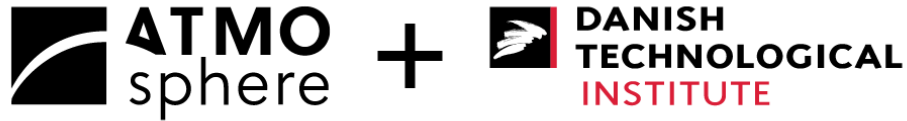




ONLINE

23-24/06/2020



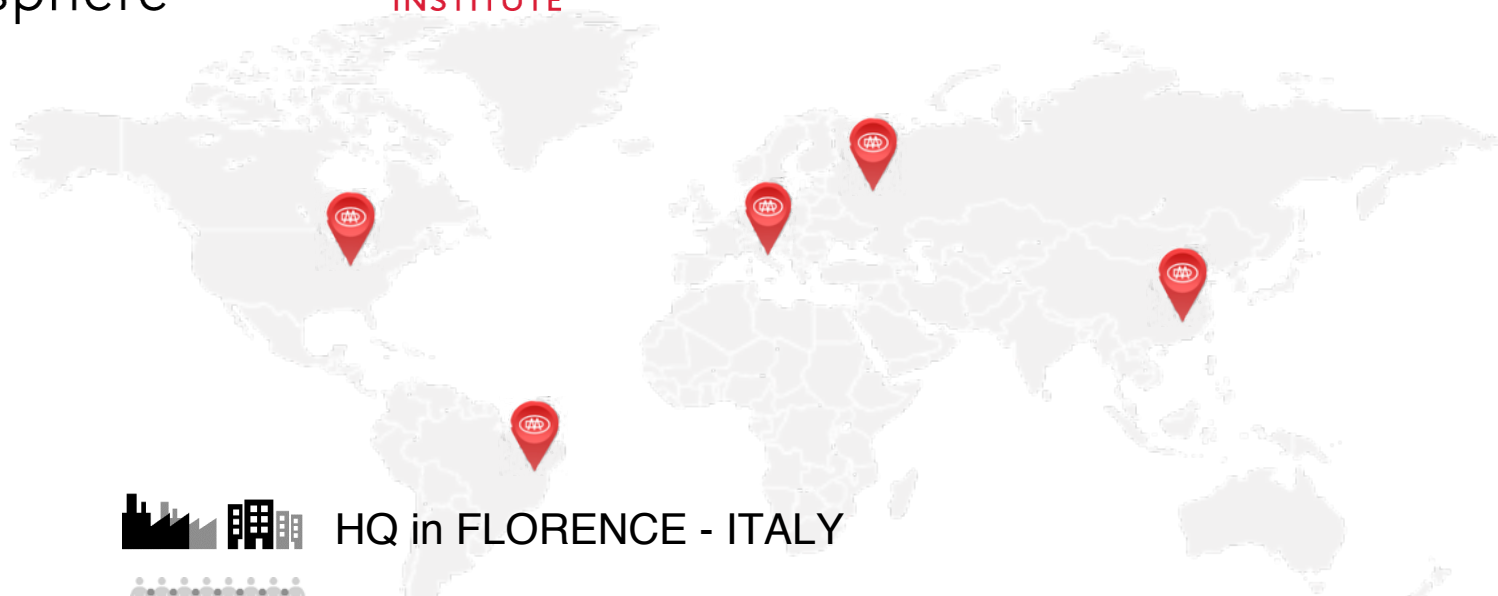
**DESIGNING A 200 kW CHILLER:
EFFICIENCY COMPARISON BETWEEN
HFCs AND NATURAL REFRIGERANTS
IN EUROPEAN CLIMATE ZONES**

