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REFRIGERATION SYSTEM USING CO_2 AS THE ONLY REFRIGERANT , SINCE 2004

DRAVA

ELBA

NEVA

HEAT PUMPS AIRHEAT / GEOHEAT

Refrigeration design concepts:

- Single stage/booster
- 2-stage simple intercooler and open flash thank
- Cascade
- Heat pumps: tap water heating (water/water and air/water)
- Heat pumps for heat recovery/combined cooling&heating

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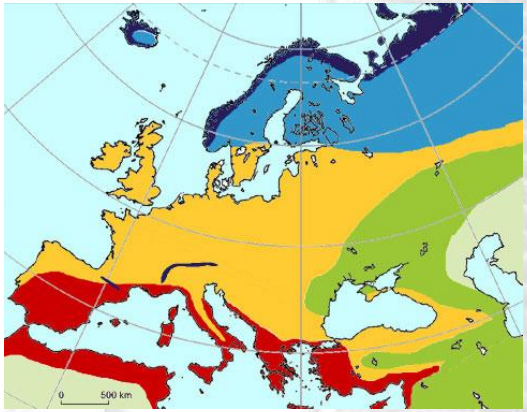
DEVELOPMENT ACTIVITY 2010-2013

Efficiency improvement

Focus on CO_2 refrigeration in Southern Europe climatic conditions

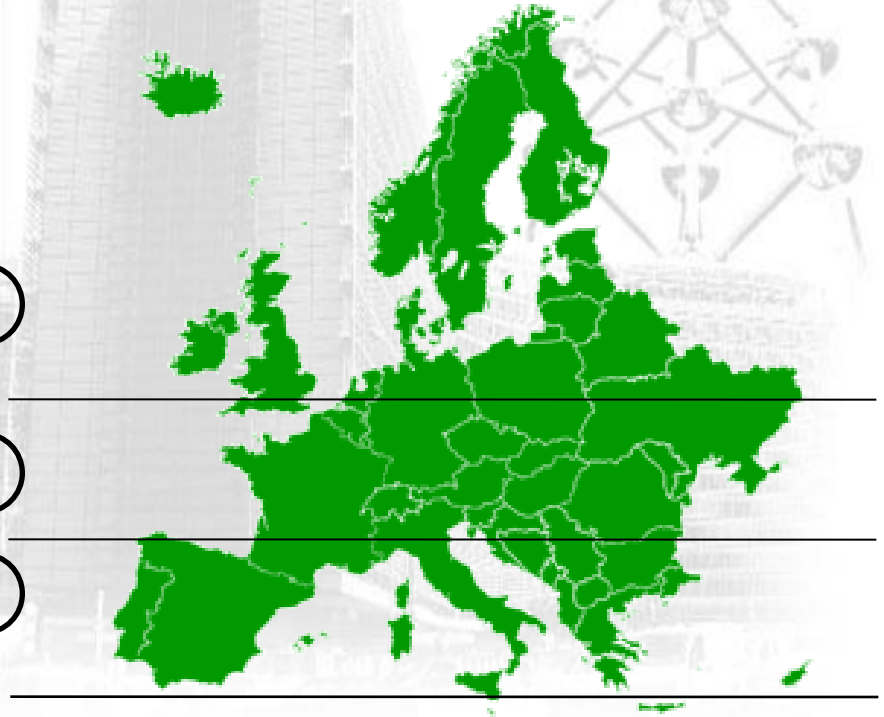


