

SIMON SCHLENKER & YANNICK FRIESS

BOTH GERMANY

SCHLENKER ARCHITEKTEN / CALDOA GMBH

CO2 Neutral Ice Power Plant



Energy-efficient redevelopment of ice
hockey rinks in Germany
Schlenker Architekten & caldoa GmbH
Approaches and experiences



Energy-efficient redevelopment of ice hockey rinks in Germany

Company introduction



SCHLENKER ARCHITEKTEN

Founded 1956 by Christian Schlenker

Continuation 2002 by Uwe Schlenker

Uwe Schlenker

Self employed architect BDA

Self employed city planner

Honorary post:

6 years on the board of "Wild-Wings" and head of the professional department

8 years on the board of "Wild-Wings Future"

Silke Schlenker Dipl.-Ing. (FH)

Industrial Engineer

Honorary post:

20 years off-ice official (youth)

Team manager, supervisor/equipment manager

Simon Schlenker

B.Eng. Architecture / B.Eng. Industrial Engineering

18 years as a hockey player (Wild-Wings Future/Wild-Wings)



Levi Schlenker



Simon Schlenker



Jonas Schlenker



Helios Arena



Sport Arena Ellental (second price)



Curt Frenzel Stadion



Ice Hockey Rink Landshut (part of design team)

Company introduction



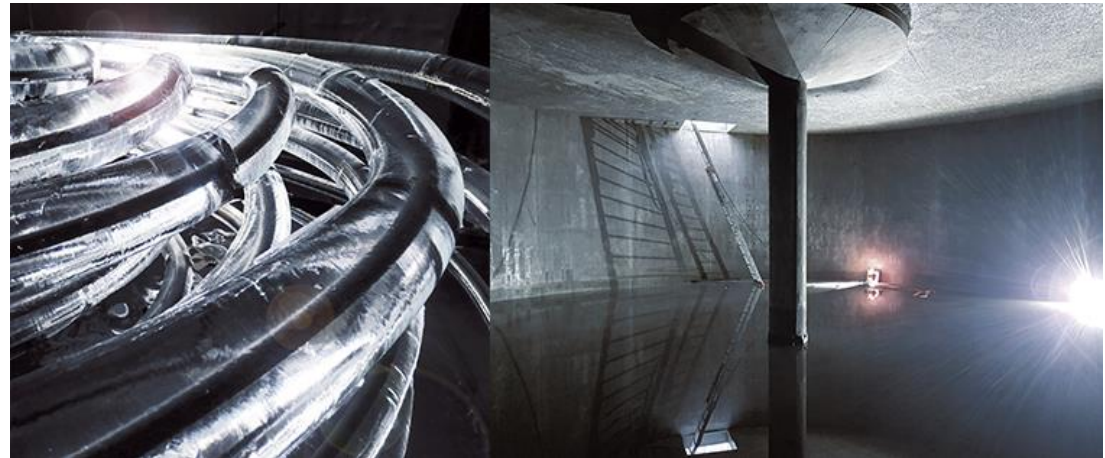
CALDOA GMBH

Innovative heating and cooling systems based on ice energy storage

Holistic system solutions: System concepts with ice storage technology, heat pumps, technical central construction and automation

- Development of the seasonal latent heat energy storage (ice storage) 2003 in Friedrichshafen (Lake Constance)
- Location
 - Friedrichshafen: (Administration)
 - Karlsruhe: Technology and development
- Market sectors:
 - Commercial Buildings (office, industry,...)
 - Residential Buildings (MFH)
 - Low temperature district heating

Yannick Friess
Engineering & Innovation



Ice hockey in Germany



- | small municipal ice hockey rinks often in a bad state (energetically and therefore structurally)
- | lack of dehumidification leads to corrosion damage
- | often times it's missing entirely (just) because of high energy costs



Helios Arena – 2007 – before fully energetic and structural renovation after „Bad Reichenhall“



Sterzing – 2021 (nobody injured)



Bad Reichenhall – 2006 (15 people deceased)

Ice hockey in Germany



Goal:

| holistic moisture management

| Ice rink as a closed system to prevent influences from outside, regardless of the season



Condensation due to the ice rink being partially open



Formation of fog due to the ingress of warm and humid summer air

Standard ice hockey rink in Germany (status quo)



- | 4 different systems with different usage for making an ice hockey rink work
- | all producing (heat and cold) waste that cannot be used
- | no cost efficient use of the ice hockey rink (up to **-200.000€/year just cost of energy**)
- | as a result, the sport continues to decline because small clubs can no longer run their ice hockey rink economically



Ventilation

- ventilation
- dehumidification (consumes the most energy)
- not available in many current hockey rinks
- because of that structural damage



