
# Closed-loop heating: an additional reliable source for boiler houses

GIZ Ukraine

12 May 2026

# Who is dtess?

- **D**utch
  - Consultant company based in the Netherlands
  - Active in: BE, DE, JP, SK, UK, US, EU, CA
  - Owner Bas Godschalk
- **T**hermal **E**nergy **S**torage
  - Shallow and deep geothermal energy projects
  - Focus on ATES, HT-ATES, BTES, Surface Water
  - Innovations in thermal energy storage
- **S**olutions
  - Project Management
  - Business Development
  - Knowledge Exchange

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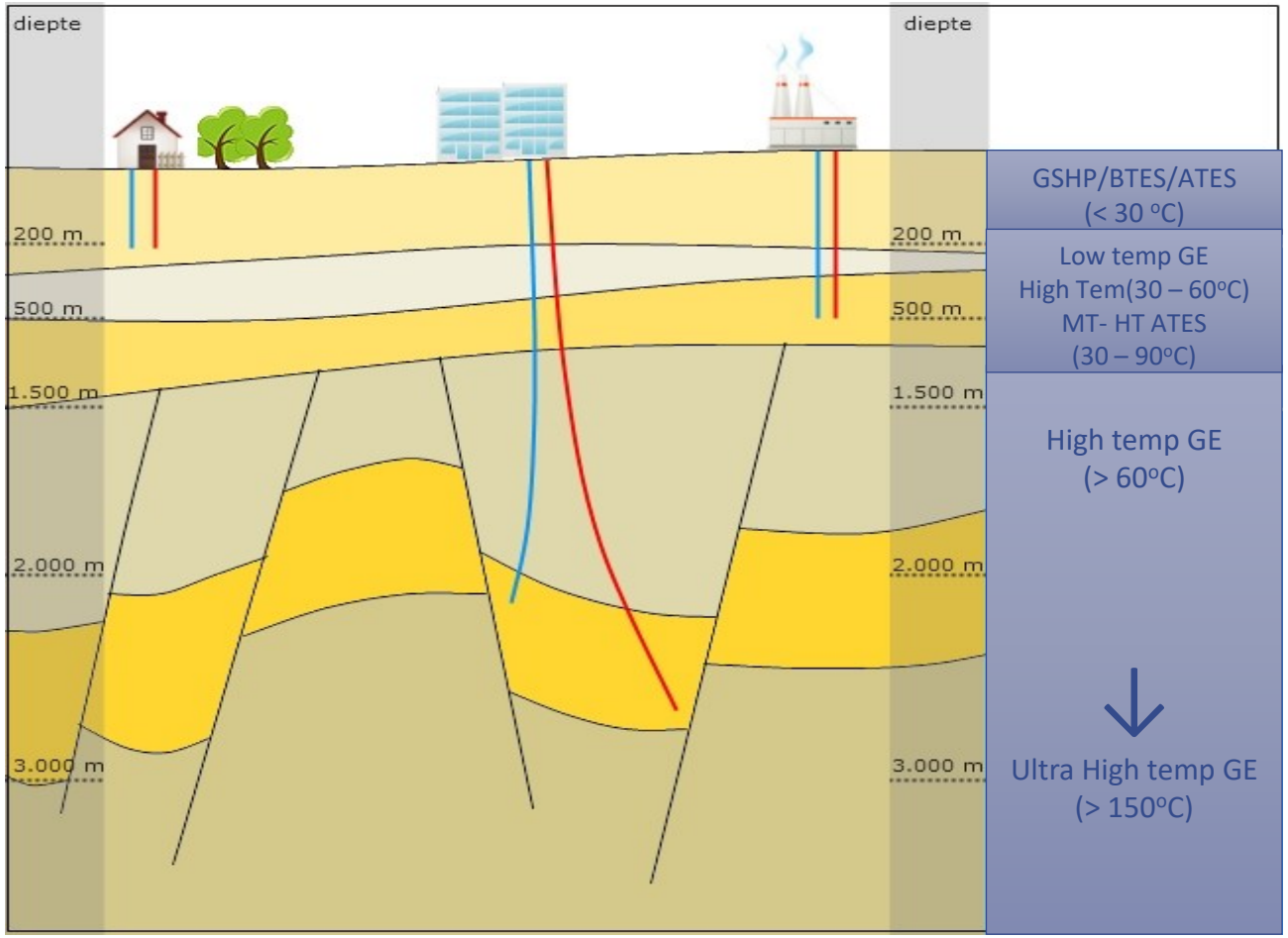
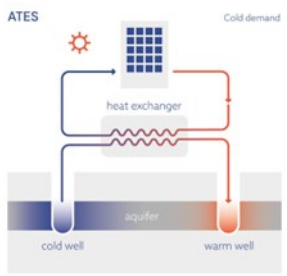
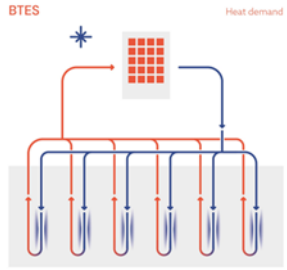
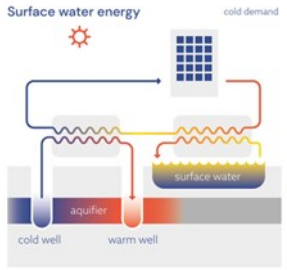
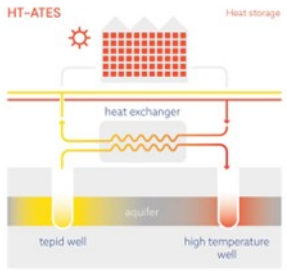
# Geothermal solutions

