Sustainable, safe and efficient cooling in Data Centers with water as refrigerant

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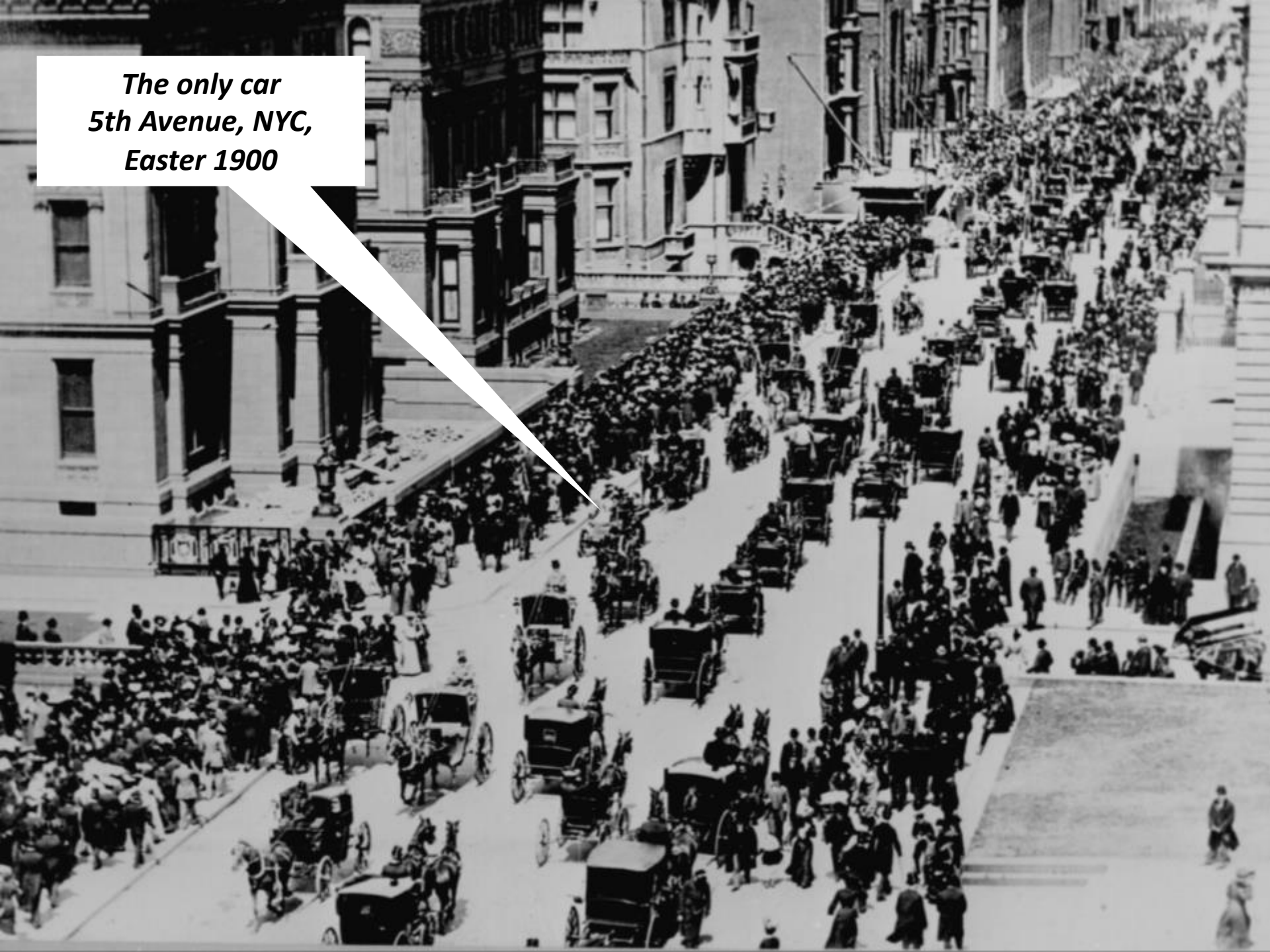
efficient energy

