

R-22 alternatives comparison

CETIAT study

Description of the study (1)

- »» CETIAT → Technical Center of Aerodynamics and Heat Sciences (*Villeurbanne, France*)
- »» Independent study published in March 2010 in French journal La Revue Générale du Froid
- »» Theoretical comparison of R-22 alternatives
- »» Applications: A/C, medium and low temperature refrigeration

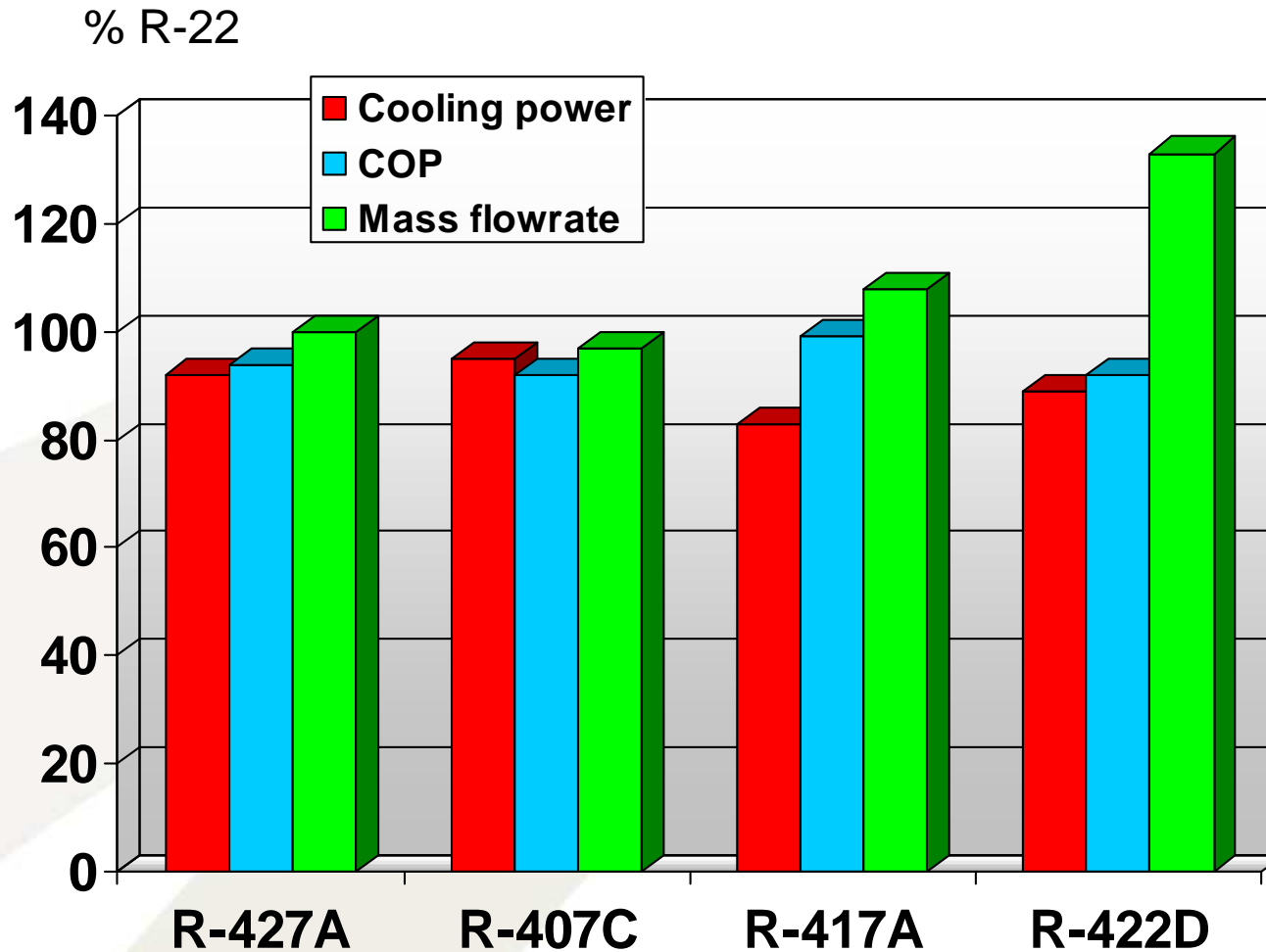
Description of the study (2)

