Interreg Danube Region

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REHEATEAST

EnTReC Energy Transition Research Center

TECHNICAL UNIVERSITY OF CLUJ-NAPOCA ROMANIA

D.2.4.3 Transnational professional workshop

FINANCING ENERGY EFFICIENCY: THE NATIONAL RENOVATION PLAN AND THE ROLE OF LOCAL AUTHORITIES

Presenters:
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Technical University of Cluj-Napoca

Sofia, 17 March 2026

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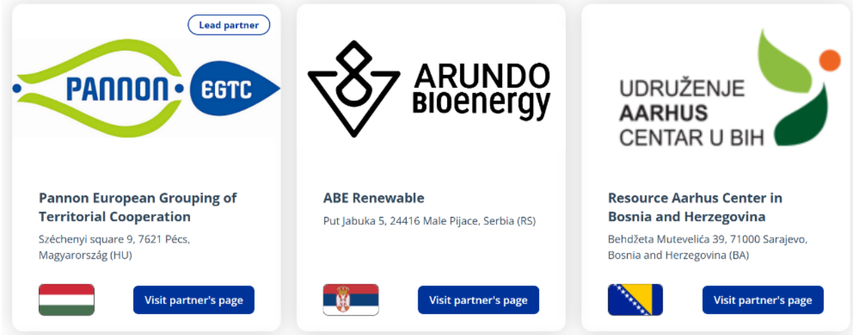
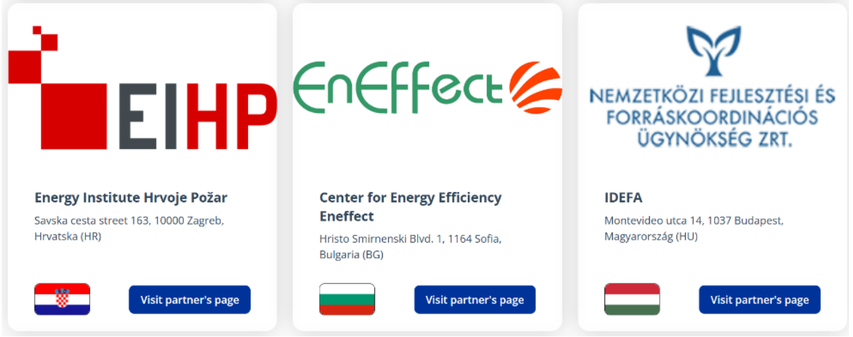
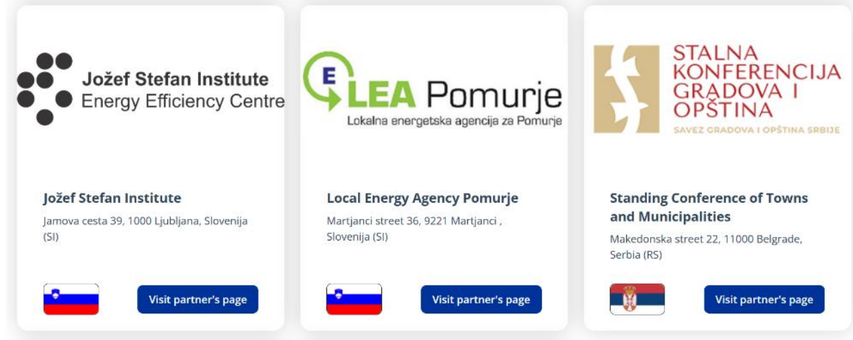
DRP0200401 Reheateast project

Building local partnerships for reducing the fossil energy demand of district heating systems in the Eastern Danube Region







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Pilot Lab Digitalisation of demand side

Objective

The pilot laboratory aims to analyse and optimise thermal energy consumption at building level through:

- ✓ monitoring of indoor conditions
- ✓ digital control of heating systems
- ✓ evaluation of low-temperature district heating operation

The system enables real-time data acquisition and advanced control strategies.

