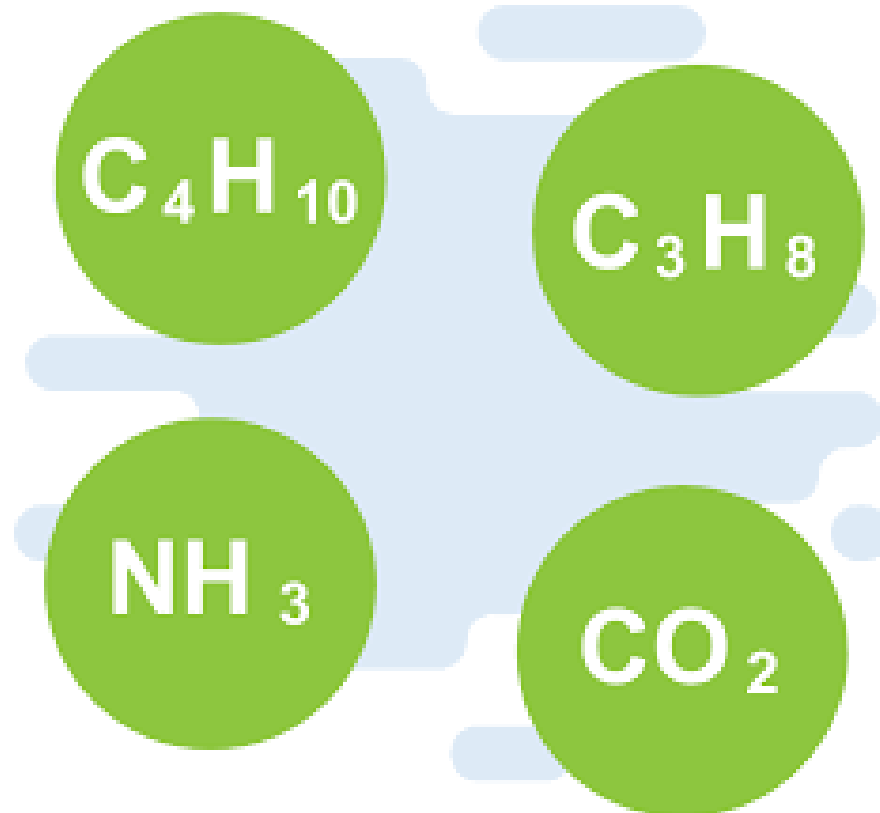
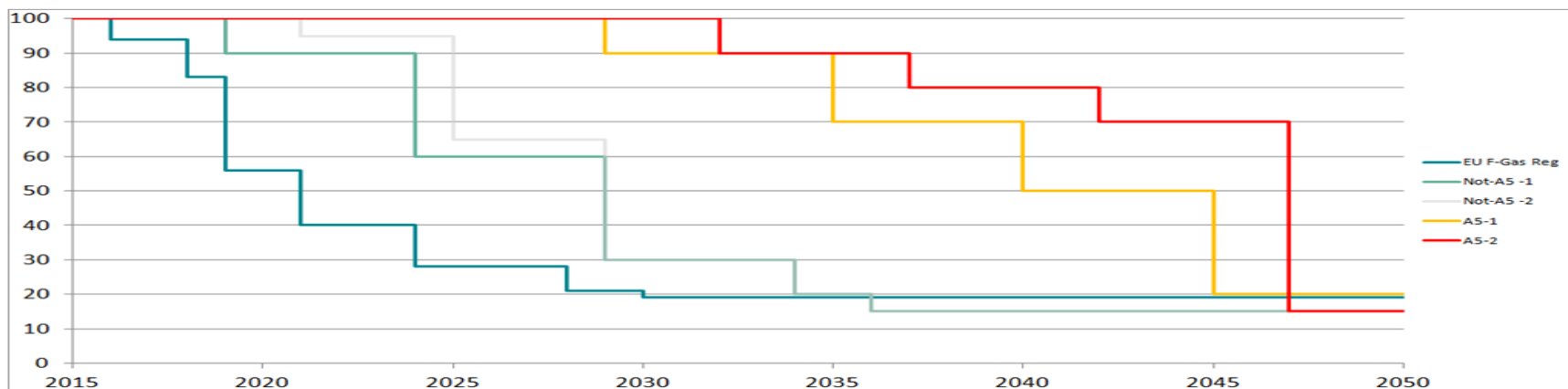
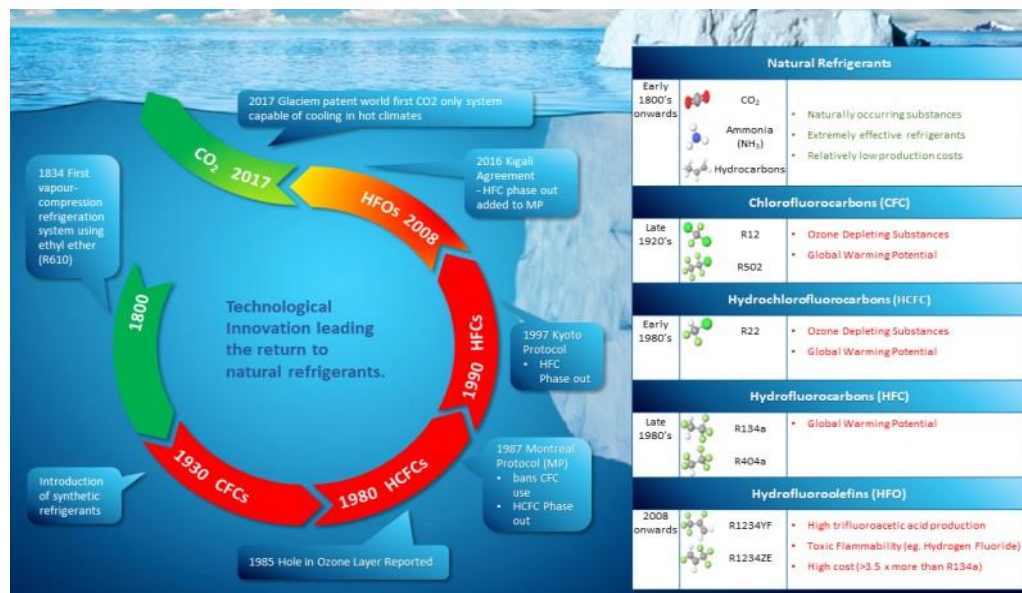


