ATMO sphere ASIA

KAV Consulting Pty Ltd

BRONZE SPONSOR

KAV CONSULTING Pty. Ltd. PO. Box 1146, KANGAROO FLAT, VIC, 3555 AUSTRALIA
Tel: +61 3 54 479 436 Email: kavconsult@bigpond.com

KAV CONSULTING PTY LTD

Advisers to the Refrigerated Food Industries

ATMO ASIA sphere

"Bring Efficient CO_2 Refrigeration to High Temperature Regions"

Moving the CO_2 Equator to the Geographical Equator

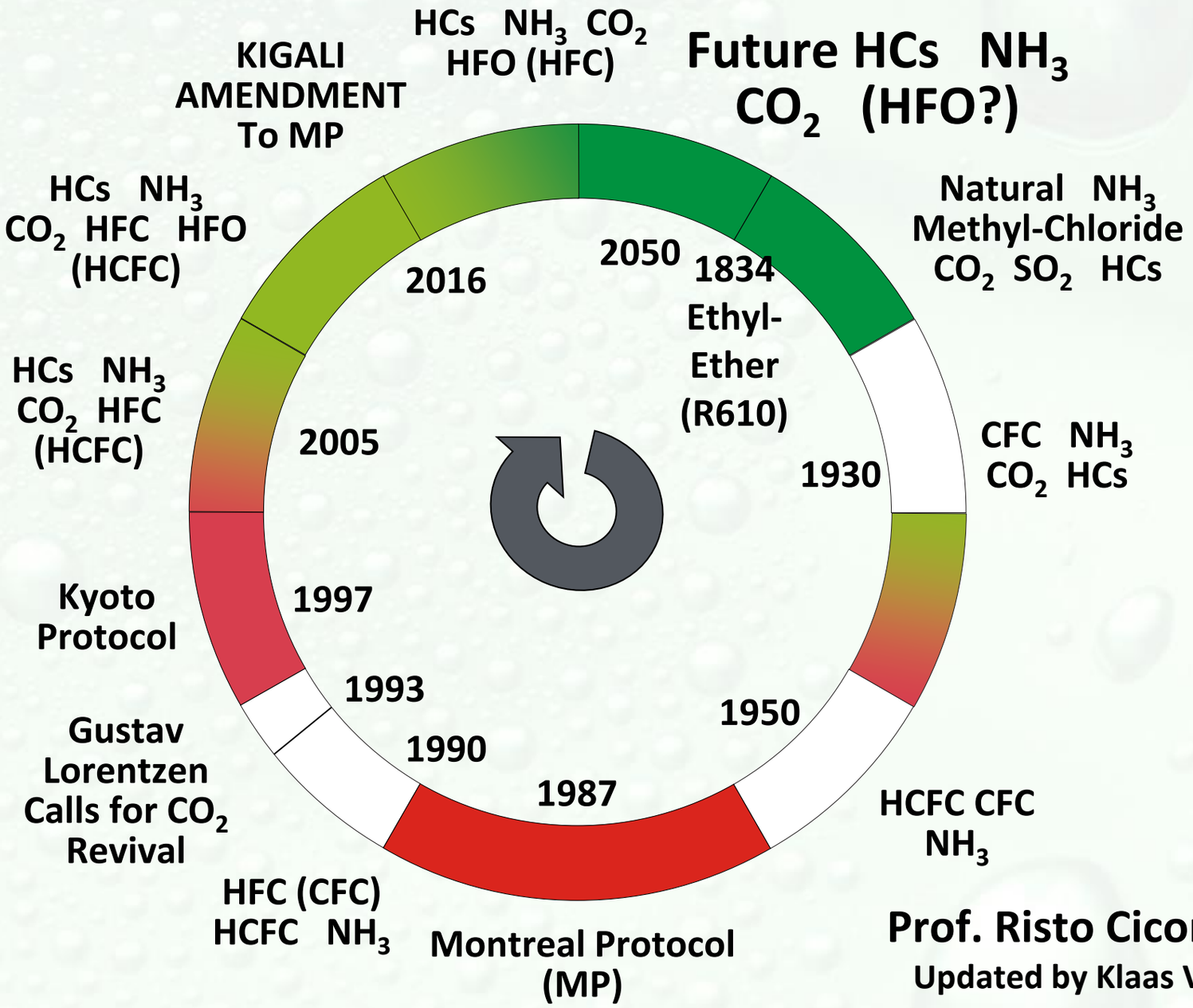
Klaas Visser, Dip.Mar.Eng. (NL) Hon.M.IIR, FInstR, M.IIAR, M. ARA, M.KNVvK, Meurammon.
Senior Consultant to JMM VISION PTE LTD

KAV CONSULTING Pty. Ltd.
PO. Box 1146, Kangaroo Flat, Victoria, 3555 Australia
Tel: +61 3 54 479 436 kavconsult@bigpond.com

Issues

- Energy Consumption
- Global Warming Resulting From Energy Consumption
- Global Warming Resulting From HFC/HCFC Fugitive Gases
- The Kigali Amendment to the Montreal Protocol
- Cooling Water Consumption
- Legionella Disease
- How will CO_2 Help?

Figure 1: The Refrigerant Circle. A 183 Year History of Refrigerants.



Prof. Risto Ciconkov.

Updated by Klaas Visser

Benefits of CO_2 Refrigeration and Hybrid Evaporative Condenser/Gas Coolers.

- Reduces Electrical Energy Consumption.
- Virtually Eliminates Gas Consumption for Building Heating and Domestic Hot Water.
- Reduces Global Warming Emissions Due to Reduction in Energy Consumption and Fugitive HFC Refrigerant Gases.
- Reduces Cooling Water Consumption.
- Virtually Eliminates the Danger of Legionella Disease.

