

# Low Capacity CO<sub>2</sub> Systems



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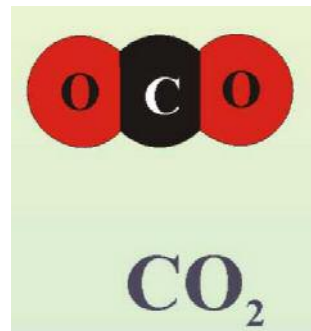
# CO<sub>2</sub> as a refrigerant

## Environment - OK

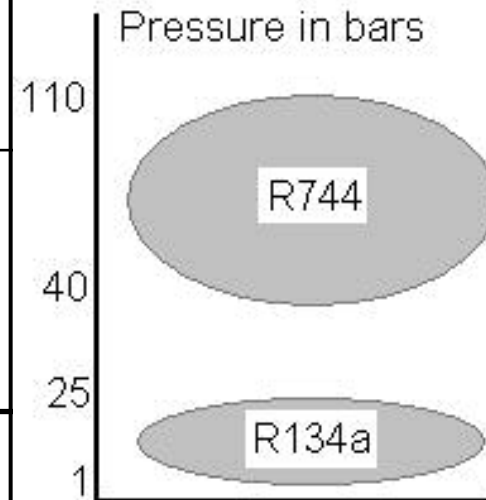
- Refrigerant phase outs
- Companies policy
- Natural substance ✓

## Safety - (OK)

- High concentrations ?
- High pressure ?
- Non flammable or toxic ✓



## The Challenge



- High pressure
- New components
- Efficiency?
- Cost?

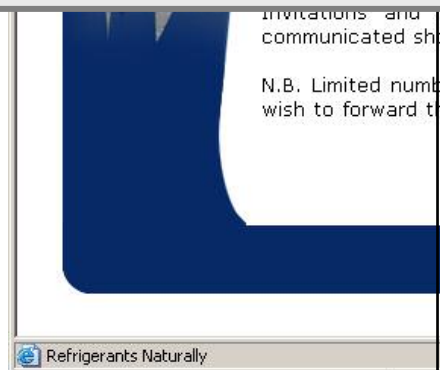
# The Right Way?

1) "By the 2004 Olympic Games in Athens, we will **no longer** purchase new cold drink equipment using **hydrofluorocarbons**... wherever cost-efficient alternatives are commercially available."

2) "We will require suppliers to improve the energy efficiency of the equipment they sell to us by **40-50 percent more energy-efficient** by the end of this decade."

