How Thermal Ice Storage can Assist to Balance the European Power Grid in the Future.

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eurammon Symposium, 18th of June 2021

eurammon
refrigerants delivered by mother nature

How Thermal Ice Storage can assist to balance the European power grid in the future.

- Company Introduction
- Power Grid Issue
- Thermal Ice Storage
  - Concept
  - Types
  - Advantages
  - Applications & References
- Conclusion
- Open Discussion

Evapco

- Global, Employee Owned Company
- 26 Facilities in 10 Countries
- 170 Offices in 50 Countries

Evapco

Sustainable, Highly Efficient Energy Storage & Transfer Solutions for all Cooling Requirements

Thermal Ice Storage

Hybride

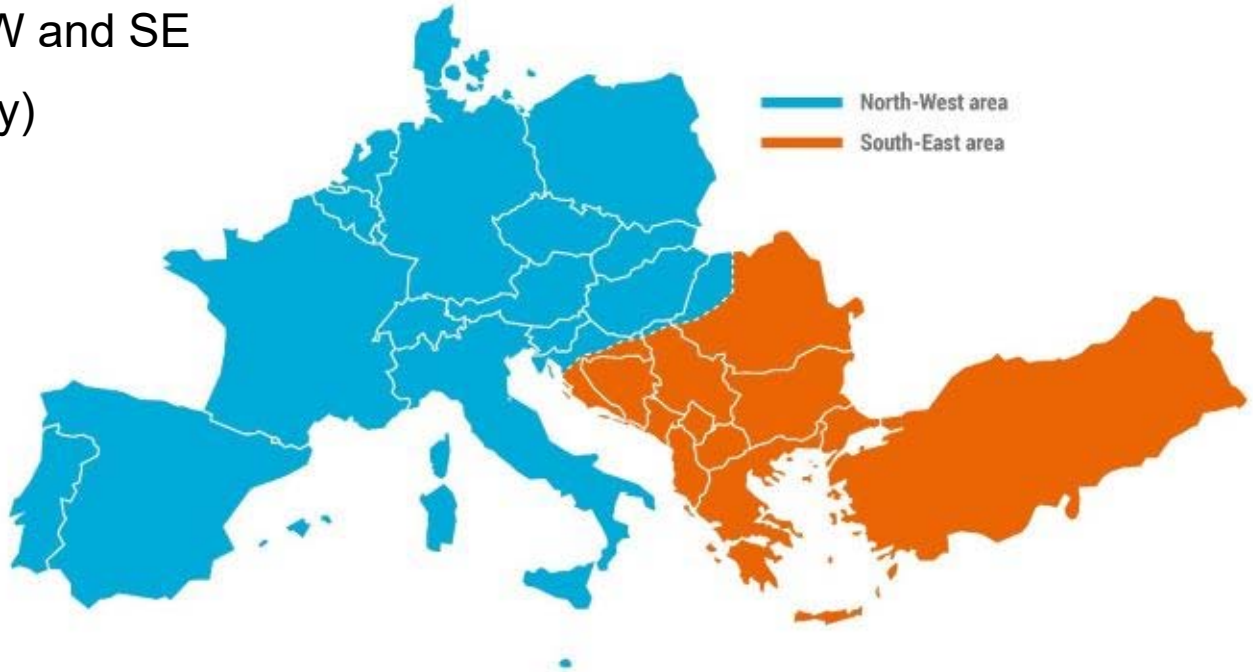
Adiabatic

Evaporative

Dry

Power Grid Issue

- 8 January 2021:
  - Near Blackout due Power Demand Surge
  - European Grid Separated: NW and SE
  - Load Shedding (France & Italy)



Power Grid Issue

- Decarbonization (European Green Deal):
  - Conventional Power Generation (Nuclear & Coal) ➔ Wind & Solar
  - Energy Efficiency
  - Electrification:
    - Transport
    - Buildings (Heat Pumps)
    - Industry
  - (Green) Hydrogen
  - ...

