GEOTHERMICA

HEATSTORE

HIGH TEMPERATURE UNDERGROUND THERMAL ENERGY STORAGE (HT-UTES)

HEAT STORAGE AND MONITORING RESULTS, 27 OCTOBER 2021

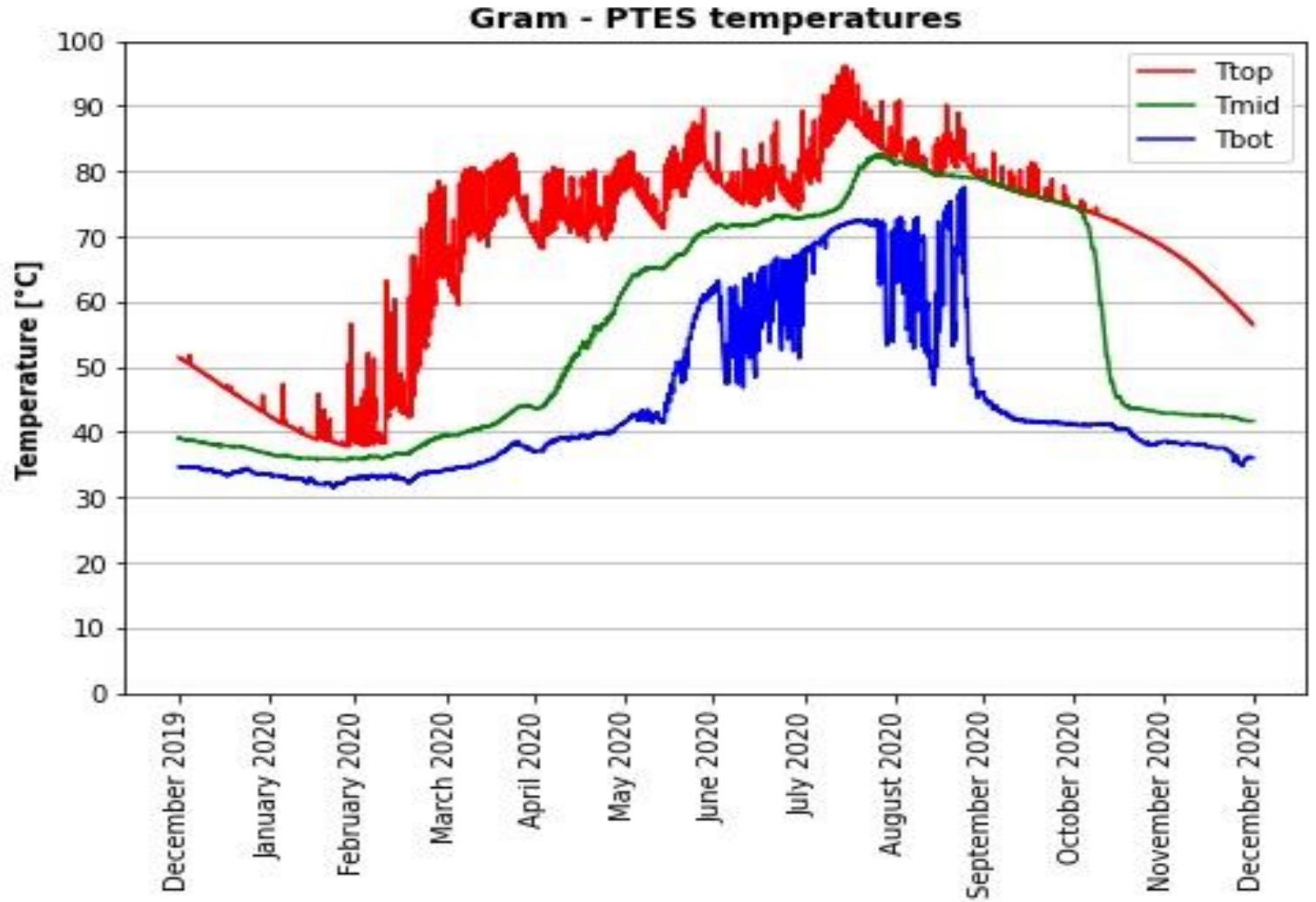
GEOFFROY GAUTHIER & DANIEL TRIER, PLANENERGI

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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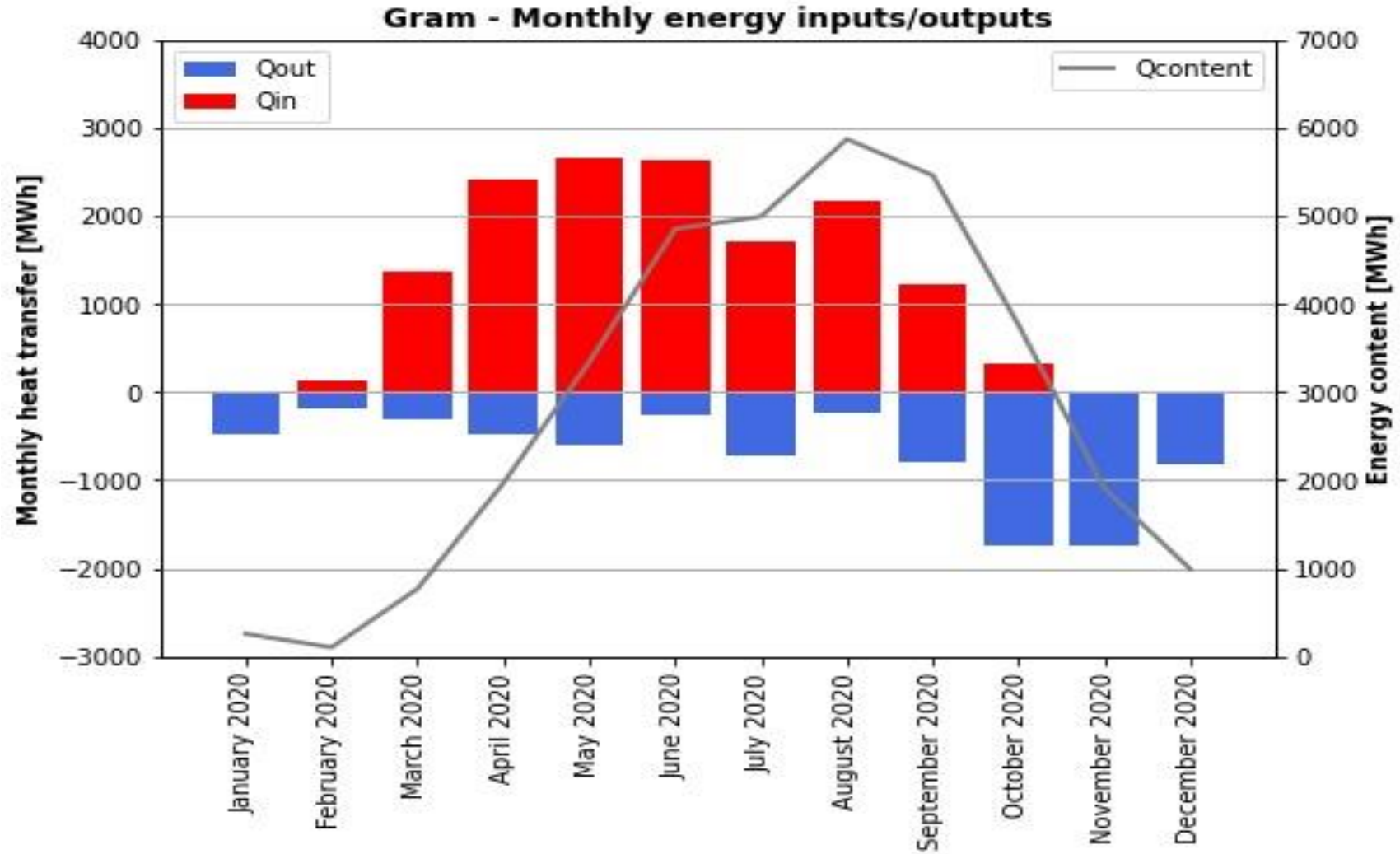
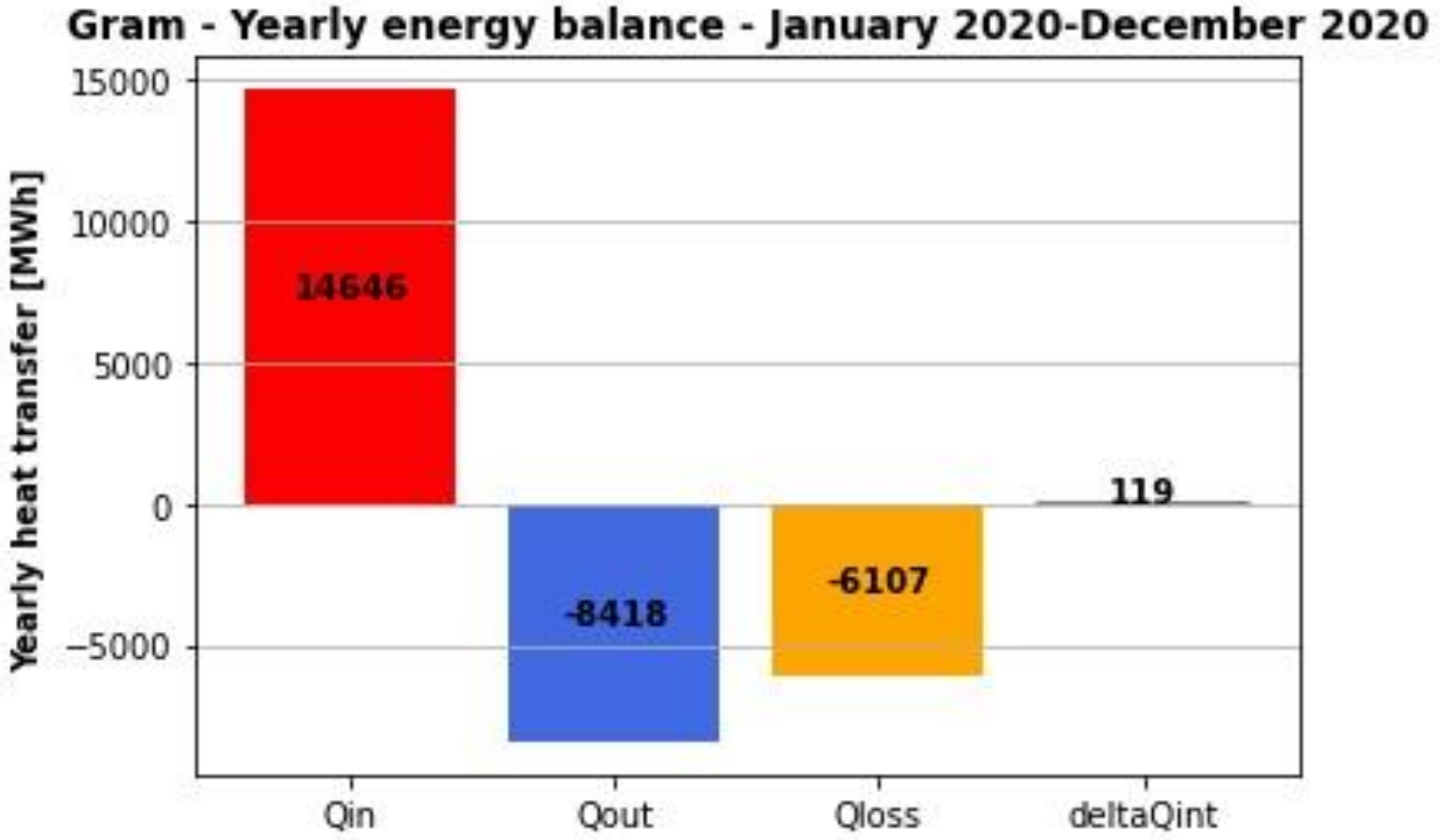