**... higher efficiency  
at lower cost ...**

***Environmental policy  
for cold drink equipment,  
June 27, 2000***

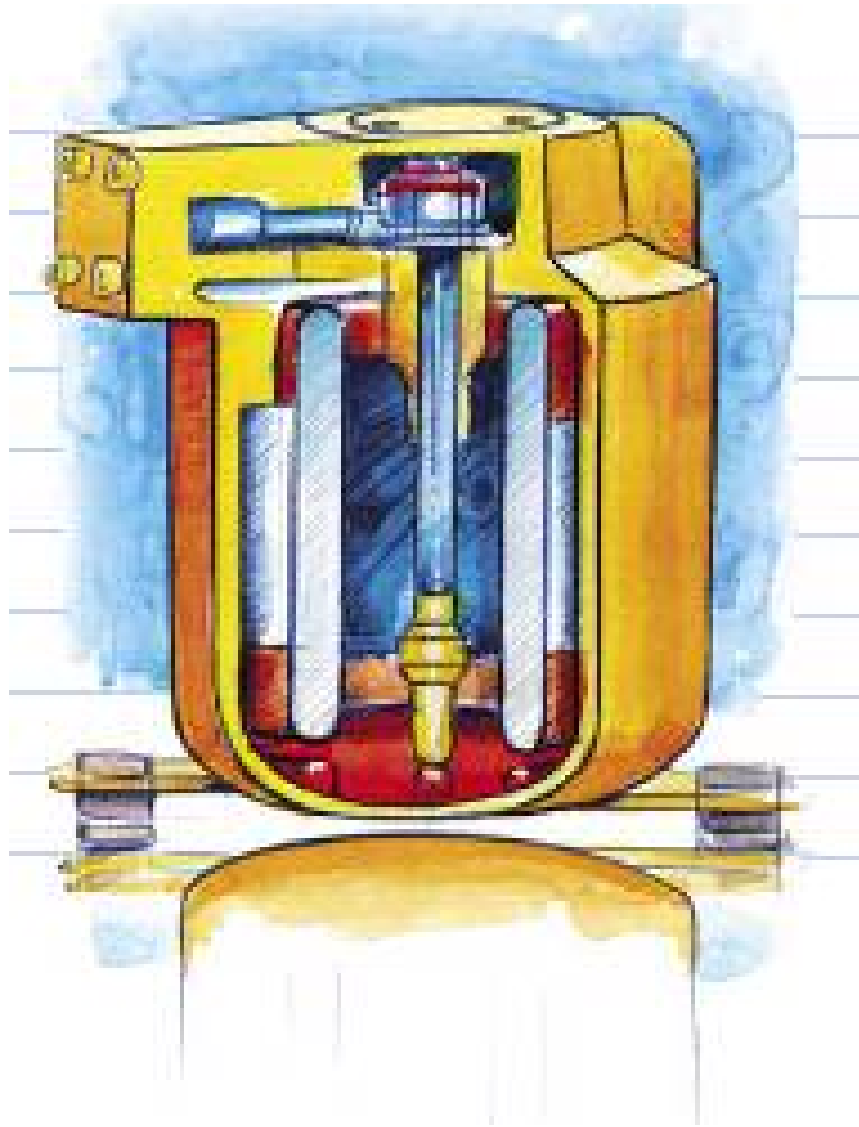


## Moving Towards Sustainable Refrigeration Commercial Applications

### Natural refrigerants in commercial applications

In contrast to industrial refrigeration, no universally accepted alternatives to HFC refrigerants are currently commercially available. Considering its very diverse range of refrigeration requirements Nestlé has therefore embarked on an active programme pursuing appropriate technical solutions also for smaller commercial refrigeration systems.

