

# THERMO CONTROL



Presentasjon for Norsk Kjøleteknisk Forening  
5 November 2019.

Hvorfor valgte Carrier R1234ZE som  
sitt langsiktige lav GWP kuldemedium



Presentasjon holdes av:  
Tommy A Iversen / Thermo Control AS  
Tim Ashton / Carrier AB



United Technologies



komfovent®

ThermoKey®  
Heat Exchange Solutions



## Thermo Control AS

Leverandør av:

Chillere, varmpumper, tørrkjølere, datakjølere, Fan Coil, splitt enheter, portable AC enheter.

Service, suport og reservedeler.

TC-Gruppen er Nordens største CARRIER forhandler

## Thermo Control Gruppen

### I hele Norge

- Tromsø
- Harstad
- Trondheim
- Bergen
- Oslo
- Fredrikstad
- Stavanger



Thermo Control AS leverte og startet opp den første Carrier HFO maskin i 2015!

Disse maskinene har gått fint siden, ingen driftsproblemer.

Service som på en Carrier R134a chiller.

Siden dette har vi levert et femtital maskiner med ymse størrelse frem til i dag.

## Carrier lav GWP maskiner

Carrier maskiner med R-1234ze

**CARRIER  
NATURLIG**



Carrier er ledene på maskiner med kuldemedie R-1234ze – et fremtidsrettet miljøvennlig kuldemedie.

KJØLING	OPPVARMING
 <p><b>30XW-P ZE</b> Kjølekapasitet fra 270 – 1100 kW</p> <p><b>30XW-V ZE</b> Kjølekapasitet fra 440 – 1320 kW</p>	 <p><b>61XWH ZE</b> Varmekapasitet fra 400 – 2000 kW</p>
 <p><b>30XA ZE</b> Kjølekapasitet fra 300 – 1100 kW</p> <p><b>30XAV ZE</b> Kjølekapasitet fra 400 – 900 kW</p>	 <p><b>30XWHP ZE</b> Varmekapasitet fra 320 – 1285 kW</p> <p><b>30XWHV ZE</b> Varmekapasitet fra 520 – 1570 kW</p>





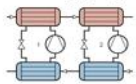
## PROJECTS IN NORWAY

### 7 Proven in the field

#### LØRENSKOG VINTERHALL



- 2 x 61XWH-ZE module 5 og 7 i serie
- Kjøling og Fjernvarme
- Varmekapasitet: 1 067 kW
- Kuldeytelse: 722 kW
- Varmeopptak fra gasskjølere fra CO<sub>2</sub> kuldeaggregater og isvannskjøling



#### FORSVARET



- 2 x 61XWH-ZE0751
- Kjøling og varme
- Varmekapasitet: 1 120 kW
- Kuldeytelse: 1 100 kW
- Sjøvann



#### JOTUN



- 3 x 30XWH-ZE0901
- 1 x 30XWH-ZE0301
- Kjøling og varme
- Varmekapasitet: 2 600 kW
- Kuldeytelse: 2 900 kW
- Sjøvann



#### FORSVARET



- 4 x 61XWH-ZE1451
- Kjøling og varme
- Varmekapasitet: 3 300 kW
- Kuldeytelse: 4 600 kW
- Energibrønner





natural  
leadership



The Norwegian Society of Refrigeration  
Association Norvegienne du Froid

## HFO - CARRIERS' SELECTED CHOICE AS THE LONG TERM SOLUTION FOR SCREW & CENTRIFUGAL SOLUTIONS

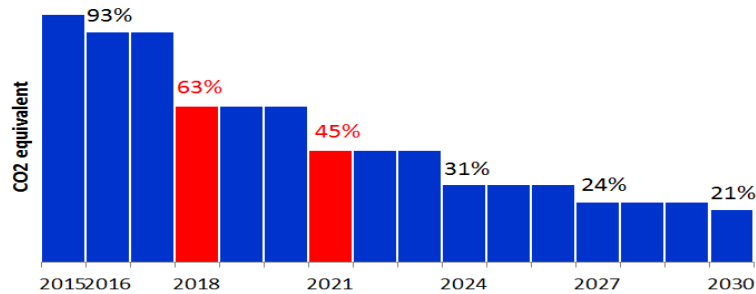
Tim Ashton  
Business Development Director  
CARRIER AB

Norsk Kjøleteknisk Møte  
5th November 2019



# THE INDUSTRY CHALLENGE IN EUROPE

## F-Gas



**-55%**  
**Refrigerant reduction**  
from 2021

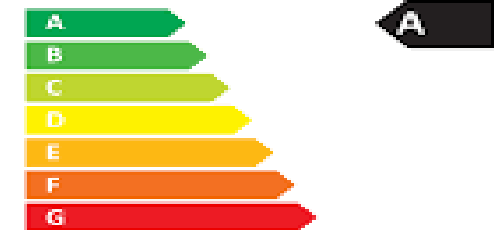


Increase energy efficiency

AND

Lower GWP refrigerants

## Eco-design



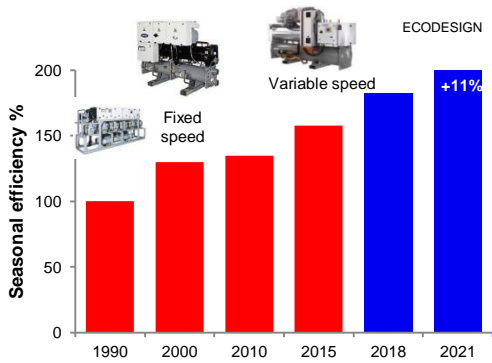
**SEER ~+10%**  
**for large comfort chillers**  
from 2021





