

Transport Refrigeration with Propene and Carbon Dioxide

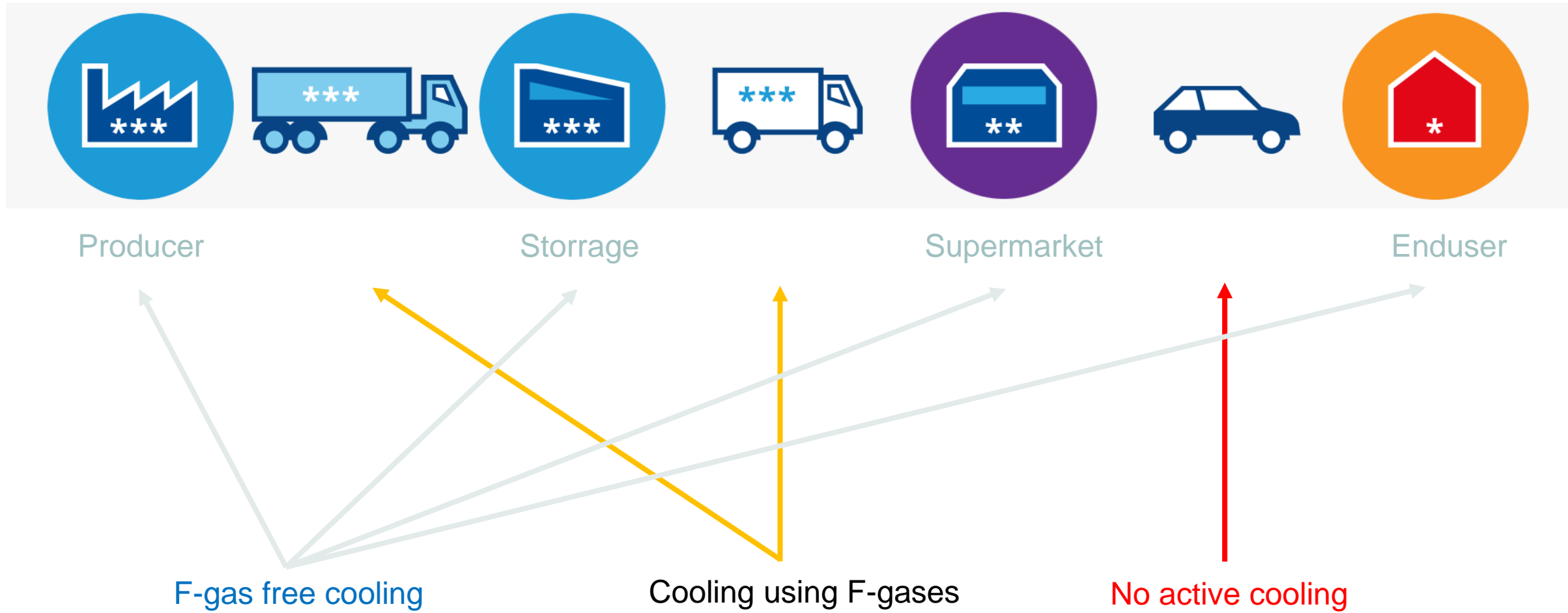
Dr. Jürgen Süß, CTO, ECOOLTEC GmbH, Mülheim an der Ruhr

eurammön Symposium, 28.06.2023

Tradition in transport refrigeration since 1978



The cold chain



EU Legislation




English

Climate Action

- Home
- About us
- Climate change
- EU Action**
- Citizens
- News & Your Voice
- Funding opportunities

Home > EU Action > Fluorinated greenhouse gases > EU legislation to control F-gases

EU legislation to control F-gases

To control emissions from fluorinated greenhouse gases (F-gases), including hydrofluorocarbons (HFCs), the European Union has adopted two legislative acts: the F-gas Regulation and the MAC Directive.

F-gas Regulation from 2015

Following the UK's withdrawal, the F-gas Regulation continues to apply to Northern Ireland as stipulated in the [Protocol on Ireland/Northern Ireland](#).

The [current F-gas Regulation](#) (EN ***), which applies since 1 January 2015, replaces the [original F-gas Regulation](#) (EN ***), adopted in 2006. The implementing Regulations of the original Regulation remain in force and continue to apply until new acts are adopted.

The current Regulation strengthened the previous measures and introduced far-reaching changes by:

- **limiting the total amount** of the most important F-gases (HFCs) that can be sold in the EU from 2015 onwards and phasing them down in steps to one-fifth of 2014 sales in 2030. This will be the main driver of the move towards more climate-friendly technologies
- **banning the use** of F-gases in many new types of equipment where less harmful alternatives are widely available, such as fridges in homes or supermarkets, air conditioning, foams and asthma sprays
- **preventing emissions** of F-gases from existing equipment by requiring checks, proper servicing and recovery of the gases at the end of the equipment's life



An agency of the European Union



EUROPEAN CHEMICALS AGENCY

- About Us
- Contact
- Jobs
- Search the website

- LEGISLATION**
- CONSULTATIONS
- INFORMATION ON CHEMICALS

ECHA > News > Hot topics > Per- and polyfluoroalkyl substances (PFAS)

Hot topics

- Preventing cancer
- Skin sensitising chemicals
- Per- and polyfluoroalkyl substances (PFAS)**
- Microplastics
- Granules and mulches on sports pitches and playgrounds

Per- and polyfluoroalkyl substances (PFAS)

Per- and polyfluoroalkyl substances (PFAS) are a large class of thousands of synthetic chemicals that are used throughout society. However, they are increasingly detected as environmental pollutants and some are linked to negative effects on human health.

They all contain carbon-fluorine bonds, which are one of the strongest chemical bonds in organic chemistry. This means that they resist degradation when used and also in the environment. Most PFAS are also easily transported in the environment covering long distances away from the source of their release.

