Cold generation – New technologies? Developments and trends Chances and barriers

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WIRTSCHAFTSKAMMER ÖSTERREICH

eneral: historical development

Refrigeration technology

1824	Carnot basics
1834	Perkins (1. cold steam refrigeration machine)
1844	Gorrie (1. air compression refrigeration machine)
1860	Carre (1. absorption refrigeration machine)
1867	NH3 as refrigerant
1881	CO2 as refrigerant
1930-1936	safety refrigerant (FCKW)
Ca.1990 ..	FKW, HFKW
Ca. 2017..	LOW-GWP refrigerant?

Global impact of refrigerants

ODP	Ozone Depletion Potential
GWP	Global Warming Potential
TEWI	Total Equivalent Warming Impact

atus Quo and trends

- Cold demand is increasing further (increasing importance of refrigeration technology as cost factor)
- Cold steam process and absorption process stay the most frequent thermodynamic processes for cold generation
- Cooling without refrigeration machines will increase
- Combined refrigeration/heat pump operation will increase
- Trend towards proven natural refrigerants (again)
- For synthetic refrigerants: switch to low-GWP-refrigerants
- Energy efficiency law leads to continuous demand for improvement
  - Implementation of energy management systems
  - Using the possibilities of energy monitoring systems
- Cold supply instead of own cold generation will increase

rends: refrigerants

Return to natural refrigerants (NH3, CO2)

- Proven technology
- High efficiency
- Low costs for refrigerants

Limitation of synthetic refrigerants (currently discussed in the EU respectively draft directive)

- Phasing out of synthetic refrigerants step by step
  - (GWP > 2.500, GWP > 150)
  - Depending of filling amount resp. product amount x GWP
  - First planned limitations for 2017 !!!!!
- Expensive new LOW-GWP refrigerants
- No long term experience (especially normal cooling and deep-freeze cooling)
- LOW-GWP refrigerants have “low flammability“

rend: efficiency and sustainability

In refrigeration and air-conditioning technology key words are used for promotion:

- efficient
- sustainable
- Advanced technology
- Environmentally friendly
- ....

rend: efficiency and sustainability

Questions:

- What is in fact efficient?
- Are the promoted products really more efficient than those used so far?
- Is an efficient plant “environmentally friendly”?
- Is everything done as soon as an “efficient plant” is purchased?

rend: efficiency and sustainability

Factors of influence on plant efficiency:

- Usage temperature
- Re-cooling temperature
- Refrigerant
- Process
- Quality of devices
- Mode of operation, regulation
- Etc.

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w was this in the past?

- Compressor: Linde L180 (NH_3, BJ 1934)
- Operation: 0=-10°C, tc=25°C
- Drive capacity shaft: 11,0 kW
- Refrigeration capacity: 49,5 kW
- EER: 4,5

rend: efficiency and sustainability
he bad news 1)

	LINDE L180	Moderner Scroll
frigerant	NH_3	R410A
int of operation	-10°C/25°C	-10°C/25°C
frigeration capacity	49,5	52,1
ive capacity	11,0	11,56
R	**4,5**	**4,51**

k: The direct comparison is not completely correct as ive capacity refers to shaft capacity for the „historical ne“ and to electrical power input of the compressor for the modern machine!

79 years “technical process“

rend: efficiency and sustainability
he bad news 2)

ny refrigeration plants do not work properly

me reasons:

- Best price principle when awarding the contract (quality costs, but pays during operation time)
- Only short pay-back periods allowed for efficiency improving concepts
- Investors passes (operation) costs down to the users
- Low planner’s fee
- Lack of know-how in the field of refrigeration technology (planners and companies carrying out the work)
- Time pressure during erection (initial operation, trial operation)
- No efficient on-going monitoring
- Etc. etc

