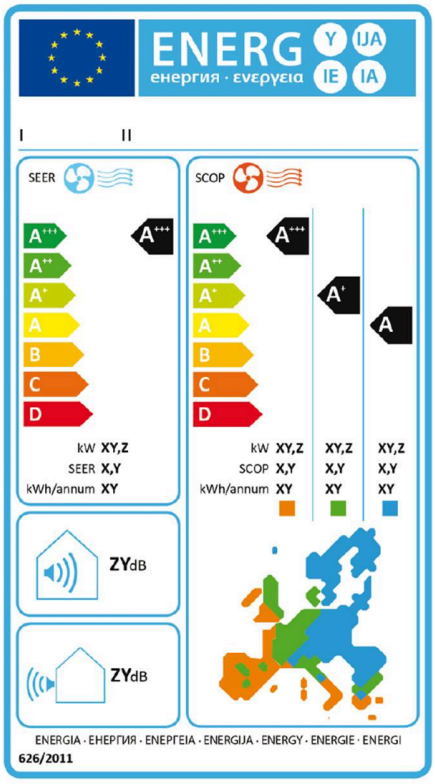


Figure 2: Energy label example for a reversible A/C heat pump.

3.4.9. Other initiatives for GPP criteria for RAC

Beside the ecolabel criteria and Energy Label criteria for RAC, other initiatives for GPP criteria are identified. Together with the eco-labels and Energy Labels, this information supports the formulation of the GPP criteria for RAC products included in the project and ensures that the criteria are based on existing knowledge.

The identified other initiatives for GPP criteria for RAC are listed below along with a short description and links for relevant documents.

Table 10: Existing efforts with relevant RAC GPP criteria.

GPP criteria source	Contents
The Danish Environmental Protection Agency	*The responsible procurer* is a project made in cooperation between several Danish ministries and agencies, the association for Danish regions and the association for Danish municipalities. The website sets out guidelines for "responsible" public procurement for a wide range of products, including heating and refrigeration appliances. - Environmental requirements for refrigeration appliances: http://csr-indkob.dk/products/koleanlaeg / (plug-in applications, chillers, condensed units). The criteria is structured in two levels – basic criteria and scoring criteria. - The basic criteria is natural refrigeration. - The scoring criteria is energy efficiency calculated as TOC for 10 years. Depending on the appliance, the basic criteria are either natural refrigerants or stipulated maximum levels for GWP for refrigerant.
The Finnish Environmental Institute (SYKE)	The Finnish Environment Institute has developed criteria for sustainable public procurement of HFCs and their alternatives, which is outlined in the project report *Sustainable Public Procurement for Reducing F-Gas Usage and Emissions - Criteria for High Global Warming Potential Alternatives.* The primary emphasis is that the used refrigerant's climate warming potential (GWP) is as small as possible. Secondly, natural refrigerants, such as carbon dioxide (CO_2) and ammonia (NH_3), hydrocarbons (HC) and HFO substances should be preferred to high GWP HFCs, and the energy efficiency of the equipment should be assessed according to Finland's cold conditions using the SCOP coefficient (Seasonal Coefficient of Performance). Criteria for high GWP HFCs alternatives are proposed at three different levels: exclusion criteria, minimum requirements and scoring criteria. **CRITERION 1 (EXCLUSION CRITERIA):** The purchasing of equipment containing ozone depleting substances as defined in the EU Ozone Regulation (1009/2009) is prohibited. **CRITERION 2 (EXCLUSION CRITERIA):** Equipment or products listed in the F-Gas Regulation (517/2014) Annex III shall not be acquired if the prohibition date for placing it on the market has entered into force. Annex III defines 17 different restrictions, of which the first 10 have already entered into force. The purchasing of equipment and products listed in the remaining 7 should also be avoided as the restrictions come into force between 2020 and 2025. **CRITERION 3 (EXCLUSION CRITERIA):** Any company or installer who has been convicted of penalties for breaching the EU F-Gas Regulation (517/2014), the EU Ozone Regulation (2005/2009) or any other relevant regulation must be excluded from the tendering procedure. **CRITERION 4 (MINIMUM REQUIRMENT):** The procurement of following applications for professional kitchens favours devices using natural refrigerants: line furniture, service lines, refrigerator and freezer rooms under 10 m^3, refrigerator and freezer cabinets, ice cream freezers and basins refrigerated shop furniture. Refrigerator and freezer rooms, with a capacity of less than 10 m^3 can already be cooled with less than 150 grams of natural refrigerants at a competitive price and with lower energy costs to HFCs. **CRITERION 5 (MINIMUM REQUIRMENT):** The procured refrigeration equipment operates with refrigerants with a GWP of less than 750. Excludes equipment used to cool products below -50 °C. **CRITERION 6 (MINIMUM REQUIRMENT):** The procurement of refrigeration solutions for supermarkets and similar commercial premises favours CO_2-based systems. **CRITERION 7 (MINIMUM REQUIRMENT):** The procurement of refrigeration equipment for indoor ice rinks and outdoor ice tracks focuses on equipment using natural refrigerants. Additional points can be given based on energy efficiency. See criterion 10. **CRITERION 8 (SCORING CRITERIA):** The procurement of highest scoring air source heat pumps. The points can be awarded according to the following scoring criteria – 100% of all points to equipment meeting all the German Blue Engel criteria and equipment using natural refrigerants, 70% of max. points with refrigerants below 750 GWP, 30% of max. points - the seasonal coefficient of performance (SCOP) must be greater than or equal to 4.6. (SCOP ≥ 4.6). For air source heat pumps, there are currently no energy-efficient devices operating on the Finnish market with natural refrigerants, but criteria for such equipment have already been approved for the German Blue Engel eco-labelling scheme. **CRITERION 9 (SCORING CRITERIA):** The procurement of highest scoring air conditioning equipment. The points