# Refrigeration System Solutions; Future

- Ammonia ( R717)
- Carbondioxide (R744)
- Isobutan ( R600a)
- Propan (R290)



- 1987 Montreal Protocol
- 1997 Kyoto Protocol
- 2016 Kigali Agreement



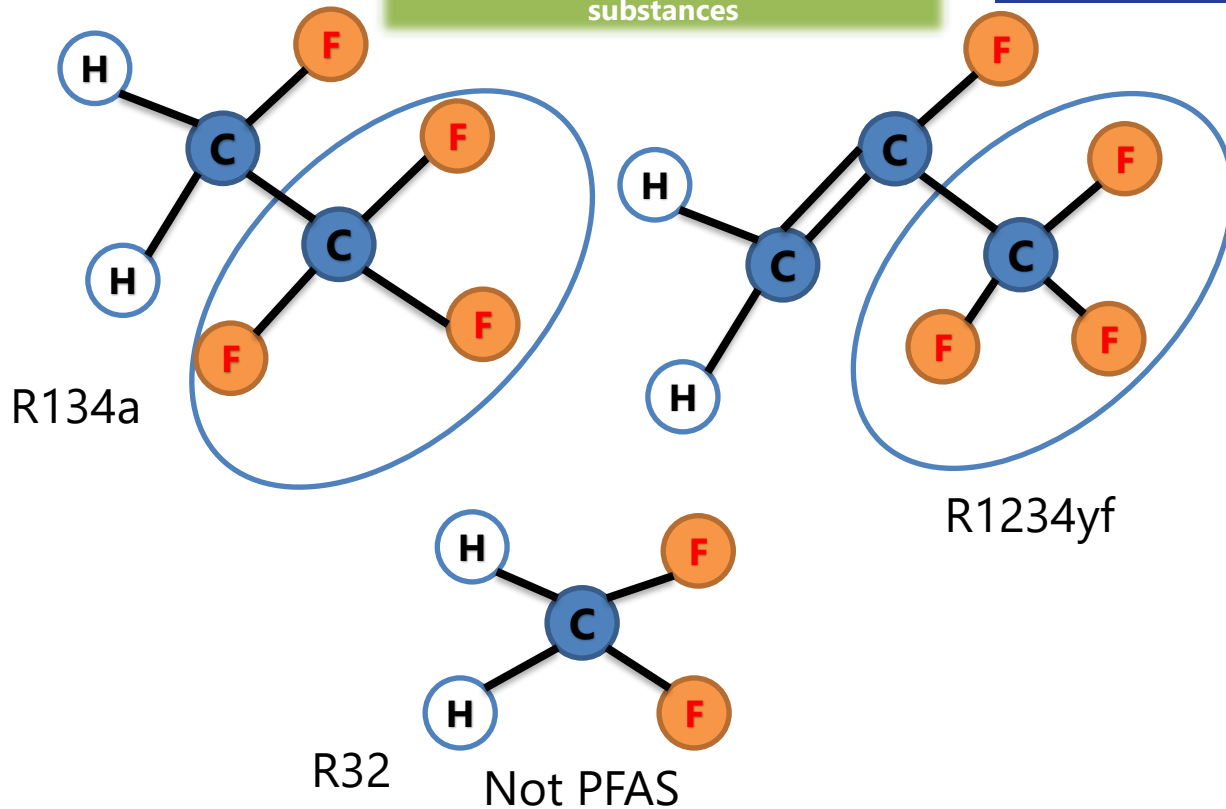
# Why Natural Refrigerants?



