



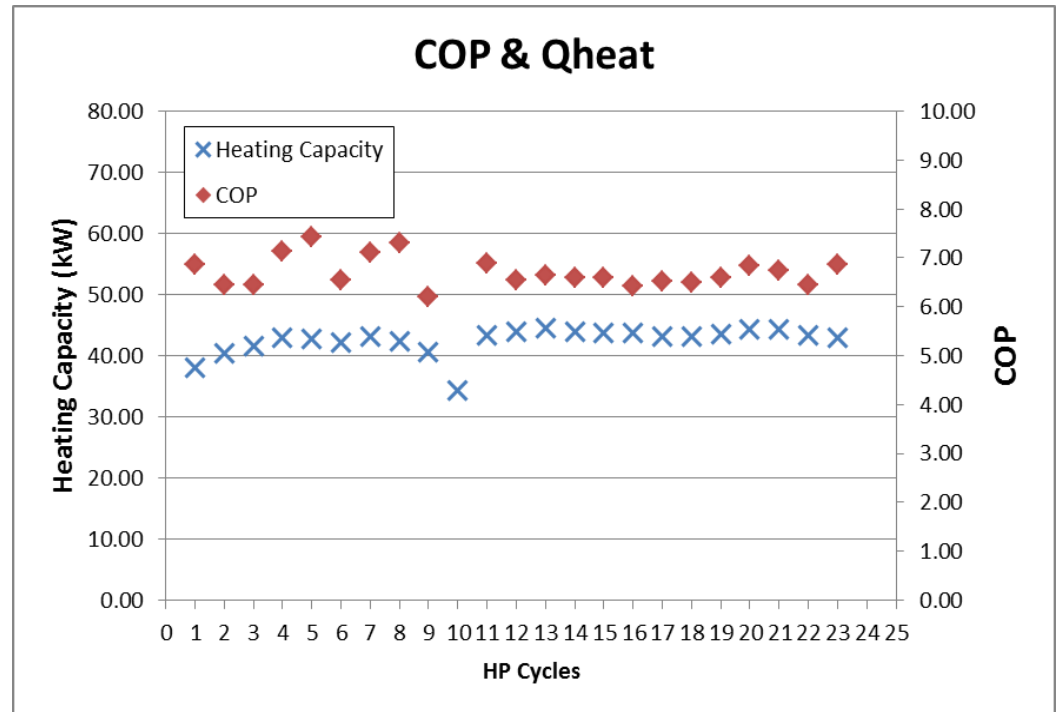
# Research Challenge 3

**Advance performance of energy transformation technologies**

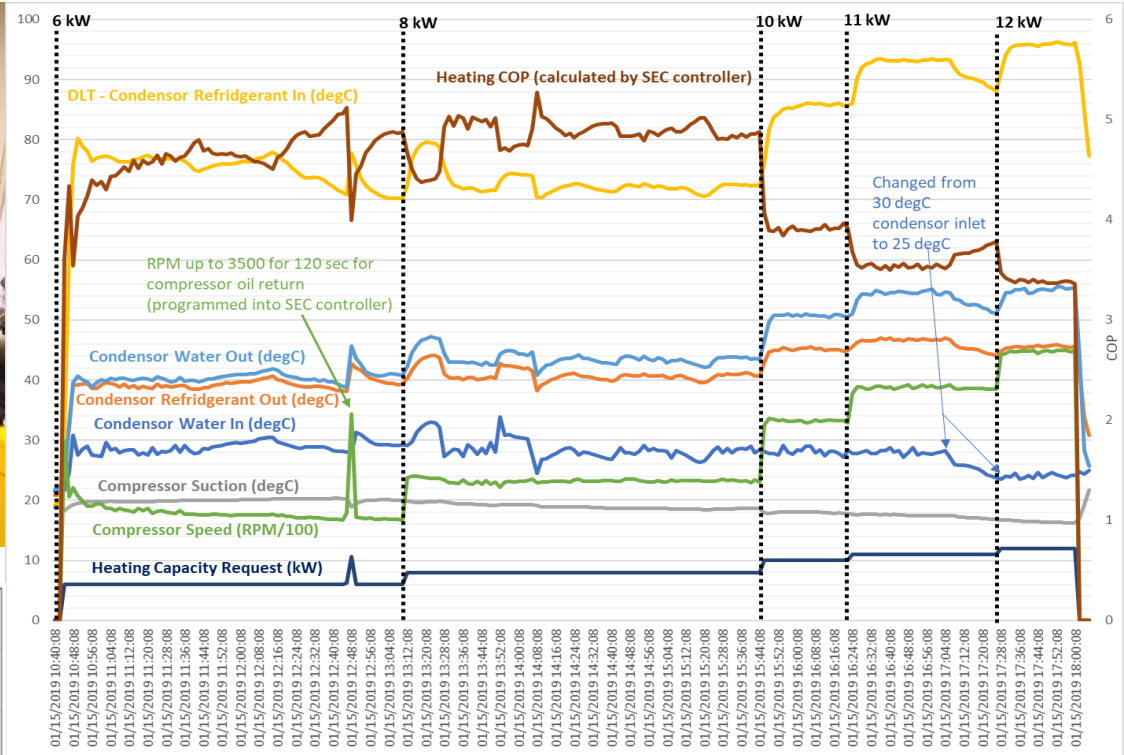
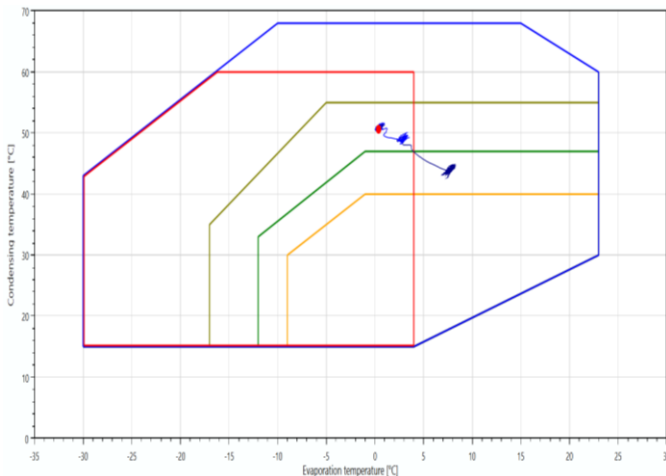


# 3.1 Low temperature lift, high COP heat pump

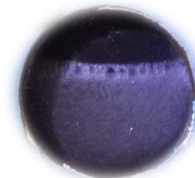