Power Grid Issue

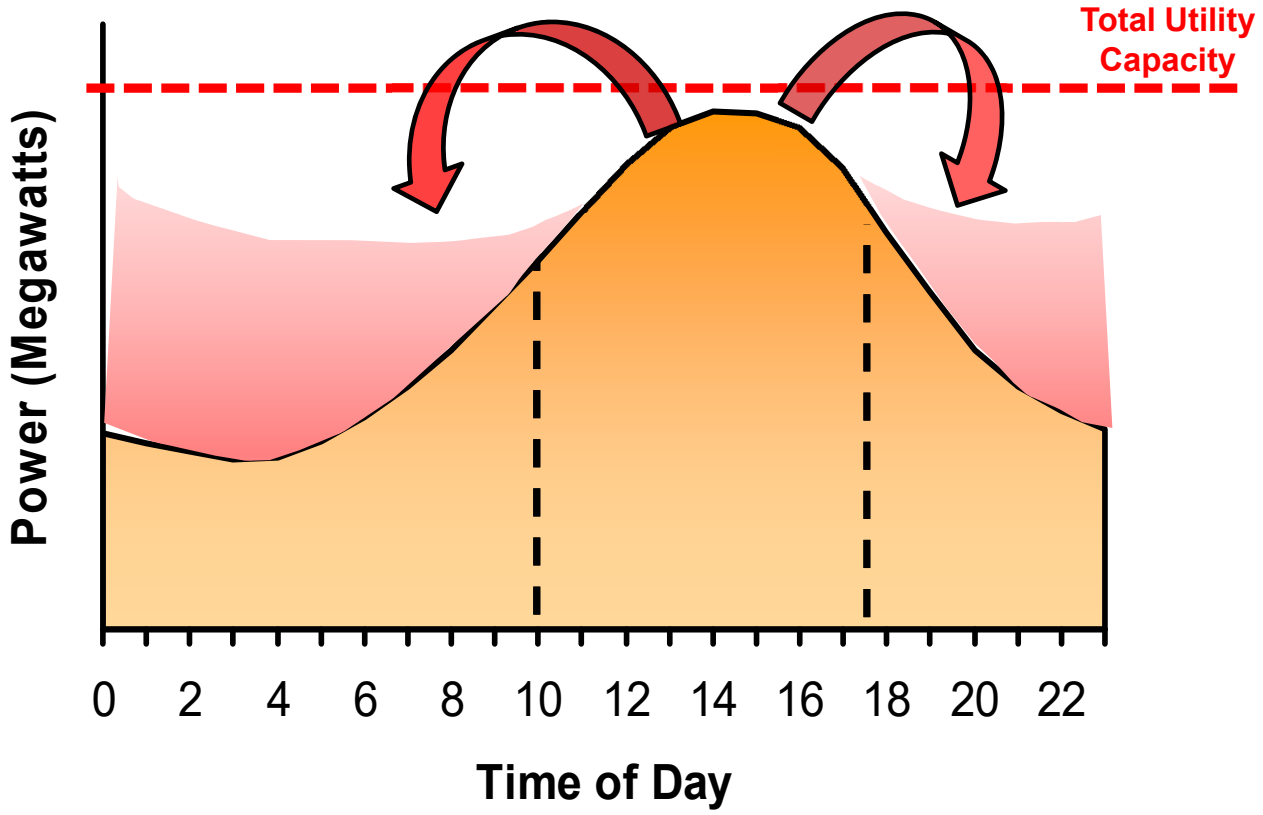
- Heating & Cooling = +/- 50% Energy Consumption

➔ District Heating & Cooling Systems: up to 45% Savings

➔ Key Role

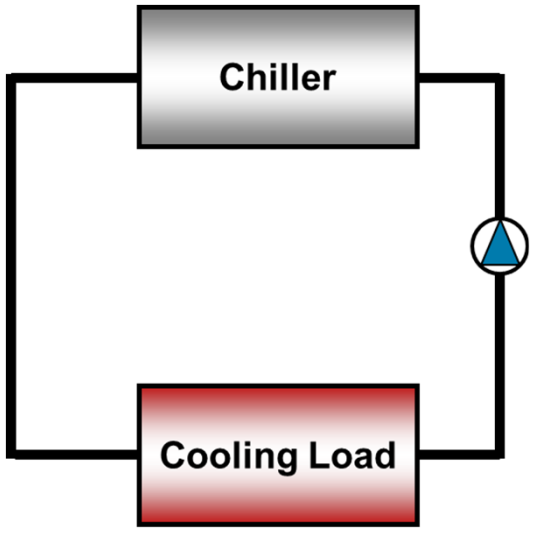
  - More Energy Efficient
  - Link between Different Sectors
    - Waste / Excess Heat (industry, data centers,...)
  - Intermittent Renewables
  - Thermal Energy Storage