Climatic zones in Europe

1- COLD CLIMATE

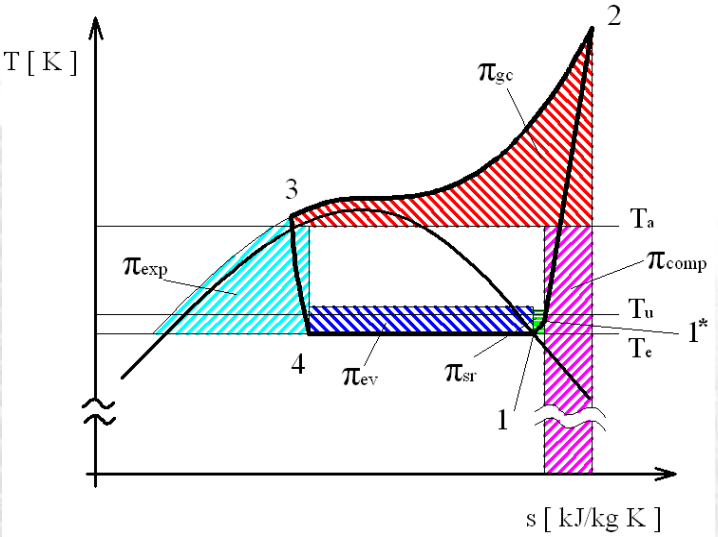
2- HIGH PEAK TEMPERATURE
Issue: Capacity at peak conditions

3- HIGH TEMPERATURE FOR LONG PERIODS
Issue: Capacity and & energy consumption



DEVELOPMENT ACTIVITY 2010-2013

THEORETICAL ANALYSIS – LOSSES OF «STANDARD CO_2»



SOLUTIONS FOR EFFICIENCY IMPROVEMENT:

A. System with auxiliary compressors - Reduction of throttling losses
B. System with evaporator overfeed - optimization of evaporator heat transfer surface *
C. Energy recovery from throttling process *

* IDENTIFIED BY enJECTOR®

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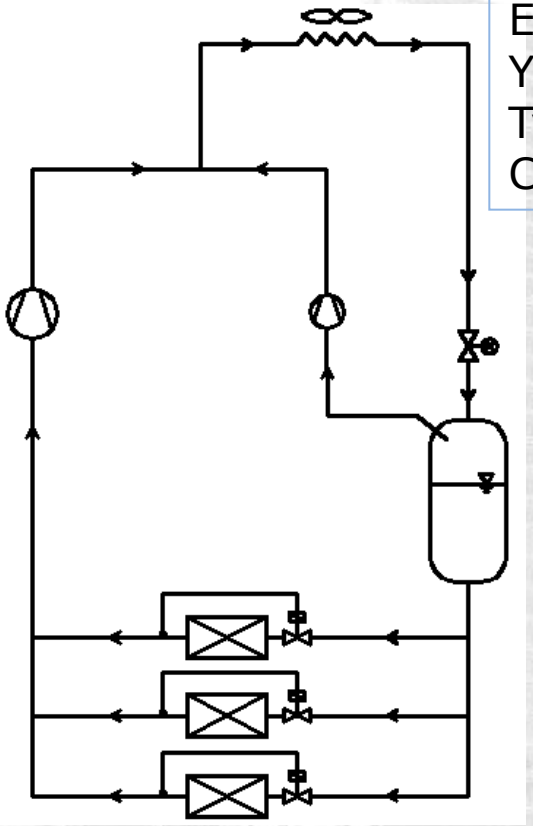
Case study - 1