# CARRIERS ROADMAP & PROGRESS

## Higher efficiency

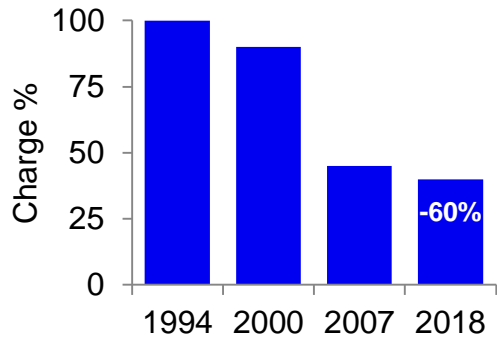


ECODESIGN REQUIREMENTS		
	Tier 1	Tier 2
Air cond.	Jan 2013	Jan 2014
Heat pumps	Sept 2015	Sept 2017
Chillers	Jan 2018	Jan 2021
VRF/roofops	Jan 2018	Jan 2021



Efficiency x2 in 30 years

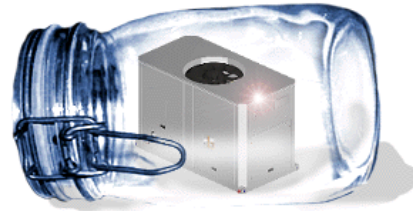
## Refrigerant charge



Heat exchanger technologies  
New refrigerants



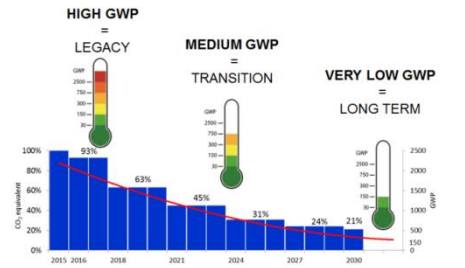
## Tightness



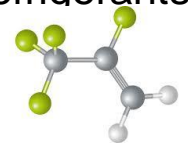
Manufacturing process  
Better design  
Smart leak detection