GIACOMO PISANO - DORIN SPA



SUMMARY

- INTRODUCTION TO DORIN
- 200 kW CHILLER: POSSIBLE SYSTEMS DESCRIPTION
- SYSTEMS PERFORMANCE CALCULATIONS
- CONCLUSIONS



HQ in FLORENCE - ITALY



150 EMPLOYEES 4 PRODUCTION SITES / 5 SALES OFFICES



75.000+ MANUFACTURED COMPRESSORS IN 2019



TOTAL GROUP T/O 55M€+ IN 2019



TODAY'S CHALLENGE

- DESIGN A 200 kW CHILLER USED FOR AIR CONDITIONING PURPOSES
- CHILLER IS ENGAGED WITH $T_{AMB} > 20^{\circ}\text{C}$
 - STRONGLY DEPENDENT ON CLIMATE ZONES
- CHILLER PRODUCES A (12°C to 7°C) WATER TEMPERATURE DROP
- NO HEAT RECOVERY IS CONSIDERED

- DESIGN A 200 kW CHILLER USED FOR AIR CONDITIONING PURPOSES

- JUNE 2020 - AVAILABLE OPTIONS:

- HFCs / HFOs - R513A

- AMMONIA - R717 - NH₃

- PROPANE - R290 - C₃H₈

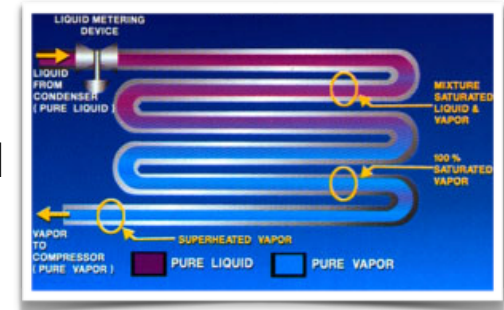
- CARBON DIOXIDE - CO₂ - R744

- EVAPORATORS OVERFEED IS VIABLE

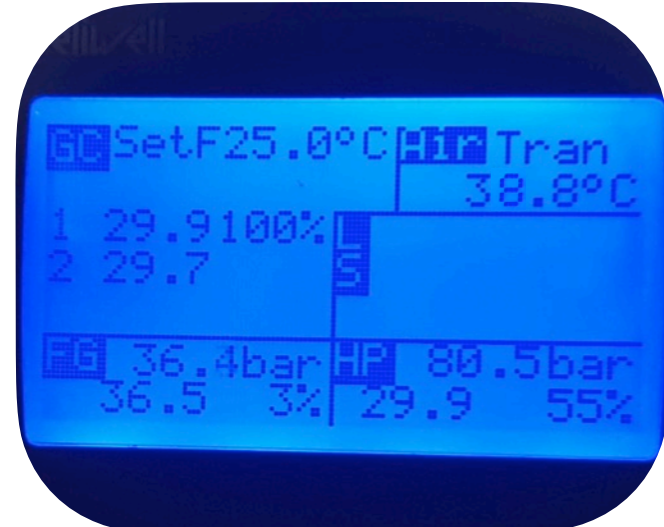
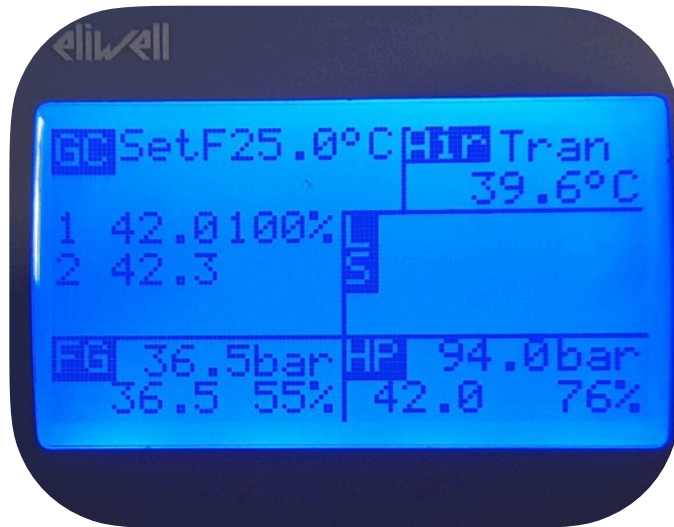
CALL FOR DX EVAPS:

- CHARGE LIMITATION

- OIL MANAGEMENT

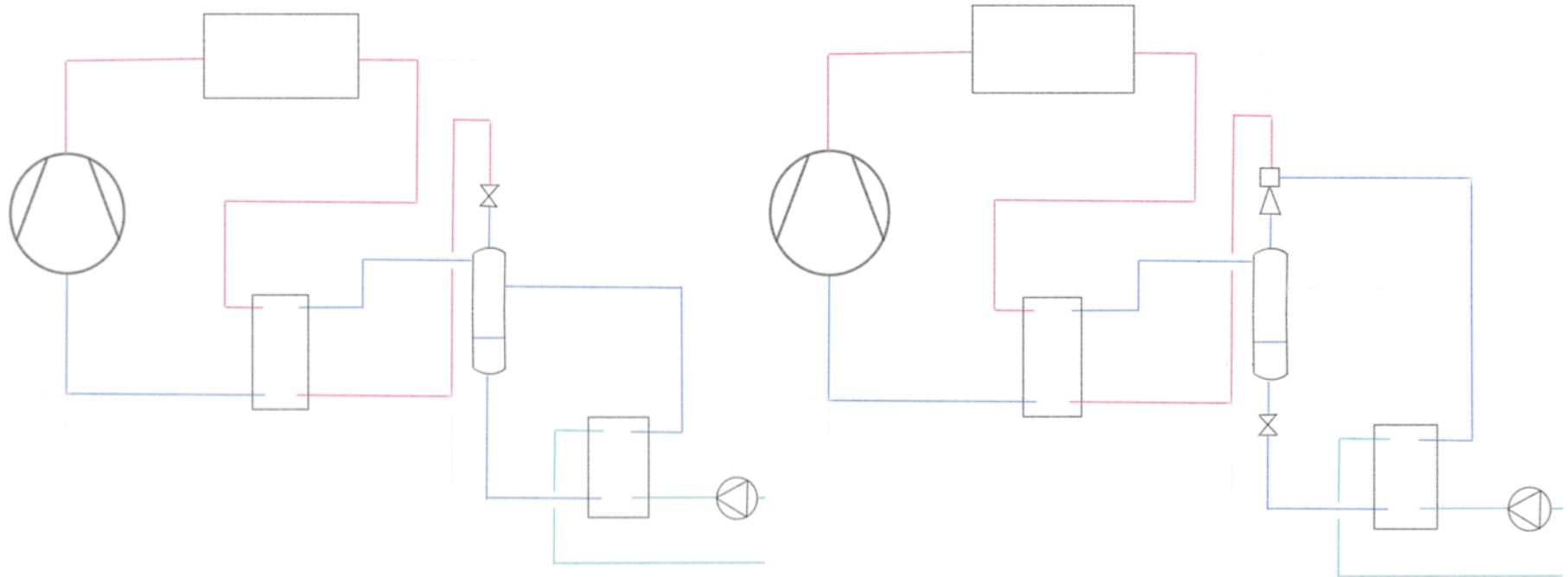


- WET HEAT REJECTION AT CONDENSER / GAS COOLER
 - POSSIBLE FOR ALL THE AFOREMENTIONED TECHNOLOGIES
 - EXAMPLE: CSF SUPERMARKET - BEIJING - CO₂ TRANSCRITICAL



