

Consultation Forum:

Preliminary results:

Availability of alternatives to HFCs in commercial refrigeration in the EU



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Service Contract
No 34.0201/2015/716695/SER/CLIMA.C.2
with DG CLIMA

Background

- Assessment of prohibition on multipack centralised refrigeration for commercial use
- Input for EC report regarding Article 21(3)
- Mission: assess availability of cost-effective, technically feasible, energy-efficient and reliable alternatives



Regulation (EU) No 517/2014 Annex III (13) prohibition:

"Multipack centralised refrigeration systems for commercial use with a rated capacity of 40 kW or more that contain, or whose functioning relies upon, fluorinated greenhouse gases with GWP of 150 or more, except in the primary refrigerant circuit of cascade systems where fluorinated greenhouse gases with a GWP of less than 1500 may be used."

Approach

- Technology assessment led by Prof.
 Kauffeld
- Analysis of affected systems and available technological options
- Questionnaire to gather stakeholder input
- Dissemination directly and via industry associations, events, meetings and workshops
- Close dialogue with industry experts



Outreach and dissemination

Total of 17 questions on:

F-gas Regulation

State of technology

Alternative options

Feasibility and reliability

Energy efficiency

Cost effectiveness

Obstacles

- Outreach to >143 organisations in 19 EU countries
- Refrigerant, component and equipment manufacturers, end-users, consultants, NGOs and research institutes were included



Questionnaire for stakeholders

Assessment of low-GWP alternatives in commercial refrigeration

Instructions

Öko-Recherche and Prof. Michael Kauffeld are entrusted by DG CLIMA of the European Commission under Service Contract No 34.0201/2015/716695/SER/CLIMA.C.2¹ to gather input from sector experts and stakeholders regarding the availability of low-GVP alternatives in commercial refrigeration. This request is linked to article 21(3) of Regulation (EU) No 517/2014 where the Commission is tasked to assess the 2022 ban on new multipack centralized refrigeration systems³ for commercial use¹ > 40 kW¹ operating with refrigerants with a GWP of 150 or more, while allowing for all initied use of HFCs in some special types of cascade systems (refrigerants with a GWP of up to 1,500 will still be allowed in primary circuits of cascade systems¹).

If your company or institution is active in the relevant commercial refrigeration sector and considers itself a relevant stakeholder for this study, you are kindly invited to provide us your input to the questions in this document.

Your responses will be treated as confidential. We nonetheless kindly ask you to provide contact details for any follow-up questions that we might have.

^{1 &}quot;Service contract for supporting F-Gas Policies — Lot 1 Supporting domestic F-gas Policies"

² According to Regulation (EU) No 517/2014 'multipack centralised refrigeration systems' means systems with two or more compressors operated in parallel, which are connected to one or more common condensers and to a number of cooling devices such as display cases, cabinets, freezers or to chillied store rooms.

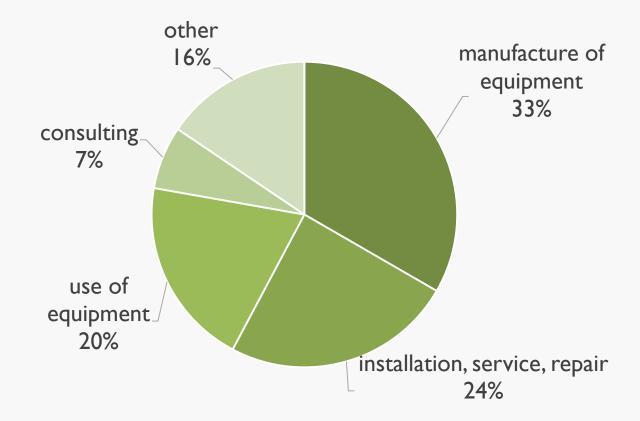
³ According to Regulation (EU) No 517/2014 'commercial use' means used for the storage, display or dispensing of products, for sale to end users, in retail and food services.

