HEATSTORE WEBINAR SERIES

HOW TO DEVELOP UNDERGROUND THERMAL ENERGY STORAGE (UTES) PROJECTS?

Learnings from the European HEATSTORE project

Host: TNO, The Netherlands

heatstore
High Temperature Underground Thermal Energy Storage

GEOTHERMICA

7, 14, 21, 28 Sept. and 5, 12 Oct. 2021 | all 15-16 h (CEST)

Register on www.heatstore.eu

HEATSTORE WEBINAR SERIES 2021

All webinars are at 15 – 16 h CEST

Tuesday 7 Sept. (Holger Cremer, TNO): Challenges in Underground Thermal Energy Storage (UTES)

Tuesday 14 Sept. (Thomas Driesner, ETH Zurich): Advances in subsurface characterization and simulation

Tuesday 21 Sept. (Koen Allaerts, VITO): Integrating UTES and DSM in geothermal district heating networks

Tuesday 28 Sept. (Florian Hahn, Fraunhofer IEG): Abandoned coal mines – promising sites to store heat in the underground

Tuesday 5 Oct. (Bas Godschalk, IF Technology): The ECW Energy HT-ATES project in the Netherlands

Tuesday 12 Oct. (Joris Koornneef, TNO): The role of UTES in the future EU energy system – a moderated table discussion.

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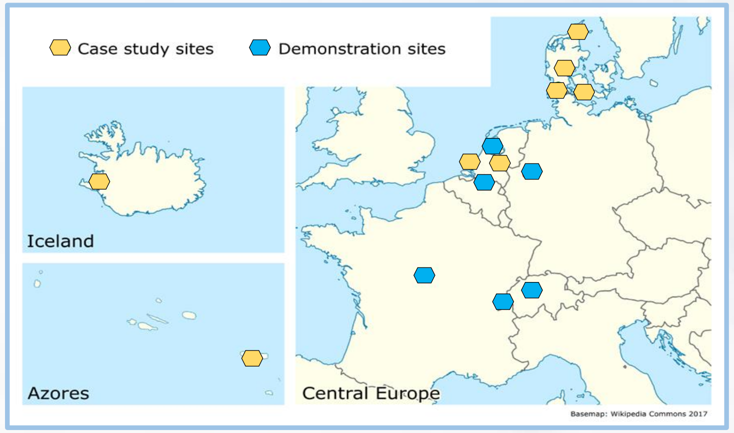
HEATSTORE

- HEATSTORE = GEOTHERMICA ERA-NET co-fund project
- 16.3 M€ | 23 partners in 9 EU countries
- 6 demonstration sites, 8 case studies.
- Coordination: TNO Netherlands Organization for Applied Scientific Research)

www.heatstore.eu



- **Best practice guidelines:** Design & System integration | Business models | Regulatory framework | Stakeholder perception & engagement | Monitoring technical, economic and environmental performance

- Proof and operation of UTES and DSM technologies

Fast track market uptake

Model & design validation

Characterization of UTES

Modelling sub-surface dynamics

Heating system integration & design optimisation

Demonstration

System performance monitoring

- **Roadmap Europe**: Technical future potential UTES and DSM in Europe | New business models | Stakeholder engagement | Roadmap for fast track uptake

Design → **Demonstration** → **Replication and scale-up**

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HEATSTORE – 21 Sept. 2021
Integrating UTES and DSM in Geothermal district heating networks

- Koen Allaerts (VITO): Convenor & Opening
- Per Alex Sørensen (PlanEnergi): Modelling and managing district heating systems in Denmark
- Koen Allaerts (VITO): Smart control of a district heating network in Belgium
- Martijn Clarijs, Ryvo Octaviano (TNO): System integration and optimization of underground storage systems in the Netherlands

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GEOTHERMICA

SMART CONTROL OF A DISTRICT HEATING NETWORK IN BELGIUM

HEATSTORE WEBINAR 21/09/2021

KOEN ALLAERTS (VITO)

GEOTHERMICA

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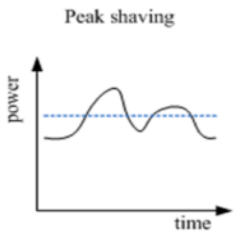
High Temperature Underground Thermal Energy Storage

OVERVIEW

- DSM technology
- The district heating network
- Setup and implementation
- Experiences and challenges
- First results and next steps