Transport Refrigeration with Propene and Carbon Dioxide

4

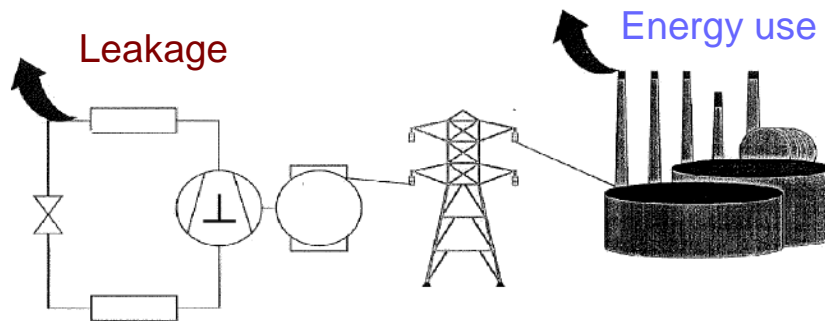
GHG emissions of the HVAC&R industry

Energy use for system operation

“Indirect Emissions”

Refrigerant leakage/release

“Direct Emissions”



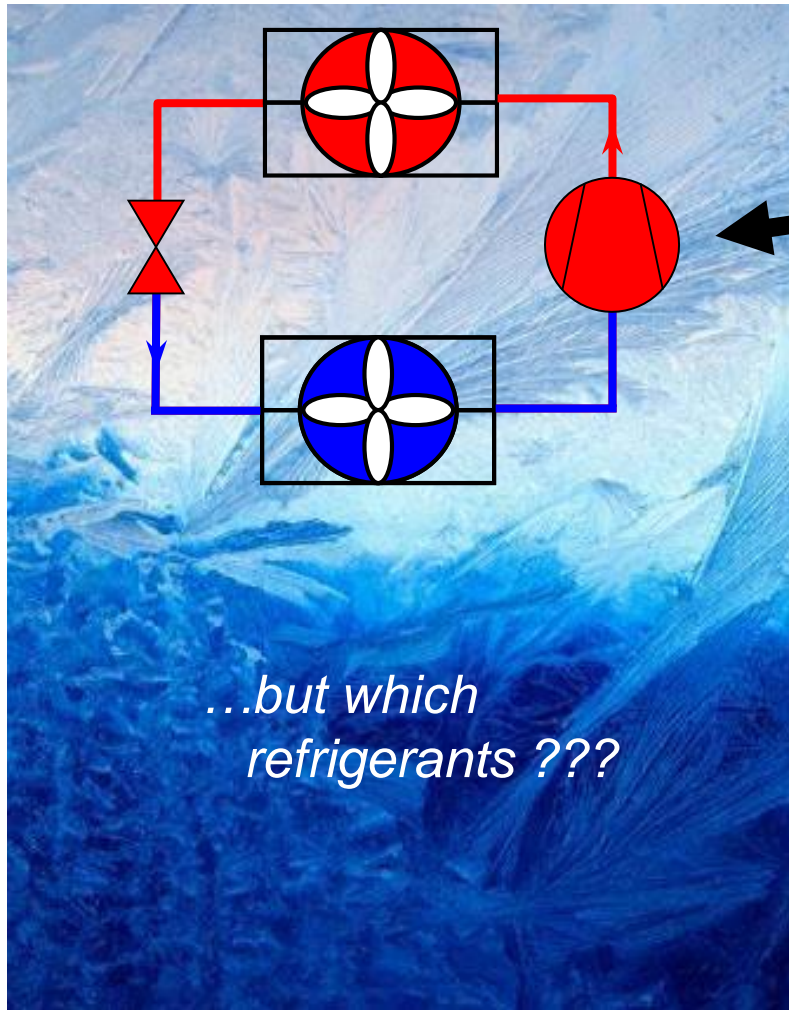
- ~~Mobile Air Conditioning (HFC)~~

MAC DIRECTIVE
2006/40/EC

- Commercial Refrigeration (Supermarket DX HFC)

- Unitary Air Condition/Heat Pump (HFC)
- Commercial Air Condition (HFC)
- Light Commercial Appliance SME (HFC)
- Water Chiller (HFC)
- Domestic Refrigerator (HFC)
- Domestic Refrigerator (HC)

How to cool best



- Reverse Rankine
- Stirling
- Magneto caloric
- Vortex tube
- Joule process
- Peltier
- Steam ejector
- Absorption
- Adsorption
-