⁴⁻⁰kW refers to the rated capacity of a single refrigeration circuit at evaporation temperatures of -10°C for medium temperature (MT) applications and -35°C for low temperature (LT) applications at an ambient temperature of 32°C. If a refrigeration circuit can deliver both MT and LT capacity at the same time, the sum of the capacities applies. Otherwise the higher of both capacities applies. For <u>multifunctional</u> only the refrigeration capacities apply and not the air conditioning or heating capacities.

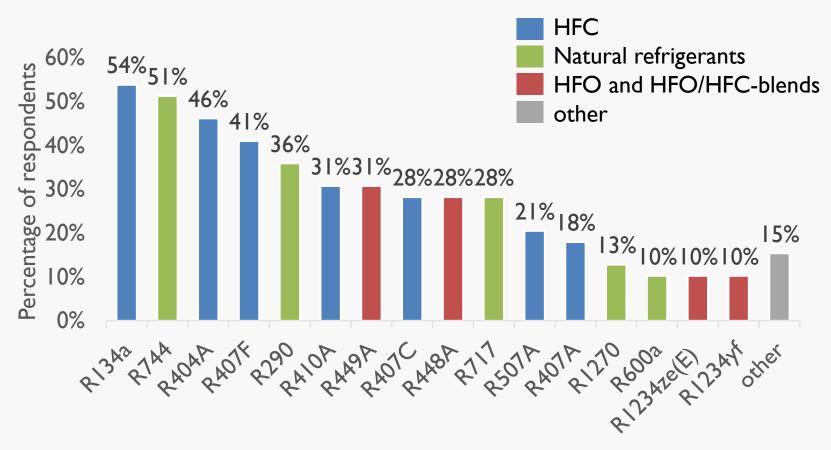
According to Regulation (EU) No 517/2014 'primary refrigerant circuit of cascade systems' means the primary circuit in indirect medium temperature systems where a combination of two or more separate refrigeration circuits are connected in series such that the primary circuit absorbs the condenser heat from a secondary circuit for the medium temperature.

Feedback

• 39 responses (incl. 18 from EU South)

