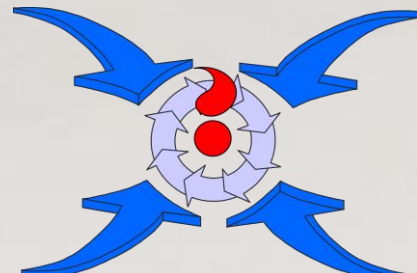
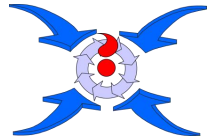






# Refrigeration technology in comparison and the down-phasing of HFC refrigerants

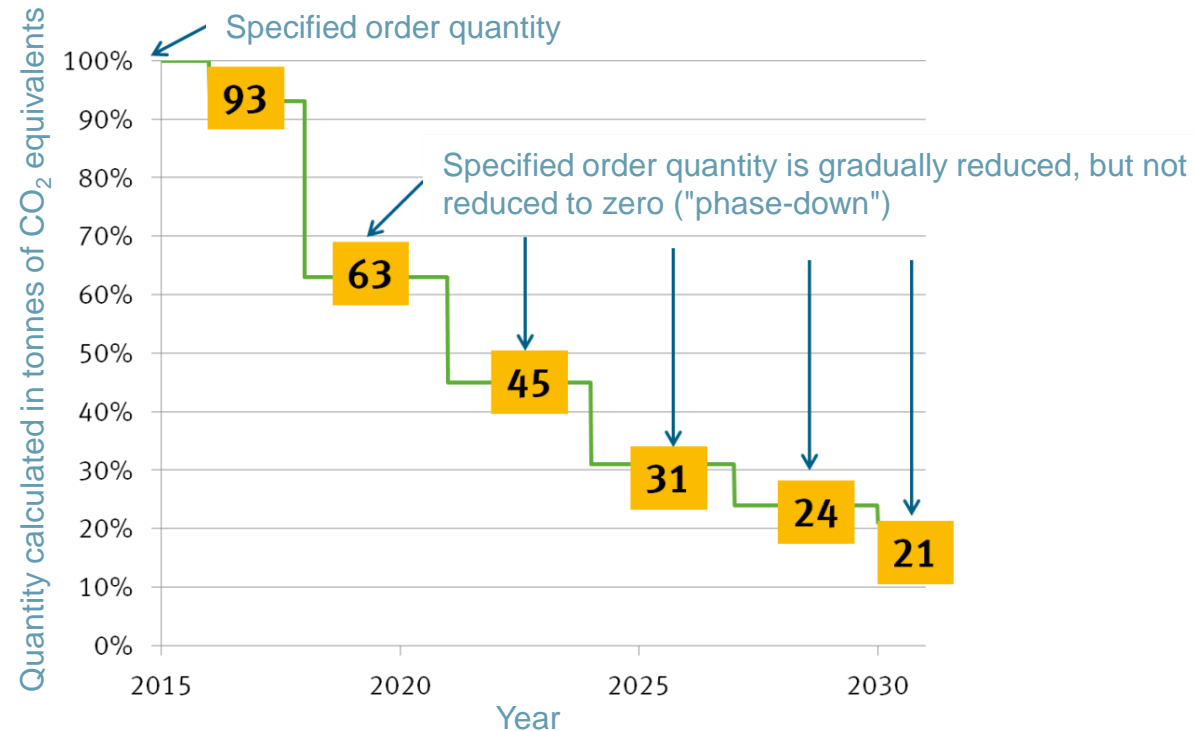
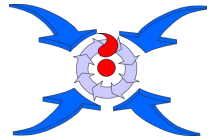


A comparison of today's refrigeration technology

Cooling with *liquid nitrogen* stands out with many advantages



Criterion:	 2-step Freon	 Liquid nitrogen (NNC cascade system)	 Flammable cascade	 Cold air cooling technology
Futureproof	X	+	+	+
Reliability	0	+	0	+
Maintenance	0	+	0	+
Running costs	-	+	-	+
Efficiency	0	+	0	0
Safety requirements	+	-	-	+
Space requirement	+	+	-	-
Initial investment	+	+	0	-
Reinvestment (cycle)	approx. 8-10 years	approx. 30 years	approx. 8-10 years	approx. 8-10 years



Source: Federal Environment Agency Germany

#### The refrigerants most frequently used

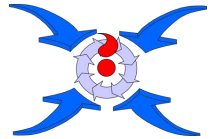
Group	Refrigerant	Atmospheric Lifetime	GWP-100 years	GWP-20 years	Composition
HFKW	R134a	14 years	1430	3830	Pure substance
HFKW-Mix	R404A	until 52 years	3920	4314	44% R125 52% R143a 4% R134a
HFKW	R23	270 years	14800	12000	Pure substance
HFO	R1234yf	10-12 days	3	-	Pure substance
HFO/HF KW-Mix	R452B	until 32,6 years	698	-	Pure substance 67% R32 7% R125 26% R1234yf
HFO/HF KW-Mix	R449A	until 32,6 years	1282	-	24,3% R32 24,7% R125 25,3% R1234yf 25,7% R134a

The refrigerants used today will be restricted or banned in the future and for good reason. This will not happen abruptly but will take place in phases over a period of years. It remains to be seen which alternatives will remain as classic refrigerants.

The NNC uses LN<sub>2</sub> (liquid nitrogen), which in the form of N<sub>2</sub> is a natural component of the air and has no effect on the greenhouse effect. After the stored "cooling energy" has been utilised in several stages, it is released back into the source, the normal air.

This table lists some of the refrigerants currently in use and shows their long-term effects (lifetime in the atmosphere and relative global warming potential).

*In the coming years, many refrigerants will only be heavily regulated or will no longer be authorised for use at all.*



## The **BOS-System** solves other refrigeration problems

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