ecw energy

ennatuurlijk maakt energie lokaal

IEA TCP / GEOTHERMICA ATES workshop
Visit ECW Middenmeer, 20th of April 2023

Agenda

- Introduction
  (Stacey Scholten)

- History HT-ATES demonstration project ECW
  (Laurens Vlaar)

- Practice versus theory and influencing factors
  (Wouter Jonker)

- Future use and potential of HT-ATES
  (Harald Droog)

- Private network operator, energy producer and trader
- Leader in geothermal production in The Netherlands
- ECW Energy produces since 2014 about 1/3 van de NL geothermal energy
- About 30 professionals mainly from the region
- Energy transition areas Agriport and Andijk
- Energy supply system step by step more futureproof for its customers
- Matching opportunities with regional energy demand

- District heating company
- Supplies heat to more than 85.000 households and 1200 enterprises in The Netherlands.
- District heating networks in 40 different municipalities in The Netherlands
- Mission: Accelerate to local and sustainable energy for everybody in The Netherlands
- >180 dedicated professionals working on a daily basis to move the energy transition

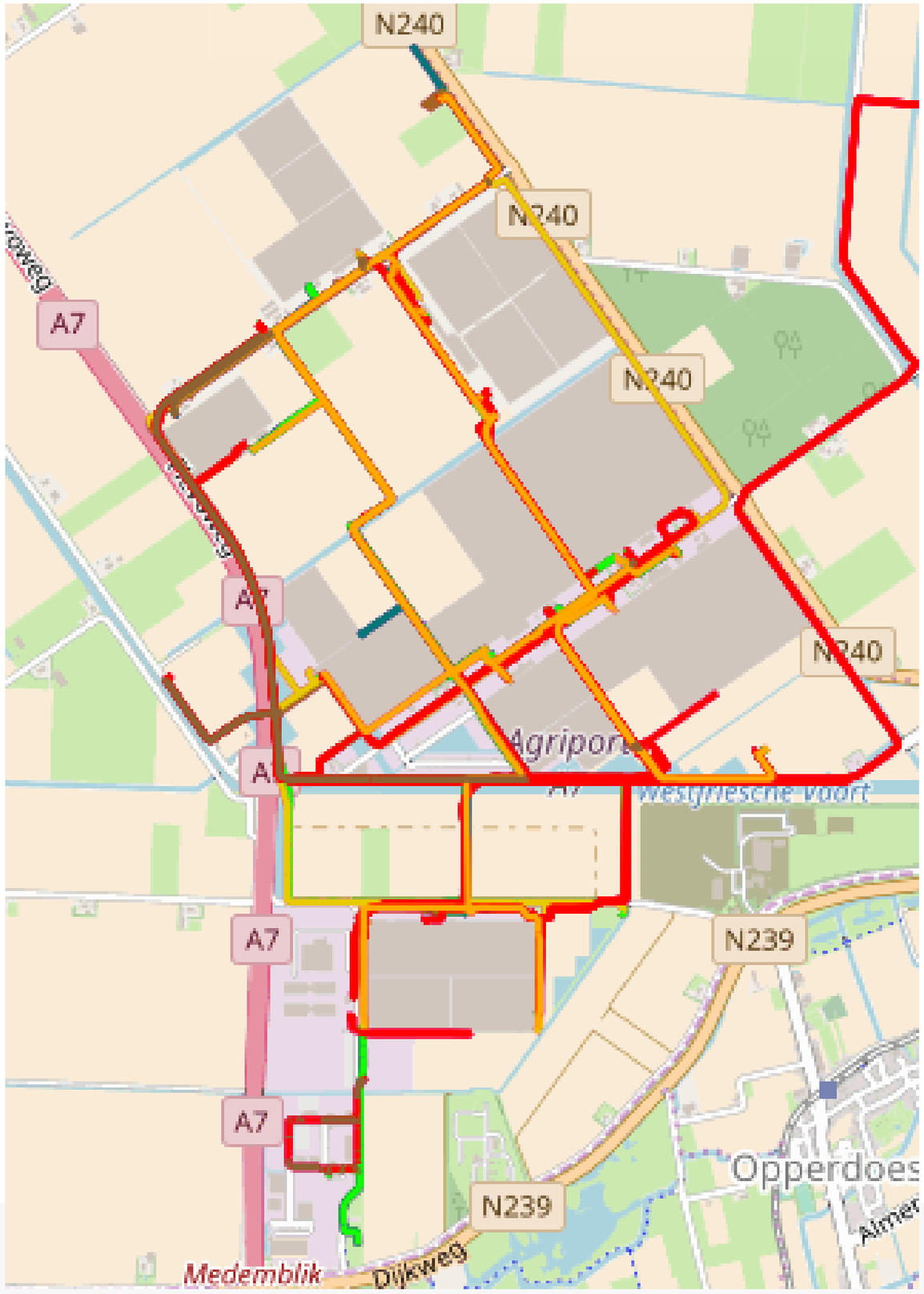
Local knowledge in combination with nationwide strenght

