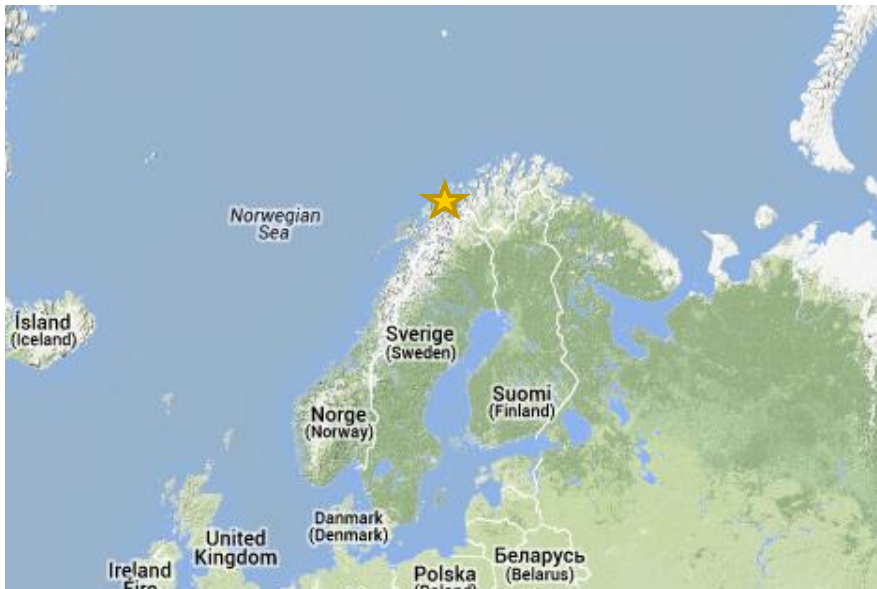




Process cooling with CO₂ at Mack`s new brewery in Norway

MACK BEER BREWERY - NEW BREWERY 2012



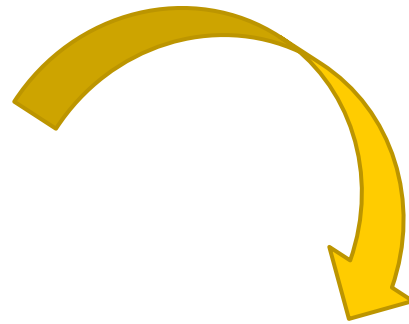
- ✘ In operation since Dec 2012
- ✘ Production premises 16800m²
- ✘ Production of mineral water lemonade and beer