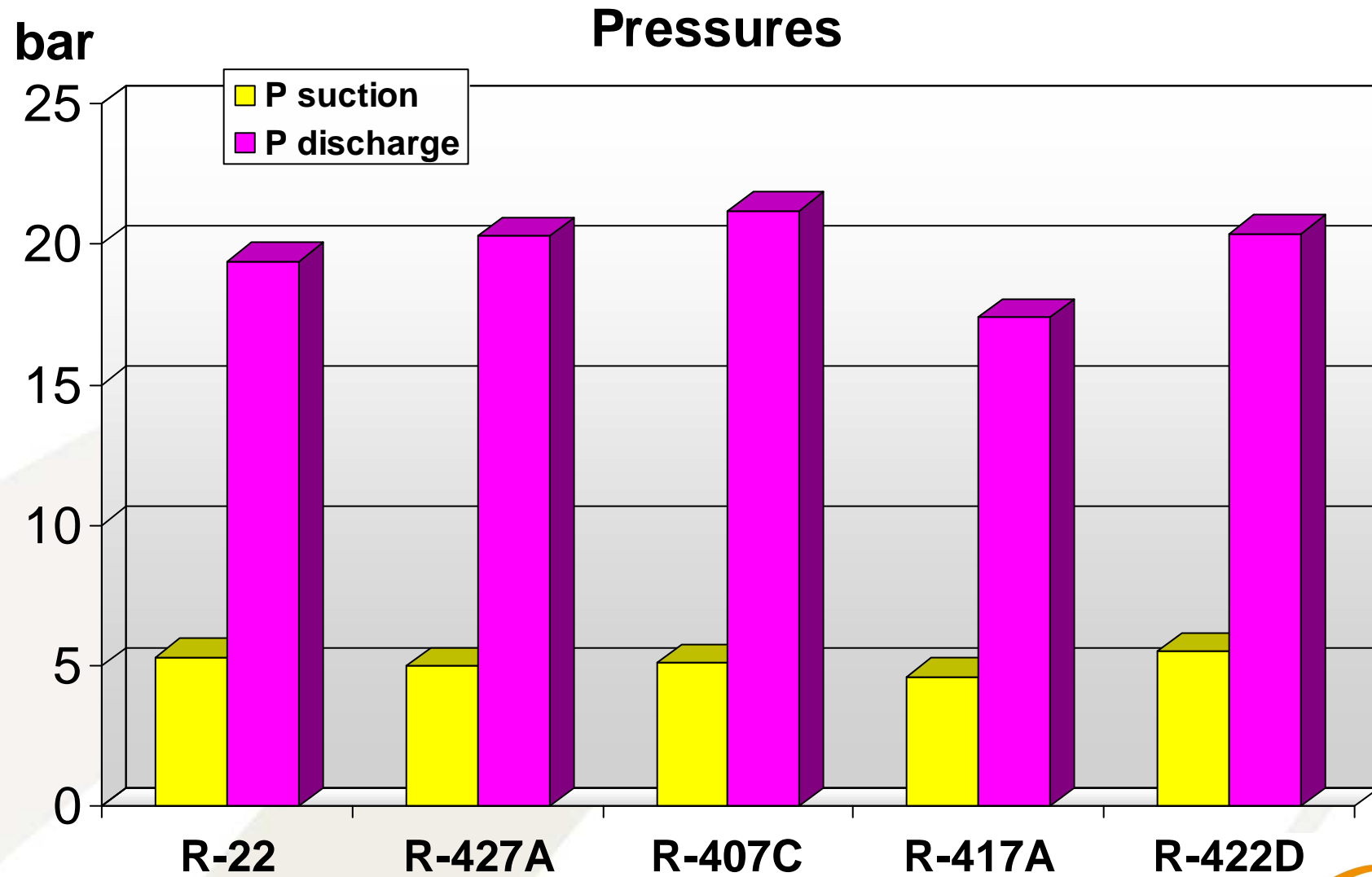
- »» Properties were calculated using Refprop software
- »» Energy consumption = compressor consumption (other components such as fans and pumps are not considered)
- »» Isentropic efficiency = 70%
- »» Compressor effective displacement = 20 m³/h
- »» Cocurrent exchangers
- »» No pressure drops