# CO<sub>2</sub> compressor technology



## **Most critical for performance:**

- Leakage
- Heat transfer
- Specific piston load

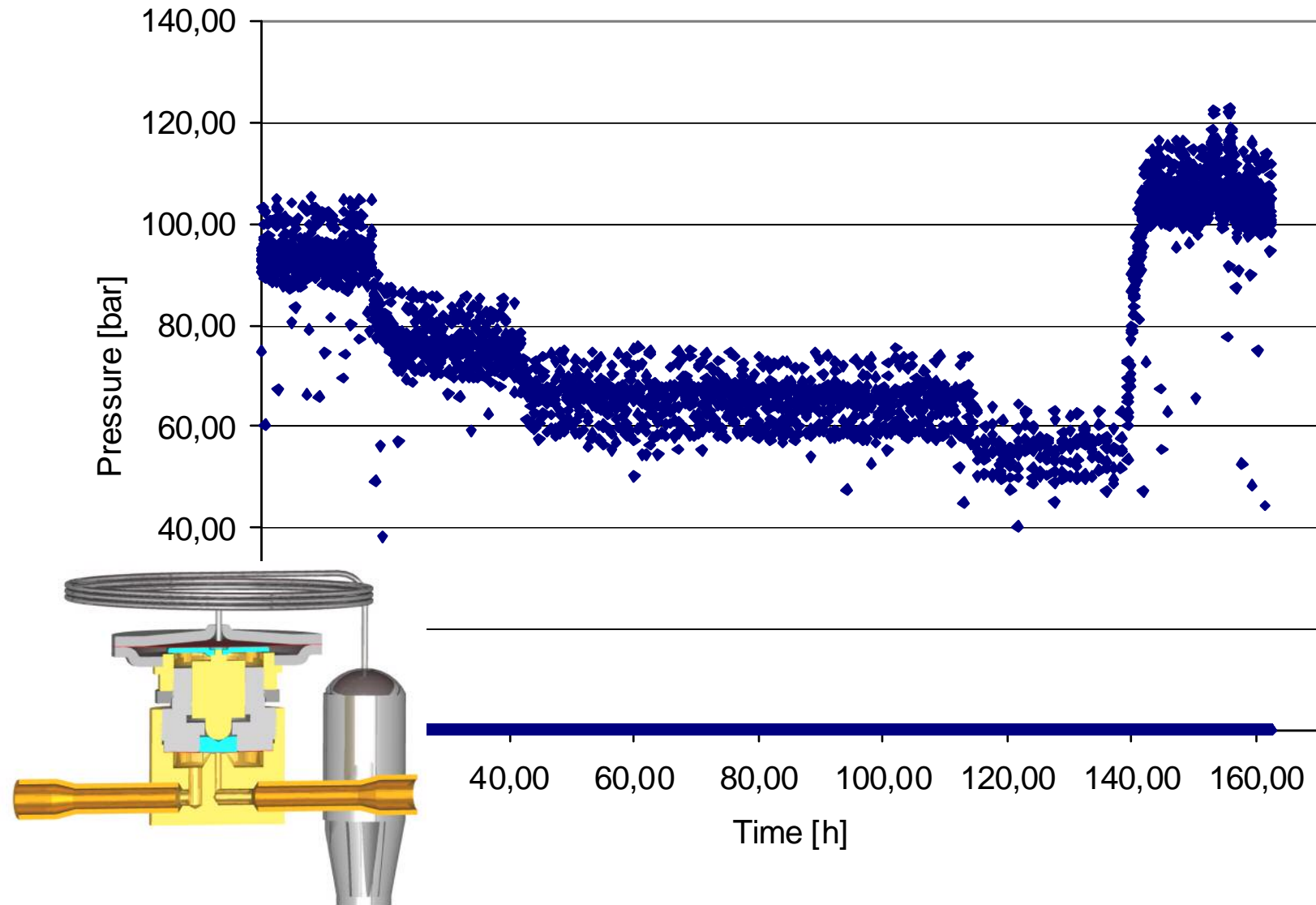
