The Xylem HT-BTES in Emmaboda, Sweden

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Presented by

Olof Andersson, Geostrata HB

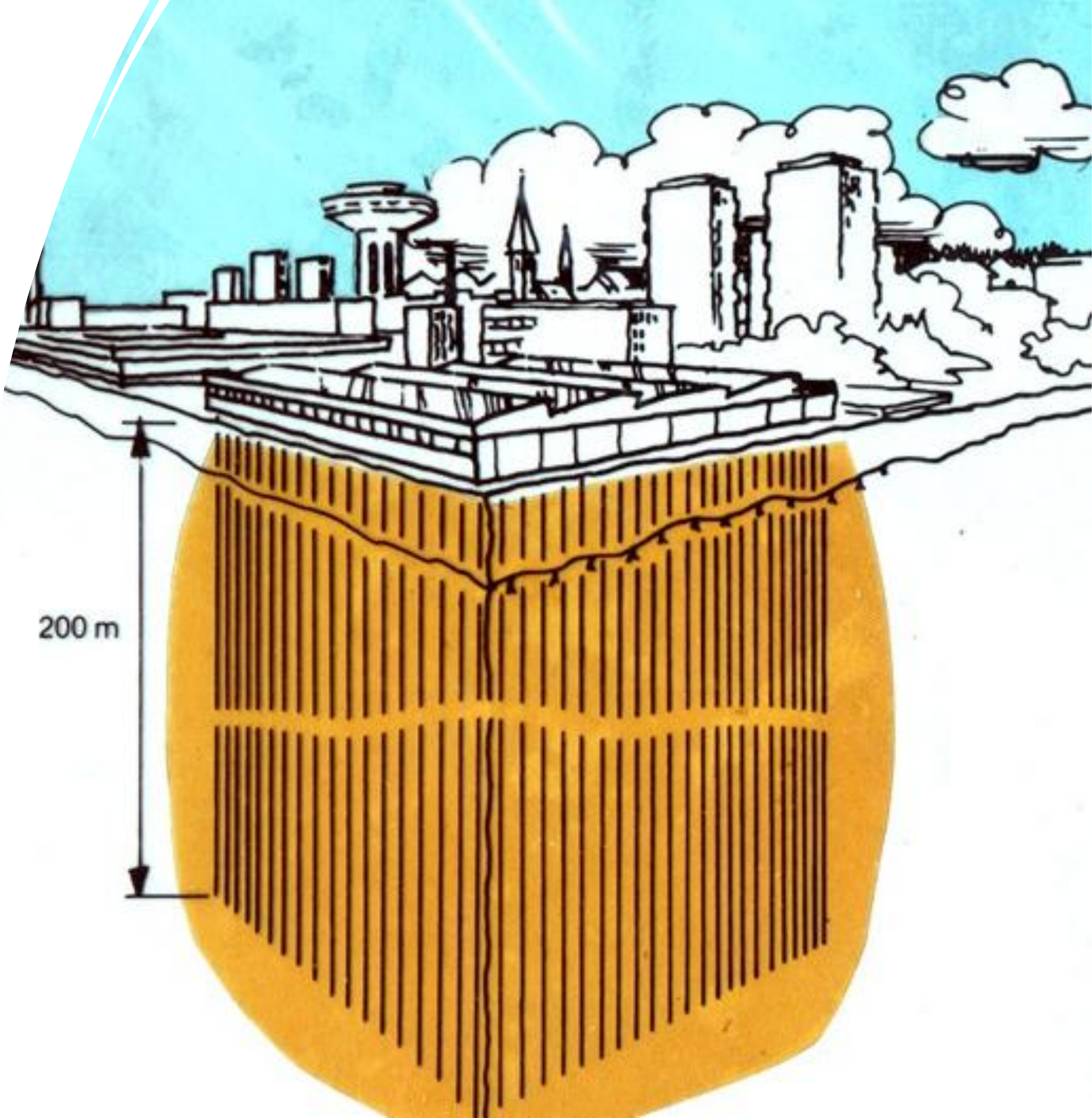
olle.geothermal@hotmail.com

Xylem Emmaboda

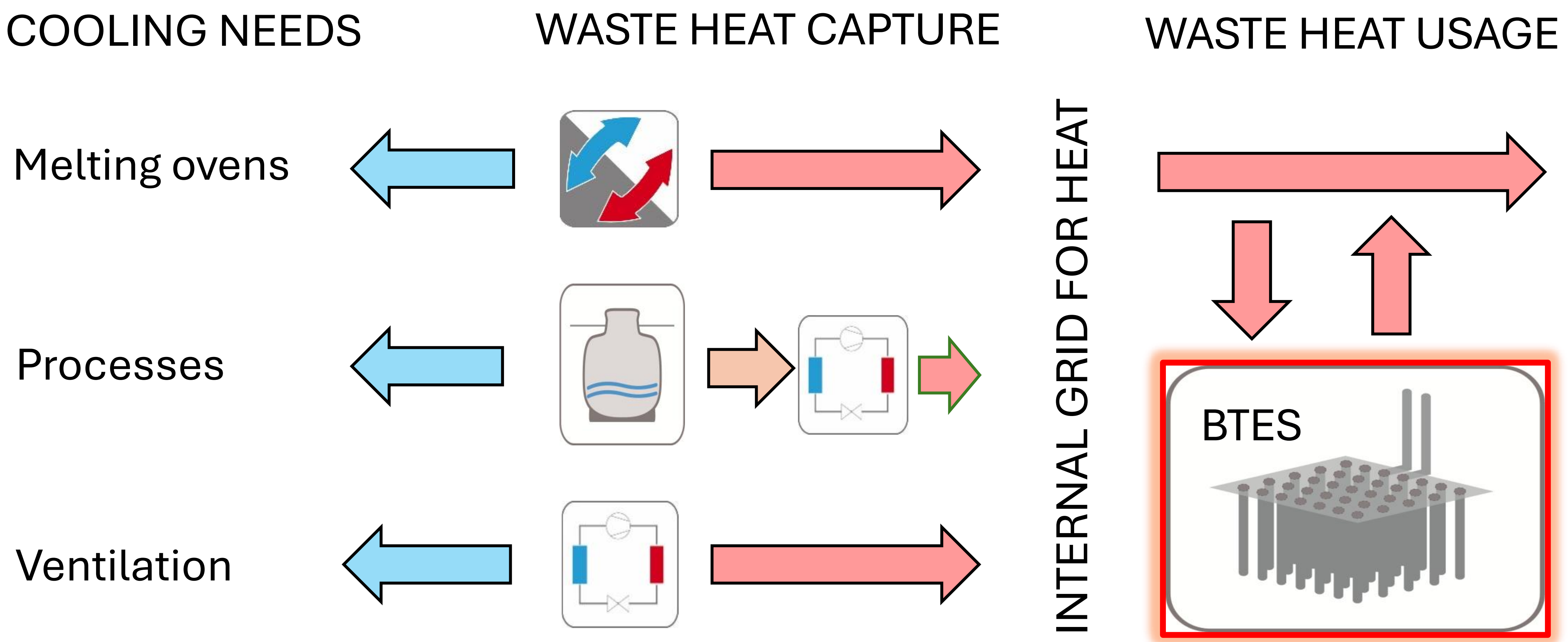
- Manufacturer of pumps
- 1100 employed
- 110 000 m^2 in-door area
- Foundry and workshops
- Large user of electricity