Heat

- Gas or oil
- not environmentally friendly
- costs keep rising (exponentially since 2022)



- purchased electricity (coal plant or gas power plant)
- transformer and local distribution
- costs keep rising (exponentially since 2022)

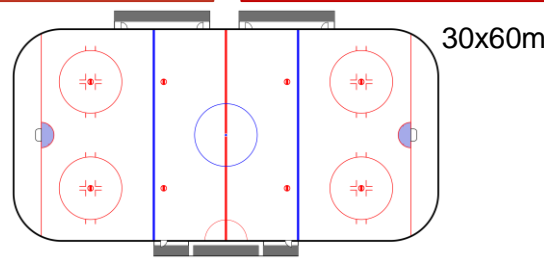


Electrical

- Ammonia (NH₃)
- potential danger
- harmful to the environment



Cold



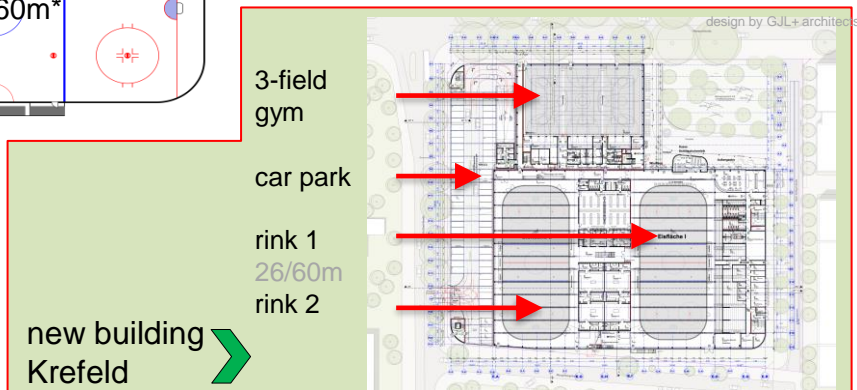
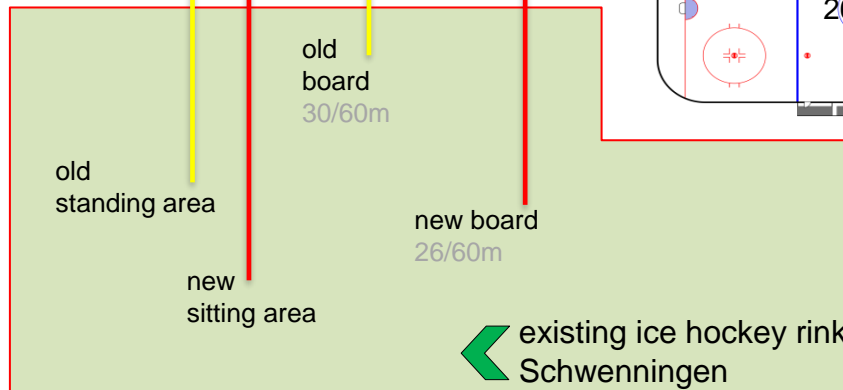
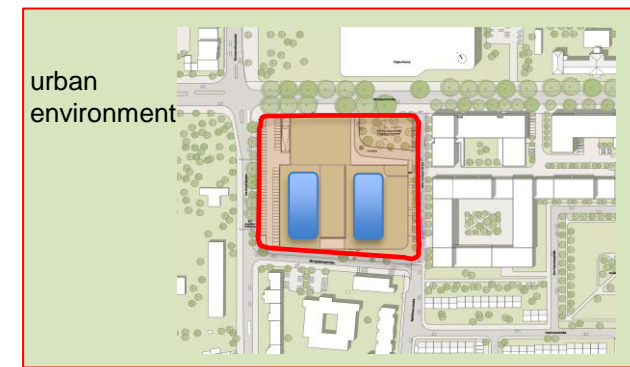
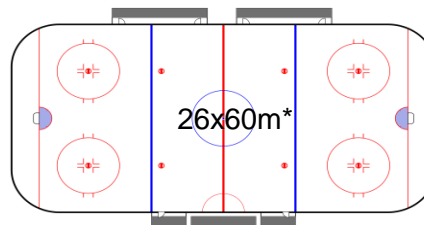
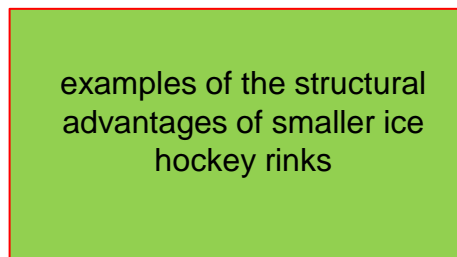
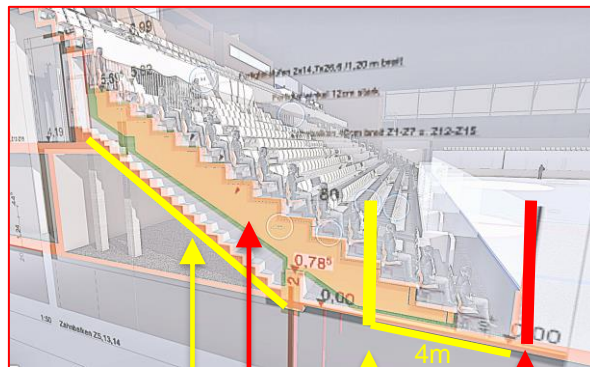
Energy-efficient redevelopment of ice hockey rinks in Germany

