CHILLVENTA

Chillventa Specialist Forums 2022
Chillventa Fachforen 2022

CONNECTING EXPERTS.

AIR CYCLE REFRIGERATION

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Development Director

MIRAI

AIR CYCLE REFRIGERATION

Mirai Intex At-A-Glance

Founded

2015 In Switzerland

Brno, Czech Republic

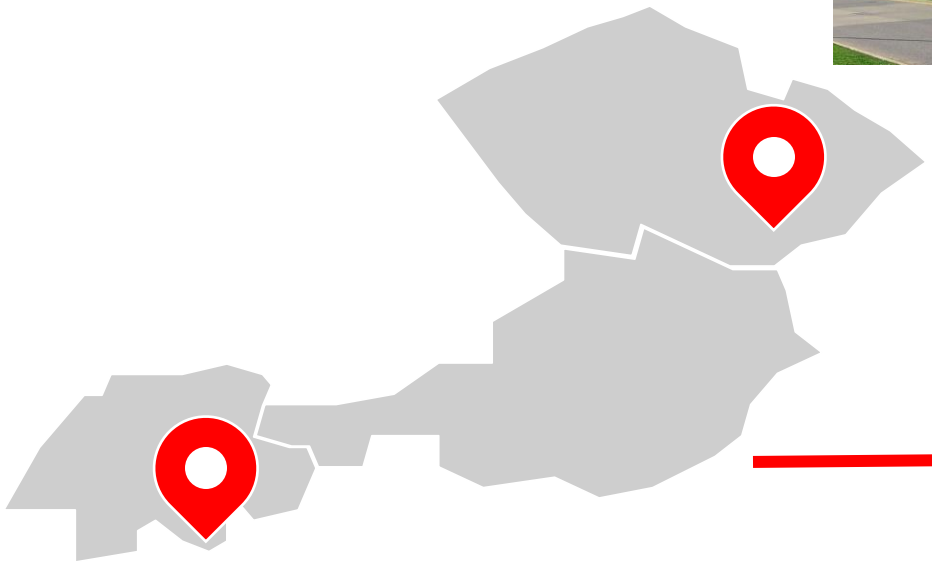
Headquarters

Manufacturing Facility

Testing Facility

Research & Development

24/7 Service Support



We are the **European pioneers** in the air cycle refrigeration technology

Our technology is developed for the **Ultra-Low Temperatures**

Our mission is to **revolutionize the refrigeration industry** by providing the cleanest and the most environmentally friendly solution

We are a growing company expanding our product portfolio continuously

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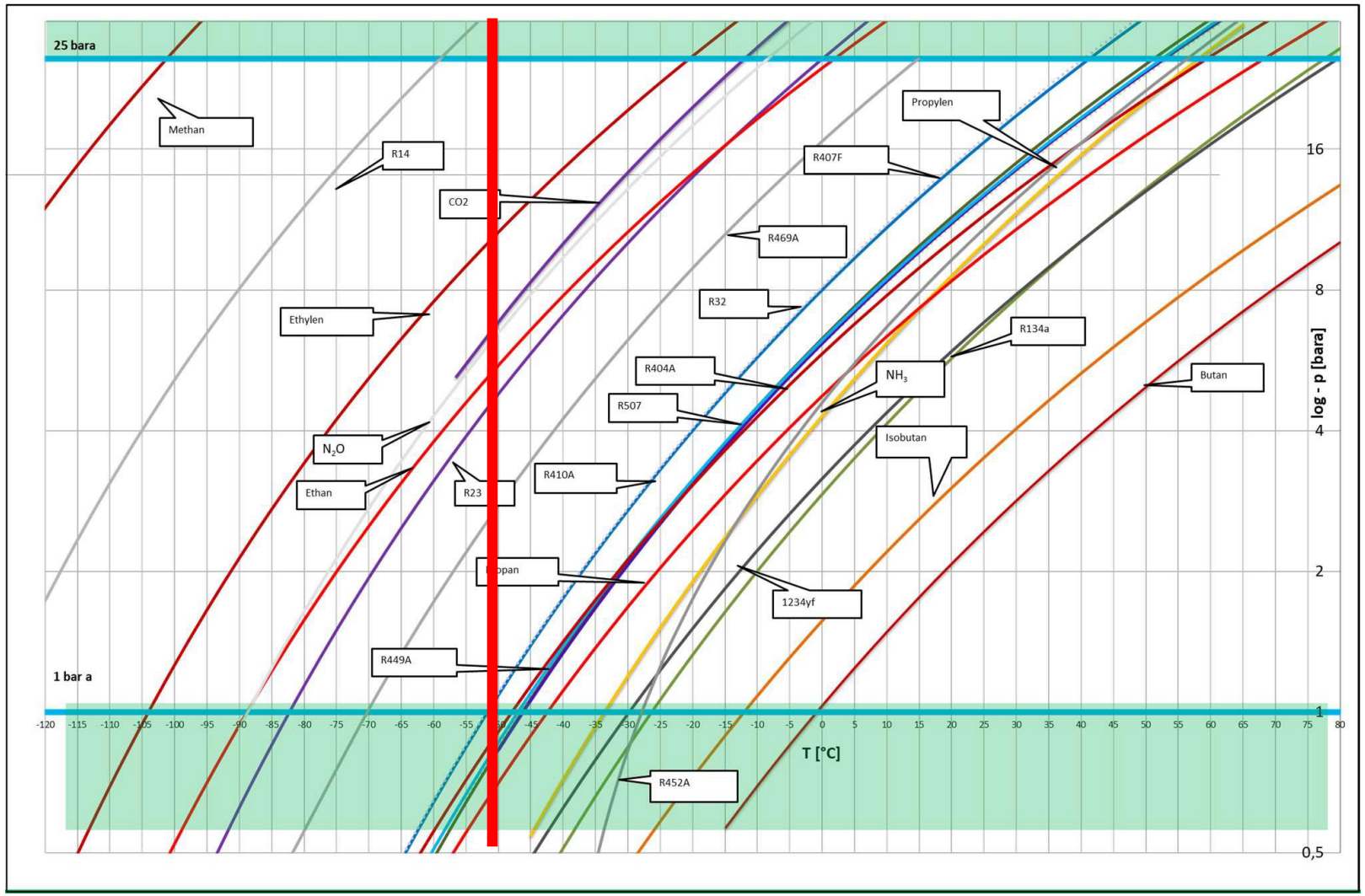
TECHNOLOGY

Refrigerants Overview

- NH3 R717 (GWP 0)
- CO2 R744 (GWP 1)
- R23 (GWP 14.800)
- R134a (GWP 1.430)
- R404A (GWP 3.922)
- R407F (GWP 1.825)
- R410A (GWP 2.088)
- R449A (GWP 1.397)
- R507A (GWP 3.985)
- 1234yf (GWP 4)
- R32 (GWP 675)
- Butan R-600 (GWP 4)
- Isobutan R-600a (GWP 3)
- Propylen R-1270 (GWP 2)
- Propan R-290 (GWP 3)
- Ethan R-170 (GWP 6)
- Ethylen R-1150 (GWP 4)
- Methan R-50 (GWP 25)
- WT69 R469A (GWP 1.357)
- R452A (GWP 2140)
- R14 (GWP 7390)
- N2O R744A (GWP 265)