Figure 2: Hi Stage & AC Compressor Rack

A Multifunction Two Stage Transcritical CO_2 Refrigeration System with Parallel Compression for Cooling & Heating

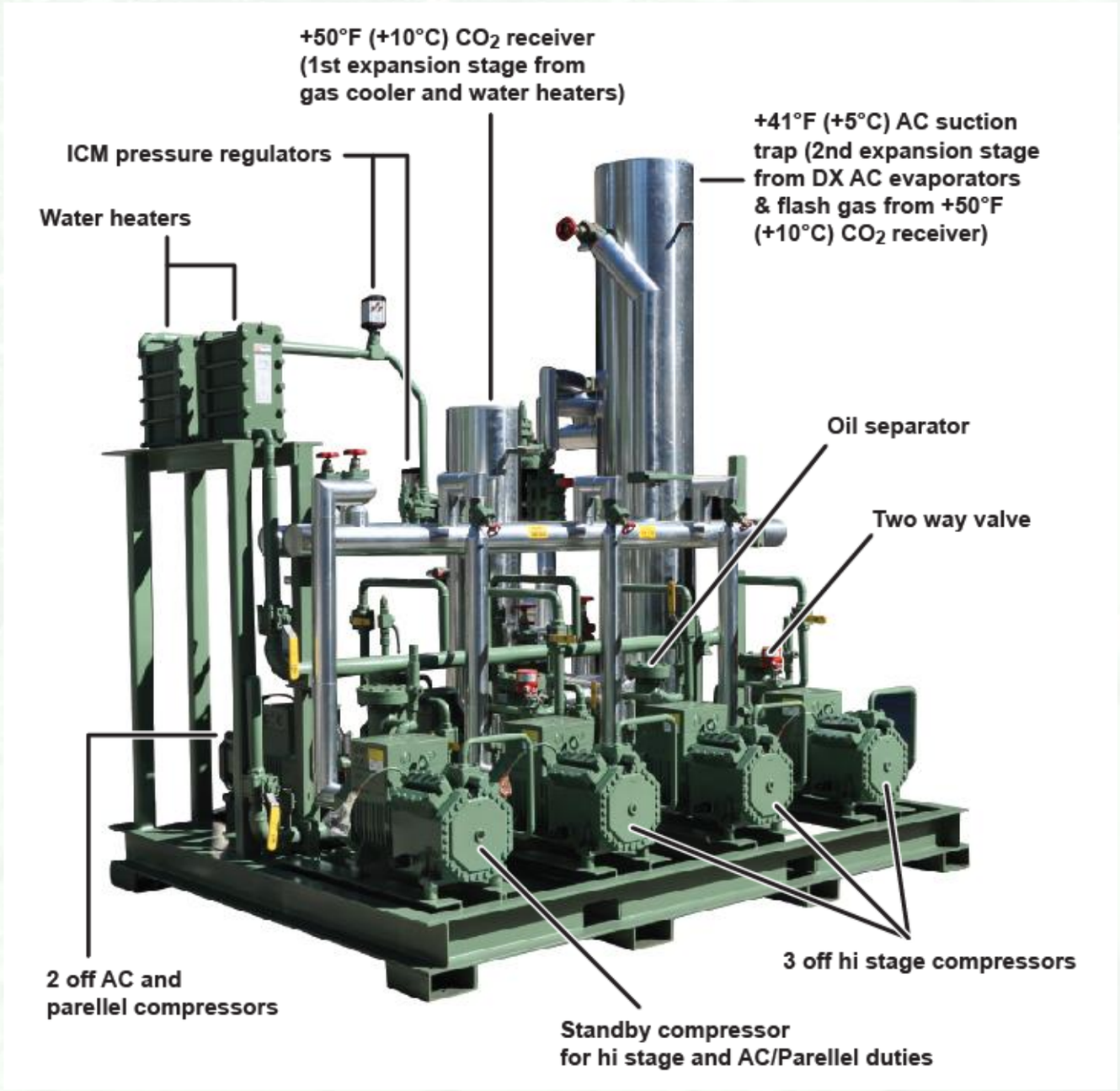
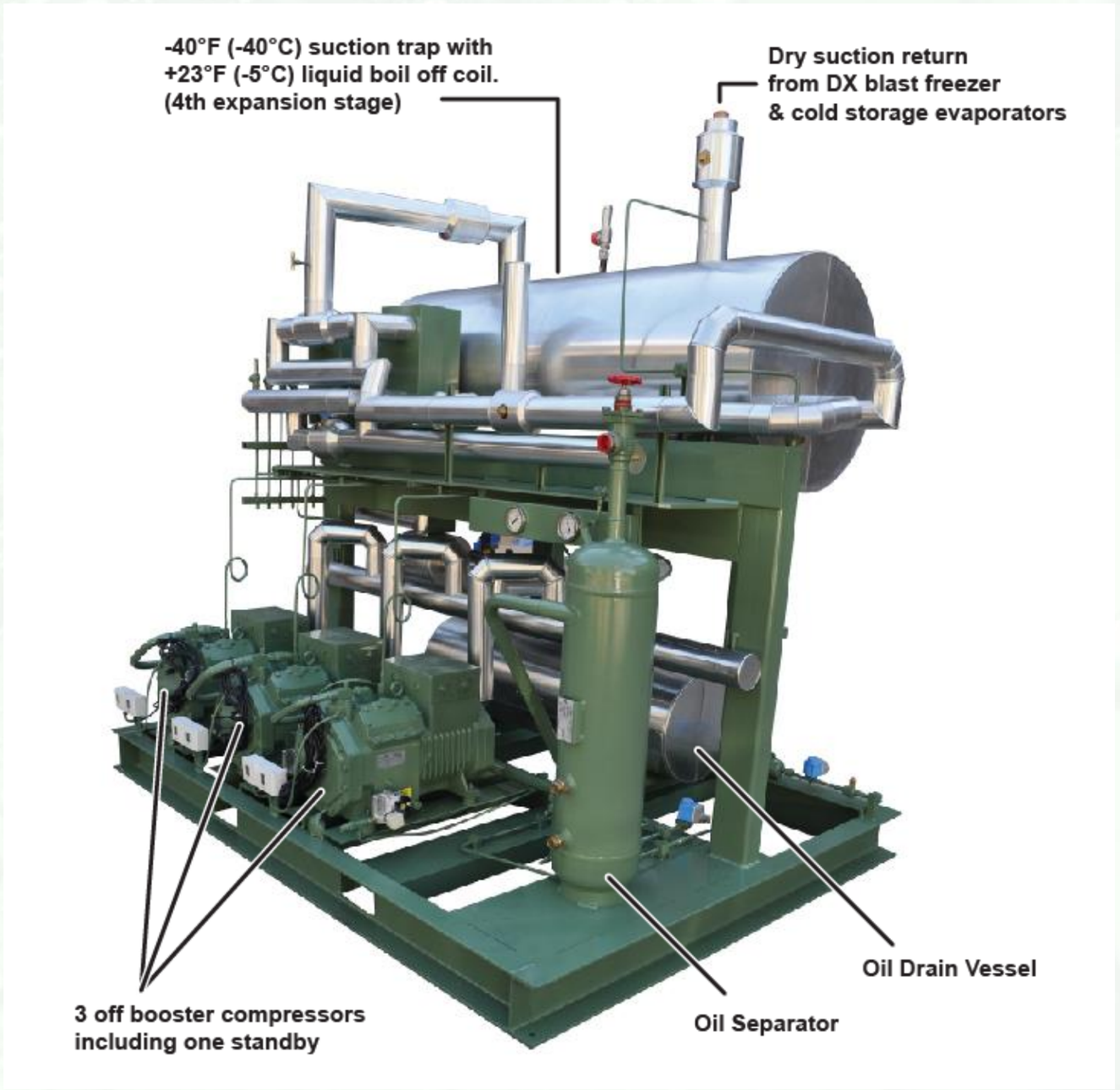


Figure 3: Booster Compressor Rack

A Multifunction Two Stage Transcritical CO_2 Refrigeration System with Parallel Compression for Cooling & Heating



Beneficial Results from 2011 Prototype Plant

1. 33% Reduction in Specific Electrical Energy Consumption. kWh/kg

2. 60% Reduction in Specific Gas Consumption, MJ/kg

3. 40% Reduction in Specific Emissions, CO_2-e/kg

4. 44% Reduction in Specific Cooling Water Consumption, l/kg

Figure 4: Current Project Under Construction in Sydney.