1. Introduction- Networks

Heat

Gas

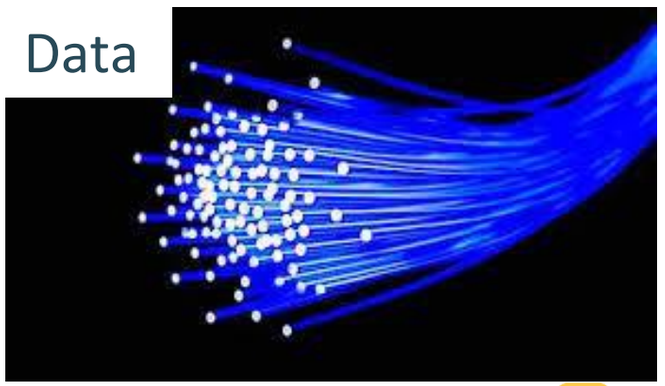
Water

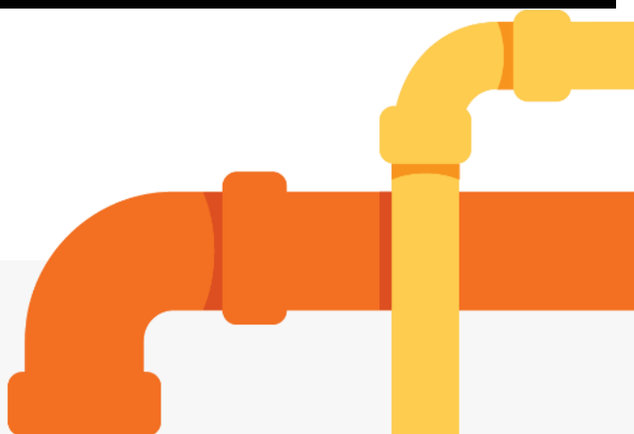


Electricity

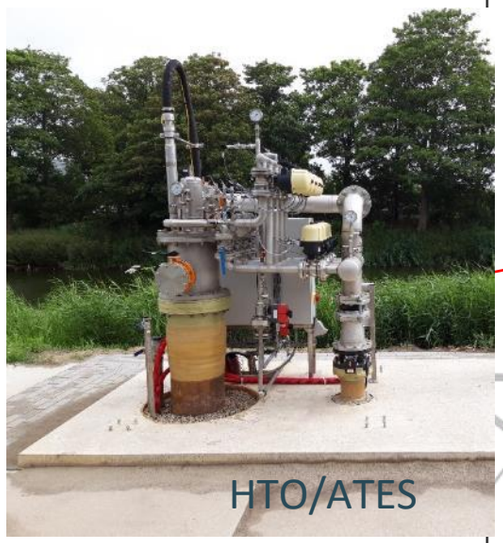
CO2

Data

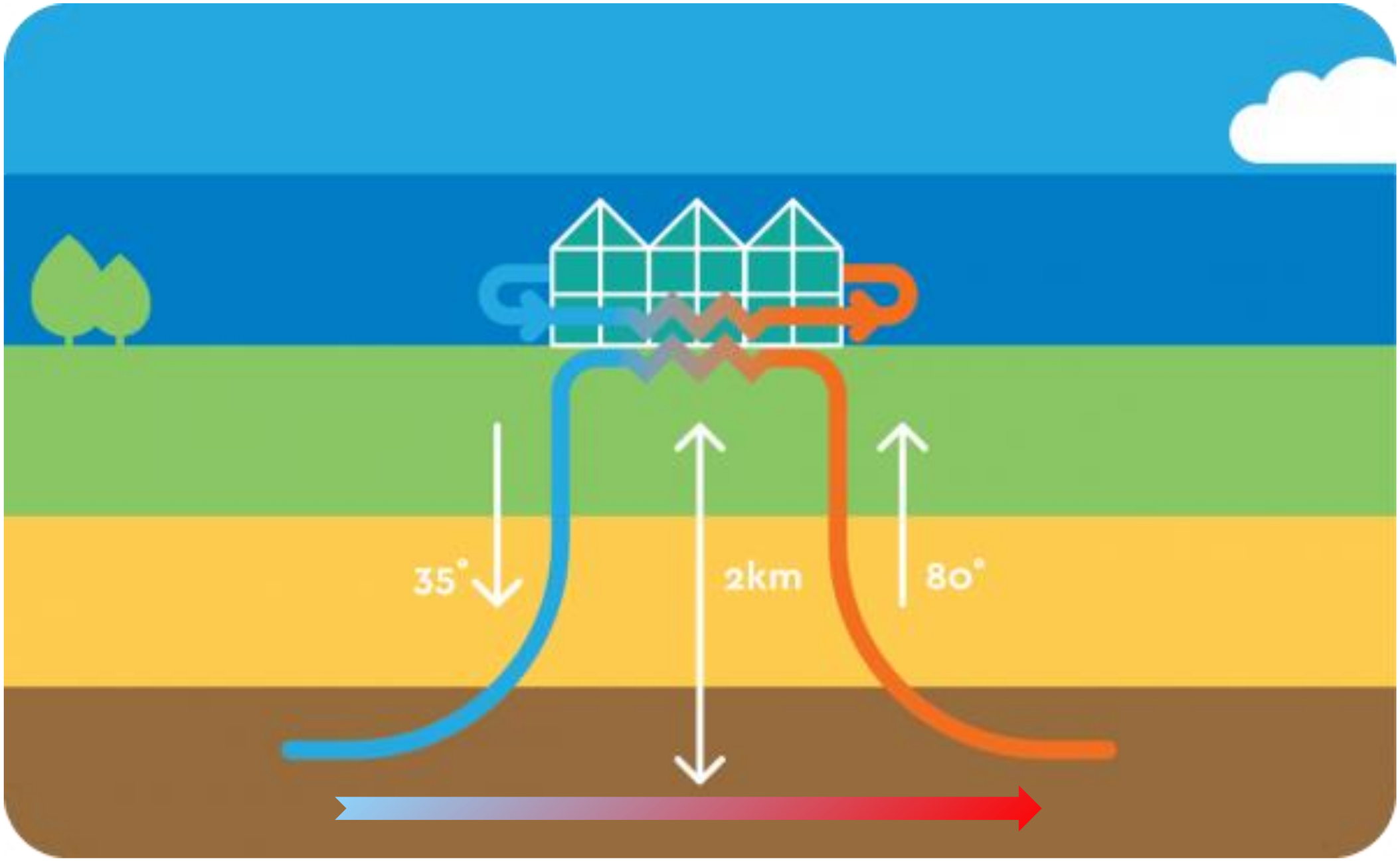




1. Introduction- Energy production

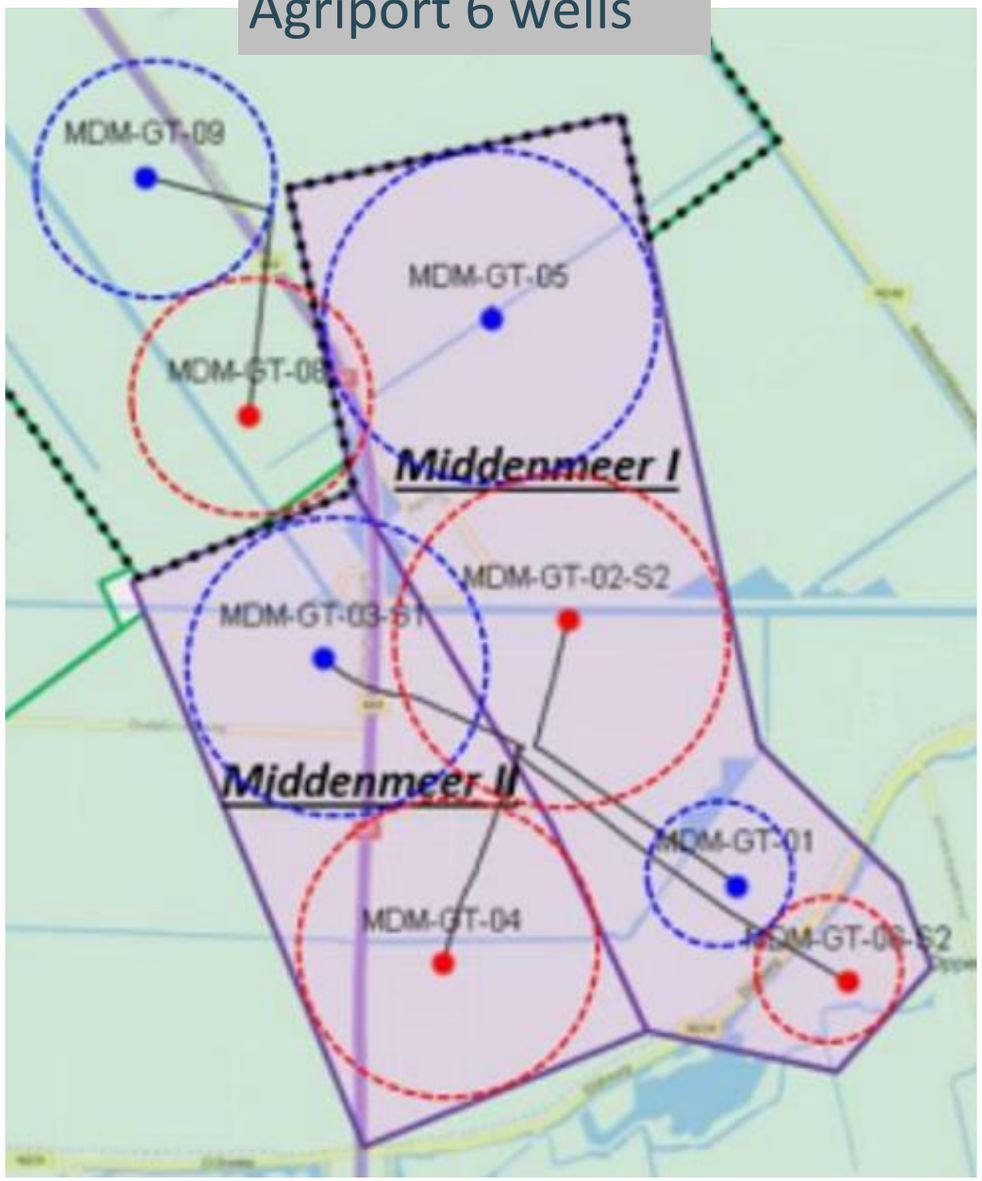


Geothermal energy



Geothermal energy locations

Agriport 6 wells



Total 40-50 MW
25% coverage annual local heat demand

Andijk 4 wells

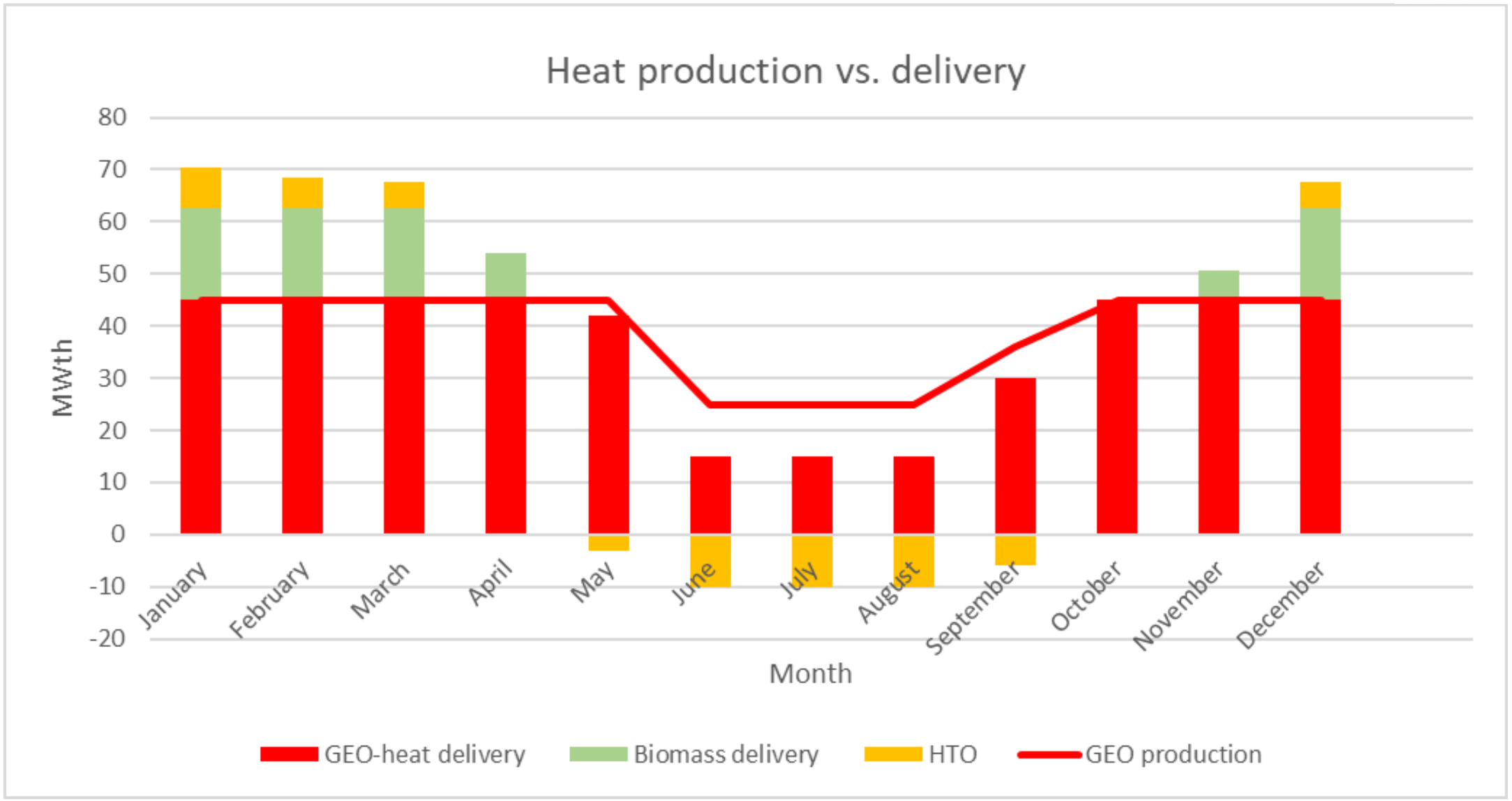
Total 30-40 MW
50% coverage annual local heat demand

