



COMMERCIAL REFRIGERATION SERVICES

# Global Trends in CO<sub>2</sub> Refrigeration Systems

# Movement towards naturals

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## Awareness

In the 1980's hole in ozone detected

HCFC's

Montreal protocol

Phase out

Global warming

HFC's

Control rise of temperature

<1,5'C in 150 years

HFC's with high GWP

R143a = 1430

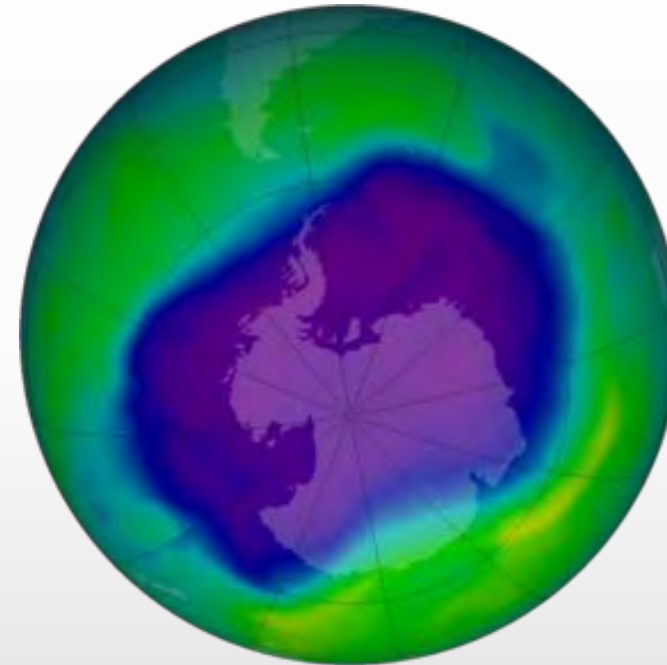
R404a = 3922

R507a = 3985

1kg of R507a leaked = 3985kg of CO2

Lifespan in atmosphere of up to 100 years

Sadly ODP substances such as R22 are still in use



# Global Regulations

## Kigali amendment to Montreal Protocol

Global phase down

Baseline period already implemented

Developed countries

Start 2019

Developing countries

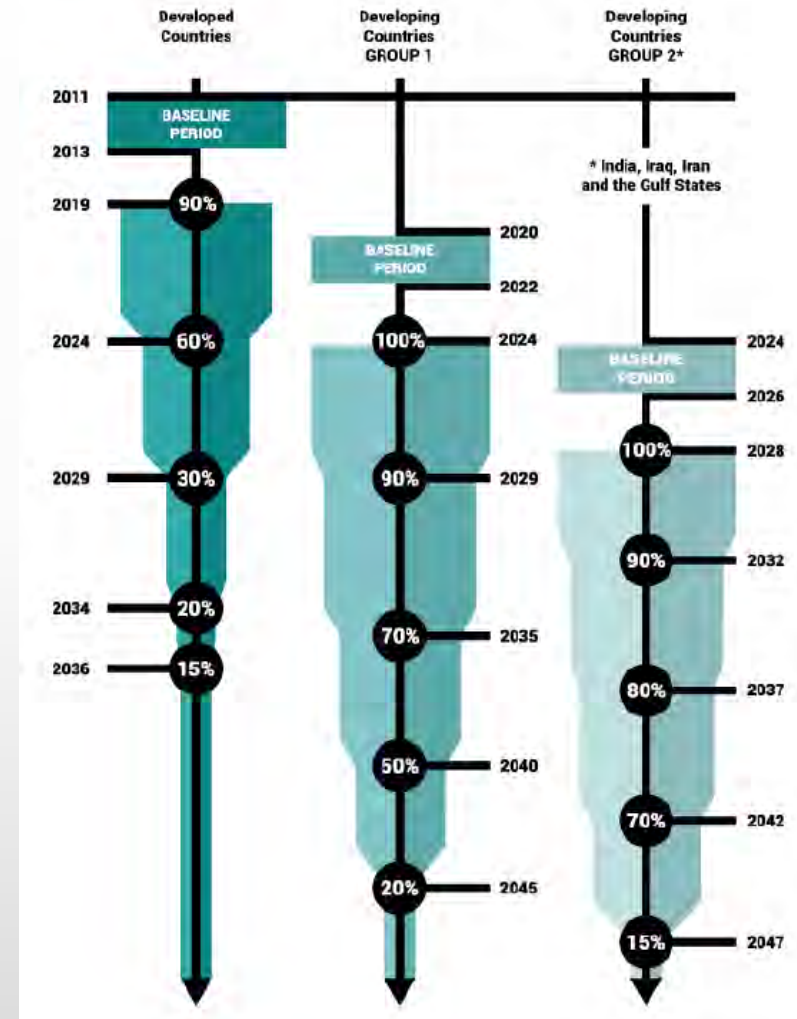
Start 2024

Next refrigerants in line to be banned

R507a

R404a

R410a



Source: Shecco

# Global Regulations

## EU F-gas regulation

Europe leading phase out  
2018 saw a decrease of 37% in allowed HFC's

Other countries:

California

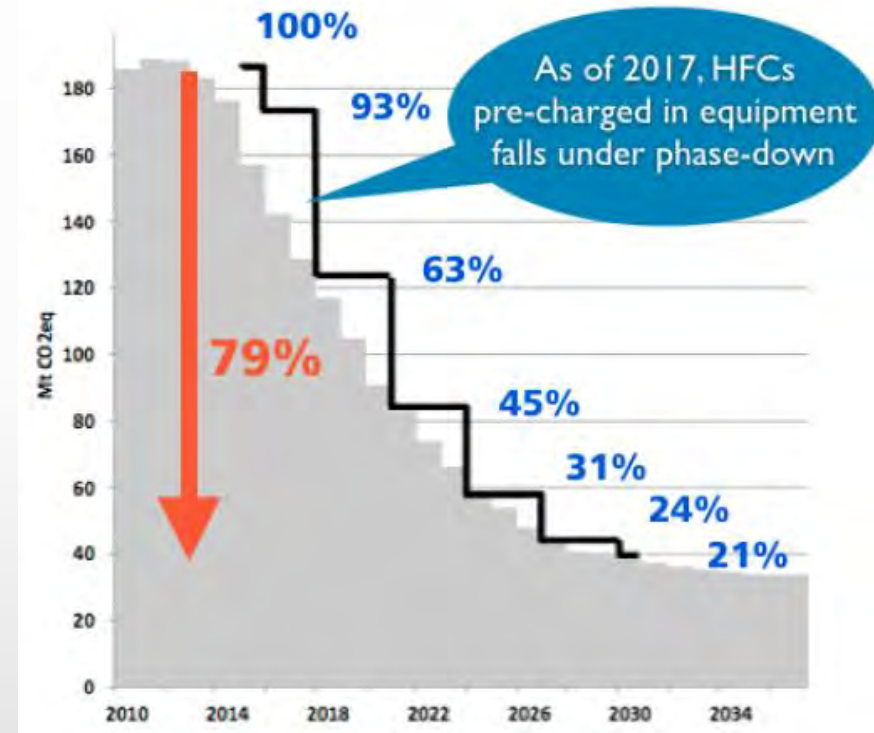
Aim to reduce HFC by 25% by 2020  
and 40% by 2030