„Sound barrier“ below -50°C use temperature



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Refrigerant – Natural air

R729

GWP 0

Natural refrigerant

Zero ODP

Zero GWP

No environmental regulations

Forever free of charge

Low temperatures (down to -160 °C)

Greater efficiency at low temperatures

More economical than Liquid Nitrogen

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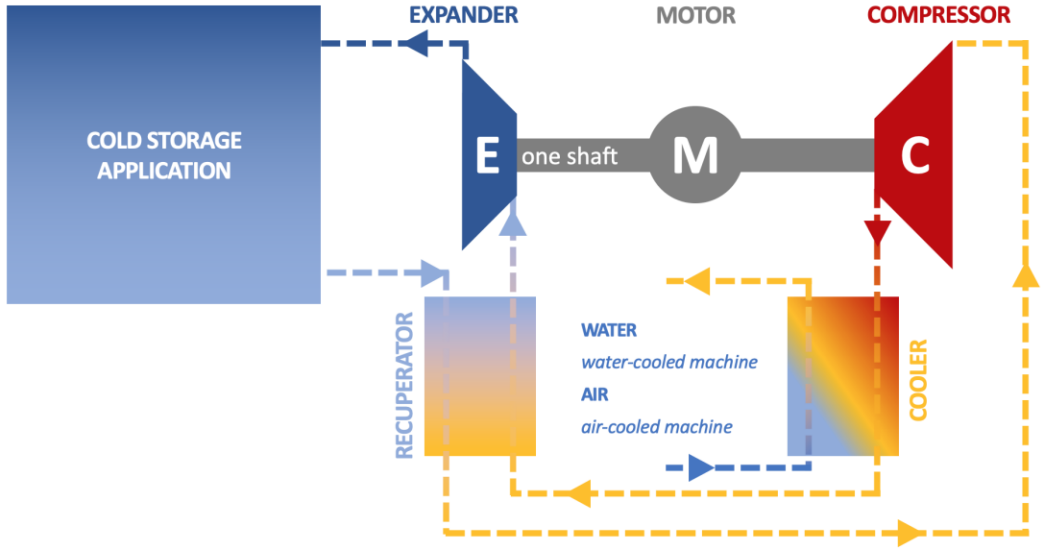
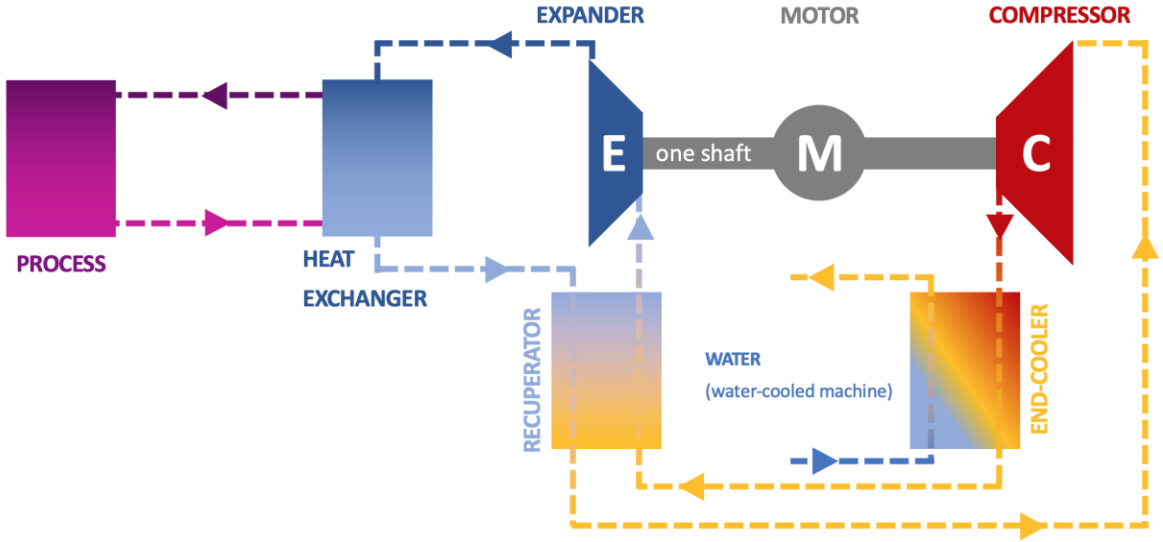
Air Cycle Technology

OPEN



CLOSED



- Based on the heating capability of air during the **compression** and cooling down during the **expansion**
- Repetition of compression and expansion allows air to reach and maintain the ultra-low temperatures
- MIRAI Cold machines works in the temperature range from -40 °C down to -130 °C

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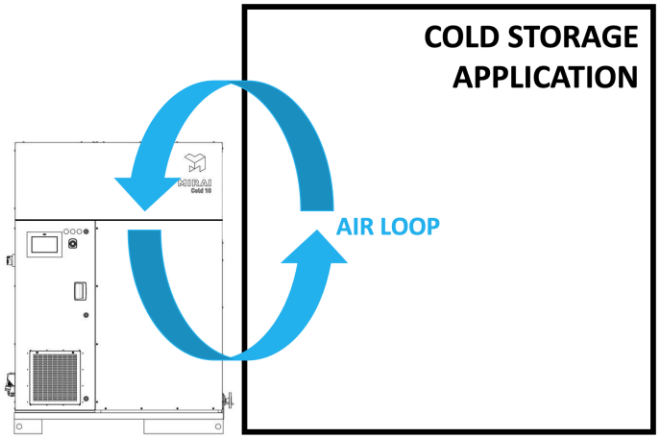
MIRAI Cold Operating Cycles