	can be awarded as follows: 100% of all points if the GWP of the refrigerant used is less than 150, 50% of all points if the GWP of the refrigerant used is less than 750. **CRITERION 10 (SCORING CRITERIA):** The procurement of most energy efficient refrigeration equipment for indoor ice rinks. The COP should be over 3.
Motiva criteria	Motiva is the Finnish agency that governs the Nordic Swan and the EU Ecolabel in Finland. Finnish criteria for GPP were developed in 2016 for a wide range of product groups. The criteria specifications are only available in Finnish: https://www.motiva.fi/julkinen_sektori/kestavat_julkiset_hankinnat/tietopankki They do not contain minimum requirements for GWP values for refrigerants. The criteria it sets out are voluntary scoring criteria. The Criteria for Purchasing Guide are as follows: "In addition, consider: HFC-free refrigerants should be favoured by scoring so that the lower the GWP value of the refrigerant, the better the scoring." In the future, awareness of the criteria will be promoted through the Sustainable and Innovative Public Procurement Centre (KEINO).
Danish Energy Agency	The Danish Energy Agency has developed some recommendations based on the Eco-design recommendations and the Energy label. The recommendations are focused on energy efficiency, but the recommendations for professional kitchens also involve the type of refrigerant used: - Recommendations for procurements of refrigerants and freezing appliances for professional kitchens[a]: A (fridges below 800 l), c (fridges above 800 l). - Recommendations for procurements of condensed units (-10 degree) for professional kitchens: max 1 kW, COP 1.4, max. 5 kW, COP 1.6, max. 20 kW, COP 2.55, max. 50 kW, COP 2.65. (if refrigerant has a GWP below 150, the COP requirement can be reduced with 10%). - Recommendations for procurements of condensed units (-35 degree) for professional kitchens: max. 0.4 kW, COP 0.8, max. 2 kW, COP 0.95, max. 8 kW, COP 1.6, max. 20 kW, COP 1.7. (if the refrigerant has a GWP below 150, the COP requirement can be reduced with 10%). - Recommendations for procurements of walk-in cold storages: EEI as for condensed units + insulation capacity for WICS cooling -0.2 W/m^{2}K, for WICS freezing -0.15 W/m^{2}K. - Recommendations for procurement of heat pumps[b]: A++ (air-air max.12 kW, air-water max. 70 kW). - Recommendations for procurement of white goods for households[c]: A+++ (fridge, freezers and combinations).
The National Agency for Public Procurement	The Swedish National Agency for Public Procurement has GPP criteria for fridges, freezers and combinations. However, criteria for refrigerants are not included. GPP criteria exist for three levels of ambitions: Basic, advanced and spearhead. GPP criteria and Excel sheets for calculating GPP scores can be downloaded from the website. Recommended Energy Label Criteria for fridges, freezers and combinations are A++ (advanced) and A+++ (spearhead).[d] Recommended GPP criteria for refrigerators and freezers in professional kitchens are only available as basic criteria. The criteria are the following:[e] Energy use for professional refrigerators and freezers, according to EN 441 or equivalent, must not exceed: - For 400 and 600 litre refrigerators: 15 kWh/48h/m^3 - For 1,300 litre refrigerators: 12 kWh/48h/m^3 - For 400 and 600 litre freezers: 40 kWh/48h/m^3 - For 1,300 litre freezers: 36 kWh/48h/m^3. - The refrigerants in refrigerators, freezers, cooling counters and serving units must have Global Warming Potential ≤150.
Topten.eu	ProCold/topten is an EU sponsored project to promote more sustainable product solutions. It offers a list of available products for procurement. The GPP criteria refer to the Eco-design and Energy Label directives. They have product recommendations for a large number of RAC appliances within air conditioners, household appliance and professional refrigeration. An overview of the different products is included in the criteria.[f] Regarding refrigerants, the general recommendation is refrigerants with a GWP of 150 or lower (according to the eco-design directive).

Note:

[a]:https://sparenergi.dk/offentlig/vaerktoejer/indkoebsanbefalinger/professionelt-udstyr-til-storkoekken

[b]:https://sparenergi.dk/offentlig-og-erhverv/indkoeb-og-adfaerd/indkoebsanbefalinger/varmepumper

[c]:https://sparenergi.dk/offentlig/indkoeb-og-adfaerd/indkoebsanbefalinger/haarde-hvidevarer-til-husholdninger

[d]:https://www.upphandlingsmyndigheten.se/en/sustainable-public-procurement/sustainable-procurement-criteria/building-and-property/household-appliances/

[e]:https://www.upphandlingsmyndigheten.se/en/sustainable-public-procurement/sustainable-procurement-criteria/building-and-property/professional-kitchen/professional-refrigerators-and-freezers/

[f]: http://www.topten.eu/

4. Suggestions for Nordic GPP criteria for RAC alternatives to high GWP HFCs

4.1. Principles for GPP criteria

4.1.1. Criteria structure

As described in section 3.3., procurement criteria should be structured in three levels:

- Exclusion Criteria
- Selection Criteria
- Award Criteria.

The Procurement Directive outlines the legal requirement for defining criteria, especially the award criteria. Overall, it is important to pay attention to the fact that the stipulated criteria do not prevent a free competition in the market and that the criteria should always be formulated in a way that assures the procurement entity an unrestricted choice to choose between bids.

The following sections describe the principles for formulating RAC GPP criteria.

4.2. Proposal for exclusion criteria

Five comprehensive exclusion criteria focusing on F-gas and ODS compliance are proposed.[24]

- E1. Equipment containing ozone depleting substances as defined in the EU Ozone Regulation (1009/2009) should not be purchased at all.
- E2. Equipment or products as defined in Annex III to the EU F-Gas Regulation shall not be acquired if the prohibition for placing it on the market in accordance with Article 11 has entered into force. Annex III to the Regulation defines 17 different restrictions, of which the first 10 have entered into force. The remaining 7 limitations will take effect between 2020 and 2025, so it is not recommended to buy them.
- E3. Any company or installer who has breached the requirements of the EU F-Gas Regulation or the EU Ozone Regulation or the requirements of the so-called leakage regulation or national related regulations or decrees and has been convicted of penalties must be excluded from the tendering procedure.
- E4. Any company or installer who has breached the requirements of legal import of HFCs or tax regulation of HFCs must be excluded from the tendering procedure.
- E5. Products banned by national F-gas legislation.

To be considered as bidder, the entity (individual companies or all companies in a

24. Four of the five exclusion criteria are adobted from SYKE's criteria proposals included in the report *Sustainable Public*

consortium) should declare full legal compliance in the last 3 years with the regulations mentioned above.

These exclusion criteria emphasize a clear threshold for the technology level for RACs to procures and secure the regulative compliances of RAC applications allowed in the tender.

By excluding bidders not complying with the ozone and the F-gas regulations, a zero tolerance threshold for using banned refrigerants is stipulated by the public authority. It makes sense that GPP supports compliance with these regulations while the general inspection of non-compliant refrigerants is sparse in the Nordic and EU.

For example, illegal import and trade of HFCs is a notified problem in the Nordic countries. The illegal import is motivated by access to cheap refrigerants sold to customers with a higher profit. The typical customers have almost no possibility to control the origins of the HFCs supplied, and most customers do not focus on the issue at all. The illegal import of HFC refrigerants to Denmark and Norway has even higher profit potential because no tax has been paid for the refrigerant. The taxes range up to EUR 80 pr. kg in Denmark[25] and EUR 200 pr. kg in Norway[26]. In Norway, the tax is refunded when delivering the HFCs for destruction.

There is no data available for the proportions of illegal import of HFCs in the Nordic countries, but the RAC sector itself claims that the problem is considerable.

The procurement authority should formulate a legal sentence for requiring economical refund, in case a winning entity has sent a declaration of full compliance which is documented false after the tender has closed.