GRAM – RENOVATED: 01-09-2020 TO 15-11-2020

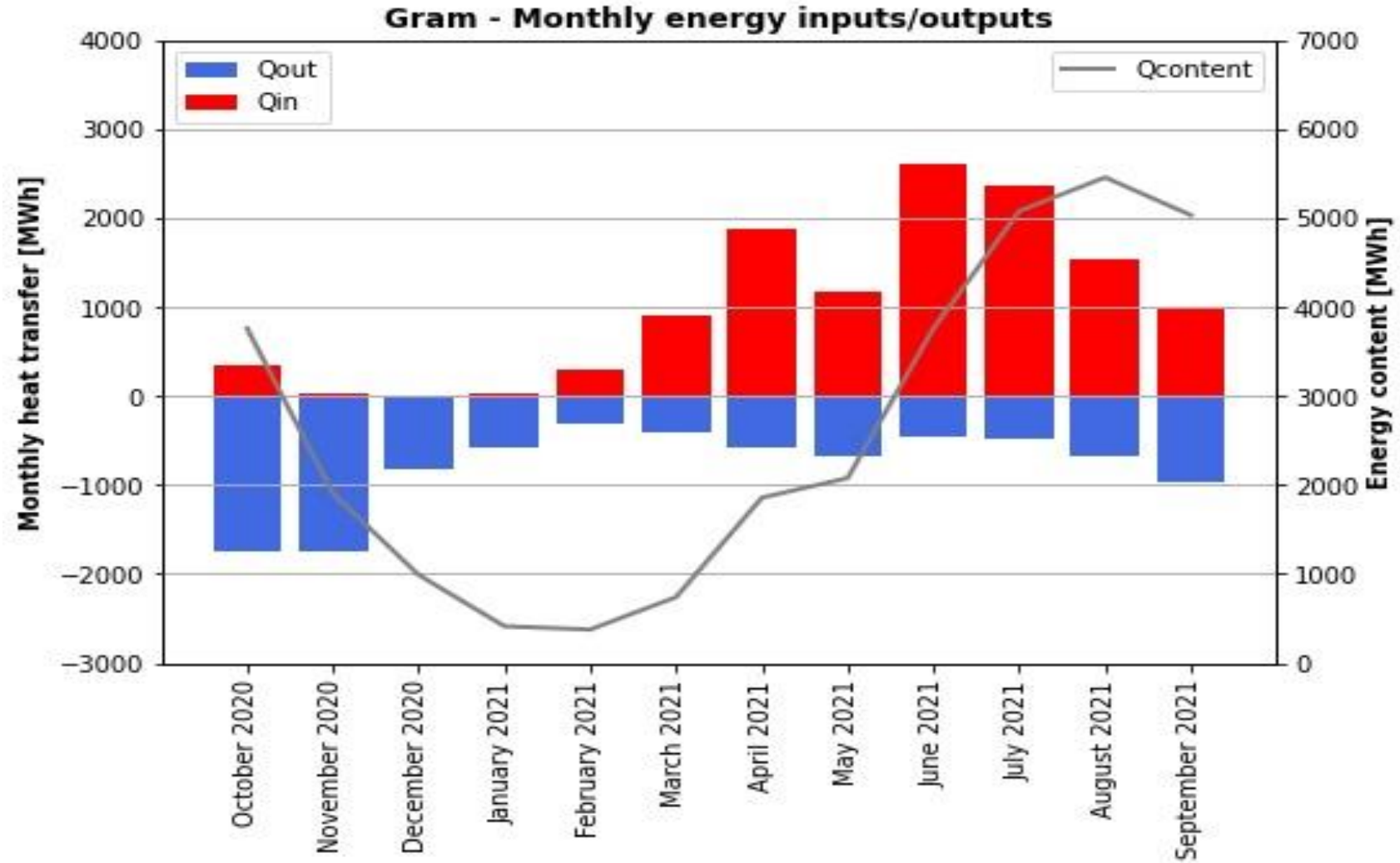
- Period: 2020 full year (Note! Renovation overlap)

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



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

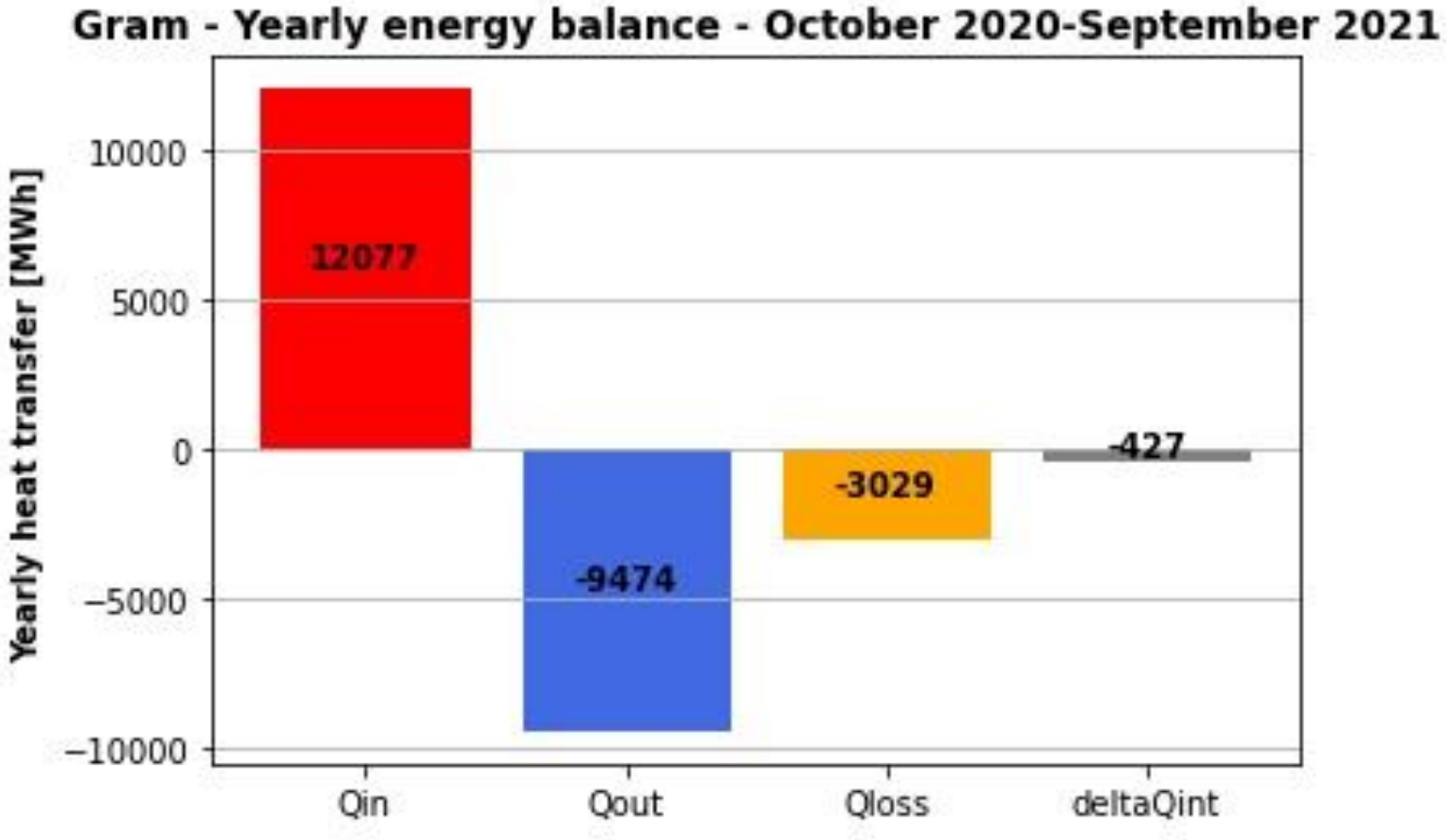
- Period: 01-10-2020 – 30-09-2021 (latest full year!)



