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TRANCRITICAL CO₂ COMPRESSORS for ECONOMIZED CYCLES



TRANSCRITICAL CO₂ COMPRESSORS

FOR ECONOMIZED CYCLES



1. INTRODUCTION

2. ECONOMIZED CYCLE: ADVANTAGES FOR HEAT PUMPS

3. CO₂ COMPRESSORS FOR ECONOMIZED CYCLES

4. CASE STUDY: HEAT PUMP FOR RESIDENTIAL HEATING

5. CONCLUSIONS

1. INTRODUCTION: DORIN

→ **COMPANY FOUNDED IN 1918**

→ **FIRST CFC COMPRESSOR: 1932**

→ **FIRST SEMIHERMETIC COMPRESSOR: 1952**

→ **CO₂ TK APPLICATIONS SINCE 1995**

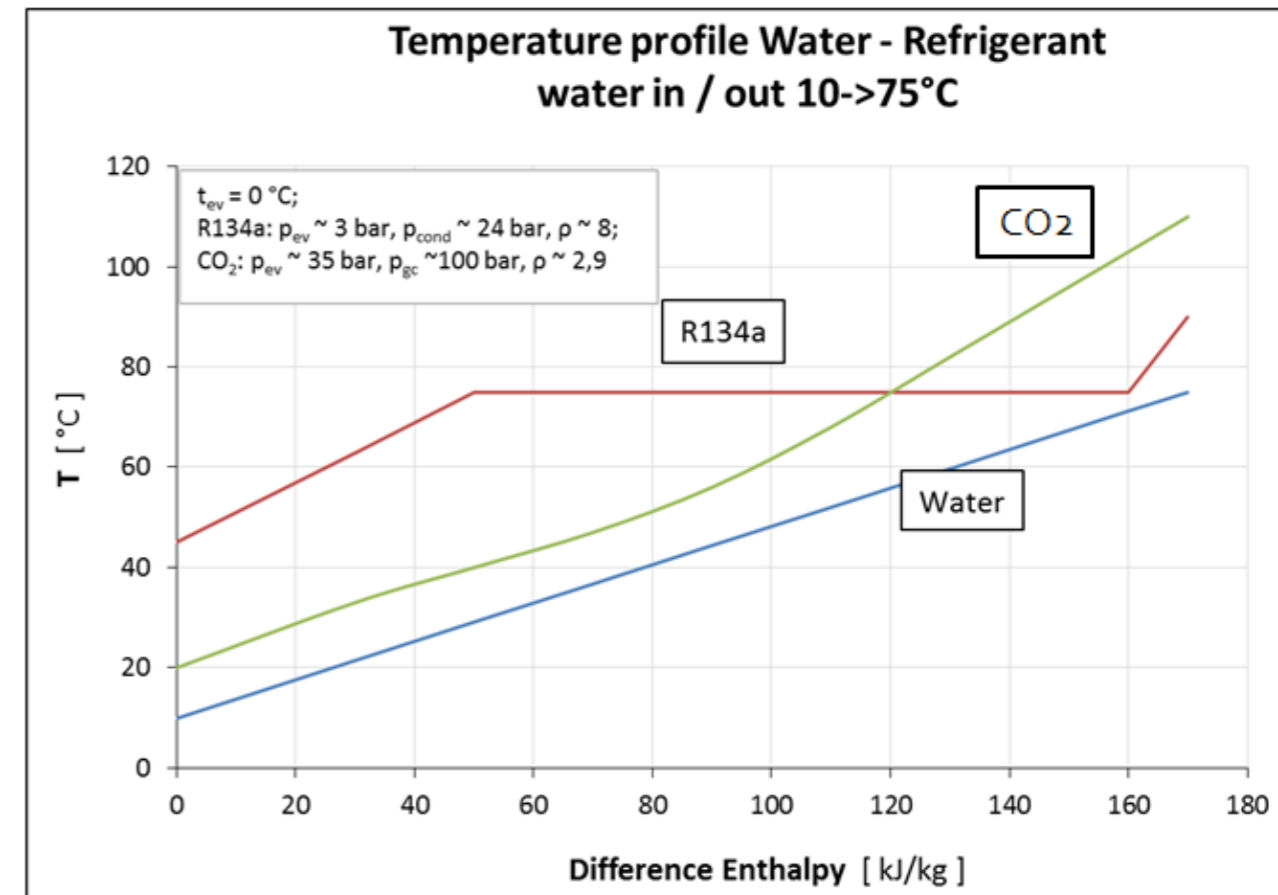
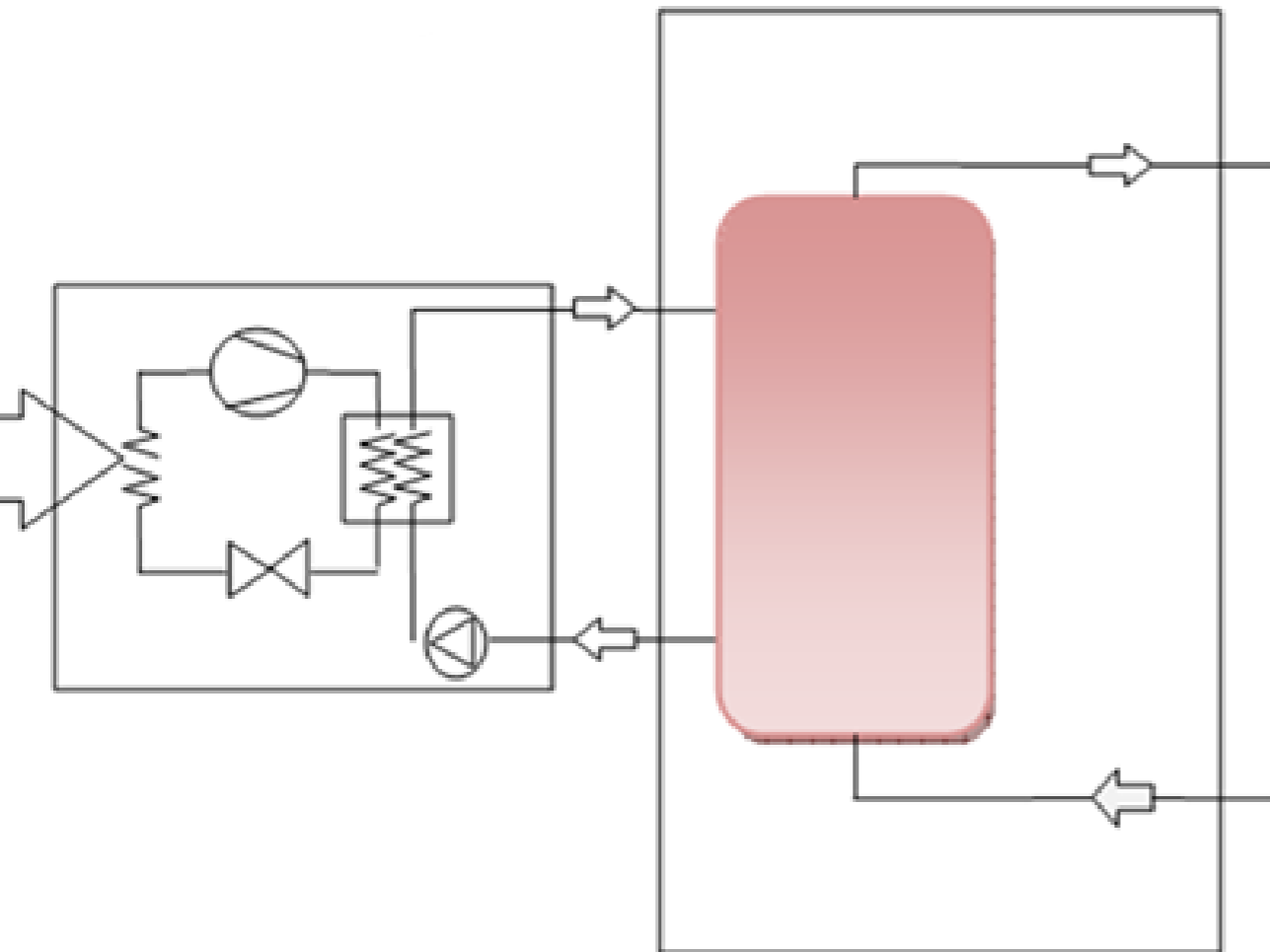
→ **15.000 TRANSCRITICAL CO₂ Compressors
supplied in the Market**