## GWP

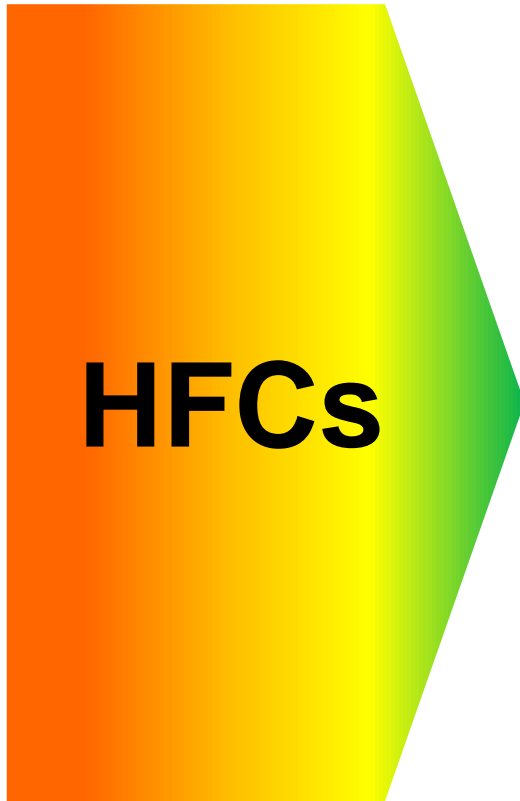


Lower GWP refrigerants



Refrigerant strategy

# WHAT ALTERNATIVES TO HFCs?

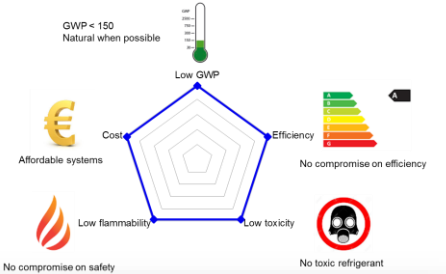
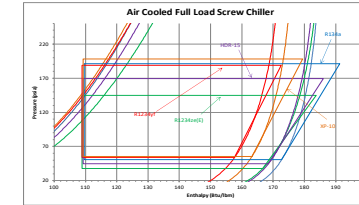
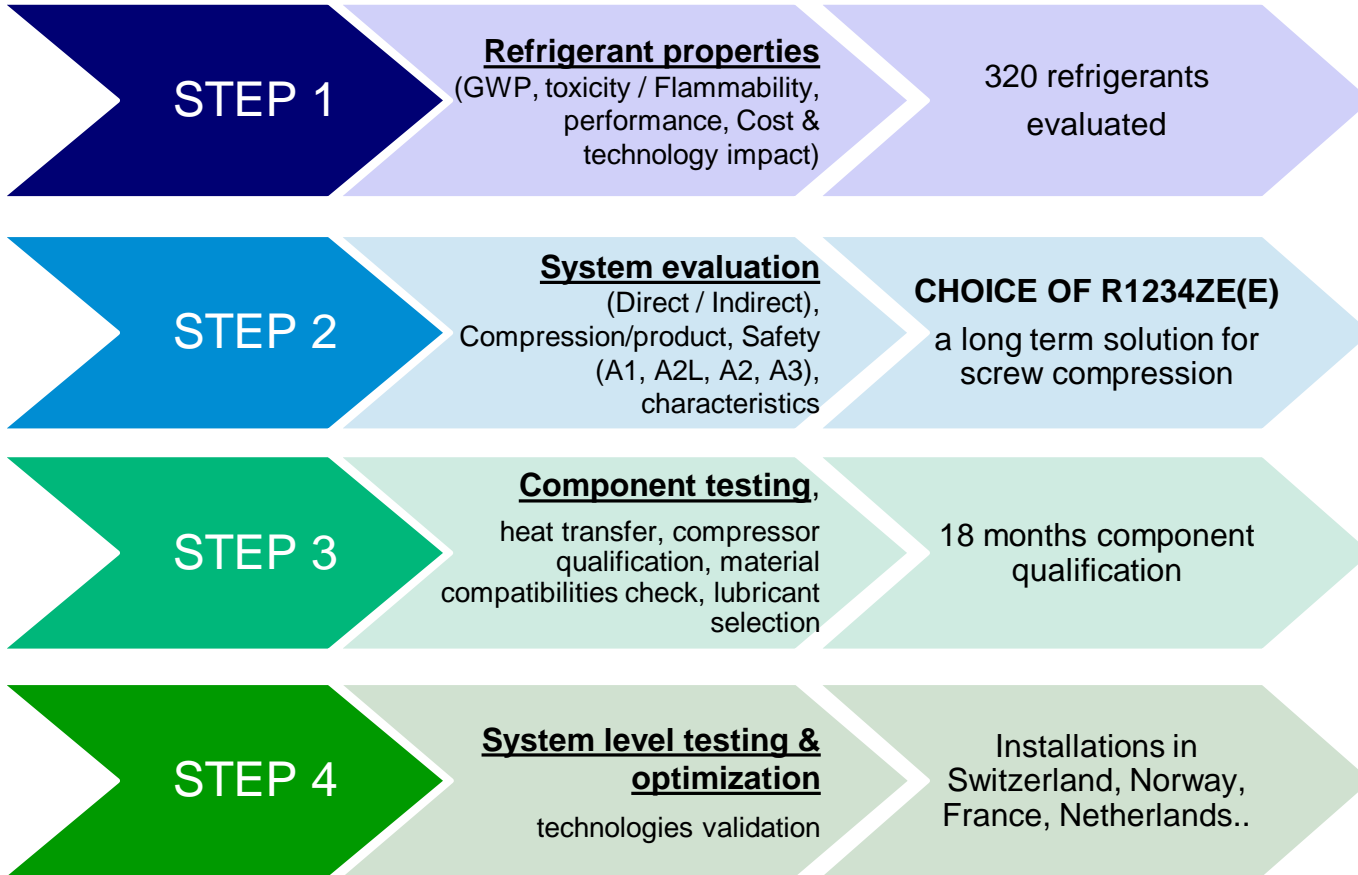


- Ammonia ?
- CO<sub>2</sub> ?
- Hydro carbons ?
- HFOs?