Pilot Laboratory Setup

The experimental setup includes the following components:

Hydraulic components: Heat Interface Unit (HIU); Three-way control valve; Circulation pump; Pressure equalisation tank; Fan coil units

Sensors and measurement devices: Flow meters; Pressure sensors; Temperature sensors; Indoor air temperature and humidity sensors; Door and window opening sensors

Control components: Two-way control valve; Data acquisition and control software

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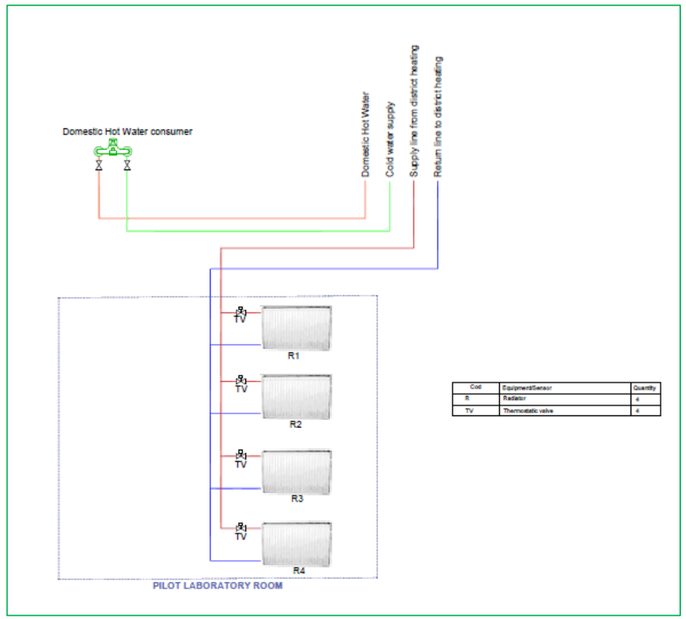
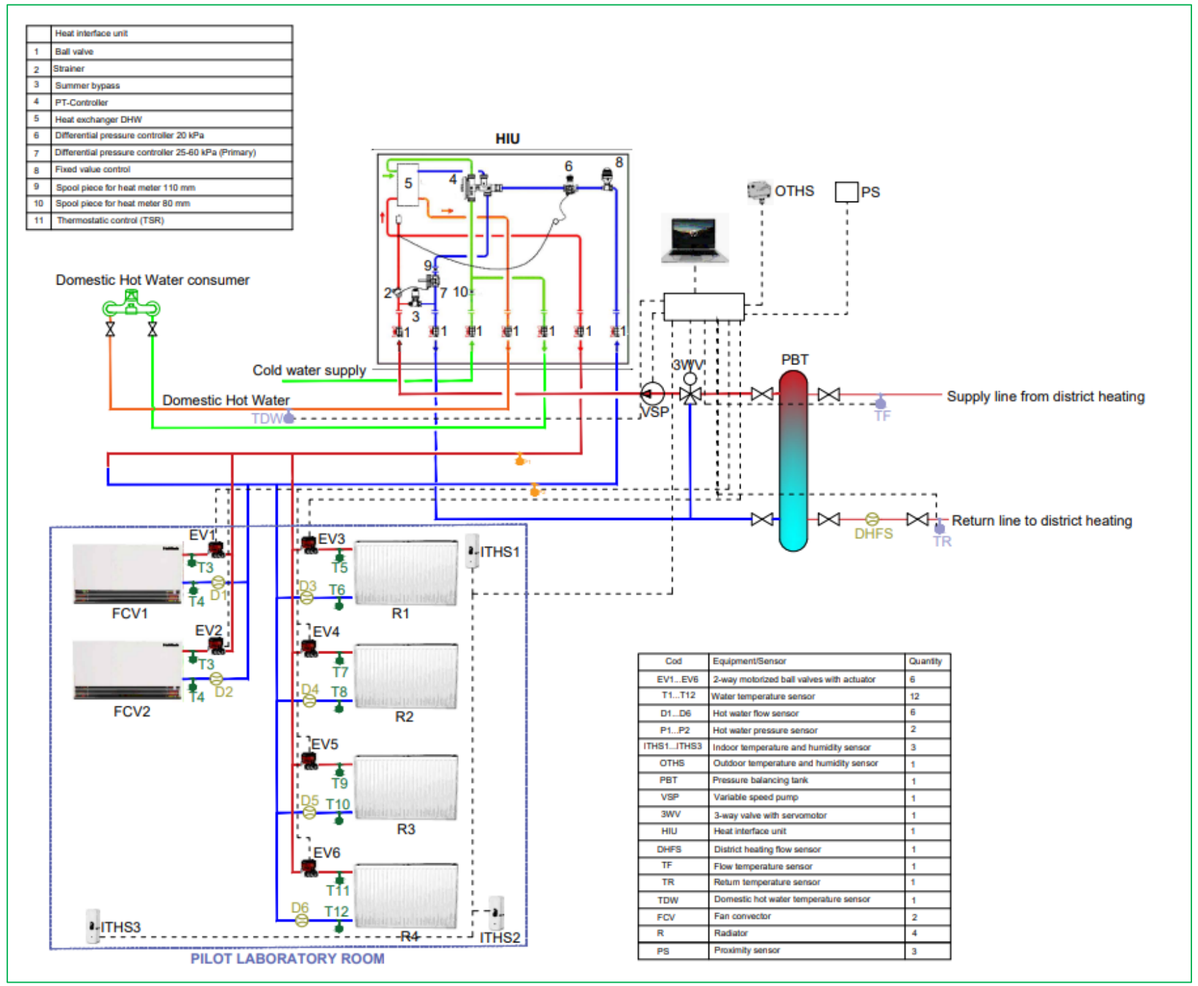
Pilot Lab Digitalisation of demand side