4.2.1. How can non-compliance be inspected?

In practise is it difficult to verify or control compliance from bidders. There exist no such registers with that information. Therefore, the exclusion criteria have first of all, a preventive role, but combined with possibilities for economical enforcement it becomes a tool, which has consequences for the bidder if violation is discovered:

- Check tax authorities for violation with illegal import.
- RAC technologies, where no natural refrigerant alternatives exist, the origin of the supplied HFCs should be documented: Who is the importer? and when was it imported?

25. CFC afgiftsloven, Skatteministeriet. https://www.skm.dk/skattetal/satser/satser-og-beloebsgraenser/cfc-afgiftsloven
26. https://www.skatteetaten.no/en/business-and-organisation/vat-and-duties/excise-duties/about-the-excise-duties/hfc-and-pfc/

4.3. Proposal for selection criteria

The selection criteria should demand the minimum levels for the RAC products' environmental performance according to the lowest possible GWP of refrigerants in the RAC product.

The general principle for the stipulated selection criteria is that the selection criteria should seek to exclude HFC refrigerants in RAC categories, where alternative low GWP or zero GWP refrigerants are implemented in the market. This principle should immediately be applied in all RAC product categories, where the investment cost and TCO (total cost of ownership) are equal (or better) than HFCs.

As a part of the project, technology screenings for 25 defined RAC product categories is conducted to determine the current status and trends for low or zero GWP refrigerants. An overview of the screened RAC product categories are included in Annex 1 and described in Chapter 2.

Based on the conducted technology screening, the overall conclusion is that almost all RAC product categories have applications with zero or low GWP refrigerants, which are appropriately represented by manufactures in the market.

According to the main GPP criteria, it is both easy and effective when it is possible to define a clear frame where only RACs with natural refrigerants are allowed.

Depending on the particular RAC product category, we propose 2 levels of selection criteria, as stipulated below.

In cases where RAC products exists with natural refrigerants, the selection criterion is:

S1. Only products with natural refrigerants (hydrocarbon, ammonia, CO2 or other natural refrigerant).

The main objective is to achieve more sustainable public procurement of low GWP RAC products, and by setting a GPP selection criteria threshold that excludes all HFCs and HFOs, where possible, it assures that only natural refrigerant RACs will be procured.

Compensations for lower energy efficiency, when applying products with natural refrigerants, is not relevant any longer. The fact is that state-of-art in RACs using natural refrigerants is as energy efficient at the same level as HFC products and up to 20–30% more energy efficient. However, it is noted that several RAC categories in the Ecodesign Directives, e.g. small air-air heat pumps, are favoured with an acceptance of a 15% higher energy consumption if the refrigerants are below GWP 150. In the context of the 2019 products in the market, this is somehow misleading, because natural refrigerants are actually more energy efficient. These formulations in the Ecodesign Directive are also officially proposed by technical workgroups to be removed in the forthcoming revisions of the Ecodesign criteria.

In cases where RAC products do not exist with natural refrigerants but with various low GWP refrigerants based on HFCs and HFOs, the selection criterion is:

S2. Only products using refrigerants with a GWP of 675 or lower.

This GPP criteria is relevant for the following product categories:

- Small and large split A/C (below/above 12 kW)
- Heat pumps up to 200 kW (air-water, air-air, air-brine).

Both split air conditioning units and heat pumps are traditionally using HFC 410A (GWP 2088), but recently HFC 32 (GWP 675) is widely applied. The trend is towards propane as refrigerant in both heat pumps and split units, and in Asia, hydrocarbons are used in some spilt unit A/Cs. Split unit A/Cs are direct refrigeration with individual control and regulation. The unit consists of one outside part and one inside part and is a reversible unit for air conditioning and heat pumps. A propane air-air heat pump below 12 kW is introduced with Blue Angel label, available in Germany,[27] and an air-water heat pump was also introduced recently.[28] However, these products are not available in the Nordic countries yet.

For RAC product categories with no low HFC or HFO alternatives, selection criteria cannot be formulated, and it does not make sense to stipulate selection criteria for low GWP HFC refrigerants. From a GPP criteria perspective, the objective is instead to achieve the best possible environmental performance. This will be handled through *award criteria* instead.

This case is only relevant for the RAC product categories:

- Small and large split A/Cs below/above 12 kW (use a.o. R32)
- Heat pumps up to 200 kW, air-water, air-air, air-brine (use a.o. R32 and the trend is propane)
- Roof top A/Cs (use R407C and there is no low GWP alternative so far).

Roof top air conditioner means an air-to-air air conditioner driven by an electric compressor, of which the evaporator, compressor and condenser are integrated into a single package. Roof top air conditioners use HFC 407C (GWP 1774).

4.4. Proposal for award criteria

The purpose of the award criteria is to distinguish and favour the best environmental performing RAC products that passed the selection criteria.

The proposed *selection criteria* should assure zero or low GWP products for all RAC product categories except for one (Roof top A/C).

Now, the procurement entity needs to apply the award criteria to select the best offer in terms of environmental performance and price. As a part of the preparation of a tender, the procurer can define the weight between e.g. price and environmental performance.

For evaluation purpose, the award criteria should be accomplished with a scoring model, e.g. points for best performance within each award criteria and lowest price.

The procurement entity usually defines an overall weighting of the scores for each individual award criteria, e.g. according to:

- Price
- Environmental performance

27. https://www.kka-online.info/artikel/kka_Propan_als_Kaeltemittel_in_Klimaanlagen_3311520.html
28. Alpha Innotec air water heat pumps.

- Quality and service.

A high weighing of price, e.g. a 50% weighting of the total score or more, is commonly applied in such tenders. This means that the price value has a major influence on the total scoring result. This highlights that it is important that the *selection criteria* can assure that the proposed RAC applications are using zero or low GWP refrigerants. If the selection criteria do not function as gatekeeper for the fundamental technology and refrigerant choice, there might be a risk that key environmental priorities are undermined when price issues are over-weighted in scoring models.

It should be noted, that HFC technologies in general have increased in price, since the HFCs have been affected by quota trading (from the EU F-gas regulation). Especially in 2018, the quota-trading effects have been visible in terms of price increase for high GWP HFC refrigerants. And combined with HFC tax charges in some Nordic countries (Denmark and Norway), both investment costs and life cycle costs increase considerably for owners of HFC based installations. A refilling with 30 kg high GWP HFCs will e.g. in Danish terms cost approx. EUR 3,000. In other words, the service cost for larger HFC units will continually increase and reach non-competitive levels.

Environmental performance in the context of this project is considered as:

- HFOs versus HFCs or natural refrigeration
- GWP value for refrigerant
- Energy efficiency
- Use of HFC as foam blowing agent in insulation.

A number of other environmental performance criteria could, in principle, also be included e.g. material use, waste, lifetime, environmental management etc. But as the overall objective is to reduce the carbon footprint, we propose only to focus on the listed subjects above.

As a note, a large number of the RAC products is covered by the Ecodesign regulations, which also cover other environmental issues, e.g. material consumption, waste etc. The regulatory impacts should therefore assure an ongoing product development comprising of all the environmental aspects.