Refrigerant Options

more flammable

more toxic

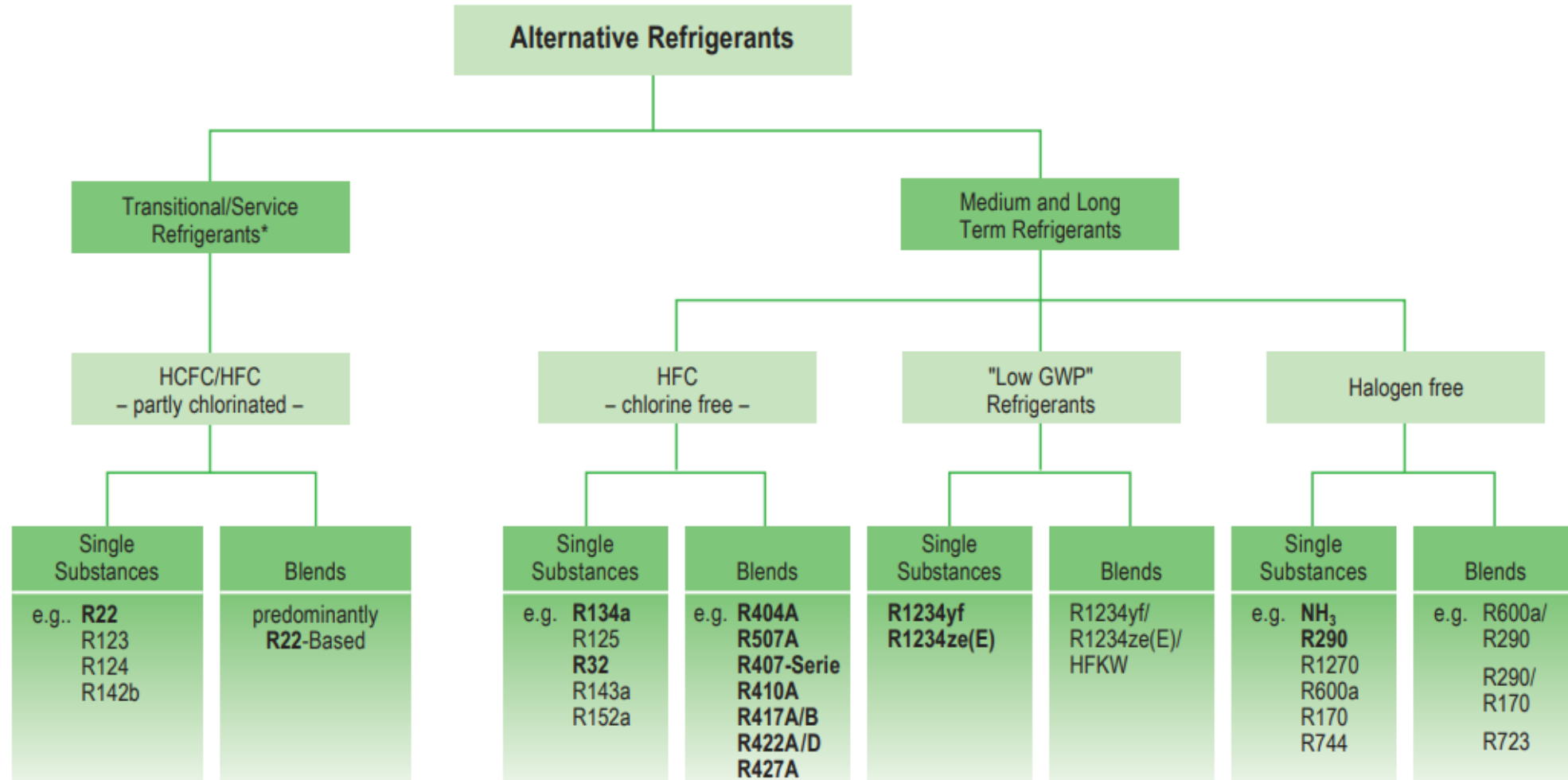
Table of Selected Radioactive Isotopes

... only 8 elements are really suitable for refrigerant molecules

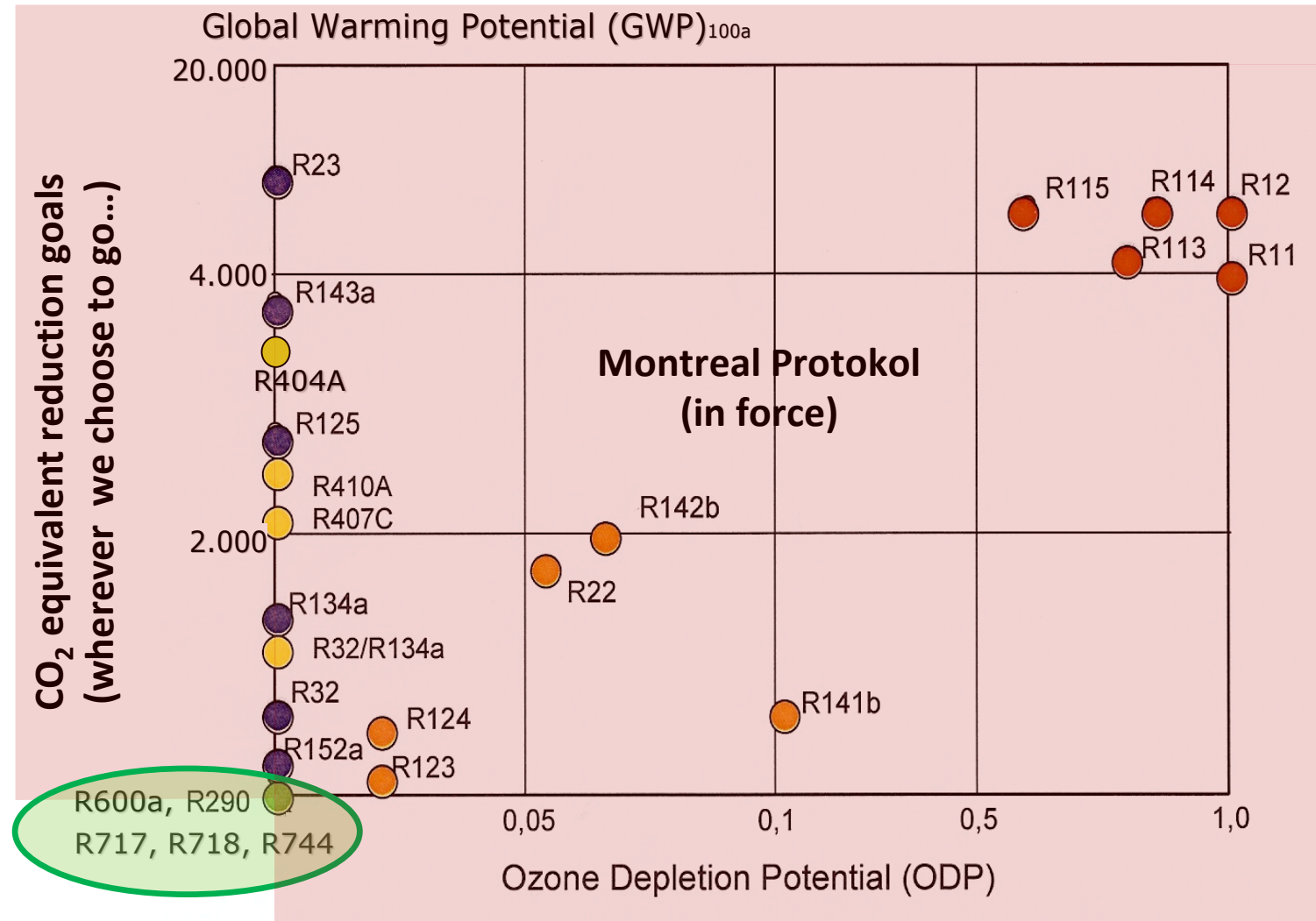


58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Refrigerants Overview



