Opportunities for compact TES on board fishing vessels and cruise ships

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Energy demand on fishing vessels

- Cooling
  - Refrigerated sea water (RSW)
  - Brine cooling
  - Chilling tank
- Freezing
  - Plate and blast freezers
  - Air cooling
- Processing of rest raw materials
- Heating, tap water

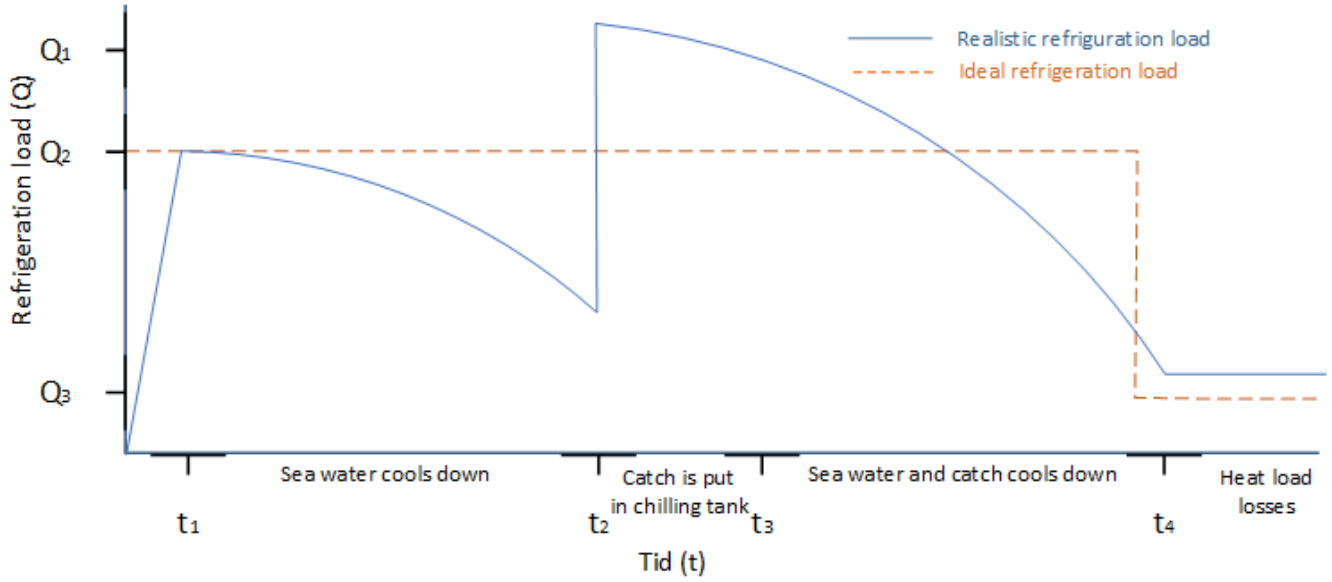