Why a BTES system?

- Improved use of waste heat to replace district heating
- Minimized usage of cooling towers
- Reached by using BTES for seasonal storage



Principal flow of thermal energy



Pictograms by TU Braunschweig IGS, used with permission within the course of IEA HPT Annex 52

Project stages and their main contents

Feasibility
2008

- Energy flow survey
- Geological survey
- Test drillings
- TRT analysis
- Test pumping
- Permit issues
- Economics
- Financing

Design
2009

- Modelling DST
- Size of BTES
- Location
- BTES outline
- Choice of BHE
- Insulation
- HVAC and control
- EA permit

Construction
2009-10

CONTRACTS
- Site preparation
- Borehole drilling
- BHE installation and connection
- HVAC and Control
- Construction control

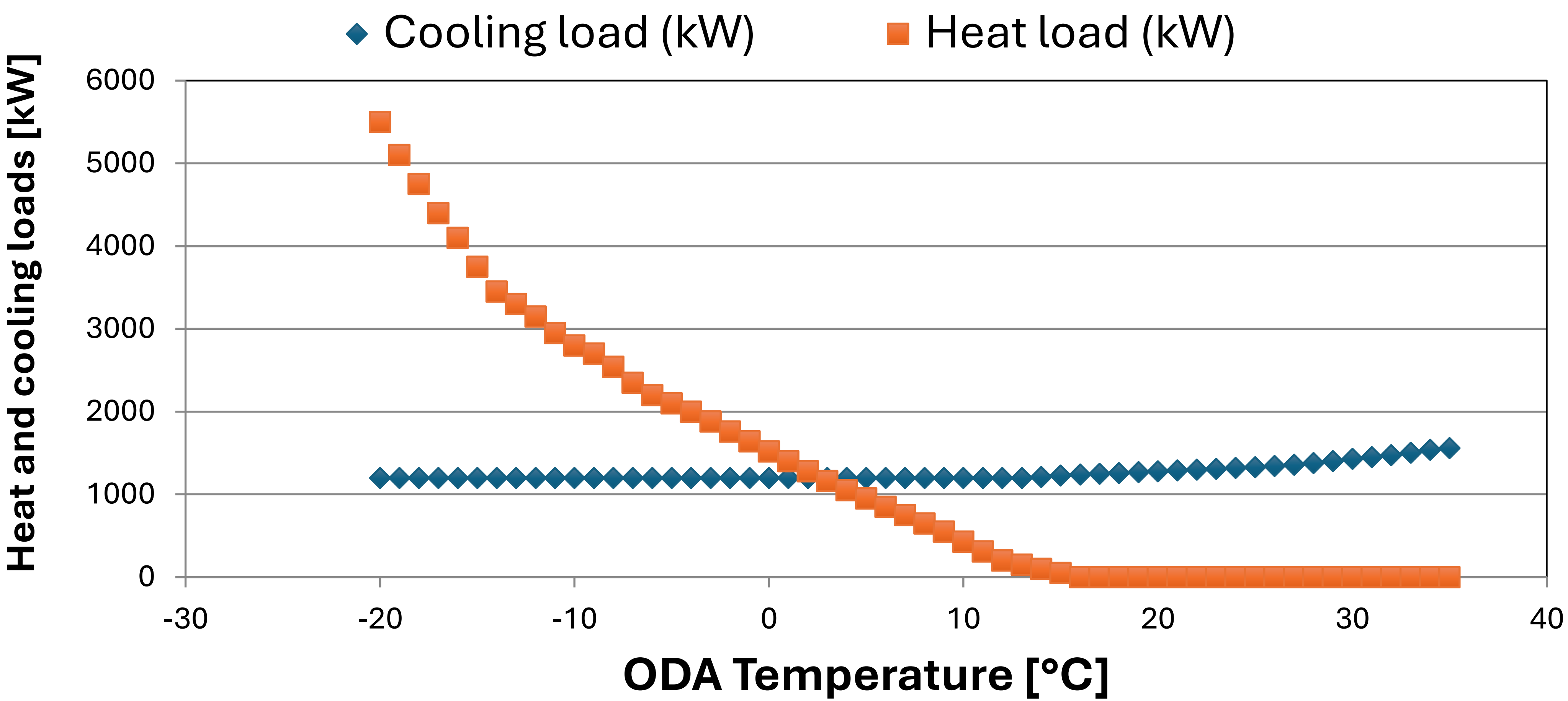
Operation
2010-

ADJUTMENTS AND SOLVING TECHNICAL ISSUES (2010-2011)

FACE 1. (2011-2018)

FACE 2, Extraction heat pump (2018-)