Annual savings 50 million nm3 natural gas

Royal geothermal location Andijk

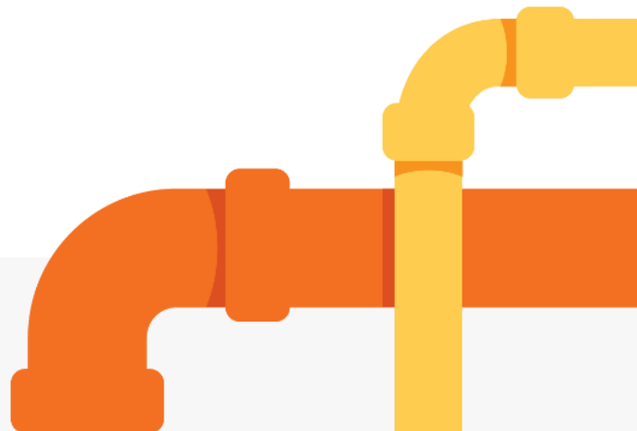
New geothermal location

Production capacity sustainable heat Agriport

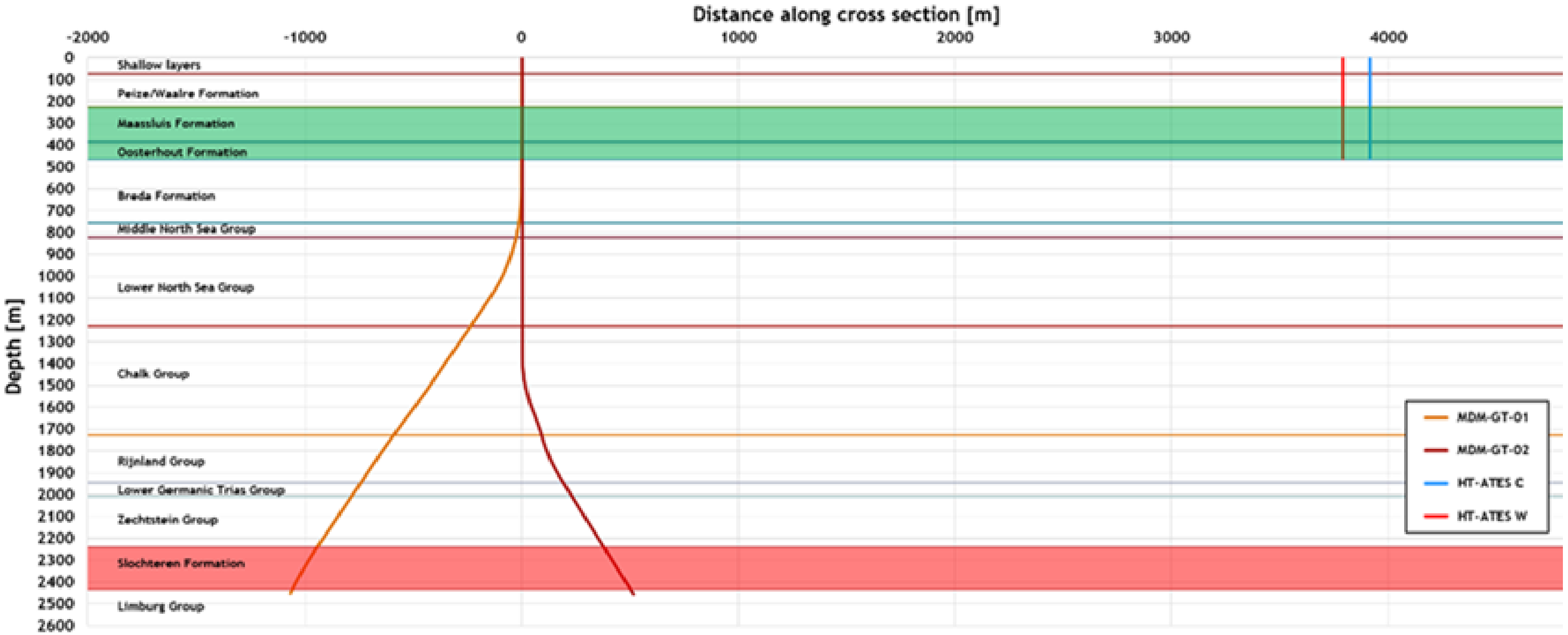


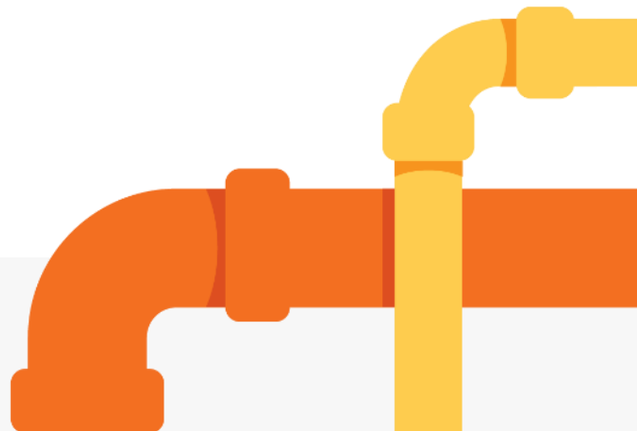
History of HT-ATES at ECW

- 2016-2017: first idea of realisation of HT-ATES, preparation of effect studies as part of water permit application
- 2017-11: Submission of MER judgement report
- 2018-1: Applied for water permit at Province of North Holland
- 2018-7: water permit granted
- 2019-3-6: drilling first test well
- 2019: 6-9: testing and sampling
- 2020-5 applied for updated water permit, based on new well locations and increased volume water and effects
- 2020-6: modified water permit granted
- 2020-5-8-: preparing, drilling, developing and testing HT ATES doublet
- 2021-5/6: start loading/ commissioning
- 2021: participation GEOTHERMICA HEATSTORE Project
- 2022-…: participation HTO-PEN (TKI Urban Energy)

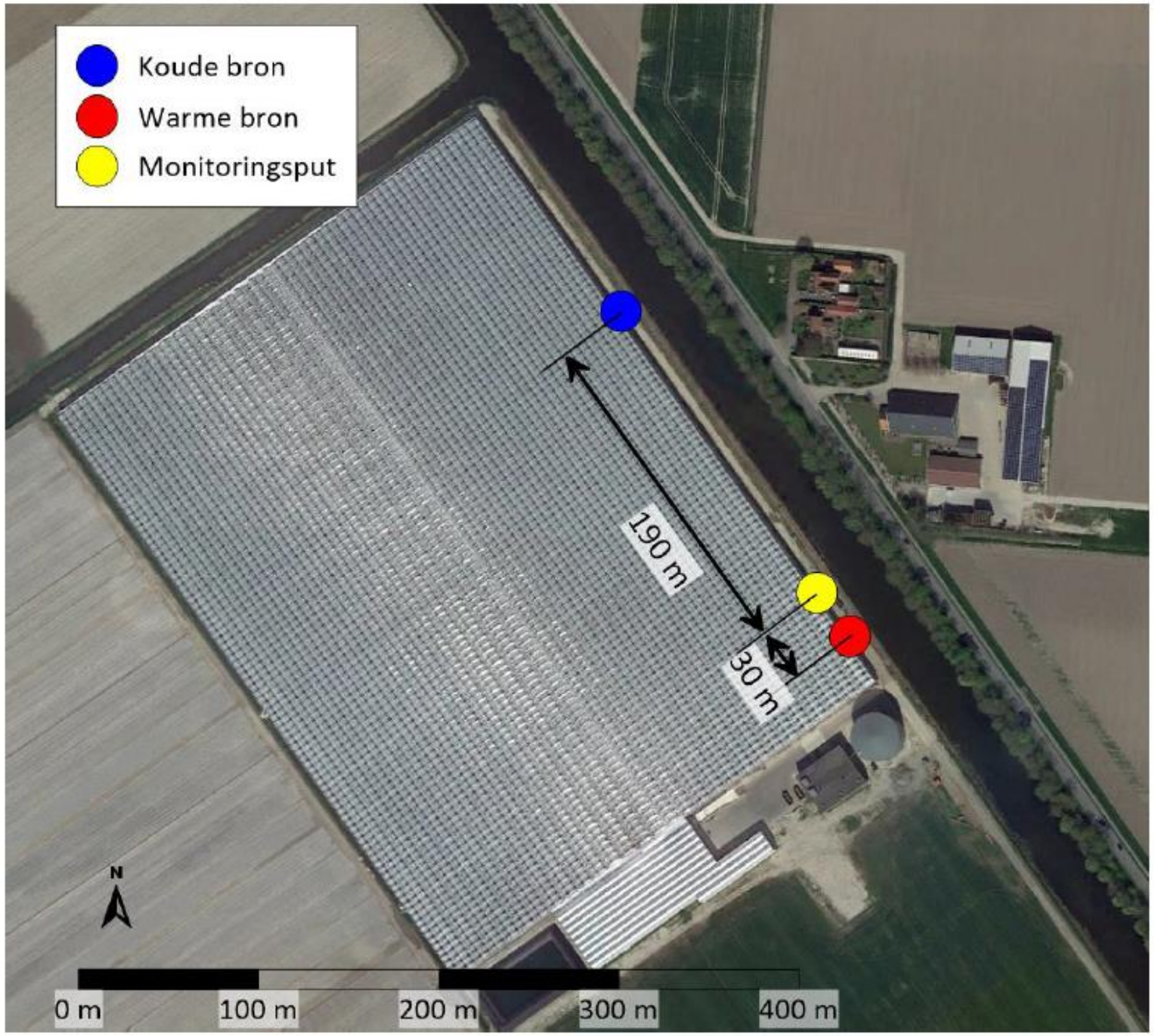


How to store heat?


Distance along cross section [m]
-2000
-1000
0
1000
2000
3000
4000
Depth [m]
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
Shallow layers
Peize/Waalre Formation
Maassluis Formation
Oosterhout Formation
Breda Formation
Middle North Sea Group
Lower North Sea Group
Chalk Group
Rijnland Group
Lower Germanic Trias Group
Zechstein Group
Slochteren Formation
Limburg Group
MDM-GT-01
MDM-GT-02
HT-ATES C
HT-ATES W