Japan

Strong funding model

China

97,5% reduction of HFC's by 2030



Source: Shecco

# Affects

## HFC price increase in Europe

5x increase in 2017

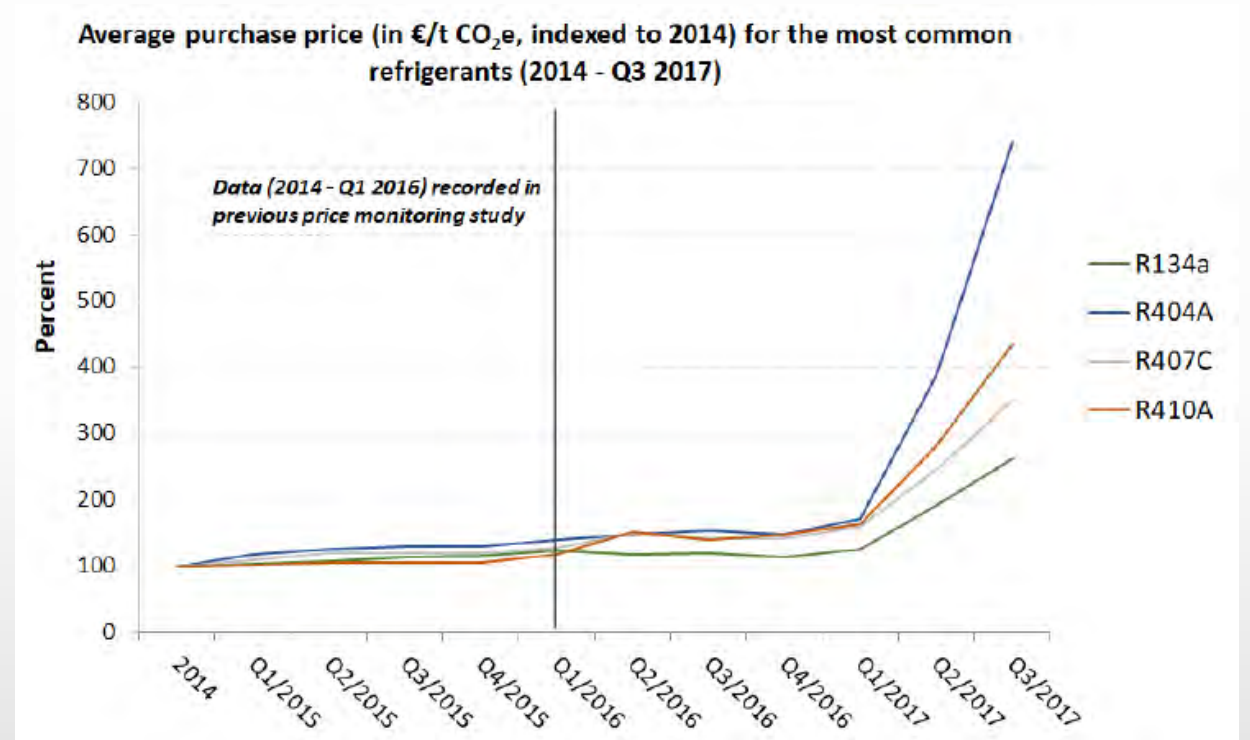
20x increase in 2018 expected

Prices growing proportional to GWP

## Impact on South Africa

Import from countries phasing out

Supply demand



Source: Shecco

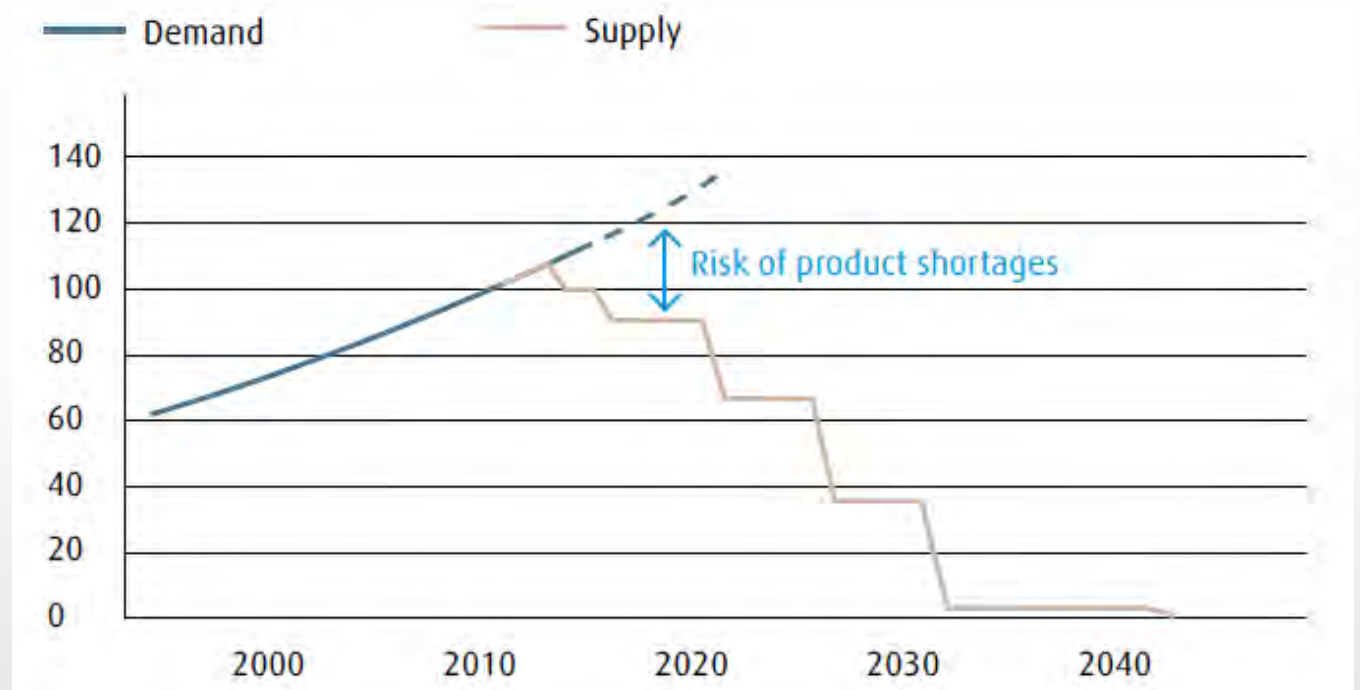
# Affects

## Shortage due to phase out

Linde warns towards a possible shortage

Producing countries to reduce production

Supply to be lower than demand



Source: Linde

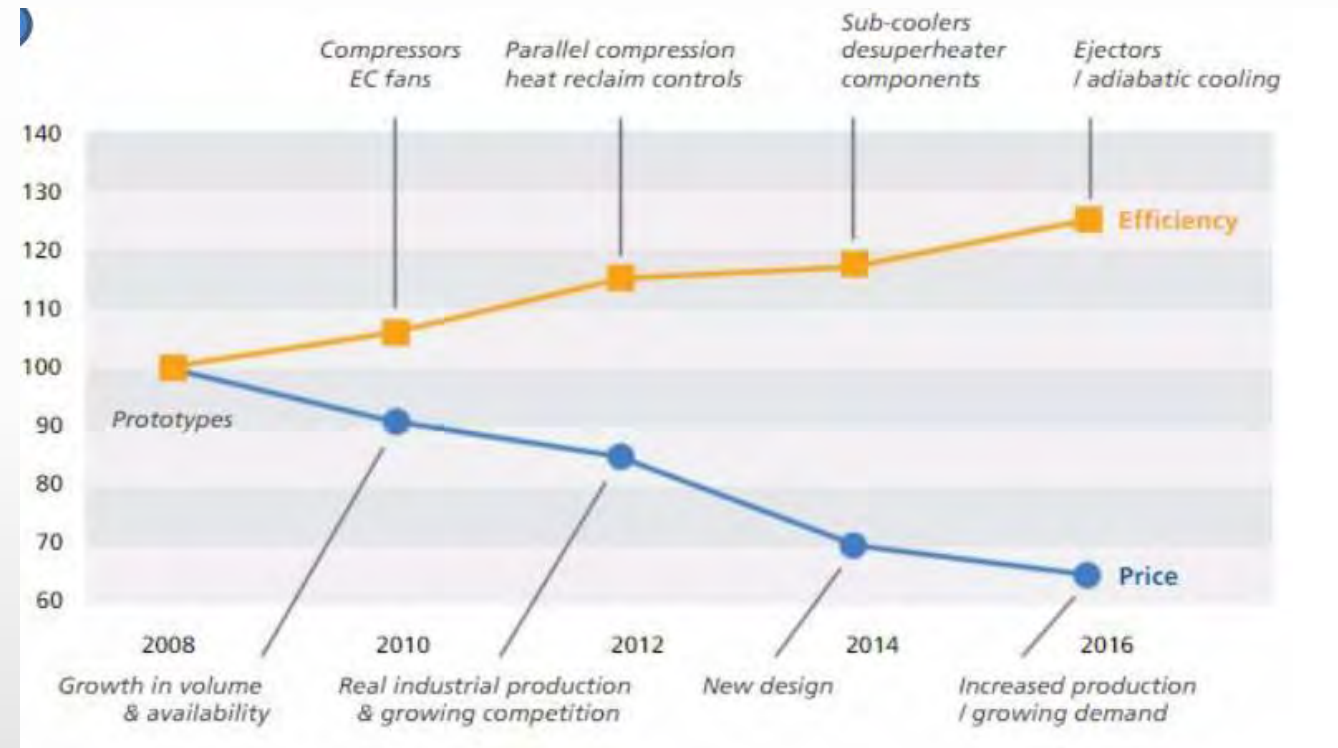
# Affects

## Cost vs Efficiency

Production increase  
Reduce price

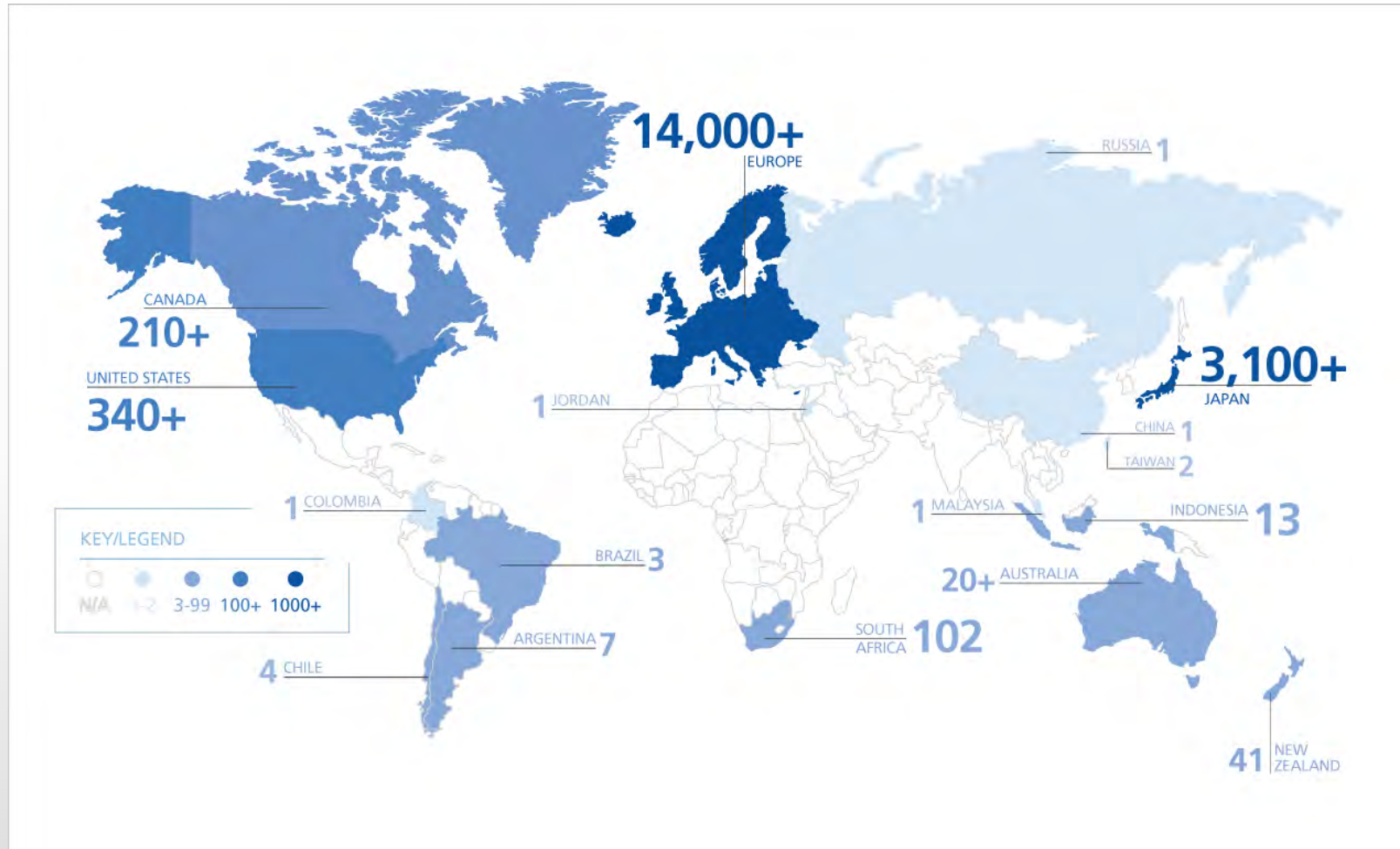
Demand increase  
Reduce price

Technology increase  
Energy efficiency rise



Source: Advansor

# Market



Source: Shecco



# Market

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## CO2 Implementation

First CO2 system installed in Europe

By 2005 23 systems installed

By 2008 Europe still only continent using CO2

In 2009 Canada and Japan installs first CO2 system

In 2010 South Africa 4<sup>th</sup> continent to install first CO2 only system

By 2013 United States and rest of world start to follow

By 2013 CO2 count is:

Europe = 2885

Japan = 100