Steps to a CO₂-neutral ice hockey rink

| first step: reducing the playing area from european standard (30x60m) to north american standard (26x60m)

- | automatically -15% in energy costs (side effect: higher quality sport)
- | smaller facilities with less construction span = lower building- and maintenance costs, opportunities for renovation (audience expansion)

| one holistic glycol-based system (heat pumps) for all areas
| optimizing the use of heat and “cold” waste



* 1.2. DIMENSIONS

The official size of the Rink shall be 60 m long and 26 m to 30 m wide. The corners shall be rounded in the arc of a circle with a radius of 7.0 m to 8.50 m. Any deviations from these dimensions for any IIHF competition require IIHF approval.

IIHF OFFICIAL RULE BOOK 2023/24 – SECTION 01

Steps to a CO₂-neutral ice hockey rink

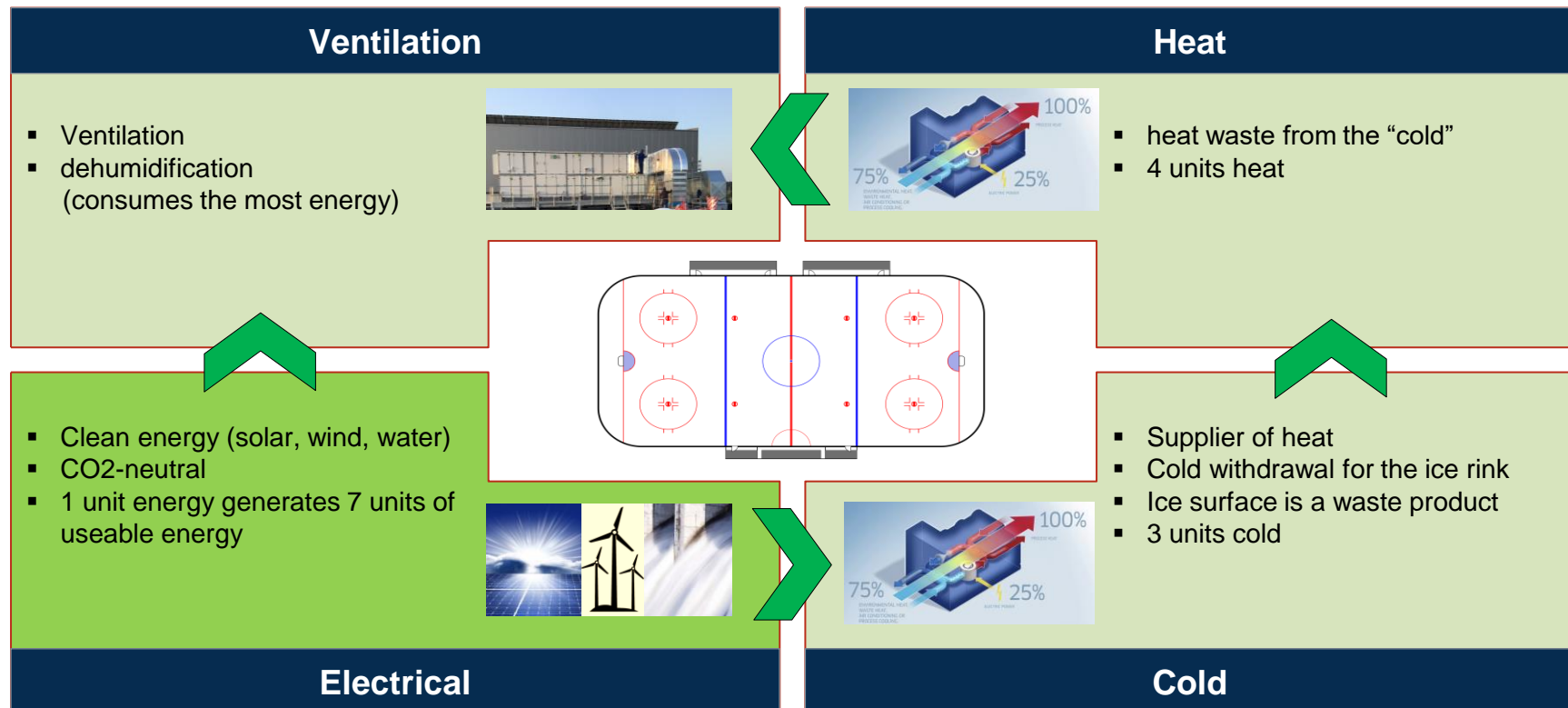
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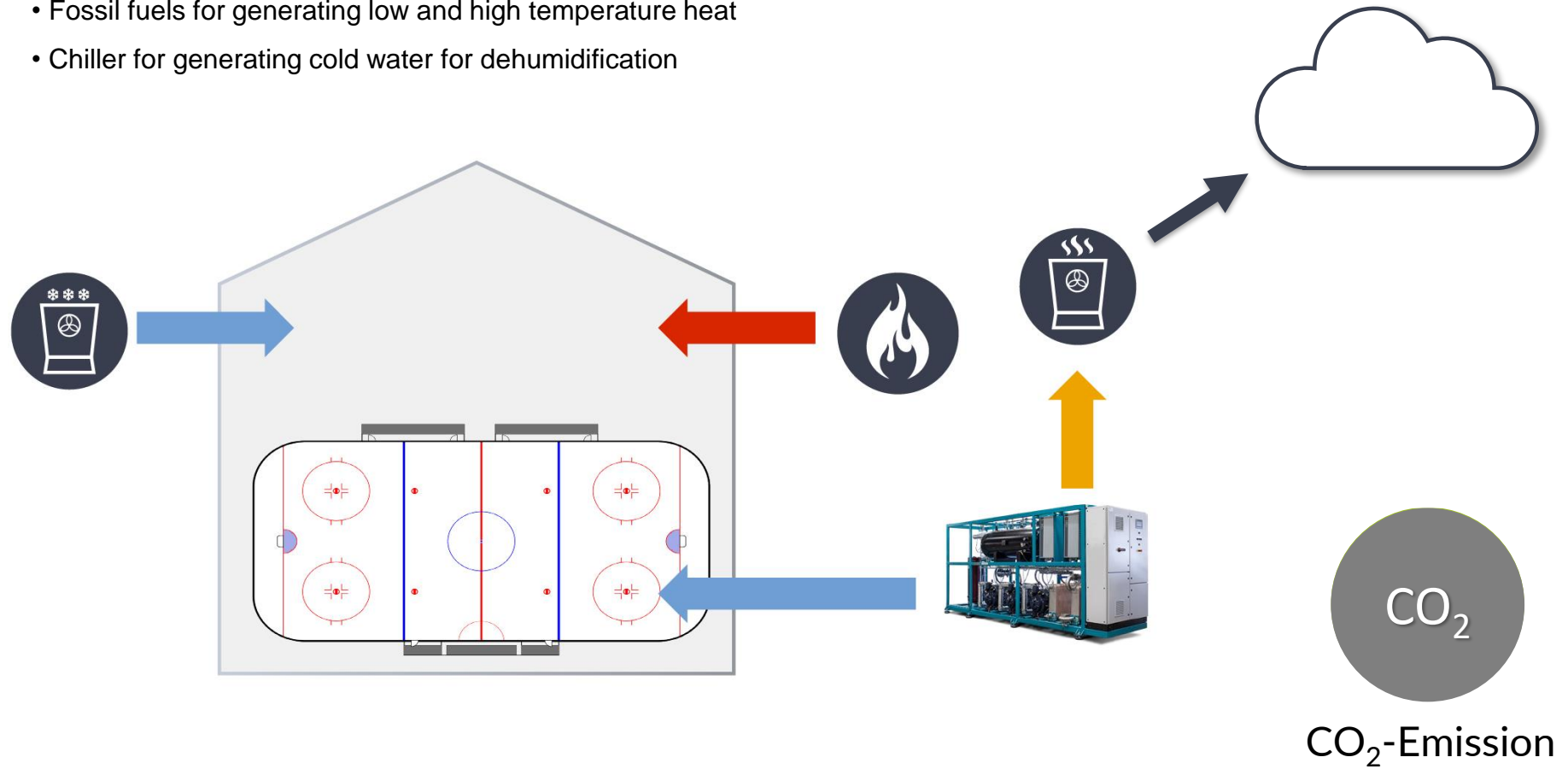
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Ice storage concepts for ice hockey rinks