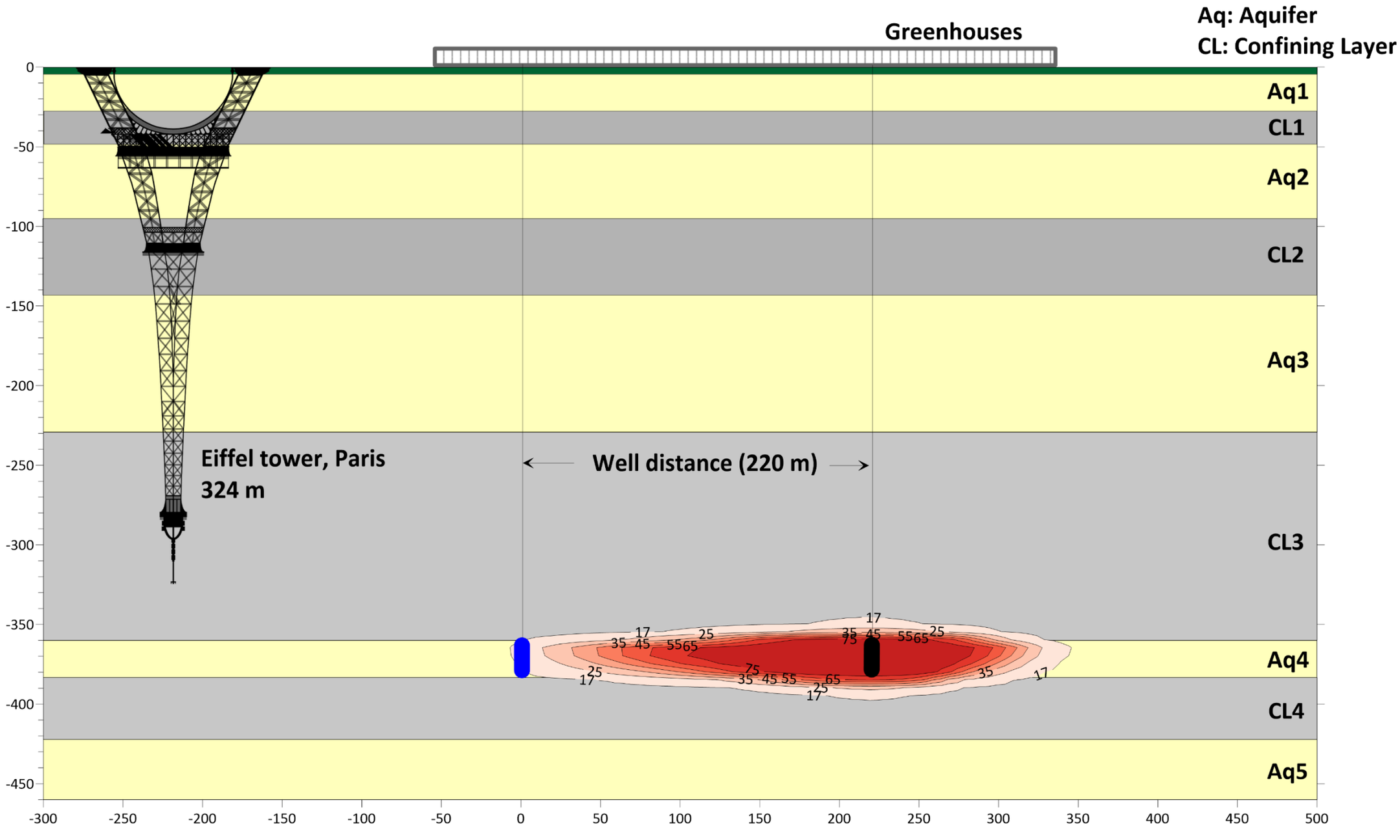


Lay-out and location HT-ATES

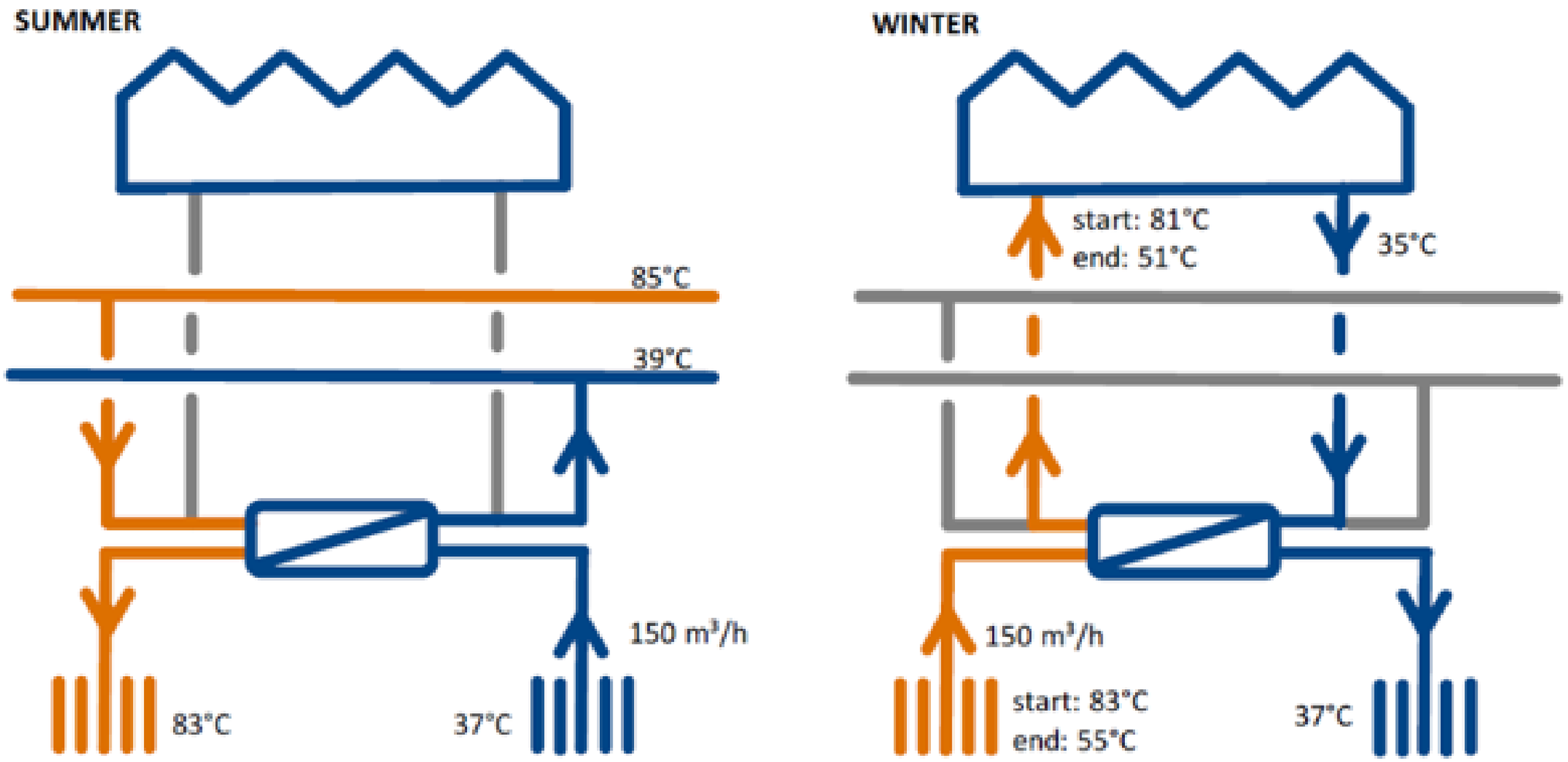


Figuur 2.1 | Overzichtskaart met daarop aangegeven de locaties van de bronnen en de monitoringsput, geplaatst op de strook land tussen de kas en de Medemblikkervaart.

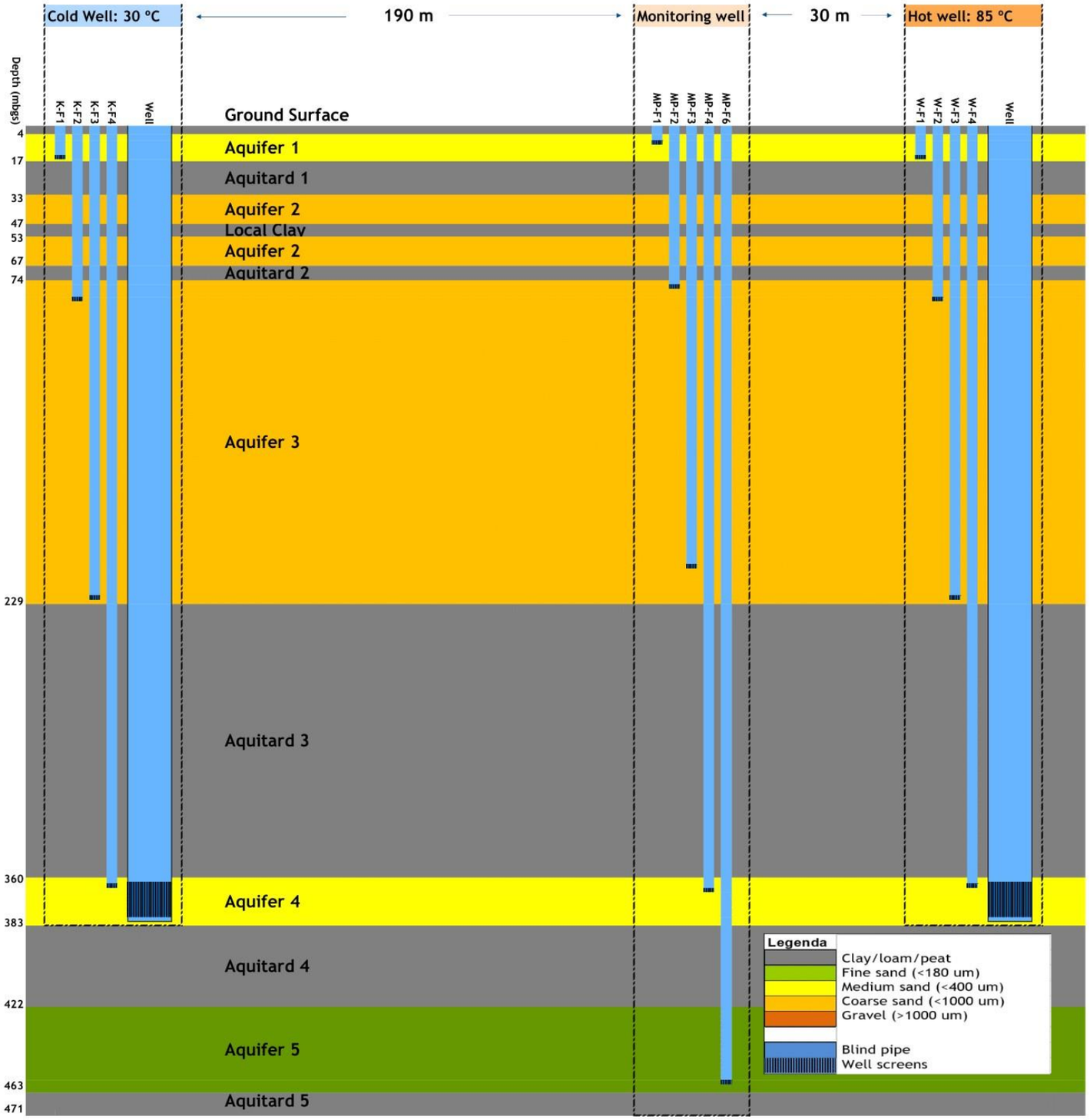
High Temperature Aquifer Thermal Energy Storage (HT-ATES)
(Worst-case) Thermal effects after 1 year



HT-ATES


SUMMER
85°C
39°C
150 m³/h
83°C
37°C
WINTER
start: 81°C
end: 51°C
35°C
150 m³/h
start: 83°C
end: 55°C
37°C

HT-ATES


Cold Well: 30 °C
190 m
Monitoring well
30 m
Hot well: 85 °C
Depth (mbgs)
K-F1
K-F2
K-F3
K-F4
Well
MP-F1
MP-F2
MP-F3
MP-F4
MP-F6
W-F1
W-F2
W-F3
W-F4
Well
Ground Surface
4
Aquifer 1
17
Aquitard 1
33
Aquifer 2
47
Local Clay
53
Aquifer 2
67
Aquitard 2
74
Aquifer 3
229
Aquitard 3
360
Aquifer 4
383
Aquitard 4
422
Aquifer 5
463
Aquitard 5
471
Legenda
Clay/loam/peat
Fine sand (<180 um)
Medium sand (<400 um)
Coarse sand (<1000 um)
Gravel (>1000 um)
Blind pipe
Well screens