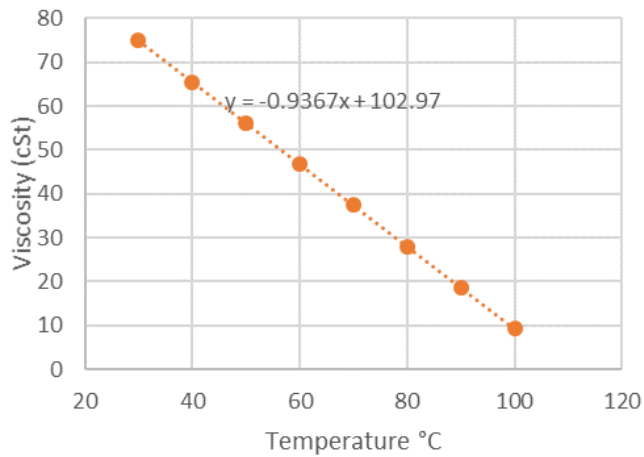
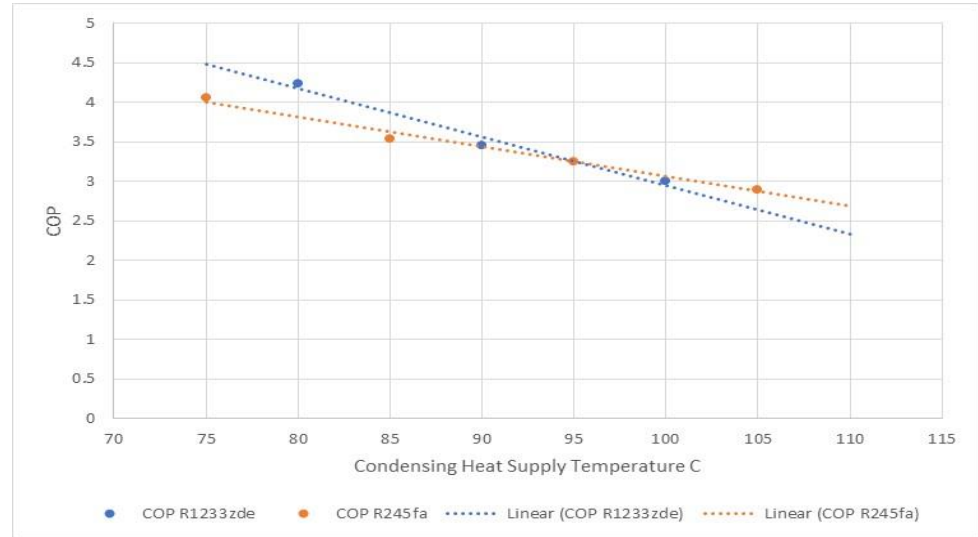
HP operation	November
Average Tamb (Low/High)	1°C/5°C
No of Cycles	24
Average operation time/cycle	36 minutes
Superheat setting	8°-12°K
Subcooling	11.3°K
STES Average temperature	34.8°C
Max. HP Water Outlet	52°C
Average Heating Capacity	43kW
Average COP	7.43



