MYCOM

kgh kongres

# 44th HVAC&R CONGRES AND EXHIBITION : INTEGRATED DESIGN AND HEALTHY ZERO $CO_2$ EMISSION BUILDINGS

**4 – 6 . XII 2013 . Beograd, Srbija**

Presented by Jan Boone, MAYEKAWA

DOC.2013-573 R.4

MAYEKAWA Europe nv/sa

# NATURAL REFRIGERANTS

*High pressure compressors in Industrial plants*

*Presentation by : Jan Boone*
*Authors : Daniel Dick & Jan Boone*

# MYCOM Compressor and Development

1924: Piston Compressor

1964: Screw Compressor

1978: 4°K Super Low temp. Particle Accelerator (Helium)

1981: Nuclear Fusion (Helium)

1984: Mag-Levi Train (Helium)

1989: Rocket Fuel (Hydrogen)

1993: Super GE (Superconduct-EL-Generator)

1958: Multi-Cylinder Piston Compressor

Ethylene Plant


LNG/LPG Tanker

Organic (EOEG)

Inorganic: (NH3)

Pharma Plant

1924 | 1960 | 1970 | 1980 | 1985 | 1990

● More than 100.000 Screw and Piston Compressors have been installed over 100 countries.

# MYCOM Compressor and Development

1924: Piston Compressor

1964: Screw Compressor

1978: 4°K Super Low temp. Particle Accelerator (Heli

1981: (Helium)

1984: Mag-Levi Train (elium)

Rocke el (Hydro )

1993: Super GE (Superconduct-EL-Generator)

90 YEARS

1958: Multi-Cylinder Piston Compressor

Ethylene Plant

LNG/LPG Tanker

Organic (EOEG)

Inorganic: (NH3)