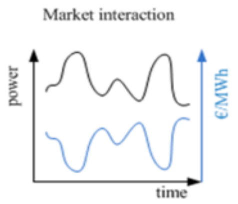
DSM TECHNOLOGY: STORM CONTROLLER

- Intelligent network controller (https://stormcontroller.eu/)
- Noda Smart heat grid platform (https://noda.se/smart-heat-grid/)
- Multiple control strategies:



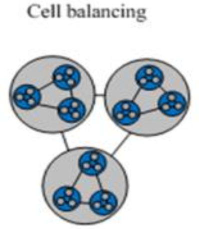
For typical networks with a smaller sustainable energy source (biomass boiler, heat pump) and a larger fossil backup

➔ Elimination of fossil fuel.



For networks coupled to the electric grid by heat pumps/CHPs

➔ Switching the devices at interesting power price.

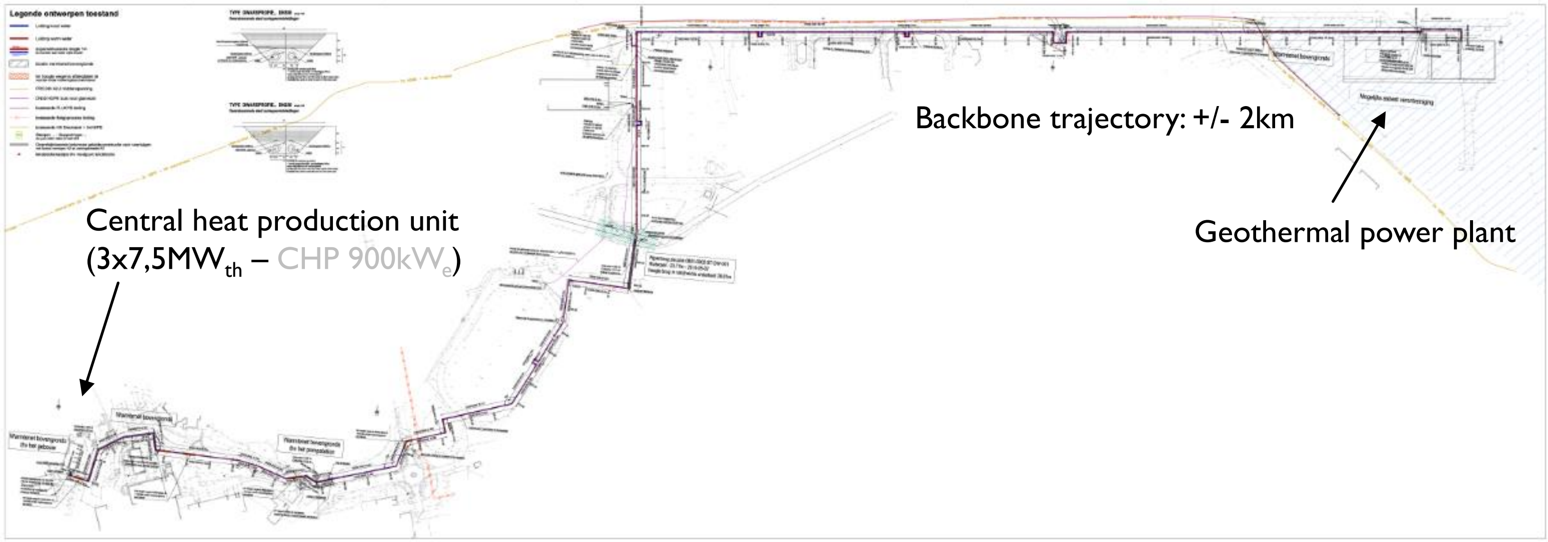


For more sophisticated networks: balance supply and demand of heat/cold in a cluster

➔ increased efficiency.

