



# HEATSTORE

## HIGH TEMPERATURE UNDERGROUND THERMAL ENERGY STORAGE (HT-UTES)

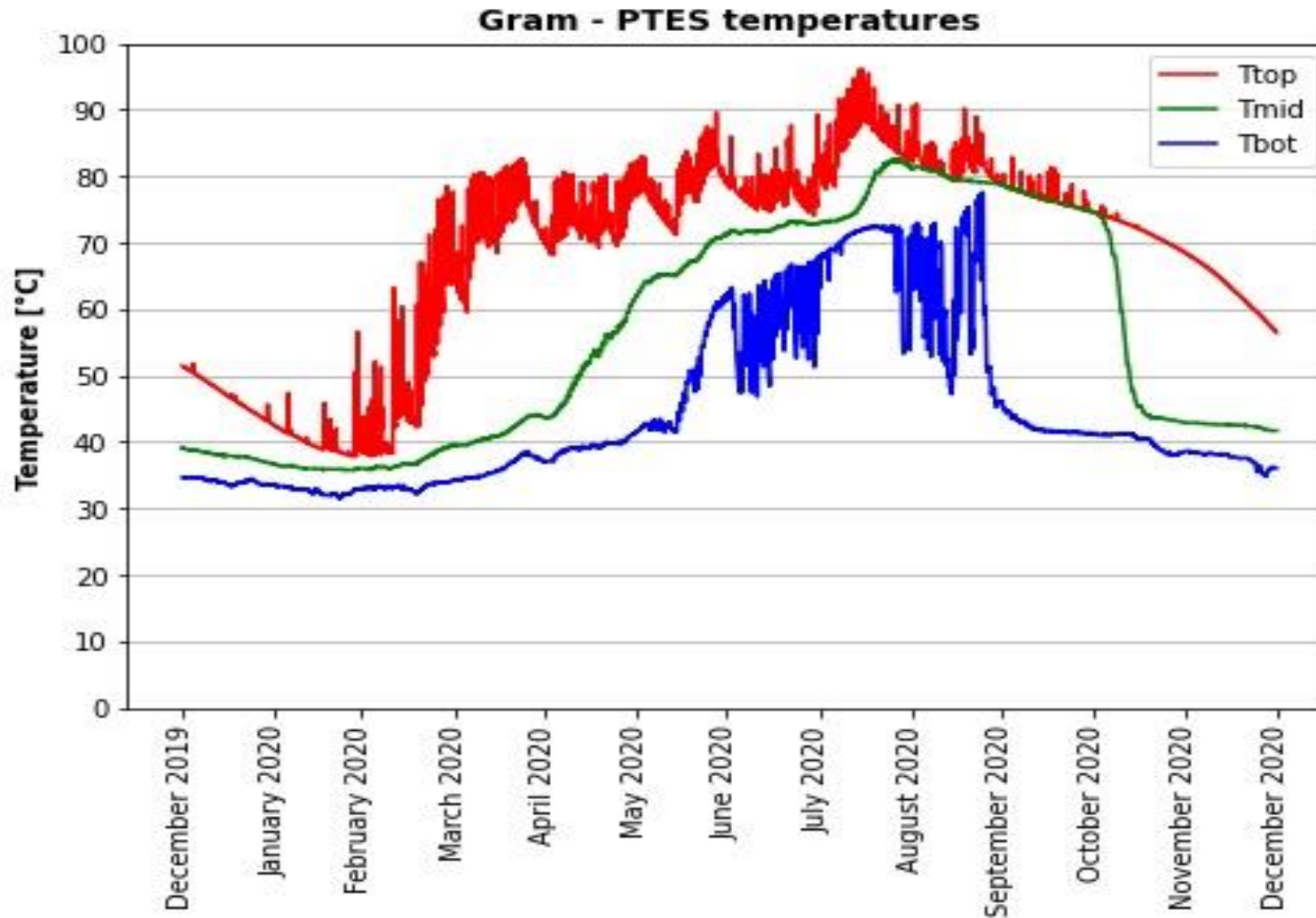
HEAT STORAGE AND MONITORING RESULTS, 27 OCTOBER 2020

GEOFFROY GAUTHIER & DANIEL TRIER, PLANENERGI

**heatstore**  
High Temperature  
Underground Thermal Energy  
Storage

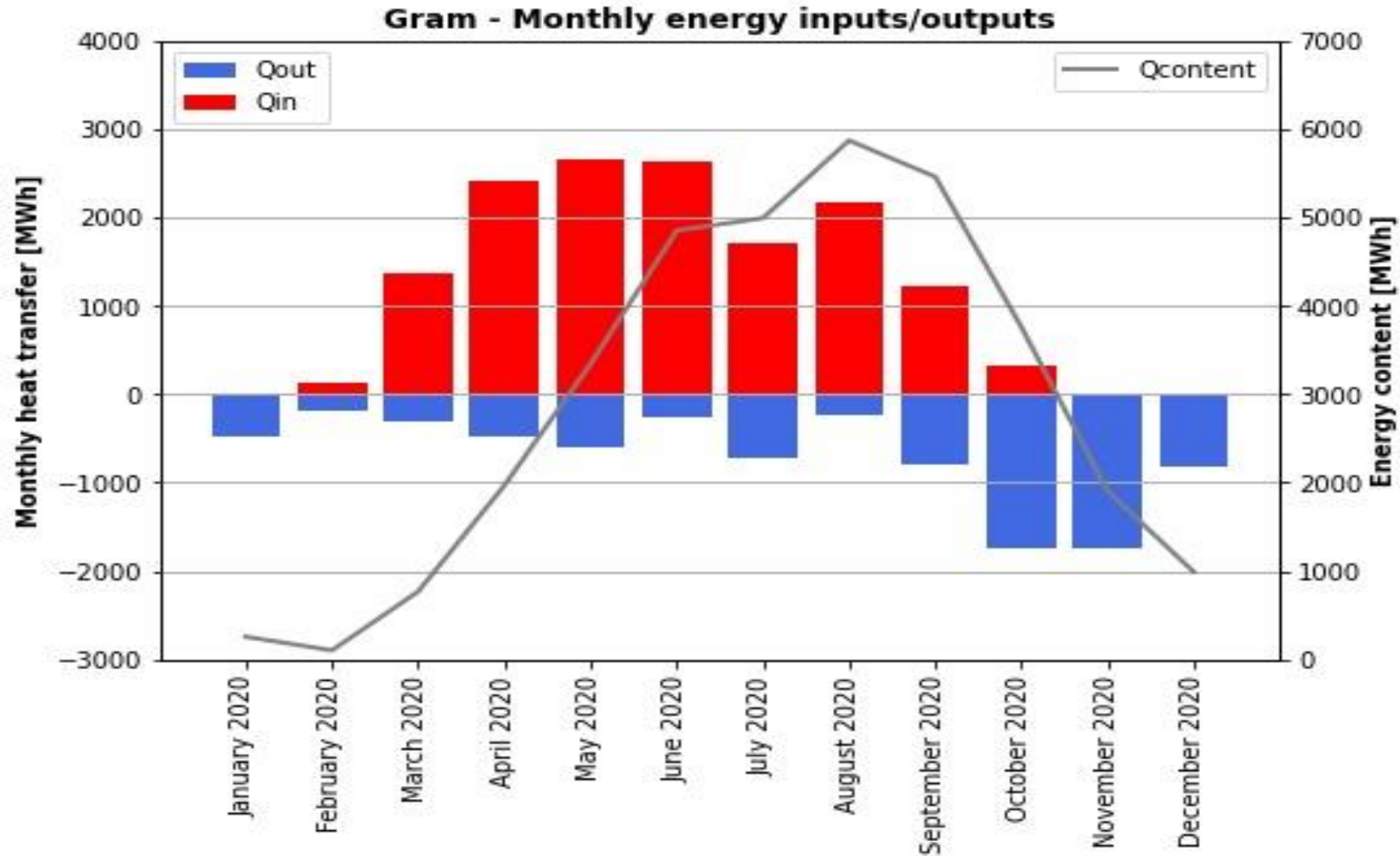
# GRAM – RENOVATED: 01-09-2020 TO 15-11-2020

- Period: 2020 full year (Note! Renovation overlap)



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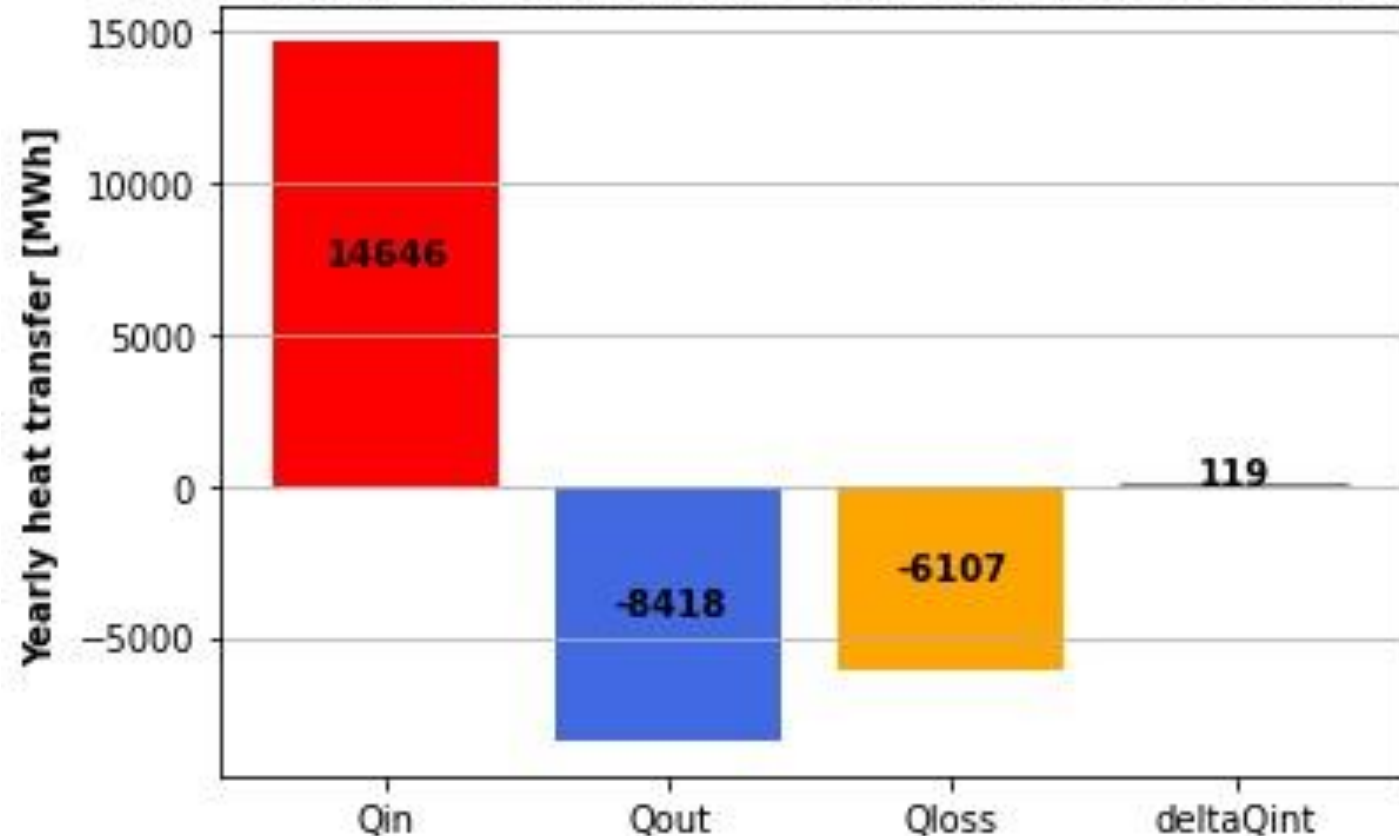