GREEN[®]
& COOL

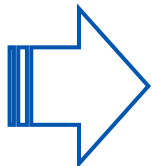
Green Refrigeration Systems

MACK BEER BREWERY – PRODUCTION AND ENERGY

- × 100 000hl/year,
- × Energy consumption:
11.3GWh/year

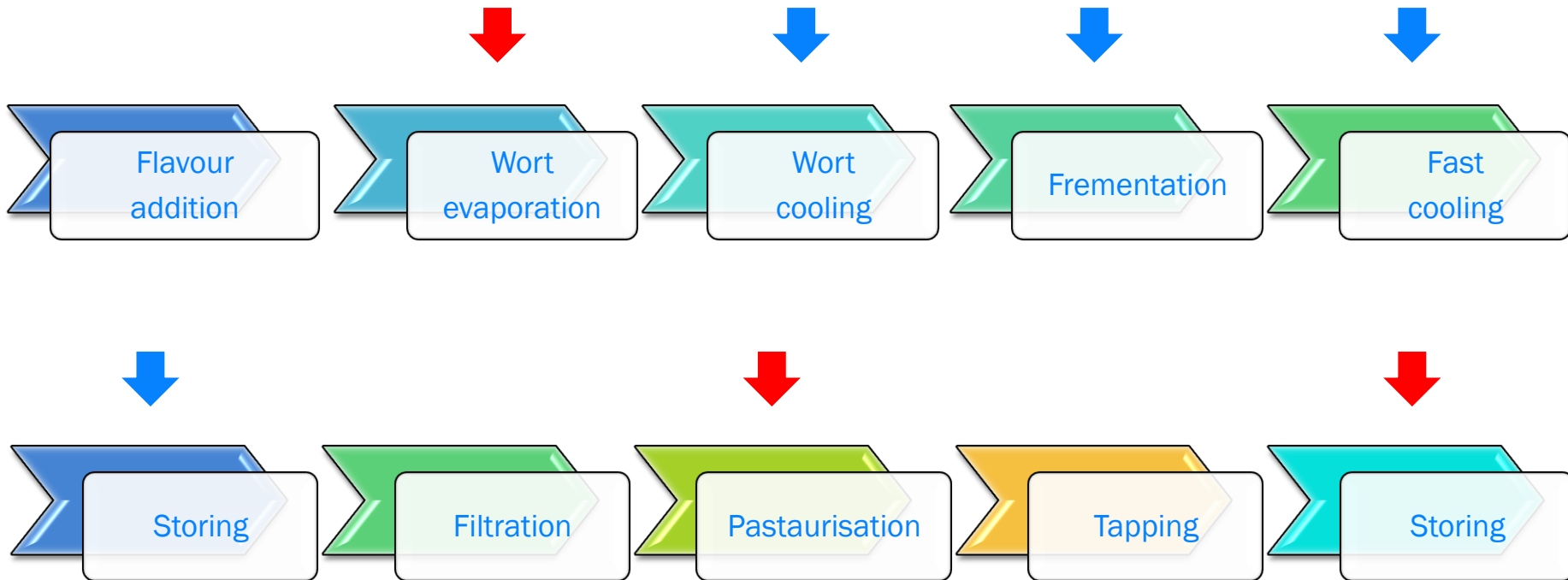


- × 200 000hl/year
- × 50% energy saving!



**Energy efficient chillers
Heat recovery**

PRODUCTION PROCESS - BEER



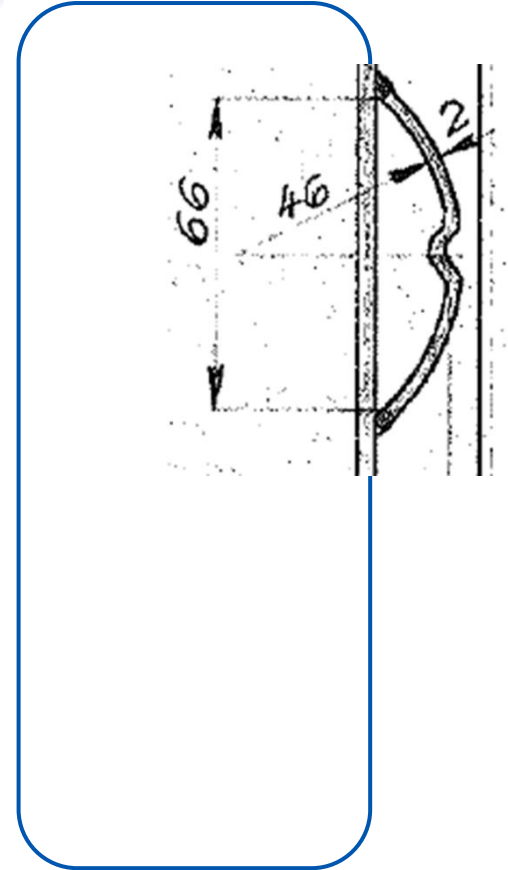
+ high demand for hot tap water

**Heat recovery to
Tap water 70C
Ventilation ~45C**

CHOICE OF SYSTEM: NH₃ / CO₂

- ✘ Bad experience of previous NH₃ plant: high NH₃ charge, leakage
 - ✘ Re-use existing fermentation tanks
- ➔ Brine solution**
- ✘ High demand for hot tap water

➔ Transcritical CO₂



COOLING PLANT

- ✘ 2 x CO2 transcritical chillers
- ✘ Total cooling capacity ~ 500Kw
- ✘ Brine -4/-8C (33%MPG)
- ✘ Air cooled gas coolers
- ✘ Heat recovery: tap water and ventilation