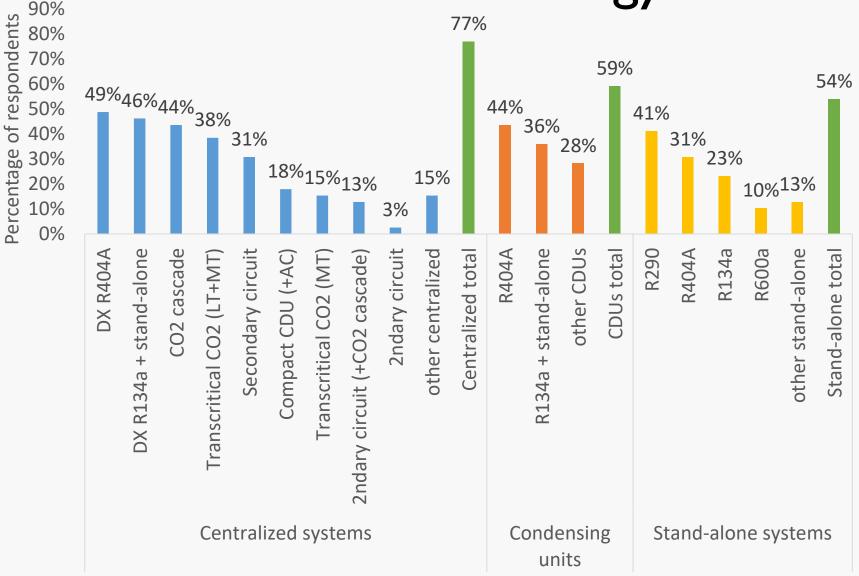


State of technology

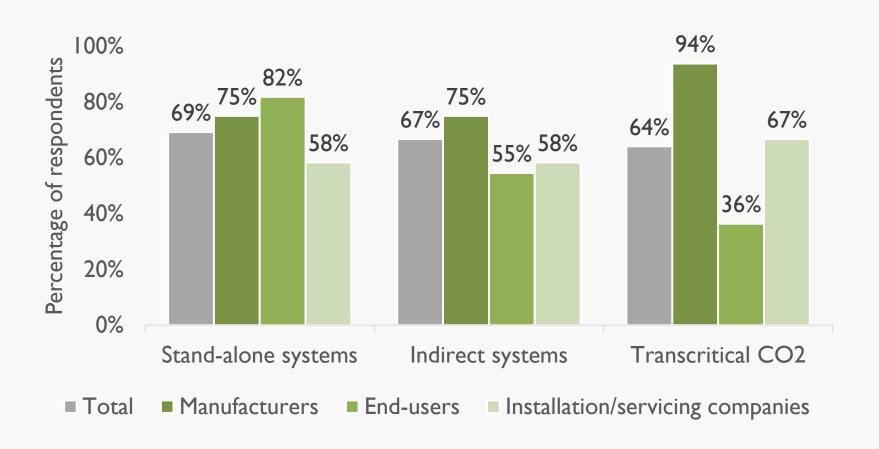


→ Natural refrigerants no longer a niche technology but HFCs still dominate market

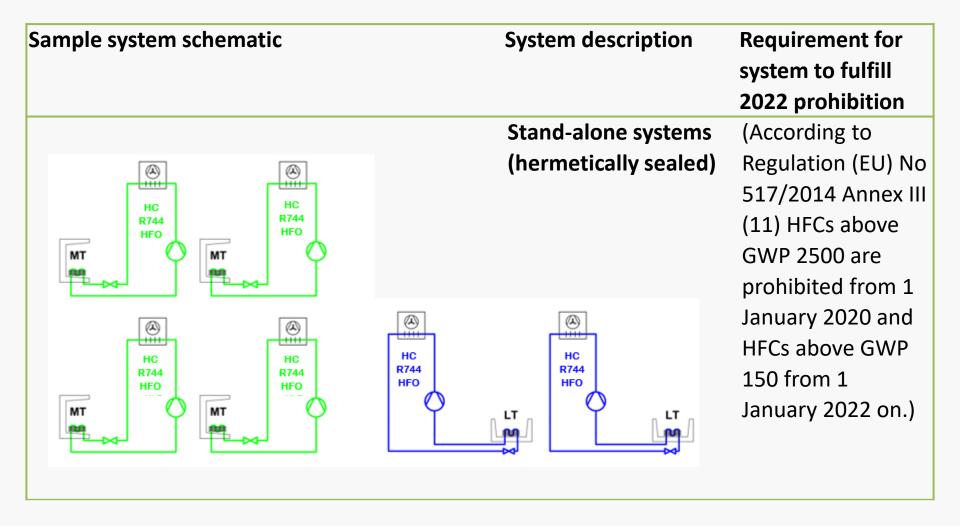
State of technology



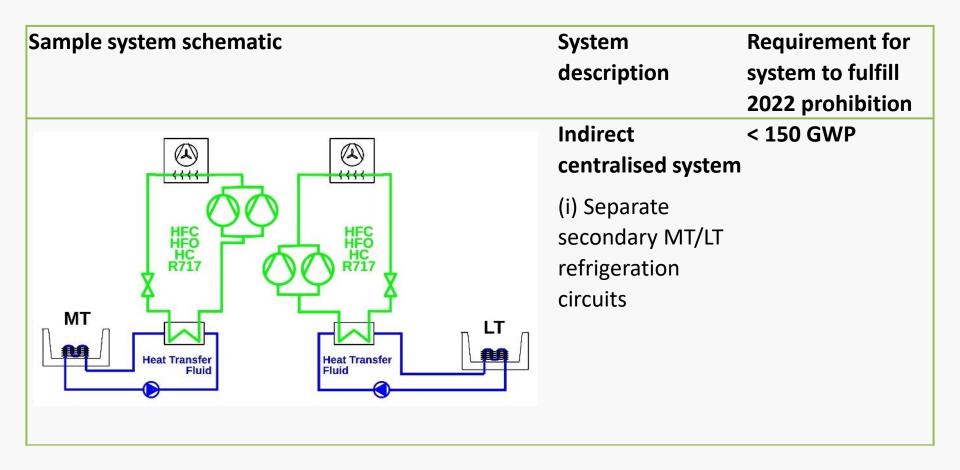
Technical options for meeting the prohibition