Initial pilot laboratory room



	Heat interface unit
1	Ball valve
2	Strainer
3	Summer bypass
4	PT-Controller
5	Heat exchanger DHW
6	Differential pressure controller 20 kPa
7	Differential pressure controller 25-60 kPa (Primary)
8	Fixed value control
9	Spool piece for heat meter 110 mm
10	Spool piece for heat meter 80 mm
11	Thermostatic control (TSR)

Cod	Equipment/Sensor	Quantity
EV1...EV6	2-way motorized ball valves with actuator	6
T1...T12	Water temperature sensor	12
D1...D6	Hot water flow sensor	6
P1...P2	Hot water pressure sensor	2
ITHS1...ITHS3	Indoor temperature and humidity sensor	3
OTHS	Outdoor temperature and humidity sensor	1
PBT	Pressure balancing tank	1
VSP	Variable speed pump	1
3WV	3-way valve with servomotor	1
HIU	Heat interface unit	1
DHFS	District heating flow sensor	1
TF	Flow temperature sensor	1
TR	Return temperature sensor	1
TDW	Domestic hot water temperature sensor	1
FCV	Fan convector	2
R	Radiator	4
PS	Proximity sensor	3

Pilot lab concept

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Pressure sensors

Fan coil unit

Heat interface unit (HIU)
Three-way control valve
Circulation pump and pressure equalization tank