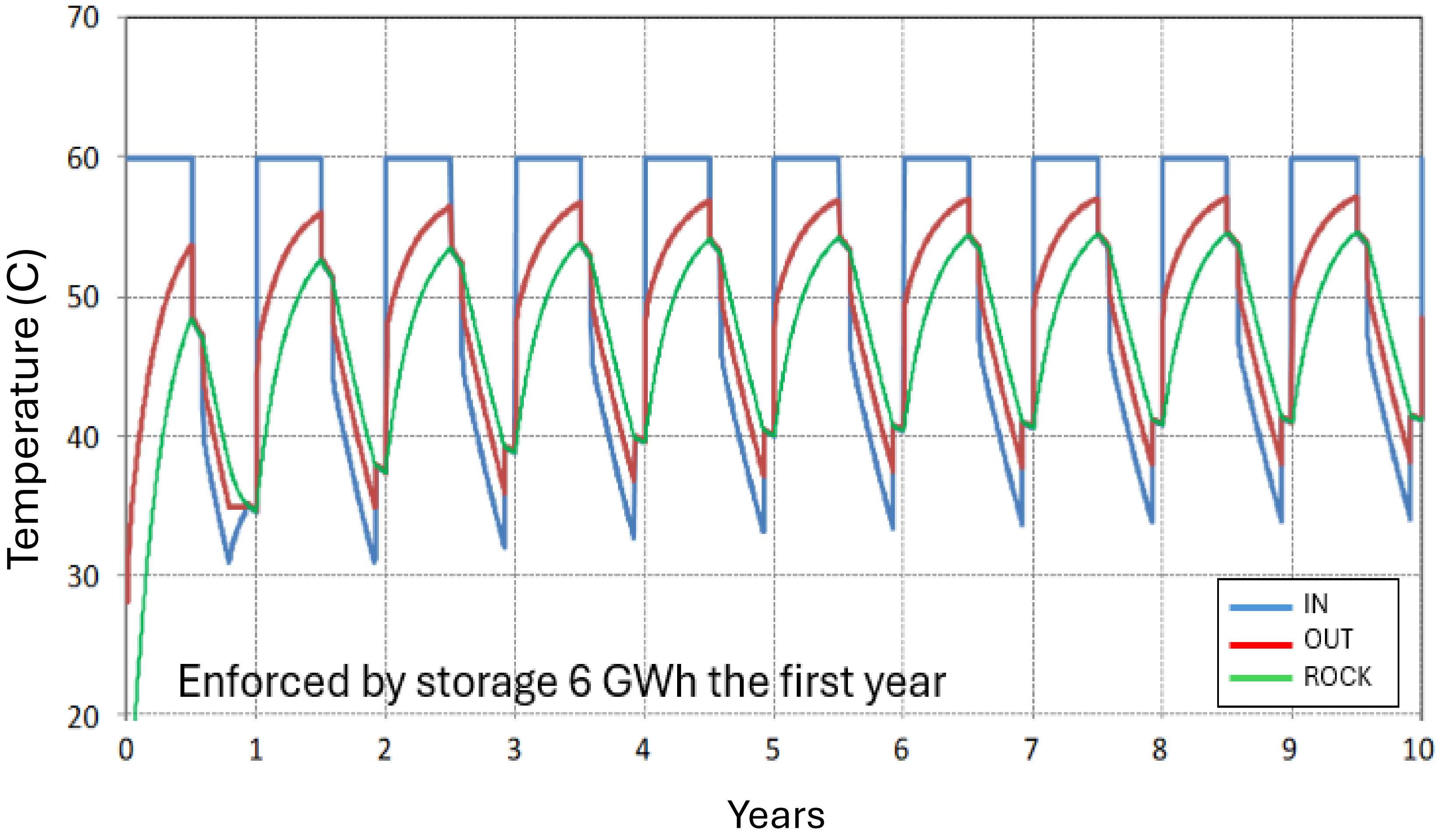
Basis for design of BTES capacity



Model simulation (DTS)

ASUMPTIONS

- Stored heat, 3 200 MWh/a
- Heat losses, 30%
- Fluid, water
- Flow rate, 25 l/s
- Working temp, 60/40ºC



Coaxial borehole heat exchanger. New design

- Dual pipes
- Insulated by standing water
- Threaded in 10 m lengths
- Allow reversed circulation
- Borehole resistance, 0,02 mK/W

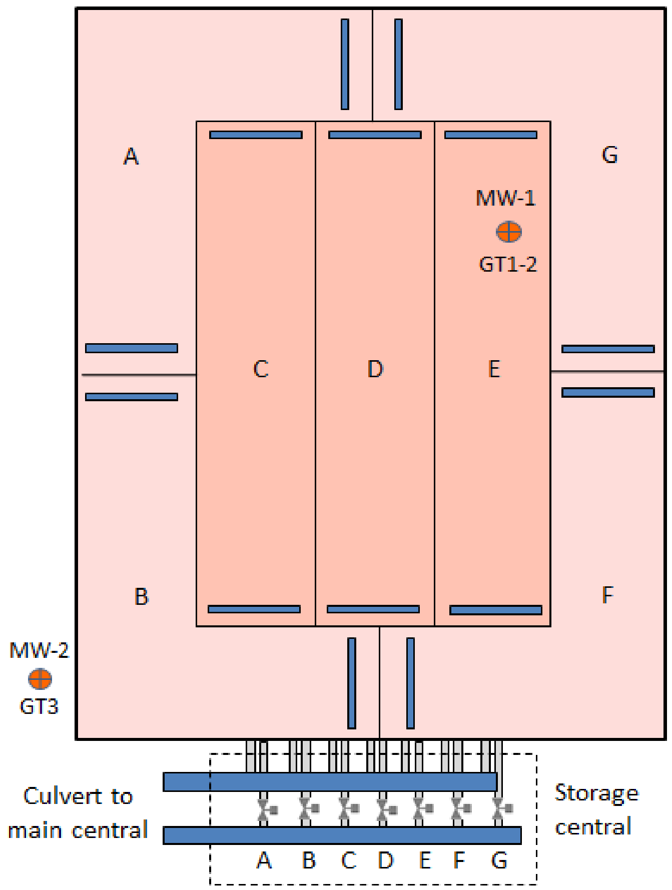
Drilling method

DTH with compressed air

Borehole design

- Number, 140
- Depth, 150 m
- Diameter, 115 mm
- Spacing, 4,5 m
- Surface, 2400 m^2
- Volume, 300 000 m^3
- Thermal conductivity, 2,9 W/m,K

