

THE USE OF EJECTORS IN CO₂ TECHNOLOGY: HOW TO BOOST EFFICIENCY IN WARM CLIMATES A REAL EXAMPLE FROM ITALY



ATMO
sphere

Business Case for
Natural Refrigerants

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GIACOMO PISANO



CONTENTS

1. INTRODUCTION

2. CO₂ SYSTEMS: ENHANCEMENTS TO BOOST ENERGY EFFICIENCY

3. CARREFOUR SHOP IN TORINO AREA - ITALY

4. CONCLUSIONS

1. INTRODUCTION



Can we phase-out the use of F-gases in commercial refrigeration systems?



IN ITALY - AS WELL

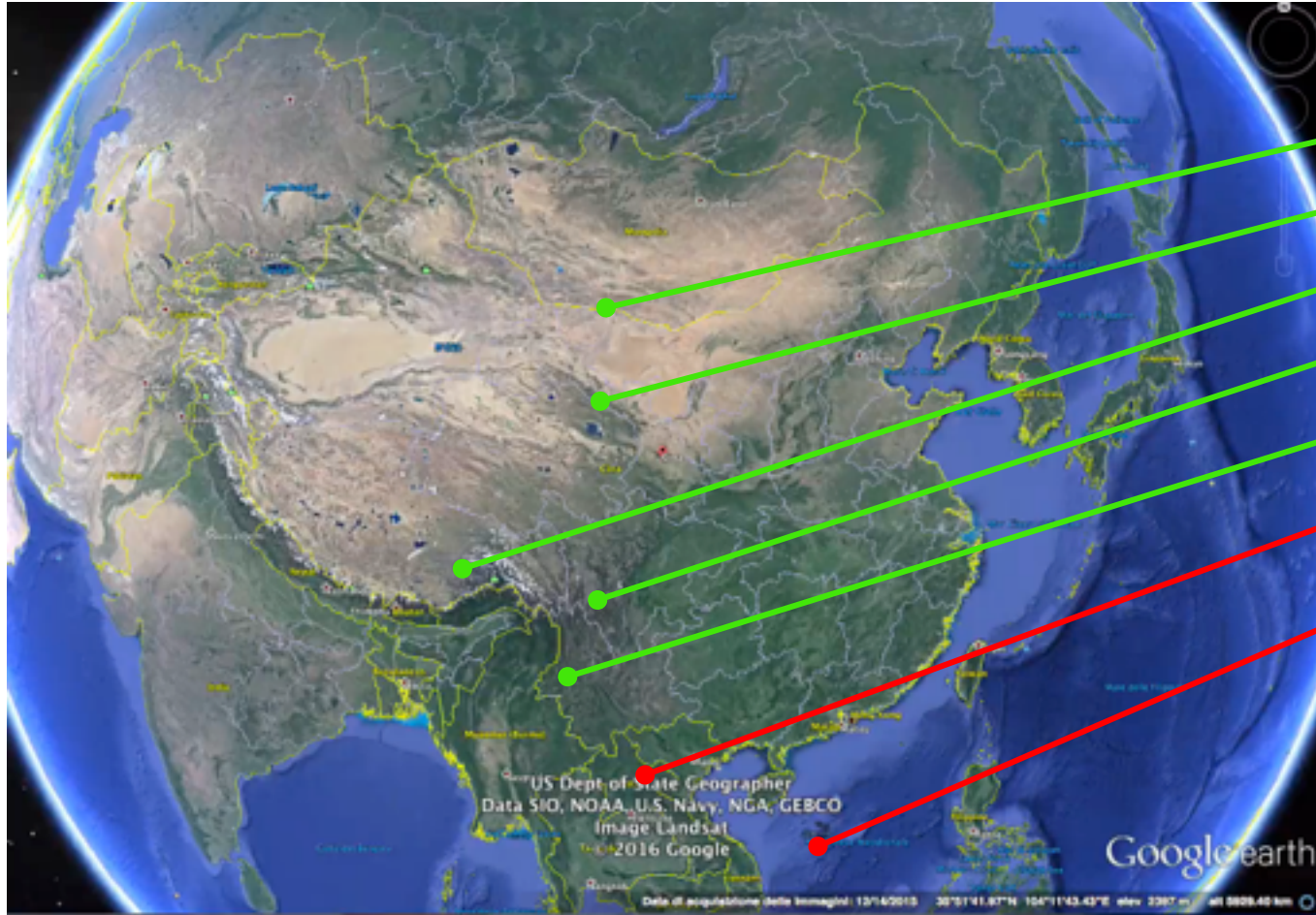


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2. CO₂ SYSTEMS: ENHANCEMENTS TO BOOST ENERGY EFFICIENCY

■ BOOSTER CONFIGURATION: ENERGY EFFICIENCY COMPARISON

RETAIL: 150 kW MT - 30 kW LT - CO₂ BOOSTER vs R404A DX



- 19.000 € / YEAR
- 12.000 € / YEAR
- 7.000 € / YEAR
- 10.000 € / YEAR
- 1.000 € / YEAR
- + 8.000 € / YEAR
- + 11.000 € / YEAR