OPEN

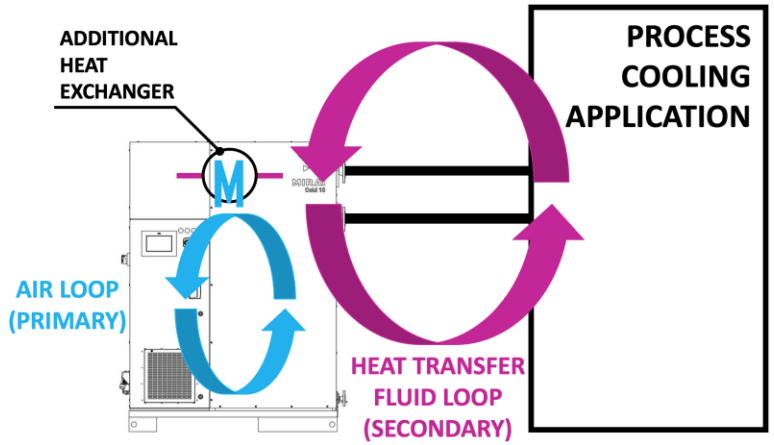


Open to refrigerated space

Direct contact of air and cooled product

Circulating between machine and Cold Room

CLOSED



Closed by definition

Air never leaves the machine

Cooling secondary medium in additional HEX

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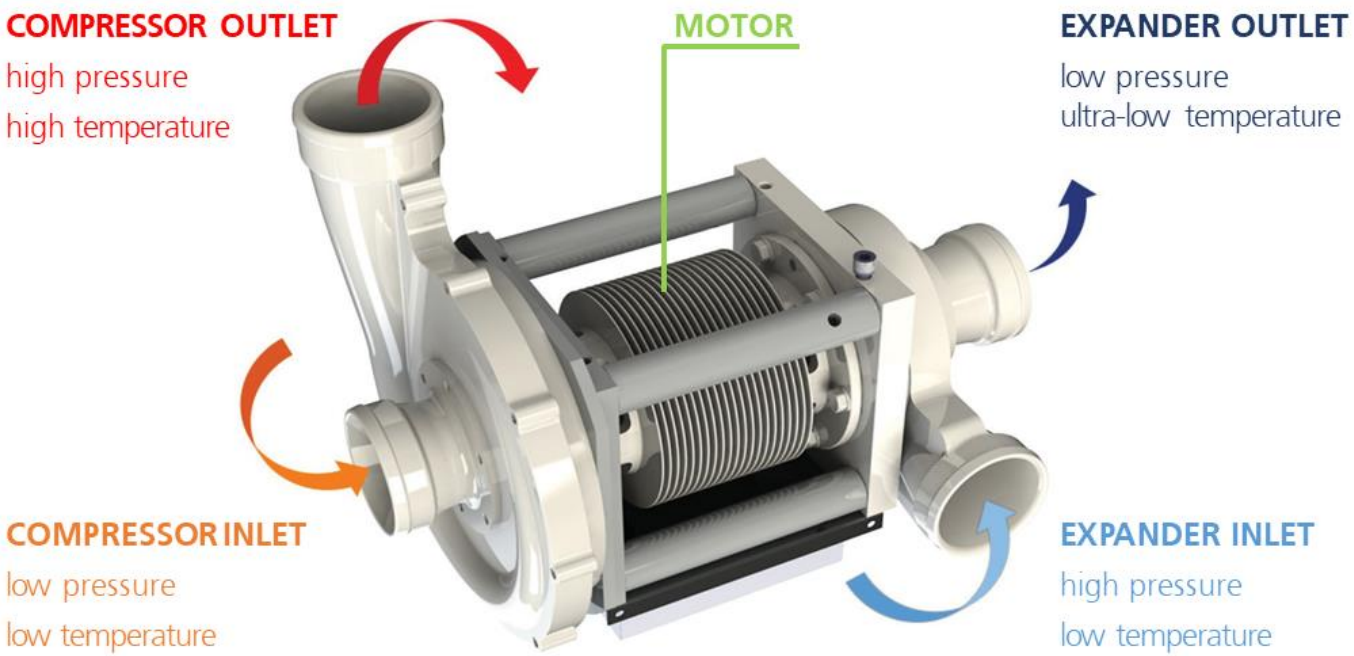
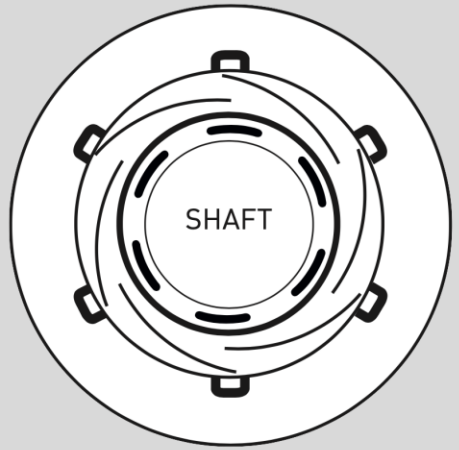
Mirai Turbo-Module

- Compressor and Expander sharing **one shaft**
- Energy **recuperation**
  - Expander → Compressor
  - Up to 30 % of energy savings



- Use of **air bearings**
  - No contacting pairs
  - No oil
  - No wear



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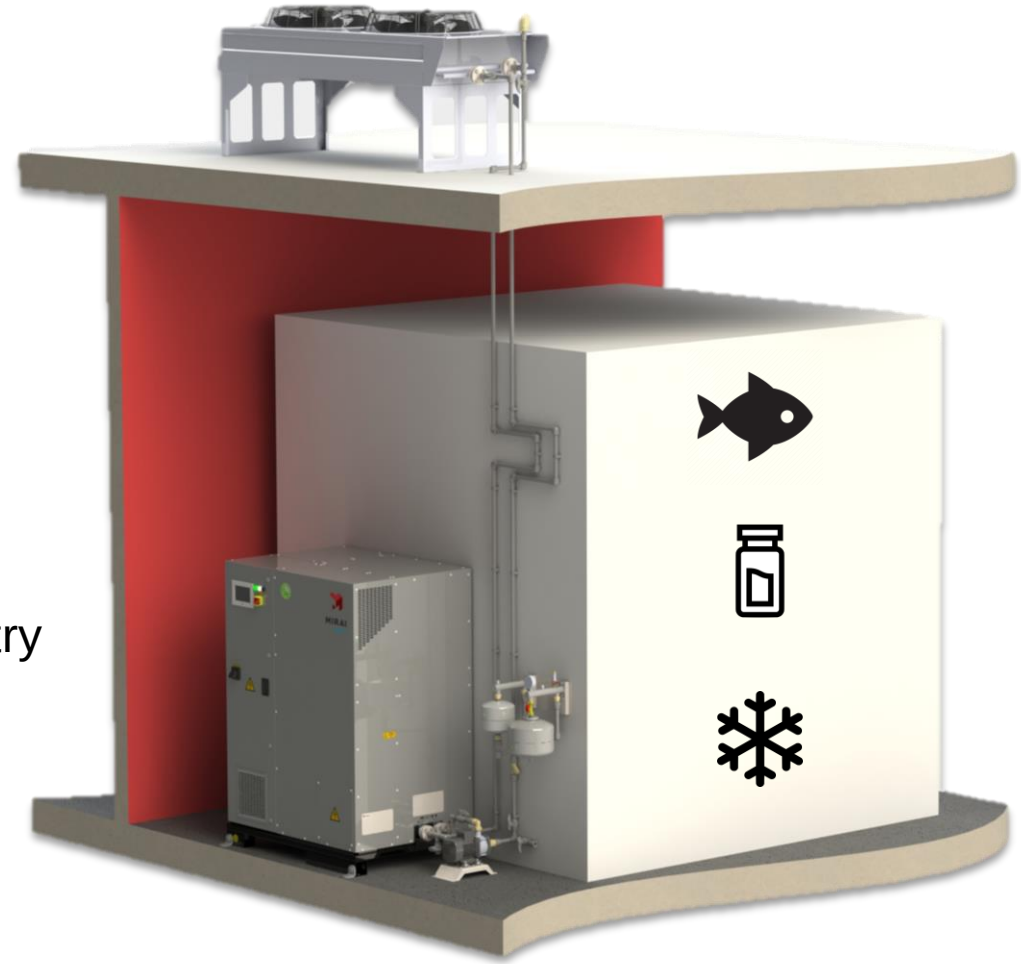
OPEN CYCLE

