



Innovative use of Phase Change Materials (PCMs) for renewable heating & cooling

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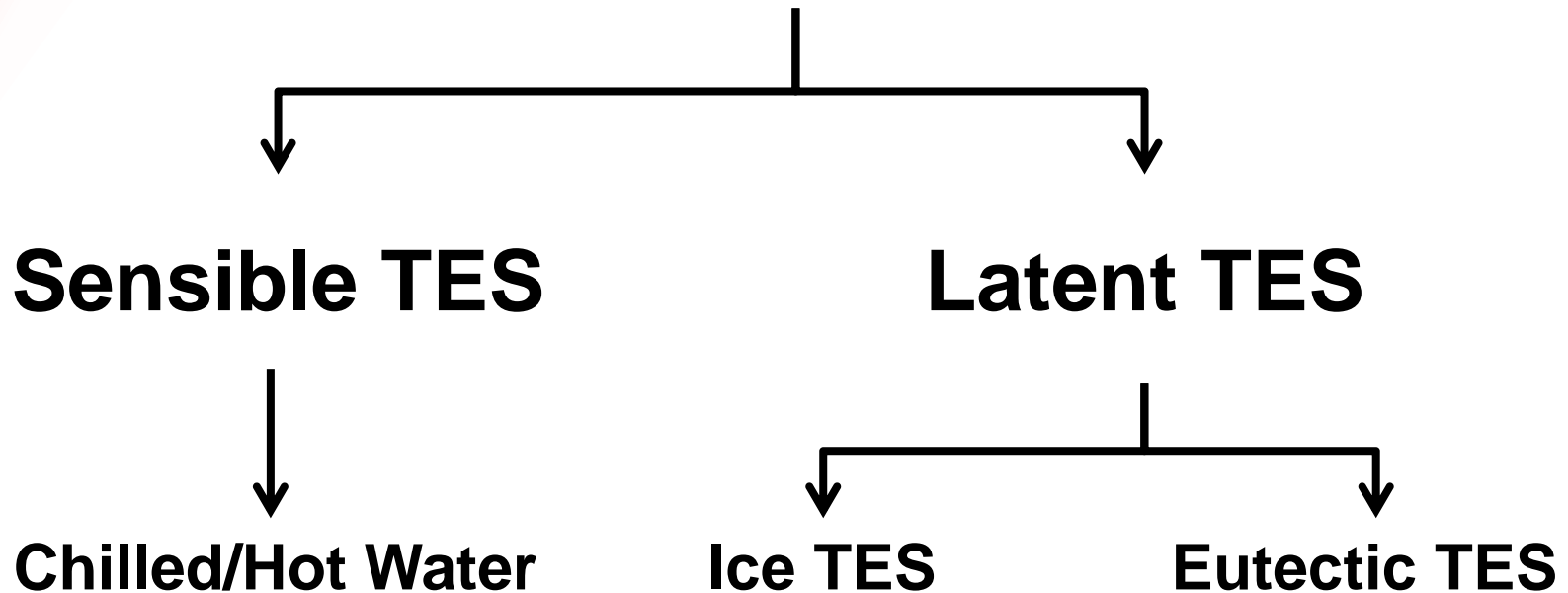
What is Thermal Energy Storage?

“ Storing High or Low temperature energy for later use in order to bridge the time gap between energy availability and energy use ”

