ENGINEERING TOMORROW

Solutions for
Energy Efficient Refrigeration systems

Rupesh Patil, Business Development Manager – APA & India,
Danfoss Commercial Compressors



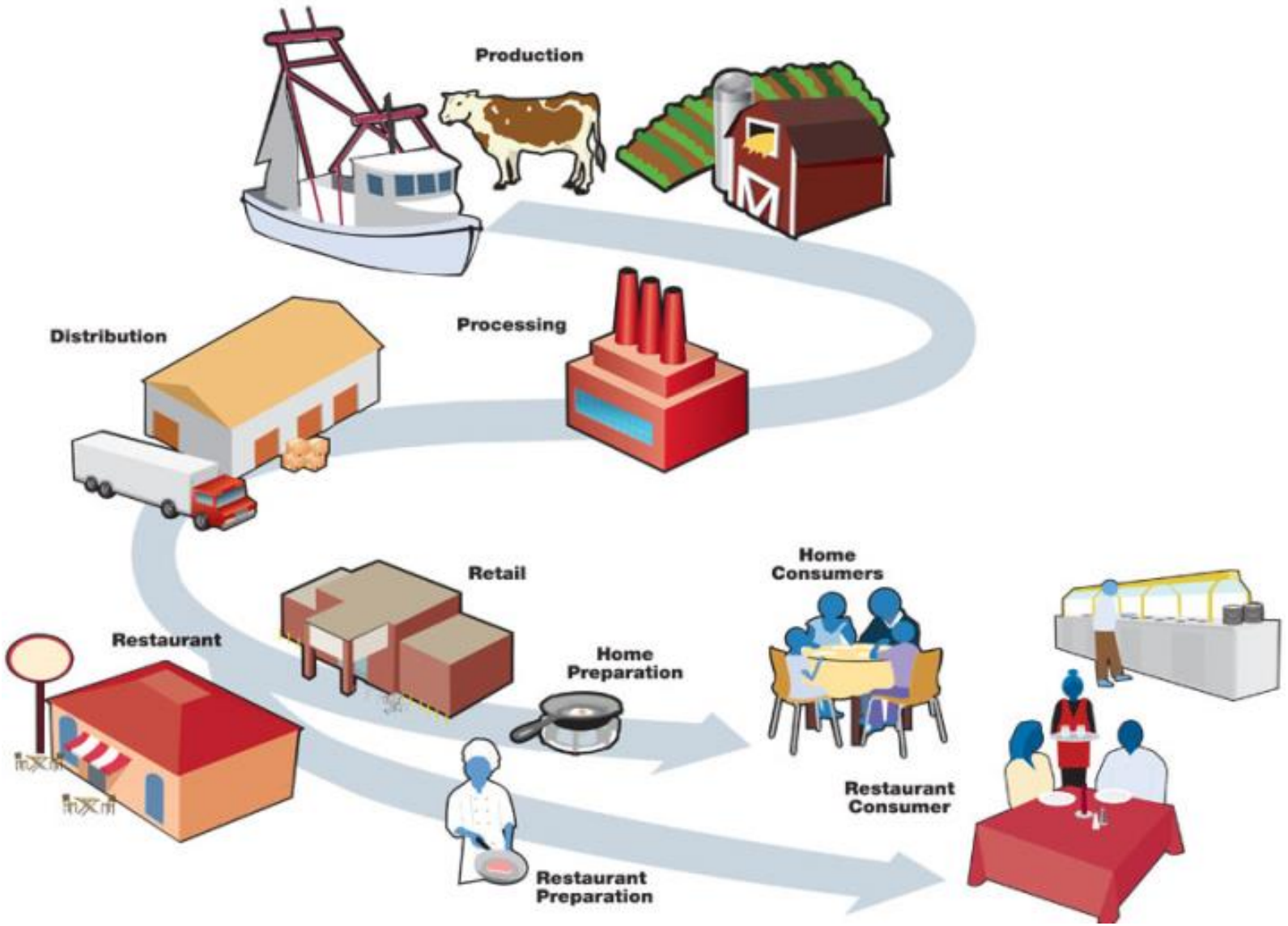
Brings benefits for everyone



Content

- **Trends and Drivers**
- Application needs
- Technical characteristics
- Solutions for Energy Efficiency
  - Low Temp Scrolls
  - New generation condensing units
  - Inverter condensing units
- Refrigerant trends

The Food Production Chain



- Meat
- Poultry
- Dairy products
- Fish
- Vegetables
- Fruits
- Frozen food
- Beverage
- Etc…

What is Food Service?



Definition: Food Service industry defines those businesses, institutions, and companies responsible for any meal prepared outside the home. This industry includes restaurants, school and hospital cafeterias, catering operations, and many other formats.

Industry facts[1]: Food Service has an annual growth rate of 5%, which is expected to continue that way until 2018. US$ 2.6 Trillion business, 1 in 10 is employed with food service sector

Mega Trends: Urbanization, Connectivity, Energy Conservation, Climate, Food Safety, Sustainability

Danfoss product offering: Danfoss offers a wide range of mechanical & electronic controls, heat exchangers, and compressors that meet the challenging demands of the Food Service segment.

1) Source: Euromonitor

Refrigeration Market Drivers:



A typical Food Service Outlet



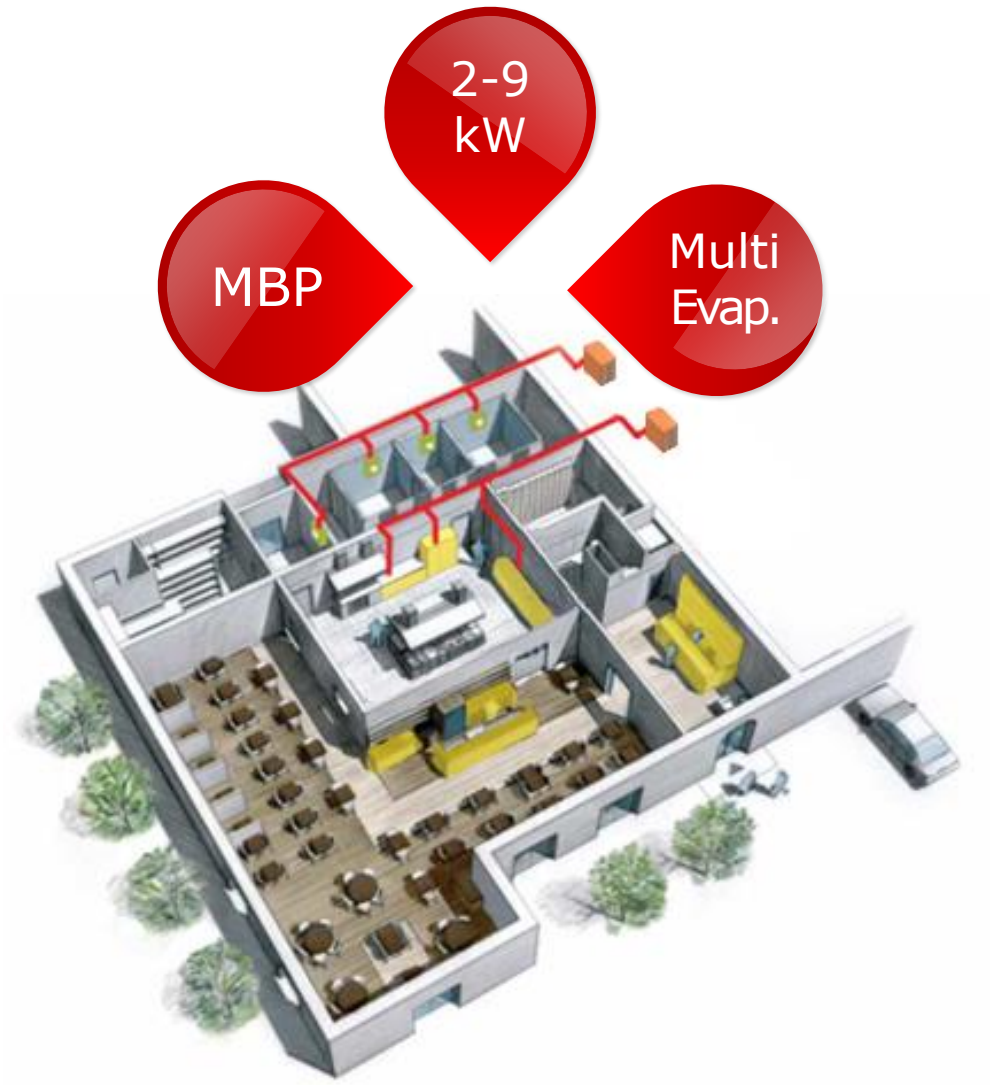
Storage/Prep	Dispenser	Merchandiser
1. Cold Room/Walk-In	4. Ice Machine	7. GDM
2. Prep Table	5. Beverage Dispenser	
3. Fridge/Freezer	6. Ice Cream Machine	