HighEFF

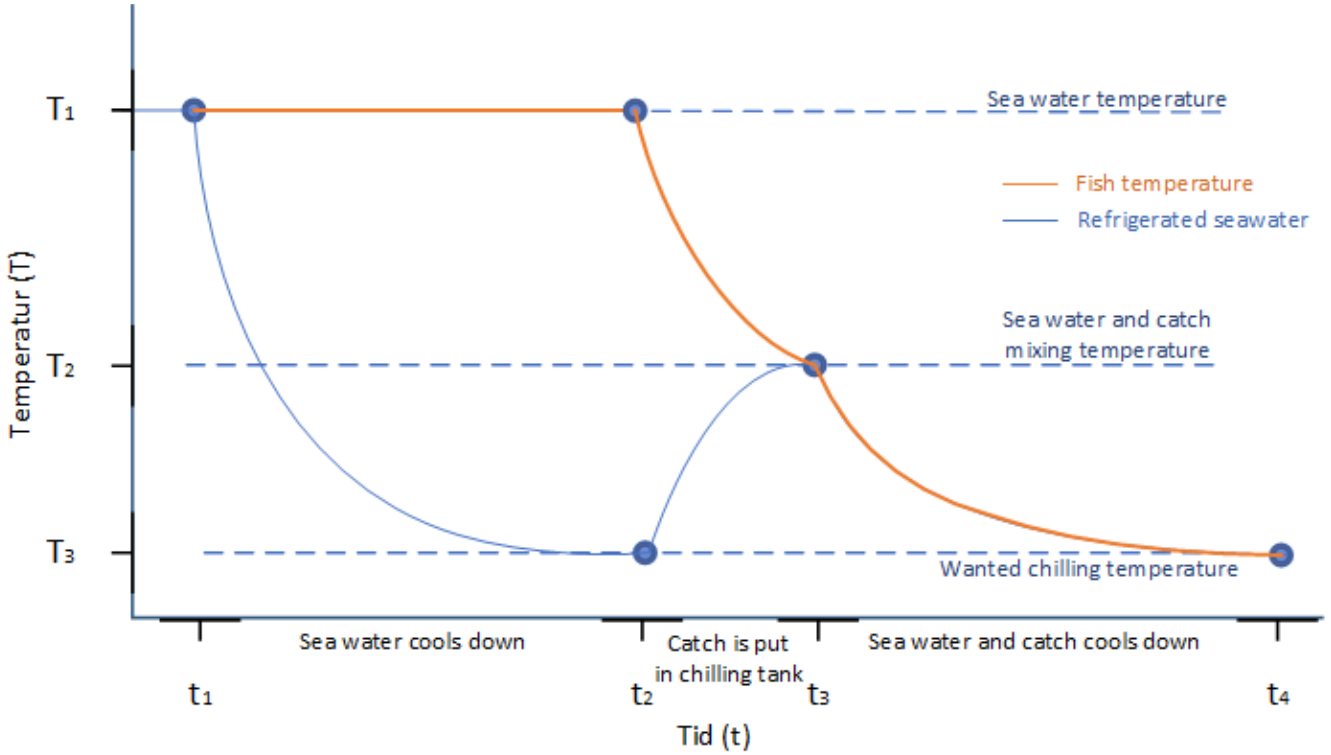
PCM-STORE

CoolFish

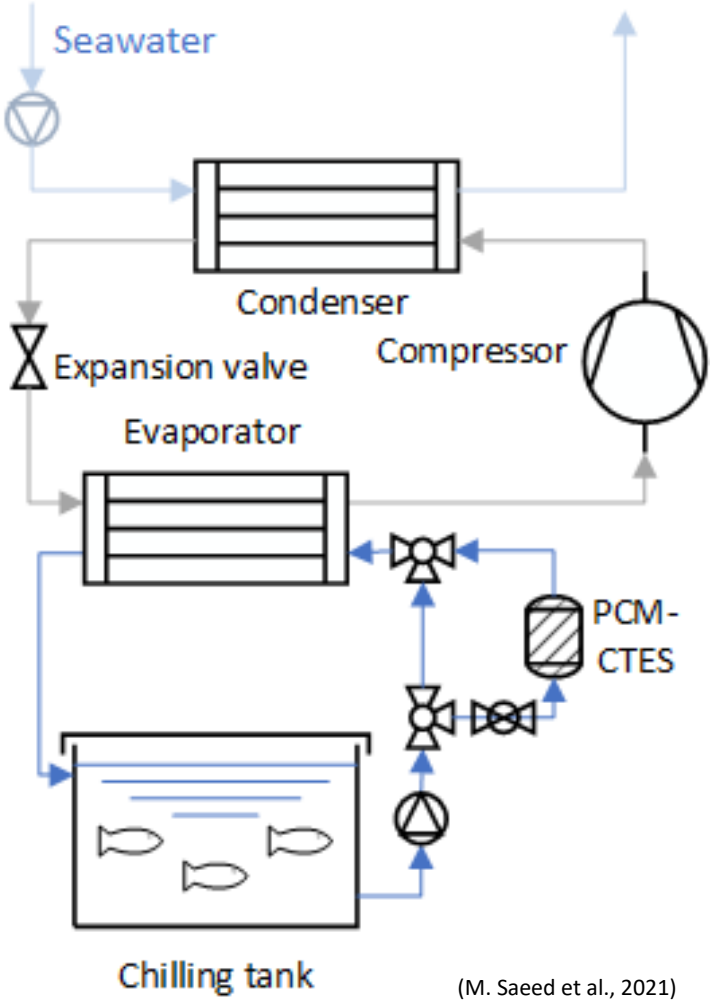
Refrigerated sea water

- Seawater chilled
  - Travel out to fishing ground
  - Not time sensitive
- Large catch brought on board
  - Time sensitive

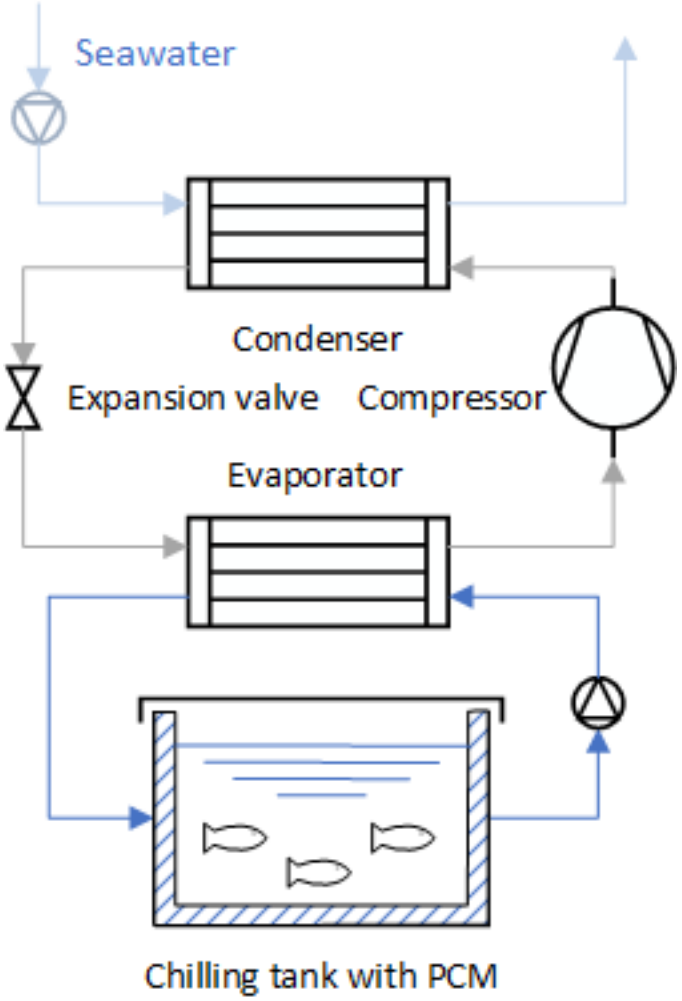




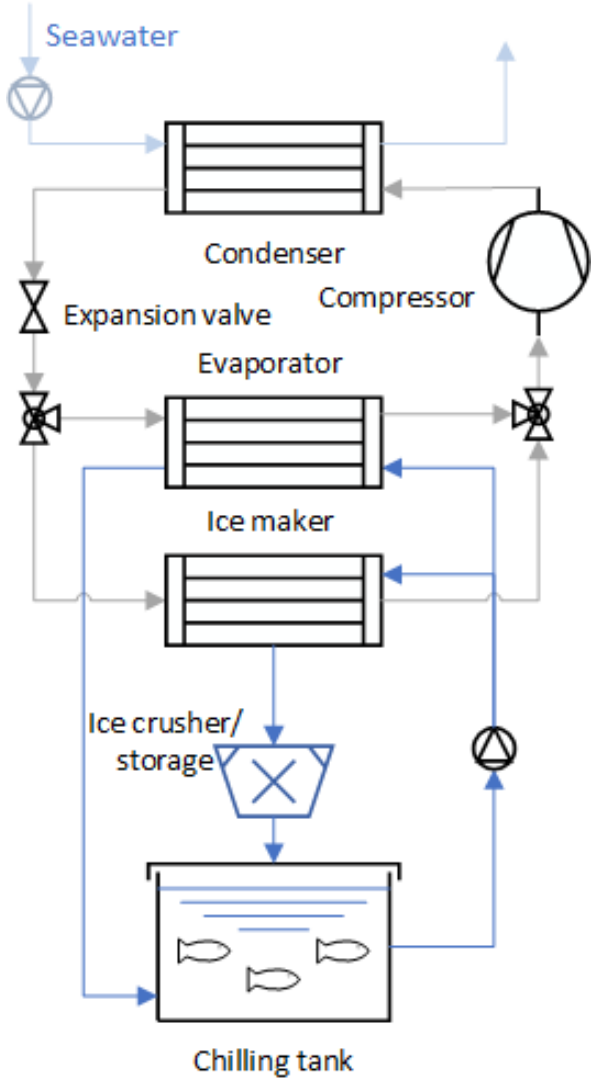
PCM-CTES in RSW systems



(M. Saeed et al., 2021)