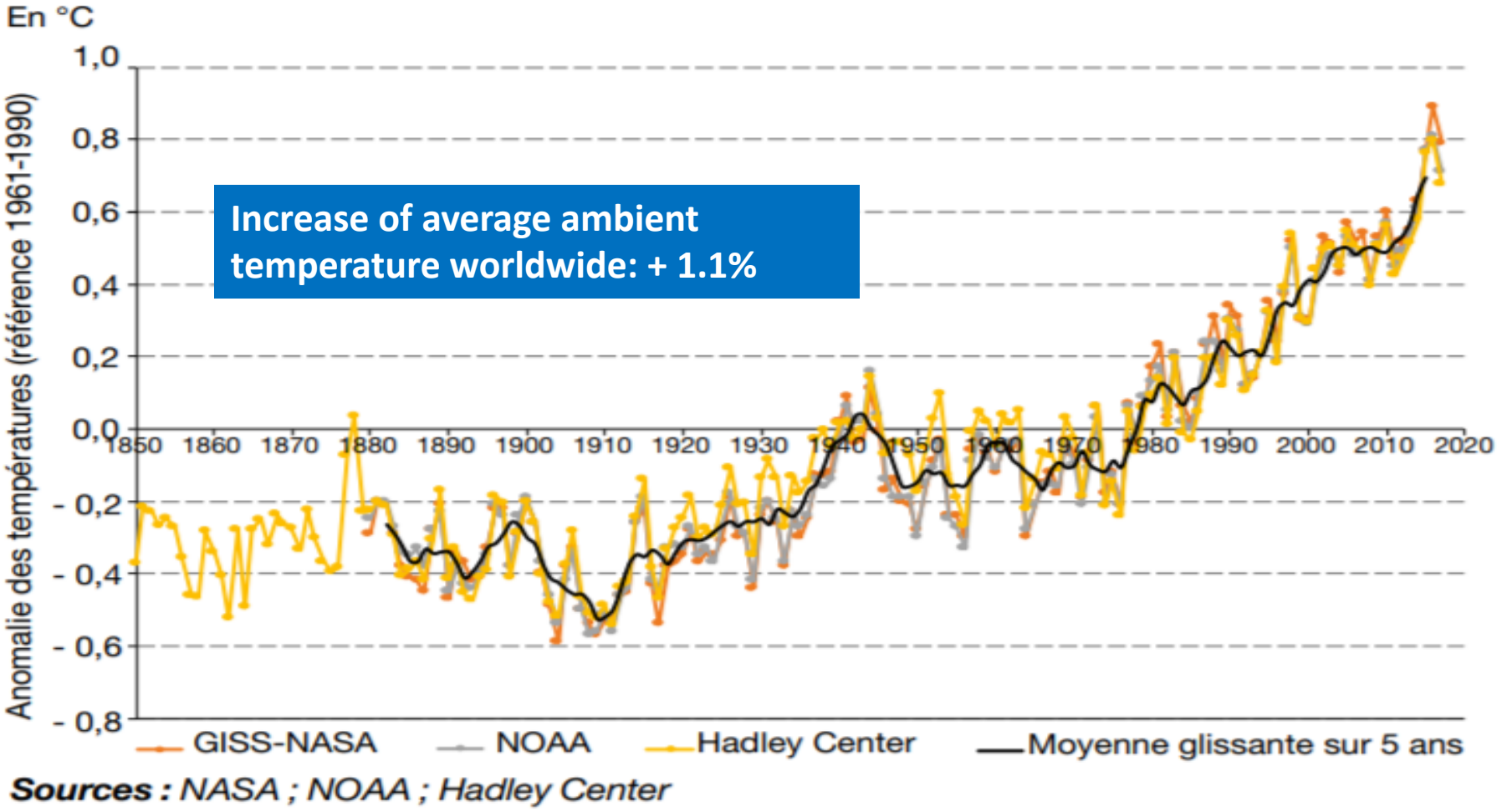
be part of tomorrow


The only car
5th Avenue, NYC,
Easter 1900

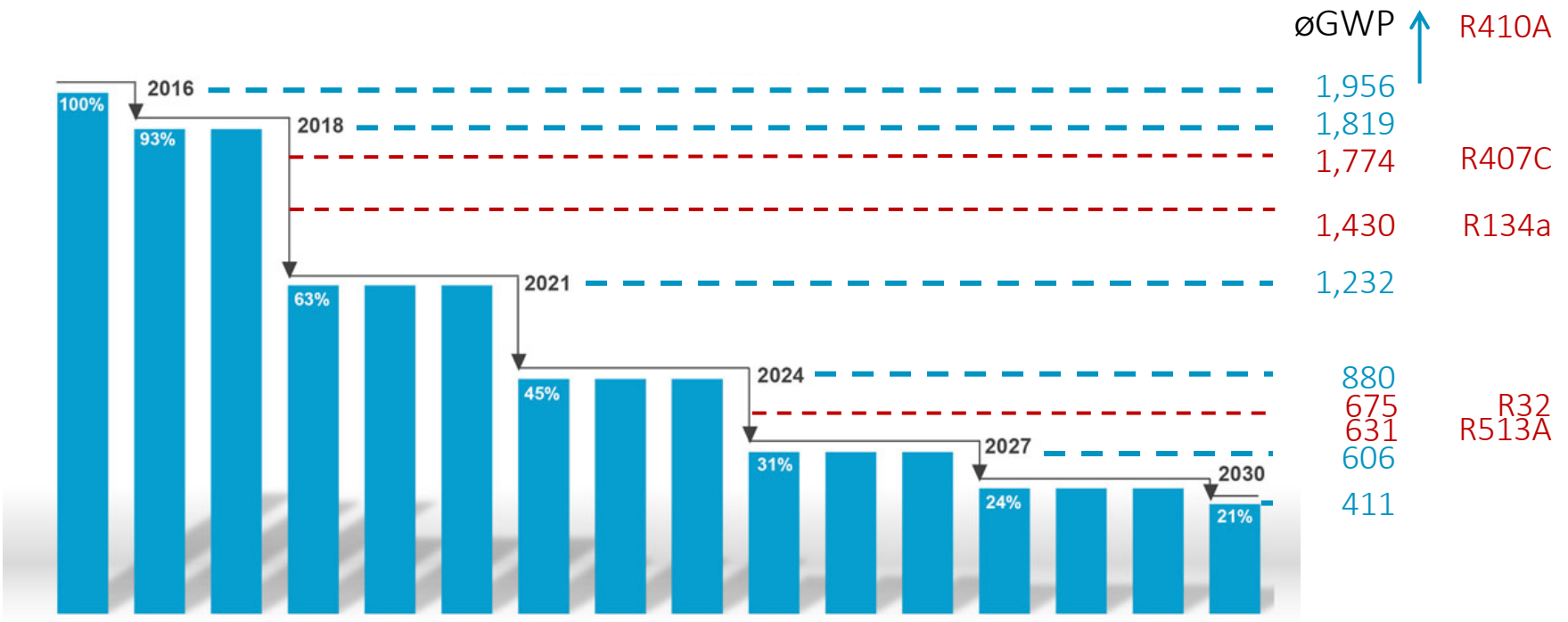

Alterations are Completed
Building will be Occupied by
PALDING & BROS.
at 25 West 42nd St.
24933 NY
30191
3529-8