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Applications requiring **capacity modulation**



Unit connected to several evaporators:
one unit cools several display cabinets, cold rooms, GDM or fermentation rooms that have different cooling needs at thee same time

- Drive / Mini-markets / Supermarkets
- Convenience Stores
- Petrol Stations
- Restaurants
- Wine cellars
- Fish markets
- Butchers' shops
- Dairy and general food storages, etc.

Unit for "critical applications":
one unit is used in applications where capacity modulation ensure the **quantity and quality of goods produced** (typically fermentation rooms, ice making machines)

Application Needs

Several cabinets with different cooling needs: one unit feeds several cabinets

Huge peaks and variations in cooling demand in the day: need for continuous load matching



Temperature and humidity controls: need for very precise temp. and humidity for food quality and safety

Lots of open / close doors: need for continuous adjustment of cooling capacity

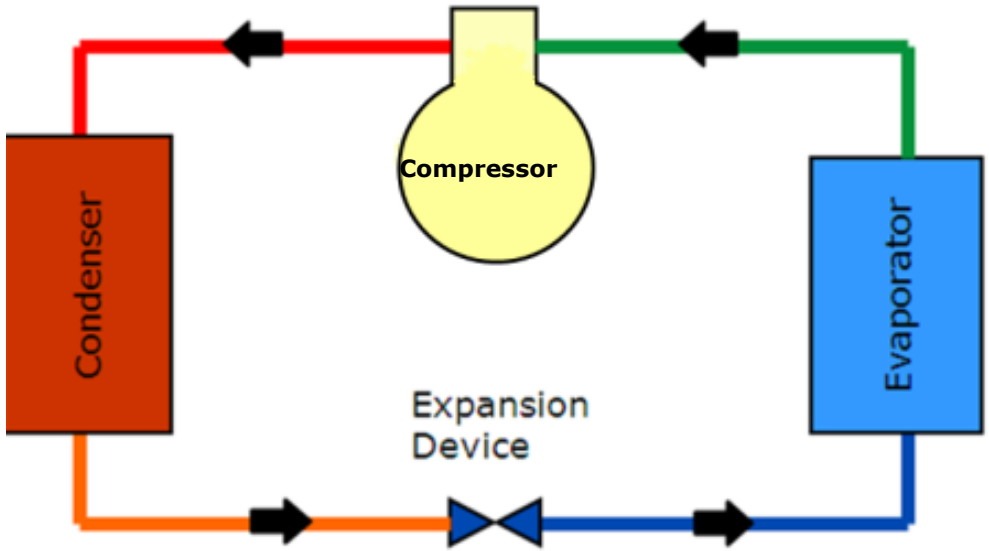


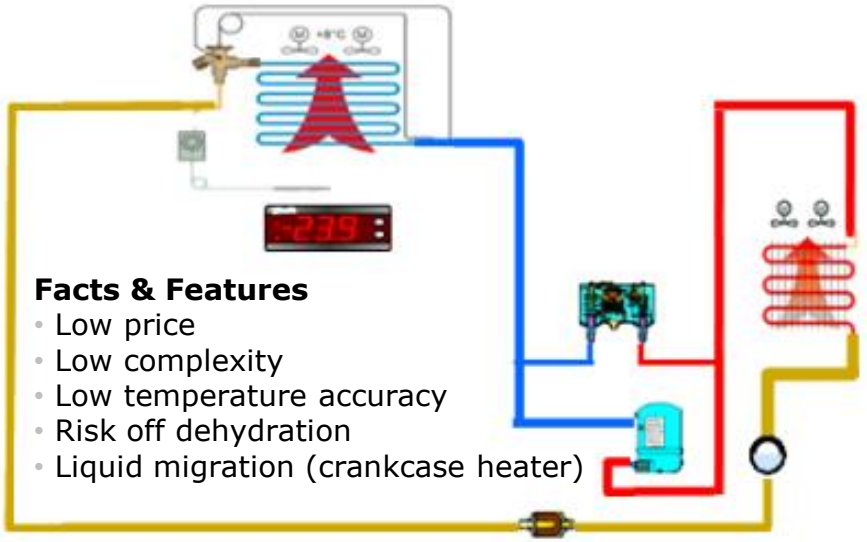
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Simple Refrigeration Circuit

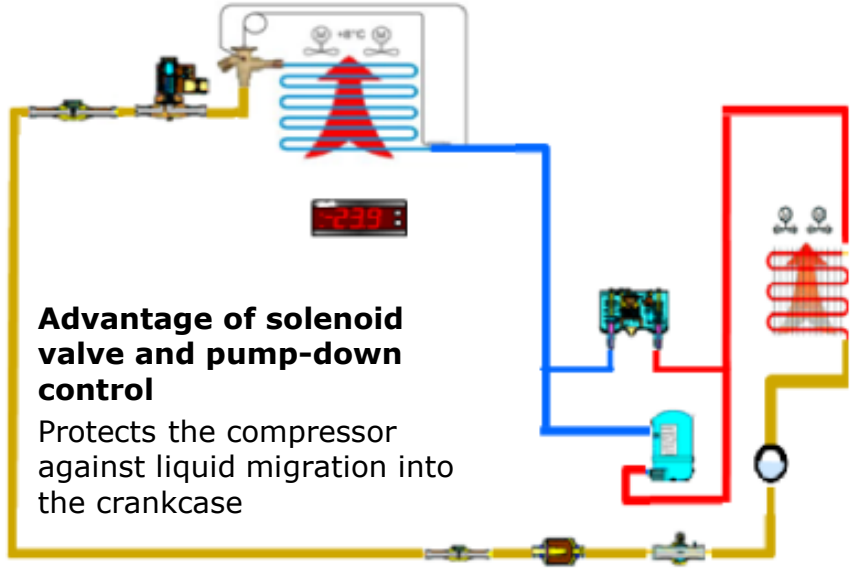
Plant without automatic controls
No electronic expansion valve
No big load variations