Air-conditioning

- » Water chiller (air-to-water exchanger)
- » Inlet 12°C → Outlet 7°C
- » Evaporating temperature = 2°C
- » External air temperature = 35°C
- » Refrigerants: R-427A, R-407C, R-417A (*Isceon MO59*) and R-422D (*Isceon MO29*)

Air-conditioning





Air-conditioning

	R-427A	R-407C	R-417A	R-422D
Cooling power	-8%	-5%	-17%	-11%
COP	-6%	-8%	-1%	-8%
Mass flowrate	Same	-3%	+8%	+33%
Suction pressure	-0.3 bar	-0.2 bar	-0.7 bar	+0.2 bar
Discharge pressure	+0.9 bar	+1.8 bar	-2.0 bar	+1.0 bar
Discharge temperature	-12.4°C	-7.7°C	-24.4°C	-24.3°C

→ Highest cooling power loss for R-417A (*Isceon MO59*)

→ High mass flowrate for R-422D (*Isceon MO29*)

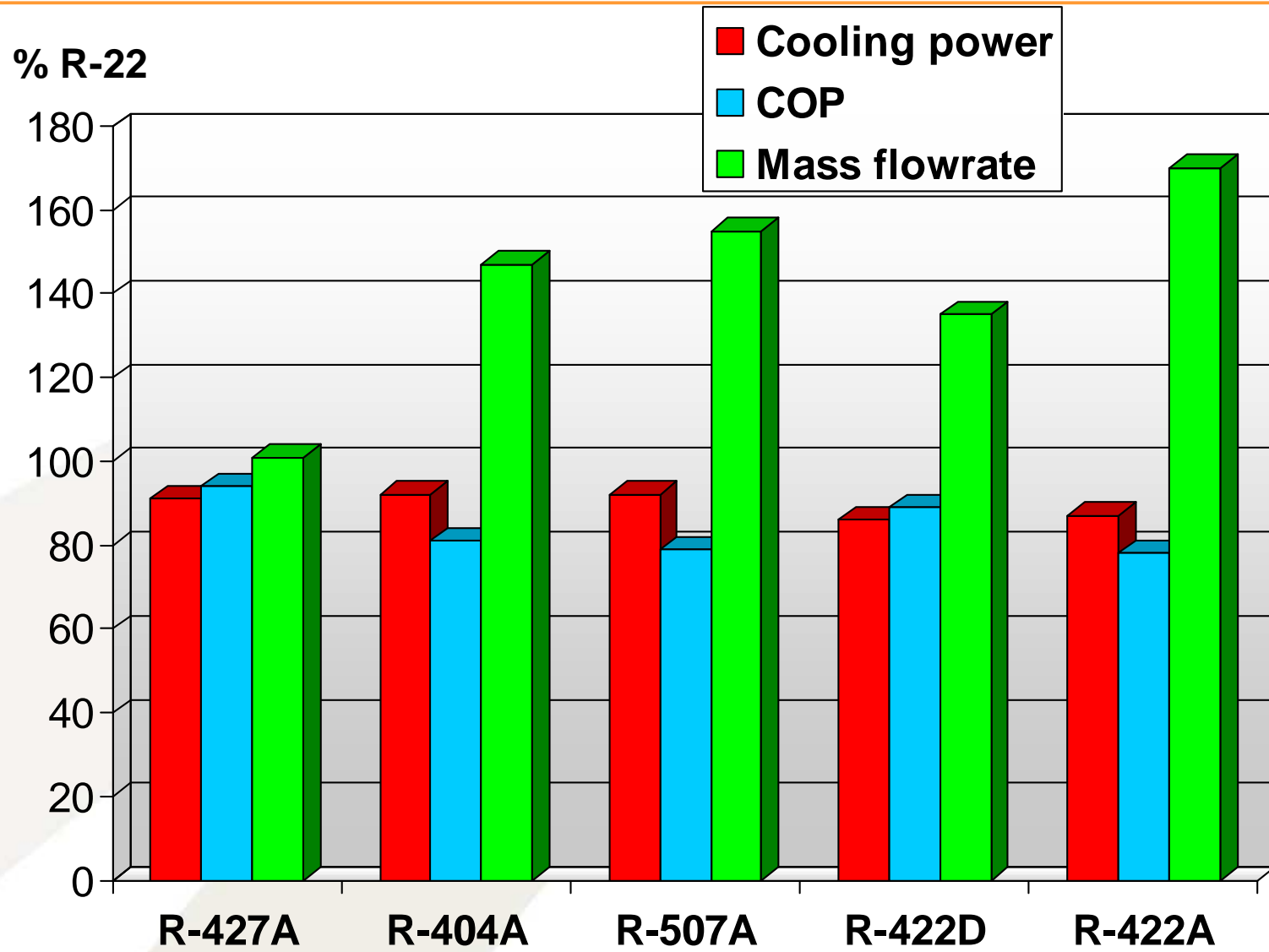
» Closest performances to R-22 for **R-427A** and **R-407C**.