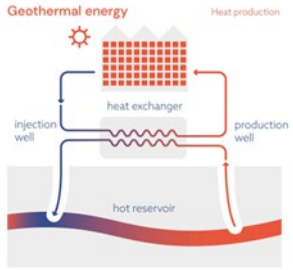


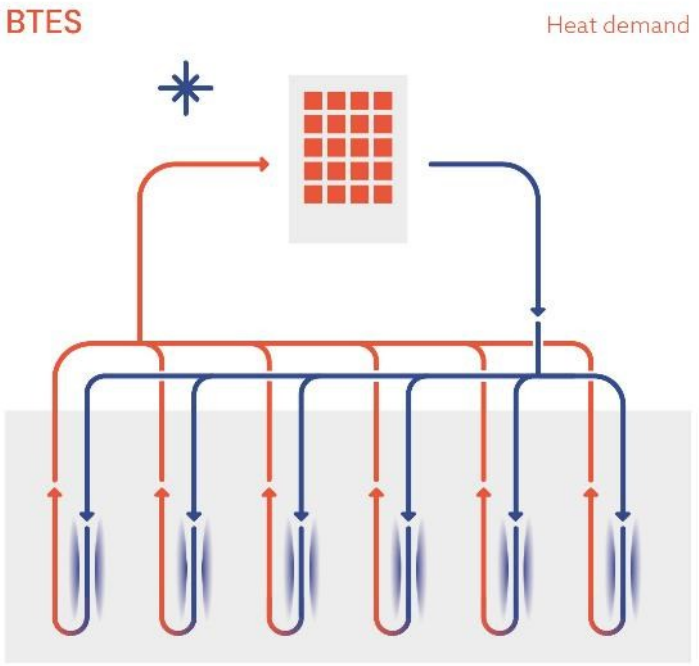



# BTES – Closed loop boreholes – GSHP




- Borehole Thermal Energy Storage
- Closed loop borehole system
- No contact with groundwater, glycol is recirculated
- No specific hydrogeological conditions are required
- Temp. range cold: 11 – 0 $^{o}$C
- Temp. range warm: 17 – 30 $^{o}$C
- Depth loops: 50 – 150 m bsl
- Application: homes, small offices
- Requires a lot of space for the boreholes

# BTES – Mollet Hospital, Spain

- In operation end 2010
- BTES + HP system
- 144 loops to 145 m depths
- Cooling demand: 1,000 kW
- Heating demand: 1,200 kW