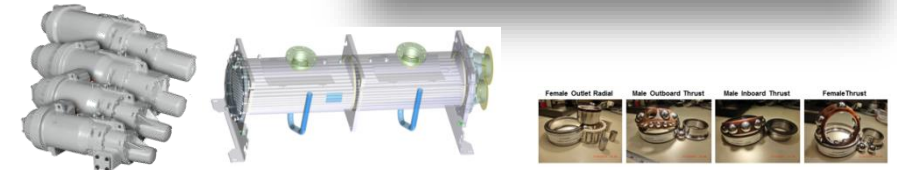




# DEVELOPING OUR REFRIGERANT STRATEGY



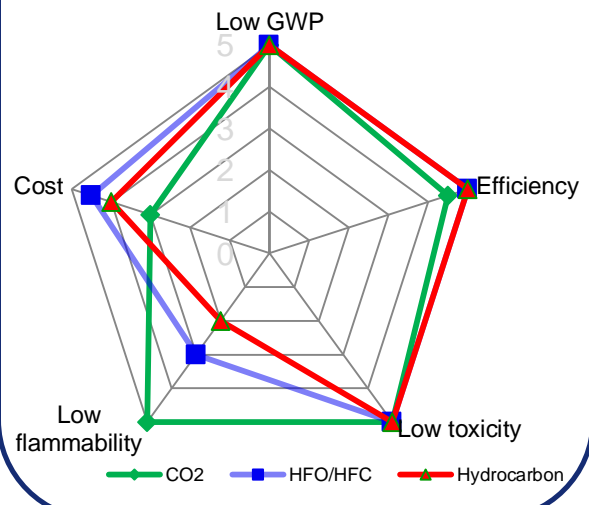
Refrigerant	Class	GWP	High Side Press. Ratio	Full Load COP	PLV in %	Max. Disch. Temp.	Disch. Temp. in °C	Comp. Disch. in °C	Refrig. Cost in \$/kWh	System Cost in \$/kWh
Existing Refrigerant (R134a)	A1	1430	1.2	0.55	100%	100%	100%	100%	100%	100%
Option 1: GWP 500<math><math>1000</math> & A1	A1	516	1.2	0.55	100%	100%	100%	100%	100%	100%
Option 2: GWP 500<math><math>1000</math> & A2L	A2L	516	1.2	0.55	100%	100%	100%	100%	100%	100%
Option 3: GWP 150<math><math>500</math> & A2L	A2L	150	1.2	0.55	100%	100%	100%	100%	100%	100%
Option 4: GWP 150<math><math>500</math> & A1	A1	150	1.2	0.55	100%	100%	100%	100%	100%	100%
Option 5: GWP <math><math>150</math> & A2L	A2L	150	1.2	0.55	100%	100%	100%	100%	100%	100%
Option 6: GWP <math><math>150</math> & A1	A1	150	1.2	0.55	100%	100%	100%	100%	100%	100%





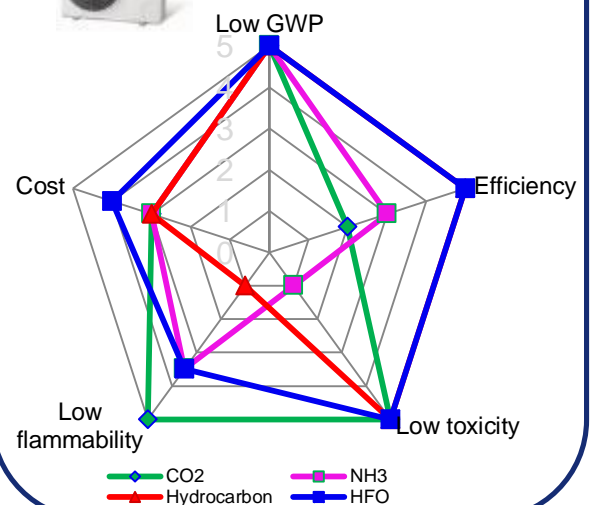
# ALTERNATIVE REFRIGERANTS

## Commercial & transport refrigeration



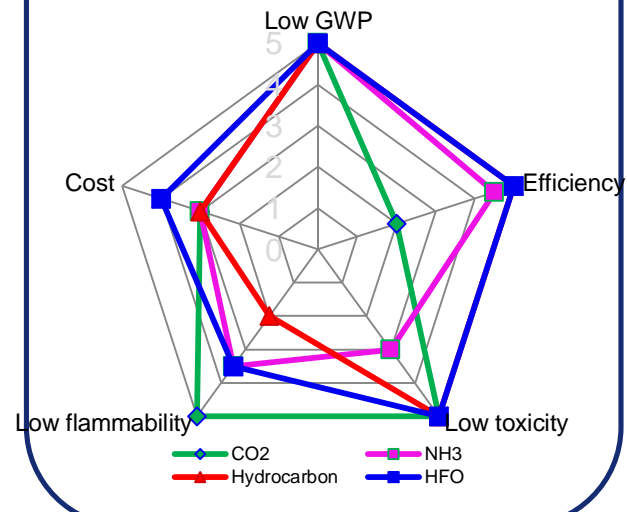
TRANSPORT: CO2, HFO BLENDS  
COMMERCIAL: CO2, HC