→ **Heat Pumps Sector: > 3500 Compr. In Japan & Korea**

→ **> 700 Compressors for HP sold in Europe and China**



1. INTRODUCTION: CO₂ HEAT PUMPS - STATE OF THE ART



- ✓ **NO CONDENSATION: WATER TEMP PROFILE IS PERFECTLY MATCHED**
- ✓ **EXCELLENT COPs FOR LARGE WATER TEMPERATURE LIFT**
 - ✓ **PERFECT FOR SANITARY PURPOSES**
- ✓ **PERFORMANCE DROPS DOWN FOR WATER LOOP SYSTEMS**

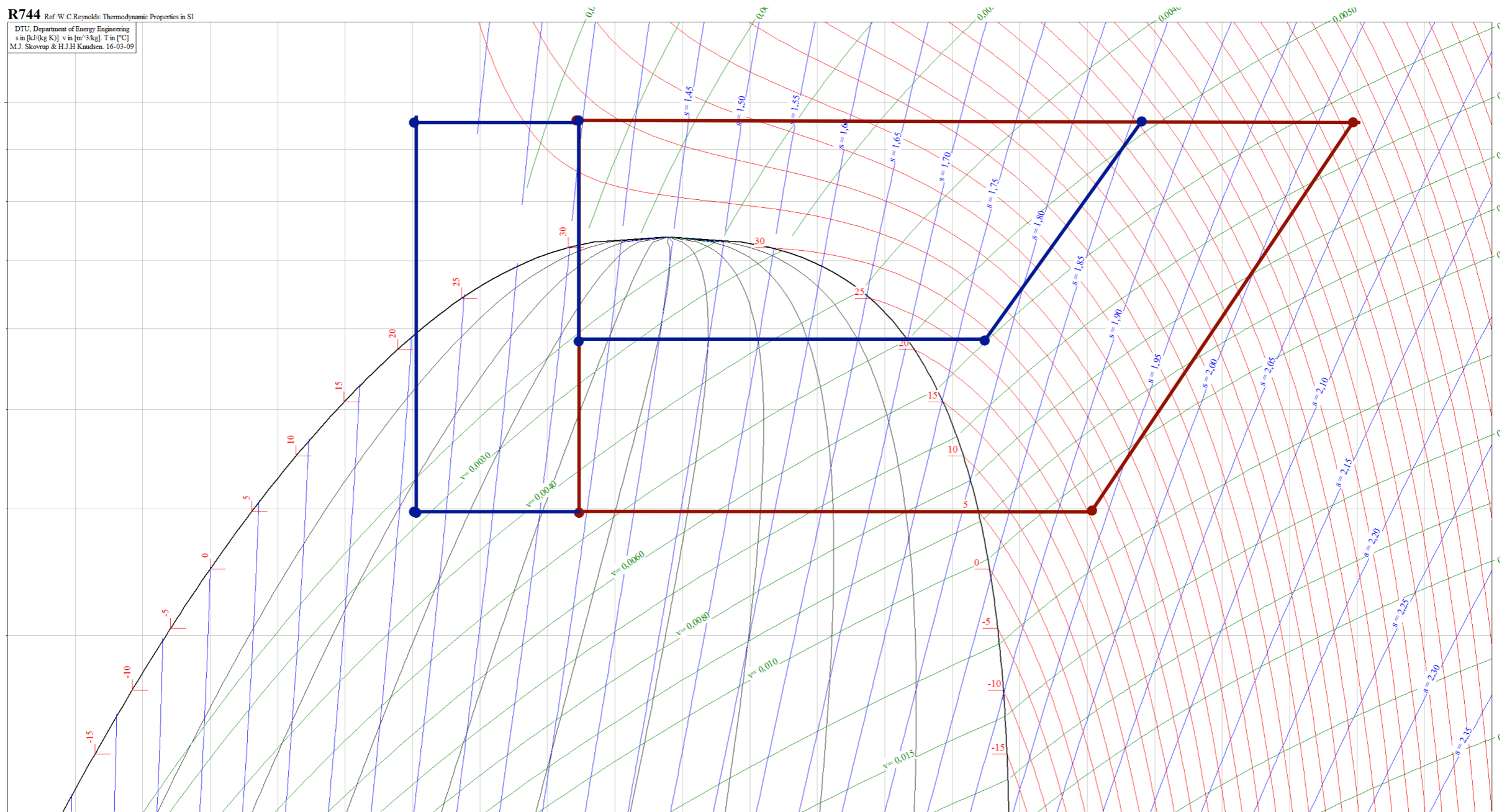


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2. ECONOMIZED CYCLES: ADVANTAGES FOR HEAT PUMPS

R744 Ref. W.C Reynolds: Thermodynamic Properties in SI

DTU, Department of Energy Engineering
s in [kJ/(kg K)], v in [m³/kg], T in [°C]
M.J. Skovrup & H.J.H Knudsen. 16-03-09