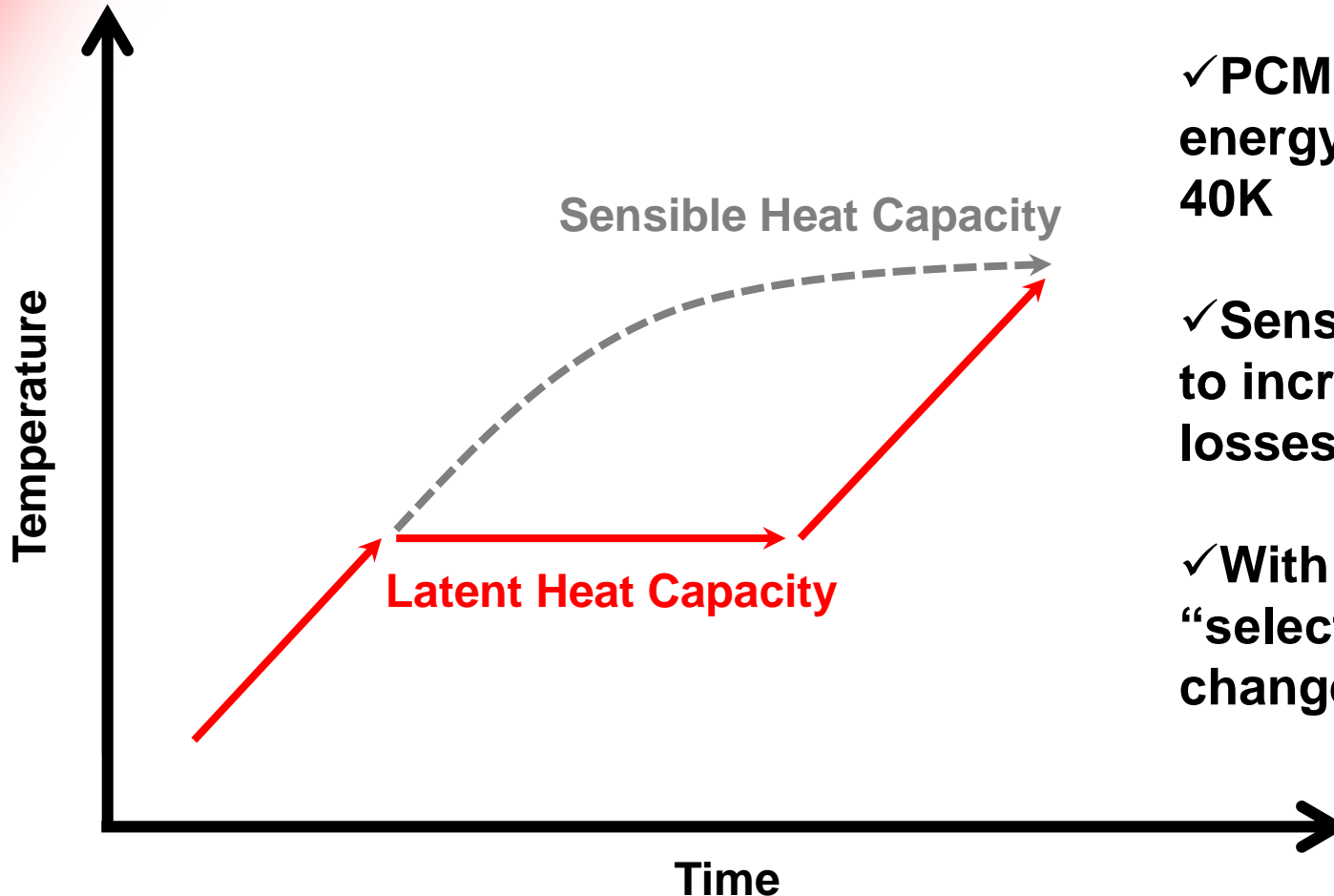
Bridging the gap



Types of Thermal Energy Storage



Sensible Heat vs Latent Heat



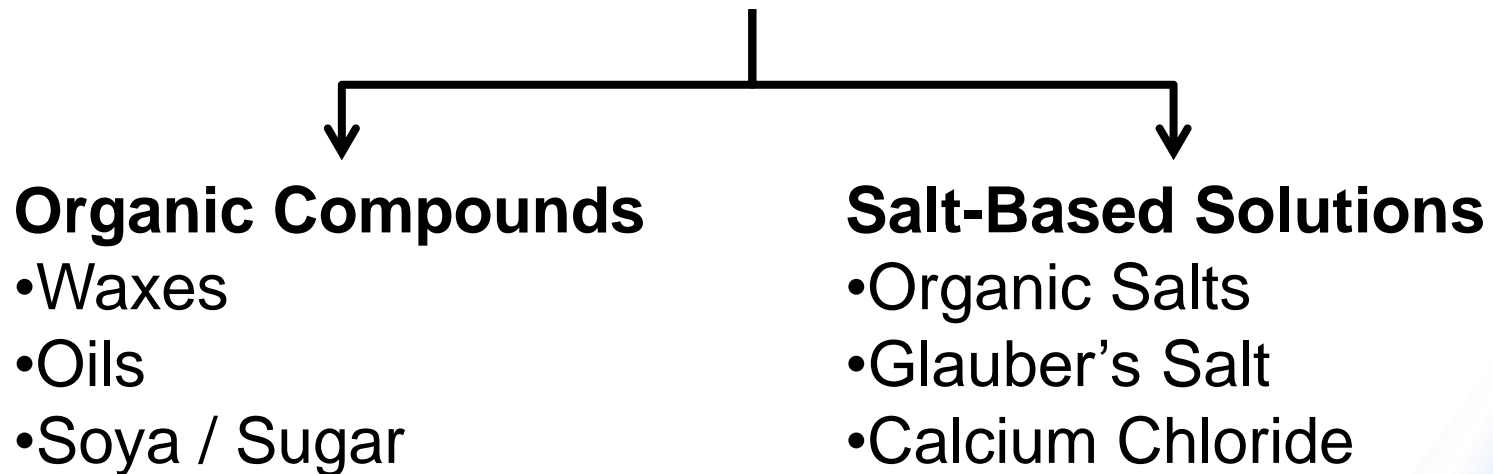
✓ PCM stores as much energy as a water ΔT of 40K

✓ Sensible heat leads to increased heat losses to surroundings

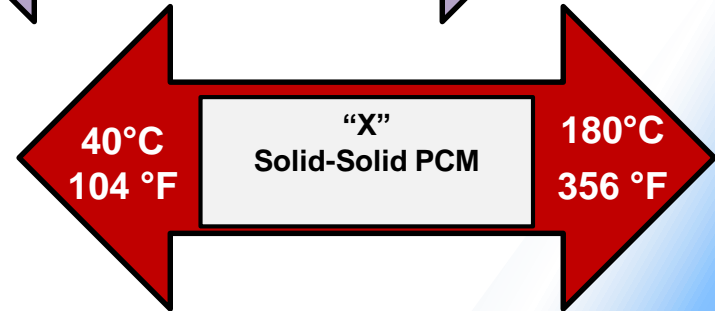
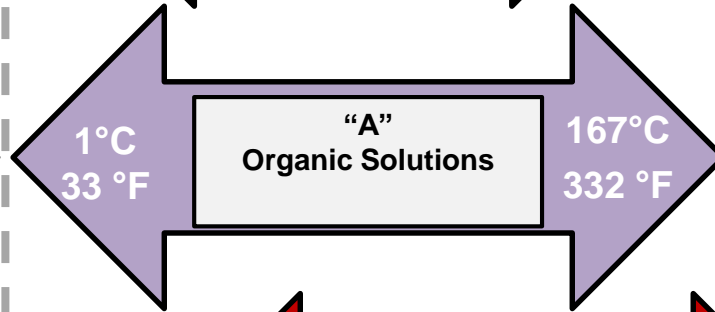
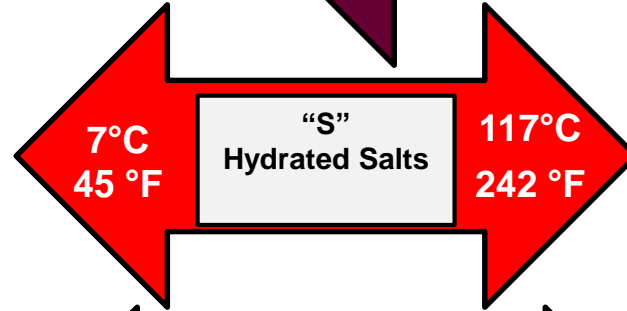
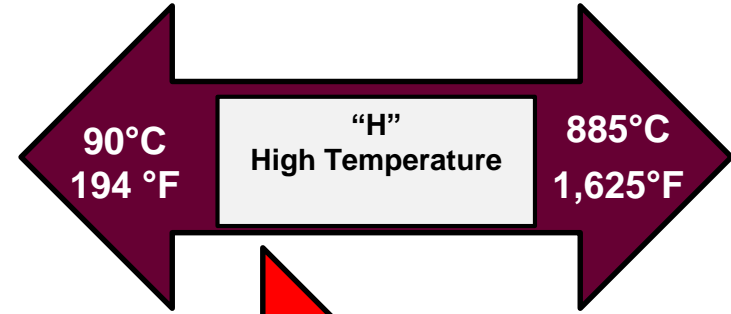
✓ With PCM you can "select" a phase change temperature

Eutectic Material Phase Change Material (PCM)

Eutectic – “Mixture of two or more chemicals (inorganic salts) having a freezing / melting temperature point which is higher or lower than those of water 0°C (32°F).”