Horizontal pipe system

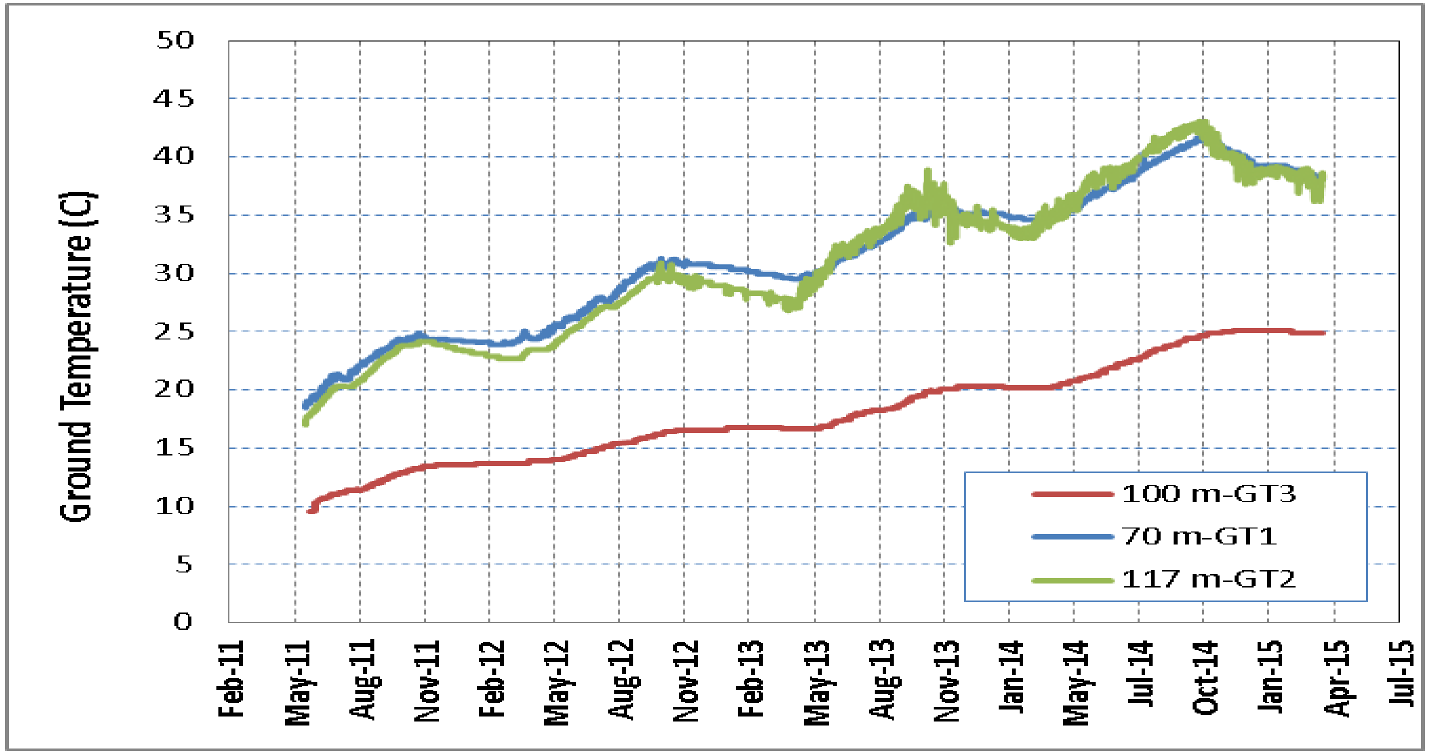


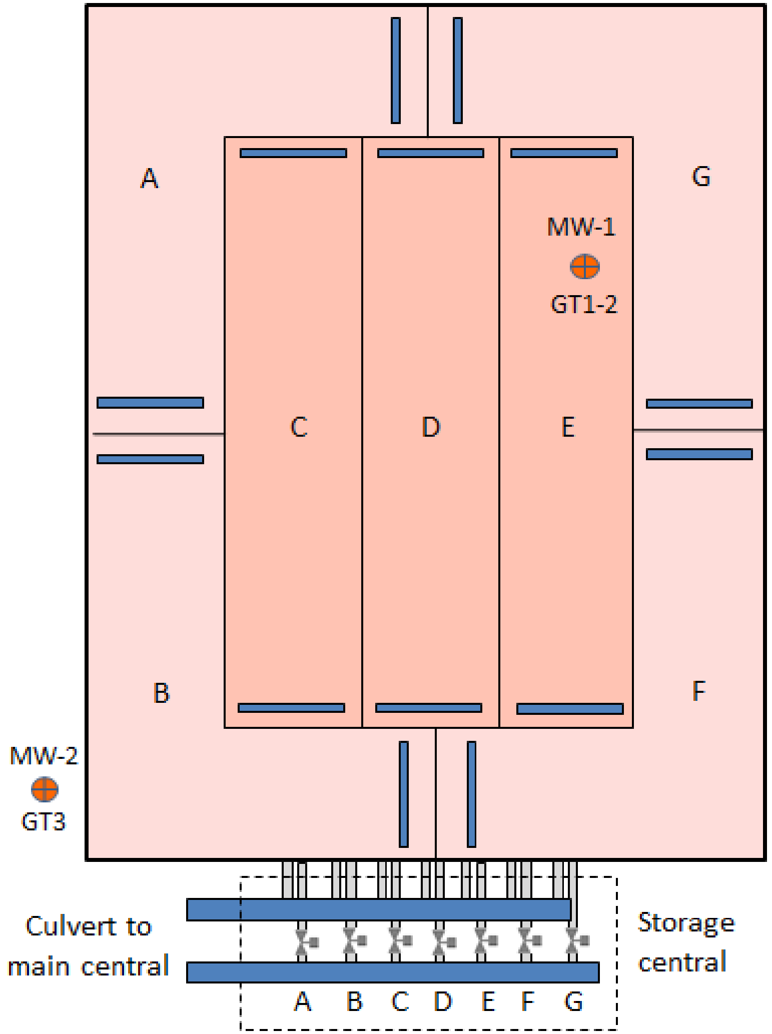
Insulated by foam glass

- Light and easy to handle
- Made of recircled glass
- Thermal conductivity, 0,4 W/m,K

Monitoring phase 1 (2011-2015)