# Feasibility study

## Closed loop systems for partly heat supply in a boiler house in Starokostiantyniv

# Step 1: Data collection

**Step 1: Data collection**

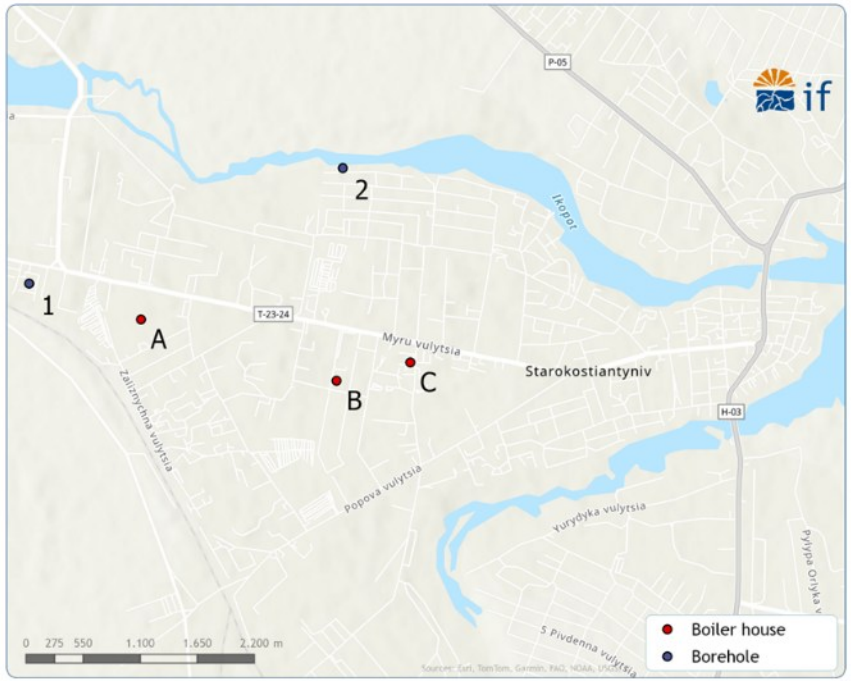
- Specifications boiler houses
  - Installed heating capacity
  - Amount and profile of supplied energy
  - Temperature levels to and from district heating network
  - Installed equipment
- Hydrogeological information
  - Built of the soil
  - Properties soil layers
  - Groundwater properties

| Borehole 1 | | Borehole 2 | |
|---|---|---|---|
| **Depth [m]** | Lithology | **Depth [m]** | Lithology |
| **0 - 1,5** | Black soil surface layer | **0 – 1,0** | Black soil surface layer |
| **1,5 – 12,5** | Loamy clay | **1,0 – 25,8** | Interbedded sands and clays |
| **12,5 – 103** | Limestone and weakly cemented cracked sandstone | **25,8 - 30,7** | Oolitic limestone |
| | | **30,7 – 45,7** | Clayey sand with limestone fragments |
| | | **45,7 – 48,0** | Weathered granite bed-rock |
| | | **48,0 – 75,0** | Granite bedrock |