Classic system for heating and cooling

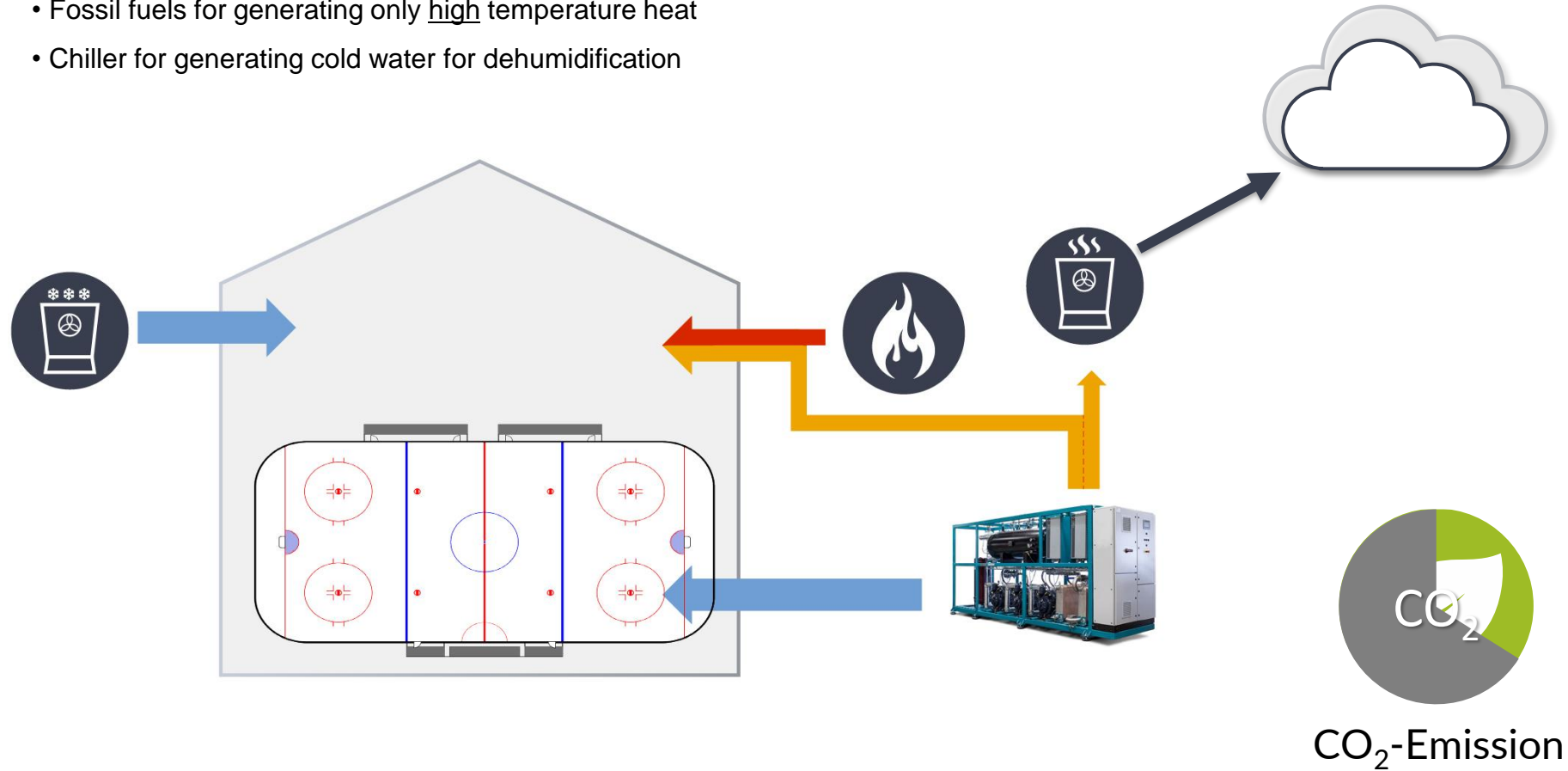
- Refrigeration system ice rink → excess heat to environment
- Fossil fuels for generating low and high temperature heat
- Chiller for generating cold water for dehumidification