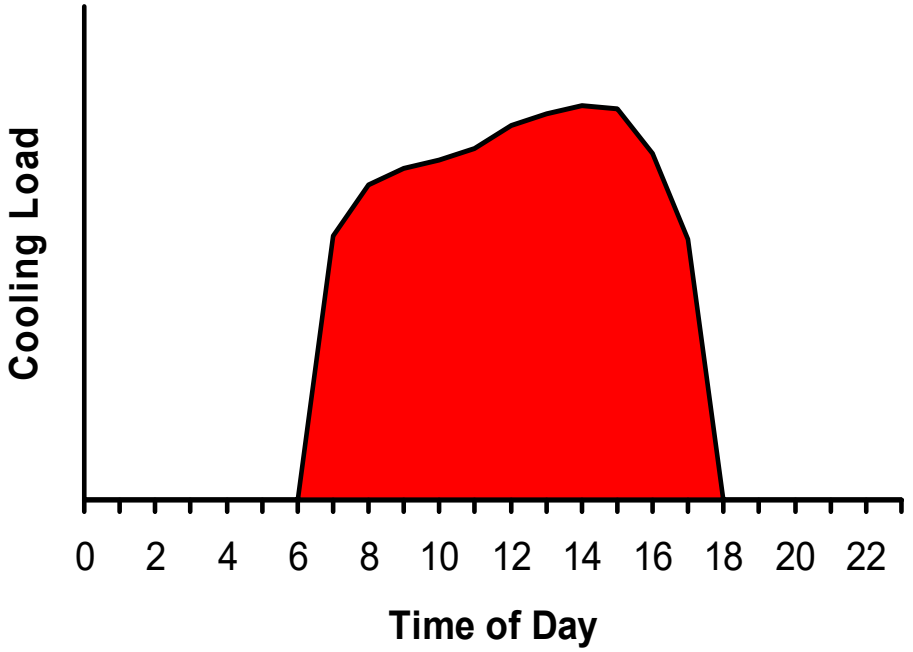
Thermal Ice Storage: Concept



Thermal Ice Storage: Concept

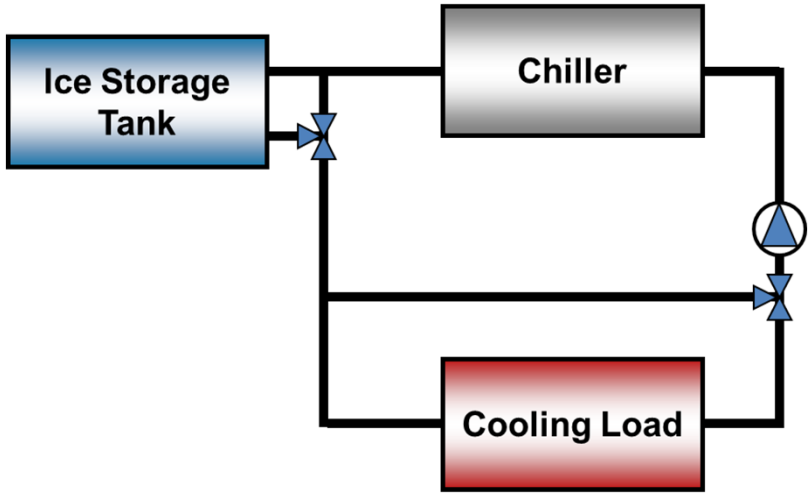
- Used since 19th Century in the Food Industry
- Convential System:
  - Equipment Sized for Peak Load