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

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

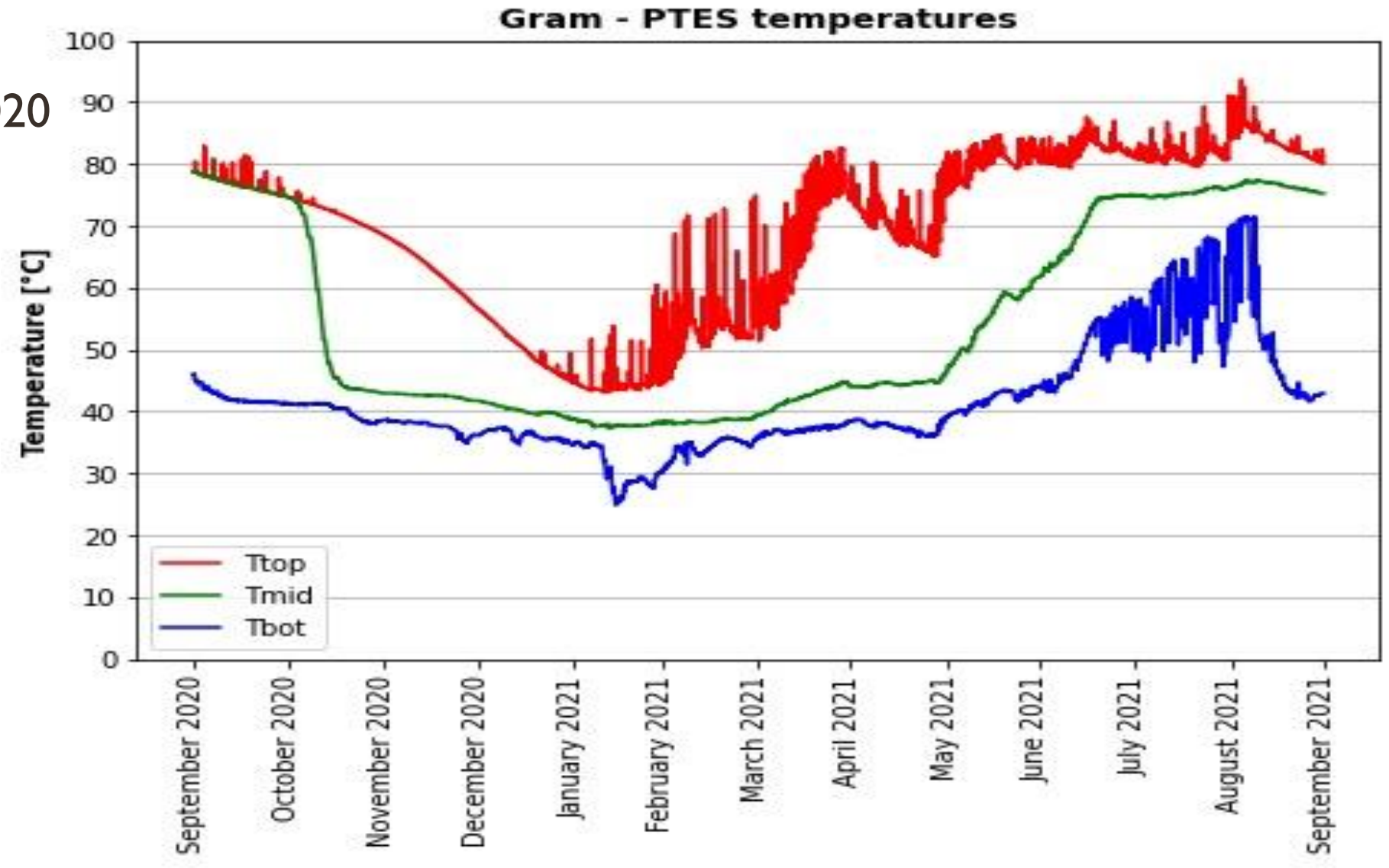
- T_{max} = 93.6°C
- T_{min} = 20.0°C
- PTES capacity = 9960 MWh
- Number of storage cycles: 1.0
- 25% losses
- 78% energy out
- -4% internal energy increase



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

- Period: 01-10-2020 – 30-09-2021

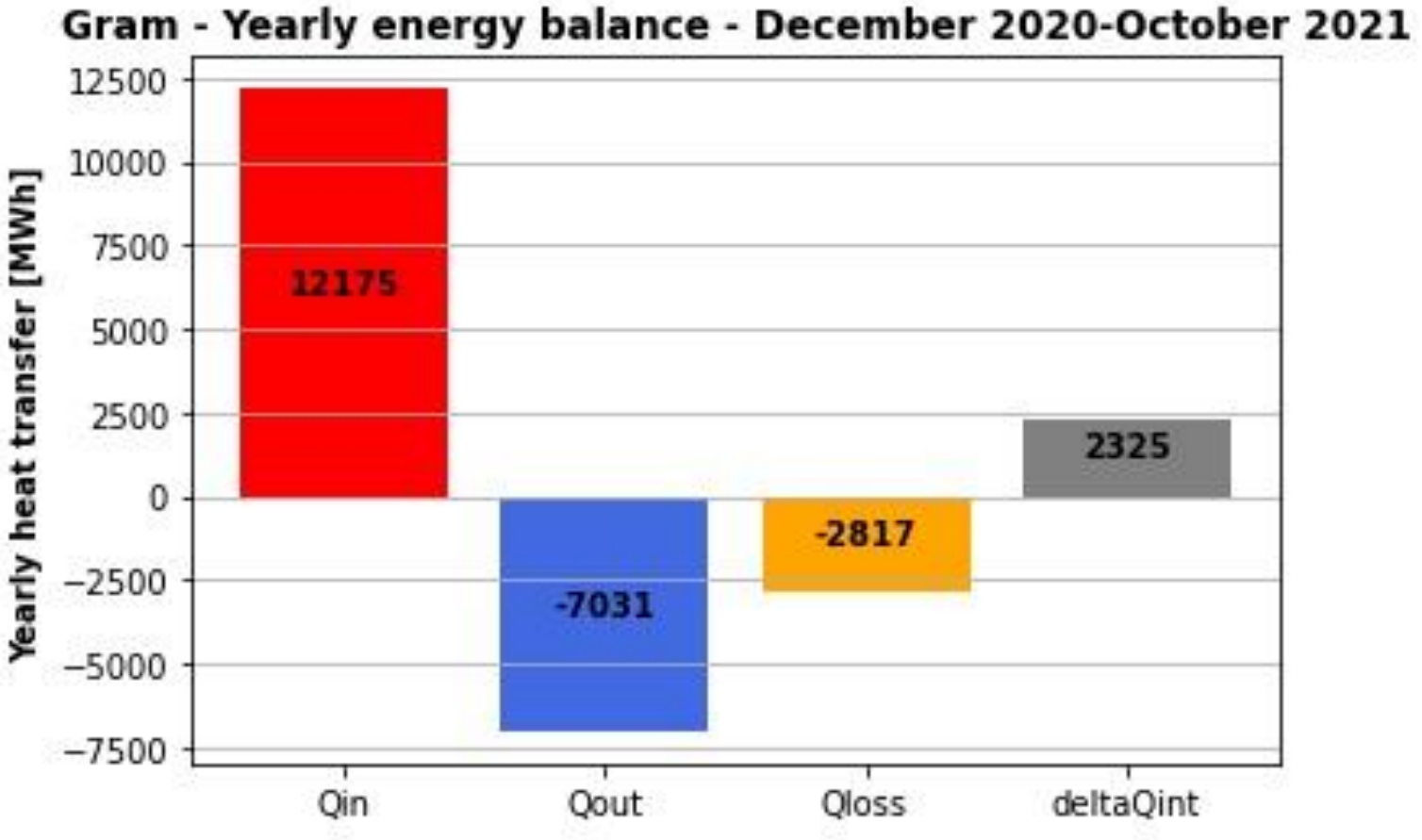
- T_{max} = 93.6°C
- T_{min} = 20.0°C



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

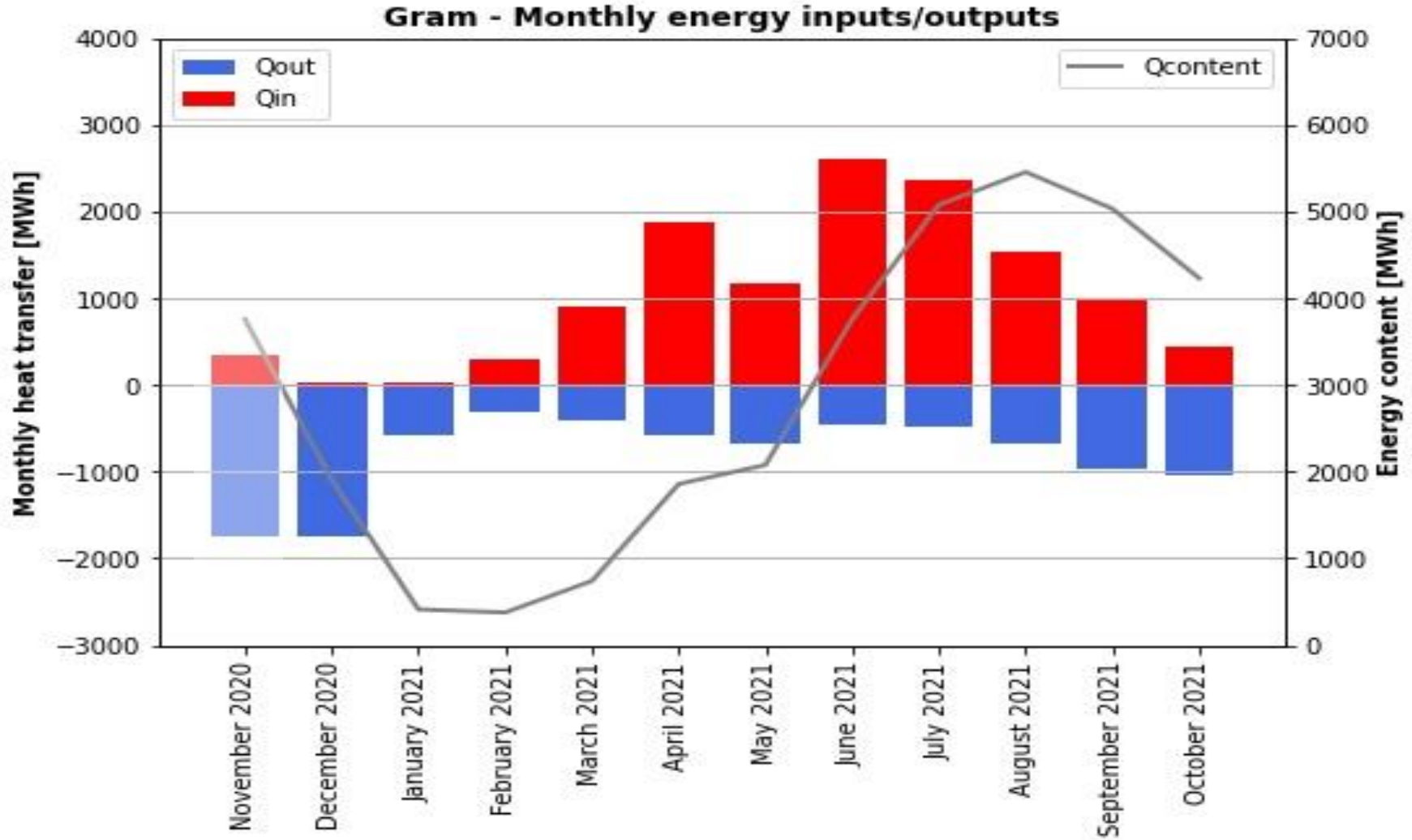
- Period: 01-12-2020 – 26-10-2021 (period since renovation – Note! Not one full year)