Pharma Plant

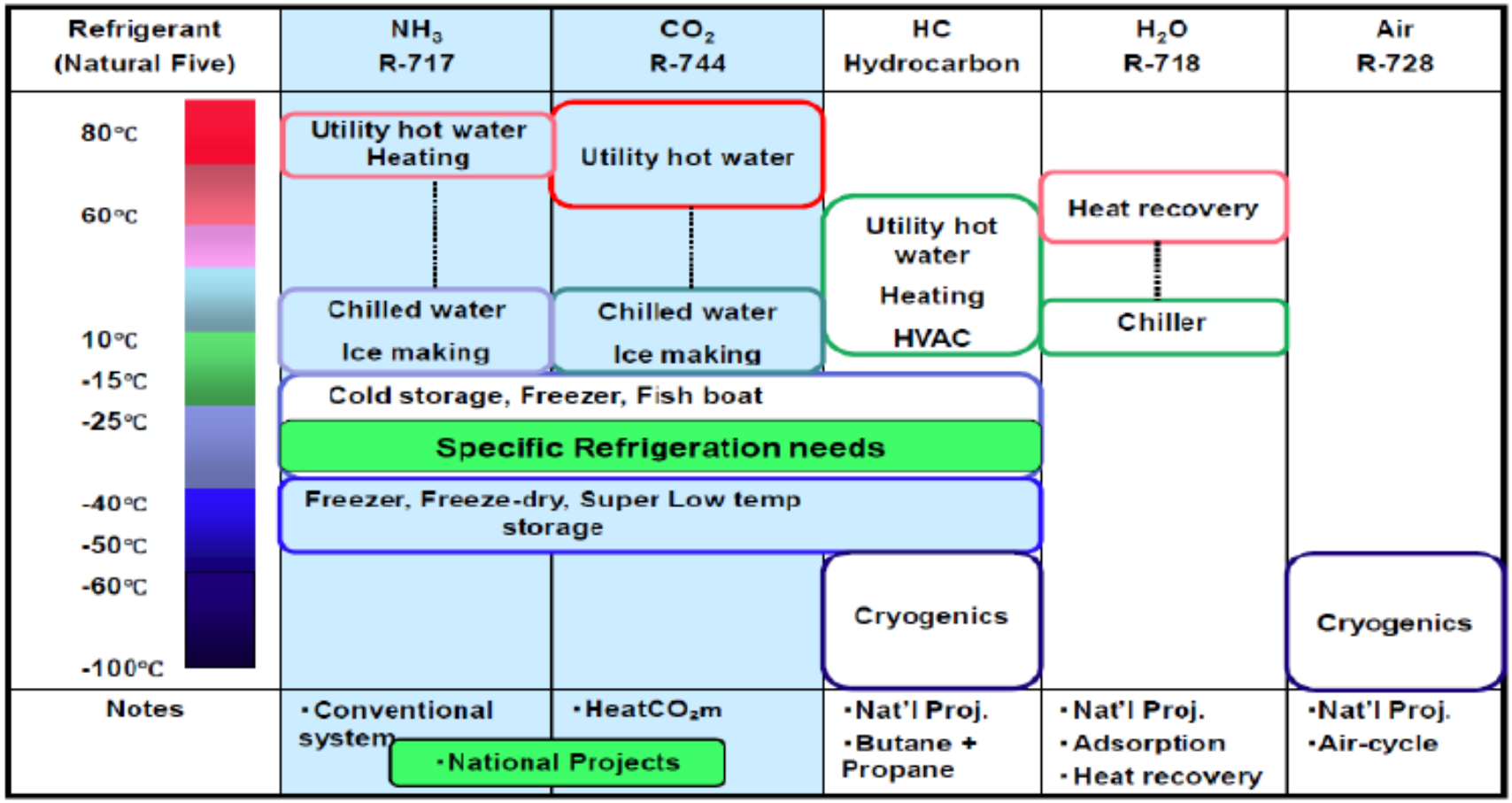
1924 | 1960 | 1970 | 1980 | 1985 | 1990

● More than 100.000 Screw and Piston Compressors have been installed over 100 countries.

