# Refrigeration and air-conditioning in warm Mediterranean climates

Alexander Cohr Pachai, Sabroe Factory by Johnson Controls, Denmark

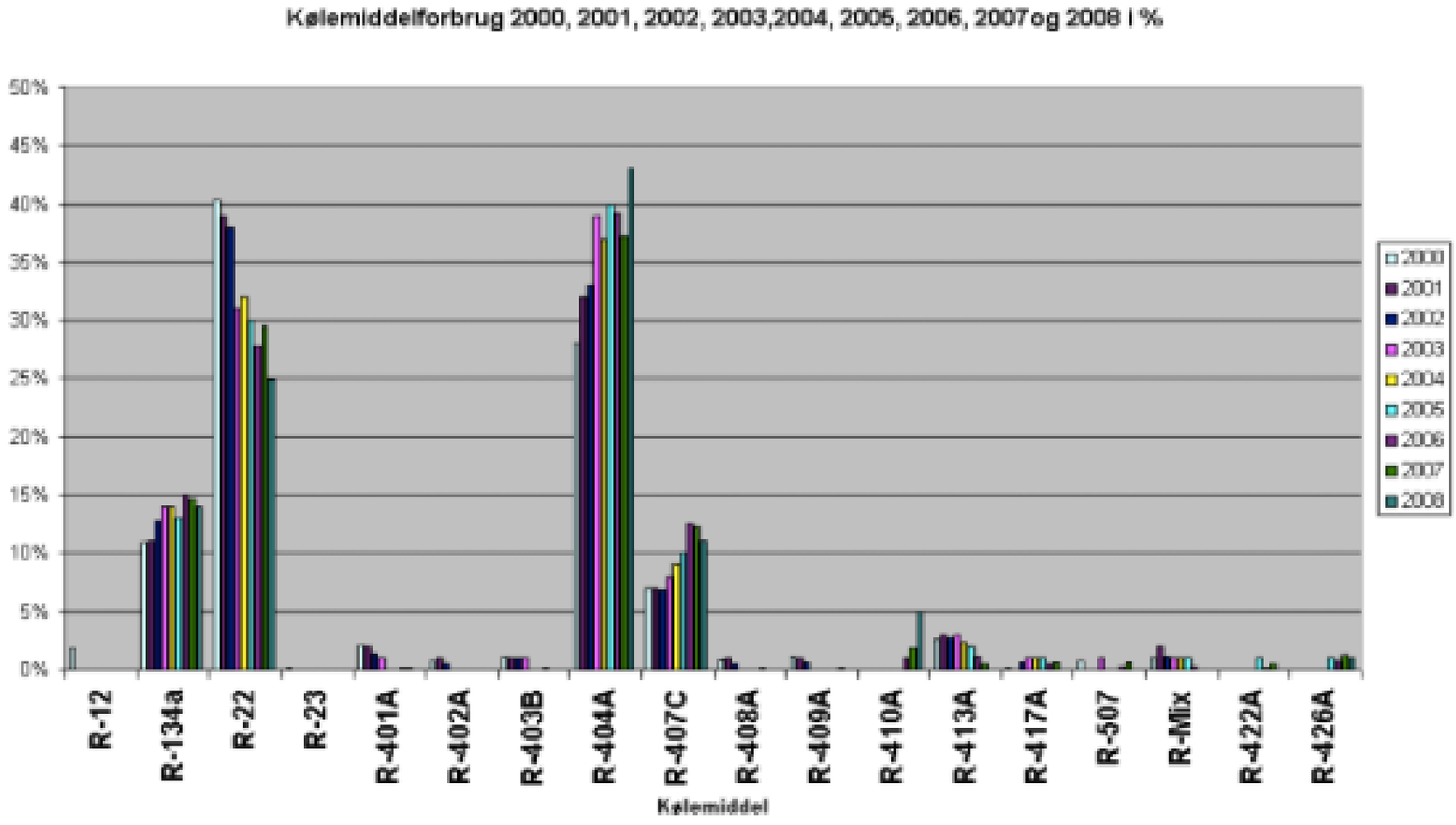
# Agenda

- Running conditions
- Systems
- How does it compare to cold climates
- An example from a warm climate
- Conclusions