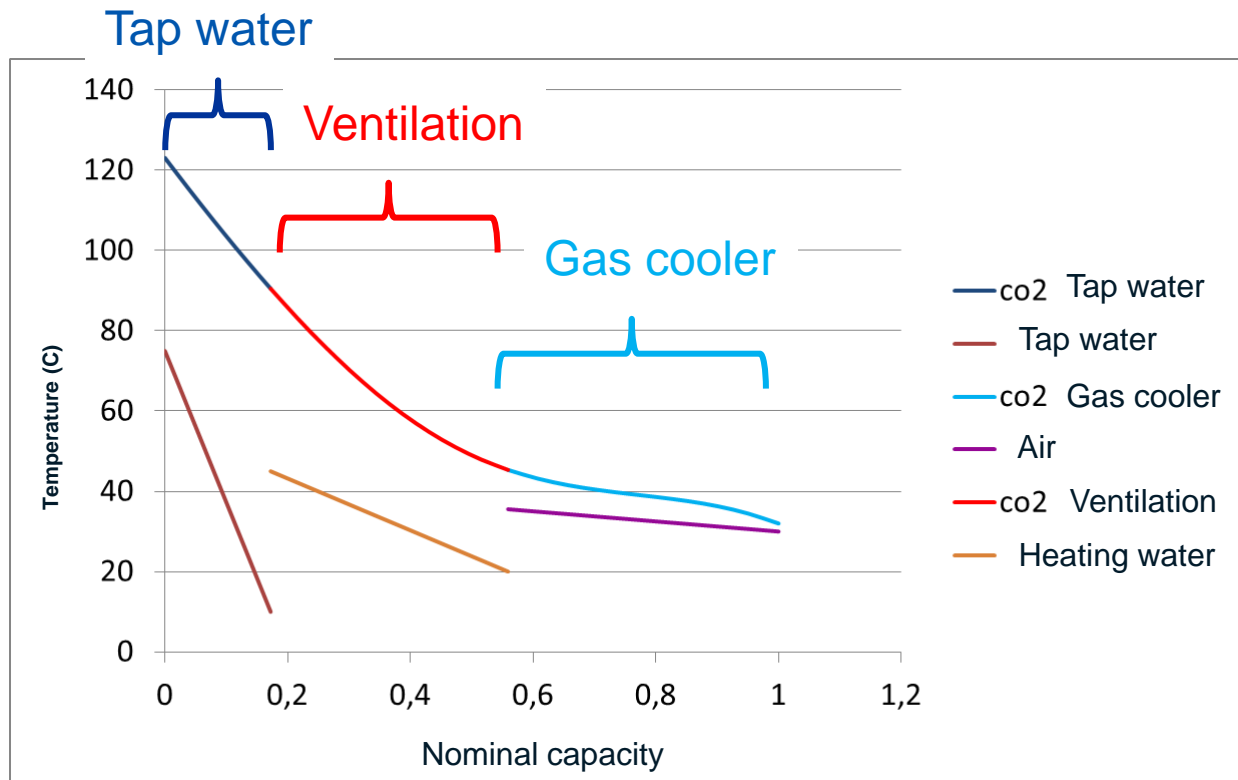
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HEAT RECOVERY

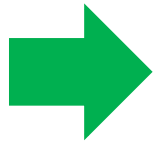
