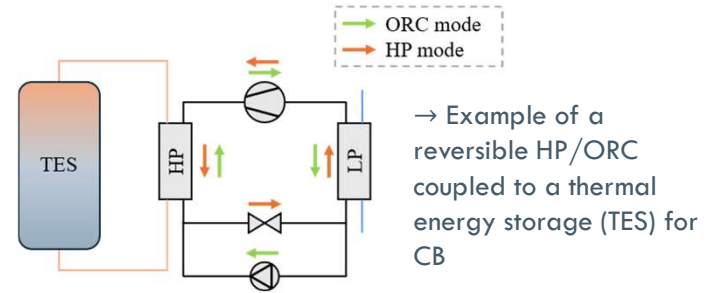


WHY REVERSIBLE HP/ORC SYSTEMS ARE INTERESTING FOR CB APPLICATIONS

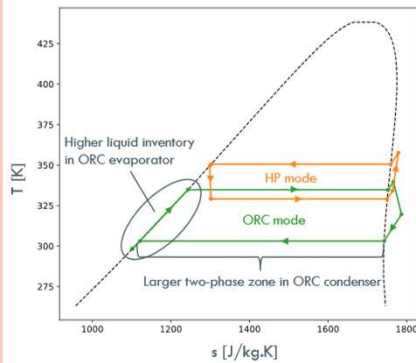
- Carnot Batteries (CB): need low-cost charge/discharge cycles especially at small-to-medium scale
- Reversible HP/ORC unit: shares the same components between charging (HP mode) and discharging (ORC mode)

→ Fewer machines, smaller footprint, lower cost



WHY WE NEED CHARGE MANAGEMENT, AND HOW TO ACHIEVE IT

More refrigerant is needed in ORC mode



~ 3 kg difference on a 2 kWe system (Tassenoy 2022)

→ Liquid Receiver (LR) manages the charge difference
→ Typically placed after the condenser

What are the issues linked to wrong refrigerant charge?

HP mode:

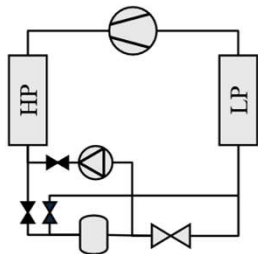
- Overcharging → high-pressure trip, efficiency loss
- Undercharging → poor condensation, unstable performance

ORC mode:

- Overcharging → high expander-outlet pressure, reduced power generation
- Undercharging → pump cavitation

There exists two main ways of handling this refrigerant charge difference

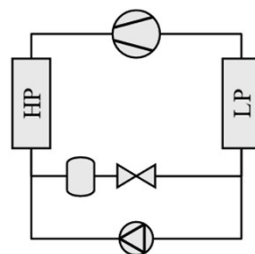
Passive charge management



→ LR always in line after condenser
→ Refrigerant charge regulates itself

Test Rig: Cendoya 2025

Active charge management



→ LR ONLY in line for HP mode
→ Requires active charge regulation for the ORC mode

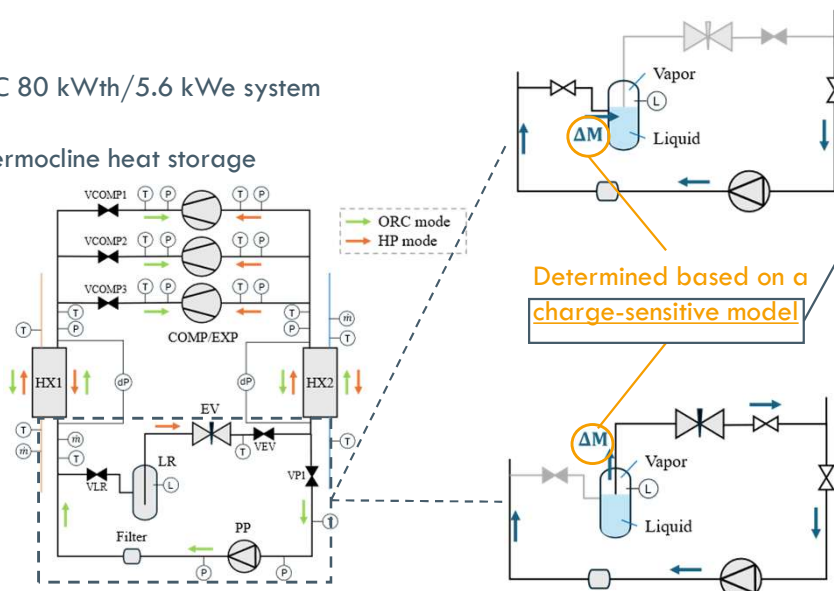
Configuration tested in this work

Can an automated charge-control strategy improve efficiency and stability across varying operating conditions?

TEST OF AN ACTIVE CHARGE MANAGEMENT STRATEGY WITH A TEST BENCH

Experimental test bench

- Fully reversible HP/ORC 80 kWth/5.6 kWe system
- Refrigerant : R1233zde
- Coupled to an 8 m³ thermocline heat storage



Determined based on a charge-sensitive model

Implemented in LaboThAPy



Github repository



Read the Docs