Cold Storage

Open Cycle Applications

- Mirai Intex is currently cooperating on several projects
  - -60 ˚C / -70 ˚C **Tuna storage**
  - -80 ˚C **Pharmaceutical / vaccine storage**
  - -110 ˚C / -120 ˚C **Whole-Body Cryotherapy**
- Our priority and goals
  - Provide future-proof refrigeration solutions
  - Raise the standards of safety and reliability in the industry
  - Supply eco-friendly solution with 0 GWP refrigerant
  - Introduce temperature flexibility as a standard
    - from -40 ˚C down to -130 ˚C with one machine



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Snow Catcher (Humidity Extraction Device)

- Air supplied **directly** from expander to **cold room**
- **No** need for **evaporators** and **auxiliary fans**
- **No** need for **defrost** procedures consuming additional energy
- **Continuous** operation

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Vaccine Storage Solution

RECIPHARM, Wasserburg – Germany

- Solution in with **two independent chambers**
- Temperature range -20 to -90 ˚C
  - Adjustable independently for each chamber
- **Storage area 85 m², volume 185 m³** (each)
- Each chamber cooled with N+1 redundancy from 3 machines **MIRAI Cold 10 O/W**
- Installation is equipped exclusively with technologies using only natural refrigerants

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MIRAI REFOLUTION INDUSTRIEKÄLTE GMBH SECON TELEDOOR

Container Vaccine Storage Solution

- Complete solution in **standard container**
- Temperature range -40 to -110 ˚C
  - Optimized for -80 ˚C
- **Storage volume 37.5 m³ / 110 m³**
- Significantly higher efficiency than upright freezers
- KTI solution presented at Medica 2021 exhibition in Düsseldorf
- Both projects use **MIRAI Cold 10 O/W**

TELEDOOR MIRAI REFOLUTION INDUSTRIEKÄLTE GMBH SECON

KTI CryoMed MIRAI REFOLUTION INDUSTRIEKÄLTE GMBH SECON

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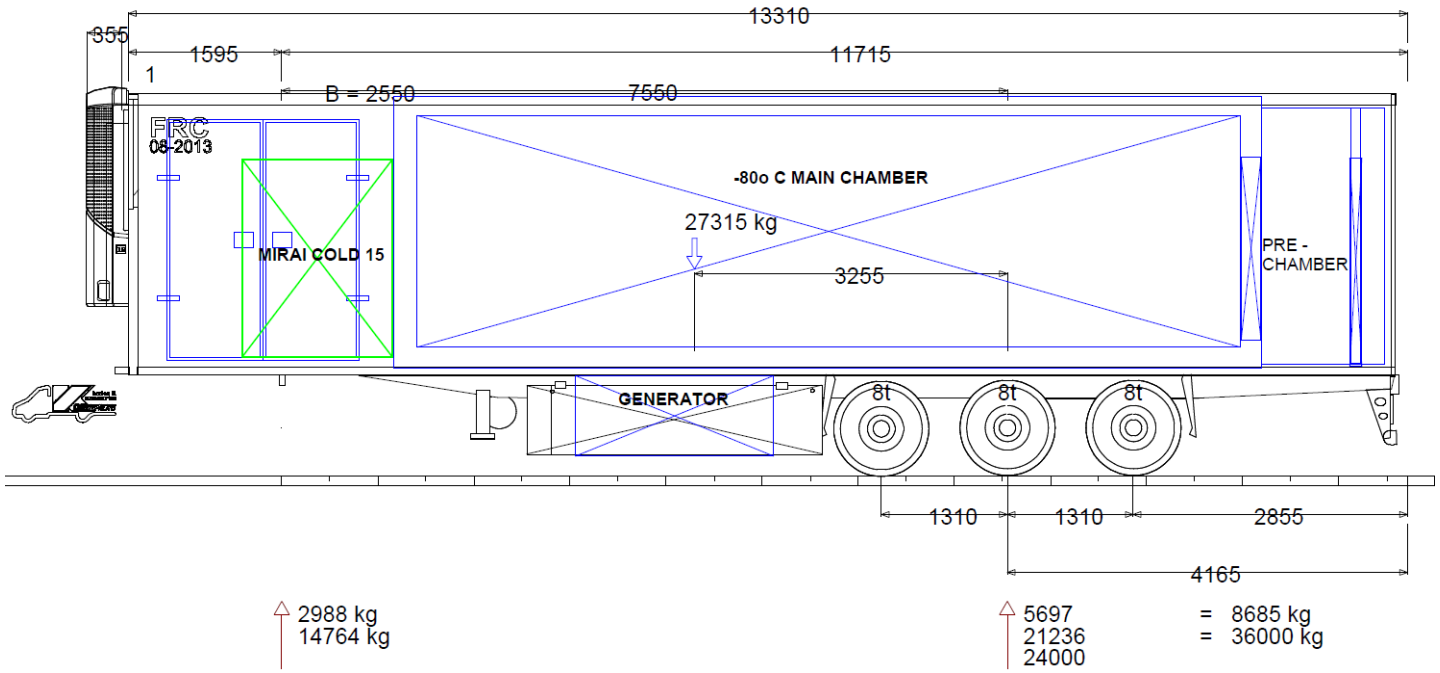
Transport Vaccine Storage Solution

- Unique solution for current shortage of ULT mobile solutions
- All-in-one solution in semi-trailer
- Temperature range -40 to -110 ˚C
  - Optimized for -80 ˚C
- **Storage volume 43 m³**
- Alternative eco friendly solution to standard transport options
- Missing link in the ULT cold chain
- **MIRAI Cold 15 O/A** used (air cooled)

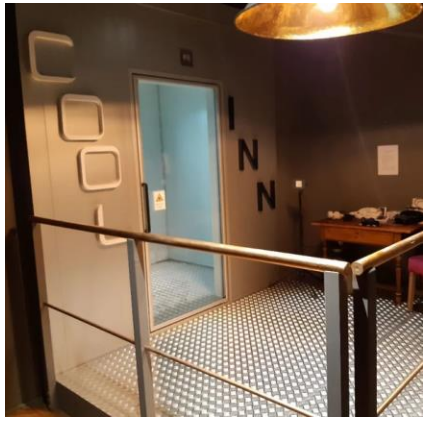


MIRAI REFOLUTION INDUSTRIEKÄLTE GMBH SECON Gebr. THOMAIDIS GmbH Transport & Logistic

Whole-Body Cryotherapy Solution

COOLINN, Karlsruhe – Germany

- World's first WBC using the air cycle technology since 2019
- **MIRAI Cold 15 O/A** used (air cooled)
- Great temperature (head / ankles) uniformity in -130 ˚C
- In 2020 system upgraded to act as a heat pump
  - Hot exhaust air from machine cooling heats wellness area
- Long-term confirmation of reliability, stable performance, low operation costs and low maintenance costs
- Ongoing projects implementing MIRAI Cold 10 in WBC