0°C



Solid Plastic Encapsulated PCM



Metal Encapsulated PCM

Metal Containers



Tubes



Balls

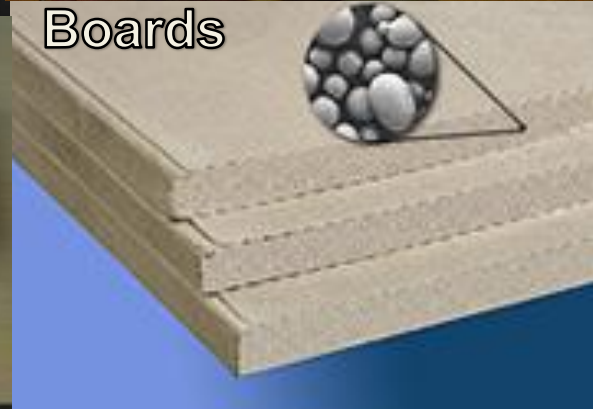


Tiles



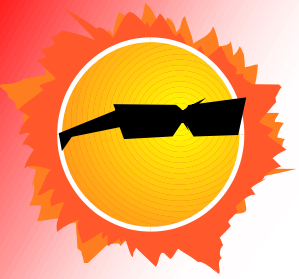
Flexible Encapsulated PCM

Pouches

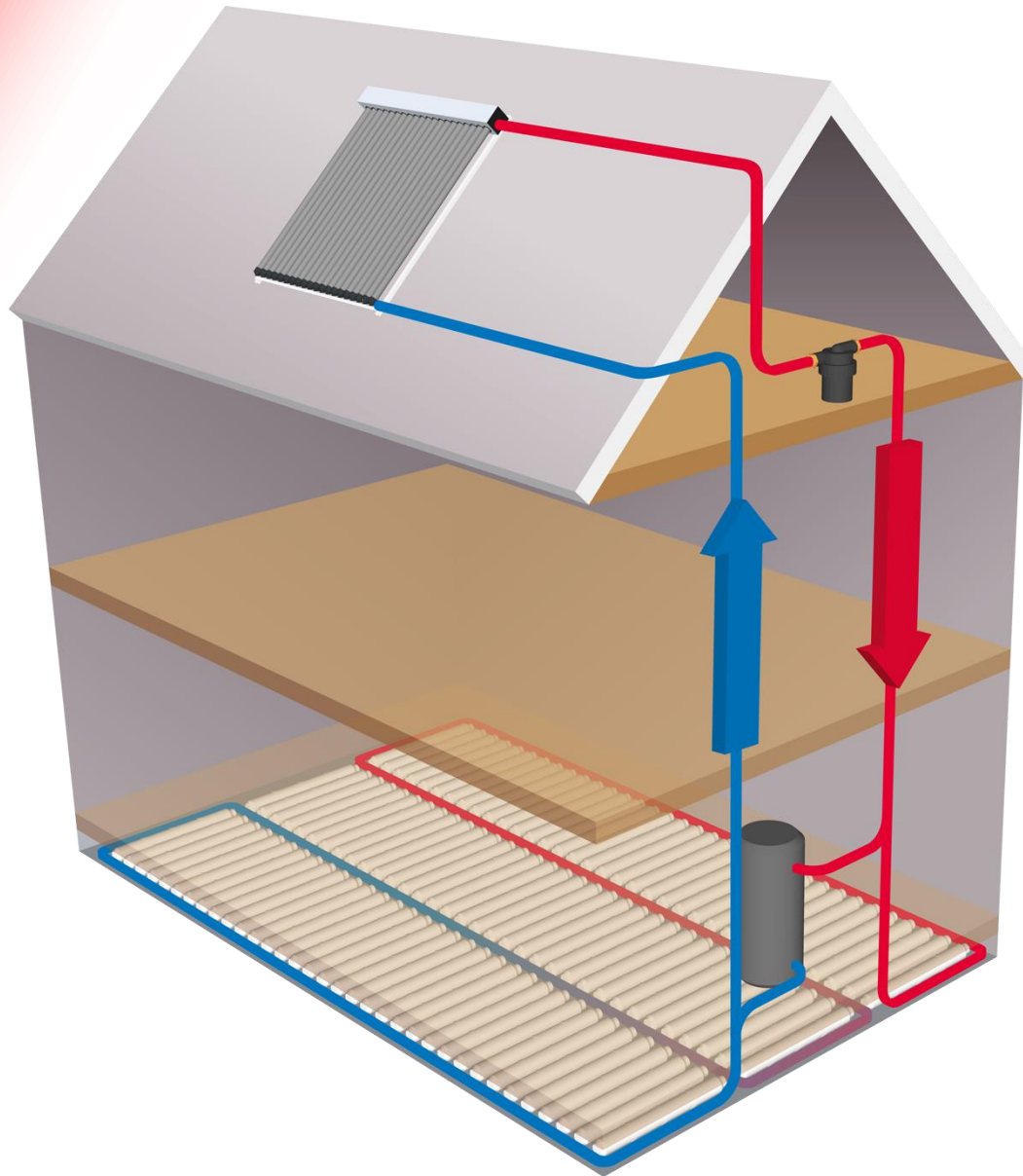


Free Energy

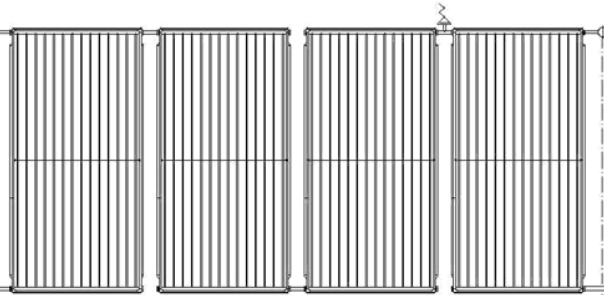
“Bridging the gap”



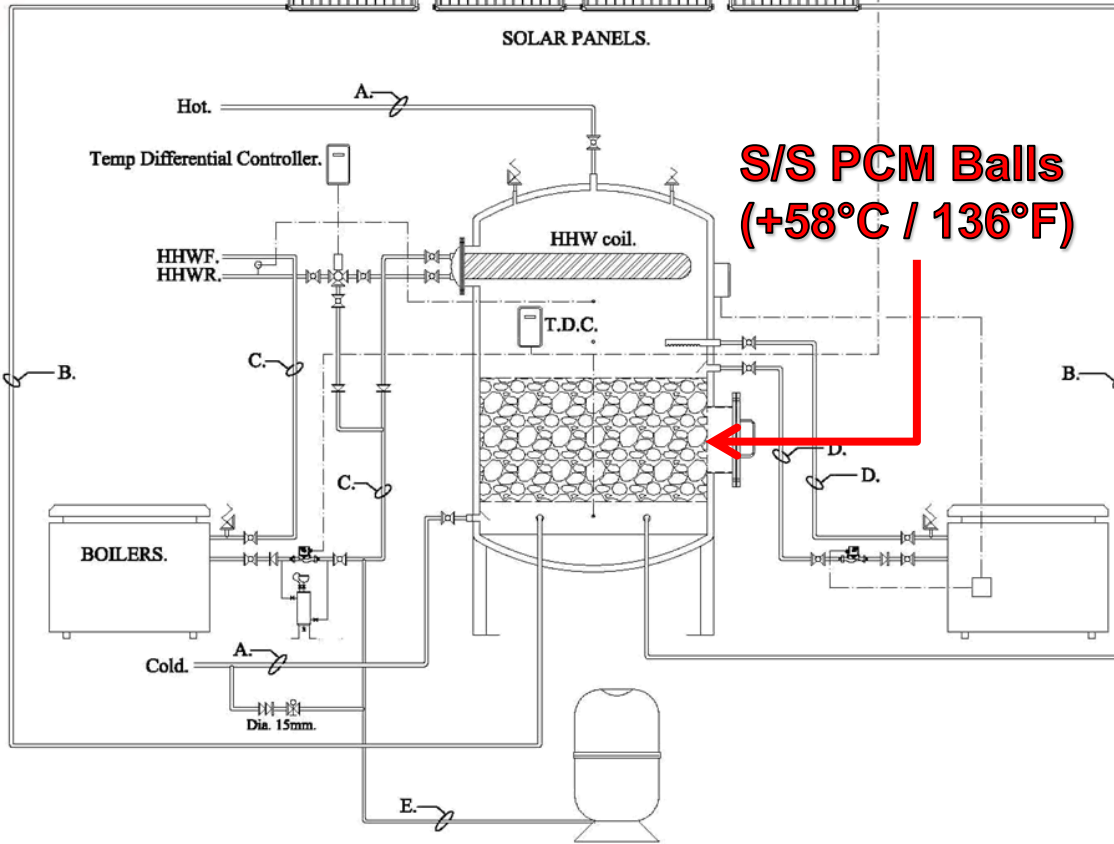
Solar Applications



Commonwealth Village, Australia



SOLAR PANELS.



LEGEND.

- ⊠ Gate Valve.
- ⊠⊠ RPZD/Dual Check.
- ⊠ Ball Valve.
- ⊠ Pressure relief valve.
- ⊠ Automatic Air-Vent.
- ⊠ Check Valve / Non-Return.
- ⊠ Balancing Valve.
- ⊠ Automatic Filling Valve.
- ⊠ Gas Valve.



00 R/E/1, 1/2007 Commonwealth Games

Total Water Management Solutions

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Designed	N.Viele
Drawn	NV
Checked	
Approved	

Job.

Commonwealth Games.

Title

Typical Hot Water Schematic.

Scale

Drawing No.