AUXILIARY COMPRESSOR FOR FLASH VAPOR RECOMPRESSION
MORE THAN 20 SYSTEMS INSTALLED SINCE 2008



Example
Year : 2013
Type : BOOSTER 4xMT+2xAUX +4xLT
CAPACITY: 165kW MT – 40kW LT

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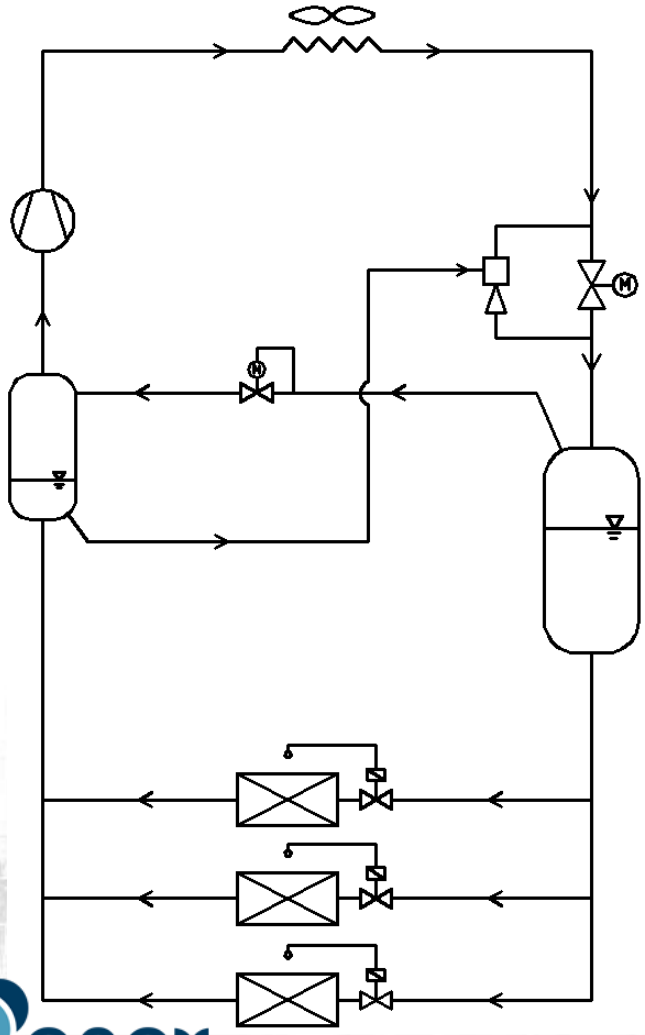
Case study - 2