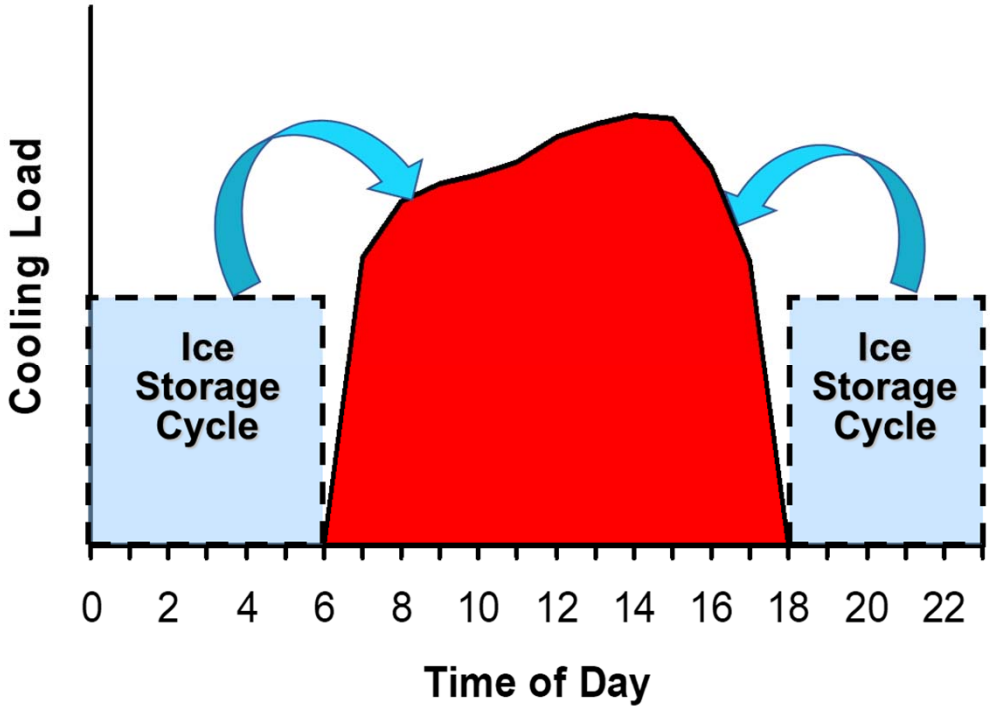




Thermal Ice Storage: Concept

- Add Ice Storage Tank
- TES System:
  - Ice built during off-peak hours
  - Ice melted during peak hours





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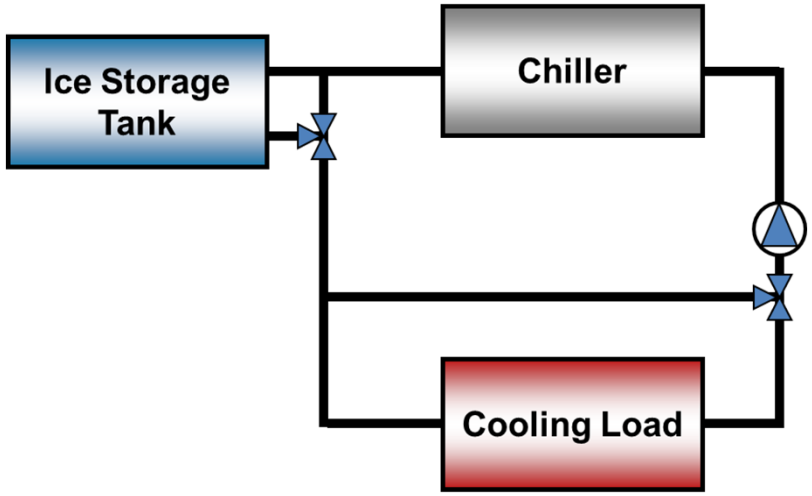