» Max. residual mineral/AB oil rate for R-407C is quite low (3 to 4%). Since it can be used with 15% of residual oil, **R-427A** is the best option.

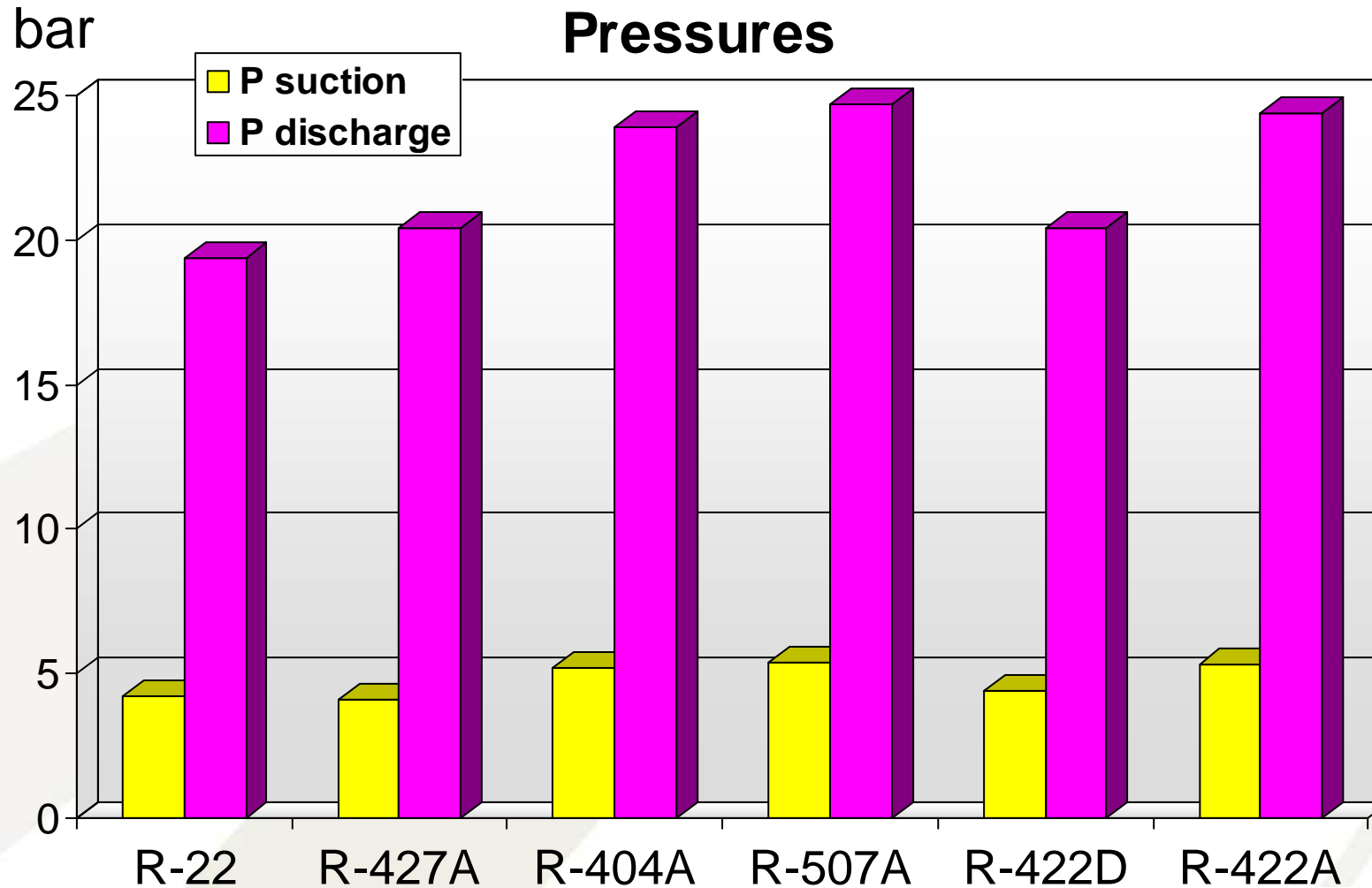
Medium temperature refrigeration

- »» Air-to-air exchanger
- »» Evaporating temperature = -5°C
- »» Inlet temperature = 4°C
- »» Blowing temperature = 0°C
- »» External air temperature = 35°C
- »» Refrigerants: R-427A, R-404A, R-507A, R-422D (*Isceon MO29*) and R-422A (*Isceon MO79*)

Medium temperature refrigeration



Medium temperature refrigeration



Medium temperature refrigeration

	R-427A	R-404A	R-507A	R-422D	R-422A
Cooling power	-9%	-8%	-8%	-14%	-13%
COP	-6%	-19%	-21%	-11%	-22%
Mass flowrate	+1%	+47%	+55%	+35%	+70%
Suction pressure	-0.1 bar	+1.0 bar	+1.2 bar	+0.2 bar	+1.1 bar
Discharge pressure	+1.0 bar	+4.5 bar	+5.3 bar	+1.0 bar	+5.0 bar
Discharge temperature	-18.2°C	-30.8°C	-31.3°C	-33.9°C	-34.6°C