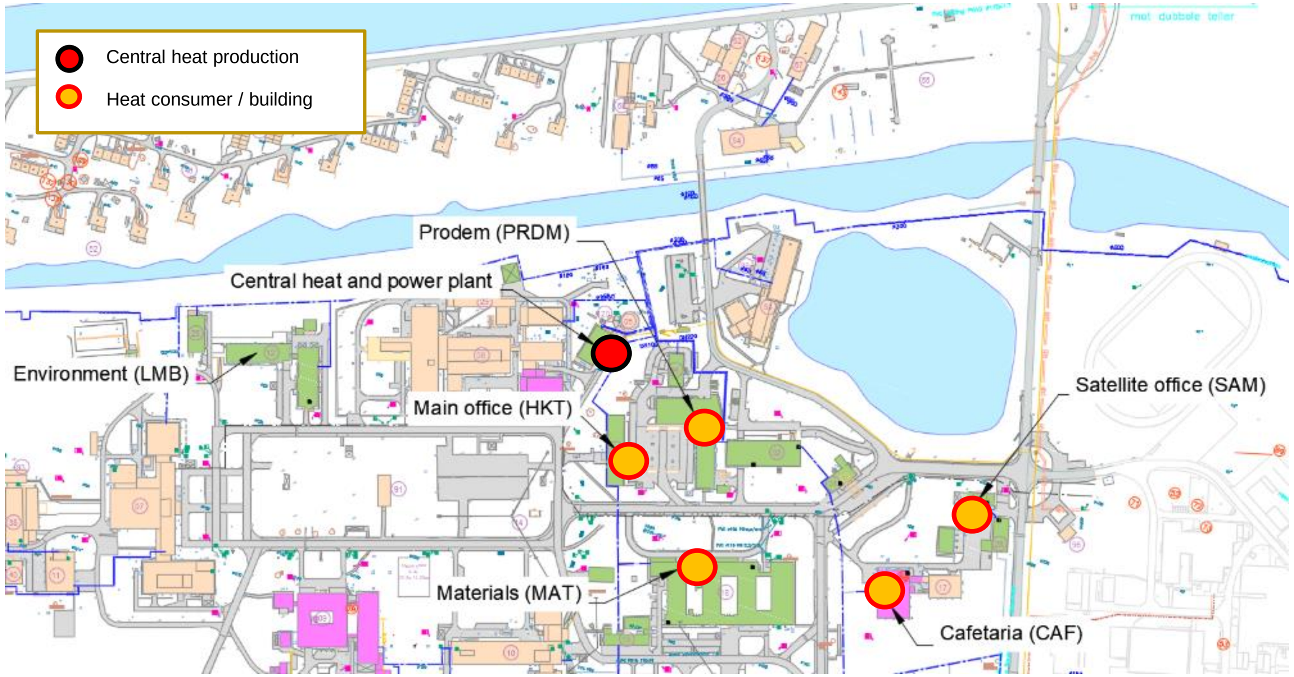
DISTRICT HEATING NETWORK (MOL, BELGIUM)

- Established in 1959 (waste heat from nearby coal-fired electricity plant)
- Provides heat to +/- 45 large buildings + 300 residential units
- High temperature network (max. 95°C)
- Recent developments:
  - Connection to deep geothermal doublet (± 3,6km deep, 120°C)
  - Connection to residential area

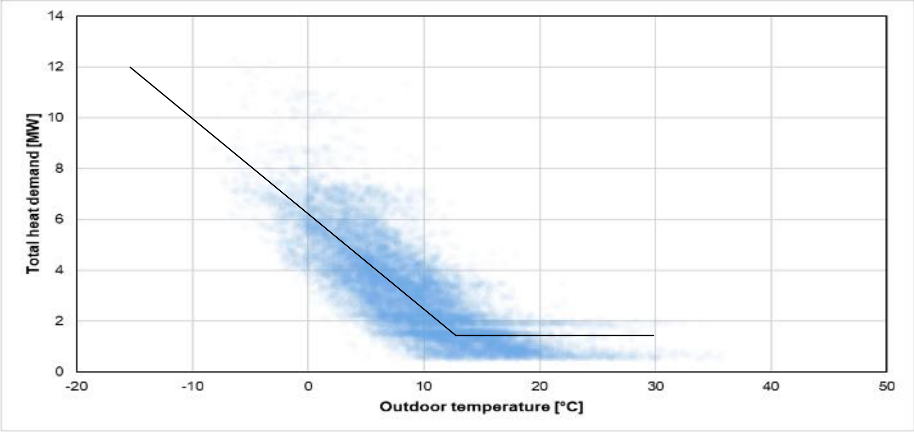


DISTRICT HEATING NETWORK (MOL, BELGIUM)

- Trajectory length: ±10km
- DN200 (distribution)
- Controllable assets (DSM):
  - 5 buildings
  - Central heat production plant