The only horse
5th Avenue, NYC,
Easter 1913
24933
30191
57041

Impact of CO2-Emissions on our climate



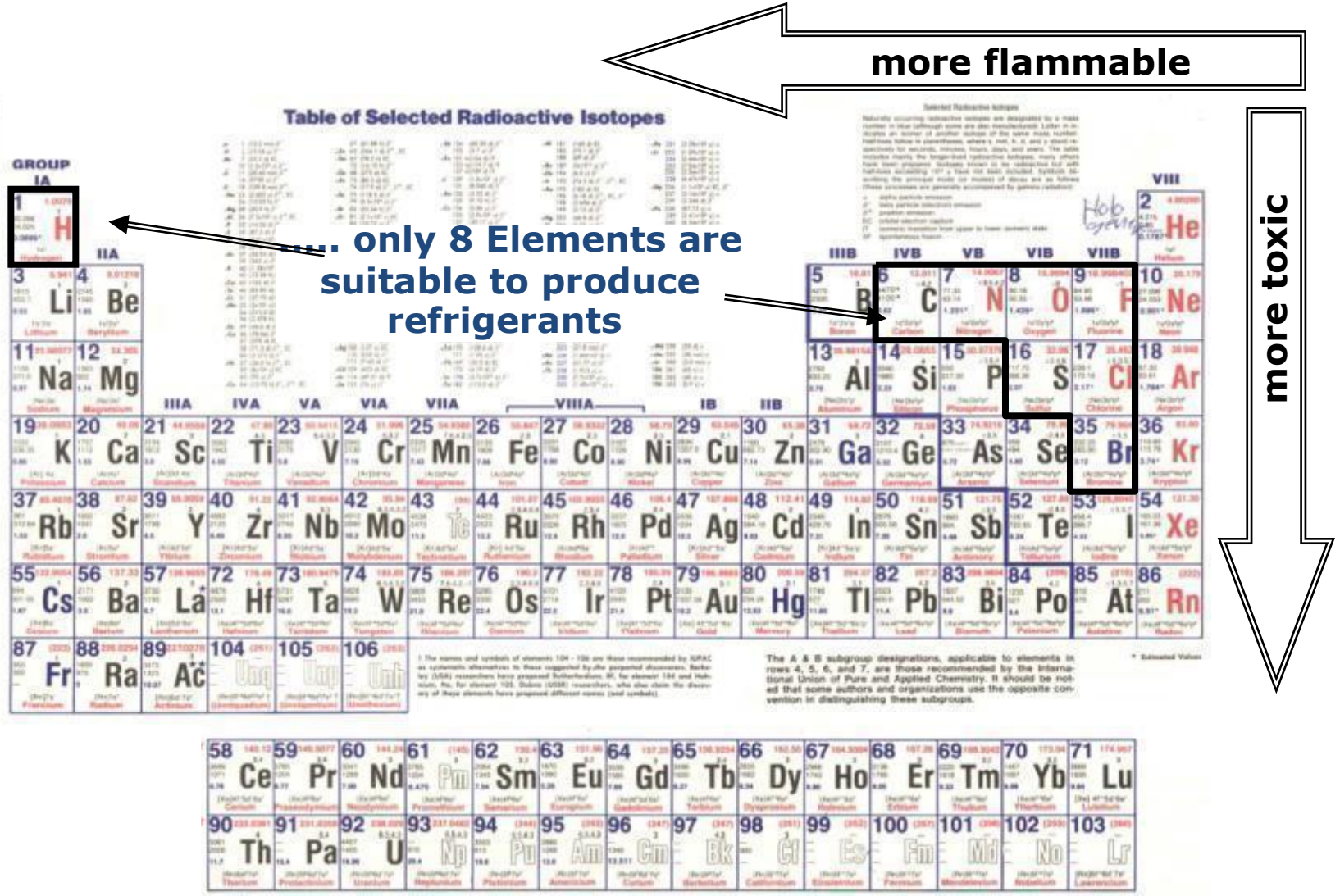
F-Gas-Directive – Phase Down & øGWP



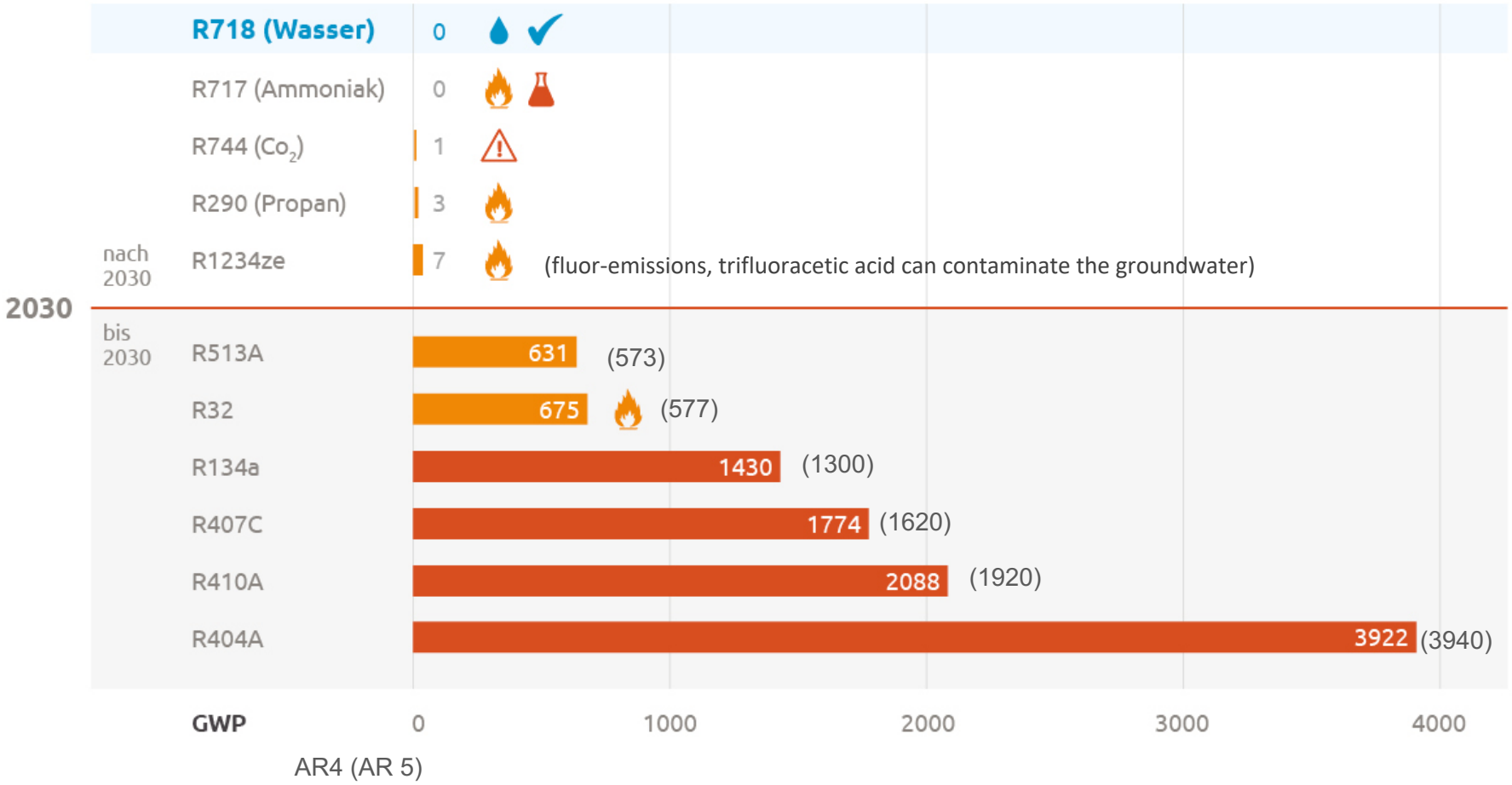
The availability of the HFCs is limited step by step due to the possible average GWPs.