- CO₂ SYSTEMS

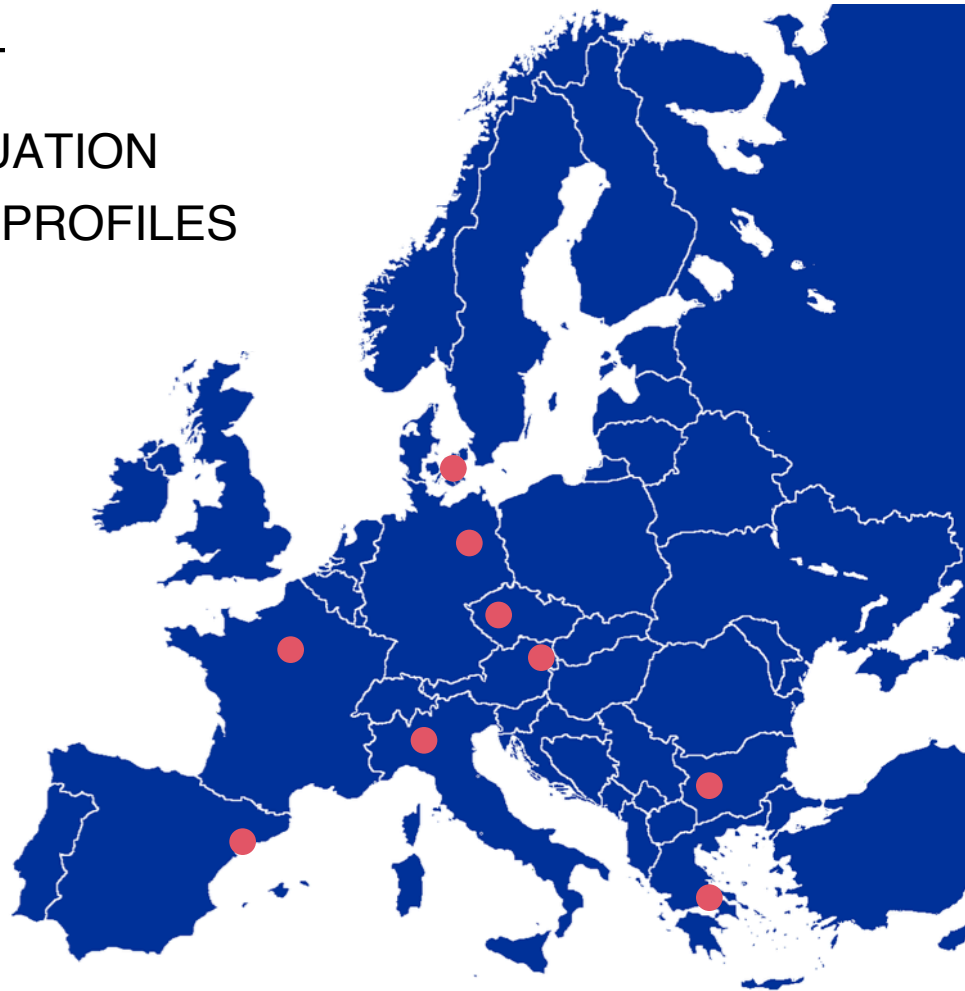
- EVAPORATOR GRAVITY OVERFEEDING, EJECTOR AS AN OPTION