4.4.1. HFOs versus HFCs or natural refrigerants[29]

For most RAC product categories, there are natural refrigerant state-of-art alternatives. In this case, considerations due to low GWP HFCs or HFOs are not relevant.

In cases where the choice of refrigerant stands between low GWP HFCs or HFOs there are some constraints to be mentioned. The recently introduced refrigerant group, HFOs (unsaturated HFCs), has a low GWP. And when mixed, also with some conventional HFCs, this can be considered as "drop-ins". There is no need to significantly modify the technology design when refilled with certain HFC/HFO blends. However, studies on HFO show negative environmental impacts.

29. Text edited from The Blaue Angel for Stationary Room Air conditioners – market analysis, technical development and regulatory framework for criteria development. Background Report. Project 3714 95 3060, Texte 22/2018. German Environment Agency, 2018.

For example, it is known that the decomposition of HFO in the atmosphere leads to formation of tri-fluoroacetic acid (TFA). TFA is a strong acid, which is toxic to some organisms and is highly persistent with no known degradation mechanism. Whilst only 10–20% of commonly used HFCs (e.g. HFC-134a) are transformed to TFA in the environment, 100% of the HFO-1234yf transforms to TFA. Above, the combustion of HFO (e.g. in case of fire) can lead to the formation of hydrogen fluoride (HF) and carbonyl fluoride. HF is highly toxic and corrosive and can cause severe burns or blindness and lead to death when inhaled.

There is an ongoing discussion in the RAC sector and among regulatory authorities about the benefits or disadvantages of HFOs and pros and cons relates to HFOs low GWP value and their environmental and occupational health risk.

Although HFOs have a very low GWP value (GWP 1–7), the other mentioned environmental risks are considered important. It is recommended not to stimulate a wider use of HFOs through green public procurement, because this regulatory tool is meant to stimulate the market and push the technology development in certain more sustainable directions. In a few years, several of the RAC product categories which use HFCs or HFOs today are supposed to be available with natural refrigerants.

GWP of refrigerant

In product categories where natural refrigerants are not available, alternative award criteria for measuring the low GWP refrigerants must be applied. For the time being, this award criteria is relevant for:

- Small and large split A/Cs below/above 12 kW (use a.o. R32)
- Heat pumps up to 200 kW, air-water, air-air, air-brine (use a.o. R32 and the trend is propane)
- Roof top A/Cs (use R407C and there is no low GWP alternative so far).

For RAC products where natural refrigerants are not introduced, the award criterias highest score is proposed for:

- *A1. Lowest GWP refrigerant.*

The points can be awarded as follows:

- 100% of all points if the GWP of the refrigerant used is less than 150
- 50% of all points if the GWP of the refrigerant used is less than 675.

This award criterion does not distinct between the use of HFCs and HFOs or combinations hereof. It only values the lowest GWP possible.

Energy efficiency

Energy efficiency is the second most important award criteria in the context of this project.

Documentation of energy efficiency can basically be applied in two ways:

- Through Energy Label
- Through Energy Efficiency documentation (EEI or similar expressions).

Both types of documentations are standardized in the EU Energy Label Regulations and in the EU Ecodesign regulations or through ISO standards.

From a procurement perspective, scoring according to the Energy Label is easy and accurate.

RACs covered by the Energy Label are:

- Professional stand-alone cabinets for refrigeration and freezing
- Refrigerated counters
- Commercial sales cabinets (from 1/3 2021)
- Household fridges and freezers
- Dry tumblers
- Split units below 12 kW
- Heat pumps up to 70 kW.

For these RAC products, the recommended award criteria for assuring the best energy efficiency is:

- *A2. Highest Energy Label.*

As supplementing information when products have the same Energy Label, EEI documentation should be provided, and the lowest value according to the annexes in the Energy Label Regulation should achieve the highest score.

For RAC products not covered by the Energy Label, the award criteria is:

- *A3. Highest energy efficiency.*

Standardized EEI documentation should be provided, and the highest energy efficiency should achieve the highest score.

The reference to EEI can be applied for all remaining product categories, except for:

- Walk in cold room (WICR)
- Remote blast chillers.

In case of WICRs, there is no appropriate standard for calculating EEI. The reference is therefore the general standard stipulated in the Ecodesign Directive. But this standard is not useful for comparing EEI between different technologies in a procurement situation. There is an ongoing progress for developing the method for calculating the total U-value for WICR within the standard EN 16855, but for the time being, the method is not yet useful as assessment tool in a procurement situation.

A simple method for assessing the energy efficiency is therefore the level of insulation thickness and eventually the U-level applied for the offered product. It is assumed that the U-level for the various types of PUR insulations applied is within the same range, so that the thickness is the main criteria[30].

For assessing EEI from WICR, the documentation should be provided as thickness of PUR insulation walls, and the award criteria are:

- *A4. Minimum 100 mm insulation thickness for freezer rooms with a lambda value of 0.023 W/mK or better (U-value of 0.23 W/m^2 K or smaller).*
- *Minimum 80 mm insulation thickness for chiller refrigeration rooms with a lambda value of 0.023 W/mK or better (U-value of 0.29 W/m^{2}K or smaller).*

30. The proposal is discussed with one of the main suppliers of WICR in the Nordic.

It should be noted that the insulation of the floor is as important as walls and roofs.

The standard *PREN 17432 Packaged refrigerating units for walk-in cold rooms - Classification, performance and energy consumption testing* offers testing methods to determine the energy efficiency of cold and frozen storage units used in WICR's.

In case of remote blast chillers and plug-in blast chillers, the method for calculating EEI is related to the product volume and *amount of food (kg) cooled to a certain degree/kWh.* This method does not necessarily favour the best EEI, while manufactures can improve the EEI by reducing the wall insulation to save more space. In case of blast chillers, it is therefore recommended not to include EEI as an award criteria. In practise, this means that best offer will depend on price and eventually on HFC free insulation.

Use of HFCs as foam blowing agent in insulation

An award criterion for HFC free foam is considered relevant. HFC-134a is still used as a blowing agent for foaming of insulation by some manufactures, and this production process courses a substantial HFC emission. The average emission from HFC foam blowing is considered as 10% according to IPCC[31]. From a life cycle perspective, it reduces the total carbon footprint of a certain RAC product if the insulation foam is using blowing agents not based on HFCs (or HCFC and CFC). The potent ODS depleting substances, HCFC-141b and 142b and CFC-11, were indeed very popular blowing agents before the substitution to HFC-134a. But the use of CFC/HCFC as blowing agents is banned through the Montreal Protocol. Even though CFC/HCFC is banned, the award criterion is recommended to explicitly mention which blowing agents are not favoured.