Ice storage concepts for ice hockey rinks

Heat recovery of the refrigeration system

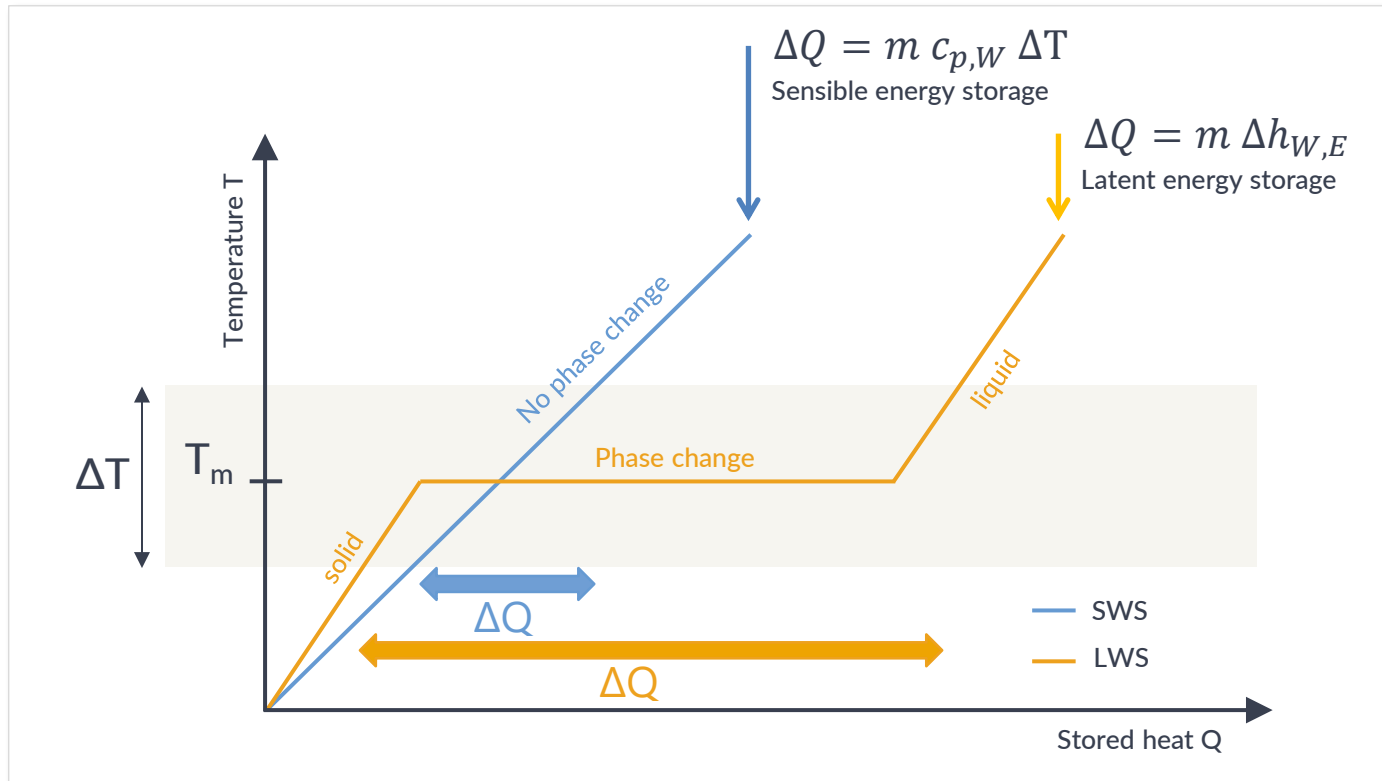
- Refrigeration system ice rink → less excess heat to environment
- Fossil fuels for generating only high temperature heat
- Chiller for generating cold water for dehumidification



How to use more excess heat? → Energy storage!