HT-ATES, Starting points permit

Starting points	***Winter***	***Summer***
Max pumped volume groundwater per season (m3)	*700.000*	*600.000*
Average pumped volume groundwater per season (m3)	*500.000*	*440.000*
Max flow (m3/hour)	*200*	*200*
Average infiltration temperature (°C)	*30*	*90*
Average transfered amount of energy per season (MWh)	*22.000*	*28.000*

Practical performance

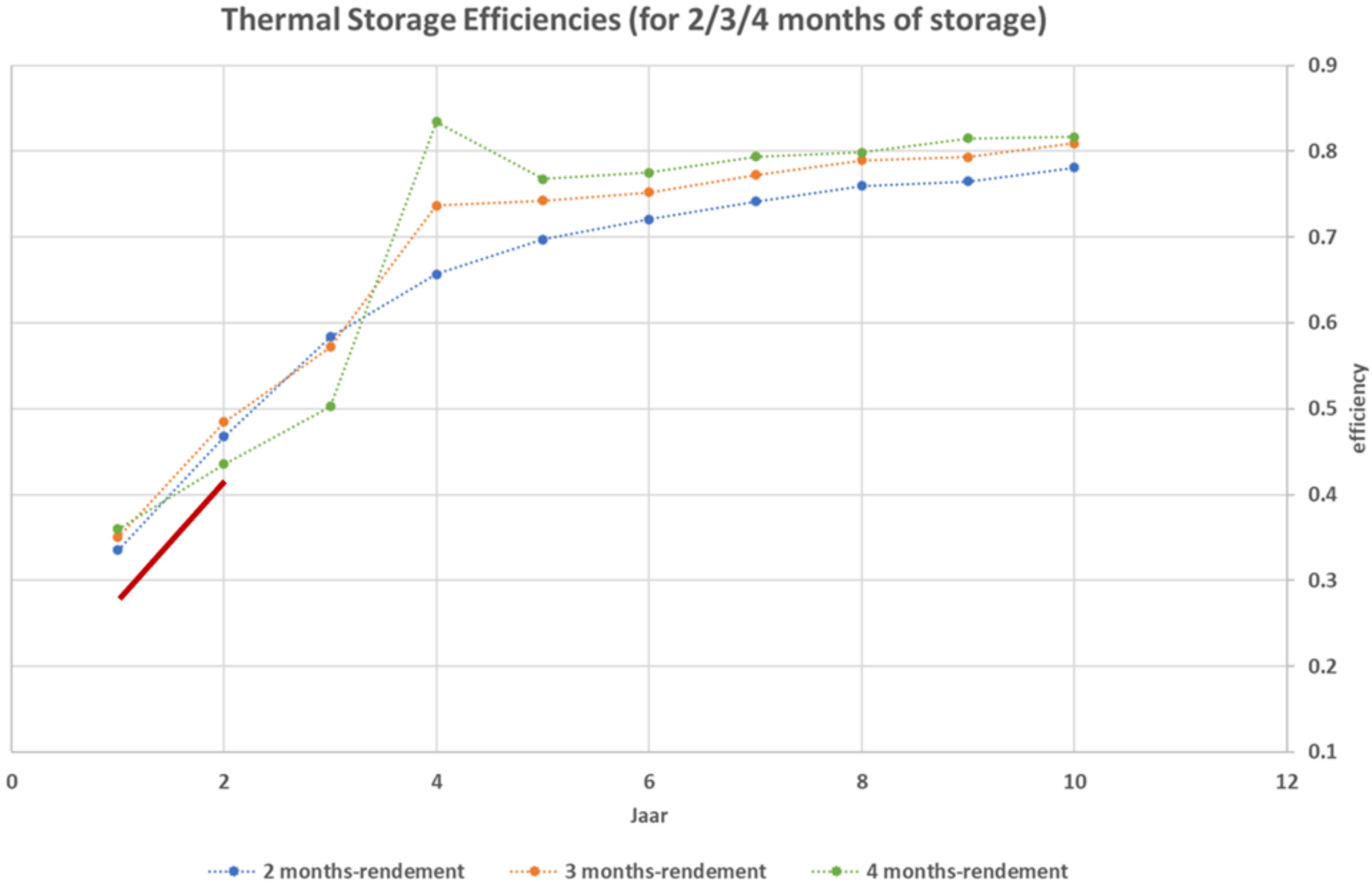
First cycle loading/discharging	(loading) **Summer-21**	(discharging) **Winter-21/22**
Pumped volume (m3)	119.230	82.568
Amount of energy (MWh)	9.236	2.469
Average flow (m3/hour)	100	69
Average MW	7,75	2,06

→ 27% storage efficiency

Second cycle loading/discharging	(loading) **Summer-22**	(discharging) **Winter-22/23**
Pumped volume (m3)	145.322	105.172
Amount of energy (MWh)	10.384	4.206
Average flow (m3/hour)	100	48
Average MW	7,15	1,94