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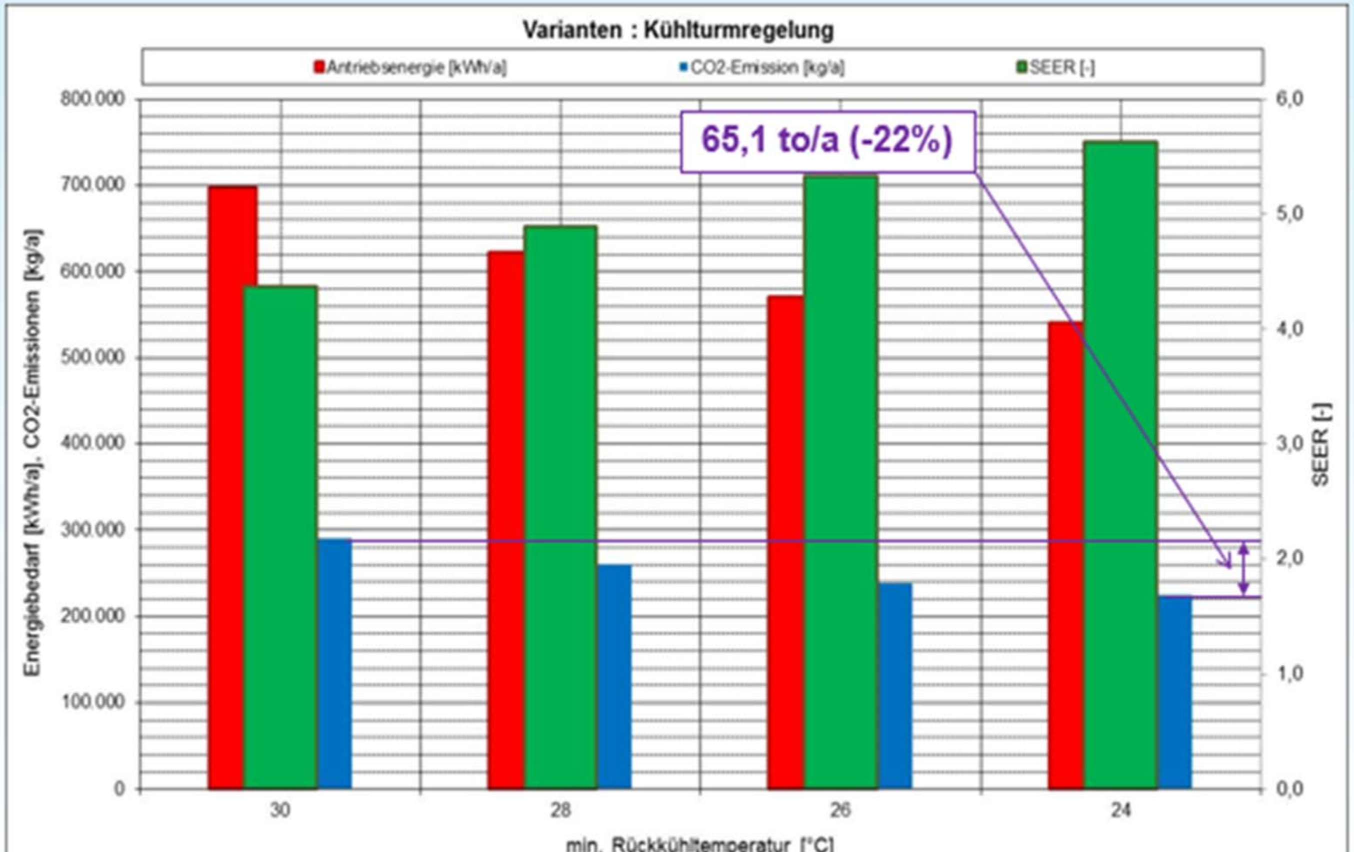
he good news)

Effizienz: Turboverdichter (var. Drehzahl) bei versch. min. Rückkühltemperatur



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he good news)

oling without refrigeration machines:

Free-cooling in winter

- For year-round loads
- Mostly, very short payback times
- Gliding cold water temperatures for maximization of FC operation hours

Cooling with cooling towers (without refrigeration machines)

- Trend in computer centres towards higher allowed computer centre temperatures allows yearlong cooling of the computer centres with cooling towers

rend: efficiency and sustainability

mbined refrigeration machine / heat pump operation:

- Simultaneous demand of cold and heat (preferably, taking both energy forms completely)
- Cold or heat driven operation

ample efficiency increase:

ld only: EER = 4

at only: COP = 5

ng both heat and cold completely : ETA = 9

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mmary 1:

- Plant efficiency basically depends on usage conditions and mode of operation!
- The most efficient plant technology may not compensate for inappropriate mode of operation!
- An optimised plant operation (e.g. lowest re-cooling level possible) offers high saving potential for drive energy and with it CO2-emissions (without relevant costs)
- Highly efficient machines are not an invention of today, they were available ca. 80 years ago

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mmary 2:

Do efficient machines contribute to environmental protection?

- YES

  The lower drive energy demand leads to lower CO_2 emissions in electricity generation!

Do efficient machines contribute to environmental protection?

- NO

  Every new (additional) machine (even the most efficient) leads to an additional drive energy demand and with it to additional CO_2 emissions in electricity generation!

rend: cold supply

vantages cold supply (customer-side)

- Environmentally friendly cold supply
- RISK is shifted to the operator (district cooling) due to the contracting model
- More comfort ➔ no operation management of the refrigeration machine by the customer
- More space as refrigeration machines are not necessary (rental fees) for district cooling
- Architectural freedom (re-cooling tower on the building are not necessary) for district cooling
- Guaranteed future of the investment (ban of refrigerants)
- Low service and maintenance costs

rend: cold supply

vantages cold supply (supplier-side, power utility)

- New product
- Customer retention (supply of the customer with “benefits”)
- Overall energy supplier of the customer
- Use of excess (district) heat in summer (use of absorption refrigeration plants)
- Higher degree of capacity utilisation of the district heating grid
- Etc.

Thanks for your attention!