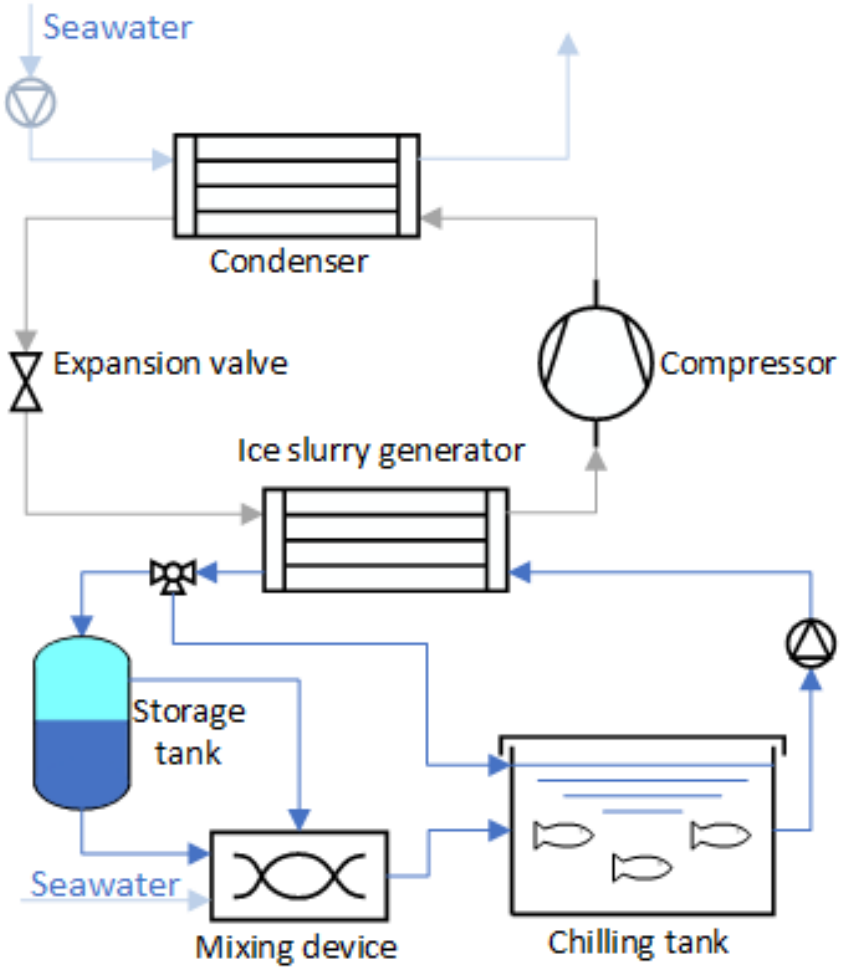


Ice vs. ice slurry



ICE

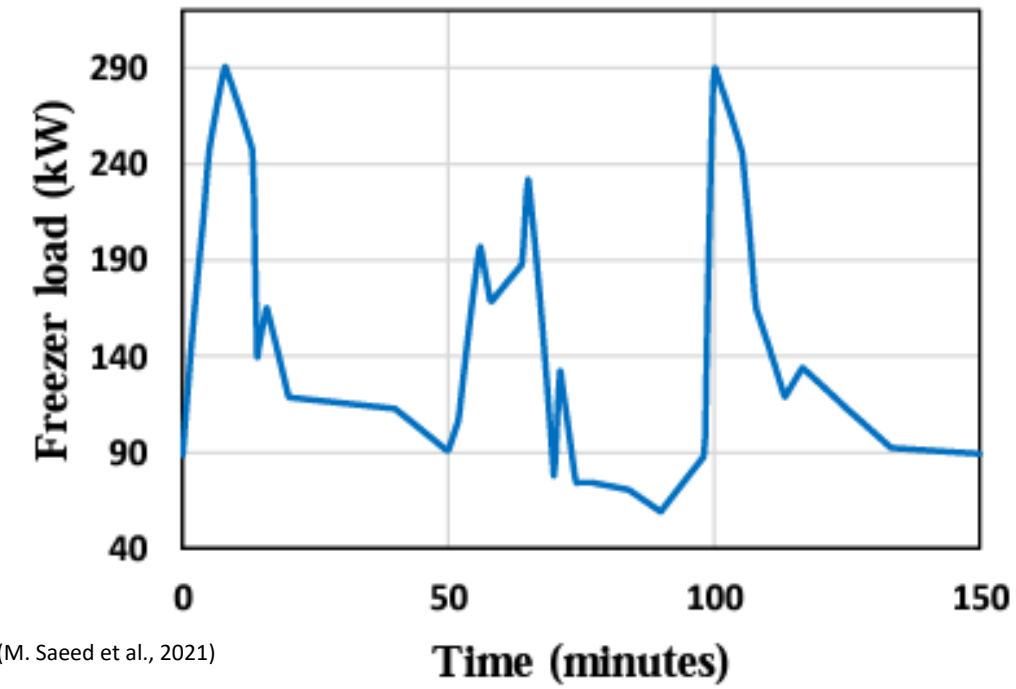
- High latent heat
- Manual handling
- Rough ice
  - Damage product



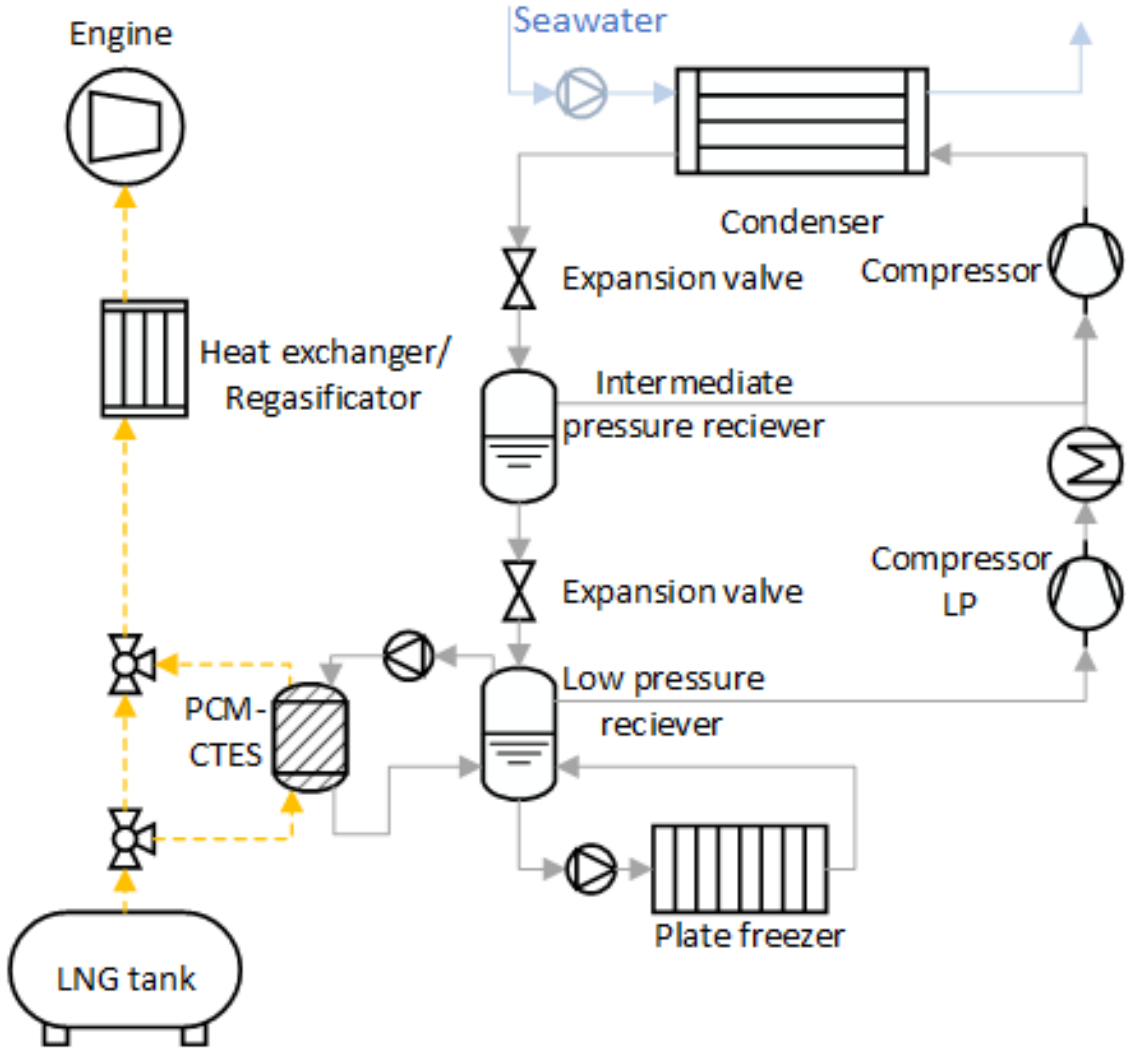
ICE SLURRY

- High latent heat
- Pumpable
- Small ice crystals
  - Gentle to product
- Increased heat transfer