EVAPORATOR OVERFEEDING WITH enJECTOR®

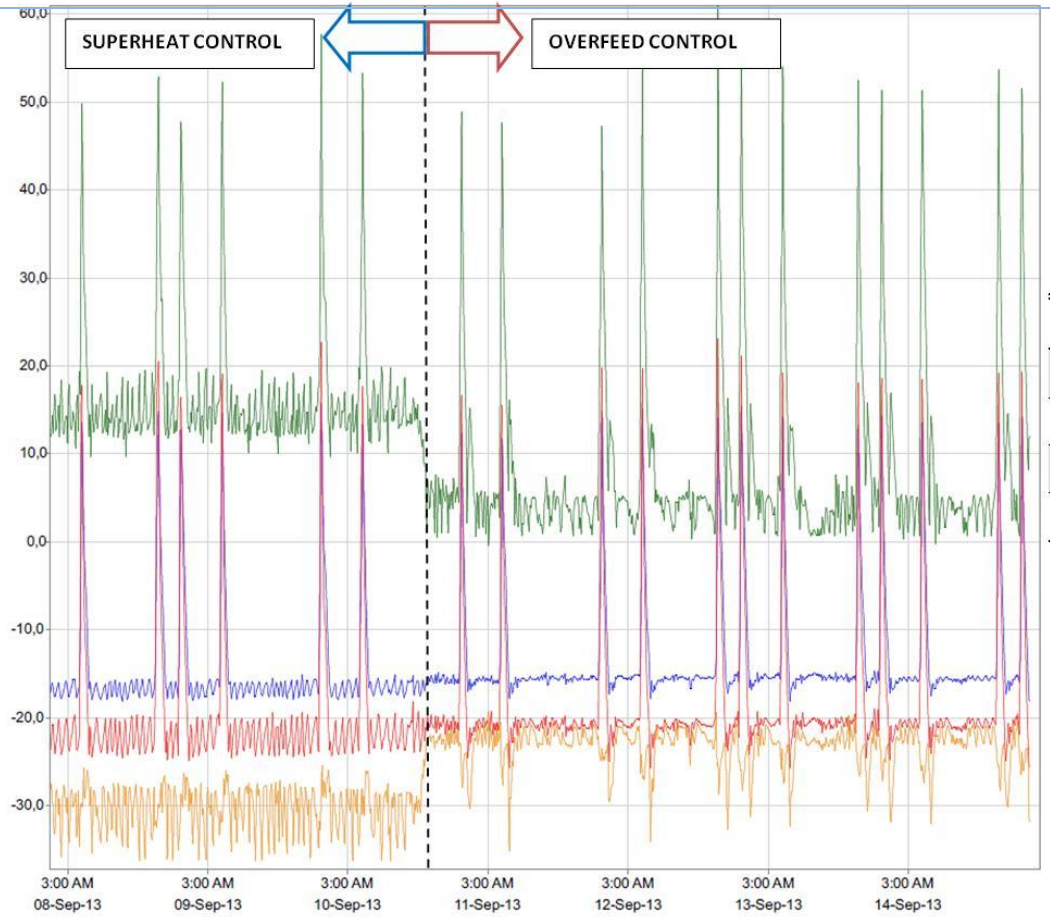


Example
Year :2013
Type: BOOSTER 3 temp.level / 4xMT1 +3x MT2 +4xLT
CAPACITY: 130 kW MT – 35 kW LT

Case study -2

EXAMPLE EVAPORATOR OVERFEEDING - 2013

Ejector: no critical moving parts added to base system
Measured efficiency improvement : 15%



	Min. [°C] Max.	Colour
Air Temperature C 1	-18.1 15.7	
Air Temperature C 2	-25.7 23.1	
Superheat	-0.4 60.9	
Evaporation temperature	-36.3 -19.3	

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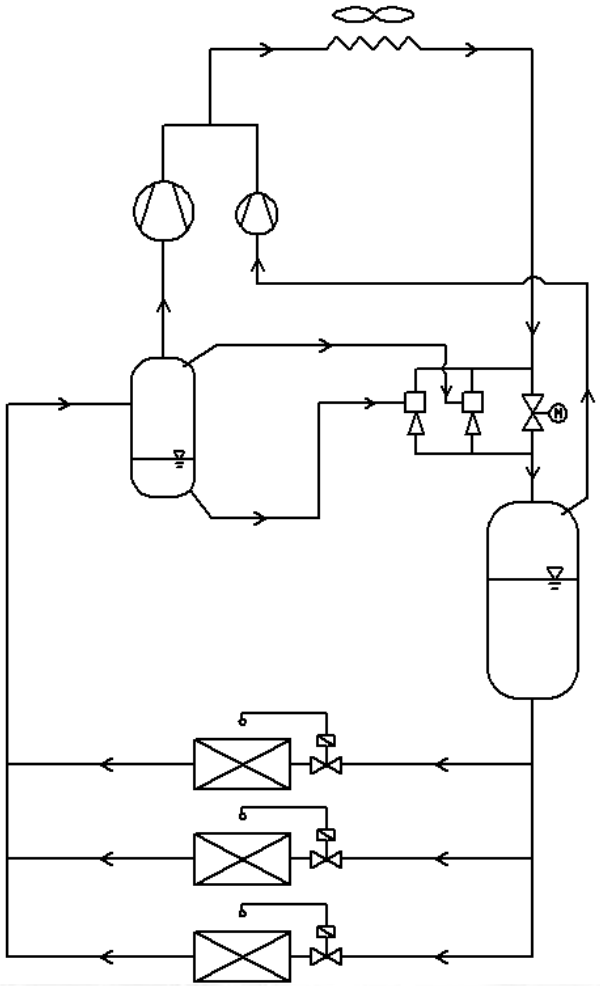
Case study - 3