Ozone Depletion and Global Warming



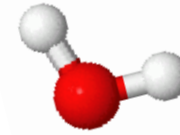


Our concept

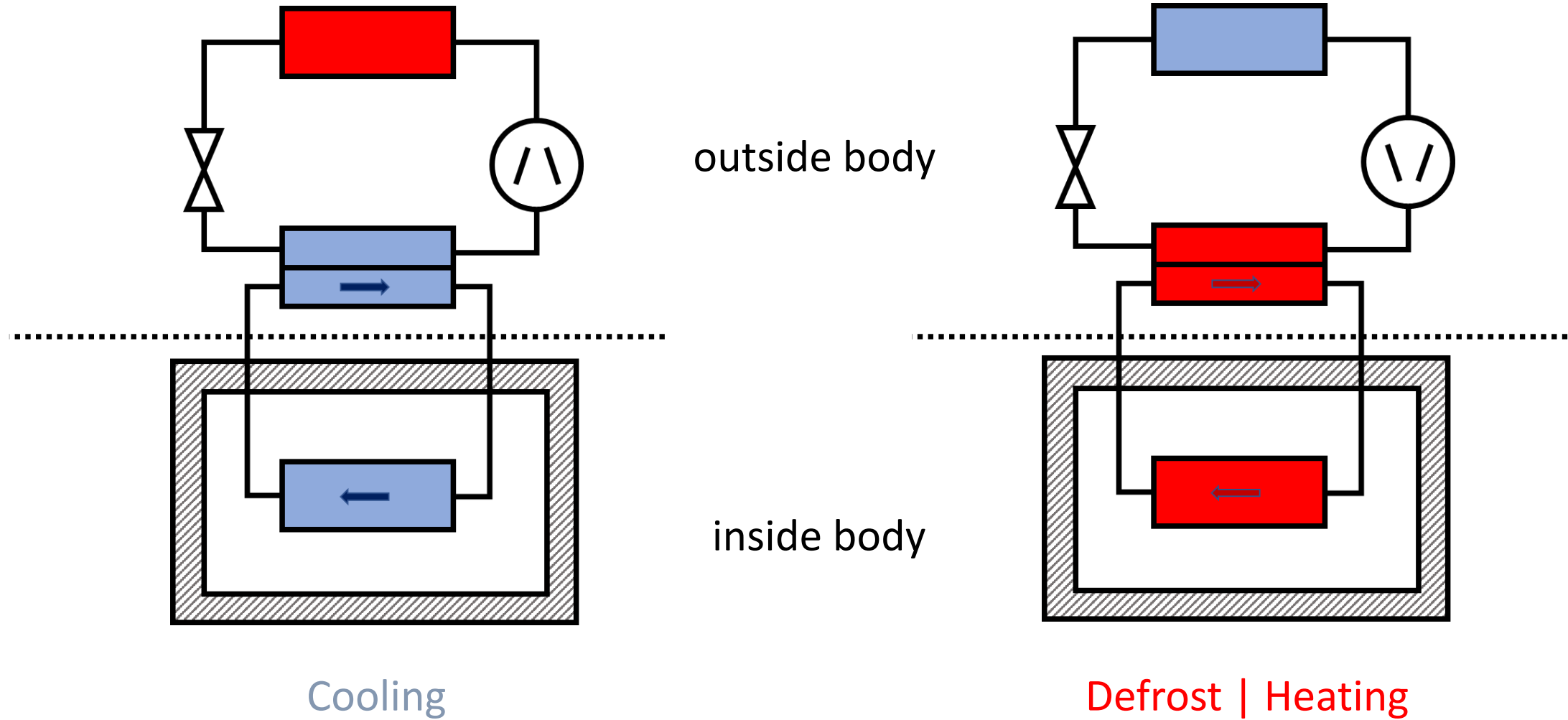
R1270 outside



R744 inside



System operation cooling, defrost and heating



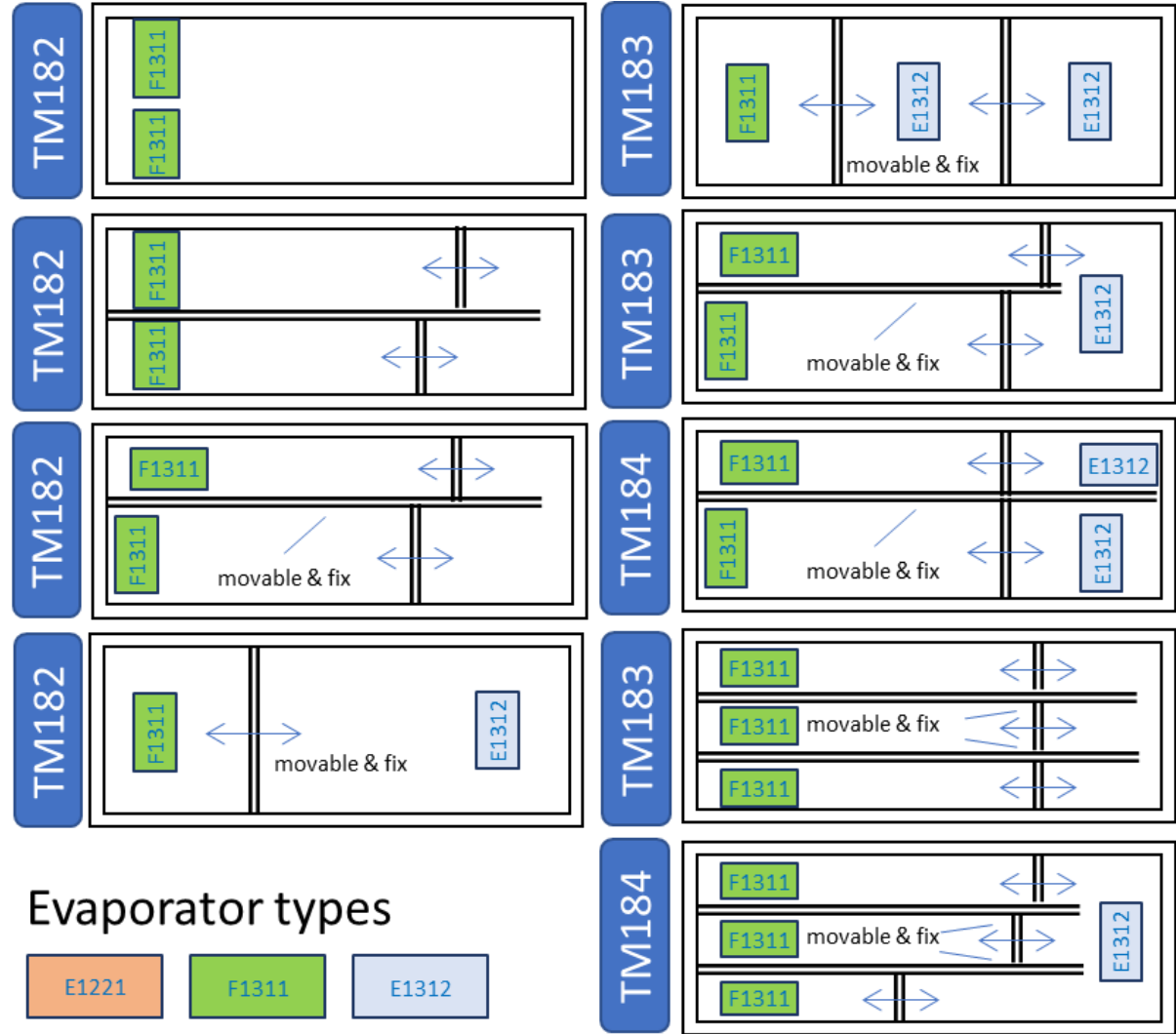
Roof top mounted transport refrigeration unit