Source øGWP:
Öko-Recherche GmbH

Refrigerant options



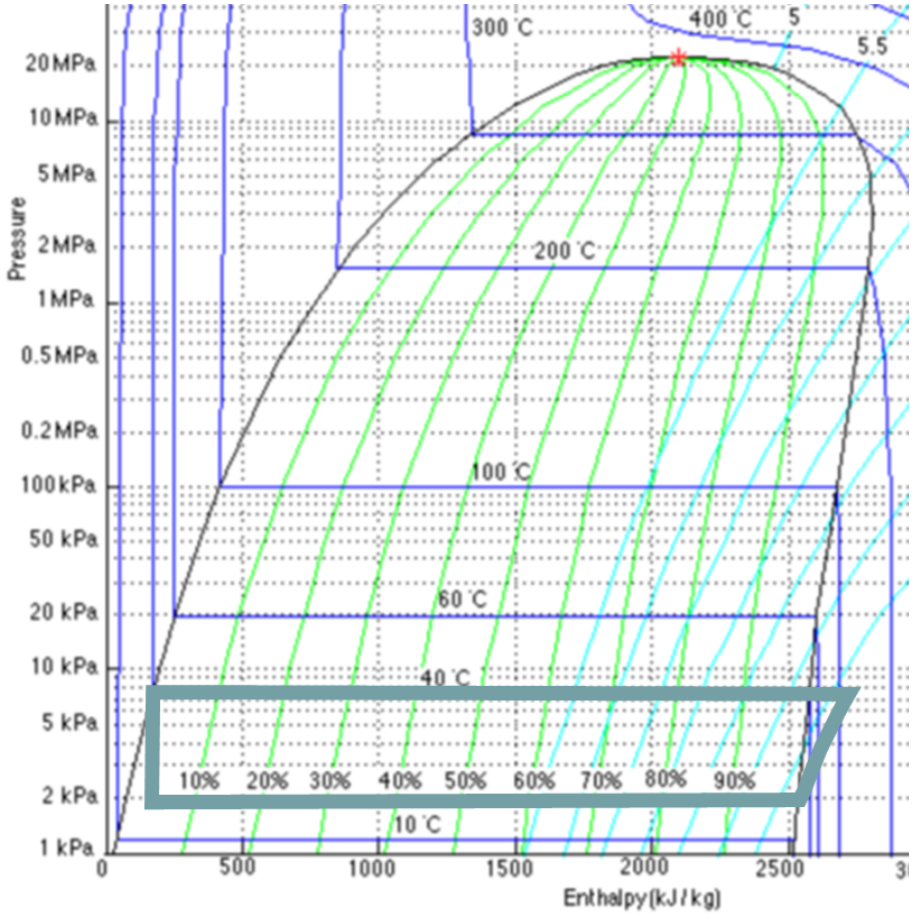
HFCs and natural replacements

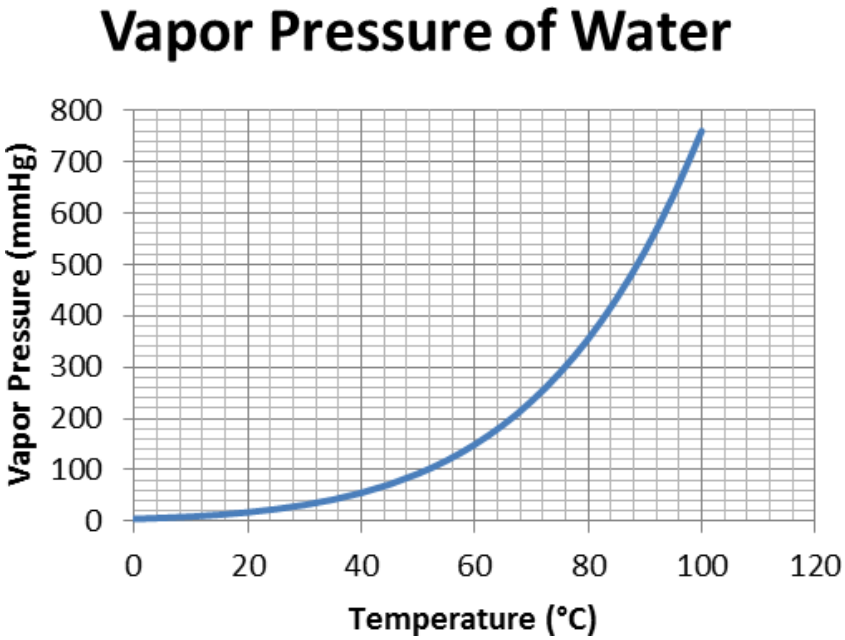


What makes a good refrigerant?

- Physical properties
  1. Environmentally benign (Low GWP, no ODP, biodegradable)
  2. Vapor pressure curve (reasonable pressures for application)
  3. Low viscosity
  4. Distinct miscibility with lubricants
  5. Good water solubility
  6. High electrical breakdown resistance
- Chemical properties
  1. High chemical stability
  2. Low flammability
  3. High chemical indifference
- Physiological properties
  1. No toxicity
  2. noticeable smell
- Economical properties
  1. High energetic coefficient of performance
  2. Volumetric refrigeration capacity
  3. Circulating refrigerant mass
  4. Availability
  5. Cost