# NATURAL REFRIGERANTS

*High pressure compressors in Industrial plants,*

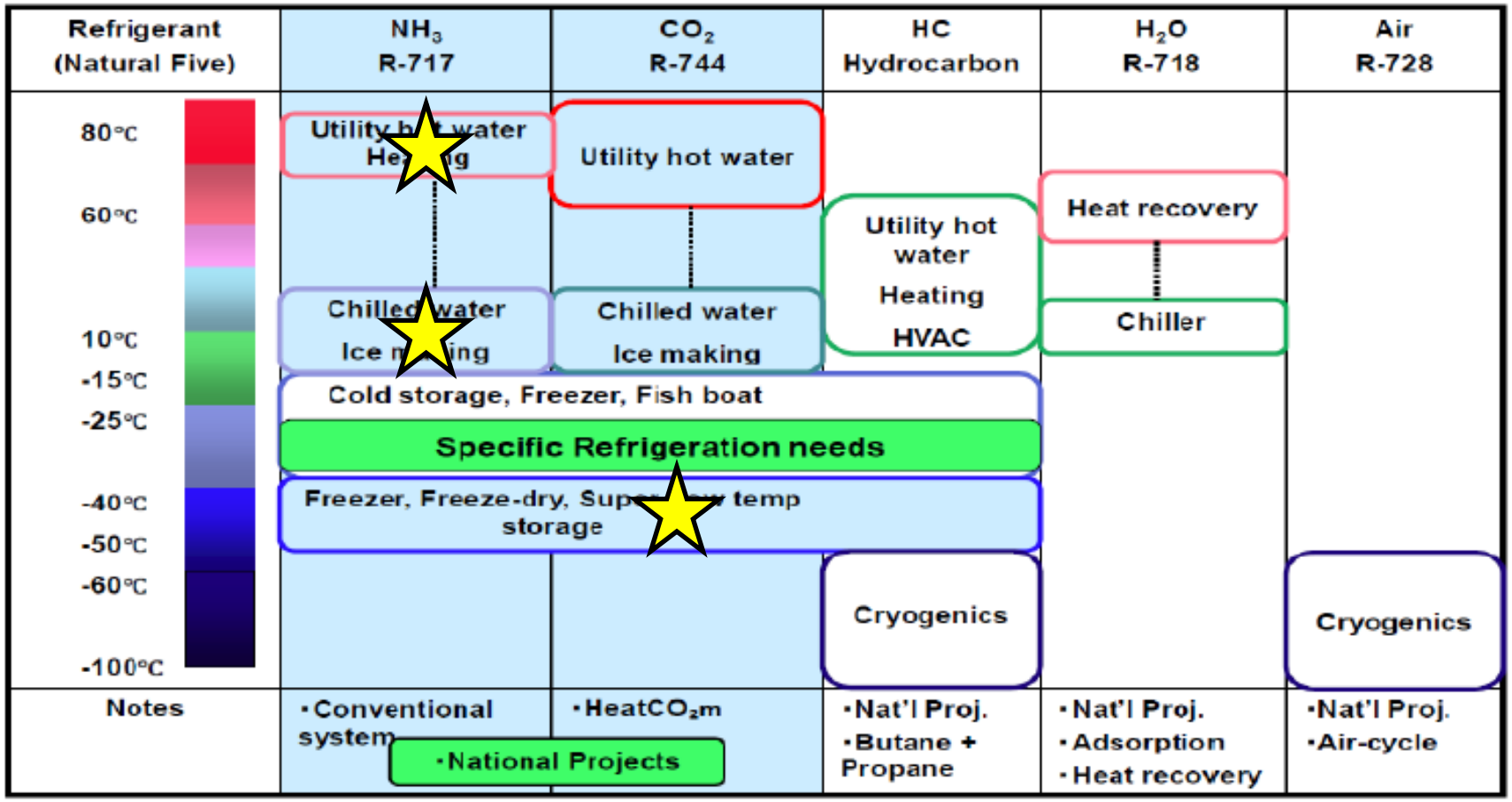
## "Natural Five" Refrigerants and Product Solutions