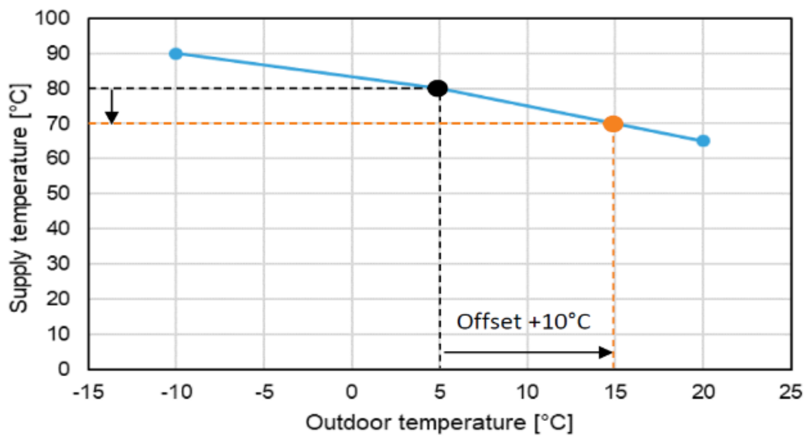


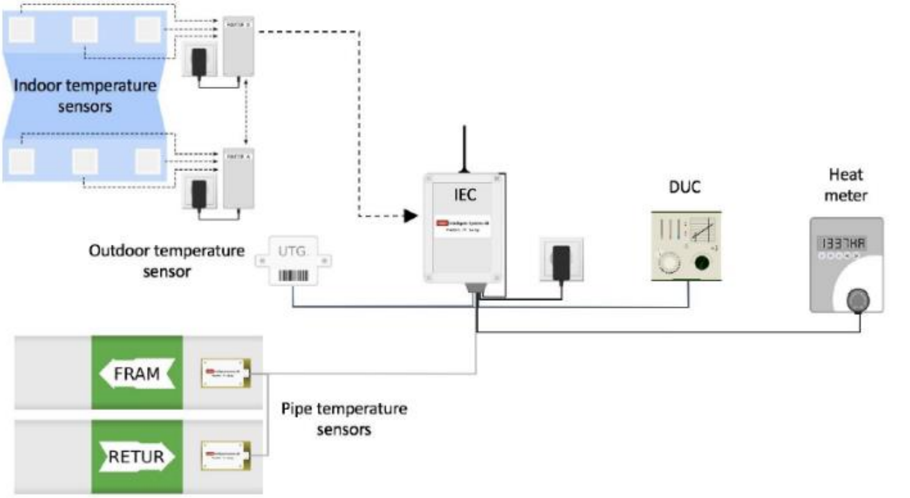
- Heat generation units:
  - Geothermal heat: ± 3MW_{th} (reduced capacity)
  - Gas-fired boilers: 3 x 7,5MW_{th}