Ice storage concepts for ice hockey rinks

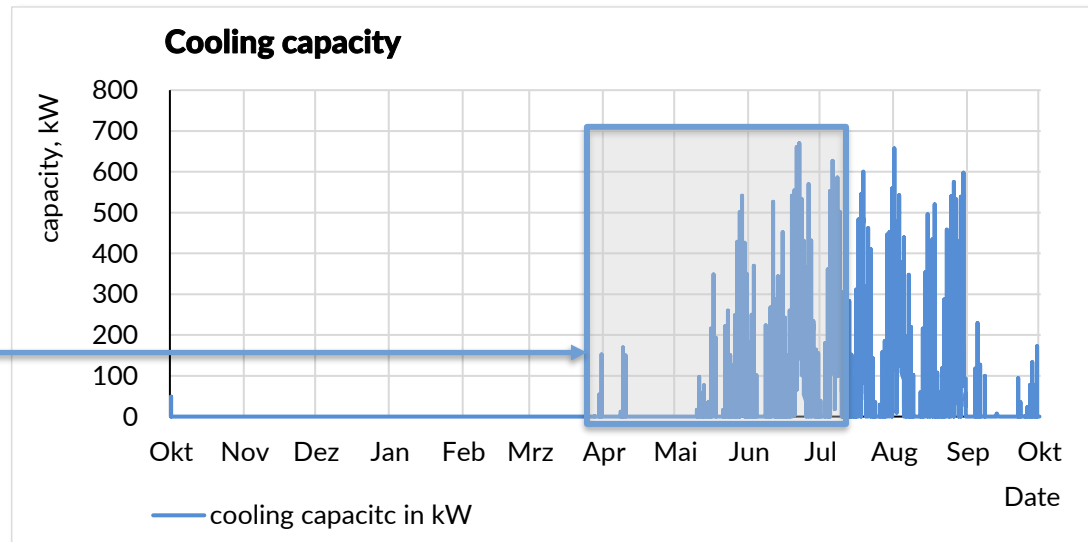
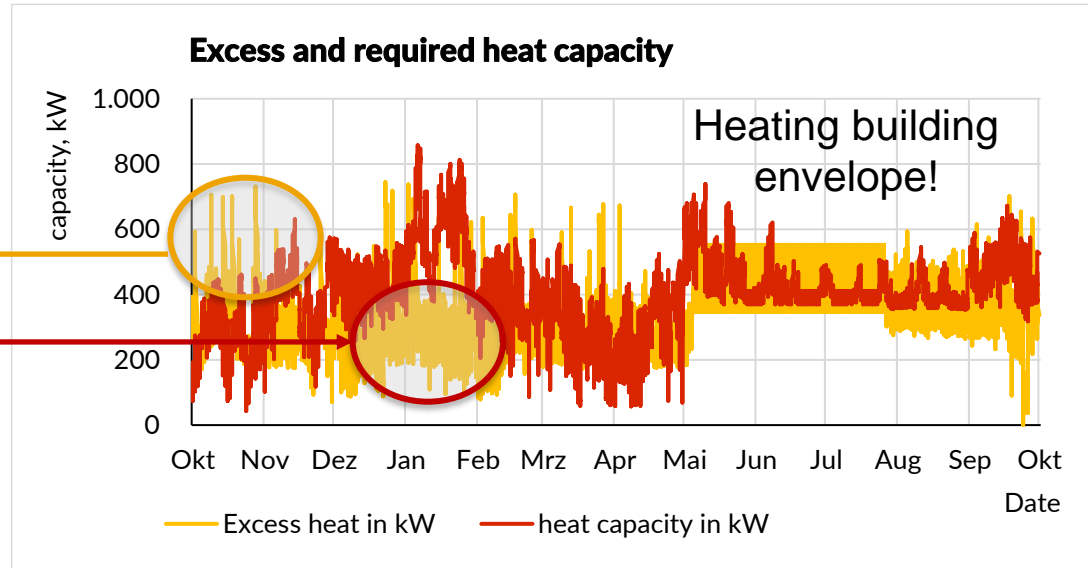
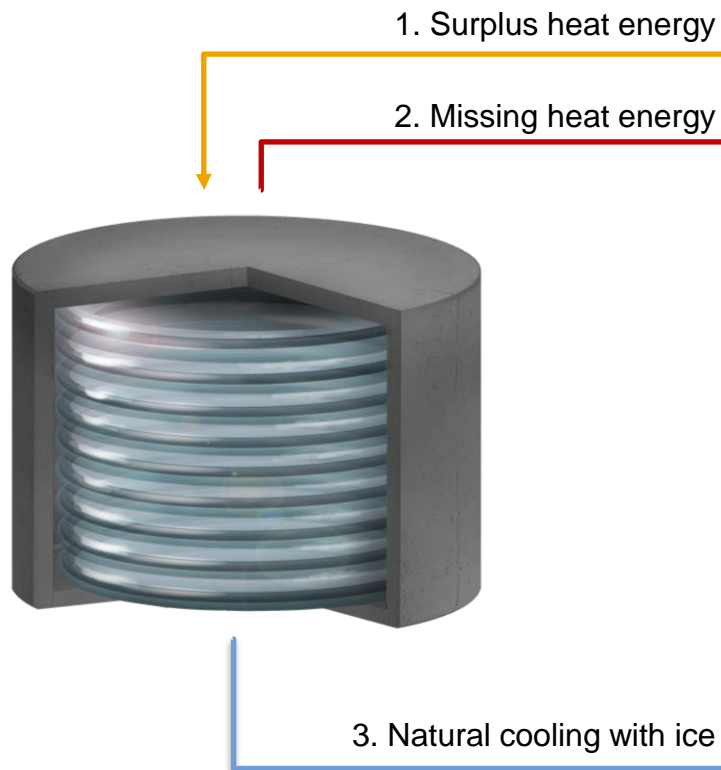
Sensible vs. latent energy storage



$$\Delta h_{\text{water,ice}} = 333 \frac{\text{kJ}}{\text{kg}} = 92,5 \frac{\text{Wh}}{\text{kg}}$$