## GRAM – RENOVATED: 01-09-2020 TO 15-11-2020

- Period: 2020 full year (Note! Renovation overlap)

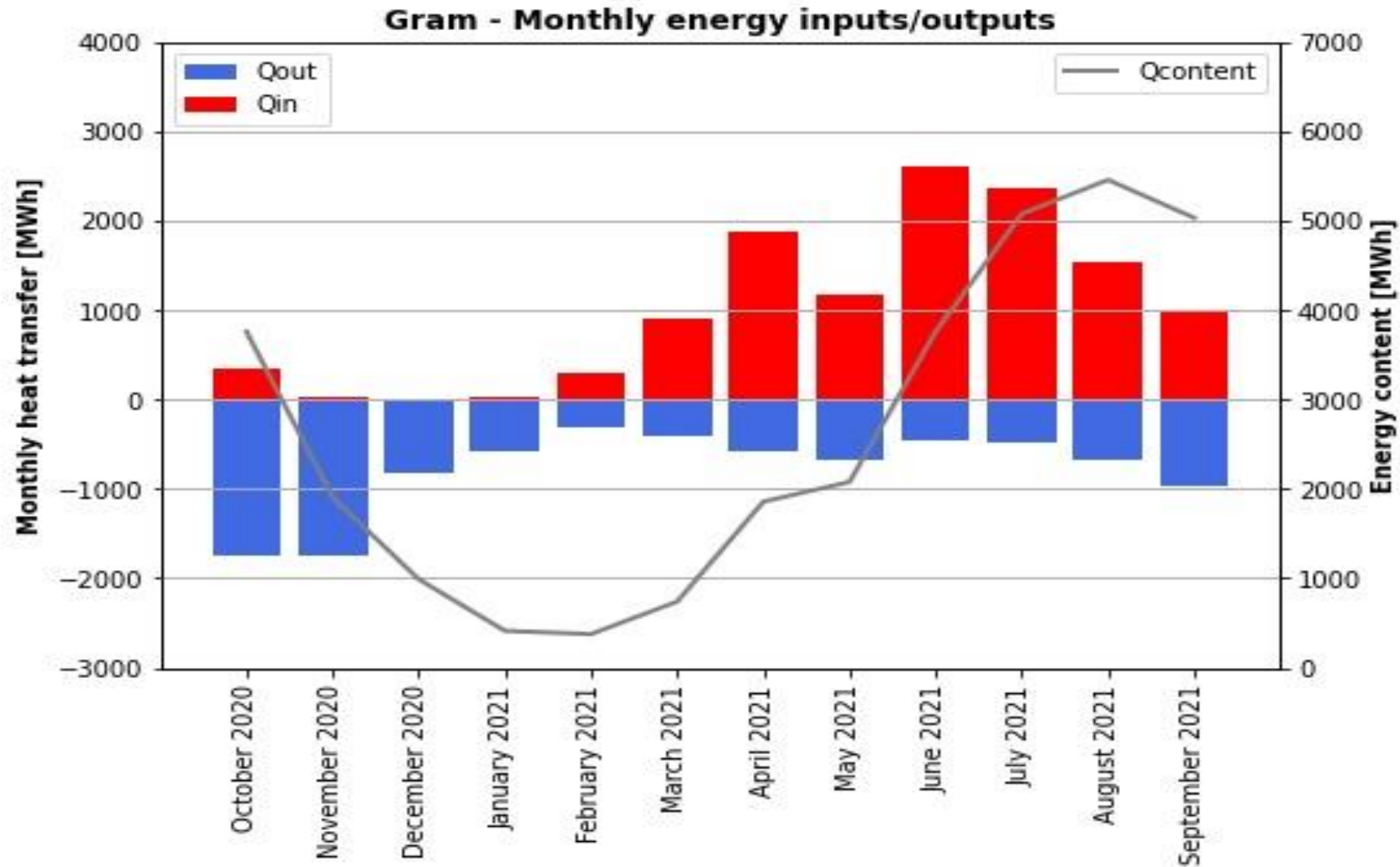
- $T_{\max} = 96.1^{\circ}\text{C}$
- $T_{\min} = 20.0^{\circ}\text{C}$
- PTES capacity = 10300 MWh
- Number of storage cycles: 0.8
- 41% losses
- 57% energy out
- 1% internal energy increase

Gram - Yearly energy balance - January 2020-December 2020



# GRAM – RENOVATED: 01-09-2020 TO 15-11-2020

- Period: 01-10-2020 – 30-09-2021 (latest full year!)

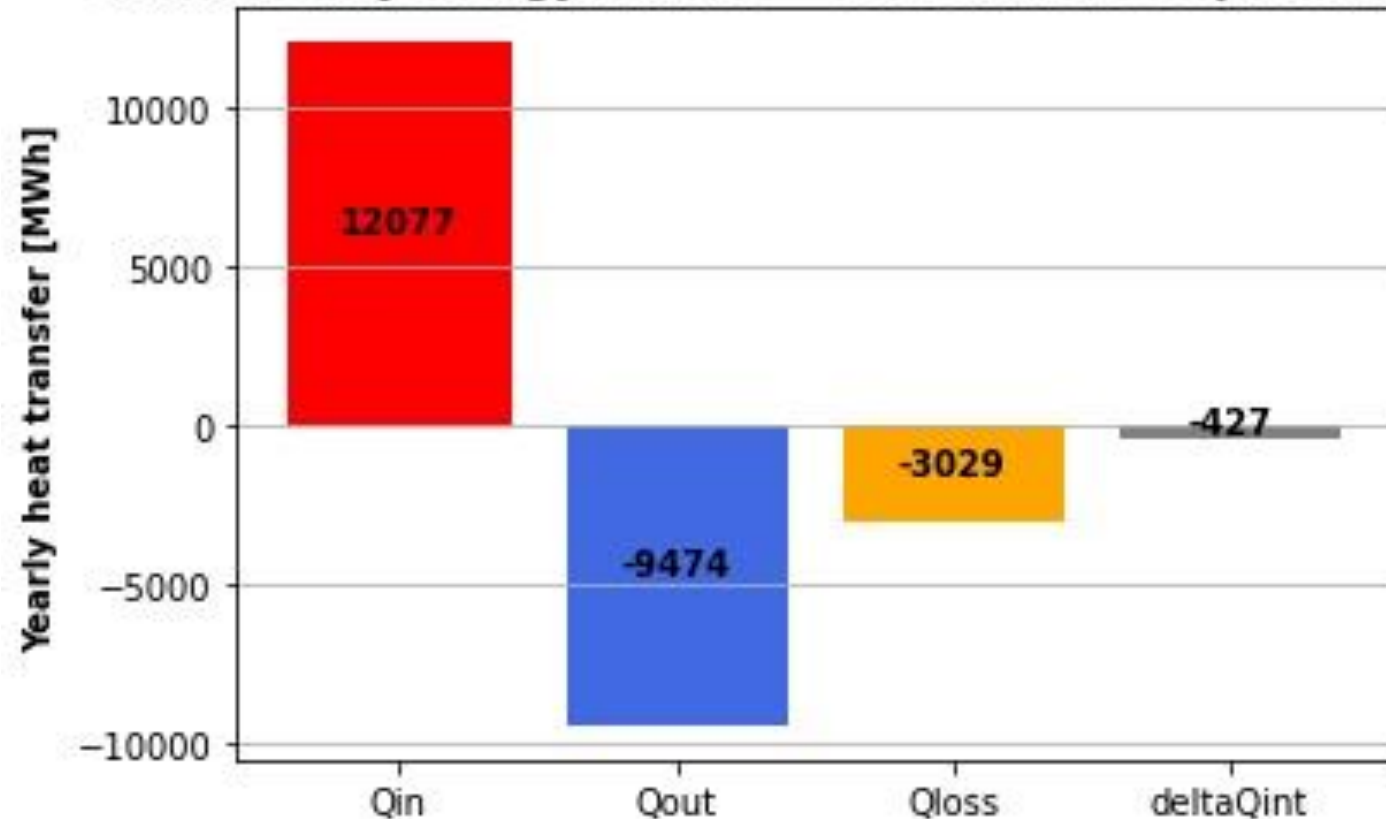


## GRAM – RENOVATED: 01-09-2020 TO 15-11-2020

- Period: 01-10-2020 – 30-09-2021 (latest full year!)