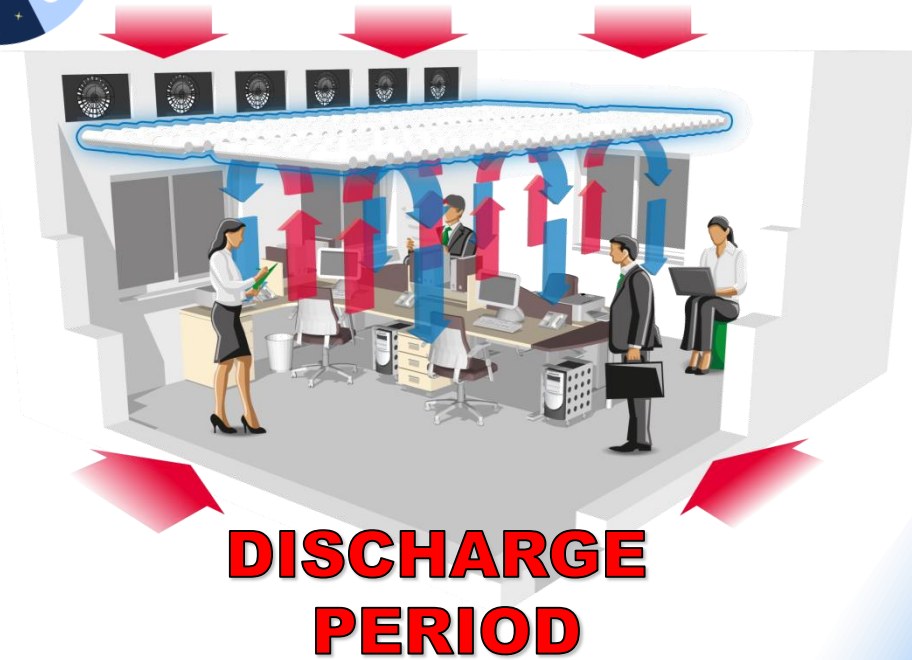
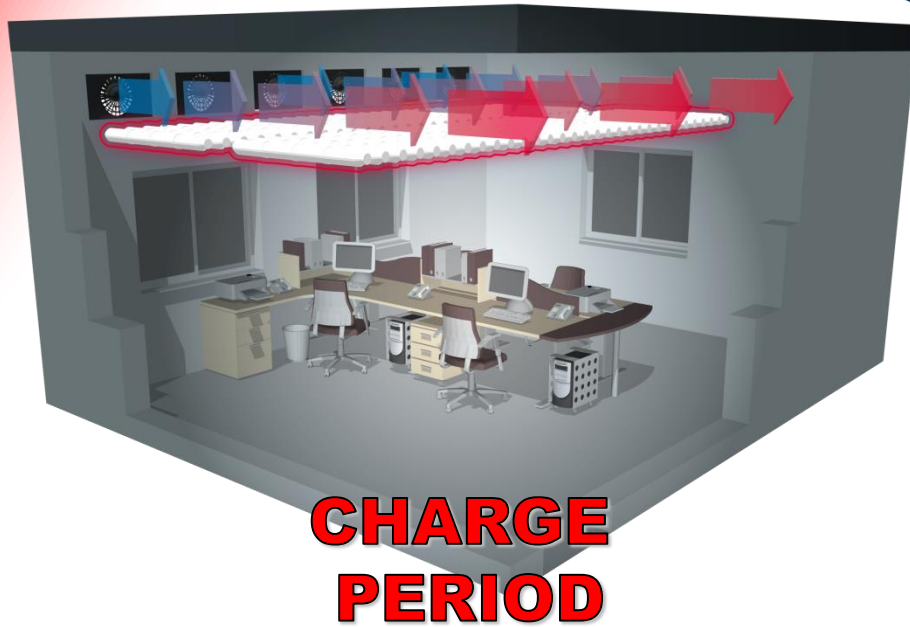
Passive Cooling



NIGHT (+21°C / 69°F)



DAY (+35°C / 95°F)



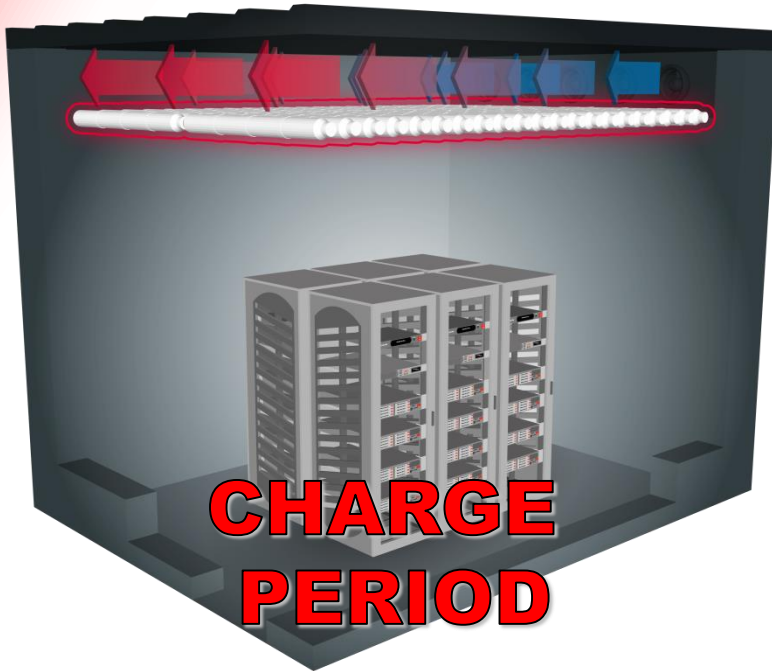
Passive Cooling



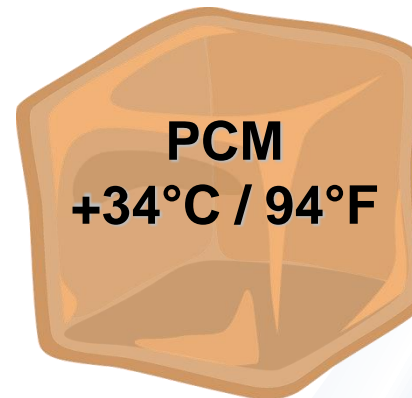
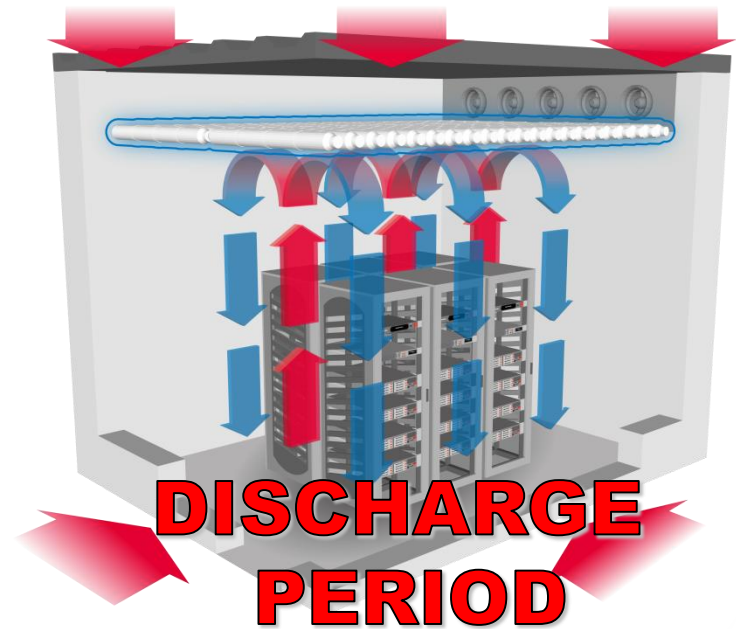
NIGHT (+21°C / 69°F)



DAY (+55°C / 131°F)