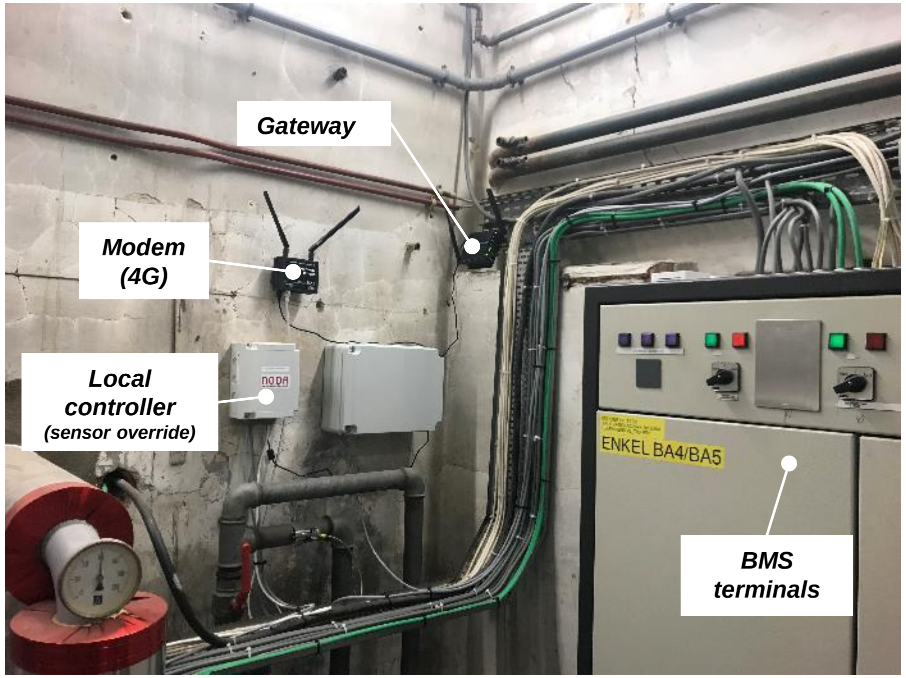


SETUP AND IMPLEMENTATION

- Different technologies were used and evaluated:
  - Sensor override solution
    - 'Plug and play'
    - Easy and fast installation
    - Additional sensors (e.g. clamp-on)
    - Indirect way of controlling setpoint:

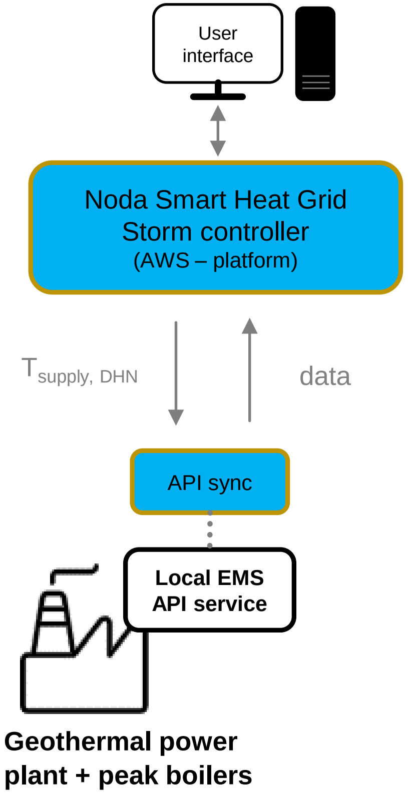






SETUP AND IMPLEMENTATION

- Different technologies were used and evaluated:
  - BMS integration
    - IOT gateway / API service
    - Communication with BMS (BACnet/IP, Modbus, …)
    - Reprogramming necessary
    - No additional sensors
    - Scalable
    - Direct control over multiple setpoints



EXPERIENCES AND CHALLENGES WITH IMPLEMENTATION

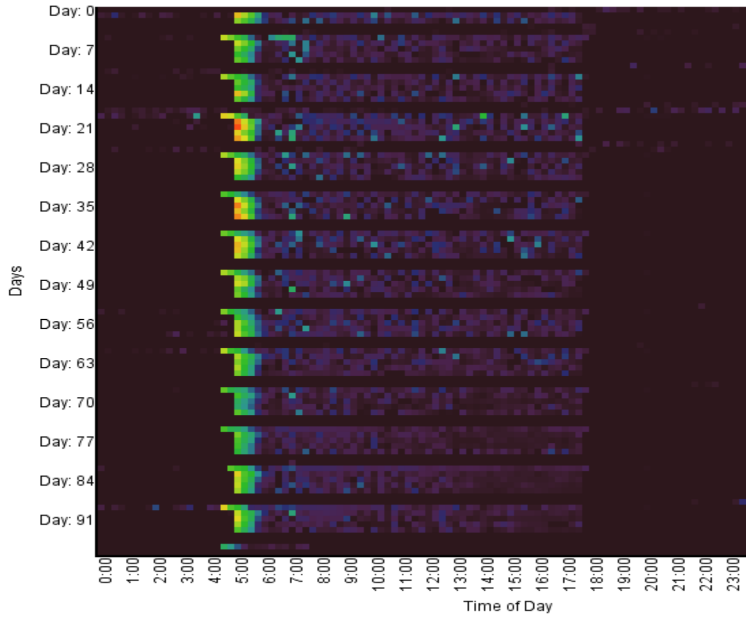
- HVAC design
  - Individually controlled thermal zones (multiple outdoor T-sensors)
  - Amount of sub circuits in certain buildings (e.g. LAB AHU's)
  - DHW heat exchanger integrated in HVAC system

- Technical
  - Malfunctioning control valves
  - Legacy equipment
  - Outdated heat meters (battery powered, no comm outputs)
  - Missing measurements (T-sensors and heat meters)