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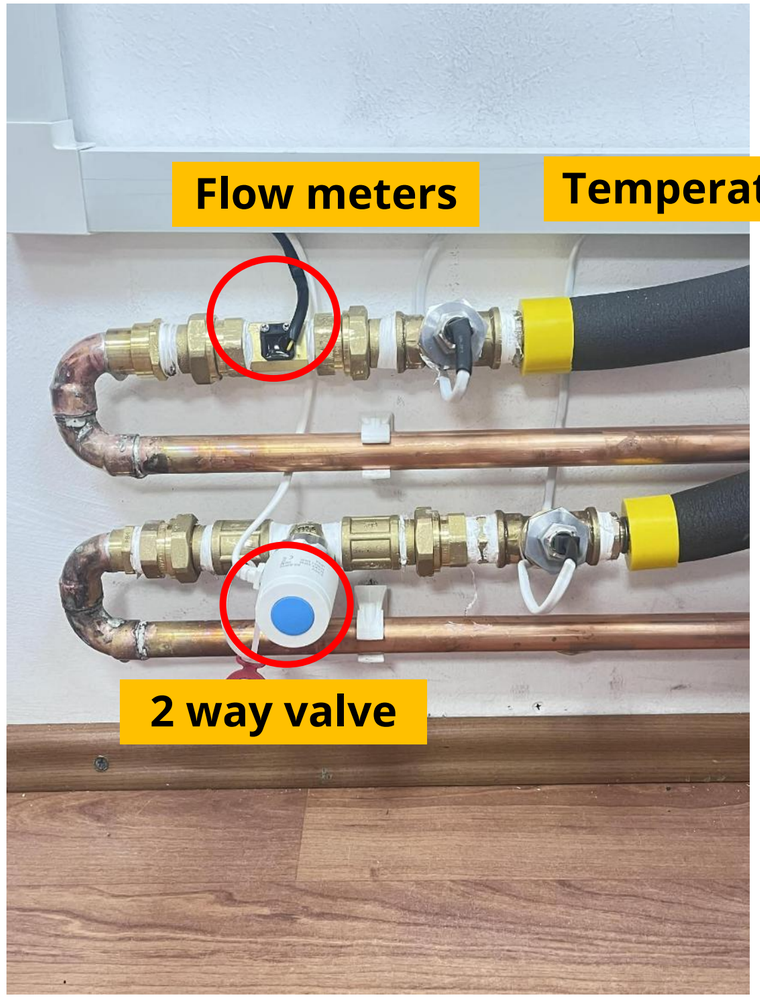
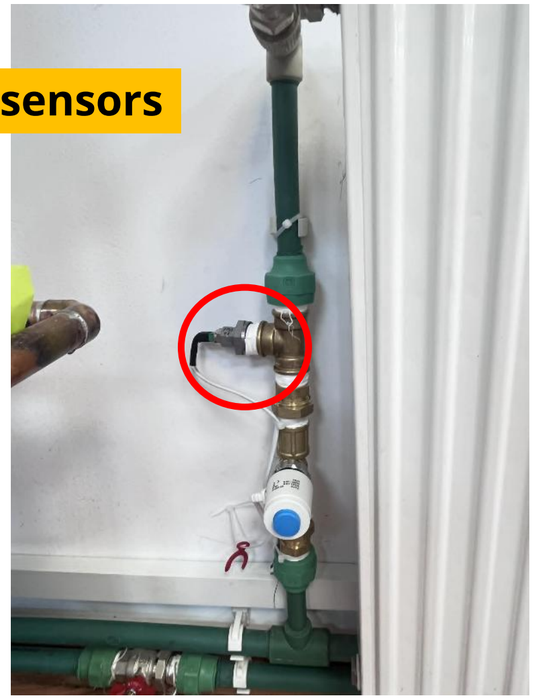