## Air conditioners, rooftops (DX systems)



HVAC: HFOS, PROPANE & CO2 POSSIBLE FOR SPECIFIC APPLICATIONS

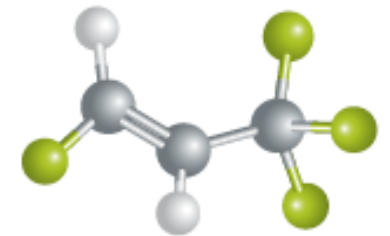
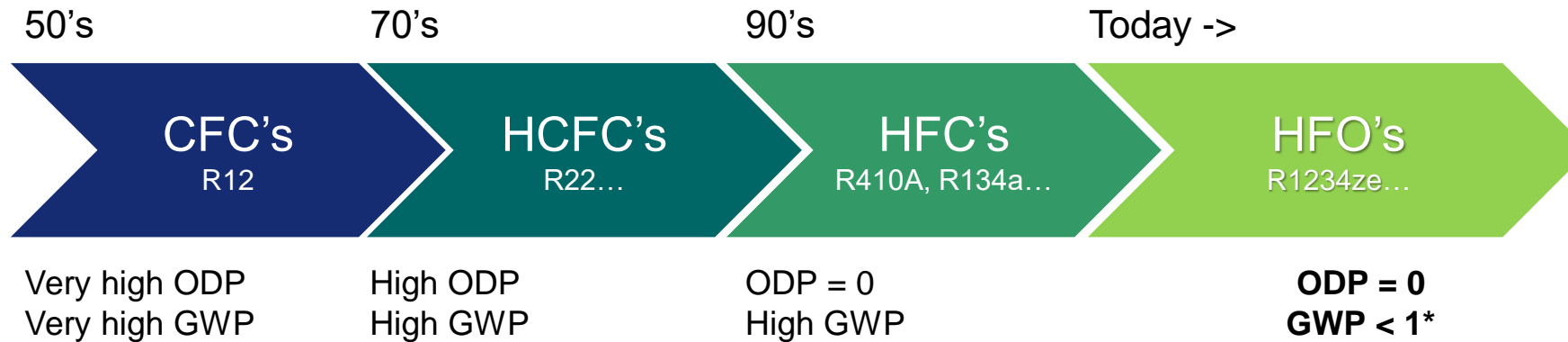
## Chillers, heat pumps (water system)





# HFO REFRIGERANTS

## Entering a new era



HFO-1234ze(E)

### HFO (HYDROFLUORO-OLÉFINES), A 4TH GENERATION OF REFRIGERANTS

- Excellent characteristics (ODP, GWP)
- Improved energy efficiency performance & extended application capabilities

**HFO 1234ZE(E) – ODP = 0, GWP <1**

\*5th Assessment Report (AR5) of the IPCC  
ODP: Ozone Depletion Potential  
GWP: Global Warming Potential



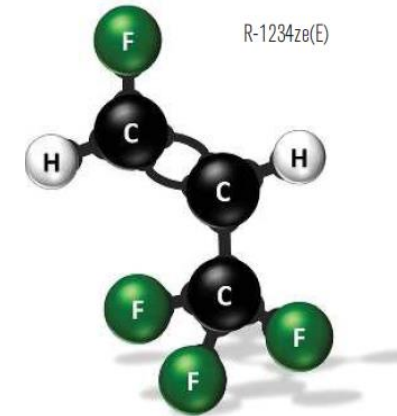




# WHY HFO?

## SEVEN OF THE HFO BENEFITS

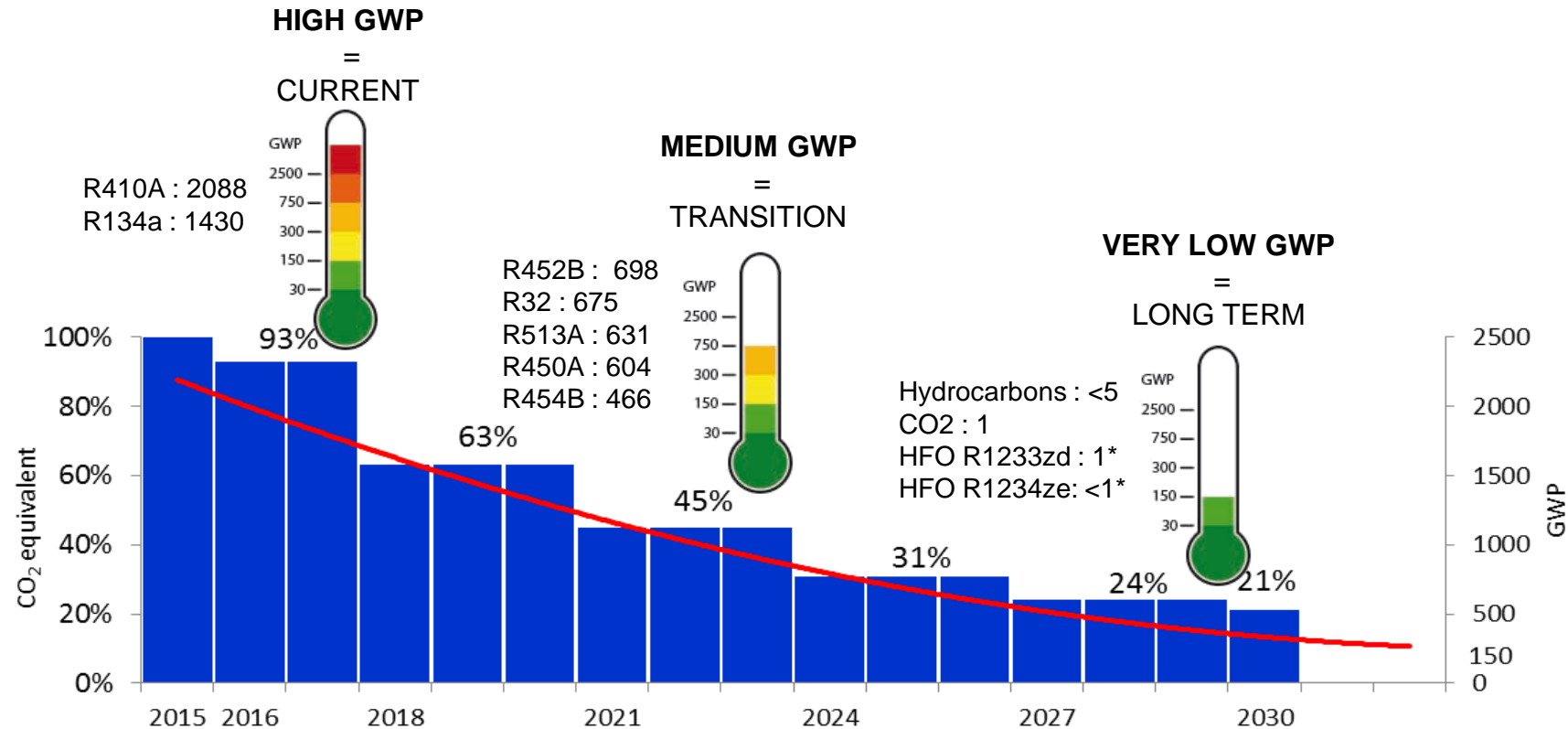
- 1 Ultra low GWP ~ 1 (IPCC AR5)
- 2 Not concerned by F-Gas regulation restrictions
- 3 Long term HFC 134a replacement
- 4 Very energy efficient offering Low Cost of Ownership
- 5 Cost effectiveness: Easy to design, install and service
- 6 Wide technologies & application possibilities
- 7 Proven in the field