For RAC products using insulation foam, the award criteria is:

- *A5. No use of HFC (CFC/HCFC) as foam blowing agent.*

31. Guidelines for national GHG inventories, volume 3, Industrial processes and product use, IPCC, 2006.

5. References

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European Union. (2020). *The uptake of Green Public Procurement in the EU27*. Available at: https://ec.europa.eu/environment/gpp/pdf/CEPS-CoE-GPP%20MAIN%20REPORT.pdf

Links to Nordic manufacturers of RAC products with natural refrigerants and other low GWP refrigerants:

- Danfoss: https://www.danfoss.com/en/
- Elcold: https://elcold.com/
- Gram Commercial: http://gram-commercial.com/dk/da-dk
- Green and Cool: https://www.greenandcool.com/en/
- Haglund: http://www.haglundindustri.se/
- Nilan: https://www.nilan.dk/

- Porkka: https://porkka.com/
- Sabroe/Johnson Control: https://www.sabroe.com/en/home/
- Vestfrost Solutions: https://www.vestfrostsolutions.com/
- Vesttherm: https://vesttherm.dk/en
- Viessmann Refrigeration Systems: https://kylma.viessmann.fi/

Link to an EU-main site with reference to all published ecodesign- and energy labelling schemes:

https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/energy-efficient-products_en

Annex 1 – Overview table of RAC product categories and current status for GPP criteria

Table A1

Product Category	Use	Description	HFC alternatives	Eco design	Energy Label*	GPP requirement Energy	GPP requirement	Nordic suppliers of GPP products	Remarks
Professional kitchens									
Small: Walk-in cold room (WICR) up to 10 m².	Professional use for kitchens, cantinas etc. Remote cabinets for cooling or freezing.	Integrated refrigeration system and mono-blocks or condensing units. There are four different types for up to 10 m³ (fresh food) and up to "5–10 m³" (frost).	Propane (R290), max. 150g units. CO_2 (Condensing Unit).	No.	No.	No objective information available.	The methods for calculating insulation levels/energy efficiency are determined through EN16855 1 and 2 standards to the ecodesign standard, but standard not comparable. Insulation level for walls, min. 100 mm for freeze, min. 80 mm for cooling with a lambda value of 0.02 kW/m².	PORKKA has developed refrigeration systems using propane (R290) for small size WICR.	Only few HFC alternatives in the market. Low GWP an option but not considered as GPP standard level. Ecodesign will probably be introduced with the revision of Regulation 2015/1095. For condensing units: COP and SEPR energy efficiency criteria in EU regulation 2015/1095 (only relevant due to market regulation). GPP criteria should be based on basic for 0 GWP.

Product Category	Use	Description	HFC alternatives	Eco design	Energy Label*	GPP requirement Energy	GPP requirement	Nordic suppliers of GPP products	Remarks
Medium size and large: Walk-in cold room (WICR) above 10 m².	Professional use for kitchens, cantinas etc. Remote cabinet storages for cooling or freezing.	Integrated refrigeration system and mono-blocks or condensing units.	Condensing units with CO^2. Systems also use R452 (HFC/HFO blend GWP 2.141). Also experiences with R32 (GWP 675) and HFO drop in. PORKKA introduce HC or CO_2 in 2020. (medium).	No.	No.	No objective information available.	The methods for calculating insulation levels/energy efficiency are determined through EN16855 1 and 2 standards to the ecodesign standard, but standard not comparable. Insulation level for walls, min. 100 mm for freeze, min. 80 mm for cooling with a lambda value of 0,02 kW/m².	CO_2 condensing units: Green and Cool (SE), Carrier, Panasonic.	Only few HFC alternatives in the market. Product consists of an adequate number of energy consuming blocks. Size of storage has no impact on the relative energy-efficiency requirements. Low GWP an option but not considered as GPP standard level. Ecodesign will probably be introduced with the revision of Regulation 2015/1095. For condensing units: COP and SEPR energy efficiency criteria in EU regulation 2015/1095 (only relevant due to market regulation). GPP criteria should be based on basic for o GWP and amending criteria for TCO or energy.
Plug-in blast cabinet chillers.	Stand-alone cabinet for quick refrigeration or freezing of food.	Integrated refrigeration system.	Propane (table units below 150g).	Yes (only information).	No.	Ecodesign contain information in relation to energy	Not relevant.	FOSTER (UK) produces small units with propane.	New standard EN 17032:2018 for calculation of energy consumption.

Product Category	Use	Description	HFC alternatives	Eco design	Energy Label*	GPP requirement Energy	GPP requirement	Nordic suppliers of GPP products	Remarks
						consumption pr. kg. food to a certain temperature. The EN17032 standard for determination of the energy efficiency of a process for quick cooling and freezing equipment is being published.			Blast chillers are included in ecodesign report but only with information requirements. Revision in some years assumes to define energy efficiency. Standard requirements to function are refrigeration within 2 hours (from +65 °C to +10 °C). And for freezer: 4.5 hours (from +65 °C to -18 °C).
Remote Blast cabinet chillers.	Remote cabinet for quick refrigeration or freezing of food.	Condensing unit system.	CO_2 condensing units. Low GWP refrigerants for smaller units (R448, R449, R452).	(Yes).	No.	The EN17032 standard for determination of the energy efficiency of a process for quick cooling and freezing equipment is being published. BUT: The amendment: EN17032/A1 (April 2019) excludes	Not relevant.	PORKKA, GRAM is probably developing alternative for medium size units.	New standard EN 17032:2018 for calculation of energy consumption. BUT: The amendment: EN17032/A1 (April 2019) excludes remote systems if cabinet and condensing unit is sold separately. Therefore, the focus should be on the efficiency of the condensing unit and the ecodesign criteria in EU regulation 2015:1095. Blast chillers are included in ecodesign report but

Product Category	Use	Description	HFC alternatives	Eco design	Energy Label*	GPP requirement Energy	GPP requirement	Nordic suppliers of GPP products	Remarks
						remote systems.			only with information requirements. Revision in some years assumed to define energy efficiency. Standard requirement to function is refrigeration within 2 hours (4.5 hours for freezing).
Professional stand-alone cabinets for refrigeration.	Professional use for kitchens, cantinas etc.	All models.	Propane (R290) and other Hydro carbons (R600a).	Yes.	Yes.	Highest Energy Label level.	Insulation foamed with cyclopentane or HFO.	GRAM, PORKKA, HAGLUND.	Many GPP products and suppliers in the market. No HFC foam blowing, but e.g. hydrocarbon foam has lower Lambda value.
Professional stand-alone cabinets for freezing.	Professional use for kitchens, cantinas etc.	All models.	Propane (R290) and other Hydro carbons (R600a).	Yes.	Yes.	Highest Energy Label level.	Insulation foamed with hydrocarbons or HFO.	GRAM, PORKKA, HAGLUND.	Many GPP products and suppliers in the market. No HFC foam blowing, but e.g. hydrocarbon foam has lower Lambda value.
Refrigerated counters.	Professional use for kitchens, cantinas etc.	All models.	Propane (R290), Hydro carbon (R600a).	Yes.	Yes.	Highest Energy Label level.	Insulation foamed with hydrocarbon or HFO.	GRAM, PORKKA, HAGLUND.	Many GPP products and suppliers in the market. No HFC foam blowing, but e.g. hydrocarbon foam has lower Lambda value.
Commercial sales cabinets: **- Stand-alone bottle refrigerators** **- Refrigerates (bottle) automates** **- Ice cream freezers.**	Professional use for kitchens, cantinas etc. Use in schools, hospitals etc.	All models.	Propane (R290), isobutene (R600a).	From 1. March 2021.	From 1. March 2021.		Hydrocarbon blown foam (e.g. cyclopentane).	Vestfrost Solutions Elcold (ice cream freezers). Viessmann Refrigeration (previously Norpe).	Many GPP products and suppliers in the market. No HFC foam blowing, but e.g. hydrocarbon foam has lower Lambda value.