Highlights

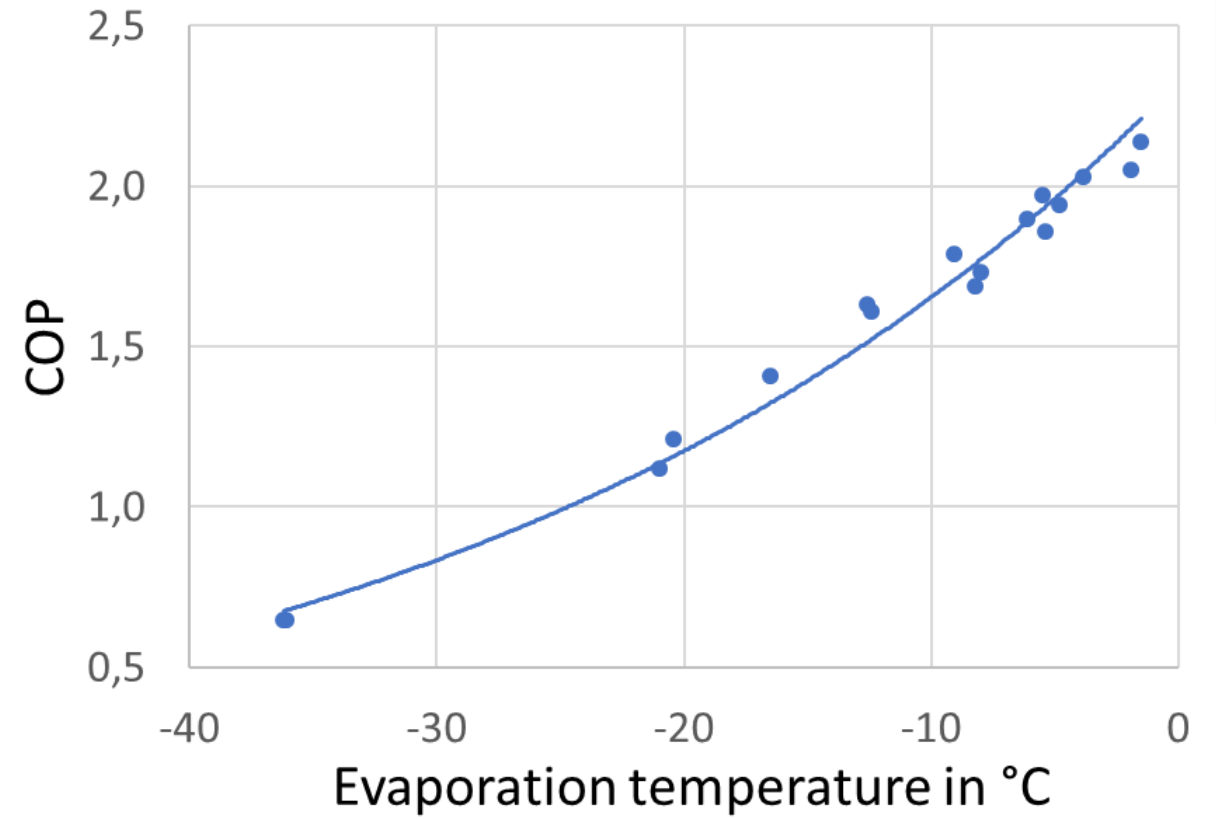
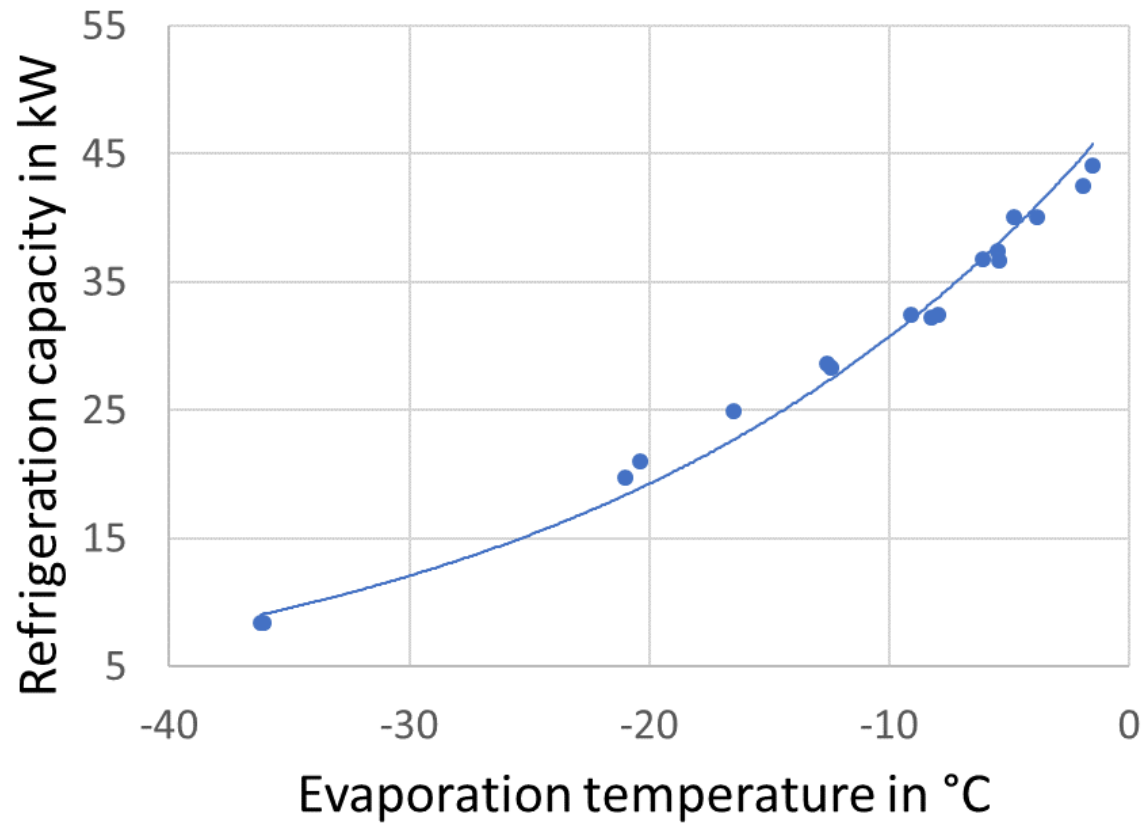
- Natural refrigerants (R1270 and R744)
- R1270 only outdoor, in free ambient
- Fully hermetic systems
- Low charge concept with 0,7 kg R1270 and 1 kg R744
- No ignition sources
- Quick release for maintenance
- Two cycles for efficient multi-temp
- Variable speed drives
- Low noise and vibration level
- Flat and fully integrated design