- T_{max} = 93.6°C
- T_{min} = 20.0°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)

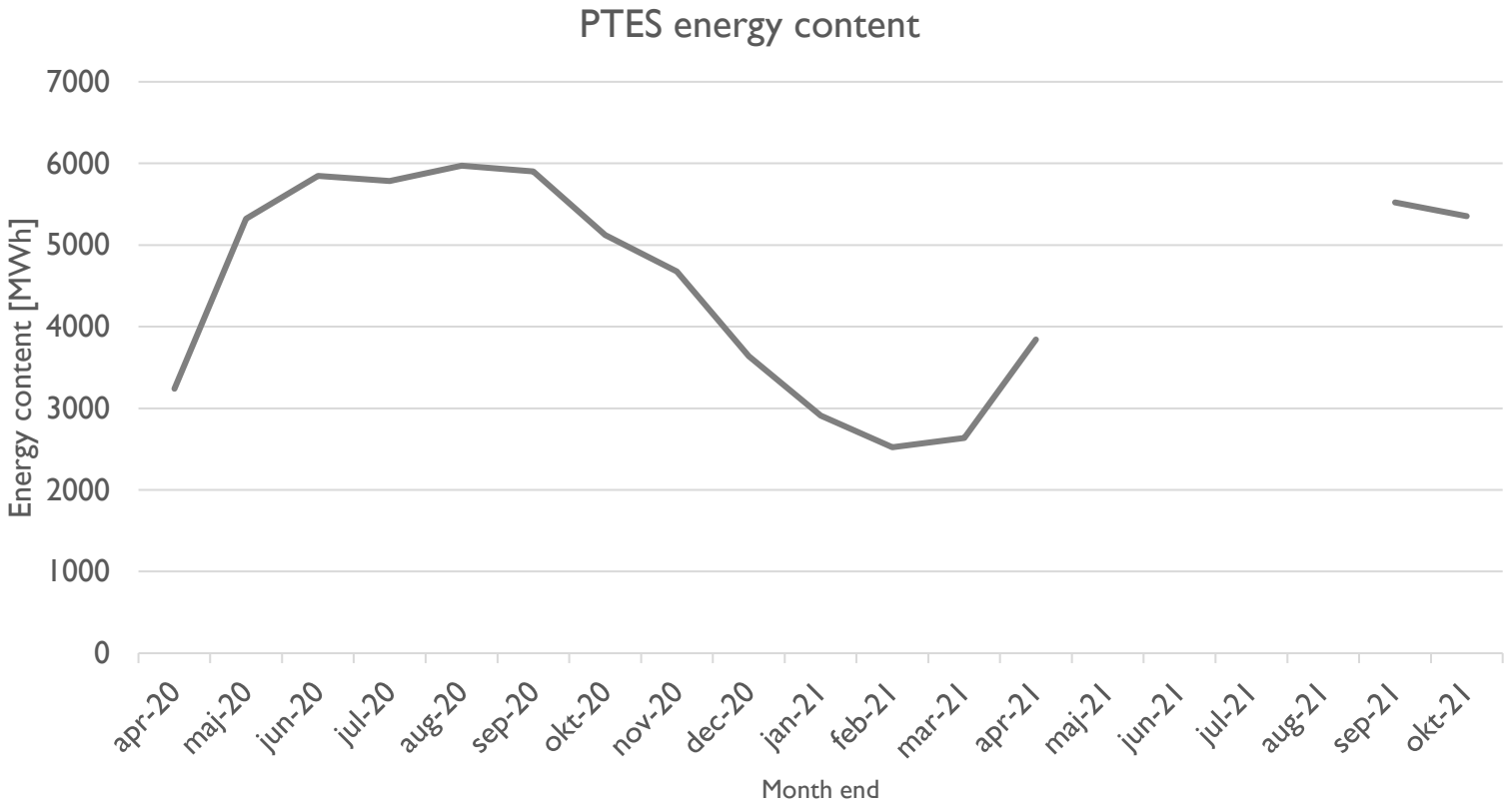


MARSTAL

- Renovation completed April 2020
- Error in data
  → missing period
- Period shown:

  04-2020

  – 10-2021

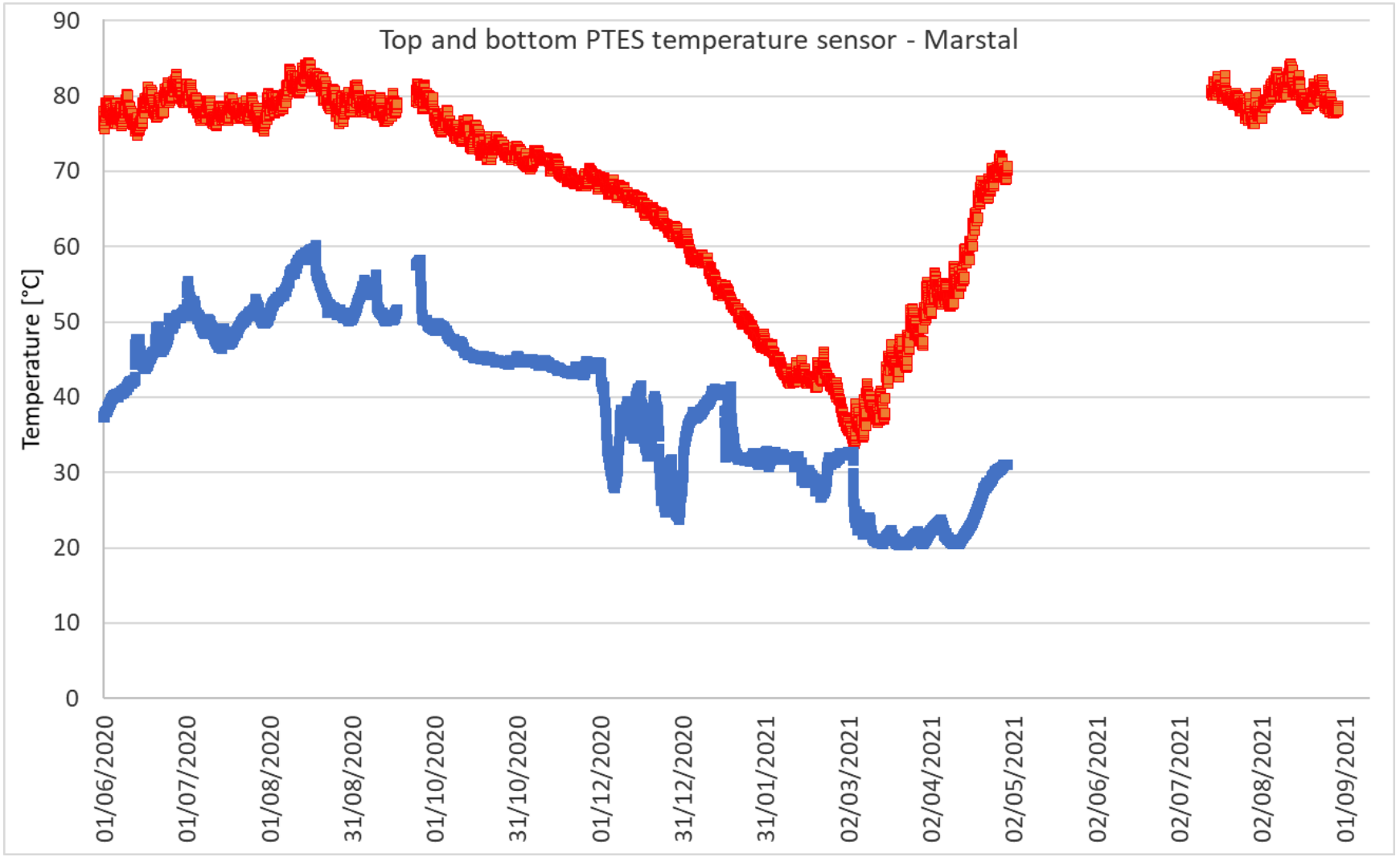


MARSTAL

- Renovation completed April 2020
- Error in data
  → missing period
- Period shown:

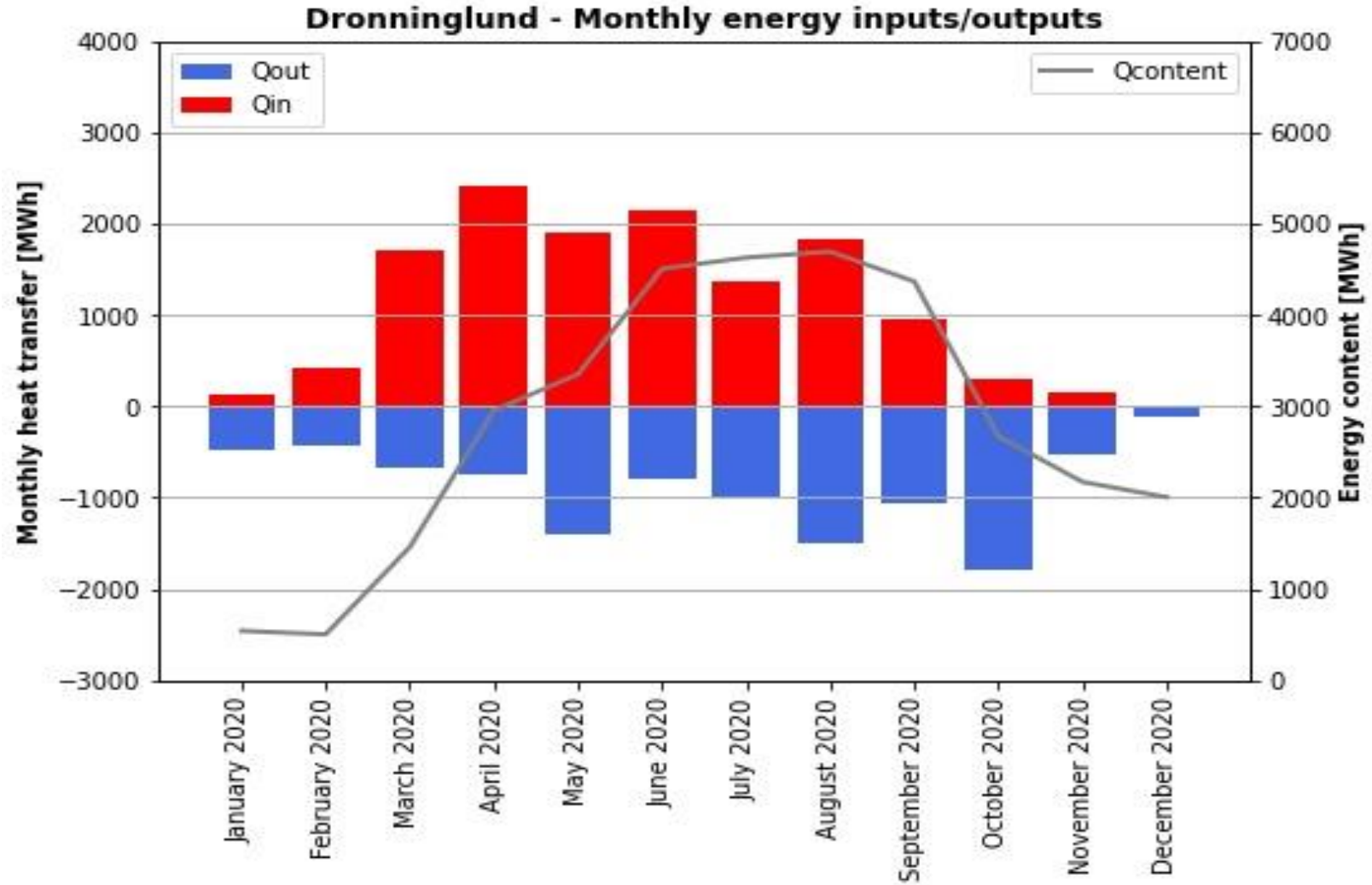
  06-2020

  – 08-2021



DRONNINGLUND

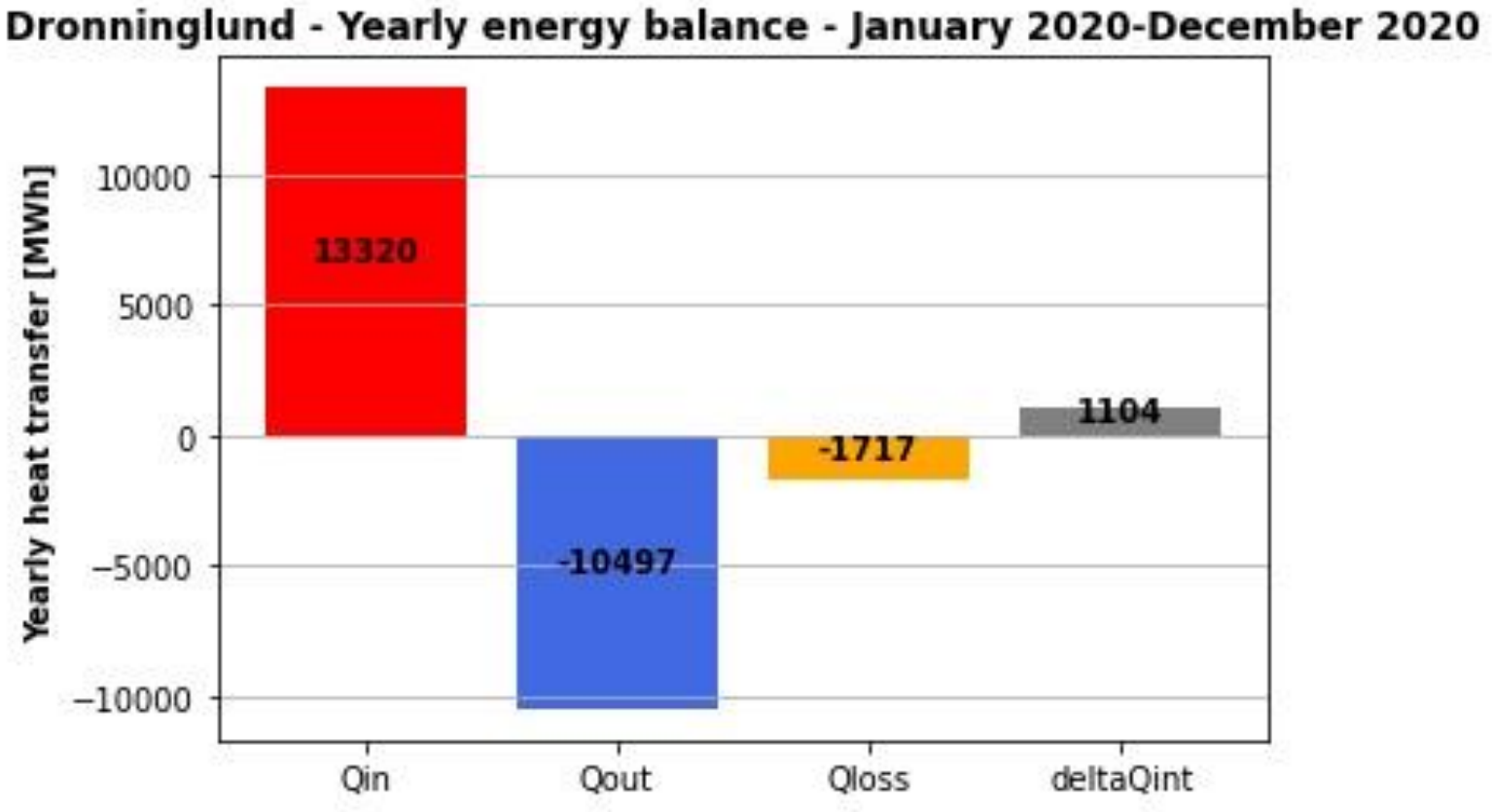
- Period: 2020 full year – problems identified in 2021!



DRONNINGLUND

- Period: 2020 full year

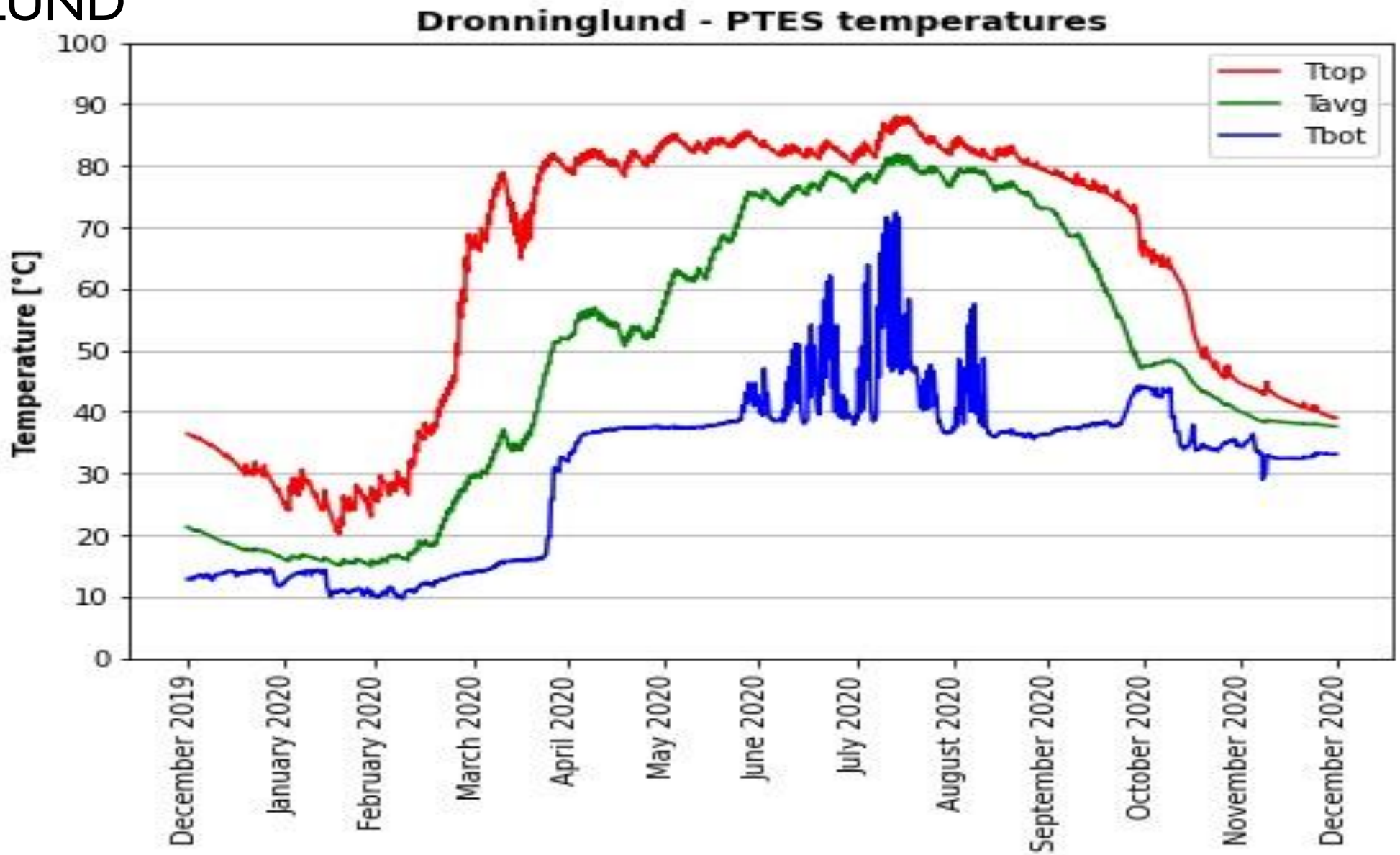
- T_{max} = 88.0°C
- T_{min} = 9.7°C
- PTES capacity = 5300 MWh
- Number of storage cycles: 2.0
- 12% losses
- 78% energy out
- 20% internal energy increase