- $T_{\max} = 93.6^{\circ}\text{C}$
- $T_{\min} = 20.0^{\circ}\text{C}$
- PTES capacity = 9960 MWh
- Number of storage cycles: 1.0
- 25% losses
- 78% energy out
- -4% internal energy increase

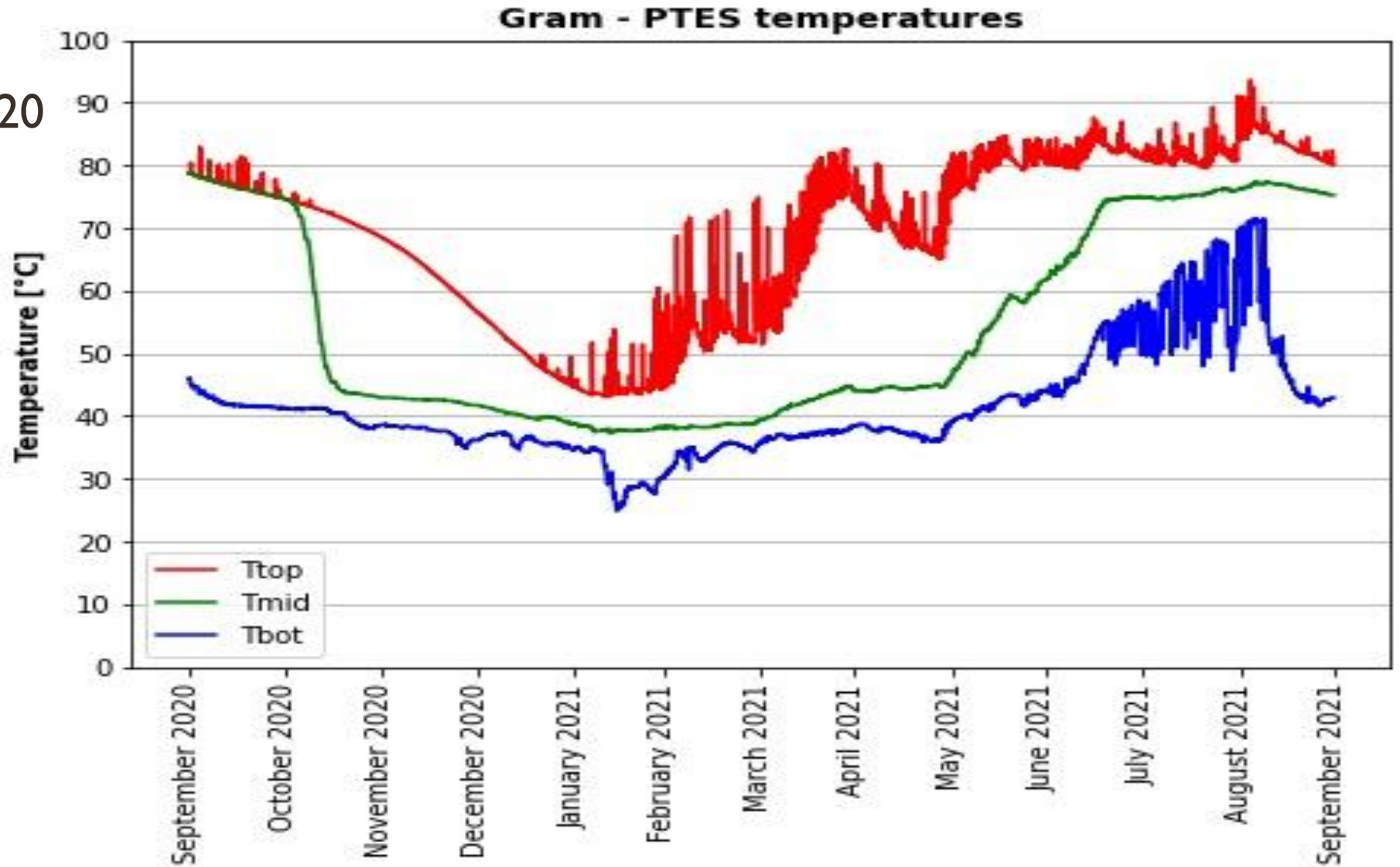
Gram - Yearly energy balance - October 2020-September 2021



# GRAM – RENOVATED: 01-09-2020 TO 15-11-2020

■ Period: 01-10-2020  
– 30-09-2021

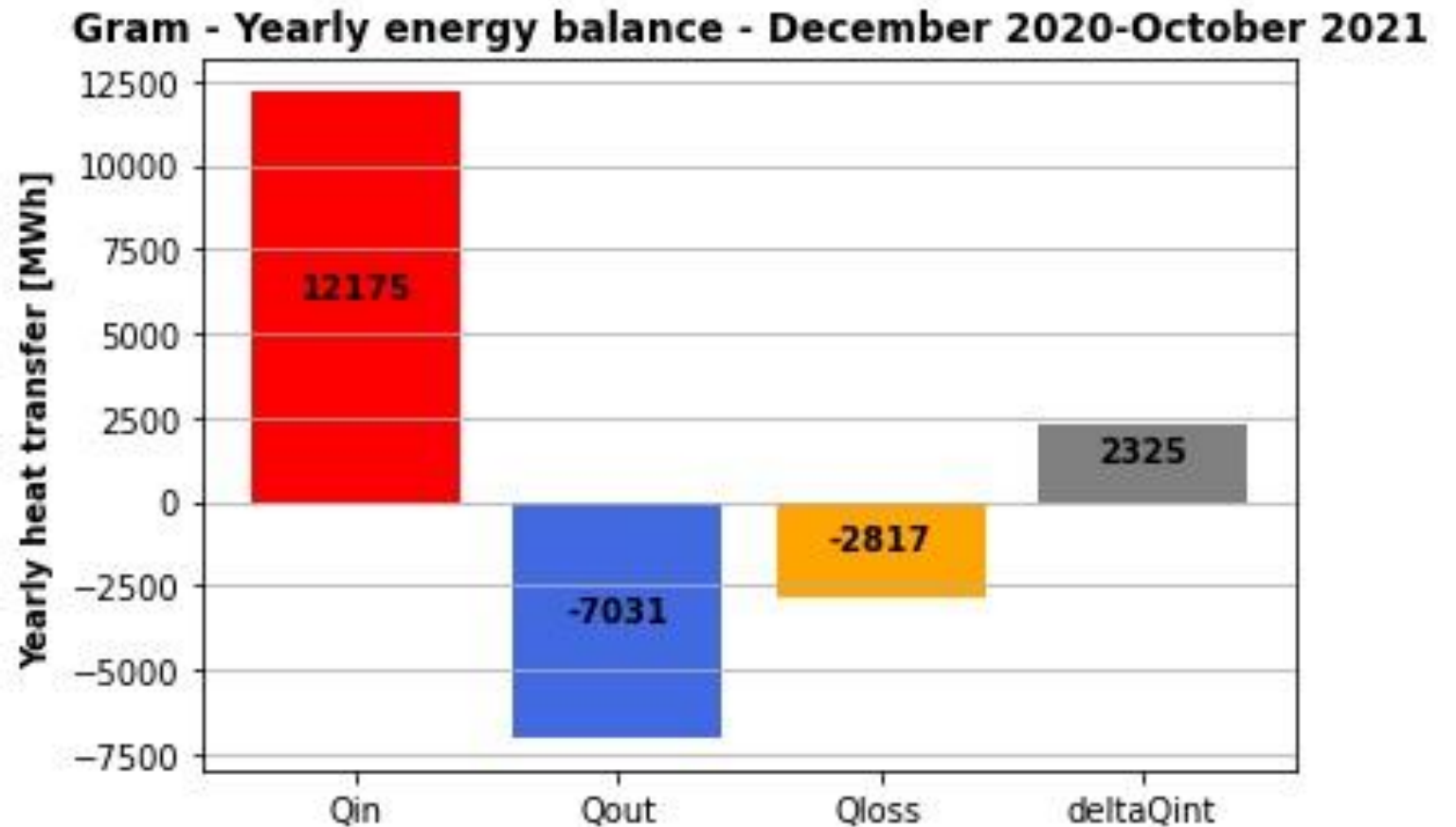
■  $T_{\max} = 93.6^{\circ}\text{C}$   
■  $T_{\min} = 20.0^{\circ}\text{C}$



## GRAM – RENOVATED: 01-09-2020 TO 15-11-2020

- Period: 01-12-2020 – 26-10-2021 (period since renovation – Note! Not one full year)