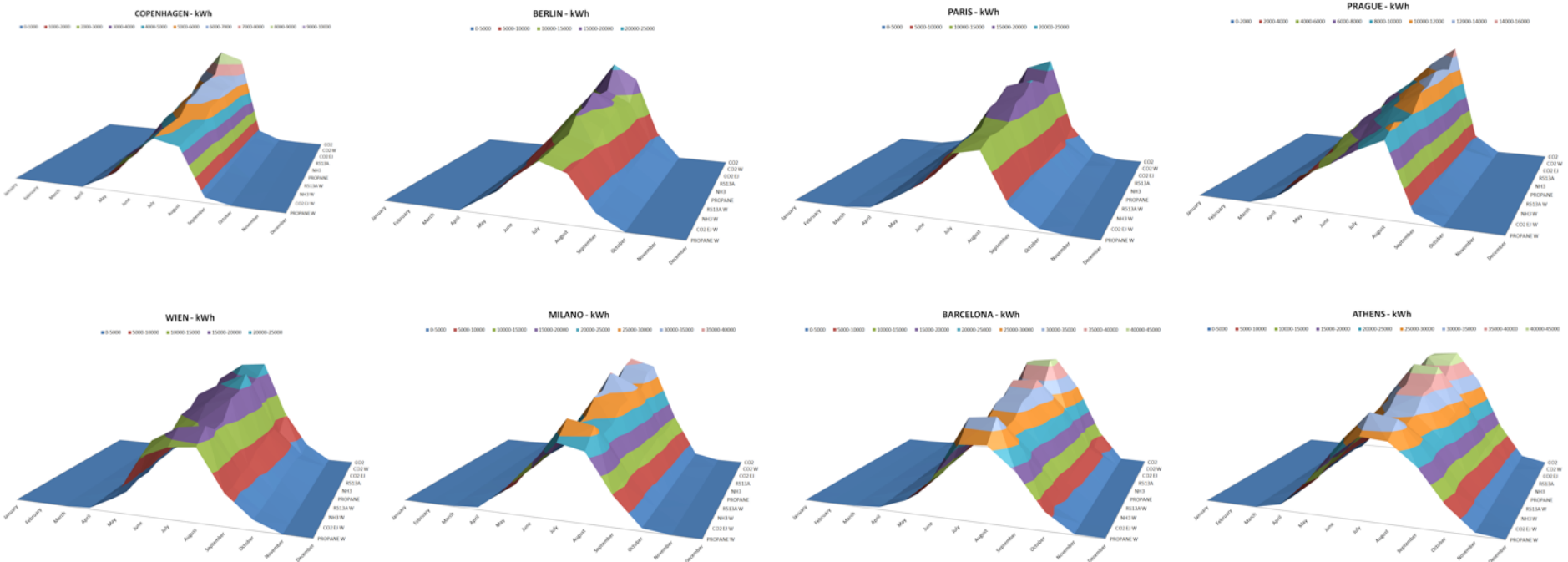


- SYSTEMS PERFORMANCE EVALUATION
VARIOUS EUROPEAN CLIMATE PROFILES

- COPENHAGEN
- PRAGUE
- BERLIN
- PARIS
- WIEN
- SOFIA
- MILANO
- BARCELONA
- ATHENS

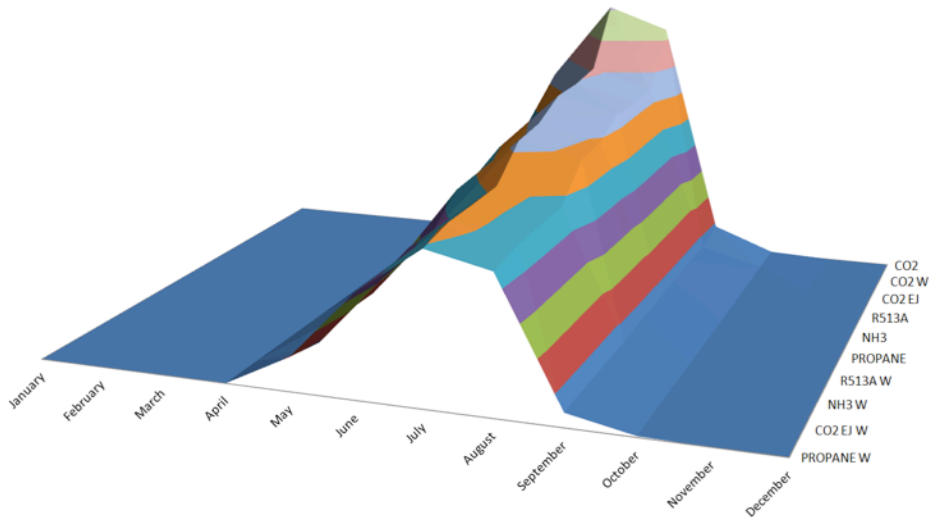