DRONNINGLUND

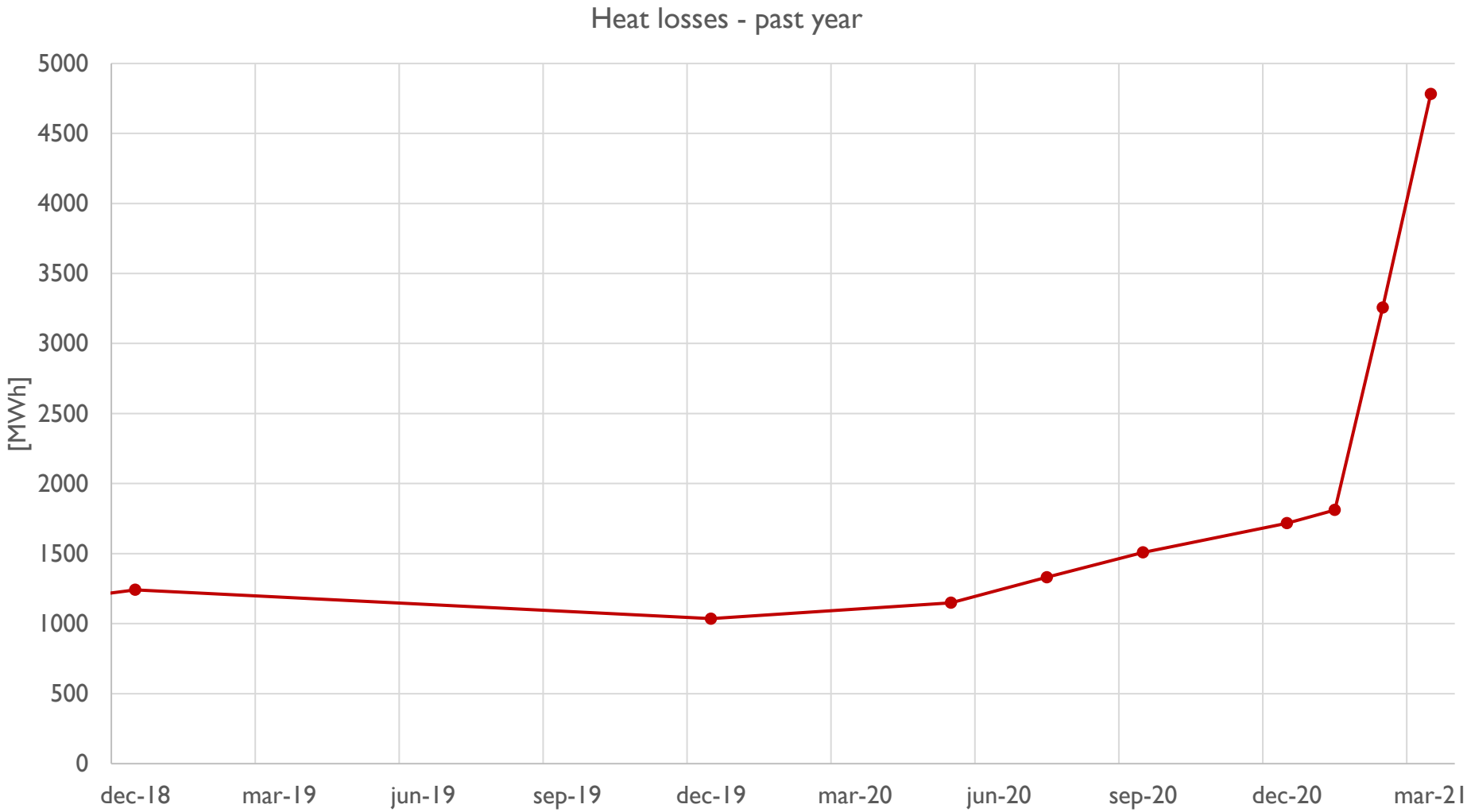
- Period: 2020

- T_{max} = 88.0°C
- T_{min} = 9.7°C



DRONNINGLUND

- Heat loss development

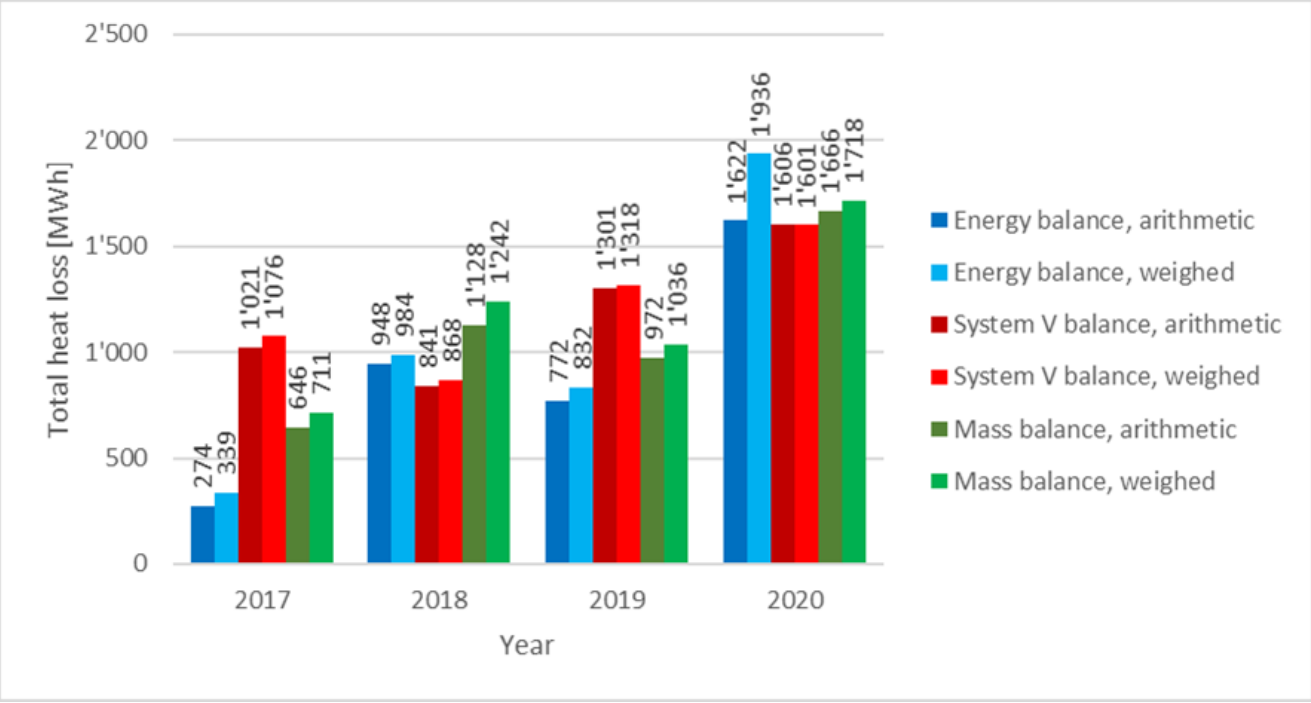


PLANENERGI'S ROLE IN HEATSTORE

- 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

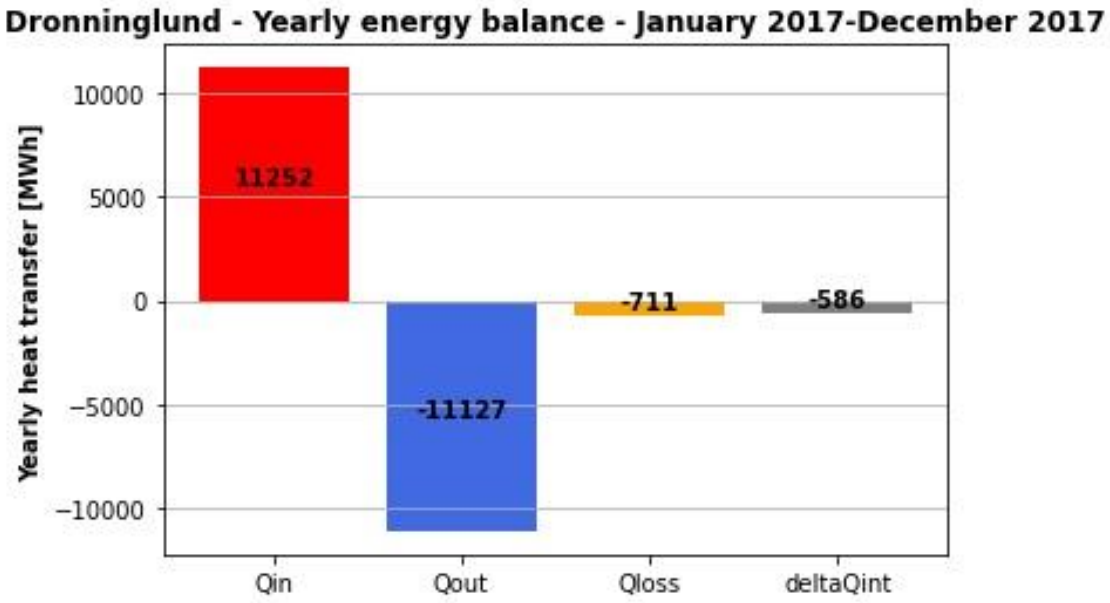
- Heat losses determined with different methods for Dronninglund over the years (D5.3)
  - Higher losses are observed already in 2020, with all methods