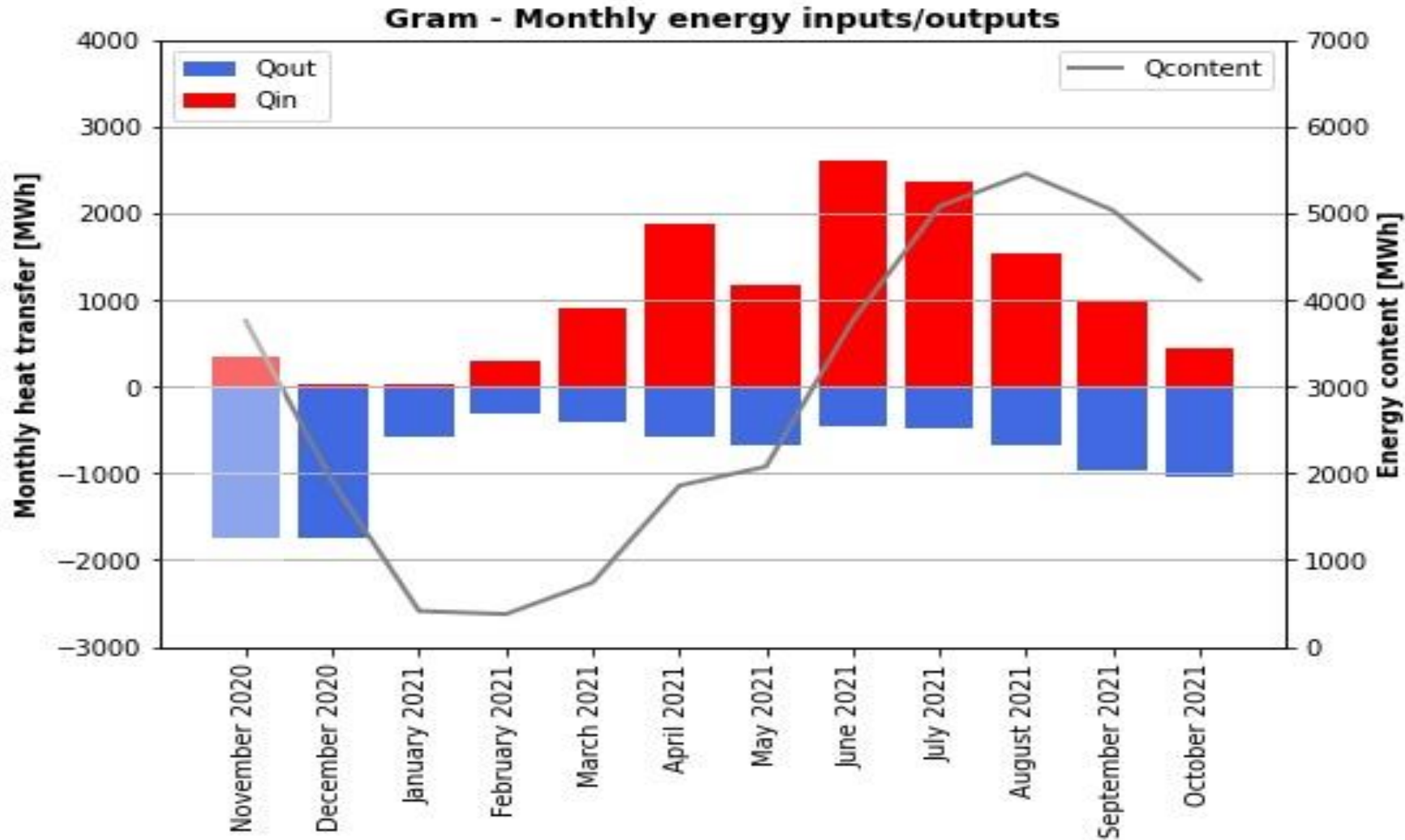
- $T_{\max} = 93.6^{\circ}\text{C}$
- $T_{\min} = 20.0^{\circ}\text{C}$
- PTES capacity = 9960 MWh
- Number of storage cycles: 0.7
- 23% losses
- 57% energy out
- 23% internal energy increase





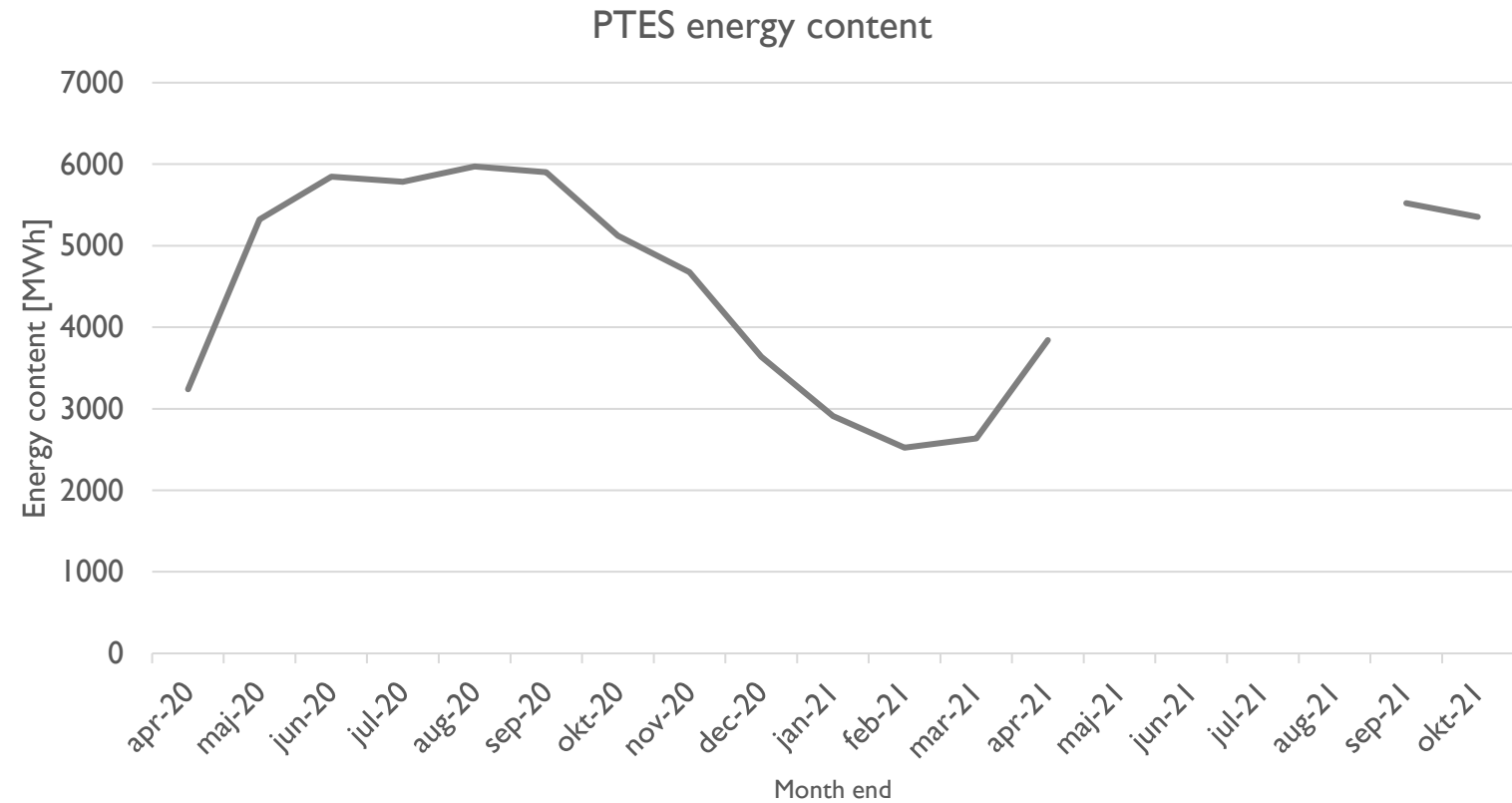
# GRAM – RENOVATED: 01-09-2020 TO 15-11-2020

- Period: 01-12-2020 – 26-10-2021 (period since renovation – Note! Not one full year)



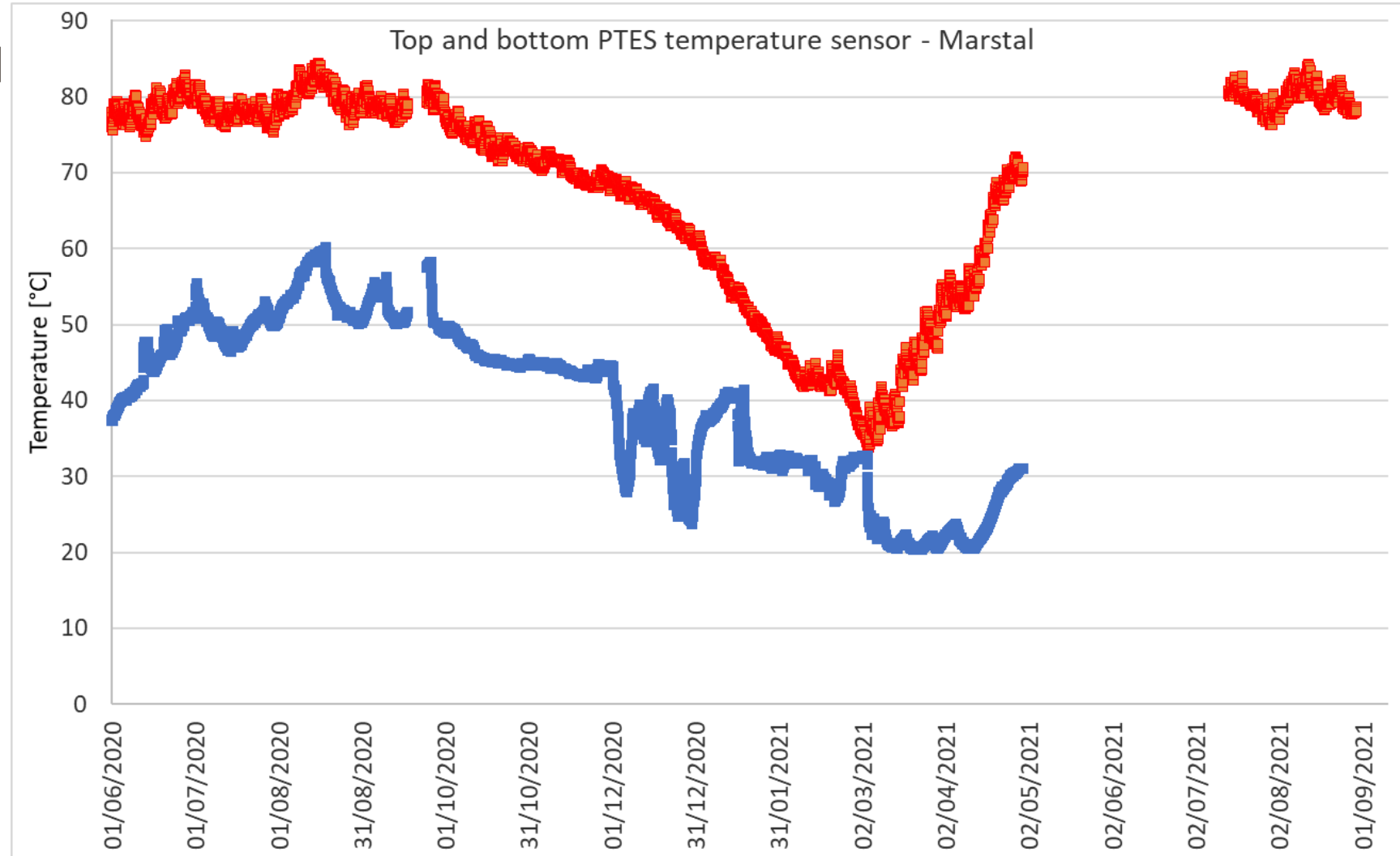
# MARSTAL

- Renovation completed April 2020
- Error in data  
→ missing period
- Period shown:  
04-2020  
– 10-2021