# Step 2: selection boiler house

## Boiler house A is selected

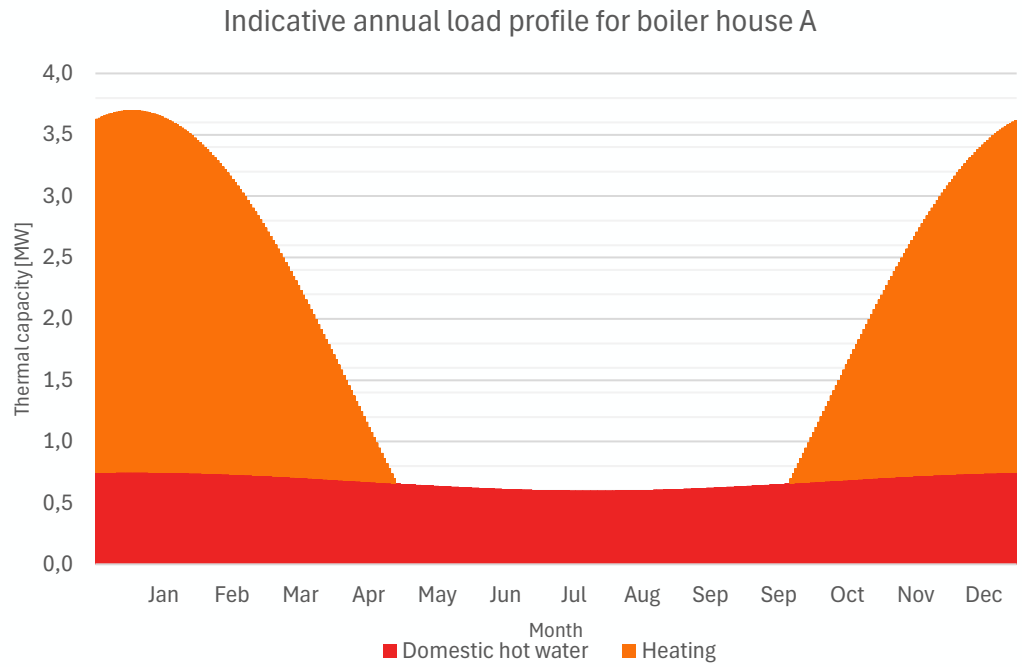
- Operational temperature fits the best with boreholes
- Heat consumption is similar for all three boiler houses
- Boiler house C less preferred due to transit hub and lack historical data
- Boiler house A smaller compared to B, but ratio borehole heat to total produced heat is higher




| Parameter | Unit | Boiler house A | Boiler house B | Boiler house C |
|---|---|---|---|---|
| Total thermal capacity | [MW] | 7 | 14,5 | 17 |
| Annual heat production | [GWh] | 10,7 | 37,2 | n/a |
| Heating temperatures (supply & return) | [°C] | 75 – 45 | 90 – 50 | 90 – 50 |

| Parameter | Unit | Boiler house A | Boiler house B | Boiler house C |
|---|---|---|---|---|
| Thermal peak capacity (Heating + DHW) | [MW] | 3,7 | 8,0 | 2,80 |
| Winter heating peak capacity | [MW] | 4,2 | 6,6 | 2,2 |
| Winter DHW capacity | [MW] | 0,8 | 1,8 | 0,6 |
| Summer DHW capacity | [MW] | 0,6 | 1,4 | 0,5 |
| Full load hours | [h] | Heating: 5.040<br>DHW: 7.200 | Heating: 5.040<br>DHW: 7.200 | Heating: 5.040<br>DHW: 7.200 |