2. CO₂ SYSTEMS: ENHANCEMENTS TO BOOST ENERGY EFFICIENCY

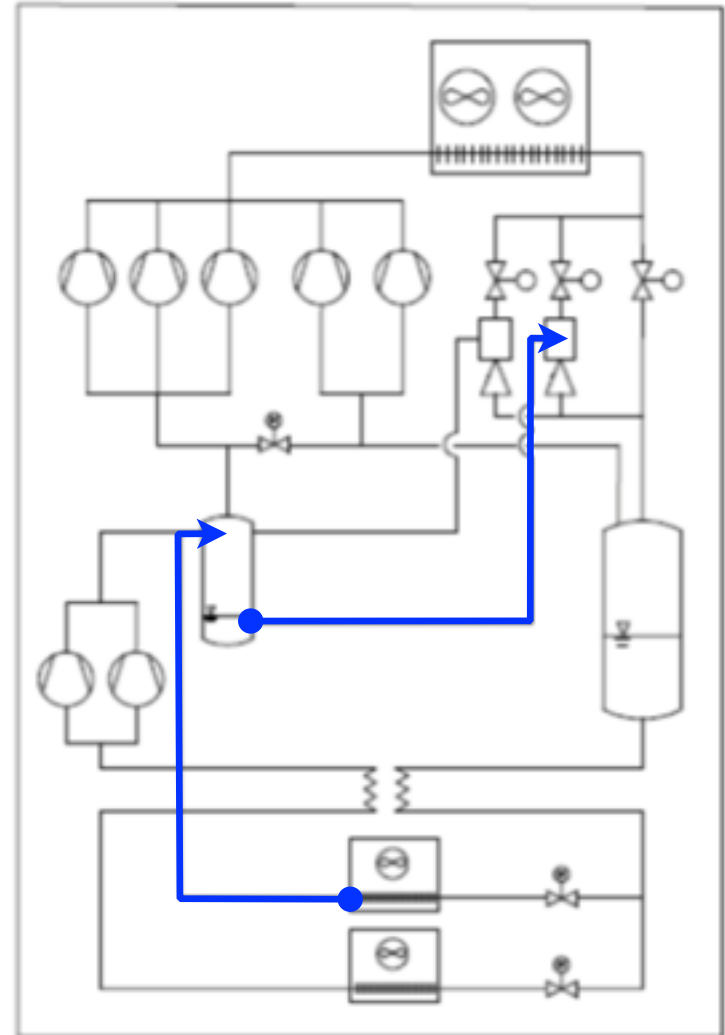
■ ENHANCED BOOSTER SYSTEMS: OVERFEEDING EJECTOR