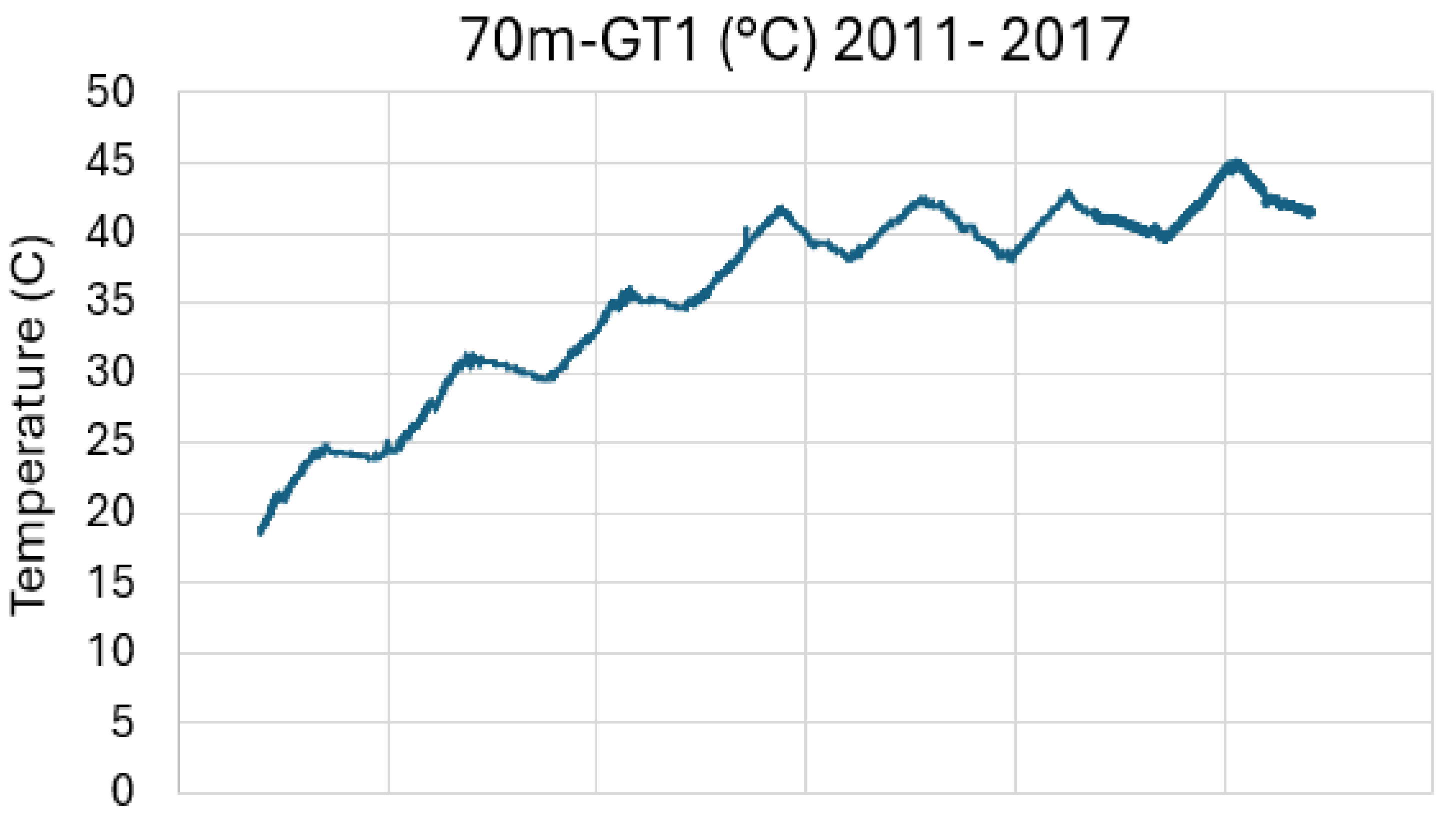
- Stored heat, 12 GWh
  Recovered, 280 MWh (8%)
- Working temp 60/40 not in sight
- Extraction heat pump suggested





After two more years

- Stored temp. levels out around 45°C
- The system still works for dumping heat (cooling)
- Heat recovery 12% is too low
- Extraction heat pump decided



Heat pump system installed 2018

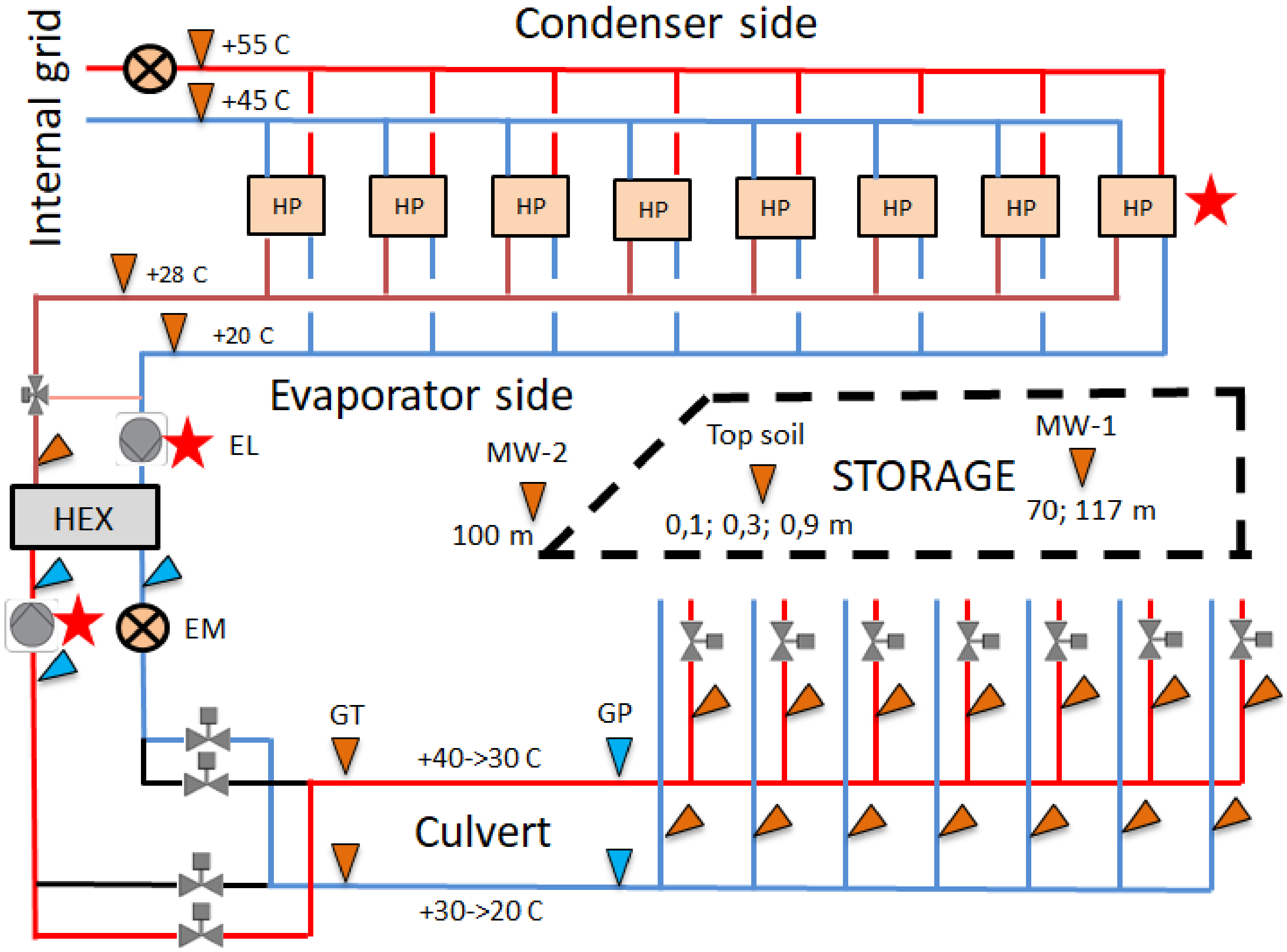
- Eight units NIBE F1345-60
- Nominal capacity 480 kW
- Actual capacity 800 kW (+25/20^{o}C as heat source)