Product Category	Use	Description	HFC alternatives	Eco design	Energy Label*	GPP requirement Energy	GPP requirement	Nordic suppliers of GPP products	Remarks
	Some bottle refrigerators are provided for free with commercial displays.								
Household aplliances									
Fridges	Schools, nursery, kindergartens, nursing homes, other public buildings and institutions.	All models.	Isobutene (R600a).	Yes.	Yes, revised.	Highest Energy Label level.	Insulation foamed with hydrocarbons or HFO.	ALL EU BRANDS.	New Energy Label levels from the EU.
Freezers.	Schools, nursery, kindergartens, nursing homes, other public buildings and institutions.	All models.	Isobutene (R600a).	Yes.	Yes, revised.	Highest Energy Label level.	Insulation foamed with hydrocarbons or HFO.	ALL EU BRANDS.	New Energy Label levels from the EU.
Dry tumblers (condensed).	Schools, nursery, kindergartens, nursing homes, other public buildings and institutions.	Condensed dry tumblers only.	Smaller units using less than 150 grams of propane (R290) are on the market.	No.	Yes.	Highest Energy Label level.		ALL EU BRANDS. NTNU (Norway).	Condensing tumblers are more energy efficient than simple dry tumblers but contain refrigerant.
Hospital equipment									
Specialized low temperature freezers.	Used for laboratory purposes, plug-in systems.	All models.	Hydrocarbon blends (low GWP, below 5).	No.	No.	No objective information available.	Insulation foamed with hydrocarbon (cyclopentan) or HFO.	Vestfrost Solutions, Elcold, Gram Commercial.	Most applications contain PFC blends, but solutions with hydrocarbons are available.

Product Category	Use	Description	HFC alternatives	Eco design	Energy Label*	GPP requirement Energy	GPP requirement	Nordic suppliers of GPP products	Remarks
									Difficult to set GPP – it is a niche market.
Specialized equipment.	A range of hospital instruments and equipment has integrated refrigeration or ventilation, e.g. scanners and other electronic devices for monitoring, operation and care purposes.	Individual.	-	No.	No.		Not relevant.		Difficult to set GPP because functionality and safety requirements are the dominating consideration at procurement, and products are very individual.
Large public installations									
Ice rink.	Arenas for ice skating.		CO_2, R717 (Ammonia).					Tekojää Oy Sabroe/Johnson Control.	GPP: natural refrigerants + EEI.
Heat recovery systems - systems for heat ventilation (hot air and hot water).	Heat pumps.							Tekojää Oy Yleiskylmä-Findri Oy, Ikaalinen's Kylmälaitteella.	In general, it makes sense to design heat recovery where possible, but no standard solutions available, therefore difficult to set GPP criteria for.
Air-based or water-based cooling products and high temperature process Chillers.	Probably not relevant due to GPP.		R290, CO_2.	Yes.	No			Sabroe/Johnson Control.	ESYCool Green from Viesmann – also with "power2ice" and "power2battery" CO_2 is approx. 10–15% more energy consuming than Propane.

Product Category	Use	Description	HFC alternatives	Eco design	Energy Label*	GPP requirement Energy	GPP requirement	Nordic suppliers of GPP products	Remarks
District cooling, district heating (large heat pumps above 300 kW).	Large heat pumps for district heating. Large heat pumps for cooling (chillers), e.g. A/C in office buildings.		HFO 1234fz, Ammonia, R290 or other hydrocarbons.	Yes, for chillers up to 2MW. Heat pumps up to 400 kW.				Turbochor (Danfoss) heat up to 65 degree, might be necessary with combination to degrees up to 90 degree. Sabroe/Johnson Control.	HFO cheaper than ammonia systems. Seasonal energy efficiency for heat pumps must not fall below 110% (Ecodesign). Refer to test standard.
Air condition									
Chillers	Comfort refrigeration in public buildings (offices, institutions etc.).	Chillers for liquid refrigerationw ith calorifares.	Ammonia, Hydrocarbon.	Yes.	No.		Not relevant.	Johnson Control International. German company using water – (e-chillers up to 50 KW).	Constructed in modules.
Roof top (air conditioner, driven by an electric compressor of which the evaporator, compressor and condenser are integrated into a single package).	Comfort refrigeration in public buildings (offices, institutions etc.).	Medium to Large size stationary A/C units with medium to large charge.	No HFC alternatives (R407c). A building could be cooled by a water-based system, where a chiller cools the water. This is another technology.	Yes.	No.	Define energy GPP from ecodesign data.	Not relevant.	NILAN. Nilan build prototypes with CO_2 as refrigerant for a McDonalds restaurant in Vejle in 2003, but this is not a product available for purchase.	Many systems are reversible and can both cool and heat.
Split units (small – below 12KW).	Comfort refrigeration where many inside parts are required, e.g.	Direct refrigeration with individual control and	No HFC alternatives in Europe (R410A).	Yes.	Yes.	Highest Energy Label level.	Not relevant.		

Product Category	Use	Description	HFC alternatives	Eco design	Energy Label*	GPP requirement Energy	GPP requirement	Nordic suppliers of GPP products	Remarks
	hotels and some office buildings.	regulation. Consists of one outside part and one inside part. Reversible unit for A/C and heat pumps.	R32 introduced recently. Hydrocarbon alternatives in Asia. Not allowed in the EU yet.						
Split top (large – above 12 KW).	Comfort refrigeration where many inside parts are required, e.g. hotels and some office buildings.	Direct refrigeration with individual control and regulation. Consists of one outside part and one or more inside parts.	No HFC alternatives in Europe (R410A). R32 introduced recently (GWP 675). No direct HFC alternatives, but system alternatives (e.g. chillers). Systems using an outdoor unit working on propane (R290) has been marketed, and the cooling and heating to the hotel rooms is distributed with water.	Yes.	No.	Define energy GPP from ecodesign data.	Not relevant.	No Nordic manufacturers.	Water based alternatives (chillers) can in some cases be used instead of split systems.