ENERGY RECOVERY FROM EXPANSION PROCESS



Example
Year : 2013
Type : BOOSTER 4xMT+2xAUX +4xLT
CAPACITY: 150 kW MT / 50 kW LT
n.1 ejector for liquid pumping
n.2 ejectors for energy recovery

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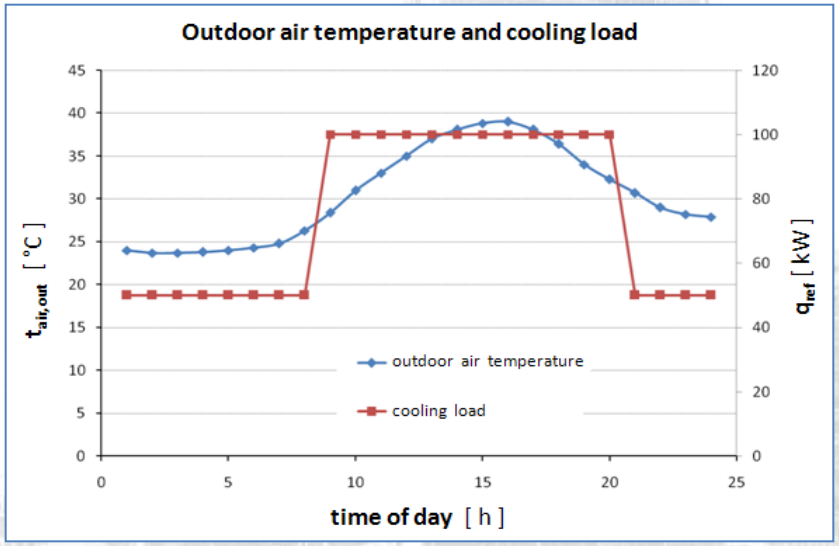
Simulation- 1

ANALYSIS FOR SOUTHERN ITALY CLIMATE

- Commercial refrigeration system for supermarkets
- Bari (Italy); 41° latitude

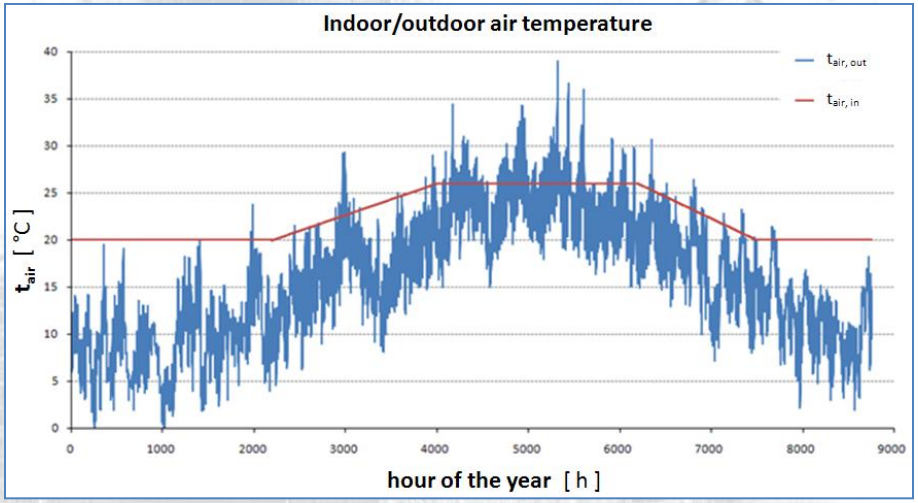
DAY

t_{ext}: 10 August
Test Reference Year (TRY)