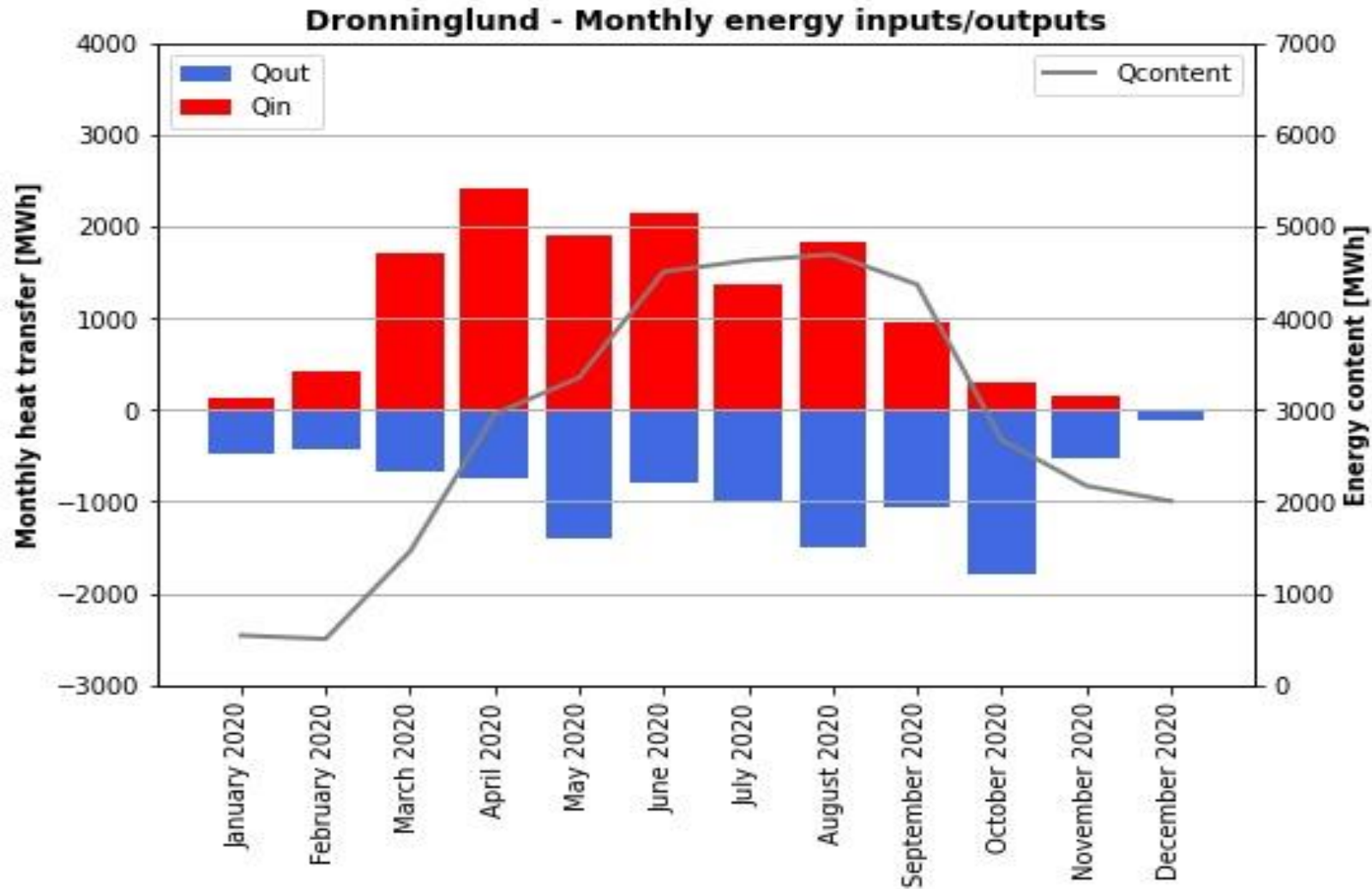
# MARSTAL

- Renovation completed April 2020
- Error in data → missing period
- Period shown:  
06-2020  
– 08-2021



# DRONNINGLUND

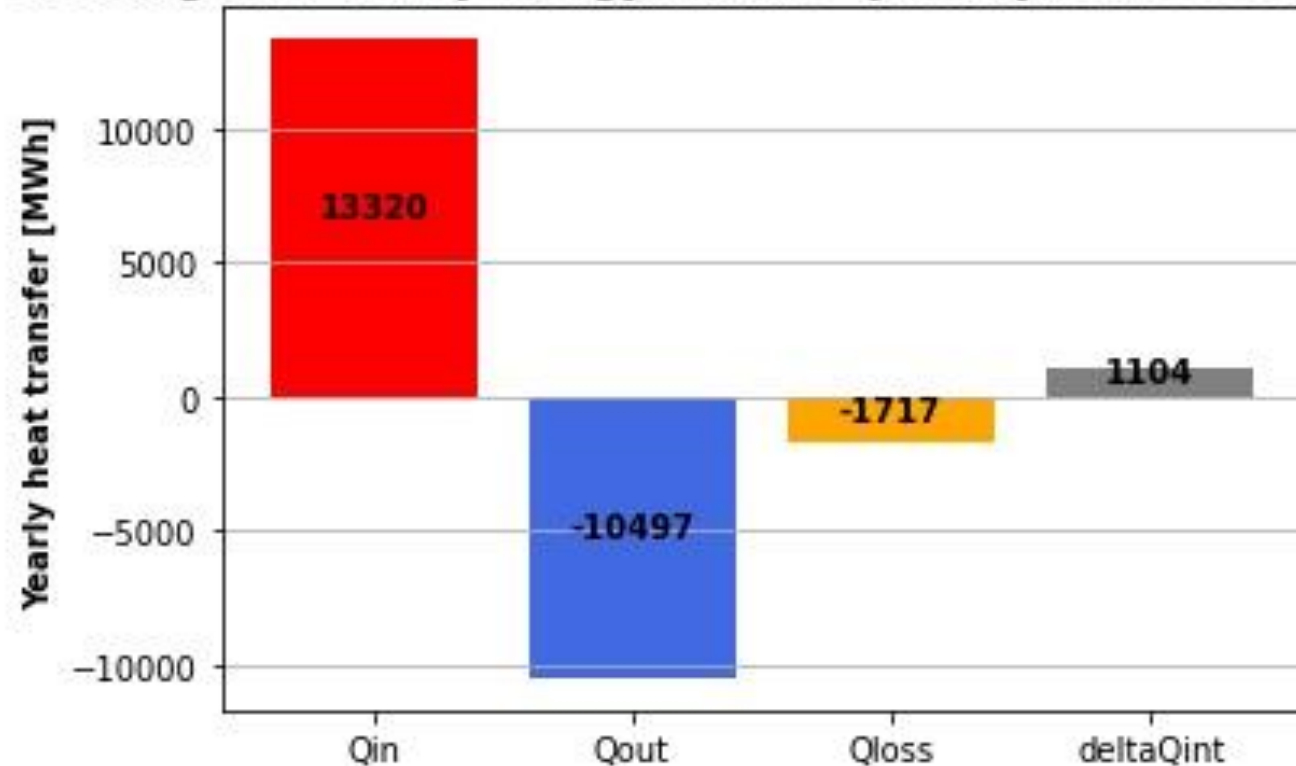
- Period: 2020 full year – problems identified in 2021!



# DRONNINGLUND

- Period: 2020 full year
- $T_{\max} = 88.0^{\circ}\text{C}$
- $T_{\min} = 9.7^{\circ}\text{C}$
- PTES capacity = 5300 MWh
- Number of storage cycles: 2.0
- 12% losses
- 78% energy out
- 20% internal energy increase