Facts & Features

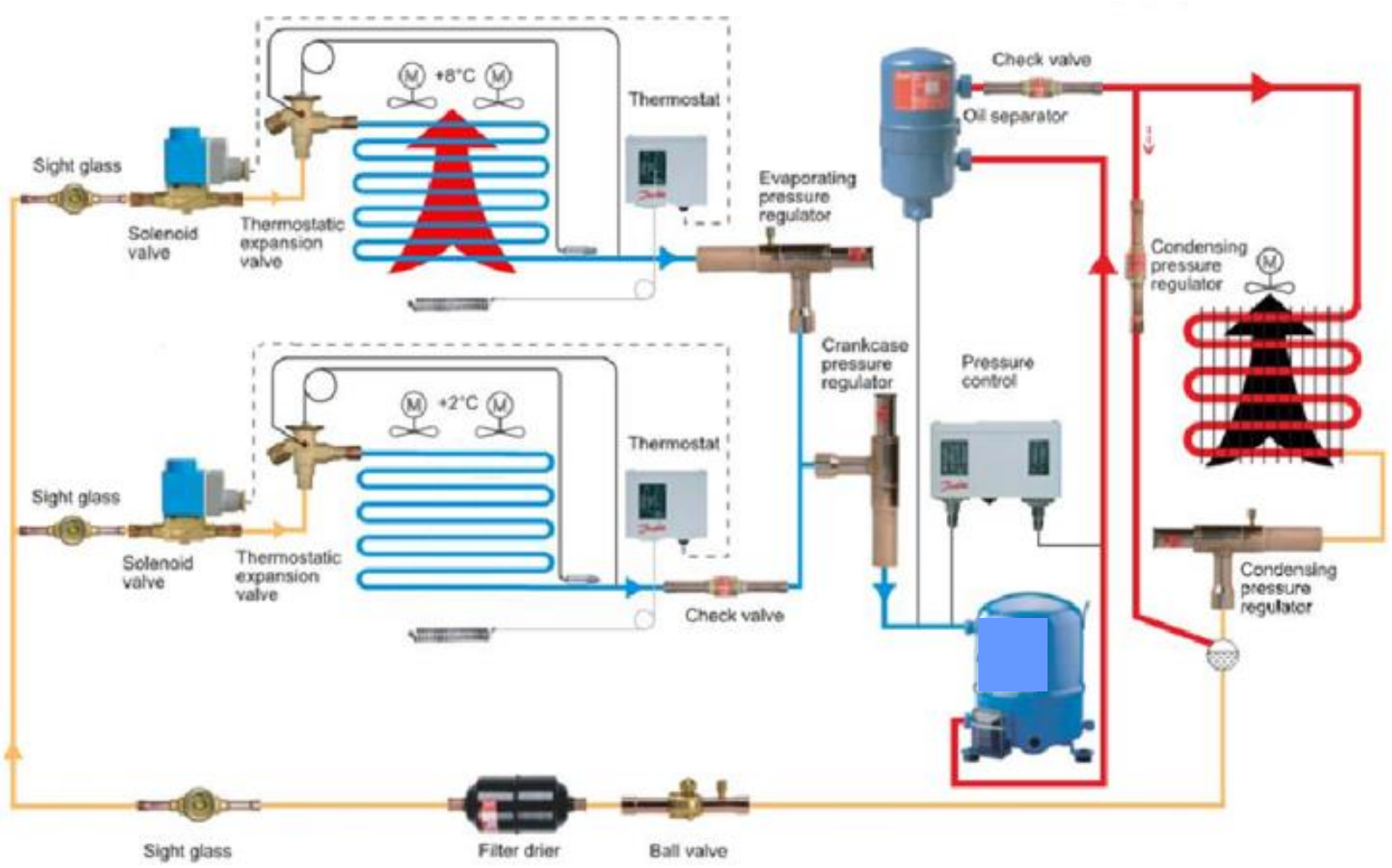
- Low price
- Low complexity
- Low temperature accuracy
- Risk off dehydration
- Liquid migration (crankcase heater)



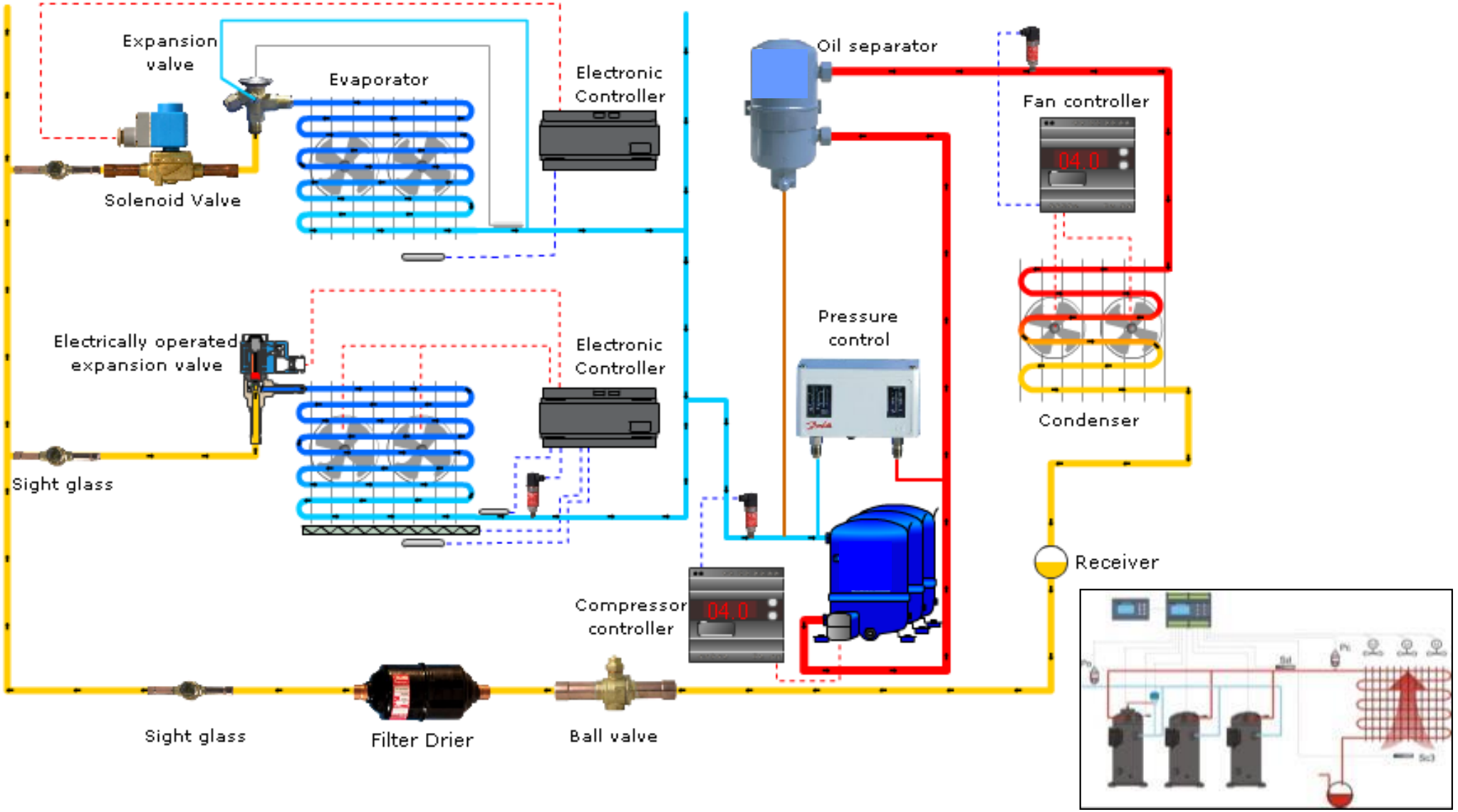
Advantage of solenoid valve and pump-down control