ROOM (+45°C / 113°F) MAX

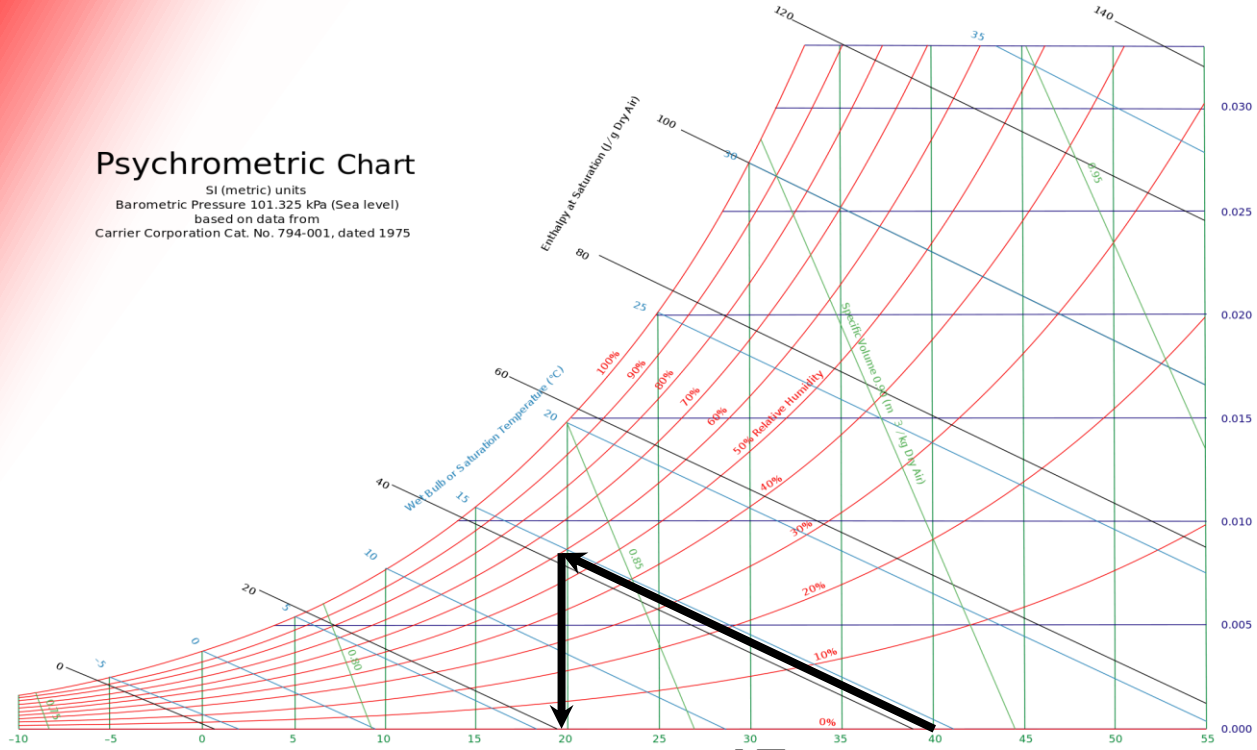


Free Cooling



Psychrometric Chart

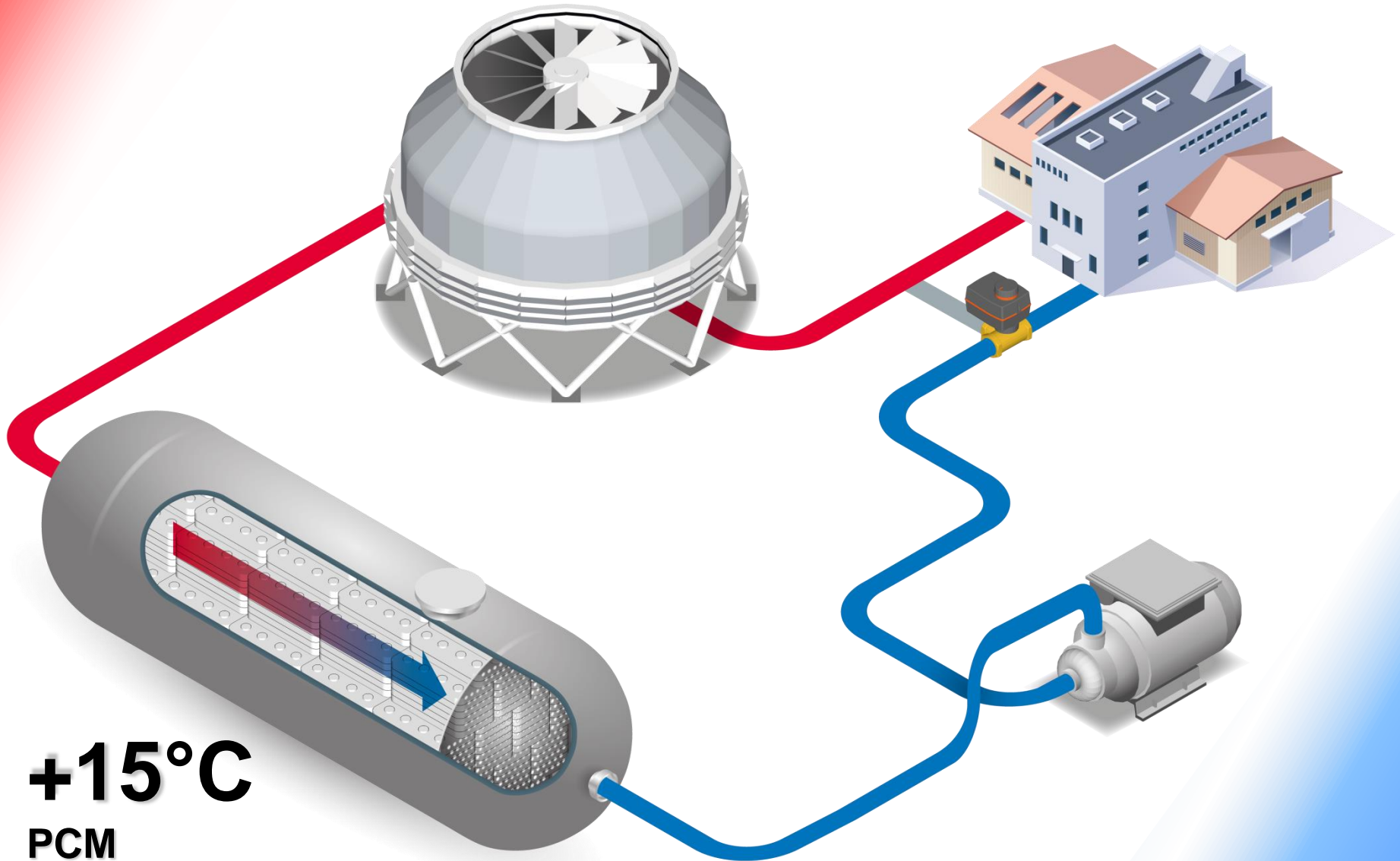
SI (metric) units
Barometric Pressure 101.325 kPa (Sea level)
based on data from
Carrier Corporation Cat. No. 794-001, dated 1975