✓ ALLOWS "OVERFED" OR "FLOODED" EVAPORATOR DESIGN

✓ SUCKS EVENTUAL LIQUID IN EXCESS COMING FROM THE EVAPORATORS

✓ EVAP TEMPS / PRESSURES UP TO 6K

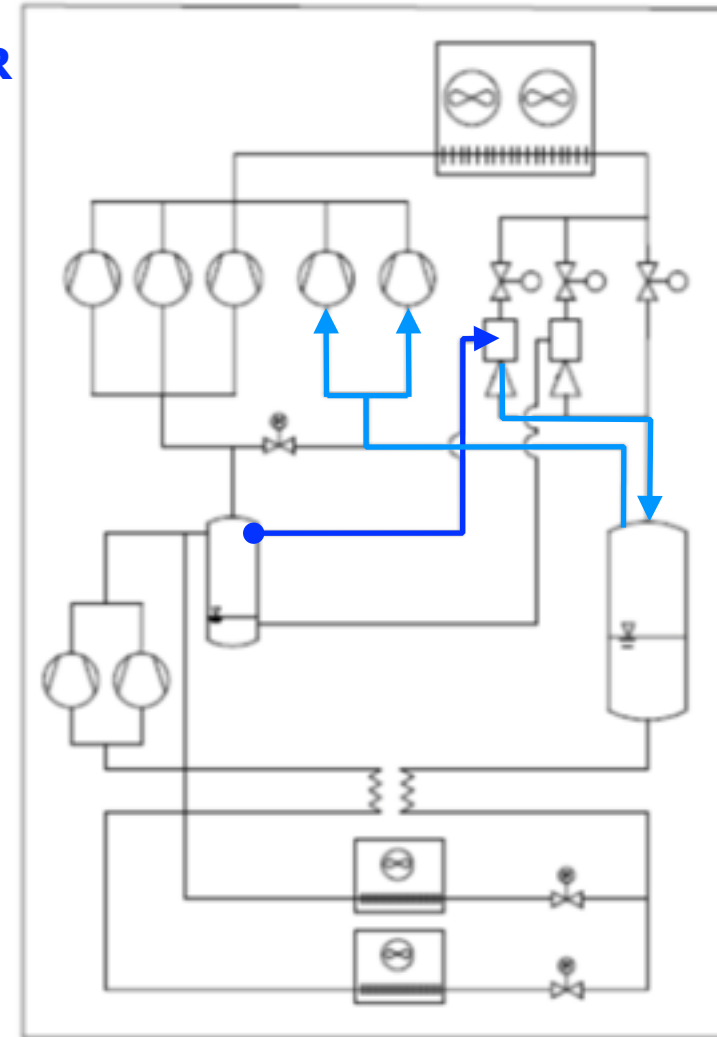
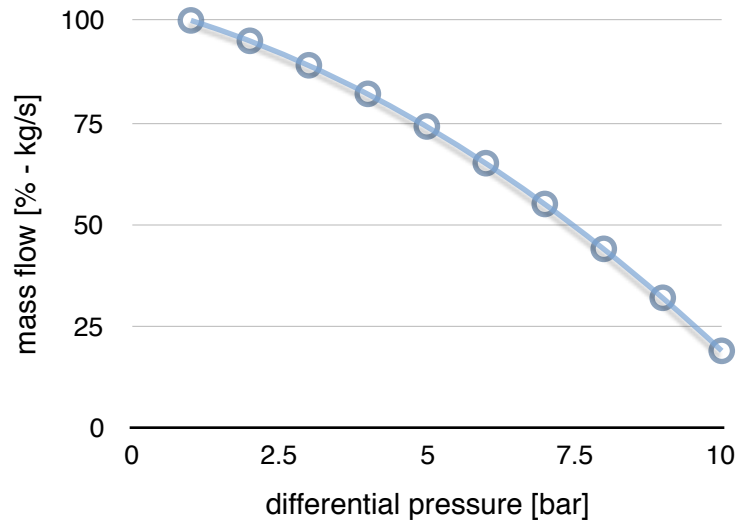
✓ EXTREME COP INCREASE



2. CO₂ SYSTEMS: ENHANCEMENTS TO BOOST ENERGY EFFICIENCY

■ ENHANCED BOOSTER SYSTEMS: PRE-COMPRESSION EJECTOR

- ✓ FREE COMPRESSION BETWEEN LPR AND MPR
- ✓ LARGE INCREASE IN FLASH GAS QUANTITY
- ✓ LARGER PARALLEL COMPRESSORS ARE NEEDED
- ✓ WORKS MOST EFFICIENTLY ONLY IF IN CONJUNCTION WITH LIQUID EJECTORS