Water as refrigerant

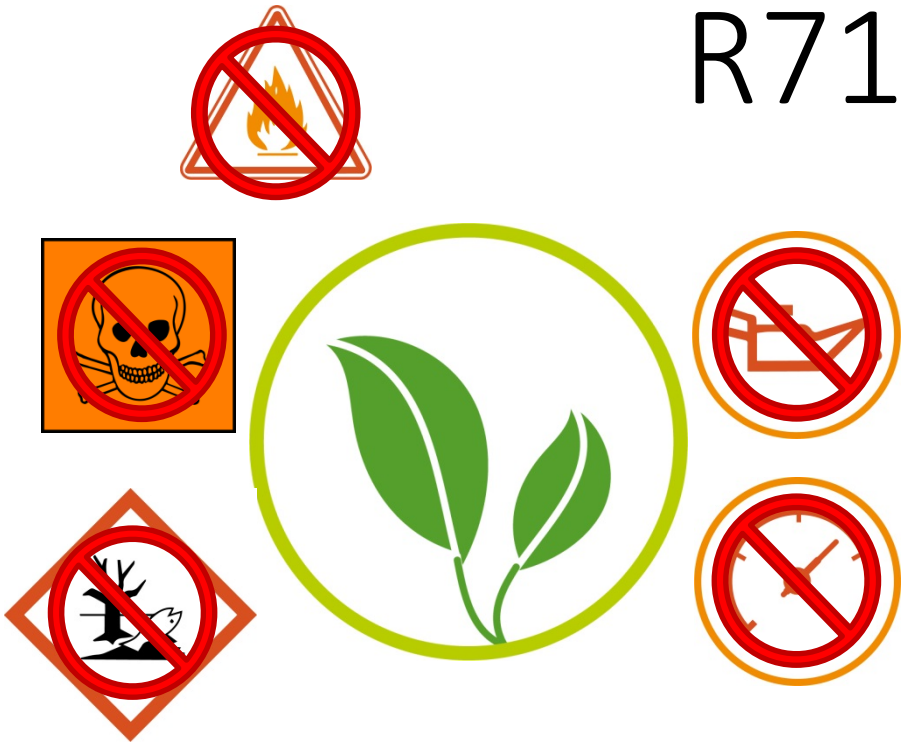




Log p-h diagram of water

Water as refrigerant - advantages

R718



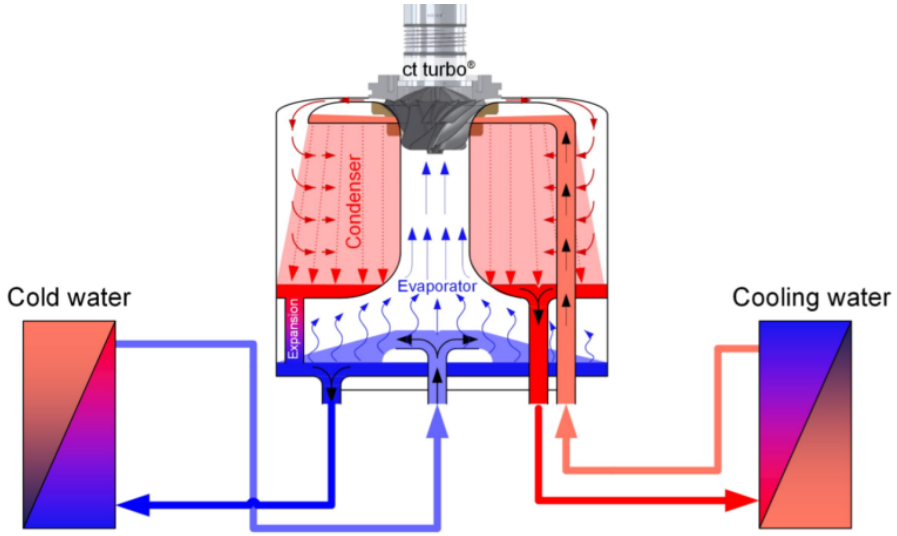
No chemical & physical risks

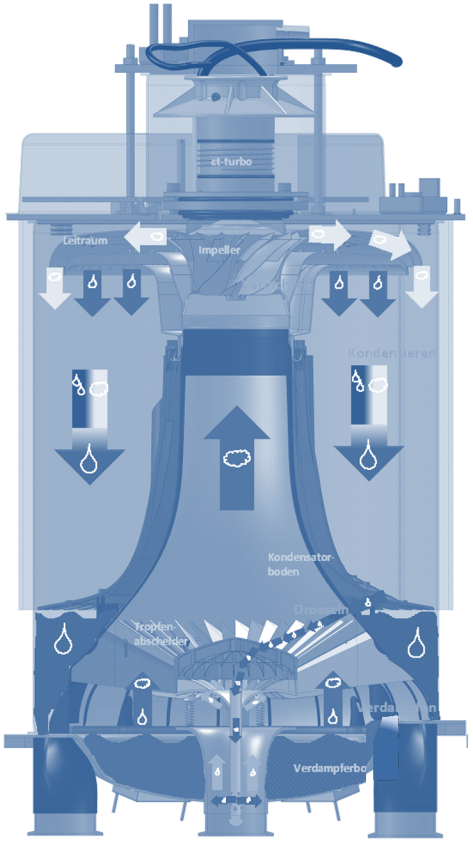
No