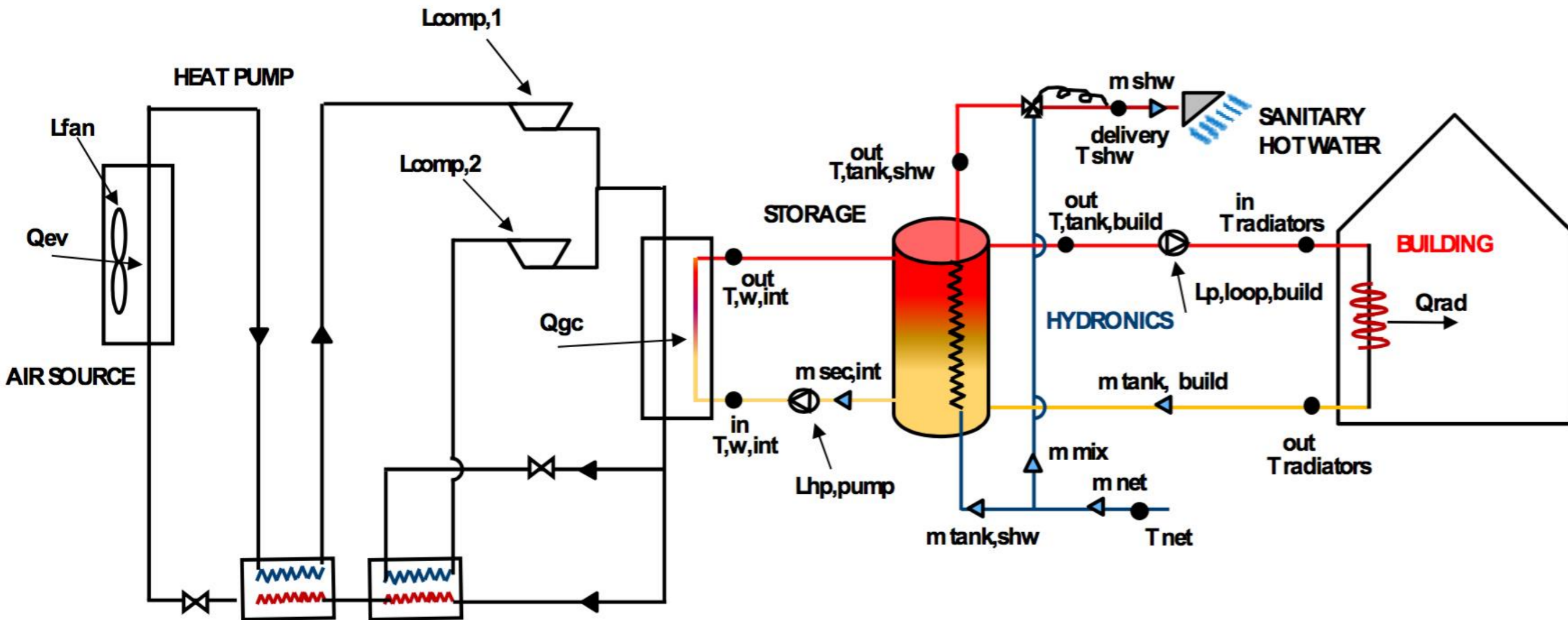


✓ **SIGNIFICANT COP INCREASE**

✓ **POSSIBLE APPLICATION TO WATER LOOP CYCLES**



2. ECONOMIZED CYCLES: ADVANTAGES FOR HEAT PUMPS

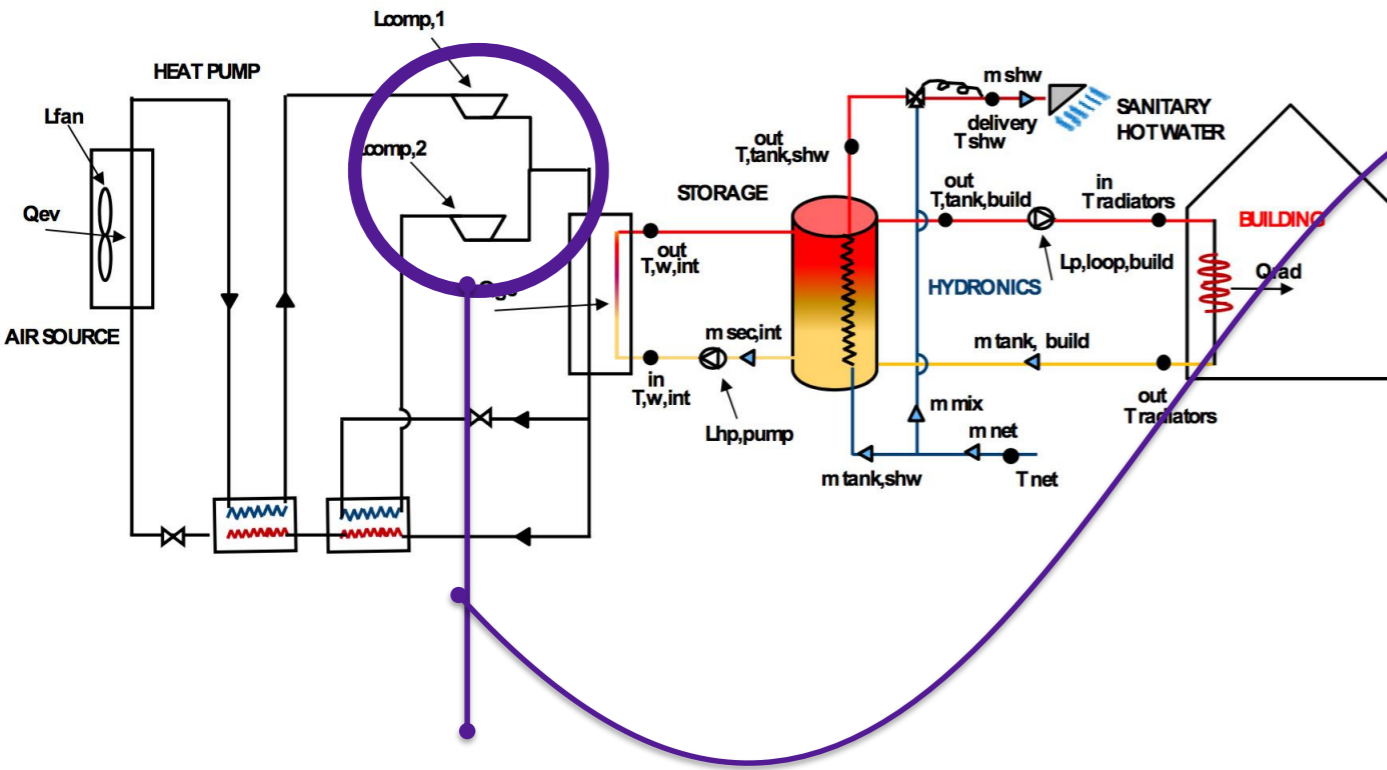


✓ **POTENTIALLY APPLICABLE FOR SPACE HEATING**

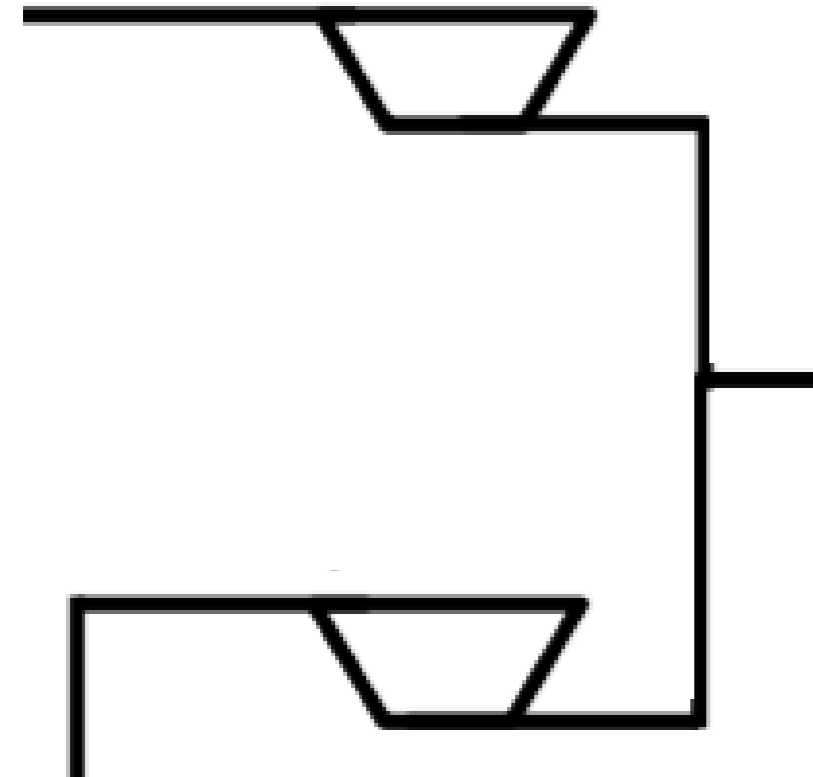
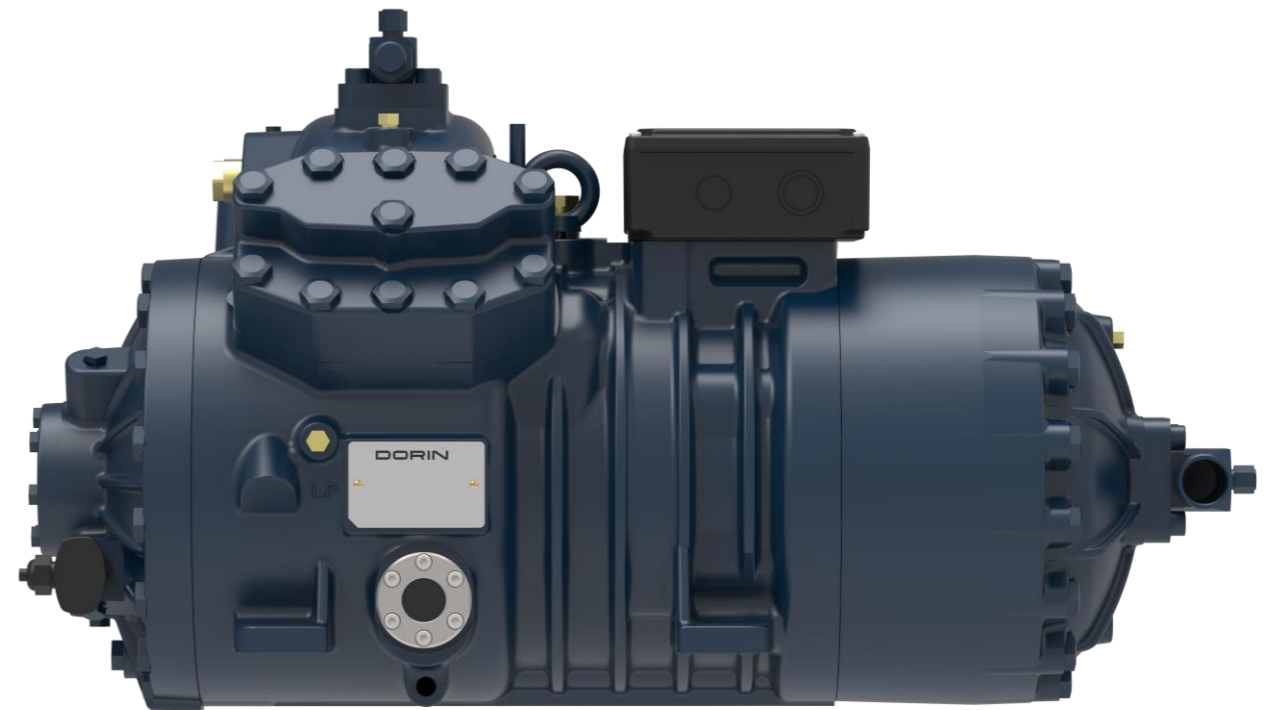
✓ **INTERESTING PERFORMANCES WHEN COMPARED TO BUILDINGS HEATED UP WITH OLD GAS BOILERS (WATER LIFT FROM 40°C TO 80°C)**



3. CO₂ COMPRESSORS FOR ECONOMIZED CYCLES



- ✓ **SATELLITE COMPRESSOR NEEDED**
- ✓ **VERY COSTLY SOLUTION**
- ✓ **4 CYLINDERS COMPRESSORS CAN BE ADAPTED TO WORK IN ECONOMIZED CYCLES**