Protects the compressor against liquid migration into the crankcase

Complete Refrigeration Circuit

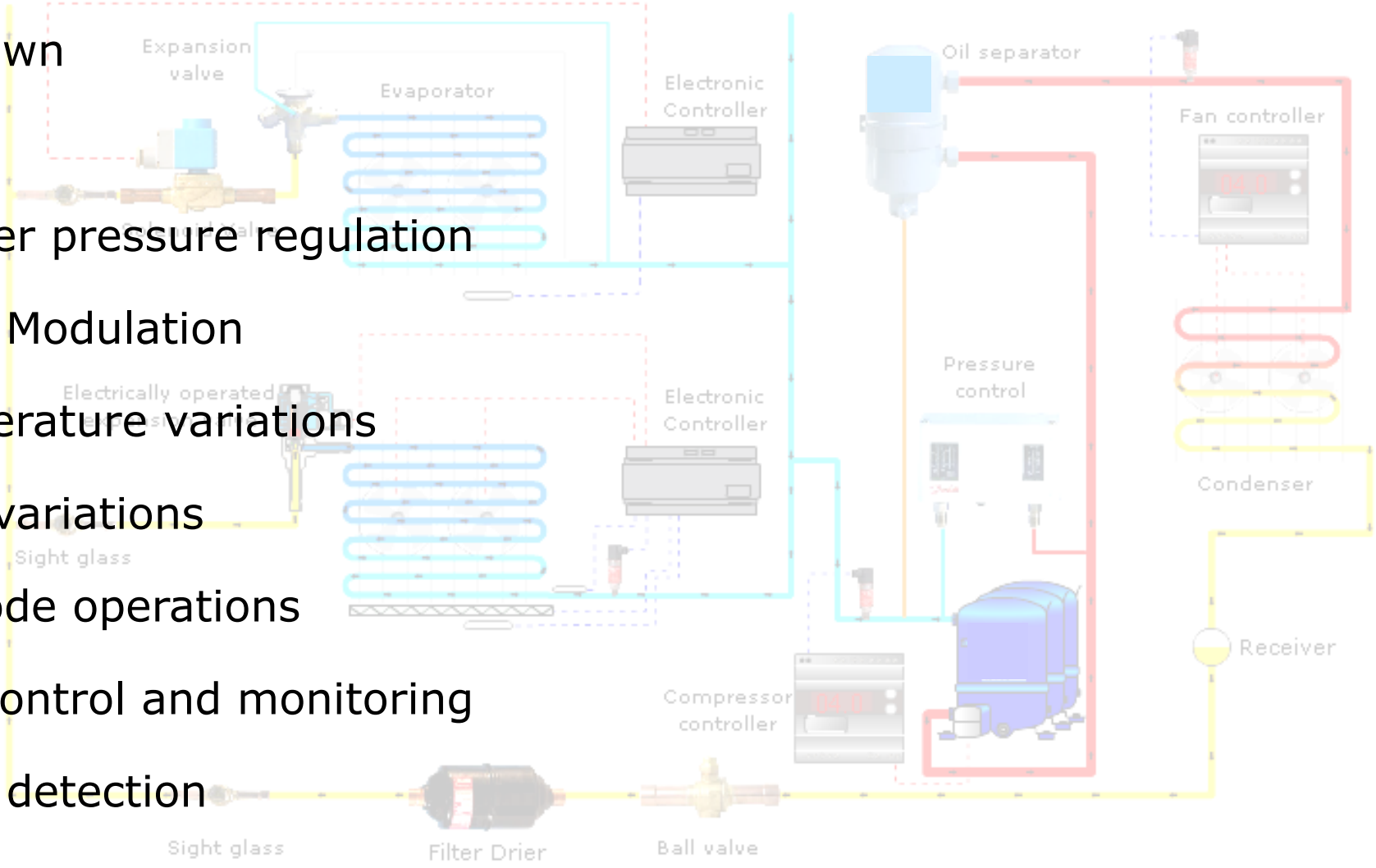


Advanced Refrigeration Circuit



Key refrigeration processes

- Pump Down
- Defrost
- Condenser pressure regulation
- Capacity Modulation
  - Temperature variations
  - Load variations
- Night mode operations
- Central control and monitoring
- Gas leak detection

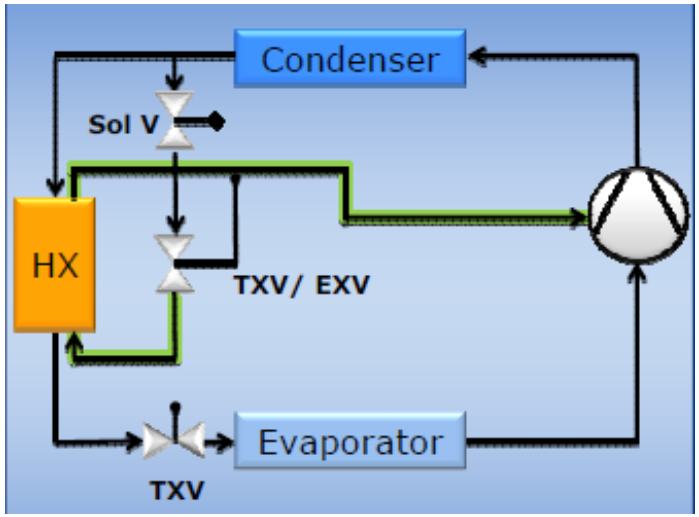


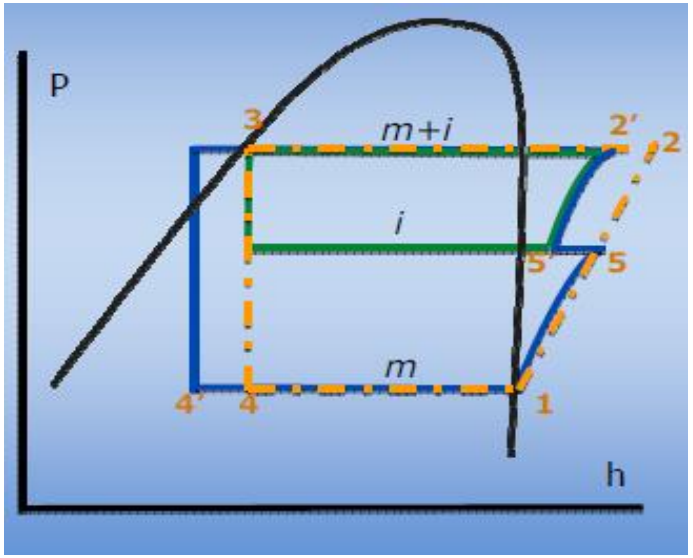


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Vapour Injection – Economiser circuit