Product Category	Use	Description	HFC alternatives	Eco design	Energy Label*	GPP requirement Energy	GPP requirement	Nordic suppliers of GPP products	Remarks
Heat pumps									
Heat pumps – water/air up to 1.5 kW domestic water.	Used for domestic hot water heating in one-family houses or similar.		Propane (R290).	Yes.	Yes.	Highest Energy Label level. Energy efficiency (COP) should refer to Nordic climate conditions.		VESTTHERM is so far the only supplier of HFC free alternative.	
Heat pumps – water/air 4–12 kW radiators.	Used for domestic heating in one-family houses.	Air/water heat pumps for heating with radiators.	Low GWP (R32). Propane is a trend for development.	Yes. Refrigerants with a GWP of 150 or lower can comply with the Ecodesign regulation.	Yes.	Highest Energy Label level. Energy efficiency (COP) should refer to Nordic climate conditions.		ALL EU BRANDS.	Define from Danish Energy Agency list with recommended pumps: https://sparenergi.dk/forbruger/vaerktoejer/varmepumpelisten. Heat pumps for floor heating have high energy efficiency. Heat pumps for radiators heating have lower energy efficiency.
Heat pumps – water/air 4–12 kW floor heating.	Used for domestic heating in one-family houses.	Air/water heat pumps for floor heating.	Low GWP (R32). Propane is a trend for development.	Yes.	Yes.	Highest Energy Label level. Energy efficiency (COP) should		ALL EU BRANDS.	Danish Energy Agency list with recommended pumps: https://sparenergi.dk/forbruger/vaerktoejer/varmepumpelisten.

Product Category	Use	Description	HFC alternatives	Eco design	Energy Label*	GPP requirement Energy	GPP requirement	Nordic suppliers of GPP products	Remarks
						refer to Nordic climate conditions.			Heat pumps for floor heating have high energy efficiency. Heat pumps for radiators heating have lower energy efficiency.
Heat pumps – water/air + 12 KW.	Used for domestic heating in larger buildings, e.g. schools and similar size public institutions.	Air/water heat pumps for floor heating or heating with radiators.	Low GWP (R32) + R290 above 20kW.	Yes (up to 400 kW).	Yes (up to 70 kW).	Highest Energy Label level. Energy efficiency (COP) should refer to Nordic climate conditions.		ALL EU BRANDS. Germany has marketed +20 kW on R290.	Danish Energy Agency list with recommended pumps: https://sparenergi.dk/forbruger/vaerktoejer/varmepumpelisten (up to 25 kW). Heat pumps for floor heating have high energy-efficiency. Heat pumps for radiators heating have low energy efficiency.
Heat pumps – brine/water.	Used for domestic heating in one-family houses.	Brine/water ground source heat pumps.	Low GWP.	Yes.	Yes.	Highest Energy Label level. Energy efficiency (COP) should refer to Nordic climate conditions.		ALL EU BRANDS.	Danish Energy Agency list with recommended pumps: https://sparenergi.dk/forbruger/vaerktoejer/varmepumpelisten
Heat pumps – air/air (all sizes).	Used for domestic heating in one-family houses.	Air to air heating – 30 to 100 m² space	No HFC alternatives in Europe (R410A). R32 introduced recently (GWP 675).	Yes.	Yes.	Highest Energy Label level. Energy efficiency (COP) should		ALL EU BRANDS.	Danish Energy Agency list with recommended pumps: https://sparenergi.dk/forbruger/vaerktoejer/varmepumpelisten

Product Category	Use	Description	HFC alternatives	Eco design	Energy Label*	GPP requirement Energy	GPP requirement	Nordic suppliers of GPP products	Remarks
			Hydrocarbon alternatives in Asia.			refer to Nordic climate conditions.			
Refrigeration of it equipment									
Refrigeration of servers, chillers.	Used for refrigeration of central server rooms etc.	Probably chillers for liquid refrigeration with calorifares.	Ammonia, Hydrocarbon CO_2.	Yes.	No.		Not relevant.		Constructed in modules.
Refrigeration of servers, switch cabinets.	Switch cabinets.		R718 (water), CO_2.	Yes.	No.			German company using water – (e-chillers up to 50 KW).	80% energy saving compared to HFC units.

Annex 2 – Result of web-search on HFC alternatives in product groups

As part of the survey exercise, a systematic Google search was carried out. The objective was to identify relevant eco-labels, GPP criteria, best practises, reports and information on environmentally friendly products, that falls within the product categories of this project. The search was carried out by using key words for the specific product groups relevant for this project in combination with either "green public procurement" or "eco". The results are presented in the following tables.

Table A2: Manufacturers and retailers of environmentally friendly products.

Product category	Manufacturers/retailers
Air conditioning	- Inventor air conditioner: https://www.inventorairconditioner.com/air-conditioning/wall-mounted-air-conditioners/discontinued-models/passion-eco - Fluo air-condition: https://fluoaircondition.com/en/wall-mounted-ac-2/tempo-dc-inverter-ecodesign-r32/ - Vesttherm: http://vesttherm.dk/en/node/111 - Phnix-E: https://www.phnix-e.com/
Professional stand-alone cabinets	- Gram: http://gram-commercial.com/gb/en-gb/premigram-commercial-takes-low-energy-to-new-heightsere-superior-and-eco - Foster Refrigerator: https://www.fosterrefrigerator.com/en/products/cabinet/ecopro-g2-cabinets - Labtron: https://www.labtron.uk/description/Solar-Powered-Products/Solar-Eco-Freezer/LSEF-E11 - Eco-fridge: https://www.eco-fridge.co.uk/
Laboratory freezers	- Frigolab: https://www.frigolab.eu/ultra-deep-freezers/267-ultra-low-freezer-eco-ultra-55.html - Panasonic: https://nordiclifescience.org/panasonic/introducing-energy-efficient-vip-eco-ult-freezer/ - PHCHD: https://www.phchd.com/global/biomedical/preservation/biomedical-freezers/biomedical-30-freezers/mdf-mu500h
Chillers	- Pfanneberg: https://www.pfannenberg.com/en/news-press/detail/eco-chillers-chillers-with-a-new-cooling-concept-offer-significant-savings/ - Eco-max Chillers: http://www.eco-maxchillers.com/ - Eco Plususa: http://www.ecoplususa.com/shop/product/ecoplus-commercial-grade-water-chillers
Ice rinks	- Huurre: http://www.huurre-eco.com/huurre-eco-co2-chiller-with-itop-control-to-testebo-ice-rink/

Table A3: Findings from systematic Google search.