AC

Chilling

Freezing & Cold Storage

Water Heating

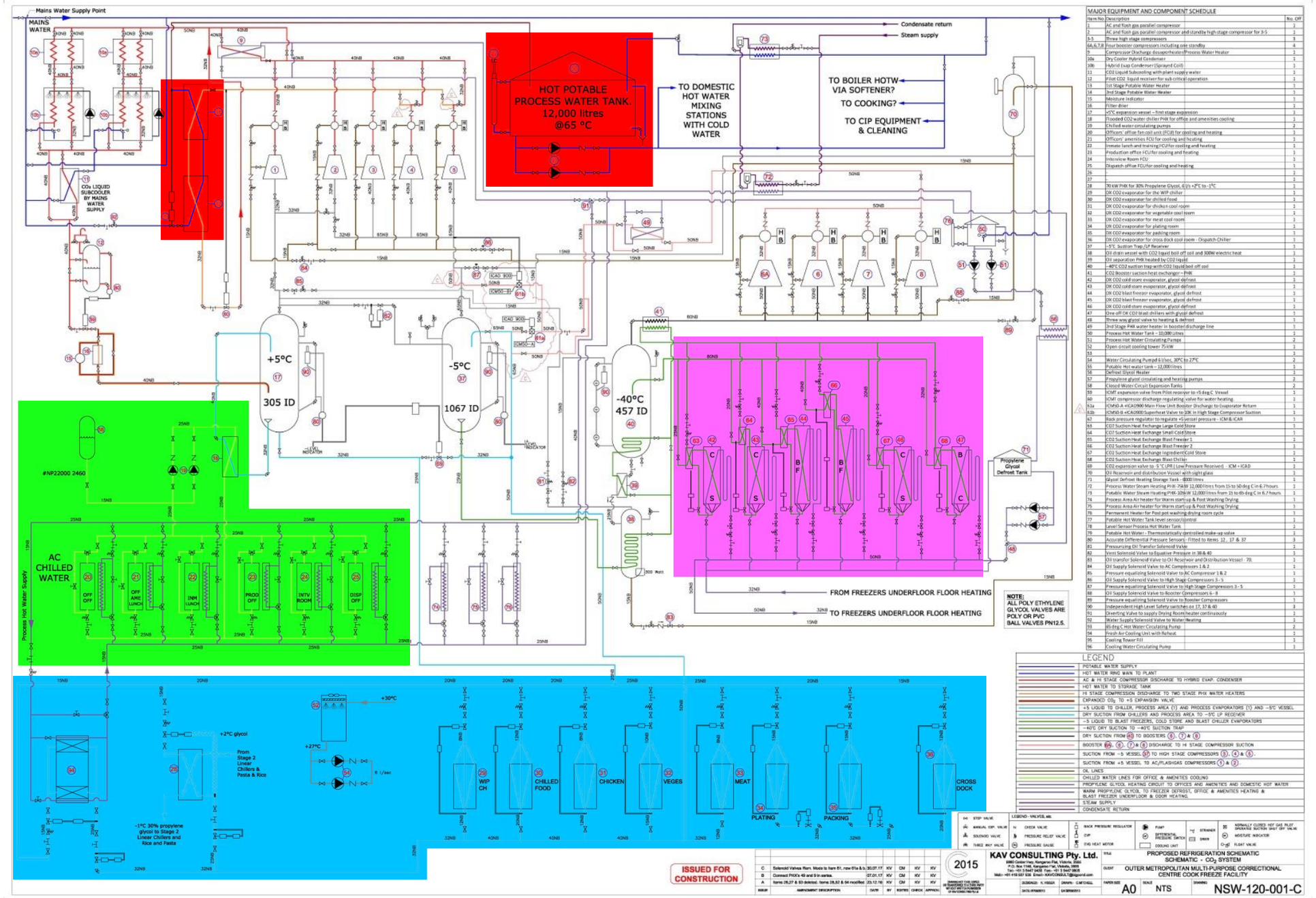


Figure 5: Consumer Energy Share

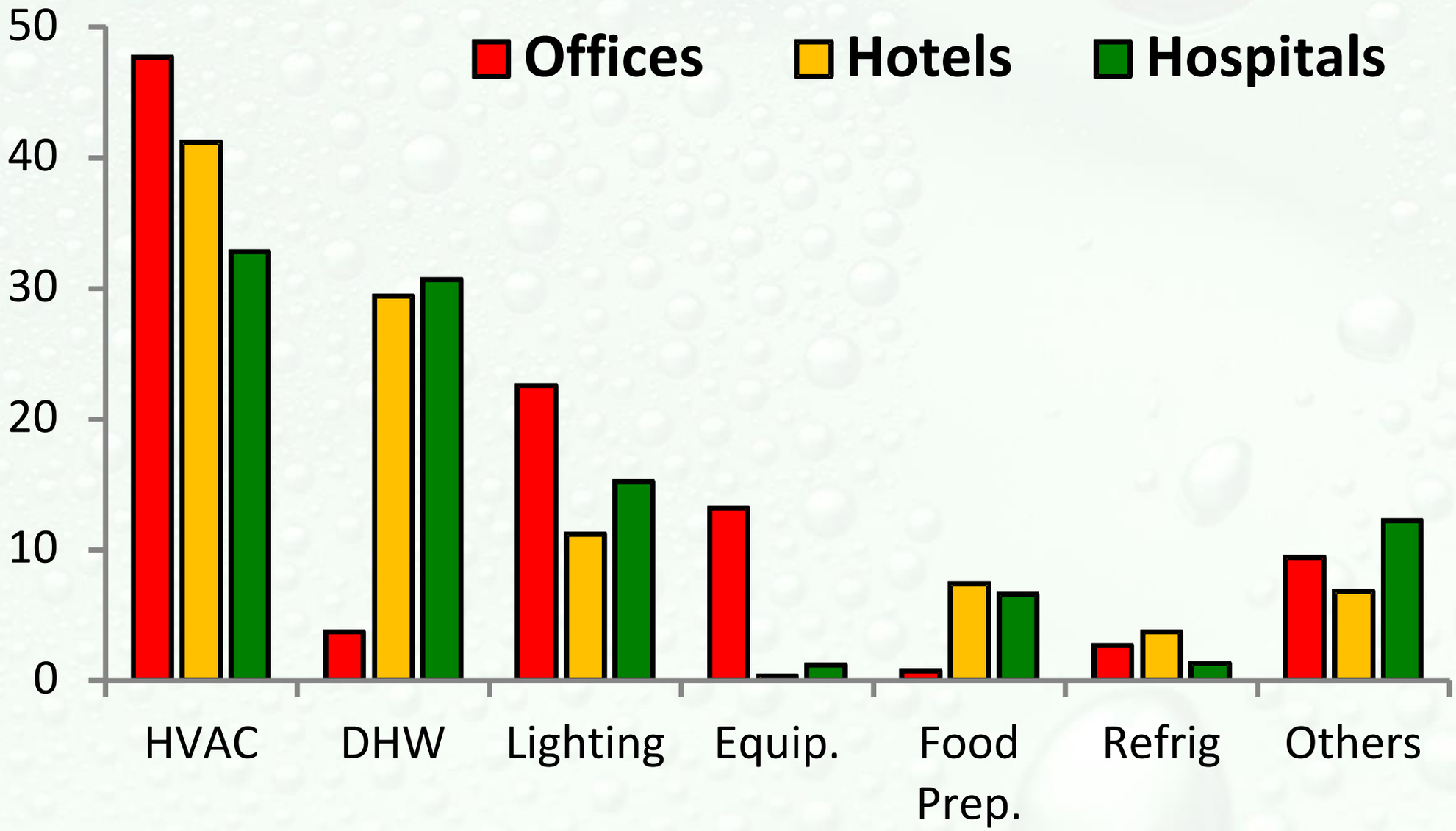


Table 1: 2009 Specific Energy Consumption Per m^2 Building Area in the Tertiary Sector in the EU27+2

	Tertiary Building Sector	Floor Area		Energy Consumption/annum		
		%	m^2x10^9	%	$kWhx10^9$	$kWh/m^2.a$
1	**Offices**	**23**	**1.4375**	**26**	**441.5**	**307.1**
2	W'sale & retail	28	1.75	28	475.4	271.7