Canada = 65

United States = 3

South Africa = 17

Rest of world = 10

Total = 3080

By 2017 CO2 count is:

Europe = 14000+

385% increase

Japan = 3100+

3000% increase

Canada = 210+

223% increase

United States = 340+

11233% increase

South Africa = 110

547% increase

Rest of world = 95+

850% increase

Total = 17855+ 479% increase



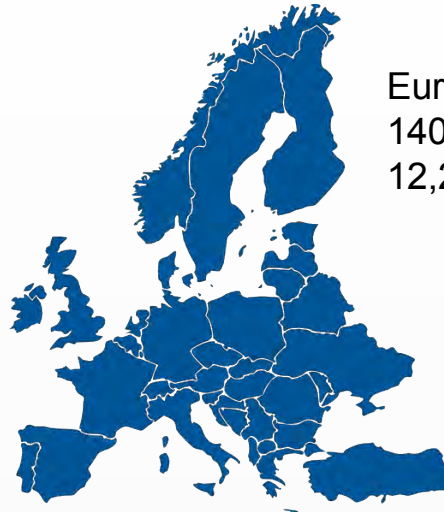
# Market

## CO2 Market Share:

Canada  
210/15000  
1,4%



United States  
340/40000  
0,9%



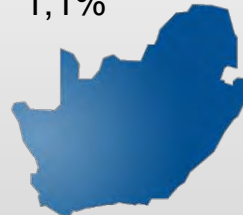
Europe  
14000/115000  
12,2%



Japan  
3100/61240  
5,1%

Rest of world  
95/?  
<0,1%

South Africa  
110/10000  
1,1%



Australia  
20/9500  
0,2%



New Zealand  
41/3860  
1,1%



# Market

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## CO2 Implementation

Estimated growth for Europe  
80,000 by 2030

United States  
close to 40,000 supermarkets

South Africa  
close to 10,000 retail stores

It is safe to assume:

Less than 1% of installed commercial refrigeration systems are operating with naturals  
Life span of plant 20 years



**Will 99% of installed refrigeration plants need to be converted to naturals in the next 20 years?**

# Market Trends

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## **Commercial**

Efficiency increasing:

Parallel compression

Ejectors

New innovations

CO2 in condensing units

## **Light Commercial**

Hydrocarbons

Global market estimate end of 2017 => 2,000,000+ R290 systems

## **Industrial**

NH3 low charge

CO2

NH3/CO2



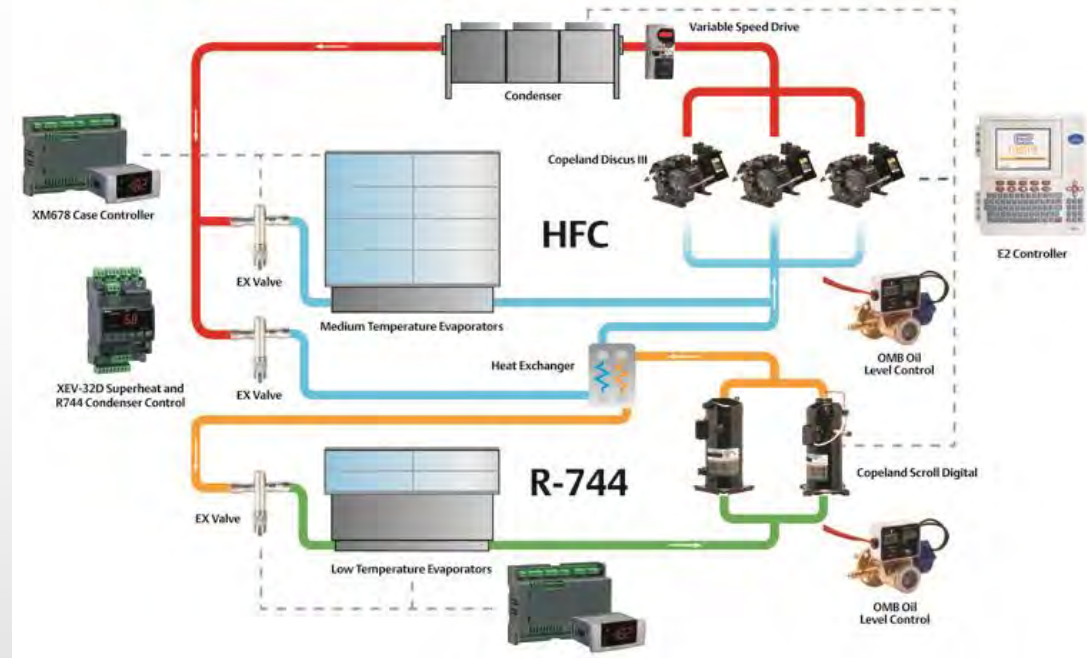
# CO2 Development

## Cascade

CO2 condensed by HFC  
Maintain pressures

Not 100% natural  
Losses due to HX's

## Typical CO<sub>2</sub> Hybrid Cascade System



Source: Emerson

# CO2 Development

## Transcritical Booster

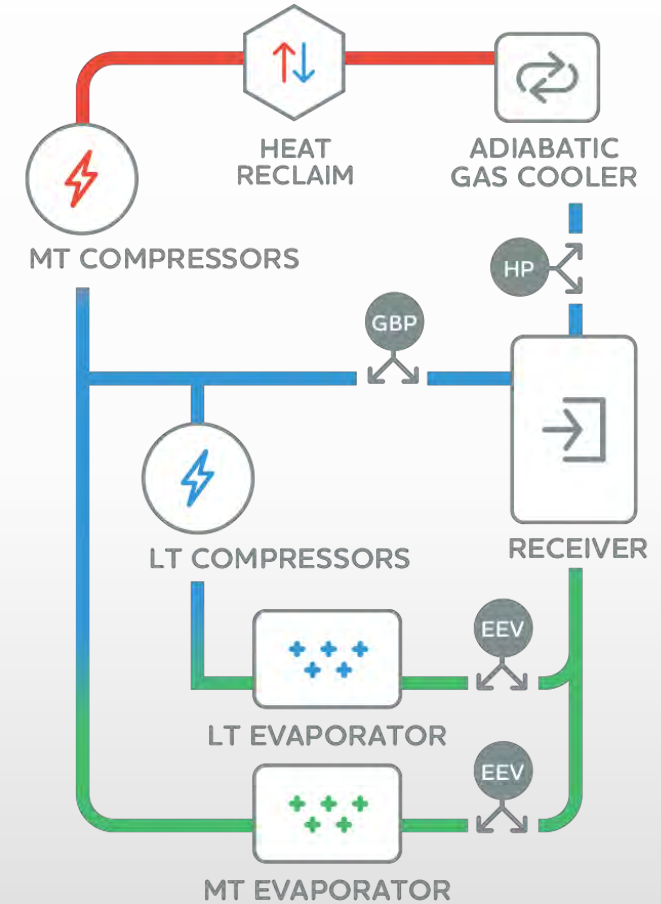
CO2 only refrigerant

No losses due to HX's

Discharge dependant on ambient

Simple CO2 system

Best fit for low ambient environments



# CO2 Development

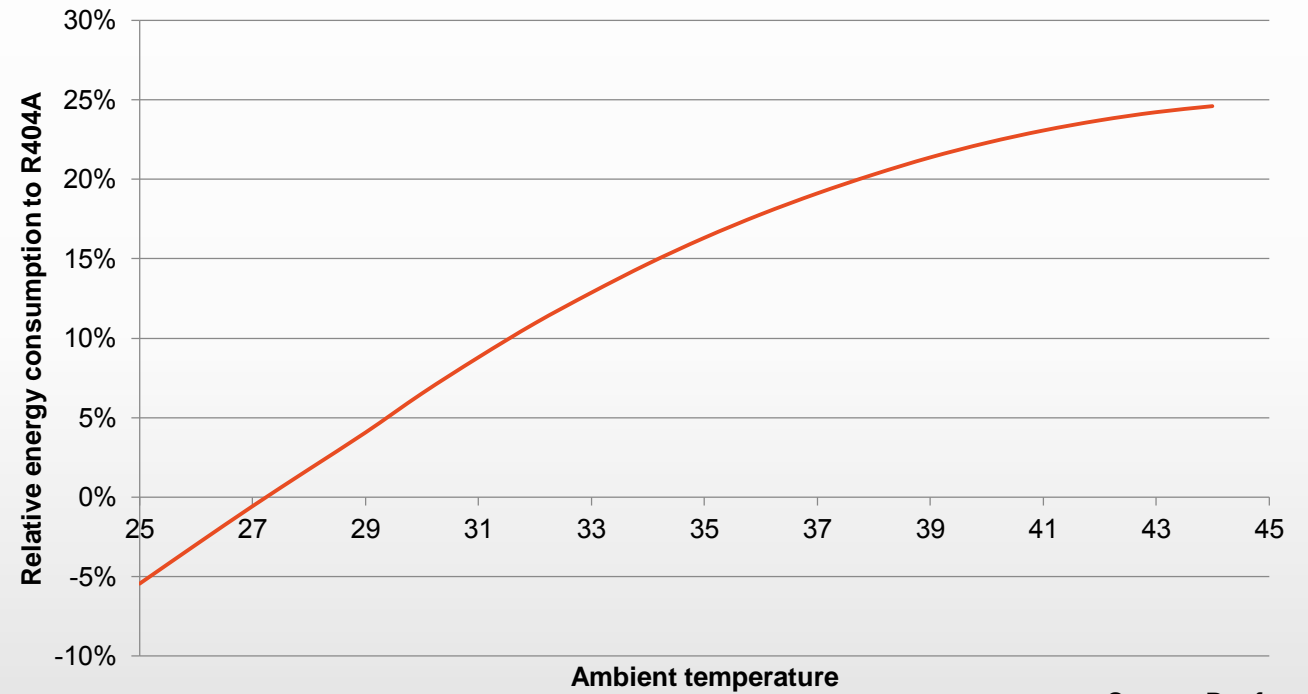
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## Transcritical Booster