F-gas-phase down

No
EN378

No reductions or limitations

Water as refrigerant – working principle





operation under vacuum

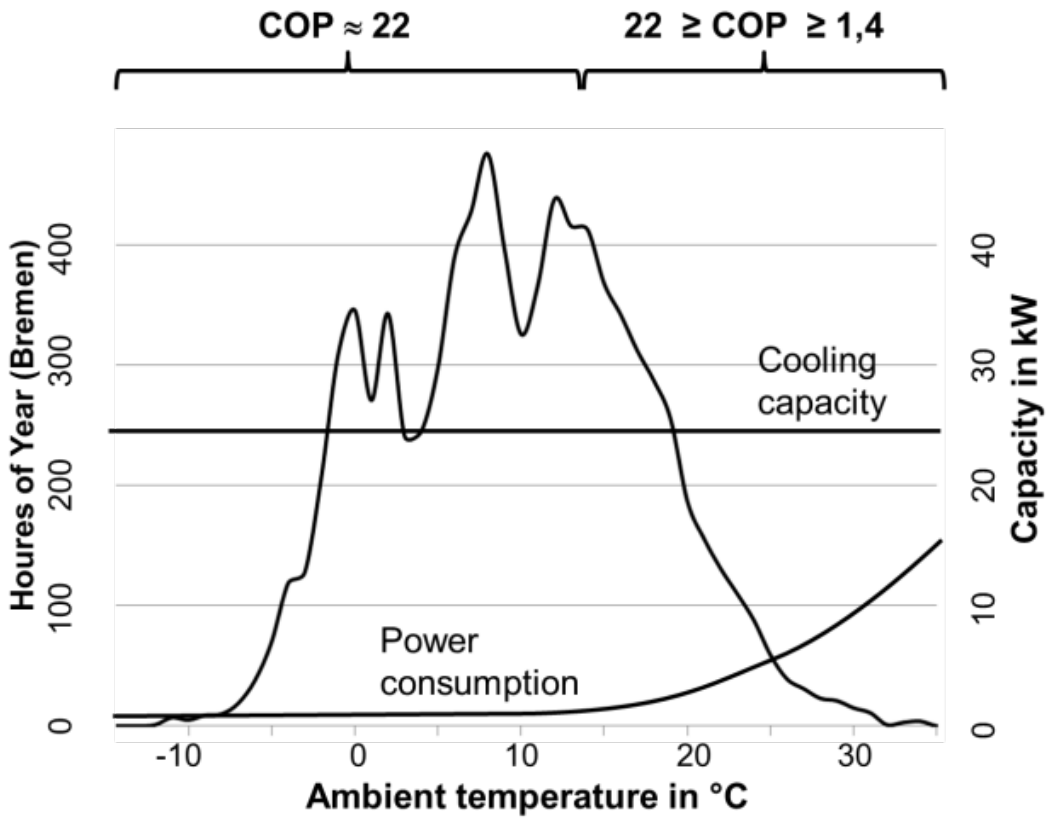
state	temperature	pressure
evaporation	16,0 °C	0,018 bar
condensation	52,0 °C	0,136 bar