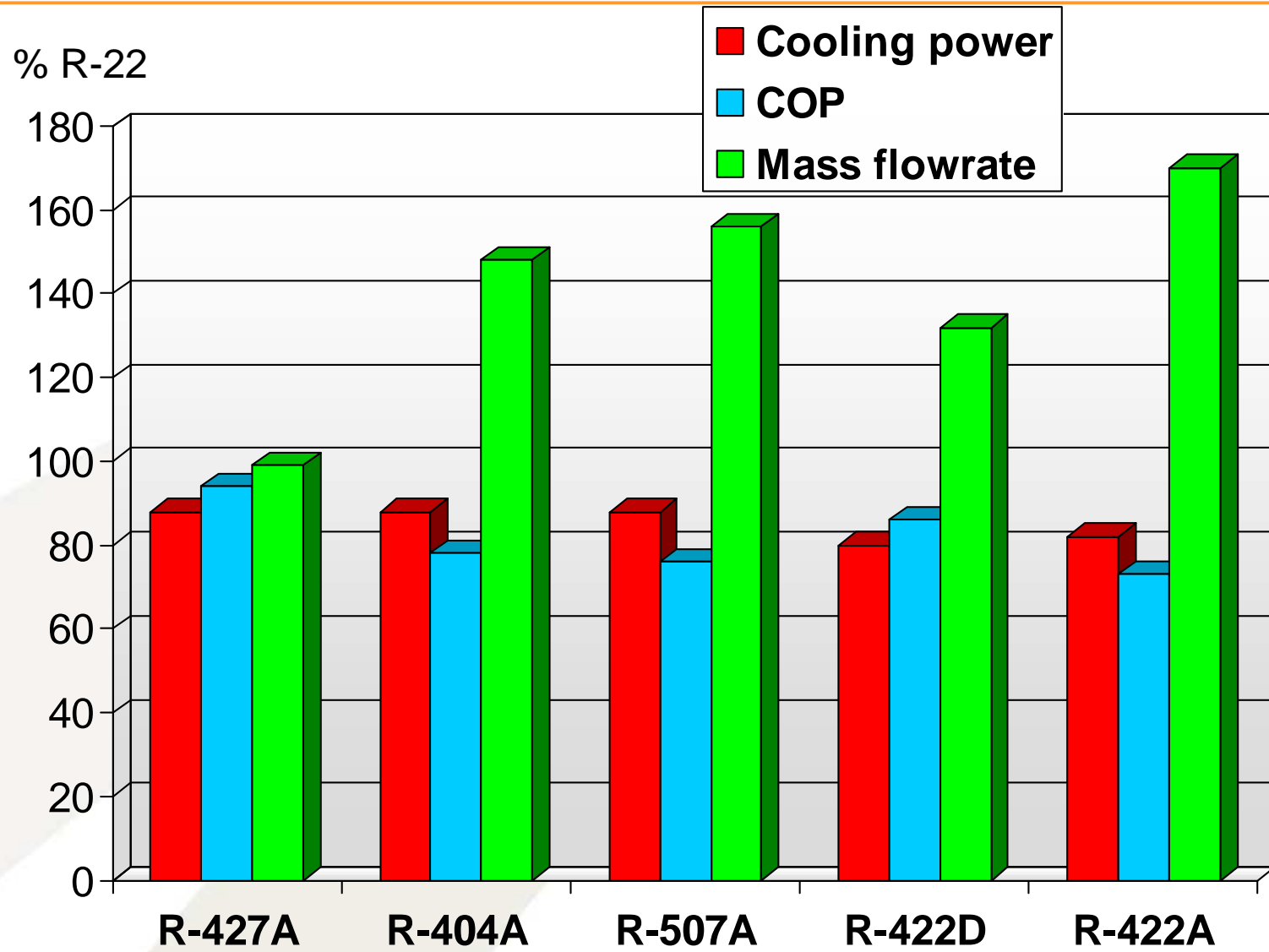
- Highest cooling power loss for R-422D and R-422A
- Lower efficiency for R-404A, R-507A and R-422A
- R-22 expansion valve might not be suited for R-404A, R-507A and R-422A (higher mass flowrates)
- Higher discharge pressures for R-404A, R-507A and R-422A