Temperature sensors



Air temperature and humidity sensor

Door/window sensors

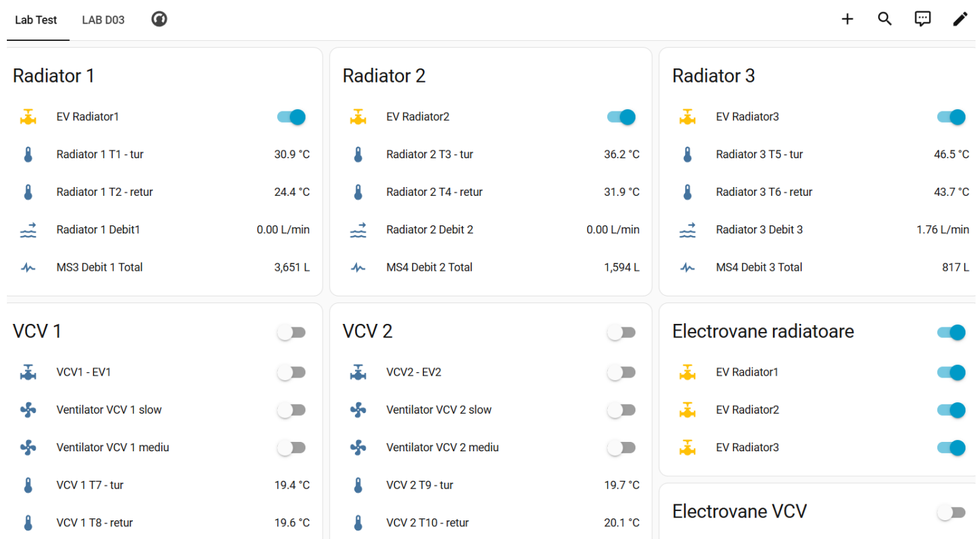
Monitoring and Data Acquisition System

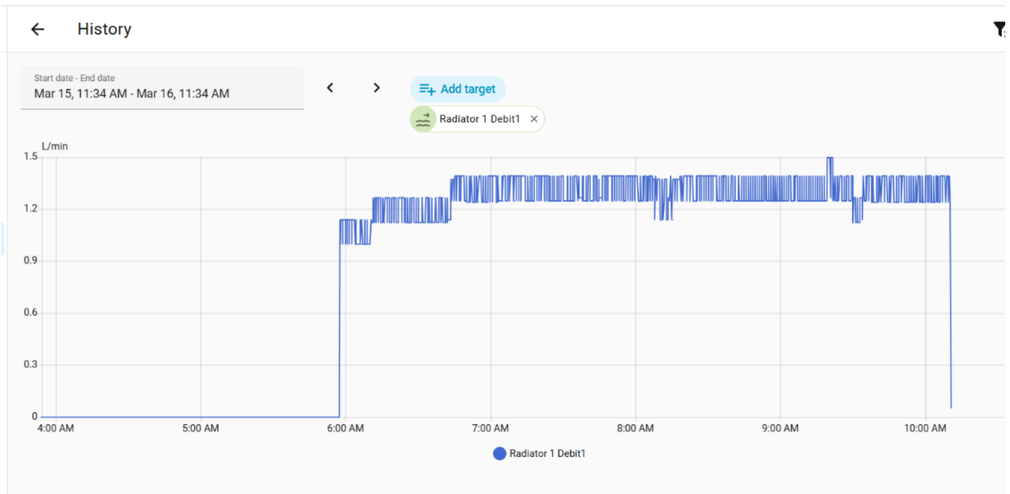
The monitoring system collects real-time operational data, including: supply and return temperatures flow rates, indoor temperature and humidity, system pressure, occupancy indicators (door/windo sensors).

The collected data are processed through dedicated data acquisition and control software.

This allows:

- system performance evaluation
- development of control strategies
- optimisation of energy consumption.





Experimental Scenarios

The pilot laboratory was used to evaluate several operating scenarios:

1. Thermal energy consumption with and without control strategies
2. System performance at low supply temperatures
3. Domestic hot water production efficiency

These experiments help identify optimal control solutions for district heating systems operating under modern conditions.

Preliminary Results

Initial experimental results indicate:

- Energy savings of approximately 10–15% when advanced control strategies are implemented.
- Improved system performance at lower supply temperatures.
- Better adaptation of heat demand to actual building occupancy and conditions.

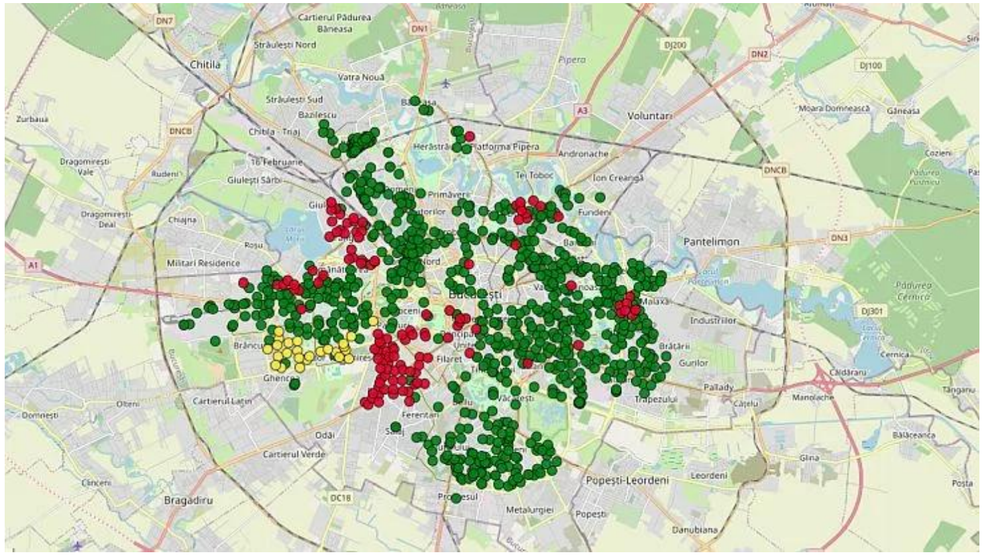
These results demonstrate the potential of digitalisation for improving district heating efficiency.

DISTRICT HEATING EXAMPLES FROM ROMANIA

To illustrate modernisation and renewable integration in district heating, three representative systems from Romania are presented:

1. Bucharest district heating system – one of the largest systems in Europe
2. Beiuș geothermal district heating system – a small city powered mainly by geothermal energy
3. Oradea district heating system – a modernised system with strong geothermal integration

1.BUCHAREST DISTRICT HEATING SYSTEM



District heating in Bucharest is one of the largest centralized heating systems in the world

Overview

- Largest system in the European Union
- Serves over 1.2 million residents
- Supplies heat to more than 500,000 apartments
- Network length: ≈3,800–3,900 km
- The system provides space heating and domestic hot water for large residential areas built mainly during the communist period.