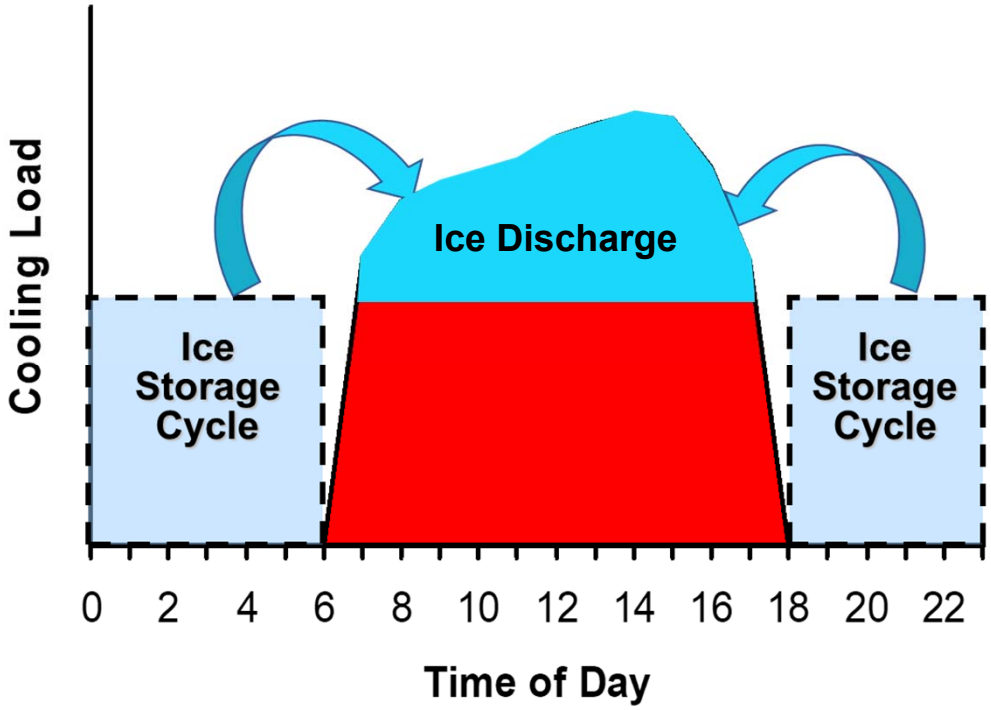

Thermal Ice Storage: Concept

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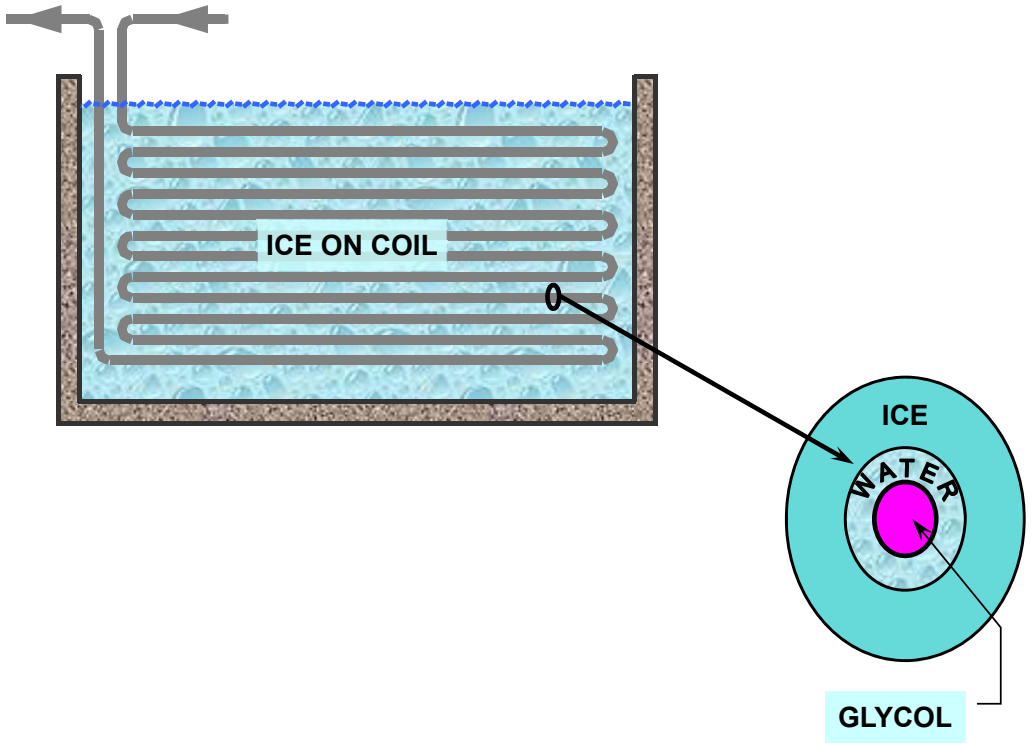
Thermal Ice Storage: Types