2. CO₂ SYSTEMS: ENHANCEMENTS TO BOOST ENERGY EFFICIENCY

■ BOOSTER CONFIGURATION: ENERGY EFFICIENCY COMPARISON

RETAIL: **CO₂ ENHANCED BOOSTER** vs CO₂ LT CASCADED WITH R134a



3. CARREFOUR SHOP IN TORINO AREA - ITALY



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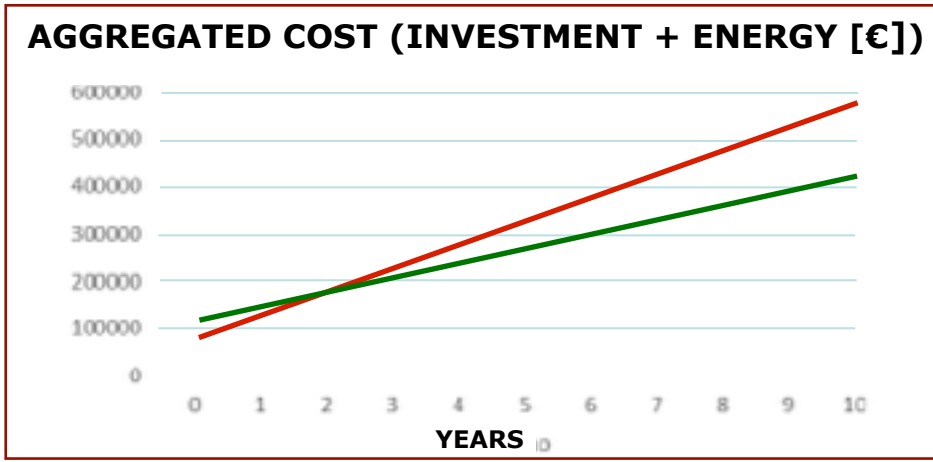
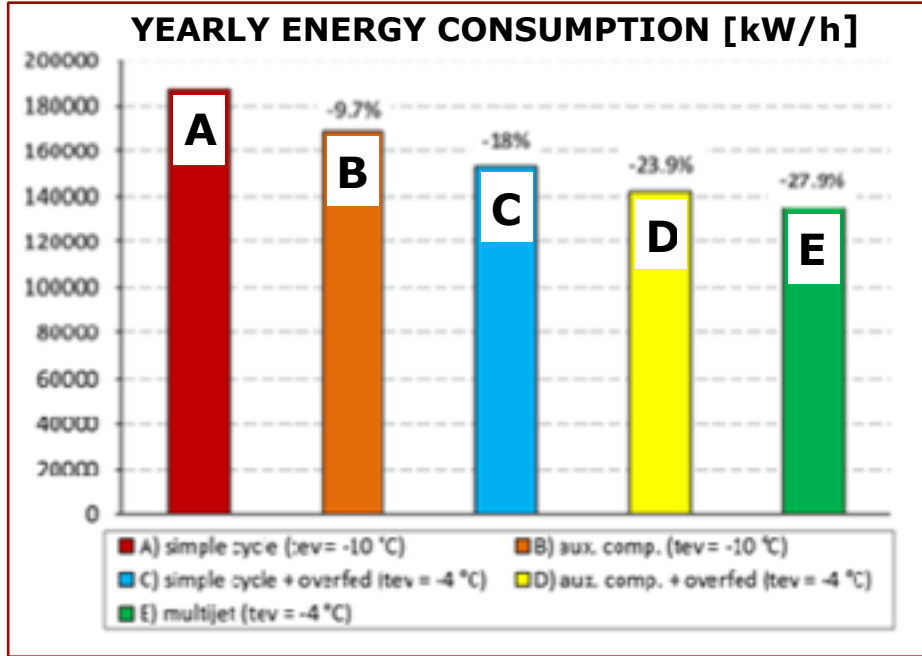
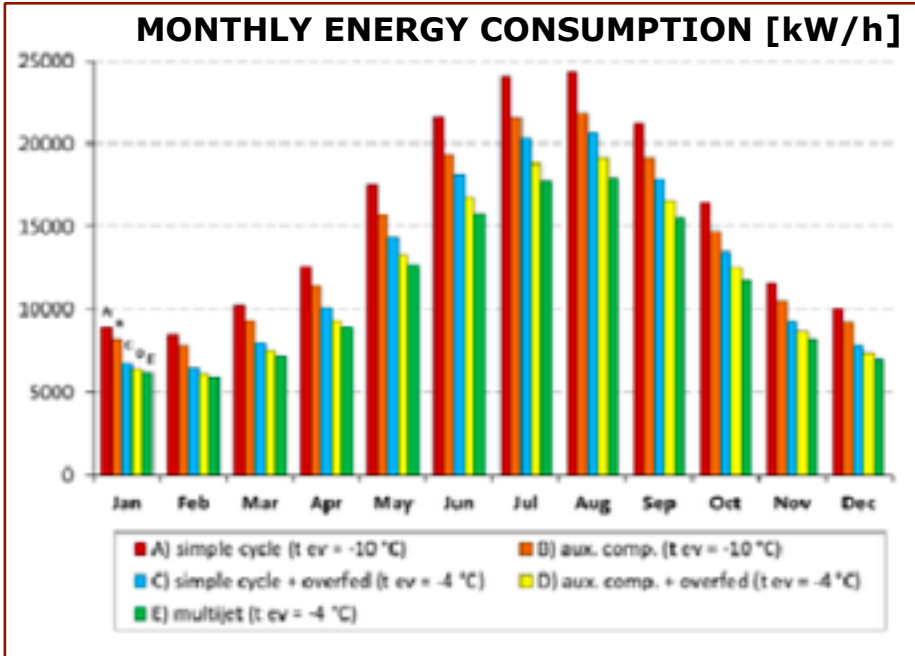


3. CARREFOUR SHOP IN TORINO AREA - ITALY

- ✓ DUTIES: MT 340 kW (1.160 kbtu/h) - LT 66 kW (225 kbtu/h)
- ✓ HEAT RECOVERY FOR AMBIENT HEATING AND SANITARY HOT WATER
- ✓ MAX AMBIENT TEMPERATURE: 45°C (113°F)
- ✓ 160 EVAPORATORS
- ✓ COMPRESSORS SUPPLIER: DORIN
- ✓ RACK BUILDER: ENEX
- ✓ CONTRACTOR: REF SYSTEMS
- ✓ END USER: CARREFOUR



3. CARREFOUR SHOP IN TORINO AREA - ITALY



**A vs E :
2 YEARS R.O.I.**

4. CONCLUSIONS

"CO₂ IS AS CLOSE TO THE IDEAL REFRIGERANT AS IT IS POSSIBLE TO COME"



1993 - prof. GUSTAV LORENTZEN



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