✘ Planning/Co-ordination

➔ Grant good functionality for each of the connected systems

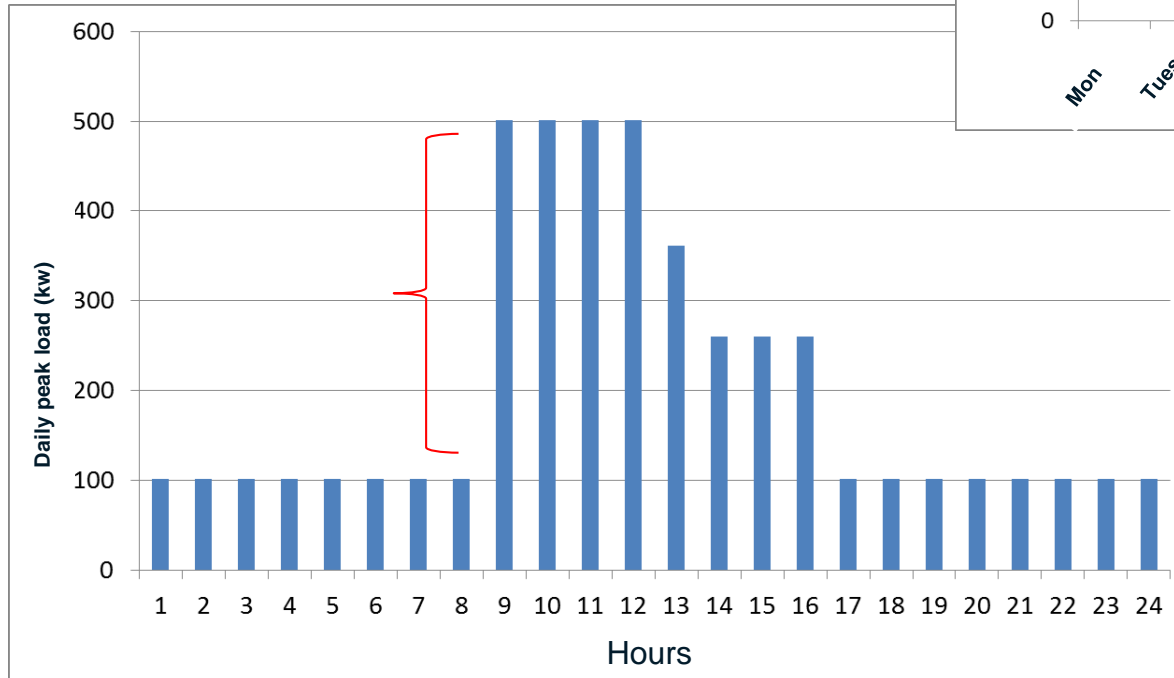
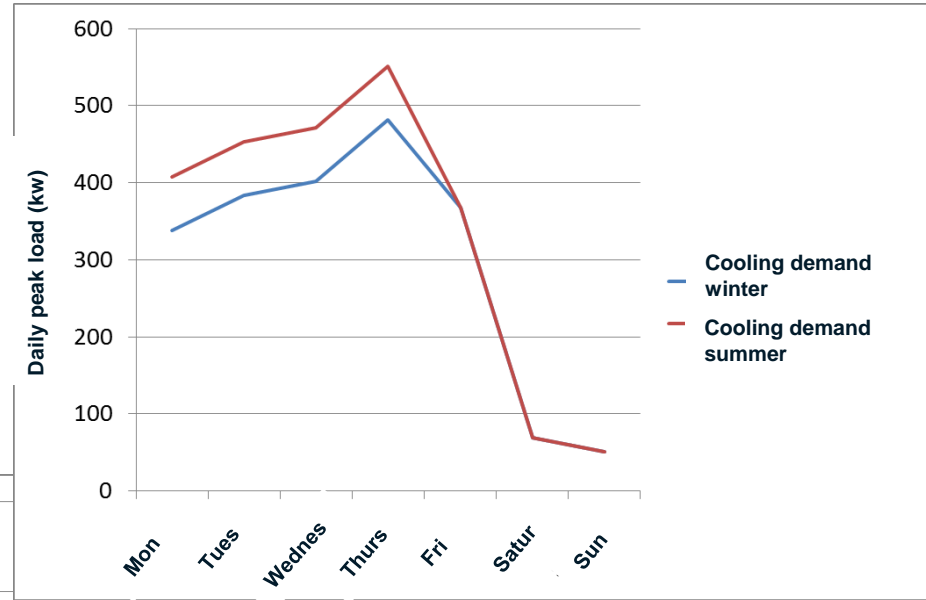