3	Educational	17	1.0625	12	203.8	191.8
4	**Hotels & Restaurants**	**11**	**0.6875**	**12**	**203.8**	**296.0**
5	**Hospitals**	**7**	**0.4375**	**10**	**169.8**	**388.1**
6	Sports facilities	4	0.25	6	101.9	407.5
7	Other types	10	0.625	6	101.9	163.0
8	**Total**	**100**	**6.25**	**100**	**1,698.0**	**271.7**

Figure 6: Specific Energy Consumption kWh/m² per Annum

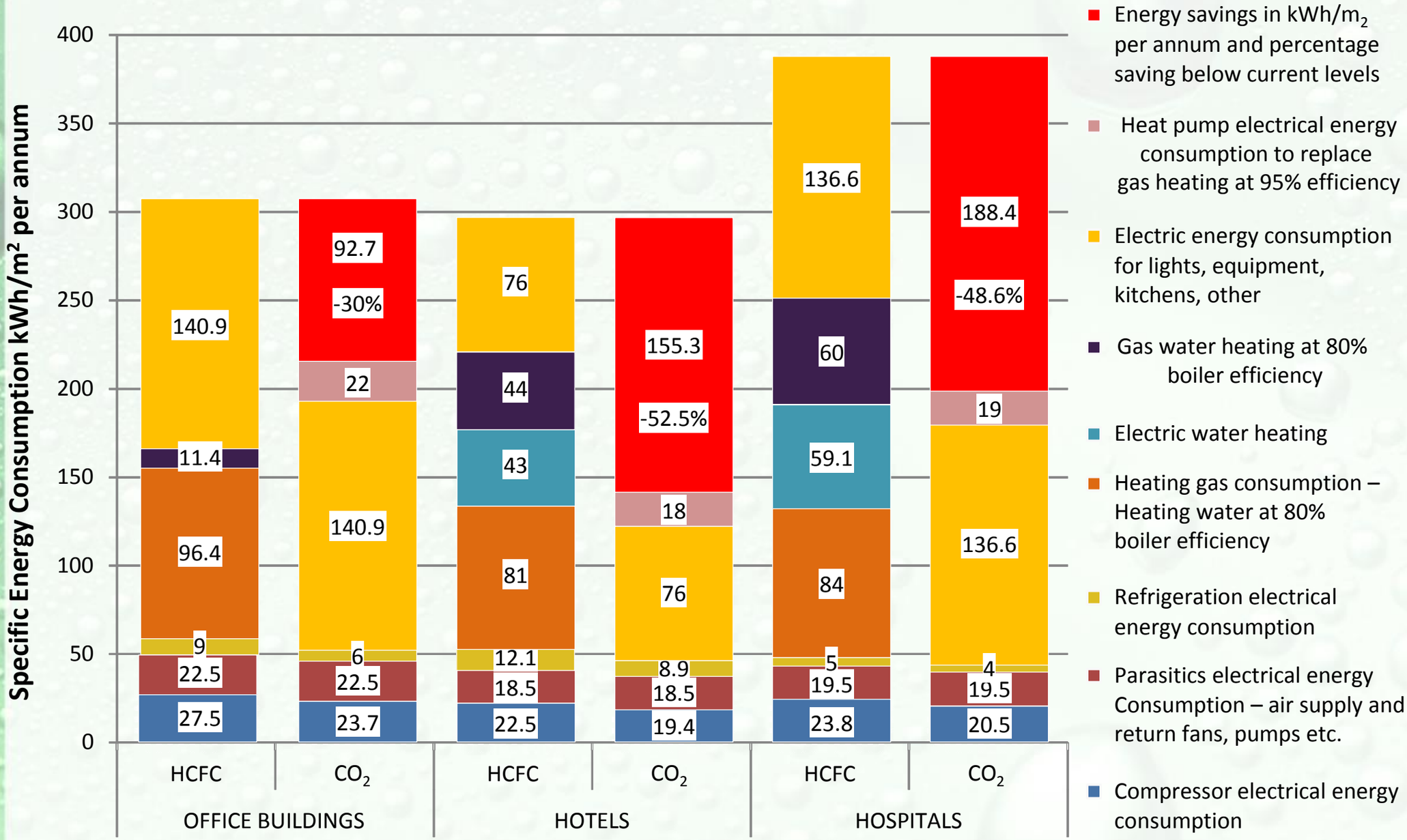


Table 2: Melbourne Supermarkets Energy Consumption Benefits of Integrated AC and Refrigeration with CO_2