YEAR

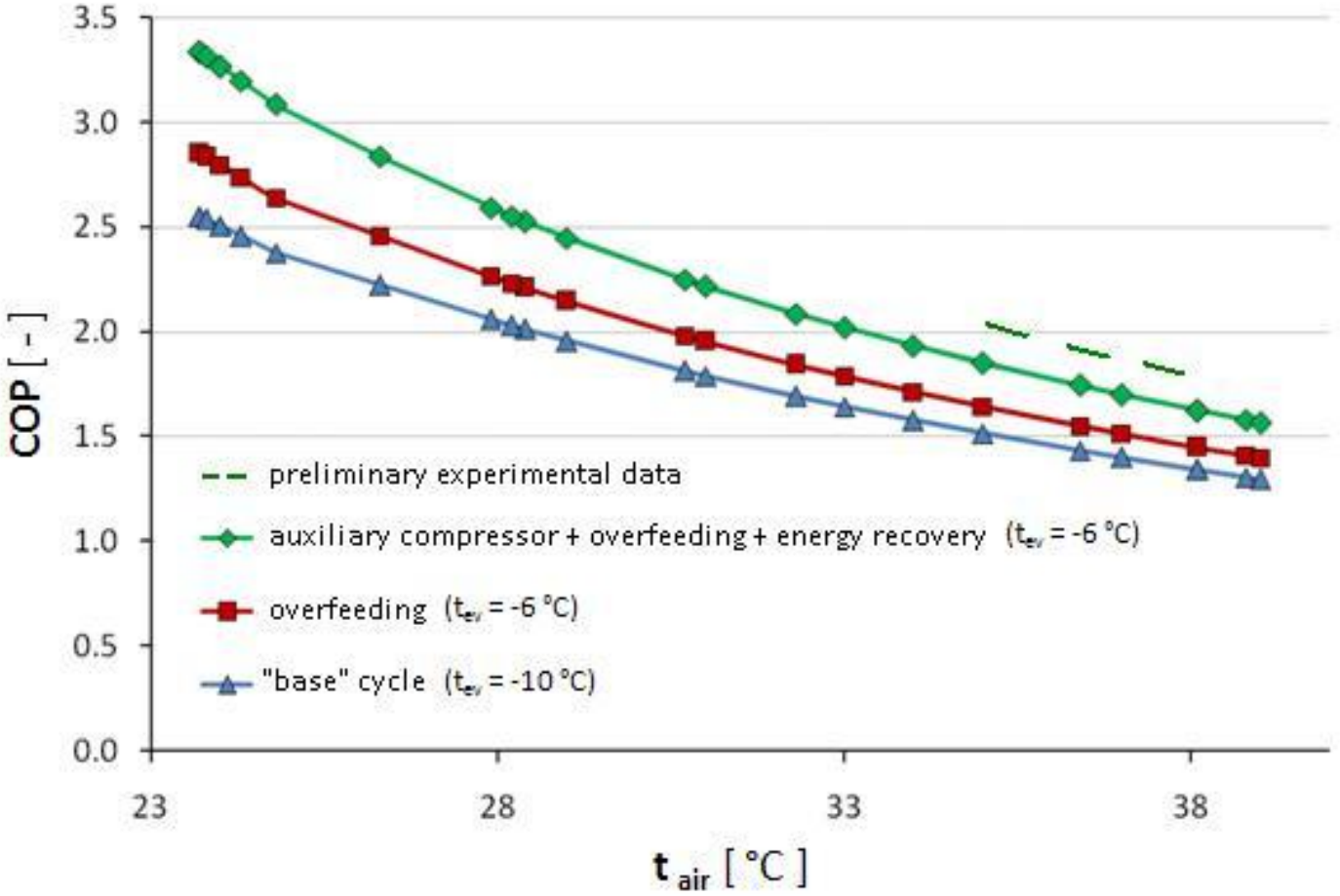
t_{ext}: "standard year"
Test Reference Year (TRY)