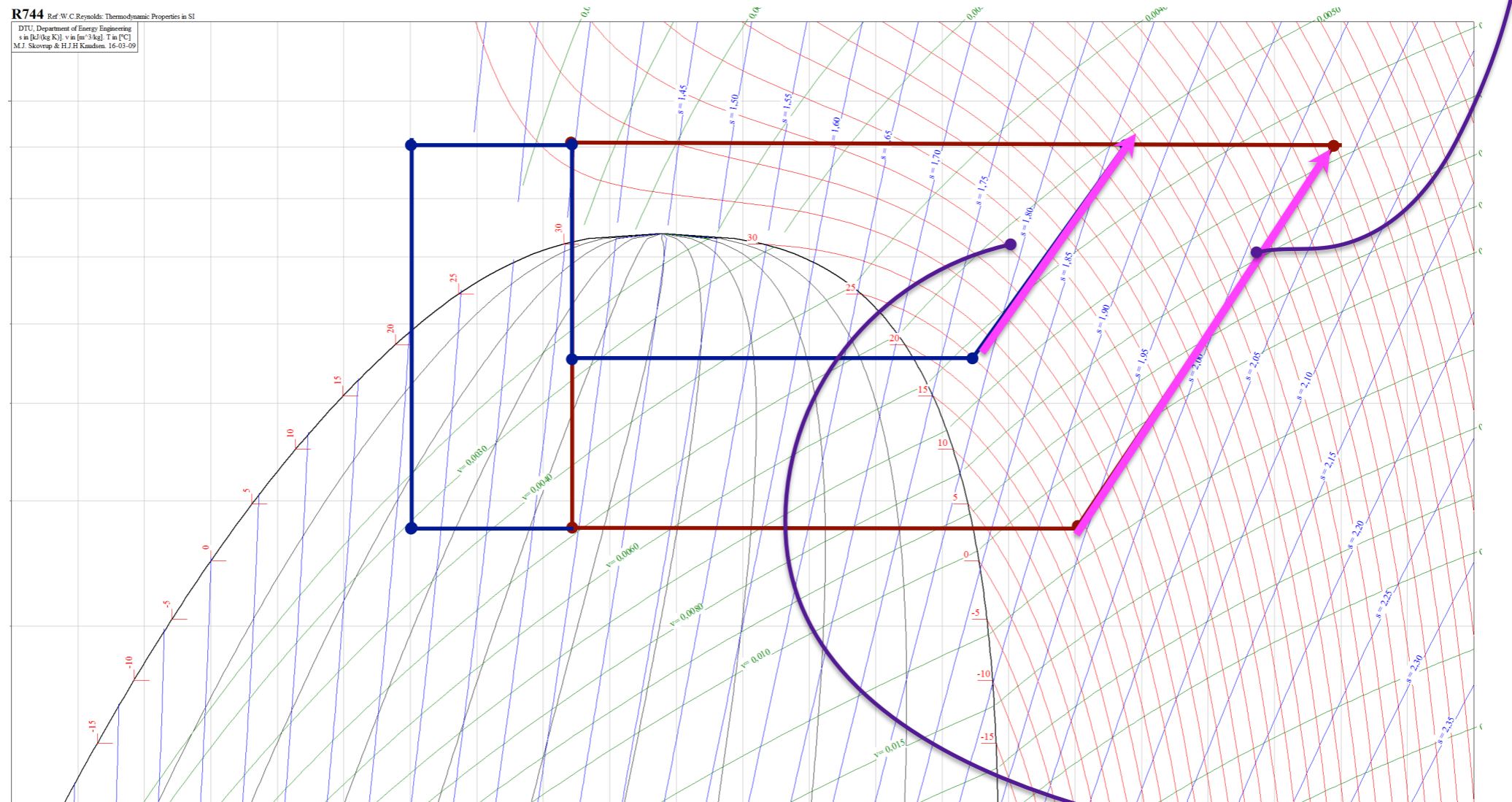


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3. CO₂ COMPRESSORS FOR ECONOMIZED CYCLES: CD HP RANGE

✓ MODIFICATIONS TO STANDARD 4 CYLINDERS DESIGN

✓ 3 PISTONS WORK BETWEEN LOW PRESSURE AND HIGH PRESSURE



✓ 1 PISTON WORKS BETWEEN INTERMEDIATE PRESSURE AND HIGH PRESSURE



3. CO₂ COMPRESSORS FOR ECONOMIZED CYCLES