MIRAI REFOLUTION INDUSTRIEKÄLTE GMBH

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CLOSED CYCLE

Process Cooling

Closed Cycle Applications

- MIRAI Cold closed cycle machine are used for variety of **process cooling applications**
- Air is working in a **closed loop**
- Machines are equipped with **additional heat exchanger**
  - Air from closed loop is cooling down heat transfer fluid
  - Most frequently used heat transfer fluid is silicone oil
- Closed air loop is using **pressure change** for operation
  - Either external or internal pressurized air source
  - Equivalent to liquid receiver function with compressor systems

Freeze-Drying Solution

- Pretreatment / **Freezing** / Primary Drying / Secondary Drying
  - Freeze-Drying usually -50˚C to -90 ˚C
  - Cold condenser usually -90 ˚C and lower
- MIRAI Cold provides high efficiency & stable loads
- **Easy installation** for new projects
- As well as **retrofits** with existing Freeze-Dryers

- Similar process cooling applications
  - Blast freezing

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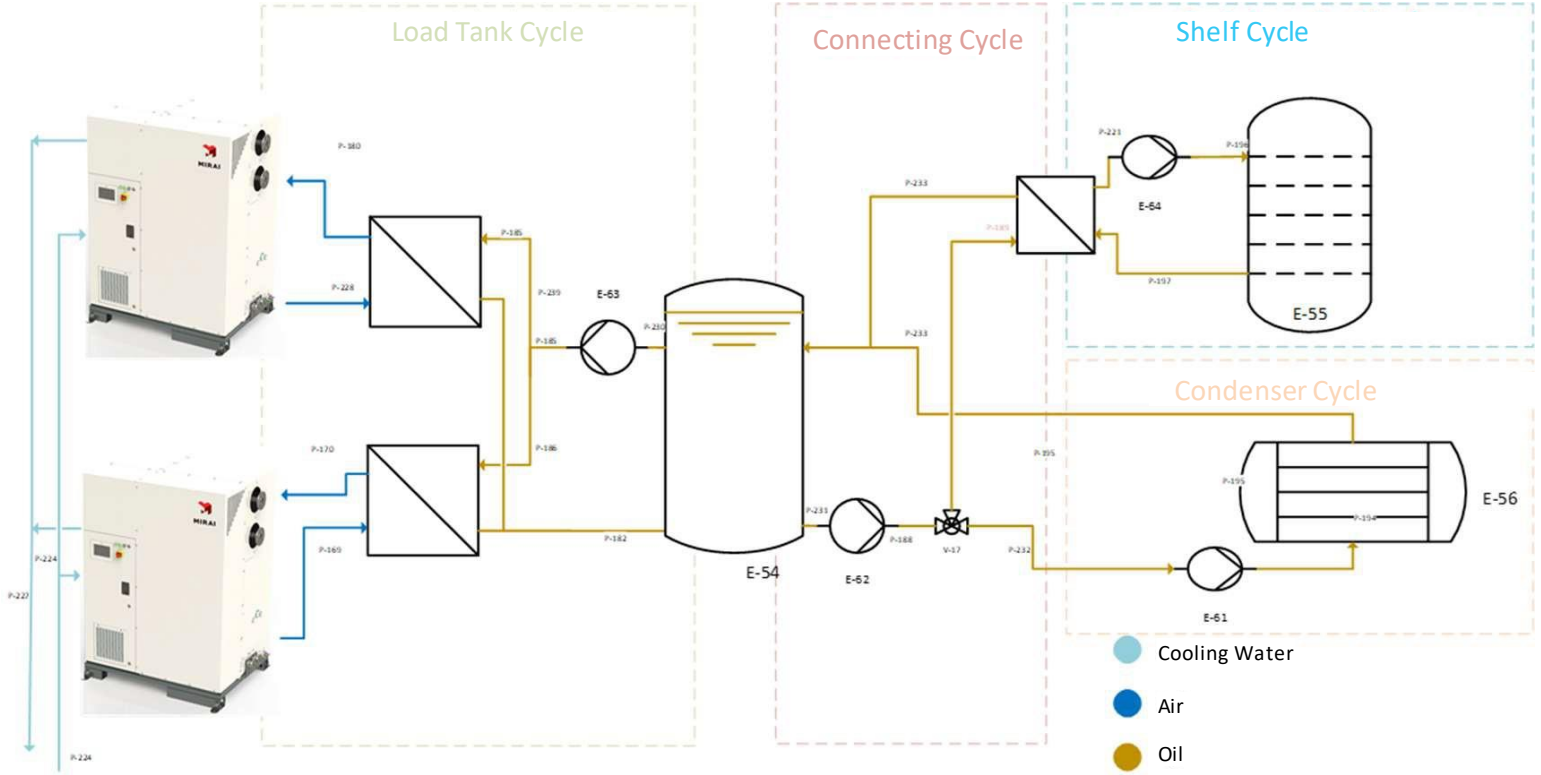
HOF - CryoBlizzard