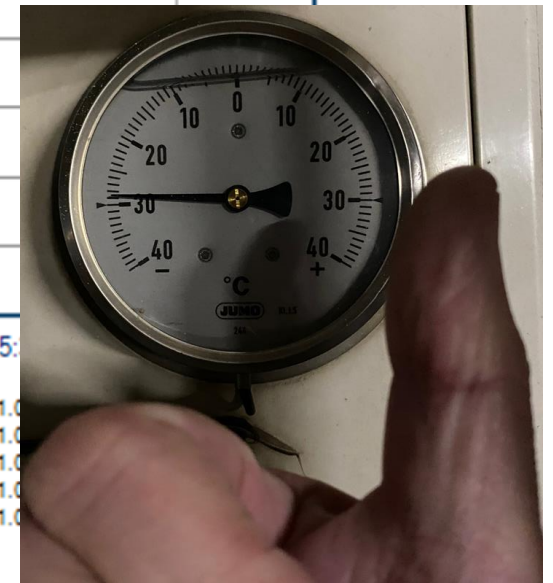
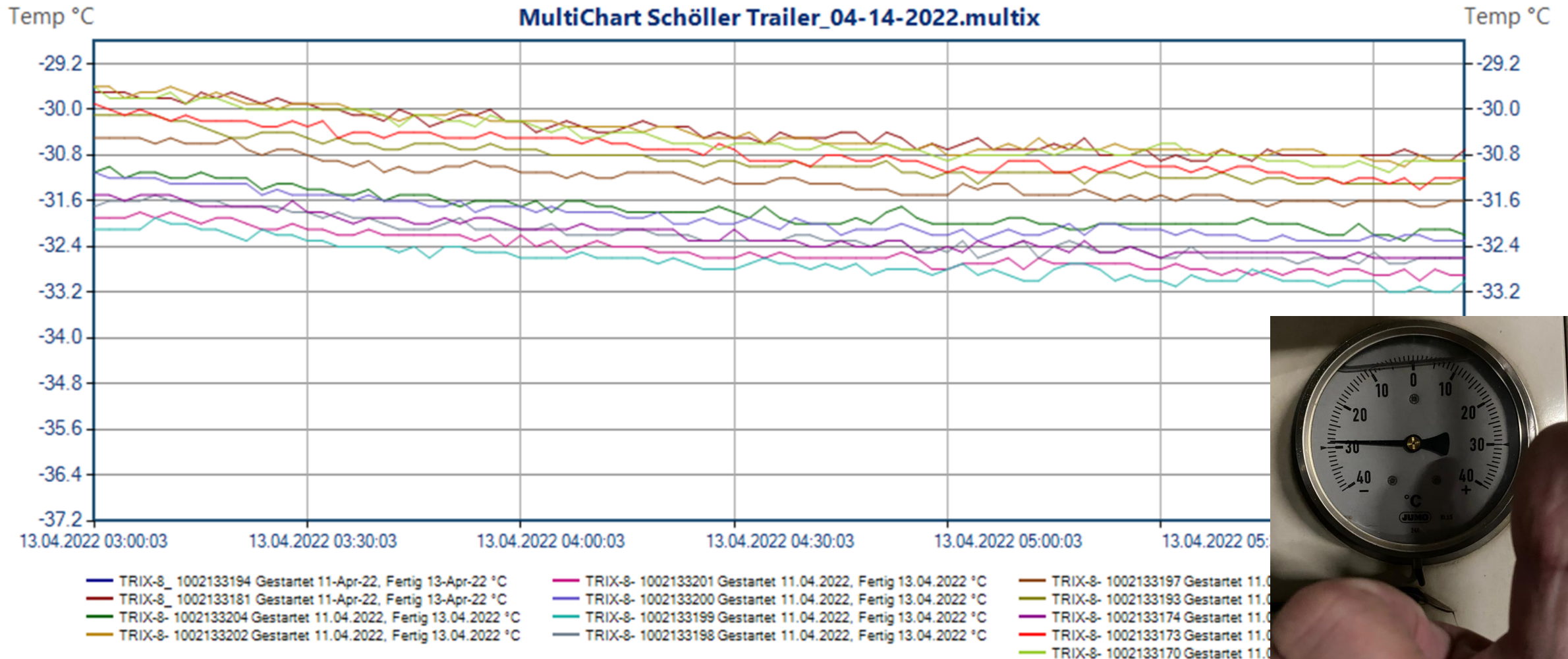
Body configuration options