Dronninglund - Yearly energy balance - January 2020-December 2020

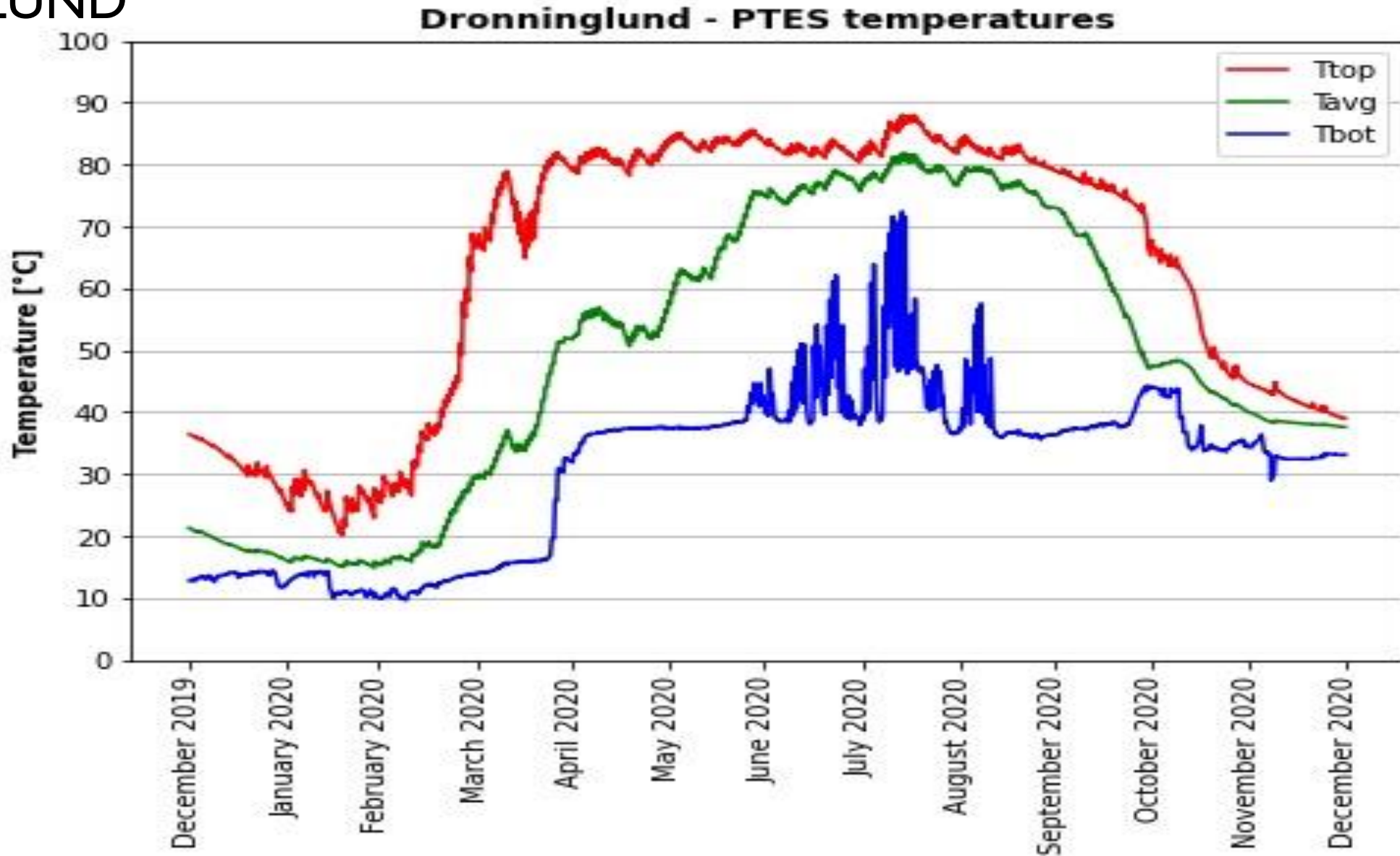


# DRONNINGLUND

■ Period: 2020

■  $T_{\max} = 88.0^{\circ}\text{C}$

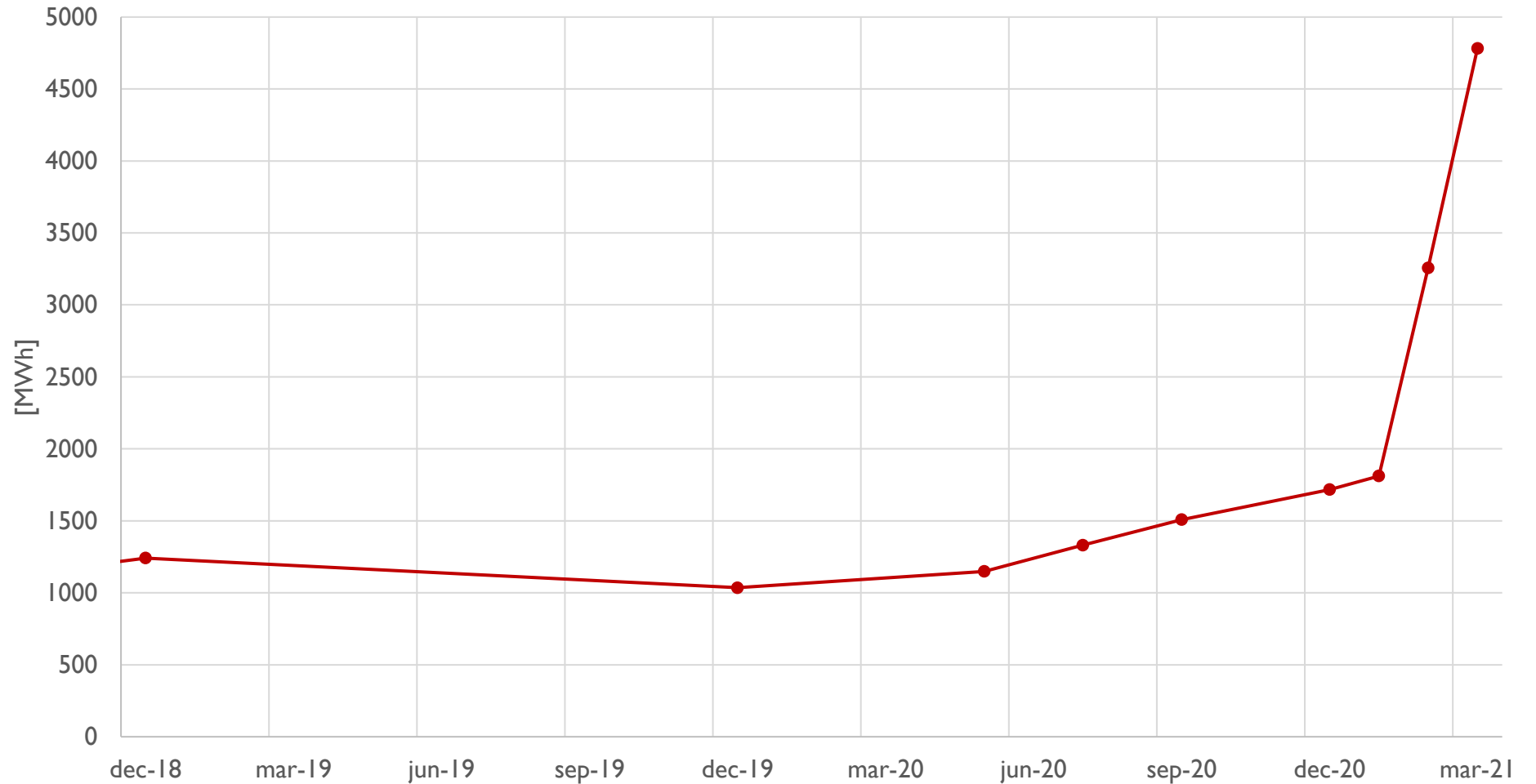
■  $T_{\min} = 9.7^{\circ}\text{C}$



# DRONNINGLUND

- Heat loss development

Heat losses - past year



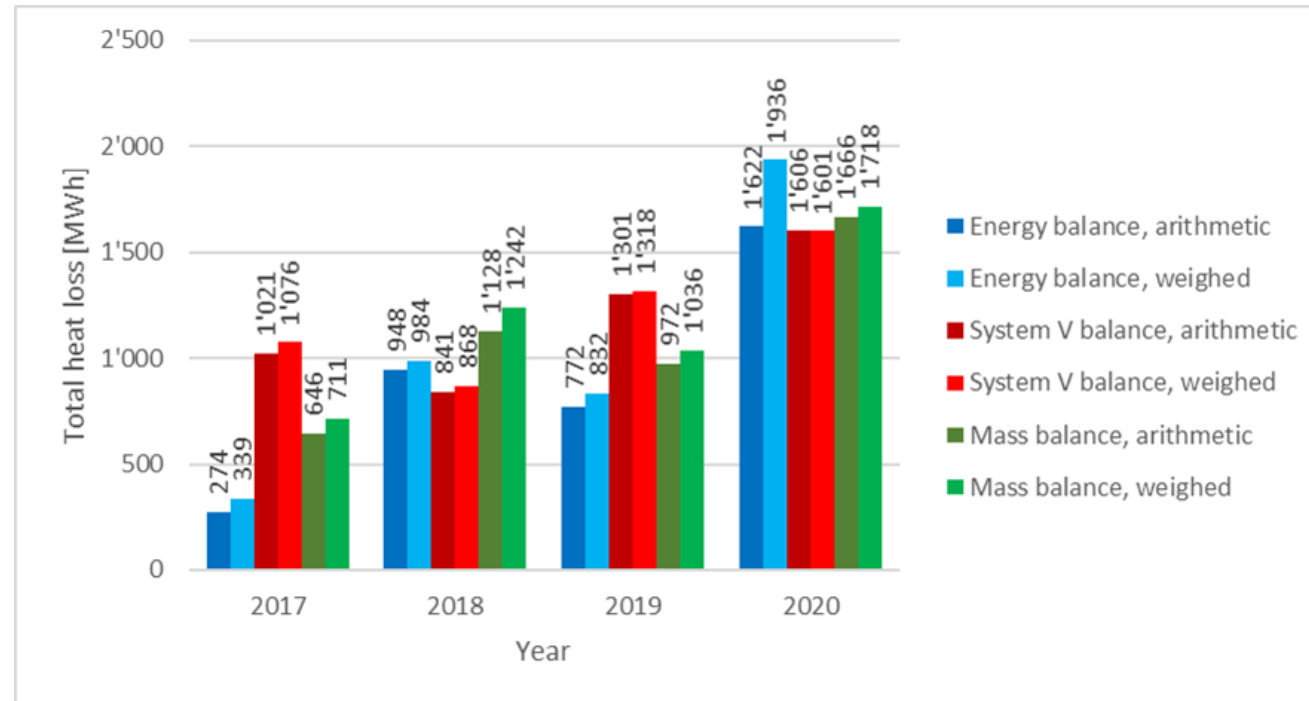
# PLANENERGI'S ROLE IN HEATSTORE

- PlanEnergi brought expertise on two main areas
  - Practical experience with PTES & BTES
  - Modelling work and monitoring of PTES & BTES
- Contribution to deliverables
  - WP1: Specifications and characterization for UTES concepts (Lessons learned/best practices)
  - WP2&3: Tools and workflows for modelling the subsurface dynamics/Heating System integration and optimization of design and operation (modelling and optimization including PTES & BTES)
  - WP4: Demonstrations and case studies: detailed design and implementation in practice (Guidelines)
  - WP5: Monitoring and validation to assess system performance and workflow (Modelling and monitoring)
  - WP6: Fast-track market uptake and dissemination (Roadmap)



# DETAILED MEASUREMENTS ANALYSIS OF DRONNINGLUND

- Heat losses determined with different methods for Dronninglund over the years (D5.3)
  - Higher losses are observed already in 2020, with all methods