No adiabatic gas cooler

More efficient till 27°C

### Transcritical booster compared to R404A



Source: Danfoss

# CO2 Development

## Transcritical Booster with parallel compression

CO2 only refrigerant

No losses due to HX's

Discharge dependant on ambient

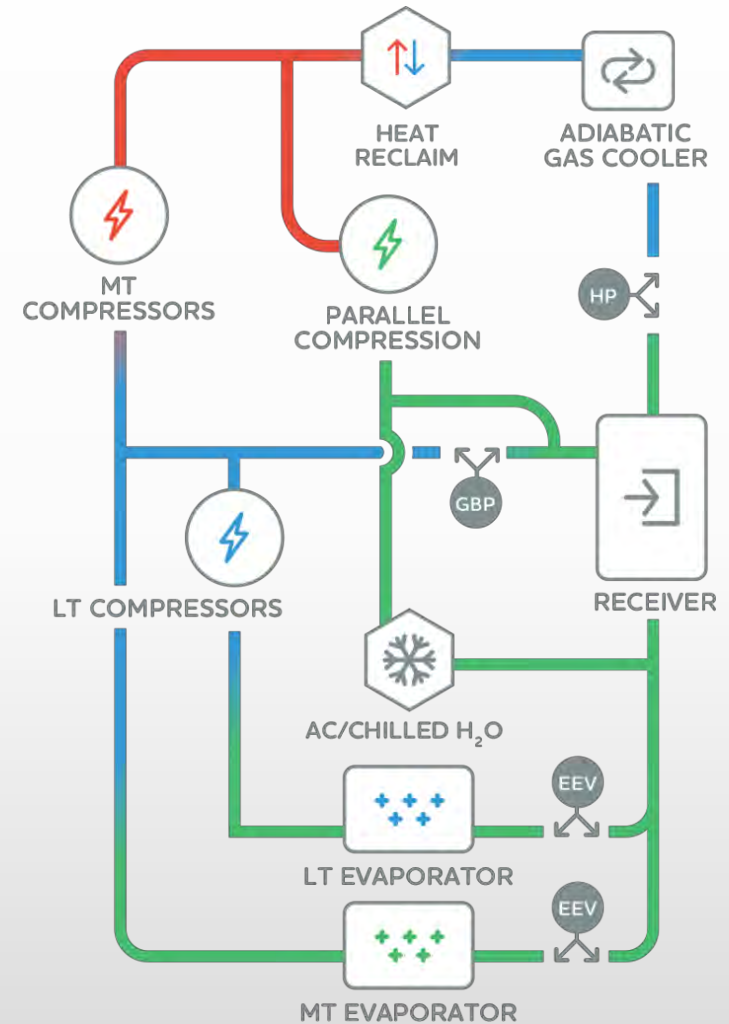
Parallel compressors take care of flash gas

A Bit more complicated CO2 system

Best fit for moderate to higher ambient environments

Higher energy efficiency than Booster

Add possibility of doing AC





# CO2 Development

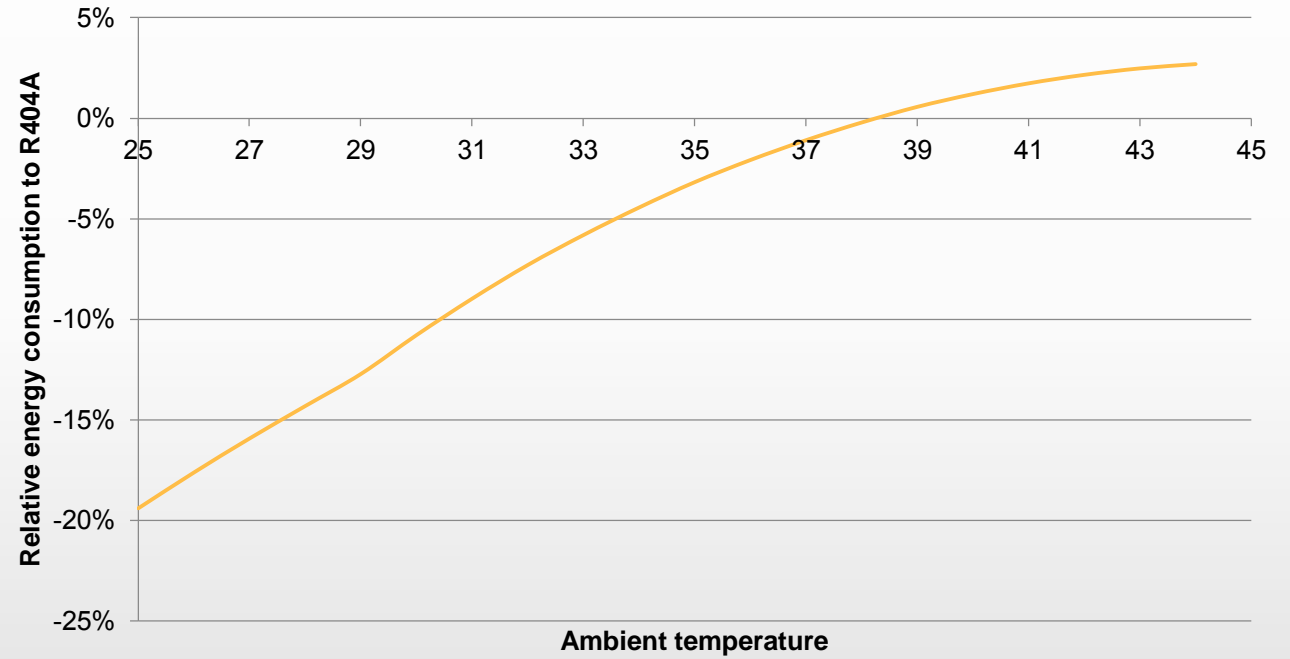
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## Transcritical Booster with parallel compression