Freeze dryer with air cycle refrigeration technology and load tank



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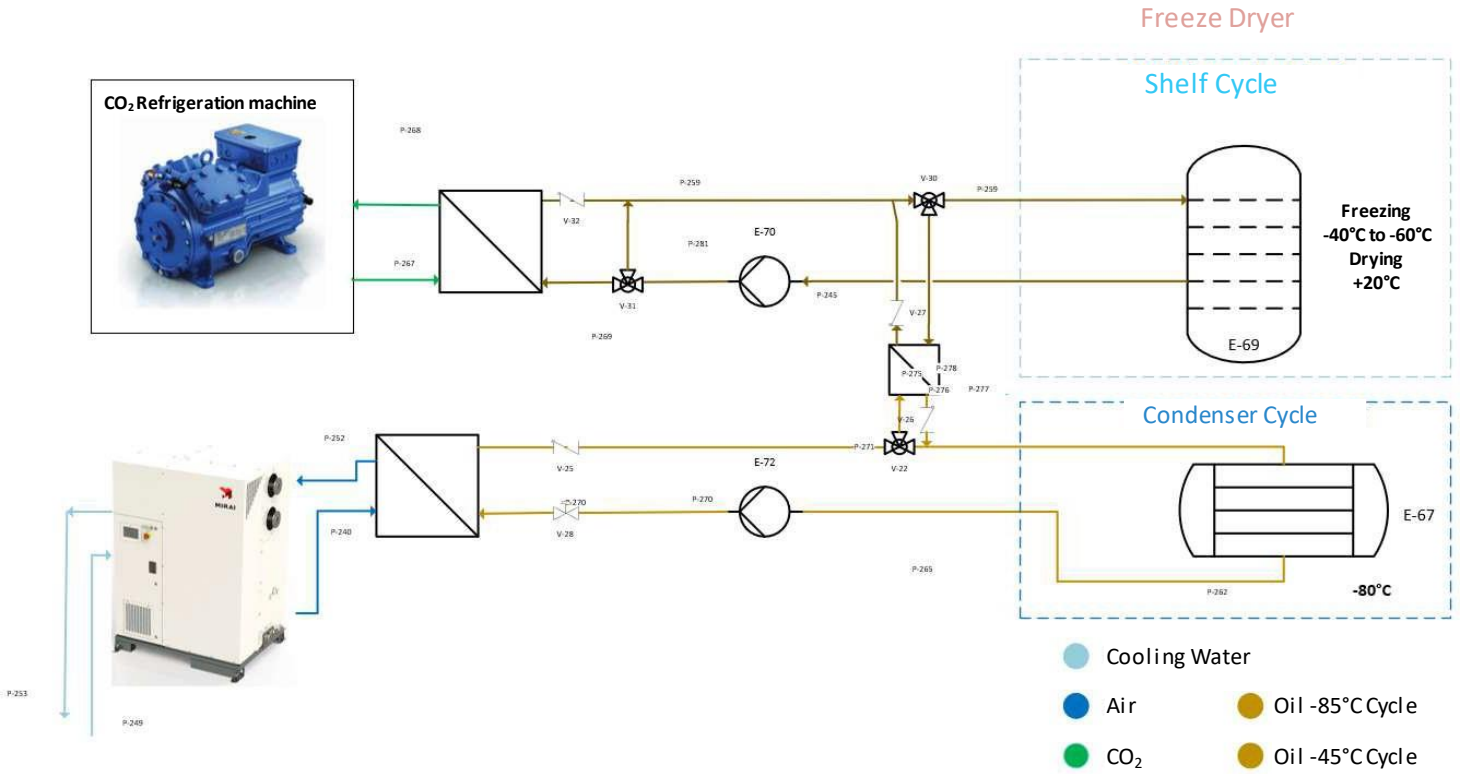
GEA - LyoAir



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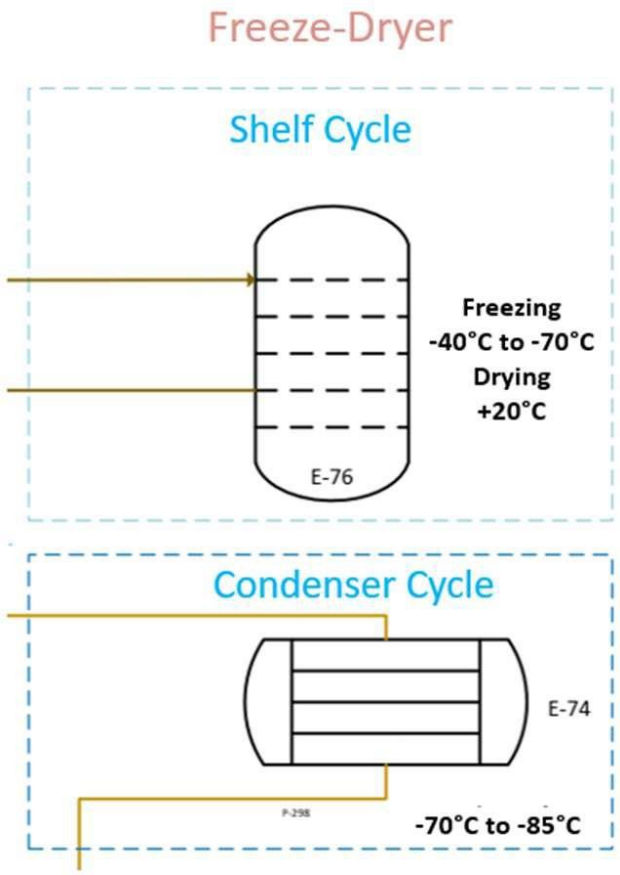
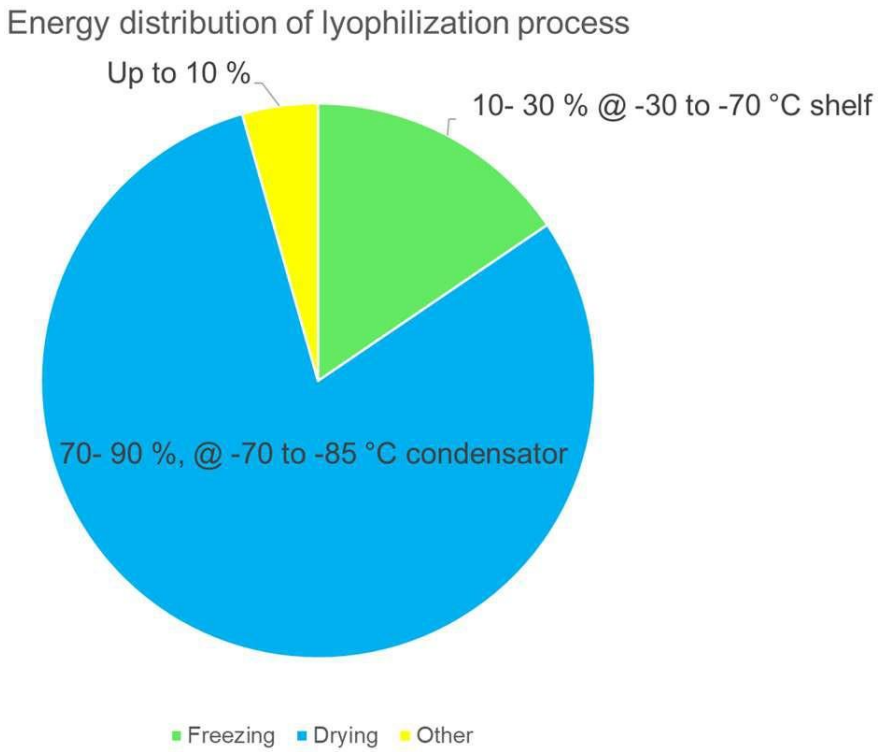
Lyophilization process from the view of refrigeration

HOF and GEA report of Lyophilization machine an overall system energy efficiency show increase of average **energy save on 15%** by using **MIRAI Cold** machines against previous solutions.





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Solvent Recovery Solution

- Recovery of solvents from process steam
  - Ethanol, Acetone, Xylene and many more
- Liquid condensate is collected by cooling the vapor
- Almost 99% recovery achieved
- MIRAI Cold installed and commissioned in one day
- Solution fully compliant with the new “TA-Luft” regulation

- Similar process cooling applications
  - Gas liquification

HOF MIRAI REFOLUTION INDUSTRIEKÄLTE GMBH SECON

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Bio LNG production

Bio-gas consist of CO2 and CH4 and the first step of Bio LNG production is their separation from each other.

A membrane technology is used for the separation process (1).