Key words	Findings
Walk in fridge + eco	-
Walk in fridge + gpp	- Canada has regulation on walk-in fridge in relations to energy efficiency: https://www.nrcan.gc.ca/energy/products/categories/food-service/cooling/walk-in/14091
Walk in fridge + green public procurement	- Report on ASIAN-countries' GPP schemes. E.g., China has a GPP scheme that also focuses on low CFCs from refrigeration: http://www.aprscp.net/Document/Final%20Report-EL%20&%20SPP%20in%20ASEAN%20+%203.pdf - List from the American Environmental protection Agency on possible substitute substances in refrigeration and air condition. Substitutes are listed per product category: https://www.epa.gov/snap/substitutes-refrigeration-and-air-conditioning - Green Procurement Compilation – an American website for public contractors to get an overview of legal requirements, saving, guiding principles, etc. Contains information on energy saving and substitution of problematic substances. It covers a wide range of products, such as fridges, freezers, commercial fridges and freezers, air conditioning, etc.: https://sftool.gov/greenprocurement/green-products/21/appliances/0
Refrigeration + green procurement	- Green Cooling Initiative – a project by the German development agency with the objective to promote a green cooling industry that is energy efficient and uses natural refrigerants. The target group is developing countries, and Africa in particular. The GCO is an alliance of key players in the RAC industry, including businesses and government bodies. The website includes a list of companies, government bodies and organizations involved in the network. That would be a good spot to look for suppliers of green products to the market. The network is truly global in scope – the initiator is Germany, but mainly developing countries' governments are among the members. There is an elaborated list of best practises, including various cooling products that use natural refrigerants: https://www.green-cooling-initiative.org/ - Cooling for all – this is an initiative supported by the Kigali cooling efficiency program. Its main contribution is an elaborated report on the rising need for cooling in the developing world, the risks of lack of access to cooling, and the possible environmental impacts of growing needs for cooling. It also deals with HFCs in cooling products and the intersection between the Kigali amendment and the Paris agreement. The report is from 2018 and titled Chilling Prospects: Sustainable cooling for all: https://www.seforall.org/interventions/cooling-for-all
Professional fridge + eco	- Producer of freezers and fridges for professional use with refrigerants with rather low GWP: https://www.foster-fridge.com/info/foster-refrigerator-gastro-eco-pro-range-explained/ - Gram: http://gram-commercial.com/gb/en-gb/premigram-commercial-takes-low-energy-to-new-heightsere-superior-and-eco - Foster Refrigerator: https://www.fosterrefrigerator.com/en/products/cabinet/ecopro-g2-cabinets - ProCold / topten – an EU sponsored project to promote more sustainable refrigeration solutions. It offers a list of sustainable products for procurement (a top ten of best products) and a set of GPP criteria with emphasis on energy efficiency and use of refrigerants. Technical specifications of the criteria: http://www.topten.eu/uploads/Storage_Refrigerators_Freezers_Procurement_Guide_August_2016.pdf
Professional fridge + green public procurement	-
Ice cream freezer + eco	-

Ice cream freezer + green public procurement	- Report from ProCold on the progress of the project. This is the research that has informed the topten.eu: http://www.pro-cold.eu/uploads/Deliverables/D3_8_Progress-Report-Food-Beverage-Companies.pdf
Bottle refrigerator + green public procurement	-
Bottle refrigerator + eco	-
Freezer + eco	- Nestlé uses eco-friendly freezers for ice cream: https://www.nestle.com/ask-nestle/environment/answers/eco-freezer-logo - Retailer of eco-friendly freezers: https://www.labtron.uk/description/Solar-Powered-Products/Solar-Eco-Freezer/LSEF-E11
Freezer + green public procurement	- The Philipines has developed criteria for GPP for a wide range of products, including freezers, fridges and aircondition: https://www.gppb.gov.ph/downloadables/forms/GPP%20Technical%20Specifications%20Doc%20-%20Final.docx
Fridge + eco	- Retailer of environmentally benign commercial fridges: https://www.eco-fridge.co.uk/
Fridge + green public procurement	-
Low temperature freezer + green public procurement	- Producers of lab freezers – not clear if they use suitable refrigerants or not: https://www.frigolab.eu/ultra-deep-freezers/267-ultra-low-freezer-eco-ultra-55.html - Panasonic produces environmentally friendly low-temperature freezers: https://nordiclifescience.org/panasonic/introducing-energy-efficient-vip-eco-ult-freezer/ - PHCHD – producer of environmentally friendly low temperature freezers: https://www.phchd.com/global/biomedical/preservation/biomedical-freezers/biomedical-30-freezers/mdf-mu500h - EU GPP criteria for equipment used in medical health care: http://ec.europa.eu/environment/gpp/pdf/criteria/health/EN.pdf
Chiller + eco	- Manufacturer of eco-friendly chillers, including use of substances with low GWP: https://www.pfannenberg.com/en/news-press/detail/eco-chillers-chillers-with-a-new-cooling-concept-offer-significant-savings/ - Manufacturer of eco-friendly chillers, including use of substances with low GWP: http://www.eco-maxchillers.com/ - Manufacturer of eco-friendly chillers, including use of substances with low GWP: http://www.ecoplususa.com/shop/product/ecoplus-commercial-grade-water-chillers
Chiller + green public procurement	- Best practise from Spain in relation to cooling of data centres: http://www.sustainable-procurement.org/fileadmin/templates/sp_platform/lib/sp_platform_resources/tools/push_resource_file.php?uid=6296a08c
Air condition + green public procurement	- IISD report on evidence from Chinese experiences with GPP. Of the product groups included in this project, only air conditioning is mentioned in the report: https://www.iisd.org/sites/default/files/publications/how-gpp-contributes-sustainable-development-china.pdf - Policy paper to promote GPP with a focus on low-GWP in refrigerants in India: http://www.ceew.in/sites/default/files/CEEW-Promoting-Low-GWP-Refrigerants-through-Public-Procurement-3Oct17.pdf
Air condition + eco	- Producer of environmentally friendly air-conditioner: https://www.inventoraironditioner.com/air-conditioning/wall-mounted-air-conditioners/discontinued-models/passion-eco - Producer of environmentally friendly air-conditioner: https://fluoaircondition.com/en/wall-mounted-ac-2/tempo-dc-inverter-ecodesign-r32/
Heat pump + eco	- Producer of eco-friendly AC: http://vesttherm.dk/en/node/111 - Producer of eco-friendly AC: https://www.phnix-e.com/

	There are lots of other producers found in this search, but we only include the ones that specifically mentioned refrigerant and not just energy efficiency as their “eco-ness”.
Heat pump + green public procurement	EU draft criteria for GPP in data centres, including cooling systems for server rooms: http://susproc.jrc.ec.europa.eu/Data_Centres/docs/181128_Draft%20Technical%20report%20EU%20GPP%20Data%20Centres%20-%20v3.0%20JRC%20Nov2018%20clean.pdf
Refrigeration of IT equipment + green public procurement	-
Ice rink + eco	Huurre makes eco-friendly cooling systems for ice rinks: http://www.huurre-eco.com/huurre-eco-co2-chiller-with-itop-control-to-testebo-ice-rink/
Ice rink + green public procurement	-

About this publication

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