## **Our Choice:**

### **Reciprocating compressor with**

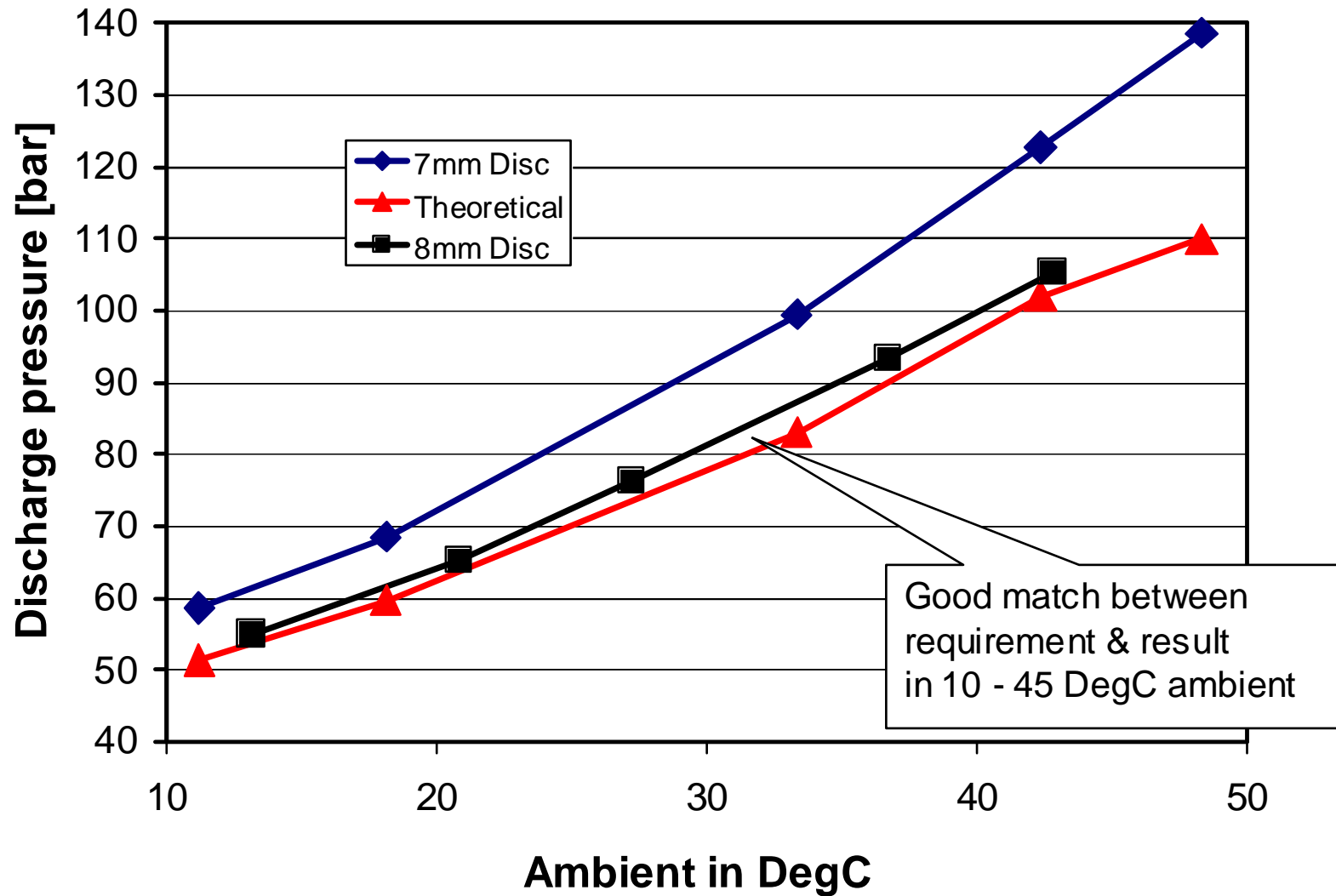
- Piston rings
- Minimized heat exchange
- Maximized bearing area