# Step 2: Energy profile



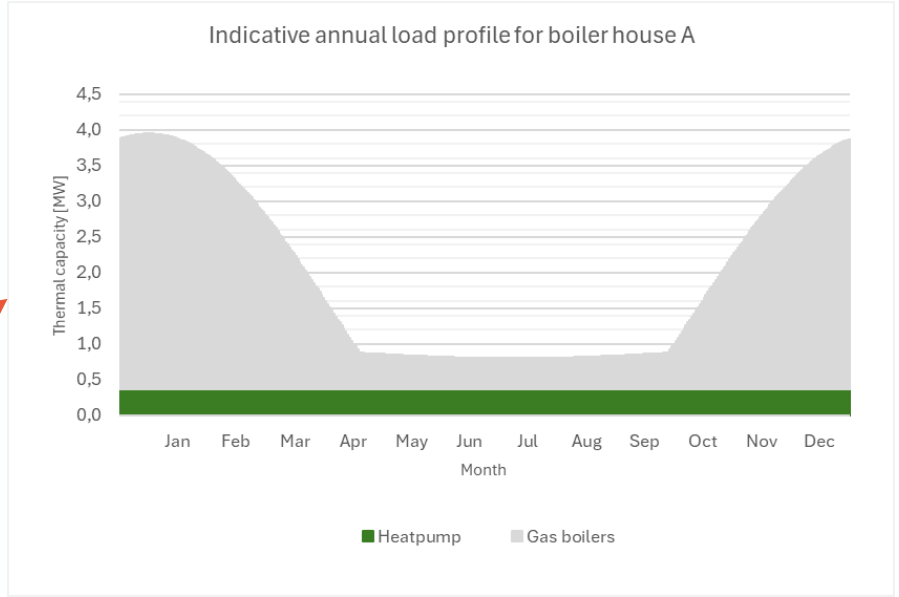

## Remarks

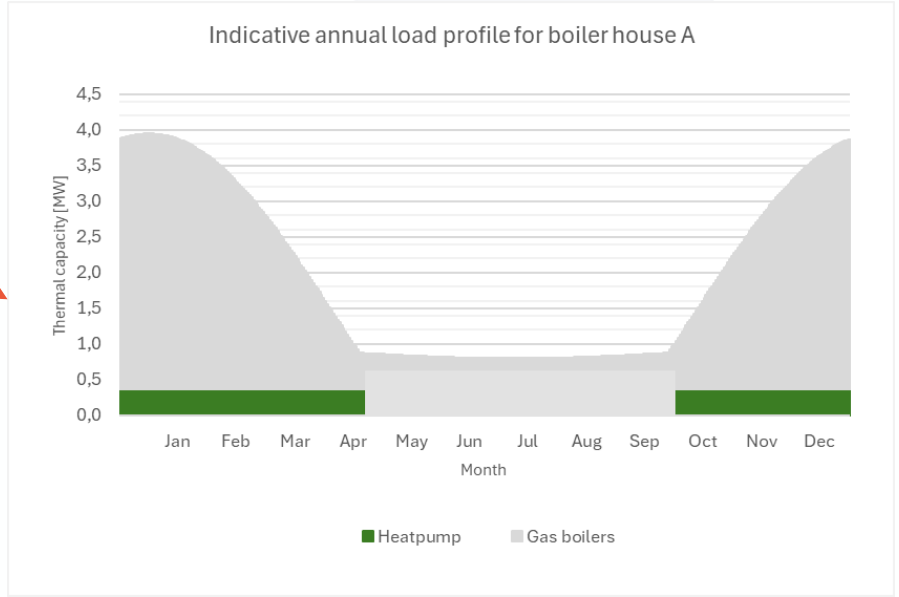
- Base load heat supply for domestic hot water
- Peak load in winter period.
- CHP is producing electricity at peak hours – rest heat is used for domestic hot water
- Remaining heat is supplied by gas-fired boilers

# Step 3: Energy setup

How to integrate closed loop system, when you have made an energy profile of the heat supply:

1. Closed loop systems in the base load of the heat supply (year-round heat supply – hardly no regeneration of the borehole field)
2. Closed loop systems in the coldest period (only in wintertime – in summertime natural regeneration)
3. Closed loop systems with active regeneration by the surplus of heat produced by the CHP in summertime



# Step 3: Pre-design

**Traditional closed boreholes:**

- 210 vertical boreholes to 100 m – grid 10*10 m.
- Average thermal conductivity 2.4 W/(m*K)
- BHE could provide 150 – 400 kW (depending on the concept)
- BHE could provide 1,200 – 2,000 MWh (depending on the concept)
- Improvement possible by using the surplus waste heat of CHP

# Opportunities for Ukraine

### Closed loop systems

- Reliable, robust and proven technology
- Mainly used for heating, but cooling is also possible
- You can apply it nearly everywhere
- Capacity per hole is relatively small, therefore you need many boreholes
- Closed loop systems are especially very suitable for single homes, small offices, smaller hospitals, revalidations centres etc.
- Closed loop system can be used as additional heating source in boiler houses, but to a certain level depending on the available surface and regeneration options

### Recommendations

- For new built and renovations of buildings, consider closed loop systems as a heating and/or cooling source.
- Also check if there are aquifers, which makes is possible to apply Aquifer Thermal Energy Storage (ATES) which is suitable for large buildings, cheaper and having a higher energy capacity.
- When evaluating shallow geothermal options, check other heat producers and users in the neighbourhood.
- Develop a vision on the implementation of shallow geothermal solutions as middle long term energy solution.


accelerating
thermal
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