→ Resolve first before proceeding with DSM

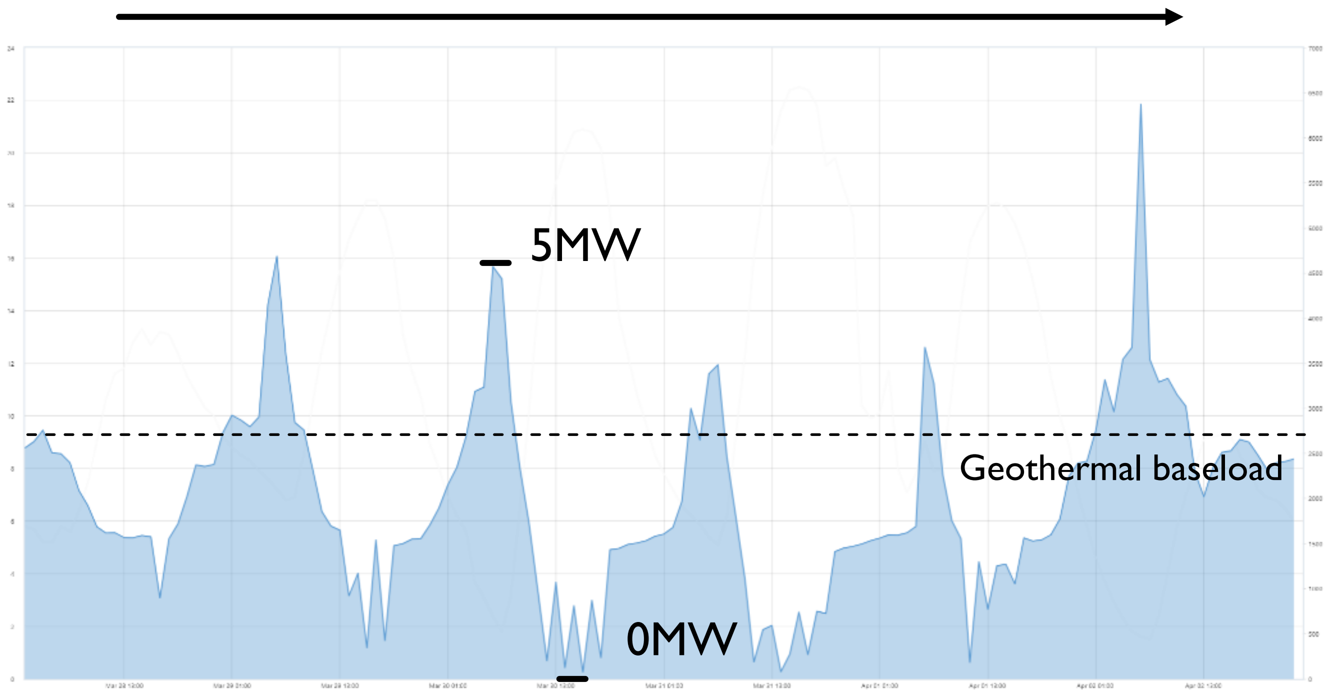
DHN OPERATIONS AND MONITORING

- High peak heat loads during mornings (6 – 8AM)
- To be ‘challenged’:
  - Static settings in the local controllers (operational time, heating curve)
  - Night setback
  - T/Δp-boost function during morning peaks