	Atmospheric life time	GWP
R134a	13,4 years	1430
R1233zd(E)	26 days	~1
R1234ze(E)	16 days	<1*

Note: GWP according to IPCC AR4, except for HFOs: IPCC AR5\*

## 1 LONG TERM R134A REPLACEMENT & SOLUTION



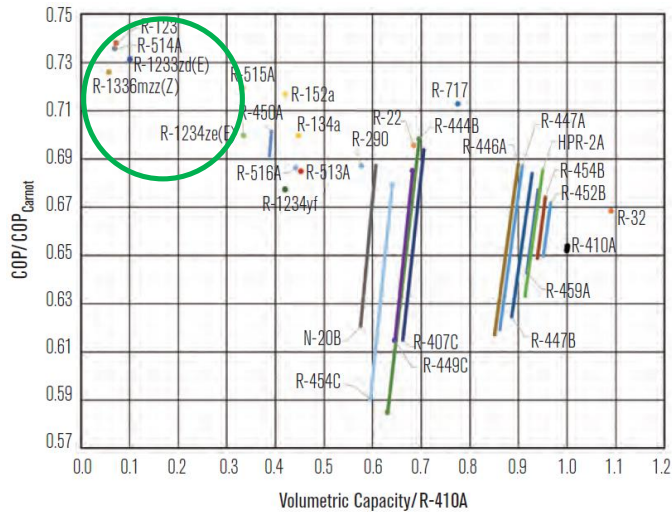
**Notes**

- 1) EU F gas regulation STATES Long term refrigerants should have GWP < 150
- 2) Note: GWP according to IPCC AR4, except for HFOs: IPCC AR5
- 3) Source: Carrier's GWP<sub>100</sub> categories derived from UNEP TEAP categories

# HFO BENEFITS

## 2 Higher energy efficiency

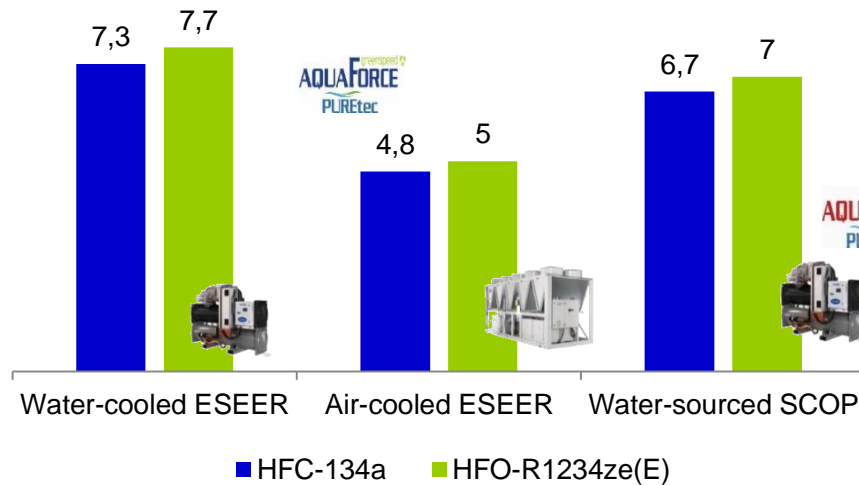
### MORE ENERGY EFFICIENT THAN "NATURAL" REFRIGERANTS