Water as refrigerant – Application Examples

Project Specification:

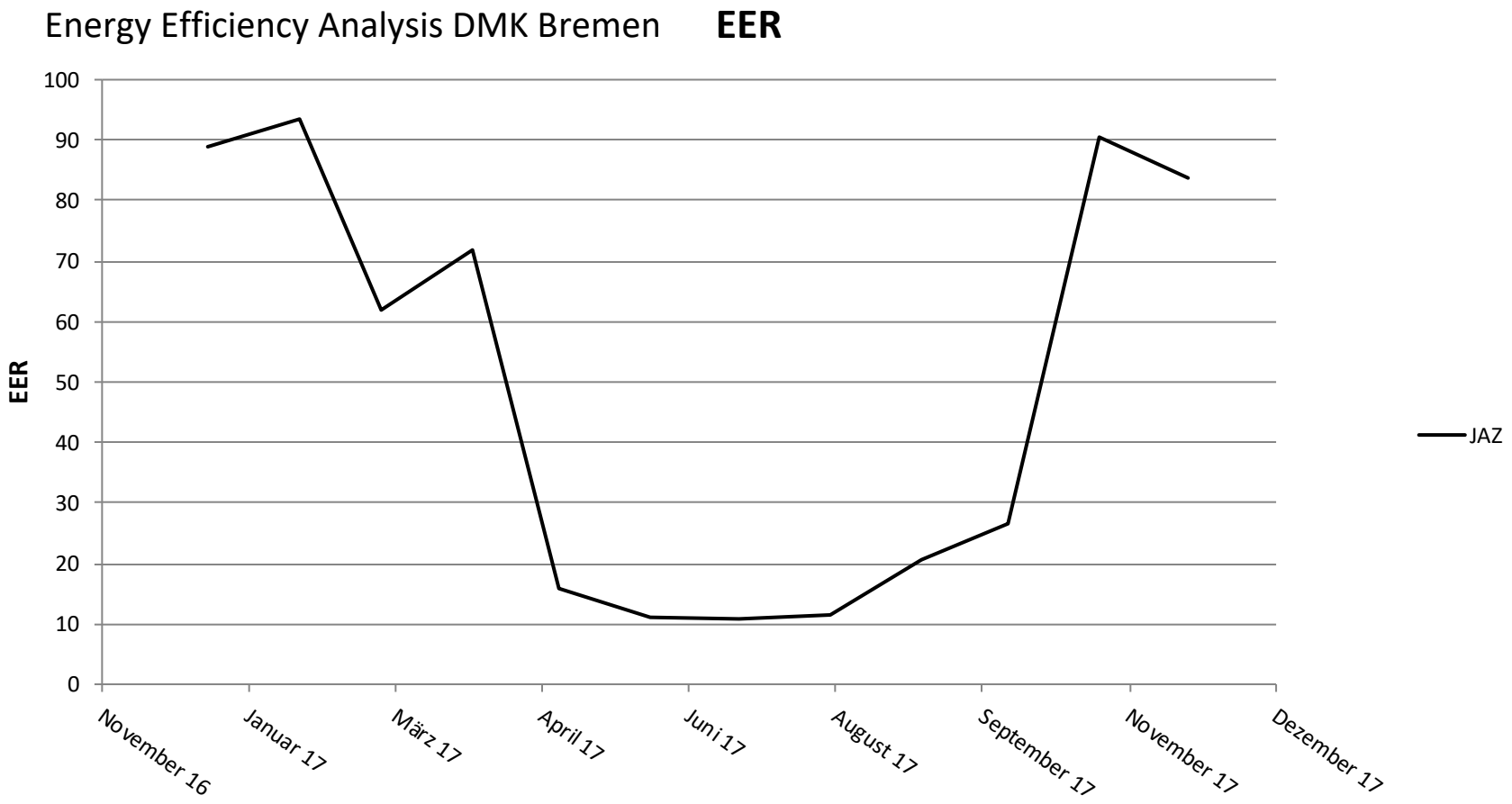
- Location: Bremen
- constant cooling capacity: 25 kW
- cold aisle temperature: 25° constant
- recooling: dry cooler

Water as refrigerant – Application Examples



- Ambient temperature distribution at the location of the unit
- Cooling capacity 25 kW all year
- Power consumption of unit rising from 1,1 kW (free cooling mode) to 17 kW (two stage operation)
- COP is rising up to 22 depending on operational mode