Energy Consumer		Existing Situation KWh/m².a	CO_2 to ALL Sections, AC with Chilled Water	CO_2 with Chilled Water & AC Fans Slowed Down 25%	CO_2 Direct to AC, Chilling & Freezing & 75% AC Fan Speed
No	Description				
1	Total	880 (100%)	--	--	--
2	Base Load, 25%	220 (25%)	220	220	220
3	AC, 35%	308 (35%)	185	165	99
4	MT Refrig. 25%	220 (25%)	97	97	97
5	LT Refrig. 15%	132 (15%)	90	90	90
6	Total Refrig.	660 (75%)	372	352	286
7	Total kWh	880	592	572	506
8	Reduction due to AC, MT & LT Refrig.	--	288	308	374
9	Refrig. Reduction, %	--	43.6	46.7	56.7
10	Total Reduction, %	--	32.7	35.0	42.5

NB: Heating amounts to about 1% of total energy input, ie 34 MJ/m².a. This has been ignored In the total projections, but is readily recovered from the CO_2 Plant.

Source – Existing Situation: Reference 7.

Figure 7: Schematic of a Conventional Central System with Water Chiller & Cooling Tower.

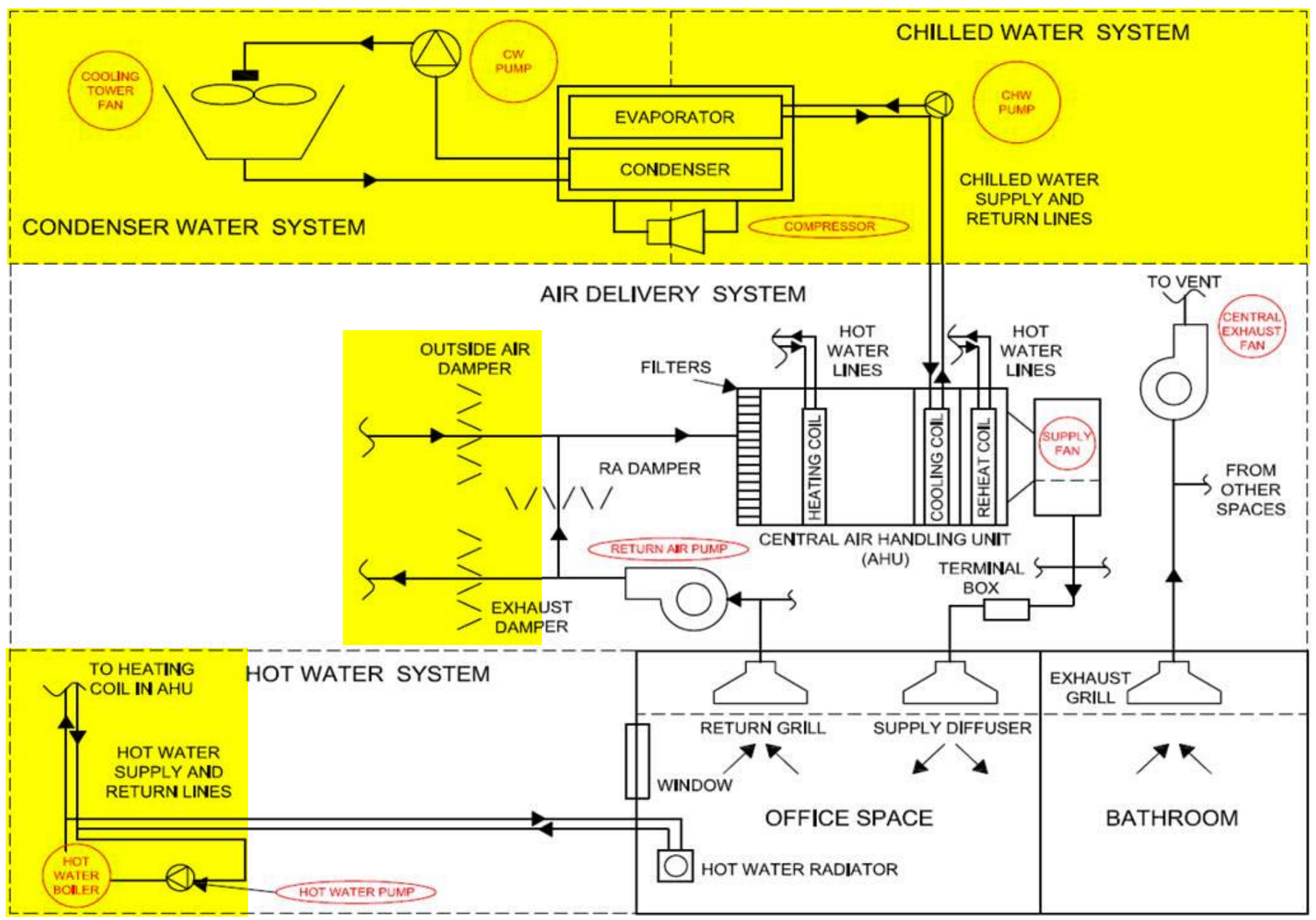


Figure 8: Schematic of a Central System with CO_2 Liquid Recirculation, Exhaust Air Energy Recovery and Water Heating.

NB: Evaporative Condenser/Gas Cooler in Lieu of Cooling Tower.