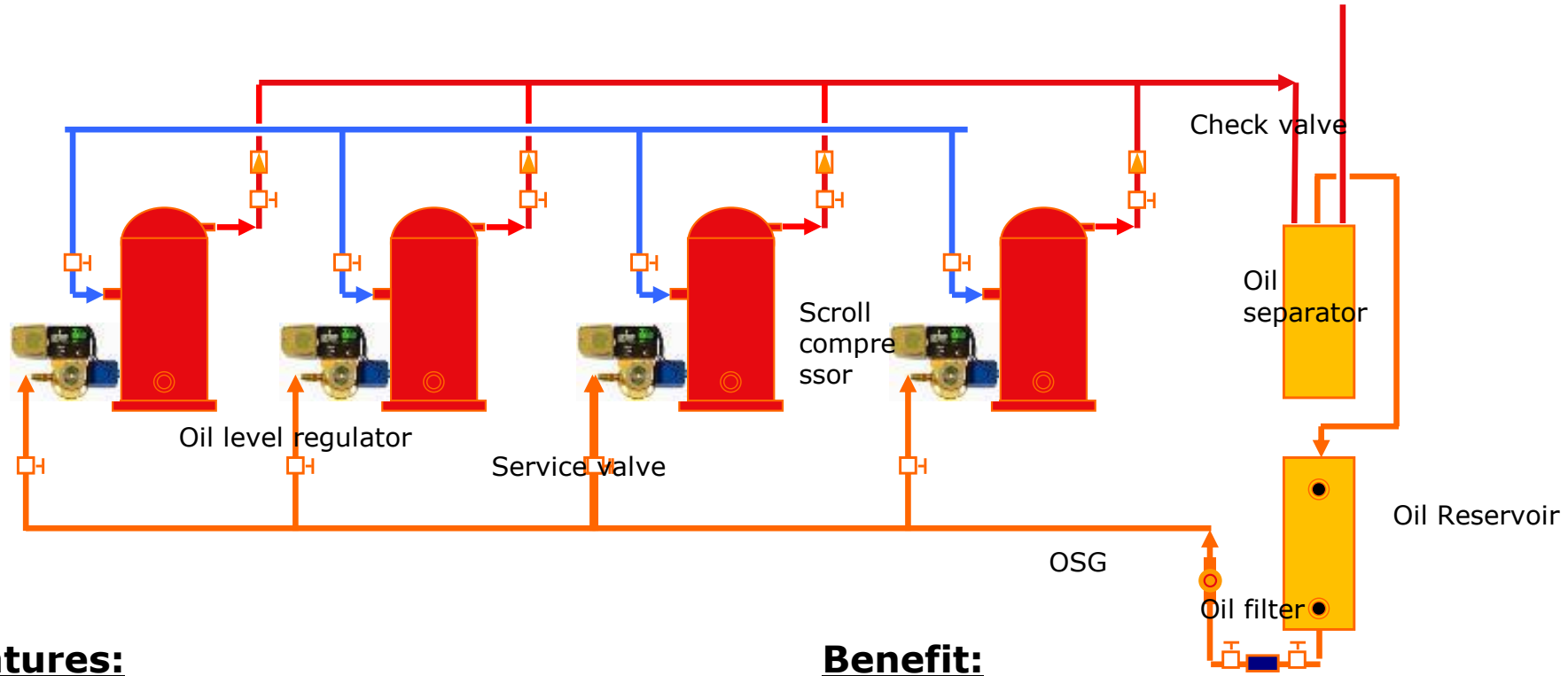
Features

- Refrigeration scroll could be equipped with a heat exchanger acting as an economizer
- Economized cycle performs much better for high pressure ratio applications

Benefits

- Capacity improvement: The capacity is improved without increasing compressor displacement, as it is increased by further increasing system subcooling
- Efficiency improvement: the efficiency improves due to the fact that the gain in capacity is greater than the increase in power that the compressor consumes
- Enlarged operating envelope: The injection of vapor through economized line will reduce the discharge temperature

Manifolding - Active oil balance



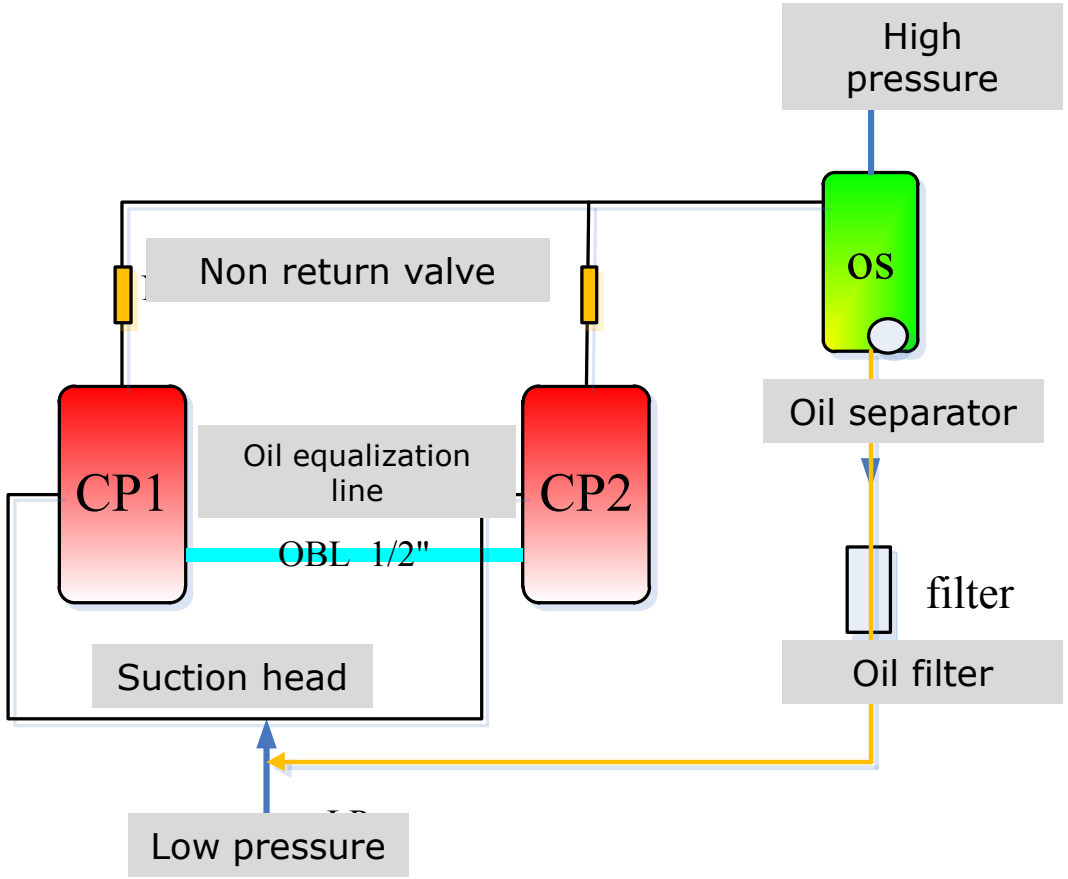
Features:

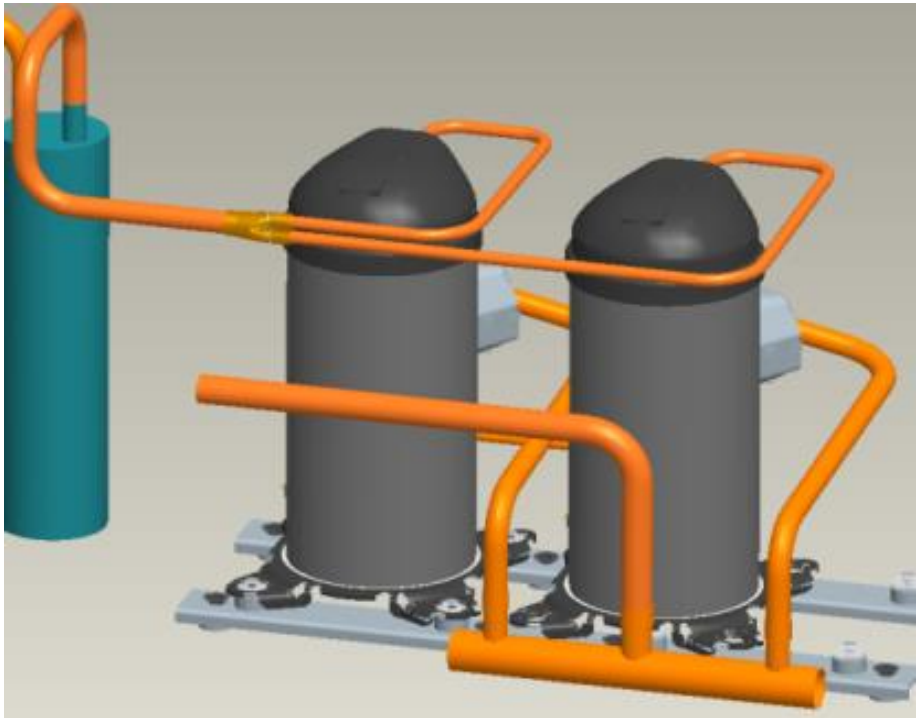
- Applied to manifolding with multiple compressors
- Oil balance and oil return are ensured with use of oil level regulator and oil separator
- Pre-qualified oil level regulators and oil separators of different brands
- Low weight and small footprint