- Internal Melt

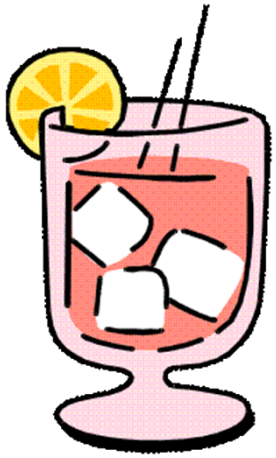
Indirect

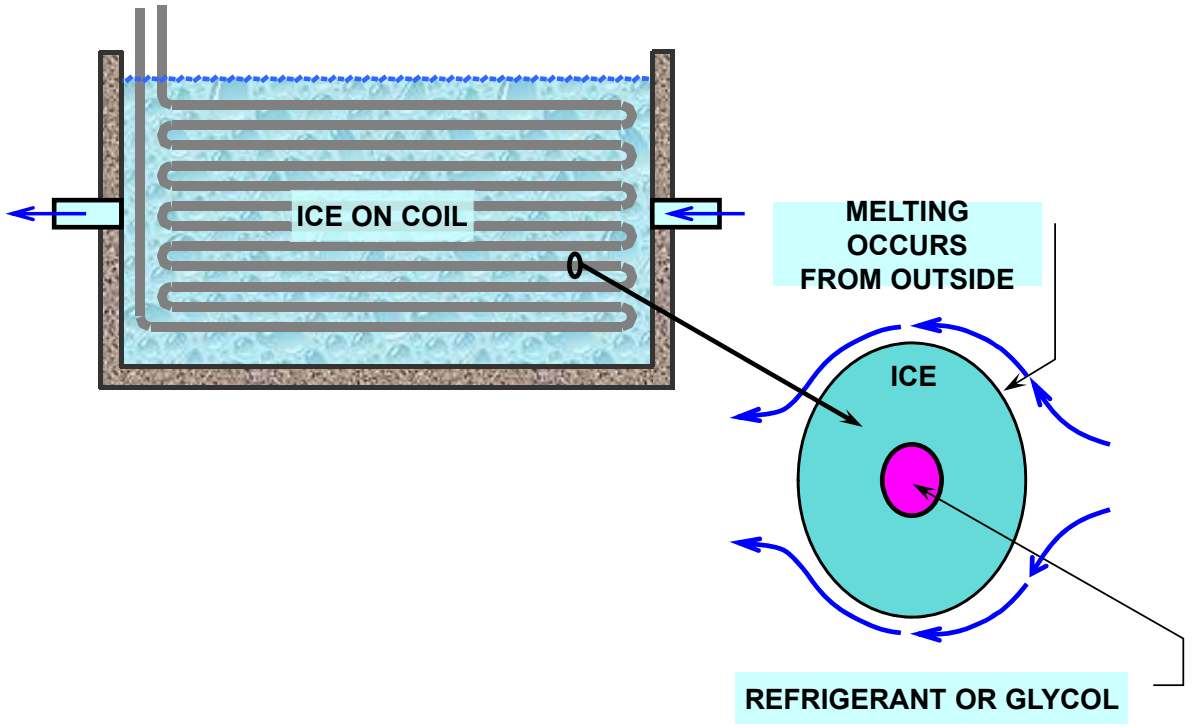


Thermal Ice Storage: Types

- External Melt

Direct





Thermal Ice Storage: Types

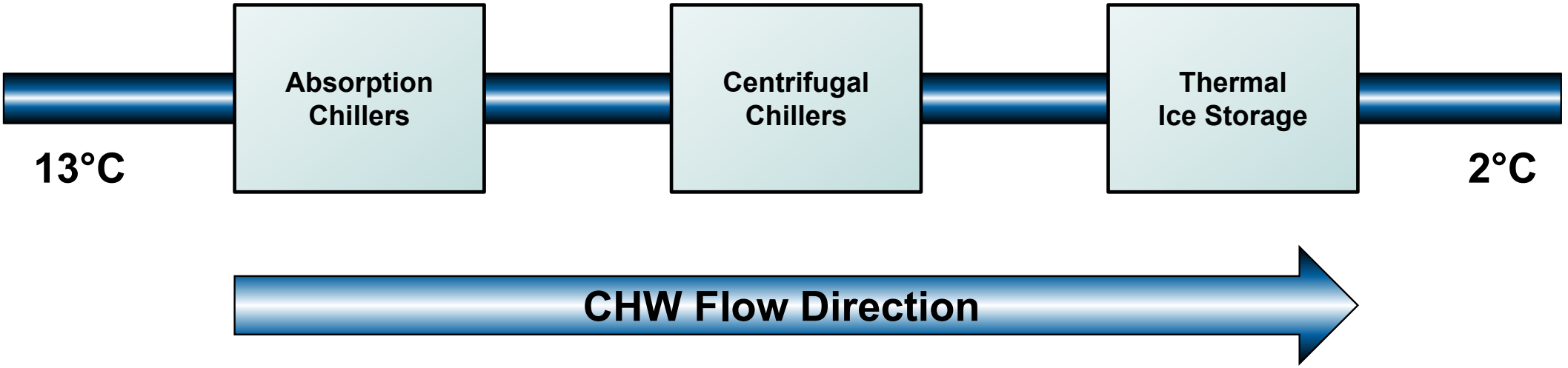
Internal Melt	External Melt
Simple Design	Coldest CHW Temperature
Easy to Operate	Quick Discharge Capability
AC Individual Buildings	District Cooling
Food Industry	Industrial Process Cooling

Thermal Ice Storage: Advantages

- Natural Energy Storage without Environmental Impact
- Reduced Connected Power
- Shift Power Usage from peak to off-peak periods ➔ Relief Power Grid
- Lower CHW Temperature ➔ Reduced Capital Costs (smaller piping, pumps, AHU, HE)
- Less Space required (vs. chilled water storage) ➔ Reduced Real Estate costs
- Improved System Flexibility ➔ Demand Site Management
- Back-up & Emergency Cooling

Thermal Ice Storage: Applications & References

- District Cooling
  - Excess/Waste Heat from Data Centers, Industrial Processes,…