BUCHAREST DISTRICT HEATING SYSTEM

1 EU-funded rehabilitation of the primary heating network (POIM project)

Key facts

- 106 km of main transmission pipelines replaced.
- Investment: about €254 million (mostly EU Cohesion Fund).
- Implemented by Termoenergetica București.
- Works concentrated in sectors 2, 3, 4 and 6.

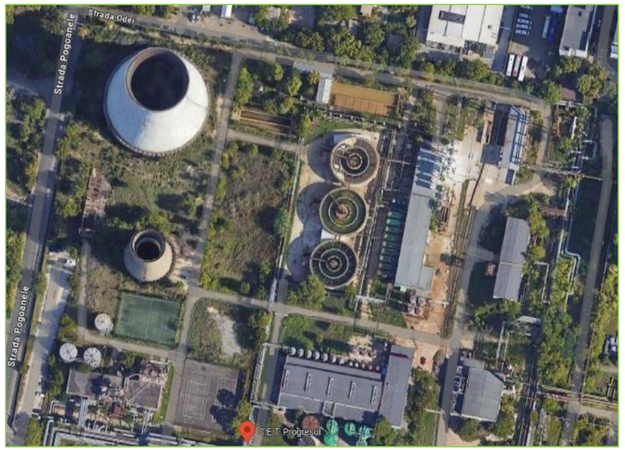
Goals

- Reduce heat losses (previously ~40%).
- Prevent pipe failures and and service interruptions
- Improve reliability for over 1 million residents.
- This project targets the most deteriorated parts of the main transport network, where most leaks occur.

2 Modernization of the Electrocentrale București plants

Investment: Modernisation Fund: 321 million Euro

Main plants: CET Grozăvești, CET Sud, CET Vest, CET Progresu.



Modernization measures

- Replacement of turbines and boilers.
- Installation of high-efficiency combined heat and power (CHP) units.
- Improved gas efficiency and lower emissions.
- Reduction of CO_2 emissions.

•Reduced natural gas consumption
•Lower greenhouse gas emissions
•Lower greenhouse gas emissions

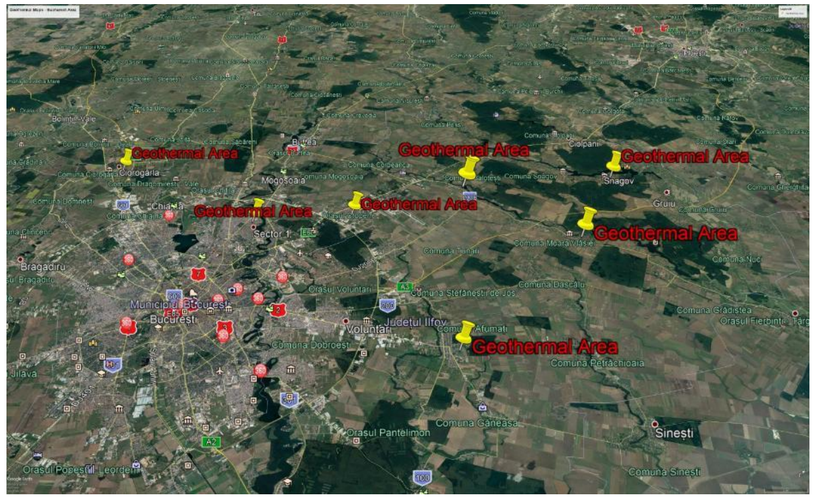
3 Renewable heat integration: Geothermal district heating project

Key parameters

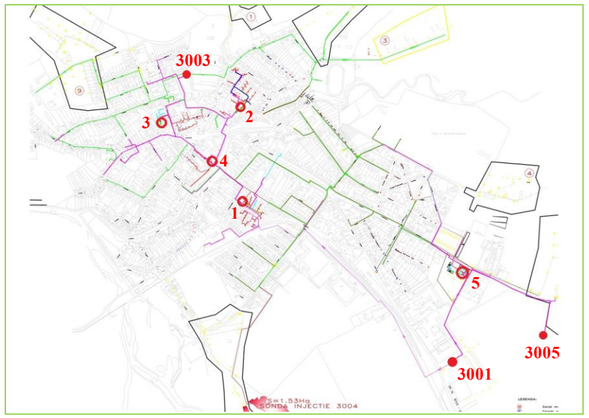
- Investment: €200 million.
- Thermal capacity: 70MW
- Geothermal wells near Otopeni.