Benefit:

- Flexible system design with different manifolding configuration
- Higher system reliability
- Flexible components selection for different markets
- Higher part load efficiency with modulated capacity

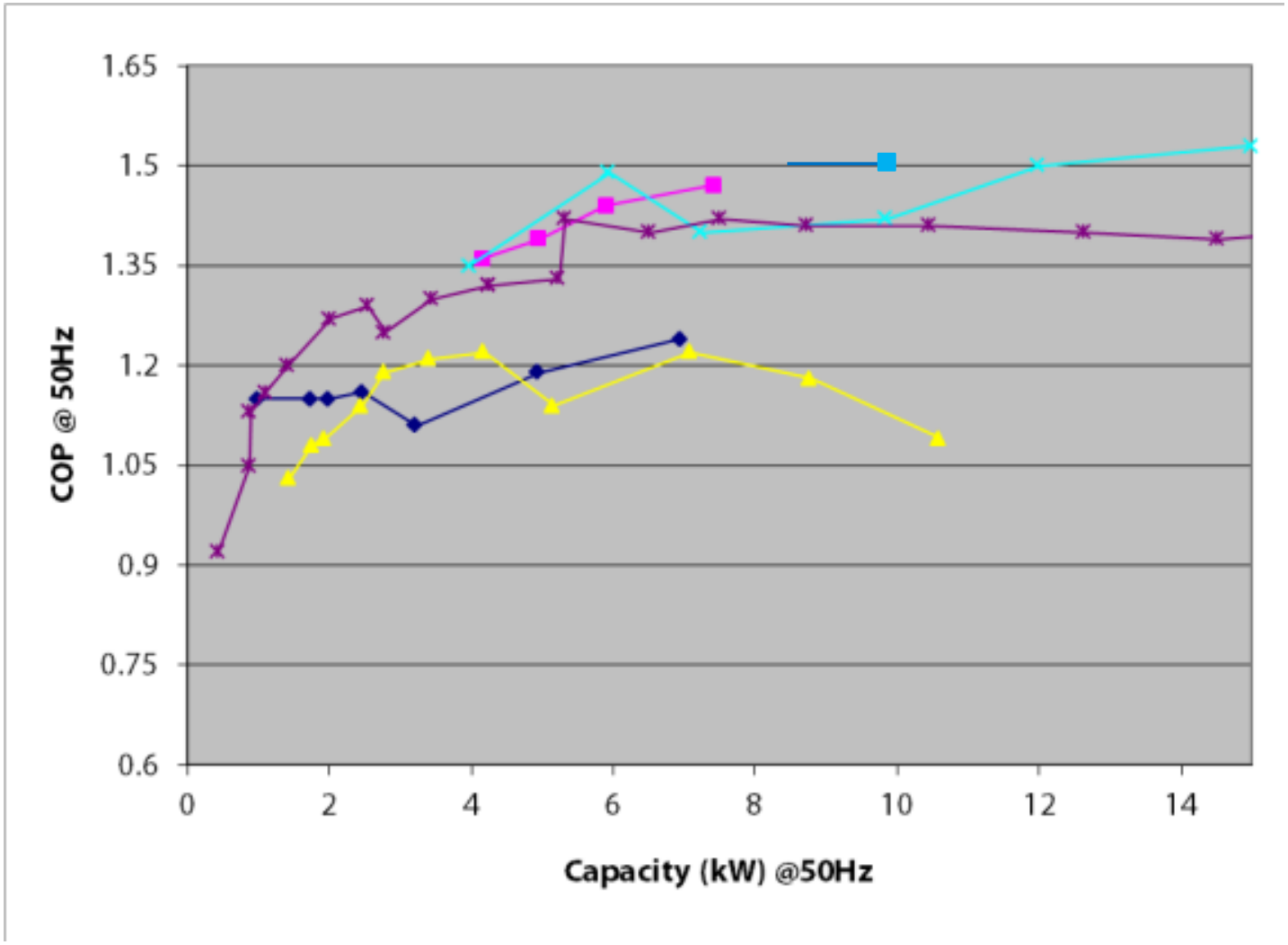
A simple solution: Passive oil balance





- Applied to even tandem
- Simple system and low cost
- Simple piping design

R404A efficiency mapping @ 50Hz



Hermetic Recip
Semi Hermetic Recip
Low temp scroll with Eco

*EN12900 LBP Te /Tc/RGT/SC: -35/40/20/0 ℃

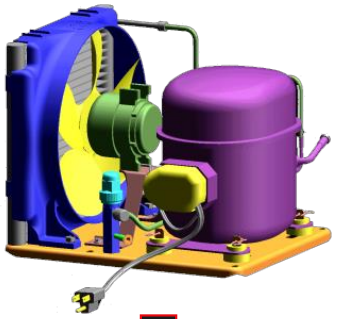


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New Generation –

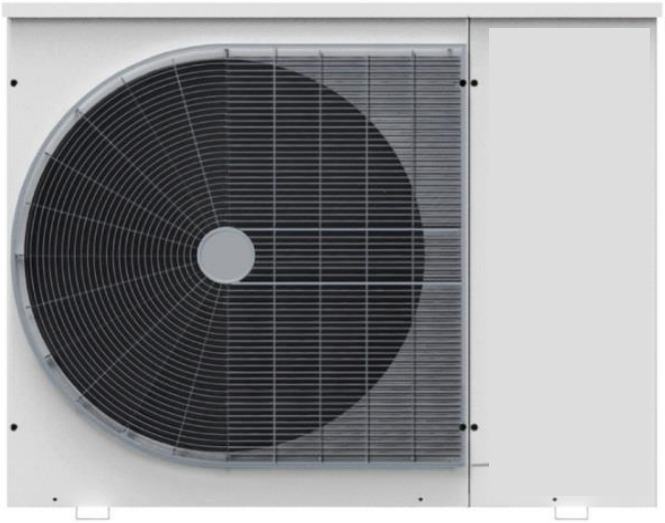
Fully dressed condensing units – Mechanical + Electrical