# Thermal high pressure controller

- tested in SME at changing ambient conditions -



# Pressure & temperature



# CO<sub>2</sub> application examples



Heat Pump  
application



## Next options:

- Low temp
- Heat pumps
- Larger platform



**Our present focus  
is on bottle cooling**



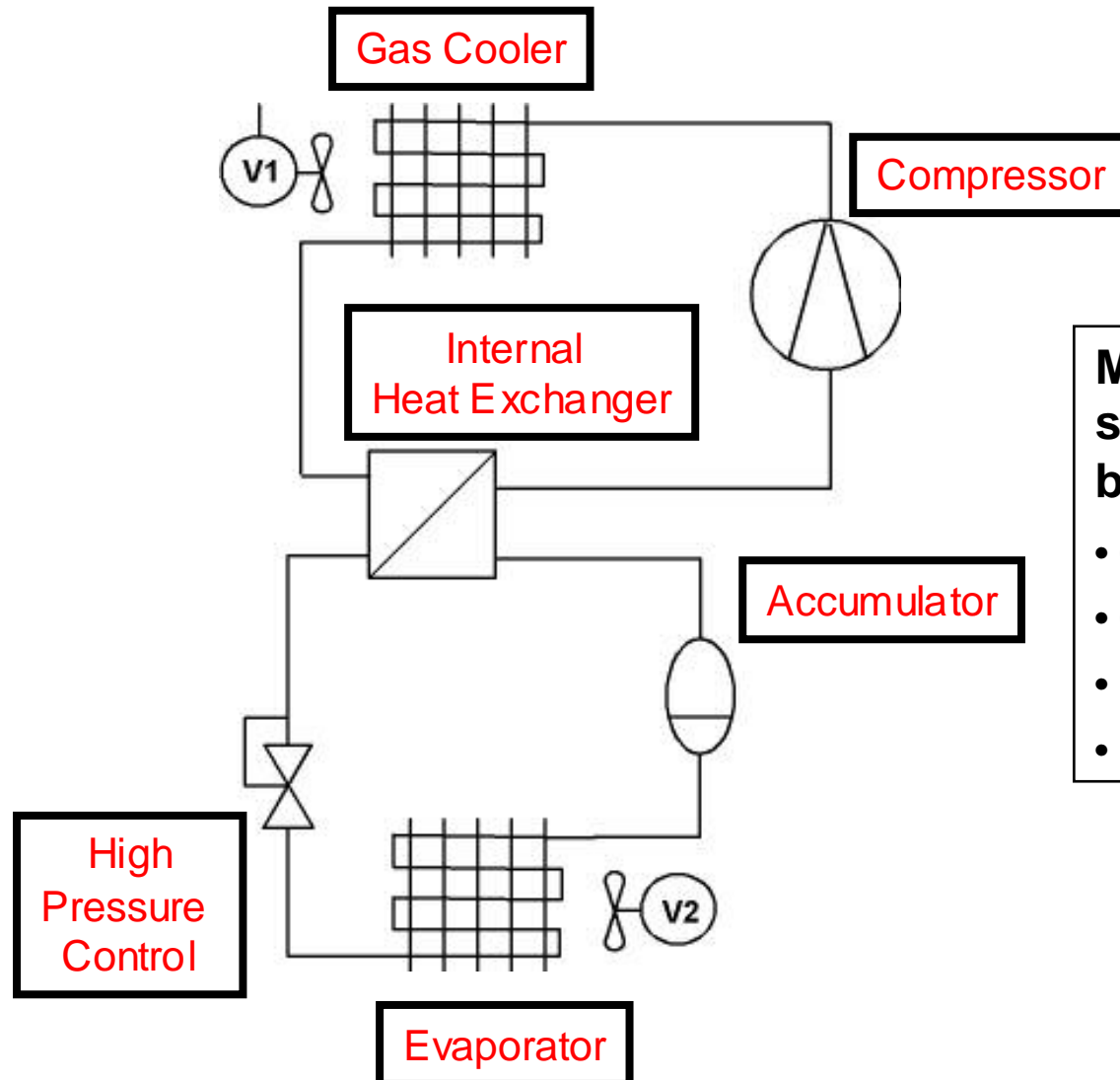
SME  
application



Ice cream  
freezer

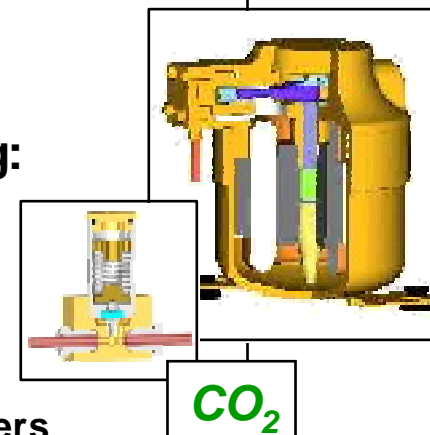


# CO<sub>2</sub> system integrated in SME



**Modified split system by changing:**

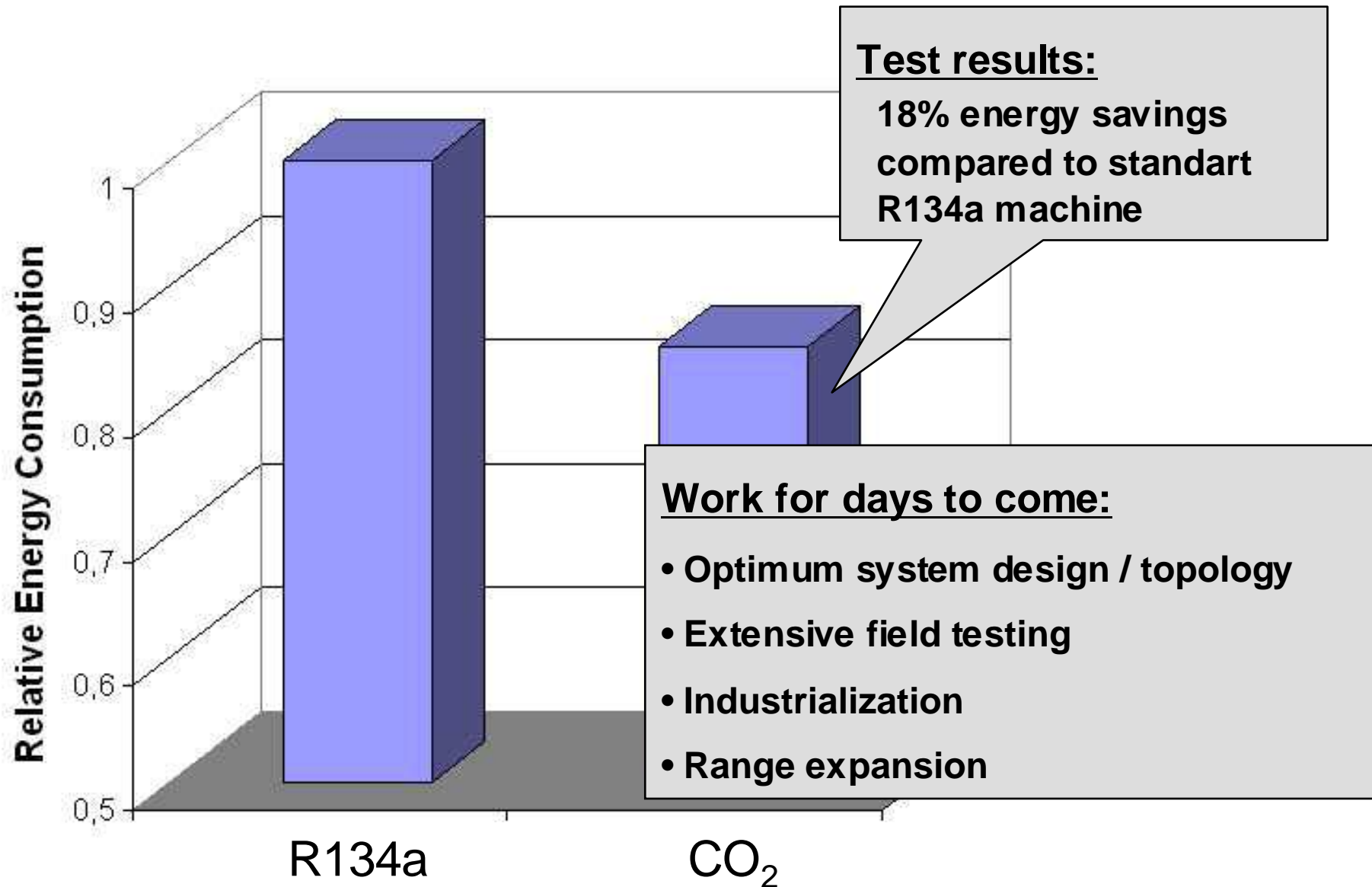
- Compressor
- Control valve
- Refrigerant
- Heat exchangers