Second phase of monitoring 2018-2021

Part of IEA HPT Annex 52

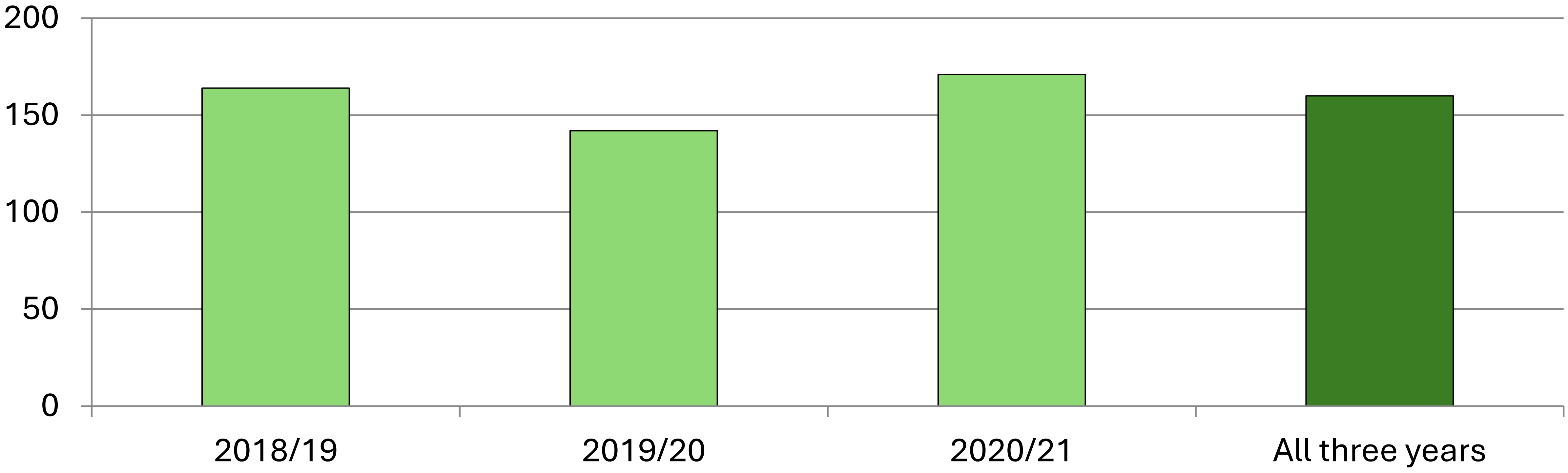
Monitoring of long-term performance factors (SPF) mainly based on