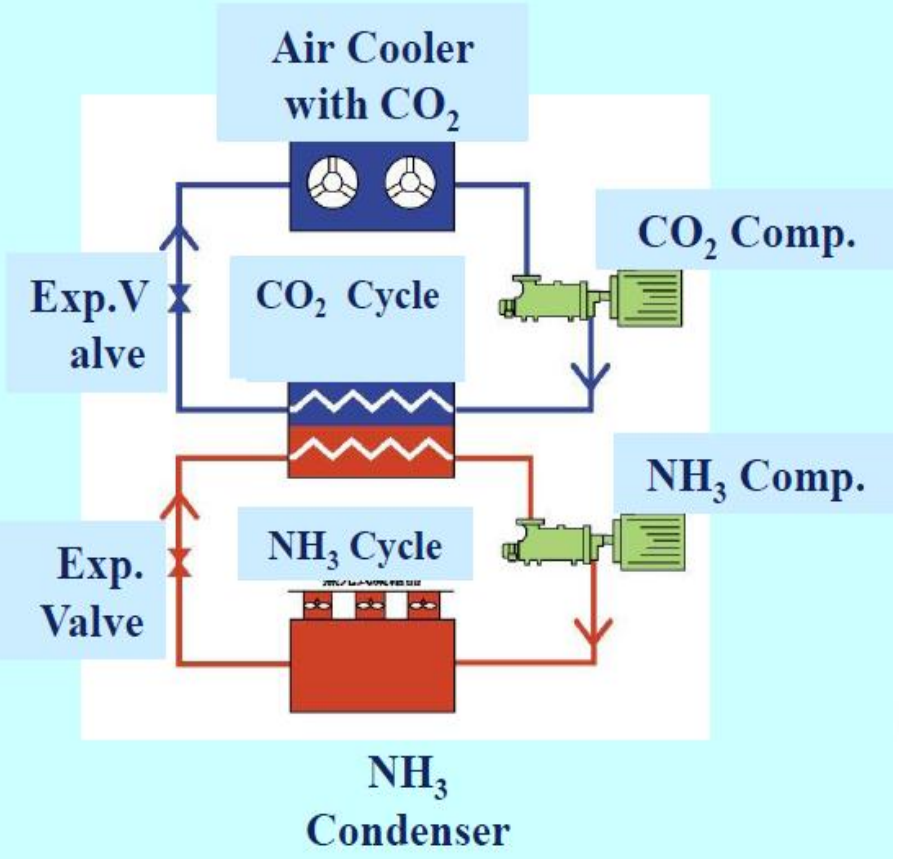
# NATURAL REFRIGERANTS

*High pressure compressors in Industrial plants,*

## "Natural Five" Refrigerants and Product Solutions



# CO2/NH3 CASCADE COMPRESSION REFRIGERATION

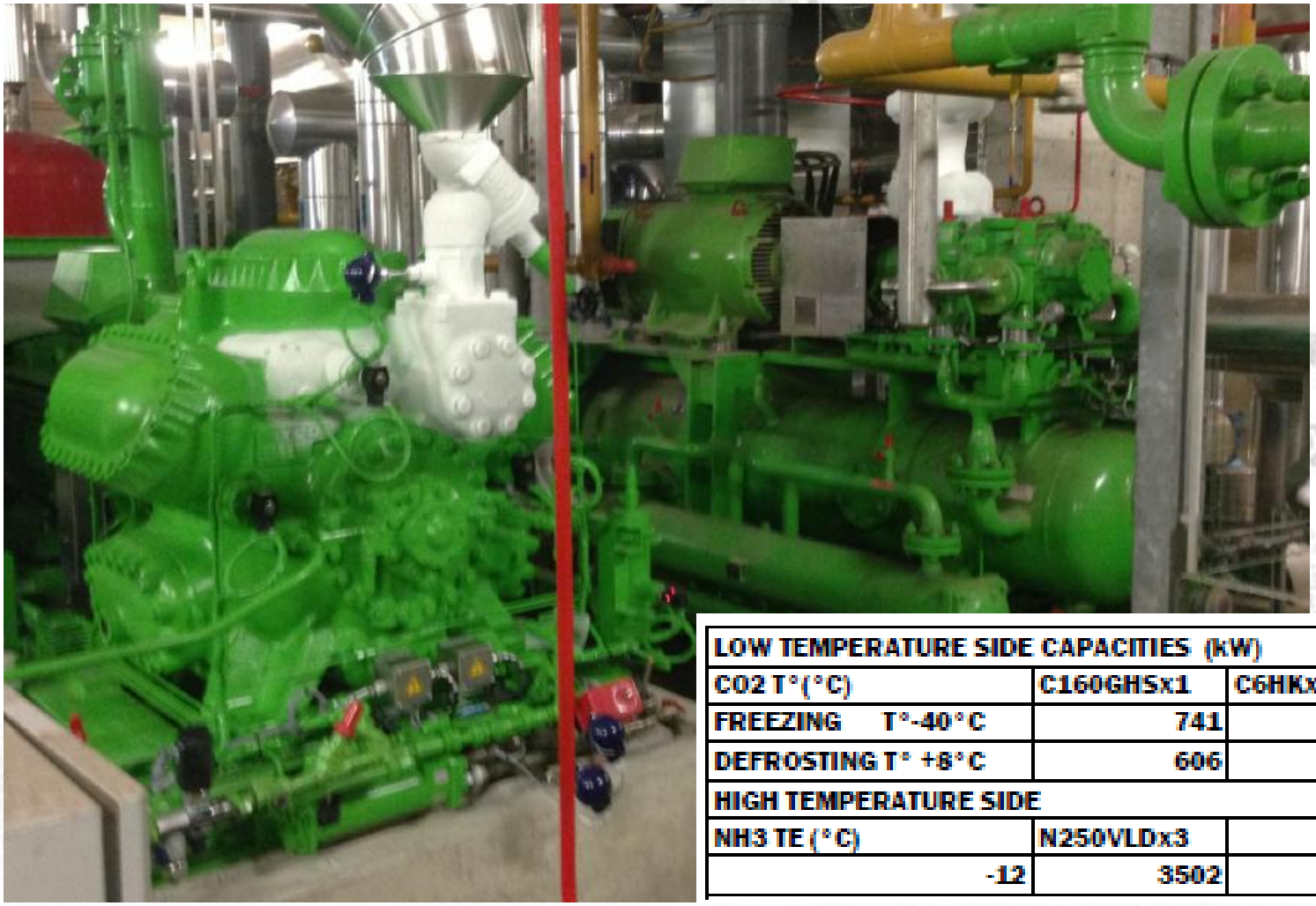


# FIELD CASE

# INTRODUCTION

| | |
|---|---|
| STARTING POINT<br>3 Mw -35°C | freezing plant for bakery products requiring -35°C product temperatures<br>for nominal 3000 kW to be realised in 2 phases<br>contractor : Cofely Axima refrigeration France |
| CHOICE<br>CO2 -40°C<br>N5<br>direct<br>charge<br>compressors | CO2/NH3 cascade system<br>CO2 at -40°C (9,8 bara) to obtain production t° -35°C<br>CO2 as natural refrigerant<br>CO2 for direct cooling on the freezers applied in a cascade system<br>with limited NH3 qty as natural refrigerant only used for the high t° side<br>high pressure compressors suitable for hot gas defrosting operation<br>design pressures up to 50bar, resp. 66bar in f(compressor model)<br>defrosting at +8°C (42,8 bara) |
| TIME FRAME | new plant :<br>phase 1 : 2011 followed by 2: 2013 |