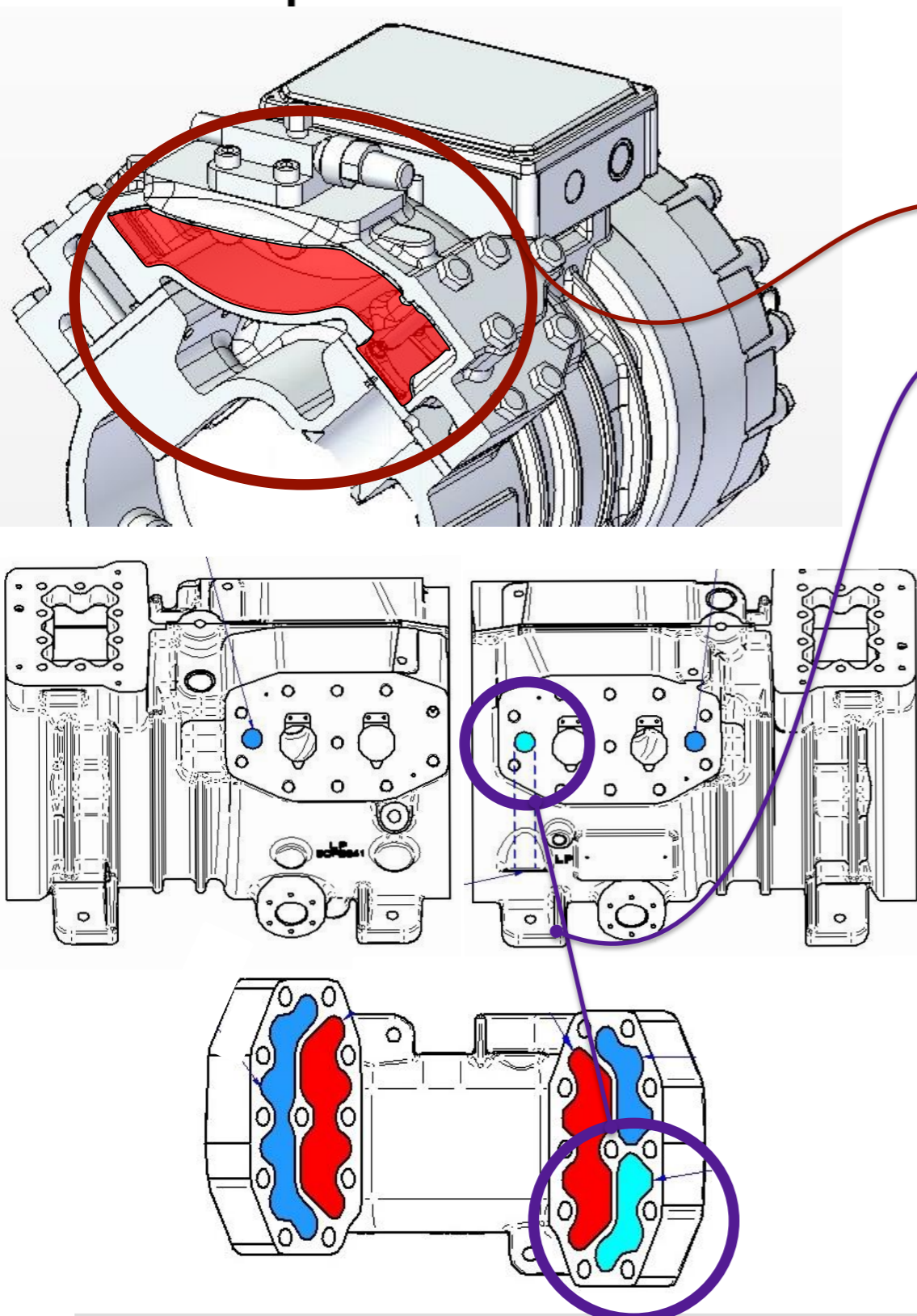
CD HP COMPRESSOR RANGE

- ✓ INNOVATIVE MANIFOLD
- ✓ COMMON DISCHARGE MANIFOLD FOR ALL THE CYLINDER BANKS
- ✓ DEDICATED SUCTION PLENUM FOR ECONOMIZED PORT
- ✓ 8 COMPRESSORS MODELS
- ✓ DISPLACEMENT FROM 7.0 TO 20 m³/h (LOW PRESSURE STAGE)
- ✓ MOTOR POWERS FROM 15 HP TO 50 HP
- ✓ DESIGN PRESSURES:
P_{ss} = 100 bar - P_s = 150 bar
- ✓ HEATING CAPACITIES:

FROM 40 kW to 110 kW

T_{amb} = 7°C - Water in = 40°C - Water out = 80°C

- ✓ EXTRA-LOW PRESSURE PULSES AND VIBRATION





4. CASE STUDY: HEAT PUMP FOR RESIDENTIAL HEATING



Next Generation Of Heat Pump Working with Natural Fluids” (NxtHPG) aims at the development of a set of safe, reliable, high efficiency and high capacity heat pumps working with HCs and CO₂.

This project has received funding from the European Union’s Seventh Programme for research, technological development and demonstration under grant agreement No. 307169)

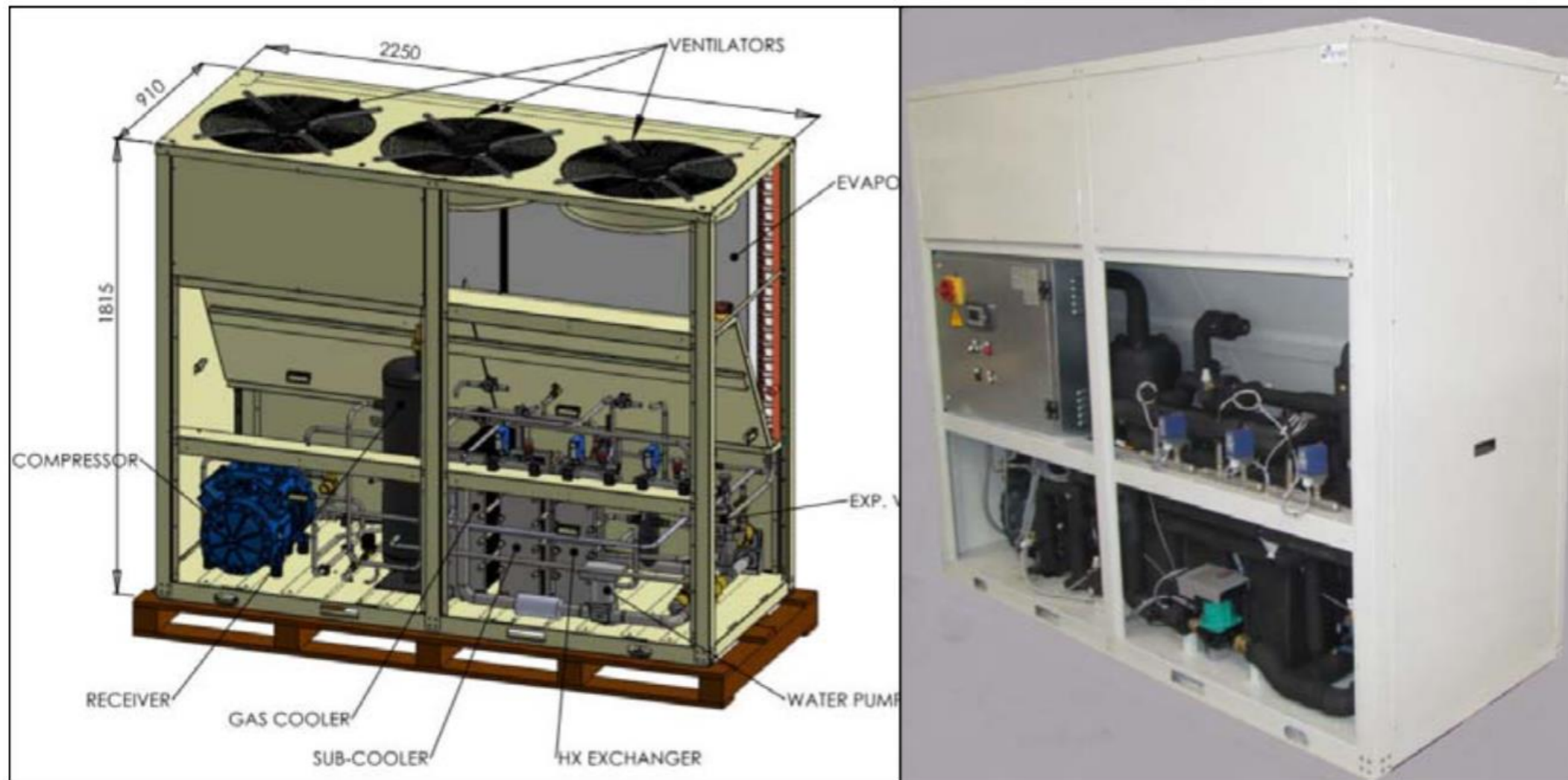


4. CASE STUDY: HEAT PUMP FOR RESIDENTIAL HEATING

Case	Fluid	Source	Tamb(°C)	Sink	T(°C)	Application	(kW)
1	HC (Propane)	Air	-10 to 35 (outdoor air)	Water	40 to 50	Heating water production	40
					60	Low demand of Domestic hot water	
2	HC (Propane)	Water (brine)	-5 to 15	Water	40 to 50	Heating water Production	60
					60	Low demand of Domestic hot water	
3	HC (Propane)	Water (Neutral loop)	10 to 15 (Sewage water) or 25 to 30 (Condensation loop)	Water	60	Domestic hot water production	50
4	CO ₂	Air	-10 to 10 (winter) 20 to 35 (summer) (outdoor air)	Water	60 to 80	Domestic hot water production	30
5	CO ₂	Air	-10 to 35 (outdoor air)	Water	80 (return water 40)	Heating & domestic hot water production	50