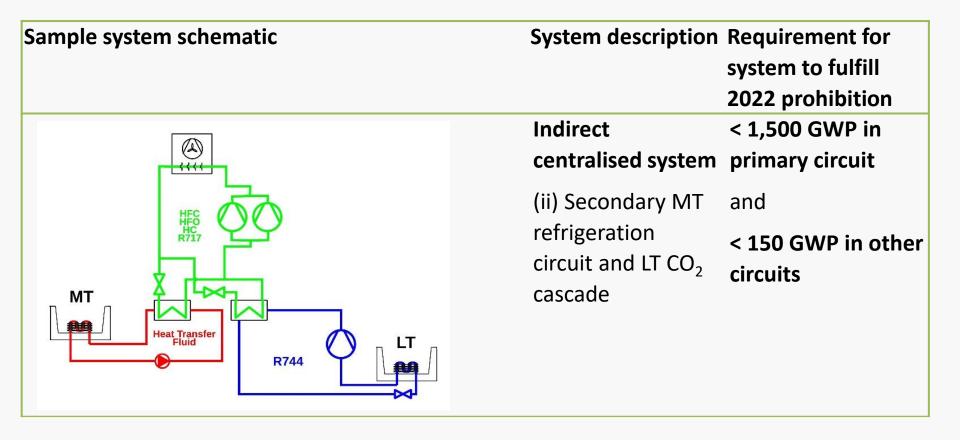
Available technical options for meeting the prohibition: Stand-alone systems



Available technical options for meeting the prohibition: Indirect systems (i)

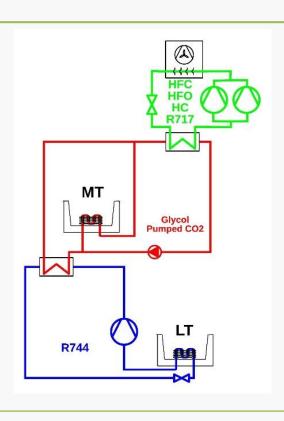


Available technical options for meeting the prohibition: Indirect systems (ii)



Available technical options for meeting the prohibition: Indirect systems (iii)

Sample system schematic



System description Requirement for

system to fulfill 2022 prohibition

Indirect centralised system

(iii) Secondary MT refrigeration circuit (e.g. pumped CO₂) and LT CO₂ cascade

< 1,500 GWP in primary circuit

and

< 150 GWP in other circuits

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Available technical options for meeting the prohibition: Transcritical CO₂

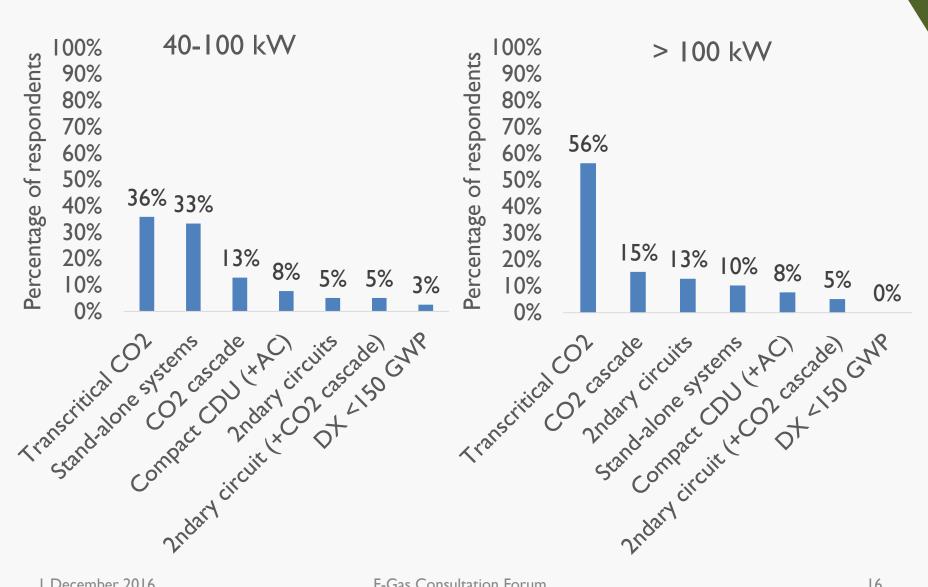
Sample system schematic	System description	Requirement for system to fulfill 2022 prohibition
R744 X	Transcritical CO ₂	