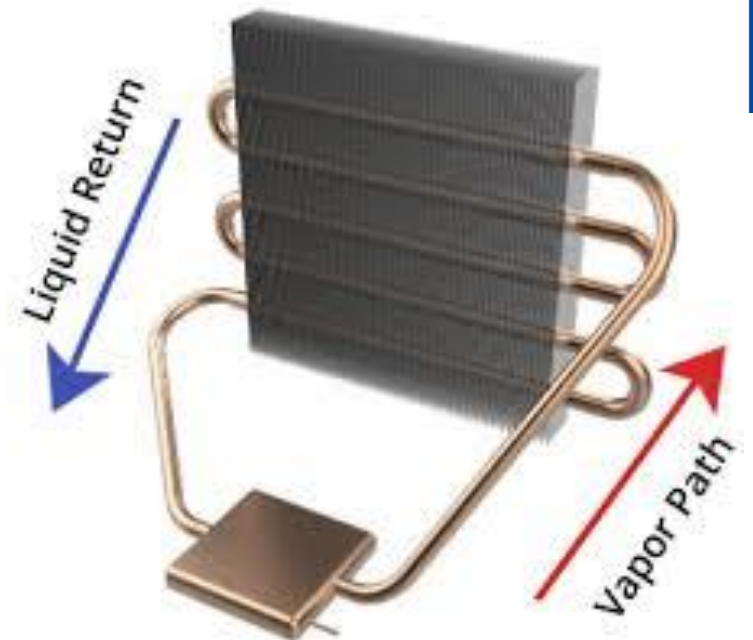
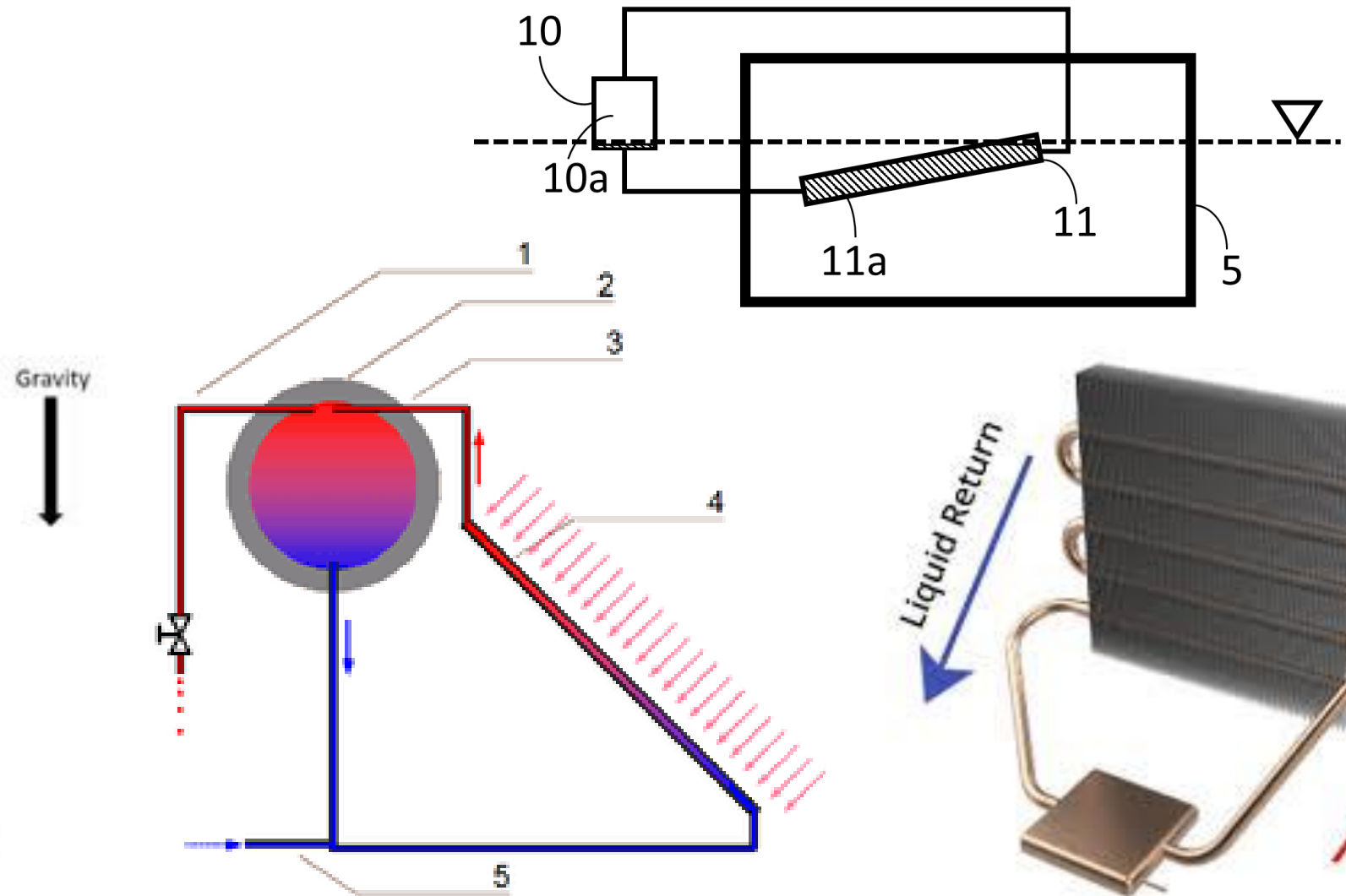
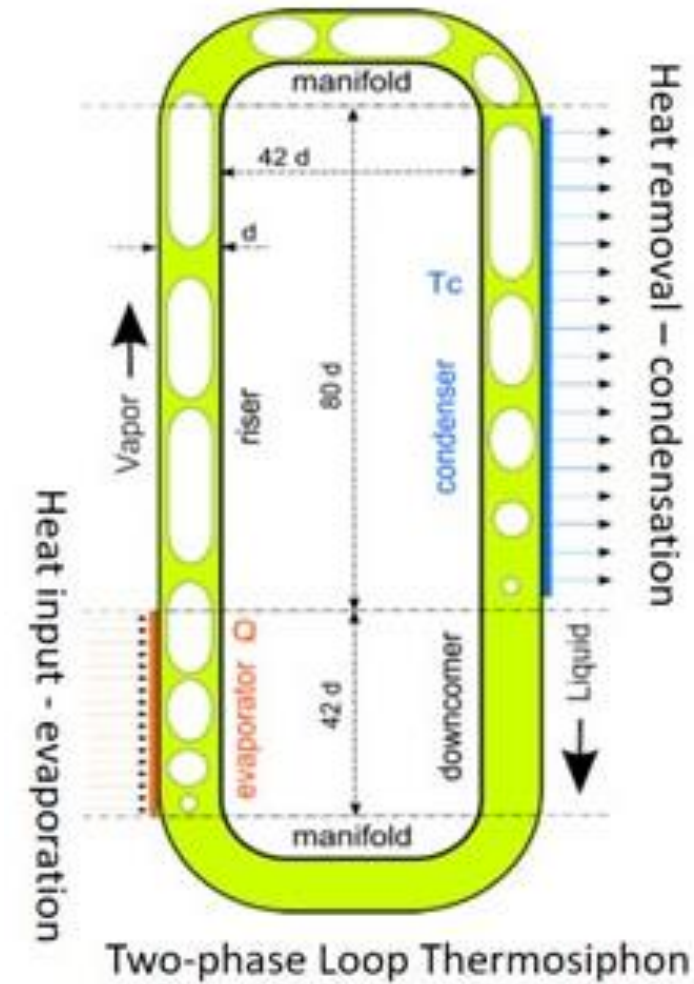
System Performance