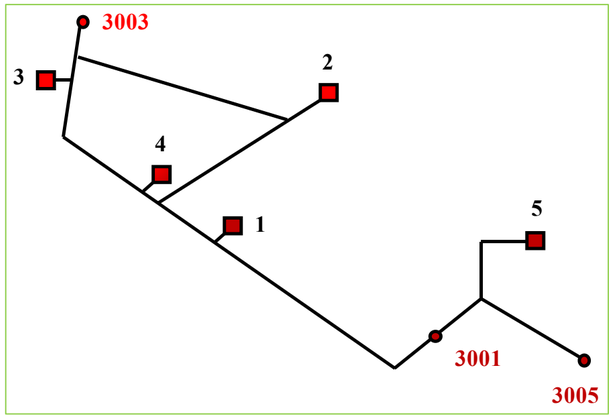
Expected results

- Estimated production: ~595,000 MWh/year of heat
- Covers approximately 13% of Bucharest's heat demand
- Reduced natural gas consumption
- Lower greenhouse gas emissions



2. GEOTHERMAL BEIUS DISTRICT HEATING SYSTEM





Overview

- Population:≈10,000 inhabitants.
- Heating coverage: about 70% of residents
- Energy source: deep geothermal water from wells beneath the town.
- Use: space heating and domestic hot water for homes, public buildings, and businesses.

Technical characteristics

- Depth of main geothermal well: ~2500–2600 m.
- Water temperature: ≈83–88 °C.
- Production flow: about 45 L/s from the main well.
- The geothermal reservoir was first confirmed by drilling in 1995–1996, which revealed a strong geothermal aquifer capable of supporting district heating

2. GEOTHERMAL BEIUS DISTRICT HEATING SYSTEM

Benefits

Low heating cost

One of the lowest heating prices in Romania

Environmental impact

The system reduces emissions because geothermal heat substitutes natural gas, oil, and lignite used in conventional heating.

Energy security

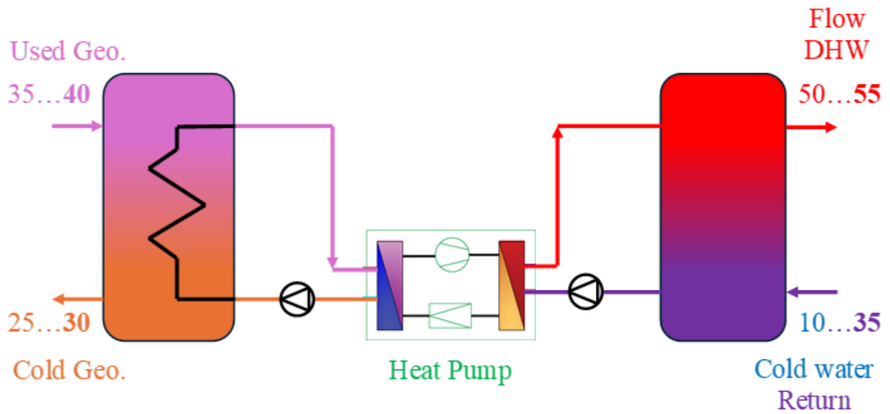
Geothermal energy is locally sourced and stable, unlike imported fuels.

Current expansion plans

- Target: 100% geothermal district coverage
- Project supported by: EEA/Norwegian grants and Icelandic geothermal experts.

Additional applications:

- greenhouses heating;
- aquaculture;
- heat pumps for energy recovery.