Feasibility and reliability of available technical options

Stand-alone:

- Millions of units in light commercial applications in the World
- Semi plug-ins possible
- Charge size limitations for flammables
- Indirect centralised systems
 - Very common in industrial applications
 - Used in supermarkets in SE, NO, LU, CH since 1990s
 - Recently R290 chillers in DE, UK, BE and CH
 - NH₃/CO₂ cascades possible
- Transcritical CO₂
 - Standard technology in many parts of EU
 - Efficiency improvements enabled installations in ES, IT and PT

Cost effectiveness (i)

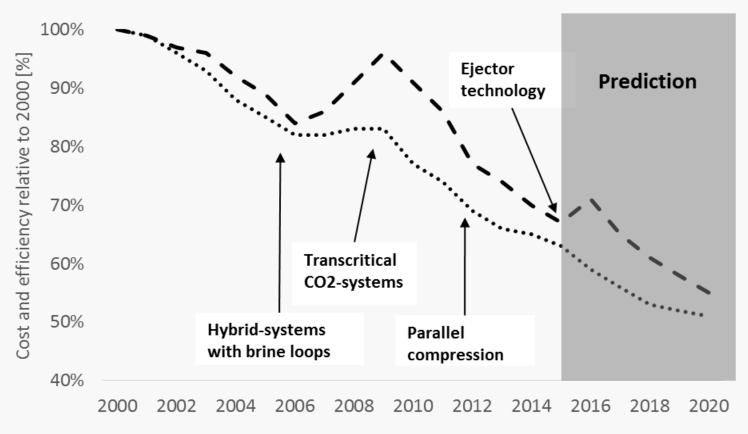


Cost effectiveness (ii)

- Stand-alone already costcompetitive especially in small and medium stores
- CO₂ cascades with NH₃, propylene, propane or HFOs and pumped CO₂ cost-competitive in large stores and hypermarkets
- Transcritical CO₂ already costcompetitive even in large stores



Cost effectiveness (iii)

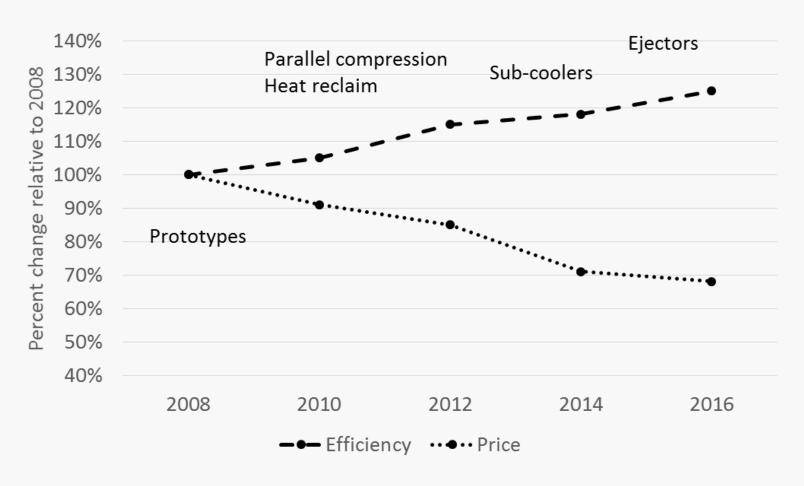


Average investment costs per length of cabinet [%]

••••• Average energy consumption per length of cabinet [%]