# EQUIPMENT



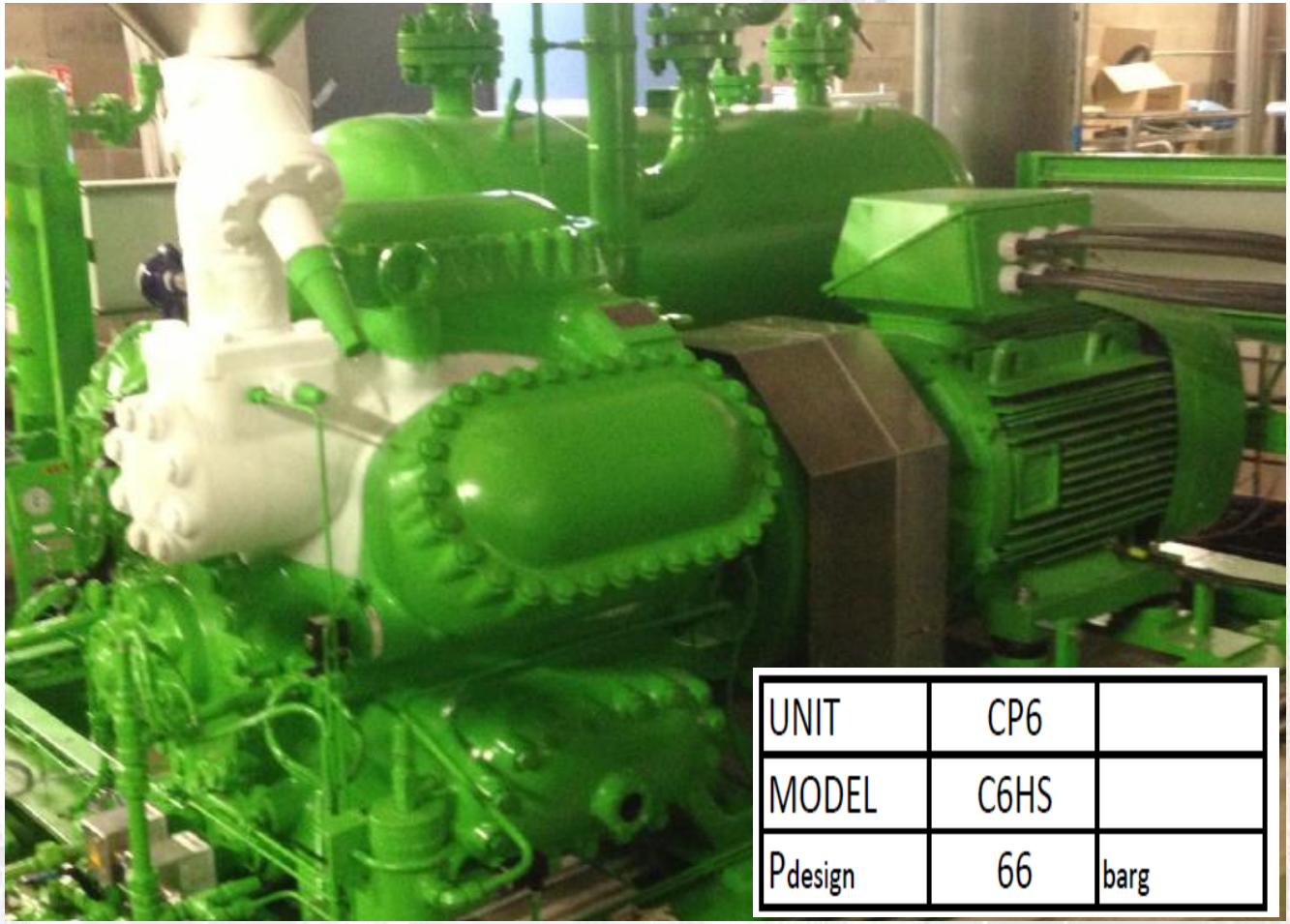
| LOW TEMPERATURE SIDE CAPACITIES (kW) | | | |
|---|---|---|---|
| CO2 T°(°C) | C160GHSx1 | C6HKx5 | C6HSx1 |
| FREEZING T°-40°C | 741 | 1495 | 940 |
| DEFROSTING T° +8°C | 606 | 870 | |
| HIGH TEMPERATURE SIDE | | | |
| NH3 TE (°C) | N250VLDx3 | | |
| -12 | 3502 | | |

# NATURAL REFRIGERANTS

*High pressure compressors in Industrial plants,*


| | | |
|---|---|---|
| UNIT | CP1/2/3/4/5 | |
| MODEL | C6HK | |
| Pdesign | 56 | barg |