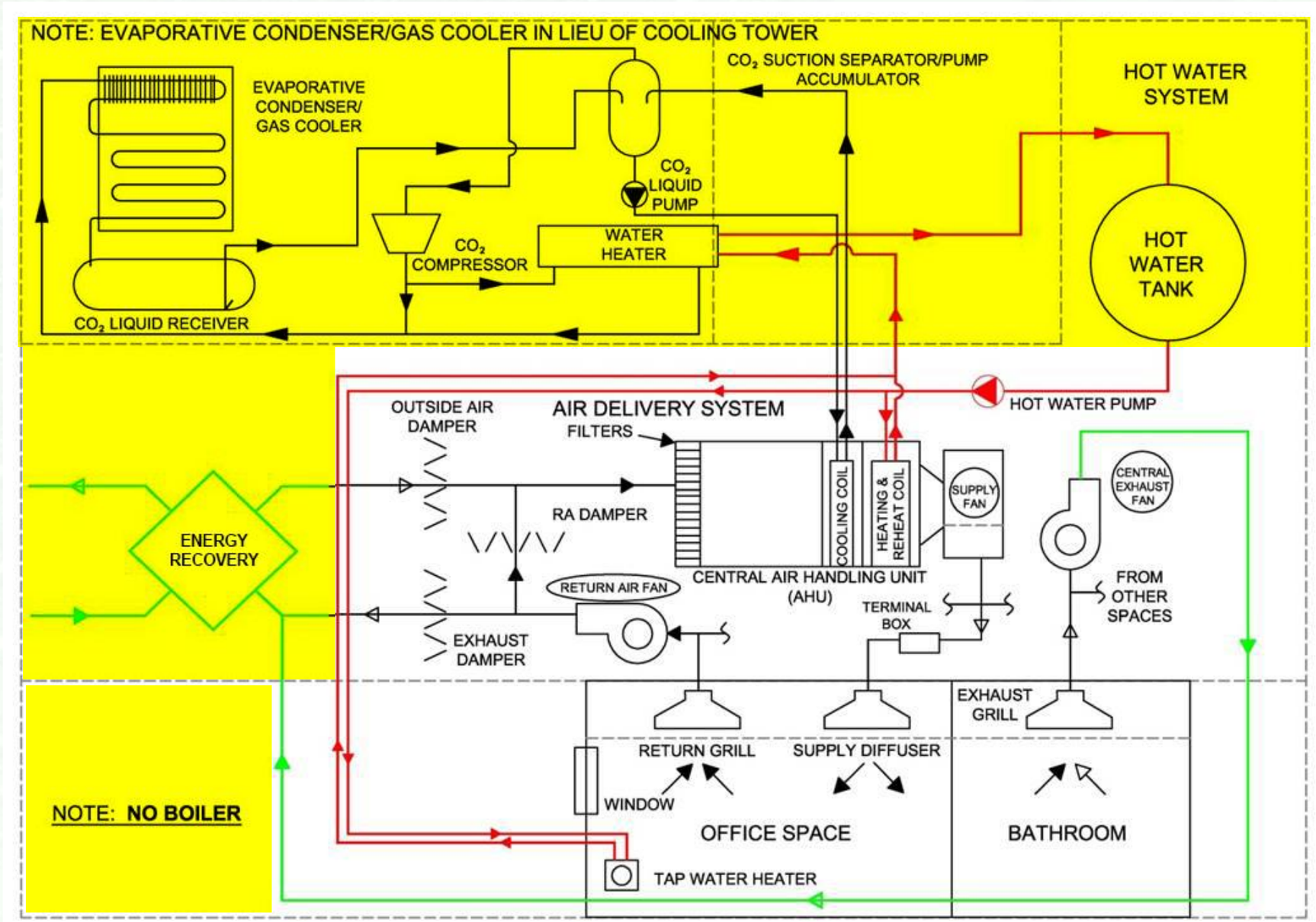


Figure 9: Schematic of a Central System with CO_2 Cooled Water Chiller, Exhaust Air Energy Recovery and Water Heating.

NB: Evaporative Condenser/Gas Cooler in Lieu of Cooling Tower.