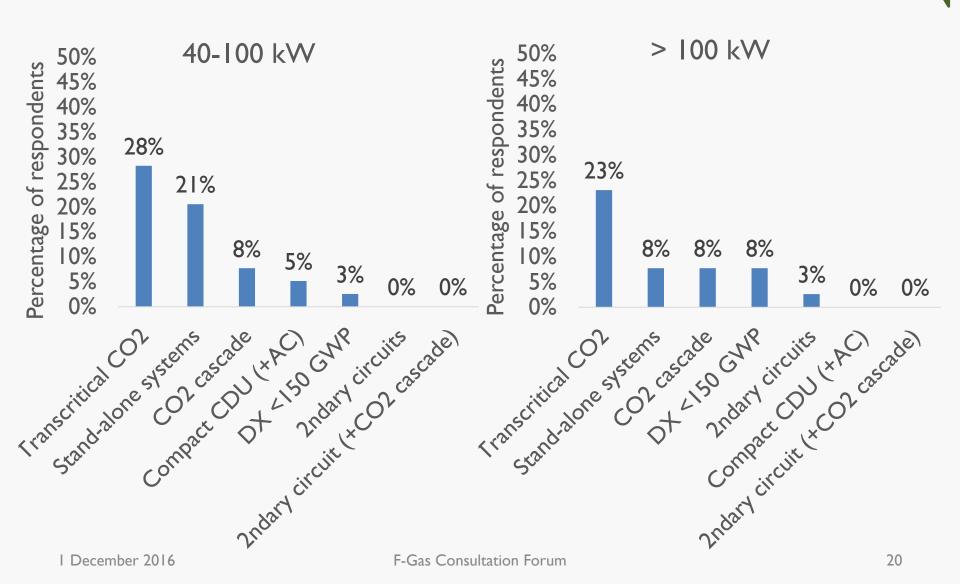
Source: Frigo-consulting AG

Cost effectiveness (iv)



Source: Advansor

Energy efficiency (i)



Energy efficiency (ii)

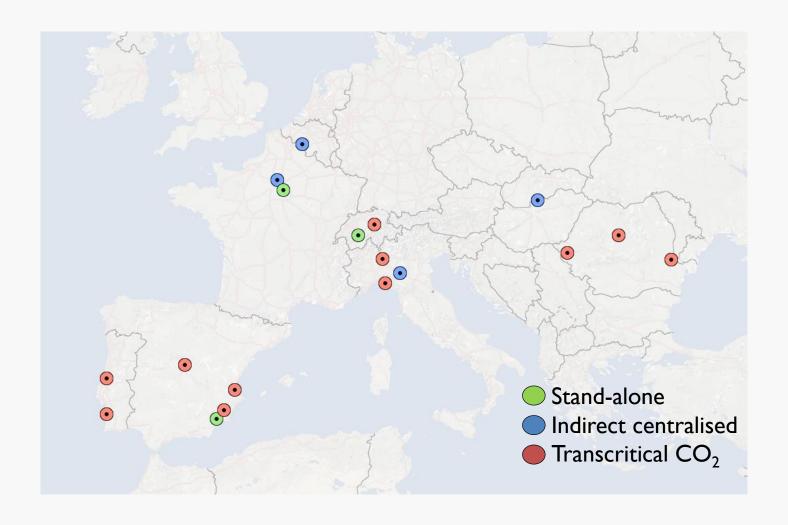
- Case studies and experts indicate:
 - Transcritical CO₂ offers 7-30% energy savings
 - Semi plug-ins offer around 20% savings
- Heat recovery can further increase energy savings
- Some respondents indicated HFC systems as most energy efficient