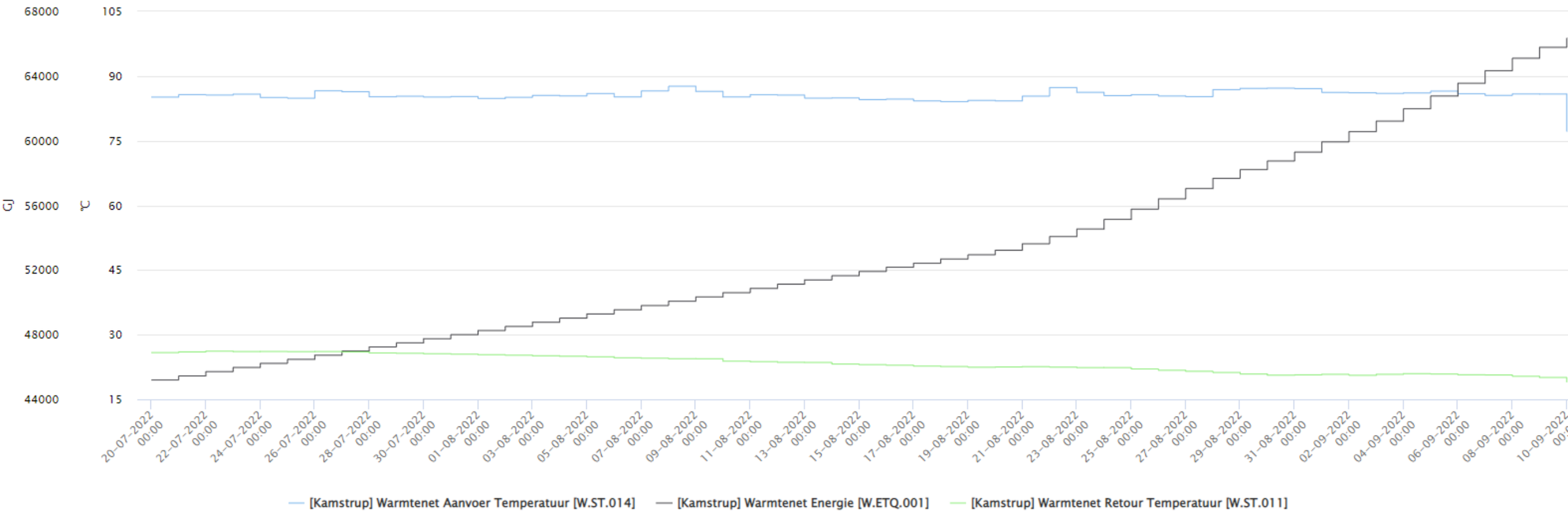
→ 41% storage efficiency

Practical performance



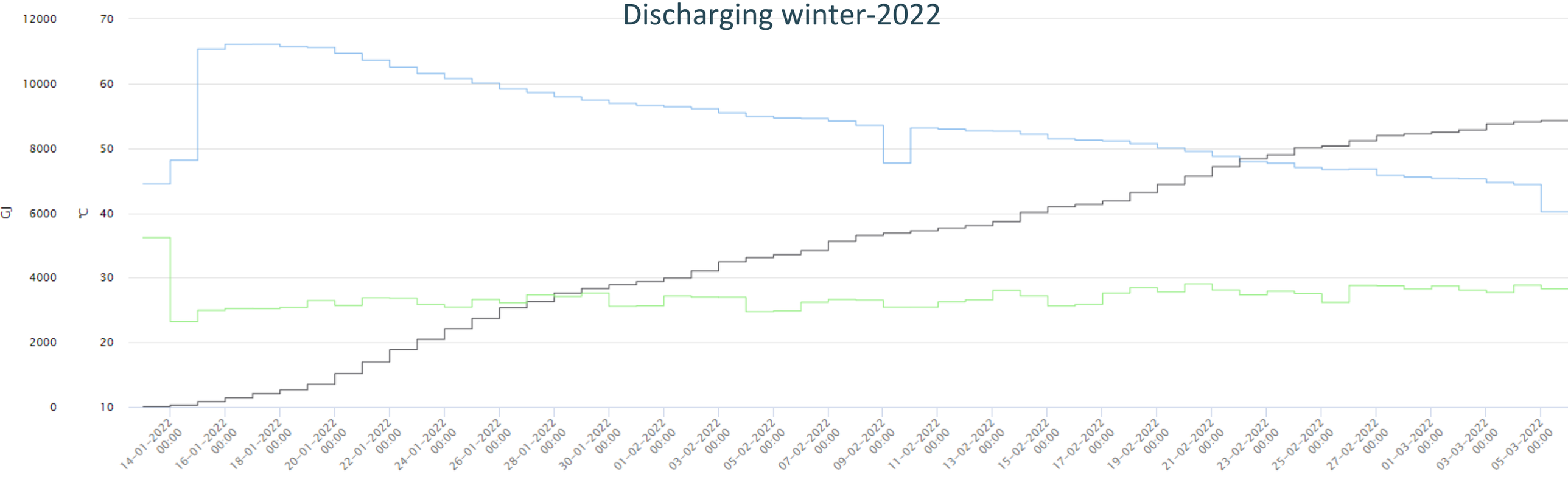
Practical performance

Loading summer-2022

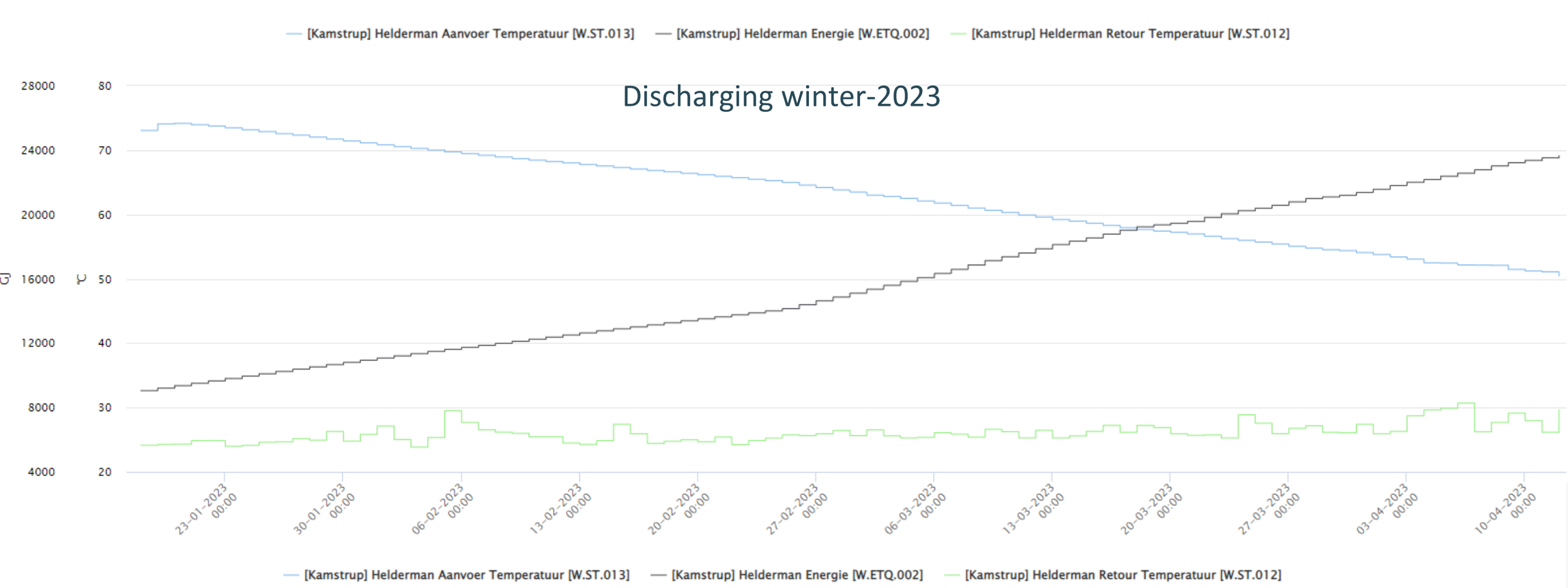


Practical performance

Discharging winter-2022



Discharging winter-2023



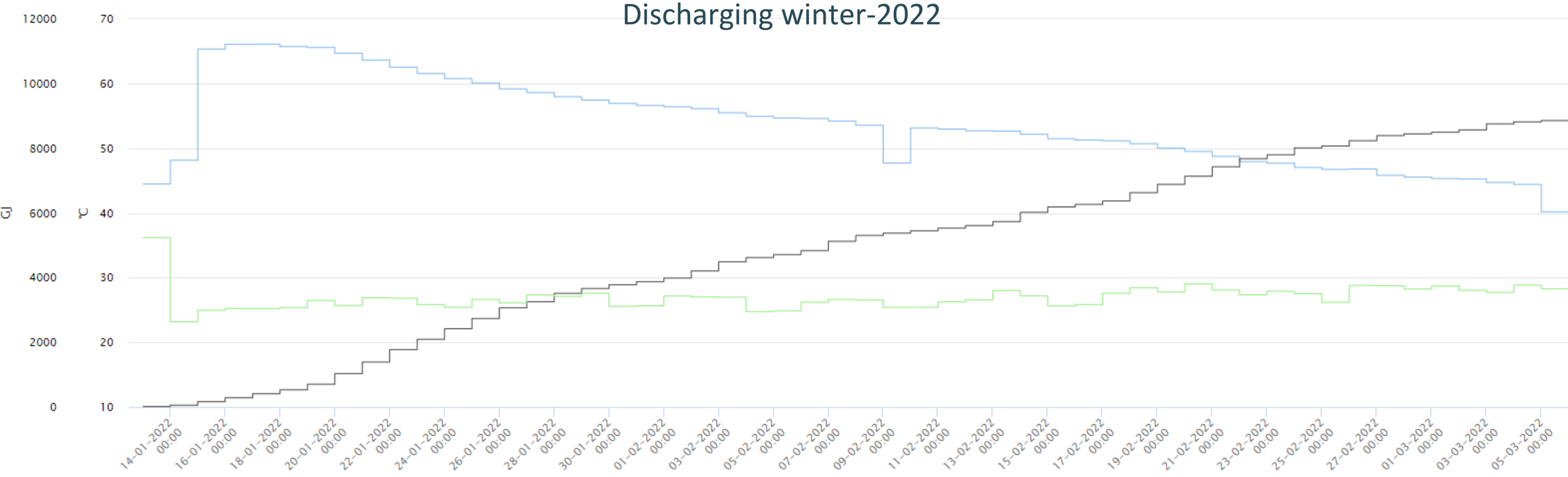
Practical performance

Factors of influence on practical performance:

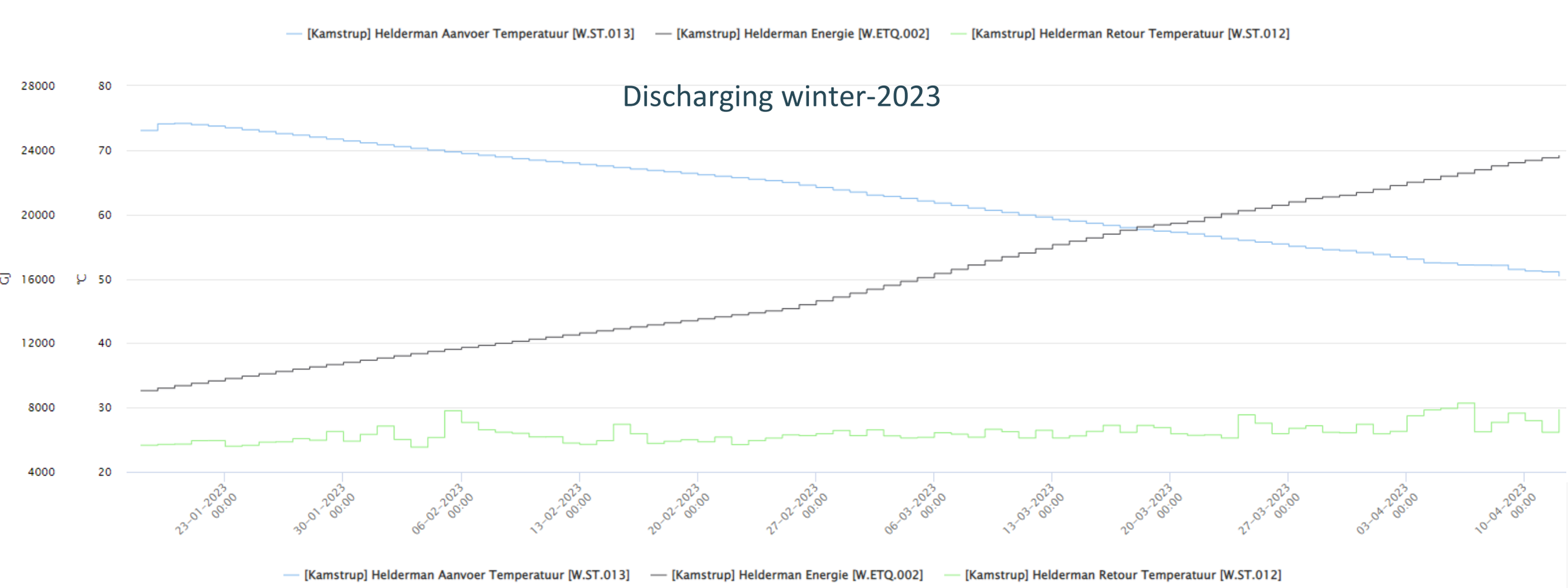
- Technically reliable installation (on/off)
- Loading and unloading strategy depends on economic factors and availability heat surplus
- Customer's heating system is designed for lower temperature (isolation, larger heat delivery tubes)
- Customer acceptance lower temperature (Cut-off temperature)