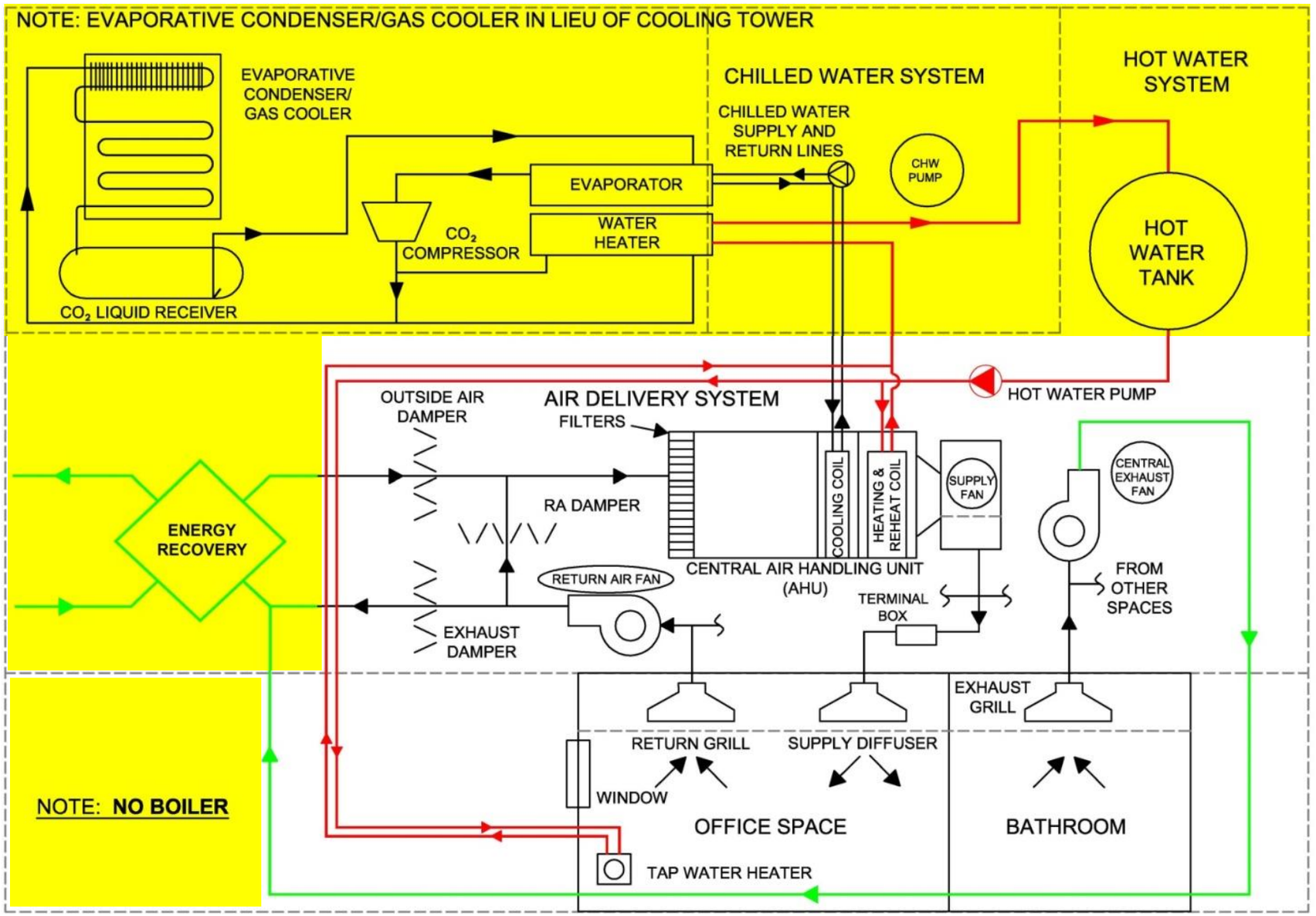


Figure 10: HFC Phase Down Schedule for Developed Countries

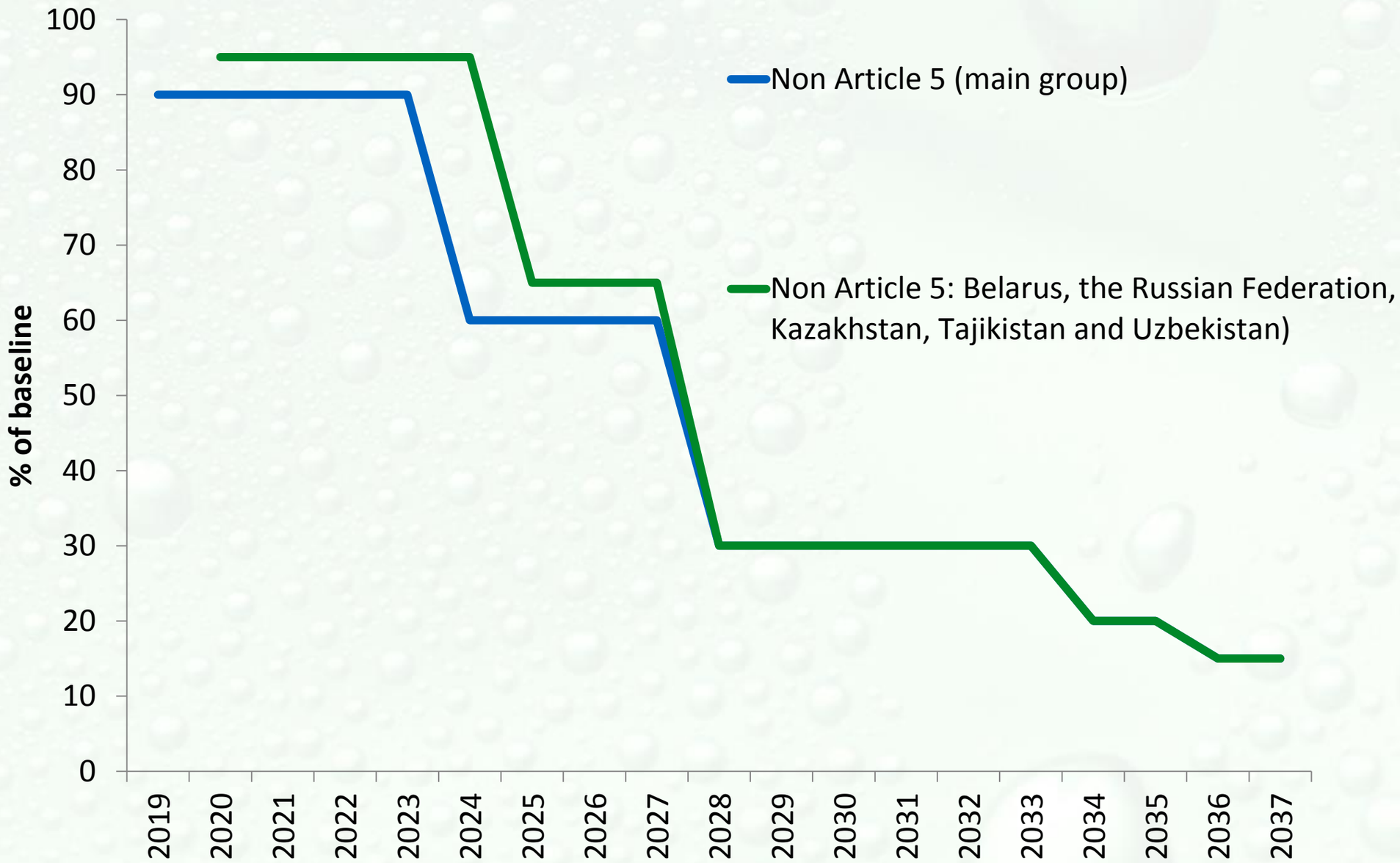


Figure 11: HFC Phase Down Schedule for Groups 1 & 2 Article 5 Developing Countries