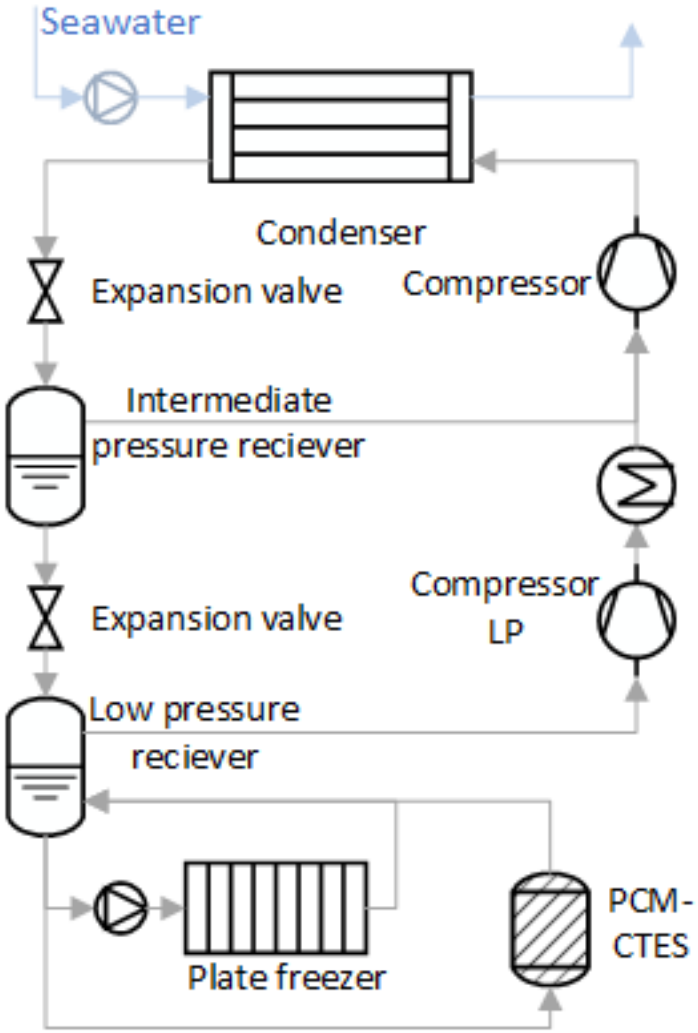
PCM-CTES in on board freezing systems

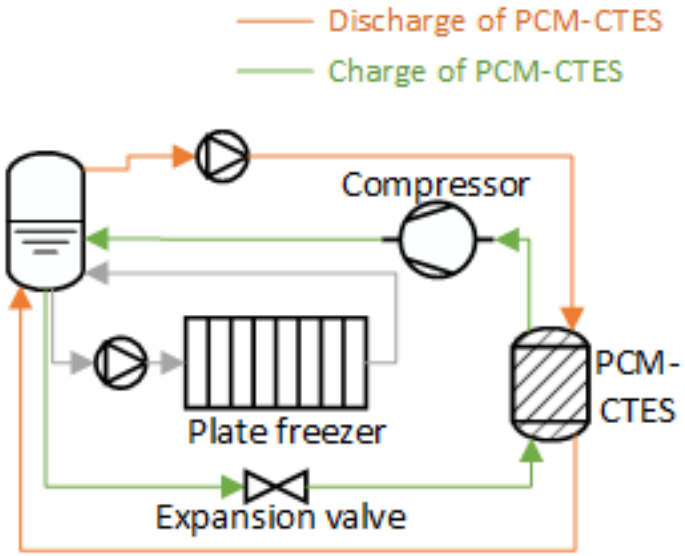


(M. Saeed et al., 2021)



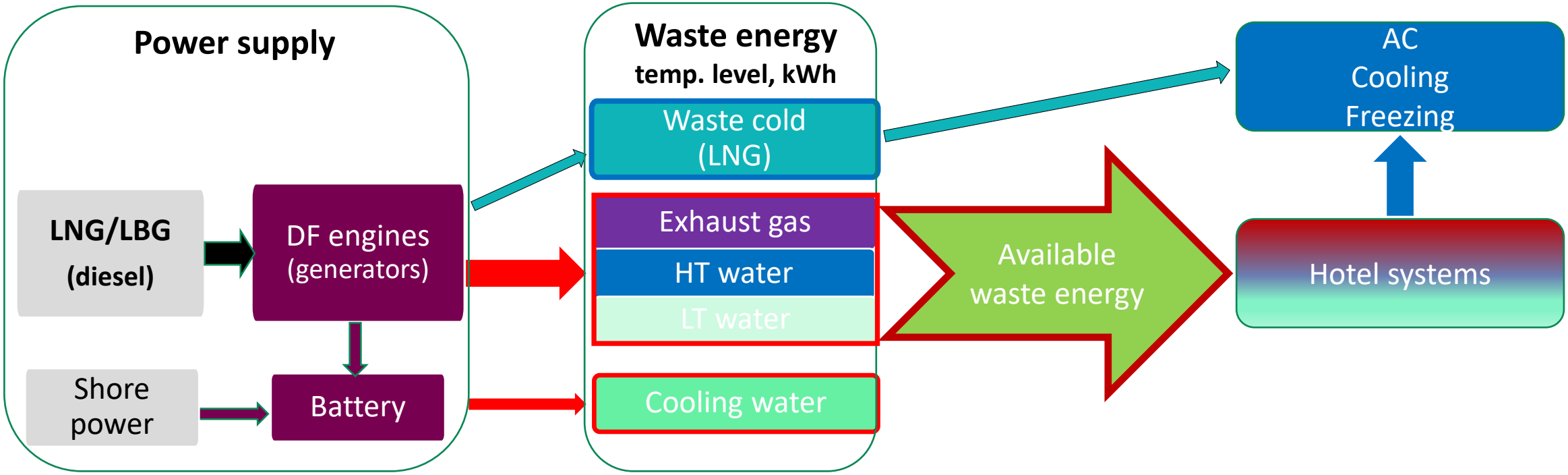
PCM-CTES in on board freezing systems





(Verpe et al., 2019)