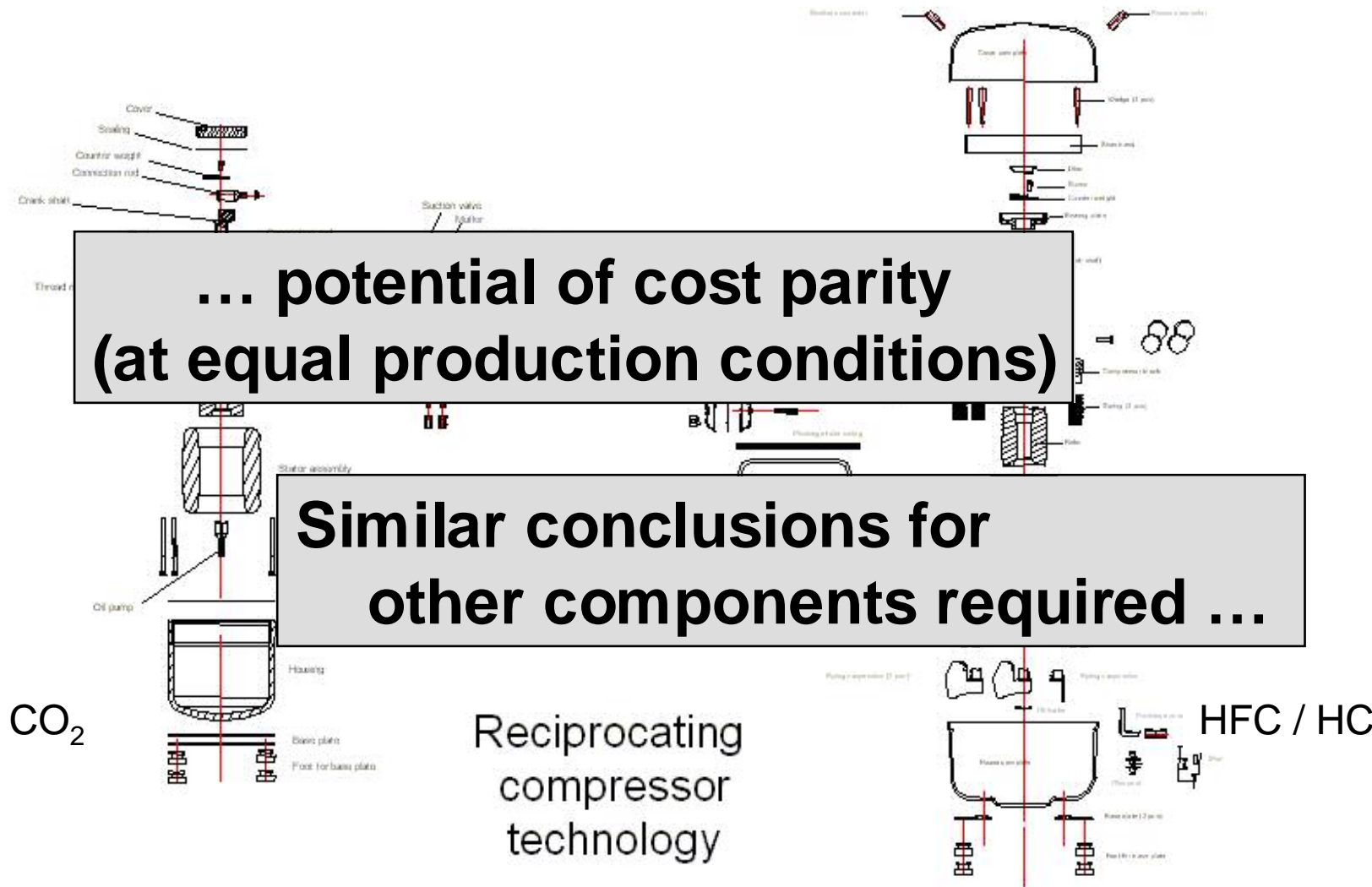


# CO<sub>2</sub>-process efficiency study





## CO<sub>2</sub> versus HFC / HC compressor technology



# The Venture for the Future ...

Year 2004	2005	2006	2007
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Development

Pilot Production

- Prototypes for few key customers

Production in Denmark  
Line capacity: 60 k/year

- One compressor platform  
5 models
- Controls and line components



# “Dream Team” for CO<sub>2</sub> systems

## Reciprocating compressor:

- “Hermetics concept”
- One cylinder
- Piston rings
- Direct suction and discharge
- Standart motor

## Thermal high pressure control:

- Matching compressor chracteristics
- Optimal system operation at varying ambient condition