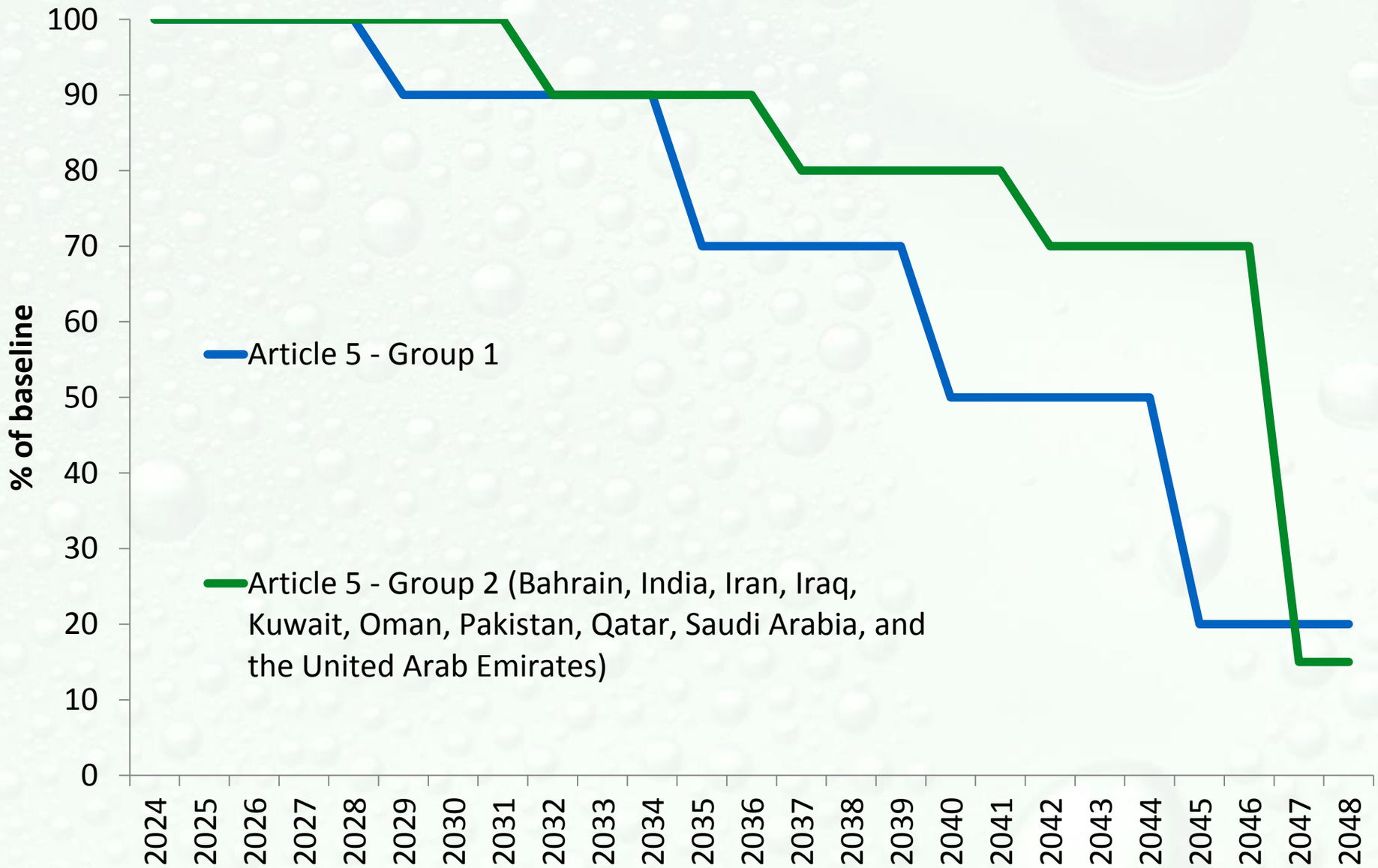


Figure 12. Asian climate zones with approximate percentage incidence of subcritical CO_2 condensing annually

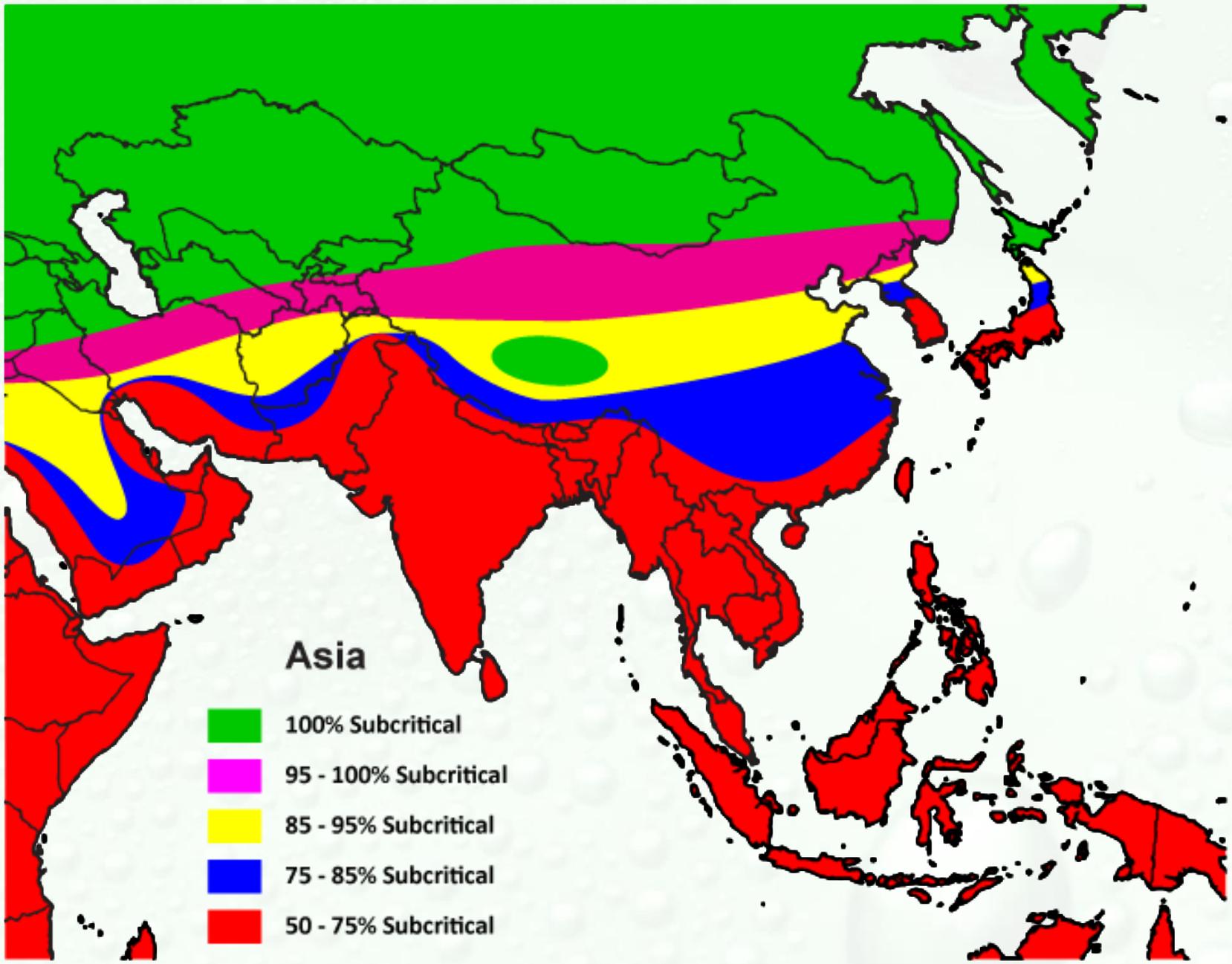


Figure 11. Hybrid CO_2 Evaporative Condenser, 2017

Conclusions

CO_2 refrigerating systems offer a number of advantages over conventional refrigeration systems with chemical refrigerants when applied to the cooling and heating in the built environment.
All issues are addressed.

- **Suitable for retrofitting replacing chillers, cooling towers and space heating boilers.**
- **Retrofitting and new systems future proof systems with respect to the HFC Phase Down in accordance with the Kigali Amendment to the Montreal Protocol.**
- **Large reduction in energy consumption.**

Conclusions (Continued)

- Large reduction in cooling water consumption if used with Hybrid Evaporative Condensers.
- Large reduction in carbon emissions due to both reduced energy consumption and no chemical refrigerants.
- Large reduction in costs for energy, water, water treatment and disposal to sewer.
- Even better results if applied to new buildings with hydronic cooling & heating.
- Low cost refrigerant.

ATMO sphere ASIA

Thank you very much for your attention!