Water as refrigerant – Application Examples

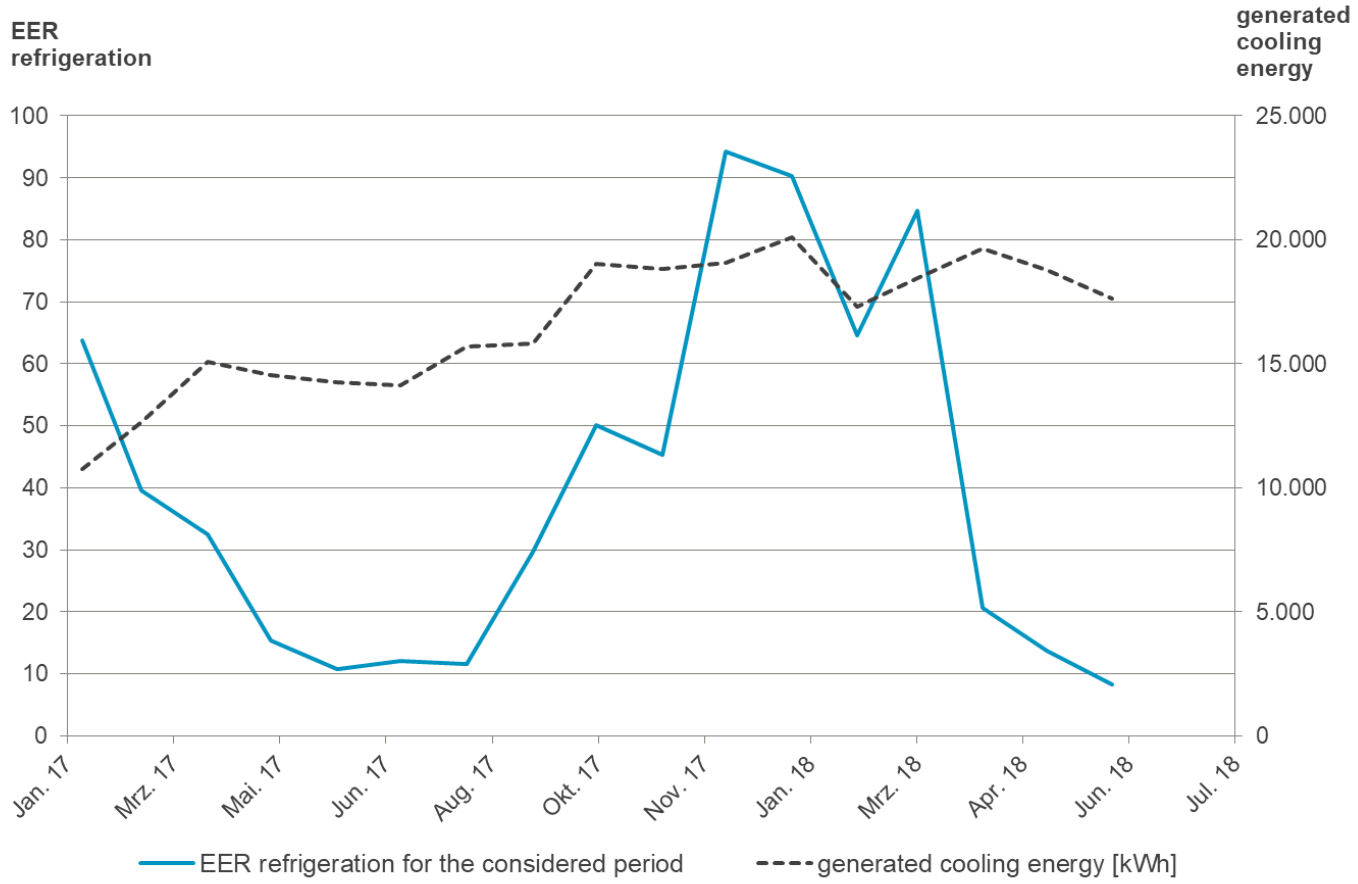


Water as refrigerant – Application Examples

Project Specification:

- Location: Calw (South Germany)
- constant cooling capacity: 35 kW
- Chilled water supply: 19°C
- Cold Aisle temperature: max. 25°C
- recooling: dry cooler

Water as refrigerant – Application Examples



EER for the considered period: 21

Water as refrigerant – Application Examples

Project Specification:

- Location: Weilheim (South Germany)
- constant cooling capacity: 60 kW
- Chilled water supply: 16°C
- recooling: adiabatic cooler

Water as refrigerant – Application Examples

Cube Data Center BT: a Data Center within a Data Center in an enclosed housing/high-density area for one customer with special needs/demands.

- Cooling water supply through central cooling water system.
- Chilled water setpoint temperature: 14°C
- Cold Aisle Temperature: 20°C
- cooling supply of 70kW
- Initial cooling capacity: 10kW
- Integrated Master Slave Control System
- Same system setup 2 x in Hamburg, 1 x in Berlin

Key advantages for Data Centers

- Unlimited refrigerant availability at low costs, no shortcuts
- no legal restrictions
- no safety and gas warning installations necessary
- no specialized refrigeration technicians necessary
- no regular leakage checks (DIN EN378 doesn‘t apply)
- low pressure systems with no hazards and risks for the operating personnel
- due to the above, minimazitation of downtimes
- high chilled water outlet temperatures
- very low energy costs due to integrated free cooling

Questions?

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