Wet Bulb ← ΔT → **Dry Bulb**

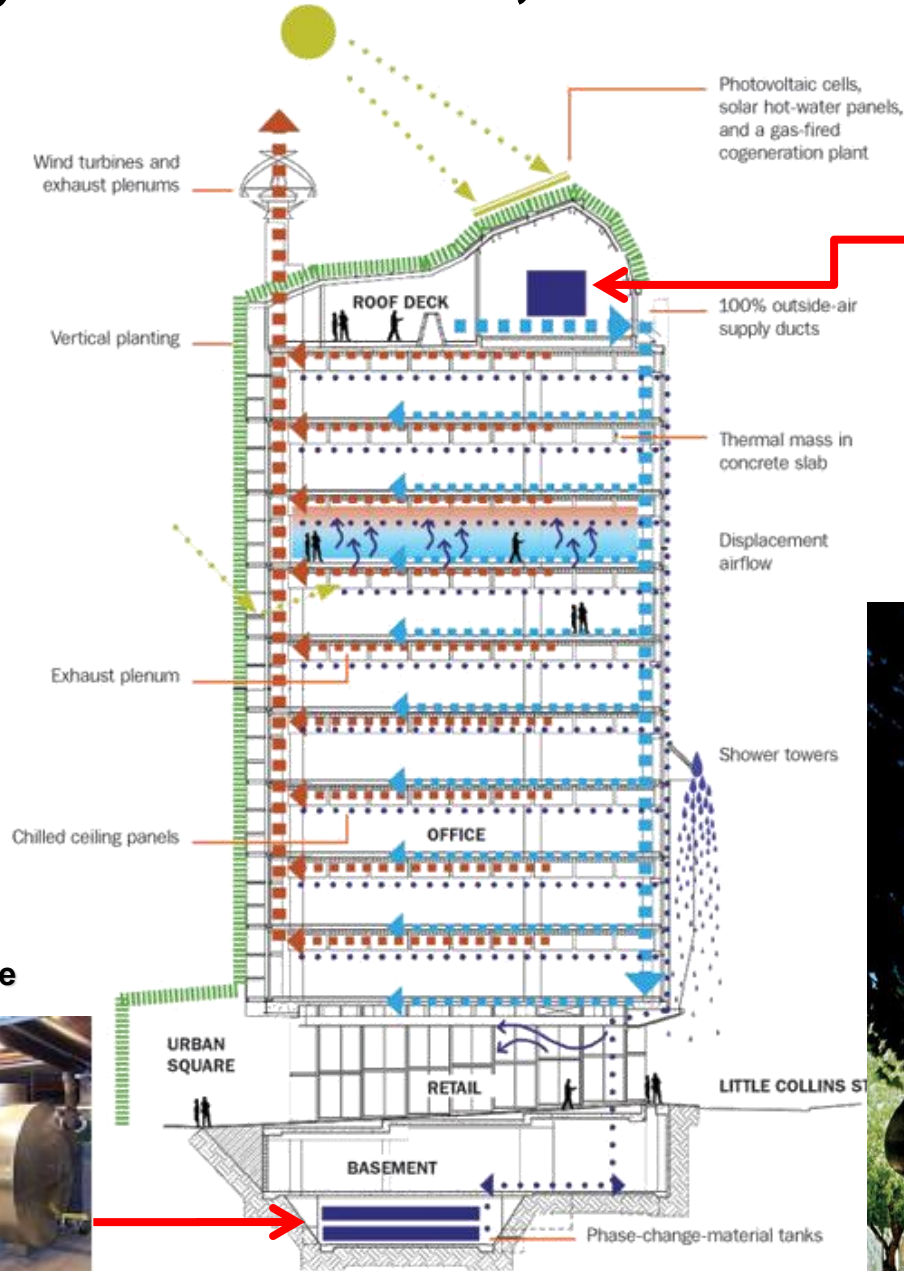


Free Cooling



+15°C
PCM
Energy Storage

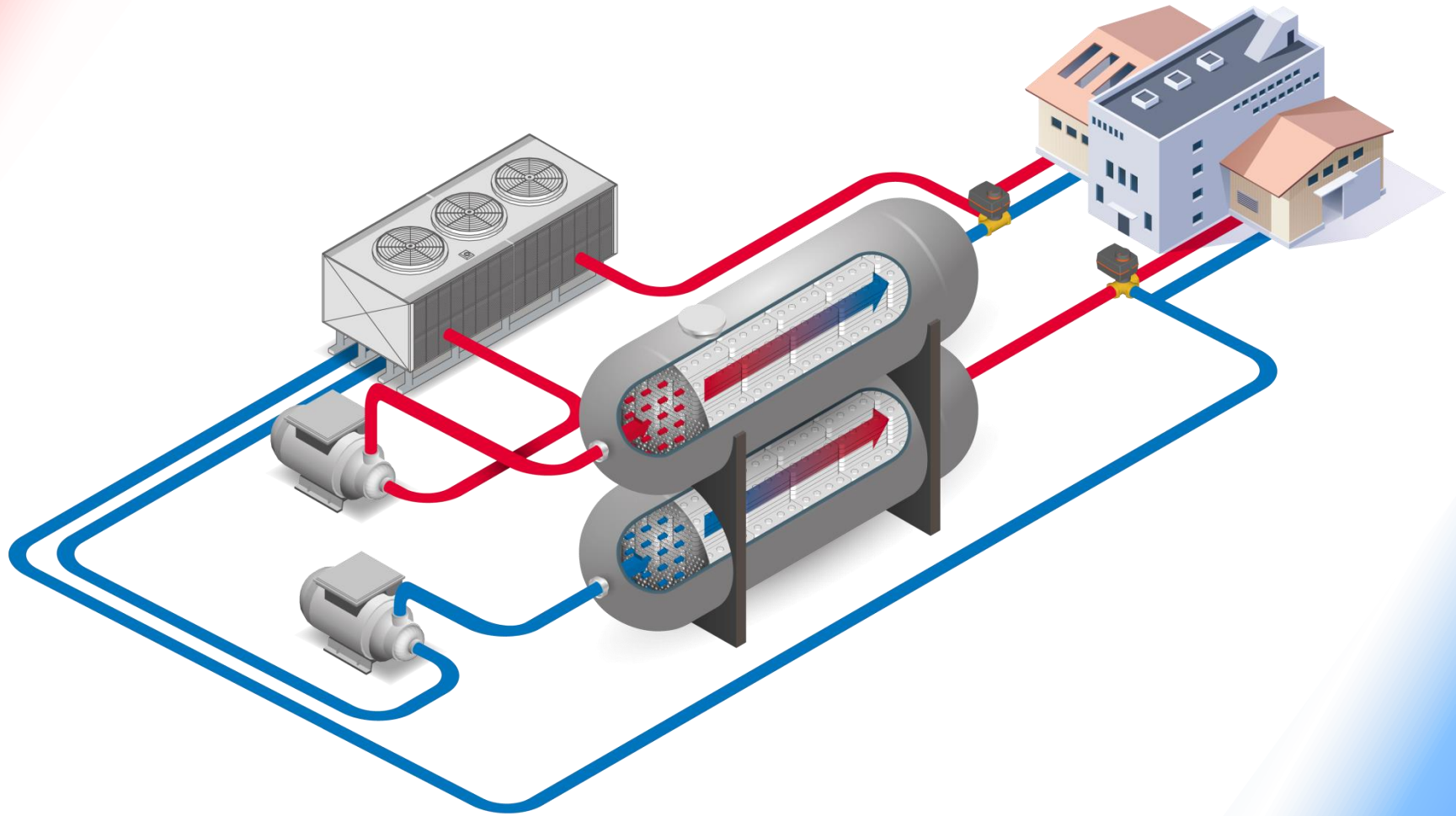
Melbourne City Council Office, Australia