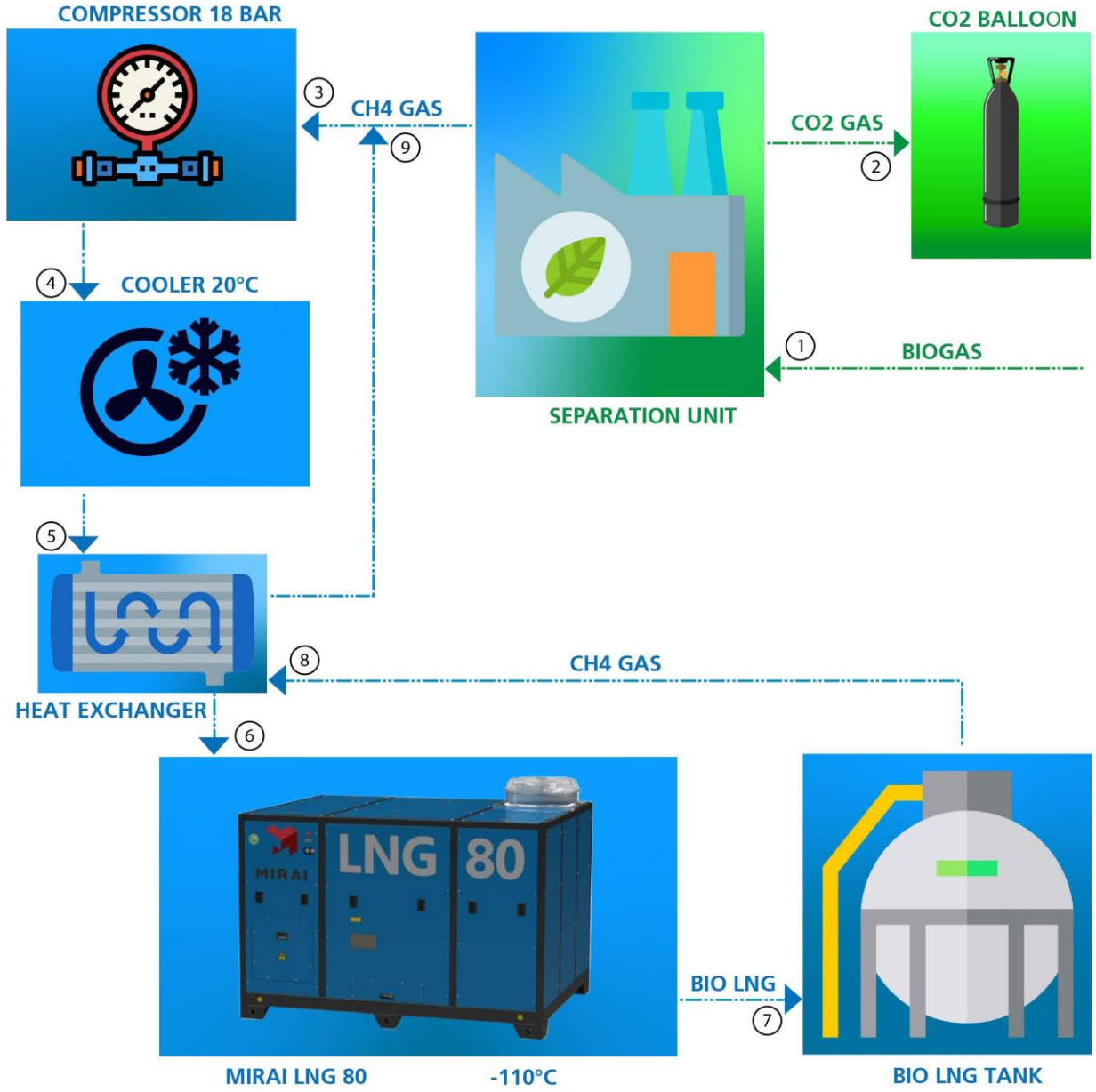
Separated CO2 goes into a balloon (2).

At atmospheric pressure CH4 boils at -162C. Before liquefaction CH4 is pressurized to 18 bar(3) and cooled down to 20C(4).

It's then supplied through a heat exchanger (5) directly to the machine (6) where CH4 is liquefied by cooling down to -120C and is then pumped into the storage tank (7).

After the cooling stage not all gas is liquefied, thus it has to repeat the cycle, at stage (8) it passes through a recuperative heat-exchanger for better efficiency of the overall process.

Then it is sent to the compressor to repeat the liquefaction process(9)



MIRAI LNG 80

Mirai LNG 80 machine for liquefaction of biogas is the special modification of general Mirai Cold 80T machine that used for process cooling. To adapt machine for new application were made list of modifications:

- High pressure protection,
- water supply cut-off protection,
- over-current protection,
- sequential and phase failure protection,
- high temperature protection,
- sensor failure protection,
- gas leakage protection

MIRAI Cold Benefits

The most **eco-friendly** refrigeration solution available today

Continuous cooling without defrost
Continuous humidity extraction

The **safest** solution on the market
Operates with very **low pressures**

Technologically **advanced**
Remote monitoring and updates

Any temperature **from -40 °C to -130 °C**
Maximal temperature accuracy & uniformity

Easy installation & serviceability

High energy **efficiency**
Economical in use

Legal **compliance**
2 years product warranty

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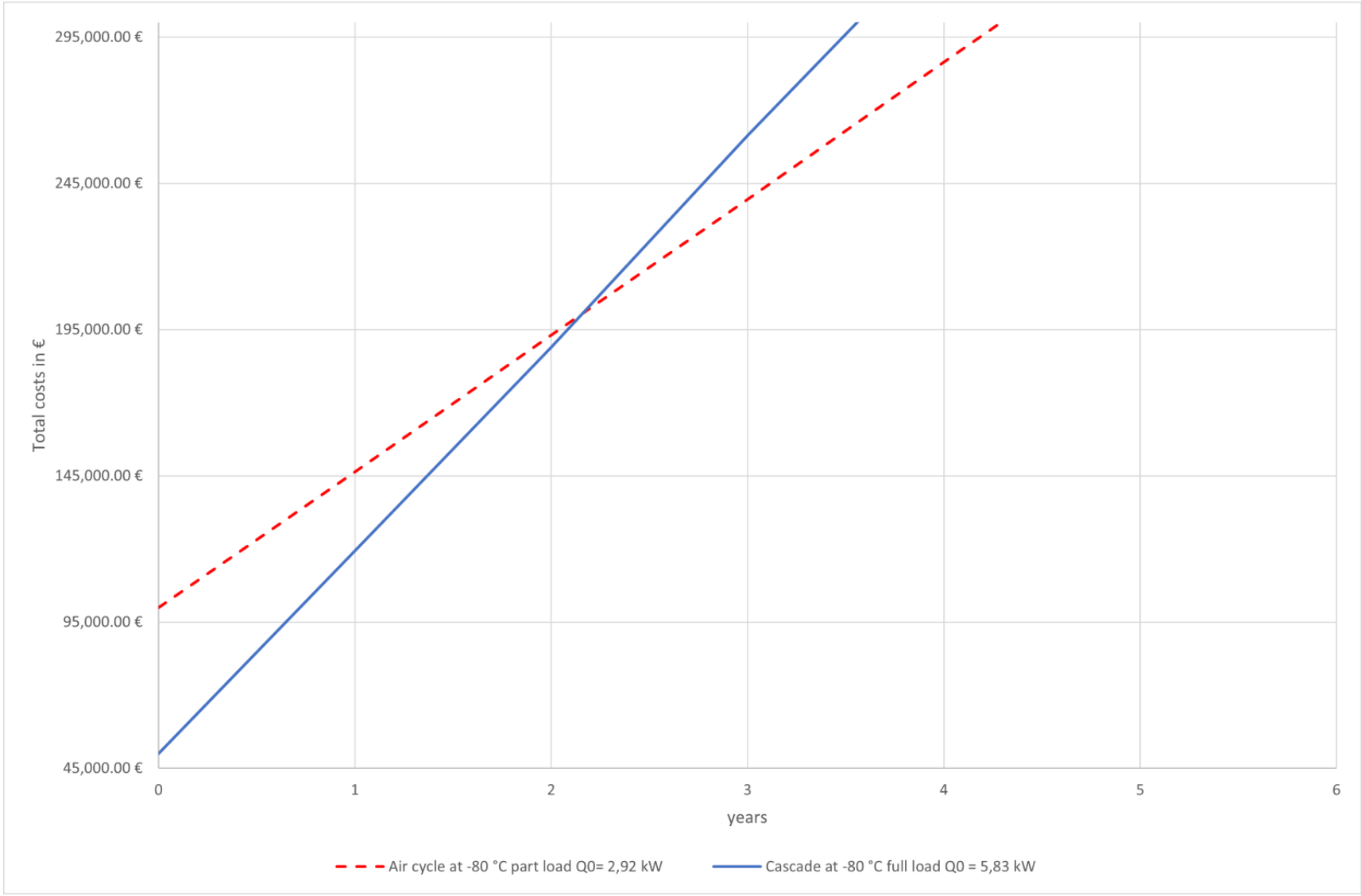
Temperature -80 °C (two-stage cascade)