- **RENOVATION OF OLD GAS BOILER HEATING SYSTEMS (5/6 FAMILIES) WITH HIGH TEMPERATURES RADIATORS**
- **BOTH AMBIENT AND DOMESTIC HOT WATER HEATING**

4. CASE STUDY: HEAT PUMP FOR RESIDENTIAL HEATING

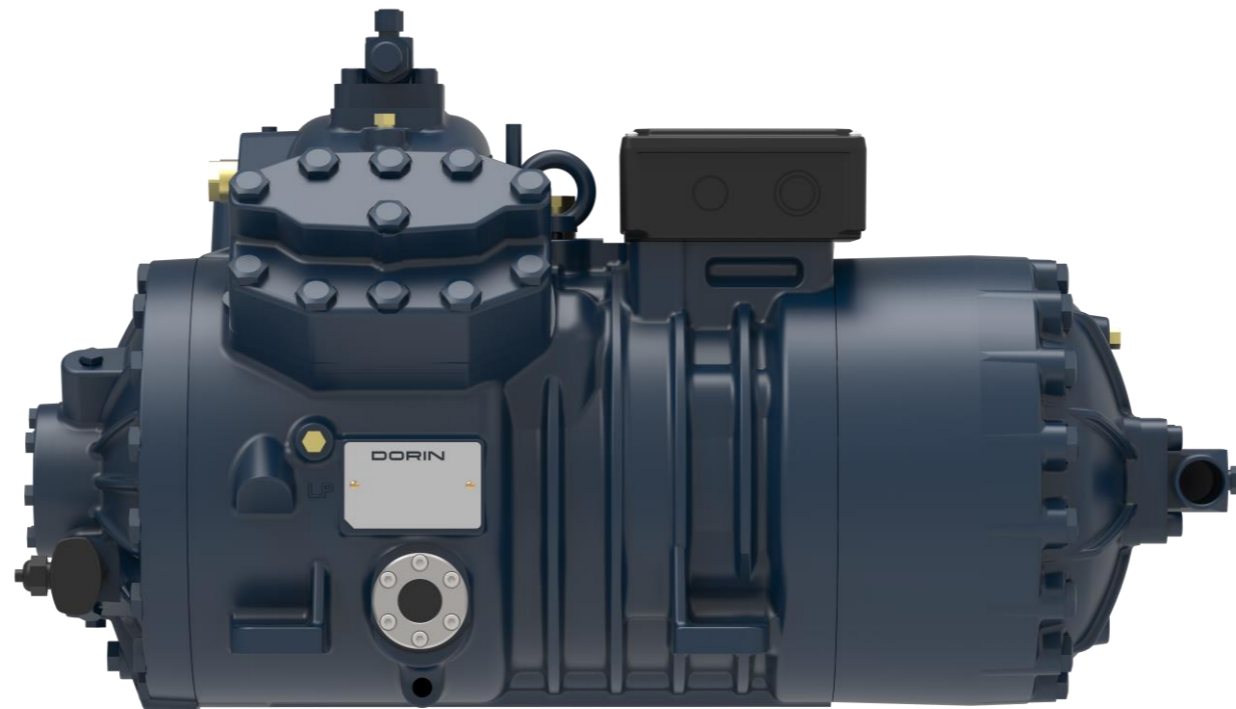


- ✓ ONE HEAT PUMP UNIT WAS ASSEMBLED AND TESTED
- ✓ RELIABLE AND EFFICIENT OPERATION DOWN TO -15°C AMBIENT TEMPERATURE
- ✓ 20% CO₂ EMISSION SAVINGS COMPARING TO SAME SIZE GAS BOILER
- ✓ Seasonal Power Factor (SPF) of 2,6 Vs 2,15 of GAS BOILER (21% incr.)
- ✓ See detailed data report on official <http://www.nxthpg.eu/>

5. CONCLUSIONS

- ✓ **CO₂ OFFERS EXCELLENT PERFORMANCES FOR HEAT PUMPS OPERATION IN OPEN WATER LOOPS (LARGE WATER TEMPERATURE LIFTS)**
- ✓ **PERFORMANCE ARE NOT ATTRACTIVE FOR SMALLER WATER TEMPERATURE LIFTS**
- ✓ **ECONOMIZED CO₂ CYCLES CAN IMPROVE HEAT PUMP PERFORMANCES WHEN APPLIED TO WATER LOOPS AND SMALLER WATER TEMPERATURE LIFTS**
- ✓ **A DEDICATED 4 CYLINDERS COMPRESSORS RANGE HAS BEEN DEVELOPED TO COPE WITH ECONOMIZED CYCLES REQUIREMENTS IN A COST EFFECTIVE WAY**
- ✓ **A HEAT PUMP PROTOTYPE HAS BEEN BUILT AND TESTED TO REPLACE OLD GAS FIRED BOILERS FOR HIGH TEMPERATURE RADIATORS**
- ✓ **THE HEAT PUMP PROVED TO WORK RELIABLY AND EFFICIENTLY IN A WIDE RANGE OF AMBIENT TEMPERATURES**
- ✓ **20% EMISSION SAVINGS ARE PROSPECTED WHEN COMPARING THE HEAT PUMP WITH A SAME SIZE GAS FIRED BOILER**

! THANK YOU FOR YOUR ATTENTION !





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Thank you very much!