Practical performance

Discharging winter-2022



Discharging winter-2023

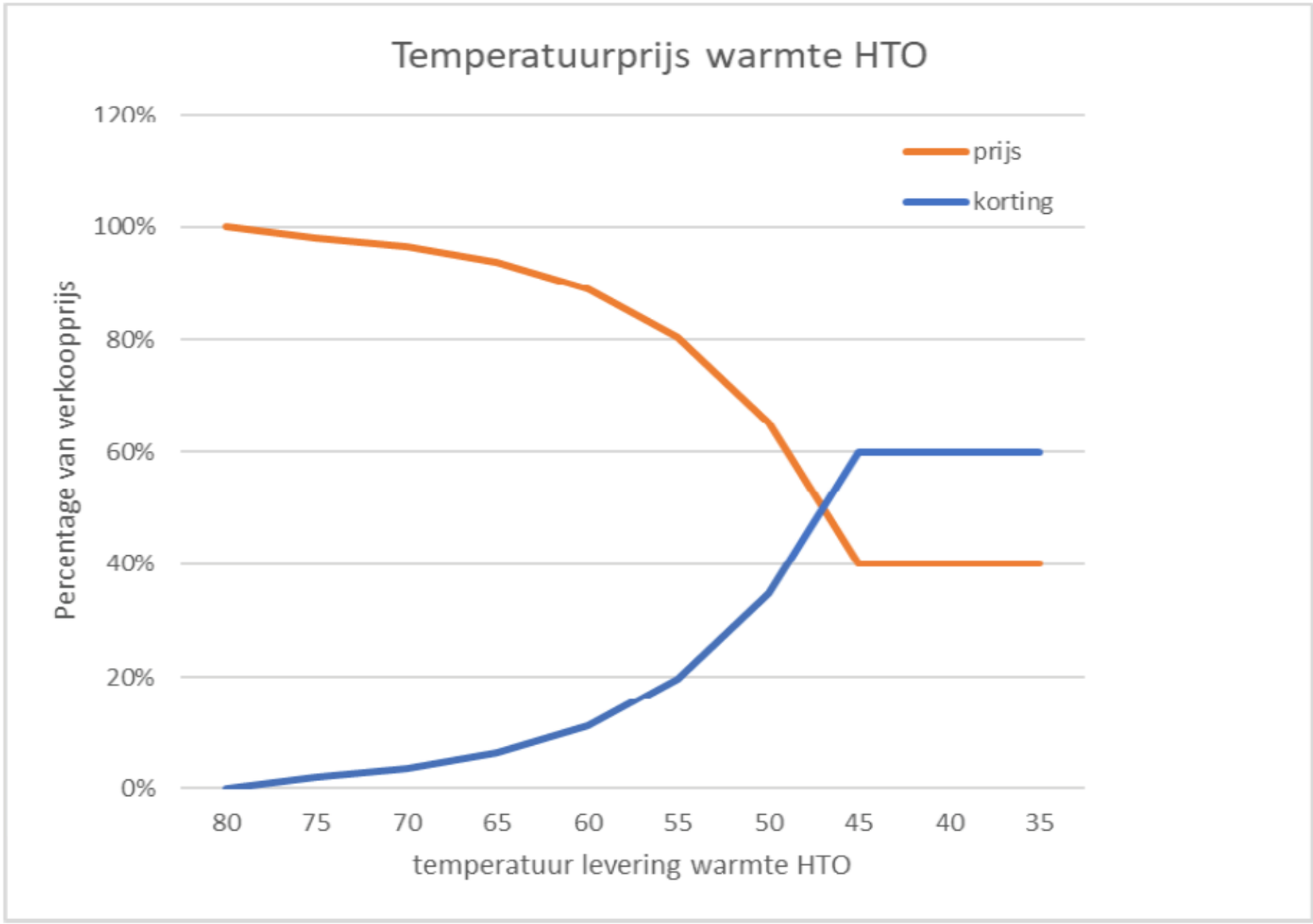


Practical performance

Customer acceptance lower temperature

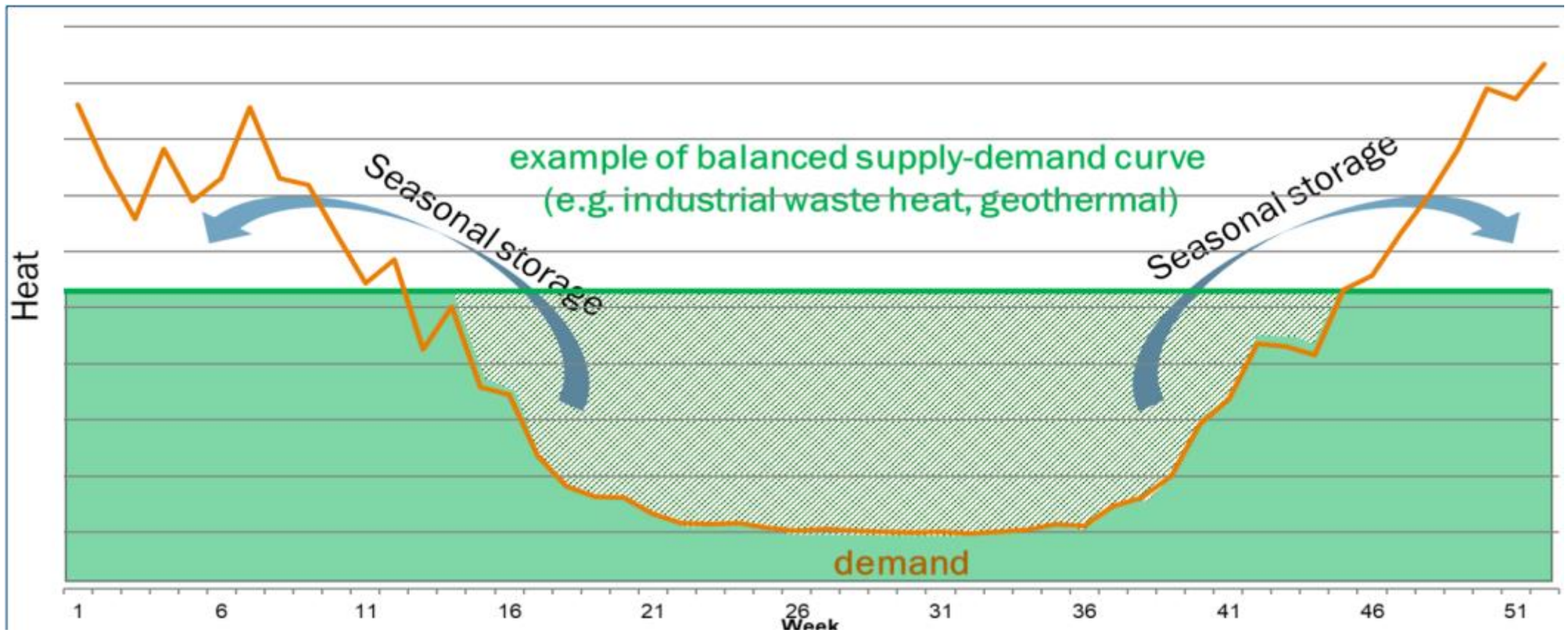
Incentive: price discount related to supply temperature

Temp	prijs	korting
80	100%	0%
75	98%	2%
70	96%	4%
65	94%	6%
60	89%	11%
55	80%	20%
50	65%	35%
45	40%	60%
40	40%	60%
35	40%	60%
30	40%	60%
25	40%	60%
Gemiddelde prijs bij		
80-55 C	93%	7%



Future potential of HT-ATES in district heating

The challenge -> A large difference between summer and winter heat demand



Most (renewable) heat sources are base load (geothermal, residual/industrial waste)

Future potential of HT-ATES in district heating

Casus Leeuwarden => Perfect example off a base load heat source v.s. seasonal heat demand curve

Value drivers seasonal storage;

1. Less usage off gas fired peak facilities (lowering marginal cost)

2. Higher sustainability label of heat sales or more heat sales with the same sustainability

3. Less maintenance & operation cost of geothermal due to a stable production year round

4. Less capex needed for back-up facilities

5. Less capex in transport grid with local heat storages (red dots) => more full load hours transport

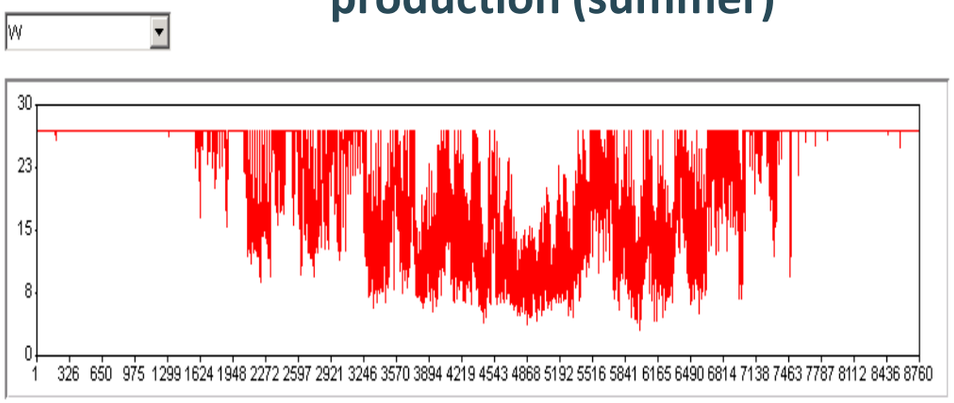
Future potential of HT-ATES in district heating

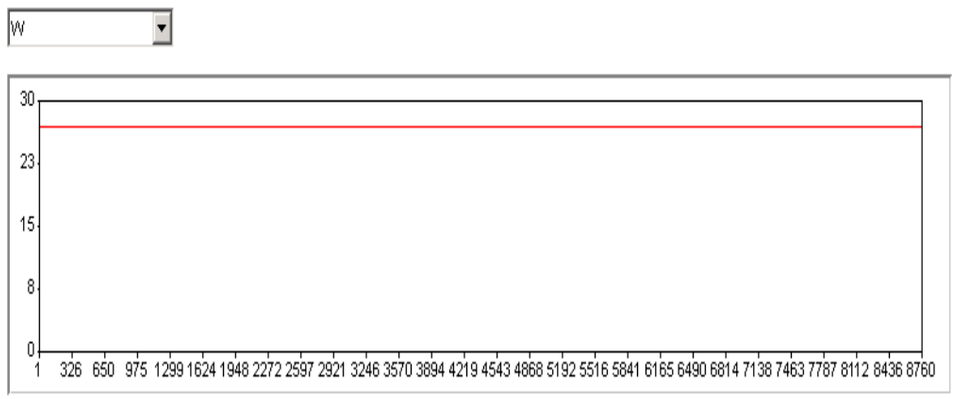
Casus Leeuwarden - Simulation

- No storage
- 43% peak boiler
- Challenging geothermal production (summer)

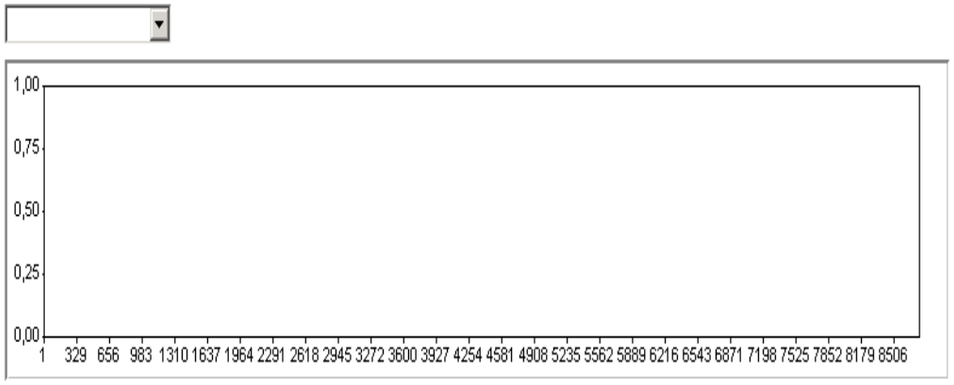
- Seasonal storage (incl. 20% losses)
- 30% peak boiler
- Stable & flat geothermal production