Compressors









Micro Channel Heat Exchanger

Filter dryer





Sight glass

Receiver





Electrical Box

Suction & Liquid valves with service ports



Crankcase heater





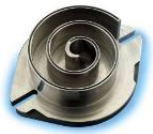


HP/LP Switch

New Generation –

Fully dressed condensing units – Electronically smart













Electronic controller



Fan speed controller



Shut off valves















access doors



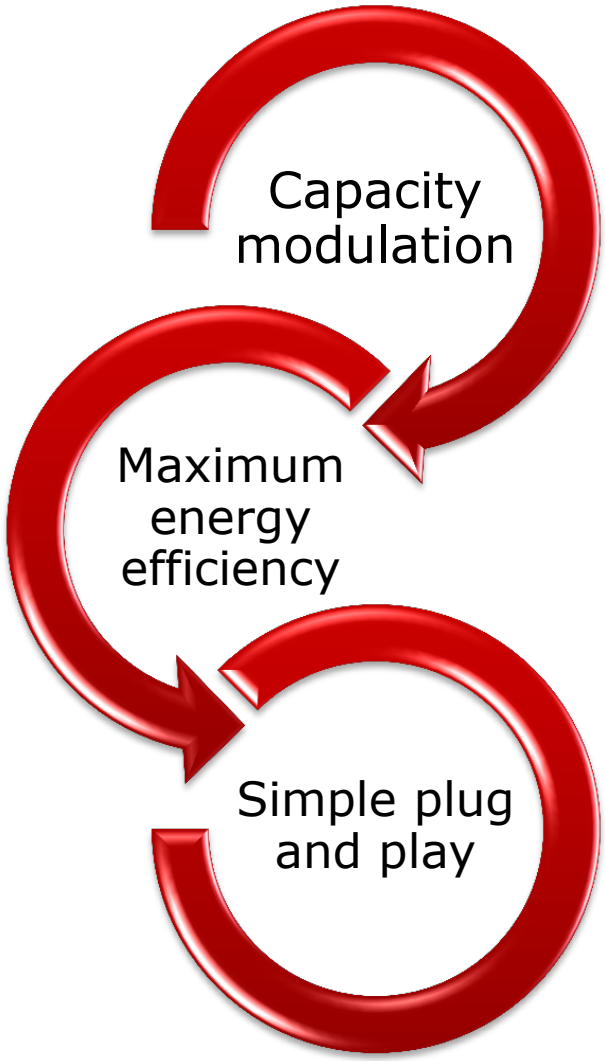


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INVERTER Condensing Units

Brings benefits for everyone



Market **leading** expertise

in condensing unit design with the unique benefits of stepless inverter scroll technology.

INVERTER Condensing units

Examples of applications







INVERTER condensing unit
Components



Oil-Seperator

Compressor & Drive





Micro channel heat exchanger

Receiver with shut off valve



Housing





Pressure sensor



Electronic controller



Temperature sensor



Liquid and suction line shut off valves

Condenser fan





Sight glass



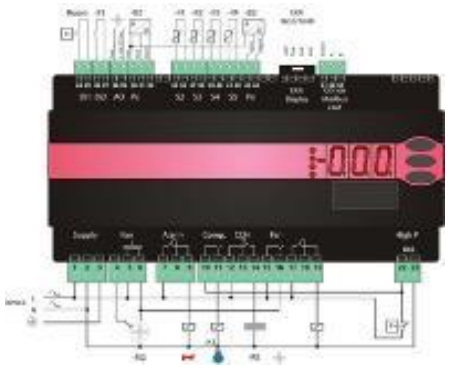
Filter drier

Electrical components



Controller

Features:



- Monitor pressures, temperatures, superheat
- Display alarms, status
- Control the condenser fan and compressor speed
- Control the crankcase heater load
- Day and night schedule for maximum condenser fan and compressor speed
- Remote alarm
- Remote display / setting modules
- Connect to main system controller front-ends via Modbus or optional LON-Bus module

Benefits:



- Faster and easier installation
- No need to connect gauges or instruments
- Reduced risk of installation error
- Energy saving
- Additional temperature input
- Increased business opportunities

MCHX - Micro Channel Heat Exchanger

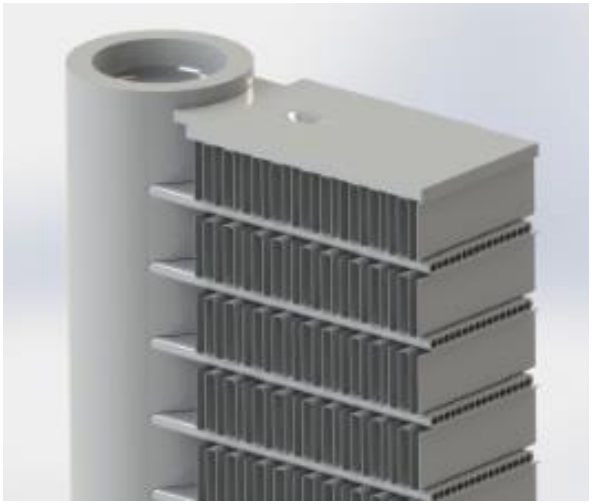
A revolution in heat transfer

Significant benefits

- **Optimize system COP**
- **Improved thermal efficiency** over fin and tube.
- **Up to 35% less system refrigerant** required: Saving on installation cost.
- **Much stronger and lighter** than traditional fin and tube.
- **Resists corrosion:** 960 hour salt test - only salt deposits on MCHX, fin and tube coil damaged.
- **Easier to clean:** Simply use a soft brush and hose pipe.
- **Higher efficiency post cleaning**
- **Safer to handle** and less prone to damage

Much better than copper tube and aluminium fins.







Content

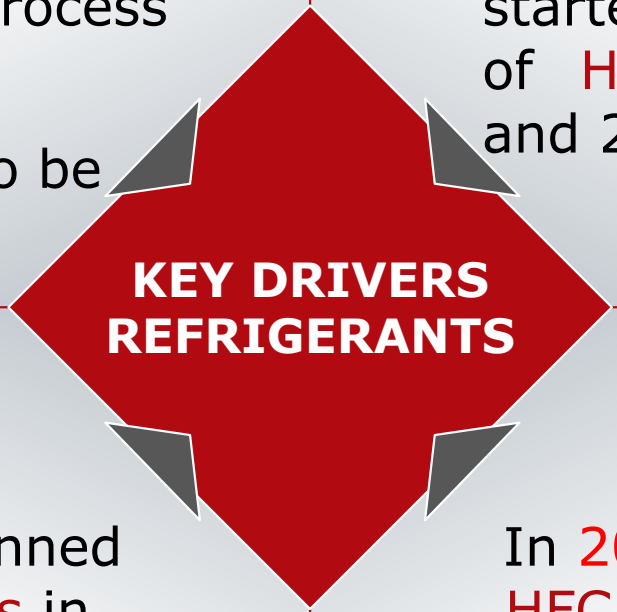
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Key drivers of the refrigerants agenda

Montreal Protocol has phased out CFC and is in the process phasing out HCFC.

HFC will eventually also be covered in 2016

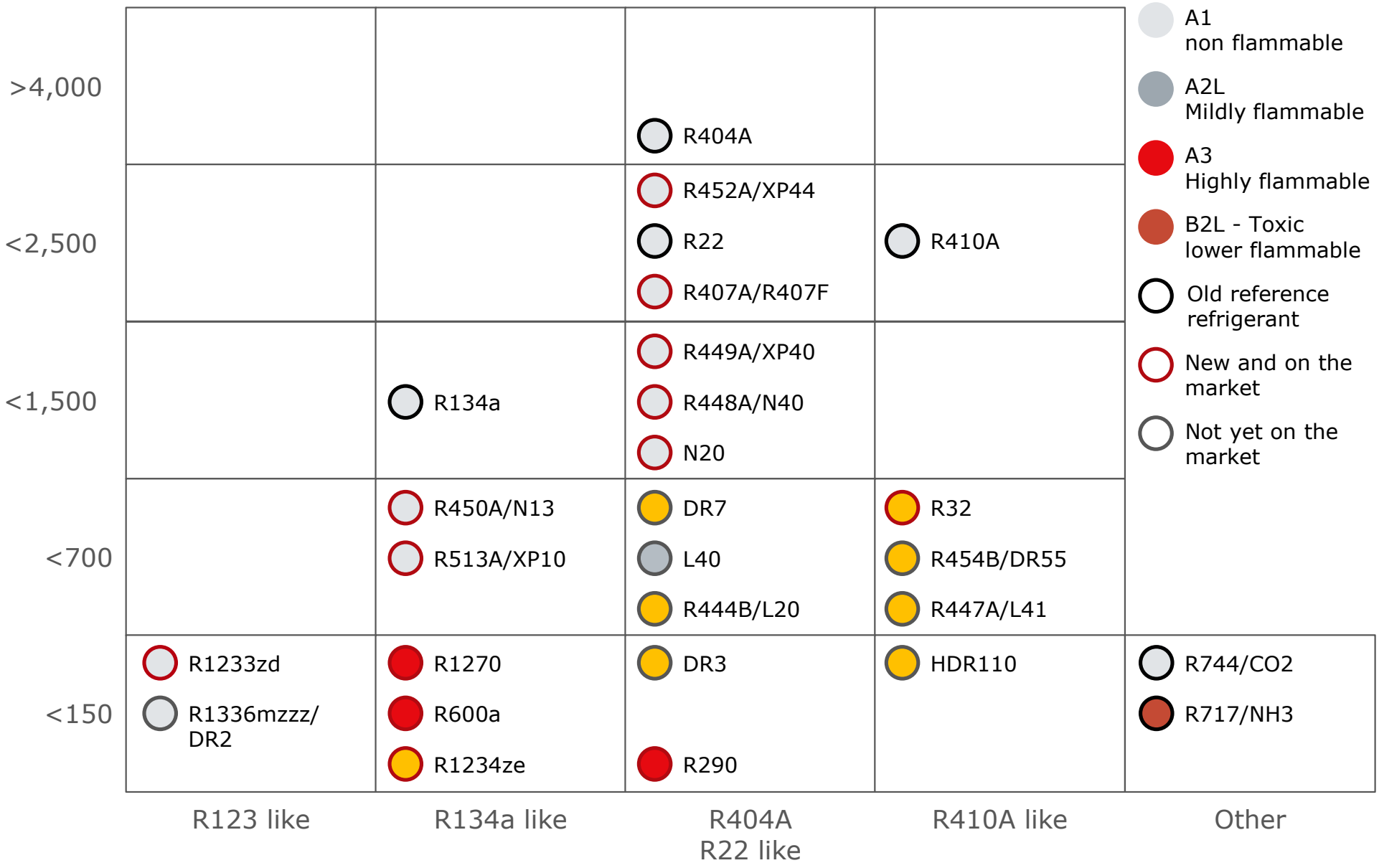
The EU F-gas regulation started a 79% phase down of HFC in between 2015 and 2030.