Yearly saving : 20- 25% compared to base «CO_2 standard» cycle

Simulation-2

IMPROVEMENT OVER THE «BASE» CYCLE



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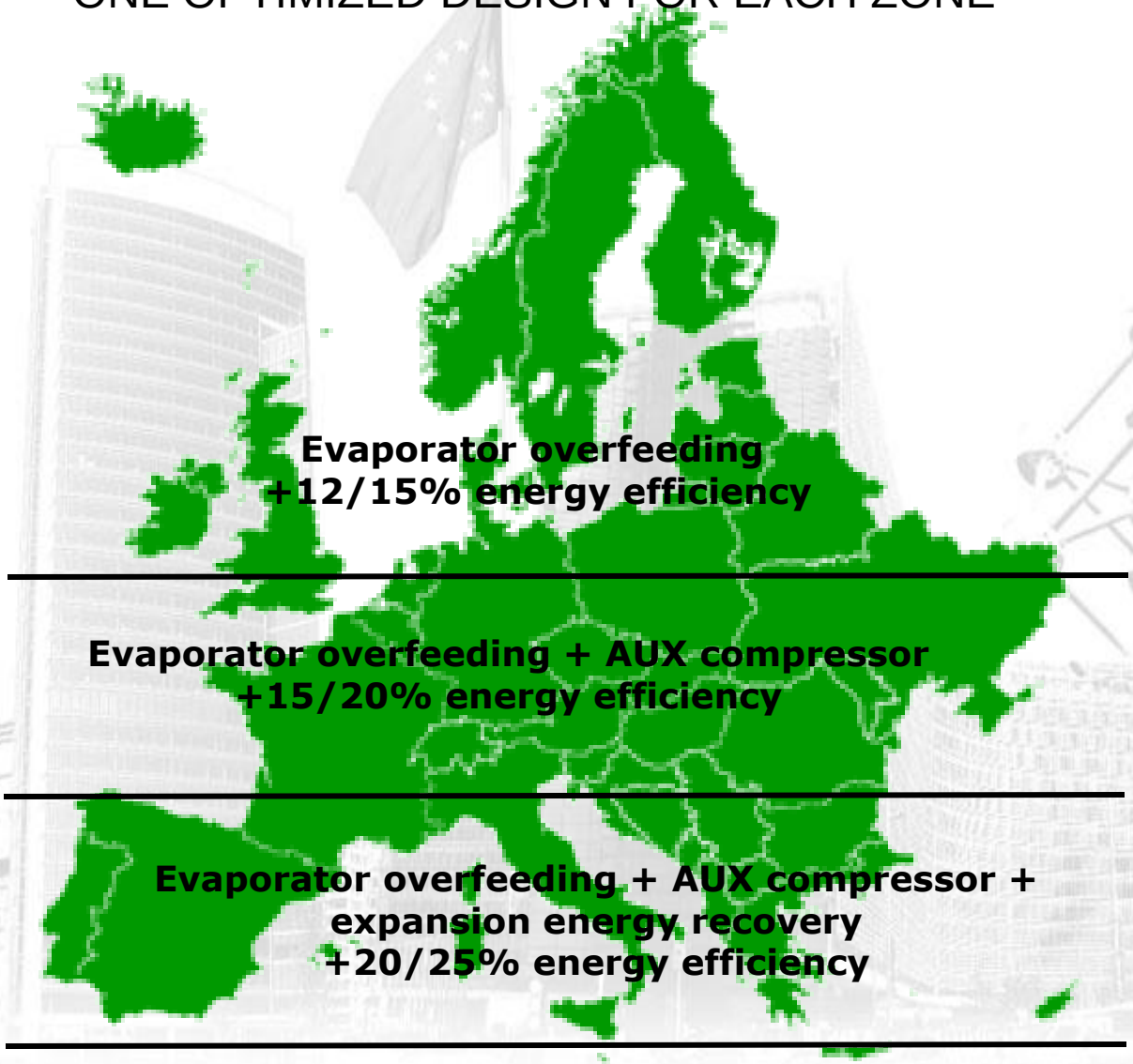
Conclusions

ONE OPTIMIZED DESIGN FOR EACH ZONE



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Thank you very much!

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