» Closest performances to R-22 for **R-427A.**

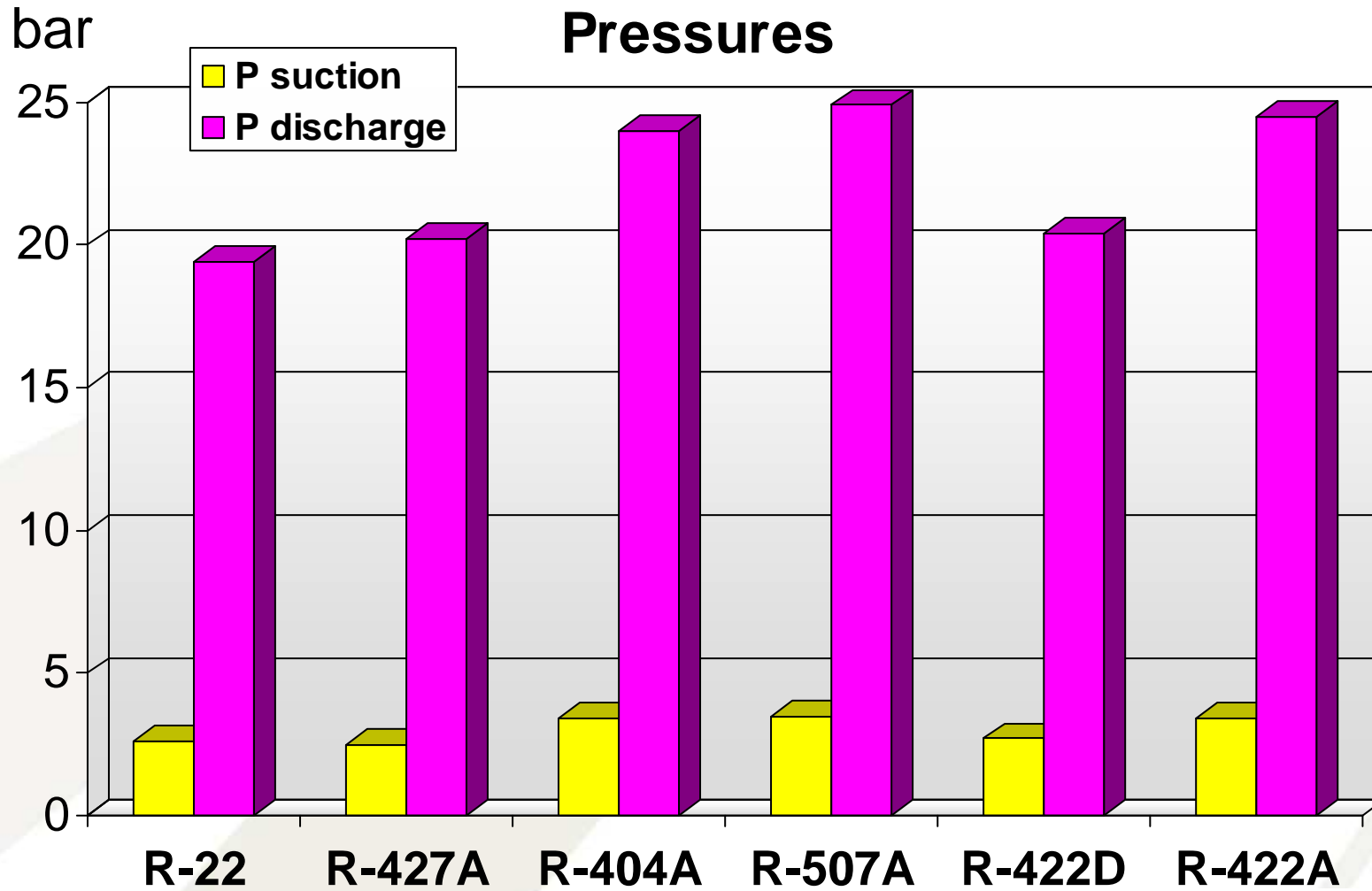
Low temperature refrigeration

- »» Air-to-air exchanger
- »» Evaporating temperature = -18°C
- »» Inlet temperature = -11°C
- »» Blowing temperature = -15°C
- »» External air temperature = 35°C
- »» Refrigerants: R-427A, R-404A, R-507A, R-422D (*Isceon MO29*) and R-422A (*Isceon MO79*)