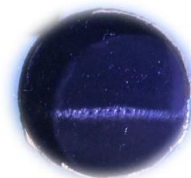
# 3.2 Heat Pump for Demand Side Management



# 3.3 High temperature heat pumps



2:00pm



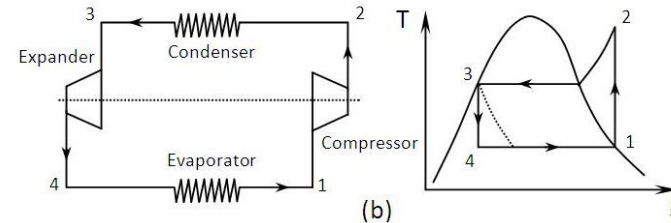
2:15pm



3:15pm

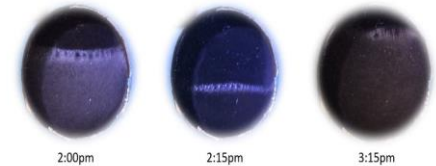
# 3.4 Combined heat pump/ORC

- Industrial applications may want to generate power from excess heat in two systems



- Stage 1 – Expander

- Stage 2 – Compressor as a Pump?



- Stage 3 – ORC/Heat Pump

# WP3.5 Low-temperature sorption cooling



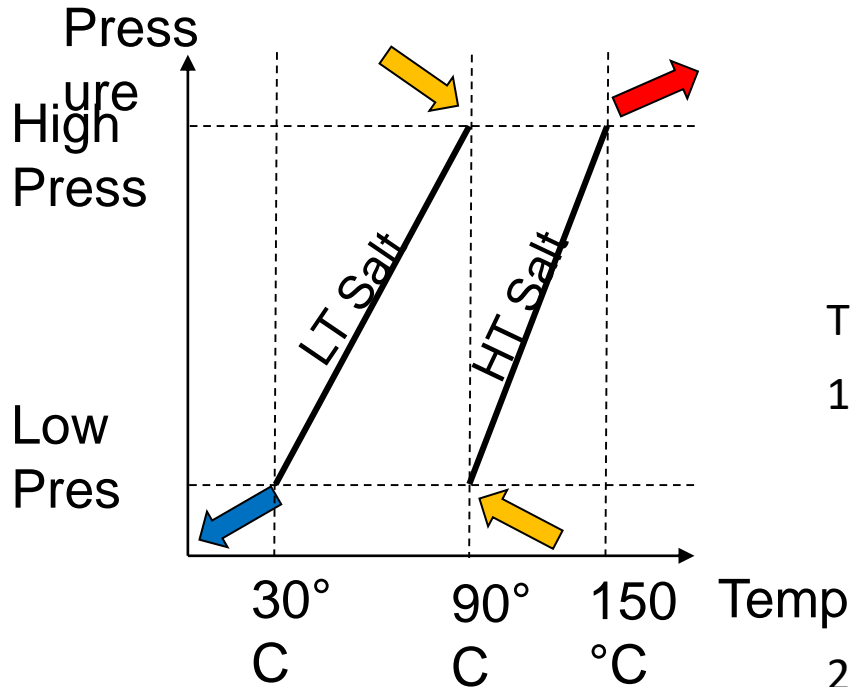
The work package will initially evaluate the alternative technologies, feeding data into the models developed in WP1. This will determine whether a new system should be developed or if existing technology can be used and incorporated within the low-temperature network. The work will be carried out by one of the Warwick PDRAs with evaluation complete (C3D5) by Month 15.