• PERFORMANCE EVALUATION: CHILLER ENGAGED ABOVE 20°C AMBIENT

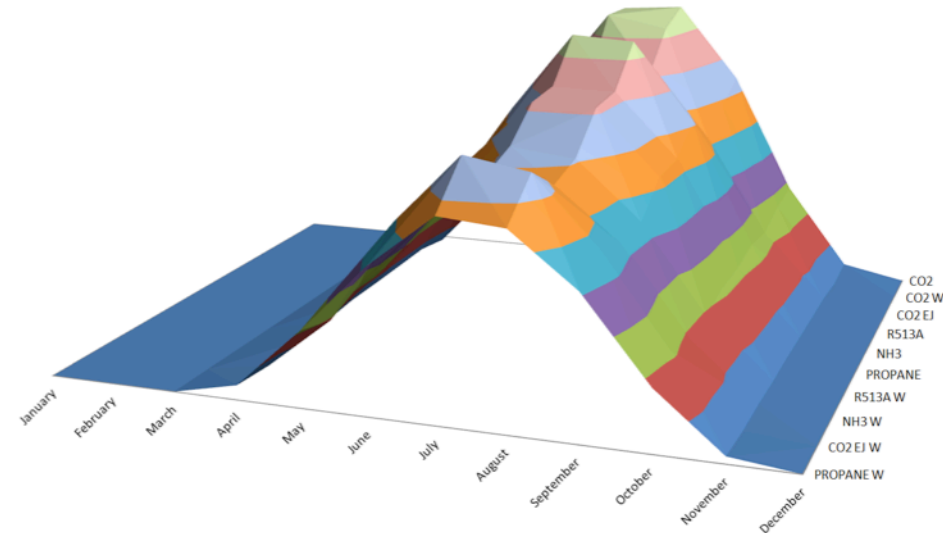


- PERFORMANCE EVALUATION: CHILLER ENGAGED ABOVE 20°C AMBIENT
- MONTHLY ENERGY CONSUMPTION

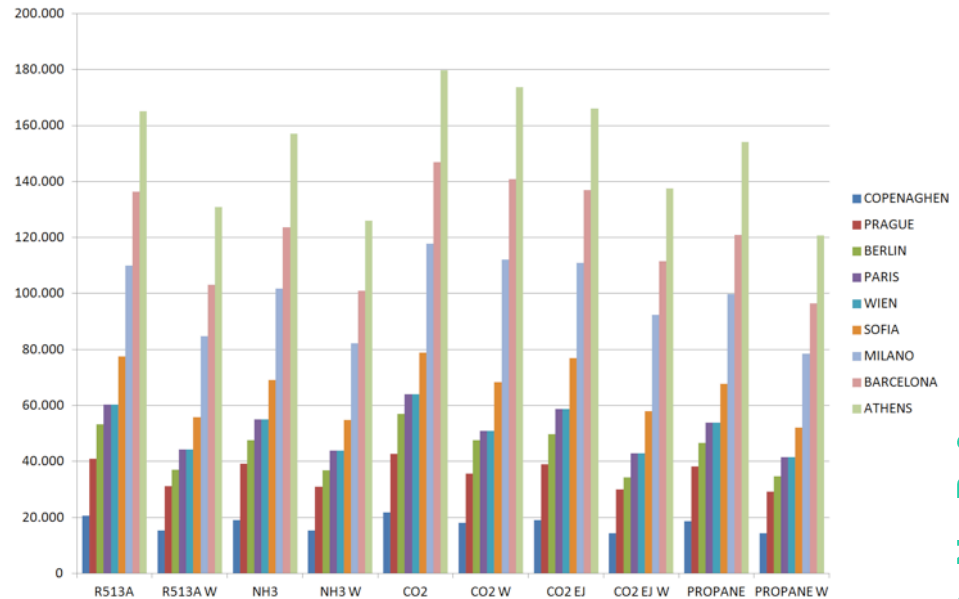
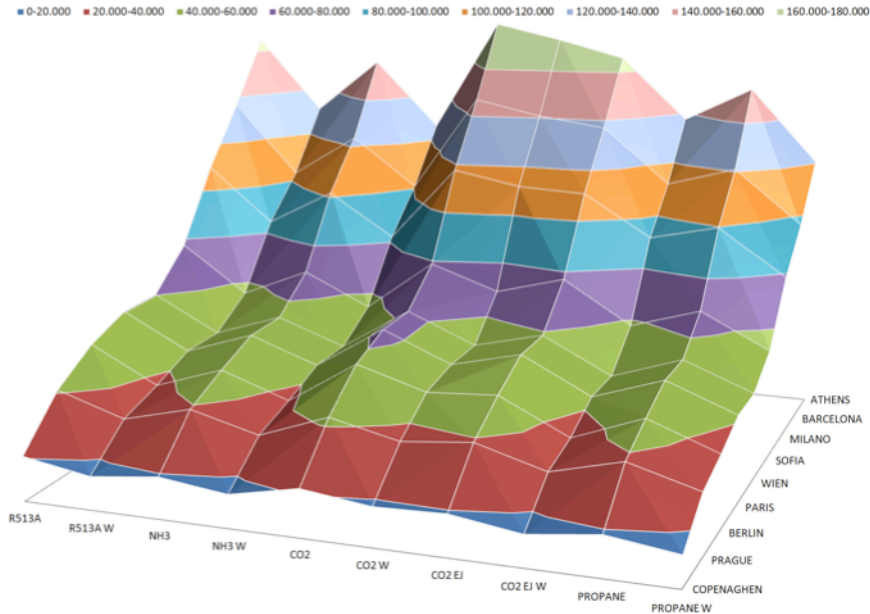
COPENHAGEN - kWh