No adiabatic gas cooler

More efficient till 38°C

### Parallel compression compared to R404A



Source: Danfoss



# CO2 Development

## Transcritical Booster with parallel compression and ejectors

CO2 only refrigerant

No losses due to HX's

Discharge dependant on ambient

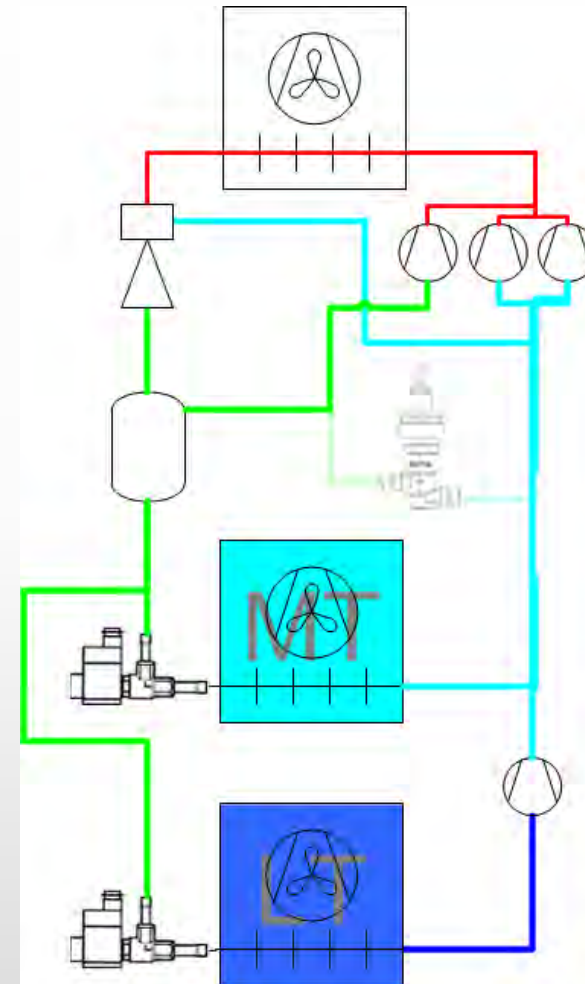
Parallel compressors take care of flash gas

Ejectors lifts MT suction to receiver

More complicated CO2 system

Best fit for high ambient environments

Higher energy efficiency



Source: Danfoss

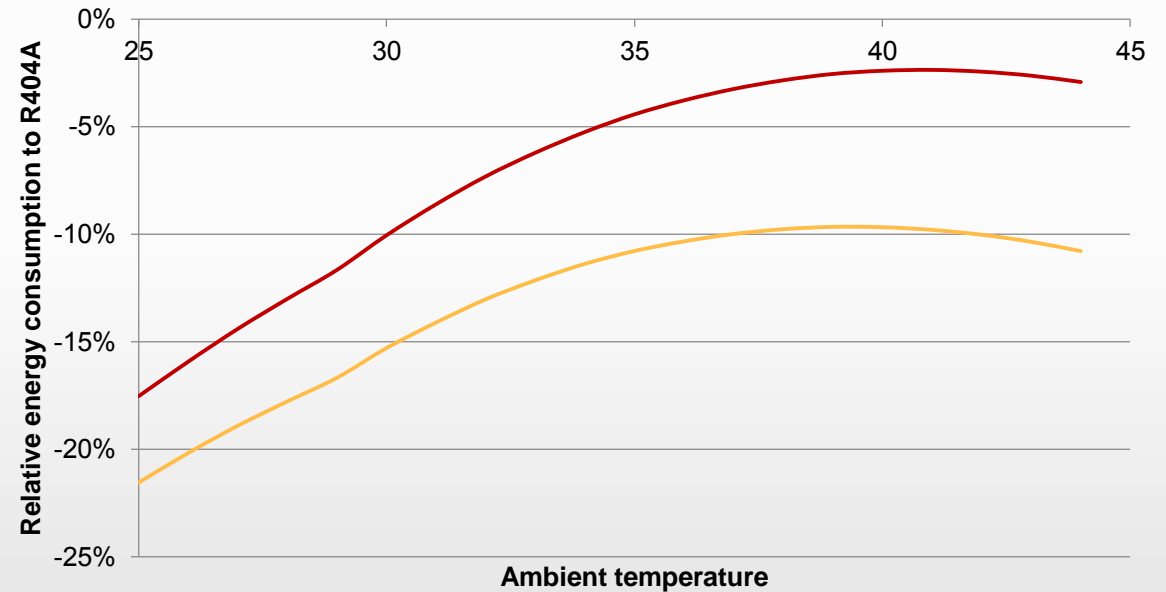
# CO2 Development

## Transcritical Booster with parallel compression and ejectors

No adiabatic gas cooler

More efficient at all ambient conditions

### Gas ejector high and low compared to R404A



Source: Danfoss



# CO2 Development

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## Other energy efficient measures