+15°C
PCM
Energy Storage

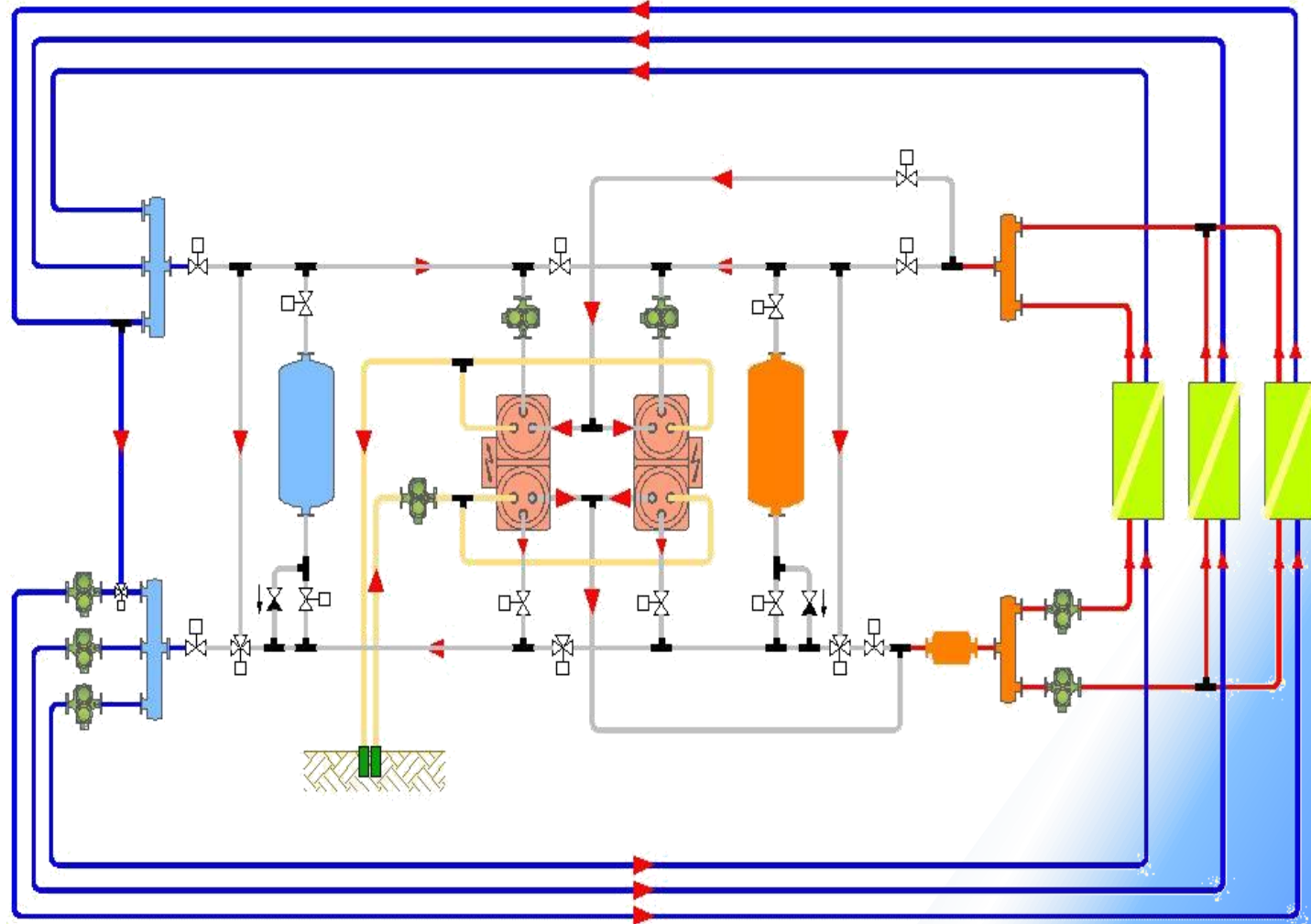
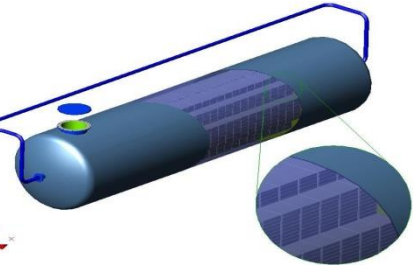
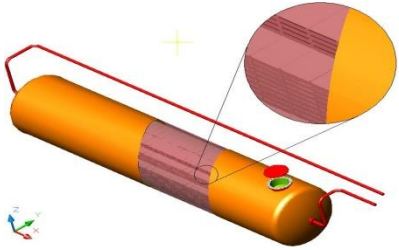
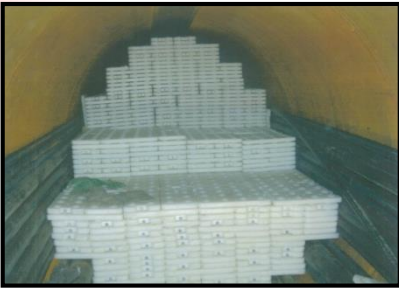