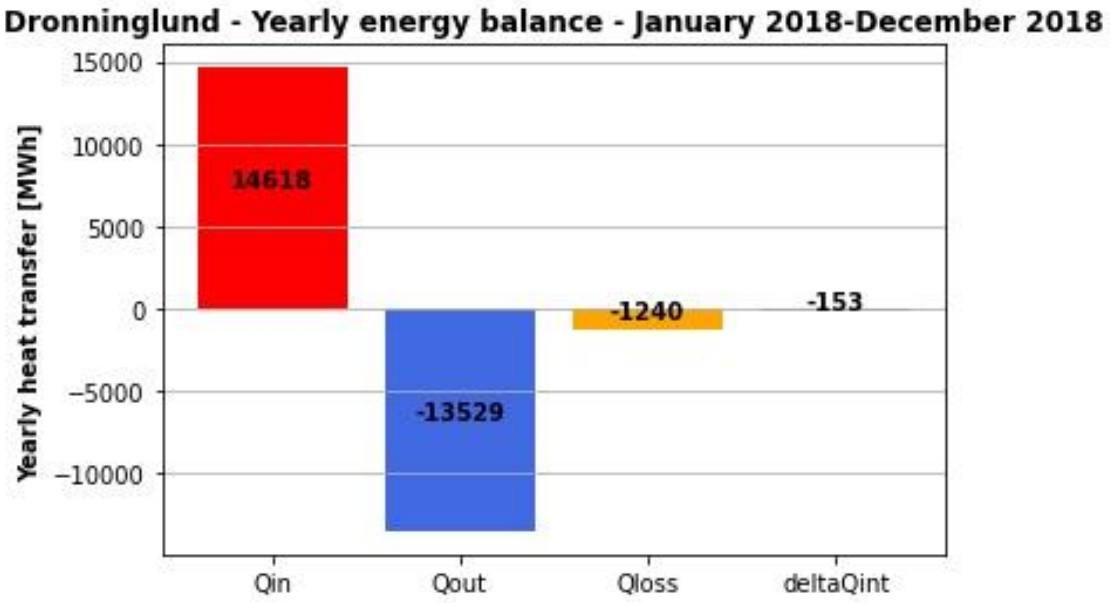


DETAILED MEASUREMENTS ANALYSIS OF DRONNINGLUND

- Heat losses determined for Dronninglund over the years

2017, 2018

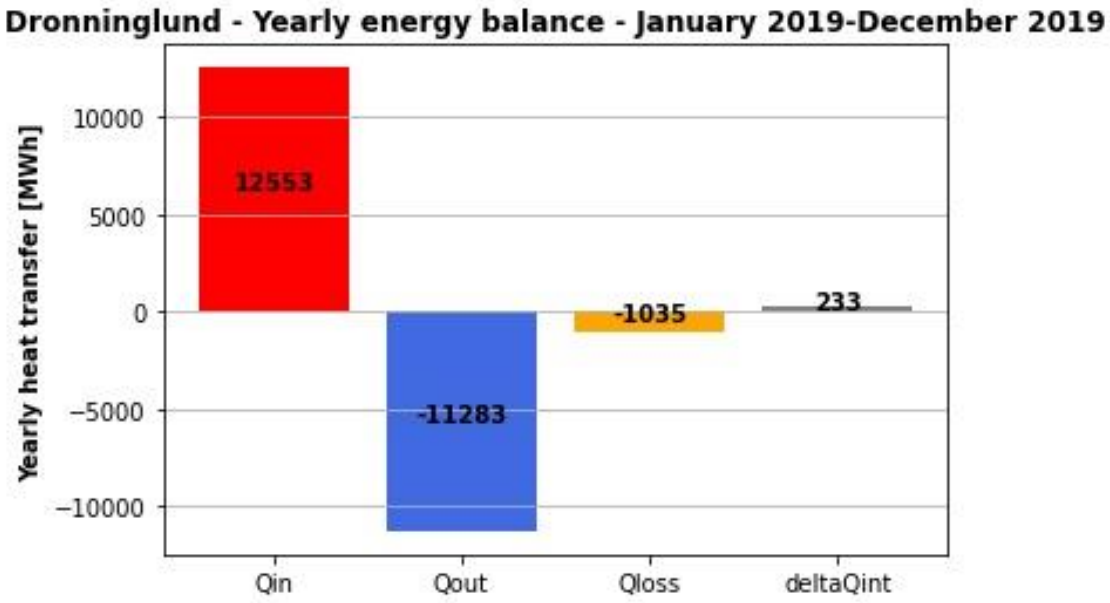


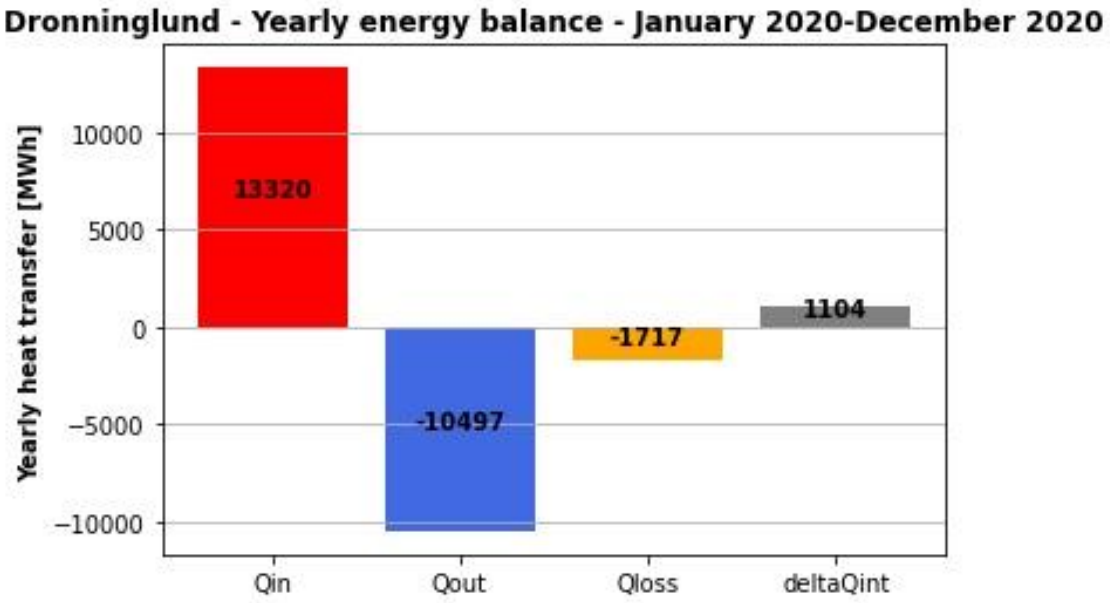


DETAILED MEASUREMENTS ANALYSIS OF DRONNINGLUND

- Heat losses determined for Dronninglund over the years

2019, 2020

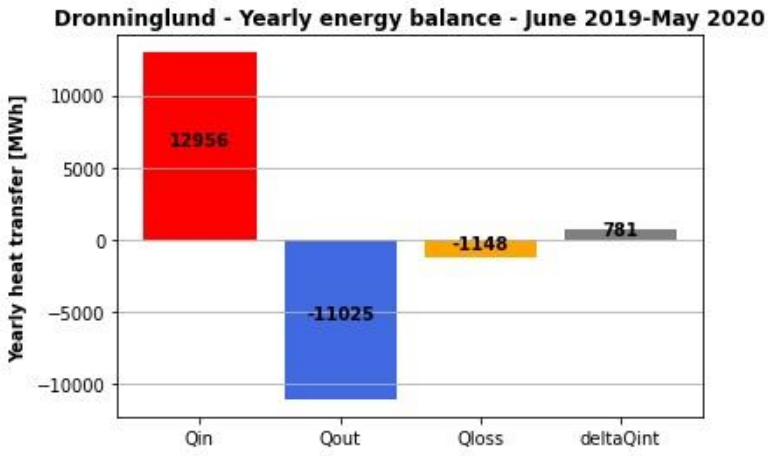


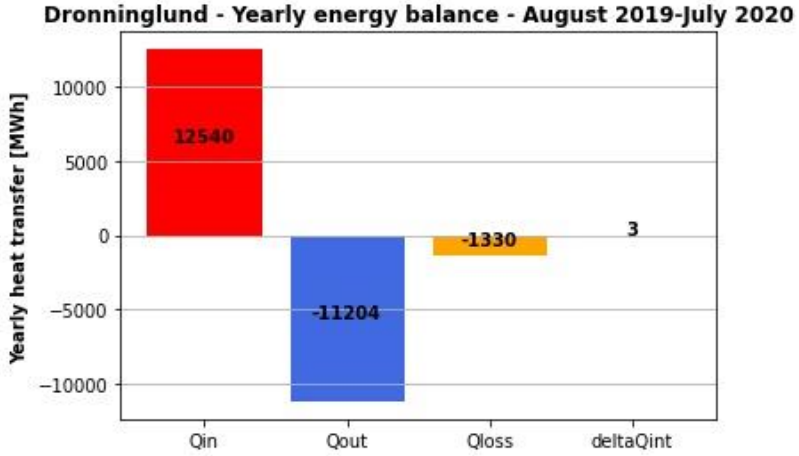


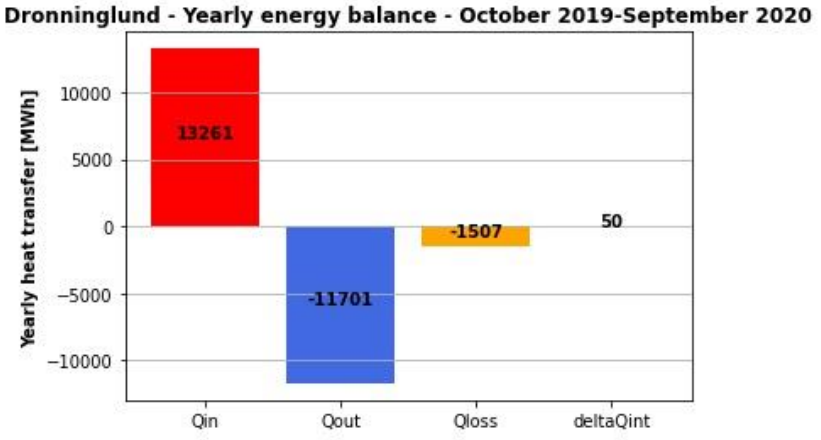
DETAILED MEASUREMENTS ANALYSIS OF DRONNINGLUND

- Heat losses determined for Dronninglund over the years

2020…



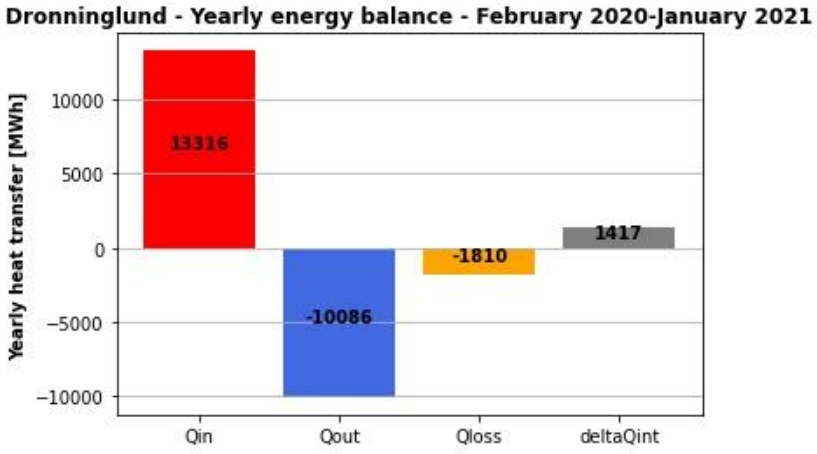


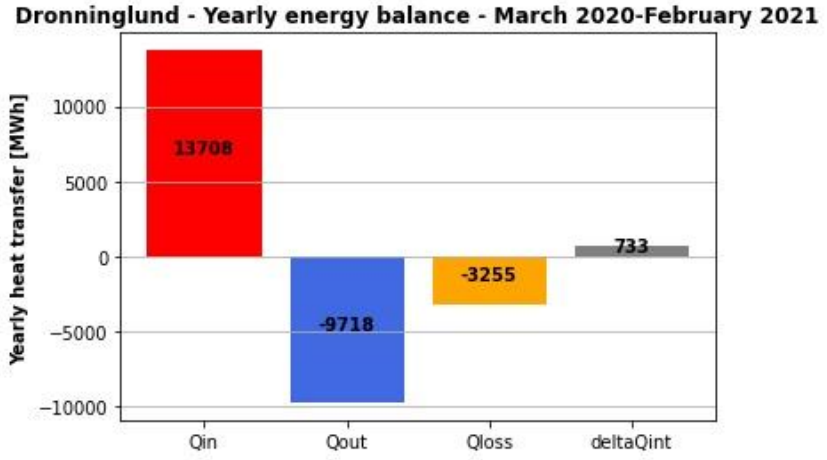


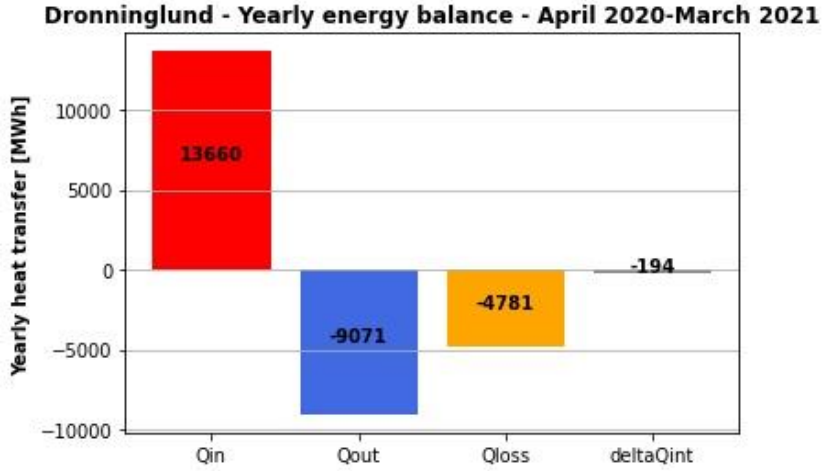
DETAILED MEASUREMENTS ANALYSIS OF DRONNINGLUND