Adiabatic gas coolers

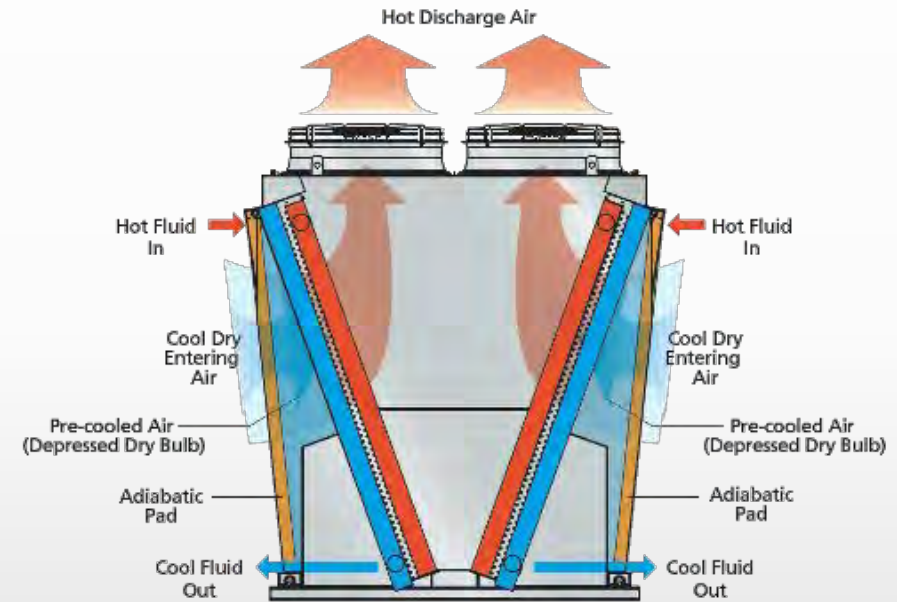
Operates at wet bulb temperature

Water is a commodity

Re-utilise water

Capture water

Control use of water



# Warm Ambient

## What is a high ambient Temperature

Average annual Temperatures

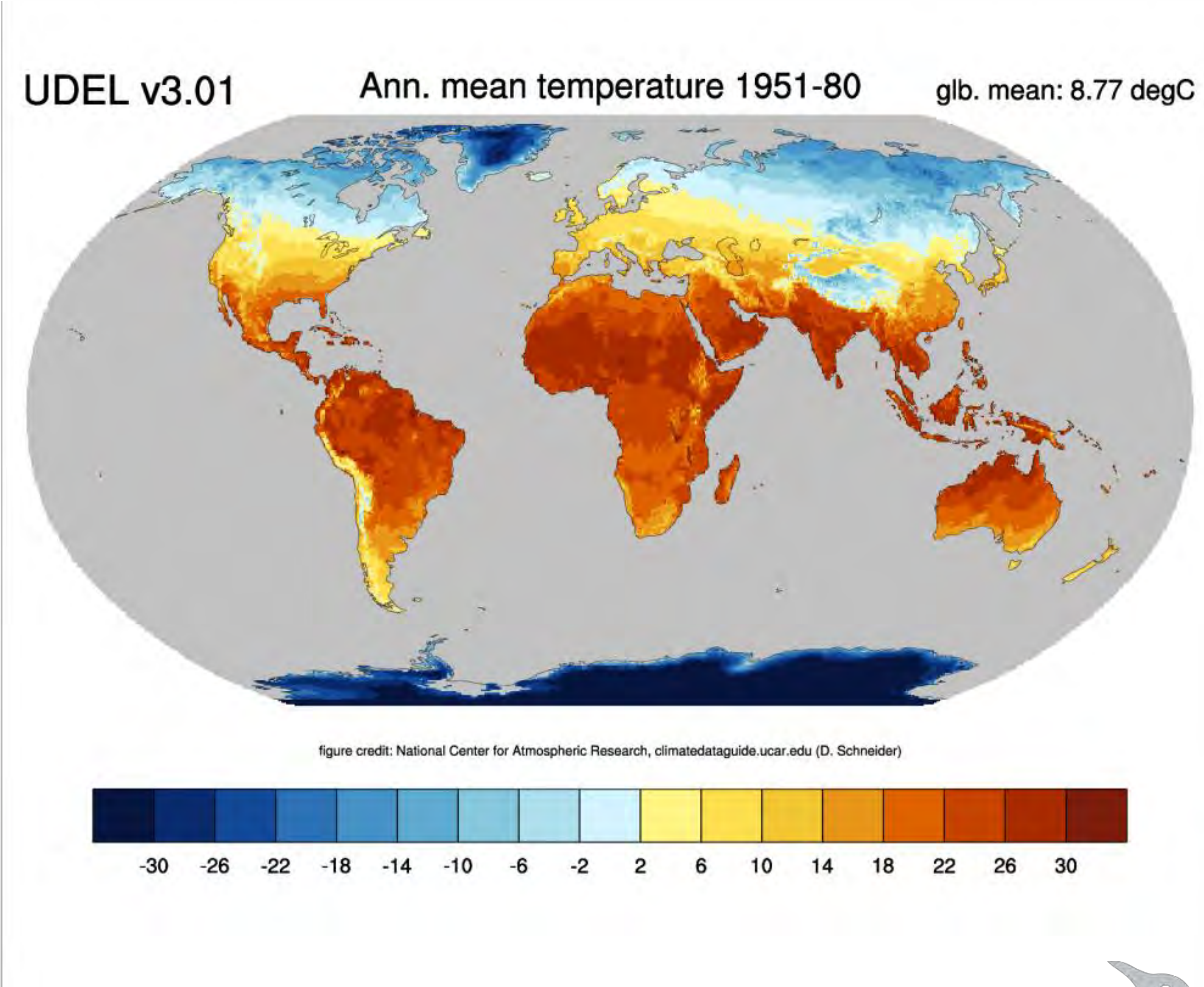
- Jhb: 16°C
- Pta: 18°C
- CT: 18°C

Highest WB design Temperature

- Jhb: 19°C

Average global annual temperatures

14°C







COMMERCIAL REFRIGERATION SERVICES

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