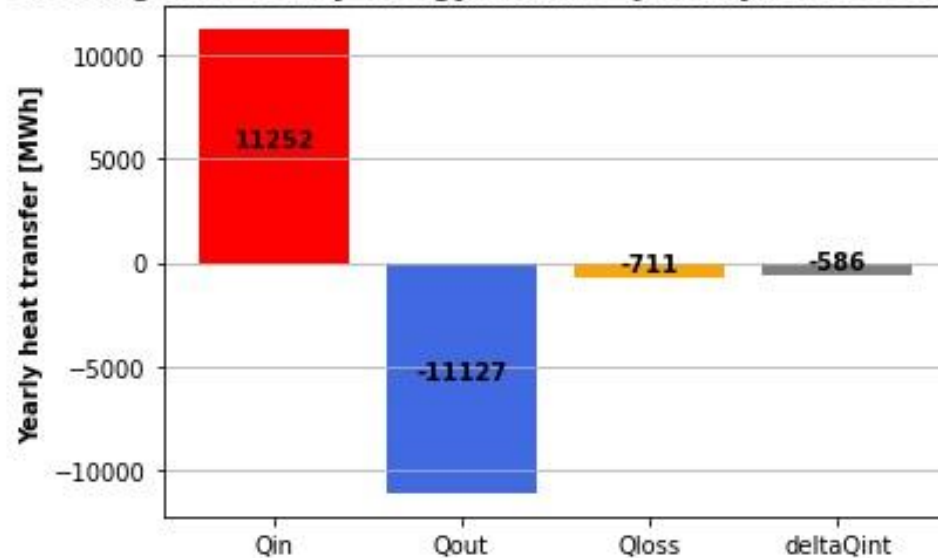


# DETAILED MEASUREMENTS ANALYSIS OF DRONNINGLUND

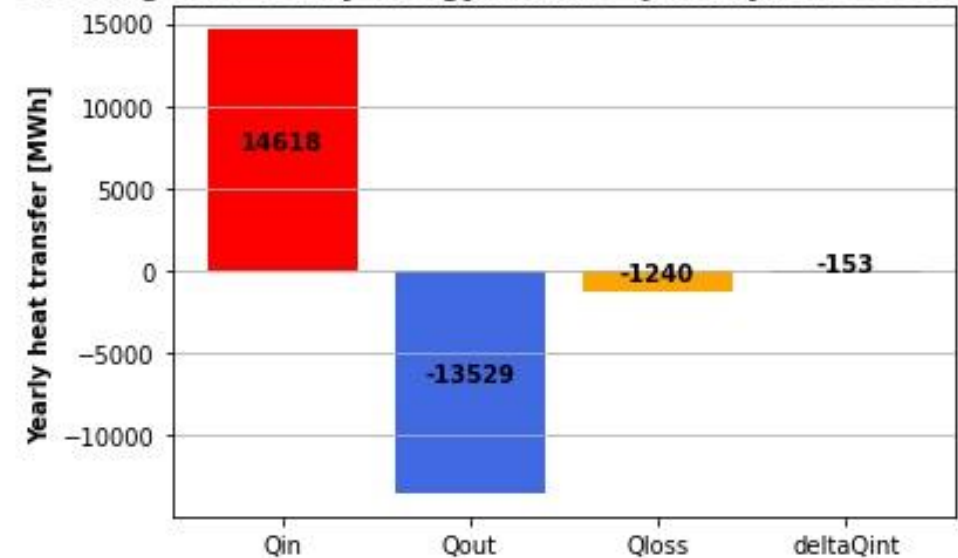
- Heat losses determined for Dronninglund over the years

2017, 2018

Dronninglund - Yearly energy balance - January 2017-December 2017



Dronninglund - Yearly energy balance - January 2018-December 2018

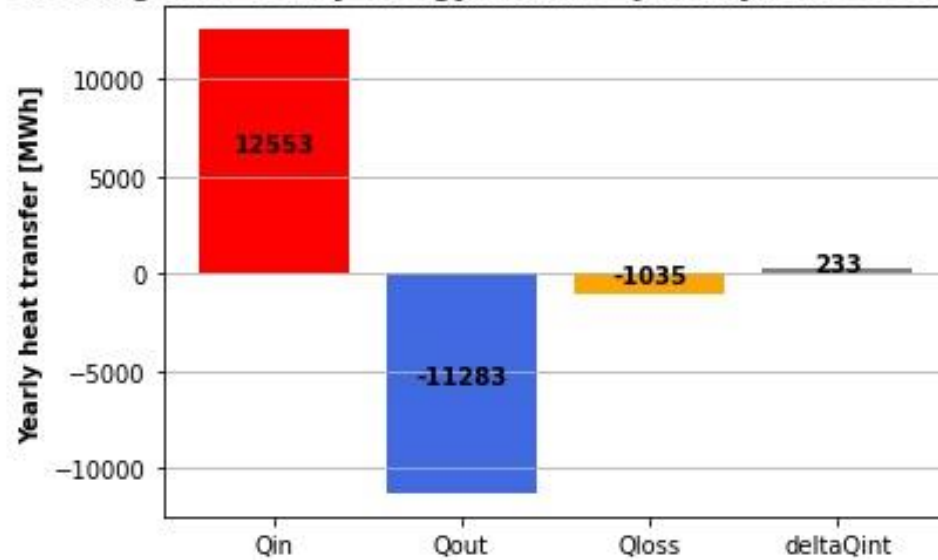


# DETAILED MEASUREMENTS ANALYSIS OF DRONNINGLUND

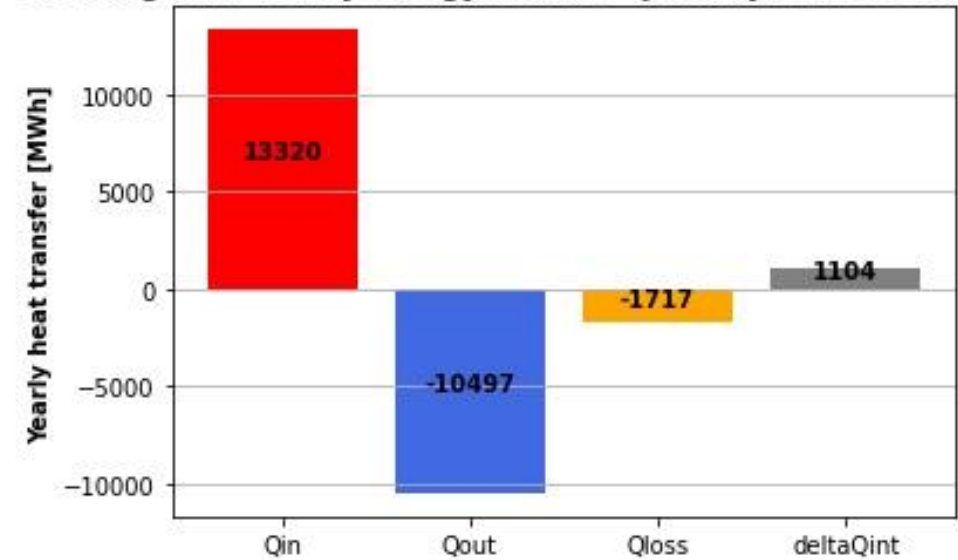
- Heat losses determined for Dronninglund over the years

2019, 2020

Dronninglund - Yearly energy balance - January 2019-December 2019



Dronninglund - Yearly energy balance - January 2020-December 2020

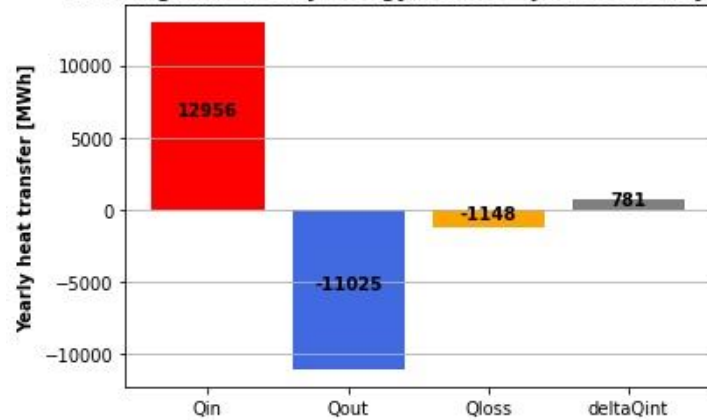


# DETAILED MEASUREMENTS ANALYSIS OF DRONNINGLUND

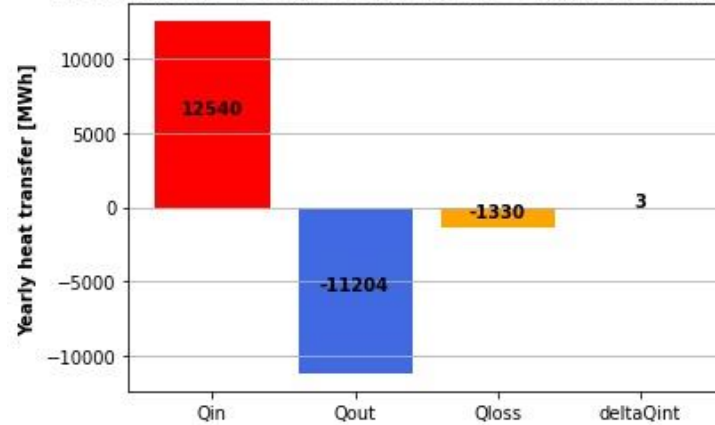
- Heat losses determined for Dronninglund over the years

2020...