- Thermal energy turnover
- Electricity used
- Thermal behavior in general



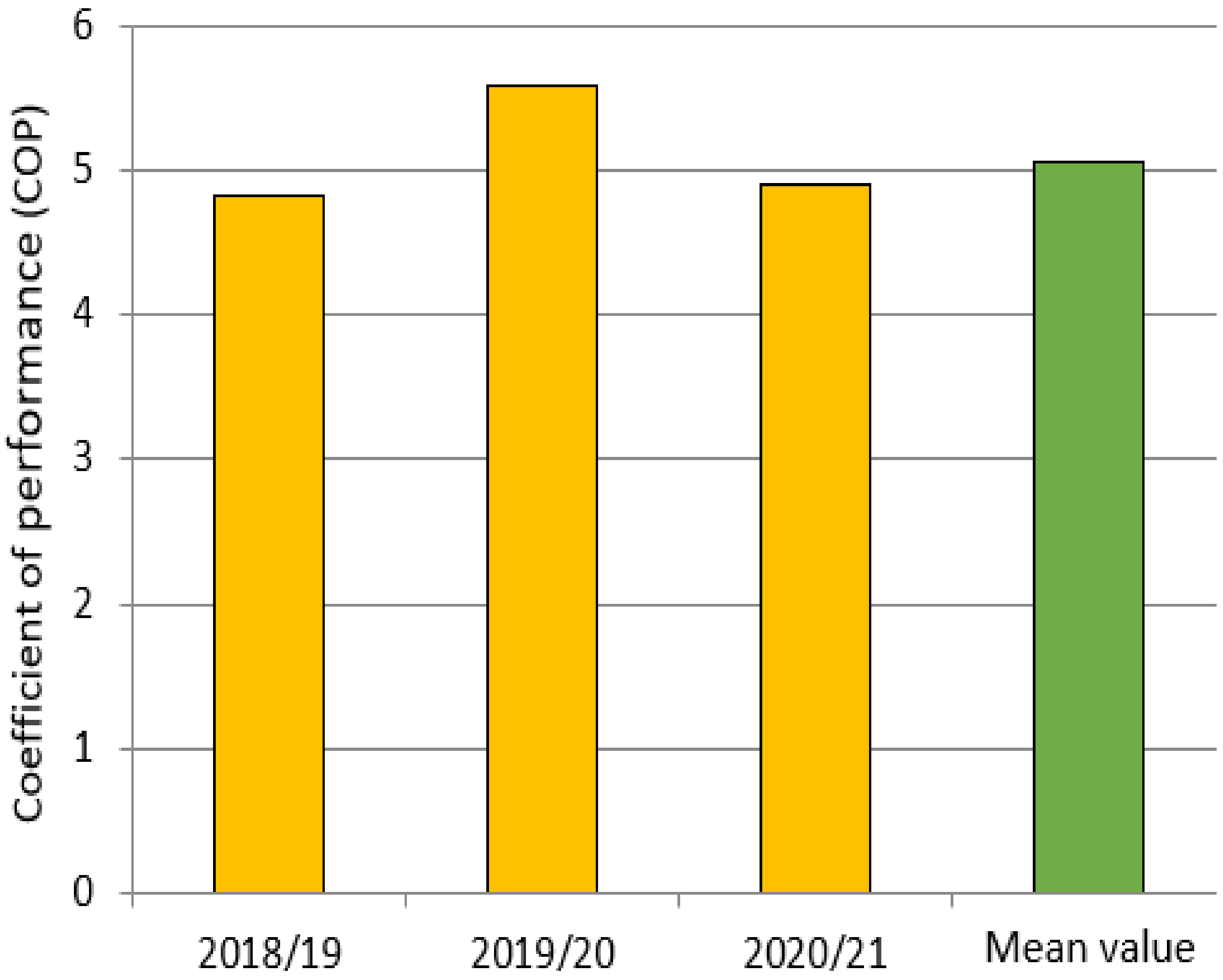
COP injection/extraction (SPF0)

Delta T depended (varies between 10-15^{o}C)

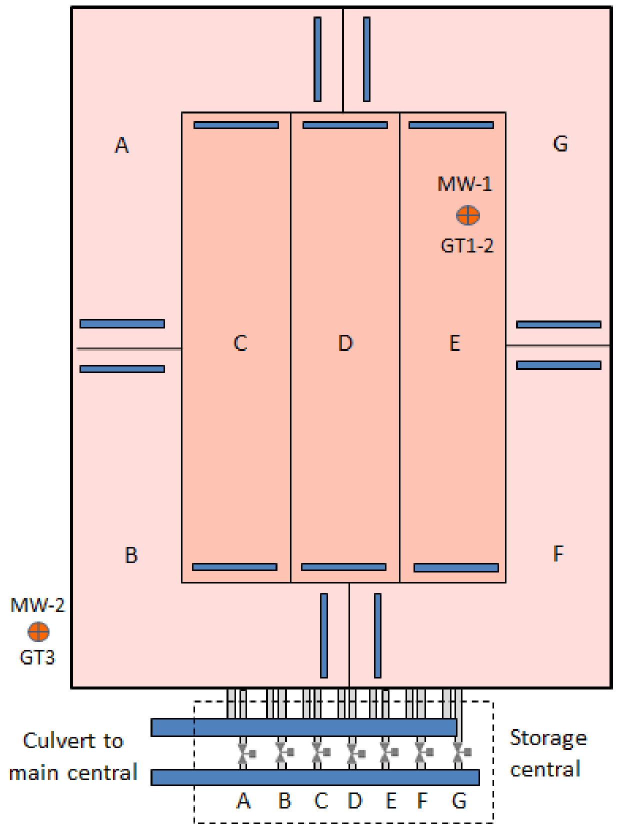


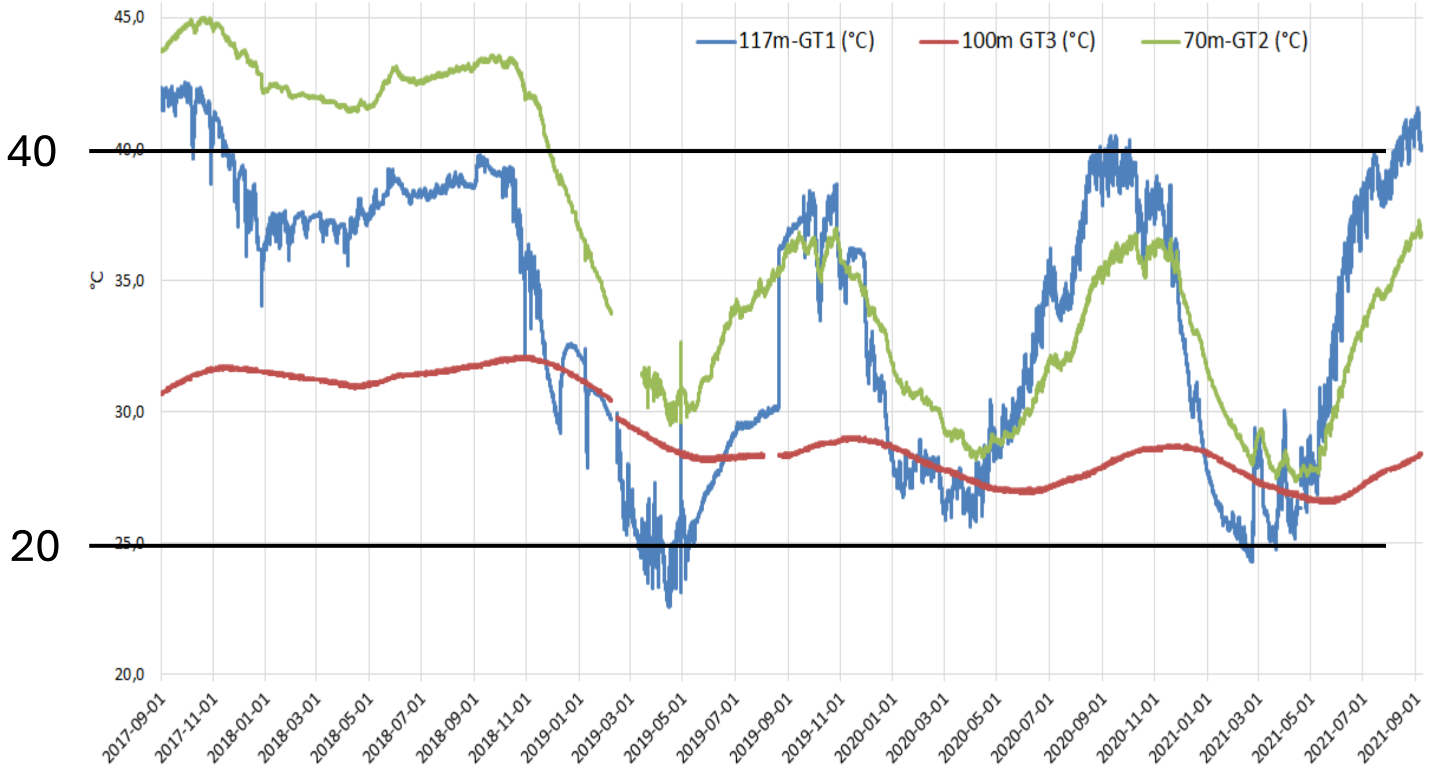
COP heat pump system (SPF1)