## GWP

R404A	3943
R22	1760
R134a	1300
R290	3
R600a	3
R744	1
R717	0

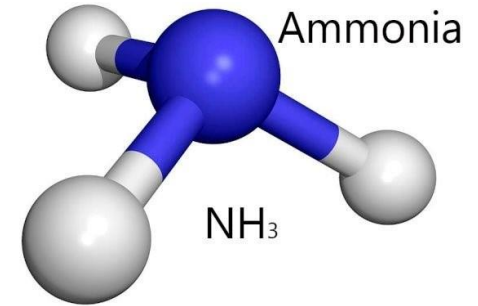
PFAS = Per-and polyfluoroalkyl  
substances

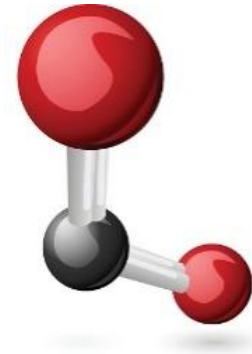


# AMMONIA (R717)

## Advantages

- High Capacity Industrial Plants
- Excellent Thermodynamic Properties
- High Heat Transfer Coefficient
- Low Refrigerants Cost





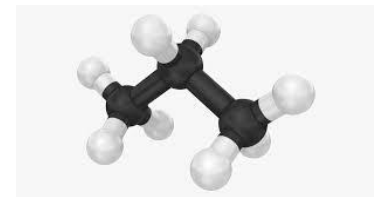
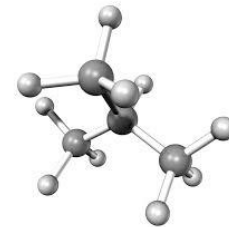
# CARBONDIOXIDE (R744)

## Advantages

- High Performance in LBP Condition (between -30 to 50°C)
- High Coefficient of Performance Value (COP)
- Excellent Heat Transfer Coefficient
- Relatively Insensitive to Pressure Losses
- Low Viscosity
- Low Refrigerants Cost

# HYDROCARBONS (R290-R600a-R1270)

## Advantages



- Excellent environmental, thermodynamical and thermophysical properties,
- Equivalent Refrigerants for R134a-R22 ve R404a,
- Ideal solutions for household refrigerators– bottle cooler– commercial refrigerators with heat pump and small air condition.

# COMPARISON

REFRIGERANT FLUIDS								
CHARACTERISTICS	R12	R22	R134a	R404A	R290	R600a	NH <sub>3</sub>	CO <sub>2</sub>
Natural refrigerant	No	No	No	No	Yes	Yes	Yes	Yes
Classification	CFC	HCFC	HFC	HFC	HC	HC	Inorganic	Inorganic
ODP (ozone Depletion Potential)	0,82	0,055	0	0	0	0	0	0
GWP (Global Warming Potential)	8.100	1.500	1.300	3.922	3	3	<1	1
Flamable	No	No	No	No	Yes	Yes	Yes	No
Toxic	No	No	No	No	No	No	Yes	No
Critical temperature (°C)	112	96,2	101,2	72,1	96,7	134,7	132,3	31,1
Critical pressure (Bar)	41,4	49,9	40,6	37,3	42,5	36,4	112,7	73,8



# Thank You!