Black: 0kW – Red: 300kW

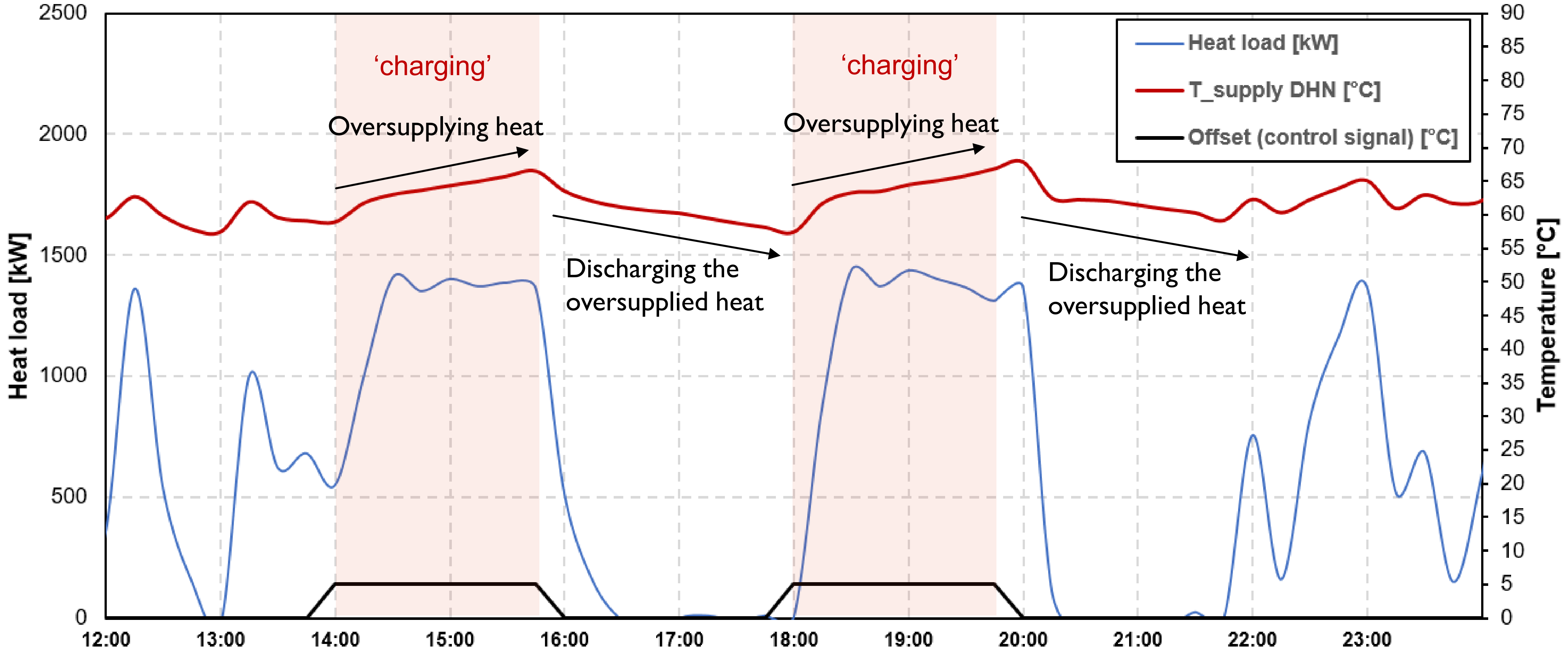
Monday – Friday (March 2021)