# WP3.6 Sorption Heat Pump from High Temperature Source to Network or Store



- Carbon-ammonia heat pump.
- The information will then be fed into the models in WP1 and the technologies evaluated.
- How should it be developed?

# WP3.7 Thermal Transformer from Process to Low-Temperature Network



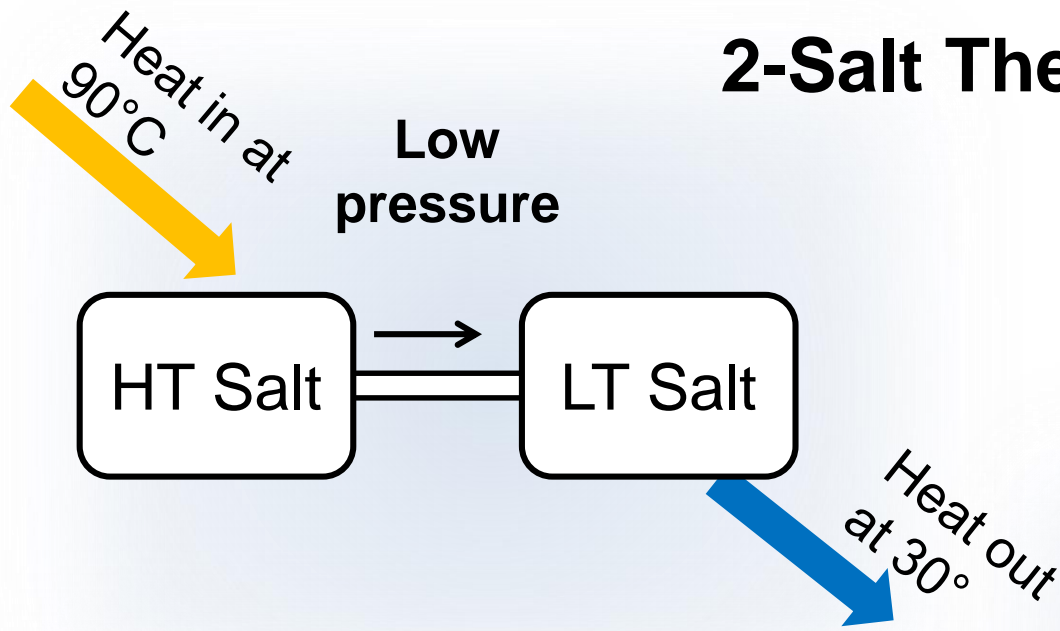
Thermal transformers allow industrial waste heat sources at circa 60-90° C to be upgraded to 140-160° C with a recovery rate of between 20 and 40%. The remaining 60-80% can be delivered to the LT Network at 20-40° C.

The two main objectives are:

1. To bring heat transformer technology to TRL3 by appropriate material and cycle design and then development and characterisation of a lab prototype.
2. To develop models which can be incorporated into the system models in WP1 to inform how best to integrate the technology into heat networks.



# 2-Salt Thermal Transformer (TT) (CaCl<sub>2</sub> & MgCl<sub>2</sub>?)



Phase 1: HT salt desorbs,  
LT salt adsorbs

- 2 salts have lower pressures compared to 1 salt with condenser/evaporator
- less susceptible to sensible heat thermal mass losses