In 2015 the US has banned several high GWP HFC's in main applications using its SNAP regulation

In 2015 Japan introduced a HFC phase down legislation with application specific GWP targets

Main refrigerants in play- summary



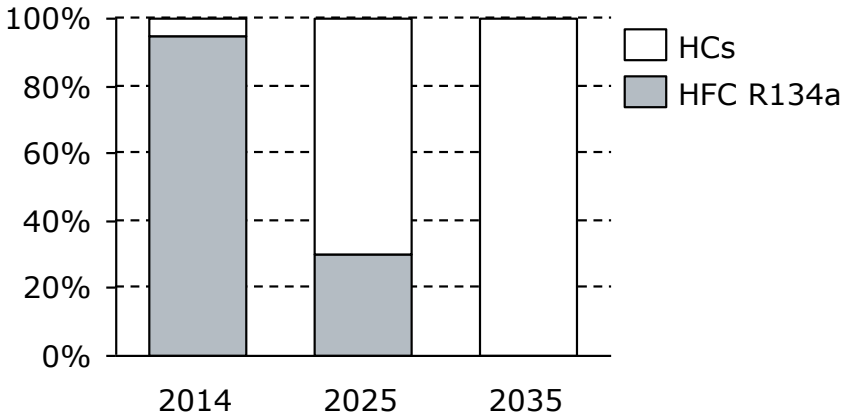
Long-term refrigerant options - Global

Refrigeration

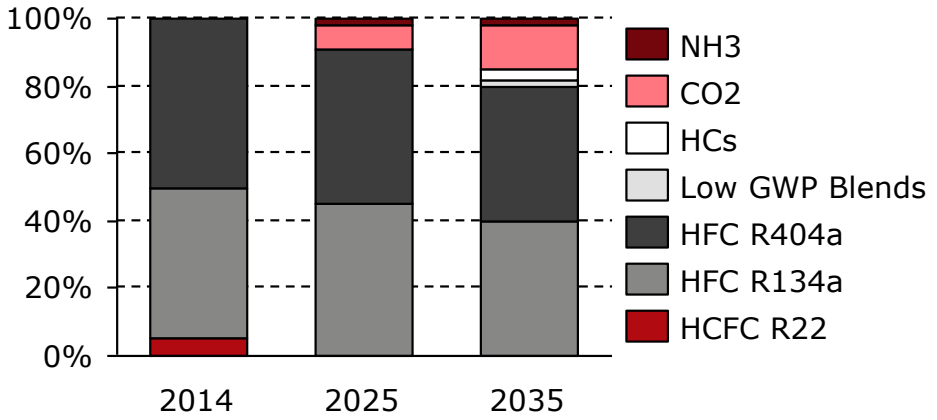
Applications Industries	Present	Short term 2016-2020	Long term 2016-2020	
Industrial	R717 R744	R717 R744	R717 R744	
Centralised systems, Supermarkets	R134a R404A R744	R134a R404A R744	R744 HFO blends	
Condensing units	R134a R404A	R134a R407A/F R448A R449A/B HFO blends	R290 HFO & Blends R744	
Self contained units	R134a R290 R404A R600a R744	R134a R290 R600a R744	R290 R600a R744 HFO & Blends	

Refrigerant Trends in ASIA*
BSRIA view

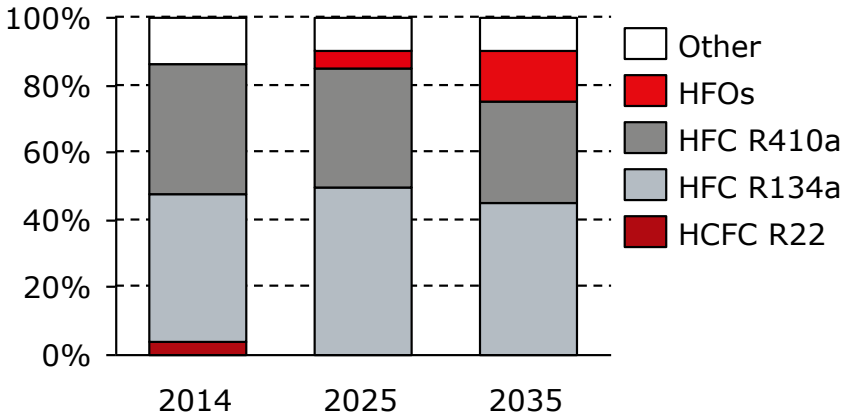
Domestic refrigeration



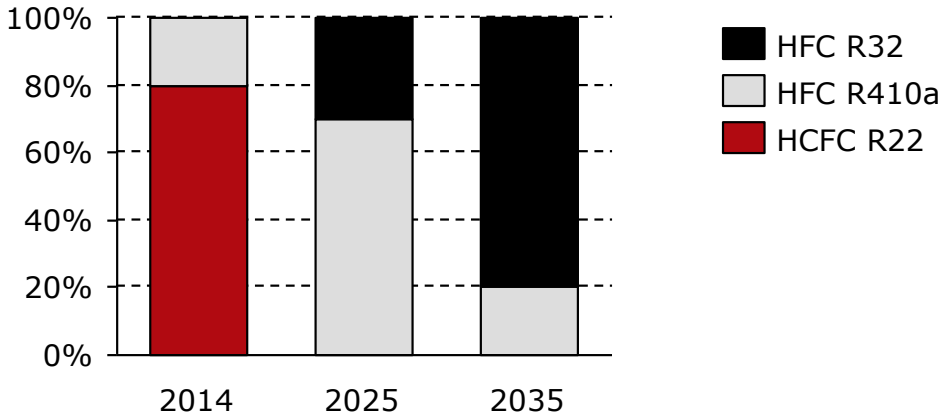
Commercial refrigeration



AC chillers



Direct expansion AC



* Excl Aus/ NZ/ JPN

Thank You!