Heat Pump System

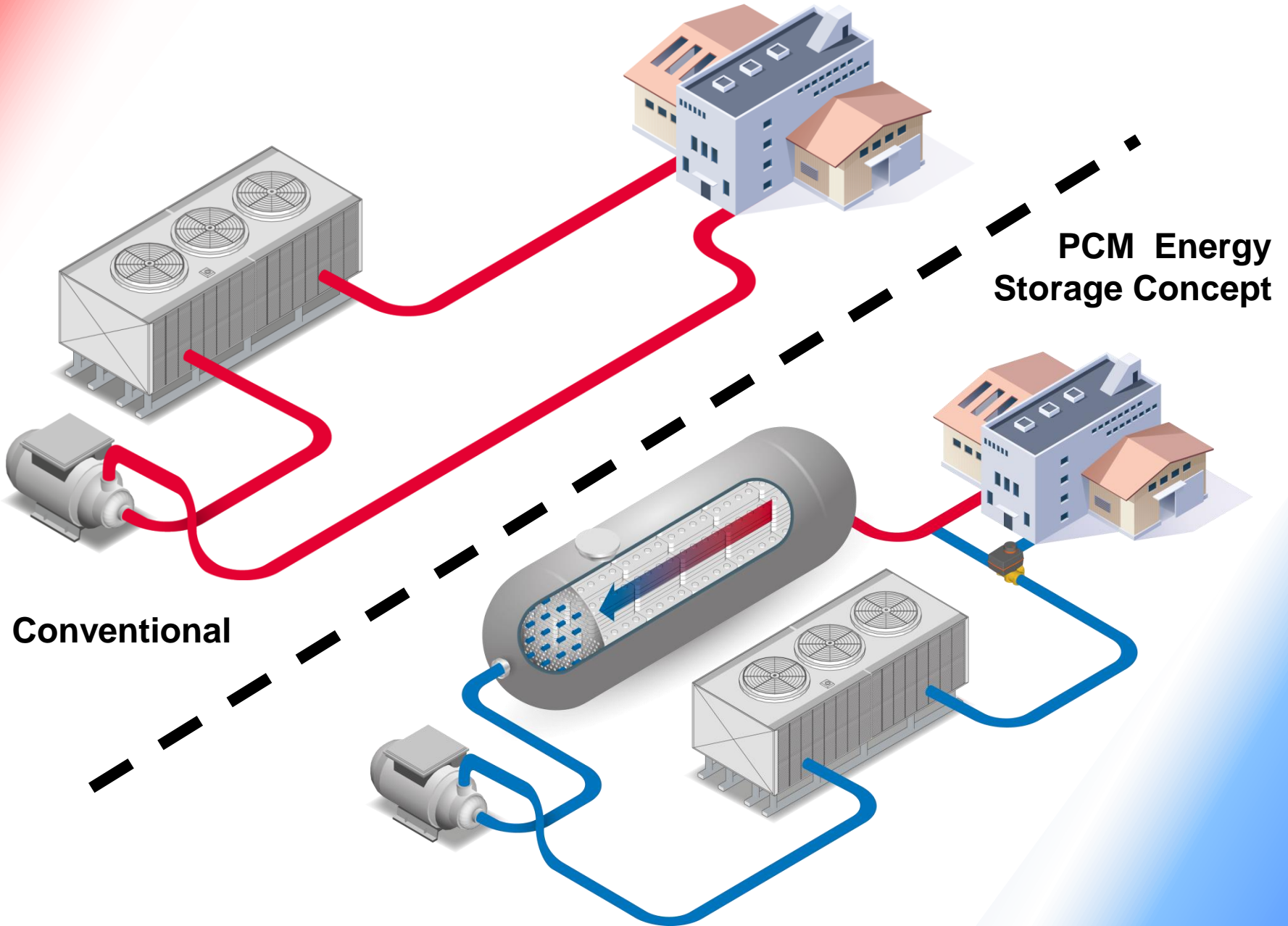


Heat & Coolth Stored

EIDOS, Turin, Italy



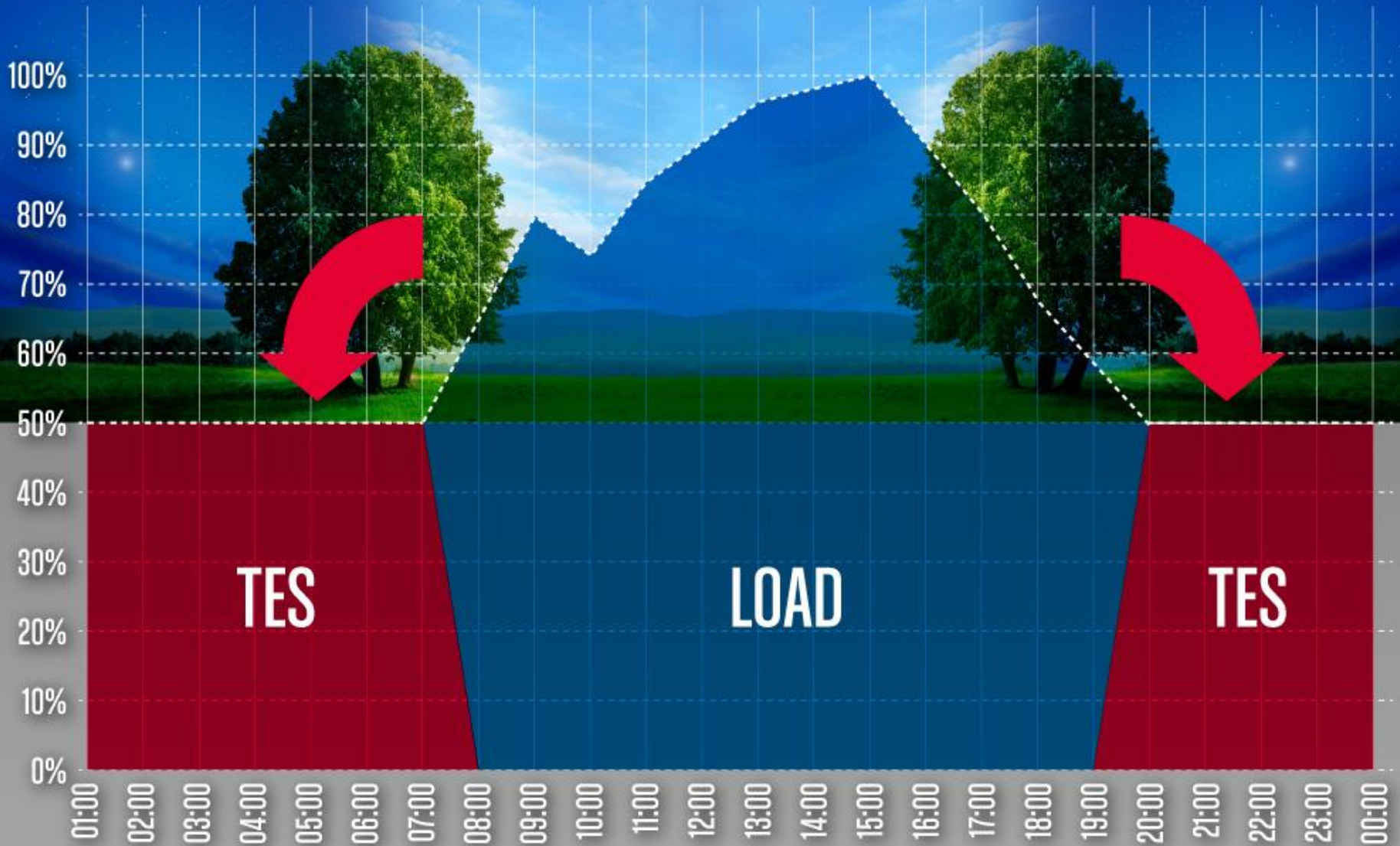
Load Shifting





PCM

Thermal Energy Storage

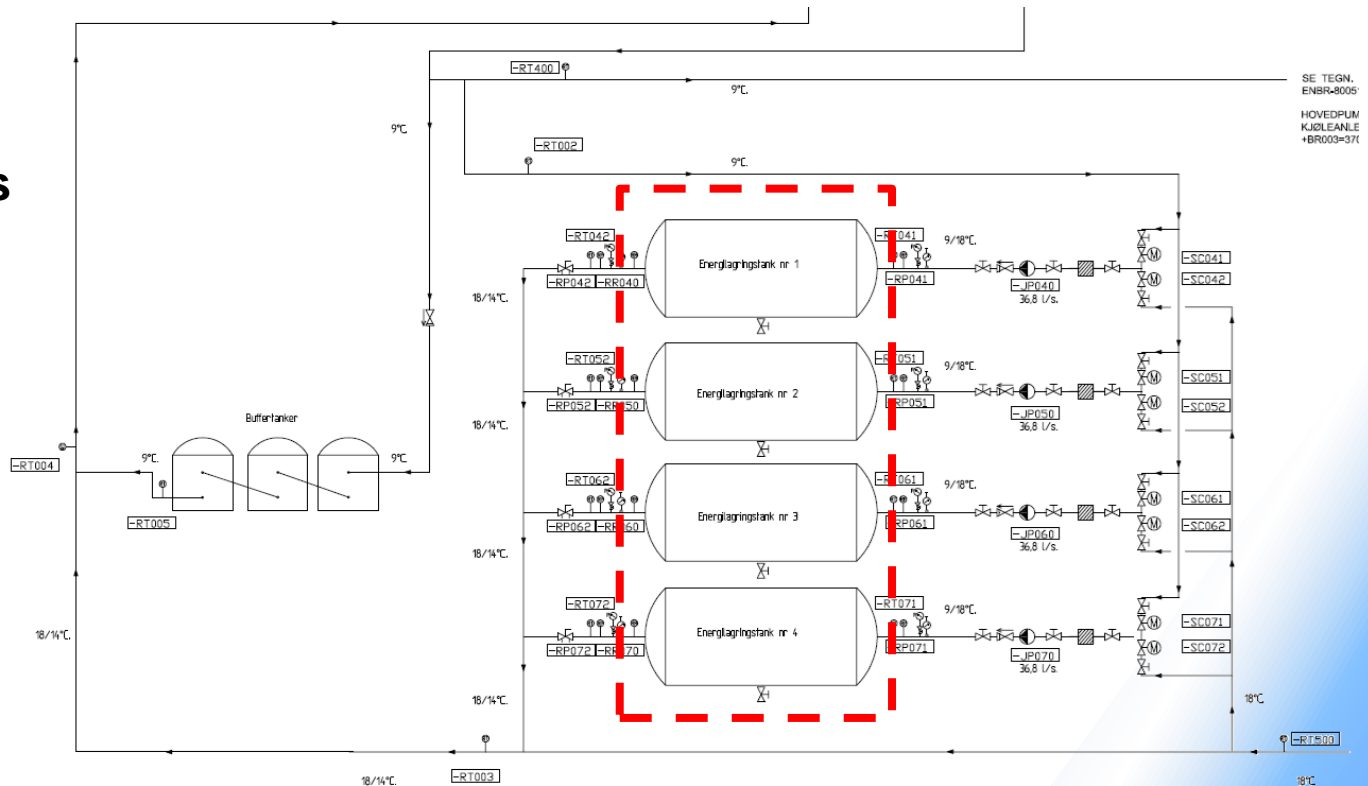


T3 Energy Centre, Bergen Airport, NOR



**4 x 60m³ Tanks
filled with S13
(+13°C/55°F)**

**Total Capacity
10,000kWh
(2,840 RT-h)**



Parliament House, Canberra, AUS.



6m³ Tank filled with +8°C PCM solution providing 270kWh TES for backup



Conclusion



- **FREE** (Day=Heat / Night=Cool) energy.
- **WASTE** not (Heat or Cold Energy).
- Load shifting/levelling.
- Consider mix of matching technologies.
- Never Forget RoI - *Someone has to pay for your idea.*
- **RIGHT** technology for **RIGHT** application.

Follow Up



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