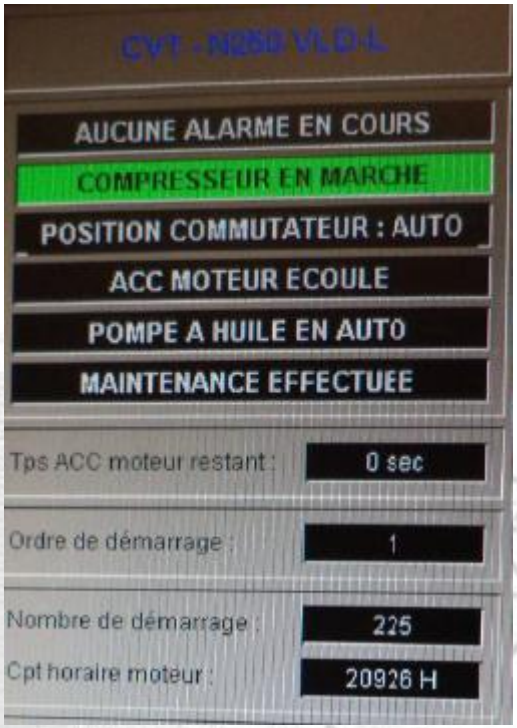
# EQUIPMENT



| | | |
|---|---|---|
| UNIT | CP6 | |
| MODEL | C6HS | |
| Pdesign | 66 | barg |

# NATURAL REFRIGERANTS

*High pressure compressors in Industrial plants,*


| | | |
|---|---|---|
| UNIT | CV1/2/3 | |
| MODEL | N250VLD | |
| $P_{design}$ | 26 | barg |

# NATURAL REFRIGERANTS

*High pressure compressors in Industrial plants,*


| | | |
|---|---|---|
| UNIT | CV5 | |
| MODEL | C160GHS | |
| Pdesign | 60 | barg |

# EFFICIENCY ANALYSIS

## DESIGN

| CO2/NH3 CASCADE | | RT | BKW | THR | COPc-each | COPc-total |
|---|---|---|---|---|---|---|
| TE=-40°C | TC=+35°C | kW | kW | kW | | |
| CO2 LS | C160GHS | 741 | 200 | 941 | 3,7 | |
| | C6HK | 1196 | 289 | 1485 | 4,1 | |
| | C6HS | 940 | 212 | 1152 | 4,4 | |
| | total | 2877 | 701 | 3578 | 4,1 | |
| NH3 HS | N250VLDx2 | 3502 | 1006 | | 3,5 | |
| | N250VLD | | | | | |
| TOTAL | | 2877 | 1707 | | | 1,68 |

## AVERAGE

| CO2/NH3 CASCADE | | RT | BKW | THR | COPc-each | COPc-total | |
|---|---|---|---|---|---|---|---|
| TE=-40°C | TC=+29,5°C | kW | kW | kW | | | |
| CO2 LS | C160GHS | 741 | 200 | 941 | 3,7 | | |
| | C6HK | 1196 | 289 | 1485 | 4,1 | | |
| | C6HS | 940 | 212 | 1152 | 4,4 | | |
| | total | 2877 | 701 | 3578 | 4,1 | | |
| NH3 HS | N250VLDx2 | 3575 | 825 | | 4,3 | | 181 kW |
| | N250VLD | | | | | | |
| TOTAL | | 2877 | 1526 | | | 1,88 | 12% |

# EFFICIENCY ANALYSIS

## DESIGN

| CO2/NH3 CASCADE | | RT | BKW | THR | COPc-each | COPc-total |
|---|---|---|---|---|---|---|
| TE=-40°C | TC=+35°C | kW | kW | kW | | |
| CO2 LS | C160GHS | 741 | 200 | 941 | | |
| | C6HK | 1196 | 289 | | | |
| | C6HS | 940 | 212 | | | |
| | total | 2877 | | | 4,1 | |
| NH3 HS | N250VLDx2 | 3502 | | | | |
| | N250VLD | | | | | |
| TOTAL | | | | | | 1,68 |

## AVERAGE

| CO2/NH3 CA | | | BKW | | | COPc-total | |
|---|---|---|---|---|---|---|---|
| TE=-40° | | W | | | | | |
| CO | | | | | 3,7 | | |
| | K | | | 1485 | 4,1 | | |
| | C6HS | | | 1152 | 4,4 | | |
| | total | | 701 | 3578 | 4,1 | | |
| NH3 HS | N250VLL | | 825 | | 4,3 | | 181 kW |
| | N250VLD | | | | | | |
| TOTAL | | 2877 | 1526 | | | 1,88 | 12% |