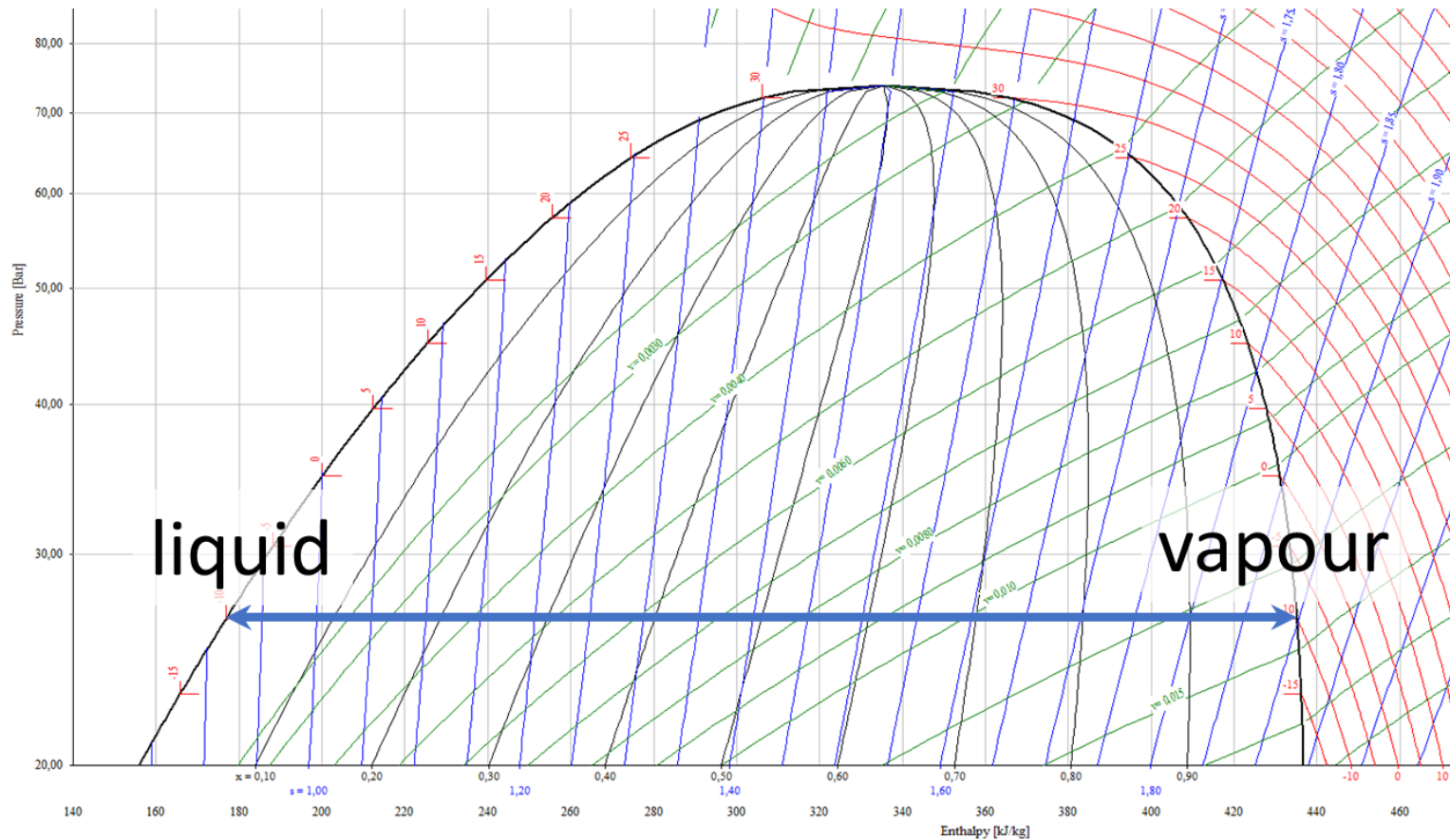
Temperature distribution inside the trailer body



Theromsyphon or heat pipe



R744 as heat transfer fluid in our system



Temp. °C	Press. bar(a)	Density kg/dm ³	Vol. flow dm ³ /min	
-31	13,8	1,080	1,16	freezing
-30	14,3	1,076	1,24	
-29	14,8	1,072	1,33	
-28	15,3	1,067	1,41	
-27	15,8	1,063	1,50	
-26	16,3	1,059	1,59	
-25	16,9	1,054	1,68	
-24	17,4	1,050	1,77	
-23	18,0	1,046	1,87	
-22	18,5	1,041	1,96	
-21	19,1	1,036	2,06	
-20	19,7	1,032	2,17	
-10	26,5	0,984	3,56	cooling
-9	27,3	0,978	3,73	
-8	28,0	0,973	3,90	
-7	28,8	0,968	4,17	
-6	29,6	0,963	4,45	
-5	30,5	0,957	4,75	
-4	31,3	0,952	5,05	
-3	32,2	0,946	5,37	
-2	33,1	0,940	5,69	
-1	33,9	0,935	6,04	

Unit status and system benefits



Interested parties:

- Food and logistics enterprises/industries

Product status:

- BOM in final qualification process
- Customer units in field operation

Benefits versus HFC diesel driven systems:

- 60 % less fuel consumption
- 80 % or 20 tons/yr CO₂ emissions savings
- Little maintenance requirements
- Operational safety and high availability
- No direct GWP due to natural refrigerants
- No local exhaust emissions

Main market entry barriers:

- Service network and technician skills
- Compatibility with TRU installation standards

***All are welcome
to become part
of the journey!***



***ECOOLTEC Grosskopf GmbH
Zinkhüttenstraße 17
45473 Mülheim a. d. Ruhr
info@ecooltec.com
www.ecooltec.com***

Transport Refrigeration with the Natural Choice

eurammon e. V. is always available as a sparring partner for questions on refrigeration with natural refrigerants.

Contact:

Dr. Alexander Schmeink | Lyoner Straße 18 | 60528 Frankfurt | Germany

Phone: +49 (0)69 6603-1277 | E-Mail: alexander.schmeink@eurammon.com