PRE-PROJECT STUDY

- ✘ High peak load
- ✘ Complex heat recovery



**ENOVA Innovasjon
Norge >2.5MNOK**



TECHNICAL ROOM



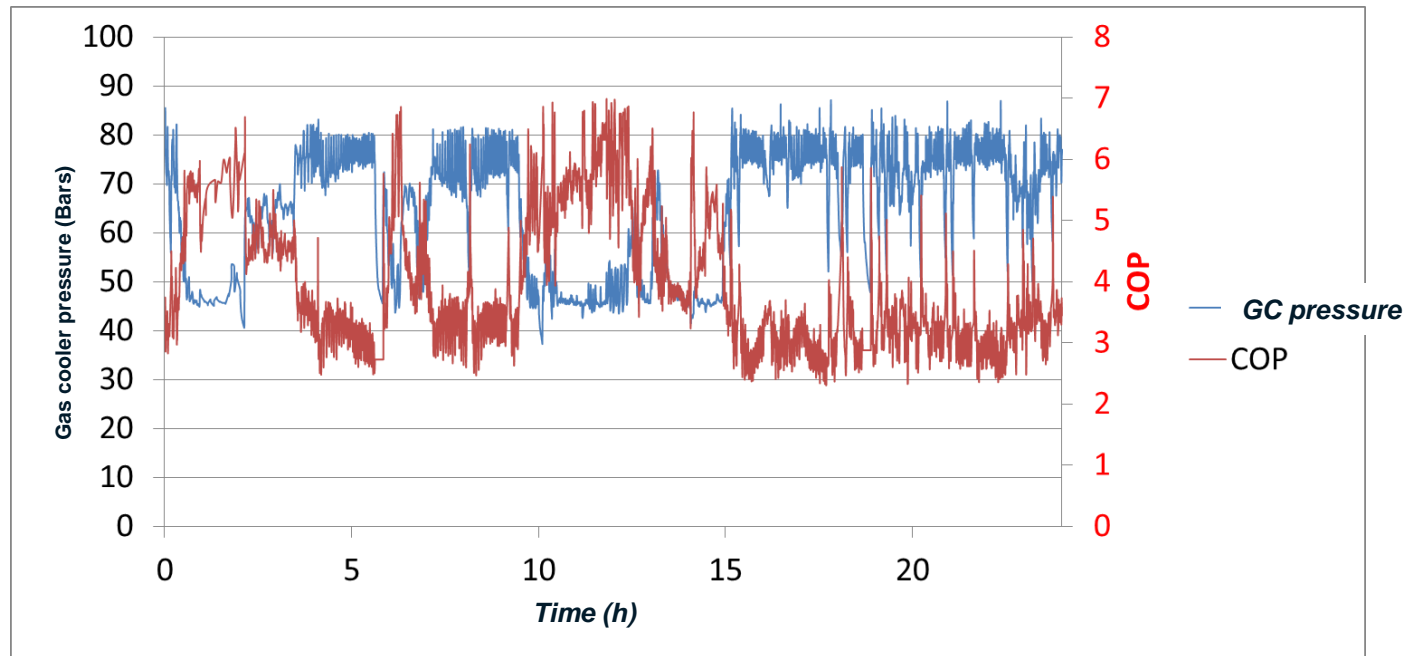
CHILLERS



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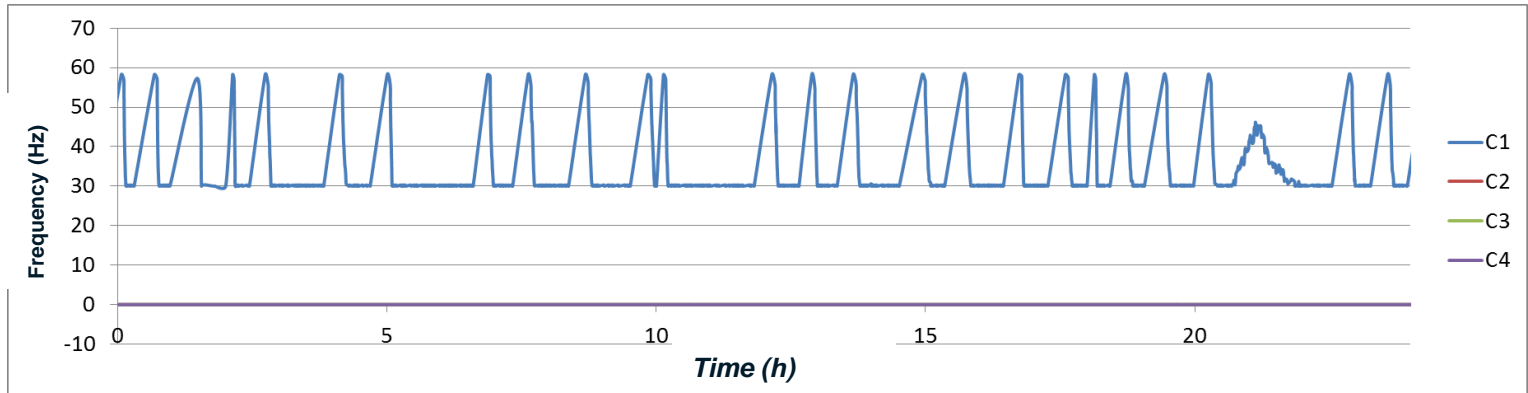
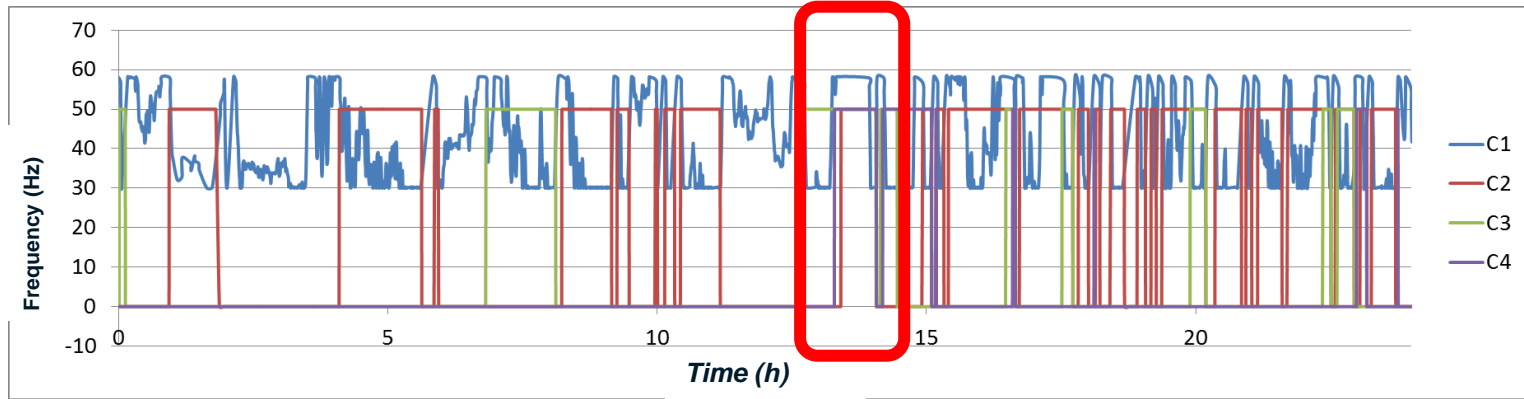
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EXPERIENCE SO FAR:

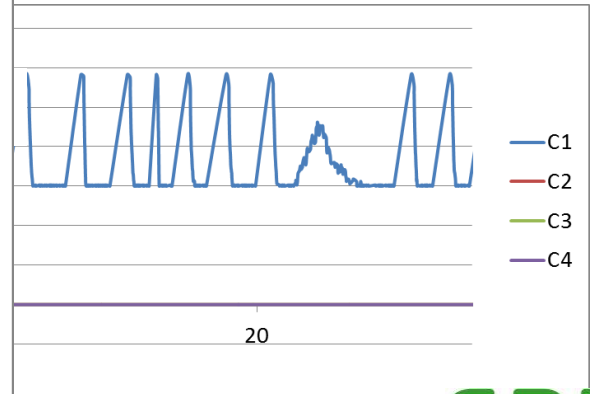
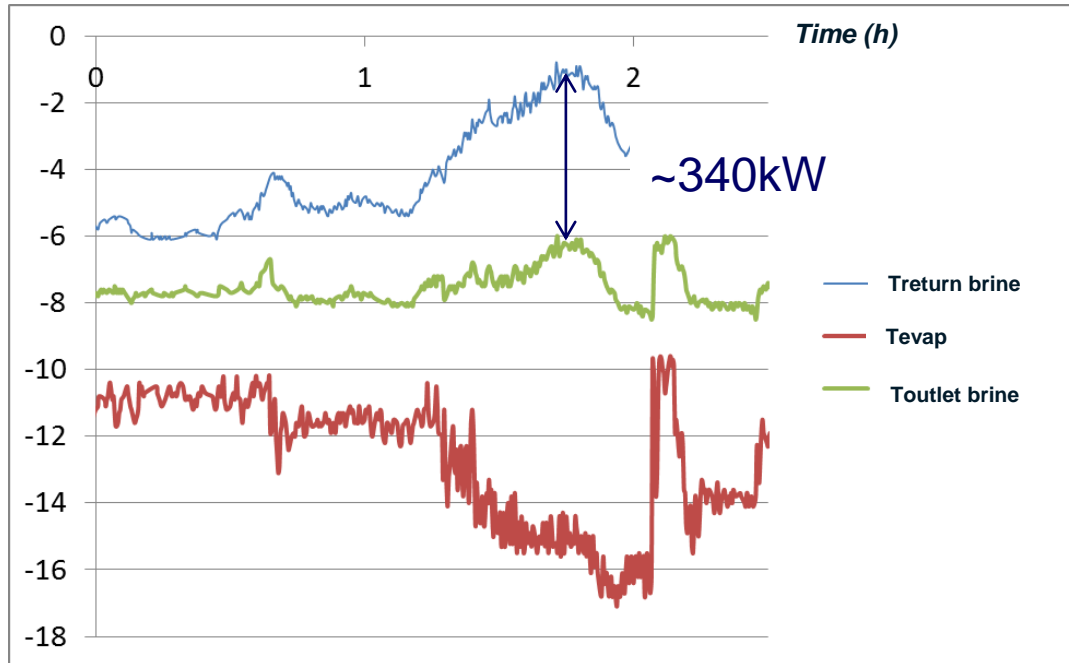
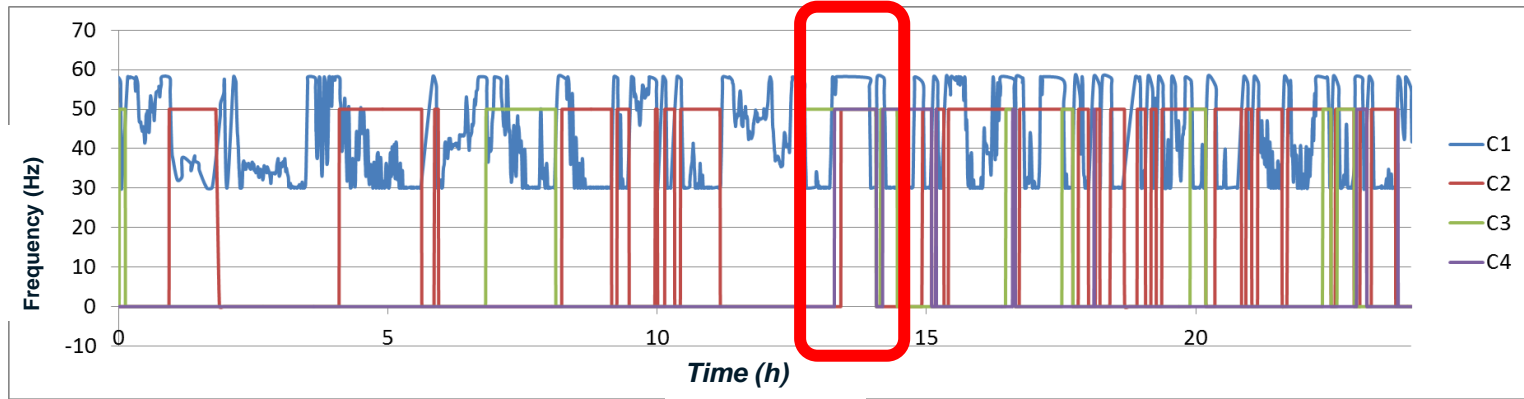