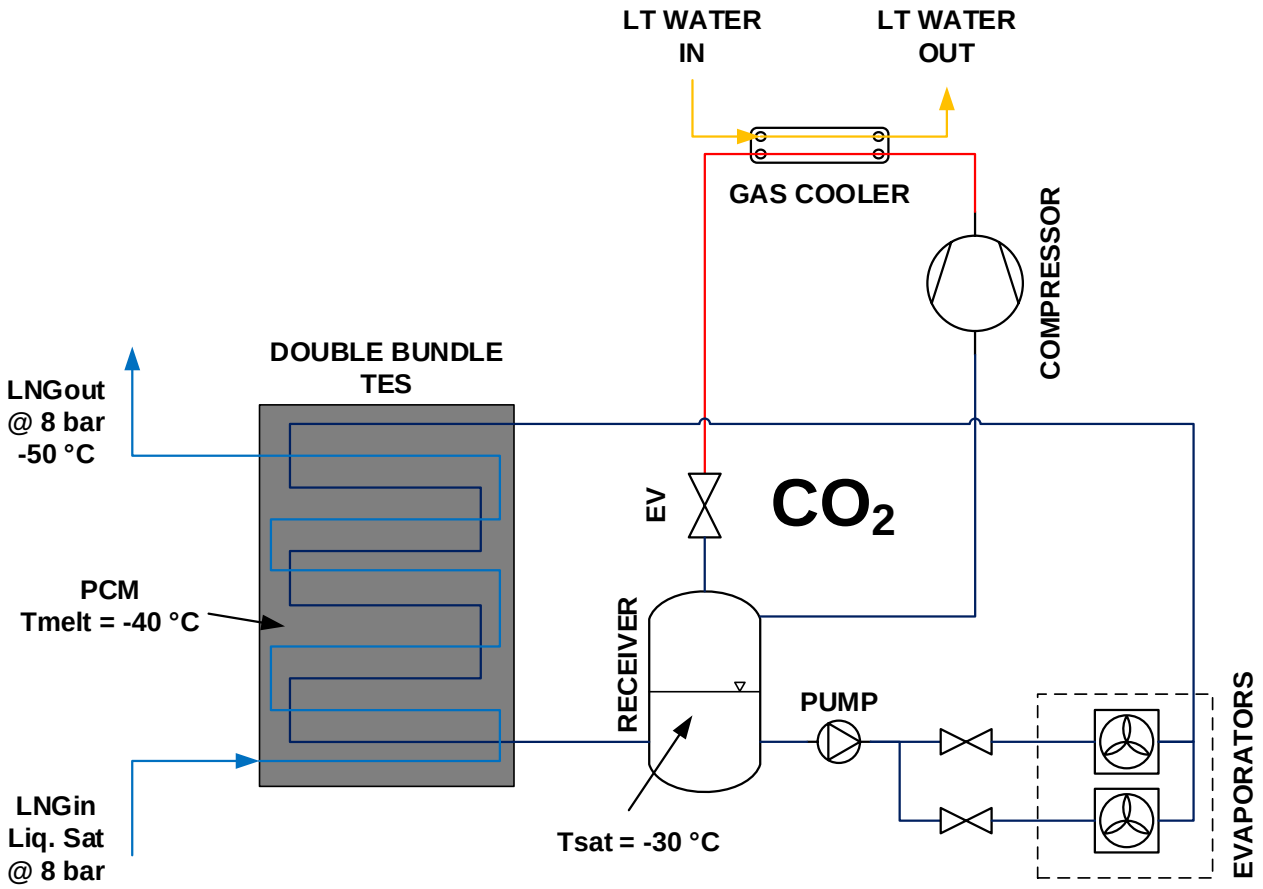
Cruise ships and TES



LNG use and PCM for cruise ships

- Maximize LNG use as cold sink.
- Concerns for stability due to:
  - Variability of loads.
  - Variability of temperatures.

PCMs?