Low temperature refrigeration



Low temperature refrigeration

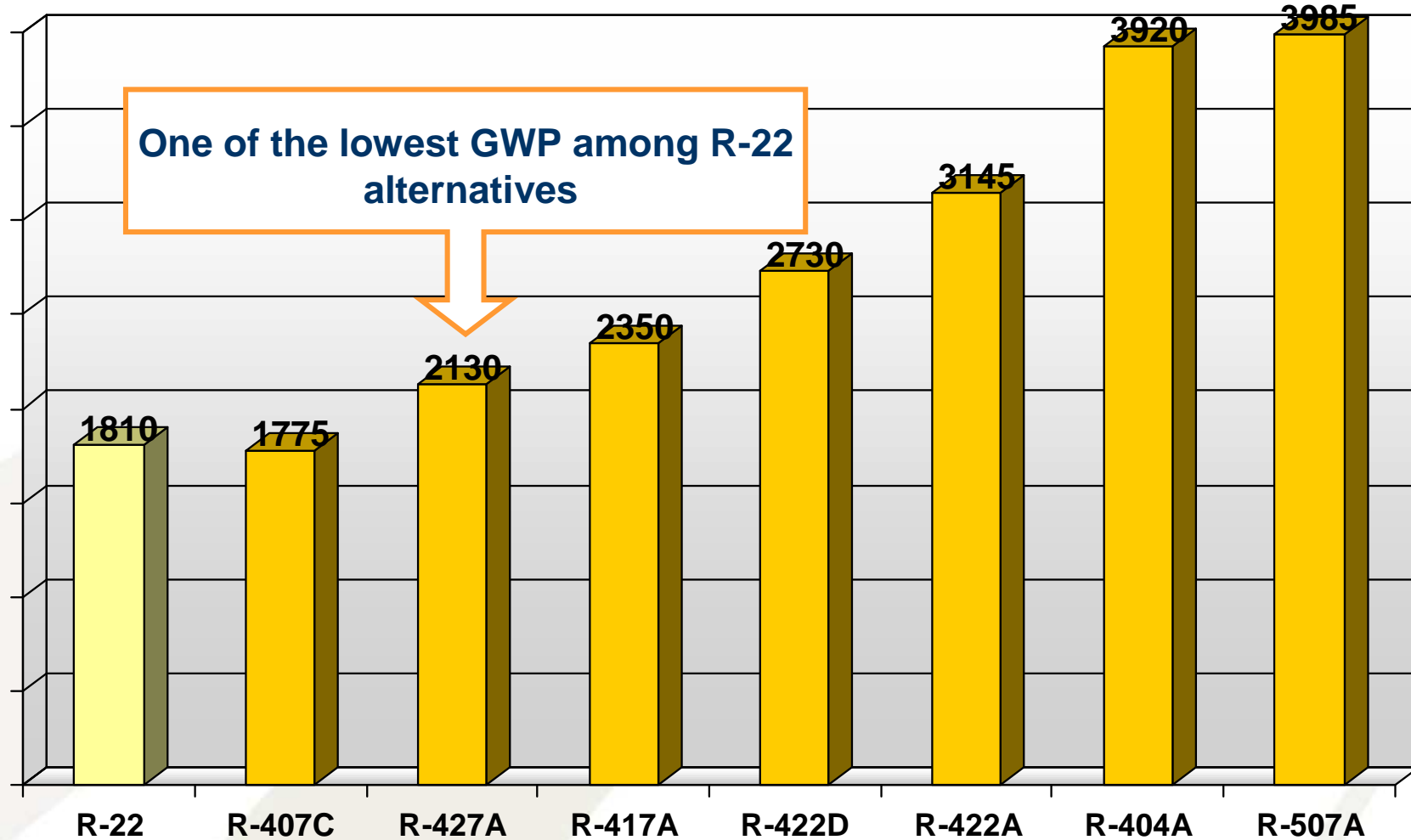


Low temperature refrigeration

	R-427A	R-404A	R-507A	R-422D	R-422A
Cooling power	-12%	-12%	-12%	-20%	-18%
COP	-6%	-22%	-24%	-14%	-27%
Mass flowrate	-1%	+48%	+56%	+32%	+70%
Suction pressure	-0.1 bar	+0.8 bar	+0.9 bar	+0.1 bar	+0.8 bar
Discharge pressure	+0.8 bar	+4.6 bar	+5.5 bar	+1.0 bar	+5.1 bar
Discharge temperature	-25.9°C	-42.3°C	-43.0°C	-46.1°C	-47.7°C

- Highest cooling power loss for R-422D and R-422A
 - Lower efficiency for R-404A, R-507A and R-422A
 - R-22 expansion valve might not be suited for R-404A, R507A and R-422A (higher mass flowrates)
 - Higher discharge pressures for R-404A, R-507A and R-422A
- » Closest performances to R-22 for **R-427A.**

GWP



GWP calculated according to IPCC 4th Assessment Report (2007)

TEWI for 15 years