4800x181=868.800kWh

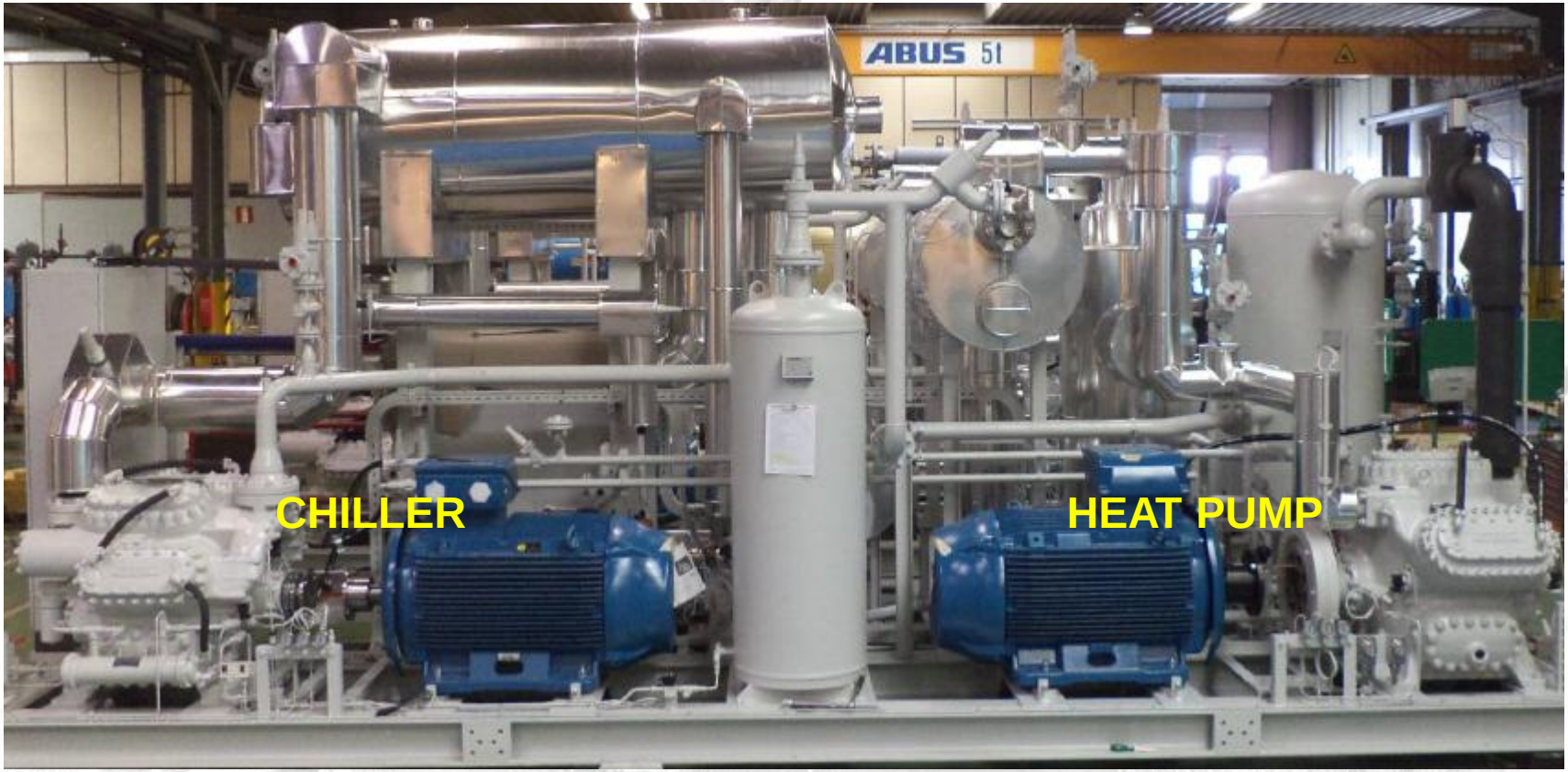
608.160€/yr

# CONCLUSION

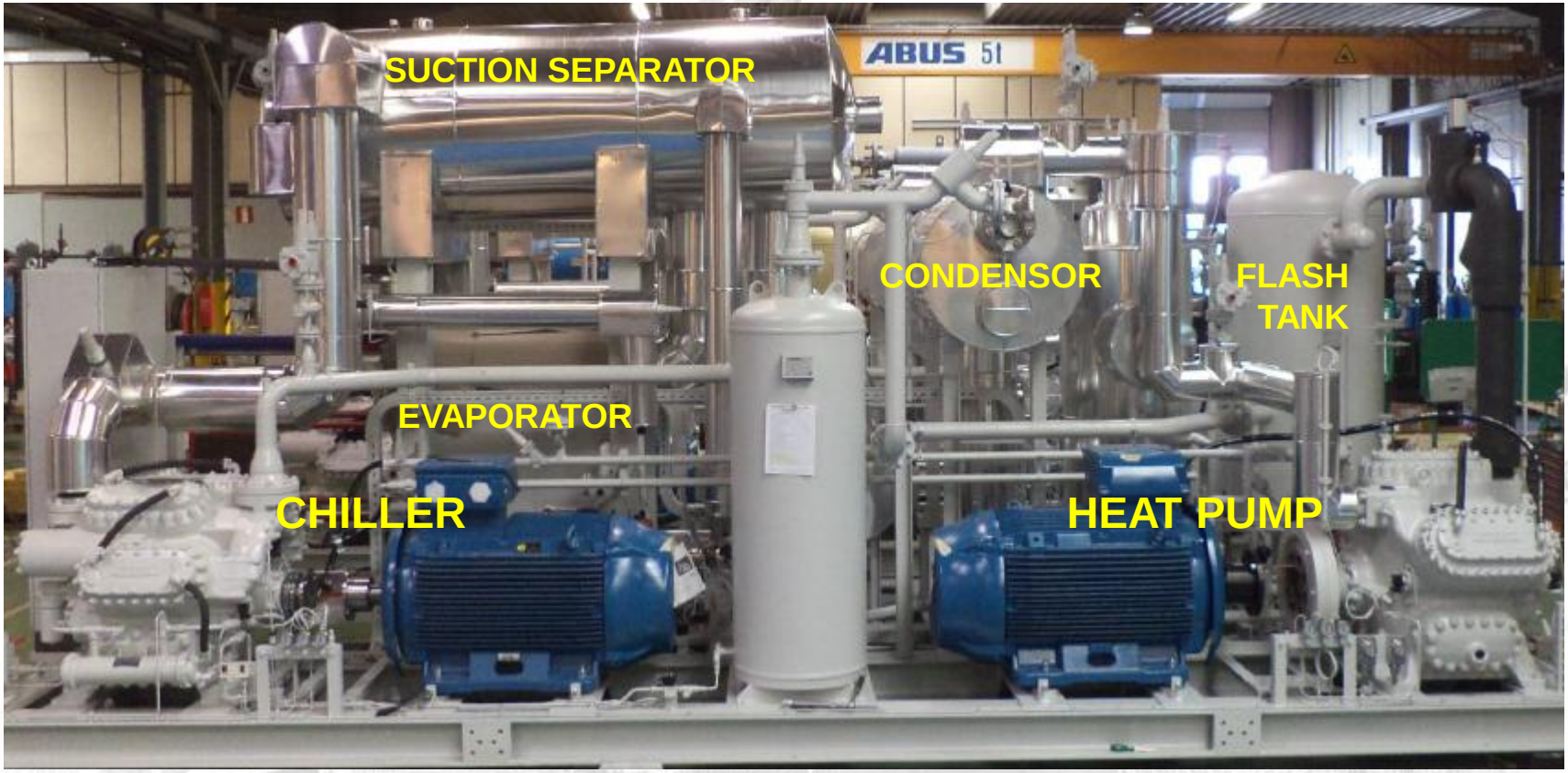
| | | |
|---|---|---|
| 1 | NATURAL REFRIGERANTS are the main trend for refrigeration in food industry | |
| 2 | CO2 | low temperature at usefull pressures (-40°C 10bara)<br>defrosting temperature (10°C 45bara, 20°C 58bara)<br>maximised COPc<br>direct use in the freezing equipment<br>low cost<br>smaller size equipment<br>less risc for food safety<br>cascade with minimised NH3 charge<br>low insurance costs<br>low CO2 emmision |

*High pressure compressors in Industrial plants,*

# COMBINED NH3 CHILLER / HOT WATER HEAT PUMP



# COMBINED NH3 CHILLER / HOT WATER HEAT PUMP



# NATURAL REFRIGERANTS

*High pressure compressors in Industrial plants,*


| | | |
|---|---|---|
| **CHILLER** | | |
| compressor model | | piston N8M |
| cooling output<br>water temperature<br>capacity | <br>°C<br>kW | <br>1,5<br>1000 |
| bkw | kW | 250 |
| COP-c | | 4,0 |
| **HOT WATER HEAT PUMP** | | |
| compressor model | | piston N6HS |
| heating output<br>water temperature<br>capacity | <br>°C<br>kW | <br>90<br>1500 |
| bkw | kW | 250 |
| COP-h | | 6,0 |
| **COP-total** | | **5,0** |

kgh

Thank you very much!

COFELY AXIMA
GDF SUEZ

MARKET AVAILABILITY

d.o.o. KLIMA
SMEDEREVO, SERBIA
tel./fax ++381 26 221715, www.klima.co.rs

MAYEKAWA



MYCOM