Source ASHRAE Journal June 2017

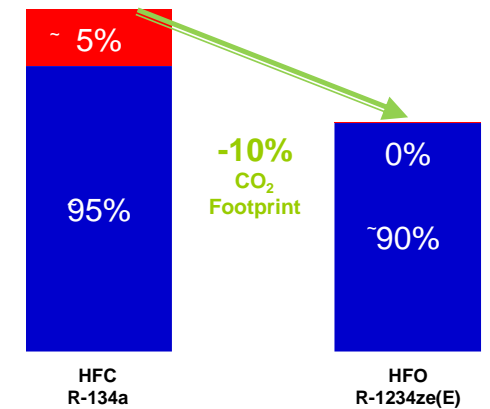
HFO  
R1334ze & R1233zd

### CURRENT TECHNOLOGY PLATFORM +5% ENERGY EFFICIENCY GAIN



HIGHER SEASONAL EFFICIENCY PERFORMANCE

### TOTAL CO2 FOOTPRINT



■ Indirect CO2 ■ Direct CO2

DIRECT + INDIRECT\* CO<sub>2</sub> EMISSIONS

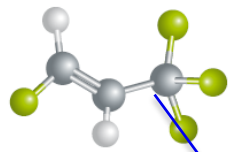
Source: Preliminary product data for information only. Final product data will be submitted by Carrier to Eurovent company during 2016.



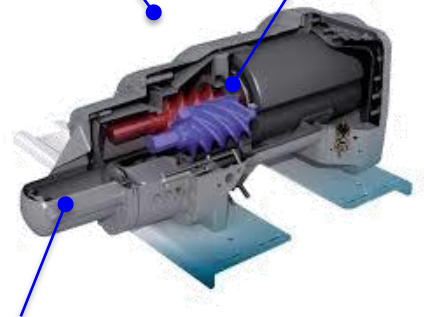
# HFO BENEFITS

## 3 Easy to design product improvements

R1234ze(E)(E) refrigerant

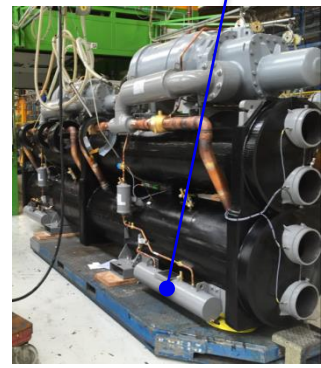


New polyol ester oil selected by Carrier



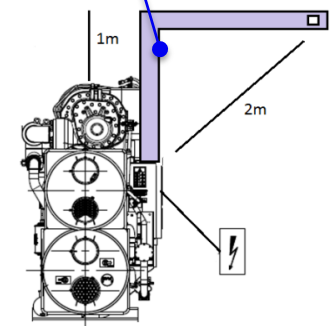
New suction & discharge compressor gaskets

External oil tank and oil line modification



Specific documentation for installation, maintenance & safety instructions

New pressurized electrical box  
- Enhanced air tightness  
- Integrated blower  
- Top connection for fresh air duct



Carrier design



\*SAME ON AIR COOLED UNITS



# HFO BENEFITS

## 4 Easy to manage

SAFETY CLASS ISO 817

		Lower Flammability Limit Kg/m <sup>3</sup>	Burning Velocity (cm/s)	Heat of Combustion MJ/kg	Minimum Ignition Energy
Highly flammable	A3 B3	<0,1	>10	>19000	Low
Flammable	A2 B2	>0,1	>10	<19000	Low
Mildly flammable	A2 L B2 L	>0,1	< 10	<19000	High
Not flammable	A1 B1	N/A	N/A	N/A	N/A

Lower toxicity ← Higher toxicity  
 R1234ze(E)

### Flammability:

*evaluated by 'chance of flame occurring' & 'effect of flame occurring'*

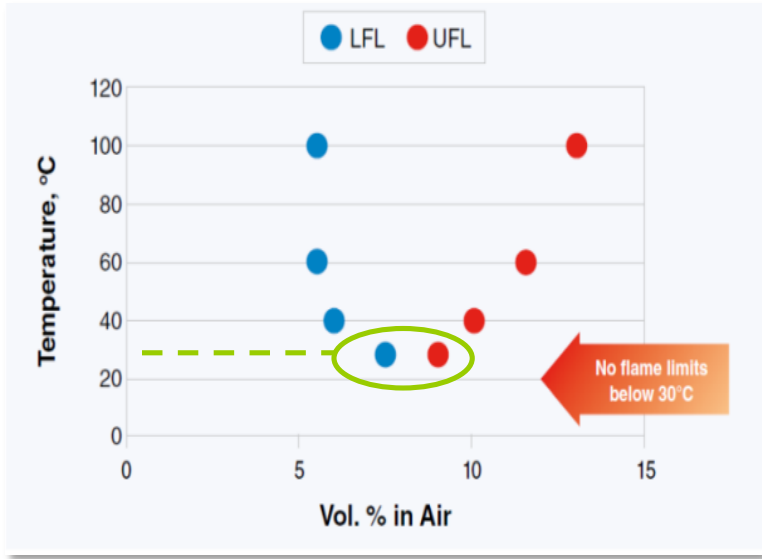
### Toxicity levels:

*R1234ze(E) is favorable, comparable to R134a and significantly better than some alternatives*

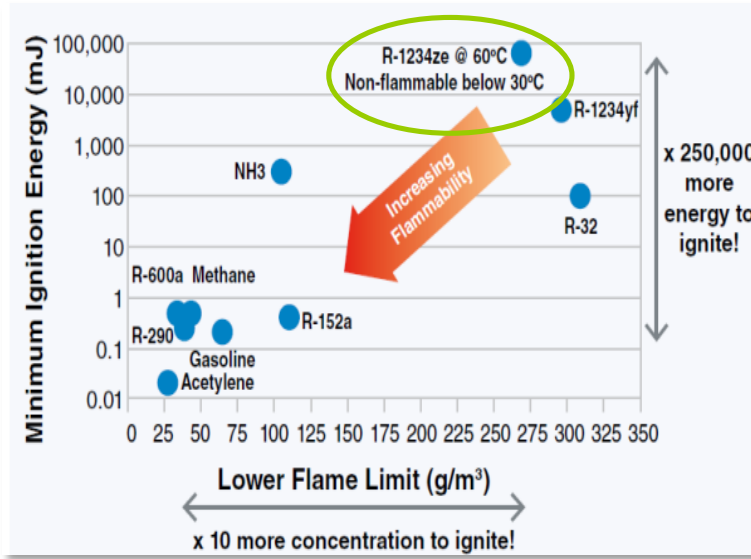


# HFO BENEFITS

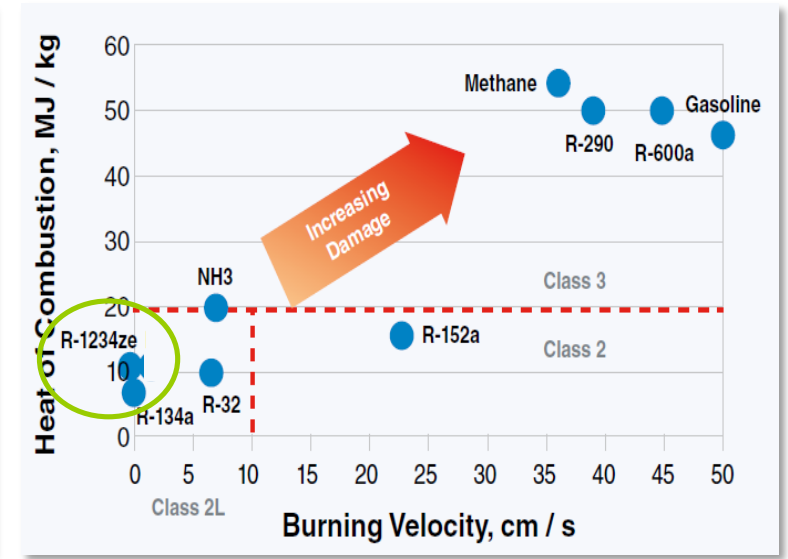
## 4 Easy to manage



T < 30°C non flammable



Needs 10x more concentration & 250,000x more energy to become flammable compared with hydrocarbons



If flame, effect extremely mild DUE to very low heat of combustion (5x< propane) AND low burning velocity that would not be enough to produce fire



# HFO BENEFITS

## 5 Easy to install



Ventilation extraction system



Leak detection sensors located under units



Plant room cooling solution

Chillers, heat pumps (water system)



No charge limit  
Machinery room safety requirements: local building code or EN378

EN378 & building codes - No new requirement for outdoors chillers & heat pumps

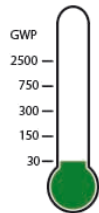
# HFO BENEFITS

## ⑥ Wide technologies & application possibilities

### Large chillers, heat pumps SCREW



Ultra low GWP < 1\*  
long term answers  
available



### Solutions

Air cooled

Water cooled

### Technologies

Screw

Centrifugal

### Applications

Comfort & industrial cooling

District cooling & heating

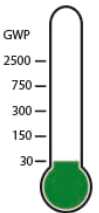
High temperature heat pumps <85°C



### Large chillers CENTRIFUGAL



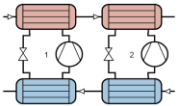
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### LØRENSKOG VINTERHALL



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- Energibrønner



**500+ UNITS TO DATE**



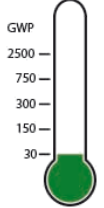


# EXECUTIVE SUMMARY

## Large chillers, heat pumps SCREW



Ultra low GWP < 1\*  
long term answers  
available



Ultra low GWP ~ 1 (IPCC AR5)

Not concerned by F-Gas regulation restrictions

Long term HFC 134a replacement

Very energy efficient offering Low Cost of Ownership

Cost effectiveness: Easy to design, install and service

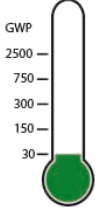
Wide technologies & application possibilities

Proven in the field

## Large chillers CENTRIFUGAL



Ultra low GWP < 1 long  
term answers available







THANK YOU