Part load break-even

2 years 2 months



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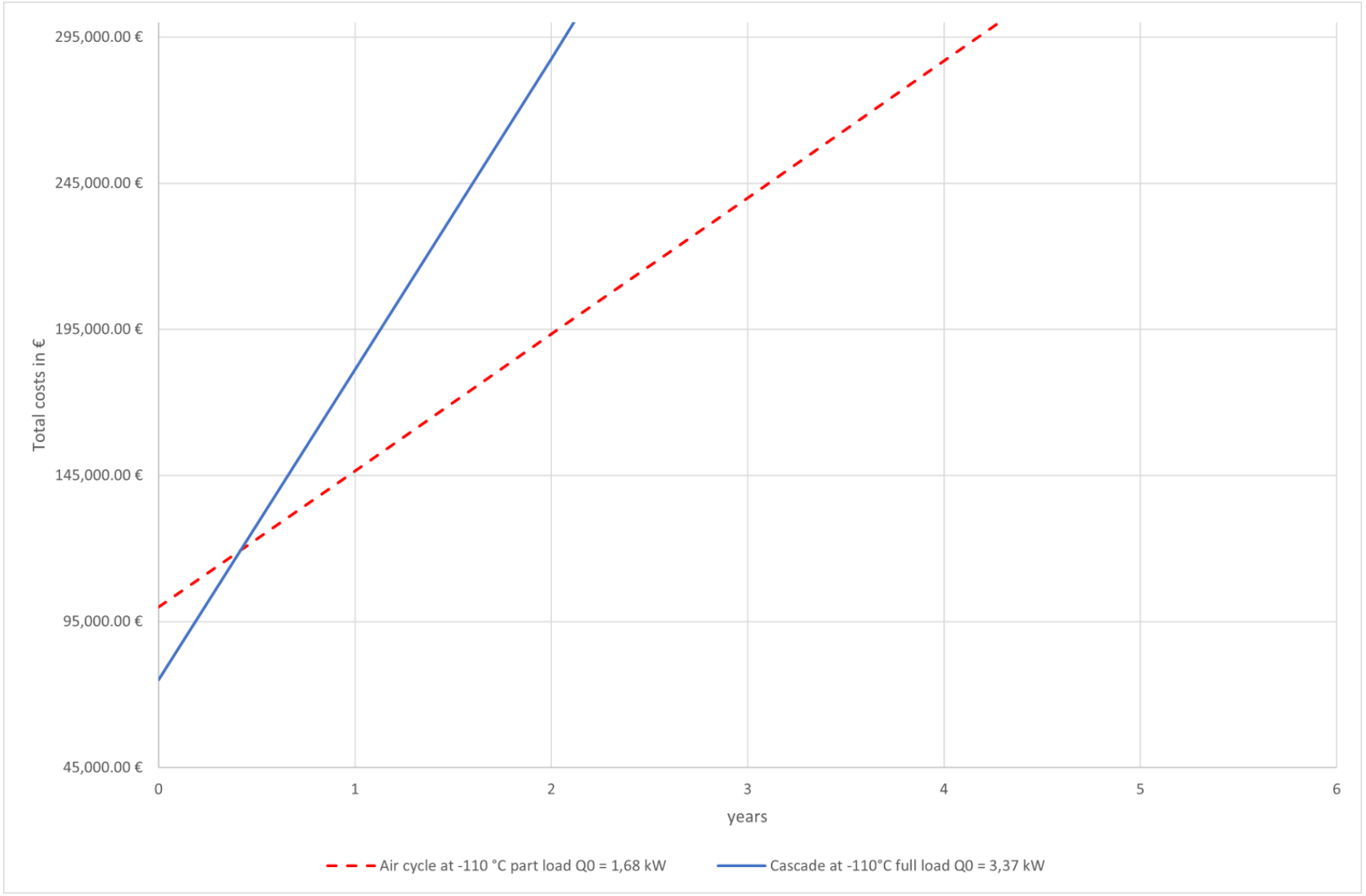
Temperature -110 °C (three-stage cascade)

Part load break-even

6 months



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MIRAI Cold Awards

Accelerate Magazine / Europe Award

2019 Innovation of the Year – MIRAI Cold 15 O/A

RAC Cooling Awards

2020 Refrigeration Product of the Year – Air Cycle Technology

2021 Refrigeration Product of the Year – MIRAI Cold 10 O/W

2021 Refrigeration Innovation of the Year – MIRAI Cold 10 C/W/T

Mirai Intex developed the ultra-low temperature air-cooling technology that has made a breakthrough

It is an innovation showing high reliability, environmentally friendly approach, and easy-to-use controls

We invite you to visit us!

MIRAI
AIR CYCLE REFRIGERATION

Hall 7 Stand 509

REFOLUTION INDUSTRIEKÄLTE GMBH
The engineering office for sustainable refrigeration technology

Hall 4 Stand 508-C

SECON
dare to be better

Hall 7A Stand 420


THANK YOU FOR
ATTENTION!
DON'T HESITATE TO
ASK YOU QUESTIONS!
MIRAI
AIR CYCLE REFRIGERATION
MIRAI INTEX | AIR CYCLE REFRIGERATION

Hall 7A

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