“Cold side” circulation pumps included

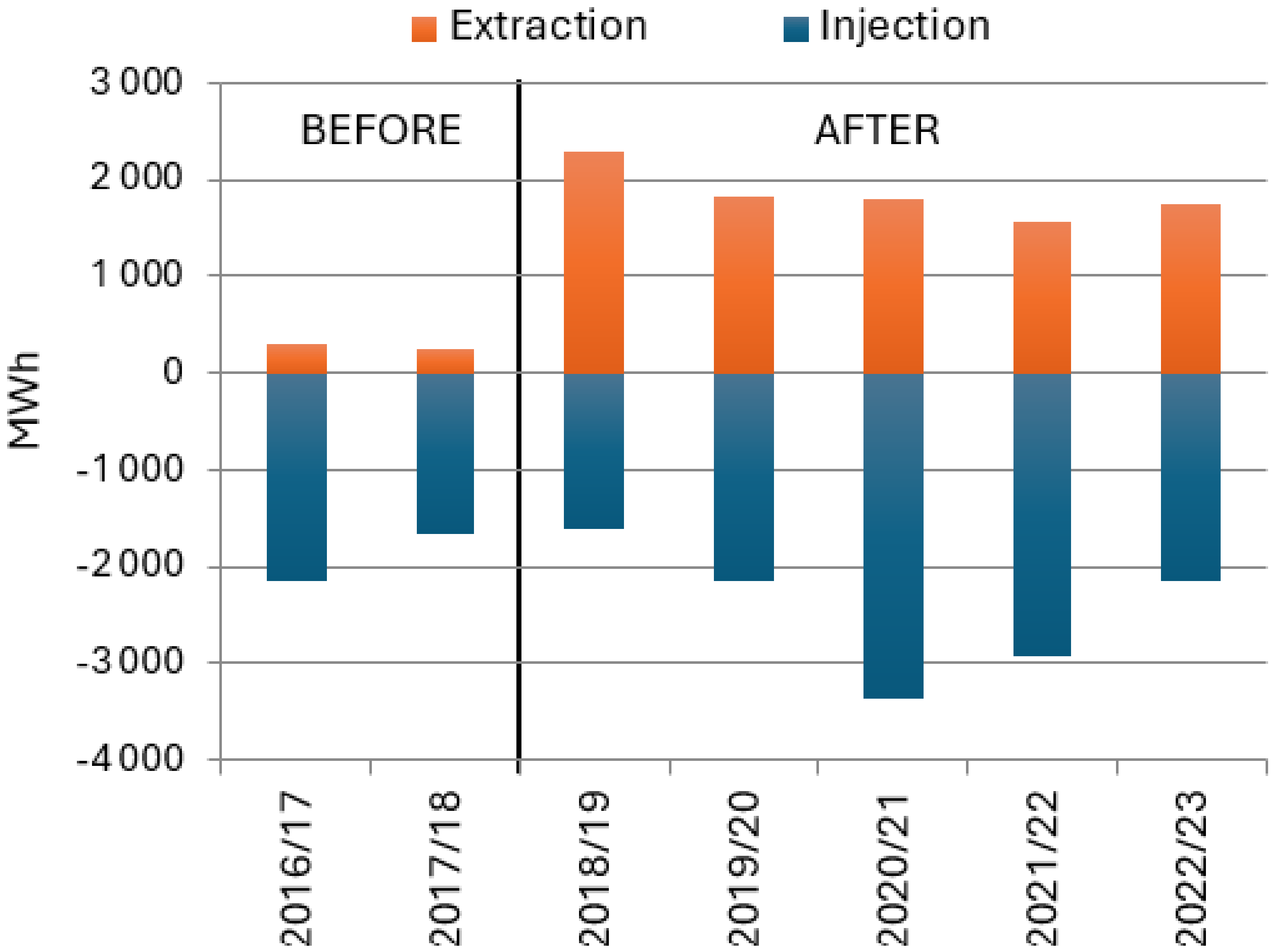


BTES Working temperature down to 20/40ºC





Before and after HP-installation



Economics (compared to DH)

Initial investment 2010-12

- Investment: 13,5 Mill. SEK
- Expected heat: 2 200 MWh/a
- Annual saving: 1,3 Mill. SEK
- Straight payback: 10 years

Additional investment 2018

- Investment: 3,0 Mill. SEK
- Produced heat: 2 200 MWh/a
- Annual saving: 1,6 Mill. SEK
- Straight payback: < 2 years

If constructed today (with HP:s)

- Investment: Approx. 22 Mill. SEK
- Produced heat: 2 400 MWh/a
- Annual saving: 2,5 Mill. SEK
- Straight payback: <10 years

Conclusion

Thanks for your attention!

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Heat pumps rescued Xylem's heat storage facility in Emmaboda, Sweden

OLOF ANDERSSON

NIKLAS HÅKANSSON

LEIF RYDELL