- ✘ COP~3 to 6
- ✘ «Low» COP cooling= high COP combined

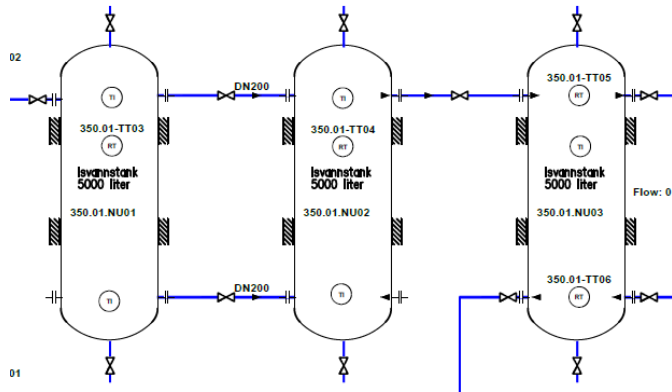
VARIABLE LOAD



VARIABLE LOAD



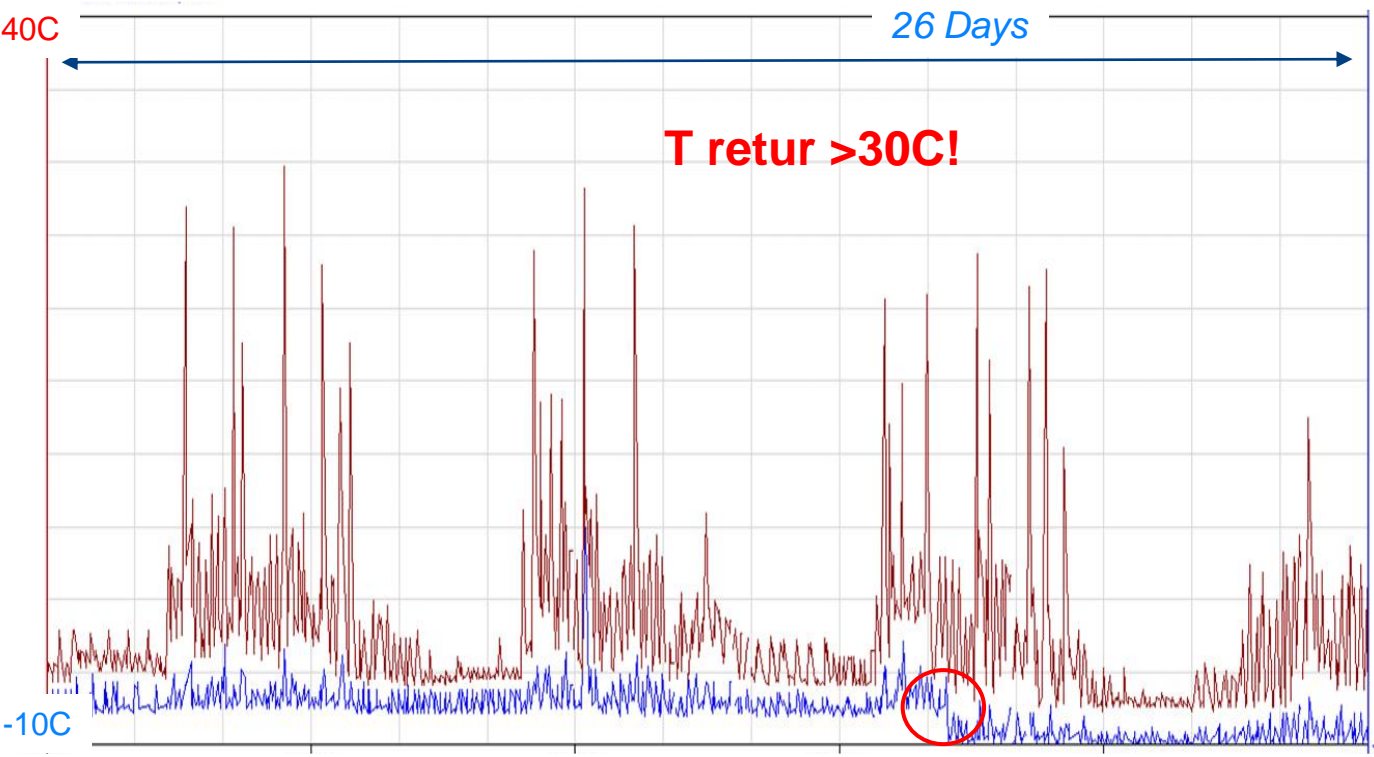
3X5M³ STORAGE TANKS BRINE



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EFFECTIVE ACCUMULATION



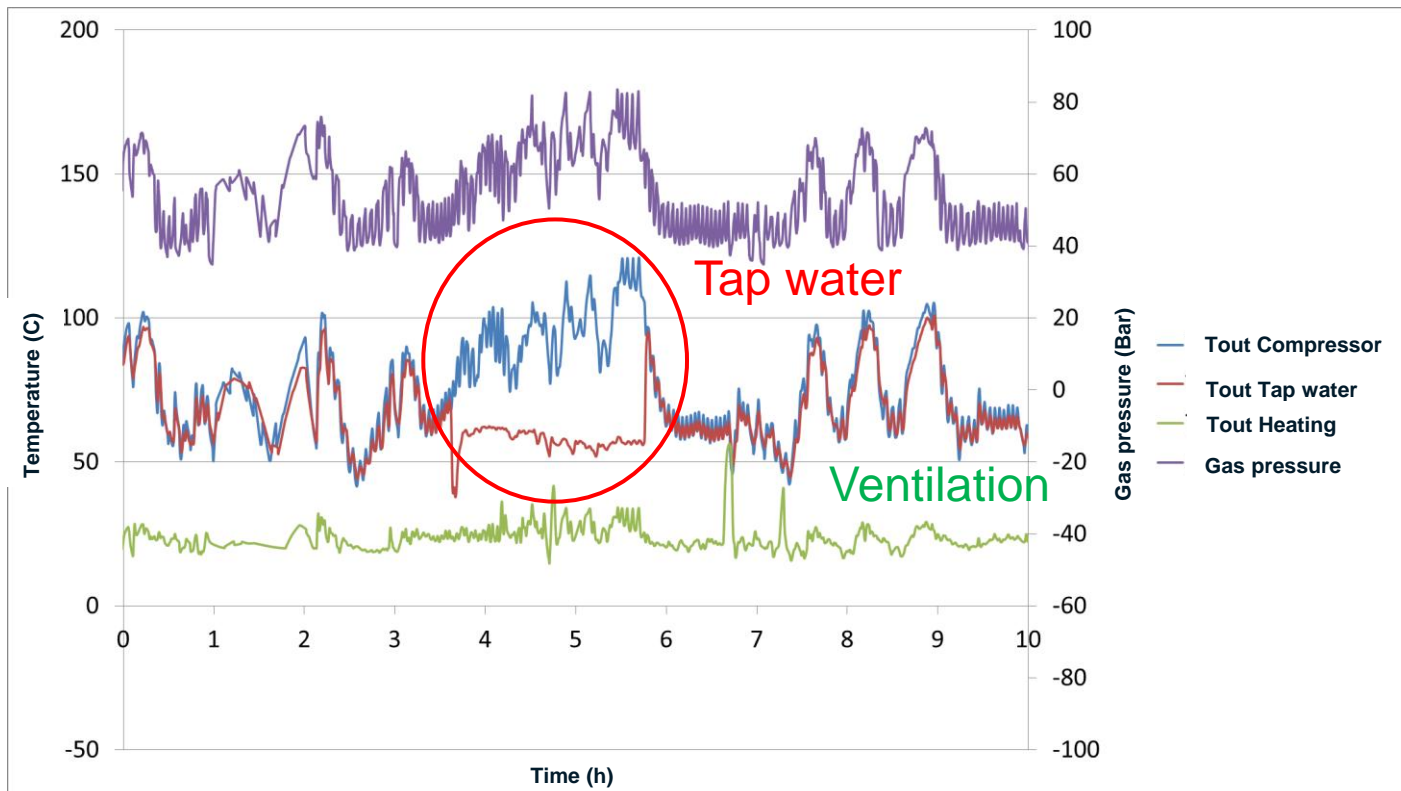
} ~2C variation on outlet



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HEAT RECOVERY WITH INCREASED PRESSURE

- ✘ Several factors has impact on high pressure
 - + Heat recovery tap water
 - + Heat recovery ventilation
 - + Ambient temperature
- Demanding to fulfill all needs!



RECOVERED HEAT SINCE START



✘ Tap water 170 000 kWh

✘ Ventilation 300 000 kWh

SUMMARY

- ✘ Operation without any major problems
- ✘ Low energy consumption
- ✘ High energy recovery
- ✘ Satisfied customer
- ✘ Satisfied installer