ATHENS - kWh



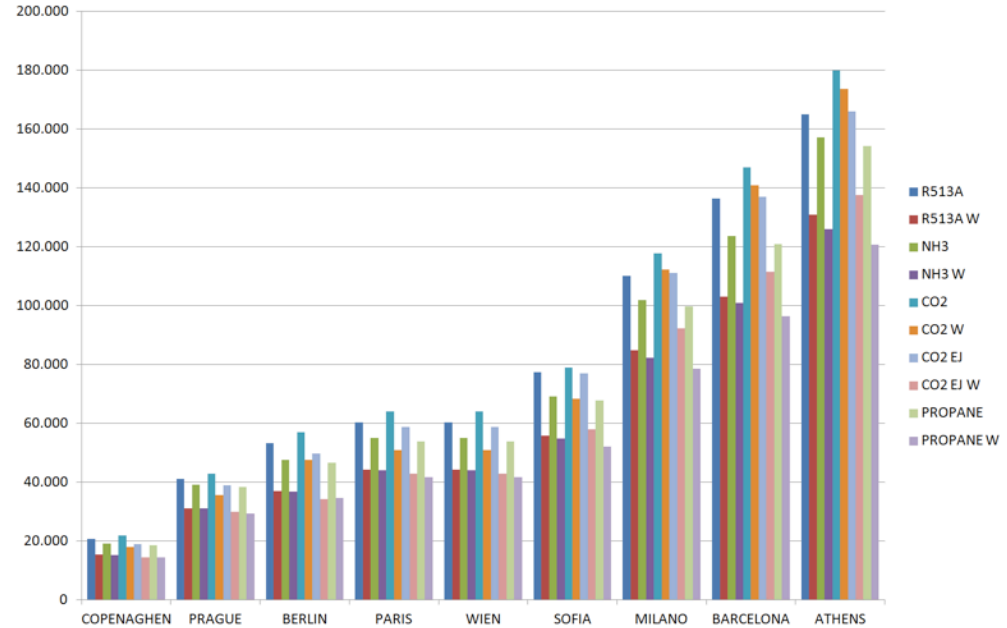
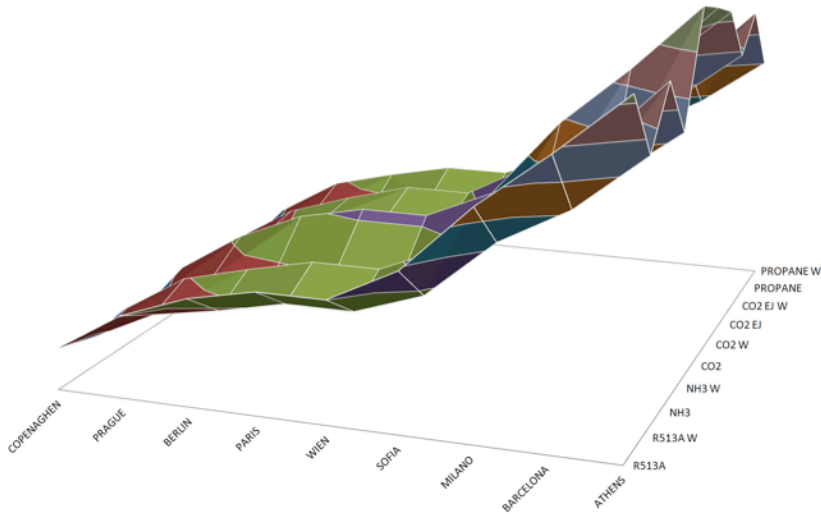
- PERFORMANCE EVALUATION: CHILLER ENGAGED ABOVE 20°C AMBIENT
- TOTAL ENERGY CONSUMPTION