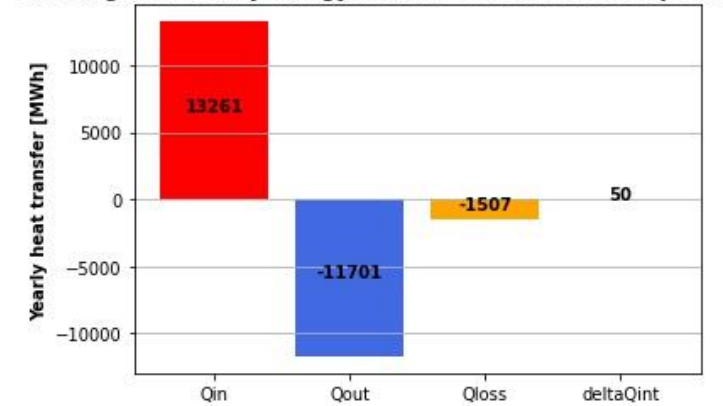
Dronninglund - Yearly energy balance - June 2019-May 2020



Dronninglund - Yearly energy balance - August 2019-July 2020



Dronninglund - Yearly energy balance - October 2019-September 2020

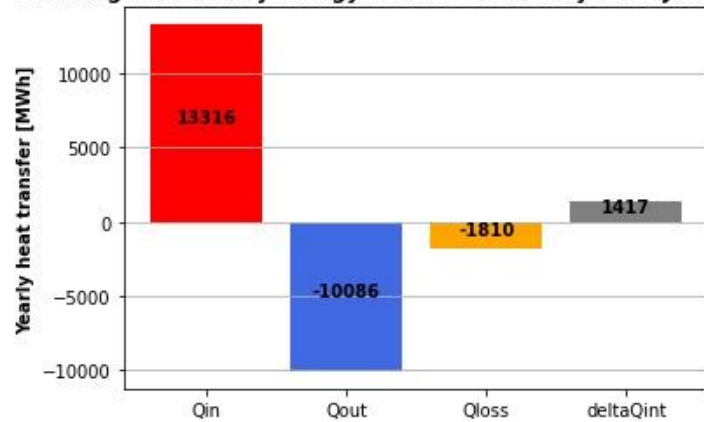


# DETAILED MEASUREMENTS ANALYSIS OF DRONNINGLUND

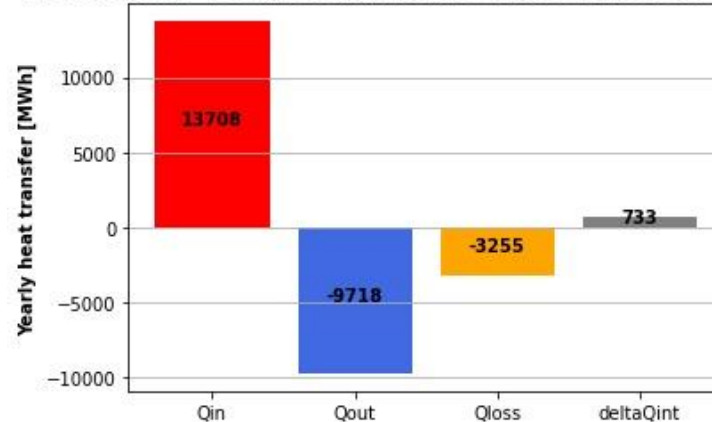
- Heat losses determined for Dronninglund over the years

2021...

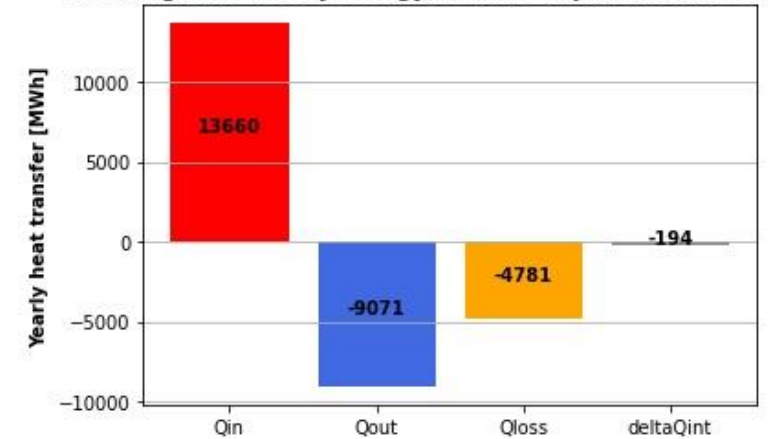
Dronninglund - Yearly energy balance - February 2020-January 2021



Dronninglund - Yearly energy balance - March 2020-February 2021

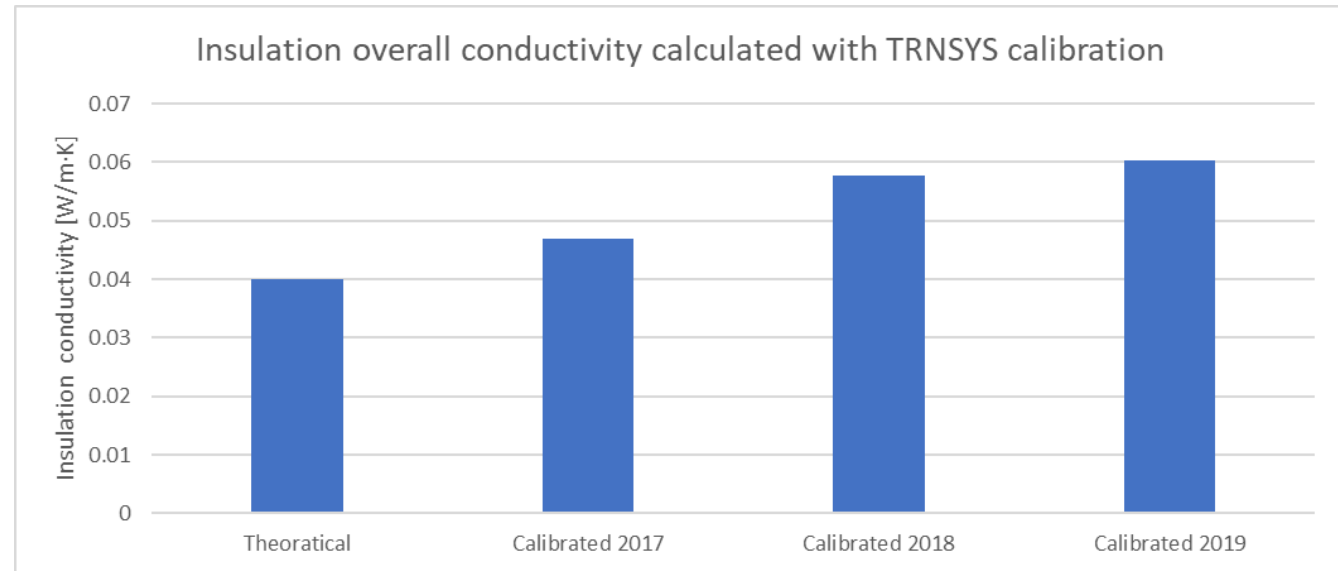
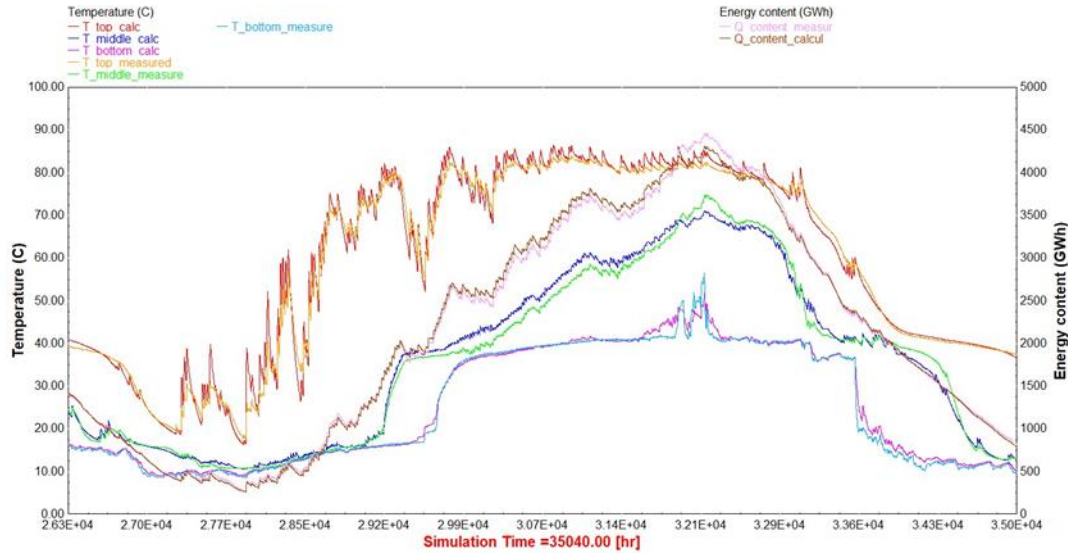


Dronninglund - Yearly energy balance - April 2020-March 2021



# DETAILED MEASUREMENTS ANALYSIS OF DRONNINGLUND

- Other methods such as calibration of a TRNSYS model can be used to evaluate the evolution of the lid loss coefficient throughout the years



# FUTURE

- New version of the website [www.varmelagre.dk](http://www.varmelagre.dk) underway...
- Include English version
- Expect to include continuous overview of KPI for the past year

**VARMELAGRE.DK** Gå til solvarmedata.dk

Map Satellite

**SÅDAN BRUGES KORTET**  
Før musen over byerne for at se den aktuelle status for varmelageret.  
Klik på byen for at få flere oplysninger og historiske data.

**TILFØJ NYT VARMELAGER**

**PARTNERE**  
PlanEnergi

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# THANK YOU FOR YOUR ATTENTION

[www.heatstore.eu](http://www.heatstore.eu)



HEATSTORE (170153-4401) is one of nine projects under the GEO THERMICA – ERA NET Cofund aimed at accelerating the uptake of geothermal energy by 1) advancing and integrating different types of underground thermal energy storage (UTES) in the energy system, 2) providing a means to maximise geothermal heat production and optimise the business case of geothermal heat production doublets, 3) addressing technical, economic, environmental, regulatory and policy aspects that are necessary to support efficient and cost-effective deployment of UTES technologies in Europe. The three-year project will stimulate a fast-track market uptake in Europe, promoting development from demonstration phase to commercial deployment within two to five years, and provide an outlook for utilisation potential towards 2030 and 2050.



The GEO THERMICA project is supported by the European Union's HORIZON 2020 programme for research, technological development and demonstration under grant agreement No 731117.