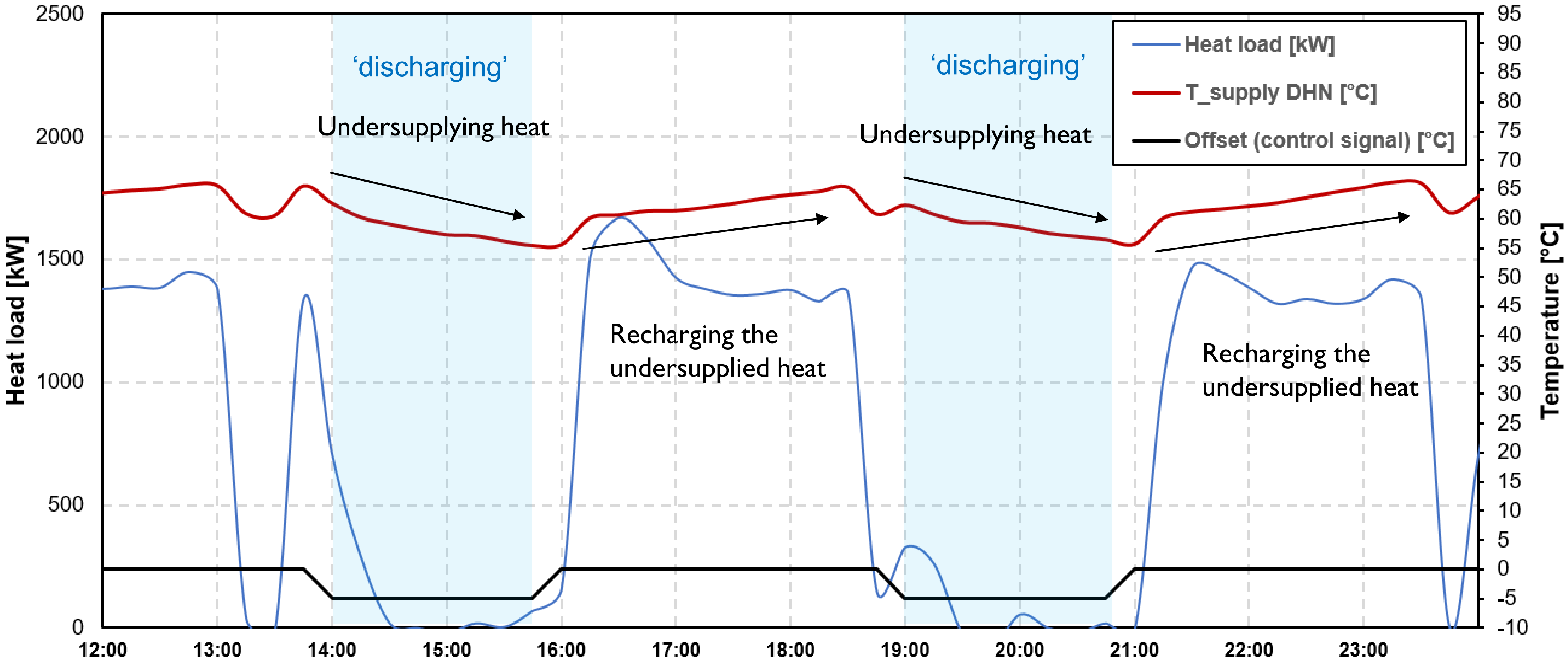
FIRST RESULTS

- Margin to reduce operational T-regime/heating curve inside buildings.
- Margin to reduce T-regime on network level.
- Available thermal flexibility in the district heating network pipes is +/- 1,5 – 2MWh for a temperature offset of 5°C, both for charging and discharging.
- Peak shaving impact on building level generally in range [10-30%], depending on many aspects:
  - Controller settings and constraints (T_{offset_max}, degree hours, available data, …)
  - Building HVAC settings (night setback, type of heat emitters, #subcircuits, …)

DHN THERMAL FLEXIBILITY – EXAMPLE (14/07/2021)

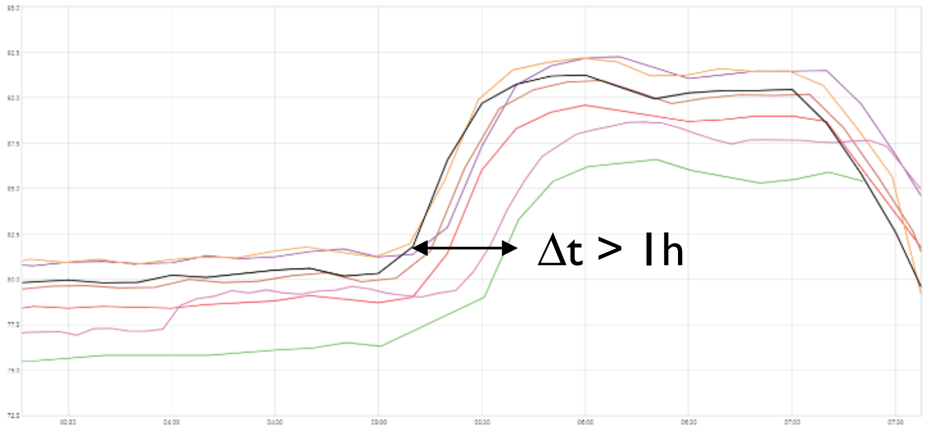


DHN THERMAL FLEXIBILITY – EXAMPLE (15/07/2021)



OUTLOOK AND NEXT STEPS

- Run the controller autonomously during next heating season
- Explore the boundary conditions on building and network level (e.g. max. T-offset, degree-hours)
- Include other buildings in the framework (focus on larger buildings)
- Include additional data (e.g. heat meter data from the whole network, T-propagation)
- Test other control objectives (supply temperature optimization + peak shaving)



THANK YOU

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.

This project has been subsidized through the ERANET cofund GEOTHERMICA (Project n. 731117), from the European Commission, RVO (the Netherlands), DETEC (Switzerland), FZJ-PtJ (Germany), ADEME (France), EUDP (Denmark), Rannis (Iceland), VEA (Belgium), FRCT (Portugal), and MINECO (Spain).