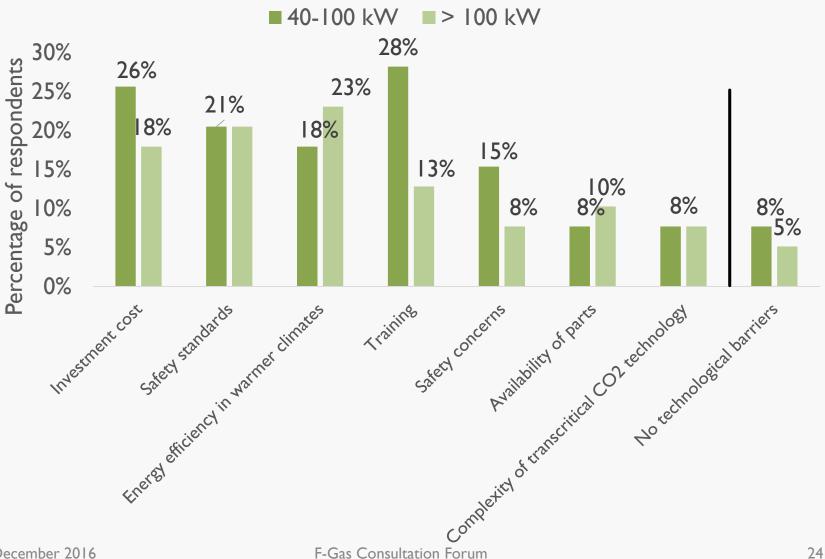
Southern Europe

- Assessment also focused on Southern Europe
- R134a/CO₂ currently most used alternative
 - No longer available from 2022 on!
- Transcritical CO₂ can be efficient and already operates in ES, PT and IT
- Stand-alone systems (CO_2 and HCs) also already operate efficiently in warm and hot regions globally
- Indirect centralised systems:
 - Experience from South Africa and US suggest NH₃/CO₂ cascades are efficient in warm climates
 - Likewise CO₂ cascade with glycol loop and R134a in primary operates efficiently in Brazil

Detailed case studies



Obstacles named by survey participants



Conclusions (i)

- Successful outreach to many stakeholders (conferences, surveys, meetings with associations)
- A clear definition of systems subject to the prohibition is available
- Three system design options available today which do not fall under the prohibition

	40-100kW	>100kW
Transcritical CO ₂		
Stand-alone systems		
Indirect centralised systems		

Conclusions (ii)

- Take away messages:
 - Current and fast-paced development of alternative technologies
 - Multiple technically feasible, energy-efficient and reliable alternatives available for all store formats
 - Cost effectiveness reached or will be reached by 2022



Thank you for your attention!

Questions...???

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Links:

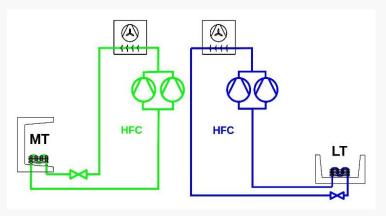
Resources for this project:

http://oekorecherche.de/de/projekte-referenzen/unterstuetzung-der-eu-f-gas-politik

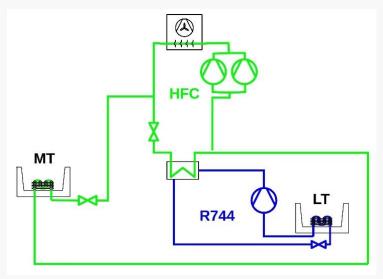
Information regarding EU F-gas policy: http://ec.europa.eu/clima/policies/f-gas/index_en.htm



Supermarkets – prohibited after 2022 ban



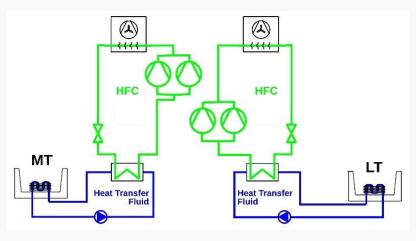
DX-systems



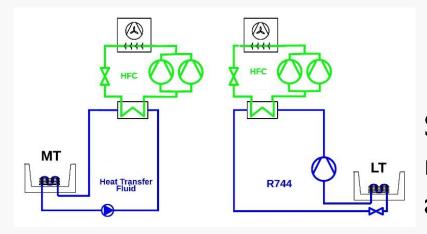
Cascade CO₂

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Supermarkets – prohibited after 2022 ban



Secondary MT/LT refrigeration circuit



Secondary MT refrigeration circuit and LT CO₂ cascade