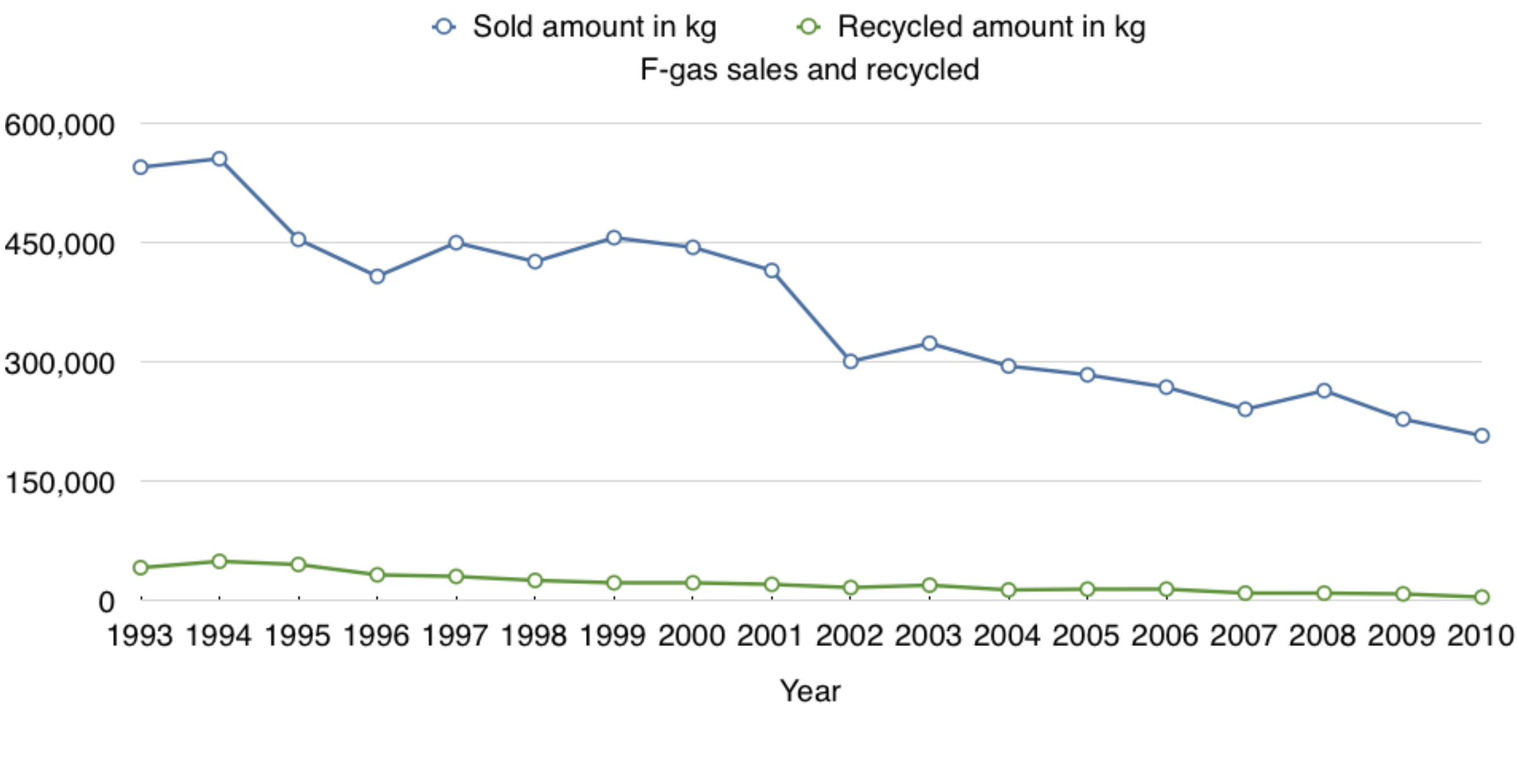
# Temperature conditions

- Condensation in many systems need to be kept over 30C
- Condensing pressure is kept up in cold climates by using cold ambient kits
- In cold climates about half of the refrigerant consumption goes to AC systems and a bit more in the warmer climates
- Industrial systems are normally designed case by case and yield a better efficiency and at a higher price - Reliability is more important than in AC systems and the losses are much higher if the cooling fails