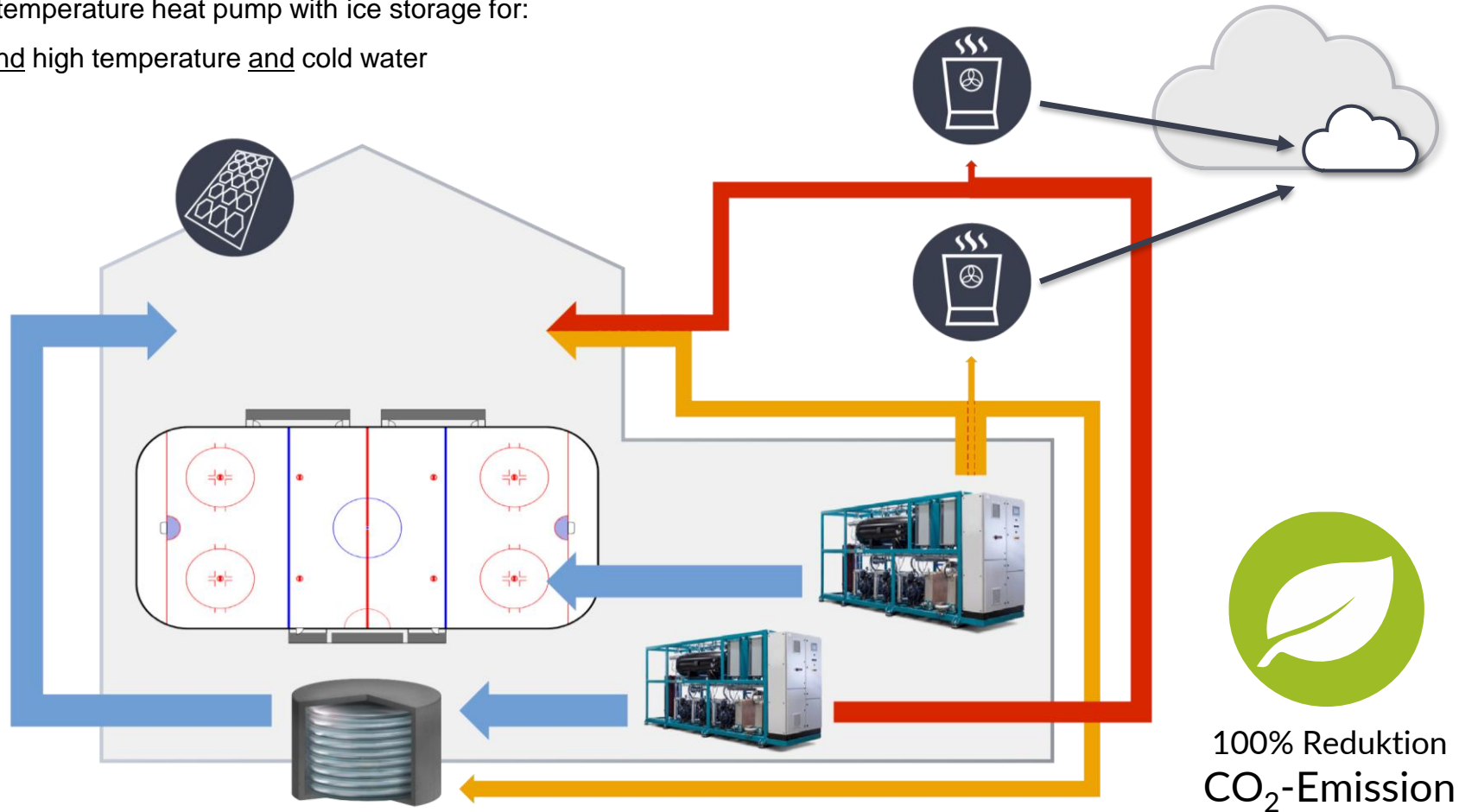
$$c_{p,\text{water}} = 4,18 \frac{\text{kJ}}{\text{kg K}} = 1,16 \frac{\text{Wh}}{\text{kg K}}$$

x80



Optimized heating and cooling supply → stand-alone solution

- Refrigeration system ice rink → min. excess heat to environment
- High temperature heat pump with ice storage for:
low and high temperature and cold water



Ice storage concepts for ice hockey rinks

Optimized heating and cooling supply → power plant solution