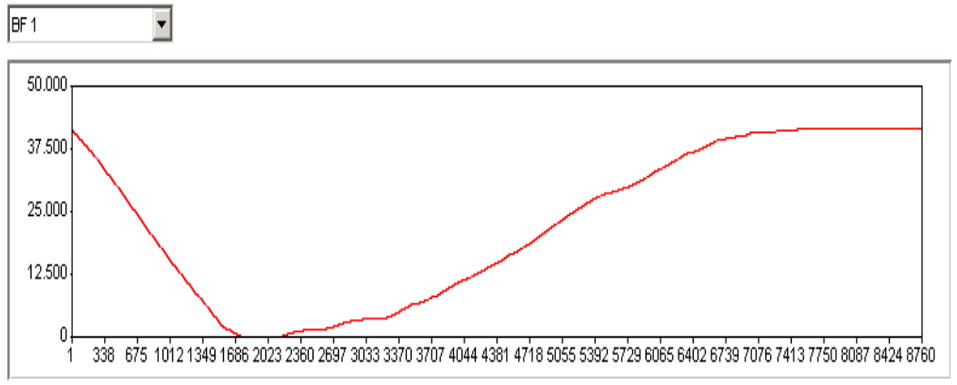
Geothermal production



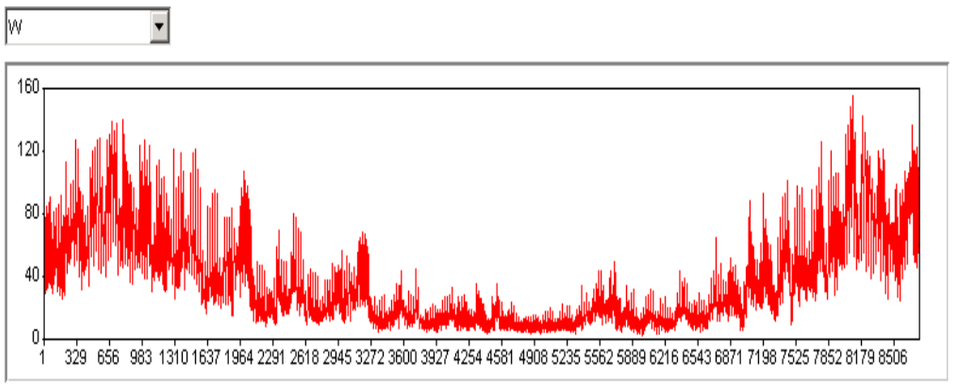


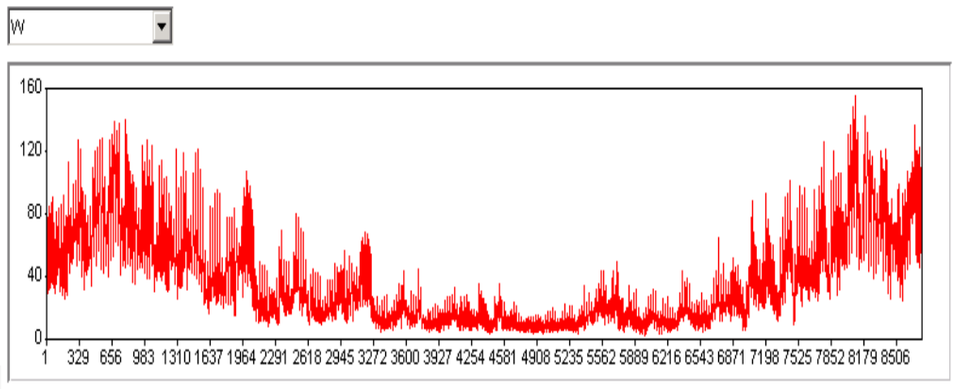
Seasonal storage





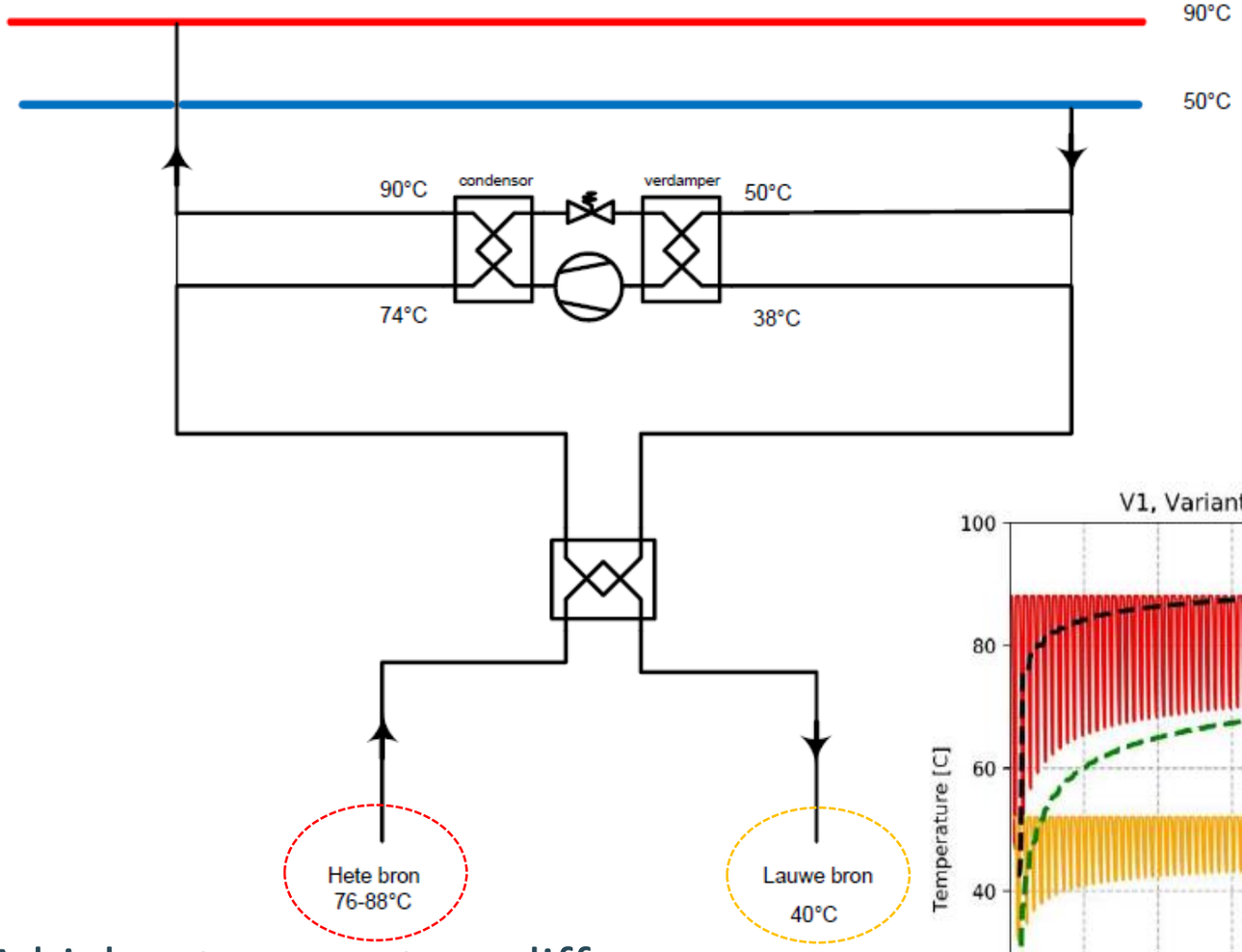
Yearly heat demand





Future potential of HT-ATES in district heating

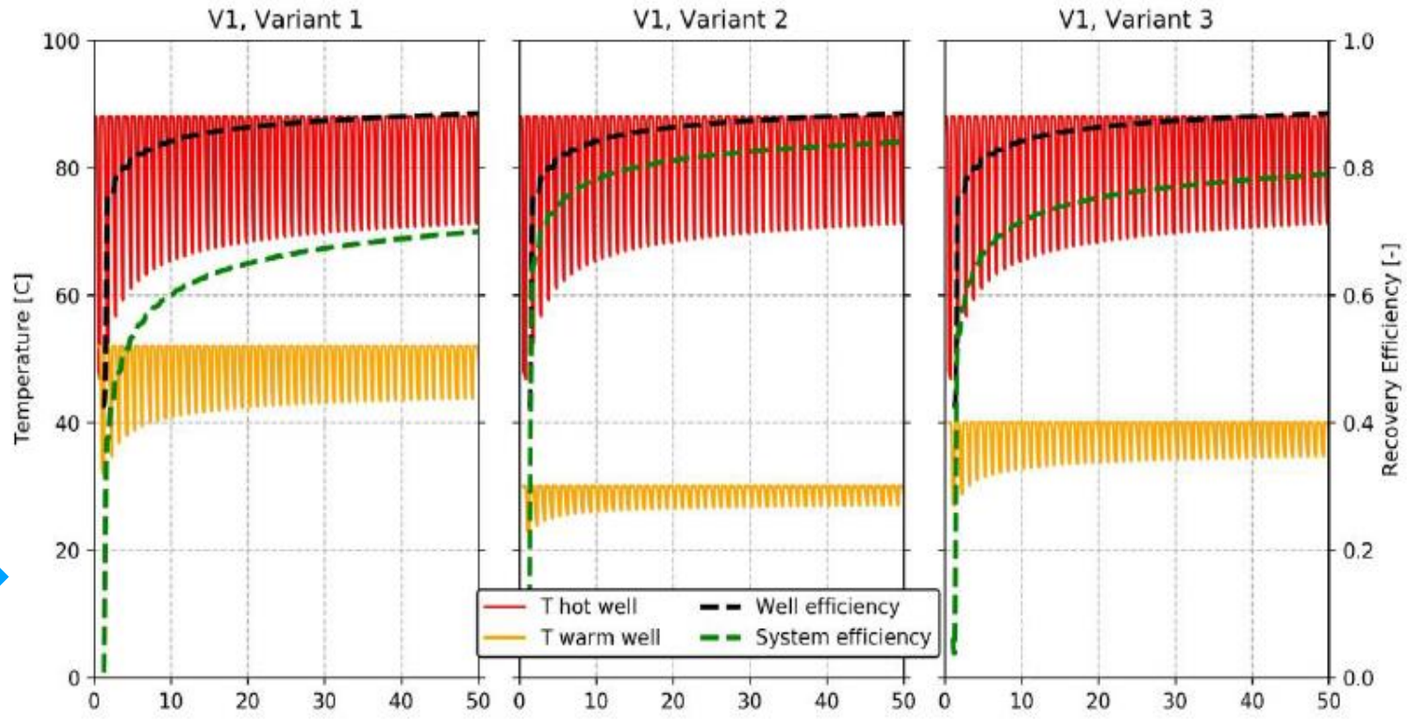
HT-ATES temperatures in district heating system -> A heat pump is essential



Fixed supply temperature in heat grid

Return temperature is higher then in greenhouse area

A higher temperature difference between the “hot” and “warm” well results in an higher system efficiency



Source; WINDOW phase 1 report Leeuwarden

ecw energy

solid solutions for a sustainable future

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maakt
energie
lokaal