- Heat losses determined for Dronninglund over the years

2021…

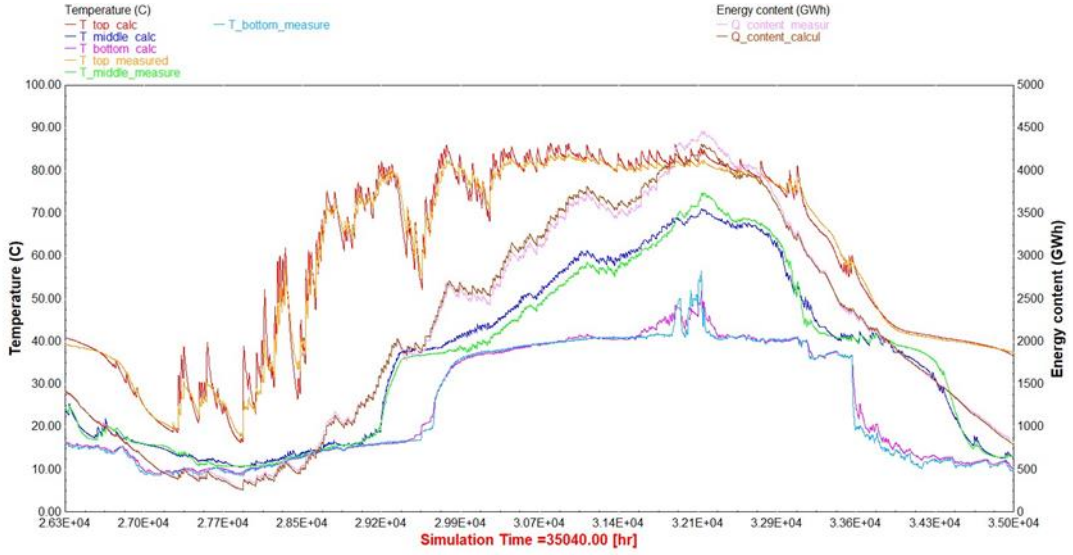


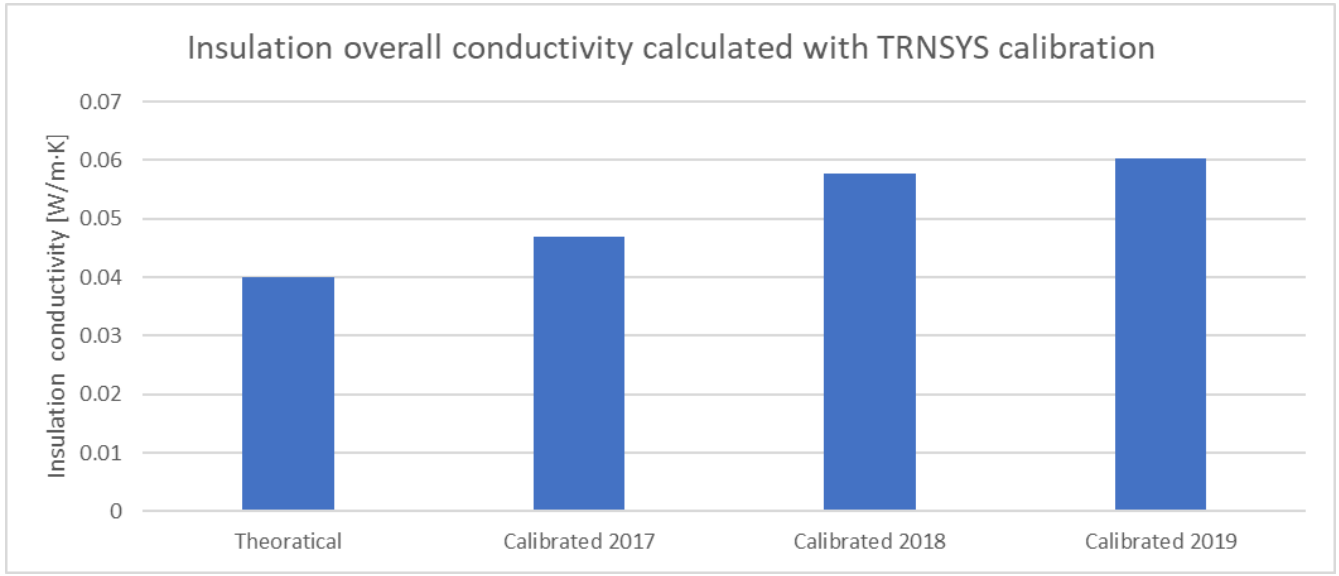




DETAILED MEASUREMENTS ANALYSIS OF DRONNINGLUND

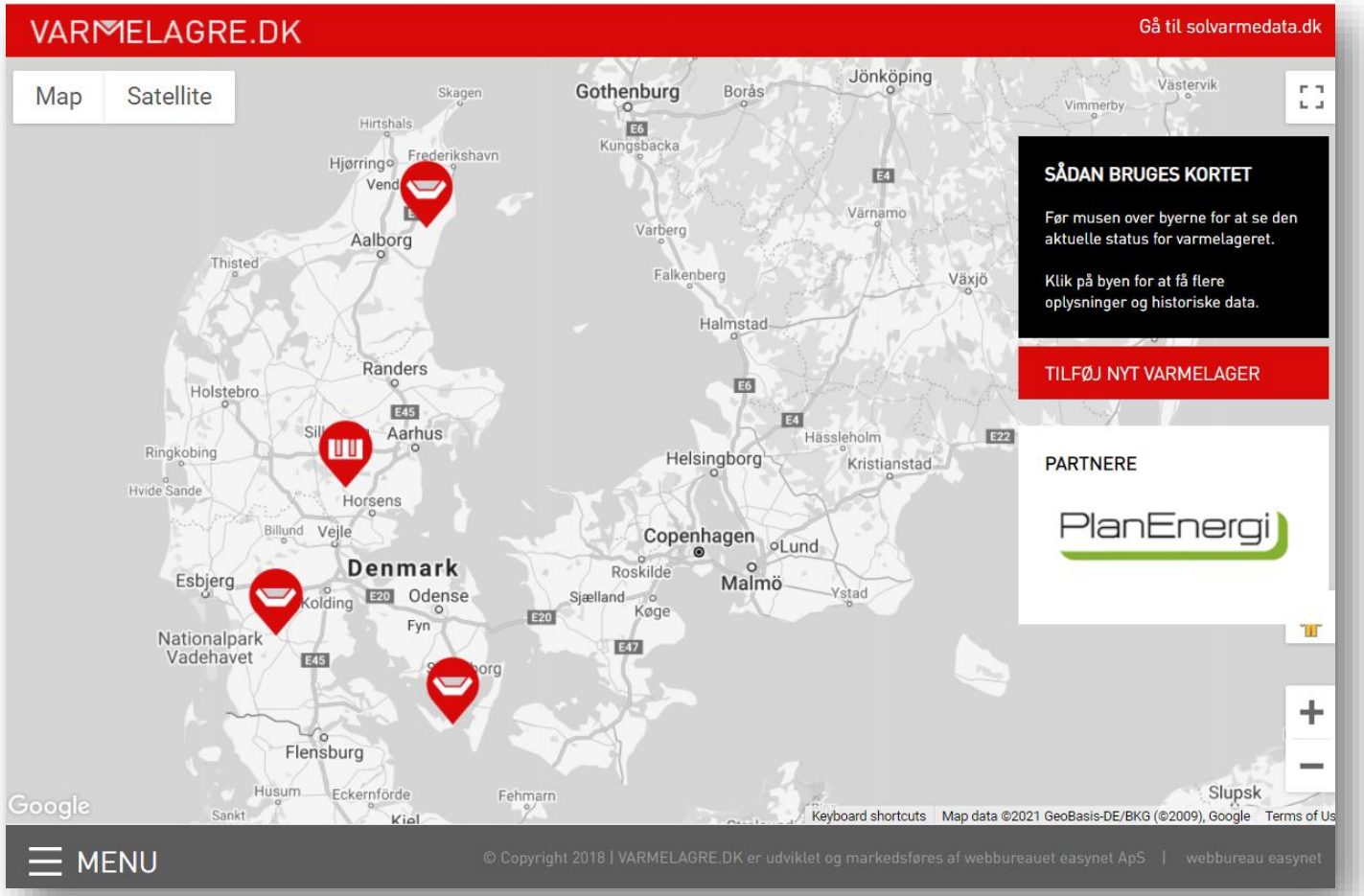
- Other methods such as calibration of a TRNSYS model can be used to evaluate the evolution of the lid loss coefficient throughout the years





FUTURE

- New version of the website www.varmelagre.dk underway...
- Include English version
- Expect to include continuous overview of KPI for the past year



THANK YOU FOR YOUR ATTENTION

www.heatstore.eu

HEATSTORE (170153-4401) is one of nine projects under the GEOTHERMICA – 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 GEOTHERMICA project is supported by the European Union's HORIZON 2020 programme for research, technological development and demonstration under grant agreement No 731117.