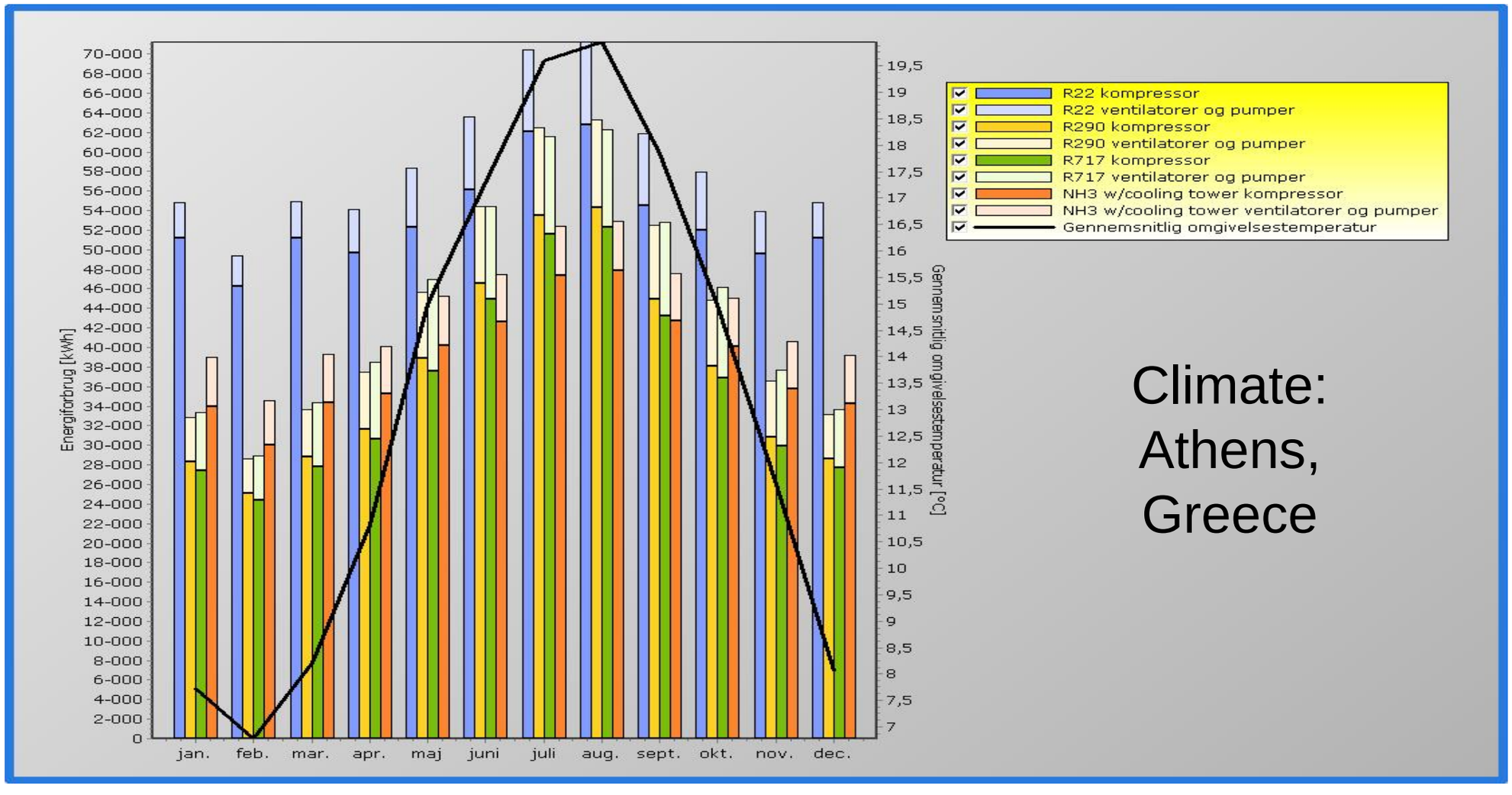
# F-gas consumption in DK



# Sales and recycling in DK



# Process -10C/40C, capacity 300 kW

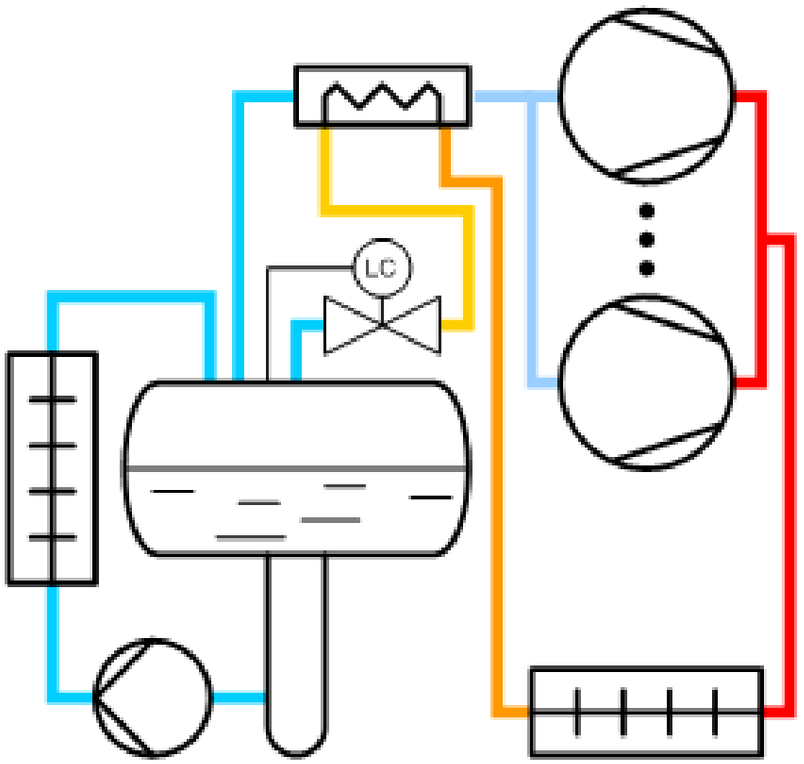



Climate: Athens, Greece

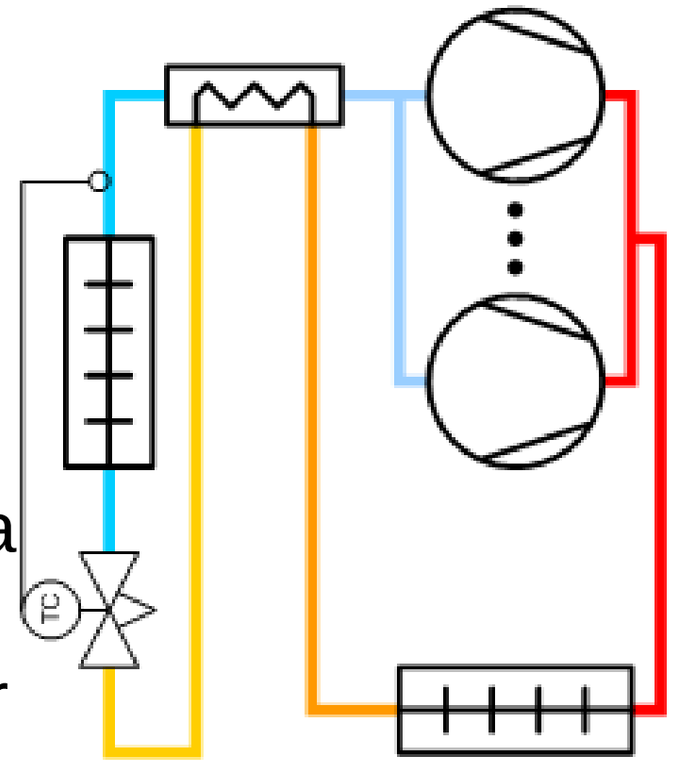
# Savings

| | R22 (reference) | R290 | R717 | NH3 w/cooling tower |
|---|---|---|---|---|
| Capacity fullfilment | | | | |
| % af time: | 100,0 | 100,0 | 100,0 | 100,0 |
| % af energy: | 100,0 | 100,0 | 100,0 | 100,0 |
| COP | | | | |
| Average COP [-]: | 3,52 | 4,73 | 4,68 | 4,75 |
| Energy consumption | | | | |
| Pumps and fans [kWh]: | 66,874 | 75,911 | 96,352 | 58,661 |
| Compressor [kWh]: | 638,526 | 449,643 | 434-327 | 464,686 |
| Total [kWh]: | 705,400 | 525,554 | 530-679 | 523,347 |
| Savings | | | | |
| Yearly energy savings [kWh]: | - | 179,845 | 174,720 | 182,053 |
| Yearly energy savings [%]: | - | 25,5 | 24,8 | 25,8 |

# Two concepts




Flooded system




Direct expansion

# Cold climates

- Compares to the same as the warm climates in the cooler period of year because the condensing pressure it kept up
- Normally done by turning of the fans on the condenser
- Some systems are more sensitive to temperature fluctuation than others - especially direct expansion and turbo systems have limits
- Keeping up the condensing temperature eliminates the biggest potential for energy savings

# What can be a barrier

- Logistics - supply of systems and new refrigerants e.g. CO2, R717
- Psychology - Human beings tend to resist against changes
- Good will - A positive will makes barriers manageable
- Wrong understandings on many levels - Pay back time, Training, safety
- Lack of competence and risk willingness - Consultants stick to what they know e.g. copy paste is more safe and less risky

# Big threats

- Patents covering specific business areas
- Standards limiting or preventing use of natural refrigerants

# An example

- An old installation from 1968 needed to be upgraded
  - The R22 system had to go out because the political climate
    - HFC was not seen as a long term option
    - $NH_3/CO_2$ cascade system was installed for the slaughter house
    - Next step is solar panels and heat pumps
- The company potentially can become a local supplier of $CO_2$

# From site

# Conclusions

- The differences between north and south are not as big as many think
- Energy savings have a price on first cost for first movers
- There is not a huge difference in how a system is running in cold climates and in cold climates
- Logistics, lack of trained personel on all levels, legislative measures are some of the barriers that has to be clarified
- Standards must not become a marketing object or object for creating hinderence for new technologies

# Conclusions

- The Commission has to keep an eye and if required interfere if standards can stop development in the direction wanted
- What has been done in DK can also be done elsewhere
- The path to follow will be different but if there is a will there is a way
- Others are already going down the route to an HFC free future all over the world in their own way

Thank you for your attention