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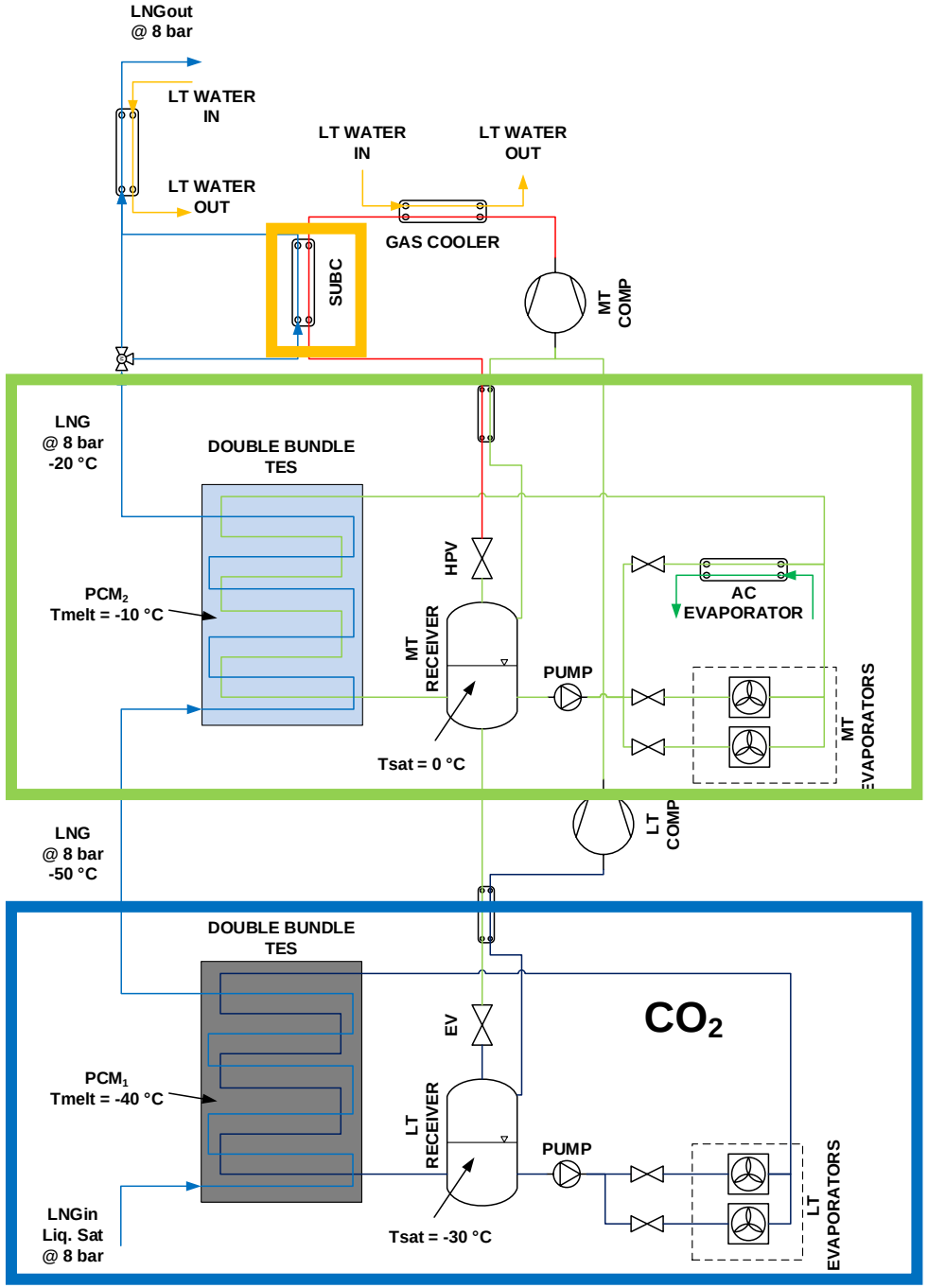
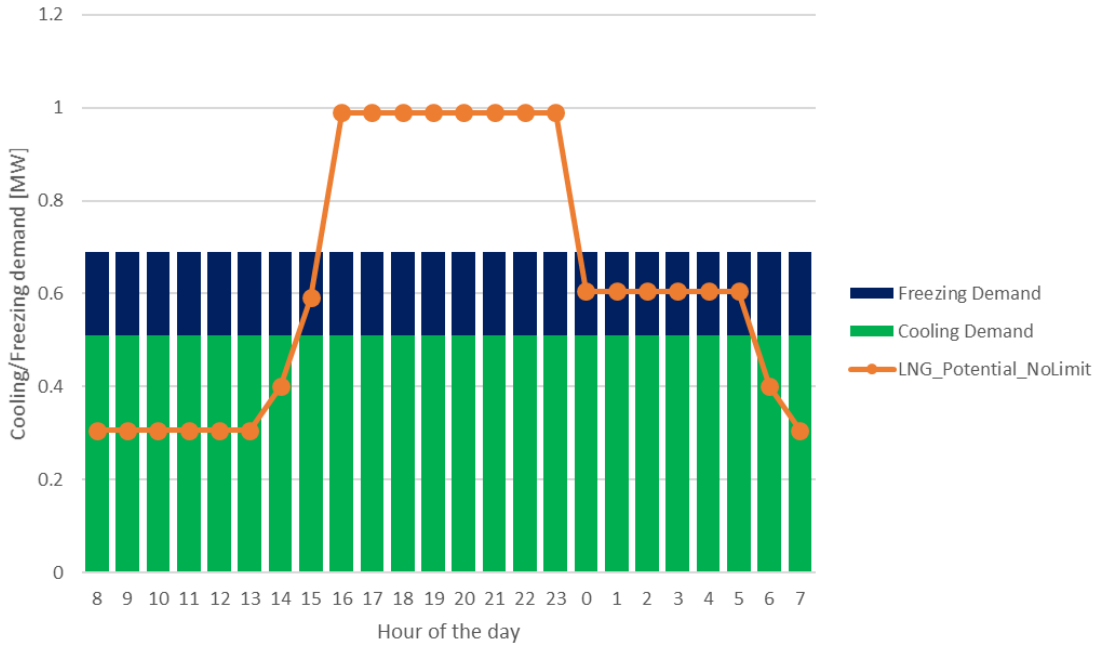
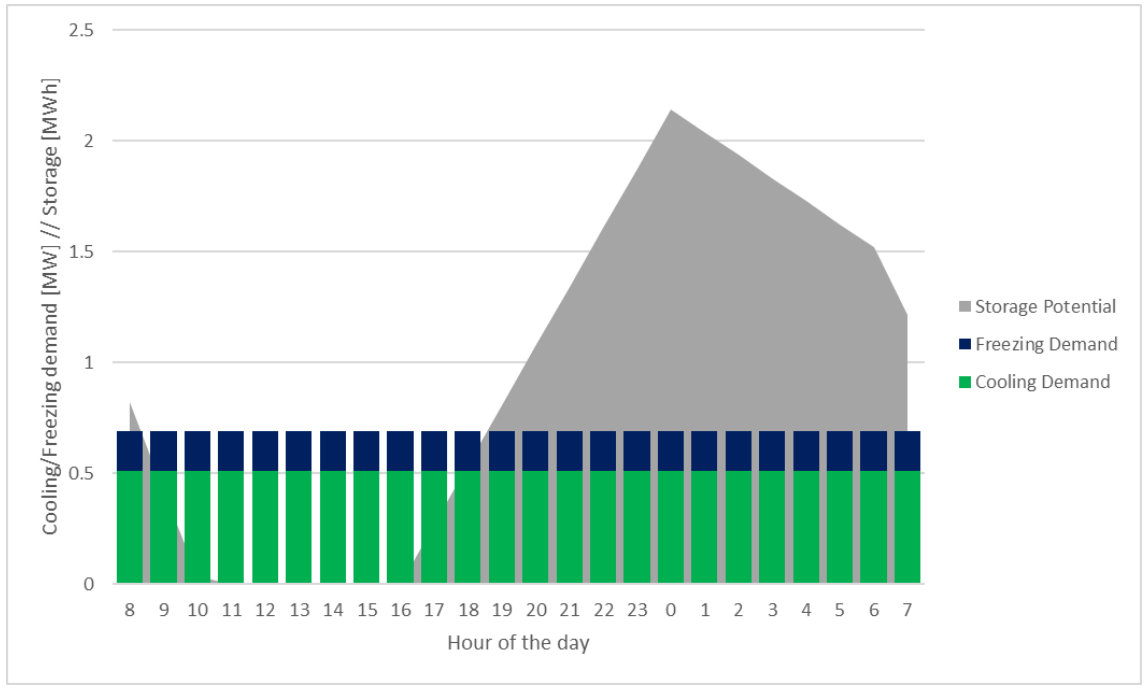
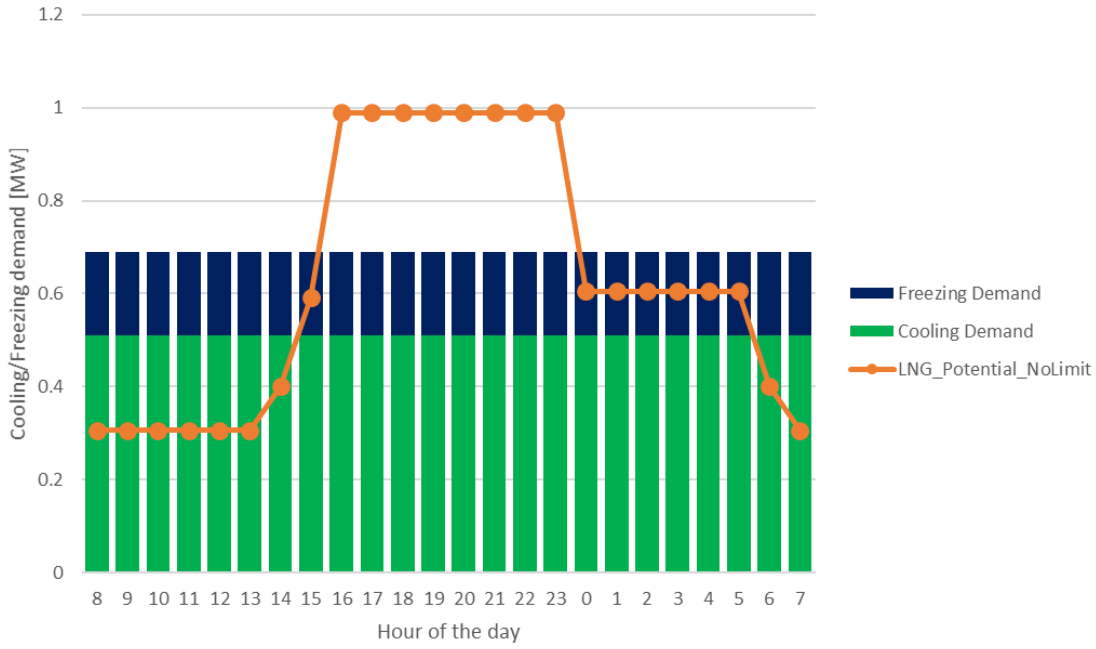