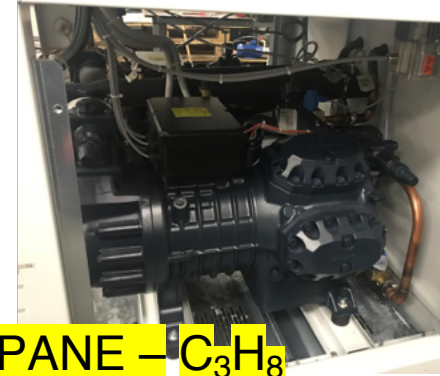
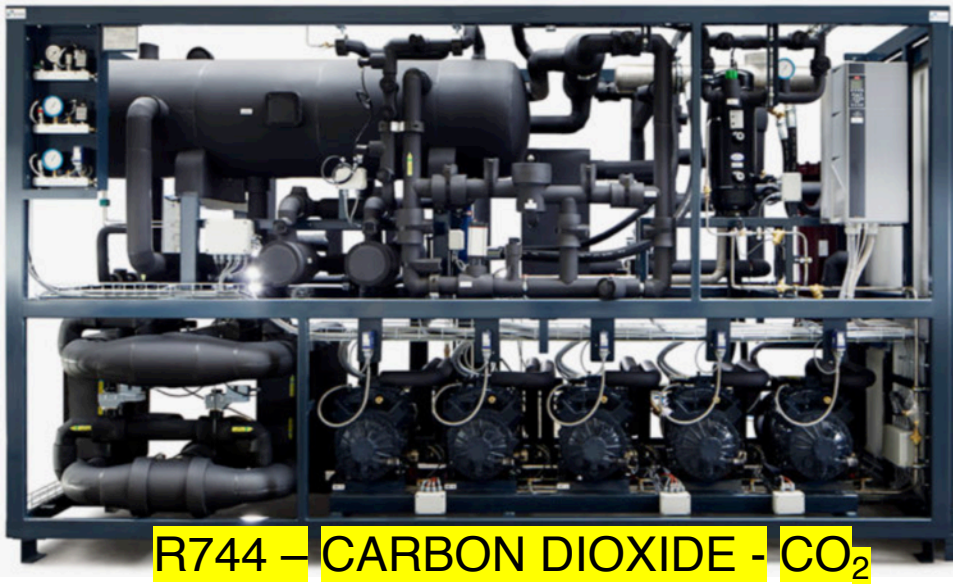
- PERFORMANCE EVALUATION: CHILLER ENGAGED ABOVE 20°C AMBIENT
- TOTAL ENERGY CONSUMPTION

0-20.000 20.000-40.000 40.000-60.000 60.000-80.000 80.000-100.000 100.000-120.000 120.000-140.000 140.000-160.000 160.000-180.000





CHILLERS WITH NATURAL REFRIGERANTS AVAILABLE TODAY





DANISH
TECHNOLOGICAL
INSTITUTE

- NATURAL REFRIGERANTS
 - ARE AVAILABLE FOR CHILLER APPLICATIONS
 - ARE AT LEAST AS EFFICIENT AS HFCs / HFOs FOR CHILLER APPLICATIONS
 - IN ALL EUROPEAN CLIMATE ZONES
- CO₂:
 - NEGLECTED REFRIGERANT FOR CHILLER APPLICATIONS IN LAST DECADES
 - NEW TECHNOLOGIES MAKES IT EFFICIENT ALSO IN WARM CLIMATES
 - GREAT POTENTIAL IN COMBINED COOLING AND HEATING REQUIREMENTS



DANISH
TECHNOLOGICAL
INSTITUTE

Thank you
for listening!