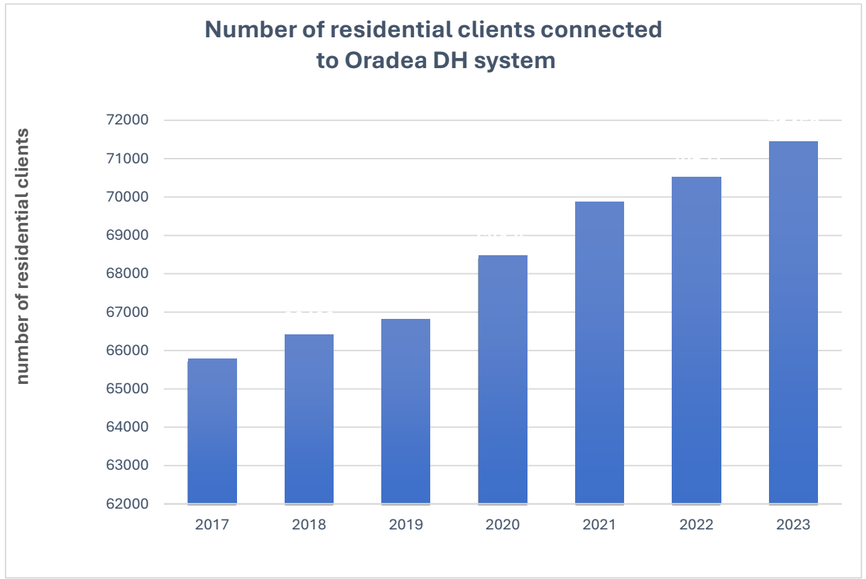
3. ORADEA DISTRICT HEATING SYSTEM

System overview

The district heating system in Oradea is considered one of the most modern systems in Romania, due to significant investments since 2010.

Key characteristics

- Operator: Termoficare Oradea SA.
- Network length: 219 km;
- Customers: 63000 households, plus 226 public institutions and 2000 commercial consumers;
- Approximately 70% of the city population is connected to district heating.



Major Modernization Projects

European Programs

1 Construction of a high-efficiency cogeneration unit

- Thermal capacity: 51 MWth
- Electrical capacity: 46 MWe
- Investment: ≈ €55 million

2 Network rehabilitation

- 42 km of primary pipelines replaced
- Investment: ≈ €32 million

EEA Grants

- Rehabilitation of a thermal point and related secondary networks; construction of a geothermal water reinjection well; (4 mil. euro)

Governmental Programs (District Heating Program 2006–2020)

Actions

- Rehabilitation of 1.5 km of primary pipelines
- Modernisation and automation of 22 substations
- Implementation of SCADA dispatch system
- Monitoring of 125 substations

Major Modernization Projects

Local Budget Investments

- Smart metering system
- 2000 meters replaced
- 3500 meters modernised

These measures improved system monitoring and management efficiency.

Results of Modernisation Projects

Achieved indicators:

- Overall efficiency of electricity and heat production > 80%
- Pollutant emissions below legal limits
- Transport and distribution losses reduced by ≈10%
- Reduced fuel consumption for the same energy demand

Geothermal heating integration

Oradea is one of the leading Romanian cities using geothermal energy for district heating.

Example subsystem:

Iosia Nord geothermal systems

- Thermal capacity: ~21.5 MW;
- Covers most heating demand in that district;
- Geothermal wells reach 2-3 km depth, producing water at 70-100 °C.

Nufărul geothermal project

One of the most important recent investments.

Key parameters:

- Capacity: ~50 MW thermal.
- Heat supplied to ≈6,200 apartments (≈13,500 residents).
- Investment: about €19 million, largely EU funded.
- Includes:
  - geothermal production wells
  - reinjection wells
  - 11 km new heat network and hundreds of building-level heat modules.
- This project significantly increases the share of renewable heat.

Geothermal heating integration

Nufărul geothermal project

In 2025, Oradea inaugurated a new geothermal heating station with:

- Capacity: ~18MW thermal.
- Well depth: ≈2800 m
- Integration with 270 modular heat points at building level.

Future objective

Increase geothermal contribution to over 30% of district heating production

Conclusions

The Oradea district heating system represents one of the most successful modernization examples in Romania, characterized by:

- extensive network rehabilitation
- large integration of geothermal energy
- development of geothermal plants (Ioșia Nord, Nufărul)
- continuous investments from EU funds and national programs

These measures have transformed Oradea into a model city for low-carbon district heating development.

Key Takeaways

- Digitalisation can improve district heating efficiency
- Geothermal energy is a reliable renewable heat source for district heating.
- Romanian cities show different modernization pathways:
- Bucharest : large-scale infrastructure rehabilitation
- Beiuș: geothermal-based heating system
- Oradea – modernised system with strong geothermal integration