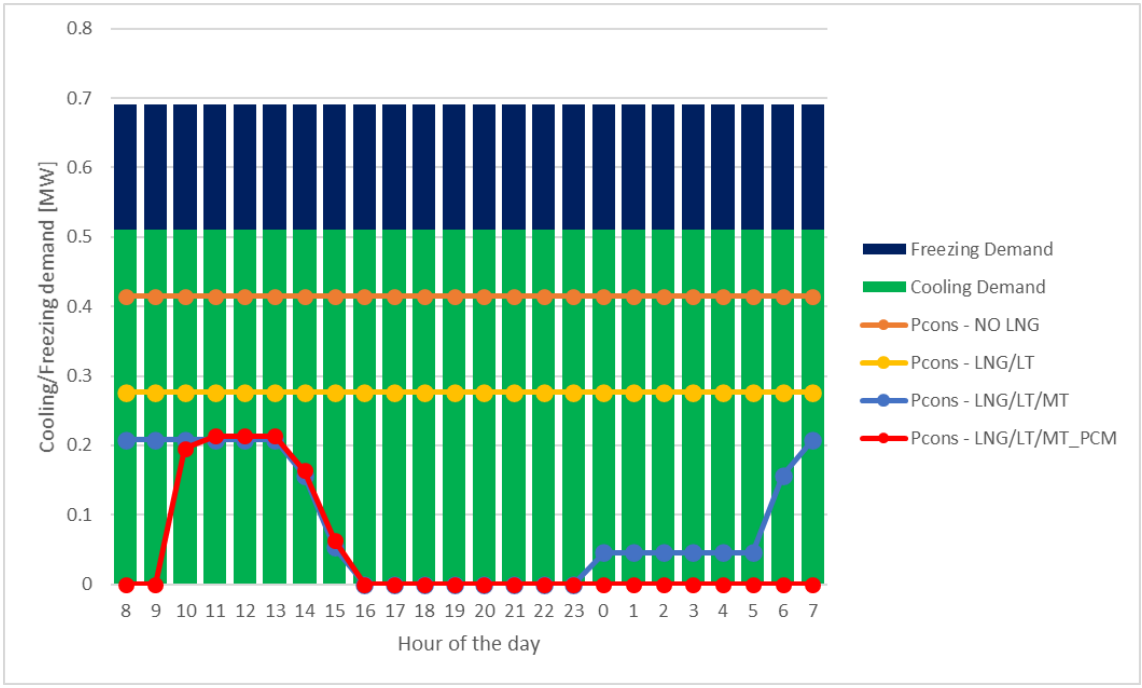
LNG use and PCM for cruise ships





LNG use and PCM for cruise ships





LNG use and PCM for cruise ships

- Maximize LNG use as cold sink.
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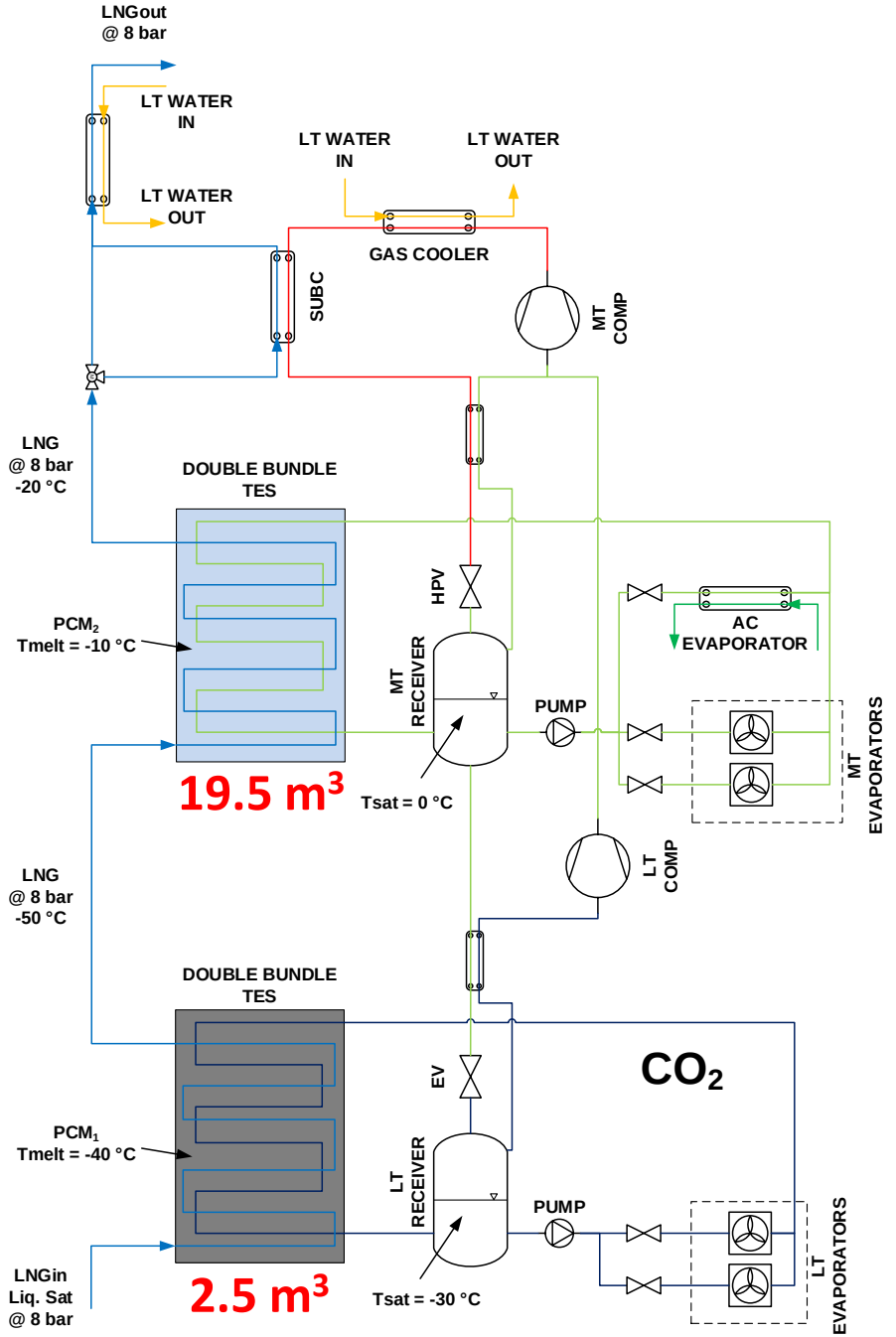
  - Variability of temperatures.