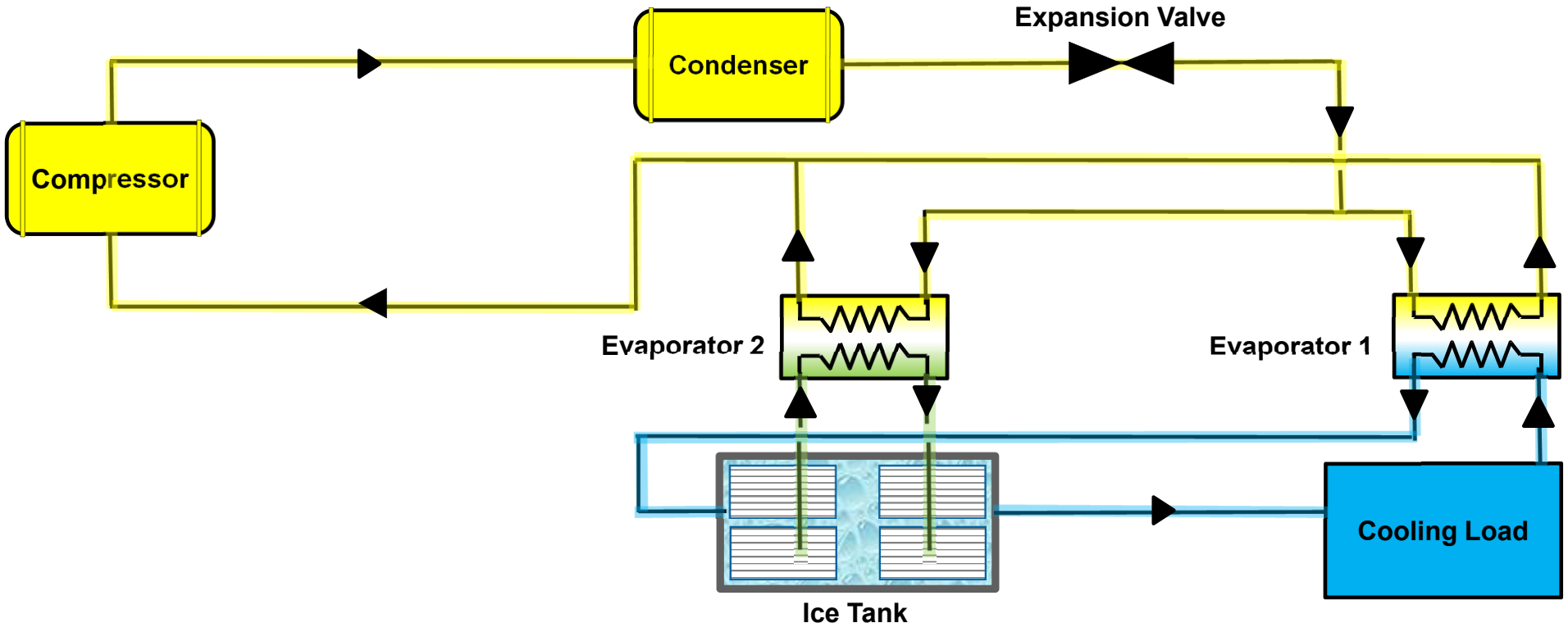
Thermal Ice Storage: Applications & References

- District Cooling
  - Use of Natural Refrigerants <==> Synthetic Refrigerants
    - High Efficiency
    - Zero ODP
    - Zero GWP
    - Lower Operating Cost
    - No Phase-Out Risk

- Reference:
  - DCP Abdali Boulevard (Amman, Jordan)
  - McCormick Place Complex (Chicago, USA)

Thermal Ice Storage: Applications & References

- Central Cooling Plant



Thermal Ice Storage: Applications & References

Compressor

Condenser

Evaporator

Thermal Ice Storage: Applications & References

- Central Cooling Plant
  - Primary Refrigerant = Ammonia
    - Multiple Independent Systems
    - Use limited to Mechanical Room
    - Components fully assembled, Tested Off-Site and Shipped with Holding Charge
      - ➔ Reduction of Environmental Liability
      - ➔ Less Safety Concerns
      - ➔ Decrease of Operational Requirement
  - Secondary Refrigerant = Glycol or CO_2
    - Can be used for Ice-Storage
    - Lower Temperature ➔ Operating Pressure less Critical (CO2)
- Reference:
  - Leipziger Messe (Leipzig, Germany)
  - Blue Cross Office Building (Chicago, USA)

Thermal Ice Storage: Applications & References

- District Cooling
  - Jiangbei Central Business District (Chongqing, China)
  - Enwave (New Orleans, USA)
  - New Pearl River (Guangzhou, China)
  - Entergy (Houston, USA)
  - Marina Bay South (Singapore)
- Universities
  - University of Maryland (USA)
  - King Abdul Aziz University (Jeddah, Saudi Arabia)
- Convention Centers
  - Baltimore, USA

Thermal Ice Storage: Applications & References

- Sport Arenas
  - Wells Fargo Center (Basketball, Ice Hockey)
  - M&T Bank Stadium – Baltimore Ravens (American Football)
  - American Airlines Arena - Miami Heat (Basketball)
- Hospitals
  - John Peter Smith Hospital (Texas, USA)
- Airports
  - Xian, China
- Food & Beverage Industry
  - Parmalat (South Africa)

Conclusion

- European Power Grid Pushed to the Limit
- European Green Deal ➔ More Load
- Power Demand Shift ➔ Relief Power Grid
- Thermal Ice Storage = Natural Battery
- Integration of Natural Refrigerants

Open Discussion

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eurammon e. V. is always available as a sparring partner for questions on refrigeration with natural refrigerants.

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refrigerants delivered by mother nature