Data sheet
ATS -12

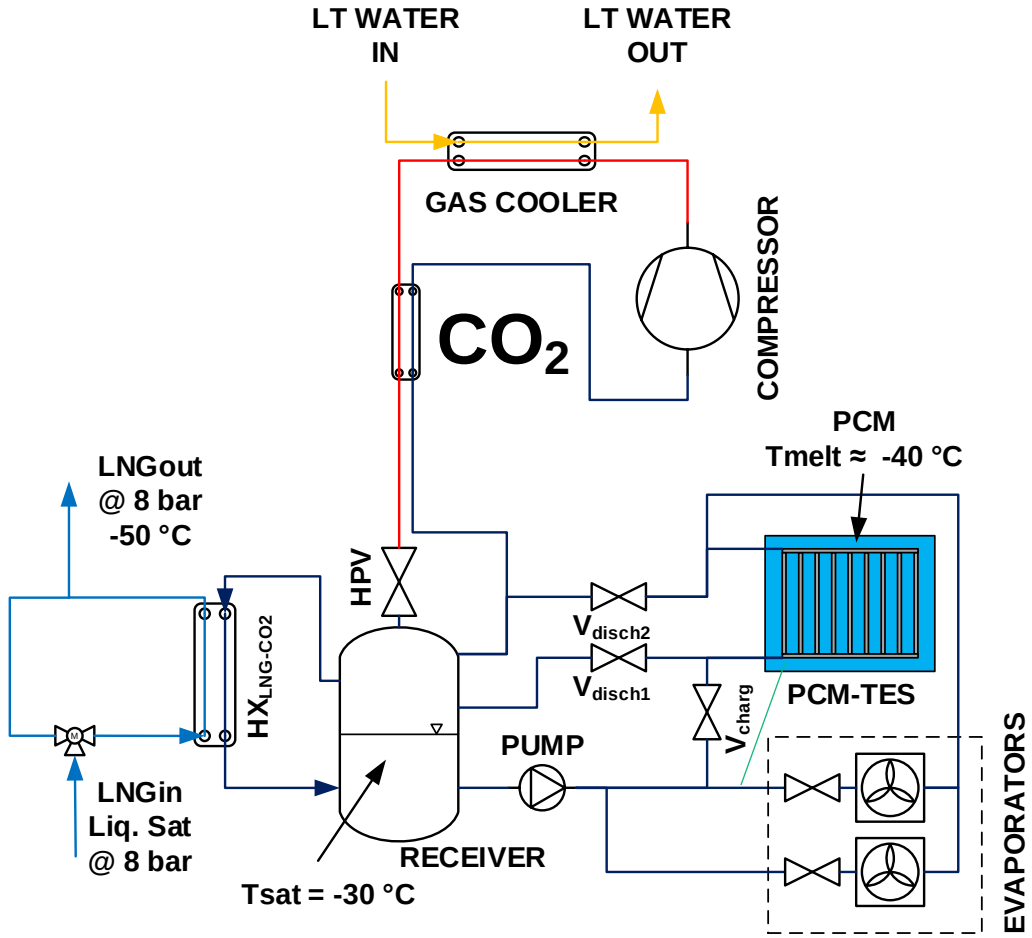

Data sheet
ATS -40

PCMs?



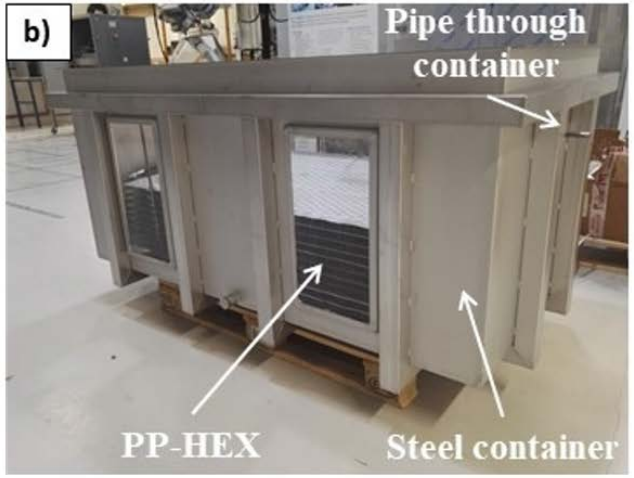
LNG use and PCM more general

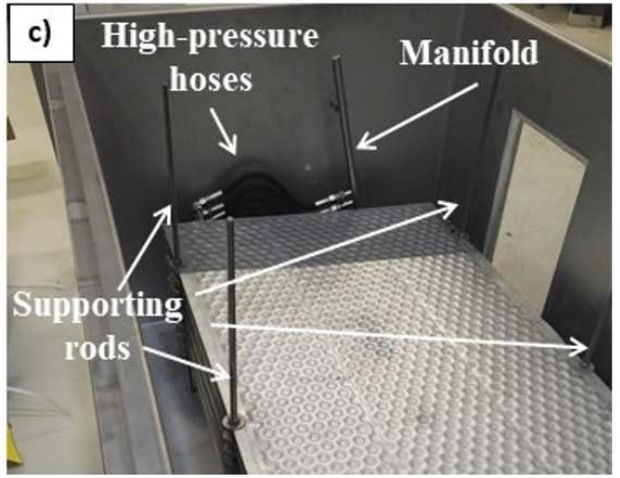
- Concern about feasibility of three-fluid HX-TES (double bundle TES)
- Alternative with more conventional PCM-TES approach (CO_2 and PCM)
- Self-circulated CO_2 in HX with LNG.
- Potential for "booster" applications → LT, MT, AC.

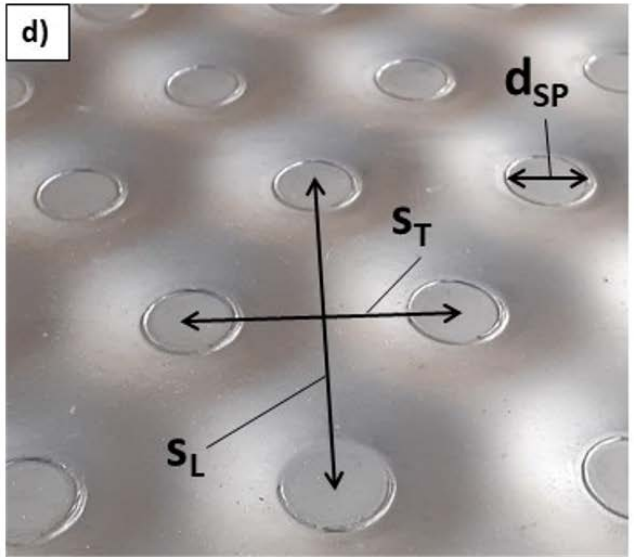


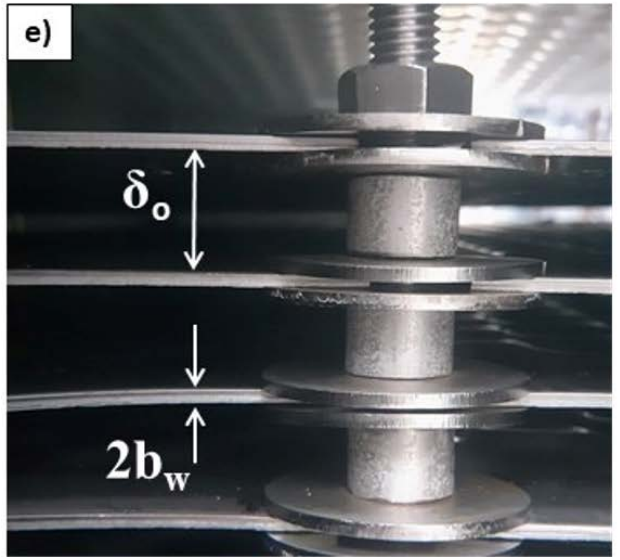
Alternative HX-TES concept – CO_2 & PCM

- Simplifying the hardware by limiting to two mediums
- Already tested at lab-scale for PCMs at subzero temperatures
- Availability of commercial PCM in -40 °C range is limited
  - Alternative for LT – TES: Using dry ice (solid CO_2) as PCM in a pressurised tank.
    → Will be investigated further









SINTEF

THANK YOU FOR YOUR ATTENTION

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CruiZE

CoolFish